M / E/ P / FP SPECIFICATIONS

DIVISION 21

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SECTION 210500 – FIRE SUPPRESSION PROVISIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Sprinkler Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK

A. This DIVISION requires the furnishing and installing of complete functioning Sprinkler systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Refer to Architectural, Structural, Mechanical, Electrical and Plumbing Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS

A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.

B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.

C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.

D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.

E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.

F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.

G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.

H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.

I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.

J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS

A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS

A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES

A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.

1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, piping and other sprinkler work are indicated diagrammatically by the drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.

B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.

C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

D. Do not scale drawings for dimensions. Contractor shall accurately layout work from the dimensions indicted on the Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of sprinkler systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.

B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in sprinkler or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.15. EXTENT OF CONTRACT WORK

A. Provide sprinkler systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation, code compliance and completion of sprinkler systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.

B. Contractor shall become familiar with equipment provided by other contractors that require sprinkler connections and controls.

C. Electrical work required to install, monitor and control sprinkler systems and equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor's base bid proposal.

D. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Sprinkler Contractor at no cost to Owner or Architect-Engineer.

E. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of sprinkler and electrical equipment are made to attain intended control sequences and system operation.

F. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.

G. Contractor shall obtain complete electrical data on sprinkler shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of sprinkler equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

1.16. WORK NOT INCLUDED IN CONTRACT

A. Consult Division 16 of specifications for work to be provided by Electrical Contractor in conjunction with installation of sprinkler equipment.

1.17. CODES, RULES AND REGULATIONS

A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.18. SAFETY CODES:

A. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
B. Occupational Safety and Health Standard (OSHA) - Department of Labor.

1.19. NATIONAL FIRE CODES:

A. NFPA No. 13 Standard for the installation of Sprinkler Systems
B. NFPA No. 70 National Electrical Code
C. NFPA No. 101 Life Safety Code
D. NFPA No. 204 Smoke & Heating Vent Guide

1.20. UNDERWRITERS LABORATORIES INC:

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.21. MISCELLANEOUS CODES:

A. ANSI A117.1 - Handicapped Accessibility
B. Americans with Disabilities Act (ADA)

1.22. STANDARDS

A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.23. PERMITS/FEES

A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

2.1. Not Used

PART 3 - EXECUTION

3.1. SHOP DRAWINGS

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.
B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer's name and address. All

shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Sprinkler shop drawings for main entrance and detailed areas shall be a minimum of 1/4" scale. Drawings shall show details of the following: Plans, elevations above finished floor, sections, components, and attachments to other work. Sprinkler layout indicating sizes on plans, fittings, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, and any required seismic restraints.

L. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

A. Contractor shall provide the following submittal sections that apply to this project:

1. SECTION 210500 - BASIC FIRE PROTECTION MATERIALS AND METHODS:

   a. Test methods and pressures
   b. Sterilization of domestic water systems
   c. Piping, and fittings

2. FIRE PROTECTION SYSTEM:

a. Automatic fire sprinkler system products
b. Plans
c. Calculations

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of sprinkler system.

D. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

1. Project name and address.
2. Section of work covered by brochure, i.e., Fire Suppression.

3.5. RECORD DOCUMENTS

A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
C. Provide one copy of on high quality heavy weight presentation type paper. Blueprints or other media which fade shall not be used.
D. Provide one electronic scanned version of record documents in Adobe PDF format on a DVD. Transmit DVD in conjunction with hard copy documents.

3.6. RECORD DOCUMENTS

A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
C. Media shall be a high quality presentation type paper. Blueprints or other media which fade shall not be used.

3.7. CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
B. Contractor shall clean up all ductwork and equipment at the completion of the project.
C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.8. WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.9. CUTTING AND PATCHING

A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
C. Patching shall be by the contractors of the particular trade involved and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of sprinkler work shall be repaired at Sprinkler Contractor's expense to approval of Architect-Engineer.

3.10. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Sprinkler contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.

3.11. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.
B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.
C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.12. FINAL CONSTRUCTION REVIEW

A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 210500

SECTION 210505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Delivery and processing of submittals.
2. Progress meetings.
3. Preinstallation conferences.
4. Project closeout activities.
5. Startup and adjustment of systems.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to

Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.
3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

1. Right-of-Way:

a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. The Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Possible conflicts.
i. Compatibility problems.
j. Time schedules.
k. Manufacturer's written recommendations.
l. Warranty requirements.
m. Compatibility of materials.
n. Space and access limitations.
o. Regulations of authorities having jurisdiction.
p. Testing and inspecting requirements.
q. Installation procedures.
r. Coordination with other work.
s. Required performance results.
t. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be

completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.

b. Review present and future needs of each contractor present, including the following:

i. Interface requirements.
ii. Sequence of operations.
iii. Status of submittals.
iv. Deliveries.
v. Off-site fabrication.
vi. Access.
vii. Quality and work standards.
viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 210505

SECTION 210510 – FIRE SUPPRESSION DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 210500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section requires the selective removal and subsequent offsite disposal of the following:

1. Sprinkler and electrical equipment, devices, piping, conduits, ductwork, insulation, lighting, etc in existing building indicated on drawings and as required to accommodate new construction.
2. Removal of MEP items in interior partitions as indicated on drawings.
3. Removal and protection of existing fixtures, materials, and equipment items indicated to be removed, salvaged, relocated, reinstalled, etc.

1.3. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
B. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed remodeled areas.

C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

1.4. JOB CONDITIONS

A. Occupancy:

1. Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.

B. Condition of Structures:

1. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
2. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted.
3. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
4. Provide protective measures as necessary and required to provide free and safe passage of Owner's personnel and general public to any occupied portions of building.
5. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
6. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
7. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.

8. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
9. Remove protections at completion of work.

C. Damages:

1. Promptly repair damages caused to adjacent facilities by demolition work.

D. Traffic:

1. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Flame Cutting:

1. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

F. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

G. Maintain fire protection services during selective demolition operations.

H. Environmental Controls:

1. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1. PREPARATION

A. General:

1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
2. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

B. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.

C. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Architect.

1. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Architect if shutdown of service is necessary during changeover.

3.2. DEMOLITION

A. General:

1. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.

C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.

D. Provide services for effective air and water pollution controls as required.

E. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.

F. If unanticipated sprinkler, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to architect in written accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3. SALVAGED MATERIALS

A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain a receipt.

3.4. DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off site.

B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

C. Burning of removed materials is not permitted on Project site.

3.5. CLEANUP AND REPAIR

A. General:

1. Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 210510

SECTION 210515 – BASIC FIRE SUPPRESSION MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 210500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. MOTORS

A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
B. ELECTRIC MOTORS (Less than ½ HP)

1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.

C. ELECTRIC MOTORS (1/2 HP and Larger)

1. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. To greatest extent possible motors for this project shall be by one manufacturer.
2. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
3. 40 degrees C (104°F) maximum ambient temperature, 3,300 Ft. maximum altitude, voltage variations of plus or minus 10% of nameplate rating, frequency variations of plus or minus 5% of nameplate rating, combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
4. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
5. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
6. Unless indicated otherwise, motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.
7. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing

housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.

8. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit holes shall conform to NEC Standards.
9. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
10. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel paint.
11. Unless indicted otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 - EXECUTION

3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
F. For test pressure schedules see Section 15100 of this specification.

3.2. TEST METHODS AND PRESSURES

A. Test methods and pressures shall be as follows:

1. Hydrostatic Test (Closed Systems):

   a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.

2. Pressure Relief and Safety Valve:

   a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
   b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
   c. Items installed in systems without test tag attached will be rejected.

3.3. CLEANING OF SYSTEMS AND EQUIPMENT

A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

3.4. MAINTENANCE OF SYSTEMS

A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer's recommendations.

3.5. PAINTING OF MATERIALS AND EQUIPMENT

A. Touch-up painting and refinishing of factory applied finishes shall be by Sprinkler Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
B. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
C. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
D. Where extensive refinishing is required equipment shall be completely repainted.

3.6. PIPING IDENTIFICATION

A. Provide pipe markers at 10'-0" maximum spacing to identify piping in sprinkler rooms and 20'-0" maximum spacing in all other areas with Seaton Setmark pipe markers with letters and flow direction arrows.
B. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers.
C. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements.

3.7. VALVE IDENTIFICATION

A. Mark all valves with Seton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black ½" high. Tags shall be minimum 2" in diameter and attached to valve with Seton No. 16 brass jack chain.
B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

3.8. EXCAVATION AND BACKFILL

A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

3.9. FIRE BARRIERS

A. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
B. Equivalent by Dow, Chemelex, 3M.
C. All holes or voids created by the sprinkler contractor to extend piping or ductwork through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall have ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.

3.10. EQUIPMENT ANCHORS

A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

3.11. WELDING

A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in

accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.

B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.

C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.

D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 210515

SECTION 211315 – EXISTING FIRE PROTECTION SYSTEM MODIFICATIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 215000.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.3. SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4. PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5. SUBMITTALS

A. Product Data: For each type of product indicated.[Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.
C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
E. Qualification Data: For qualified Installer and professional engineer.
F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
G. Welding certificates.
H. Fire-hydrant flow test report.
I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
J. Field quality-control reports.
K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6. QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."

1.7. PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

B. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.

C. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.8. COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Notify Building Owner no fewer than two days in advance of proposed interruption of sprinkler service.

C. Do not proceed with interruption of sprinkler service without Building Owner's written permission.

1.9. EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10. AUTOMATIC SPRINKLER SYSTEM

A. Provide modifications to the existing wet or combination wet/dry sprinkler system as required, complete with alarm valves, drain valves, mains, risers, branches, sprinkler heads, test pipes, gauges, and dialers as hereinafter specified or shown on plans.

B. An approved automatic sprinkler subcontractor shall perform all work under this heading. The system shall be installed in strict accordance with the National Board of Fire Underwriters latest pamphlet No. 13, No. 14 and all local and state authorities having jurisdiction. The sprinkler system shall be certified. Contractor shall retain certification until such time as Contractor turns copies of certificates and permits over to Owner.

C. Sprinkler system shall be installed using hydraulically designed system by Contractor's option. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 15 percent, including losses through water-service piping, valves, and backflow preventers. Clearly note this provision in the submitted calculations.

D. Design of sprinkler system shall coordinate main and branch lines with structure, ceilings, piping, ductwork and light fixtures.

E. Entire building area under renovation or modification shall be sprinkled. The existing system and head arrangement shall be modified as necessary for proper coverage of the affected areas.

PART 2 - PRODUCTS

2.1. SPRINKLER HEADS

A. Provide as required by NFPA 13 sprinkler heads as manufactured by Central, Viking, Star, Reliable, Grinnell, or Automatic. Sprinkler heads shall be semi-recessed chrome plated brass where exposed. Rough brass where concealed and where

exposed in mechanical rooms and shall be provided with all necessary hardware for mounting into gypsum board ceiling or acoustical ceilings. The fire protection contractor shall be responsible to reference the architectural drawings for ceiling types and locations. Where no ceilings occur, provide standard brass upright or pendant as required by construction.

B. Sprinkler heads shall be Underwriters-approved, automatic spray type. Temperature rating of heads shall be 165 degrees F., except furnish 212 degrees F. heads where required.

C. Heads shall be of the following types:

1. Areas without ceilings: Standard bronze upright type.
2. Areas with lay in ceilings: Concealed pendent with finish to match ceiling color or finish.
3. Areas with hard ceilings: Concealed pendent with finish to match ceiling color or finish.
4. Sidewall: Bronze sidewall type with finish to match wall color or finish.

D. Location of sprinkler heads is not shown on drawings but nevertheless shall be furnished and installed to meet the requirements of these specifications and NFPA. General scheme of head spacing shall be so as to clear ducts, beams, pipes, air units, lights and conduits. Exact location of heads shall be approved by the Architect.

E. Install sprinkler heads located in center of ceiling tiles or ceiling panels or as otherwise directed by architect.

F. Provide head guards where required by NFPA.

G. Furnish spare heads for each type of head mounted in metal cases where directed by Architect and as required by NFPA. Cases shall include wrenches for each type of head.

2.2. PIPE, FITTINGS, AND HANGERS

A. Provide pipe material and schedule as required by NFPA 13.

1. Submit detailed pipe material submittals indicating thickness and joining methods.
2. Pipe 2" and smaller shall be threaded connected Schedule 40 black steel pipe or thicker with cast iron fittings. Pipe 2-1/2" and larger may be roll grooved or welded connected Schedule 10 black steel pipe or thicker.
3. Steel pipe with wall thicknesses less than Schedule 40 shall not be joined by threaded fittings.

B. Pipe shall be scale free, round, straight and true to size, free from weld flaws and other defects. Steel pipe shall be as manufactured by U.S. Steel, Sawhill, Wheatland, LTV, Laclede or approved equal. All piping shall be U.L. listed and F.M. approved. All fire service piping below grade shall be ductile iron pipe of the thickness Class 52 complete with all accessories conforming to ANSI A21.51; ASTME A536, Grade 60-42-10. The joints shall be of the push-on type conforming to ANSI A21.11 except gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable. The pipe shall be cement-mortar lined conforming to ANSI A21.4 and shall be coated inside and out with a coal-tar enamel. Fittings shall be ductile iron or cast iron fittings complete with accessories and shall be ASTM A536, Grade 80-60-03 conforming to ANSI A21.10, 150 p.s.i. pressure rating. The joints shall be of standard mechanical joint type or of the push-on type conforming to ANSI A21.11. All fittings shall be cement-mortar lined conforming to ANSI A21.4 and shall be coated inside and out with a coal-tar enamel.

C. All fittings inside building shall be 125 p.s.i. steam cast iron screwed sprinkler fittings approved by Underwriters' Laboratories and meeting approval of Factory Mutual. Cast iron flanges, of the same pressure rating as the fittings above specified, shall be installed in piping 8" and over, and elsewhere where required.

D. Pipe hangers shall be of type and spacing required to support pipes from building construction and meet the approval of the Underwriters' Laboratories. Note: Do not support piping from pipes, ducts or conduits. Furnish structural steel headers bolted to concrete and bolted or welded to steel joists as required. Do not support pipes from bulb tees or steel roof decks. Support exposed risers in stairs from structure below, as shown on drawings. Do not support risers in stairs from pipe clamps above floor.

E. Contractor, at their option, may install fire protection piping using Victaulic couplings with gaskets, reducing couplings and gaskets, outlet couplings, flanges with gaskets, fittings, reducers, adapter nipples, flange adapters, bolts, nuts and miscellaneous material required to install fire protection piping system to meet NFPA approval in lieu of screwed and flanged fittings specified above. The piping system shall be grooved, assembled, installed and supported as covered in Victaulic Piping and Installation Manual.

2.3. PIPE SLEEVES AND COLLARS

A. Pipes passing through walls and partitions shall be run through not less than No. 12 gauge steel pipe sleeves finishing flush with the finished wall surfaces. Where covered pipes pass through the walls or partitions, same shall be centered in steel pipe sleeves. All sleeves or thimbles shall be independent of the pipes they enclose and centered in sleeves to insure free movement of the pipes without injury to wall or other finish. Caulk around all pipes and pipe sleeves passing

through walls, floors or ceilings with untarred jute and make airtight and soundproof.

B. Covered and uncovered pipes passing through fire and smoke walls and partitions shall be run through Proset Proseal fire rated wall sleeves, or approved equal wall sleeving system, consisting of PVC sleeves in masonry walls, 20 Ga. G.I. split wall sleeves in gypsum walls, ceramic fiber firefill to fill the void between the pipe and the interior wall of the sleeve, and PVC or neoprene rubber Proseal plug on each end of sleeve.

C. Pipe passing through floors shall be run through Proset Proseal or approved equal fire rated floor sleeve assemblies, consisting of PVC couplings, ceramic fiber firefill to fill the void between the pipe and the interior wall of the sleeve, and PVC or neoprene rubber Proseal plug on each end of sleeve. Sleeves shall be watertight and fireproof.

2.4. CHECK VALVES

A. Furnish and install 175 p.s.i. Underwriter's approved flanged type check valves in fire service, at Fire Department connection, and where required by NFPA. Check valve at Fire Department connection shall be installed with automatic ball drip with drain pipe extended and turned down over floor drain.

2.5. VALVES

A. Drain valves and test valves shall be similar and equal to Stockham B-22 screwed globe of Fig. B-222 screwed angle, bronze body 150 lb., screw over bonnet and renewable disc.

B. Gauge control valves shall be bronze body needle type with inspector's test connections and plug.

C. Gate valves 2" and smaller shall be UL approved for 175 lb. WWP, bronze gate, solid wedge, screw in bonnet, outside screw and yoke, rising stem, Stockham B-122 or approved equal.

D. Gate valves 2-1/2" and larger shall be UL approved for 175 lb. WWP, iron body, bronze mounted, solid wedge, outside screw and yoke, rising stem, Stockham Fig. G-634 or approved equal.

E. Check valves 2-1/2" and larger shall be UL approved 175 lb. WWP iron body, bronze mounted, Stockham G-939 or approved equal.

2.6. VANE TYPE WATER FLOW DETECTORS

A. Furnish and install Notifier WFD Series or approved equal vane type, U.L. approved, water flow detector switches full size of piping served if required due to modifications of system. Detectors shall be installed at each sprinkler zone and where indicated on drawings. Switches shall be designed for 150 p.s.i. working pressure and shall make contact with flow in one direction only.

B. Each detector shall include a vane-operated, retard switch assembly mounted on an aluminum base plate, a cast aluminum pipe saddle to which the base plate is attached, a steel "U" bolt to clamp saddle to the sprinkler piping, and a steel cover enclosure to enclose the switch assembly consisting of two (2) SPDT circuit switches rated 10 amperes, 125 volt A.C., for actuating the fire alarm system.

2.7. TAMPER SWITCHES

A. Furnish and install U.L. and F.M. approved tamper switches for indicator post and for each gate or butterfly type cutoff valve for pipes 2" and above in sprinkler and standpipe systems. Furnish and install tamper switches on certain valves under 2" as indicated or required. Switches shall be similar and at least equal to Notifier tamper switches for connecting to alarm system. Omit tamper switches on drain valves.

2.8. SIGHT GLASSES

A. Furnish and install at each inspector's test valve where test pipe does not terminate where it can be readily observed an approved sight test connection containing a smooth bore orifice giving a flow equivalent to one sprinkler head.

2.9. FIRE PROTECTION PIPING

A. Size of fire service piping is shown on drawings. All other fire protection piping shall be sized according to hydraulic calculations to provide the prescribed densities hereinbefore specified.

B. Conceal mains back or above the construction in finished areas.

C. Pipes shall have ends reamed to full bore.

D. Piping shall clear lighting fixtures, construction, conduits, air outlets, air ducts and miscellaneous service pipes. Piping shall be designed to provide maximum head room in all areas.

E. Piping shall not pierce ductwork.

F. Sprinkler piping shall be divided into zones.

G. Pitch all dry pipe sprinkler piping to drain according to NFPA requirements, without exception and without traps. Wet pipe

sprinkler systems may be pitched to drain or run level, but piping must be installed straight and true, without traps.

H. Furnish and install suitable drain valves and inspector test valves as necessary to drain the system and meet the requirements of NFPA. Furnish and install cutoff valve, vane type flow detector, test valve, drain valve, sight glass and tamper switch in each sprinkler zone, of type hereinbefore specified.

I. No sprinkler piping shall be installed below a ceiling, (exposed) unless the contractor has specific approval from the Architect. Prime and paint all exposed sprinkler piping. Coordinate with architectural plans for color and finish.

PART 3 – EXECUTION

3.1. GENERAL

A. All modifications and additions shall be performed without hampering the proper operation of the remaining system. Shop drawing submittals shall indicate by calculation total system compliance.

B. Provide installation of water flow switches and tamper switches on bypass lines and shut-off valves. Wiring by Electrical Contractor. Coordinate with early warning fire detection system.

C. Submit drawings and calculations to the State Fire Marshall, owner's insurance company and local building officials for approval.

3.2. PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.3. PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

1. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
2. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
3. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Install sprinkler piping with drains for complete system drainage.

E. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

F. Install alarm devices in piping systems.

G. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

H. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.

I. Fill sprinkler system piping with water.

J. Sprinkler piping in areas subject to freezing shall be installed with glycol systems in accordance with NFPA installation requirements. Electric cables or insulation shall not be considered and adequate means of freeze protection.

3.4. JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges

with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

O. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

P. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5. INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.6. VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.7. SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.8. ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.9. SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and

walls.

B. Sleeves are not required for core-drilled holes.
C. Permanent sleeves are not required for holes formed by removable PE sleeves.
D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
E. Install sleeves in new partitions, slabs, and walls as they are built.
F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."
G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."
H. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

3.10. SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11. IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

3.12. FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
D. Energize circuits to electrical equipment and devices.
E. Start and run excess-pressure pumps.
F. Coordinate with fire-alarm tests. Operate as required.
G. Coordinate with fire-pump tests. Operate as required.
H. Verify that equipment hose threads are same as local fire-department equipment.
I. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
J. Prepare test and inspection reports.

3.13. CLEANING

A. Clean dirt and debris from sprinklers.
B. Remove and replace sprinklers with paint other than factory finish.

3.14. TESTS

A. All piping shall be tested and made tight to meet requirements of NFPA Pamphlets No. 13 and 14 before joints are covered. Such tests shall be witnessed by the Owner's Representative and the Architect. Provide three (3) copies of test certificates to Architect-Engineer.
B. Furnish all gauges, pumps, compressors and equipment required to perform tests.

3.15. PAINTING

A. Paint post indicator valve, fire hydrant and all pipes and valves not in furred walls or ceilings with one (1) metal prime coat and one (1) coat of Cook's Armocote No. 801 or approved equal high gloss enamel, color as directed by architect.

END OF SECTION 211315

END OF DIVISION 210000

END OF DIVISION 210000

DIVISION 22

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PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Plumbing Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK

A. This DIVISION requires the furnishing and installing of complete functioning Plumbing systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS

A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.

B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.

C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.

D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.

E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.

F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.

G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.

H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.

I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.

J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS

A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS

A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES

A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in

writing for review of Architect-Engineer. No verbal change orders will be recognized.

1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, piping and other plumbing work are indicated diagrammatically by the plumbing drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.

B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.

C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

D. Do not scale mechanical, plumbing and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicted on the Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of plumbing systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.

B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after

this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in plumbing or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.15. EXTENT OF CONTRACT WORK

A. Provide plumbing systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of plumbing systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.

B. Contractor shall become familiar with equipment provided by other contractors that require plumbing connections and controls.

C. Electrical work required to install and control plumbing equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor's base bid proposal.

D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.

E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Plumbing Contractor at no cost to Owner or Architect-Engineer.

F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of plumbing and electrical equipment are made to attain intended control sequences and system operation.

G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.

H. Contractor shall obtain complete electrical data on plumbing shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of plumbing equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

1.16. WORK NOT INCLUDED IN CONTRACT

A. Consult Division 21, 23, and 26 of specifications for work to be provided by Electrical Contractor in conjunction with installation of plumbing equipment.

1.17. CODES, RULES AND REGULATIONS

A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.18. SAFETY CODES:

A. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
B. Occupational Safety and Health Standard (OSHA) - Department of Labor.

1.19. NATIONAL FIRE CODES:

A. NFPA No. 54 Gas Appliance & Gas Piping Installation
B. NFPA No. 70 National Electrical Code
C. NFPA No. 89M Clearances, Heat Producing Appliances

1.20. UNDERWRITERS LABORATORIES INC:

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.21. MISCELLANEOUS CODES:

A. ANSI A117.1 - Handicapped Accessibility
B. Applicable State Boiler Codes
C. Americans with Disabilities Act (ADA)

1.22. ENERGY EFFICIENCY REQUIREMENTS:

A. All plumbing systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

1.23. STANDARDS

A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.24. PERMITS/FEES

A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

2.1. Not Used

PART 3 - EXECUTION

3.1. SHOP DRAWINGS

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.
B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls,

fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Plumbing shop drawings for pipe fabrication shall be a minimum of 1/4" scale. Provide drawings where the complexity of the system or confines of the space require coordination with construction and other trades. Plumbing shop drawings shall not be a reproduction of the contract document and shall show details of the following: Plans, elevations above finished floor, sections, components, insulation and attachments to other work. Plumbing layout indicating sizes on plans, fittings, insulation, clearances, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and attachment.

L. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

A. Contractor shall provide the following submittal sections that apply to this project:

1. SECTION 220520 - BASIC PLUMBING MATERIALS AND METHODS:

a. Test methods and pressures
b. Sterilization of domestic water systems
c. Piping, and fittings

2. SECTION 220523 – VALVES
3. SECTION 220530 - MOTOR CONTROL AND EQUIPMENT DISCONNECTS

a. Disconnect Switches
b. Motor Starters

4. SECTION 220548 – PLUMBING VIBRATION CONTROL:

a. Vibration isolation
b. Isolation of piping systems
c. Isolation of fractional horsepower equipment

5. SECTION 220700 – PLUMBING INSULATION:

a. Piping and equipment insulation

6. SECTION 221116 – PLUMBING PIPING:

a. Piping materials
b. Supports, anchors
c. Sleeves and seals

7. SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES:

a. Temperature mixing valves
b. Hose bibbs / wall hydrants
c. Backflow preventers
d. Domestic hot water expansion tanks
e. Water hammer arresters
f. Recirculation pumps
g. Thermometers and gauges

8. SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES:

a. Cleanouts
b. Floor drains

9. SECTION 223300 – WATER HEATERS
10. SECTION 224000 – PLUMBING FIXTURES

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of plumbing system.

D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

1. Project name and address.

2. Section of work covered by brochure, i.e., "Plumbing", etc.

3.5. RECORD DOCUMENTS

A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
C. Provide one copy of on high quality heavy weight presentation type paper. Media which fade shall not be used.
D. Provide one electronic version of record documents in Adobe PDF format on a DVD or otherwise electronically transmitted. Transmit electronic copies in conjunction with hard copy documents.

3.6. CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
B. Contractor shall clean up all ductwork and equipment at the completion of the project.
C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.7. WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.8. CUTTING AND PATCHING

A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of plumbing work shall be repaired at Contractor's expense to approval of Architect-Engineer.

3.9. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Plumbing contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer

for review before proceeding with fabrication or installation.

3.10. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.

B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.

C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.11. FINAL CONSTRUCTION REVIEW

A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 220500

SECTION 220505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.
3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments,

including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

    1. Right-of-Way:

        a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
        b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Organize meeting with agenda and invite all pertinent attendees. Notify Architect and owner of relevant meetings. Record all decisions made and distribute minutes within 3 days of meeting.
B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    a. The Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Possible conflicts.
    i. Compatibility problems.
    j. Time schedules.
    k. Manufacturer's written recommendations.
    l. Warranty requirements.
    m. Compatibility of materials.
    n. Space and access limitations.
    o. Regulations of authorities having jurisdiction.
    p. Testing and inspecting requirements.
    q. Installation procedures.
    r. Coordination with other work.
    s. Required performance results.
    t. Protection of adjacent work.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Notify Architect of meeting.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress.
    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    b. Review present and future needs of each contractor present, including the following:
        i. Interface requirements.
        ii. Sequence of operations.
        iii. Status of submittals.
        iv. Deliveries.
        v. Off-site fabrication.
        vi. Access.
        vii. Quality and work standards.

viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 220505

SECTION 220510 – PLUMBING DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section requires the selective removal and subsequent offsite disposal of the following:

1. Plumbing and electrical equipment, devices, piping, conduits, ductwork, insulation, lighting, etc in existing building indicated on drawings and as required to accommodate new construction.
2. Removal of MEP items in interior partitions as indicated on drawings.
3. Removal and protection of existing fixtures, materials, and equipment items indicated to be removed, salvaged, relocated, reinstalled, etc.

1.3. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
B. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed remodeled areas.

C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

1.4. JOB CONDITIONS

A. Occupancy:

1. Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.

B. Condition of Structures:

1. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
2. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted.
3. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
4. Provide protective measures as necessary and required to provide free and safe passage of Owner's personnel and general public to any occupied portions of building.
5. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
6. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
7. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.

8. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
9. Remove protections at completion of work.

C. Damages:

1. Promptly repair damages caused to adjacent facilities by demolition work.

D. Traffic:

1. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Flame Cutting:

1. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

F. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

G. Maintain fire protection services during selective demolition operations.

H. Environmental Controls:

1. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1. PREPARATION

A. General:

1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
2. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

B. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.

C. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Architect.

1. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Architect if shutdown of service is necessary during changeover.

3.2. DEMOLITION

A. General:

1. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
D. Provide services for effective air and water pollution controls as required.
E. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.
F. If unanticipated plumbing, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to architect in written accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3. DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off site.
B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
C. Burning of removed materials is not permitted on Project site.

3.4. CLEANUP AND REPAIR

A. General:

1. Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 220510

SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. MOTORS

A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
B. ELECTRIC MOTORS (Less than ½ HP)

1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 220513

SECTION 220520 – BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
F. For test pressure schedules see Section 221100 of this specification.

3.2. TEST METHODS AND PRESSURES

A. Test methods and pressures shall be as follows:

1. Hydrostatic Test (Open System):

a. Test entire system with 10-foot head of water. Where system is tested in sections each joint in building except uppermost 10 feet of system shall be submitted to at least 10-foot head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.

2. Pneumatic Test:

a. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
b. Allow at least 1 hour after test pressure has been applied before making initial test.
c. Curing test, completely isolate entire system from compressor or other sources of air pressure.

3. Pressure Relief and Safety Valve:

a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
c. Items installed in systems without test tag attached will be rejected.

3.3. STERILIZATION OF DOMESTIC WATER SYSTEMS

A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
D. Test samples taken from several points in system shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

3.4. CLEANING OF SYSTEMS AND EQUIPMENT

A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

3.5. MAINTENANCE OF SYSTEMS

A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer's recommendations.

3.6. PAINTING OF MATERIALS AND EQUIPMENT

A. Paint all exterior piping with (2) two coats of an enamel rust inhibiting exterior paint in a color selected by architect.
B. Touch-up painting and refinishing of factory applied finishes shall be by Plumbing Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
E. Where extensive refinishing is required equipment shall be completely repainted.

3.7. PIPING IDENTIFICATION

A. Provide pipe markers at 10'-0" maximum spacing to identify piping in mechanical rooms and 20'-0" maximum spacing in all other areas with Seaton Setmark pipe markers with letters and flow direction arrows.
B. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers.
C. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements.

3.8. VALVE IDENTIFICATION

A. Mark all valves with Seton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black ½" high. Tags shall be minimum 2" in diameter and attached to valve with Seton No. 16 brass jack chain.
B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

3.9. EQUIPMENT LABELS:

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Black letters on white background.
B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
C. Minimum Letter Size: 1/4 inchfor name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
D. Fasteners: Stainless-steel rivets or self-tapping screws.
E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
F. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

3.10. EXCAVATION AND BACKFILL

A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.

C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

3.11. FIRE BARRIERS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
B. SUBMITTALS

1. Product Data: For each type of product indicated.
2. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

a. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
b. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

3. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

a. Types of penetrating items.
b. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
c. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

C. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.
G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
H. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
I. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
J. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson “Flameseal” fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
K. Equivalent by Hilti, Inc., Johns Manville, Nelson Firestop Products, NUCO Inc., RectorSeal Corporation, Specified

Technologies Inc., 3M, Tremco, USG, Dow, Chemelex.

3.12. EQUIPMENT ANCHORS

A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

3.13. WELDING

A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.
D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 220520

SECTION 220523 – VALVES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. EQUIVALENTS

A. Equivalent valves shall be used only from the following specified valve manufacturers and listed on current comparison charts by Apollo, Hammond, Hays, Milwaukee, Muessco, Nibco, Rockwell-Nordstrom, Stockham, and Watts.

1.3. SUBMITTALS

A. Product Data: For each type of valve indicated.

1.4. QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1. GENERAL REQUIREMENTS FOR VALVES

A. Plumbing valve applications specified in this Section are limited to NPS 12 (DN 300).
B. Refer to valve schedule articles for applications of valves.
C. Caution: Revise pressure ratings and insert temperature ratings in valve articles if valves with higher ratings are required.
D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
E. Valve Sizes: Same as upstream piping unless otherwise indicated.
F. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller[except plug valves.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

H. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

2.2. VALVES

A. BALL VALVES

1. Ball valves shall be scheduled as type “BLV” valves. Valve specifications by type number shall be as follows:
2. Provide ball handle with extension or offset as required to clear piping insulation.

a. BLV-1: 2-1/2” valves and smaller, Hammond #8501 (screwed) or 8511 (solder) series bronze two piece large port ball valve 600 PSI-WOG/150 PSI-WSP reinforced TFE seats, chrome plate brass ball (tunnel or drilled design), silicon bronze stem vinyl-covered steel lever handle. Stainless steel ball and stem shall be provided for steam applications.

B. PLUG VALVES

1. Plug valves shall be scheduled as type "PLV" valves. Valve specifications by type number shall be as follows:

   a. PLV-1: 1" valves and smaller Hays 7400 series iron body gas cock, 175 PSI-WOG bronze plug washer and nut, screwed ends.
   b. PLV-2: 1-1/4" through 4" valves, Rockwell-Nordstrom Fig. 142, semi-steel lubricated plug valve, 175 PSI-WOG coated plug, two bolt cover, and short pattern screwed ends. Provide complete with standard pattern cast handle.
   c. .

C. CHECK VALVES

1. Check valves shall be scheduled as type "SCV" valves. Valve specifications by type number shall be as follows:

   a. SCV-1: 2" valves and smaller Hammond #IB940 (screwed) or IB912 (solder) bronze check valve, 200 PSI-WOG/125 PSI-WSP, Teflon or bronze disc and seat ring.
   b. SCV-2: 2-1/2" and larger Hammond #IR1124 HI flanged, ASTM 126 iron body, bronze trimmed, 200PSI-WOG/125 PSI-WSP.

D. MANUAL BALANCING VALVES

1. Balancing valves shall be scheduled as Type "BAV" valves. Contractor shall provide bronze balancing valves with provisions for connecting differential pressure meter for purposes of setting flow rate through valve. Contractor shall install balancing valves in a manner that allows access to the setting indicator and the gauge connections. Valves shall be shipped in polyurethane block to be used as insulation. Equivalent valves by Armstrong, Bell and Gossett, Tour and Anderson, Nibco. Valves shall be as follows:

   a. BAV-1 Sizes ½" through 6" Armstrong Model CBV I or CBV II circuit balance valve, 125 PSI-WP at 250 degrees F., meter connections with built-in check valves screwed or flanged ends. Provide complete with polyurethane insulation cover.

2.3. VALVE SCHEDULE

SYSTEM	SIZE	STOP	CHECK	BALANCE
Domestic Water	½"-2-1/2"	BLV-1	SCV-1	BAV-1
Natural Gas	½" - 1"	PLV-1	--	--
Natural Gas	1-1/4"-4"	PLV-2	--	--

PART 3 – EXECUTION

3.1. VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2. INSTALLATION

A. Install necessary valves within piping systems to provide required flow control, to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
B. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance and wherever possible, gate, check and ball valves shall be installed on a horizontal run with the handle upright and within 15 degrees of vertical. Butterfly valves shall be installed with the stem in the horizontal position and the handle at 90 degrees from vertical.
C. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining

method, and fluid or gas conveyed in system.

D. Valves 2-1/2" and smaller shall have soldered or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections.

E. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Architect-Engineer non-rising stem valve may be installed at particular points where space is restricted.

F. Provide butterfly valves 6" and smaller with 10 position lever handle for on-off application and infinite position handle for throttling applications.

G. Install globe valves with pressure on top of disc except that must be completely drained for inspection, maintenance or to prevent freezing shall be installed with stem in horizontal position to insure complete drainage of pipelines.

H. Valves shall be designed for repacking under pressure when fully opened and backseated.

I. Balancing valves installed by means of sweating or soldering shall have their interiors removed before installation and reinstalled upon dissipation of the heat associated with installation. Using a wet rag in lieu of removing the valve interior as a means of heat dissipation during installation is not acceptable.

3.3. ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

SECTION 220530 – MOTOR CONTROL AND EQUIPMENT DISCONNECTS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. DISCONNECT SWITCHES

A. General

1. Provide heavy-duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, or Square D.

B. Product

1. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
2. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
3. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.

C. Execution

1. All fuse holders shall have rejection clips installed.
2. Mount switch enclosure rigidly and with proper alignment on building structure or steel supports with centerline of operating handle not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
3. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.
4. All disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.

2.2. MOTOR STARTERS

A. General

1. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.
2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.

B. Product

1. MAGNETIC MOTOR STARTERS

a. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
b. Enclosures shall be NEMA type required by starter location and environment.
c. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size

that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.

d. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.

e. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.

f. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.

g. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.

h. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.

i. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.

j. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.

2. COMBINATION MAGNETIC MOTOR STARTERS

a. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.

b. Starter NEMA enclosure type shall be type required for starter location and environment.

c. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.

d. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.

e. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.

f. All fuse holders shall have rejection clips installed.

g. See plans for combination magnetic starters.

3. MANUAL MOTOR CONTROL (1 HP Maximum)

a. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.

b. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.

c. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.

d. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

C. Execution

1. All fuse holders shall have rejection clips installed.
2. Mount starter enclosure rigidly and with proper alignment on building structure or steel supports with operating switches not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
3. Furnish and install a nameplate for each starter/switch engraved with the equipment designation which the disconnect serves.
4. All starters/disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.
5. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and

manufacturer's installation requirements.

END OF SECTION 220530

SECTION 220548 – PLUMBING SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. GENERAL

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amber/Booth Company, Inc.
   b. Kinetics Noise Control.
   c. Mason Industries.
   d. Vibration Eliminator Co., Inc.
   e. Vibro Acoustics.
   f. Vibration Mountings & Controls, Inc.

2.2. VIBRATION ISOLATION

A. Furnish and install vibration isolation devices for rotating or reciprocating plumbing equipment and piping systems attached thereto.
B. Work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Architect-Engineer. Specific mounting arrangements for each item of plumbing equipment shall be as described herein and as indicated by schedules and details on the drawings.
C. All vibration isolation equipment, including steel framing and reinforcing for concrete inertia bases and including steel rail bases, shall be furnished by one of the following manufacturers: A single manufacturer for all vibration isolation equipment will be required except as specifically approved in writing by the Architect-Engineer or by his specific approval of shop drawings.
D. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:
E. Obtain from the Architect-Engineer the approved manufacturer's name, model number, and other necessary identifying data for each item of plumbing and electrical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.
F. Obtain all necessary data in regard to piping systems which are to be resiliently supported so that proper isolators can be selected. Select piping system isolators for proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.
G. Submit shop drawings as required by other portions of this specification. These drawings shall include specification information as follows:

   1. Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
   2. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.
   3. For elastomer or glass fiber isolators - free height, deflected height, and isolator loading.
   4. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

H. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
I. Replace at no extra cost to the Owner any isolators which do not produce the required deflection, are improperly loaded above or below their operating height, or which in any way do not produce the required isolation.

J. The vibration isolation systems described herein and identified by type letter designations shall be applied to specific classifications of plumbing and electrical equipment as indicated in this specification.

2.3. ISOLATION TYPES

A. TYPE 3 ISOLATION

1. The equipment shall be suspended with double deflection neoprene-in-shear hangers which are complete with elastomer washers as required to prevent metal-to-metal contact.
2. Hangers shall be installed as near as possible to the supporting overhead structure. Suspension points shall be on a rigid portion of both the overhead structure and equipment framework.

PART 3 - EXECUTION

3.1. GENERAL

A. Cooperate with all other Contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.
B. Notify the Architect-Engineer of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.
C. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect-Engineer so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the Contractor responsible at no additional cost to the Owner.

3.2. RESILIENT MOUNTINGS FOR SPECIFIC CLASSIFICATIONS OF EQUIPMENT

Equipment	Power(HP) or as Noted	Rotating Speed RPM	Mounting Type	Static Deflection*
Suspended Pumps	0 - 5	500 and Up	3	0.50"

* Minimum static deflection of isolators specified for mounting type indicated.

3.3. ISOLATION OF PIPING SYSTEMS

A. All piping which connects to resiliently mounted equipment shall be suspended with resilient hangers or supported by floor mounted isolators for a distance of 100 pipe diameters from the connected machine or within the plumbing equipment room whichever is the greater distance. The first three supports from the connected machine shall have the same static deflection as indicated for the machine; the next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and remaining pipe supports shall provide static deflection of 0.35 inches minimum. These remaining isolators may be elastomer.
B. Steel spring hangers shall be as specified for Type D isolation except that a scale shall be attached to the hanger housing to indicate deflection. Elastomer hangers shall be as specified for Type E isolation.
C. Flexible stainless steel connectors shall be used to connect all piping to all isolated equipment except equipment for which flexible connectors are not permitted by code. For this application provide swing connectors changing direction a minimum of 3 times before joining isolated equipment. Swing connections should be made within approximately 6 feet of the isolated equipment.
D. Drain connections from isolated equipment to floor drains shall be at least 1" free from drain or use rubber hose.

3.4. ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of sprint isolators.
D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220700 – PLUMBING INSULATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.

B. SUBMITTALS

1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
2. Shop Drawings:

a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
b. Detail attachment and covering of heat tracing inside insulation.
c. Detail insulation application at pipe expansion joints for each type of insulation.
d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
e. Detail removable insulation at piping specialties, equipment connections, and access panels.
f. Detail application of field-applied jackets.
g. Detail application at linkages of control devices.
h. Detail field application for each equipment type.

3. Qualification Data: For qualified Installer.
4. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. QUALITY ASSURANCE

1. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
2. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.3. DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.4. COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.5. SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1. INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2. PIPING AND EQUIPMENT INSULATION

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

B. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

C. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000(Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3. INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4. ADHESIVES

A. Military Specification referenced in this article is the only standard available when this Section was updated. MIL-A-3316C was last updated in October 1987.
B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5. MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

2.6. SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7. FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

2.8. FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

2.9. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. Although other thicknesses for PVC jackets are available, a flame-spread index of 25 and a smoke-developed index of 50 apply only to thicknesses of 30 mils (0.8 mm) and less.
C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Factory cut and rolled to size.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Among the three moisture barriers in first subparagraph below, 1-mil (0.025-mm) barrier provides the least protection against galvanic corrosion, 3-mil (0.075-mm) barrier offers better protection, and Polysurlyn barrier offers the best protection. For most indoor applications, 1-mil (0.025-mm) barrier is adequate. For outdoor applications, select either 3-mil (0.075-mm) or Polysurlyn barrier.
4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper].
6. Factory-Fabricated Fitting Covers:
    a. Same material, finish, and thickness as jacket.
    b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    c. Tee covers.
    d. Flange and union covers.
    e. End caps.
    f. Beveled collars.
    g. Valve covers.
    h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10. TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
    1. Width: 3 inches.
    2. Thickness: 11.5 mils.
    3. Adhesion: 90 ounces force/inch in width.
    4. Elongation: 2 percent.
    5. Tensile Strength: 40 lbf/inch in width.
    6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
    1. Width: 3 inches.
    2. Thickness: 6.5 mils.
    3. Adhesion: 90 ounces force/inch in width.
    4. Elongation: 2 percent.
    5. Tensile Strength: 40 lbf/inch in width.
    6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
    1. Width: 2 inches.
    2. Thickness: 6 mils.
    3. Adhesion: 64 ounces force/inch in width.
    4. Elongation: 500 percent.
    5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
    1. Width: 2 inches.
    2. Thickness: 3.7 mils.
    3. Adhesion: 100 ounces force/inch in width.
    4. Elongation: 5 percent.
    5. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
    1. Width: 3 inches.
    2. Film Thickness: 6 mils.
    3. Adhesive Thickness: 1.5 mils.
    4. Elongation at Break: 145 percent.
    5. Tensile Strength: 55 lbf/inch in width.

2.11. SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.12. INSULATION SCHEDULE

A. See plans for piping and insulation schedule. Other insulation requirements are scheduled below:

INSULATION SERVICE	SIZE	TYPE	THICKNESS	JACKET
Drinking Fount. Drain	All Sizes	FE	1”	ASJ-SSL
Condensate Drain	All Sizes	FE	½”	ASJ-SSL
MF - Mineral-Fiber		FE - Flexible Elastomeric		

2.13. LAVATORIES AND SINK INSULATION

A. Insulate all exposed hot, cold and waste piping associated with lavatories and sinks with Truebro “Handi Lav-Guard” insulation kit model no. 102. Equivalent by Brocar Products Inc. or Proto P-trap and valve covers.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3. GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
B. All portions of piping shall be insulated, including inside walls, chases and other concealed spaced.
C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
F. Install multiple layers of insulation with longitudinal and end seams staggered.
G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
H. Keep insulation materials dry during application and finishing.
I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
J. Install insulation with least number of joints practical.
K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure

with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

R. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

3.4. PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Penetration Firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping."

3.5. GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as

adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe

segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7. MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8. FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

3.9. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Plumbing Contractors expense at no cost to owner.

END OF SECTION 220700

SECTION 221100 – PLUMBING PIPING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. PIPING MATERIALS

A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. See piping material schedule at end of this Section for materials to be used for each piping system.

1. Cast Iron Bell and Spigot Soil Pipe

a. Pipe and fittings shall be gray cast iron bell and spigot conforming to ASTM A-74.
b. Seal joints with neoprene gaskets conforming to ASTM C-564.
c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

2. Hubless Cast Iron Soil Pipe

a. Pipe and fittings shall be gray cast iron conforming to CISPI 301.
b. Pipe joints shall be no-hub heavy duty couplings consisting of neoprene rubber sleeve conforming to ASTM C-564 and mfg. by Husky SD 4000, Clamp all-125 or MG. Equivalent Mission.Heavyweight couplings.
c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

3. Carbon Steel Pipe (1/8" thru 2"):

a. Pipe:

i. Provide seamless carbon steel conforming to ASTM specification A-106.
ii. Pipe joints shall be threaded conforming to ANSI Standard B2.1.

b. Carbon Steel Welding Fittings:

i. Provide carbon low alloy seamless steel welding fittings conforming to current ANSI Standard B16.9 and ASTM Specification A234.

c. Branch Connection Welding Fittings:

i. Provide carbon steel weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM specification A105, Grade 11.

d. Branch Connection, Welding to Screwed Fitting:

i. Provide carbon steel threadolet fitting conforming to ANSI Standards B16.9, B16.11, B31.1, and ASTM Specification A105, Grade 11.

e. Carbon Steel Flanges:

i. Provide carbon steel flanges conforming to ASTM Specification A181, Grade 1, and ANSI Standard B16.5.

f. Malleable Iron Screwed Fittings:

i. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, and ASTM Specification A-47 grade 32510.

g. Cast Iron Screwed Fittings:

i. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.

h. Roll Grooved Pipe Couplings:

i. Provide Victaulic style #107 or approved equal style (zero flex) couplings with Grade "E" gasket (EPDM compound) in mechanical areas. Provide Victaulic style #177 or approved equal style (flexible) couplings with Grade "E" gasket in other areas. Provide with ductile iron housing and nuts and bolts.

ii. Equivalent by Grinnell.

4. Copper Tube:

a. Tube/Pipe:

i. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule. Tubing joints shall be soldered, brazed or Viega Pro-Press style fittings. See schedule for joining method to be used.

ii. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.

b. Wrought Copper Fittings:

i. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22

ii. Fittings by Anaconda, Chase, Viega or Nibco.

5. Polyvinyl Chloride Drain Waste Pipe:

a. Pipe:

i. Provide Schedule 40 polyvinyl chloride solid core plastic drain waste and vent pipe conforming to ASTM D2665. Joints shall be properly cleaned, primed and glued where scheduled.

ii. Polyvinyl Chloride (PVC) Pipe & Fittings Cell Class 12454 B. ASTM D 2241 SDR-26

iii. Pipe by Charlot, Genova, Crestline or equal.

b. PVC Fittings:

i. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

ii. Joints shall be of a push-on type with a bell-end grooved to receive a synthetic rubber gasket when scheduled. Solvent welded joints are not allowed outside the building. The joint shall be made in accordance with ASTM D 3212.

iii. Equivalents: Spears, Lasco or equal.

PART 3 EXECUTION

3.1. PIPING INSTALLATION

A. Piping systems materials and installation shall conform to the following standards and codes.

1. System: Natural Gas Piping

a. Code: ANSI Standard B31.12 "Fuel Gas Piping"

B. No piping containing water shall be located in areas subject to freezing temperatures, including: unheated attics, unheated plenums, chases wall spaces or cavities within exterior walls, under slabs, or in concrete.

C. Pipe sizes indicated on plans and as specified refer to nominal size in inches, unless otherwise indicated. Pipes are sized to nearest ½". In no case shall piping smaller than size specified be used.

D. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings.

E. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers

and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer's recommendations for fixed hanger and supports.

F. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.

G. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be ¾".

H. Drain valves on closed piping systems such as chilled water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.

I. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.

J. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed and control valves with unions adjacent to each piping connection. Provide screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line.

K. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.

L. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricate pipe threads with Teflon thread sealant and lubricating compound applied full strength. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.

M. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.

N. Soft soldered socket type joints shall be made with sill-floss or 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.

O. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

3.2. PIPING SUPPORTS, ANCHORS, SLEEVES AND SEALS

A. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor.

B. Plumbing Contractor shall supervise installation of sleeves to insure proper location and installation.

C. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.

D. Sleeves passing through above grade floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.

E. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.

F. Pipe insulation shall run continuous through pipe sleeves with ¼" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.

G. Pipe wall penetrations exposed to view shall have tight fitting escutcheons or flanges to cover all voids around openings.

H. All below grade and exterior wall penetrations shall be installed in a pipe sleeve and sealed between the pipe and pipe sleeve with Thunderline High Temperature Link Seal.

I. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around cables with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

J. Equivalent by Dow, Chemelex, 3M.

3.3. PIPE HANGERS AND SUPPORTS

A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58.
B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position.
D. Hangers shall not become disengaged by movements of supported pipe.
E. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.
F. Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1-1/4”	3/8”	8 Ft.
1-1/2” to 2”	3/8”	10 Ft.
2-1/2” to 3-1/2”	½”	12 Ft.
4” and 5”	5/8”	15 Ft.

G. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1”	3/8”	6 Ft.
1-1/4” to 1-1/2”	3/8”	8 Ft.
2”	3/8”	9 Ft.
2-1/2”	½”	9 Ft.
3” and 4”	½”	10 Ft.

H. Support horizontal cast iron soil pipe with two hangers for each section located close to each hub.
I. Support vertical cast iron soil pipe at every floor, steel and copper tubing at every other floor except where indicated otherwise on drawings.
J. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used.
K. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect-Engineer for review prior to fabrication.
L. Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	½” thru 4”	CT-121
Steel	¾” thru 20”	261

M. Provide Grinnell Fig. 194, 195 or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.
N. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation.

O. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing. Provide wood block at each pipe hanger in thickness of insulation. Insulation vapor barrier jacket shall overlap wood block to maintain vapor barrier.

3.4. INSULATION MATERIALS AND APPLICATIONS METHODS (HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS, ETC.)

A. Insulation materials and application methods for piping hangers supports, anchors, guides expansion joints, etc., shall be as follows:

1. Insulate hangers and supports from direct contact with cold or hot surfaces (-120°F to 450°F) with "Buckaroos Inc." or approved equal pipe insulation support system or similar rigid calcium silicate insulation at suspension points to prevent crushing of insulation.
2. The length or thickness of the insulation support same as the pipe insulation thickness. Provide ASJ type discs or otherwise reestablish vapor barrier.

B. Structural attachments for pipe hangers shall be as follows:

C. Concrete Structure: Provide Grinnell Fig. No. 285 cast in concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge cast in type concrete insert for loads up to 1200 lbs.

D. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

PIPE MATERIALS	PIPE SIZE	HANGER FIG. NO.
Copper	½" thru 4"	CT-65
Steel	3/8" thru 4"	65
Steel	5" thru 30"	260

E. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	8600 CP*	8010 CP*
Steel	3/8" thru 6"	8500	8010

*Copper Plated

F. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Elcen or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Architect-Engineer for review prior to fabrication.

G. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

H. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.

I. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Architect-Engineer prior to installations.

J. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Bee Line, Elcen, Fee & Mason, Fluorocarbon Company, Unistrut or Super Strut Inc.

K. Provide polycarbonate pipe support for piping located on flat roofs, unless otherwise indicated on drawings. Support will be of modular stackable design with a nylon roller bearing directly supporting pipe and a preformed saddle to keep piping on roller bearing. Maximum pipe support spacing shall be 10'. Provide pipe supports from Miro Industries, or approved equivalent, in the following sizes:

PIPE SIZE	MODEL NUMBER
Up to 2"	02

2 ½" thru 4"	24R

END OF SECTION 221100

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and maintenance data.

1.3. QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1. INSULATING UNIONS AND FLANGES

A. Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturers name and pressure class rating. Unions and flanges shall be as follows:

1. Steel pipe to steel pipe screwed end:

a. Provide Stockham malleable iron No. 693-1/2 insulating union with high dielectric strength insulating sleeve and gasket.

2. Steel pipe to steel pipe flanged end:

a. Provide two weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.

3. Iron or steel pipe to copper pipe:

a. Provide Epco Dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.

2.2. UNIONS

A. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.
B. Provide Stockham brass seat unions of material and pressure rating required by piping system.
C. Where piping systems of dissimilar materials are jointed together provide proper insulating union as specified under this specification.
D. Equivalent unions by Fairbanks or Grinnell.

2.3. STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. If retaining more than one screen size, indicate screen size on Drawings.
6. Perforation Size:

a. Strainers NPS 2 and Smaller: 0.062 inch
b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
c. Strainers NPS 5 and Larger: 0.125 inch.

7. Drain: Factory-installed, hose-end drain valve.

B. Install strainers upstream from automatic control valves, water service backflow preventers and RPZ backflow preventers 1" and larger. Where strainers are an integral part of these items or incorporated in accessory equipment directly upstream, individual line strainers will not be required. Strainers shall be same size as piping. Provide strainers with proper isolation and blow down valves to allow basket removal for cleaning.

C. Install strainer so that basket contains debris by gravity at no flow conditions to allow removal of large debris not able to be passed by blow down.

2.4. FLEXIBLE PUMP CONNECTIONS

A. Resistoflex Model R6904, multiple arch contour molded virgin fine powder/paste extrusion grade of Teflon TFE62, ASTM D-1457, Type III Teflon bellows with stainless steel reinforcing rings, 150# ASA drilled, adjustable control units have complete insulating grommets, and published dynamic pressure/temperature rating. Dupont TFE T62 Fluoroflex T-1001.

2.5. GAS PRESSURE REGULATORS

A. Provide gas pressure regulators with internal relief and low pressure cut-off as manufactured by Fisher Controls or Equimeter. Units shall be of size capable of capacities and pressures as shown on plans or as required for proper service. Verify capacities and pressures with each piece of equipment served.

2.6. BACKFLOW PREVENTERS

A. Provide where shown on plans the following types of backflow preventers. Provide isolation valve ahead of backflow preventers.

B. Equivalent backflow prevents by Watts, Febco, Lawler.

1. Double Check Valve (1/2"-2"):

a. Watts Series 007 double check valve assembly complete with ball type test cocks, full port ball valve shut offs and strainer.

2. Pressure Vacuum Breakers (1/2"-2"):

a. Watts Series 800M4QT pressure vacuum breaker with integral ball valve shut offs.

3. Pressure Vacuum Breakers (3/8"-1/2"):

a. Watts Series 008QT pressure vacuum breaker for anti-spill applications, with integral ball valve shut offs.

4. Atmospheric Vacuum Breaker (1/4"-3"):

a. Watts Series 288A atmospheric vacuum breaker in plain brass finish.

5. Hose Bibb Vacuum Breakers

a. Vacuum Breakers for hose end connections shall be Watts Series 8 non removable type.

2.7. DOMESTIC HOT WATER EXPANSION TANKS

A. The expansion tank shall be welded steel, diaphragm type tank, and pre-charged to the minimum operating pressure. Tanks shall be suitable for domestic water service.

B. Provide expansion tanks as shown on plans by Amtrol, Bell and Gossett, Watts.

2.8. WATER HAMMER ARRESTERS:

A. ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F. Manufacturers: Amtrol, Josam, Sioux Chief, Watts, Zurn.

B. Provide water hammer arrestors for all plumbing banks with fixtures utilizing flush valves in any capacity. Locate arrester between the last two fixtures served on the branch line. Water Closet = 10FU, Urinals = 5FU, Lavatories = 1.5FU.

FIXTURE UNITS (FU)	UNIT SIZE
1-11	A
12-32	B
33-60	C
61-113	D
114-154	E
155-330	F

C. When no flush valves are installed on a branch of piping provide ¾"x12" air chambers at each hot and cold water supply connection to a plumbing fixture. Contractor may provide water hammer arresters above the ceiling before dropping into masonry construction in lieu of air chambers. Connections to other items such as washers, ice makers, or other equipment shall be provided with an appropriately sized water hammer arrester for each water connection.

2.9. RECIRCULATION PUMPS

A. The pump shall be of the horizontal, oil-lubricated type and of all bronze construction. Specifically designed and guaranteed for quiet operation. Suitable for 125# working pressure.
B. The pump shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall be supported by two horizontal sleeve bearings designed to circulate oil. The pump is to be equipped with a mechanical seal with carbon seal face rotating against a ceramic seat. The motor shall be non-overloading at any point on pump curve.
C. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber-mounted construction. Motors shall have built-in thermal overload protectors.
D. Provide pump with aquastat or built in temperature control/timer system.
E. Equivalents pumps by Grundfos, Armstrong, Bell & Gossett and Taco.

2.10. THERMOMETERS AND GAUGES

A. Provide thermometers and wells and pressure test plugs as hereinafter specified and shown on the plans so that proper testing and balancing and trouble shooting can be accomplished.
B. THERMOMETERS

1. Thermometers shall be red reading mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Trerice or Weksler.
2. Install thermometers at eye level (5'-0") at easily readable locations.

C. GAUGES

1. Gauges shall be bourdon tube with minimum 4-1/2" dial and die cast aluminum case with black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube brazed at socket and tip. The accuracy of the gauge shall be within ½ percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure, compound, and differential pressure gauges shall have suitable scale ranges, shall be submitted and are subject to the review of the Engineer. Graduations shall be one pound or less on all gauges where this is standard for the required range.
2. Gauges shall have ¼" IPS connections and shall be Moeller "Vantage" gauges with Case Style No. 2, or approved equal. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Ashcroft, Marsh, Trerice, Moeller, Weksler, Taylor, Weiss, or Midwest.
3. Install a Sisco ¼" or ½" NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1000 psig.
4. Install gauges vertically.

D. INSTALLATION

1. Thermometers shall be installed as hereinafter specified. Where thermometer is scheduled, a thermometer well shall be provided.
2. All thermometer wells shall be constructed of brass or stainless steel and where installed in insulated piping shall

have at least 2-1/2" lagging extension. Gauges shall be installed as hereinafter specified.

3. Gauge cocks shall be polished brass A10 ¼" tee handle type with threaded ends. 125 psi rated.
4. Provide gauge cock with ¼" pipe nipple for connection to gauge cock.
5. Pressure temperature ratings of each well shall be suitable for the system in which it is installed in accordance with specifications and as indicated on the drawings. All wells shall be filled with Silicon and be complete with caps and chains.
6. Thermometers shall have the temperature ranges as required for the intended application and shall be installed as scheduled.

E. THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

SERVICE	Thermometer & Well	Press Gauge & Gauge Cock
Hot water entering and leaving heaters	X	

PART 3 EXECUTION

3.1. INSTALLATION

A. Refer to other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.
B. Install backflow preventers in each water supply to plumbing equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
D. Install balancing valves in locations where they can easily be adjusted.
E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
G. Install water hammer arresters in water piping according to PDI-WH 201.
H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2. FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3. ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.
B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Cleanouts.
2. Floor drains.

1.4. QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 PRODUCTS

2.1. CLEANOUTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated below or a comparable product by one of the following:

1. Josam Company; Josam Div.
2. Sioux Chief Manufacturing Company, Inc.
3. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Floor (Concrete Floor Finish):

1. Wade #W-6000-XS cast iron cleanout with square, heavy duty, scoriated nickel bronze top, adjustable above to finished floor.

C. Floor (Quarry Tile Floor Finish):

1. Same as concrete floor finish.

D. Floor (Tile Floor Finish):

1. Wade #W-6000-TS cast iron cleanout with square heavy duty nickel bronze top, recessed for tile and adjustable to finished floor.

E. Floor (Carpet Floor Finish):

1. Wade #W-6000-XS-72 cast iron cleanout with round, heavy duty nickel bronze top with carpet retainer and adjustable to finished floor after concrete has set.

F. Wall:

1. Wade #W-8450-C cleanout with dura-coated cast iron ferrule and cadmium plated cast iron counter-sunk plug complete with round smooth nickel bronze wall access cover and flush over-wall frame.

G. Verify floor materials used from Architectural plans and provide proper cleanout tops, where they occur in carpet, quarry tile, vinyl tile or ceramic tile.

2.2. FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group.

2. Standard: ASME A112.6.3.
3. Body Material: Gray iron.
4. Seepage Flange: Required for all elevated slabs.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze in public spaces or rough bronze in mechanical spaces unless otherwise scheduled.
9. Top of Body and Strainer Finish:
10. Top Shape: Square in tiled areas. All others shall be round.
11. Dimensions of Top or Strainer: As scheduled.
12. Trap Material: Cast iron.
13. Trap Pattern: Deep-seal P-trap.
14. Trap Features: Trap-seal primer valve drain connection where shown on plans.

2.3. FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
D. Fasteners: Metal compatible with material and substrate being fastened.
E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
F. Solder: ASTM B 32, lead-free alloy.
G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.1. INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. Not all required cleanouts are shown on the plans in the interest of drawing clarity. Cleanout that are shown are shown are to be located as shown. Additional code required cleanouts shall be located to be along walls (not in middle of halls or large floor areas) and out of general sight lines where possible. Install cleanouts so they are accessible by extending them through walls, and floors, to outside of building, or to above grade as required.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

I. Install deep-seal traps on floor drains and other waste outlets..

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2. CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
C. Install piping adjacent to equipment to allow service and maintenance.
D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3. FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4. PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 – ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. ELECTRICAL WORK REQUIRED

A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

1.3. SUBMITTALS

A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.

C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
D. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
E. Warranties: Special warranties specified in this Section.

1.4. QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
D. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
2. ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings," for household water heaters.

1.5. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
C. Warranty Period: From date of Substantial Completion:

1. Storage Tanks: 3 years.

PART 2 - PRODUCTS

A. COMMERCIAL, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS LARGER THAN 30 GALLONS

1. Provide water heaters as scheduled by State, Rheem, A.O. Smith, PVI. Refer to schedule for capacities and characteristics.
2. Description: Comply with UL 174 or UL 1453, and listed by manufacturer for commercial applications.
3. Storage Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
d. Jacket: Steel, with enameled finish.

4. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.

   a. Temperature Control: Adjustable thermostat.

5. Anode Rod: Factory installed, magnesium.
6. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
7. Special Requirement: NSF 5 construction.
8. Provide water heaters as scheduled by State, Rheem, National, or A.O. Smith. Refer to schedule for capacities and characteristics.
9. Units shall have a porcelainized glasslined tank, protected in the following ways:

   a. Against failure due to overheating caused by the buildup of scale, film and other sediment by a cold water inlet tube, which is an integral part of the heater, that churns and agitates particles of sand, silt or scale present in the water, so they are carried out of the water heater on successive hot water draws.
   b. Against electrolytic corrosion by conveniently located, easily replaceable magnesium anode rods.

10. Water heaters shall have the U.L. seal of certification, a working pressure rating of 160 psi, a factory installed Temperature and Pressure Relief Valve, and a full-size (4”x5”) inspection port. Water heater shall also be equipped with N.S.F. construction.
11. Water heater tanks shall be covered by a 3 year limited warranty against failure due to metal fatigue and overheating caused by buildup of sand, sediment or sludge.

PART 3 - EXECUTION

3.1. WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

   1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
C. Anchor water heaters to substrate.
D. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
E. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
F. Install vacuum relief valves in cold-water-inlet piping.
G. Install vacuum relief valves in water heater storage tanks that have copper lining.
H. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for drain valves.
I. Install thermometers on water heater inlet and outlet piping. Refer to Division 22 Section "Meters and Gages" for thermometers.
J. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Valves" for general-duty valves and Division 22 Section "Meters and Gages" for thermometers.
K. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.
L. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat

traps.

M. Fill water heaters with water.

N. Charge compression tanks with air.

3.2. CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.

D. Make connections with dielectric fittings where piping is made of dissimilar metal.

E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.

F. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

B. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
2. Verify that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Check operation of circulators.
6. Test operation of safety controls, relief valves, and devices.
7. Energize electric circuits.
8. Adjust operating controls.
9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
10. Balance water flow through manifolds of multiple-unit installations.

3.4. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

1. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.
2. Review date in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 223300

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. ELECTRICAL WORK REQUIRED

A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

1.3. PIPING SYSTEMS

A. Refer to Section 221116 of this specification for piping material specifications and installation instructions. Specific piping materials and joining methods for systems installed under this section shall be as listed in schedule.

1.4. PIPING SYSTEMS VALVES

A. Refer to Section 22 “Valves” of this specification for valve type specifications and installation instructions.

1.5. PIPING SYSTEMS INSULATION

A. Refer to Section 22 “Insulation” insulation type specifications and installation instructions.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Equivalent fixtures and accessories by following manufacturers will be acceptable.

1. Fixtures: American Standard, Kohler, Crane, Zurn, Toto.
2. Institutional/Correctional: Bradley, or Acorn
3. Stainless Steel Fixtures: Elkay, Just, Moen Commercial
4. Fittings and Supports: Josam, Smith, Wade, Zurn, or Jonespec.
5. Seats: Church, Olsonite, Bemis or Beneke.
6. Drinking Fountains: Halsey Taylor, Elkay, Oasis, or Haws.
7. Lavatory & Sink Trim: Eljer, Chicago, Bradley, Sloan, Moen Commercial or American Standard.
8. Traps, Supplies and Stops: Dearborn, Brass Craft, Central D, Sanitary Dash or as specified under plumbing fixtures.

   a. Supplies and Stops: Dearborn Fig. No. 2700 CW ½” compression loose key stop and 3/8” O.D. risers in length required. Provide deep chrome plated brass escutcheons.
   b. Traps: Dearborn #FS510 (1-1/2”) and/or EFS507 (1-1/4”) cast brass body with clean-out and 17 gauge tube outlet “P” trap. Provide deep chrome plated brass escutcheon with set screw.

2.2. PLUMBING FIXTURES

A. Provide plumbing fixtures as shown on drawings and as specified complete including piping and connections. China fixtures shall be of best grade vitreous ware without pit holes or blemishes and outlines shall be generally true. Architect-Engineer reserves right to reject any piece, which in their opinion is faulty. Fixtures fitting against walls shall have ground backs. Exposed piping and fittings shall be chrome plated.
B. All wall mounted urinals and lavatories shall be furnished with concealed arm carriers. All wall-mounted water closets shall be furnished with concealed carriers.
C. Set fixtures true and level with all necessary supports for fixtures installed before wall finish is done. Nipples through wall to fixture connections shall be chrome plated brass. Provide silicone sealer around perimeter of lavatories, water closets, and urinals at connection to wall and/or floor.

2.3. LAVATORY FAUCETS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a

comparable product by one of the following:

1. ADM Bathroom Design
2. American Standard Companies, Inc.
3. Bradley Corporation.
4. Chicago Faucets.
5. Delta Faucet Company.
6. Eljer.
7. Kohler Co.
8. Moen Commercial
9. Zurn Plumbing Products Group; Commercial Brass Operation.

B. Description: Single-control mixing, Single-control nonmixing, and Two-handle mixing as scheduled valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

1. Body Material: Commercial, solid brass
2. Finish: As Scheduled.
3. Maximum Flow Rate: 0.5 gpm (1.5 L/min.) for public lavatories. Private lavatories shall be a maximum of 2.2 gpm (8.3 L/min.)
4. Centers: As scheduled and coordinated with fixtures.
5. Valve Handle(s): ADA Compliant wrist blade, 4 inches (102 mm) unless otherwise scheduled.
6. Spout: Rigid in public locations. Coordinate gooseneck swing or rigid installation with architect prior to installation.
7. Spout Outlet: As scheduled.
8. Tempering Device: Provide thermostatic tempering device piped in supply for all public lavatories unless tempering is otherwise provided.
9. Where electronic fixtures are specified, provide will all transformers, cables, junction boxes, sensors and controls. All equipment and installation shall have neat and orderly appearance.

2.4. PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Co.
b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
c. McGuire Manufacturing Co., Inc.
d. Plumberex Specialty Products Inc.
e. TCI Products.
f. TRUEBRO, Inc.
g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 EXECUTION

3.1. GENERAL

A. All plumbing fixtures shall be cleaned and free of all construction debris.
B. Electric water cooler shall be protected during construction.
C. Any chrome trim with wrench marks shall be removed and new trim installed.
D. Architect-Engineer reserves the right to reject any plumbing fixture.
E. See plans for Plumbing Fixture Schedule.

3.2. INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.
E. Install fixtures level and plumb according to roughing-in drawings.
F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
I. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
J. Install toilet seats on water closets.
K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
N. Install shower flow-control fittings with specified maximum flow rates in shower arms.
O. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

P. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
Q. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck where sink is stainless steel type or on countertop at sink where sink is integral or there is no deck for sink. Connect inlet hose to dishwasher and outlet hose to disposer.
R. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Basic Plumbing Materials and Methods."
S. Set bathtubs and showers in leveling bed of cement grout.

T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3. CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4. FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
E. Install fresh batteries in sensor-operated mechanisms.

3.5. PROTECTION

A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

END OF DIVISION 220000

END OF DIVISION 220000

DIVISION 23

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SECTION 230500 – MECHANICAL PROVISIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Mechanical Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK

A. This DIVISION requires the furnishing and installing of complete functioning Mechanical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS

A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.

B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.

C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.

D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.

E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.

F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.

G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.

H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.

I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.

J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS

A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS

A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES

A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in

writing for review of Architect-Engineer. No verbal change orders will be recognized.

1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the mechanical drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.

B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.

C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

D. Do not scale mechanical and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicted on the Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.

B. Warranty for all equipment shall take effect from the date of substantial completion regardless of the date equipment was installed.

C. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. TEMPORARY USE OF PERMANENT HVAC UNITS

A. If the Contractor elects to use permanent equipment for temporary conditioning only that permanent equipment associated with the heating system shall be allowed for use as space conditioning during the construction period. The Mechanical Contractor shall take full responsibility for all permanent equipment used for temporary conditioning during the construction period and shall provide a total of two years warranty covering all parts and labor on all permanent equipment utilized for temporary conditioning. This warranty shall cover all piping, fittings, valves, pipe and equipment insulation, pumps, boilers, chillers, condensing units, cooling towers, air handling units, exhaust and relief air fans, ductwork, ductwork insulation, diffusers, temperature controls, all electric motors, starters, disconnect switches, fuses, wire and conduit. This warranty shall cover all required maintenance on the system with the exception of filter changes, and shall start on the date shown on the final completion certificate.

B. CAUTION: The Contractor is being warned that the Architect-Engineer will not accept dirty equipment caused by construction contamination.

1.14. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.15. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.16. EXTENT OF CONTRACT WORK

A. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.

B. Electrical work required to install and control mechanical equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor's base bid proposal. Mechanical systems and components are to be installed as a complete system, including all miscellaneous interlock (low voltage and minor line voltage power wiring such as control motors, limit switches, relays, etc), control wiring, safeties. Coordinate interlock to other systems such as fire alarm that interlock to mechanical systems and insure that provisions are made in equipment for connection of these systems. Coordinate with all other trades for specific needs and requirements based on submitted systems.

C. Contractor shall become familiar with equipment provided by other contractors that require mechanical connections and controls.
D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.
E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Mechanical Contractor at no cost to Owner or Architect-Engineer.
F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
H. Contractor shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

1.17. WORK NOT INCLUDED IN CONTRACT

A. Consult Division 26 of specifications for work to be provided by Electrical Contractor in conjunction with installation of mechanical equipment.

1.18. CODES, RULES AND REGULATIONS

A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.19. SAFETY CODES:

A. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
B. Occupational Safety and Health Standard (OSHA) - Department of Labor.

1.20. NATIONAL FIRE CODES:

A. NFPA No. 13 Standard for the installation of Sprinkler Systems (2010 Edition)
B. NFPA No. 14 Standard for the installation of Standpipe and Hose Systems (2010 Edition)
C. NFPA No. 54 National Fuel Gas Code (2012 Edition)
D. NFPA No. 70 National Electrical Code (2011 Edition)
E. NFPA No. 89M Clearances, Heat Producing Appliances
F. NFPA No. 90A Air Conditioning and Ventilating Systems (2012 Edition)
G. NFPA No. 91 Standard for Exhaust Systems (2010 Edition)
H. NFPA No. 99 Standard for Health Care Facilities (2012 Edition)
I. NFPA No. 101 Life Safety Code (2012 Edition)
J. NFPA No. 204 Standard for Smoke and Heat Venting (2012 Edition)

1.21. UNDERWRITERS LABORATORIES INC:

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.22. MISCELLANEOUS CODES:

A. ANSI A117.1 - Handicapped Accessibility
B. Applicable State Boiler Codes
C. Americans with Disabilities Act (ADA)

1.23. ENERGY EFFICIENCY REQUIREMENTS:

A. All mechanical systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 and latest adopted version of IECC.

1.24. STANDARDS

A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.25. PERMITS/FEES

A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

2.1. Not Used

PART 3 - EXECUTION

3.1. SHOP DRAWINGS

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.
B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.
D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.
E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.
G. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.
H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.
I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked

to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Sheet metal shop drawings for duct fabrication shall be a minimum of 1/4" scale. Sheet metal shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans, fittings, reinforcement and spacing, seam and joint construction, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.

L. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

1. BASIC MECHANICAL MATERIALS AND METHODS:
   a. Test methods and pressures
   b. Piping, and fittings
2. PIPING:
   a. Piping specialties
   b. Supports, anchors
   c. Sleeves and seals
   d. Piping and equipment insulation
3. SHEET METAL:
   a. Ductwork
   b. Ductwork materials
   c. Sheet metal specialties and ductwork accessories
   d. Exhaust hoods
   e. Ductwork insulation
   f. Grilles, registers and diffusers
4. HVAC AIR SIDE EQUIPMENT:
   a. Air handling units
   b. Variable air volume boxes
   c. Fan powered boxes
   d. Rooftop heating and cooling units
   e. Exhaust fans
5. MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL:
   a. Vibration isolation
   b. Isolation of piping systems
   c. Isolation of fractional horsepower equipment
6. SYSTEM TESTING & BALANCING:

a. Testing Contractor
b. Balance Report

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.

D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

1. Project name and address.
2. Section of work covered by brochure, i.e., “Plumbing”, etc.

3.5. RECORD DOCUMENTS

A. A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
C. Provide one copy of on high quality heavy weight presentation type paper. Blueprints or other media which fade shall not be used.
D. Provide one electronic scanned version of record documents in Adobe PDF format on a DVD. Transmit DVD in conjunction with hard copy documents.

3.6. CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
B. Contractor shall clean up all ductwork and equipment at the completion of the project.
C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.7. WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.8. CUTTING AND PATCHING

A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect’s and Structural Engineer’s approval and in a manner approved by them.
B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality,

finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of mechanical work shall be repaired at Contractor's expense to approval of Architect-Engineer.

3.9. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Mechanical contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.

3.10. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.
B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.
C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.11. FINAL CONSTRUCTION REVIEW

A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 230500

SECTION 230505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.
3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor

and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

    1. Right-of-Way:

        a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
        b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Organize meeting with agenda and invite all pertinent attendees. Notify Architect and owner of relevant meetings. Record all decisions made and distribute minutes within 3 days of meeting.
B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

    1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation

and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. The Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Possible conflicts.
    i. Compatibility problems.
    j. Time schedules.
    k. Manufacturer's written recommendations.
    l. Warranty requirements.
    m. Compatibility of materials.
    n. Space and access limitations.
    o. Regulations of authorities having jurisdiction.
    p. Testing and inspecting requirements.
    q. Installation procedures.
    r. Coordination with other work.
    s. Required performance results.
    t. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Notify Architect of meeting.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    b. Review present and future needs of each contractor present, including the following:

        i. Interface requirements.
        ii. Sequence of operations.
        iii. Status of submittals.
        iv. Deliveries.
        v. Off-site fabrication.
        vi. Access.
        vii. Quality and work standards.
        viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 220505

SECTION 230510 – MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section requires the selective removal and subsequent offsite disposal of the following:

1. Mechanical and electrical equipment, devices, piping, conduits, ductwork, insulation, lighting, etc in existing building indicated on drawings and as required to accommodate new construction.
2. Removal of MEP items in interior partitions as indicated on drawings.
3. Removal and protection of existing fixtures, materials, and equipment items indicated to be removed, salvaged, relocated, reinstalled, etc.

1.3. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
B. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed remodeled areas.

C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

1.4. JOB CONDITIONS

A. Occupancy:

1. Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.

B. Condition of Structures:

1. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
2. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted.
3. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
4. Provide protective measures as necessary and required to provide free and safe passage of Owner's personnel and general public to any occupied portions of building.
5. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
6. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
7. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.

8. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
9. Remove protections at completion of work.

C. Damages:

1. Promptly repair damages caused to adjacent facilities by demolition work.

D. Traffic:

1. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Flame Cutting:

1. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

F. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

G. Maintain fire protection services during selective demolition operations.

H. Environmental Controls:

1. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1. PREPARATION

A. General:

1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
2. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

B. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.

C. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Architect.

1. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Architect if shutdown of service is necessary during changeover.

3.2. DEMOLITION

A. General:

1. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
D. Provide services for effective air and water pollution controls as required.
E. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.
F. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to architect in written accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3. SALVAGED MATERIALS

A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain a receipt.

3.4. DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off site.
B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
C. Burning of removed materials is not permitted on Project site.

3.5. CLEANUP AND REPAIR

A. General:

1. Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 230510

SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. MOTORS

A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
B. ELECTRIC MOTORS (Less than ½ HP)

1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.

C. ELECTRIC MOTORS (1/2 HP and Larger)

1. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. To greatest extent possible motors for this project shall be by one manufacturer.
2. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
3. 40 degrees C (104°F) maximum ambient temperature, 3,300 Ft. maximum altitude, voltage variations of plus or minus 10% of nameplate rating, frequency variations of plus or minus 5% of nameplate rating, combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
4. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
5. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
6. Unless indicated otherwise, motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.
7. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing

housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.

8. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit holes shall conform to NEC Standards.
9. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
10. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel paint.
11. Unless indicated otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 220513

SECTION 230520 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. MOTORS

PART 3 - EXECUTION

3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
F. For test pressure schedules see piping material schedules.

3.2. TESTING OF REFRIGERANT LINES

A. After the system is installed and before any piping is insulated, the entire refrigeration circuit must be thoroughly leak tested. Test all pipe joints for leaks. Make certain that all joints are inspected thoroughly. Mark carefully any spots where leaks occur.
B. Leaks are repaired by disassembling the connection, cleaning the fitting and remaking. No attempt should be made to repair a leak by simply adding brazing material.

3.3. CLEANING OF SYSTEMS AND EQUIPMENT

A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

1. Air Handling Systems:

a. Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment by mechanical contractor before final acceptance inspection by Architect and Engineer.

3.4. MAINTENANCE OF SYSTEMS

A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as

determine by Equipment Manufacturer's recommendations.

3.5. PAINTING OF MATERIALS AND EQUIPMENT

A. Touch-up painting and refinishing of factory applied finishes shall be by Mechanical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
B. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
C. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
D. Where extensive refinishing is required equipment shall be completely repainted.

3.6. EXCAVATION AND BACKFILL

A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

3.7. FIRE BARRIERS

A. General

1. For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Submittals

1. Product Data: For Each Type Of Product Indicated.
2. Shop Drawings: For Each Through-Penetration Firestop System, Show Each Type Of Construction Condition Penetrated, Relationships To Adjoining Construction, And Type Of Penetrating Item. Include Firestop Design Designation Of Qualified Testing And Inspecting Agency That Evidences Compliance With Requirements For Each Condition Indicated.

   a. Submit Documentation, Including Illustrations, From A Qualified Testing And Inspecting Agency That Is Applicable To Each Through-Penetration Firestop System Configuration For Construction And Penetrating Items.
   b. Where Project Conditions Require Modification To A Qualified Testing And Inspecting Agency's Illustration For A Particular Through-Penetration Firestop Condition, Submit Illustration, With Modifications Marked, Approved By Through-Penetration Firestop System Manufacturer's Fire-Protection Engineer As An Engineering Judgment Or Equivalent Fire-Resistance-Rated Assembly.

3. Through-Penetration Firestop System Schedule: Indicate Locations Of Each Through-Penetration Firestop System, Along With The Following Information:

   a. Types Of Penetrating Items.
   b. Types Of Constructions Penetrated, Including Fire-Resistance Ratings And, Where Applicable, Thicknesses Of Construction Penetrated.
   c. Through-Penetration Firestop Systems For Each Location Identified By Firestop Design Designation Of Qualified Testing And Inspecting Agency.

C. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.
G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
H. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
I. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
J. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
K. Equivalent by Hilti, Inc., Johns Manville, Nelson Firestop Products, NUCO Inc., RectorSeal Corporation, Specified Technologies Inc., 3M, Tremco, USG, Dow, Chemelex.

3.8. EQUIPMENT ANCHORS

A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

3.9. WELDING

A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.
D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 230513

SECTION 230530 – MOTOR CONTROL AND EQUIPMENT DISCONNECTS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. DISCONNECT SWITCHES

A. General

1. Provide heavy-duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, or Square D.

B. Product

1. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
2. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
3. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.

C. Execution

1. All fuse holders shall have rejection clips installed.
2. Mount switch enclosure rigidly and with proper alignment on building structure or steel supports with centerline of operating handle not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
3. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.
4. All disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.

2.2. MOTOR STARTERS

A. General

1. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.
2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.

B. Product

1. MAGNETIC MOTOR STARTERS

a. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
b. Enclosures shall be NEMA type required by starter location and environment.
c. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.

d. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
e. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
f. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
g. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
h. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
i. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
j. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.

2. COMBINATION MAGNETIC MOTOR STARTERS

a. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
b. Starter NEMA enclosure type shall be type required for starter location and environment.
c. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
d. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
e. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
f. All fuse holders shall have rejection clips installed.
g. See plans for combination magnetic starters.

3. MANUAL MOTOR CONTROL (1 HP Maximum)

a. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
b. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
c. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
d. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

C. Execution

1. All fuse holders shall have rejection clips installed.
2. Mount starter enclosure rigidly and with proper alignment on building structure or steel supports with operating switches not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
3. Furnish and install a nameplate for each starter/switch engraved with the equipment designation which the disconnect serves.
4. All starters/disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.
5. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.

END OF SECTION 230530

SECTION 230548 – MECHANICAL SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. GENERAL

A. Equivalents by Amber-Booth Company, Mason Industries, Peabody Noise Control (Kinetics).

2.2. VIBRATION ISOLATION

A. Furnish and install vibration isolation devices for rotating or reciprocating mechanical equipment and piping systems attached thereto.
B. Work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Architect-Engineer. Specific mounting arrangements for each item of mechanical equipment shall be as described herein and as indicated by schedules and details on the drawings.
C. All vibration isolation equipment, including steel framing and reinforcing for concrete inertia bases and including steel rail bases, shall be furnished by one of the following manufacturers: A single manufacturer for all vibration isolation equipment will be required except as specifically approved in writing by the Architect-Engineer or by his specific approval of shop drawings.
D. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:
E. Obtain from the Architect-Engineer the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical and electrical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.
F. Obtain all necessary data in regard to piping systems which are to be resiliently supported so that proper isolators can be selected. Select piping system isolators for proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.
G. Submit shop drawings as required by other portions of this specification. These drawings shall include specification information as follows:

1. Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
2. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.
3. For elastomer or glass fiber isolators - free height, deflected height, and isolator loading.
4. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

H. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
I. Replace at no extra cost to the Owner any isolators which do not produce the required deflection, are improperly loaded above or below their operating height, or which in any way do not produce the required isolation.
J. The vibration isolation systems described herein and identified by type letter designations shall be applied to specific classifications of mechanical and electrical equipment as indicated in this specification.
K. TYPE D ISOLATION

1. The equipment shall be suspended with steel spring vibration isolators which are complete with neoprene-in-shear isolators for high frequency noise control. The neoprene-in-shear isolators shall provide static deflection of 0.20 inches minimum. In addition, elastomer washers shall be furnished as necessary to prevent metal-to-metal contact.
2. Hanger rod misalignment of up to 15 degrees relative to vertical shall not cause "short-circuiting" of the isolation

components due to metal-to-metal contact.

3. Spring hangers shall utilize free standing springs which are unhoused except for the required partial and open housing assembly. Spring hangers shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection of each hanger shall not be less than that specified for each classification of mechanical equipment. The spring deflection from the point of rated deflection to the point at which the spring is solid shall not be less than one-half of the rated static deflection. The yield point of the steel used in the springs shall be sufficiently great so that the springs may be compressed to shorted turns without danger of spring failure.
4. Resilient hangers shall be installed as near as possible to the supporting overhead structure. The machine suspension points shall be in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs shall be avoided, particularly at the center of structural spans.
5. Suspension rods shall be attached to rigid members of the machine structure. When such attachment points do not exist, a heavy steel framework shall be furnished to support the machine with suspension rods attached to this framework.

L. TYPE F ISOLATION (Curb Mounted Roof-Top Air Conditioning Machines)

1. The roof-top air conditioning machine shall be mounted on a free standing steel spring isolated rectangular rail (curb) system which in turn is mounted on a roof curb as normally used to mount the machine when vibration isolation is not used. The isolation system shall be suitable for outdoor unprotected locations and it shall include a soft and flexible elastomer air and water seal which shall not short circuit the spring isolators. The spring isolators shall provide uniform deflection of not less than 0.9 inch for the entire machine. The isolation system shall not allow lateral movement greater than 5/8 inch for wind loads up to 100 miles per hour. Suitable systems of this type are Peabody Noise Control Type ASR, Mason Industries Type CMAB, and Amber Booth Type RTIR.

PART 3 - EXECUTION

3.1. GENERAL

A. Cooperate with all other Contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.

B. Notify the Architect-Engineer of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.

C. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect-Engineer so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the Contractor responsible at no additional cost to the Owner.

3.2. RESILIENT MOUNTINGS FOR SPECIFIC CLASSIFICATIONS OF EQUIPMENT

Equipment	Power(HP) or as Noted	Rotating Speed RPM	Mounting Type	Inertia Base*	Static Deflection**
Suspended AHU's, fan coils, and other Suspended Equipment	0 - 7-1/2	500 and Up	D		.75"
Rooftop units	7-1/2 - 50	500 and Up	F		.75"

* Minimum inertia base weight expressed as multiple of weight of supported equipment.

** Minimum static deflection of isolators specified for mounting type indicated.

3.3. ISOLATION OF PIPING SYSTEMS

A. All piping which connects to resiliently mounted equipment shall be suspended with resilient hangers or supported by floor mounted isolators for a distance of 100 pipe diameters from the connected machine or within the mechanical equipment room whichever is the greater distance. The first three supports from the connected machine shall have the same static deflection as indicated for the machine; the next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and remaining pipe supports shall provide static deflection of 0.35

inches minimum. These remaining isolators may be elastomer.

B. Steel spring hangers shall be as specified for Type D isolation except that a scale shall be attached to the hanger housing to indicate deflection. Elastomer hangers shall be as specified for Type E isolation. Floor mounts shall be free standing steel spring isolators as specified for Type A isolation where static deflection in excess of 0.35 inches is required. Floor mounts, where static deflection of 0.35 inches or less is required, shall be double deflection neoprene-in-shear as specified for Type C isolation.

C. Vertical pipe risers shall be resiliently mounted, preferably with each riser anchored near the center of the run. The risers shall be supported at the anchor points with steel spring or double deflection neoprene-in-shear isolators which provide static deflection of at least 0.35 inches. Isolators for the remainder of each run shall be steel spring type specifically designed to control load shifting due to pipe expansion and contraction. At least 0.35 inches deflection shall be maintained under all conditions.

D. Flexible neoprene connectors shall be used to connect all piping to all isolated equipment except equipment for which flexible connectors are not permitted by code. For this application provide swing connectors changing direction a minimum of 3 times before joining isolated equipment. Swing connections should be made within approximately 6 feet of the isolated equipment. Connectors shall be manufactured of multiple plys of nylon tire cord fabric and neoprene both molded and cured in hydraulic presses. No steel wire or rings shall be used as pressure reinforcement. Connectors up to and including 2" diameter may have threaded ends. Connectors 2-1/2 inches and larger shall be manufactured with floating steel flanges. All connections shall be rated a minimum of 150 psi at 220 degrees F. All flanged equipment shall be directly connected to neoprene elbows in the size range 2-1/2 inches through 6 inches or any larger available size if the piping makes a 90 degree turn at the equipment. All straight through connections shall be made with either flanged or screwed connectors properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. Sizes 12 inches and larger operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2 inch thick bridge bearing neoprene washer bushing designed for a maximum of 1000 psi. Elbows shall be Mason-Flex type MFNEC, straight connectors Mason-Flex type MFTFU or MFTNC, and control cables assemblies type ACC, all as manufactured by Mason Industries, Inc.

E. Drain connections from isolated equipment to floor drains shall be at least 1" free from drain or use rubber hose.

3.4. ISOLATION OF FRACTIONAL HORSEPOWER EQUIPMENT

A. All fractional horsepower fans, pumps, etc., which are mounted on or suspended from floors that are on-grade shall be isolated with neoprene-in-shear isolators furnished by the vibration isolation supplier except where such isolators are furnished as an integral part of the machine.

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1. SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.

1.2. SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1. EQUIPMENT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Black letters on white background.
B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
C. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
D. Fasteners: Stainless-steel rivets or self-tapping screws.
E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
F. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
G. Install or permanently fasten labels on each major item of mechanical equipment.
H. Locate equipment labels where accessible and visible.

END OF SECTION 230553

SECTION 230593 – SYSTEM TESTING & BALANCING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. TESTING AND BALANCING CONTRACTORS

A. Testing and balancing (TAB) of the building air and hydronic systems will be to be completed near the end of construction. The Mechanical Contractor has responsibility to cooperate with, make adjustments for, and provide any equipment necessary for the TAB contractor to complete the job.

PART 2 - PRODUCTS

A. Not Used

PART 3 - EXECUTION

3.1. SCOPE OF WORK

A. The Contractor shall procure the services of an independent air balance and testing contractor, approved by the A/E, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution and exhaust systems and all water flow circuits. All work by this contractor shall be done under engineer employed by them. All instruments used by this contractor shall be accurately calibrated and maintained in good working order. If requested the tests shall be conducted in the presence of the A/E responsible for the project and/or his representative. The testing and balancing contractor shall be certified by NEBB or AABC and all work shall be performed in accordance with these organizations' published procedure manuals.
B. The balancing contractor shall prepare a certified report of all tests performed. The report shall be written on standard forms prepared by NEBB or AABC or facsimiles thereof. The balancing contractor shall submit 3 copies of this report to the Mechanical Contractor who shall submit them to the A/E for review and distribution.
C. Air balance and testing shall not begin until systems have been completed and are in full working order. All heating, ventilation, and air conditioning systems and equipment shall be in full operation during each working day of testing and balancing.

3.2. SYSTEM PREPARATION FOR TESTING AND BALANCING

A. Prior to requesting testing and balancing contractor to perform their work the installing contractor shall make all necessary inspections and adjustments to insure that systems are completely installed and operating in accordance with the manufacturer's recommendations and the contract documents.
B. The following checks shall be performed on each system installed under this contract. A report sheet shall be prepared for each system indicating checks made, corrective action taken where required, date, and name of person making inspection. Submit one copy to testing and balancing contractor and two to A/E. Testing and balancing contractor will not begin until checklist has been received and reviewed.

3.3. TEMPERATURE CONTROLS CONTRACTOR COORDINATION

A. The temperature control contractor shall have a technical representative present with the balancing contractor on the first day of balancing for a minimum of four hours of active balancing and temperature controls coordination.
B. For the remainder of the balancing the temperature contractor may either have a technical representative present, or may furnish the balancer with the latest DDC software and all required interface devices. This includes instructions and coordination in the use of all interface devices, including laptop computers. There shall be no charge to the balancing contractor for the use of these interface devices and they shall be returned to the temperature controls contractor at the end of the balancing process.

3.4. AIR HANDLING SYSTEMS:

A. Clear system of all foreign objects and clean system.
B. Verify fan rotation.

C. Check bearing condition and lubrication.
D. Check fan wheel clearances and fan alignment.
E. Check motor security to mounting base.
F. Check alignment of drive.
G. Check vibration isolator adjustment.
H. Verify that proper filter media is installed.
I. Verify that all control dampers are installed and operable without binding or sticking.
J. Confirm that all fire, smoke and volume dampers are installed and in full open position.
K. Verify that all air terminal units are installed.
L. Confirm that all air openings in walls above ceilings have been provided.
M. Check for and repair all excessive air leaks in duct systems, at equipment connections and at coils.
N. Air leaks shall not exceed SMACNA parameters for system pressure.
O. Verify that ductwork is constructed and installed in accordance with contract drawings and/or approved ductwork shop drawings.
P. Inspect and clean all coils (including evaporator and condenser) and correct fin damage.

3.5. AIR SIDE TESTING AND BALANCING

A. GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

1. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
2. Prepare schematic diagrams of systems' "as-built" duct layouts.
3. For variable-air-volume systems, develop a plan to simulate diversity.
4. The TAB contractor shall cycle each air handling unit through its control sequence of operation to verify proper operation. Any inconsistency with contract documents shall be reported to A/E and temperature control contractor. Temperature control contractor shall take prompt action to correct any control inconsistency as reported by the TAB contractor.
5. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
6. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
7. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
8. Verify that motor starters are equipped with properly sized thermal protection.
9. Check dampers for proper position to achieve desired airflow path.
10. Check for airflow blockages.
11. Check condensate drains for proper connections and functioning.
12. Check for proper sealing of air-handling-unit components.
13. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

B. PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

1. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

   a. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
   b. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   c. Measure total system airflow. Adjust to within indicated airflow.
   d. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow

is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

e. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

i. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

f. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

i. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

g. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

h. Record final fan-performance data.

C. PROCEDURES FOR HEAT-TRANSFER COILS

1. Measure, adjust, and record the following data for each electric heating coil:

a. Nameplate data.
b. Airflow.
c. Entering- and leaving-air temperature at full load.
d. Voltage and amperage input of each phase at full load and at each incremental stage.
e. Calculated kilowatt at full load.
f. Fuse or circuit-breaker rating for overload protection.

2. Measure, adjust, and record the following data for each refrigerant coil:

a. Dry-bulb temperature of entering and leaving air.
b. Wet-bulb temperature of entering and leaving air.
c. Airflow.
d. Air pressure drop.
e. Refrigerant suction pressure and temperature.

3.6. PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7. TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10% percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.8. REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9. FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

3.10. ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.11. AIR AND WATER BALANCE CONSTRUCTION COORDINATION

A. During installation of the mechanical systems the testing and balancing contractor shall make no less than (3) inspection visits to the project site. Proper placement and installation of all control and balancing devices shall be verified by these inspections. The mechanical contractor shall make all corrections in control and balancing device locations as requested by the TAB contractor. Following each inspection visit the TAB contractor shall report to the A/E all items noted, action taken, and progress of control device installation. The last inspection and balancing shall be performed in the presence of a professional engineer active in the design of mechanical building systems.

END OF SECTION 230593

SECTION 230900 – AUTOMATIC TEMPERATURE CONTROLS

PART 1 GENERAL

1.1. SUBMITTALS

A. Product Data: For each control device indicated.
B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.
5. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
6. Control System Software: Schematic diagrams, written descriptions, and points list.

C. Software and firmware operational documentation.
D. Field quality-control test reports.
E. Operation and maintenance data.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2. CONTROL SYSTEM

A. Manufacturers:

1. Automated Logic Corporation.
2. Distech Controls
3. Honeywell International Inc.
4. Schneider Electrics - SmartStruxure.
5. Johnson Controls, Inc.; Controls Group.
6. Siemens Building Technologies, Inc. - APOGEE
7. Staefa Control System Inc.

B. Control system and components shall be backward compatible and utilize and support open protocols. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

2.3. DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4. UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5. ANALOG CONTROLLERS

1. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
2. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
3. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

    a. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

2.6. ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
B. Accuracy: Plus or minus 0.5 deg F at calibration point.
C. Wire: Twisted, shielded-pair cable.
D. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
E. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
F. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
G. Room Sensor Cover Construction: Manufacturer's standard locking covers.
H. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
I. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
J. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

K. Humidity Sensors: Bulk polymer sensor element.

1. Accuracy: 5 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
4. First five subparagraphs below are optional features.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

L. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
2. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
3. Output: 4 to 20 mA.
4. Building Static-Pressure Range: 0- to 0.25-inch wg.
5. Duct Static-Pressure Range: 0- to 5-inch wg.
6. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
7. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

2.7. STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
D. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
F. Electronic Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.8. GAS DETECTION EQUIPMENT

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.
B. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.9. ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque.
3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24-V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: Minus 22 to plus 122 deg F.

PART 3 EXECUTION

3.1. INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install adjustable devices 48 inches above the floor.
B. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
C. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
H. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.2. PANEL AND DEVICE LOCATIONS

A. Coordinate all control cabinets and other wall mounted controllers with other trades.
B. Panels and cabinets shall be located in mechanical spaces and other ancillary use spaces such as storage rooms. These locations shall be submitted and approved as part of the submittal process.
C. Do not locate control cabinets in spaces dedicated to other uses such as IT closets, data rooms, chases, etc without prior approval.

3.3. ELECTRICAL POWER WIRING PROVISIONS

A. Provide a 20A/1P 120 or 277 volt circuit from the nearest panelboard related to the work for miscellaneous HVAC control system power. Contractor may provide multiple circuits at their option. Utilize spare circuit breakers or provide new when one is not available.
B. Coordinate with mechanical equipment specifics and contractors proposed method of control power provisions. All work

shall comply with Division 26 requirements and latest adopted version of the National Electric Code.

C. Provide all necessary line voltage wiring and connections for control equipment, power supplies, dampers, actuators, and other items requiring line voltage power. This work shall be coordinated with other trades and shall be in conformance with other portions of this contract and requirements.

3.4. ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Install exposed cable in raceway, including mechanical rooms, at wall mounted control cabinets and any location control wiring would be exposed to view or damage. Exposed raceway in finished spaces shall be wiremold or similar appearing material and painted if required by the finish of the room.
2. Install concealed cable in walls and other non-accessible spaces in raceway. Wall mounted devices shall be provided with backbox and conduit.
3. Install cable in accessible plenums as plenum rated and properly supported.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

3.6. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
8. Check DDC system as follows:

a. Verify that DDC controller power supply is from emergency power supply, if applicable.

b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
c. Verify that spare I/O capacity has been provided.
d. Verify that DDC controllers are protected from power supply surges.

9. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.7. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

3.8. TRAINING

1. Provide a minimum of 4 classroom training sessions, 4 hours each, for personnel designated by the Owner.
2. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system; add additional panels when required.
3. Provide one copy of training material per student.
4. The instructors shall be factory-trained instructors experienced in presenting this material.
5. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customers site.
6. At such time acceptable performance of the system hardware and software has been established, the Temperature Control Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent Temperature Control Contractor's representative familiar with the system's software, hardware and accessories.
7. The Temperature Control Contractor shall give instruction to the Owner's personnel on the operation of all equipment within the building and describe its intended use with respect to the programmed functions specified. Operator orientation of the system shall include, but not be limited to, the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, system generation, advisories, and appropriate operator intervention required in responding to the system's operation.
8. The Temperature Control Contractor shall give web based access with temporary log-in and password to design engineer for the period of one year from substantial completion.

3.9. TESTING AND BALANCING COORDINATION

1. The temperature control contractor shall have a technical representative present with the balancing contractor on the first day of balancing for a minimum of four hours of active balancing and temperature controls coordination.
2. For the remainder of the balancing the temperature contractor may either have a technical representative present, or may furnish the balancer with the latest DDC software and all required interface devices. This includes instructions and coordination in the use of all interface devices, including laptop computers. There shall be no charge to the balancing contractor for the use of these interface devices and they shall be returned to the temperature controls contractor at the end of the balancing process.

END OF SECTION 230900

SECTION 231000 – PIPING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. PIPING MATERIALS

A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. See piping material schedule on the drawings for materials to be used for each piping system.

1. Polyvinyl Chloride Drain Waste Pipe:

a. Provide Schedule 40 polyvinyl chloride solid core plastic drain waste and vent pipe conforming to ASTM D2665. Joints shall be properly cleaned, primed and glued where scheduled.
b. Polyvinyl Chloride (PVC) Pipe & Fittings Cell Class 12454 B.

i. ASTM D 2241 SDR-26

c. Pipe by Charlot, Genova, Crestline or equal.

2.2. PIPING FITTINGS

A. Piping fitting used throughout project shall be proper type for installation method used and shall be compatible with piping system material. Fittings listed in piping material schedule shall conform to the following specifications:

1. PVC Fittings:

i. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.
ii. Joints shall be of a push-on type with a bell-end grooved to receive a synthetic rubber gasket when scheduled. Solvent welded joints are not allowed outside the building. The joint shall be made in accordance with ASTM D 3212.

b. Equivalents: Spears, Lasco or equal.

PART 3 - EXECUTION

3.1. PIPING INSTALLATION

A. Piping systems materials and installation shall conform to the following standards and codes.

1. System: Heating and Air Conditioning Piping

a. Code: ANSI Standard B31.1.0 “Power Piping”

B. No piping containing water shall be located in areas subject to freezing temperatures, including: unheated attics, unheated plenums, chases wall spaces or cavities within exterior walls, under slabs, or in concrete.
C. Pipe sizes indicated on plans and as specified refer to nominal size in inches, unless otherwise indicated. Pipes are sized to nearest ½”. In no case shall piping smaller than size specified be used.
D. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings.
E. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer’s recommendations for fixed hanger and supports.
F. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping

system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.

G. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be ¾".

H. Drain valves on closed piping systems such as chilled water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.

I. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.

J. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed and control valves with unions adjacent to each piping connection. Provide screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line.

K. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.

L. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricate pipe threads with Teflon thread sealant and lubricating compound applied full strength. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.

M. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.

N. Soft soldered socket type joints shall be made with sill-floss or 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.

O. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

3.2. PIPING SUPPORTS, ANCHORS, SLEEVES AND SEALS

A. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor.

B. Mechanical Contractor shall supervise installation of sleeves to insure proper location and installation.

C. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.

D. Sleeves passing through above grade floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.

E. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.

F. Pipe insulation shall run continuous through pipe sleeves with ¼" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.

G. Pipe wall penetrations exposed to view shall have tight fitting escutcheons or flanges to cover all voids around openings.

H. All below grade and exterior wall penetrations shall be installed in a pipe sleeve and sealed between the pipe and pipe sleeve with Thunderline High Temperature Link Seal or similar compressed link type system.

I. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around cables with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

J. Equivalent by Dow, Chemelex, 3M.

3.3. PIPE HANGERS AND SUPPORTS

A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58.

B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position.
D. Hangers shall not become disengaged by movements of supported pipe.
E. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.
F. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1”	3/8”	6 Ft.
1-1/4” to 1-1/2”	3/8”	8 Ft.
2”	3/8”	9 Ft.
2-1/2”	½”	9 Ft.
3” and 4”	½”	10 Ft.

G. Support horizontal cast iron soil pipe with two hangers for each section located close to each hub.
H. Support vertical cast iron soil pipe at every floor, steel and copper tubing at every other floor except where indicated otherwise on drawings.
I. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used.
J. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect-Engineer for review prior to fabrication.
K. Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	½” thru 4”	CT-121

L. Provide Grinnell Fig. 194, 195 or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.
M. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation.
N. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing. Provide wood block at each pipe hanger in thickness of insulation. Insulation vapor barrier jacket shall overlap wood block to maintain vapor barrier.
O. Structural attachments for pipe hangers shall be as follows:
P. Concrete Structure: Provide Grinnell Fig. No. 285 cast in concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge cast in type concrete insert for loads up to 1200 lbs.
Q. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

PIPE MATERIALS	PIPE SIZE	HANGER FIG. NO.
Copper	½” thru 4”	CT-65

R. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.

Copper	3/8" thru 4"	8600 CP*	8010 CP*

*Copper Plated

S. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Elcen or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Architect-Engineer for review prior to fabrication.

T. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

U. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.

V. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Architect-Engineer prior to installations.

W. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Bee Line, Elcen, Fee & Mason, Fluorocarbon Company, Unistrut or Super Strut Inc.

X. Provide engineered pipe supports for piping located on flat roofs. Wood blocking is not acceptable. Support will be of modular stackable design with a nylon roller bearing directly supporting pipe and a preformed saddle to keep piping on roller bearing. Maximum pipe support spacing shall be 10'. Provide pipe supports from Miro Industries, Unistrut, Bee Line, or approved equivalent.

END OF SECTION 231000

SECTION 231900 – PIPING SPECIALTIES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. THERMOMETERS AND GAUGES

A. Provide thermometers and wells and pressure test plugs as hereinafter specified and shown on the plans so that proper testing and balancing and trouble shooting can be accomplished.
B. THERMOMETERS

1. Thermometers shall be red reading mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Trerice or Weksler.
2. Install thermometers at eye level (5'-0") at easily readable locations.

C. INSTALLATION

1. Thermometers shall be installed as hereinafter specified. Where thermometer is scheduled, a thermometer well shall be provided.
2. All thermometer wells shall be constructed of brass or stainless steel and where installed in insulated piping shall have at least 2-1/2" lagging extension. Gauges shall be installed as hereinafter specified.
3. Gauge cocks shall be polished brass A10 ¼" tee handle type with threaded ends. 125 psi rated.
4. Provide gauge cock with ¼" pipe nipple for connection to gauge cock.
5. Pressure temperature ratings of each well shall be suitable for the system in which it is installed in accordance with specifications and as indicated on the drawings. All wells shall be filled with Silicon and be complete with caps and chains.
6. Thermometers shall have the temperature ranges as required for the intended application and shall be installed as scheduled.

D. THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

SERVICE	Thermometer & Well	Press Gauge & Gauge Cock	Pete's Plug
Supply air, return air, outside air at AHU	X		

END OF SECTION 231900

SECTION 233113 – METAL DUCTS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Sealants and gaskets.
6. Hangers and supports.

1.3. PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4. SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

E. Welding certificates.
F. Field quality-control reports.

PART 2 PRODUCTS

2.1. SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct allowing for insulation if lined.

2.2. SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Lindab Inc.
        b. McGill AirFlow LLC.
        c. SEMCO Incorporated.
        d. Sheet Metal Connectors, Inc.
        e. Spiral Manufacturing Co., Inc.
        f. Norlock Metal Products, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
        a. Transverse Joints in Ducts Larger Than 60 Inchesin Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3. DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Transverse Joints in Ducts Larger Than 60 Inchesin Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch [perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent] [solid sheet steel].

E. Interstitial Insulation: Flexible duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

2.4. ELBOW CONFIGURATION:

A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

1. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

B. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

1. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

a. Radius-to Diameter Ratio: 1.5.

2. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
3. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

2.5. BRANCH CONFIGURATION:

A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

1. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Rectangular Main to Round Branch: High Efficiency 45 degree takeoff.

B. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

1. Velocity 1000 fpmor Lower: 90-degree tap.
2. Velocity 1000 to 1500 fpm: Conical tap.
3. Velocity 1500 fpm or Higher: 45-degree lateral.

2.6. SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.7. SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Sealant: Modified styrene acrylic.
3. Indoor and outdoor, Water resistant, Mold and mildew resistant.
4. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
5. VOC: Maximum 75 g/L (less water).
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solids Content: Minimum 60 percent.
4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
5. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

H. Pressure sensitive duct joint sealer:

1. Provide Hard Cast, Inc. “Foil Grip” pressure sensitive duct joint sealer. Seal class “A”, “B”, and “C”.

2.8. HANGERS AND SUPPORTS

A. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
C. Straps shall not be installed on exposed ductwork.
D. Ductwork installed on the service platform shall be shall be supported above the structure with galvanized channel and metal straps.
E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 EXECUTION

3.1. DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
C. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1” or 2” in height and width of ductwork as required to accommodate insulation thickness. Mount specialties such as turning vanes, dampers, etc., to ductwork with that section insulated “Build Outs” to maintain continuity of thermal barrier.
D. All ductwork within 15 feet of connection to rooftop units shall be constructed to 6” WG class regardless of unit static pressure ratings and be a minimum of 18 gauge sheet metal. Roof deck shall only be cut out as required for ductwork penetrations and annular gap around duct shall be sealed with elastomeric caulk to reduce rooftop unit breakout noise.
E. Install round and flat-oval ducts in maximum practical lengths.
F. Install ducts with fewest possible joints.
G. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
H. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
M. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2. INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct

accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3. DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the scheduled seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

3.4. HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5. CONNECTIONS

A. Coordinate duct installations and specialty arrangements with Drawings.

B. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

C. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6. PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

B. Prime and paint all exterior ductwork, per architectural plans. Coordinate with Architect for color and finish.

3.7. FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-

pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
3. Duct system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

3.8. START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9. DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

SYSTEM	Material	Pressure Class	Min. SMACNA Seal Class	Leakage Class
Supply				
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	Galv. SM	2” Pos.	C	Round-3 Rect-6
Ducts Connected to Variable-Air-Volume Air-Handling Units	Galv. SM	4” Pos.	B	Round-3 Rect-6
Return				
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	Galv. SM	2” Neg.	C	Round-3 Rect-6
Ducts Connected to Rooftop Air Conditioner Units	Galv. SM	2” Neg.	C	Round-3 Rect-6
Exhaust				
Ducts Connected to General Exhaust	Galv. SM	2” Pos. or Neg.	B	Round-3 Rect-6

END OF SECTION 233113

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

2. Operation and maintenance data.

C. QUALITY ASSURANCE

1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS

2.1. MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2. BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.
2. Cesco Products.
3. Duro Dyne Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ruskin Company.
9. SEMCO Incorporated.
10. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
E. Blade Action: Parallel.
F. Blade Seals: Neoprene, mechanically locked.
G. Blade Axles: Nonferrous metal.
H. Tie Bars and Brackets: Galvanized steel.
I. Return Spring: Adjustable tension.
J. Bearings: Steel ball or synthetic pivot bushings.
K. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Retain one of first two subparagraphs below.
6. Screen Mounting: Front mounted in sleeve.

a. Sleeve Thickness: 20-gage minimum.
b. Sleeve Length: 6 inches minimum.

L. Screen: Rear mounted. Galvanized steel. Bird.
M. 90-degree stops.

2.3. MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance Inc.
b. Flexmaster U.S.A., Inc.
c. McGill AirFlow LLC.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Pottorff; a division of PCI Industries, Inc.
g. Ruskin Company.
h. Trox USA Inc.
i. Vent Products Company, Inc.

2. Suitable for horizontal or vertical applications.
3. Frames: Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness. Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades: Multiple or single blade. Parallel blade design for mixing applications and opposed-blade design for balance only applications. Stiffen damper blades for stability. Galvanized-steel, 0.064 inch thick.
5. Blade Axles: Galvanized steel.
6. Bearings: Molded synthetic. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.4. FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Prefco; Perfect Air Control, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
D. Fire Rating: 1-1/2 and 3 hours.
E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
G. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
H. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
I. Mounting Orientation: Vertical or horizontal as indicated.
J. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
K. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
L. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5. FIRE/SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Prefco.
6. Ruskin Company.

B. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
C. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
D. Leakage: Class I.
E. Rated pressure and velocity to exceed design airflow conditions.
F. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
G. Damper Motors: two-position action.

1. Electrical Connection: 115 V, single phase, 60 Hz. Coordinate voltage with Fire alarm contractor prior to ordering. Where building is not equipped with a fire alarm system, provide a stand alone 120v smoke detector and remote LED indicator light mounted in ceiling below duct detector. Mount detector within 5' of damper and provide all necessary wiring and interconnections to damper and detector and relays/power supplies.
2. Power open, locked and reset, spring closed.

2.6. TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7. DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cesco Products; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ventfabrics, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. 1-by-1-inch butt or piano hinge and cam latches.
b. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8. FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

1. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene. 26 oz./sq. yd. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

2.9. LOW PRESSURE FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Thermaflex
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Low Pressure Flexible Duct

1. Thermaflex M-KE rated for +6" W.G. max. and -1" W.G. max. for duct sizes 4" to 14", +6" W.G. max. and -0.5" W.G. max for duct sizes 14" to 16", +4" W.G. max. and -0.5" W.G. max for duct sizes 18" to 20". Rated for 3500 FPM maximum velocity. UL listed "UL-181 Standards Class I Duct Material" complying with NFPA Standards 90A and 90B. Duct shall be composed of an acoustically rated inner polymeric liner duct bonded to coated steel wire helix. Fiberglass insulation and tear resistant metalized polyester film outer vapor barrier. Maximum flexible duct length or run shall be 5'-0" unless otherwise noted. Flexible ductwork shall be securely attached to both the rigid duct connection and diffuser neck with plastic band clamps or stainless steel worm driven clamps. Equivalent by Wiremold, Cleavaflex, Flexmaster.

2.10. HIGH PRESSURE FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Thermaflex
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Flexible Duct Inlet to Terminal Boxes

1. Flexmaster type Triple Lock-Acoustic (TL/A) insulated acoustic air duct, manufactured by using a dead soft aluminum strip which is perforated, spirally wound and mechanically joined together. The inner duct is draped with a thick fiberglass insulation and covered by a flame retardant, non-toxic polyethylene vapor barrier. UL-181 Class 1 product uses a Triple Lock (T/L basic) perforated core with an open area of 20% to 25% to completely cushion sounds such as air movement and duct vibrations.
2. Maximum flexible duct length or run shall be 4'-0" unless otherwise noted. Attach ducts with metal screws and stainless steel clamp. Equivalent by Wiremold, Cleavaflex, Flexmaster.

2.11. DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.
G. Install fire and smoke dampers according to UL listing.
H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.
J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Install flexible connectors to connect ducts to equipment.
L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
M. Connect terminal units to supply ducts directly with maximum 12-inch lengths of high pressure flexible duct. Do not use flexible ducts to change directions.
N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
O. Connect flexible ducts to metal ducts with draw bands.
P. Install duct test holes where required for testing and balancing purposes.

3.2. FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423 – EXHAUST FANS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. CENTRIFUGAL INLINE FANS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Twin City
2. Greenheck.
3. Loren Cook Company.
4. Penn Ventilation.

B. Centrifugal inline duct fans shall be of the belt driven or direct drive type as called for in the schedule. The wheel and spun inlet venturi shall be a centrifugal design of non-sparking construction. For maximum performance and quiet, efficient operation, the wheel shall overlap the inlet venturi and have backward inclined blades. The wheels shall be dynamically balanced to assure smooth and vibration-free rotation under maximum loading. The fans shall be constructed out of the heavy gauge paintable steel.
C. Motor and drives shall be isolated from the exhaust airstream. The motor shall be mounted external to the cabinet and free from discharge contaminants. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Motors shall be readily accessible for maintenance. The wheel shaft shall be ground, polished, coated with a rust inhibitive finish and mounted in heavy duty, permanently sealed pillowblock ball bearings which are capable of 200,000 hours of life, average operation. The drives shall be sized at a minimum of 165% of driven horsepower. Drive belts shall be oil-resistant, non-static and be capable to 25,000 hours of life, average operation. Sheaves shall be fully machined cast iron or pressed steel, keyed and securely attached to the shafts. Variable pitch motor sheaves shall be standard.
D. The motor shall be factory wired to the disconnect junction box and a disconnect switch shall be supplied. Wheel, shaft, bearings, motor and drive components shall be readily accessible for inspection, repair or replacement without disturbing inlet or outlet duct work.
E. Horsepower and noise levels shall not exceed the published values and oversized motors will not be acceptable.

PART 3 EXECUTION

3.1. INSTALLATION

1. Install power ventilators level and plumb.
2. Support suspended units from structure using threaded steel rods and spring hangers. Vibration-control devices are specified in SECTION 230548 – MECHANICAL SOUND AND VIBRATION CONTROL
3. Install units with clearances for service and maintenance.
4. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

B. CONNECTIONS

1. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible

connectors are specified in Division 23 Section "Duct Accessories."

2. Install ducts adjacent to power ventilators to allow service and maintenance.
3. Ground equipment.
4. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
5. Interlock operation of fans to associated backdraft and control dampers.

C. FIELD QUALITY CONTROL

1. Equipment Startup Checks:

   a. Verify that shipping, blocking, and bracing are removed.
   b. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   c. Verify that cleaning and adjusting are complete.
   d. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   e. Verify lubrication for bearings and other moving parts.
   f. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   g. Disable automatic temperature-control operators.

2. Starting Procedures:

   a. Energize motor and adjust fan to indicated rpm.
   b. Measure and record motor voltage and amperage.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Shut unit down and reconnect automatic temperature-control operators.
6. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
7. Replace fan and motor pulleys as required to achieve design airflow.
8. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

D. ADJUSTING

1. Adjust damper linkages for proper damper operation.
2. Adjust belt tension.
3. Lubricate bearings.

E. CLEANING

1. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
2. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

F. DEMONSTRATION

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 233423

SECTION 233430 – COMMERCIAL / INDUSTRIAL CEILING FANS

PART 1 GENERAL

1.1. SUMMARY

A. Section Includes
B. The ceiling-mounted, circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.
C. Summary of Work

1. Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others. Consult the appropriate installation scope of work for information on the available factory installation options, overview of customer and installer responsibilities, and details on installation site requirements.

1.2. REFERENCES

A. National Fire Protection Agency (NFPA)
B. Underwriters Laboratory (UL)
C. Canadian Standards Association (CSA)
D. National Electric Code (NEC)
E. International Organization for Standardization (ISO)

1.3. SUBMITTALS

A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods
B. Part 2 Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information
C. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All data is subject to change without notice.

1.4. QUALITY ASSURANCE

A. Certifications

1. The fan assembly, as a system, shall be ETL-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
2. The fan shall be compliant with NFPA 13—Standard for the Installation of Sprinkler Systems, NFPA 72— National Fire Alarm and Signaling Code, and NFPA 70-2011—NEC.
3. Controllers shall comply with NEC and UL standards and shall be labeled where required by code.

B. Manufacturer Qualifications

1. The fan and any accessories shall be supplied by manufacturer that has a minimum of ten (10) years of product experience.
2. ISO 9001-certified.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
B. The fan and its components must be stored in a safe, dry location until installation.

1.6. WARRANTY

A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge, pursuant to the complete terms and conditions of the Warranty in accordance to the following schedule:

1. Item Period of Coverage

a. Hub and airfoils Lifetime (Parts)
b. Motor, drive, and controller 10 years
c. Labor 1 year

d. Enhanced finishes 1 year

PART 2 PRODUCT

2.1. MANUFACTURER

A. Big Ass Fans, Entrematic, MacroAir, SkyBlade, or approved equal.

2.2. HIGH VOLUME, LOW SPEED FANS

A. Complete Unit

1. Regulatory Requirements: The entire fan assembly shall be ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2. No. 113-08.
2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification of conditioned commercial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 35 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Controls

1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.

C. Airfoil System

1. The fan shall be equipped with minimum of five (5) high volume, low speed airfoils blades. Each airfoil shall be of the high-performance Mini-Elipto design. The airfoils shall be connected to the hub and interlocked with stainless steel retainers and two (2) sets of clear zinc plated steel bolts and lock washers per airfoil on indoor fans and stainless steel bolts and lock washers per airfoil on outdoor fans.
2. The fan shall be equipped with vertical winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw.
3. As an option, the fan may be equipped with plug-style airfoil tips, molded of high strength polymer, in place of the vertical winglets. Must be specified on the schedule or in the specification. The airfoil tips shall be attached at the tip of each airfoil with a stainless steel screw. The airfoil tips shall be offered standard in black.

D. Motor

1. The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100–130 VAC, single phase, and 60Hz, or 200–250 VAC, single phase, and 50 Hz, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -40°F to 131°F (-40°C to 55°C) ambient conditions.
2. Fans that are rated for wet locations include a motor with potted electronics to protect from moisture.

E. Mounting System

1. The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. Designed for quick and secure installation to the mounting structure, all components in the mounting system shall be of formed metal design using low-carbon steel and contain no critical welds. The mounting systems shall be powder coated for appearance and resistance to corrosion. No mounting hardware substitutions, including cast aluminum, are acceptable.

F. Hub

1. The fan hub shall be constructed of steel for high strength and durability. The hub shall be precision machined to

achieve a well-balanced and solid rotating assembly. The hub shall incorporate five (5) safety retaining clips made of 1/8" (0.3 cm) thick steel that shall restrain the hub/airfoil assembly in case of shaft failure.

G. Safety Cable

1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be Ø3/16" (0.48 cm) diameter and fabricated out of 7 x 19 zinc galvanized steel cable, pre-loaded and tested to 3,200 lbf (13,345 N).
2. Field construction of safety cables is not permitted.

H. Wall Control

1. The fan is equipped with a remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box and shall include a display for controlling the fan's power and speed. Communication with the fan drive and controller shall be by a standard line voltage cable (14 Ga/3 wire with ground) that is field installed.

I. Fire Control Panel Integration

1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

J. Guy wires

1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 EXECUTION

3.1. PREPARATION

A. Fan location must have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
B. Mounting structure must be able to support weight and operational torque of fan. Consult structural engineer if necessary.
C. Fan location must be free from obstacles such as lights, cables, or other building components.
D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
E. Each fan requires dedicated branch circuit protection.

3.2. INSTALLATION

A. The fan shall be installed by a factory-certified installer according to the Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle iron for bar joist applications. Consult a structural engineer for installation methods outside the manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
B. Minimum Distances

1. Airfoils must be at least 10 ft (3 m) above the floor.
2. Installation area must be free of obstructions such as lights, cables, sprinklers or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
3. The structure the fan is attached to shall be capable of supporting a torque load of up to 40 ft·lb (54 N·m) of torque.
4. The fan shall not be located where it shall be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the Installation Manual.
5. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:

   a. The HVLS fan shall be centered approximately between four adjacent sprinklers.
   b. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (0.9 m).
   c. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code.

END OF SECTION 233430

SECTION 233601 – VARIABLE AIR VOLUME BOXES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL

A. Furnish and install where shown on plans shut-off terminal units. All variable volume boxes shall be by one manufacturer.
B. Equivalents by Trane, Titus, Carnes, EnviroTec, E.H. Price.

2.2. UNIT

A. BOX

1. Provide units with capacities as scheduled.
2. Casing shall be 22 gauge galvanized steel.
3. Interior surface of unit casing is acoustically and thermally lined with fiber free insulation. Insulation is UL listed and meets NFPA-90A and UL 181.
4. The VAV box shall be a flow control device with an integral electric actuator with electronic pressure independent controls. Box inlet is die cast aluminum and tapered to fit standard round flexible ductwork. Maximum leak rate is 1 percent at 4 inches WG. inlet static pressure,. Integral multiple point, averaging flow sensing ring to provide primary air flow measurement with 5 percent of unit rated airflow with 1-1/2 diameters of straight duct upstream of unit. Integral flow taps and calibration chart provided on each unit.
5. All units shall be UL listed and CSA approved.

B. Automatic Temperature Control Interface: Equipment manufacturer (Rooftop Unit, Blower Coils VAV Terminals) shall take possession of and shall mount, wire, and factory test all required automatic temperature control devices as called out on plans and in "Automatic Temperature Control" Section of the Specifications. Only those manufacturers listed in the "Automatic Temperature Control" section of the specification will be acceptable to provide the controls as listed herein. If unit manufacturer does not have a means to take possession of, mount, wire and factory test controls as herein specified. Equipment manufacturer shall include in base bid price, cost for field mounting, wiring, and testing of above referenced controls by the Automatic Temperature Control Contractor. Exceptions taken to this requirement will result in disapproval of equipment during the submittal phase of the project.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.
B. Units installed above service platform shall be installed on rubber vibration isolation pad.
C. Connect ductwork to air terminals according to Division 23 ductwork Sections.

3.2. CONNECTIONS

A. Coordinate piping installation and specialty arrangement requirements with schematics on Drawings and with requirements specified in hydronic piping and steam and condensate piping systems. If Drawings are explicit enough, these

requirements may be reduced or omitted.

B. Electrical: Comply with applicable requirements in Division 24 Sections.

1. Ground equipment.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4. CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.5. COMMISSIONING

A. Verify that installation of each air terminal is according to the Contract Documents.
B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.
C. Check that controls and control enclosure are accessible.
D. Verify that control connections are complete.
E. Check that nameplate and identification tag are visible.
F. Verify that controls respond to inputs as specified.

3.6. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233601

SECTION 233602 – FAN POWERED TERMINALS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL

A. Furnish and install where shown on plans shut-off terminal units. All variable volume boxes shall be by one manufacturer.
B. Equivalents by Trane, Titus, Carnes, EnviroTec, E.H. Price.
C. Furnish and install Parallel Flow parallel fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
D. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. Testing does not ensure acceptance.

2.2. PRODUCT

A. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, electric heating coils, and accessories as shipped. All electrical components shall be UL listed and installed in accordance with UL standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
B. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with dual density insulation which complies with UL 181 and NFPA 90A. Any exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent entertainment of fibers in the airstream. The terminal shall have a round duct collar for the primary air connection and a rectangular discharge suitable for flanged duct connection. The casing shall be designed for hanging by sheet metal straps.
C. The terminal casing shall have a bottom access panel which allows removal of fan and servicing of terminal without disturbing duct connections.
D. The fan shall be constructed of steel and have a forward curved, dynamically balanced wheel with direct drive motor. The motor shall be suitable for 120, 208, 240, or 277 volt, 60 cycle, single phase power. The motor shall be of energy efficient design, permanent split capacitor type, with integral thermal overload protection and permanently lubricated bearings, and be specifically designed for use with an SCR for fan speed adjustment. Fan assembly shall include a tuned spring steel suspension and isolation between motor and fan housing.
E. The terminals shall utilize a manual SCR, which allows continuously adjustable fan speed from maximum to minimum, as a means of setting fan airflow. Setting fan airflow with any device that raises the pressure across the fan to reduce airflow is not acceptable. The speed control shall incorporate a minimum voltage stop to insure that the motor cannot operate in a stall mode.
F. The terminals shall include a gasketed backdraft damper at the fan section discharge to prevent primary air from flowing back through the fan section into the return air plenum.
G. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other

removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table.

H. Electric Heating Coils

1. Electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coil shall be integral with the terminal. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3½ inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure, with hinged access door for access to all controls and safety devices.
2. Electric coils shall contain a primary automatic reset thermal cutout per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall include an integral door interlock type disconnect switch, which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

I. SCR Electric Heat

1. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be integral with the terminal. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3½ inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.
2. Electric coils shall contain a primary automatic reset thermal cutout, a secondary replaceable heat limiter per element, proportional electronic airflow switch, and line terminal block. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow.

J. Unit shall include an integral door interlock type disconnect switch that will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

K. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:

L. Fan Powered Terminals Parallel Flow - Low Profile Option

1. Furnish and install Parallel Flow parallel fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space. The entire terminal with accessories shall not exceed 10½ inches in overall height.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.

B. Units installed above service platform shall be installed on rubber vibration isolation pad.

C. Connect ductwork to air terminals according to Division 23 ductwork Sections.

3.2. CONNECTIONS

A. Coordinate piping installation and specialty arrangement requirements with schematics on Drawings and with requirements specified in hydronic piping and steam and condensate piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Install piping adjacent to air terminals to allow service and maintenance.

C. Electrical: Comply with applicable requirements in Division 24 Sections.

1. Ground equipment.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4. CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.5. COMMISSIONING

A. Verify that installation of each air terminal is according to the Contract Documents.
B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.
C. Check that controls and control enclosure are accessible.
D. Verify that control connections are complete.
E. Check that nameplate and identification tag are visible.
F. Verify that controls respond to inputs as specified.

3.6. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233602

SECTION 233700 – DUCT INSULATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.

1.3. SUBMITTALS

1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

B. QUALITY ASSURANCE

1. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4. DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5. COORDINATION

A. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 PRODUCTS

2.1. INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2. DUCT LINER

A. Fibrous-Glass Duct Liner (Flat Applications): Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Fibrous-Glass Duct Liner (Round Applications): Engineered, pre-formed insulation designed for specific duct diameters and fittings. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." Rigid, resin bonded fibrous glass board with a damage-resistant, flame retardant veil faced airstream surface with a reinforced aluminum foil (FRK) backing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

i. Maximum Thermal Conductivity: Type I, Flexible: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

C. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA Inc.
b. Armacell LLC.
c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.3. DUCT WRAP

A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. 1.0 lb. density standard duct insulation type IV with foil-scrim-craft facing and .27 BTUH thermal conductivity at 75 degrees mean temperature.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.

e. Owens Corning; All-Service Duct Wrap.

B. SOUND LAGGING

1. For all HVAC equipment greater than 7500 cfm provide sound lagging for all vertical ductwork up or down to unit and also for the next horizontal 10 feet of ductwork. Also provide lagging where called for on plans.
2. System shall provide SoundSeal Barricade Lag Series loaded vinyl noise barrier with fibrous glass scrim reinforced aluminum foil facing on one side. The reinforced foil facing shall accept matching tape for quick and easy installation.
3. Where external thermal insulation is specified provide Soundseal B-10 LAG (1#/sf) over the thermal insulation. Where exterior thermal insulation is not specified provide 2" thick Soundseal B-10 LAG/QFA-9 (1#/sf and 0.4#/sf) lagging with quilted fiberglass decoupler on the back of the product to form a tight fitting “floating” noise barrier.
4. Sound transmission coefficient (STC) shall be 26 or 30 for the installed system.

Sound Transmission Loss (dB) Frequency (Hz)							
	125	250	500	1000	2000	4000	STC
B-10 LAG	15	16	21	26	33	38	26
B-10 LAG/QFA-9	19	20	23	33	44	53	30

5. Meets Class A flammability rating per ASTM E-84

2.4. INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5. ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.6. MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

2.7. SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.

4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8. FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Factory cut and rolled to size.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
4. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
5. Factory-Fabricated Fitting Covers:

a. Same material, finish, and thickness as jacket.
b. End caps.
c. Beveled collars.
d. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10. TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

PART 3 – EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3. INSULATION SCHEDULE

A. Refer to drawings for insulation and ductwork schedule.

3.4. GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and duct system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Keep insulation materials dry during application and finishing.
G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
H. Install insulation with least number of joints practical.
I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
N. For above ambient services, do not install insulation to the following:

    1. Vibration-control devices.
    2. Testing agency labels and stamps.
    3. Nameplates and data plates.
    4. Access doors.

O. Undamaged insulation systems on cold surface ductwork and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
P. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

    1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
    2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
    3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. For double wall ductwork, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.5. PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
    1. Comply with requirements in Penetration Firestopping and fire-resistive joint sealers.
C. Insulation Installation at Floor Penetrations:
    1. Pipe: Install insulation continuously through floor penetrations.
    2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping."

3.6. MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
    1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
    2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
    3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
        a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
        b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
        c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
        d. Do not overcompress insulation during installation.
        e. Impale insulation over pins and attach speed washers.
        f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
B. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor

barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
2. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

C. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

D. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

E. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8. FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9. FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

3.10. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

3.11. FIELD QUALITY ASSURANCE

A. Upon completion of insulation work and before operation is to commence, visually inspect the work and verify that it has been correctly installed.
B. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.
C. Check the duct system to ensure that there are no air leaks through joints.

3.12. PROTECTION

A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with duct liner damage and moisture-saturated insulation.
B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation

work.

END OF SECTION 233700

SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1. GRILLES, REGISTERS AND DIFFUSERS

A. Provide units by Titus, E.H. Price, Metal-Aire, Tuttle & Bailey, Krueger
B. Provide product data for each type of product indicated, include the following: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings. Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
C. Submit information showing ceiling suspension assembly members, method of attaching hangers to building structure, size and location of initial access modules for acoustical tile. ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings. Duct access panels.
D. Unless noted otherwise finish shall be off white when mounted in ceiling, prime coat when mounted on wall finish.

PART 3 EXECUTION

A. Provide where shown on plans grilles, registers, and diffusers. Set all units with rubber gaskets for air tight connection with mounting surface, see drawings for types, sizes, air flow and quantity. Refer to schedule on plans. Install diffusers, registers, and grilles level and plumb.
B. Install all registers with curve of louver away from line of sight. Unless noted otherwise, provide duct mounted diffusers and registers with standard margins.
C. Provide proper mounting supplies and arrangements for areas shown. Check Architectural drawings for ceiling and all construction. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Proceed with installation only after unsatisfactory conditions have been corrected.
D. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
F. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233719 – HVAC LOUVERS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. PERFORMANCE REQUIREMENTS

A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
C. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 PRODUCT

2.1. LOUVERS

A. Equivalent by Ruskin, Louvers and Dampers, Greenheck, American Warming and Ventilating, Industrial Louvers, ACME.
B. Louvers shall be Ruskin Model ELF375DXH extruded 6063T5 aluminum alloy construction as follows: 4" deep frame, 0.125" wall thickness. 0.125" wall thickness blades, Drainable blades are postioned at 37-1/2° angle and spaced approximately 53/32" center to center. Screen: 3/4" x .051" expanded, flattened aluminum in removable frame. Provide in custom Kynar finish as selected by Architect. AMCA Certified.
C. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 54% free area based on a 48" wide x 48" high size. Stationary drainable blades shall be contained within a 4" frame. Louver components (heads, jambs, sills, blades, & mullions) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 10 feet and shall incorporate structural supports required to withstand a windload of 20 lbs. per sq. ft. (equivalent of a 90 mph wind).
D. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
E. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
F. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
G. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
H. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

END OF SECTION 233719

SECTION 237413 – ROOFTOP HEATING/COOLING UNITS (3-20 TON)

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL

A. Provide where shown on plans, rooftop units as hereinafter specified and indicated in the schedule.
B. Equivalents by Aaon, Carrier, Daikin Applied, Lennox, Tempmaster, York.

2.2. UNIT

A. Provide dedicated downflow or horizontal gas heating electric cooling rooftop air handling units capable of operating range between 115 deg F and 0 deg F cooling as shown on plans. Cooling performance shall be rated in accordance with DOE and /or ARI testing procedures. Unit shall be factory assembled, internally wired, fully charged with R-410a and 100 percent run-tested before leaving the factory. Wiring internal to the unit shall be colored and numbered. Unit shall be UL listed and labeled, classified in accordance to ANSI Z21.47 for gas-fired central furnaces and UL 1995/CAN/CSA No. 236-M90 for central cooling air conditioners.
B. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels with minimum insulation level of R-13. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removable while providing a water and airtight seal. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1-1/8" high supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting. The top cover shall be one piece or where seams exist, it shall be double hemmed and gasket sealed.
C. Unit shall have scroll compressor(s). Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity. Crankcase heater, internal temperature and current-sensitive motor overloads shall be included for maximum protection. Internal spring isolation and sound muffling shall be provided. External high pressure cutout shall be provided. Low pressure switches shall be standard.
D. Each refrigerant circuit shall have independent fixed orifice expansion devices, service pressure ports and refrigerant line filter driers. An area shall be provided for replacement suction line driers.
E. Provide internally finned 3/8" copper tubes mechanically bonded to configured aluminum plate fin evaporator and condenser coils. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil and condenser coil shall be leak tested to 200 psig and pressure tested to 450 psig. Cooling coils shall be provided that do not carryover moisture with a 10% velocity safety factor.
F. The heating section shall have a drum and tube heat exchanger design using corrosion resistant steel components. A forced combustion blower shall supply premixed fuel to a single burner ignited by a pilotless hot surface ignition system. A negative pressure gas valve shall be used that requires blower operation to initiate gas flow. On an initial call for heat, the combustion blower shall purge the heat exchanger 45 seconds before ignition. After three unsuccessful attempts, the entire heating system shall be locked out until manually reset at the thermostat. Unit shall be suitable for use with natural

gas. All units shall have two-stage heating.

G. The outdoor fans shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and have built-in thermal overload protection.

H. Unit shall have direct driven, BC plenuml fans with VFDs for variable airflow volume operation. All motors shall be thermally protected. Oversized motors shall be available for high static operations. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency. Refer to schedule.

I. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting fused disconnect device. Micro-processor controls shall be provided for all 24 volt control functions. The resident control algorithms shall make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures.

J. Provide minimum 24" tall roof curb designed to mate with the downflow unit and provide support and a watertight installation. Verify thickness of insulation at each unit and provide curb extension or taller curb to maintain top of curb a minimum of 8" above roof. The roof curb design shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curb shall ship knocked down for field assembly and include wood nailer strips. Provide sloped curb as required for level unit installation.

K. Provide factory installed controller to connect into building DDC system. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

   1. Unit shall utilize a variable capacity compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling loads and to save operating energy. Supply fan speed shall modulate based on supply air duct static pressure. Cooling capacity shall modulate based on supply air temperature.
   2. Modulating hot gas reheat shall modulate cooling and hot gas reheat as efficiently as possible, to meet space humidity loads and prevent supply air temperature swings and overcooling of the space.
   3. Unit shall modulate heating with to meet space temperature heating loads.

L. Economizer shall be factory installed. The assembly includes - fully modulating 0-100 percent motor and dampers, barometric relief, 10% minimum position setting, preset linkage, wiring harness with plug and fixed dry bulb control.

M. Provide pleated media MERV 8 two-inch filters.

N. Provide unit with louvered hail guards.

O. Provide low ambient accessories to allow operation to 30 degrees F.

P. Provide with factory installed hot gas reheat coil for dehumidification.

Q. SCHEDULES

   1. See schedule on plans for capacity

PART 3 EXECUTION

3.1. INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances.

B. Curb Support: Install roof curb on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure rooftop air conditioners on curbs and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts. Coordinate height of curb with roof insulation thickness and roof slope to have a minimum of 10" above the finished roof level.

C. Isolation Curb Support: Install units scheduled for vibration isolation on isolation curbs and install flexible duct connectors and the following vibration isolation and seismic-control devices. Flexible duct connectors are specified in Division 23 Section "Duct Accessories." Vibration isolation and seismic-control devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."

3.2. CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Gas Piping: Comply with applicable requirements in Division 22 Sections for Fuel Gas Piping. Connect gas piping to

burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

D. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.
E. Install ducts to termination in roof curb.
F. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
G. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch-thick, acoustic duct liner.
H. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
I. Ground equipment according to Division 26 Section "Grounding and Bonding."
J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
B. Perform the following field quality-control tests and inspections and prepare test reports:

1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4. STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Adjust vibration isolators.
13. Inspect operation of barometric dampers.
14. Lubricate bearings on fan.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
18. Start refrigeration system in summer only.
19. Complete startup sheets and attach copy with Contractor's startup report.
20. Inspect and record performance of interlocks and protective devices; verify sequences.
21. Operate unit for an initial period as recommended or required by manufacturer.
22. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
23. Measure gas pressure on manifold.
24. Measure combustion-air temperature at inlet to combustion chamber.

25. Measure flue-gas temperature at furnace discharge.
26. Calibrate thermostats.
27. Adjust and inspect high-temperature limits.
28. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.

C. Start refrigeration system and measure and record the following:

1. Coil leaving-air, dry- and wet-bulb temperatures.
2. Coil entering-air, dry- and wet-bulb temperatures.
3. Outside-air, dry-bulb temperature.
4. Outside-air-coil, discharge-air, dry-bulb temperature.

D. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

E. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

1. Supply-air volume.
2. Return-air volume.
3. Relief-air volume.
4. Outside-air intake volume.

F. Simulate maximum cooling demand and inspect the following:

1. Compressor refrigerant suction and hot-gas pressures.
2. Short circuiting of air through outside coil or from outside coil to outside-air intake.

G. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:

1. High-limit heat exchanger.
2. Warm-up for morning cycle.
3. Freezestat operation.
4. Economizer to limited outside-air changeover.
5. Alarms.

H. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

I. Provide one spare set of clean filters and deliver to owner.

3.5. ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.6. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners.

END OF SECTION 237413

END OF DIVISION 230000

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SECTION 260500 – ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Electrical Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK

A. This DIVISION requires the furnishing and installing of complete functioning Electrical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Refer to Architectural, Structural and Mechanical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing conduit in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS

A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, EMAIL admin@pkmreng.com.

B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.

C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.

D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.

E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.

F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.

G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.

H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.

I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.

J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS

A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS

A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES

A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in

writing for review of Architect-Engineer. No verbal change orders will be recognized.

1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, conduit and other electrical work are indicated diagrammatically by electrical drawings. Layout work from dimensions on Architectural and Structural Drawings. Verify equipment size from manufacturers shop drawings.
B. Study and become familiar with contract drawings of other trades and in particular general construction drawings and details in order to obtain necessary information for figuring installation. Cooperate with other workmen and install work in such a way to avoid interference with their Work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
C. Any conduit, apparatus, appliance or other electrical item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other Work caused by this contractor, subcontractor, workers or any cause whatsoever, shall be restored as specified for new work.
D. Do not scale electrical drawings for dimensions. Accurately layout work from dimensions indicated on Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for the Contractor to use their ingenuity and abilities to perform the work to their and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all conduits passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.15. EXTENT OF CONTRACT WORK

A. Provide electrical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of electrical systems. In no case will claims for "Extra Work" be allowed for work about which Electrical Contractor could have been informed before bids were taken.

B. Where specific information for devices, lights or equipment shown on the plans is missing, provide an allowance in the contract amount for furnishing a product reasonably implied by the level of other devices, lights and equipment provided in the contract documents.

C. Electrical Contractor shall be familiar with equipment provided by other Contractors that require electrical connections and control. Follow circuiting shown on drawings for lighting, power and equipment connections.

D. Make required electrical connections to equipment provided under Architectural and Mechanical divisions of this project. Receive and install electric control devices requiring field installation, wiring, and service connection. Equipment supplied by the automatic temperature control contractor shall be installed by the mechanical or automatic temperature control subcontractor. Make required internal field wiring modifications indicated on wiring diagrams of factory installed control systems for control sequence specified. These field modifications shall be limited to jumper connections and connection of internal wiring to alternate terminal block lugs. The cost for field modifications requiring rewiring of factory installed control systems for equipment provided by General or Mechanical Contractors shall be included in base bid of the respective contractor. All temperature control wiring shall be by a licensed electrician under the supervision of temperature control contractor.

E. Check electrical data and wiring diagrams received from Mechanical Contractor of compliance with project voltages, wiring, controls and protective devices shown on electrical drawings. Promptly bring discrepancies found to attention of Architect-Engineer for a decision.

F. Provide safety disconnect switches, contactors, and manual and magnetic motor starters for mechanical and electrical equipment requiring such devices. Omit these devices where included as part of factory installed prewired control systems provided with mechanical equipment. With exception of factory installed devices, provide safety disconnect switches, contacts and motor starters by one manufacturer to allow maximum interchangeability of repair parts and

accessories for these devices.

G. To maximum extent possible electrical controls in boiler rooms, equipment rooms, and control rooms shall be grouped in accessible locations and arranged according to function. Where possible use group control panels and combination starters in lieu of individually enclosed devices.

1.16. CODES, ORDINANCES, RULES AND REGULATIONS

A. Provide work in accordance with applicable rules, codes, ordinances and regulations of Local, State, Federal Governments, and other authorities having lawful jurisdiction.
B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.17. BUILDING CODES:

A. International Building Codes

1.18. SAFETY CODES:

A. National Electrical Safety Code Handbook H30 - National Bureau of Standards
B. Occupational Safety and Health Standard (OSHA) Department of Labor

1.19. NATIONAL FIRE CODES AND STANDARDS:

A. NFPA No. 70 National Electrical Code
B. NFPA No. 72 National Fire Alarm and Signaling Code
C. NFPA No. 101 Life Safety Code
D. NFPA No. 110 Standard for Emergency and Standby Power Systems

1.20. UNDERWRITERS LABORATORIES INC.:

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.21. MISCELLANEOUS CODES:

A. ANSI A117.1 - Handicapped Accessibility
B. ASHRAE 90.1 2001
C. Americans with Disabilities Act (ADA)

1.22. STANDARDS

A. Drawings and specifications indicate minimum construction standard, should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect/Engineer in writing before proceeding with work so that necessary changes can be made. However, if Electrical Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations he shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.23. PERMITS/FEES

A. Electrical Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect/Engineer with request for final review.
B. Contractor shall include in bid any charges by local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exact which part of the work is to be performed by whom.

PART 2 - PRODUCTS

A. Not Used

PART 3 - EXECUTION

3.1. SHOP DRAWINGS

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.
B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.

C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Electrical equipment location and conduit coordination shop drawings for conduit fabrication and electrical equipment clearances shall be a minimum of 1/4" scale. Shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work.

L. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

A. Contractor shall provide submittals as required by the specifications.

B. Refer to each specification section for the submittals (if any) required for that section.

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

A. Submit with shop drawings of equipment, three sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.
B. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.
C. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Architect/Engineer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.
5. Record Set Drawings: The Contractor shall mark up a set of contract documents during construction noting all changes and deviations including change orders. These will be delivered to Architect at end of the project. After the originals are changed to reflect the blue line set, a copy shall be included in the brochure.
6. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

   a. Project name and address.
   b. Section of work covered by brochure, i.e., Electrical.

3.5. RECORD DOCUMENTS

A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.

3.6. PREMIUM TIME WORK

A. The following Work shall be performed at night or weekend other than holiday weekends as directed and coordinated with the Owner.

1. All tie-in, cut-over and modifications to the existing electrical system and other existing system requiring tie-ins or modifications shall be arranged and scheduled with the Owner to be done at a time as to maintain continuity of the service and not interfere with normal building operations.

3.7. CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
B. Contractor shall clean up all fixtures and equipment at the completion of the project.
C. All switchboards, panelboards, wireways, trench ducts, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.8. WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.9. CUTTING AND PATCHING

A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.

B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.

C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of electrical work shall be repaired at Contractor's expense to approval of Architect-Engineer.

3.10. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown or specified. Level, shim, and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instruction. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.

B. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.

C. Provide electrical floor mounted equipment with 3-1/2" high concrete bases unless shown or specified otherwise. Electrical contractor shall size all pads. General contractor shall form all pads, provide and place all concrete for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.

D. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. Electrical contractor shall arrange for attachment to building structure, unless otherwise indicated on drawings or as specified. Provide hangers with vibration eliminators where required. Contractor shall verify that structural members of building are adequate to support equipment. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect/Engineer for review before proceeding with fabrication or installation.

E. Provide 3-1/2" high concrete housekeeping pad as specified above where two or more conduits penetrate floor below panelboards.

3.11. START-UP, CHANGEOVER, TRAINING AND OPERATION CHECK

A. Electrical Contractor shall be responsible for training Owner's operating personnel to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructor's name, names of Owner's personnel attending and total hours of instruction given each individual.

B. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.12. FINAL CONSTRUCTION REVIEW

A. At final construction review, Electrical Contractor and the major sub-contractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by Architect/Engineer, that the work complies with purpose and intent of plans and specifications. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 260500

SECTION 260505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.
3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

    1. Right-of-Way:

        a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
        b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Organize meeting with agenda and invite all pertinent attendees. Notify Architect and owner of relevant meetings. Record all decisions made and distribute minutes within 3 days of meeting.
B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    a. The Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Possible conflicts.
    i. Compatibility problems.
    j. Time schedules.
    k. Manufacturer's written recommendations.
    l. Warranty requirements.
    m. Compatibility of materials.
    n. Space and access limitations.
    o. Regulations of authorities having jurisdiction.
    p. Testing and inspecting requirements.
    q. Installation procedures.
    r. Coordination with other work.
    s. Required performance results.
    t. Protection of adjacent work.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Notify Architect of meeting.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress.
    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    b. Review present and future needs of each contractor present, including the following:
        i. Interface requirements.
        ii. Sequence of operations.
        iii. Status of submittals.
        iv. Deliveries.
        v. Off-site fabrication.
        vi. Access.
        vii. Quality and work standards.

viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 260505

SECTION 260510 – ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SCOPE

A. Demolition work to be performed whether shown or not on the drawings. Disconnect and remove any lights, equipment, conduit, wiring, devices, etc. not required to remain and/or required to be removed to accommodate new construction.

1.3. SUMMARY

A. This Section requires the selective removal and subsequent offsite disposal of the following:

a. Mechanical and electrical equipment, devices, piping, conduits, ductwork, insulation, lighting, etc in existing building as required to accommodate new construction.
b. Removal of MEP items in interior partitions.
c. Removal and protection of existing fixtures, materials, and equipment items to be removed, salvaged, relocated, reinstalled, etc.

1.4. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
B. Schedule indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed remodeled areas.

C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Architect prior to start of work.

1.5. JOB CONDITIONS

A. Occupancy: Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.
B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
C. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted.
D. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.

a. Provide protective measures as necessary and required to provide free and safe passage of Owner's personnel and general public to any occupied portions of building.
b. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
c. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

d. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
e. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
f. Remove protections at completion of work.

2. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
3. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Flame Cutting:

1. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

F. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

G. Maintain fire protection services during selective demolition operations.
H. Environmental Controls:

a. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1. PREPARATION

A. General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
B. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
C. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.

a. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Architect.
b. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Architect if shutdown of service is necessary during changeover.

3.2. DEMOLITION

A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to

remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.

2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
3. Provide services for effective air and water pollution controls as required.
4. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.

B. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to architect in written accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3. SALVAGED MATERIALS

A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain a receipt.

3.4. DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off site.
B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
C. Burning of removed materials is not permitted on Project site.

3.5. CLEANUP AND REPAIR

A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 260510

SECTION 260519 – WIRE AND CABLE

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Qualification Data: For testing agency.
C. Field quality-control test reports.

1.4. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

1.5. COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1. CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Corporation.
2. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.
C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

1. Provide consistent color coding of all circuits as follows:

Phase	120/208
A	Black
B	Red
C	Blue
N	White
Ground	Green w/ White Stripe

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2. CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1. CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2. CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.
F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway; Metal-clad cable, Type MC.
G. Branch Circuits Concealed in Concrete, Block walls, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
J. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable, concealed in building finishes.
K. Metal Clad (MC) cable installations shall be in accordance with the following:

1. Standard MC cable may be used for non-emergency circuits in other than patient care areas.
2. MC cable shall not be used for homeruns.
3. MC cable may be used for light fixture and equipment whips in lengths no longer than 6’-0”. The use of MC cable from lighting fixture to lighting fixture shall not be allowed.
4. MC cable shall not be installed in exposed locations for lighting purposes. MC cable may be exposed in mechanical spaces for equipment whips.

3.3. INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4. CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5. FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance

and feeder conductors for compliance with requirements.

2. Test Reports: Prepare a written report to record the following:

   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260520 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1. NEUTRAL AND GROUND WIRES

A. Where individual circuit homeruns (hots, neutral, and ground as part of a single circuit) are indicated on the plans serving lighting and branch circuit receptacle loads, these shall be individual circuits with individual neutrals (no sharing of neutrals and/or grounds).
B. Where shared circuit homeruns (hots, neutral, and ground as part of separate circuits) are indicated on the plans, these shall be allowed to share one (common) ground for three (3) circuits from different phases occurring in one (1) conduit run. When additional circuits occur in conduit run, additional ground wires shall be installed. Conduit shall be upsized and conductors shall be de-rated based on NEC current carrying conductor tables, counting all hots and neutrals as current carrying conductors.

1. No sharing of neutral conductors is allowed in multi-wire branch circuit homeruns, unless the installation meets the requirements of 2014 NEC 210.4(B), and is specifically approved by the engineer of record.

3.2. TESTS RECORDING, REPORTING TESTS AND DATA

A. Record nameplate horsepower, amperes, volts, phase service factor and other necessary data on motors and other electrical equipment furnished and/or connected under this contract.
B. Record motor starter catalog number, size and rating and/or catalog number of thermal-overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specification for instructions for proper sizing of thermal-overload units.
C. Record amperes-per-phase at normal or near-normal loading of each item of equipment furnished and/or connected.
D. Record correct readings of each feeder conductor after energized and normally loaded, and again after balancing of feeder loads as required by current readings.
E. Record voltage and ampere-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load.
F. Short-Circuit Calculations

1. Contractor shall contact utility company after utility company design is complete and determine exact available fault current in amperes at the point of utility connection (Service Point).
2. Contractor shall utilize the above available fault current to calculate the available fault current in amperes (RMS-SYM) at the service equipment.
3. The available fault current shall be labeled on the service equipment – refer to Section 260553.

G. Submit at least two (2) typewritten copies of data noted above to Architect-Engineer for review prior to final inspection.
H. Keep a record of all deviations made from routes, locations, circuiting, etc. shown on contract drawings. Prior to final inspection submit one new set of project drawings with all deviations and changes clearly indicated.

3.3. CLEANING AND PAINTING OF MATERIALS AND EQUIPMENT

A. Before energizing switchboards, transformers, panelboards, starters, variable frequency drive and other similar electrical equipment, Contractor shall thoroughly vacuum out all dirt, dust and debris from inside of equipment and shall thoroughly clean outside and inside of equipment.
B. Touch-up painting and refinishing of factory applied finishes shall be by Electrical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only

after they have been properly cleaned and coated with a corrosion resistant primer.

D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.

E. Where extensive refinishing is required equipment shall be completely repainted.

3.4. EXCAVATION AND BACKFILL

A. Perform necessary excavation to receive work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.

B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.

C. Conduct excavations so no walls or footings are disturbed or injured.

D. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by A/E.

E. Mechanically tamp backfill under concrete and pavings in 6" layers to 95% standard density, Reference Division 2.

F. Backfill trenches and excavations to required heights with allowance made for settlement.

G. Tamp fill material thoroughly and moistened as required for specified compaction density.

H. Dispose of excess earth, rubble and debris as directed by Architect.

I. When available, refer to test hole information on architectural drawings or specifications for types of soil to be encountered in excavations.

3.5. FIRE BARRIERS

A. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

B. Equivalent by Dow, Chemelex, 3M.

C. All holes or voids created by the electrical contractor to extend conduit or wiring through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall have ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.

3.6. TEMPORARY COVERINGS

A. Provide temporary covering over all electrical panels, distribution panelboards, outlet boxes and other equipment as required to keep same free from damage due to moisture, plaster, paint, concrete or other foreign materials. Any equipment with finish damaged by moisture, paint, plaster or other foreign materials shall be cleaned and refinished as directed by the Architect without additional cost to the Owner.

B. All temporary openings in conduits shall be covered with metal or plastic caps.

3.7. PROTECTIVE COVERS

A. Provide protective wire guards over all wall mounted and ceiling mounted devices subject to damage in areas such as gymnasiums, shops and similar occupancies.

B. Provide lockable covers over thermostats and similar wall mounted devices where items are located in public spaces but should not be operable by the general public.

3.8. SLEEVES

A. Provide proper type and size sleeves to General Contractor for electrical ducts, busses, conduits, etc. passing through building construction. Supervise installation to insure proper sleeve location. Unless indicated or approved install no sleeves in structural members.

B. Provide cast iron sleeves extending 1 inch above finished floor where sleeves pass through floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchen. Seal opening between pipe and sleeve with Thunderline Corp. Link Seal.

C. Unless specified otherwise provide 18 gauge galvanized sheet metal sleeves through floors and non-bearing walls. Where piping passes through exterior walls, equipment room walls, air plenum walls and walls between areas that must be isolated from occupied areas, seal space between sleeves and piping, air or water tight are required with Thunderline Corp. Link Seal.

D. Provide O-Z Electrical Manufacturing Co., Inc. Type "FSK" or "WSK" or equivalent thruwall and floor seals where conduits pass through concrete foundation walls below grade.

E. Provide Zurn Z-195 or equivalent flashing sleeve through walls and floors with waterproof membrane. Seal annular space between conduit and sleeve with Thunderline Link Seal or O-Z type CSM sealing bushing.

END OF SECTION 260520

SECTION 260526 – GROUNDING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK

A. Provide grounding electrodes, conductors, connections and equipment to provide a solidly grounded electrical system.

1.3. STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Underwriters Laboratory Standard No. U.L. 467.
2. ANSI C-1 1978.
3. IEEE Standards No. 142-1982, 1100-1992 and No. 80.
4. National Electrical Safety Code.
5. NFPA.

1.4. SUBMITTALS

A. Submit test reports certifying resistance values for buried or driven grounds and water pipe grounds.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Ground Cables: green color coded, insulated, annealed stranded tinned copper wire as indicated on Drawings; insulated wire to conform with requirements of Section 16120.
B. Mechanical Connectors: Tin-plated aluminum alloy, UL approved and stamped for use with aluminum or copper conductors.
C. Ground Rods:

1. Copper-clad steel fabricated by molten welding process.
2. Diameter: 5/8 Inch. Use 3/4" for rocky soil.
3. Length: 8 feet.

D. Ground Lugs and Connectors for Cable Tray: Tin-plated aluminum alloy suitable for use with aluminum or copper conductors.

2.2. GENERAL

A. Grounding systems shall be installed in accordance with the requirements of the local authorities, and subject to the approval of the Architect/Engineer.
B. All ground wires and bonding jumpers shall be stranded copper installed in conduit. All ground wires shall be without joints and splices over its entire length.
C. The system neutral shall be grounded at the service entrance only, and kept isolated for grounding systems throughout the building.
D. Each system of continuous metallic piping and ductwork shall be grounded in accordance with the requirements of the National Electrical Code.
E. Mechanical equipment shall be bonded to the building equipment grounding system. This shall include but is not limited to, fans, pumps, chillers, etc.
F. PVC conduits and portions of metallic piping and duct systems which are isolated by flexible connections, insulated couplings, etc., shall be bonded to the equipment ground with a flexible bonding jumper, or separate grounding conductor.
G. Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings and other metal noncurrent-carrying parts that are to serve as grounding conductors shall be effectively bonded where necessary to assure electrical

continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings so designed as to make such removal unnecessary.

2.3. RECEPTACLES

A. Receptacles shall be grounded to the outlet box by means of a bonding jumper between the outlet box and the receptacle grounding terminal.

2.4. CONCENTRIC KNOCKOUTS

A. Provide grounding type bushings for conduits terminated through multiple concentric knockouts not fully knocked out, on inside of electrical enclosures. Install bonding jumper between ground bushing and enclosure

2.5. TOGGLE SWITCHES

A. Provide grounding clip on each toggle switch. Mount over device mounting strap such that contact is made between mounting strap, screw, faceplate and outlet box.
B. Provide devices with ground screw and bond to switch box.

2.6. GROUNDING METHODS

A. The metal frame of the building, where effectively grounded.
B. A metal underground water piping system used for grounding shall be in direct contact with the earth for ten feet or more and shall be electrically continuous. Provide bonding jumpers at water meter and at insulated joints.
C. Steel reinforcing bars used for grounding shall be encased by at least two inches of concrete, located within and near the bottom of a concrete foundation or footing that is in direct contact with the earth. Reinforcing bars shall be minimum 1/2 inch diameter and consisting of twenty feet of one or more steel reinforcing bars.
D. All bonding jumpers for the above grounding systems shall be sized in accordance with National Electrical Code.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Cold Water Pipe Grounding:

1. Make connection with clamp type fitting; do not damage water pipe.
2. Bond ground conductor and its conduit to water pipe.
3. Install No. 4/0 AWG bonding jumper with ground clamps around water meter.

B. Ground Conductors:

1. Size as shown on Drawings or as required by National Electrical Code. Grounding conductors shall be as shown on plans or if not specifically shown shall be no smaller than that required by the NEC.
2. Where ground cables are required, install insulated copper ground conductors in steel conduit, or as indicated.
3. Where ground cable is installed in metallic conduit, bond cable to conduit at both ends.
4. Connect ground conductors in cables and in conduit to appropriate ground buses (as in switchgear, motor control centers, and distribution panelboards) or directly to metallic enclosure if no ground bus is provided.

C. Service Ground

1. Connect system neutral ground and equipment ground system to common ground bus.
2. Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with National Electric Code.
3. Provide each service disconnect enclosure with neutral disconnecting means which interconnects with insulated neutral and uninsulated equipment ground sub to establish system common ground point.
4. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.

D. Conduit Attachment to Electrical Equipment:

1. Ground conduits to metal framework of electrical equipment with double locknuts or grounding bushings and bonding jumpers unless otherwise noted.
2. Install bonding jumpers at all electrical equipment to provide continuous ground return path through conduit.

3. Install bonding jumpers across expansion fittings between conduit sections for ground path continuity.
4. Bond conduits to cable tray where conduit enters or exits tray.
5. Equipment grounding conductors for branch circuit home runs shown on the drawings shall indicate an individual and separate ground conductor for that branch circuit which shall be terminated at the branch circuit panelboard, switchboard, or other distribution equipment. No sharing of equipment grounding conductors sized according to the size of the overcurrent device and NEC Table 250-95 shall be allowed.
6. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Table 250-95.
7. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with approved pressure connectors.
8. Provide feeder servicing several panelboards with a continuous grounding conductor connected to each related panelboard ground bus. Installation shall include necessary precautions regarding terminations with dissimilar metals.

E. Circuiting

1. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder.
2. Single phase 120 volt branch circuits for lighting and power shall consist of phase and neutral conductors and a green ground conductor installed in common metallic conduit which shall serve as grounding conductor.
3. Provide flexible metallic conduit utilized in conjunction with above single phase branch circuits with suitable green insulated grounding conductors connected to approved grounding terminals at each end of flexible conduit.
4. Single phase branch circuit installed in nonmetallic conduits shall be provided with separate grounding conductor.
5. Install grounding conductor in common conduit with related phase and/or neutral conductors.
6. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.

F. Receptacles and Switches:

1. Install bonding jumpers between outlet box and receptacle grounding terminal except where contact device or yoke is provided for grounding purposes.

G. Wireways:

1. Install grounding jumpers for bonding between wireway and other panelboards, conduit, switchgear, motor control centers, and at any other point where solid connection would otherwise not provided in supporting system to insure continuous ground.

H. Pull Boxes, Junction Boxes and Enclosures:

1. Connect all equipment grounding conductors together and connect to the box.

3.2. FIELD QUALITY CONTROL

A. Resistance Values for System and Equipment Grounds: for each ground rod and ground grid.

1. Acceptable Testing Equipment: Vibroground by Associated Research, Inc.; or Megger Earth Tester by James G. Biddle Co.
2. Method: Three (3) electrode fall of potential as prescribed by instrument manufacturer.
3. Drive additional ground rods spaced eight feet apart, if necessary, until total resistance of system is measured at five ohms or less.

END OF SECTION 260526

SECTION 260550 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK

A. Provide complete raceways systems, boxes and fittings for all required electrical systems.

1.3. STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Rigid Steel Conduit
   a. U.L. Standard UL-6
   b. A.N.S.I. C80-1
   c. Federal Specification WW-C-581E
2. Intermediate Metallic Conduit
   a. U.L. Standard UL-1242
   b. Federal Specification WW-C-581E
3. Electrical Metallic Tubing
   a. U.L. Standard UL-797
   b. A.N.S.I. C80-3
   c. Federal Specification WW-C-563
4. Flexible Steel Conduit
   a. U.L. Standard UL-1
5. Liquid Tight Flexible Conduit
   a. U.L. Standard UL-360
6. Non-Metallic Conduit
   a. U.L. Standard UL-651
   b. A.N.S.I. Standard F512
   c. N.E.M.A. Standard TC-2
   d. Federal Specifications GSA-FSS and W-C-1094-A
7. Wireways and Auxiliary Gutters
   a. U.L. Standard UL-870
8. Rigid Aluminum Conduit
   a. A.N.S.I. C80.5

1.4. SUBMITTALS

A. Provide manufacturer's catalog cuts of fittings.
B. Where wireways and/or auxiliary gutters are employed full erection drawings must be submitted. Drawings to include plan views, elevations, size of wireways, type and quantity of conductors proposed to be installed therein, etc.
C. Indicate duct banks or multi-trade coordinated shop drawings.
D. Submit shop drawings or catalog descriptive data on boxes exceeding twenty-four (24")inches for any one dimension.
E. Submit shop drawings or catalog descriptive for floor boxes and accessories.

PART 2 - PRODUCTS

2.1. RACEWAY TYPES

A. Standard Threaded Rigid Steel Conduit.

1. Rigid conduit heavy wall galvanized.
2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.

B. Intermediate Metallic Conduit

1. Light weight rigid steel conduit.
2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.

C. Electrical Metallic Tubing

1. Continuous, seamless tubing, galvanized or sheradized on the exterior, coated on the interior with a smooth hard finish of lacquer, varnish, or enamel.
2. Couplings and connectors:

   a. Indoor and two (2") inches in size and smaller, shall be steel set-screw type fittings.
   b. 2-1/2 inch size and larger must employ steel compression gland fittings.
   c. Outdoor shall be raintight steel compression gland fittings.

3. Indent type fittings shall not be used.
4. All connectors shall have insulated throat.
5. Where installed in slab or concrete work, provide approved concrete tight fittings.

D. Flexible Steel Conduit

1. Single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel.
2. Maximum length: (six 6) feet.
3. Each section of raceway must contain an equipment grounding wire bonded at each end and sized as required. Provide connectors with insulating bushings.
4. Steel squeeze-type or steel set screw type fittings.

E. Liquid Tight Flexible Electrical Conduit

1. Same as flexible steel conduit except with tough, insert water-tight plastic outer jacket.
2. Cast malleable iron body and gland nut, cadmium plated with one-piece brass grounding bushings which thread to interior of conduit. Spiral molded vinyl sealing ring between gland nut and bushing and nylon insulated throat.

F. Non-Metallic Raceway

1. Composed of polyvinyl chloride suitable for 90 degrees C. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.
2. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years experience in manufacturing the products.
3. Materials must have a tensile strength of 7,000-7,200 psi at 73.4 degrees F., flexural strength of 12,000 psi and compressive strength of 9,000 psi.
4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer.

G. Wireways and Auxiliary Gutters

1. Painted steel or galvanized steel.
2. Of sizes and shapes indicated on the Drawings and as required.
3. Provide all necessary elbows, tees, connectors, adapters, etc.
4. Wire retainers not less than twelve (12") inches on center.

2.2. LOCKNUTS AND BUSHINGS

A. Locknuts shall be steel. Die cast locknuts shall not be used.

B. All bushings shall be insulated. Use nylon insulated metallic bushings for sizes 1" and larger. Plastic bushings may be used in 1/2" and 3/4" sizes.

2.3. OUTLET, JUNCTION, AND PULL BOXES

A. Cast Type Conduit Boxes, Outlet Bodies and Fittings

1. Provide surface mounted outlet and junction boxes, in indoor locations, where exposed to moisture and in outdoor locations.
2. Use Ferrous Alloy boxes and conduit bodies with Rigid Steel or IMC.
3. Use Ferrous Alloy or cast aluminum boxes and conduit bodies with Electrical Metallic Tubing.
4. Covers: Cast or sheet metal unless otherwise required.
5. Tapered threads for hubs.

B. Galvanized Pressed Steel Outlet Boxes

1. General

a. Pressed steel, galvanized or cadmium-plated, minimum of four (4") inches, octagonal or square, with galvanized cover or extension ring as required.

2. Switch and Receptacle Box, Indoors

a. Nominal four (4") inches square, 1-1/2" or 2-1/2" deep as required, with raised cover unless otherwise indicated on drawings. Gangable boxes shall not be used.

3. Data/Telephone outlet box, Indoors

a. Nominal four (4") inches square, 2-1/2" deep, with raised cover unless otherwise indicated on drawings. Gangable boxes shall not be used.

4. Lighting Fixture Box

a. Four (4") inch octagon with 3/8" fixture stud.
b. For suspended ceiling work, four (4") inch octagon with removable backplate where required, and two (2) parallel bars for securing to the cross-furring channels and extend flexible conduit to each fixture.

5. Plug any open knockouts not utilized.

C. Sheet Steel Boxes Indoors

1. No. 12 USS gauge sheet steel for boxes with maximum side less than forty (40") inches, and maximum area not exceeding 1,000 square inches; riveted or welded 3/4 inch flanges at exterior corners.
2. No. 10 USS gauge sheet steel for boxes with maximum side forty (40") to sixty (60") inches, and maximum area 1,000 to 1,500 square inches; riveted or welded 3/4 inch flanges at exterior corners.
3. No. 10 USS gauge sheet steel riveted or welded to 1-1/2 by 1-1/2" by 1/4" welded angle iron framework for boxes with a maximum side exceeding sixty (60") inches and more than 1,500 square inches in area.
4. Covers

a. Same gauge steel as box.
b. Subdivided single covers so no section of cover exceeds fifty (50) pounds.
c. Machine bolts, machine screws threaded into tapped holes, or sheet metal screws as required; maximum spacing twelve (12") inches.

5. Paint

a. Rust inhibiting primer; ANSI No. 61 light gray finish coat.

6. Where size of box is not indicated, size to permit pulling, racking and splicing of cables.

D. Floor Boxes

1. General

a. Class I, water-tight, normal depth cast iron construction Type I, fully adjustable, for use in concrete.
b. Single Gang Round type.

c. Multiple Gang or Combination.

i. Rectangular type partitions for separating power from communication sections.

2. Floor Box Covers

a. Rugged construction, impervious to cleaning detergents.
b. Compatible with floor covering.
c. Brass or bronze for flush lid mounting with devices below floor level. Lid shall have hinged or guarded openings for wires to route through the closed lid.
d. Providing continuous ground path to box.
e. Provide carpet flange in carpeted areas.

E. Fire Rated Poke Throughs

1. General

a. 4, 6 or 8" fire rated poke throughs, UL listed for installation in fire rated concrete construction. Hubbell System One - Recessed Activation.
b. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
c. Comply with UL 514 scrub water exclusion requirements. Class I, water-tight, normal depth cast iron construction Type I, fully adjustable, for use in concrete.
d. Partitions for separating power from communication sections.

2. Covers

a. Rugged construction, impervious to cleaning detergents.
b. Compatible with floor covering.
c. Brass or bronze for flush lid mounting with devices below floor level. Lid shall have hinged or guarded openings for wires to route through the closed lid.
d. Providing continuous ground path to box.
e. Provide carpet flange in carpeted areas.

PART 3 - EXECUTION

3.1. APPLICATION OF RACEWAYS

A. The following applications must be adhered to except as otherwise required by Code. Raceways not conforming to this listing must be removed by this Contractor and replaced with the specified material at this Contractors expense.

1. Rigid Steel - Application: Where exposed to mechanical injury, where specifically required, exterior exposed locations, and where required by codes and for all circuits in excess of 600 volts.
2. I.M.C. - Application: Same as standard threaded rigid steel conduit.
3. E.M.T. - Applications: Use in every instance except where another material is specified. EMT shall not be used underground or in slab on grade.
4. Flexible Steel - Applications: Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings at bus duct takeoffs, at all transformer or equipment raceway connections where sound and vibration isolation is required.
5. Liquid-Tight Flexible Conduit - Applications: Use in areas subject to moisture where flexible steel is unacceptable at connections to all motors, and all raised floor areas.
6. Non-Metallic Conduit - Application: Schedule 40 - Where specifically indicated on the drawings and for raceways in slab or below grade. All bends shall be made with steel elbows and wrapped unless the bend is encased in concrete.
7. Wireways and Auxiliary Gutters - Application: Where indicated on the Drawings and as otherwise specifically approved.

3.2. RACEWAY SYSTEMS IN GENERAL

A. Provide raceways for all wiring systems, including security, data transmission, paging, low voltage et. al. 277/480 volt wiring shall be kept independent of 120/208 volt wiring. Emergency system wiring shall be kept independent of the

normal system wiring. Where non-metallic raceways are utilized, provide sizes as required with the grounding conductor considered as an insulated additional conductor. Wiring of each type and system must be installed in separate raceways.

B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Lay out the work in advance to avoid excessive concentrations of multiple raceway runs.

C. Locate raceways so that the strength of structural members is unaffected and they do not conflict with the services of other trades. Install one (1") inch or larger raceways, in or through structural members (beams, slabs, etc.) only when and in the manner accepted by the Architect/Engineer. Draw up couplings and fittings full and tight.

D. Install no conduits or other raceways sized smaller than permitted in applicable NEC Tables. Where conduit sizes shown on drawings are smaller than permitted by code, Contractor shall include cost for proper size conduit in his base bid. In no case reduce conduit sizes indicated on drawings or specified without written approval of Architect-Engineer.

E. Above-grade raceways to comply with the following:

1. Install raceways concealed except at surface cabinets and for motor and equipment connection in electrical and mechanical rooms. Install a minimum of six (6") inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route exposed raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run concealed raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways. Waterproof sleeved raceways where required.
2. Raceways shall not be run on roofs or exposed on the outside of the buildings unless specifically noted as exposed on the drawings or approved by the Architect/Engineer.
3. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction. Provide expansion fittings every 200 feet on outdoor conduit.
4. Provide one (1) empty 3/4 inch raceway for each three (3) spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension.
5. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling, or floors which separate adjacent rooms having substantially different maintained temperatures, as in refrigeration or cold storage rooms.
6. Provide pull string in spare or empty raceways. Allow five (5) feet of slack at each end and in each pull box. Tie each end of the string to a washer or equivalent that does not fit into the conduit. Tag both ends of string denoting opposite end termination location.

F. Below Grade

1. Below grade raceways to comply to the following:

   a. Do not penetrate waterproof membranes unless proper seal is provided.

2. Protect steel raceway in earth or fill with two (2) coats of asphalt base paint. Touch up abrasions and wrench marks after conduit is in place.
3. In lieu of the above, protect steel raceways with a minimum of ten (10) mil tape approved for the purpose and overlapped a minimum of one-half tape width to provide a minimum twenty (20) mil thickness.

G. No raceway may be installed in a concrete slab or members except with the permission of the Structural Engineer and with the written consent of the Owner.

1. Conduits embedded in structural concrete slabs shall have an outside diameter less than one third of the thickness of the concrete slab and shall be installed entirely within the center one third of the concrete slab.
2. Raceways embedded in concrete slabs shall be spaced not less than eight (8") inches on centers and as widely spaced as possible where they converge at panels or junction boxes.
3. In no case will installation of raceways be permitted to interfere with the proper placement of principal reinforcement.
4. Raceways running parallel to slab supports, such as beams, columns, and structural walls, shall be installed not less than twelve (12") inches from such supporting elements.
5. To prevent displacement during concrete pour of lift slab, saddle supports for conduit, outlet boxes, junction

boxes, inserts, etc., shall be secured with suitable adhesives.

H. Non-metallic raceway installation shall conform to the following:

1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. To insure good joints, components shall be cleaned prior to assembly.
2. Raceway cut-offs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.
3. Electrical devices which are served by PVC raceways shall be grounded by means of a ground wire pulled in the raceway.
4. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the N.E.C.
5. Raceway expansion fittings shall be provided where necessary. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.
6. Raceway supports shall be installed, in such a manner, to allow the PVC conduit to slide through the supports as the temperature changes.
7. Elbows must be galvanized rigid steel, intermediate metallic conduit or concrete encased. Plastic conduit may only be used for exterior underground applications or circuits beneath slabs on grade. Provide galvanized rigid steel (GRS) radius bends and risers as conduits rise above grade or above floor slab.
8. Provide exterior underground conduit with metal detection strip.
9. Provide matching plastic fittings. Fittings shall meet the same standards and specifications as the conduit on which it is installed.
10. Joining and bending of conduit and installation of fittings shall be done only by methods recommended.
11. Provide conduit support spacing as recommended for the highest ambient temperature expected.
12. Provide interlocking conduit spacers for multiple runs of underground conduits installed in same trench.
13. Provide expansion couplings on long runs regardless of ambient temperatures. Determine amount of conduit expansion and contraction from published charts or tables.
14. Test workmanship by conducting a low-pressure air (3.0-5.0 psi) test after system is installed and cemented joints are set. Plug and block ends to prevent movement prior to pressurization. Check for leaks at all joints with a soap solution. Even low-pressure air can cause high thrust loads and caution must be observed. The test shall be observed by the architect, engineer or owner's representative, prior to backfill. All below grade conduit that could potentially drain water into electrical equipment (ie. Main electrical service located in basement below utility transformer) must be watertight.

I. Raceways in hung ceiling shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars, Z-bars, or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than 1'-0" above hung ceilings.

J. Exposed raceways shall be run parallel or at right angles with building lines. Secure raceway clamps or supports to masonry materials by toggle bolts, expansion bolts, or steel inserts. Install raceway on steel construction with approved clamps which do not depend on friction or set screw pressure alone.

K. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt, or similar material. This assembly may be pulled in together with, but ahead of, the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway which rejects ball mandrel.

L. Support raceways at intervals no greater than ten (10) feet and with one support within three (3) feet of each coupling, box, fitting, or outlet box. Provide one support within three (3) feet of each elbow or bend.

3.3. OUTLET, JUNCTION, AND PULLBOXES

A. Provide outlet, junction, and pullboxes as indicated on the drawings and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of wires and cables. J-boxes and pullboxes shall be sized per electrical code minimum. Boxes on empty conduit systems shall be sized as if containing conductors of #4 AWG.

B. Install boxes and covers for wiring devices so that the wiring devices will be installed with a vertical orientation unless otherwise noted on the drawings.

C. The exact location of outlets and equipment is governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets,

panels equipment, etc., with Architect.

D. Back-to-back outlets in the same wall, or "thru-wall" type boxes not permitted. Provide twelve (12") inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.

E. Provide twenty four (24") inch (minimum) horizontal spacing for outlets shown on opposite sides of a fire rated wall and provide listed fire putty pads around the each box to maintain fire rating.

F. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide Series "GW" (Steel City) tile box, or as accepted, or a four (4") inch square box with tile ring in masonry walls, which will not be plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of the type and size suitable for the specific application. Where outlet boxes contain two (2) or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in same box, provide suitable barrier.

G. Install top of switch outlet boxes 48” above floor unless otherwise called for or required by wainscot, counter, etc. Install bottom of receptacle outlet boxes 16” above floor unless otherwise called for on drawings. Adjust mounting heights to nearest masonry joint for minimum cutting in case of flush outlets.

H. Install all wall mounted switch and receptacle boxes with bracing between two adjacent studs where rigid conduit is not used for circuiting. Box and receptacle shall not deflect on operation or insertion of plugs.

I. Pull Box Spacing

1. Provide pull boxes so no individual conduit run contains more than the equivalent of four (4) quarter bends (360 degrees total).
2. Conduit Sizes 1-1/4" and Larger.
   a. Provide boxes to prevent cable or wire from being excessively twisted, stretched, or flexed during installation.
   b. Provide boxes for medium voltage cables so that maximum pulling tensions do not exceed cable manufacturer's recommendations.
   c. Provide support racks for boxes with multiple sets of conductors do not rest on any metal work inside box.
3. Conduit Sizes one (1") inch and smaller, low voltage wire and cable (maximum distances)
   a. 200 feet straight runs.
   b. 150 feet runs with one 90 degree bend or equivalent.
   c. 125 feet runs with two 90 degree bends or equivalent.
   d. 100 feet runs with three or four 90 degree bends or equivalent.

J. Floor Boxes

1. Prior to Concrete Pour
   a. Firmly support boxes.
   b. Adjust leveling screws to insure box covers are flush with finished floor.
   c. Plug unused opening with proper fittings and seal joints with compound for exclusion of concrete and moisture.
2. After Concrete Pour
   a. As soon as traffic is permitted on slab, remove any accumulation of water and foreign matter to avoid corrosion and rust.
   b. Insure covers are flush with finished floor.
   c. Install cover plates and accessories after floor finishing materials have been installed.

END OF SECTION 260533

SECTION 260553 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK

A. A. Provide identification on all equipment, raceways, boxes and conductors.

PART 2 - PRODUCTS

2.1. NAMEPLATES

A. Nameplates shall be lamacoid plates with engraved upper-case letters and beveled edges.
B. Color:

1. Normal-power equipment shall have white nameplates with black letters, enclosed by a black border.
2. Equipment fed from the emergency electrical system, or otherwise designated on the plans for emergency use, shall have red nameplates with white letters, enclosed by a white border.
3. Equipment designated as clean/isolated ground power shall have orange nameplates with black letters, enclosed by black border.
4. Nameplates for short circuit ratings and calculations shall be yellow with black letters, enclosed by black border.

C. All nameplates shall be engraved and must be secured with rivets, brass or cadmium plate screws. The use of Dymo tape or the like is unacceptable.
D. Nameplate inscriptions shall bear the name and number of equipment to which they are attached as indicated on the Drawings. The engineer reserves the right to make modifications in the inscriptions as necessary.

2.2. CABLE TAGS AND WIRE IDENTIFICATION LABELS

A. Cable tags shall be flameproof secured with nylon ties.
B. Wire markers shall be preprinted cloth tape type or approved equivalent.

2.3. IDENTIFICATION LABELS

A. Acceptable Manufacturers

1. W.H. Brady Company (Style A)
2. Thomas & Betts Company (T&B), Style A.
3. Seaton

B. Plasticized Cloth

1. Non-conductive.
2. Waterproof.
3. Capable of withstanding continuous temperatures of 235 degrees F and intermittent temperatures to 300 degrees F.
4. Overcoating for protection against oil, solvents, chemicals, moisture, abrasion and dirt.

C. Heavy, thermo-resistant industrial grade adhesive, for adhesion of label to any surface without curling, peeling or falling off.
D. Label Designations, Nominal System Voltages Applied to the covers of all medium and low voltage pull, splice and junction boxes.
E. Machine printed.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Service Entrance Equipment

1. Where electrical equipment (switchboard, panelboard, disconnect switch, etc.) is installed as service entrance equipment, contractor shall furnish and install a nameplate listing the following:
2. Equipment Short-Circuit Current Rating in amperes (RMS SYM), as indicated on the drawings.
3. Whether or not the equipment is fully or series-rated.
4. Available Fault Current in amperes
    a. Contractor shall perform available fault current calculation (as outlined in Section 260520) to obtain available fault at Service Equipment.
5. Date fault current calculations were performed.
6. Example:

EQUIPMENT FULLY-RATED AT 65,000 AMPERES RMS SYM AVAILABLE FAULT CURRENT: 61,603 AMPERES DATE CALCULATED: 12/06/2011

B. Panelboards and Load Centers.

1. Furnish and install a nameplate for each panelboard and load center. Nameplate shall be engraved with the following information:
    a. Top Line: Equipment identification as indicated on the Drawings.
    b. Middle Line: Specific device or equipment where feeder originates.
    c. Bottom Line: Equipment voltage, size, and phase as indicated on the drawings.
    d. Example:

PANELBOARD LN1 FED FROM SWITCHBOARD SWDP1 IN ROOM #332 208/120V, 200A, 3-PHASE

2. Nameplate shall be mounted at the top of the panel.
3. After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door, a neat, accurate, and carefully typed directory properly identifying the lighting, receptacles, outlets, and equipment each overcurrent device controls.
    a. Include on directory the panel or load center identification, the cable and raceway size of panel feeder, and the feeder origination point.

C. Disconnect Switches.

1. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.

D. Motor Controllers.

1. Furnish and install a nameplate for each motor controller or combination motor controller for both individual motor controllers and those in a motor control center. Engraving must indicate the motor served and the type of service (e.g., AC-8-1st floor supply, EF-2 electric closet exhaust.)

E. Feeder Switches.

1. Furnish and install for each feeder switch including, but not limited to those in switchboards, switch and fuse panelboards, take-offs at bus ducts, motor control centers, multiple meter centers, etc., two (2) nameplates as follows:
    a. The first nameplate must be white background with red lettering. Engrave with the words "REPLACE ONLY WITH _____ FUSE." Engrave with proper fuse trade name and ampere rating (i.e. Bussman LPS-R 100).
    b. The second nameplate shall indicate the load served, the size and type of cable and raceway example:

i. LP-4, LP-5, LP-6
ii. 4#500 KCMILS-THW-CU-3-1/2"C

F. Remote Smoke Detector Lamps and Test Stations.

1. Furnish and install a nameplate on each remote smoke detector lamp and/or test station.
2. Engraving must indicate the location of the device to which the lamp is connected, as approved by the Engineer.

G. Switches.

1. Furnish and install an engraved nameplate for each switch, controlling loads that are not local to the switch. Engraving shall be as directed by the Engineer.

H. Receptacles.

1. Furnish and install an engraved label on each faceplace for each receptacle indicating panel and circuit.

I. Pullboxes, Enclosures, and Cable Terminations.

1. Circuits rated over 40 Amp and all cables over 600V:

J. Provide identification label with circuit numbers on enclosure cover.

a. Furnish and install cable tags on each cable that enters a pullbox, enclosure, switchboard, and at terminations. Mark tags with type written inscription noting the load served, type and size of cable, and the overcurrent device protecting the cable.

K. Branch circuits:

1. Provide identification label with panel and circuit numbers on enclosure cover.
2. Identify each circuit with wire markers when enclosure label and wire colors do not provide enough information to identify each circuit without tracing.
3. Provide feeders and branch circuit home runs with plasticized wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
4. 4 square box covers hidden above lay-in ceilings may be marked with indelible ink marker in lieu of using printed labels.

L. Fire Alarm Terminal Cabinets.

1. Furnish and install an approved nameplate on each fire alarm terminal cabinet.
2. Nameplates shall indicate floor and where multiple terminal cabinets are installed a prime designation for each cabinet (e.g. FATC-1A, FATC-1B).
3. Terminals shall be permanently identified in an approved manner.
4. Label all wiring.

M. Telecommunications System.

1. Each horizontal cable from a termination block or patch panel to a telecommunications outlet shall be labeled at both ends. Tags shall be consecutively numbered so that no two (2) cables have the same identification. In addition cable tag shall note the room number in which the data transmission outlet is located.
2. Each backbone cable shall have a flameproof tag attached at both ends of the tag. Tags shall be consecutively numbered so that no two (2) cables have the same identification. Additional inscriptions shall be provided as directed by the Owner.
3. Patch panel ports shall be consecutively numbered so that no two (2) ports have the same number.

N. Warning Signs

1. Provide electrical equipment and accessible wiring enclosures operating at voltage above 240 volts with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications “Danger High Voltage” warning sign and voltage marker applied to front door or cover of device or enclosure.
2. Provide large equipment such as transformers and main distribution equipment with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications indicating all electrical characteristics.

O. Boxes

1. Provide identification labels for all low voltage and medium voltage pull, splice and junction boxes in main feeder and subfeeder runs, indicating nominal system voltage.
2. Apply labels after painting of boxes, conduits, and surrounding areas have been completed.
3. Clean surfaces before applying labels; clean aluminum surfaces with solvent wipe.
4. Apply labels on cover and minimum of one (1) fixed side; one (1) label visible from floor where boxes are Installed exposed.

END OF SECTION 260553

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1. SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relay.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and maintenance data.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.1. TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Retain one of first three subparagraphs below.
4. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Five subparagraphs below describe optional features.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic dial in first subparagraph below makes the time switch self-adjusting for seasonal changes and automatically adjusts on-off times as days grow shorter or longer.
6. Astronomic time dial.
7. Eight-Day Program: Uniquely programmable for each weekday and holidays.
8. Skip-a-day mode.

9. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2. OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3. INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper (Greengate)
2. Hubbell Lighting.
3. Leviton Mfg. Company Inc.
4. Philips Controls
5. Sensor Switch, Inc.
6. Steinel
7. Watt Stopper.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..

2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

2.4. LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. GE.
3. Hubbell Lighting.
4. Square D.
5. TORK.
6. Watt Stopper.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure. Provide with accessory module for 2-wire control as necessary for control.
5. The contactor shall have provisions for factory or field addition of:

a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
c. Control-circuit fuse holder, one or two fuses.
d. 0.2-60 second TDE or TDD timer attachment.
e. Transient-suppression module for control circuit of 120 volts.

PART 3 EXECUTION

3.1. SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.2. CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3. IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4. FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923

SECTION 260930 – DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.1. SUMMARY

A. Section Includes:

1. Digital Lighting and Plug Load Controls
2. Relay Panels
3. Emergency Lighting Control (if applicable)

B. Related Sections:

1. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
2. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Emergency Lighting control (if applicable)

D. REFERENCES

1. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org)
2. International Electrotechnical Commission (IEC) (www.iec.ch)
3. International Organization for Standardization (ISO) (www.iso.ch):
4. National Electrical Manufacturers Association (NEMA) (www.nema.org)
5. WD1 (R2005) - General Color Requirements for Wiring Devices.
6. Underwriters Laboratories, Inc. (UL) (www.ul.com):

   a. 20 – Plug Load Controls
   b. 508 – Industrial Controls
   c. 916 – Energy Management Equipment
   d. 924 – Emergency Lighting

7. Underwriter Laboratories of Canada (ULC) (www.ulc.ca)

1.2. SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:

1. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
2. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
3. Digital Plug Load Controllers – Self-configuring, digitally addressable, single relay, plenum-rated application-specific controllers. Selected models include integral current monitoring capabilities.
4. Digital Fixture Controllers – Self-configuring, digitally addressable one relay fixture-integrated controllers for on/off/0-10V dimming control.
5. Digital Occupancy Sensors – Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
6. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
7. Handheld remotes for personal control – On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.
8. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop

daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.

9. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.
10. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded) to connect multiple DLM local networks for centralized control.
11. Network Bridge – Provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
12. Segment Manager – BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
13. Programming and Configuration Software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
14. Digital Lighting Management Relay Panel and Zone Controller – Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS). Zero relay Zone Controller primarily supports Digital Fixture Controller applications.
15. Emergency Lighting Control Unit (ELCU) – Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.3. LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local energy codes are more stringent, provide a minimum application of lighting controls as follows:

1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
3. Task Lighting / Plug Loads – Provide automatic shut off of non essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area.
4. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

    a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
    b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
    c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.
    d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

5. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four preset lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to turn off all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.4. SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
B. Shop Drawings:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show exact location of all digital devices, including at minimum sensors, load controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.
D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.
2. Prove that the sensor is suitable for the proposed application.

1.5. QUALITY ASSURANCE

A. Manufacturer: Minimum [10] years experience in manufacture of lighting controls.

1.6. PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.7. WARRANTY

A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.8. MAINTENANCE

A. Spare Parts:

1. Provide spares of each product to be used for maintenance as listed below:
2. 3% of each type of wall or ceiling sensor utilized but not less than one of each.
3. 3% of each type of room controller but not less than one of each.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper (Greengate)
2. Hubbell Lighting.
3. Leviton Mfg. Company Inc.
4. Philips Controls
5. Sensor Switch, Inc.
6. Watt Stopper.
7. Lutron

2.2. DIGITAL LIGHTING CONTROLS

A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.3. DLM LOCAL NETWORK (Room Network)

A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to

control a small area of a building.

B. Features of the DLM local network include:

1. Automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
2. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
3. Push n' Learn™ configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.

D. If manufacturer's pre-terminated Cat5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.

E. WattStopper Product Number: LMRJ-Series

2.4. DIGITAL LOAD CONTROLLERS (ROOM, PLUG LOAD AND FIXTURE CONTROLLERS)

A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are sequentially assigned using each controller's device ID's from highest to lowest.
4. Device Status LEDs to indicate:
   a. Data transmission
   b. Device has power
   c. Status for each load
   d. Configuration status
5. Quick installation features including:
   a. Standard junction box mounting
   b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100%
   b. Turn off
   c. Turn on to last level
7. Each load shall at a minimum be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)
8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:

a. Load status
b. Electrical current (when available)
c. Total watts per controller
d. Schedule state – normal or after-hours
e. Demand response enable and disable
f. Room occupancy status
g. Total room lighting and plug loads watts
h. Total room watts/sq ft
i. Force on/off all loads

10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
13. Zero cross circuitry for each load
14. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.

B. On/Off Room Controllers shall include:

1. One or two relay configuration
2. Efficient 150 mA switching power supply
3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
4. WattStopper product numbers: LMRC-101, LMRC-102

C. On/Off/Dimming enhanced Room Controllers shall include:

1. Real time current monitoring
2. Multiple relay configurations

a. One, two or three relays (LMRC-21x series)
b. One or two relays (LMRC-22x series)

3. Efficient 250 mA switching power supply
4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
5. One dimming output per relay

a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
f. Calibration and trim levels must be set per output channel.
g. Devices that set calibration or trim levels per controller are not acceptable.
h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.

7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
    a. Establish preset level for each load from 0-100%
    b. Set high and low trim for each load
    c. Set lamp burn in time for each load up to 100 hours
9. Override button for each load provides the following functions:
    a. Press and release for on/off control
    b. Press and hold for dimming control
10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Fixture Controllers shall include:

1. A form factor and product ratings to allow various OEM fixture manufacturers to mount the device inside the ballast/driver cavity of standard-sized fluorescent or LED general lighting fixtures.
2. One 3A 120/277V rated mechanically held relay.
3. Programmable behavior on power up following the loss of normal power:
    a. Turn on to 100%
    b. Turn off
    c. Turn on to last level
4. Requirement for 7 mA of 24VDC operating power from the DLM local network.
    a. The Fixture Controller does not require a connection to a neutral conductor to operate, and unlike other types of Load Controllers it does not contribute power to the DLM local network to drive accessory devices.
    b. Power to drive the LMFC Fixture Controller electronics can come from any Room or Plug Load Controller, LMPB-100 Power Booster and/or LMZC-301 Zone Controller (described later in the LMCP LIGHTING CONTROL PANELS specification section).
5. 0-10V dimming capability via a single 0-10 volt analog output from the device for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Fixture Controller.
6. Terminals to connect an RJ-45 adaptor with 24" leads, mountable in a ½" KO, for connection to the DLM local network.
    a. The adaptor leads are insulated for use in a fixture cavity, and the lead length allows the OEM fixture manufacturer flexibility to position the Fixture Controller and the RJ45 jack in the best locations on each fixture.
7. A complete set of dimming features described above in the section detailing On/Off/Dimming Enhanced Room Controllers (subsection C.5 onward).
8. WattStopper product numbers: Fixture Controller: LMFC-011, DLM Cable Connector: LMFC-RJ-50-24, Power Booster: LMPB-100

2.5. DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton configuration for the following variables:
    a. Sensitivity – 0-100% in 10% increments
    b. Time delay – 1-30 minutes in 1 minute increments
    c. Test mode – Five second time delay
    d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    e. Walk-through mode

2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
3. Programmable control functionality including:
    a. Each sensor may be programmed to control specific loads within a local network.
    b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
    d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
    e. Ultrasonic and Passive Infrared
    f. Ultrasonic or Passive Infrared
    g. Ultrasonic only
    h. Passive Infrared only
    i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. One or two RJ-45 port(s) for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
6. Device Status LEDs, which may be disabled for selected applications, including:
    a. PIR detection
    b. Ultrasonic detection
    c. Configuration mode
    d. Load binding
7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
8. Manual override of controlled loads.
9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

C. Units shall not have any dip switches or potentiometers for field settings.
D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.6. DIGITAL WALL SWITCH OCCUPANCY SENSORS

A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
    1. Digital calibration and pushbutton configuration for the following variables:
        a. Sensitivity – 0-100% in 10% increments
        b. Time delay – 1-30 minutes in 1 minute increments
        c. Test mode – Five second time delay
        d. Detection technology – PIR, Dual Technology activation and/or re-activation.
        e. Walk-through mode
        f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
    2. Programmable control functionality including:
        a. Each sensor may be programmed to control specific loads within a local network.
        b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
        c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.

d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:

i. Ultrasonic and Passive Infrared
ii. Ultrasonic or Passive Infrared
iii. Ultrasonic only
iv. Passive Infrared only

3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. Two RJ-45 ports for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
6. Device Status LEDs including

a. PIR detection
b. Ultrasonic detection
c. Configuration mode
d. Load binding

7. Assignment of any occupancy sensor to a specific load within the room without wiring or special tools.
8. Assignment of local buttons to specific loads within the room without wiring or special tools
9. Manual override of controlled loads
10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

C. BACnet object information shall be available for the following objects:

1. Detection state
2. Occupancy sensor time delay
3. Occupancy sensor sensitivity, PIR and Ultrasonic
4. Button state
5. Switch lock control
6. Switch lock status

D. Units shall not have any dip switches or potentiometers for field settings.
E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:

1. Left button

a. Press and release - Turn load on
b. Press and hold - Raise dimming load

2. Right button

a. Press and release - Turn load off
b. Press and hold - Lower dimming load

G. Low voltage momentary pushbuttons shall include the following features:

1. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED
b. Dim locator level indicates power to switch
c. Bright status level indicates that load or scene is active

2. The following button attributes may be changed or selected using a wireless configuration tool:

a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
b. Individual button function may be configured to Toggle, On only or Off only.
c. Individual scenes may be locked to prevent unauthorized change.
d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
e. Ramp rate may be adjusted for each dimmer switch.
f. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
g. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.7. DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
3. Configuration LED on each switch that blinks to indicate data transmission.
4. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED
b. Dim locator level indicates power to switch
c. Bright status level indicates that load or scene is active
d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

5. Programmable control functionality including:

a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Button state
2. Switch lock control
3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.
D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
E. The following switch attributes may be changed or selected using a wireless configuration tool:
F. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

1. Individual button function may be configured to Toggle, On only or Off only.
2. Individual scenes may be locked to prevent unauthorized change.
3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
4. Ramp rate may be adjusted for each dimmer switch.
5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependant; each button may be bound to multiple loads.
6. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.8. DLM HANDHELD USER INTERFACE REMOTES

A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote

controls shall include the following features:

1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
2. LED on each button confirms button press.
3. Load buttons may be bound to any load on a load controller or relay panel and are not load type dependant; each button may be bound to multiple loads.
4. Inactivity timeout to save battery life.

B. A wall mount holster and mounting hardware shall be included with each remote control
C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

2.9. DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 footcandles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:

    a. Light level
    b. Day and night setpoints
    c. Off time delay
    d. On and off setpoints
    e. Up to three zone setpoints
    f. Operating mode – on/off, bi-level, tri-level or dimming

14. One RJ-45 port for connection to DLM local network.

15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
16. Any load or group of loads in the room can be assigned to a daylighting zone
17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
4. WattStopper Product Number: LMLS-400, LMLS-400-L.

D. Open loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
4. WattStopper Product Number: LMLS-500, LMLS-500-L.

E. Dual loop digital photosensors shall include the following additional features:

1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this con
2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
6. Device must include extendable mounting arm to properly position sensor within a skylight well.
7. WattStopper product number LMLS-600.

2.10. HANDHELD AND COMPUTER CONFIGURATION TOOLS

A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:

1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.

2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100.

2.11. DLM SEGMENT NETWORK (Room to Room Network)

A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.

1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.
2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERs, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.

B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

2.12. LMCP LIGHTING CONTROL PANELS AND LMZC ZONE CONTROLLER

A. HARDWARE:
Provide LMCP lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.
2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. LMCP panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:

a. Removable, plug-in terminal blocks with connections for all low voltage terminations.
b. Individual terminal block, override pushbutton, and LED status light for each relay.
c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.
d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.

e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.
h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

a. Electrical:

i. 30 amp ballast at 277V
ii. 20 amp ballast at 347V
iii. 20amp tungsten at 120V
iv. 30 amp resistive at 347V
v. 1.5 HP motor at 120V
vi. 14,000 amp short circuit current rating (SCCR) at 347V
vii. Relays shall be specifically UL 20 listed for control of plug-loads

b. Mechanical:

i. Replaceable, ½" KO mounting with removable Class 2 wire harness.
ii. Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
iii. Dual line and load terminals each support two #14 - #12 solid or stranded conductors.
iv. Tested to 300,000 mechanical on/off cycles.

5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
7. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700.
8. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.

a. Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
b. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.
c. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
d. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

i. Scheduled ON / OFF
ii. Manual ON / Scheduled OFF

iii. Astro ON / OFF (or Photo ON / OFF)
iv. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

e. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)
f. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

9. The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.
10. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol.

a. The panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.
e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.
f. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:

i. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
ii. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.
iii. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.
iv. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
h. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (http://www.bacnet.org/Addenda/Add-135-2010aa.pdf)
i. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.

j. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.

11. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where LMFC-011 Fixture Controllers or other distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:

    a. The LMZC shall use the same intelligence board as the LMCP relay panel.
    b. The LMZC shall not include relay driver boards or relays.
    c. The LMZC shall have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.
    d. The LMZC tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.
    e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.

12. To aid in project start up, if LMFC Fixture Controllers are connected to an LMZC Zone Controller, Plug n' Go automatic configuration will establish a unique sequence of operation so that all LMFC-controlled fixtures will turn on to 50% output when any digital occupancy sensor detects motion..
13. WattStopper Product Number: Relay Panels: LMCP8, LMCP24 or LMCP48, Zone Controller: LMZC-301.

2.13. USER INTERFACE

A. Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

    1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
    2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
    3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
    4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
    5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
    6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
    7. WattStopper Product Number: LMCT-100

2.14. SEGMENT MANAGER

A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).

B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manger via external BACnet-to-IP interface routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.

C. Operational features of the Segment Manager shall include the following:

1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. The Segment Manager shall not require installation of any lighting control software on an end-user PC.
3. Log in security capable of restricting some users to view-only or other limited operations.
4. Segment Manager shall provide two main sets of interface screens – those used to initially configure the unit (referred to as the config screens), and a those used to allow users to dynamic monitor the performance of their system, and provide a centralized scheduling interface.
5. Capabilities using the Config Screens shall include:

    a. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
    b. Allow information for all discovered DLM devices to be imported into the Segment Manager via a single XML based site file from the WattStopper LMCS Software, significantly reducing the time needed to make a system usable by the end user. Importable information can include text descriptions of every DLM component and individual loads, and automatic creation of room location information and overall structure of DLM network. Info entered into LMCS should not have to be re-entered manually via keystrokes into the Segment Manager
    c. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
    d. Ability to view and modify DLM device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
    e. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an “Export Table” that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator’s request for info and the overall system performance.

6. Capabilities using the Segment Manager’s Dashboard Screens shall include:

    a. A dynamic “tile” based interface that allows easy viewing of each individual room’s lighting and plug load power consumption, and lighting and plug load power density (power consumption information requires Enhanced DLM Room and Plug Load Controllers with integral current transducers such as LMRC-21x).Tiles will be automatically organized according to location so a single tile for the building summarizes all information for tiles beneath it on every floor, in every area, in every room. Tiles shall be color coded based on three energy target parameters, allowing an owner to quickly identify rooms that are not performing efficiently. Tiles for rooms with occupancy sensors shall include an icon to indicate whether that room is occupied. Tiles shall be clickable, and when clicked the underlying hierarchical level of tiles shall become visible. The tile interface shall be accessible via mouse, or touch screen devices. Tiles shall be created automatically by the segment manager, based on the information found during the device discovery and/or information included in a file imported in from LMCS (such as tagged descriptions for each room) without any custom programming.
    b. Ability to set up schedules for DLM local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms with either on/off or normal hours/after hours set controlled zones or areas to either a normal hours or after hours mode of operation. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as astro On or astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled events by day, week or month.

c. Ability to provide a simple time vs. power graph based on information stored in each Segment Manager's memory (typically two to three days' data).

7. If shown in the contract drawings, Segment Managers shall be integrated into a larger control network by the addition of a Network Supervisor package. The Supervisor is a server level computer running a version of the Segment Manager interface software with dedicated communication and networking capability, able to pull information automatically from each individual Segment Manager in the network. By using a Supervisor, information for individual Segment Managers can be accessed and stored on the Supervisor's hard drive, eliminating the risk of data being overwritten after a few days because of Segment Manager memory limits.
8. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.

D. Segment Manager shall support multiple DLM rooms as follows:

1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).

E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, LM-SUPERVISOR, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

2.15. PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

B. Additional parameters exposed through this method include but are not limited to:

1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
6. Load control polarity reversal so that on events turn loads off and vice versa.
7. Per-load DR (demand response) shed level in units of percent.
8. Load output pulse mode in increments of 1second.
9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:

1. Device list report: All devices in a project listed by type.
2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
7. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:

1. Set, copy/paste an entire project site of sensor time delays.
2. Set, copy/paste an entire project site of sensor sensitivity settings.
3. Search based on room name and text labels.
4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
5. Filter by parameter value to search for product with specific configurations.

E. Network-wide firmware upgrading remotely via the BACnet/IP network.

1. Mass firmware update of entire rooms.
2. Mass firmware update of specifically selected rooms or areas.
3. Mass firmware upgrade of specific products.

F. WattStopper Product Number: LMCS-100, LMCI-100

2.16. EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 EXECUTION

3.1. CONTRACTOR INSTALLATION AND SERVICES

A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufactuerer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

1. Adjust time delay so that controlled area remains lighted while occupied.

E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

END OF SECTION 260930

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Field quality-control reports.
D. Operation and maintenance data.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA PB 1.
C. Comply with NFPA 70.

1.4. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. GENERAL

A. Provide panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with fusible switches or thermal-magnetic, molded case circuit breakers as indicated on the schedules.
B. Equivalents by Eaton (Cutler-Hammer), Square D, GE, or ITE Siemens.

1. Equivalent Panelboards to those specified on the plans shall be considered as follows:

Cutler Hammer	Square D	GE	Siemens
Pow-R-Line 1A	NQOD	AQ	P1
Pow-R-Line 2A	NQOD	AE	P2
Pow-R-Line 3A	NF* / I-Line	AE* / Spectra	P3
Pow-R-Line 4B	I-Line	Spectra	P4

* Submitted equipment must be able to accommodate ALL breakers shown in panelboard schedules as branch-mounted devices. If unable to do so, provide distribution panelboard as noted.

2.2. PRODUCT

A. BUSSING ASSEMBLY AND TEMPERATURE RISE:

1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50 degrees C rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67.
2. Provide tin-finished copper bars full length of panel with rating listed in schedule. Bus bar connection to branch circuit breakers shall be "Phase Sequence" type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable for copper or aluminum conductors. Provide each panel with equipment tin finished copper grounding bus grounded to box and tin finished copper neutral bus insulated from box.

B. INTEGRATED EQUIPMENT SHORT CIRCUIT RATING

1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating as indicated in the schedules. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

C. CABINET

1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Provide branch circuit panelboard cabinets with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. Endwalls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electrodeposited over cleaned phosphatized steel. Fusible panelboards and large distribution circuit breaker panelboards shall not be provided with doors.

D. SAFETY BARRIERS

a. The panelboard interior assembly shall be dead front type with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

E. UL LISTING

a. Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. When required, panelboards shall be suitable for use as service equipment.

F. OVERCURRENT PROTECTION AND BRANCH DEVICES

1. BRANCH CIRCUIT BREAKERS

a. Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self-protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall open and close all poles of a multipole breaker simultaneously. Conforming to NEMA Standards Publications No. AB1-1964 and be approved by UL. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Multiple pole trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one pole.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine panelboards before installation. Reject panelboards that are moisture damaged or physically damaged.
B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Store, handle, and install panelboards and accessories per manufacturer's recommendations.
B. Secure the assembly in place.
C. Provide 3½" housekeeping pad where two or more conduits penetrate floor or when equipment is floor/ground mounted.
D. Wall-mounted equipment:

1. Mount bottom of trim a minimum of 24" above finish floor. Maintain accessibility to overcurrent devices per NEC. Where both conditions cannot be met, consult with engineer on mounting height of equipment.
2. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
3. Where flushed mounted, the fire integrity of the wall in which it is installed must be maintained.
4. Where flush mounted provide (2)2" conduits from the can to above an accessible ceiling and terminate with a minimum 8"x8" junction box located in a concealed manner.

E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon "Ty-Raps", or approved equal at minimum 4 inch intervals.
F. Plug all knockouts removed and not utilized.
G. Install overcurrent protective devices and controllers not already factory installed.
H. Install filler plates in unused spaces.

3.3. IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
B. Panelboard Nameplates: Label each panelboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
C. Device Nameplates: Label each disconnecting and overcurrent protective device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
D. For panelboards (and distribution panelboards where labeling of individual breakers is not possible or practical), provide a typed circuit directory for same as follows:

1. Panels shall have branch circuit directory holders with clear plastic cover.
2. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers. Handwritten directories are not acceptable.
3. For remodel work or changes, trace circuits to determine loads and provide new updated directory.

3.4. FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, and feeder.
2. Test continuity of each circuit.

C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
B. Set field-adjustable circuit-breaker trip ranges as indicated in the coordination study.

3.6. TOUCH UP AND CLEANING

A. Vacuum all backboxes clean of debris after installation and prior to contract closeout.
B. Touch up scratch marks, etc. with matching paint.

3.7. OBSERVATIONS

A. All panel fronts shall be removed by the Contractor for observation of the panel interiors by the Engineers.
B. Panel fronts shall be removed when directed by the Engineer/Architect for observation and reinstalled immediately after the observations.

END OF SECTION 262416

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 PRODUCTS

2.1. GENERAL

A. Manufacturers

1. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

a. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
c. Leviton Mfg. Company Inc. (Leviton).
d. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2. All devices shall be from the same manufacturer.

B. Finishes

1. Color: Wiring device catalog numbers in Section Text do not designate device color.

a. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.

i. Wiring devices in finishes WD-1 and CNT-2 shall be black.
ii. Color shall be coordinated and verified with Architect and owner.

2.2. STRAIGHT BLADE RECEPTACLES

A. General Requirements for Convenience Receptacles

1. Unless otherwise modified below, all receptacles shall comply with the following:
2. Commercial / Common Areas: 125 V, 20 A
3. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
4. Multiple types of receptacles may be required of a single device (Ex.: a Hospital-Grade GFCI receptacle), as indicated on the plans and in the execution section below. Where such a device is required, it shall meet the requirements of all applicable sections below.
5. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).

d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. GFCI Receptacles

1. Straight blade, feed or non-feed-through type.
2. Include indicator light that is lighted when device is tripped.
3. Where devices are shown labeled as GFI on drawings provide GFCI receptacle (feed-through devices are not acceptable unless otherwise noted, or with written permission from the engineer).
4. Devices labeled as GFIP on the drawings may be protected as a feed-through device.

C. Weather-Resistant Receptacles

1. Receptacles shall UL-listed as weather-resistant.
2. Receptacles shall be identified with an “WR” on the receptacle face.

D. USB Receptacles

1. Convenience receptacle with USB charging ports.
2. Two USB charging ports, minimum 3.6 A, compatible with USB 1.0/2.0 devices.

E. Tamper-Resistant Receptacles

1. Tamper-Resistant Receptacles shall be safety type, “childproof,” duplex, 3 wire, ground type.

2.3. SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.
B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Catalog numbers in subparagraphs below are for 20-A devices; revise catalog numbers if 15-A devices are desired.
b. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
c. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
d. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
e. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.4. OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 6111 for 120 V, 6117 for 277 V.
b. Hubbell; WS1277.
c. Leviton; ODS 10-ID.
d. Pass & Seymour; WS3000.
e. Steinel; IL WLS 1.
f. Watt Stopper (The); PW-101.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

B. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Hubbell; ATP1600WRP.
b. Leviton; ODWWV-IRW.
c. Pass & Seymour; WA1001.
d. Steinel; IL WLS 1
e. Watt Stopper (The); CX-100.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..

2.5. SPECIAL PURPOSE DEVICES

A. Provide where indicated, specified or as required other appropriate NEMA configured devices appropriate for such equipment as thru-wall units manufactured by the same manufactures.

2.6. WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel. Verify with architect.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable in-use cover.

2.7. FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
B. Compartments: Barrier separates power from voice and data communication cabling.
C. Service Plate: solid brass with satin finish.
D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

PART 3 EXECUTION

3.1. INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Receptacle Types:

1. The following receptacle types shall be furnished in lieu of “standard” 120V, 15 or 20 amp receptacles at all of the following locations, regardless of plan designation:

    a. Refer to the National Electrical Code (NEC), for definitions of all locations listed below.

2. GFCI Receptacles:

    a. Bathrooms / Locker Rooms
    b. Kitchens (unless circuit is provided with GFCI protection at the circuit breaker)
    c. Rooftops
    d. Outdoors
    e. Where located within 6’-0” of a sink.
    f. Garages, Service Bays, etc.
    g. Unfinished areas.

3. Weather-Resistant Receptacles:

    a. In all damp or wet locations.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Wall plates shall not support wiring devices. Provide wiring device with accessories as required to properly install devices and wall plates.
11. All devices shall be flush-mounted except as otherwise noted on the drawings.
12. Locations

    a. Comply with layout drawings for general location; contact Owner's Representative for questions about locations and mounting methods.
    b. Relocate outlets obviously placed in a location or manner not suitable to the room finish.
    c. Avoid placing outlets behind open doors.
    d. Align devices vertically and horizontally. Device plates shall be aligned vertically with tolerance of 1/16". All four edges of device plates shall be in contact with the wall surface.

13. Mounting Heights as indicated on the Drawings and according to ADA requirements.
14. Ganging of Switches - provide barriers between ganged 277 volt switches of different phases.
15. Power Outlets - install power outlets complete with back boxes, where installed in existing buildings or extensions of existing buildings. Coordinate phase connections for rotating equipment with connections in existing building.
16. Install device plates on all outlet boxes. Provide blank plates for all empty, spare and boxes for future devices.
17. Caulk around edges of outdoor device plates and boxes when rough wall surfaces prevent a raintight seal. Use caulking material as approved by the Architect/Engineer.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

G. Device Plates:

1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
2. Provide matching blank wall plates to cover outlet or junction boxes intended for future devices.
3. Provide matching blank wall plates with 4 port knock outs at all telephone, data, and tele/data outlet locations. Also provide with matching blankouts in each port.
4. Where wall plates for special devices are available only from manufacturer of device, provide designs and finishes equivalent to above specification.
5. Verify with Architect finish of any plate where it may be apparent a special finish or color should have been specified.

H. Switches

1. Where switches are indicated to be installed near doors, corner walls, etc., mount same not less than 2 inches and not more than 18 inches from trim. Verify exact locations with the Architect.
2. Carefully coordinate the location of switches to insure locations at the strike side of doors.
3. Furnish and install an engraved legend for each switch that controls exhaust fans, motors, equipment systems, etc., not located within sight of the controlling switch.

I. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

J. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2. IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3. FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

B. Tests for Convenience Receptacles:

1. Test for correct wire terminations (no open ground, neutral, or hot).
2. Test for correct polarity (no hot/ground reverse or hot/neutral reverse).
3. Verify GFCI devices are operating properly.
4. Using the test plug, verify that the device and its outlet box are securely mounted.

END OF SECTION 262726

SECTION 262813 – FUSES

PART 1 GENERAL

1.1. SUBMITTALS

A. First paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Action Submittal."
B. Product Data: For each type of product indicated.
C. Paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Informational Submittal."
D. Operation and maintenance data.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA FU 1 for cartridge fuses.
C. Comply with NFPA 70.

PART 2 PRODUCTS

2.1. FUSES

A. PRODUCT

1. Provide fuses by Bussman or Gould Shawmut.
2. Provide fuses of same characteristics as scheduled to insure selective coordination of power system.
3. Fuses 601 amp and larger shall be U/L Class L with minimum four (4) seconds time delay at 500% rating.
4. Fuses 600 amp and below shall be U/L Class J, RK-1 or RK-5 as scheduled time delay sized as shown on drawings or schedules.
5. Special temperature conditions, motors, motor loads or other conditions requiring other types or sizes of fuses must be reviewed by the Contracting Officer. Fuse reducers are not permitted.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer's catalog number.
B. Furnish Owner with spare fuses of each size and type installed on job as follows:

1. 601 Amps or Larger - three (3) of each size and type
2. 600 Amps or Less - 10% with minimum of three (3) of each size and type

C. For fuse types and ampacities, see plans.
D. Provide spare fuse cabinet with three shelves.
E. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.
D. Operation and maintenance data.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1. DISCONNECT SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Cutler-Hammer)
2. General Electric Company
3. Siemens
4. Square D

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Suitable for number, size, and conductor material.
4. Service-Rated Switches: Labeled for use as service equipment.

2.2. FUSIBLE SWITCHES

A. Refer to disconnect switches for all requirements in addition to the following.
B. Switches shall be furnished with clips or bolt pads to accommodate indicated fuses.
C. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.
D. Accessories:

1. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.3. MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Cutler-Hammer)
2. General Electric Company
3. Siemens

4. Square D

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
D. Electronic Trip Circuit Breakers (where indicated on drawings or elsewhere in this specification): Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I2t response.

E. Features and Accessories (where called for or required):

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4. ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
D. Install fuses in fusible devices.
E. Comply with NECA 1.

3.2. IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3. FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder,

and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 262913 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of enclosed controller.
B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.
D. Operation and maintenance data.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1. MOTOR STARTERS

A. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.

1. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.
2. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.

B. MAGNETIC MOTOR STARTERS

1. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
2. Enclosures shall be NEMA type required by starter location and environment.
3. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
4. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
5. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
6. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
7. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
8. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
9. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.

10. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.

C. COMBINATION MAGNETIC MOTOR STARTERS

1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
2. Starter NEMA enclosure type shall be type required for starter location and environment.
3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
6. All fuse holders shall have rejection clips installed.
7. See plans for combination magnetic starters.

D. MANUAL MOTOR CONTROL (1 HP Maximum)

1. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
2. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
3. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
4. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

PART 3 EXECUTION

3.1. INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch enclosed controller.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Comply with NECA 1.

3.2. IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

3.3. CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices[and facility's central control system]. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
B. Bundle, train, and support wiring in enclosures.
C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4. FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING

A. Set field-adjustable switches and overload-relay pickup and trip ranges.
B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

3.6. DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 265100 – LUMINAIRES, LAMPS AND BALLASTS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data:

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
D. Field quality-control test reports.
E. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

PART 2 - PRODUCTS

2.1. INSPECTION

A. Prior to installation of luminaires Electrical Contractor shall inspect luminaire and verify unit meets or exceeds specifications, is new and unused without damage or defect and is suitable for the intended service.
B. See architectural and electrical plans for luminaire locations, coordinate installation with other trades. At the completion of the project all luminaires shall be aligned, level and cleaned to the satisfaction of the A/E.

2.2. EQUIVALENT MANUFACTURERS

A. The following light fixture manufacturers are generally approved equals to those manufacturers listed in the Lighting Fixture Schedule on the drawings. The approval herein no way relieves the contractor of meeting all specification requirements. All light fixtures substituted for fixtures specified on drawings must conform in materials, dimensions, appearance, performance, and be of equal quality to the fixture specified and described in the Lighting Fixture Schedule. Fixture manufacturers not listed here must be submitted and approved a minimum of 10 days prior to bid.
B. Provide luminaires by the following manufacturers:
C. Downlights:

1. Category 1: (Only Category 1 fixtures may be substituted for Category 1 fixtures specified on the drawings). Calculite, Edison Price, Focal Point, Kirlin, Kurt Versen, Rambusch, RSA, USA Lighting
2. Category 2: (Category 1 or Category 2 fixtures may be substituted for Category 2 fixtures specified on the drawings). Elite, Halo, Hubbell, Indy, Intense, Lightolier, Lithonia, Marko, Nulite, Pathway, Prescolite, Portfolio, Spectrum, Williams, Zumtobel

D. LED/Fluorescent Troffer Type: Columbia, Cooper (Metalux), Daybrite, Elite, Finelite, Focal Point, Lithonia, Williams

1. Equivalent troffers shall be considered the following: Columbia (PS Series), Cooper (Metalux GC Series), Daybrite (SP Series), Elite (OT Series), Finelite (HPR Series), Lithonia (SP Series), Williams (50 Series)

E. Undercounter: Columbia, Color Kinetics, Daybrite, Elite, Fail-Safe, Lithonia, Metalux, Nulite, WAC, Williams

F. Strip Fluorescents: Birchwood, Columbia, Daybrite, Elite, Lithonia, Metalux, Paramount, Prudential, Williams
G. Linear/Tubes: A Light, Corelite, Finelite, Focal Point, Ledalite, Linear Lighting, LiteControl, Metalumen, Peerless, Precision, Prudential, Williams, Zumtobel
H. Specialty Lights: Advent, Baselite, Bega, Beta Calco, Casey Architectural, Cole, Design Plan, Engineered Lighting Products, Focal Point, G Lighting, iGuzzini, Interlux, Juno, Justice Design, Kramer, Louis Poulson, Lighting Services Inc., Neoray, Prudential, Sharper, SPI, Manning, MP Lighting, Sistemalux, Sterner, Tivoli, Trend Lighting, Trimblehouse, Visa, Visual Lighting Technologies, WAC, Winona, Zaneen, Zumtobel
I. Indirect: Ametrix, Elliptipar, Engineered Lighting Products, Focal Point, LiteControl, SPI, Zumtobel
J. HID: ABS Lighting, Daybrite, Gardco, G.E., Holophane, Hubbell, Lumark, Kim, Lithonia, SPI, Williams
K. Exit Signs and Emergency Lights: Beghelli, Chloride, Concealite, Devine, Dual-Lite, EELP, Elite, Emergi-Lite, Evenlite, Exitronix, Fail-Safe, Hubbell, Lithonia, Prescolite, Surelites, Williams.
L. Security/Vandal Resistant: Daybrite, Eclipse, Failsafe, Holcor, Kenall, Kirlin, L.C. Doane, Moldcast.
M. Hazardous Locations: Appleton, Chloride, Cross-Hinds, Daybrite, Dialight, Dual-Lite, Halo, Hubbell, Kirlin, L.C. Doane, Paramount, Phoenix
N. Outdoor: ABS Lighting, Antique Street Lights, Architectural Area Lighting, Bega, Beta Calco, Daybrite, Devine, Excelsior, Gardco, G.E., Hadco, Hubbell, Holophane, Hydrel, Invue, Kim, King Luminaire, Lithonia, LSI Lighting Systems, Lumark, Lumec, Lumiere, Lumenton, McGraw-Edison, McPhilben, Ruud, Sterner, Stonco, Sun Valley Lighting, US Architectural, Vista Pro, Williams.
O. Track Lighting: Alfa, Bruck, Elite, Halo, Intense, Lithonia, Lightolier, Lighting Services Inc., Lite Lab, Marko, Prescolite
P. LED lamps and Modules: Philips, General Electric, Osram/Sylvania, Cree, Nichia.
Q. LED Power Supplies: Osram/Sylvania, General Electric, Philips.

2.3. LUMINAIRES

A. Provide luminaires complete with lamps and accessories required for hanging. Contractor shall insure that lamps, reflector lens and trim are clean at time of final inspection. Mount recessed luminaires with trim flush to ceilings, free of gaps or cracks.
B. Coordinate mounting of ceiling mounted luminaires with General Contractor. Where additional supports are required due to luminaire location or weight, electrical contractor shall provide supports, unless otherwise specified under ceiling specifications.
C. Consult architectural plans and existing conditions where applicable for ceiling types and provide surface and recessed lighting fixtures with appropriate mounting components and accessories. Verify mounting requirements prior to ordering and shop drawing submission.
D. Fixtures mounted in fire rated ceilings shall be provided and installed with fire rated enclosures to maintain ceiling integrity. Provide engineered products by EZ-Barrier, Tenmat or similar products or provide enclosures fabricated in accordance with building code and UL requirements. Maintain all fixture required heat sink and other clearances.
E. Provide troffer luminaires with the following devices wherever possible and not specified otherwise on the luminaire schedule: cam latches, 100% door gasketing, post fabrication painted finish, t-bar clips, lens clips, suspension tabs, and a minimum of 0.125" lens.

2.4. LAMPS

A. Lamps shall be lamp types recommended by luminaire manufacturer. Lamp no fixtures above manufacturers recommended maximum wattages.
B. Incandescent lamps shall be inside frosted (IF) type unless otherwise called for in luminaire schedule.
C. Low-Mercury Fluorescent Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
D. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 32 W maximum, nominal length 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.
E. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
F. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
G. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

H. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
I. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
J. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
K. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.
L. MR16 Halogen Lamps: 12V, 10,000 Hours Average Life, Universal Burn Position, Color Temperature - 3100K, Spot, Narrow Flood, and Flood beam spreads. Ushio Ultraline only.
M. Equivalent lamps by General Electric, Venture, Phillips, Sylvania, or Eiko.

2.5. BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant and programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. 120/277 dual rated.

1. Sound Rating: A.
2. See Evaluations for discussion of harmonic considerations.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Consider specifying the higher frequency in subparagraph below if fixtures with default ballasts are used in proximity to infrared sensors.
6. BF: 0.88 or higher.
7. Power Factor: 0.98 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 42 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.6. BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 42 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.7. LED LIGHTING SYSTEMS

A. LED components, lamps, drivers, and fixtures shall comply with: PCC 47 CFR Part 15; UL 8750; ANSI/NEMA Standards C78.377, NEMA SSL-1, C82.77, IESNA Standards TM-16-05, RP-16, LM-79, LM-80 and TM-21.
B. The LED module itself and all its components must not be subject to mechanical stress.
C. Assembly must not damage or destroy conducting paths on the circuit board.
D. Installation of LED modules (with power supplies) shall adhere to all applicable electrical and safety standards.
E. Correct polarity shall be clearly identified.
F. LED module must be protected from unbalanced voltage drop, and/or overload.
G. Ensure that the power supply is of adequate power to operate the load.
H. Install system according to manufacturer's heat sinking parameters.
I. For applications involving exposure to humidity and dust, the module shall be protected by a fixture or housing with a suitable protection glass. The module shall be protected against condensation water by treatment with an appropriate circuit board conformal coating. The conformal coating should have the following features.

1. Optical transparency
2. UV resistance
3. Thermal expansion properties matching those of the module (15-30 x 10-6cm/cm/K)
4. Low permeability of steam for all climate conditions
5. Resistance against corrosive environments

J. The LED module shall be operated with an electronically stabilized power supply offering protection against short circuits overload and overheating.
K. All drivers used for supplying power to LED arrays in lighting fixtures shall be by the light fixture manufacturer.
L. Drivers shall be integral to the fixture unless otherwise shown or specified.

2.8. EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1200 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night-Light Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.

5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Provide 5-year warranty.
7. Battery packs shall be Bodine B-50 or Iota I-232. Equivalent by Lithonia.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night-Light Connection: Operate one fluorescent lamp in a remote fixture continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Provide 5-year warranty.
9. Battery packs shall be Bodine B-50 or Iota I-232. Equivalent by Lithonia.

2.9. EMERGENCY LED DRIVER

A. Emergency LED driver specified herein is by Iota (CP Series). Approved equals by Bodine.

1. The emergency driver shall accommodate an LED load with a forward voltage requirement ranging from 10 to 60 VDC.
2. The output voltage sensing shall be automatic and instantaneous with a resulting, inversely-proportional current to maintain constant power to the LED array with an output tolerance of +/- 3%.
3. The unit shall supply the rated load for a minimum of 1 1/2 hours or to 87 1/2% of rated battery terminal voltage.
4. The output power to the LED load during emergency operation shall be held constant (refer to plans for wattage) from minute one throughout the entire emergency run time resulting in no loss or degradation of the light source during emergency operation.
5. The unit shall be furnished with an electronic, AC-lockout circuit which will connect the battery when the AC circuit is activated, and an electronic brownout circuit which will enable a transfer to emergency operation when utility power dips below an acceptable level.

B. Installation

1. Emergency drivers shall be UL-listed for use with respective LED array and/or UL-listed for field installation. Where drivers are only listed for use with a respective LED array, they shall be installed integral to the fixture by the fixture manufacturer.
2. Maximum remote mounting distance of the emergency driver shall be 50-feet

C. Driver: Constant Power emergency LED driver system as indicated on the plans. The emergency driver system shall be UL class 2 certified in accordance with UL 1310 and shall be UL listed for use in damp locations with a temperature range of 0° to 55° C.

D. AC input: Two-wire, universal voltage capable 120 thru 277 VAC, 50/60 Hz and be UL Classified to Category Control Number (CCN) FTBR, Emergency Lighting and Power Equipment, and FTBV, Emergency Light-Emitting-Diode Drivers for field installation.

E. Battery: Self-contained, high-temperature, sealed, maintenance-free nickel cadmium battery rated for a 10-year service life.

F. Charger: two-stage charging system which samples the battery in relation to its temperature, state of charge and input voltage fluctuations. The charger shall be current limited, temperature compensated, short-circuit protected with reverse polarity protection. The unit shall achieve a full recharge in 24-hours.

G. Protection: A low voltage battery disconnect (LVD) circuit shall be provided and will disconnect the load and circuitry from the battery when it reaches approximately 80 to 85% of its nominal terminal voltage, preventing a non-recoverable, deep-discharge condition as well as equipment initialization failure when utility power is restored.

H. Housing: NEMA 250, Type 1 enclosure.

I. Test Push Button: Illuminated push-to-test switch.

J. Provide 5-year warranty.

2.10. BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts (all interior fixtures): Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. See Evaluations for discussion of CFR compliance required in first subparagraph below.
8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
9. Protection: Class P thermal cutout.

C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output. (where specified on plans)

D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

   a. Restrike Range: 105- to 130-V ac.
   b. Maximum Voltage: 250-V peak or 150-V ac RMS.

2. Minimum Starting Temperature: Minus 40 deg F.
3. Open-circuit operation shall not reduce average lamp life.

2.11. POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and

formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.12. STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.

1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: [Single-arm] [Truss] [Davit] type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect.

2.13. ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as pole and luminaire.

E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect from manufacturer's full range.

2.14. POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1. LUMINAIRES

A. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.

B. Reference luminaire schedule on plans for specific luminaire, lamp, and ballast requirements.

C. Reinstall any fixtures called out for relocation or remounting in renovation areas as though they are new fixtures. Make all provisions to properly mount and support existing fixtures being reused.

D. Luminaires submitted must meet or exceed specified luminaire in performance and construction and appearance. Provide luminaires at each location shown on drawings. Luminaires shall be in accordance with type designation on drawings.
E. Luminaire supports shall comply with the latest edition of the NEC Sections 410-30 and 410-36. Provide luminaire securing clips or otherwise securely fasten fixtures to ceiling grid. At least two support wires shall be connected from the structure above to each troffer style light fixture.

3.2. INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.
C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

E. Air-Handling Lighting Fixtures: Install with dampers open and ready for adjustment.
F. Adjust aimable lighting fixtures to provide required light intensities
G. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.
H. Recessed luminaires installed in rated assemblies shall be installed per UL listing requirements to maintain the rating of the construction. Provide sheet rock enclosures or other UL listed manufactured assemblies to maintain rating of construction and listing of fixtures for heat dissipation and clearances.

3.3. POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
B. See Evaluations for structural- and soil- engineering coordination.
C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
2. Install base covers, unless otherwise indicated.
3. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.4. BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches> above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

3.5. INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.6. CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7. GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

C. Occupancy Adjustments: When requested within [12] <Insert number> months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to [two] <Insert number> visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

3.8. FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

END OF DIVISION 260000

END OF DIVISION 260000

DIVISION 27

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SECTION 270500 – COMMON WORK FOR COMMUNICATIONS

SECTION 270500 – COMMON WORK FOR COMMUNICATIONS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500 for Electrical Provisions as well as other Division 26 Sections for other electrical requirements and provisions.

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 270500

END OF DIVISION 270000

DIVISION 28

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SECTION 280500 – COMMON WORK FOR ELECTRONIC SAFETY & SECURITY

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500 for Electrical Provisions as well as other Division 26 Sections for other electrical requirements and provisions.

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 280500

SECTION 280510 – ELECTRONIC SAFETY AND SECURITY DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500 for Electrical Provisions as well as Section 260510 and other Division 26 Sections for other electrical requirements and provisions.

B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 280510

SECTION 280513 – CONDUCTORS/CABLES FOR ELECTRONIC SAFETY/SECURITY

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500 for Electrical Provisions as well as Section 260510 and other Division 26 Sections for other electrical requirements and provisions.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

1. Fire alarm wire and cable.

1.3. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4. PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 PRODUCTS

2.1. PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

2.2. FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Honeywell Cable
2. Belden
3. West Penn Wire
4. Allied Wire and Cable

B. General Wire and Cable Requirements:

1. NRTL listed and labeled as complying with NFPA 70, Article 760.
2. Generally, cable insulation color shall be red. Refer to Part 3, Execution for further direction.

C. Signaling Line Circuits: Twisted, shielded pair, minimum No. 16 AWG unless larger size recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 EXECUTION

3.1. INSTALLATION OF PATHWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.

3.2. FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.
B. Wiring Method:

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system where exposed. This system shall not be used for any other wire or cable.

   a. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

3. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
4. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red. Generally cabling shall be red.
F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3. CONNECTIONS

A. Comply with requirements in Division 28 Section "Fire Detection and Alarm" for connecting, terminating, and identifying wires and cables.

3.4. GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.5. IDENTIFICATION

A. Identify system components, wiring, and cabling. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.6. FIELD QUALITY CONTROL

A. Perform tests and inspections.

END OF SECTION 280513

SECTION 283110 – FIRE-ALARM SYSTEM MODIFICATIONS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500 for Electrical Provisions as well as Section 260510 and other Division 26 Sections for other electrical requirements and provisions.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SYSTEM DESCRIPTION

A. This scope is to provide additional devices and modifications to the existing building systems. All components required for a complete fire alarm system as shown on plans and as necessary to upgrade and modify the existing system. Contractor shall field verify necessary components prior to bid.

1.3. SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated.
C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.
F. Field quality-control reports.
G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include

the following:

a. Frequency of testing of installed components.
b. Frequency of inspection of installed components.
c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.
e. Manufacturer's required maintenance related to system warranty requirements.
f. Abbreviated operating instructions for mounting at fire-alarm control unit.
g. Copy of NFPA 25.

H. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB stick or other digital media, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5. SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.
B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. The fire alarm control panel for the building is a Notifier by Honeywell NFS-320 Series panel. Contractor to field verify exact model. New devices, equipment, monitoring, initiation, notification, etc. shall connect to the existing fire alarm control panel and be compatible with same.
B. Provide all necessary equipment, wiring, software upgrades, modifications, etc. as required to support the additional devices from the existing FACP.

2.2. SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire-extinguishing system operation.
6. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm-notification appliances.
2. Identify alarm at the fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.

5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Activate emergency lighting control.
8. Activate emergency shutoffs for gas and fuel supplies.
9. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Duct Smoke Detectors.
2. Valve supervisory switch.
3. Low-air-pressure switch of a dry-pipe sprinkler system.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3. MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.4. SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Remote test/indicator switch(es).
7. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5. NON-SYSTEM SMOKE DETECTORS

A. Refer to Section 262726 – Wiring Devices.

2.6. HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg Fper minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7. NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
2. Audio notification appliances located in sleeping spaces (as defined by NFPA) shall produce a low-frequency (520 hz) audible signal.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
E. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens

mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.8. MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9. REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10. ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

PART 3 EXECUTION

3.1. EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.
B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control or monitoring equipment as necessary to extend existing control or monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
7. Fire alarm panels and power extenders: Provide smoke detectors above all new panels and components as required by NFPA.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
K. Power Extenders: Located in electrical closets, mechanical spaces or otherwise in unobtrusive locations. Extenders in shell spaces shall be located in unobtrusive locations and not in locations that will conflict with future buildout. Provide smoke detectors above panels.
L. Annunciator: Install with top of panel not more than 72 inches above the finished floor.
M. Provide wire guards over all indicating devices or devices subject to damage in gymnasium or similar spaces.

3.2. CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to activate emergency lighting control.
3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
4. Supervisory connections at valve supervisory switches.
5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
6. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
7. Supervisory connections at fire-pump engine control panel.

3.3. IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
B. Install framed instructions in a location visible from fire-alarm control unit.

3.4. GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5. FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.
B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.
F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283110

END OF DIVISION 280000

GEOTECHNICAL REPORT

(PREPARED BY OTHERS FOR ENTIRE DEVELOPMENT)

GEOTECHNICAL ENGINEERING REPORT
UNION BERKLEY PARK

Prepared for

F&C Union Berkley Park, LLC
Flaherty & Collins Properties, Inc.
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CGC PROJECT NUMBER **01C2014005**

January 2016

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January 4, 2016
CGC Project 01C2014005

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c/o Mr. Sean Murphy, EIT
Project Lead
Landform Professional Services, LLC
105 S. Fifth Avenue, Suite 513
Minneapolis, Minnesota 5401

RE: Geotechnical Engineering Report
Union Berkley Park
Kansas City, Missouri

Dear Mr. Murphy,

Cammack GeoConsulting (CGC) is pleased to transmit with this letter its Geotechnical Engineering Report for Union Berkley Park (revised), which includes the findings of the field investigation, laboratory test results, discussions of subsurface soil and groundwater conditions, soil properties, and recommendations for foundation system design and construction. The recommendations are based on certain assumptions and limitations. The primary assumptions are that existing construction debris materials will be excavated, processed, and replaced as structural fill at the site along with about 50,000 cubic yards of off-site borrow material. Essentially, the soil that will support the apartment buildings is not yet present at the site. It is expected that this fill placement will begin when weather conditions improve and that CGC will have a role in that process

Very Truly Yours,

Charles H. Cammack

Charles H. Cammack, PE, PhD
President, Cammack GeoConsulting, P. A.

STATE OF MISSOURI
CHARLES H. CAMMACK
NUMBER E-24689
REGISTERED PROFESSIONAL ENGINEER

GEOTECHNICAL ENGINEERING REPORT
UNION BERKLEY PARK

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UNION BERKLEY PARK GEOTECHNICAL ENGINEERING REPORT

1 INTRODUCTION

F&C Union Berkley Park, LLC (F&C) plans to develop a mixed-use project on Parcels 1 and 2 of Port KC's Downtown Riverfront Development located on the south side of the Missouri River between the Christopher S. Bond Bridge and the Heart of America Bridge in Kansas City, Missouri. F&C has retained Landform Professionals (Landform) to serve as civil engineer, the Cunningham Group to serve as project architect, Cammack GeoConsulting (CGC) to serve as geotechnical engineer, ARCADIS to serve as environmental consultant, and Geotechnology to complete soil borings and laboratory testing. CGC helped to coordinate the work of ARCADIS and Geotechnology for F&C and Landform.

The project will include construction of two four-level parking garages and two four-story apartment buildings that enclose two courtyards. Commercial spaces will be located within the footprint of the apartment buildings. The East Riverfront Road will be reconstructed near Union Berkley Park, and parking spaces will be added to the south side of the roadway.

The site is subject to a Restrictive Deed Covenant, or No Further Action (NFA) agreement, between Port KC and the Missouri Department of Natural Resources (MDNR). Environmental contamination was discovered at the site in the 1990's, and Parcels 1 and 2 were previously used as construction debris landfills. The landfill located in Parcel 2 (east side of Gillis Street Sewer) was removed in 2000. An environmental remediation project completed in 2005 removed the source of environmental contamination, remnants of a former manufactured gas plant, located near Parcel 1. This effort also included removal of the construction debris landfill located in Parcel 1. Processing of construction debris through a rock crusher produced excellent fill material that serves as a protective barrier between residual contamination present at depth and the ground surface. These efforts made most of the property suitable for development. However, some construction debris remains at the ground surface adjacent to Gillis Street Sewer and along the north perimeter of Parcels 1 and 2. Significant earthwork must be completed to effectively remove the remaining construction debris. This will make the full area of the property suitable for development. About 50,000 cubic yards of fill must be placed and compacted to raise grades to the required level, about El 765. Port KC will place and compact the fill to prepare the site for construction under separate contracts. Port KC will also reconstruct East Riverfront Road and add parking spaces on the south side of the roadway.

Foundation piles installed to support the parking garages may encounter soils containing residual contamination during installation. A proprietary displacement pile system is proposed for the parking garages to reduce potential environmental problems and to avoid disturbing Gillis Street Sewer.

Shallow spread footings are proposed for the apartment buildings and excavations for these foundations are not expected to involve contact with soils containing residual contamination. Although many factors must be considered in this project, the project is believed to be technically feasible.

2 PROJECT DESCRIPTION

Berkley Riverfront Development is located as shown on Figure 1, Site Vicinity Map. Parcels 1 and 2 form the Phase 1 portion of the project as shown on the attached Figure 2, Proposed Phasing Plan & Prohibited Uses, prepared by T&B and Phronesis. A more detailed view of Parcels 1 and 2 is shown on Figure 3, Rendered Site Plan, prepared by Landform and Cunningham Group. The latest set of plans is named FCP12003 - Civil Documents - 100 DD Submittal (2015-05-15).

A four-story parking garage will be constructed on both the east and west sides of the existing Gillis Street Sewer as shown on Figure 3. The garages will be separated by 73 feet and each above-grade level will be joined by a bridge at both ends of the garages. Columns will be spaced on 36-foot centers N-S and 61-foot centers E-W within each garage. Column loads are expected to range between 200 kips and 850 kips. Wall loads will be about 20 kips per foot. The primary entrance will be on the north side giving direct access to upper levels. The south entrance will provide direct access to the ground floor and indirect access to the upper floors. Entrances will be located mid-way between garages. The design must permit the Water Services Department to access the sewer through excavation in the future without disturbing the garage foundations.

Four-story wood-framed residential structures including some commercial space will be constructed on the periphery of the two parcels forming two enclosed courtyards as shown on Figure 3. These apartment buildings will be connected to the parking garages and will be leased to tenants. Wall loads of about 5.5 kips per foot are expected. Some columns in the retail space will support loads of 200 kips. The floor slabs will be raised from 3 to 6 feet above adjacent exterior grade. Shallow spread footings will support stem walls that rise to the floor slab level. Floor slabs will butt up against the stem walls and will be doweled to the stem walls. Stem walls must serve as cantilever retaining walls until the floor slabs are cast. After that, they must serve as a retaining wall supported laterally by the slab. A two-tiered cantilever retaining wall system and seven sets of steps are planned for the west end of the western set of apartments. Each wall will have a height of about 2 to 3 feet. Each flight of stairs will have four steps.

Port KC also plans to reconstruct East Riverfront Drive (north roadway). Parking spaces will be added to the south side of the roadway adjacent to Union Berkley Park.

A stockpile of large concrete fragments is present on top of the structural fill east of Gillis Street Sewer, and unprocessed construction debris including large concrete and limestone fragments and soil is present along the north edge of both parcels. These materials must be excavated, processed through a crusher, then placed and compacted as structural fill as part of site preparation. The earthwork must support curbs, pavements, and shallow spread footings. The fill must not contain large concrete or limestone fragments that would make it difficult for contractors to excavate underground utility trenches. Port KC will also transport approximately 50,000 CY of soil to the site, place the soil in lifts, and compact the soil as structural fill to prepare the site for construction of the project. As much as about 10 feet of earth must be placed over a 400-foot long segment of the existing Gillis Street Sewer to reach the planned general site grade of El 765. Contractors must place approximately 4 feet of fill in Parcel 1 to reach the prepared subgrade elevation. In Parcel 2, cut depths of up to about 2 feet and fill depths of up to about 4 feet are planned.

Some of these improvements and modifications will be made within the 500-foot critical zone of the nearby levee. This report includes exhibits and discussions that show that this project will not adversely affect seepage and slope stability of the levee.

3 PREVIOUS REPORTS AND SITE PREPARATION ACTIVITIES

Background

Several geotechnical and environmental reports have previously been written for the site, and three significant site preparation activities have been conducted as outlined below in the following sections.

Initial Phase I Environmental Assessment

Port KC retained a consultant to complete a Phase I Environmental Assessment (ESA) prior to 1996 that revealed that a manufactured gas plant (MGP) once existed near the site.

Updated Phase I Environmental Assessment

Woodward-Clyde Consultants (WCC) produced an updated Phase I ESA and completed a Phase II ESA of the site under their project number 6E11039 in 1996 for Port KC. WCC collected soil and groundwater samples from soil borings and groundwater quality monitoring wells. Significant contamination was detected near the location of the former MGP.

Phase II Environmental Site Assessment and Initial Geotechnical Investigation

WCC simultaneously completed a Phase II ESA and a geotechnical investigation of the entire Riverfront Development Park under their project numbers 6E11039 and 6E11040, respectively. The borings were widely spaced and were intended to allow preparation of a site development plan as well as to provide information needed to complete the Phase II ESA. The geotechnical report focused on the types of foundations that would be suitable for large multi-story office buildings and parking garages. Construction debris (large fragments of steel reinforced concrete beams and slabs) was present in large areas of the site and borings could not be drilled in these areas. A total of 28 geotechnical borings and 12 environmental borings were drilled at the site between April 24 and May 16, 1996. In addition, four test pits were excavated and four groundwater quality monitoring wells were in installed.

Geotechnical Investigation of 1999

WCC completed a Soil and Foundation Investigation Report for the Riverfront Park Office Park Development under the WCC project number 4901999014 in 1999. That study addressed Parcels 6 and 7 in detail and the other parcels in general and was based on 7 new borings drilled to a nominal depth of 80 feet and an 8th boring drilled to a depth of 43 feet. Column loads of 1,600 kips were expected. For these large column loads, the report recommended the use of driven piles having capacities of between 90 and 160 tons.

Gillis Street Sewer Investigation

URS completed an investigation in 2010 where Berkley Parkway now crosses Gillis Street Sewer under the URS project number 16530540. URS completed two shallow borings for that project.

East Side Rubble Remediation Project

A large construction debris landfill located east of Gillis Street Sewer contained large fragments of concrete beams, columns, and slabs. In 2000, a contractor crushed the fragments in-place using

a hydraulic crusher attached to a large track hoe, removed the reinforcing steel, processed the remaining construction debris through a rock crusher, then placed the processed material as structural fill under quality control procedures performed by Woodward-Clyde Consultants. Other debris excluded from the fill included some shingles that contained asbestos. T&B prepared construction plans that showed the expected lateral and vertical extent of the excavation. However, as-built drawings were not prepared.

Kingston Environmental Investigations

In 2002, Kingston Environmental completed a Phase II environmental investigation of the former MGP site that involved three principal activities:

1. Site Assessment and characterization including sampling of surface and subsurface soils and groundwater, followed by Risk Assessment.
2. Excavation and offsite disposal of soils contaminated with coal tar constituents, petroleum hydrocarbons, lead, arsenic, and polynuclear aromatic hydrocarbons (PAHs).
3. Excavation, sorting, size reduction, sampling, replacement and capping of soils, rubble and debris containing levels of lead, arsenic and PAHs exceeding unrestricted use target levels.

Significantly, the site assessment and characterization included soundings made using ROST/cone penetration tests (CPTs). These CPT data files have been retrieved and were used in preparation of this report. The CPT report prepared by Papadopulos & Associates, Inc. is included in Appendix A. Kingston also completed numerous test pits, installed groundwater quality monitoring wells, sampled both soil and water, and completed analytical testing on the collected samples. Kingston then developed a plan for environmental remediation of the former MGP facility that included removal of the source area of the contamination and placing a cap of non-impacted soil over the residual contamination. Kingston and T&B worked together to prepare the necessary construction documents. T&B's plans entitled ***West Side Environmental Remediation & Site Preparation*** are dated September 2005 and are numbered 90-3030. These plans show the planned lateral and vertical extent of the excavations. Kingston included drawings in the NFA that showed the as-built condition. However, the exhibits in the NFA that are available to CGC are not clearly legible throughout.

Environmental and West Side Rubble Remediation

Kingston Environmental led the environmental remediation of the former MGP site, which was accomplished with the support of Tetra-Tech and T&B. Contaminated soil within targeted zones was removed from the site. T&B's West Side Environmental Remediation & Site Preparation plans were implemented by processing the construction debris in the same manner as for the landfill formerly located east of Gillis Street Sewer. T&B retained URS to review the earthwork specifications and to serve as Special Inspector during earthwork operations. URS performed quality control testing on the structural fill as it was replaced west of Gillis Street Sewer. This processed construction debris and soil forms a cap over the residual contamination in the deeper soils. Planned limits of the excavation are shown on Figure 4, Boring Location and Site Map.

4 FILL PLACEMENT HISTORY

The original ground surface consisted of by Missouri River alluvium and is believed to have been at about El 725, or near the invert elevation of Gillis Street Sewer. The Operations and Maintenance Manual for the levee indicates that sand dredged from the river was placed landward of the levee and east of the present day Heart of America Bridge during levee construction to reduce seepage and exit gradients. Imported low plastic clay was placed on the levee slope to serve as a seepage barrier. Construction debris including reinforced concrete beams, columns, and slabs was placed on both sides of Gillis Street Sewer and between the levee and the railroad property to the south. Construction debris was not placed above Gillis Street Sewer.

East Riverfront Road was designed as a four-lane roadway; however, only two lanes were constructed. Grades were lowered by 3 feet in Berkley Park and East Riverfront Road. Fill free of construction debris was transported to the site and placed in the excavated areas to reach planned subgrade elevation. However, fill containing construction debris is still present in Berkley Park and in the East Riverfront Road right-of-way below a depth of 3 feet below current grades.

5 PREVIOUSLY DRILLED BORINGS

Logs of borings previously drilled at the site are presented in Appendix G of this report. It is important to note that the depths of fill and shallow subsurface conditions indicated by some old borings have been altered by subsequent earthwork operations. In particular, much of the fill containing construction debris has been replaced with fill containing processed construction debris. The largest particle size in the processed fill is typically less than about 4 inches in maximum dimension.

6 CONE PENETRATION TESTING

Kingston Environmental completed 22 cone penetration test (CPT) soundings across the western half of the Riverfront Park Development site as part of their environmental remediation effort. The CPT soundings were completed using an advanced system that included a Rapid Optical Screening Tool (ROST) as well as the standard load sensors for the tip and sleeve resistance. Kingston's interest was focused on the ROST data, but the standard CPT data are very useful for soil type characterization and design of deep foundations. The CPT data were presented in a report dated May 20, 2002 prepared by S.S. Papadopulos & Associates, Inc. that is included in Appendix A of this report.

The CPT/ROST soundings were made before the rubble remediation work was performed west of Gillis Street Sewer. The cone could not be pushed through the construction debris, so casings were installed to depths between 7 and 24 feet below the ground surface to enable testing of soil below those depths using the CPT/ROST instrument. The CPT data leads to an interpretation of soil type and an estimate of soil shear strength based on empirical correlations. CGC evaluated the CPT test data and created boring logs that show the general soil type over broad depths of the borings for the purpose of creating subsurface profiles.

7 FIELD INVESTIGATION

Working under contract to F&C, Geotechnology drilled twelve soil borings and excavated seven test pits within Parcels 1 and 2. Geotechnology also excavated two test pits in the old I-35 ramp embankment, a potential borrow area, for the benefit of Port KC. Taliaferro & Browne, Inc. surveyed boring locations and elevations. The state plane coordinates, ground surface elevations, and nominal drilling or excavating depths in units of feet at the exploration points are listed in Table 7.1.

Table 7.1 Boring and Test Pit Location Data

BORING	EASTING	NORTHING	ELEV	DEPTH
B-201	2767745	1073973	761.0	50
B-202	2767804	1073836	760.4	50
B-203	2767884	1073684	758.3	45
B-204	2767929	1074048	763.7	85
B-205	2767965	1073890	757.8	80
B-206	2768015	1073729	757.4	65
B-207	2768126	1074024	764.2	65
B-208	2768190	1073875	760.4	65
B-209	2768200	1073773	758.7	80
B-210	2768241	1074181	769.1	60
B-211	2768351	1073979	765.1	55
B-212	2768450	1073871	759.0	55
TP-201	2767667	1073836	761.6	10
TP-202	2767843	1074003	762.5	10
TP-203	2767991	1074065	763.0	10
TP-204	2768244	1074207	768.6	10
TP-205	2768132	1073810	758.2	10
TP-206	2768069	1074004	758.7	10
TP-207	2767853	1073893	759.7	10
TP-208	2770178	1075503	784.5	10
TP-209	2770172	1075340	780.6	10

New boring and test pit locations at the site are shown on Figure 4, Boring Location and Site Map. Figure 4 also shows the locations of borings that were drilled as part of previous investigations. Only those borings considered useful for this investigation are shown. Previously drilled shallow borings and all test pits have been excluded.

Since the site is under an NFA and contains residual levels of contamination at depth, Geotechnology first prepared a Health and Safety Plan (HASP) and a Soil Management Plan (SMP) for this project. ARCADIS, the environmental consultant working for F&C, reviewed both

documents. Geotechnology modified the plans based on ARCADIS' comments. The HASP is included in Appendix B, and the SMP is included in Appendix C. Fieldwork commenced after an on-site review of the HASP with all field personnel present.

The NFA identifies requirements that must be met before intrusive construction work is done at the site. It was concluded that the NFA did not require Geotechnology to obtain permission from MDNR to complete the intrusive investigative work. This understanding was confirmed in a telephone conversation with Dr. Chris Cady of MDNR held on March 6, 2015 before fieldwork began. Construction work at the site must be approved in advance by MDNR.

Geotechnology completed twelve new borings for this project using a CME 550 drill rig mounted on a rubber-tired, all-terrain vehicle. They advanced borings to a nominal depth of 30 feet using 3.75-inch ID, hollow-stem augers that served as casing and allowed advancement of the borings using mud-rotary drilling techniques to the maximum depths of drilling.

Disturbed soil samples were collected in accordance with ASTM D-1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. In the SPT test, a split-barrel sampler is driven a total of 18 inches using a 140-pound hammer falling freely for 30 inches. Hammer blows are recorded for each of three 6-inch long driving intervals. The sum of the 2nd and 3rd component values is taken to be the blows per foot, SPT result, or N-value. SPT test data can be used to characterize the relative density of cohesionless soils and the consistency of cohesive soils. The geologist performed a pocket penetrometer test on the disturbed SPT samples that were cohesive. One-half the pocket penetrometer reading serves as an estimate of the soil shear strength. However, the SPT samples are highly disturbed; thus, this testing does not conform to ASTM standards. At best, pocket penetrometer data provide an indication of soil consistency.

A total of 5 low-disturbance samples were recovered by hydraulically pushing a nominal 3-inch diameter thin-walled Shelby tube 24 inches into the soil. However, none of the recovered thin-walled samples were suitable for engineering property testing.

In accordance with the HASP, a photo-ionization detector (PID) was used to scan the soil samples for indications of volatile organic compounds. Nearly all of the tests yielded a reading of Non Detect. The remaining PID test results are listed in Table 7.2, PID Test Results.

Table 7.2 PID Test Results

Boring No.	Sample No.	Depth (Ft)	PID Reading (PPM)
B-203	SS-7	23.5-25	10
	ST-8	25-27	6
	SS-9	28.5-30	2
B-204	SS-8	28.5-30	11
B-205	SS-7	28.5-30	8
B-212	SS-4	8.5-10	139

The corresponding samples were considered to be impacted and were not subjected to geotechnical testing in the laboratory. Soils having PID values of Non Detect were tested in Geotechnology's local laboratory using routine precautions.

The central rod of a settlement measuring instrument was installed in each of four borings (B-202, B-205, B-206, B-209) after the borings were completed. The central rods were formed as shown in Figure 5. A pipe flange was attached to the bottom end of ½-inch diameter steel pipe and positioned near the bottom of each boring. Cement grout was placed in the bottom 5 feet of the boring using a tremie pipe. The tremie pipe was then raised about 5 feet before filling the remainder of the boring with bentonite slurry. The flange and cement grout are located within native alluvial sands that are considered to have a low compressibility. These flanges and their connected central pipes should not settle when fill is placed at the ground surface. Only the central pipes have been constructed at this time. Prior to fill placement, an outer pipe and base plate should be placed over each central pipe as shown in Figure 5. The change in distance between the central and outer pipes represents ground surface settlement and can be measured very accurately using a dial gauge. Protective barriers must be placed around the settlement instruments so that construction equipment will not damage them during fill placement. The object is to verify that settlement is largely complete so that building construction can begin without undue delay.

Geotechnology's geologist prepared field logs while observing the samples, auger cuttings, drilling characteristics, and depths where groundwater was first observed to enter borings. Geotechnology prepared formal logs based on the field logs and laboratory test data that are presented in Appendix D of this report.

8 LABORATORY TESTING

Laboratory tests were performed to allow evaluation of pertinent soil index properties including visual classification, moisture content, grain size distribution, and Atterberg (liquid and plastic) limits. These laboratory test data are used to classify the soils according to type, texture, and general properties including swell potential and erosion resistance. These data are charted on the boring logs. Grain size distribution tests were performed on eleven soil samples in accordance with ASTM D-6913, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis. All of the samples except for one were classified as a poorly graded sand. The sample taken at a depth of 28.5 feet contained about 95 percent fines (silt and clay). Most of the other samples tested contained less than 10 percent fines. These samples were obtained at depths ranging from 13.5 feet to 48.5 feet. However, most of the grain size tests were performed on samples obtained from depths greater than about 28 feet. Thus, these tests were commonly performed on the sand alluvium for the purpose of providing information useful for the design of deep foundations.

None of the Shelby tube samples proved to be suitable for engineering property testing including unconfined compression testing. Engineering properties have been evaluated using the results of SPT and CPT soundings.

Test results are listed in the Summary of Laboratory Results included in Appendix E. The gradation curves from 11 particle size analysis tests are also included in Appendix E.

9 ANALYTICAL TESTING OF DRILLING MATERIALS

Geotechnology collected drilling spoils, decontamination water, and drilling fluids and placed them in containers at the site in accordance with the Materials Management Plan. Geotechnology submitted samples of these materials to Pace Analytical Testing for testing. The results are included in Appendix F. Based on the test results, the decontamination water was released to KCMO's sanitary sewer system while the drilling spoils and drilling fluids were placed in 55-gallon steel drums and placed on wooden pallets at the site. These drums will be disposed of in a landfill as a Special Waste in the future. Disposal actions must comply with the Materials Management Plan (MMP). ARCADIS has been retained by F&C to ensure that the disposal actions comply with the MMP. The analytical testing report is included in this report solely for the purpose of documentation.

10 SUBSURFACE PROFILES AND CONDITIONS

New Fill

The soil that will directly support the buildings is not yet present at the site. About 50,000 cubic yards of fill must be transported to the site and compacted as structural fill. The most likely source of the borrow is the loess deposits located north of the Missouri River. Loess typically has a low plasticity, a liquid limit less than about 40, a plastic limit of about 16, and a compacted dry unit weight of about 95 to 100 pcf. Loess typically experiences large changes in consistency with small changes in water content. Control of water content at the time of compaction is critical if adequate density and strength are to be achieved. The undrained shear strength of compacted loess is commonly about 1,000 to 2,000 psf. Additionally, the soil softens readily in the bottom of open excavations upon wetting.

SPT Results

Figure 6 shows a chart of the N values from all of the new borings drilled in areas where structural fill is present. Borings B-201 and B-204 were drilled north of the construction debris remediation limit and were excluded from the chart for that reason. In general, structural fill is present above about El 740 and alluvium is present at greater depths. The structural fill is largely composed of fine-grained soils, exhibits cohesive soil properties, and is appropriately described in terms of consistency. The average N-value for samples taken between the ground surface and about El 740 feet in the remaining 10 new borings was about 15 and the uniformity was high. The fill was generally described as consisting of crushed rock, concrete, and brick in a matrix of lean clay. Atterberg limit tests of the fill generally indicated a plastic limit of about 18, a liquid limit of about 37, and a plasticity index of 19. Soil water contents were generally near or below the plastic limit. Structural fill is normally placed at water contents near the plastic limit; thus, this finding serves to confirm the understanding that this fill material was placed and compacted as structural fill. The N-value corresponds to a stiff consistency and an undrained shear strength of about 2,000 psf.

Figure 6 indicates that the structural fill has a medium to very stiff consistency. The undrained shear strength of the structural fill ranges from about 500 psf to 4000 psf based on the N values and correlations.

Data points charted above El 740 show no clear trend. Data points charted below El 740 show a trend of increasing N-value with depth. These observations are consistent with the cohesionless

soils that compose the alluvium. The alluvium is described as having a loose to compact relative density. Grain size test results indicate that the alluvium is poorly graded and contains only small amounts of fines. Some of the sand may have been dredged from the Missouri River.

Soil Profiles

Figures 7-12 show six generalized subsurface profiles along the six vertical cross section planes shown on Figure 4, Boring Location and Site Map. The soil layers reported on the boring logs have been projected onto the planes of the cross sections in their proper vertical and horizontal positions. In addition, current ground lines and future grade lines are shown on each figure.

Layer boundaries, sample locations, N-values and pocket penetrometer values are shown on or adjacent to each boring location. Lines and soil type labels have been added to each cross section to show the major boundaries between soil types or conditions.

Sections 7 – 9 (A-A', B-B', and C-C') face north and show deep fill near the west end of the sections and shallower depths of fill farther east. The deep section of fill in the west extends down to about El 740 whereas fill extends down to only about El 750 elsewhere. These elevations correspond very closely to the elevations of the bottom of fill indicated on drawings prepared by T&B during both rubble remediation programs.

Sections 10 – 12 (D-D', E-E', and F-F') face east and show both the planned bottom of excavation and the position of fill as indicated by soil borings. These sections indicate that excavation of fill was slightly less extensive laterally than planned in the north end of the site. As a consequence, fill containing unprocessed construction debris is present beneath the future position of footings on the north side of the project. A two-lane roadway was previously planned to be located in that area.

Structural Fill

Structural fill composed of processed construction debris and soil is present at the ground surface in most of both Parcels 1 and 2. Boring logs indicate that the structural fill consists of cohesive soils containing a significant portion of silt and sand.

Non-Structural Fill

Non-structural fill (remnants of the two construction debris landfills) is present at the ground surface along the northern border of Parcels 1 and 2 and on both sides of Gillis Street Sewer. Test pit excavations exposed construction debris including large concrete and limestone fragments in a clay matrix. The approximate lateral and vertical extent of the remaining construction debris is indicated on Sections A-A, B-B, and C-C. The expected limits of excavation required to prepare the site for construction are also shown on these sections.

Alluvium

Alluvium consisting of poorly graded sand, silty sand, and silt was encountered beneath the fill and extended to the bottom of the soil borings. The average N-value of the alluvium was about 16 to 17, but the variation was high because N values increased with depth. This high variation is due in part to the fact that some silt and silty sand layers are present near the middle of the soil profile, and these materials have lower relative density than the poorly graded sands that compose the remainder of the alluvium. The relative density of the alluvium ranges from loose to medium dense.

Table 8.1 and 8.2 list general subsurface profiles that represent areas west (Parcel 1) and east (Parcel 2), respectively, of Gillis Street Sewer. After the site is brought to the required grade elevation, the corresponding fill depths will be 25 feet and 15 feet, respectively.

Table 8.1 – General Subsurface Profile – West End

Elevation Range (feet)	Soil Type & Description
760 – 740	Fill consisting of small construction debris fragments in a clay matrix, stiff, dry
740-727	Alluvial silt and silty sand, loose, moist
727 - 673	Alluvial Sand - Loose to medium dense, poorly graded silty sand

Table 8.2 – General Subsurface Profile – East End

Elevation Range (feet)	Soil Type & Description
768 – 750	Fill consisting of small construction debris fragments in a clay matrix, stiff, dry
750 -673	Alluvial Sand - Loose to medium dense, poorly graded silty sand

Groundwater

Groundwater entry into the borings was generally first observed near El 730, or a depth of about 35 feet below the planned general grade elevation of El 765 feet. There was little variation in groundwater entry elevation except in B-203 where it was first observed near El 715. Groundwater levels are expected to rise and fall with the stage of the Missouri River that reaches flood state at El 738.68 ft, or about 26 feet below planned site grade of El 765.

11 EARTHWORK

Stockpiled Concrete Fragments

The stockpile of large concrete fragments located east of Gillis Street Sewer must be crushed in-place, passed through a crusher for further size reduction, then replaced onsite as structural fill. The usefulness of the processed material will depend on the fines content and maximum particle size. The material will probably be useful as general fill, but may also be suitable and beneficial as a pavement subgrade material.

Construction Debris

Construction debris is present in the East Riverfront Drive area below a depth of 3 feet, and extends southward to the line labeled “Northern Limit of Debris Removal” indicated on Figure 4, Site and Boring Location Map. The debris extends below the northern end of the apartment buildings. Unprocessed construction debris does not extend below the area of the planned parking garage structure.

Construction debris present along the north property line and within 10 feet laterally of the apartment building foundations must be excavated, processed, and placed as structural fill in the

excavations. Excavation of the construction debris will produce a long trench that extends down to alluvium or to El 745, whichever is shallower, at the plan position of the foundations.

Construction debris is also present at the ground surface adjacent to both sides of Gillis Street Sewer. All of the unprocessed construction debris below the footprint of the two parking garages must be replaced with structural fill regardless of its depth. The minimum ground surface elevation above the sewer is about El 753. Cross section E-E' shown on Figure 11 indicates that the construction debris is expected to be present above about El 750. All of the debris must be removed to allow installation of displacement auger-cast piles in the parking garage area.

Processed construction debris material should be very similar in texture to the material that has previously been produced at the site.

Approved materials should be placed as structural fill in the excavations. Groundwater is not expected rise into the excavations and impact fill placement operations. However, contractors should prevent surface water from entering the excavations. Additionally, contractors should provide a means of removing water that may enter the trench.

Preparation For Fill Placement

Although test data indicate that the processed fill material is of high quality, the shallow soils have been loosened by many cycles of freezing, and some additional earthwork has been completed related to roadway construction or stockpiling of soils. For example, a substantial quantity of large concrete fragments has been stockpiled at the site. It is possible that some of the surficial soils are not highly compacted. Proof rolling is commonly employed to identify the location of unstable soils. However, proof rolling might not detect soils below the surface that are not adequately compacted. This is most important for the soils below the apartment buildings.

It will be prudent to perform some remedial earthwork that will correct deficiencies that may exist in the shallow soils and give an indication of poorly compacted soil. It is recommended that all areas below the apartment buildings be treated before new fill is placed using a heavy drop hammer type of utility trench compactor such as those provided by Arrow-Master Incorporated (http://www.arrowmaster.com/hammer.shtml). A heavy drop hammer can compact soils present within about 2 to 3 feet of the ground surface. Soils in cut areas located beneath the apartment buildings should also be treated in this manner.

Structural fill should be placed and compacted in accordance with the Recommended Earthwork Specifications included in Appendix F, Earthwork Specifications.

12 PARKING GARAGES

Background

The two parking garages will be positioned east and west of the existing Gillis Street Sewer. The maximum column load of 850 kips precludes the use of shallow foundations because the footings would be too large and too near the existing Gillis Street Sewer. The foundations must both support the parking garage and permit excavations to be made in the future should it become necessary to excavate down to the sewer to make repairs. The potential problem is that excavations made well below the ground surface might lead to increased shear stresses across potential shear

surfaces that transect the pile foundations. Practical foundation designs can generally only be developed if the repair techniques do not lead to increased shear stresses in the soil. Many sewers are repaired using cured in place liners (CIPP). Use of this technique should not lead to increases in shear stresses within the soil. If a problem does develop that requires repair or replacement of a section of sewer, then some means of making an excavation must be developed that will allow the work to be done without increasing shear stresses in the soil. One possible method involves these steps:

1. Complete the excavation using a slurry of bentonite and water to support the soil
2. Install steel sheet piles in the slurry forming a box
3. Install cross bracing if necessary while pumping slurry from the excavation
4. Complete the repair
5. Place Backfill

Another possible method involves these steps:

1. Install H-piles in drilled holes at the points of a polygon (hexagon, octagon, etc.) around the problem area with a pile spacing distance of about 6 to 10 feet.
2. Excavate within the polygon while installing timber lagging
3. Complete the sewer repair
4. Place Backfill

Both of these approaches are considered technically feasible and would not lead to increases in soil shear stress. It is therefore reasonable to select and design a deep foundation for the parking garage without providing a means of supporting increased shear stresses in the soil. Therefore, several deep foundation systems can be considered for this project.

Pile Type Selection

Steel H-piles, steel pipe piles, and precast concrete piles were considered for this project but were rejected due to fear that driving of these piles might damage the Gillis Street Sewer either by inducing damaging ground movements (heave or settlement) or by structural distress.

The NFA agreement was developed under the expectation that auger-cast piles would be used to support multi-story office buildings and parking garages at the site. During conventional auger-cast pile installation, a large diameter hollow-stem auger is advanced into the ground while soil is removed by the continuous flights to make room for the concrete pile. More soil is generally removed from the ground than is needed; hence, pile installation normally causes some ground surface settlement. For totally new construction, this settlement is generally inconsequential. However, any nearby existing structures, such as the Gillis Street Sewer, might experience damaging settlement. Additionally, installation of conventional auger-cast piles at this site would produce large quantities of spoils that would need to be placed in a special waste landfill. Conventional auger-cast piles are not recommended for this project because pile installation might damage the existing Gillis Street Sewer and disposal costs would be high.

Displacement Auger-Cast Piles

Displacement auger-cast piles (displacement piles) are now available from Berkel and Company (see http://www.berkelandcompany.com/deep-foundations/drilled-displacement-piles) and offer several improvements over conventional auger-cast piles. Displacement piles are a proprietary system and are installed using a drilling tool that includes a hollow stem of variable diameter and two sections of continuous flight augers. Hollow stem diameter increases near the bottom of the tool, then decreases to the normal size at the tip creating a bulge a few feet above the tip. An upper section of continuous flight auger tends to remove soil as the tool is rotated. The lower section of flights is oriented so that it presses the soil down the hole as the tool is rotated. During installation, the lower section of auger tends to pull the tool downward facilitating pile installation.

After reaching the planned elevation, fluid cementitious grout is pumped down the hollow shaft to a port that allows the grout to flow outward into the void created by the hollow stem auger. The drilling tool is then withdrawn slowly as the drilling tool is rotated in the opposite direction. The lower section of auger tends to push the soil downward when the auger is rotated in the opposite direction and the tool is withdrawn from the hole. This action increases soil density and pile capacity. In addition, little soil is reduced compared to conventional auger-cast piles. Since these piles will be installed through possibly contaminated soil, this leads to a reduction in disposal fees.

After the drilling tool is removed, a steel reinforcing cage composed of at least four bars and circular ties is inserted into the still fluid grout and pushed down to the correct elevation. Circular rather than spiral ties should be used to contain vertical reinforcing bars so that advancement of the cage does not cause cage rotation. The bottom-most tie is eliminated and the free ends of the four bars are brought tightly together forming a point. No mechanical downward forces should be applied during cage insertion into the grout. The typical maximum length of cage reinforcement is 20 feet, and the ties are spaced far apart to aid insertion. A single full-length bar can be inserted into the piles if special steps are taken. If a full-length central bar is to be used, it should be fitted with a centralizer before insertion into the grout.

Displacement auger-cast piles cannot be easily installed through ground that contains obstructions like large concrete or stone fragments (construction debris). These materials have been removed from much of the parking garage area, but the area near the Gillis Street Sewer still contains construction debris. It will be necessary to remove construction debris from below the footprint of the parking garages. Failure to remove debris may result in the need to install additional piles.

Displacement piles will be installed within pile cap excavations and spoils will be collected, tested for environmental contamination, and placed in a special waste landfill. Berkel has estimated a design pile capacity of 90 tons for a 14-inch diameter, 56-foot long pile based on the CPT test data provided to them. The test pile butt would be at El 765 and the pile tip would be at El 709.

Parking Garage Walls

Some walls within the parking garages will impose loads of 20 kips per foot on their foundations. The required width of foundation for such walls would be about 8 feet. However, these walls are not independent of the pile-supported structure. These walls can be supported on the column foundations at their ends and at appropriate intervals along their lengths by additional piles. If walls are truly independent of the structure (free-standing), they can be supported on spread footings proportioned using a maximum allowable bearing pressure of 3,000 psf. The foundation bases should be positioned at least 3 feet below exposed grade.

Parking Garage Slabs on Grade

First floor concrete paving within the parking garages should be supported by at least 6 inches of dense-graded crushed limestone (AB-3). The subgrade soil can be considered to have a CBR value of 4. Concrete should be placed directly on the crushed rock. It is expected that the MDNR will not require a vapor mitigation system within the parking garages.

13 APARTMENT BUILDINGS

The soil profile throughout much of Parcels 1 and 2 includes structural fill at the ground surface that was placed during the two rubble remediation efforts. The fill depth is at least 10 feet, and the earthwork quality is high as indicated by previous earthwork testing and by N-values obtained from the current borings. The stockpile of large concrete fragments present east of Gillis Street Sewer and the soil containing construction debris located along the north property line must be excavated, passed through a crusher, then replaced as structural fill on the site. Topsoil and vegetation present on the ground surface must also be excavated and stockpiled for future use in landscape areas.

The soil profile in the extreme north end of the two parcels and the central portion near Gillis Street Sewer includes construction debris at the ground surface. This material will be replaced as part of site development efforts made by Port KC. In general, the soil profile at the time of foundation construction will include about 15 feet to 25 feet of structural fill overlying medium dense alluvial sand. This soil profile is considered suitable for the use of shallow spread footings to support the apartment buildings. Placement of additional structural fill will induce settlement that has been estimated to be about ¾ inches (see CGA's geotechnical engineering report for the Gillis Street Sewer evaluation). This settlement is expected to occur very rapidly. Foundation stresses will induce small additional settlements due to compression of the structural fill. This settlement is expected to be elastic and should occur as the structures are built. The expected wall loading is 5.5 kips per foot of wall. Using a maximum allowable net bearing pressure of 3.0 ksf, the required foundation width is only 1.83 feet. It is recommended that the minimum foundation width be 2 feet. The base of the exterior foundations should be positioned at least 3.5 feet below adjacent exterior grade to provide frost protection and to increase the structural capacity of the foundation stem wall. The interior foundations can be positioned at depths sufficient to meet the structural requirements. Settlement is expected to be less than 1 inch.

The apartment buildings will have long plan dimensions. Control joints will likely be required to accommodate settlement, shrinkage, and thermally induced movements. These joints can beneficially extended into the foundation stem wall.

The slab-on-grade elevation of the apartment buildings will be as much as about 4 feet above adjacent grade. It is recommended that all fill necessary to support the floor slabs be placed before foundation construction. Footings will then be excavated in the structural fill and most of the settlement due to the weight of the fill will occur before the apartments are constructed.

Foundation Stem Walls

Exterior apartment building foundations can be composed of base slabs and stem walls, and at least two different configurations can be constructed:

1. Cantilever stem wall with backfill present only on the interior side of the stem
2. Stem wall with backfill present on both sides of the stem wall

Footings for the cantilever stem wall will be wider than the 2-foot minimum width given above because toe pressures will be increased due to the cantilever action. If backfill is placed evenly on both sides of the stem walls, then the footings can be as narrow as about 2 feet, but the backfill on the exterior of the building must be removed after the floor slab is joined to the stem wall.

The foundations and stem walls can be proportioned and designed using an equivalent fluid weight of 60 pcf to represent the backfill. This value should account for both the unit weight of the backfill as well as compactive effort provided compactive effort from self-propelled machines is applied no closer than a distance equal to the height of the backfill. The foundation base slab should be cast neat within an excavation so that passive earth pressure can develop against the exterior side of the foundation. It is expected that the base slab width will be much wider than is required based on just the vertical foundation loads since the toe pressure will be increased due to the unbalanced earth pressure. Designers can use a coefficient of lateral earth pressure of 2.5 to evaluate passive earth pressure acting on the face of the foundation slab. They can evaluate base resistance using a coefficient of friction of 25°.

Interior Foundations

The retail portion of the buildings will have interior columns that support 200 kips. With a maximum allowable bearing pressure of 3.0 ksf, the required width for a square foundation is 8.2 feet. The depth of strong influence is expected to be less than 15 feet, which is less than the depth of structural fill below the planned building. These values and conditions are considered reasonable and proper for these interior columns. Thus, it is recommended that interior columns be proportioned using a maximum allowable bearing pressure of 3.0 ksf. They can be positioned at the minimum depths that meet the structural requirements. However, consideration should be given to floor slab performance in the vicinity of the columns. The concrete foundations will be quite rigid compared to the subgrade that supports the floor slabs. It is recommended that at least 12 inches of fill be placed over the isolated spread footings to provide more uniform support for the floor slabs in that vicinity.

Floor Slab Subgrades

Weather conditions at the time of apartment building construction will likely be different from those that existed at the time of fill placement. Subgrades may have become overly dry, wet, or frozen. Subgrade conditions should be adjusted, if necessary, to provide suitable support for floor slabs. Soil moisture content should be adjusted to between 0 and 3 percentage points above the optimum water content as determined by the Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort, ASTM D-698. It may be useful to place at least 6 inches of additional fill over the building area that will serve to protect the prepared subgrade soil. In this way, the excess soil can be removed exposing properly prepared soil even during wet or winter months. The excess soil can then be placed in the courtyard area.

Vapor Mitigation System

A vapor mitigation system designed by others will be required within the apartment buildings and their commercial spaces. This information is intended to aid them in their design. Drainage material consisting of ASTM No 57 stone is generally used as the porous media from which vapors are released. Groundwater is not anticipated to reach the subgrade, therefore the No 57 stone can be placed directly on the clay subgrade. A vapor barrier will likely be placed on top of the No. 57 stone. The tops of collector pipes should be positioned at least 2 inches below the surface of the crushed rock. This may require excavating trenches in the clay subgrade to provide the needed clearance. It is understood that the floor slab will be butt up against the stem wall and will be joined to the stem wall using dowels that extend from the stem wall. In this case, the thickness of the vapor mitigation system can be uniform throughout the floor slab area.

Since the floor slabs are elevated above the exterior grade, there should be no need to provide an outlet for large quantities of water. The vapor mitigation system, whether passive or active, should remove excess water vapor reducing the potential for water to accumulate below the vapor barrier. Nevertheless, outlets for water that might collect in the granular fill should be provided.

Cantilever Earth Retaining Walls

A two-tiered cantilever earth retaining wall system will be constructed at the far west end of the site. These walls will have a maximum height of about 3 feet and will be structurally isolated from the adjacent apartment buildings. The retaining walls should be designed in accordance with the USACE standards presented in EM 1110-2-2502, Retaining and Flood Walls, since the walls may be located within the Critical Zone (see next section). Driving forces should be evaluated assuming at-rest earth pressure conditions, and the maximum passive pressure should be limited to one-half of the ultimate passive pressure. Further, passive pressure should only be assigned to surfaces that will remain in contact with the soil. In this case, passive pressure should only be assigned to the face of the foundation slab provided the foundation is cast neat within an excavation, or on the face of a keyway. The base of the foundations should be placed a minimum of 3 feet below the adjacent grade to provide frost protection.

Seven sets of stairs will intersect the upper tier retaining wall. Differential movements should be expected because the stairs will likely move due to frost formation in the supporting soil. Control joints should be provided to reduce the potential for distress due to vertical movements of the steps due to frost formation and melting. The at-rest earth pressure can be evaluated using these properties:

Total Unit Weight of Backfill = 125 pcf

At-Rest Earth Pressure Coefficient = 0.58

Passive Pressure Coefficient = 2.5

Coefficient of Friction = 0.46 (tangent of 25°)

Active Earth Pressure Coefficient = 0.4

14 CRITICAL ZONE

The United States Army Corps of Engineers (USACE) identifies the area within 500 feet of the levee centerline as the critical zone for seepage. The landside boundary of this zone is shown on Figure 4, Site and Boring Location Map. The Missouri River reached a peak stage of 48.87 feet (El 755 feet) on July 27, 1993 at the gauge located just downstream from the Broadway Bridge in Kansas City. Planned grades will be at about El 765 throughout Parcels 1 and 2. Placement of additional fill on the site will increase safety because seepage stability will be improved. The additional fill will be placed sufficiently far from the levee that, by inspection, sliding and slope stability will not be adversely affected.

However, excavations made to replace the construction debris must be made within the critical zone. The USACE may restrict Port KC's site work between April 1 and August 1 of each year. It is anticipated that this work will be completed before foundation construction begins.

Placement of the additional fill has the potential to affect Gillis Street Sewer. CGC has completed a report for T&B under a separate contract that addresses the feasibility of placing more fill over the sewer. CGC recommended that closed-cell expanded polystyrene (Geofoam) be placed over the sewer and included in the backfill. The Geofoam will be located above El 755 and thus should not affect levee stability during extreme flooding events.

Structural integrity of Gillis Street Sewer is important for levee safety. Additional recommendations made concerning fill placement over Gillis Street Sewer included visual inspections of the sewer after fill placement and again after foundation construction. Given these precautions, it is expected that USACE will permit construction of the project. Nevertheless, their approval must be obtained.

15 CONCLUSIONS AND ADDITIONAL RECOMMENDATIONS

The following conclusions and recommendations are based on the findings included in this report and my experience.

1. The project is believed to be technically feasible provided the site is developed as planned by Port KC. Included in that plan are the excavation, processing, and replacement of existing construction debris, placement of additional fill over Gillis Street Sewer, and placement of an additional 50,000 cubic yards of imported fill. Approval for fill placement must be obtained from KCMO's Water Services Department and the US Army Corps of Engineers.
2. It is recommended that the design team be involved with earthwork operations needed to provide the planned site grade as the quality and uniformity of this fill will affect the quality of the buildings.
3. Parcels 1 and 2 are subject to an NFA, and the requirements of that agreement must be met. Approval for construction must be obtained from the Missouri Department of Natural Resources. It is expected that approval will be granted.
4. Conventional foundation design and construction is expected for the apartment buildings. However, a vapor mitigation system will be needed below the floor slabs.
5. Displacement piles should be used to support the two parking garages. This proprietary system will be designed by the provider, Berkel and Company.

16 LIMITATIONS

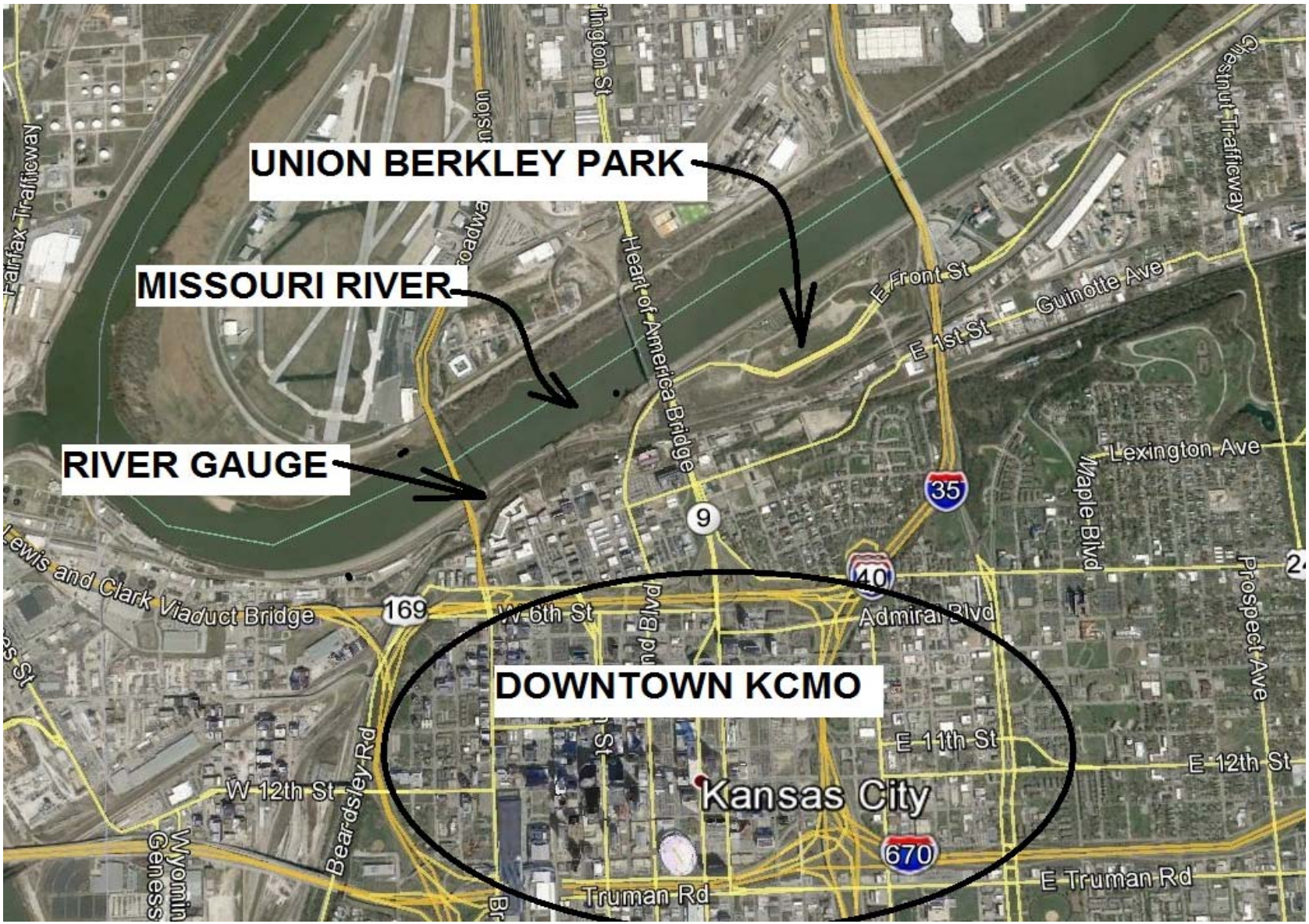
The conclusions and recommendations presented in this report are based on the results of a limited number of borings and test pits. Due to the presence of construction debris on and within the site soils, subsurface conditions are highly variable, especially at the north property line.

The soil that will support the apartment buildings has yet to be transported to the site and placed as structural fill. Strict quality control procedures must be followed to provide the needed high-quality fill and subsurface conditions.

While it is believed that the agencies that must approve construction will approve construction, there is always some uncertainty. The opinions stated in this report do not constitute a guarantee that the agencies will approve construction.

CGC's services were completed with a level of care and skill like that ordinarily exercised by other professional consultants under similar conditions. No other representation is intended.

FIGURES



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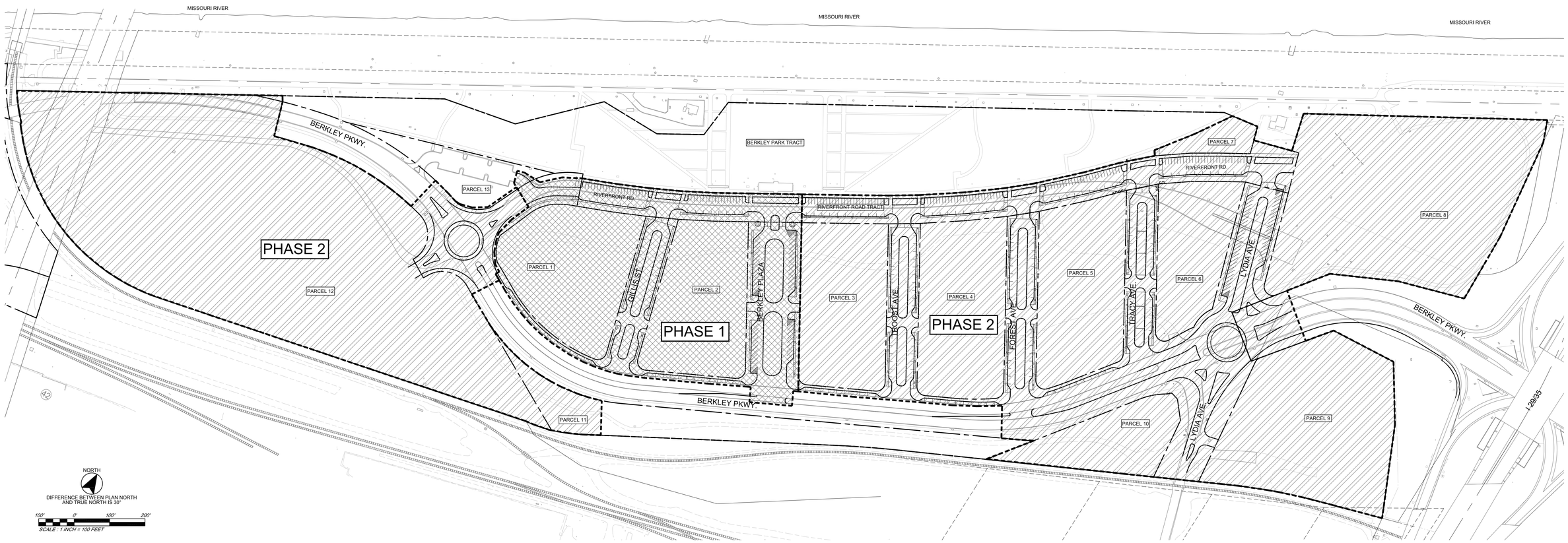
Site Vicinity Map
Union Berkley Park
F&C Union Berkley Park
Kansas City, Missouri

Project No:	**01C2015005**
Drawn By:	**CHC**
Date:	**May 2015**
Drawing No:	**1**



LEGEND

- PROPOSED MPD BOUNDARY
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- PROPOSED RIGHT-OF-WAY LINE
- EXISTING "OFF-SITE" PROPERTY LINE

PROJECT TIMELINE: (PROJECT WILL BE CONSTRUCTED IN TWO PHASES)

PHASE 1 CONSTRUCTION START: FALL 2014
PHASE 1 CONSTRUCTION END: FALL 2018
PHASE 2 CONSTRUCTION START: FALL 2016
PHASE 2 CONSTRUCTION END: FALL 2026

PHASING PLAN

PHASE 1

PHASE 1 CONSISTS OF THE FOLLOWING:

- DEVELOPMENT OF PARCELS 1 AND 2
- RIGHT-OF-WAY DEDICATION FOR ALL OF BERKLEY PARKWAY, GILLIS STREET, BERKLEY PLAZA, AND LYDIA AVENUE SOUTH OF BERKLEY PARKWAY
- PLATTING PARCEL 1, PARCEL 2, THE BERKLEY PARK TRACT, AND THE RIVERFRONT ROAD TRACT
- CONSTRUCTION OF GILLIS STREET AND BERKLEY PLAZA
- IMPROVEMENTS TO RIVERFRONT ROAD ALONG THE NORTH SIDE OF PARCELS 1 AND 2
- CONSTRUCTION OF THE PARALLEL PARKING LANE ON BERKLEY PARKWAY ALONG THE SOUTH SIDE OF PARCELS 1 AND 2
- CONSTRUCTION OF A MEDIAN BREAK AND LEFT TURN LANE ON BERKLEY PARKWAY TO ALLOW VEHICULAR ACCESS BETWEEN BERKLEY PLAZA AND EASTBOUND BERKLEY PARKWAY
- CONSTRUCTION OF PUBLIC WATER MAINS, SANITARY SEWER MAINS, AND STORM SEWER INFRASTRUCTURE TO SERVICE PARCELS 1 AND 2
- CONSTRUCTION OF WATER, SANITARY SEWER, AND STORM SEWER SERVICE LINES TO SERVICE PARCELS 1 AND 2

PHASE 2

PHASE 2 CONSISTS OF THE FOLLOWING:

- DEVELOPMENT OF PARCELS 3 THROUGH 13
- RIGHT-OF-WAY DEDICATION FOR TROOST AVENUE, FOREST AVENUE, TRACY AVENUE, AND LYDIA AVENUE NORTH OF BERKLEY PARKWAY
- PLATTING PARCELS 3 THROUGH 13
- CONSTRUCTION OF TROOST AVENUE, FOREST AVENUE, TRACY AVENUE, AND LYDIA AVENUE
- IMPROVEMENTS TO RIVERFRONT ROAD ALONG THE NORTH SIDE OF PARCELS 3, 4, 5, AND 6
- CONSTRUCTION OF THE PARALLEL PARKING LANE ON BERKLEY PARKWAY ALONG THE SOUTH SIDE OF PARCELS 3, 4, AND 5
- CONSTRUCTION OF THE ROUNDABOUT AT THE INTERSECTION OF BERKLEY PARKWAY AND RIVERFRONT ROAD
- CONSTRUCTION OF THE ROUNDABOUT AT THE INTERSECTION OF BERKLEY PARKWAY AND LYDIA AVENUE, INCLUDING THE ELIMINATION OF THE LEFT TURN LANE FROM EASTBOUND BERKLEY PARKWAY TO NORTHBOUND LYDIA AVENUE
- CONSTRUCTION OF A MEDIAN BREAK AND LEFT TURN LANE ON BERKLEY PARKWAY TO ALLOW VEHICULAR ACCESS BETWEEN FOREST AVENUE AND EASTBOUND BERKLEY PARKWAY
- CONSTRUCTION OF PUBLIC WATER MAINS, SANITARY SEWER MAINS, AND STORM SEWER INFRASTRUCTURE TO SERVICE PARCELS 3 THROUGH 13
- CONSTRUCTION OF WATER, SANITARY SEWER, AND STORM SEWER SERVICE LINES TO SERVICE PARCELS 3 THROUGH 13

PROHIBITED USES

In addition to the applicable prohibited use provisions of the Kansas City, Missouri Development and Zoning Code adopted May 21, 2009 (the "**Development Code**"), the following prohibitions shall apply to the property subject to this MPD, notwithstanding more permissive provisions of the Development Code to the contrary. Although uses related to the land use categories of school, liquor, tobacconist and drive-through are not listed as strictly prohibited uses on the table below, such uses may be limited by covenants and restrictions hereinafter imposed upon the property subject to the MPD.

USE GROUP	
RESIDENTIAL	
Group Living	
	Domestic Violence Residence
	Domestic Violence Shelter
	Group Homes
	Nursing Homes (unassociated with assisted living facilities
PUBLIC/CIVIC	
Day Care	
	Home-based Family (6 and up)
Detention and Correctional Facilities	
Halfway House	
Safety Service	
	Ambulance
	Fire Station
	Police Station (with multi-vehicular response services)
COMMERCIAL	
Adult Business	
Animal	
	Stable
Building Equipment Sales and Service	
Convenience Store (non-neighborhood serving)	
	With fueling station
	Offering the sale of materials and equipment to be used in consuming or preparing illegal substances
Day Labor Employment Agency	
Funeral and Interment Services	
Gasoline and Fuel Sales	
Hookah Bar	
Hospital (Full-service)	
Lodging	
	Manufactured Home Parks
	Motel
	Recreational Vehicle Park
Motion Picture Arcade	

USE GROUP	
Booth	
Office, Medical	
	Blood/plasma center
Parking (non-accessory)	
Pawn Shop	
Retail and Wholesale Sales	
	Automotive Parts
	Firearms and Weapons
Shelter	
Short-Term Loan Establishment	
Transportation	
	Maintenance Facilities
Vehicle Sales and Service	
	Car Wash/Cleaning Service (Free-standing)
	Heavy Equipment Sales/Rental
	Motor Vehicle Repair, General
	Vehicle Storage/Towing
Video Store	
INDUSTRIAL	
Auto Wrecking	
Junk/Salvage Yard	
Manufacturing, Production and Industrial Services	
Mining and Quarrying	
Recycling Service	
Waste-Related Use	
Warehousing, Wholesaling, Freight Movement	
	Exterior
AGRICULTURE	
Animal	
Wireless Communication Facility	
	Freestanding Facility

PLAN SUBMITTAL DATE: 21 MARCH 2014
REVISION - 10 JUNE 2014

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MISSOURI LICENSE NO. 000466 KANSAS LICENSE NO. E-1481
PROFESSIONAL LAND SURVEYING CORPORATION
MISSOURI LICENSE NO. 000094

Port Authority
of Kansas City, Missouri
300 WYANDOTTE, SUITE 100
KANSAS CITY, MO 64105
816.559.3750

BERKLEY RIVERFRONT DEVELOPMENT
PORT AUTHORITY OF KANSAS CITY, MISSOURI
300 WYANDOTTE, SUITE 100
KANSAS CITY, MO 64105
TASK NO. 3013-6-19-3

SEAL

PHASE
ISSUED FOR:
MPD SET - 21 MAR 2014
KCMO COMMENTS - 10 JUN 2014

PROPOSED PHASING PLAN & PROHIBITED USES

C006

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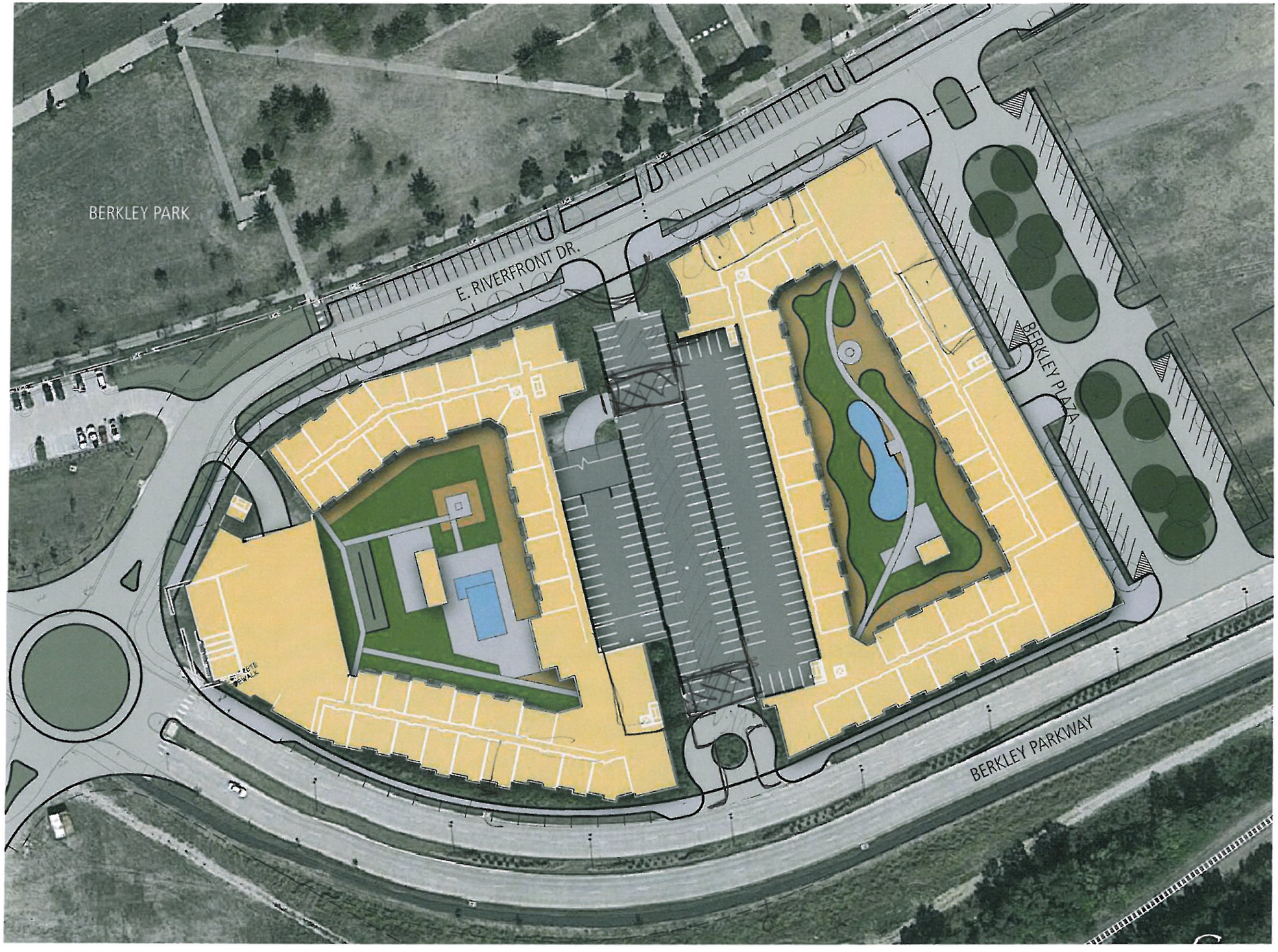
FIGURE 2



apt
BERKLEY PARK

FLAHERTY & COLLINS Properties

NORTH

0 80

LANDFORM
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CUNINGHAM GROUP

RENDERED SITE PLAN

6-4-2014

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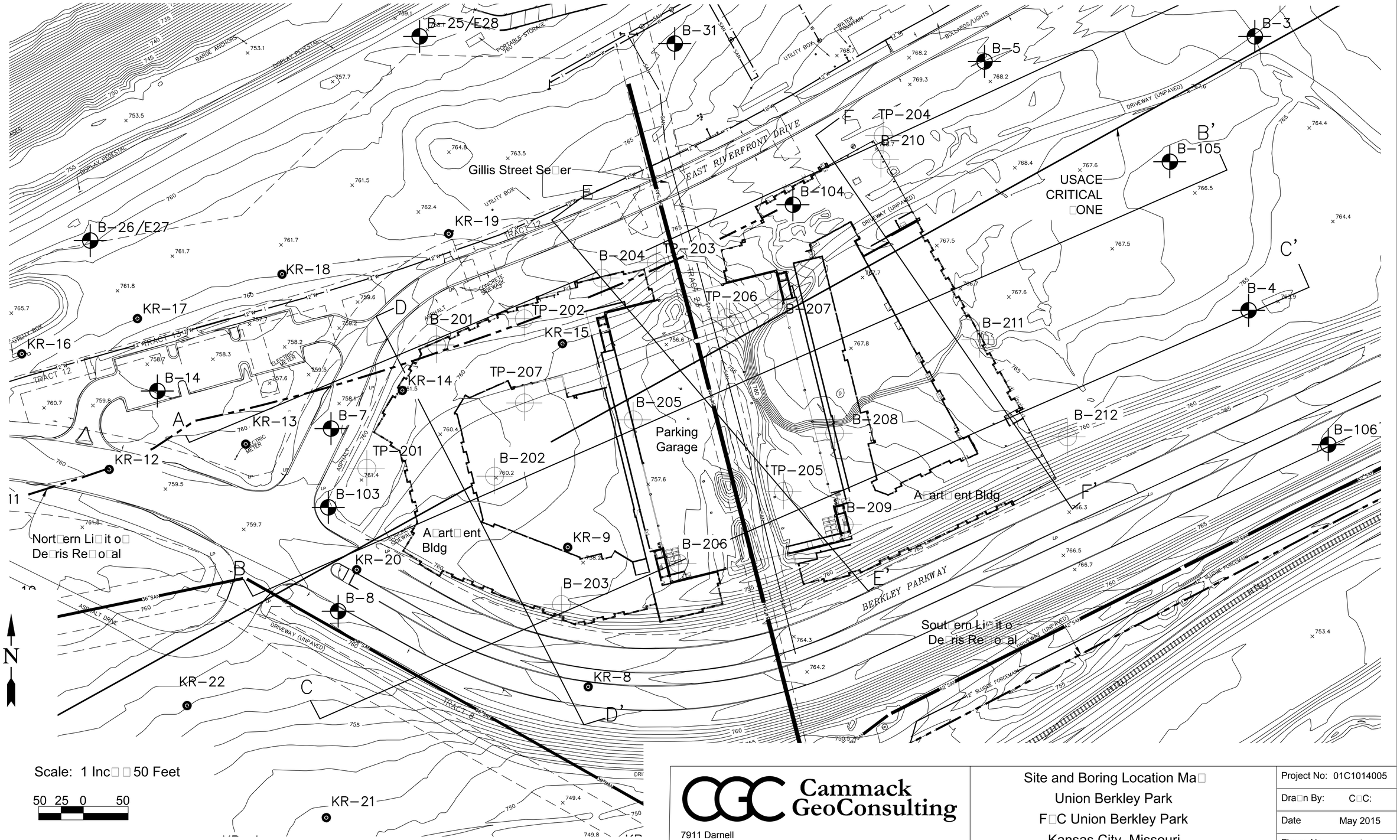
Figure 3



Cammack GeoConsulting

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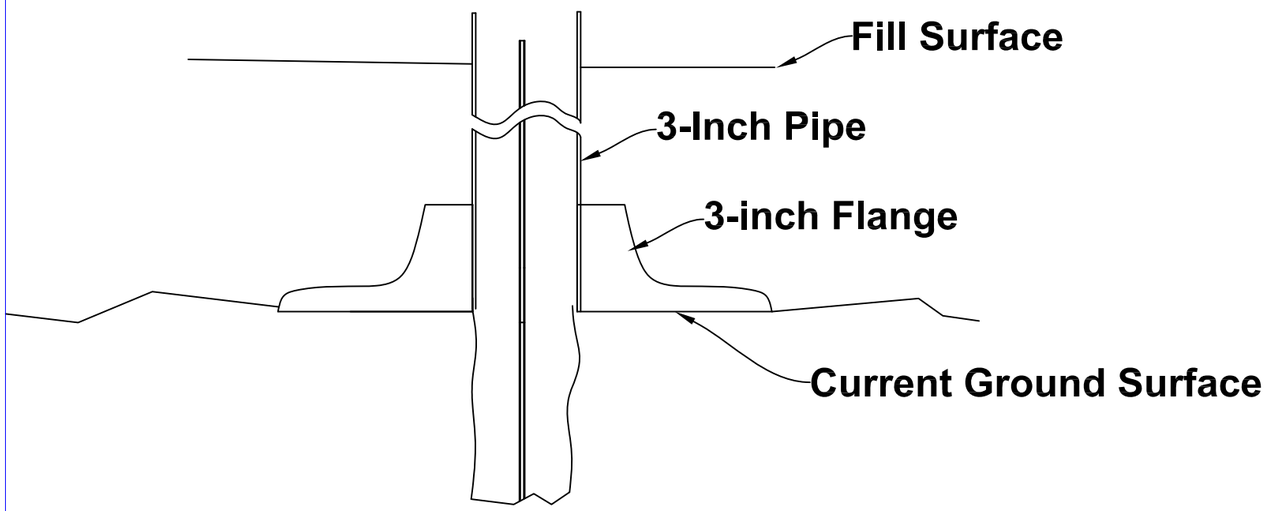
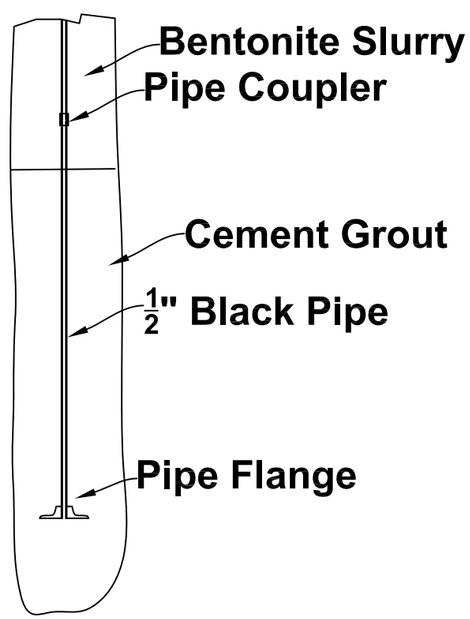
Lenexa, Kansas 66215

Tel: 913-730-8646

Site and Boring Location Ma
Union Berkley Park
F C Union Berkley Park
Kansas City, Missouri

Project No:	01C1014005
Dra n By:	C C:
Date	May 2015
Figure No.	4





Assemble 1/2-inch black pipe sections with couplers after applying Locktite to the coupler threads.

Attach a flange to the bottom of the black pipe

Insert the flange and black pipe into the boring placing the flange between 2 and 3 feet from the bottom of the boring

Place 5 feet of cement grout in the bottom of the boring using a tremie pipe.

Raise the tremie pipe about 5 feet and begin placing bentonite slurry.

Continue placing bentonite slurry to the ground surface.

The top end of the black pipe should protrude above the ground surface at least 1 foot.

General Notes

F&C UNION BERKLEY PARK SETTLEMENT INSTRUMENT

No.	Revision/Issue	Date

Cammack GeoConsulting, P.A.
7911 Darnell Lane
Lenexa, Kansas 66215

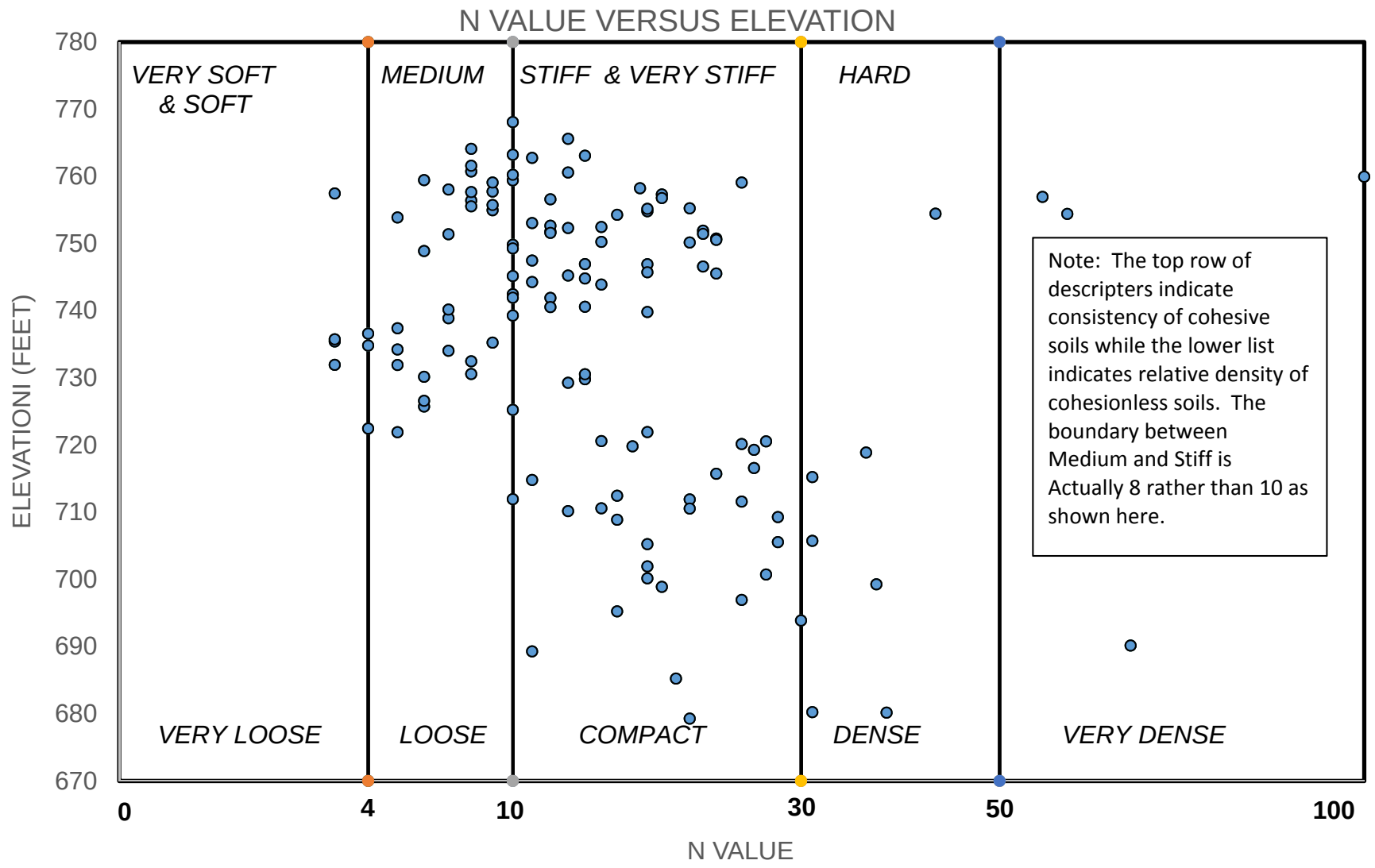
F&C UNION
BERKLEY PARK

Project: 01C2014005

Date

Scale

Sheet 5



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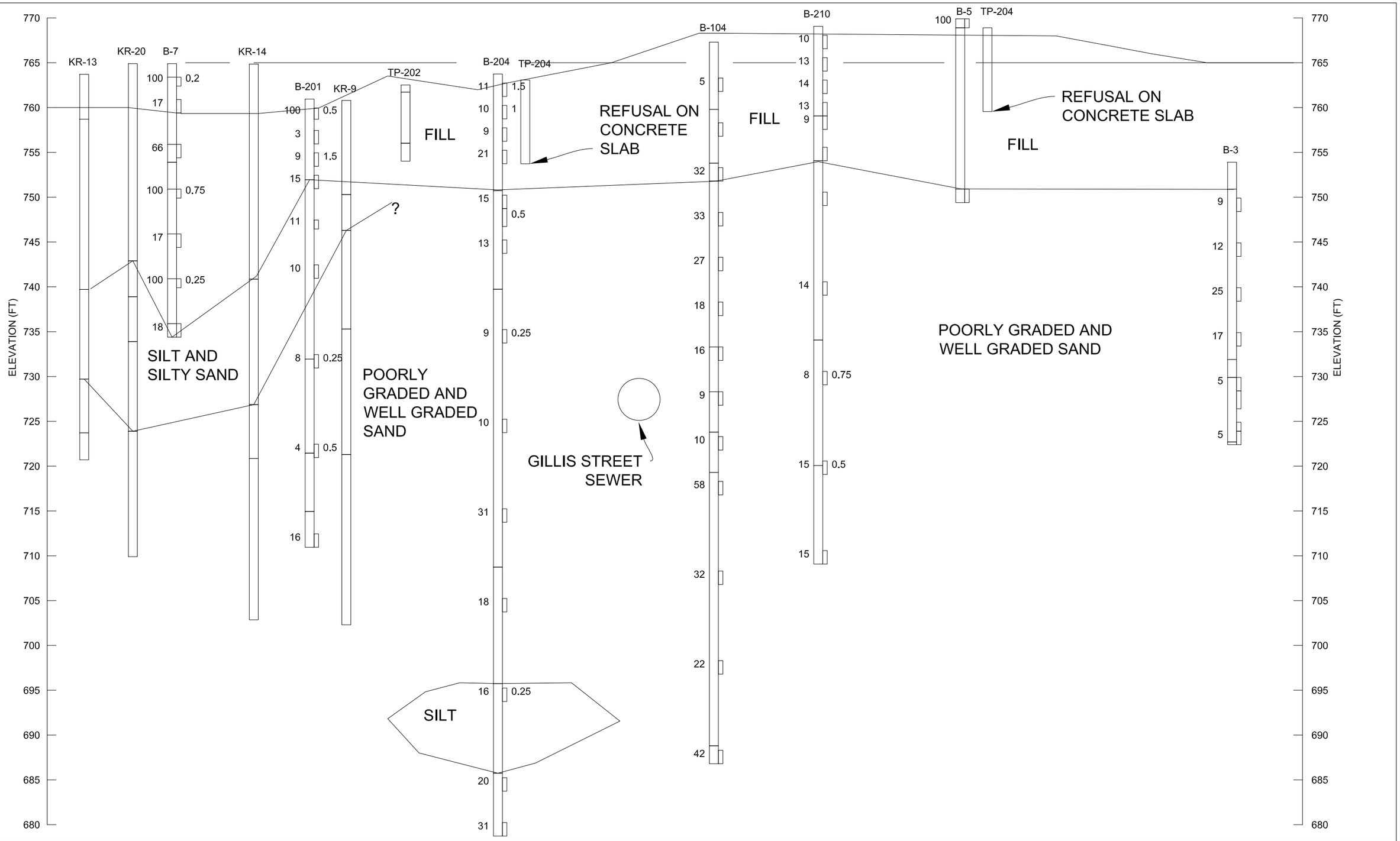
N Values Versus Elevation

Union Berkely Park

Kansas City, Missouri

F&C Union Berkely Park, LLC

Project No:	**01C2015005**
Drawn By:	**CHC**
Date:	**5/26/2015**
Drawing No:	**6**



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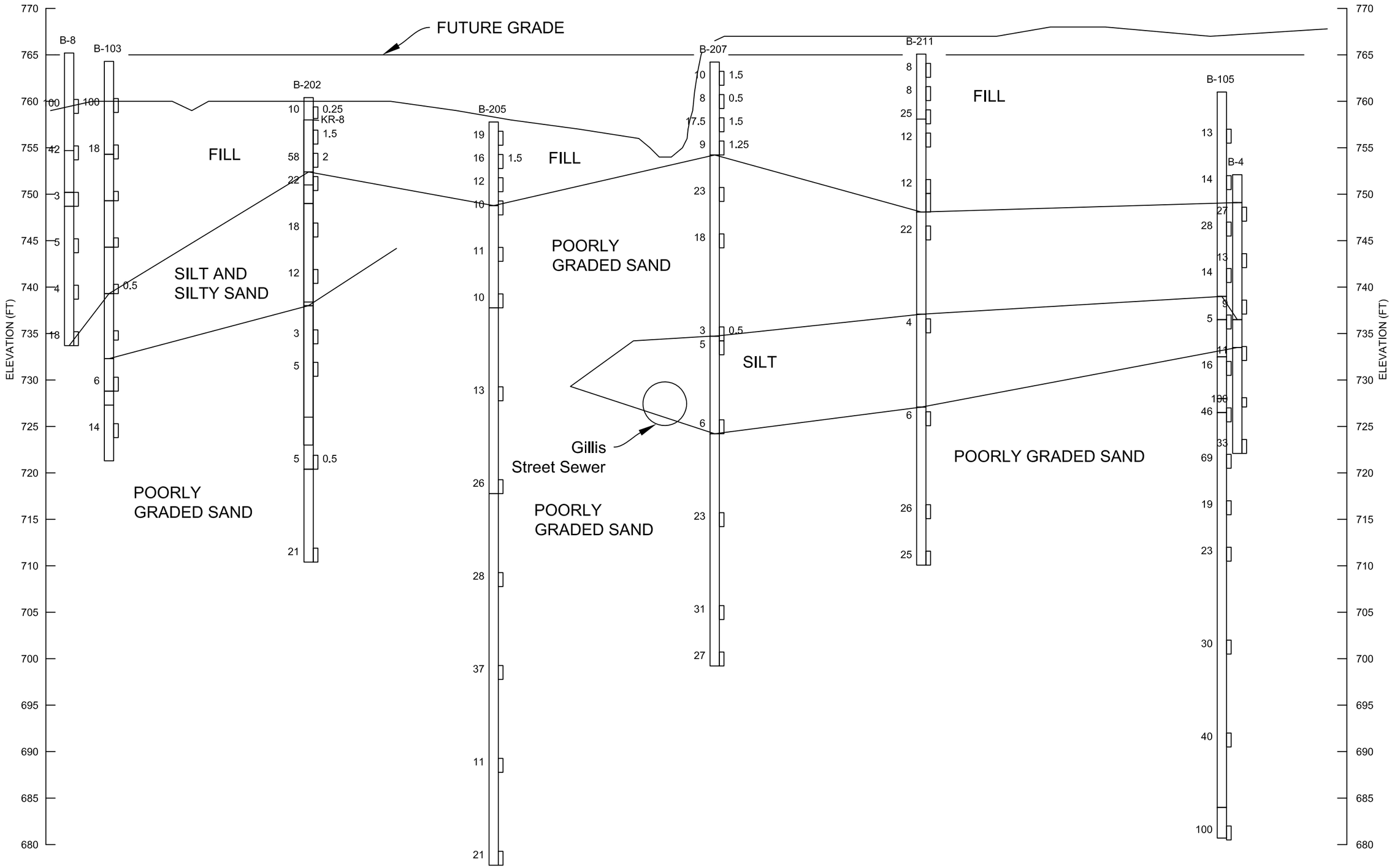
Lenexa, Kansas 66215 913-730-8646

Cross Section A - A'
Union Berkley Park
Kanas City, Missouri

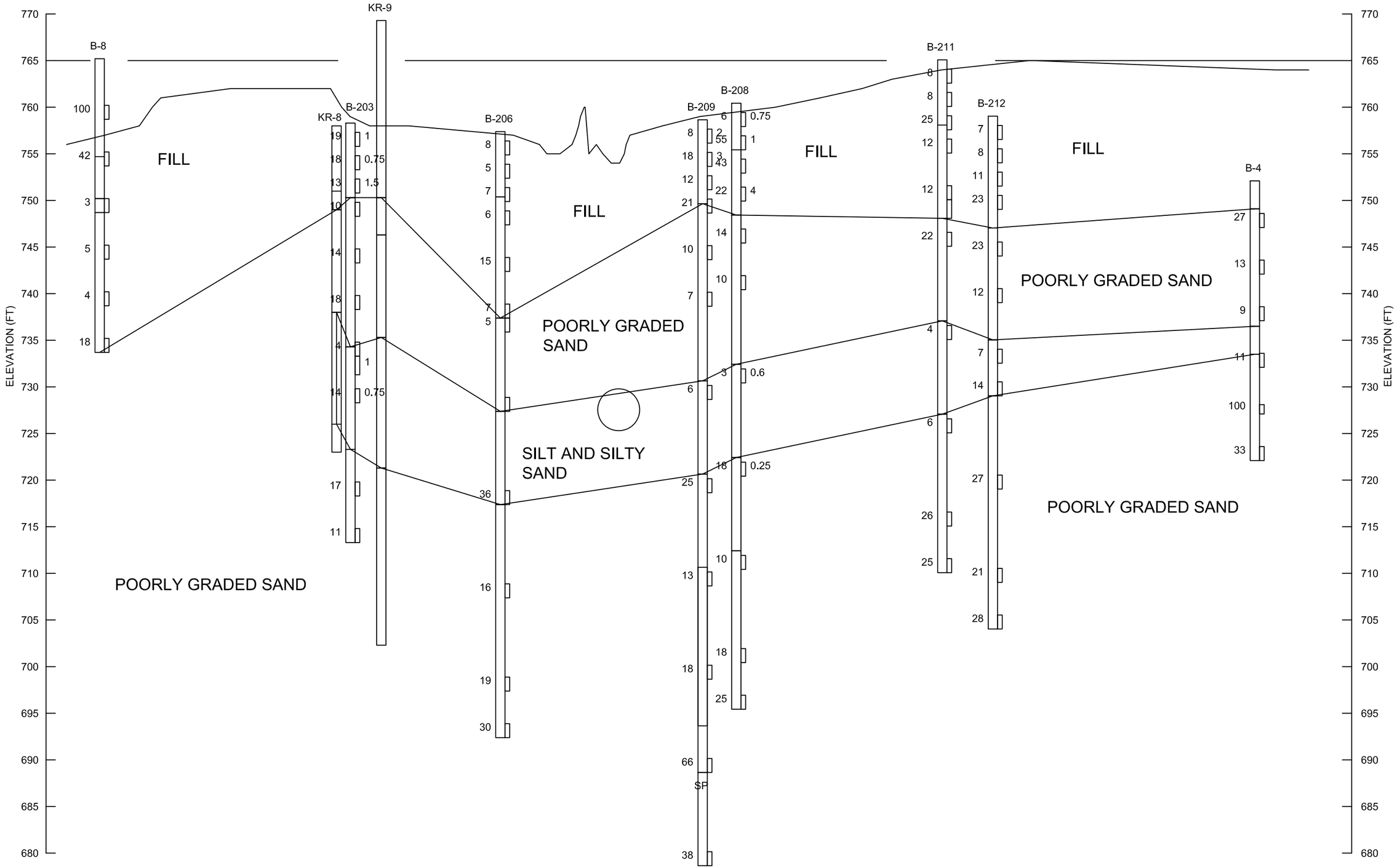
Project No:	01C2014005
Date:	4/20/2015
Figure:	7



Cammack GeoConsulting
7911 Darnell Lane
Lenexa, Kansas 66215 913-730-8646

Cross Section B - B'
Union Berkley Park
Kanas City, Missouri

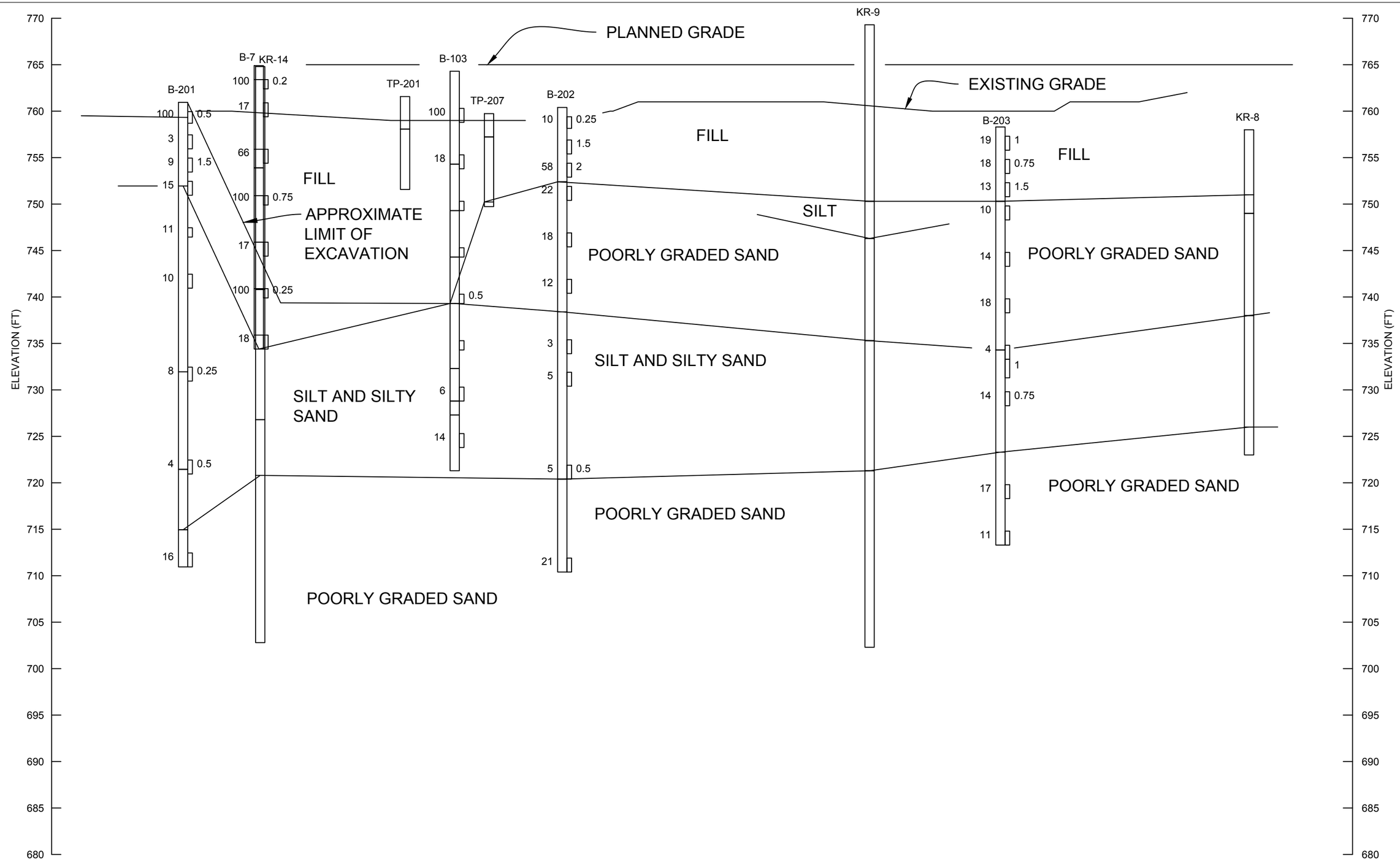
Project No:	01C2014005
Date:	4/20/2015
Figure:	8



Cammack GeoConsulting
7911 Darnell Lane
Lenexa, Kansas 66215 913-730-8646

Cross Section C - C'
Union Berkley Park
Kanas City, Missouri

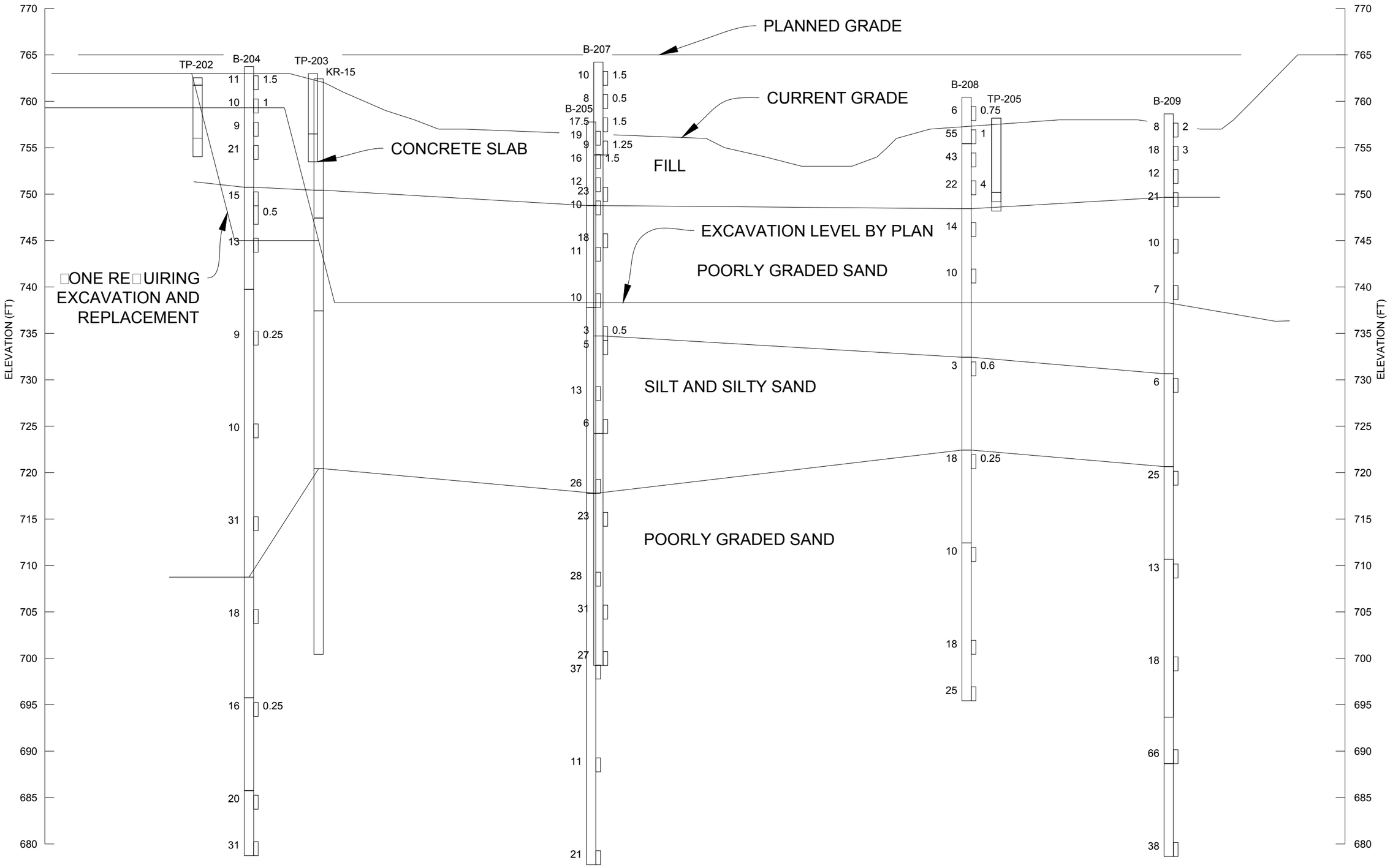
Project No:	01C2014005
Date:	4/20/2015
Figure:	9



Cammack GeoConsulting
7911 Darnell Lane
Lenexa, Kansas 66215

Cross Section D - D'
Union Berkley Park
Kanas City, Missouri

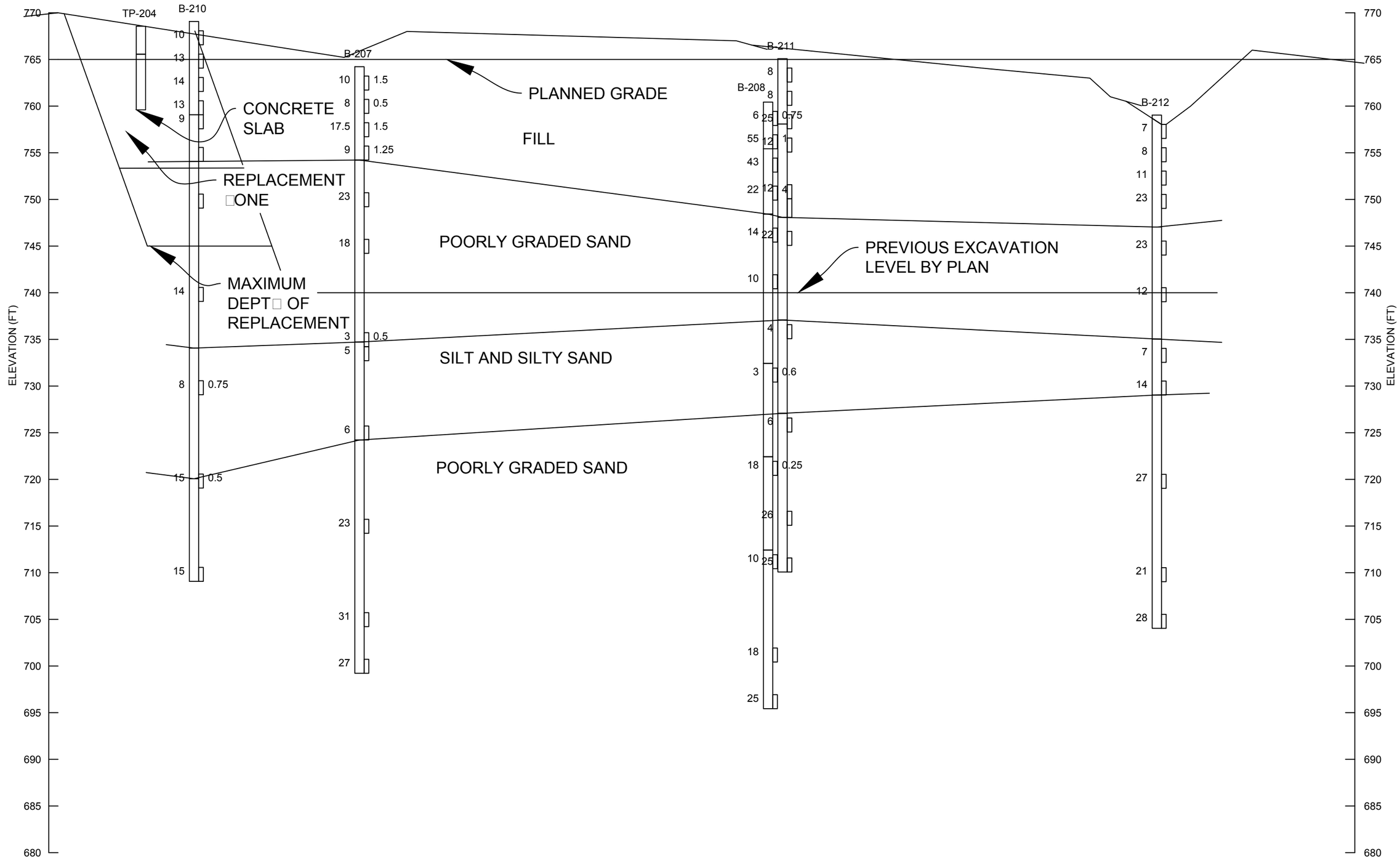
Project No:	01C2014005
Date:	4/20/2015
Figure:	10



Cammack GeoConsulting
7911 Darnell Lane
Lenexa, Kansas 66215

Cross Section E - E'
Union Berkley Park
Kanas City, Missouri

Project No:	01C2014005
Date:	4/20/2015
Figure:	11



Cammack GeoConsulting
7911 Darnell Lane
Lenexa, Kansas 66215

Cross Section F - F'
Union Berkley Park
Kanas City, Missouri

Project No:	01C2014005
Date:	4/20/2015
Figure:	12

APPENDIXES

CPT DATA

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: May 20, 2002

From: Harvey Cohen and Steve Larson

To: Dan Evans, Kingston Environmental

Subject: ROST Probe Study at Riverfront Property

This memo presents results and conclusions of the CPT/ROST Probe study conducted at the Kansas City Riverfront Property from March 25-29, 2002. In addition to the figures and tables that comprise part of this memo, three additional sets of information are attached:

- Attachment A: Data Report on the CPT/ROST Testing by Fugro Geosciences, dated April 5, 2002
- Attachment B: Analytical data sheets for confirmatory soil samples from the ROST Probe locations
- Attacment C: Field Log of well KMW-13 (Interval 30 – 50 ft depth)

Introduction

From March 25 through March 29, 2002, Fugro Geosciences conducted a site investigation on and adjacent to the Riverfront development property in Kansas City, MO under the supervision of S.S. Papadopulos & Associates (SSP&A) and Kingston Environmental. The purpose of this investigation was to delineate the horizontal and vertical extent of a smear zone of hydrocarbons known to exist at the site.

Previous site investigations, including soil sampling, groundwater sampling, and prior deployment of the CPT/ROST probe system, had determined that hydrocarbons derived from former manufactured gas operations were present in the subsurface. On the basis of soil borings and test pits, it had been determined that some of these hydrocarbons were present around the top of the saturated zone (water table). Where hydrocarbons are present as a separate phase in soils, those less dense than water tend to accumulate as a layer atop the water table. With seasonal and decadal fluctuations of the water table, hydrocarbons from this layer become trapped within soils across a vertical zone known as a smear zone. This zone, straddling the water table, becomes a continuing source of dissolved contamination to groundwater. It may also be a source of vapors to the unsaturated zone.

Based upon the extent of soil/groundwater contamination observed in previous investigations, twenty-two (22) locations were identified for investigation with the CPT/ROST probe. These define a coarse grid, approximately ~700 x 700 feet in dimensions. Following approval by MDNR, the investigation was completed as detailed in the Work Plan of February 28, 2002.

7944 Wisconsin Avenue, Bethesda, Maryland 20814-3620 • Tel: (301) 718-8900 • Fax: (301) 718-8909
www.sspa.com • e-mail: bethesda@sspa.com

CPT/ROST Probe – Technical Background

The Rapid Optical Screening Tool (ROST) is an in-situ laser-induced fluorescence (LIF) technique owned and operated by Fugro Geosciences Inc. It uses a laser to cause fluorescence in aromatic hydrocarbons that may be present in the soil, and then measures the response. This tool is deployed as part of a cone penetrometer test (CPT) assembly and provides a continuous record of LIF as it is pushed into the soil. Standard CPT output, including sleeve friction, tip resistance, calculated soil type, and pore pressure are collected simultaneously with the ROST probe data. These data are compiled into a single log for each location, and presented in graphic format (see Attachment A). Electronic files with ROST and CPT data, and software for viewing the ROST data, were provided to SSP&A by Fugro Geosciences after completion of the field investigation.

The ROST probe uses a tunable ND-YAG dye laser to create the excitation pulses. From the source unit in the CPT truck, the laser light is transmitted through the CPT rod assembly via optic cables, and exits the tool through a sapphire window. Resulting fluorescence is collected through the window, returned to the vehicle, and analyzed at four (4) wavelengths: 340, 390, 440, and 490nm. The total intensity at each point is also recorded. In general, lighter hydrocarbons fluoresce at lower wavelengths than do heavier hydrocarbons. Comparison of unknown data to example wavelength spectra from known hydrocarbon types can provide information on the types of hydrocarbons present.

For this study, an excitation wavelength of 290 nm was used. At this wavelength, aromatic hydrocarbons of two or more rings are expected to fluoresce. The ROST calibration standard was "M1", and total intensity results are presented in terms of percent fluorescence relative to this standard.

Site Investigation – Background

Much of the Riverfront development site is underlain by coarse fill, including concrete rubble and poured concrete, through which the CPT probe cannot push. Therefore, prior to the CPT/ROST study, four-inch diameter borings were completed and cased with PVC at fifteen (15) locations. These holes were completed at depths anticipated to be below coarse rubble, but above the water table. The CPT truck was then positioned over these holes, and the probe advanced thought the cased interval. The details of each hole's construction are presented in Table 1. In some cases, depending upon the physical characteristics of the soils/fill, a 3.75 inch, temporary steel casing was advanced with the CPT/ROST probe in order to provide additional lateral support for the CPT rod.

As planned, twenty-two (22) ROST probe locations were completed. These are shown on Figure 1. The total depths of these holes varied from twenty-four (24) to seventy-nine (79)

feet. Locations KR-1, 2, 4, 5, 6, and 21 are located near the area of ROST investigation previously completed by Environmental Operations, Inc., and CH2M-Hill.

Results – Stratigraphy and Groundwater

As anticipated, the upper 25-40 feet of material encountered under the Riverfront site consists of relatively fine-grained soils and fill (silts and clays, with some sands) interspersed with concrete and/or other hard rubble. In several of the probe locations (e.g. KR-17), hard rubble was encountered below the level of the pre-cased interval, but the CPT was able to advance through, or push aside these apparently small-scale obstacles.

In those probe holes that advanced sufficiently deep (e.g. KR-5), a sand layer was encountered at depths of 30 to 40 feet below the surface. This sand is at least 20 feet thick, and likely continues beyond the maximum depth tested here. The CPT stratigraphy of the site is portrayed in two cross sections (Figures 2 and 3) trending East-West and North-South across the site.

Measurements from monitoring wells indicate that water table is encountered between depths of about 20 to 60 feet below the surface. In general, groundwater elevations decrease northerly, toward the river. Water levels are somewhat lower under the poured-concrete mound on the eastern part of the site (e.g. near location KR-9 on Figure 1). The CPT piezocone response suggests that water is present as shallow as 10 feet in some probe locations. Several "perched" intervals of groundwater may also be present at varying depths within the fine-grained materials, particularly under the eastern, cement-covered portion of the site. Within the deeper sandy layer penetrated at locations KR-21, KR-20, and KR-5, the CPT pore pressure response indicates a more homogeneous sand without significant confining intervals.

ROST LIF Results

Laser-induced fluorescence above background levels was encountered in every location, although the magnitude and persistence of the signal with depth varied from hole to hole. In general, a clear LIF signal was observed at depths associated with the top of the saturated zone. The magnitude of these signals, and the thickness over which they were observed were greatest in the areas of KR-5, KR-6, and KR-21. In contrast, at the eastern and western edges of the investigation, the LIF signal was relatively weak and thin (e.g. KR-1, KR-19)

In many locations, LIF peaks were encountered at multiple depths. For example, at location KR-5, a strong LIF peak (up to ~24% of the calibration standard M1) was encountered at depths of ten to twenty three feet. Signals at or just above background dominated through the next fifteen feet of soils, and a strong LIF signal was again encountered coincident with the top of sand at about forty feet depth.

The fluorescence waveform characteristics are similar in soils across the site (excluding depths within and immediately under the PVC-cased intervals). The waveform profile is typically dominated by strong peaks for the two highest wavelengths, with decreasing magnitudes for the lower two wavelengths. This waveform response is very similar to the Coal Tar/Creosote signature, as illustrated by Fugro Geosciences (see Attachment A).

Results - Confirmatory Sampling

Following completion of the ROST probe investigation, fifteen soil samples were collected for the purposes of laboratory confirmation of the ROST results. The sample depths were chosen to represent the full range of observed LIF intensity response. Using a direct-push (geoprobe-type) system, Kingston Environmental collected these soil samples immediately adjacent to selected ROST probe locations. The analytical results are presented in Tables 2 and 3.

The LIF response and TPH-diesel-range organics concentrations are compared in Figure 4. A direct correlation between LIF response and TPH concentration is not observed. This is not unexpected, as the ROST response to heavy hydrocarbons associated with the heavier PAHs is not linear (Bujewski and Rutherford, 1997; Randy St. Germain, pers. comm. 2002). In addition, interferences from non PAH fluorescence, the effects of varying grain size, soil type, and moisture content may all affect the fluorescence intensity.

There is, however, a clear threshold level above which LIF responses are correlated with significant concentrations of TPH. For illustration, Figure 4 displays the current Missouri Scenario "A" CALM limit for TPH of 200 ppm. It is clear that LIF responses above about 1-2% correspond to concentrations of TPH likely to exceed this Tier I cleanup level.

In April 2002 a new groundwater monitoring well, KMW-13, was installed in the vicinity of KR-17 (Figure 1). On the basis of the ROST log for KR-17, a depth interval of thirty-eight to forty feet was identified as a likely hydrocarbon zone. During the course of drilling, on April 18, 2002, a soil sample was collected from this interval. The drilling log for this interval identifies it as a dark grey clayey silt to clay, with an organic odor (Attachment C). Laboratory analysis of this soil sample found 1,160 mg/kg of TPH-diesel, and fifteen of sixteen PAH's above their detection limits (Table 2). BTEX, including 1,060 ug/kg benzene was also detected in this sample.

Interpretation – Smear Zone

The ROST probe is a screening tool, designed to rapidly determine the presence of hydrocarbons in the subsurface. The results presented above clearly document the presence of

hydrocarbons typical of former manufactured gas sites in soils, with a laterally persistent zone present around the top of the saturated zone. Based upon the confirmatory sampling, this interval is likely to represent hydrocarbons with a TPH concentration greater than 200 ppm. We interpret this as the smear zone of hydrocarbons associated with the former manufactured gas operations.

The thickness and lateral extent of this smear zone are presented in Figure 5 and on the cross-sections, Figures 1 and 2. The blue outline on Figures 5 and 6b approximates the limits of the smear zone within the Riverfront Development Property. The northern and southern boundaries are defined by Riverfront Drive and the railroad tracks, respectively. The eastern and western boundaries are defined by the estimated extent of the observed smear zone and the proposed Gillis Street extension.

Based upon these data it is clear that the smear zone extends at least as far north as the area of KR-17. Since shallow groundwater in this location discharges to the river, it likely that this zone extends as far as the edge of the Missouri River, approximately 300 feet further north.

It is also important to note that the ROST probe results indicate contamination with hydrocarbons both shallower and deeper than this smear zone. For example, in location KR-13, the prominent hydrocarbon interval at ~35-37 feet depth was interpreted as the smear zone due to its total intensity and relationship with water levels. However, a shallower zone of lower intensity fluorescence (from about 27-31 feet) was also present. In the area of KR-5, hydrocarbons are present in the sand at depths of 40-60 feet. Although there are limited data, it appears that this deeper contamination is present at least as far north as KR-20.

Figures 6a and 6b present two additional views of the smear zone and the soil that overlies it. The smear zone within the blue boundary depicted in Figures 5 and 6 has a volume of approximately 86,000 cubic yards. The volume of soil overlying the top of the smear zone in this area is approximately 457,000 cubic yards.

Reference:

Bujewski, Grace, and Brian Rutherford, 1997, The Rapid Optical Screening Tool (ROST™) Laer-induced Fluorescence (LIF) System for Screening of Hydrocarbons in Subsurface Soils, US EPA Innovative Technology Verification Report, 58 pp.

FUGRO GEOSCIENCES, INC.

6105 Rookin
Houston, TX 77074
Phone: 713-346-4000
Fax: 713-346-4002

April 5, 2002
Report Number: 0305-0710

Kingston Environmental Services
15450 Hangar Road
Kansas City, MO 64147

Attn.: Mr. Dan T. Evans

DATA REPORT
CPT/ROST™ TESTING
AND RELATED SERVICES
RIVERFRONT DEVELOPMENT SITE
KANSAS CITY, MISSOURI

Dear Mr. Evans:

Fugro Geosciences (Fugro) is pleased to present this data report for Cone Penetration (CPT) and Rapid Optical Screening Tool (ROST™) testing at the above-referenced site. CPT/ROST™ provided continuous characterization of stratigraphy and petroleum hydrocarbon distribution at the testing locations. A description of the CPT and ROST™ technologies and a discussion of general ROST™ data interpretation follows. CPT and ROST™ logs and electronic data diskette(s) are included as attachments.

Cone Penetration Testing

CPT was performed simultaneously with each ROST™ sounding and yielded real-time stratigraphic data. CPT is a proven method for rapidly evaluating the physical characteristics of unconsolidated soils. It is based on the resistance to penetration of an electronically-instrumented cone which is continuously advanced into the subsurface. In accordance with ASTM Standard D5778-95, the cone was advanced at a rate of two centimeters per second with the driving force provided by hydraulic rams.

The CPT cone used at this site had an apex angle of 60 degrees with a base area of 15 square centimeters (cm^2), and friction sleeve with a surface area of 200 cm^2. The standard geotechnical sensors within the cone measure tip resistance and sleeve friction in tons per square foot (TSF). The combined data from the tip resistance and sleeve friction form the basis of the soil classification (e.g., sand, silt, clay, etc.).

Soil stratigraphy was identified using Campanella and Robertson's Simplified Soil Behavior Chart. Please note that because of the empirical nature of the soil behavior chart, the soil identification should be verified locally.

ROST™ Testing

Fugro Geosciences' ROST™ Laser-Induced Fluorescence system was used for this investigation to screen soils for petroleum hydrocarbon materials containing aromatic hydrocarbon constituents. The system consists of a tunable laser mounted in the CPT truck that is connected to a down-hole sensor. The down-hole sensor consists of a small diameter sapphire window mounted flush with the side of the cone penetrometer probe.

The laser and associated equipment transmit 50 pulses of light per second to the sensor through a fiber optic cable. The wavelength of the pulsed excitation light is tunable and can be set to wavelengths of 266 nanometers (nm) or to wavelengths between 280 and 300 nm. An excitation wavelength of 290 nm was used for each test during this project.

The laser light passes through the sapphire window and is absorbed by aromatic hydrocarbon molecules in contact with the window, as the probe is advanced. This addition of energy (photons) to the aromatic hydrocarbons causes them to fluoresce. A portion of the fluorescence emitted from any encountered aromatic constituents is returned through the sapphire window and conveyed by a second fiber optic cable to a detection system within the CPT rig. The emission data resulting from the pulsed laser light is averaged into one reading per one second interval (approximately one reading per 2 cm vertical interval) and is recorded continuously. ROST™ may be operated in single or multi-wavelength mode, depending on project objectives. For this project, ROST™ was operated in multi-wavelength mode (MWL).

Multi-Wavelength Mode (MWL). In MWL mode, the emitted fluorescence is measured simultaneously at four monitoring wavelengths (340, 390, 440, and 490 nm). The four monitoring wavelengths cover the range of light produced by light fuels through heavy contaminants such as coal tar and creosote and enhance detection of widely ranging product types. The emission data is reported continuously as a total of the fluorescence intensity recorded at each of the four wavelengths. The total fluorescence intensity data is presented in real-time on a computer monitor as a graph of fluorescence intensity versus depth (FVD).

The relative percentage of fluorescence measured at each of the monitoring wavelengths (340, 390, 440, and 490 nm) is plotted continuously on the ROST™ logs as four continuous "color bands". The width of each color band represents the relative percentage of fluorescence emitted by the contaminant at each of the monitoring wavelengths (340, 390, 440, and 490 nm). For general interpretation purposes, lighter aromatic hydrocarbon molecules will emit fluorescence at shorter wavelengths and heavier, longer chained hydrocarbons will emit fluorescence at longer wavelengths.

By comparing the relative percentage ratios generated by known product samples with field data, interpretations of product type can often be made. Utility of product identification is often dependent on the degree of similarity between the reference product and the in-situ product composition.

Reference Solution. The fluorescence intensity of a reference solution placed on the sapphire window was measured immediately prior to conducting each test. This reference solution measurement serves two purposes. First, as a quality control check, the solution is used to ensure that the performance of the system is within specifications. Second, it allows for normalization of the data from different test locations for variation in laser power, operating conditions, and monitored emission wavelength. The reference solution used for this project was the standard M1 reference, which is a proprietary PHC containing solution. M1 provides consistent fluorescence response across the portion of the spectrum analyzed by ROST and therefore, allows the fluorescence data collected to be consistently normalized to intensities recorded as a percentage of M1.

LIMITATIONS OF ENVIRONMENTAL SUBSURFACE WORK

Fugro Geosciences' report is based upon our observations made during field work, the information provided to Fugro and the results of the ROST/CPT survey. Given the inherent limitation of environmental subsurface work, Fugro can not guarantee that the site is free of hazardous or potentially hazardous materials or conditions or that latent or undiscovered conditions will not become evident in the future. Fugro's report was prepared in accordance with our proposal and the General Conditions agreed to between Fugro and Client and no warranties, representations, or certifications are made.

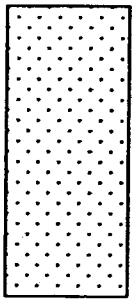
Fugro Geosciences, Inc. appreciates the opportunity to be of service to your organization. Please do not hesitate to contact us if we can be of further assistance. We look forward to working with you in the future.

Sincerely,
FUGRO GEOSCIENCES, INC.

Recep Yilmaz
President

RY/jm

KEY TO SOIL BEHAVIOR TYPE



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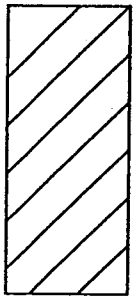
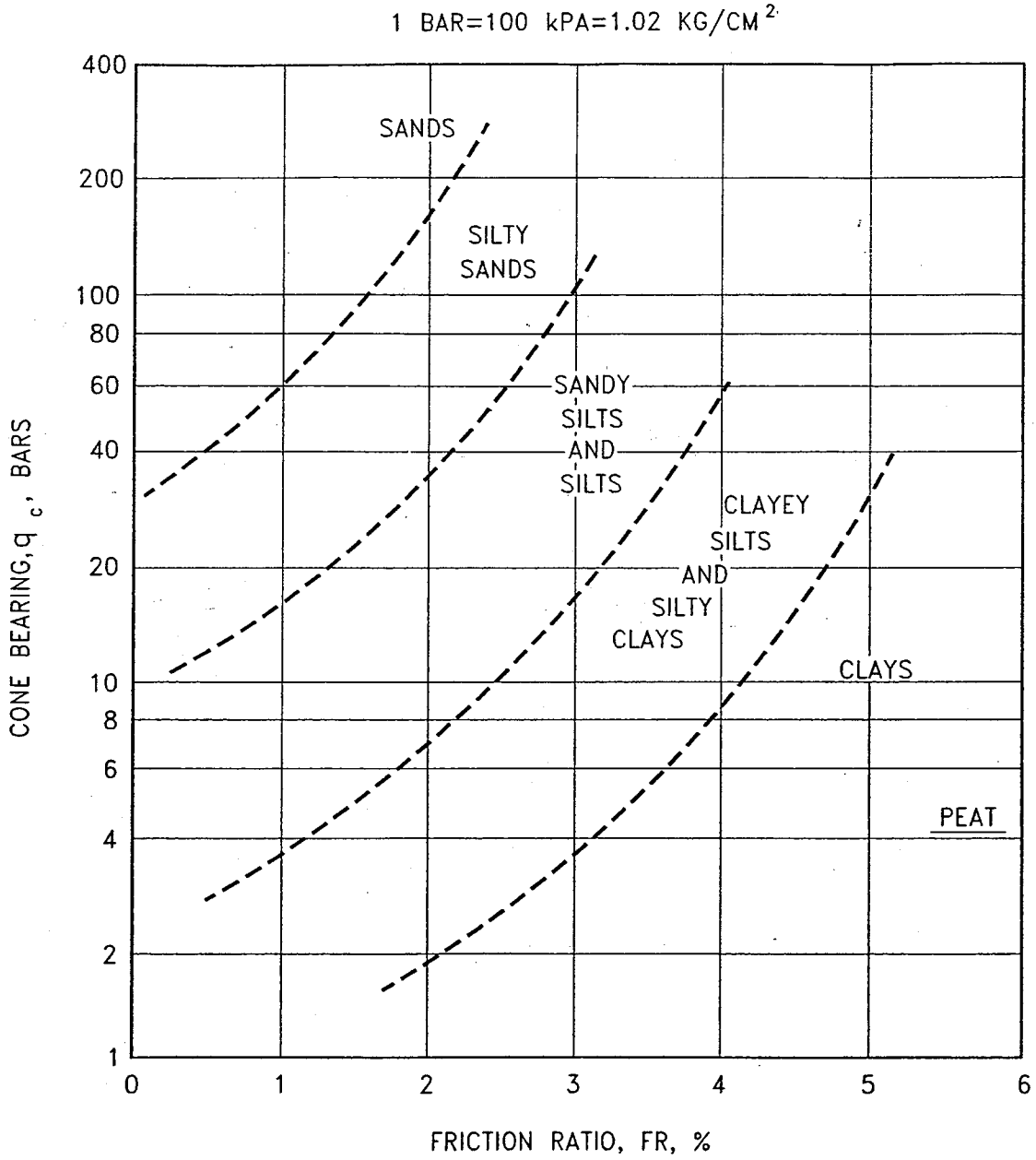


CLAY AND CLAYEY SOIL

SILT AND SILTY SOIL

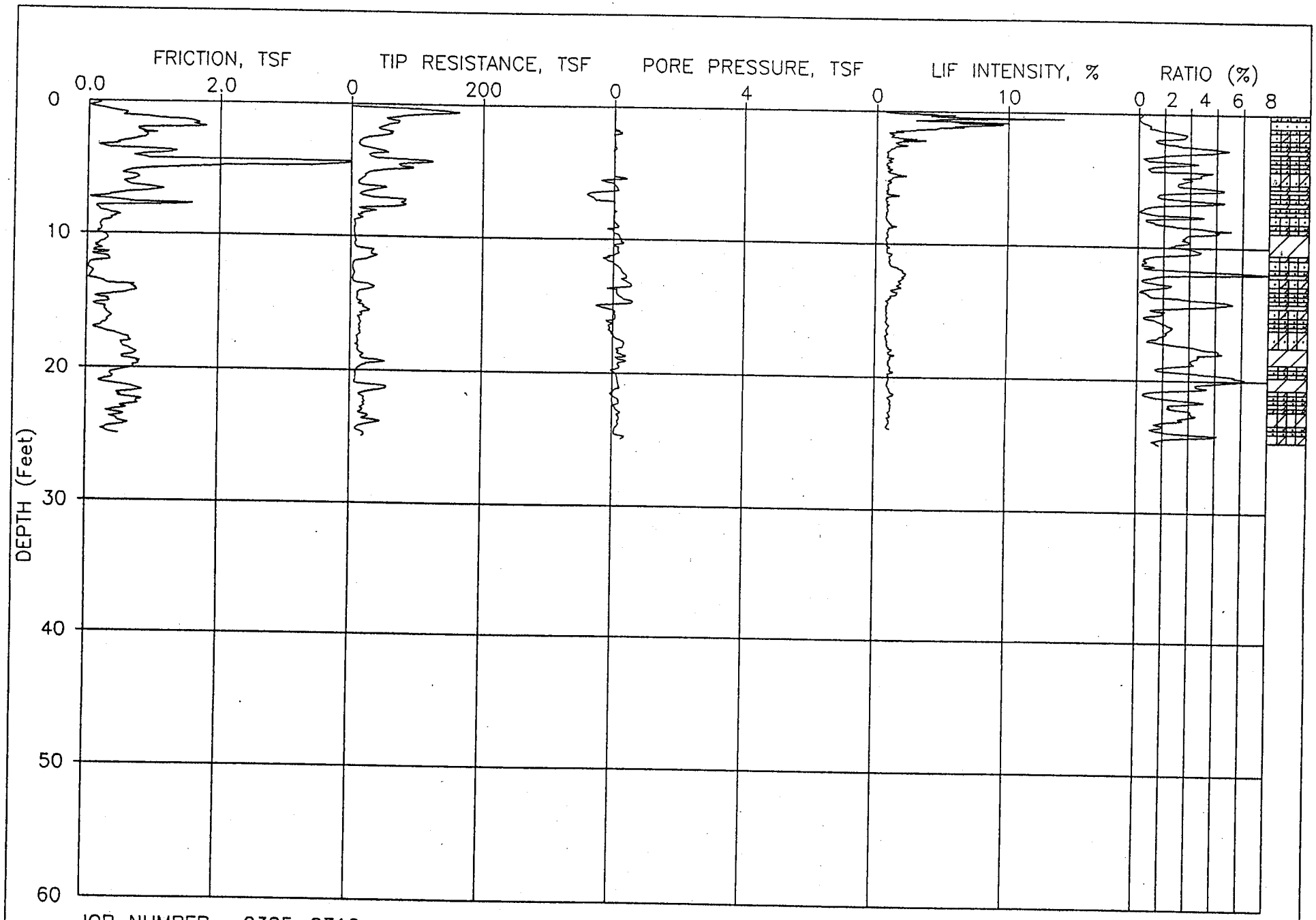


CAMPANELLA AND ROBERTSON SOIL BEHAVIOR CHART (1983)

The following CPT/ROST™ tests were pushed through an open hole at various depths:

KR03 casing at 11.8 ft
KR08 casing at 8.5 ft
KR09 casing at 21.0 ft
KR10 casing at 15.9 ft
KR11 casing at 18.9 ft
KR12 casing at 18.9 ft
KR13 casing at 24.0 ft
KR14 casing at 24.0 ft
KR15 casing at 23.2 ft
KR16 casing at 24.2 ft
KR17 casing at 27.4 ft
KR18 casing at 18.2 ft
KR19B casing at 13.7 ft
KR20 casing at 22.0 ft
KR22 casing at 14.0 ft

CPT LOGS



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ELEVATION: 0.00

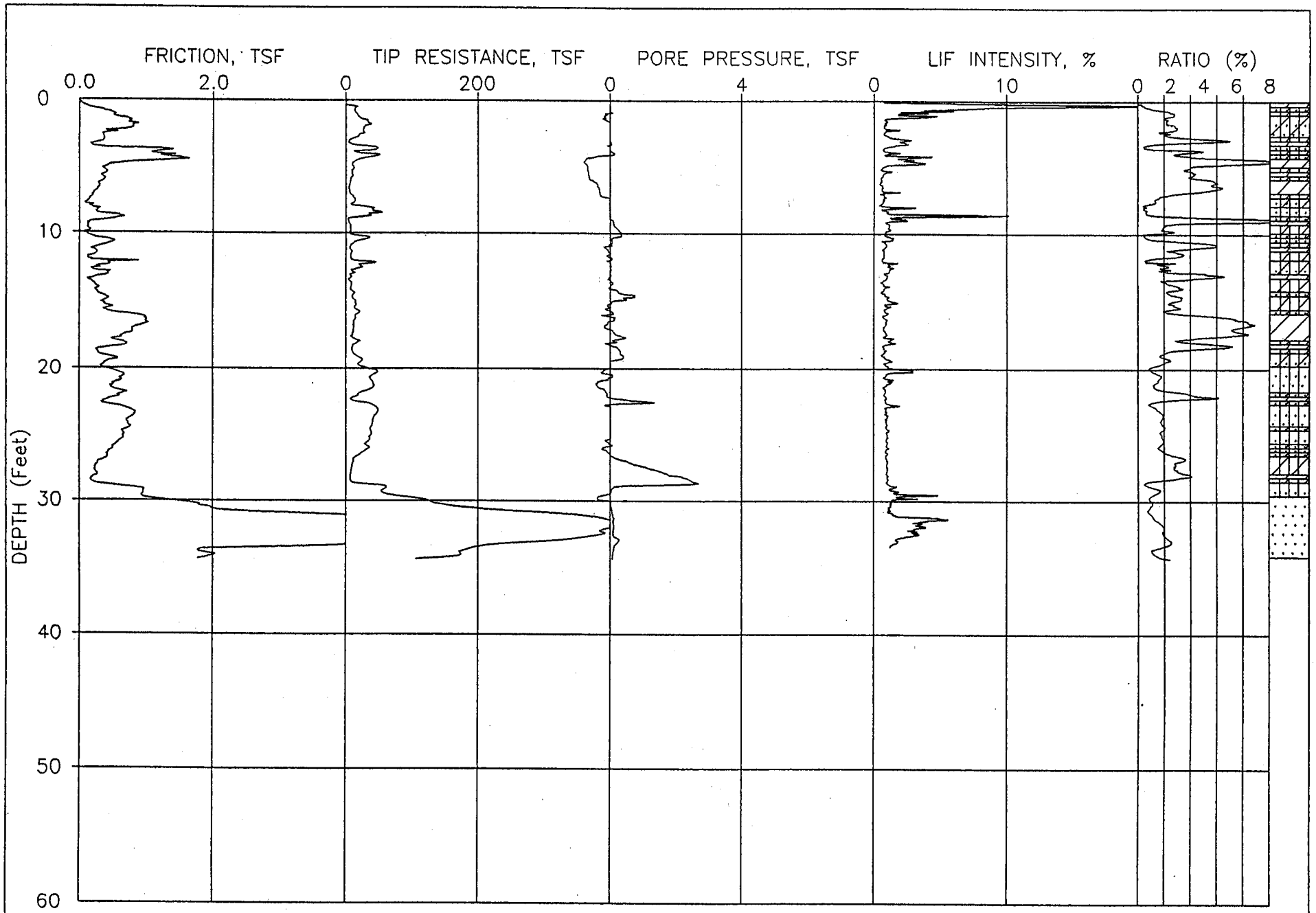
CPT NUMBER: KR-01

CONE NUMBER: F7.5CKEW1133

DATE: 03-26-2002

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: KR-02

DATE: 03-27-2002

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CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

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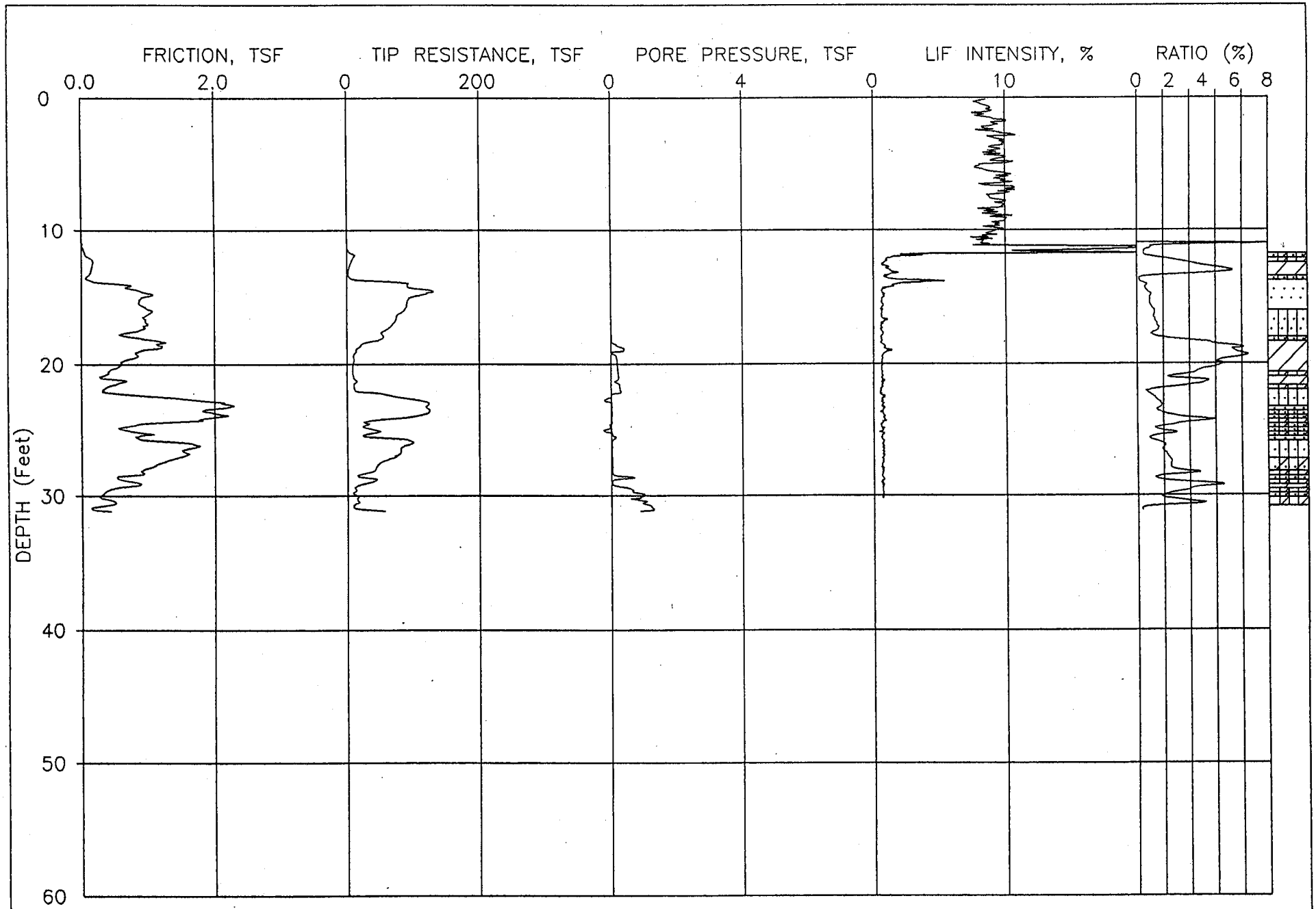

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ELEVATION: 0.00 CONE NUMBER: F7.5CKEW1133 PLATE: 1 OF 1

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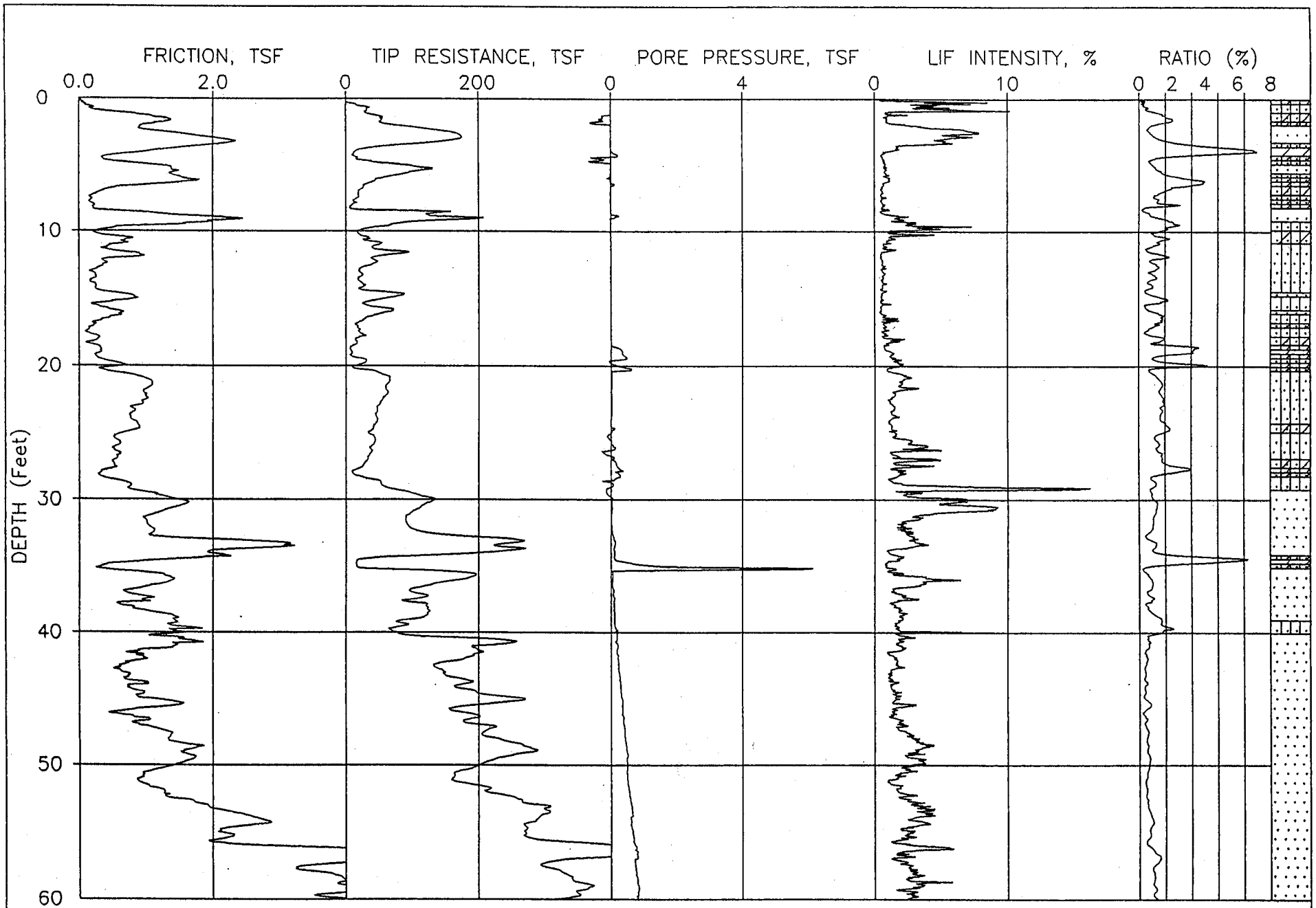

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CPT NUMBER: KR-04

DATE: 03-27-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 2

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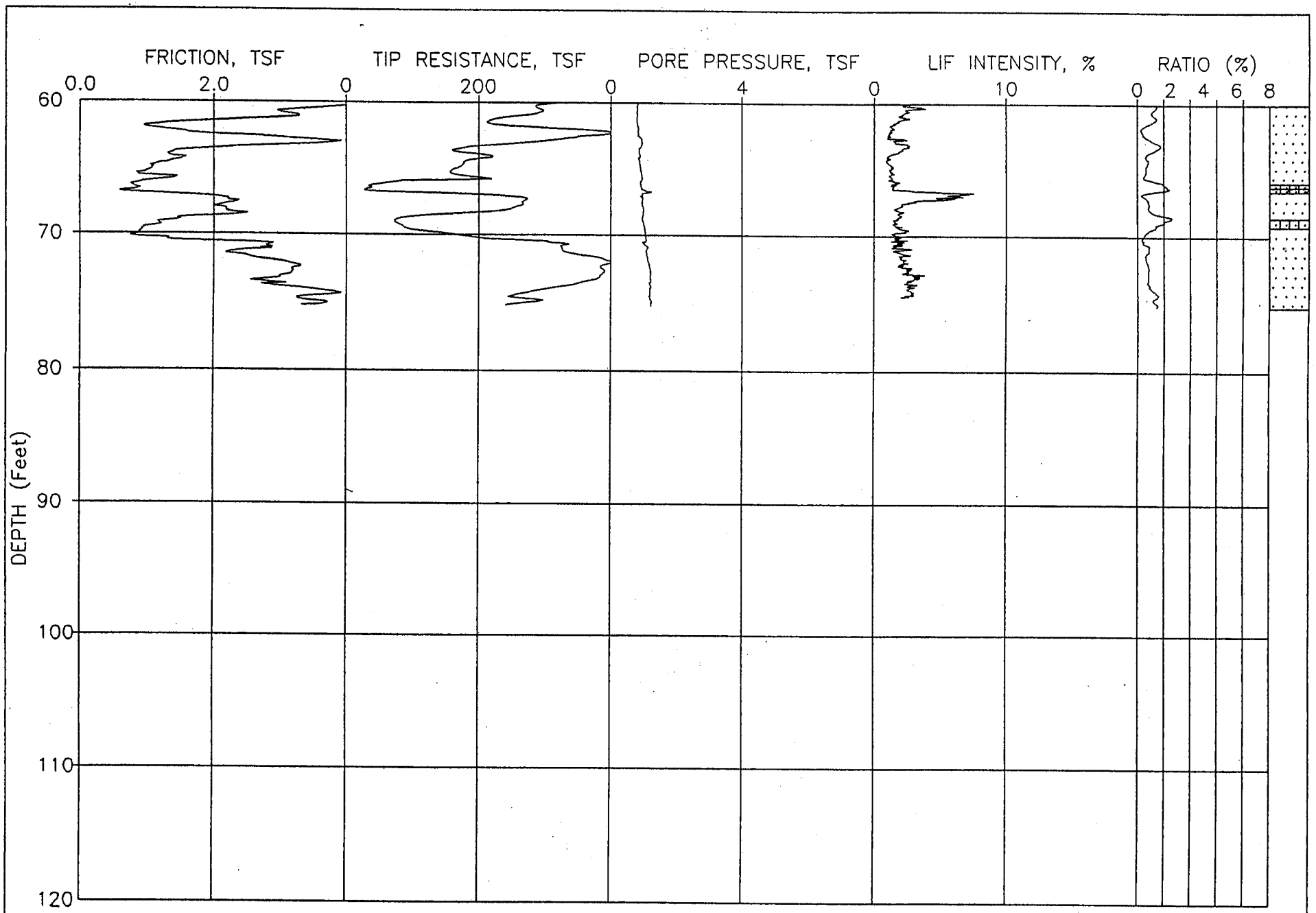

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CPT NUMBER: KR-04

DATE: 03-27-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 2 OF 2

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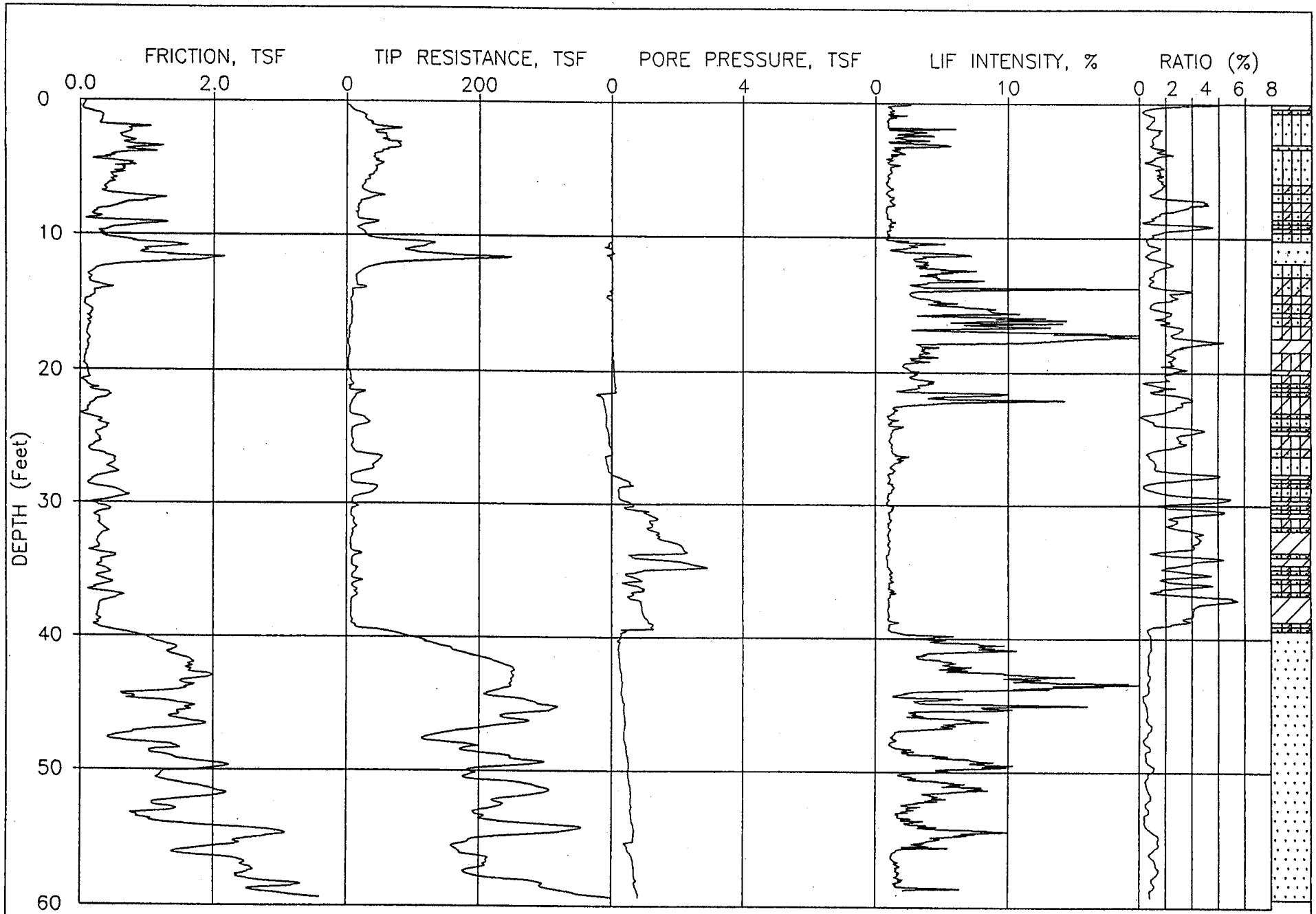

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DATE: 03-26-2002

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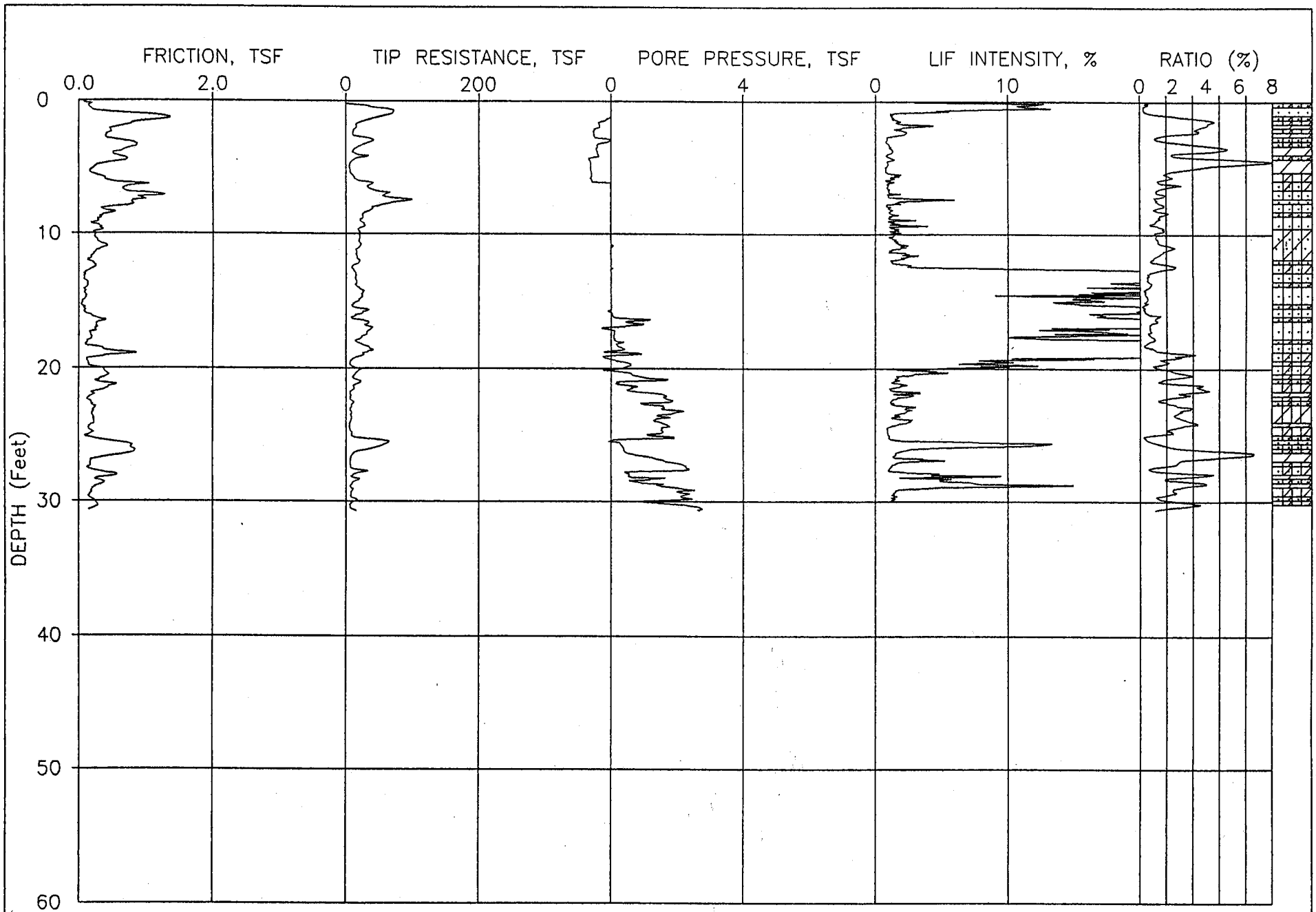
PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: KR-06

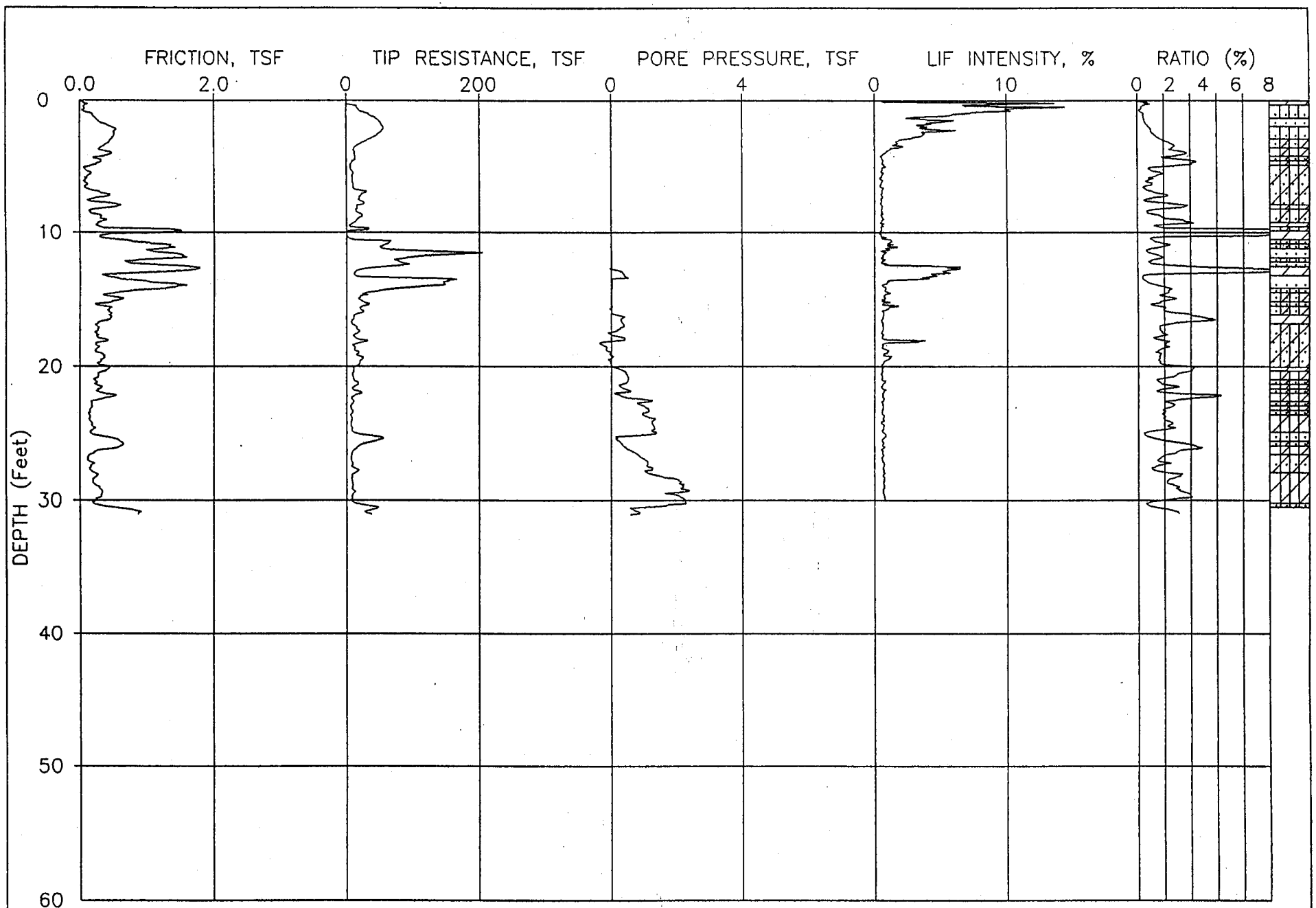
DATE: 03-27-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



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CPT NUMBER: KR-07

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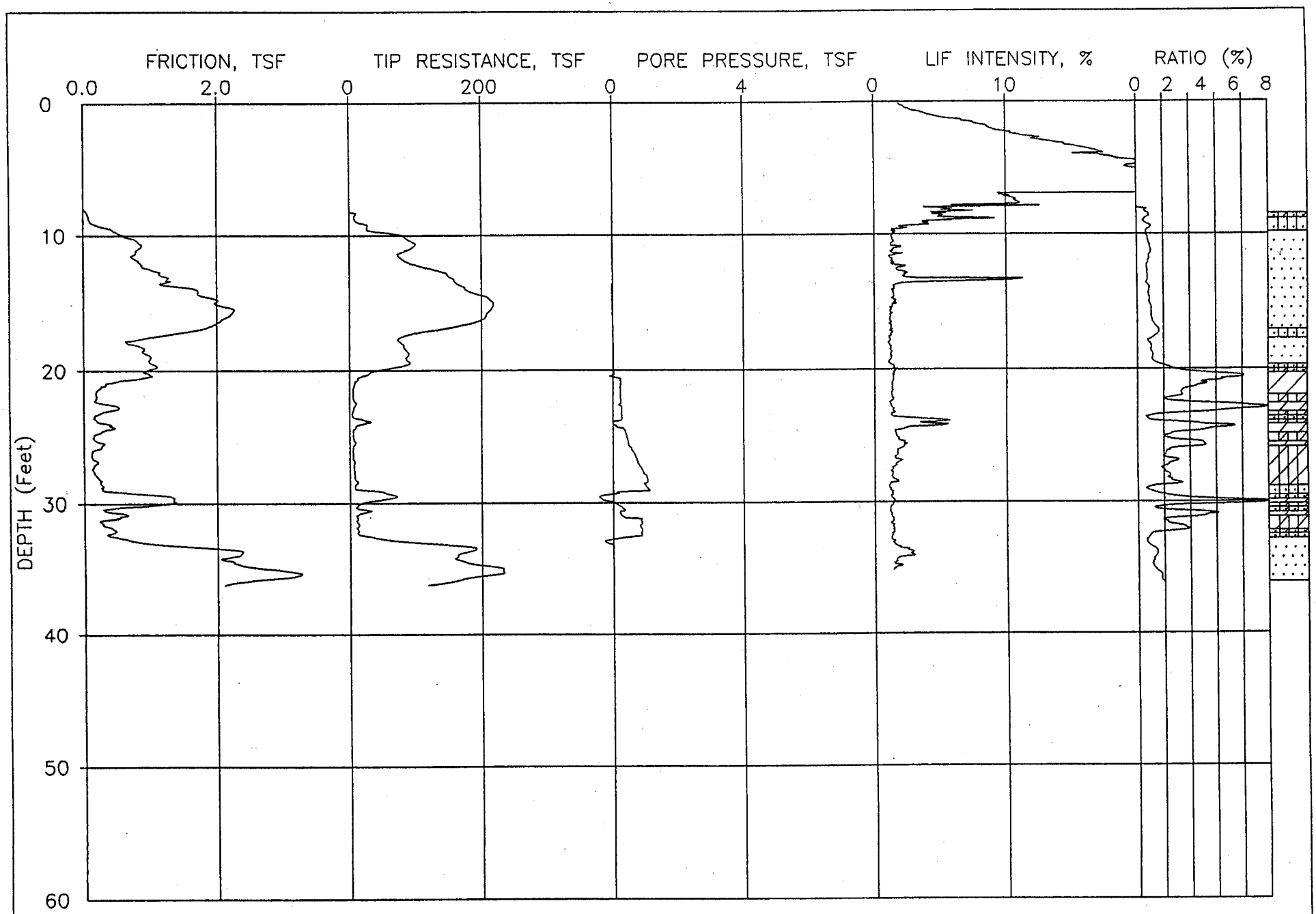
CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-08

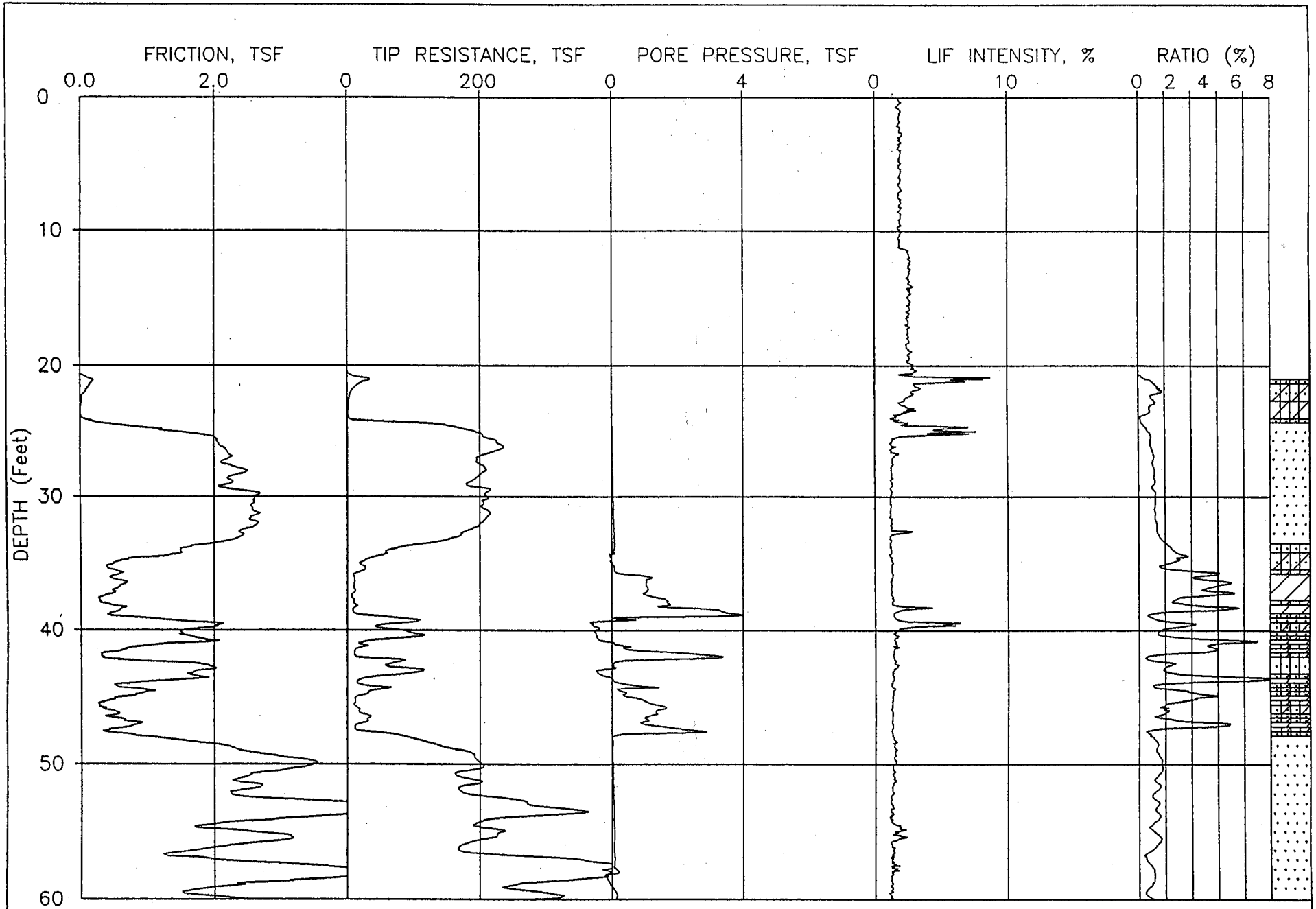
DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-09

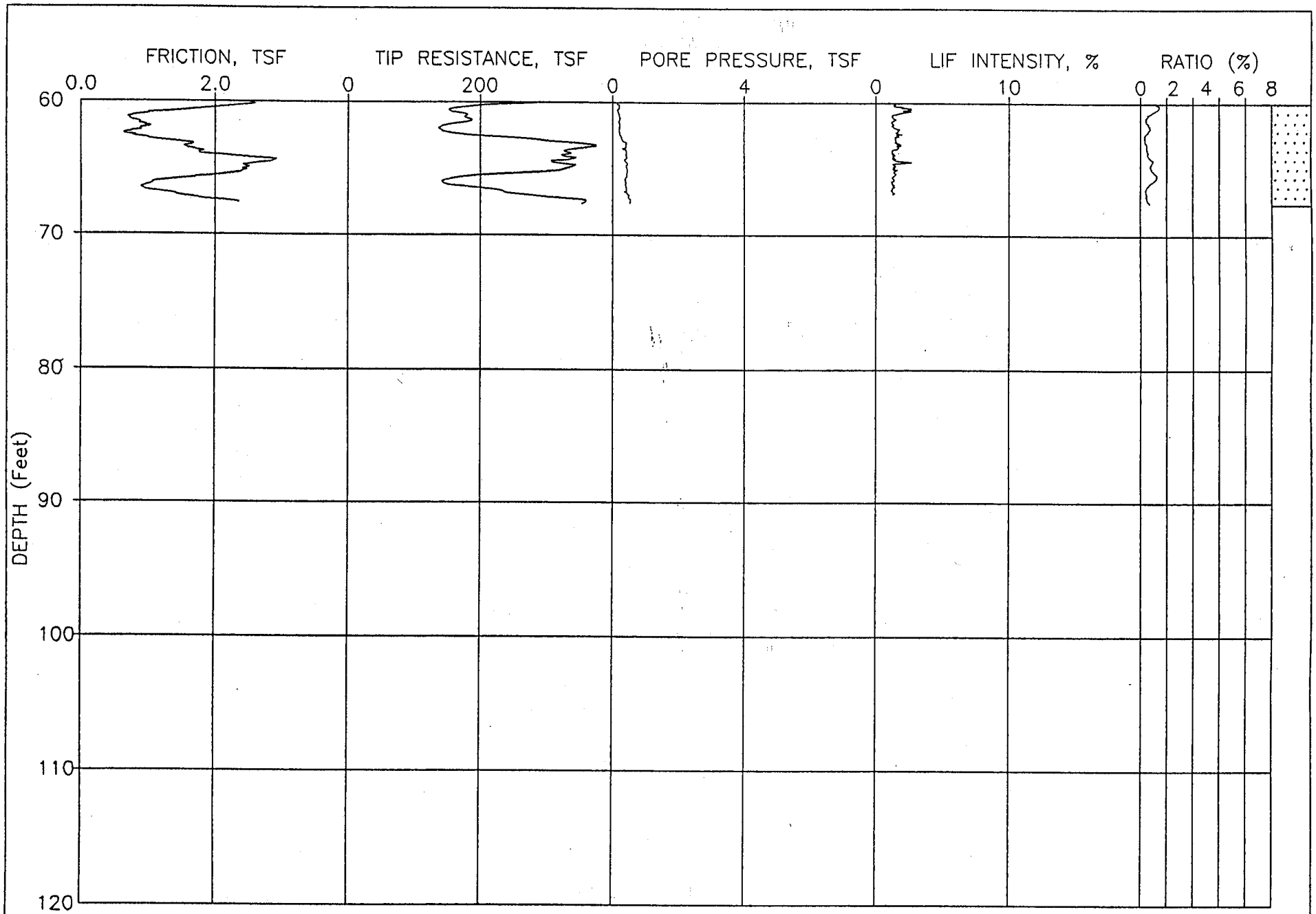
DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-09

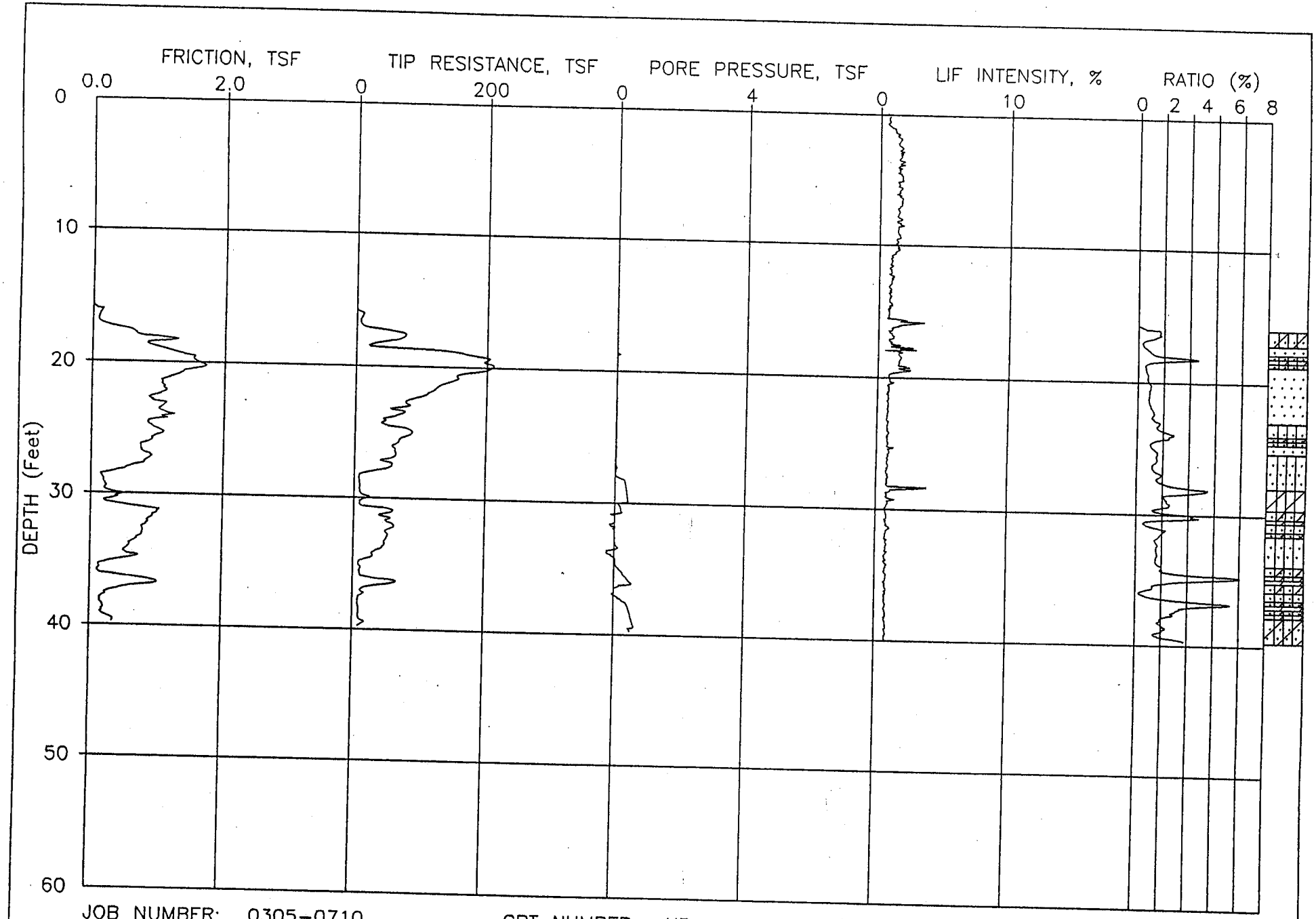
DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

ELEVATION: 0.00

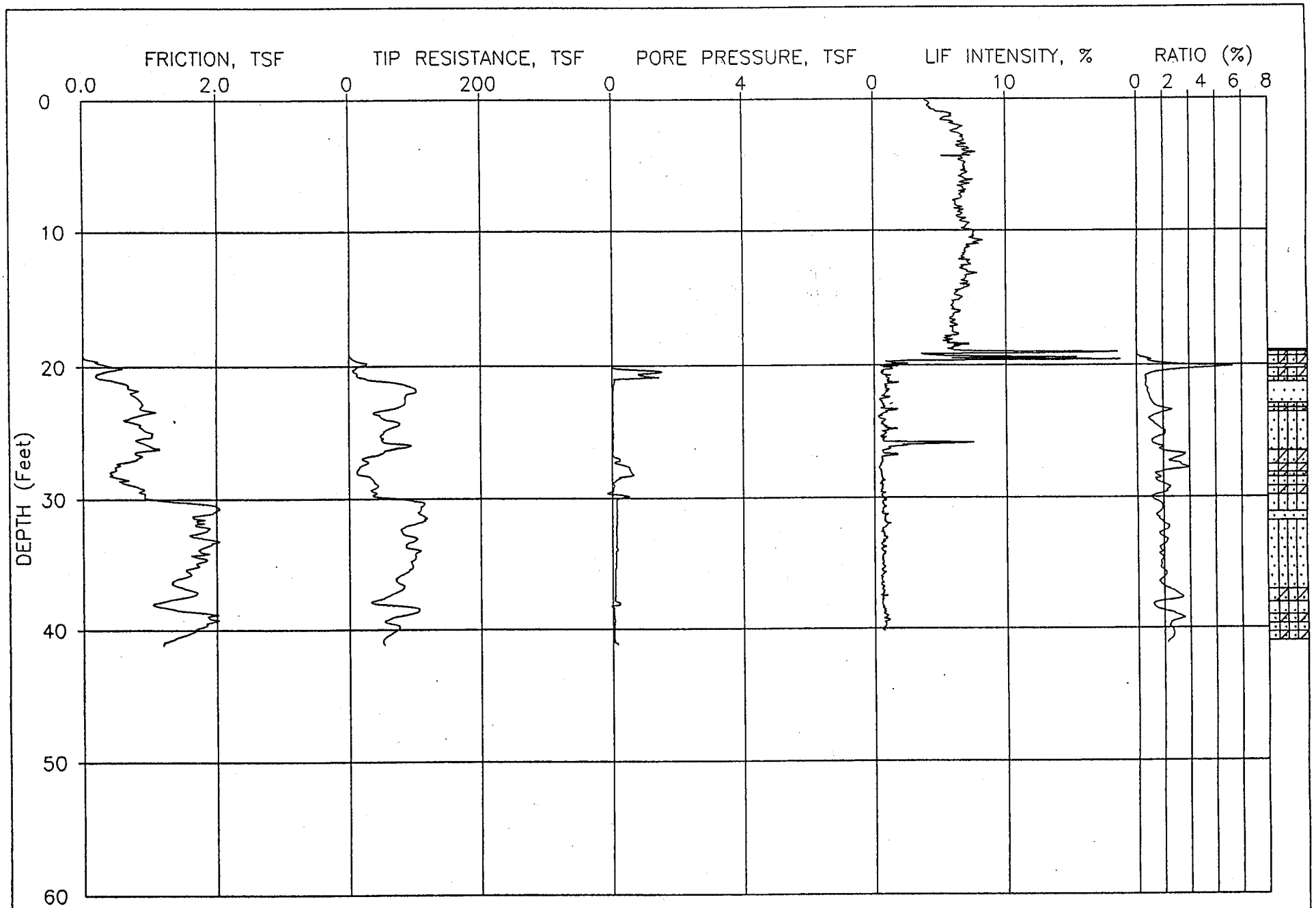
CPT NUMBER: KR-10

CONE NUMBER: F7.5CKEW1133

DATE: 03-28-2002

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-11

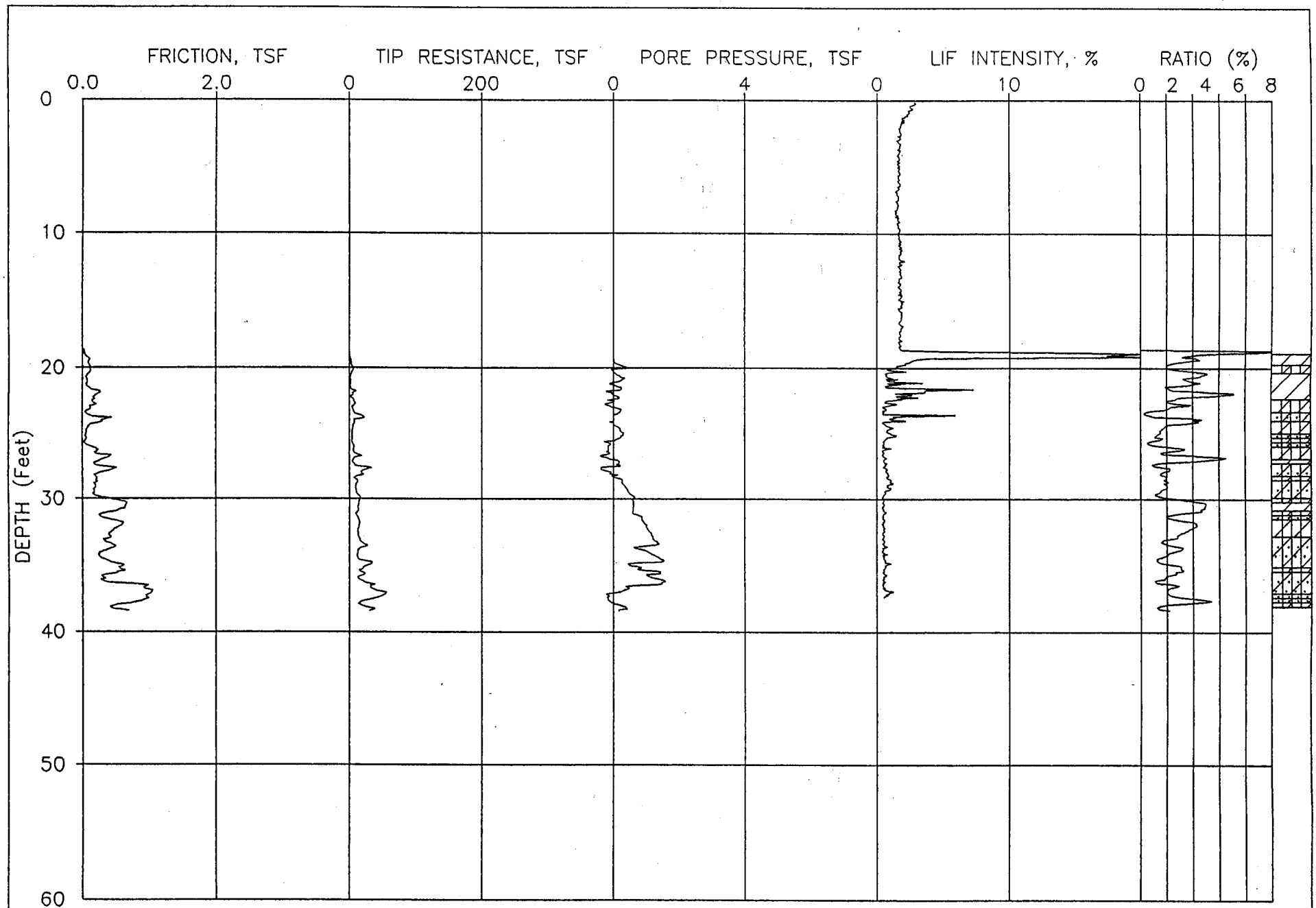
DATE: 03-30-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-12

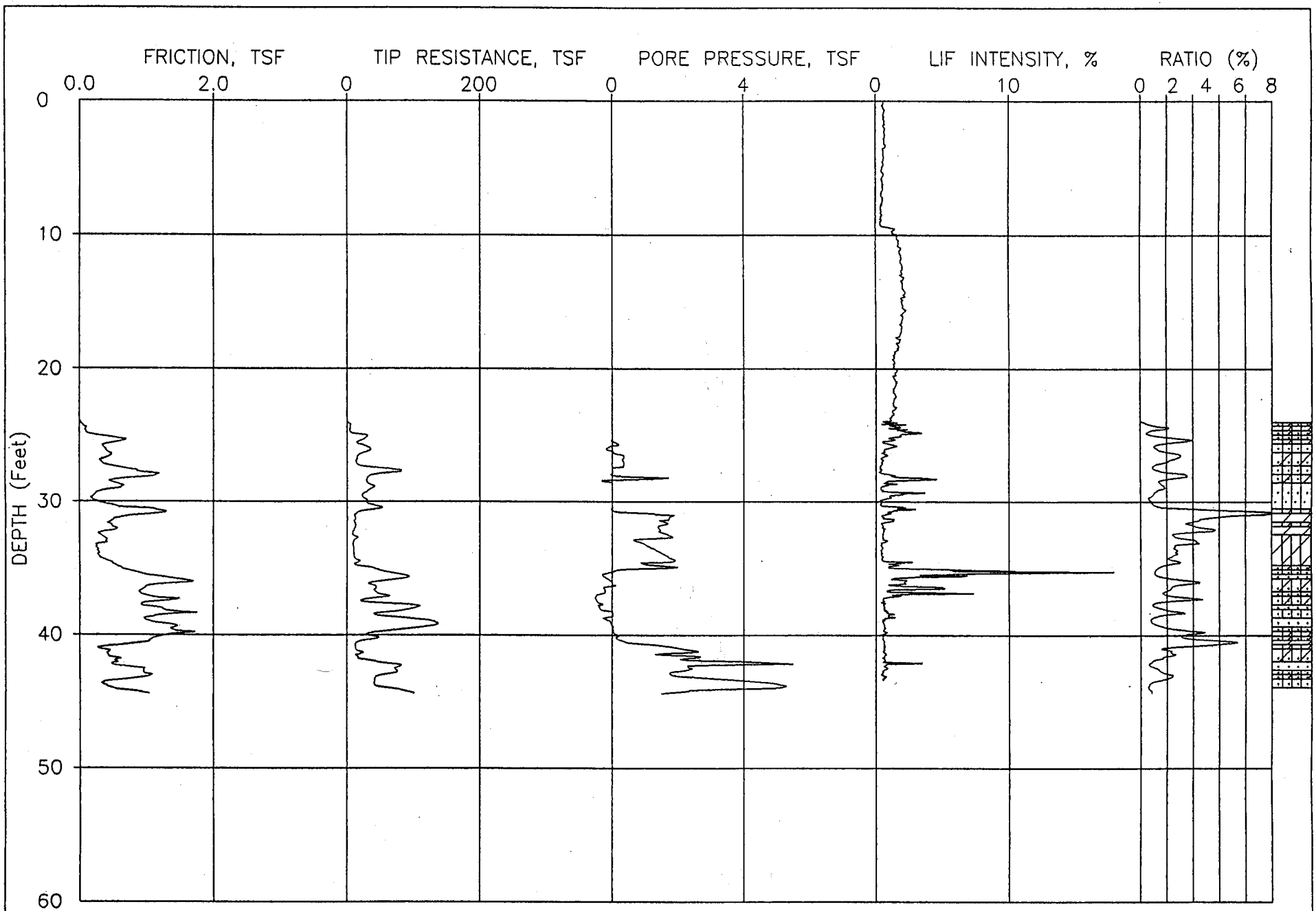
DATE: 03-30-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-13

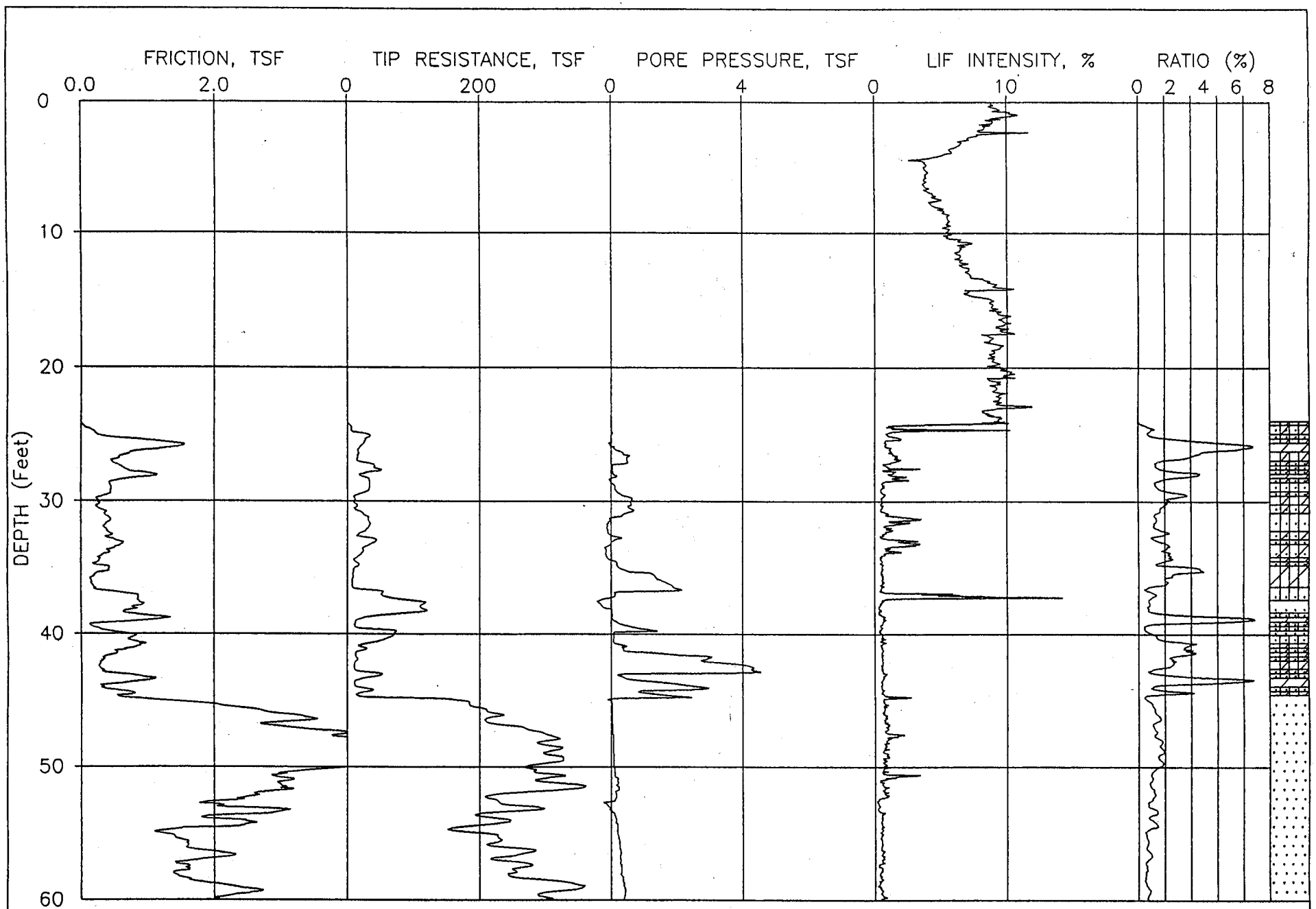
DATE: 03-30-2002

ELEVATION: .0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-14

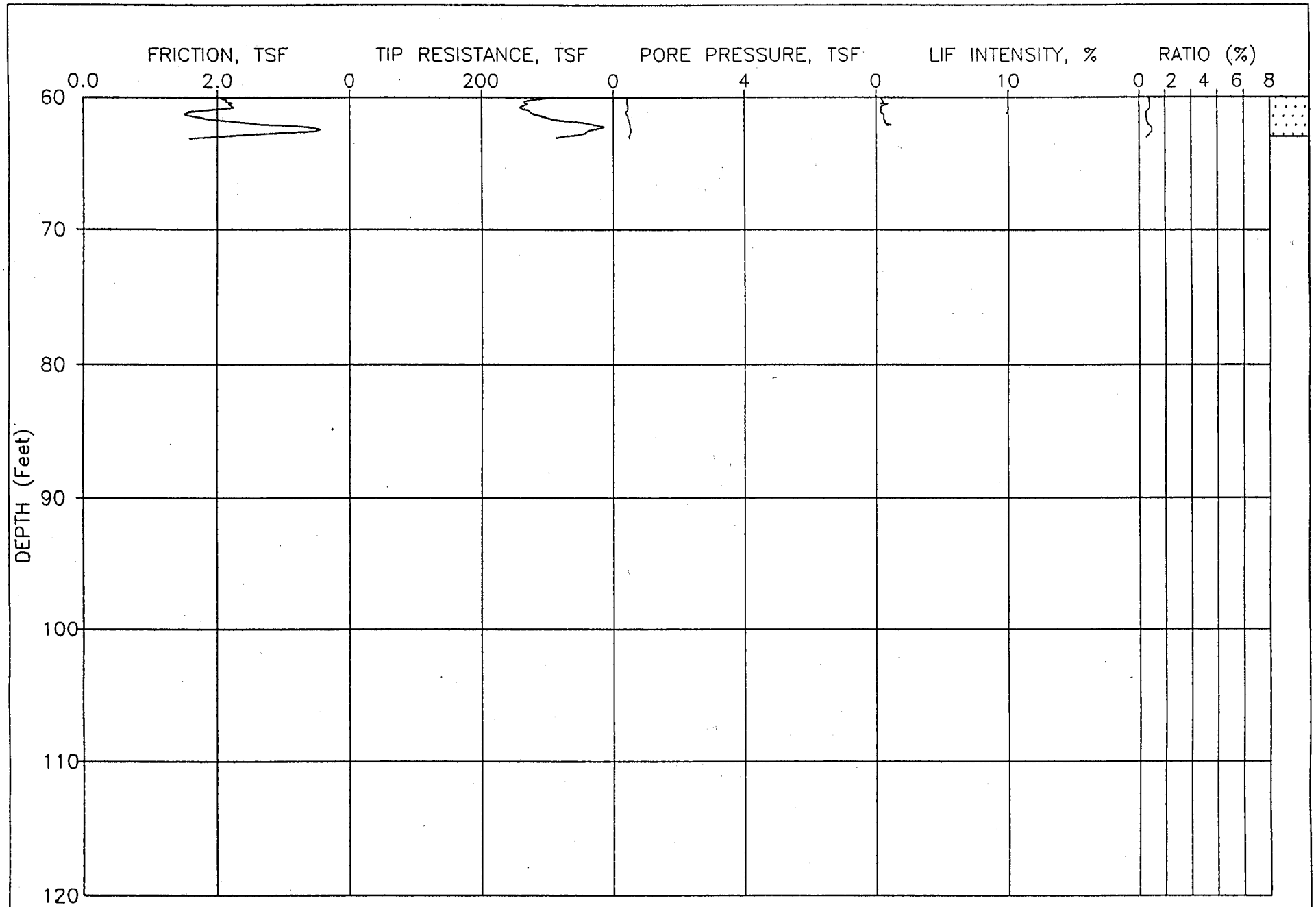
DATE: 03-30-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-14

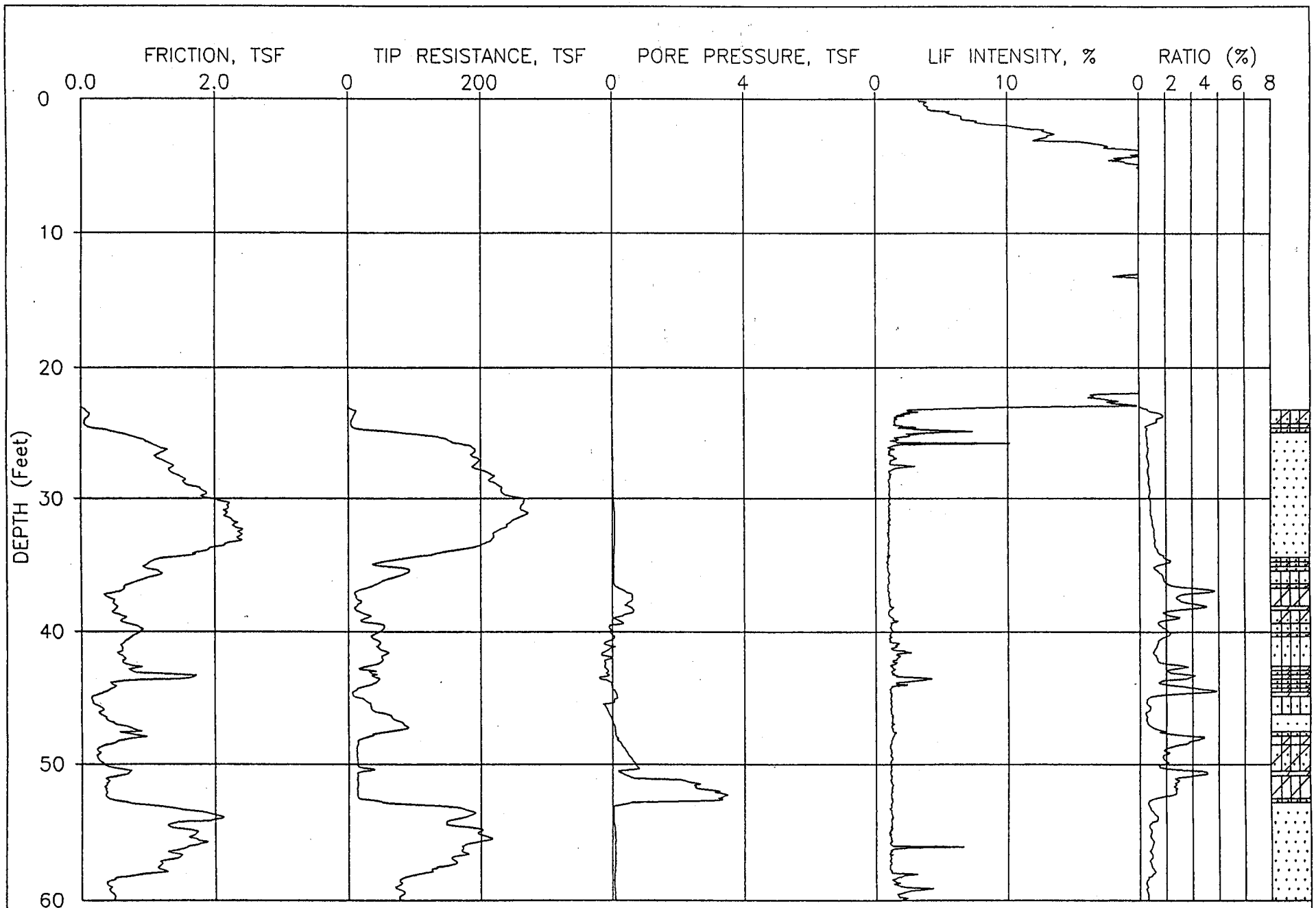
DATE: 03-30-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-15

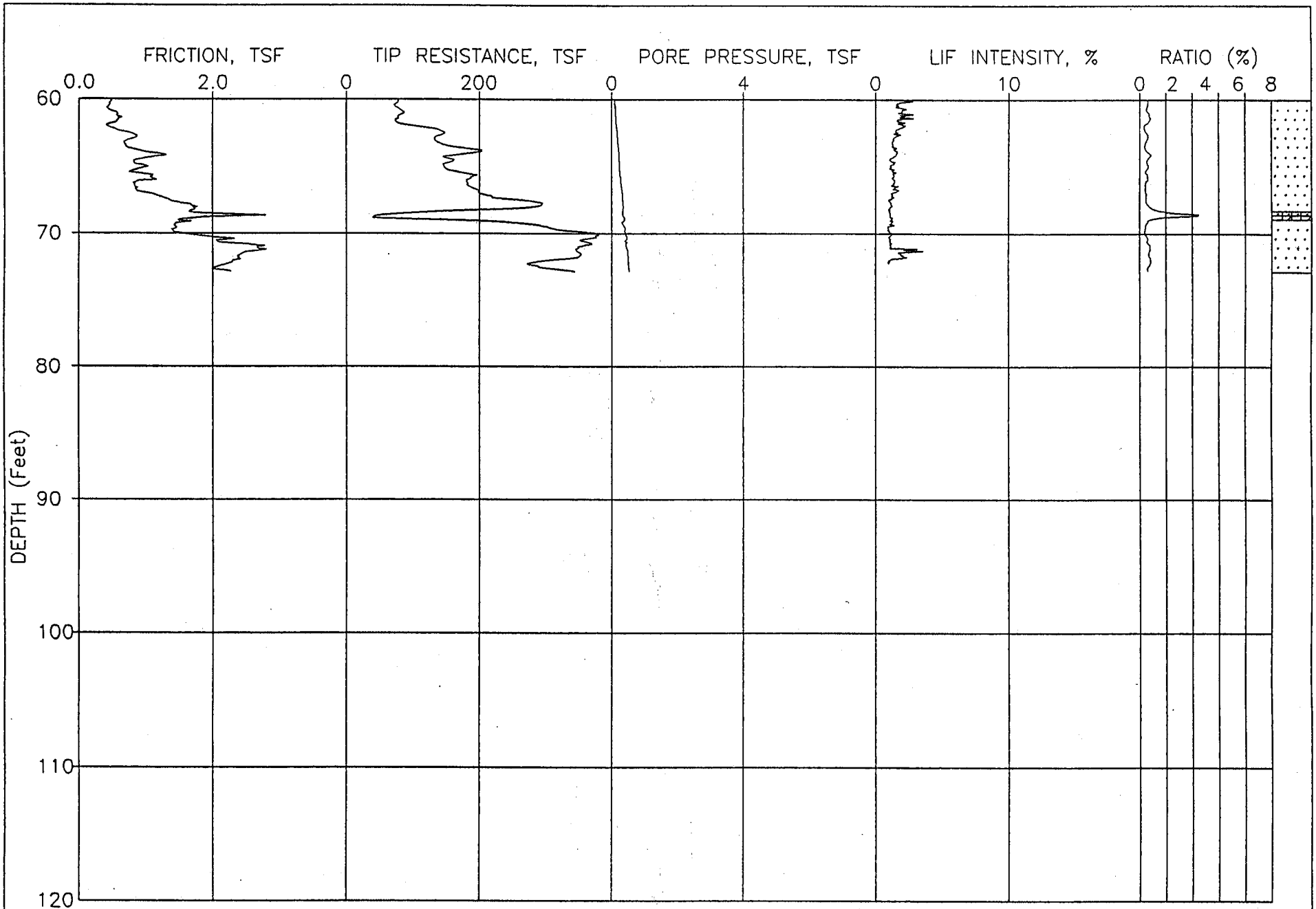
DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-15

DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 2 OF 2

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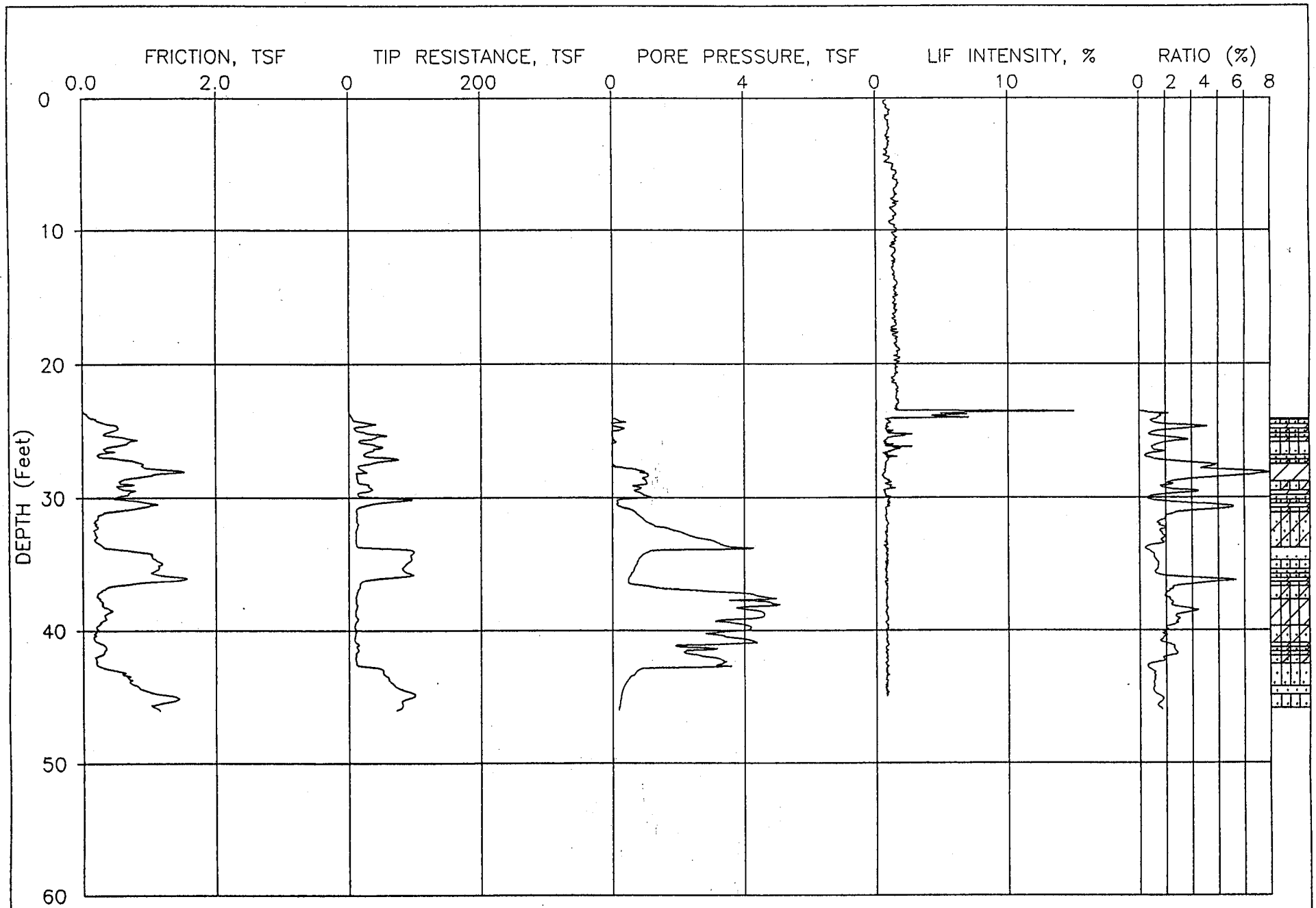


JOB NUMBER: 0305-0710

CPT NUMBER: KR-16

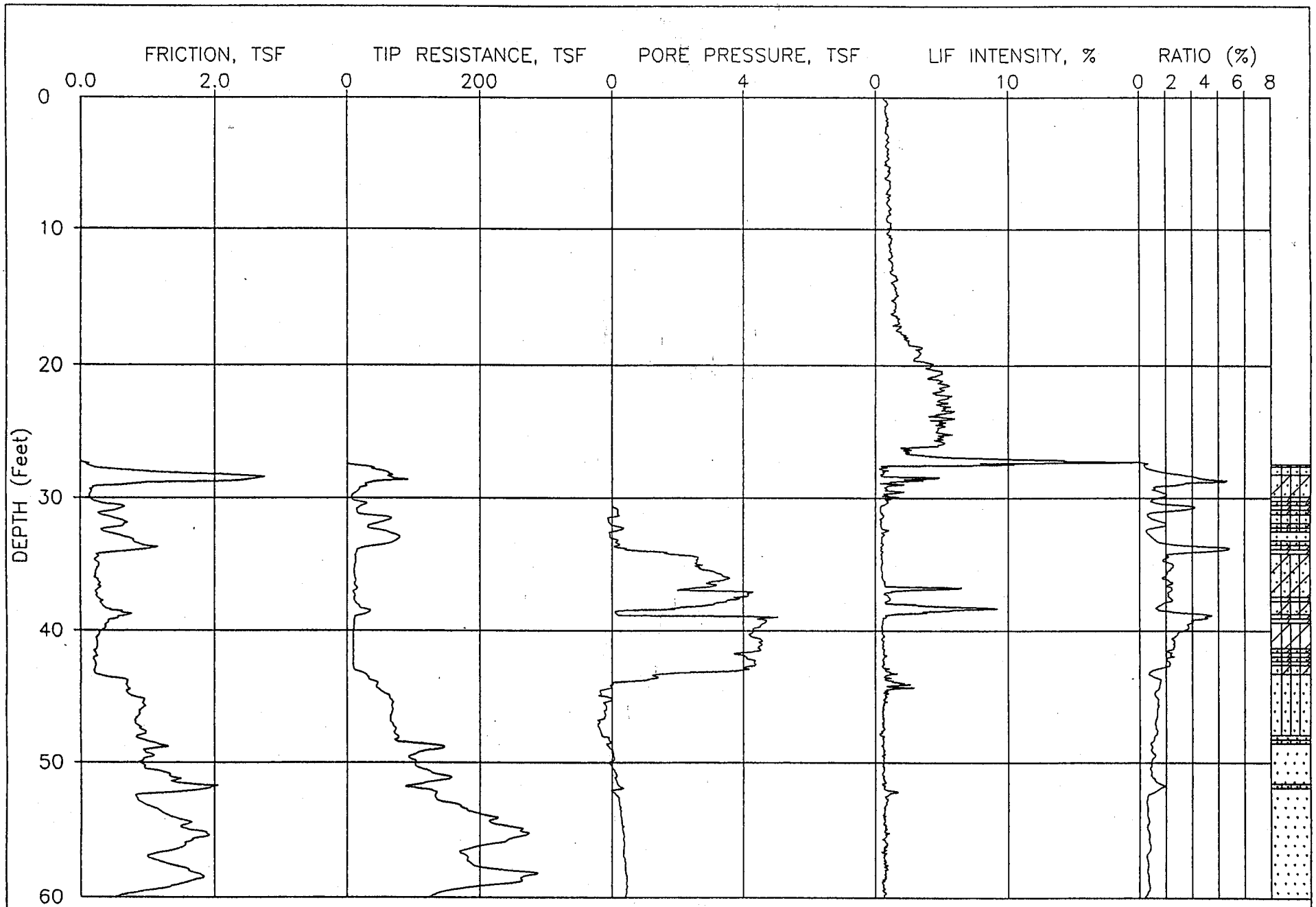
DATE: 03-28-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-17

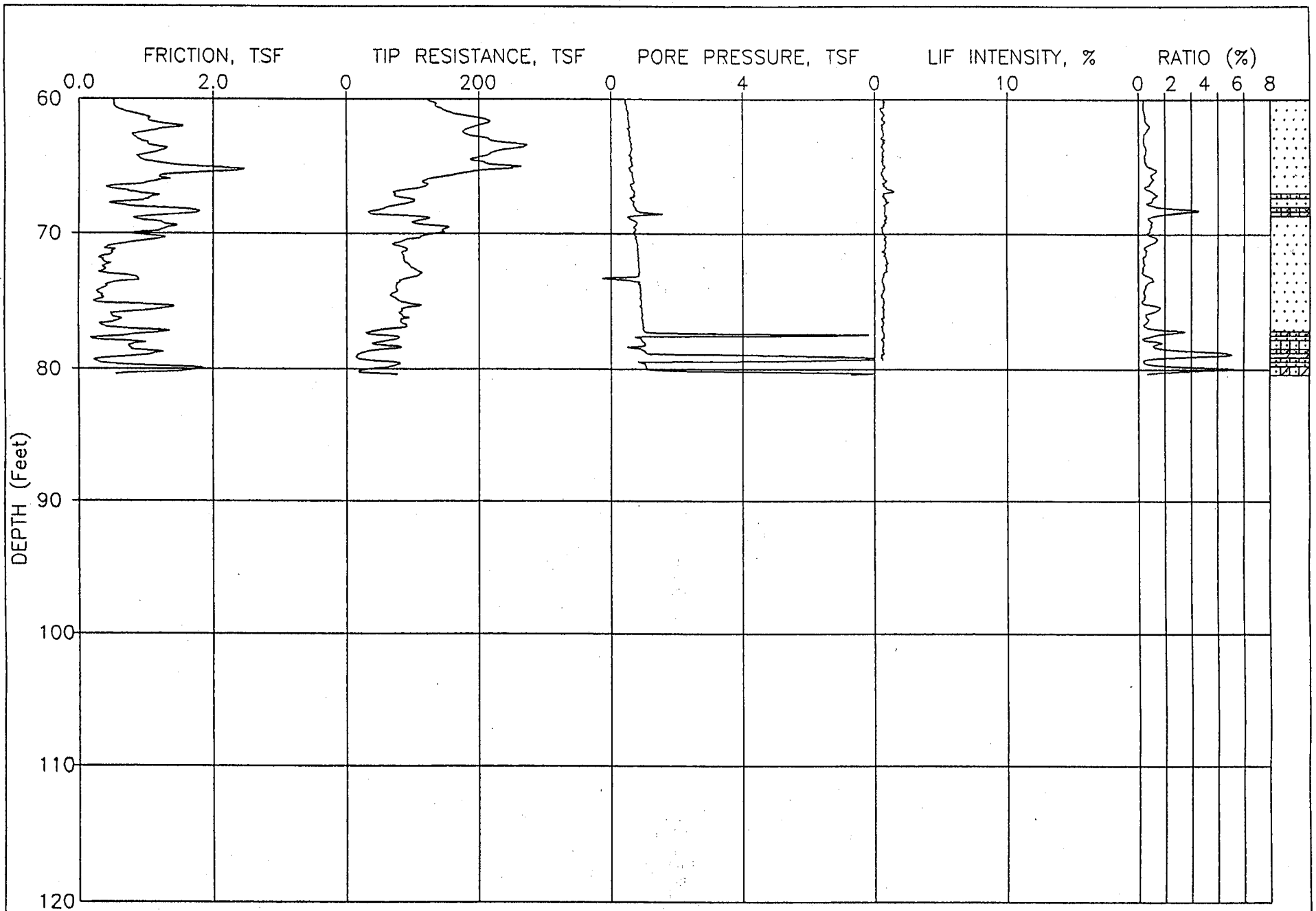
DATE: 03-28-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-17

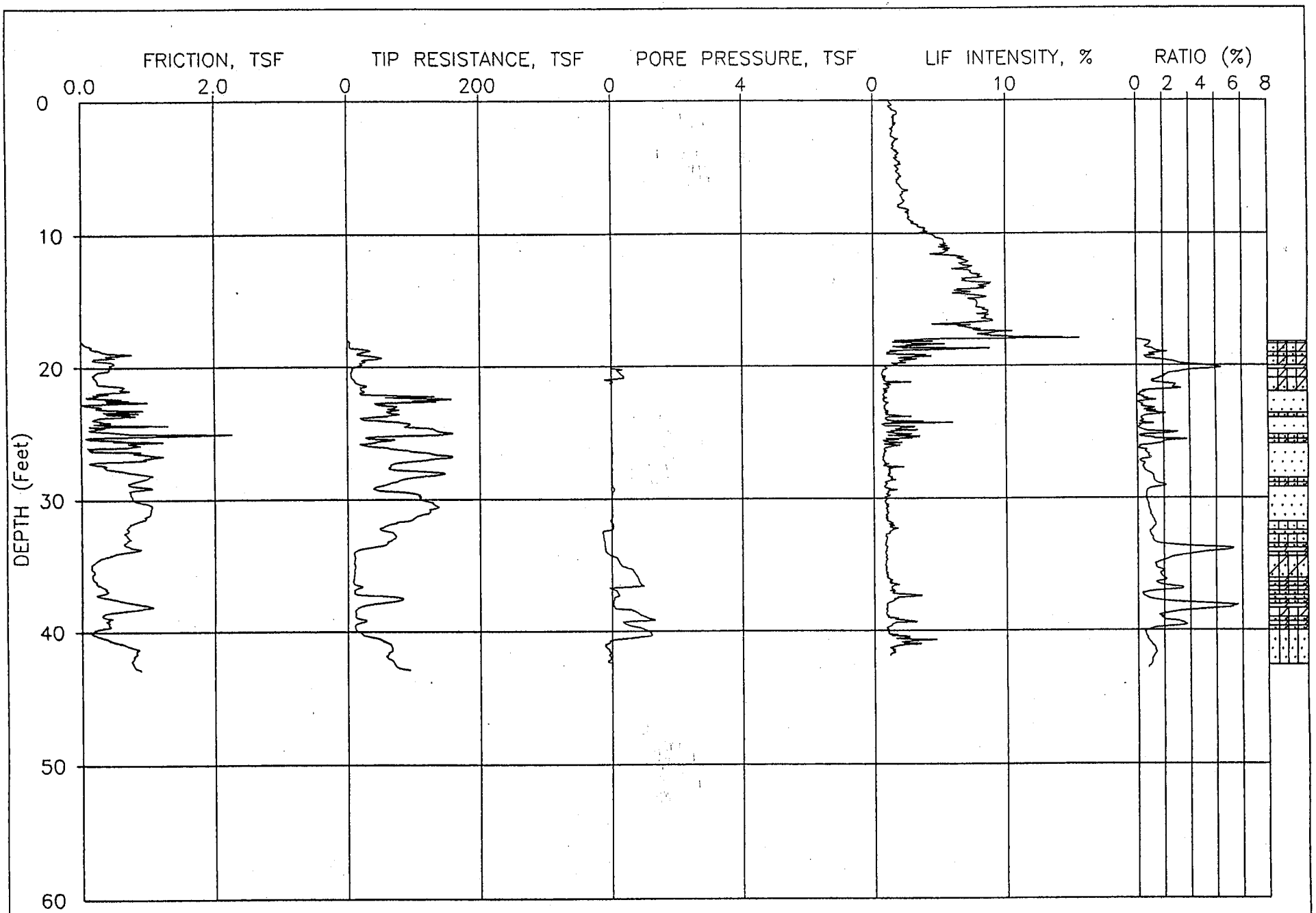
DATE: 03-28-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 2 OF 2

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-18

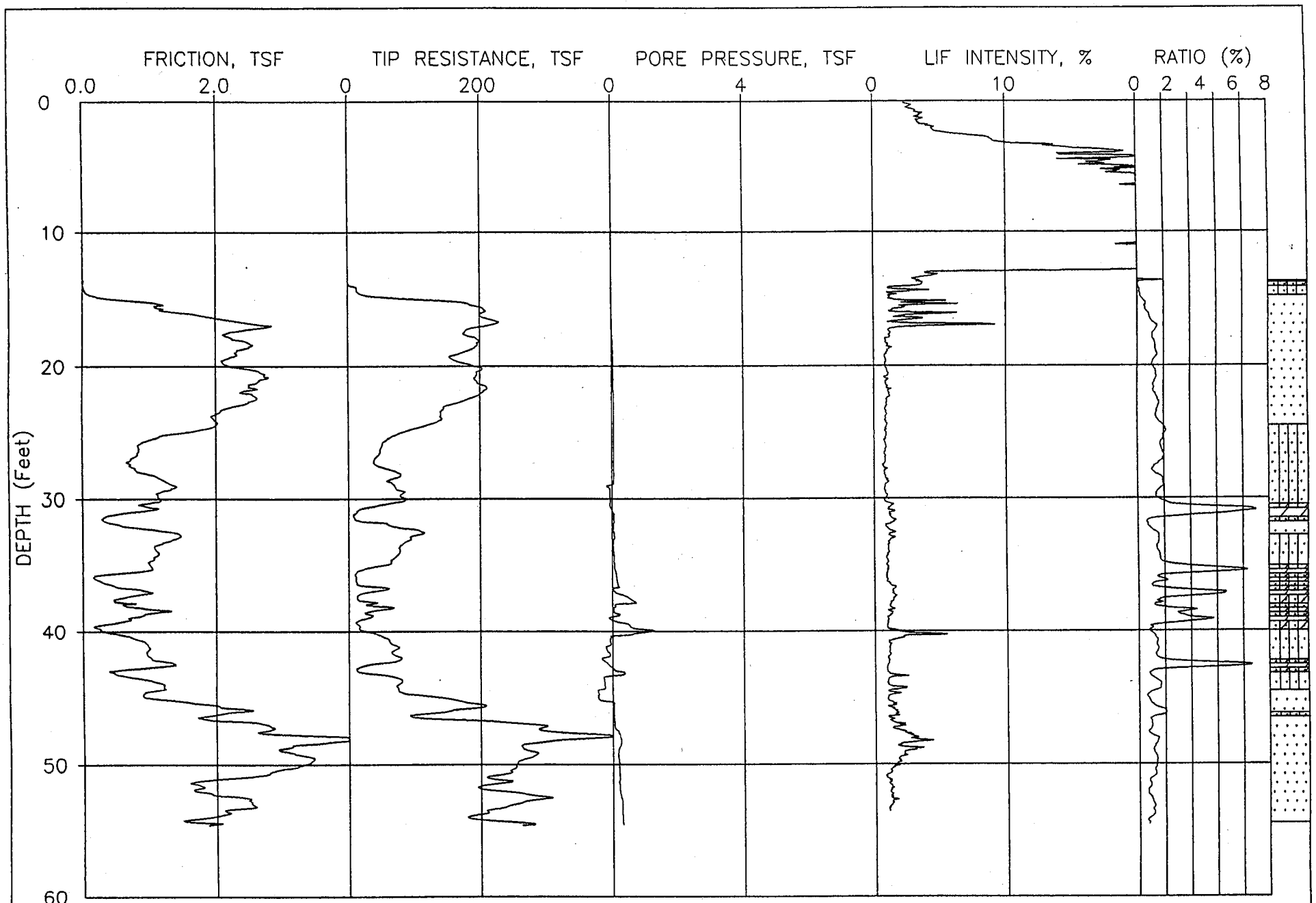
DATE: 03-28-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-19

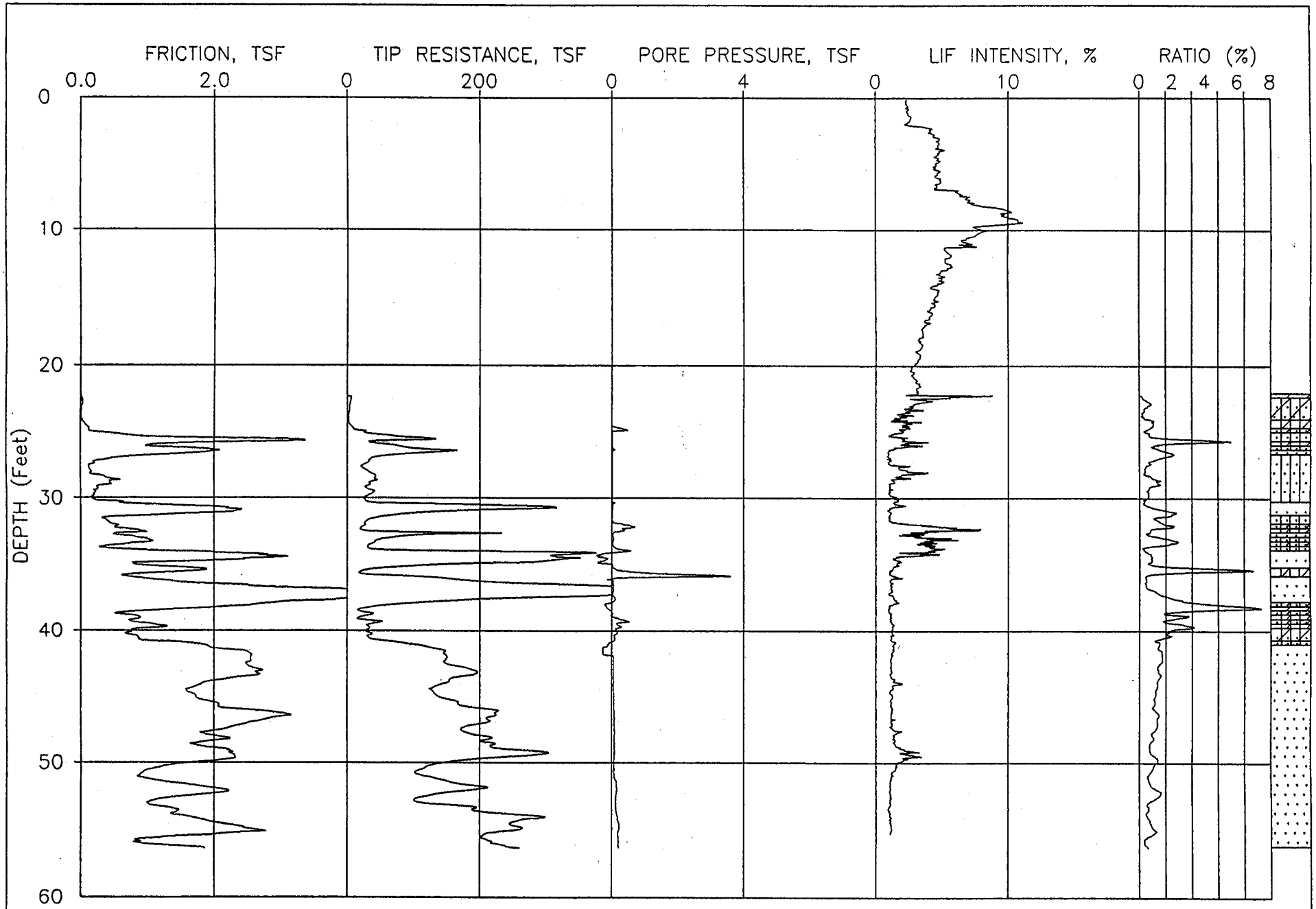
DATE: 03-28-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-20

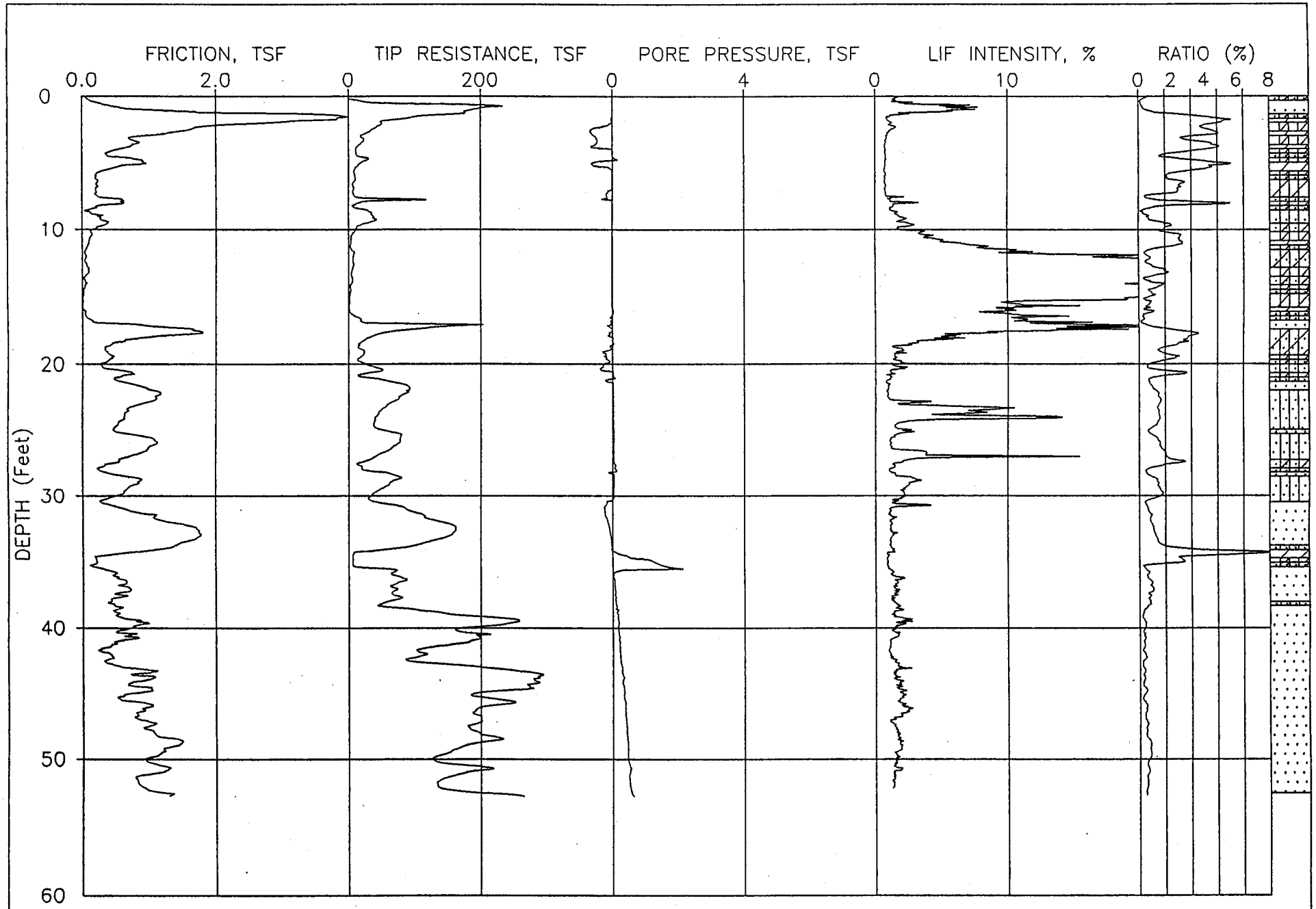
DATE: 03-29-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-21

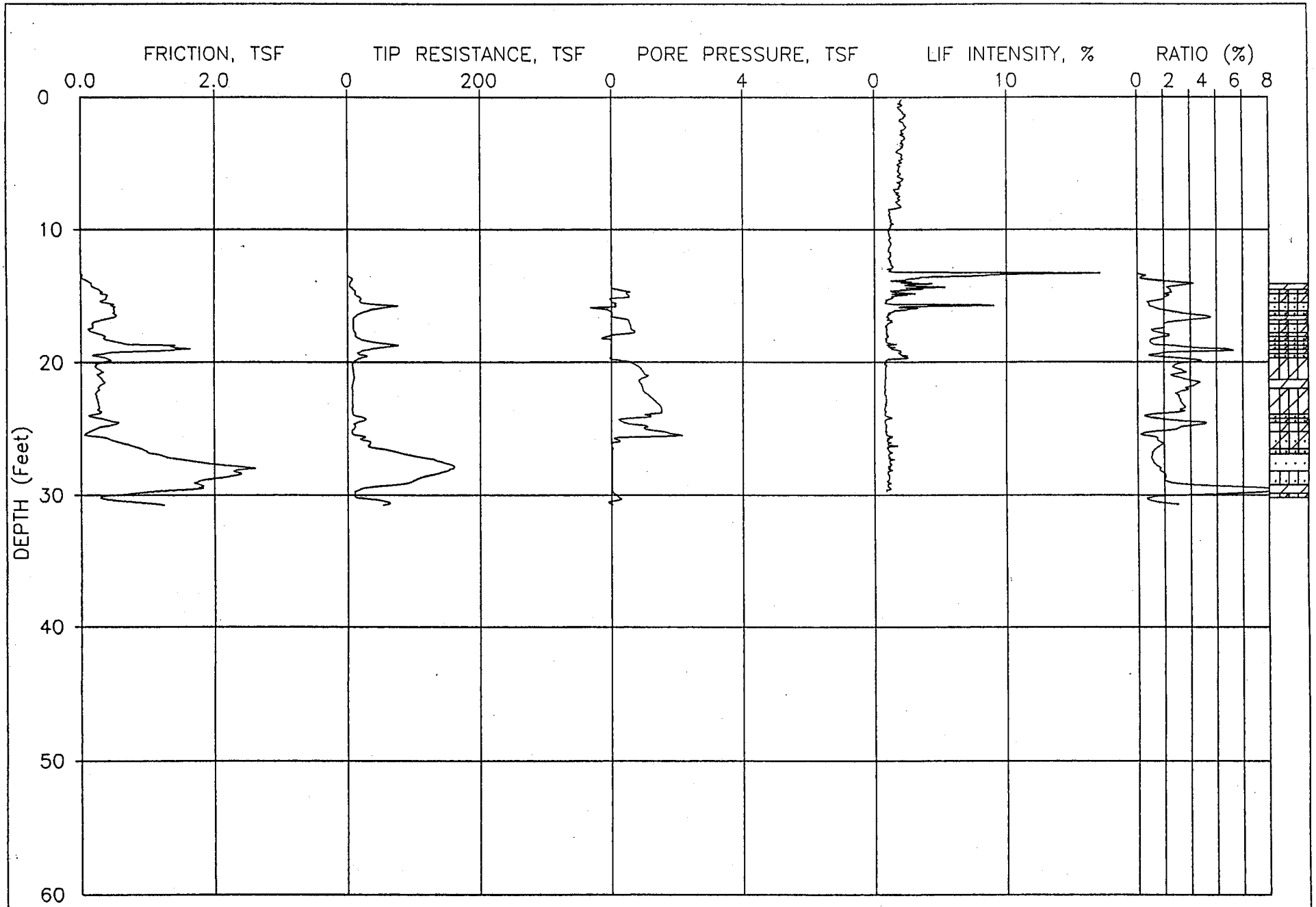
DATE: 03-27-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0710

CPT NUMBER: KR-22

DATE: 03-27-2002

ELEVATION: 0.00

CONE NUMBER: F7.5CKEW1133

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

TABLE 1

Details of ROST Probe Locations, March 2002

Location	Easting	Northing	Ground Elevation (Ft MSL)	Pre-Drilled Casing Depth (Ft)	Total Depth (Ft)
KR-1	2767309.2	1073281.5	752.2	N/A	24
KR-2	2767289.0	1073398.1	752.1	N/A	33
KR-3	2767268.9	1073527.0	755.9	11	30
KR-4	2767489.0	1073413.1	750.7	N/A	74
KR-5	2767531.2	1073320.8	751.1	N/A	58
KR-6	2767757.6	1073370.1	749.9	N/A	30
KR-7	2767952.7	1073403.7	749.2	N/A	30
KR-8	2767912.0	1073587.8	758.0	7	35
KR-9	2767889.1	1073743.7	769.3	19	67
KR-10	2767239.9	1073683.8	760.5	16	40
KR-11	2767224.1	1073786.5	762.3	19	40
KR-12	2767376.9	1073830.6	762.8	19	38
KR-13	2767531.2	1073866.8	763.6	24	43
KR-14	2767704.4	1073918.8	764.8	24	62
KR-15	2767885.5	1073972.3	772.3	22	72
KR-16	2767279.2	1073959.7	761.1	24	45
KR-17	2767408.4	1073999.1	760.0	28	79
KR-18	2767570.5	1074046.3	760.0	18	42
KR-19	2767756.4	1074095.1	761.3	14	53
KR-20	2767653.3	1073718.6	764.9	22	55
KR-21	2767619.4	1073441.7	750.2	N/A	52
KR-22	2767452.0	1073579.3	753.4	15	30

HEALTH AND SAFETY PLAN

Site Specific Health and Safety Plan

Union Berkley Park Development
River Front Road and East Front Street
Kansas City, Missouri

Geotechnology, Inc.
5055 Antioch Road
Overland Park, Kansas 66203
Phone: 913-438-1900
Fax: 913-438-1923

March 4, 2015

SITE SPECIFIC HEALTH AND SAFETY PLAN
UNION BERKLEY PARK DEVELOPMENT
RIVER FRONT ROAD AND EAST FRONT STREET
KANSAS CITY, MISSOURI

1.0. SITE DESCRIPTION

Date Prepared: March 4, 2015

Site Location: Union Berkley Park Development
River Front Road and East Front Street
Kansas City, Missouri

Site Description: The subject property is known as Union Berkley Park, located on the south side of the Missouri River between the Broadway and Kit Bond Bridges, and is bordered by East Front Street and East Riverfront Drive. A former manufactured gas plant was located near the southwest side of the site. The site is subject to a Restrictive Covenant and Grant of Access agreement between the Port Authority of Kansas City and the Missouri Department of Natural Resources. Remediation of the former manufactured gas plant occurred in the 1990s, but contaminated soil and groundwater zones could be encountered. Previously observed contaminants include polycyclic aromatic hydrocarbons (PAHs), arsenic and lead. The arsenic and lead sample concentrations were above the Missouri Risk-Based Corrective Action (MRBCA) Default Target Levels (DTLs).

Areas Affected: The property and adjacent areas surrounding the subject site.

Site Activities: Levee Drilling
Health and Safety
Material Management Plan
Field Exploration

2.0 HAZARD EVALUATION

2.1 CHEMICAL HAZARDS. Elevated levels of volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene and xylenes may be encountered during site activities. Contamination related to the operation of manufactured gas plants includes contaminants such as volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs); and heavy metals. In addition, special care is needed when free product is encountered due to the increased risk of fires and/or exposure.

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2.1.1 VOLATILE ORGANIC COMPOUNDS: Many VOCs are suspected carcinogens that present both an inhalation and skin contact hazard. Overexposure can cause dizziness and light-headedness due to their narcotic effects. Generally, chlorinated volatile organics are not flammable, but release very toxic fumes of phosgene gas when heated to decomposition. Non-chlorinated volatile organics are highly flammable and may create fire and explosion risks in the vicinity of excavating and/or drilling operations.

BENZENE: While poisoning occurs most commonly through inhalation of vapors, benzene can be absorbed through the skin and is considered a skin irritant. It is a recognized leukemogen. Symptoms of exposure include headache, dizziness, nausea and loss of appetite. Acute poisoning may include reddening of the skin, a burning sensation and blistering. The victim may become dizzy and confused. Tightening of the leg muscles and pressure over the forehead may also occur. First aid for victims of overexposure should include washing exposed skin with copious amounts of soap and water. The victim should be taken to an area of fresh air.

TOLUENE: Exposure is generally via inhalation and ingestion. Inhalation of 200 parts per million toluene for 8 hours may cause impairment of coordination and reaction time. Symptoms of exposure to toluene are very similar to those of benzene. Recovery is usually the rule following removal from exposure.

ETHYLBENZENE: Ethylbenzene is an irritant to the skin, eyes and mucous membranes via ingestion and inhalation. The liquid is an irritant to the skin and mucous membranes. Exposure to the vapors causes irritation to the nose and throat, dizziness and a sense of chest constriction. Victims exhibiting signs of overexposure should be removed to an area of fresh air.

XYLENES: Xylenes are considered less toxic than benzene. Exposures to high concentrations may cause dizziness due to a narcotic effect. Exposure is generally via inhalation and ingestion. Victims exhibiting signs of overexposure should be removed to an area of fresh air.

2.1.2 POLYNUCLEAR AROMATIC HYDROCARBONS: PAHs are typically absorbed through skin contact and inhalation. PAHs are formed through the incomplete combustion of carbon-containing fuels. Some PAHs are known carcinogens. Symptoms of exposure are dermatitis, bronchitis, and similar. The organs targeted are the respiratory system, skin, bladder and kidneys.

2.1.3 TOTAL PETROLEUM HYDROCARBONS (TPH): TPH compounds are general classes of petroleum hydrocarbons such as gasoline, diesel and oil-range hydrocarbon chains. The TPH compounds are made up of various VOCs and Semi-VOCs, and as a result, hazard information associated with these chemicals (as shown above) may apply to TPH compounds.

2.1.4 HEAVY METALS: Heavy metals are toxic by ingestion and inhalation of dusts or fumes. Some are carcinogenic and are cumulative in the body. They include such metals as lead, arsenic, cadmium, chromium, selenium, silver, mercury and barium.

2.1.5 UNKOWN CHEMICAL CONTAMINATION: It is impossible to describe the hazards of all chemicals. Because the possibility of chemical hazards exists, one must always be alert to signs indicating their presence. Some signs to look for are odd colors in the soil, strange odors, the absence of vegetation in an area that would normally be expected to have it, the presence of a vapor cloud, irritation to the eyes, nose, throat or skin, or a feeling of lightheadedness or dizziness. These signs or symptoms could indicate exposure and personnel should evacuate the area.

2.2 PHYSICAL HAZARDS. The normal physical hazards of working near machinery may also exist. Excessive noise, lifting and material handling, possible heavy objects falling, close proximity to moving parts, and overhead or underground utilities can create special hazards and must be recognized. Missouri One-Call will be notified to mark public utilities at the site. Private utilities at the site are not expected based on institutional knowledge. Traffic control will not be required as the boring locations will be outside the right-of-way of city streets.

Some excavation activities will result in an open pit creating additional potential hazards including undermining of adjacent structures (buildings, canopies, etc.). The potential for slope failure exists if excavations are not sloped or shored properly. The potential for bodily damage to pedestrians exists if excavations are not secured either during excavation activities or overnight. The applicable contractor is responsible for providing shoring and the applicable safety precautions to secure excavations in accordance with OSHA guidelines.

3.0 PERSONAL PROTECTIVE EQUIPMENT

3.1 MINIMUM PROTECTIVE EQUIPMENT. Site activities will be initiated in Level D personal protective equipment (PPE). The following minimum PPE will be required for the site activities previously stated in Section 1.0:

- Steel Toed Boots
- Safety Glasses
- Hard Hat
- Safety Vest
- Safety Cones (if vehicular traffic is identified as a hazard)
- Hearing Protection (if noise is identified as a hazard)

Hearing protection will be available on-site should noise be identified as a hazard.

3.2 ADDITIONAL PROTECTIVE EQUIPMENT. The following site activities will require the use of the additional specified PPE:

- SOIL BORING/MONITORING AND OBSERVATION OF FIELD ACTIVITIES (Drilling, Test Pit Installation, Soil Excavation)

  – Hard Hat
  – Cotton Gloves (switch to Nitrile Gloves when the water table is reached)

- SOIL SAMPLING ACTIVITIES

  – Hard Hat
  – Latex Inner Gloves (optional)
  – Nitrile Outer Gloves
  – Tyvek if sampling through "smear" zone

4.0 SITE MONITORING EQUIPMENT

Continuous monitoring for volatile organics and flammable vapors will be performed during the remaining site activities specified in Section 1.0. The instrumentation to be used for site monitoring is as follows:

- Photoionization Detector or equivalent (volatile organics)
- Multi-gas detector

5.0 ON-SITE CONTROL

The project scientist/engineer has been designated to coordinate access control and security on-site. Only essential personnel will be allowed in the vicinity of the applicable site operations. Due to the fact that limited PPE is being used initially, the following conditions will necessitate stopping work by all personnel until further site hazard characterization can be performed and/or additional PPE provided:

- **Volatile Organic Compounds -** 10 parts per million (ppm) total volatile organics above the background ppm in the breathing zone near the site activities (i.e. monitoring/extraction well, drill rig, excavation, etc.) as measured by the photoionization detector or equivalent instrument.

- **Chemical Exposure -** Anyone experiencing dizziness, light-headedness or skin, eye, nose or throat irritation.

- **Flammable and Explosive Vapors** - 10 percent of the lower explosive limit (LEL) in the vicinity of the excavation equipment, as measured by the multi-gas meter calibrated with an appropriate calibration gas.

Should any of the above conditions be encountered at the site, the level of protection may be upgraded pending additional site characterization. Additional PPE may include the use of air purifying respirators.

6.0 DECONTAMINATION PROCEDURES

A decontamination area will be established upwind of site activities. All personnel and equipment involved with sampling activities will be thoroughly decontaminated. Reusable sampling equipment will be cleaned using a soap and water wash followed by a potable water rinse, before and after each sampling activity is performed. Drilling equipment will be decontaminated using a steam cleaner. Wash water will be containerized in 55-gallon drums.

Protective suits (tyvek, saran coated tyvek, etc.), if worn, and all gloves will be disposed of and new suits and gloves will be supplied prior to reentering the sampling area. In addition, any rips in the protective clothing or gloves will require that the clothing be changed immediately. All gloves and protective clothing will be containerized and left on-site for ultimate disposal, or included with the shipment and disposal of contaminated soils.

Decontamination equipment is as follows:

- scrub brush
- soap and water
- steam cleaner

7.0 ACCIDENTS/NEAR-MISS INCIDENTS

If an accident occurs, site activities will cease. After evaluation of any injuries, 911 will be called by field personnel in the event of an emergency. Field personnel will inform the Geotechnology project manager of the accident prior to resuming site activities. Field personnel will document the accident including completion of an Accident/Near Miss Investigation Report.

If a near-miss incident occurs at the site, field personnel will complete the Accident/Near Miss Investigation Report and forward the Report to the Geotechnology project manager.

8.0 PERSONNEL TRAINING AND MEDICAL MONITORING

Personnel have previously received the required Hazardous Waste Operations and Emergency Response (HAZWOPER) Training in accordance with 29 CFR 1910.102. Employees are certified in first aid and CPR and receive 8-hour HAZWOPER refresher training annually. In addition, personnel working on-site participate in an annual medical monitoring program.

9.0 EMERGENCY SERVICES

Emergency Medical Care:	North Kansas City Hospital 2800 Clay Edwards Drive North Kansas City, Missouri
Phone #:	(816) 691-2000
Route to Hospital:	SEE ATTACHED MAP
Ambulance:	911
Police:	911
Fire:	911
Poison Control:	(800) 366-8888
Geotechnology:	(913) 438-1900
Missouri One-Call:	(800) 344-7483

10.0 SIGNATURES

ALL GEOTECHNOLOGY PERSONNEL MUST READ AND UNDERSTAND THIS PLAN PRIOR TO ENTERING THE SITE.

BY SIGNING AND DATING BELOW, EACH PERSON INDICATES THAT A HEALTH AND SAFETY MEETING WAS CONDUCTED PRIOR TO INITIATION OF FIELD ACTIVITIES WHICH INCLUDED, AT A MINUMUM, A DISCUSSION OF THE FOLLOWING: SITE HAZARDS, MONITORING EQUIPMENT, PPE, AND THE ROUTE TO THE HOSPITAL.

Name: _____ Signature: _____

Company: _____ Date: _____

Name: _____ Signature: _____

Company: _____ Date: _____

Name: _____ Signature: _____

Company: _____ Date: _____

Name: _____ Signature: _____

Company: _____ Date: _____

Name: _____ Signature: _____

Company: _____ Date: _____

Name: _____ Signature: _____

Company: _____ Date: _____

mapquest

Notes

Trip to:

2800 Clay Edwards Dr
Kansas City, MO 64116-3220
3.27 miles / 5 minutes

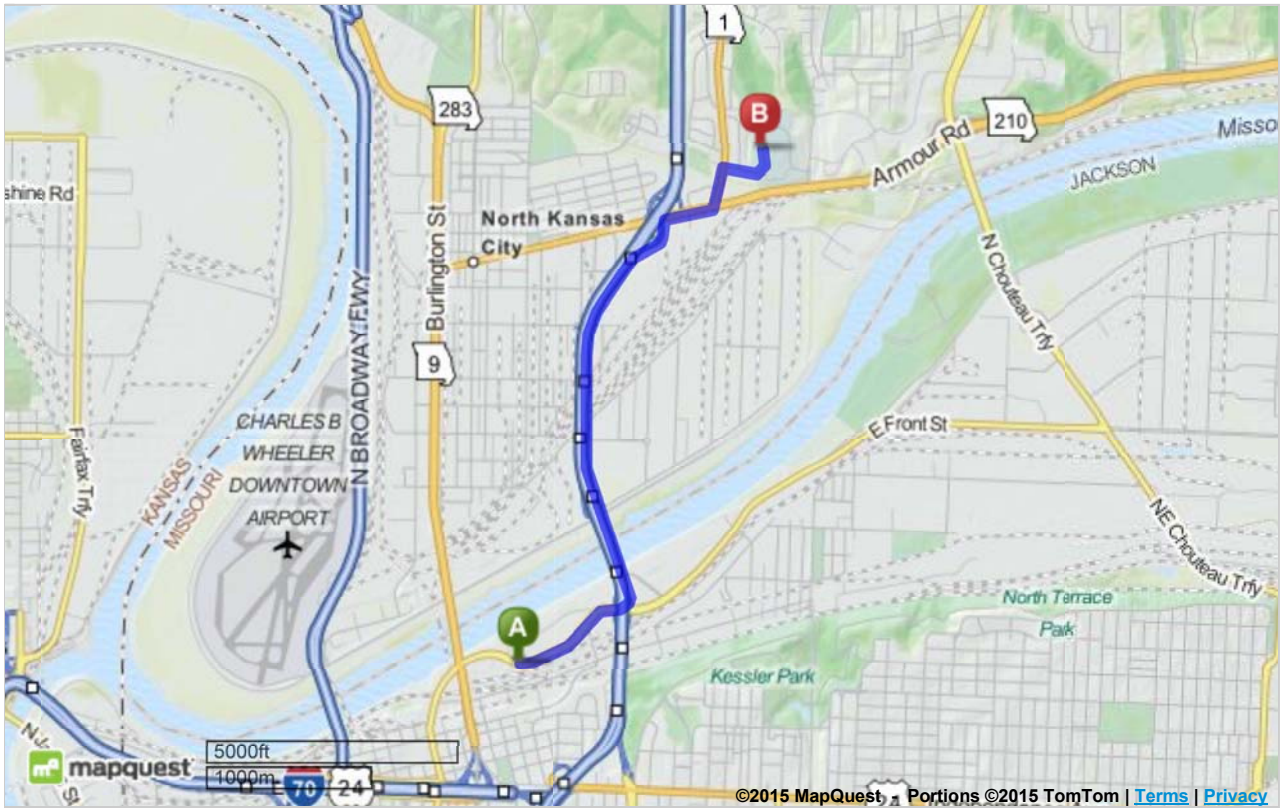
1014 E 1st St, Kansas City, MO 64120-140339.114175, -94.573943
(Address is approximate)

Download Free App

1. Start out going **northeast** on **Front St** toward **N Lydia Ave**. Map	**0.6 Mi**
2. Merge onto **I-35 N / I-29 N / US-71 N** via the ramp on the **left**. Map	**1.7 Mi**
3. Take the **MO-210 / Armour Rd** exit, **EXIT 6**. Map	**0.3 Mi**
4. Turn **right** onto **Armour Rd / MO-210**. Map	**0.2 Mi**
5. Turn **left** onto **Vernon St / MO-1**. Map	**0.2 Mi**
6. Turn **right** onto **E 26th Ave**. Map	**0.2 Mi**
7. **E 26th Ave** becomes **Clay Edwards Dr**. Map	**0.1 Mi**
8. **2800 CLAY EDWARDS DR** is on the **left**. Map	

2800 Clay Edwards Dr, Kansas City, MO 64116-3220

Total Travel Estimate: **3.27 miles - about 5 minutes**



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SOIL MANAGEMENT PLAN

March 4, 2015 J024061.01

Mr. Jess Fisher, LEED AP
Flaherty & Collins Properties, Inc.
8900 Keystone Crossing, Suite 1200
Indianapolis, Indiana 46240

Re: Soil Management Plan
Union Berkley Park
River Front Road and East Front Street
Kansas City, Missouri

Dear Mr. Fisher:

Geotechnology, Inc. (Geotechnology) has prepared the following soil management plan for the referenced site. The plan addresses soil management during exploration activities at the site.

If you have questions, please contact the undersigned.

Respectfully submitted,

GEOTECHNOLOGY, INC.

Sheryl D. Gallagher, P.E.
Senior Project Manager

SDG/AMS/MSR:sdg/ljd

Attachment: Soil Management Plan
RCGA Agreement

SOIL MANAGEMENT PLAN
UNION BERKLEY PARK
RIVER FRONT ROAD AND EAST FRONT STREET
KANSAS CITY, MISSOURI

SITE HISTORY

The site is currently known as Union Berkley Park. The site is located on the south side of the Missouri River between the Broadway and Kit Bond bridges, and is bordered by East Front Street and East Riverfront Drive. A former manufactured gas plant was located near the southwest portion of the site. Geotechnical and environmental studies have previously been completed at the site. In addition, construction debris has been processed and used as structural fill on the site.

The site is subject to a Restrictive Covenant and Grant of Access[1] (RCGA) agreement between the Port Authority of Kansas City and the Missouri Department of Natural Resources (MDNR). A copy of this agreement is attached to this plan. Although remediation of the former manufactured gas plant occurred in the 1990s, contaminated soil zones could be encountered. Previously observed contaminants include polycyclic aromatic hydrocarbons (PAHs), arsenic and lead. The arsenic and lead sample concentrations were above the Missouri Risk-Based Corrective Action (MRBCA) Default Target Levels (DTLs).

PROJECT DESCRIPTION

The project includes two parking garages and two commercial/residential structures that will be constructed on Parcels 1 and 2 on the west side of the site. Parcels 1 and 2 are separated by a large diameter sewer that is referred to as the Gillis Street sewer. The four-level parking garages will be 73 feet apart and located east and west of the north-to-south sewer. The parking garages will be joined at each level by a pedestrian bridge. Column loads will range from 200 to 850 kips with wall loads of about 20 kips per lineal foot. Four story, wood-framed commercial and residential structures will be constructed on the periphery of the two parcels and connected to the parking garages. The expected building wall and column loads are 5.5 kips per lineal foot and 200 kips, respectively.

Approximately 50,000 cubic yards of structural fill is required to raise the site to planned grades. As much as 20 feet of fill is required over a 400-foot long section of the Gillis Street sewer. Structures are planned to be supported on auger cast-in-place displacement piles to reduce the volume of spoils returning to the surface due to the environmental concerns.

A portion of the site is within the critical zone of the Missouri River levee. Exploration activities within the critical zone will be approved by the US Army Corps of Engineers. The site is generally accessible, except for a stockpile of concrete construction debris. We understand the stockpile will be processed and re-used as engineered fill. Another concrete construction debris stockpile is located on the Missouri Department of Transportation (DOT) property that will be evaluated for use as engineered fill.

[1] *Declaration of Restrictive Covenant and Grant Access,* Grantor: Port Authority of Kansas City (PAKC). Grantee: Missouri Department of Natural Resources, dated September 13, 2007.

printed on recycled paper

SOIL MANAGEMENT PLAN

The intent of this plan is to provide standard operating field and laboratory procedures for use by Geotechnology's staff during subsurface exploration activities at the site. It is anticipated soil samples for geotechnical laboratory testing, drilling spoils, and soil from test pits will be managed under this plan.

Test Pits. Test pits to a maximum depth of approximately 10 feet are planned. Excavated material from the test pits are expected to be processed construction debris fill and the levee clay blanket. Contaminated soils are not expected to be encountered in the test pits.

Based on the Soil Contingency Plan contained in the RCGA, soils from an excavation are subject to the following requirements:

- Soil excavated from 0-3 feet is considered clean fill and must be replaced in the same zone.
- Soil excavated below 3 feet but above 15 feet must be replaced in the same zone.
- Provided the soils are being placed in the same excavation they were removed from, analytical testing of each zone is not required.

Soil Borings. The Soil Contingency Plan contained in the RCGA indicates that hydrocarbon impacted groundwater could be encountered at the south side of the site at depths as shallow as 12 feet. The depth of the hydrocarbon contamination increases as proximity becomes closer to the Missouri River. Soil borings are planned to depths ranging from 45 to 85 feet and are expected to encounter this zone. The following protocol for waste soil and drill fluids will be used for collection of the geotechnical samples.

- Drill tooling will be decontaminated between each boring by use of a high pressure sprayer. Decontamination water will be collected and containerized in a 55-gallon DOT drum.
- Drilling spoils from auger methods will be placed in a 55-gallon DOT drum.
- Drilling below the water table will use rotary wash methods. Returned circulation water and soils will be collected in a wash tub. At the completion of drilling, the drill fluid will be placed in 55-gallon DOT drums and soils will be placed with auger drilling spoils in 55-gallon DOT drums. The drums will be staged on site.
- A composite sample of drill fluid/decontamination water and a composite sample of soils will be collected and sent to an analytical laboratory for testing. Testing will include Toxicity Characteristic Leaching Procedure (TCLP), Resource Conservation and Recovery Act (RCRA) 8 metals, TCLP Volatile Organic Compounds (VOCs), and TCLP Semi-Volatile Organic Compounds (SVOCs). The circulation water sample will also be tested for closed cup flashpoint.

- Collected geotechnical samples will be screened for VOCs using a photoionization detector (PID). Samples with PID results indicating VOCs will be placed in a 5-gallon bucket with a lid labeled "VOC contaminated samples". In addition, samples with visual or olfactory indications of contamination will be placed in a separate 5-gallon bucket with a lid labeled "potentially contaminated samples."

Geotechnical Laboratory Testing Samples. Samples will be staged in a designated area of Geotechnology's Overland Park soils laboratory on a pallet. The pallet will be labeled "Caution – Potentially Contaminated Samples". Thin-walled tube samples identified in the field as impacted or potentially impacted samples will be placed in a plastic garbage can sealed with a lid. Impacted or potentially impacted soils samples that are selected for geotechnical testing will be packaged for shipping to a geotechnical laboratory that can test impacted samples by a competent person.

Samples not identified with unusual odors or colors will be tested at Geotechnology's Overland Park laboratory. Laboratory personnel will use latex or nitrile gloves as a precaution when working with the samples. At the conclusion of each test, the technician will wash their hands and decontaminate equipment before proceeding to the next task.

Disposal. Based on the information in the RCGA, it is assumed that the containerized drilling spoils/decontamination water from the site will be transported to a third party disposal site by a special waste hauler.

Hauler Requirements

Special waste material haulers must be permitted to transport special waste in the State of Missouri. The contractor will provide evidence of regulatory approval for the type of material being transported. Truck loading, covering, and hauling protocols will be followed. Special waste manifests will be required for transportation of special waste material, and will be provided by the landfill to the haulers prior to project initiation. Geotechnology will provide to the hauler the analytical test results from the composite samples of the containers. A representative of the owner or a representative of Geotechnology (on the owner's behalf) will sign the manifests during hauling operations.

HEALTH AND SAFETY

General health and safety guidelines and information related to potentially contaminated materials are provided in the following sections. Contractors will be expected to implement site-specific health and safety plans for their operations.

Missouri-One Call will be notified to mark public utilities at the site. Borings are not planned within the right-of-way or streets so permits and traffic control is not required.

Hazard Evaluation

***Volatile Organic Compounds (VOCs)*:** Many of the VOCs are suspected carcinogens that present both an inhalation and skin contact hazard. Overexposure to VOCs can cause headache, dizziness (due to narcotic effects), nausea and loss of appetite. In addition to the narcotic effects described, VOCs may be highly flammable and may create fire and explosion risks in the vicinity of subsurface drilling and/or excavation operations.

BENZENE: While poisoning occurs most commonly through inhalation of vapors, benzene can be absorbed through the skin and is considered a skin irritant. It is a recognized leukemogen. Symptoms of exposure include headache, dizziness, nausea and loss of appetite. Acute poisoning may include reddening of the skin, a burning sensation and blistering. The victim may become dizzy and confused. Tightening of the leg muscles and pressure over the forehead may also occur. First aid for victims of overexposure should include washing exposed skin with copious amounts of soap and water. The victim should be taken to an area of fresh air.

TOLUENE: Exposure is generally via inhalation and ingestion. Inhalation of 200 parts per million toluene for 8 hours may cause impairment of coordination and reaction time. Symptoms of exposure to toluene are very similar to those of benzene. Recovery is usually the rule following removal from exposure.

ETHYLBENZENE: Ethylbenzene is an irritant to the skin, eyes and mucous membranes via ingestion and inhalation. The liquid is an irritant to the skin and mucous membranes. Exposure to the vapors causes irritation to the nose and throat, dizziness and a sense of chest constriction. Victims exhibiting signs of overexposure should be removed to an area of fresh air.

XYLENES: Xylenes are considered less toxic than benzene. Exposures to high concentrations may cause dizziness due to a narcotic effect. Exposure is generally via inhalation and ingestion. Victims exhibiting signs of overexposure should be removed to an area of fresh air.

***Polycyclic Aromatic Hydrocarbons (PAHs)*:** PAHs are a class of semi-volatile organic compounds that, by their nature, present a higher degree of hazard via skin contact and ingestion than by inhalation due to the fact that less volatilization occurs. Most are considered combustible materials, meaning they have a flash point that is greater than 100 degrees Fahrenheit but less than 200 degrees Fahrenheit. Some of the PAHs can be absorbed through the skin. Their effects are on the central nervous system with symptoms developing rapidly. Symptoms of exposure are headache, dizziness, muscular weakness and dimness of vision.

***Total Petroleum Hydrocarbons (TPH)*:** TPH compounds are general classes of petroleum hydrocarbons such as gasoline, diesel and oil-range hydrocarbon chains. The TPH compounds are made up of various VOCs and Semi-VOCs, and as a result, hazard information associated with these chemicals (as shown above) may apply to TPH compounds.

***Heavy Metals*:** Heavy metals are toxic by ingestion and inhalation of dusts or fumes. Some are carcinogenic and are cumulative in the body. They include such metals as lead, arsenic, cadmium, chromium, selenium, silver, mercury, and barium.

***Unknown Chemical Contamination*:** It is impossible to describe the hazards of all chemicals. Because the possibility of chemical hazards exists, one must always be alert to signs indicating their presence. Some signs to look for are odd colors in the soil, strange odors, the absence of vegetation in an area that would normally be expected to have it, the presence of a vapor cloud, irritation to the eyes, nose, throat or skin, or a feeling of lightheadedness or dizziness. These signs or symptoms could indicate exposure and personnel should evacuate the area.

Worker/Personnel Requirements

Personnel who have the potential to contact contaminated material (excavation contractors, superintendent, utility workers, etc.) on the site should participate in a medical monitoring program and have received 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training in accordance with 29 CFR 1910.120, including annual 8-hour HAZWOPER refresher training.

Health and Safety

Although contractors will be expected to implement site-specific health and safety plans, certain procedures will be followed to enhance site safety. These general health and safety activities apply in the event contaminated soil/fill material is encountered during excavation activities:

- Personal protective equipment – based on potential hazards involved, personal protective equipment will be worn for applicable work areas or tasks. Hard hats, steel-toed boots, gloves and hearing protection are common equipment for construction projects. Personal protective equipment for hydrocarbon-impacted soil management may include latex/nitrile gloves and Tyvek coveralls.
- Site monitoring – periodic monitoring for organic vapors will be performed by Geotechnology in breathing zones during drilling and excavation activities. A photoionization detector (PID) can be used for organic vapor monitoring. Flammable and explosive vapors will be monitored near the borehole by use of an explosimeter.
- Decontamination – Personnel and equipment that come in contact with contaminated soil and fill material should be thoroughly decontaminated prior to leaving the site. Decontamination activities may include onsite steam cleaning and manual cleaning/rinsing with brushes, water and non-phosphate cleaning solution.

RECORDER'S CERTIFICATION
JACKSON COUNTY, MISSOURI
09/13/2007 03:48:25 PM
INSTRUMENT TYPE: MISC FEE: $147.00 44 Pages
NON-STANDARD FEE: $25.00

INSTRUMENT NUMBER/BOOK & PAGE:
2007E0120653

ROBERT T. KELLY, DIRECTOR, RECORDER OF DEEDS

Jackson County
Recorder of Deeds

Non-Standard Document

This document has been recorded and you have been charged the non-standard fee pursuant to RSMo 59.310.3.
This certificate has been added to your document in compliance with the laws of the State of Missouri.

Robert T. Kelly, Recorder of Deeds

415 E. 12th Street, Room 104
Kansas City, MO 64106

308 W. Kansas, Suite 104
Independence, MO 64050

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43

AC80645

Assured Quality Title Company

1001 Walnut, Kansas City, MO. (816)221-2880

Recording Cover Sheet

Title of Document: **Declaration of Restrictive Covenant and Grant of Access**

Date of Document: **September 13, 2007**

Grantor(s): **Port Authority of Kansas City (PAKC)**

Grantee(s): **Missouri Department of Natural Resources**

Mailing Address(s): **P O Box 176**
1101 Riverside Dr.
Jefferson City, MO 65102

Legal Description: **Page 11**

Reference Book and Page:

DECLARATION OF RESTRICTIVE COVENANT AND GRANT OF ACCESS

This Restrictive Covenant and Grant of Access entered into as of this 13th day of September, 2007, by and between the Port Authority of Kansas City (PAKC), having a mailing address of 1100 Walnut Street, Suite 1700, Kansas City, Missouri 64106, as party of the first part, and Missouri Department of Natural Resources (the department), a political subdivision of the State of Missouri, having a mailing address of P. O. Box 176, 1101 Riverside Drive, Jefferson City, Missouri 65102, as party of the second part. PAKC entered into a Letter of Agreement (Agreement) pursuant to the Brownfields/Voluntary Cleanup Program (BVCP), § 260.565, *et seq.*, RSMo, with the department for the Riverfront Development Site, a site of environmental contamination located on Riverfront Drive in the city of Kansas City, Missouri, as shown on the site map and legal description attached hereto as Exhibit A, hereinafter referred to as "the Property."

The Agreement requires PAKC to file a Restrictive Covenant and Grant of Access with the Jackson County Recorder of Deeds for the Property in the event that chemicals of concern remain at the site above levels suitable for unrestricted land use for any reason following the investigation and remediation of the site under the BVCP.

Pursuant to the Agreement, PAKC implemented certain response activities at the Property, including the following:

1. Site Assessment and characterization including sampling of surface and subsurface soils and groundwater, followed by Risk Assessment
2. Excavation and offsite disposal of soils contaminated with coal tar constituents, petroleum hydrocarbons, lead, arsenic and polynuclear aromatic hydrocarbons (PAHs)
3. Excavation, sorting, size reduction, sampling, replacement and capping of soils, rubble and debris containing levels of lead, arsenic and PAHs exceeding unrestricted use target levels

Because chemicals of concern will remain at levels above those appropriate for unrestricted use of the property, this Restrictive Covenant is being recorded with the Jackson County Recorder of Deeds for the purposes of protecting public health and safety and the

environment, and to prevent interference with the performance, operation, and maintenance of any future response activities selected and/or undertaken by the department, any party acting as an agent for the department, or any party acting pursuant to a work plan approved by the department.

For the purposes of this Restrictive Covenant and Grant of Access, the term **"Residential Land Use"** refers to property whose use is unrestricted and that is either being used for residential use, or is zoned for residential use, or access to the Property is not restricted and children under 18 years of age are on the Property more than 250 days per year.

"Restricted Residential Land Use" refers to multi-family residential use such as condominiums and apartments, where children under 18 years of age are on the Property more than 250 days per year. Restricted Residential does not include single-family, owner-occupied homes.

"Non-residential Land Use" refers to property not included in "Residential Land Use", which is publicly accessible with public access limited to non-routine visits, and where visitors are not supervised while on the property, commonly referred to as "commercial use," and to property which is not publicly accessible, and where visitors are supervised while on the property, commonly referred to as "industrial use."

If any provision of this Restrictive Covenant and Grant of Access is the subject of any laws or regulations established by any federal, state, or local government, the stricter of the two standards shall prevail.

NOW THEREFORE, Port Authority of Kansas City, 1100 Walnut St. Suite 1700, Kansas City, MO, hereby imposes restrictions on the Property and covenants and agrees that:

1. **Purpose.**
   In accordance with the Agreement, the purpose of this Restrictive Covenant is to assure:

   A. That the Property is used in a manner consistent with the risk assessment and resulting risk management plan or risk-based cleanup standards for the Property, which assessment has either been prepared or approved by the Missouri Department of Health and Senior Services.
   B. That groundwater at the Property is not utilized
   C. That humans are not exposed to soils at the Property contaminated with substances in concentrations exceeding the levels established in the cleanup plan or risk assessment for the Property, which assessment has either been prepared or approved by the Missouri Department of Health and Senior Services
   D. That Buildings are not constructed over soils or ground water at the Property contaminated with substances in concentrations exceeding that pose a potential risk of forming dangerous levels of vapors inside such buildings

E. That the engineered control(s) described herein are not disturbed and are properly maintained to prevent human and ecological exposure to soils at the Property polluted with substances in concentrations exceeding the levels established in the cleanup plan or risk assessment for the Property

F. That any soil excavated from certain areas and depths at the site in the future is properly handled and/or disposed of.

2. Restrictions Applicable to the Property.

In furtherance of the purposes of this Restrictive Covenant, Owner shall assure that use, occupancy, and activity of and at the Property are restricted as follows:

A. **Restricted Residential Use** The Property currently meets the department's standards for restricted residential use and, based on reports on file at the department offices in Jefferson City, Missouri, the contaminants present pose no significant present or future risk to human health or the environment based on restricted use of the Property. The Property may be used for multi-family residential uses such as apartments or condominiums. No further response action for the Property is required by the department as long as the Property is not used for single-family, detached residential homes or other purposes constituting unrestricted use. Since cleanup standards for Non-Residential Use, are less stringent than Restricted Residential, the Property also meets or exceeds Non-Residential standards and may be used for non-residential purposes such as commercial or industrial.

B. **Vapor Intrusion Mitigation** If any occupied enclosed structure is to be built that extends within 10 vertical feet of the Smear Zone, as shown in the approved Soil Management Plan, additional sampling, risk assessment, and/or mitigation must be performed as outlined in the approved Soil Management Plan to address vapor intrusion risks.

C. **No Drilling or Use of Groundwater** Groundwater beneath the Property contains chemicals at concentrations exceeding applicable standards for domestic use. The owner and operator of the Property shall prevent: use of and exposure to the groundwater; any artificial penetration of the groundwater-bearing unit(s) containing chemicals which could result in cross-contamination of clean groundwater-bearing units; installation of any new groundwater wells on the Property, except those used for investigative purposes; use of groundwater for drinking or other domestic purposes and the use of groundwater for purposes other than domestic purposes; release of groundwater to surface water bodies, whether such release is the result of human activities or is naturally occurring. Should a release of contaminated

groundwater occur, the owner must take action to contain and properly dispose of such groundwater.

D. **Disturbance of Soil Permitted Under Approved Contingency Plan** Soil at the Property contains chemicals, as identified in reports on file at the department offices in Jefferson City, Missouri, at concentrations exceeding the department's standards for surface soil for Residential use. Soil in these areas, shown on the drawings at Exhibit B, Soil Disturbance Contingency Plan, shall not be excavated or otherwise disturbed in any manner unless under the provisions of the department-approved Contingency Plan.

The Owner shall prohibit all activities as presented above that will result in human or ecological exposures above those specified in risk assessments or risk management plans approved by the department for the Property, or that would result in the release of a hazardous substance that was contained as a part of the risk management or remedial action.

3. **Potential Hazards.**
Except as provided in Paragraph 7 below, no action shall be taken, allowed, suffered, or omitted if such action or omission is reasonably likely to:

A. Create a risk of migration of chemicals or a potential health hazard to human health or the environment.

B. [Result in disturbance of the structural integrity of the engineered controls designed or utilized at the Property to contain chemicals or limit human and/or ecological exposure to chemicals.]

4. **Alterations of Property**
Owner shall not make, or allow or suffer to be made, any alteration of any kind in, to, or about any portion of the Property inconsistent with this Restrictive Covenant unless the Owner has first recorded the department's written approval of such alteration upon the land records of the Jackson County Recorder of Deeds. The Owner may appeal the department's decisions regarding proposed alterations to the Missouri Hazardous Waste Management Commission pursuant to 10 CSR 25-15.010(9).

5. **Interfering Activities.**
The Owner shall prohibit all activities on the Property that may interfere with the response activities, operation and maintenance, long-term monitoring, or measures necessary to assure the effectiveness and integrity of the remedial action.

6. Emergencies.

In the event of an emergency which presents a significant risk to human health or the environment, the application of Paragraph 3 above may be suspended, provided such risk cannot be abated without suspending such Paragraph and the Owner:

A. Immediately notifies the department of the emergency;

B. Limits both the extent and duration of the suspension to the minimum reasonably necessary to adequately respond to the emergency;

C. Implements all measures necessary to limit actual and potential present and future risk to human health and the environment resulting from such suspension; and

D. Implements a plan approved in writing by the department, on a schedule approved by the department, to ensure that the Property is remediated or restored to its condition prior to such emergency.

7. Grant of Access to the department.

Owner hereby grants and conveys to the department, its agents, contractors, and employees, and to any person performing pollution remediation activities under the direction thereof, access to the Property. Pursuant to this Agreement, the department, its agents, contractors, and employees, and any person performing pollution remediation activities under the direction thereof, may enter upon and inspect the Property and perform such investigations and actions as the department deems necessary for any one or more of the following purposes:

A. Ensuring that use, occupancy, and activities of and at the Property are consistent with this Restrictive Covenant;

B. Ensuring that any remediation implemented complies with state law, including, but not limited to, § 260.350, *et seq.*, RSMo; § 260.565, *et seq.*, RSMo; § 260.435, *et seq.*, RSMo; § 260.500, *et seq.*, RSMo;

C. Performing any additional investigations or remediation deemed necessary to protect human health and the environment as related to the BVCP-approved remedial action plan;

D. [if engineering controls are used:] Ensuring the structural integrity of any engineering controls described in this Restrictive Covenant and Grant of Access and their continuing effectiveness in containing chemicals and limiting human and ecological exposure to the chemicals.

8. Notice and Time of Entry onto Property.

Entry onto the Property by the department pursuant to this Agreement shall be upon reasonable notice (not less than 2 weeks) and at reasonable times, provided

that entry shall not be subject to these limitations if the department determines that immediate entry is necessary to protect human health or the environment.

9. **Notice to Lessees and Other Holders of Interest in the Property.**
Owner, or any future holder of any interest in the Property, shall cause any lease, grant, or other transfer of any interest in the Property to include a provision expressly requiring the lessee or transferee to comply with this Restrictive Covenant and Grant of Access. The failure to include such provision shall not affect the validity or applicability to the Property of this Restrictive Covenant and Grant of Access.

10. **Enforceability of Restrictions; Persons Entitled to Enforce Restrictions.**
The restrictions in this Restrictive Covenant on use, occupancy, and activity of and at the Property shall be enforceable in an appropriate Court by Owner and/or by the department, their successors, transferees, and assigns. Owner agrees that the restrictions are enforceable, and agrees not to challenge the appropriate circuit court's jurisdiction. If the department believes that the Owner has failed to comply with the terms of the Restrictive Covenant or Institutional Control Contract, within 30 calendar days of notice from the department that a deficiency has been found the Owner shall respond with a proposed plan to remedy the deficiency. If the Owner fails to remedy the deficiency or the remedy is unacceptable to the department, the department may order compliance and seek judicial enforcement. Furthermore, the department may take enforcement action against the Owner and impose, as a last resort, any applicable penalties.

11. **Written Notice of Property Conveyance Required.**
The Owner shall provide written notice to the Director of the department, of the intent to transfer an interest in the Property not less than 14 days prior to the expected date of transfer. This notice shall include the name and business address of the transferee and the expected date of transfer.

12. **Property Conveyance – Continuance of Provisions.**
The Owner shall not convey any title, Access, or other interest in the Property without adequate and complete provision for the continued implementation, operation, and maintenance of any remedial action that has been implemented on the Property and without assuring prevention of the releases and exposures described in the provisions of Paragraph 1, above.

13. **Duration of Restrictive Covenant.**
The restrictions and other requirements described in this Restrictive Covenant and Grant of Access shall run with the land and shall be binding upon any future

Owners, heirs, successors, lessees, or assigns and their authorized agents, employees, or persons acting under their direction or control. This Restrictive Covenant and Grant of Access shall continue into perpetuity, unless and until rescinded by the department. A copy of this Restrictive Covenant and Grant of Access shall be provided to all heirs, successors, assigns, and transferees of Owner.

If any provision of this Restrictive Covenant and Grant of Access is held invalid by any Court of competent jurisdiction, invalidity of any such provision shall not affect the validity of any other provisions hereof. Also, such provisions shall continue unimpaired in full force and effect.

14. Amending, Modifying, or Rescinding the Restrictive Covenant

This Restrictive Covenant and Grant of Access shall not be amended, modified or terminated except by a written instrument executed by and between the Owner at the time of the proposed amendment, modification, or termination and the department. Within five (5) days of executing an amendment, modification, or termination of this Restrictive Covenant and Grant of Access, the Owner shall record such amendment, modification, or termination, on the appropriate form provided by the department, with the Jackson County Recorder of Deeds, and within five (5) days thereafter, the Owner shall provide a true copy of the recorded amendment, modification, or termination to the department.

In the event the department determines that risks posed by the site have substantially changed subsequent to the execution of this Restrictive Covenant and Grant of Access (e.g., contaminant levels at the site change, or cleanup levels change), the department may rescind this Restrictive Covenant and Grant of Access.

15. Disputes

Any disputes regarding provisions of this covenant that cannot be resolved by the department and the property owner will be addressed pursuant to 10 CSR 25-15.010(9).

16. Location of Administrative Record

Further information regarding the site and contamination may be obtained from the Missouri Department of Natural Resources through a written request under the Missouri Open Records Law, Chapter 610 RSMo, by providing the Department with the site identification name of **(name of site per DNR's record keeping system)** to Missouri Department of Natural Resources, Attn: BVCP Custodian of Records, P.O. Box 176, Jefferson City, Missouri 65102-0176.

17. Institutional Control Contract

The department's Hazardous Waste Program requires that owners of property enrolled in the BVCP for which a Restrictive Covenant and Grant of Access is required, enter into an Institutional Control Contract with the department. Owner of the Property has entered into such a Contract with the department. Said Contract is attached hereto as Exhibit C and by this reference made a part hereof.

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SIGNATURES

The undersigned property owner or person executing this Restrictive Covenant and Grant of Access on behalf of the Owner represents and certifies that they are truly authorized and have been fully empowered to execute and deliver this Restrictive Covenant and Grant of Access.

STATE OF MISSOURI)
) SS
COUNTY OF Jackson)

Property owner(s) or authorized representative(s) thereof

Type or Print : VINCENT P. GAUTHIER Signature _____ Date: 09/13/07

Type or Print : _____ Signature _____ Date:

IN WITNESS WHEREOF, the Owner(s) or Owner's authorized representative(s) of the above-described Property has caused this Restrictive Covenant and Grant of Access to be executed on this 13th day of September, 2007. Signed in the presence of Property Owner/Authorized Representative subscribed and acknowledged.

Subscribed and acknowledged before me this 13th day of September, 2007.

Melissa L Lloyd
Notary Public Notary Seal
State of Missouri County of Platte
My Commission Expires 07/11/2011
Commission # 07117790

Melissa L Lloyd
Notary Public

My commission expires 7-11-11.

Exhibit A
Legal Descriptions and Property Maps

Tract I - (Lying South of Riverfront Road):

All that part of Fractional Section 32, Township 50, Range 33, as originally surveyed by the United States and certain accredited lands, in Kansas City, Jackson County, Missouri, described as follows:

Commencing at Southeast corner of the Fractional Northeast Quarter of said Section 32;

Thence North 2°14'55" East 620.12 feet, more or less, (626.31 feet measured), along the East line of the Fractional Northeast Quarter of said Section 32, to a point on the Northerly line of a tract conveyed to the Chicago, Burlington & Quincy Railroad Company (now the Burlington-Northern Railroad Company) by deed dated August 2, 1948 and filed for record and recorded under Document No. A-931618, in Book B-4228, at Page 681;

Thence South 65°59'55" West 35.51 feet along said Northerly line;

Thence Southwesterly along said Northerly line, being a curve to the left, from the last-described course as a tangent, having a radius of 2,914.94 feet and a central angle of 3°31'00", a distance of 178.91 feet;

Thence South 62°28'55" West 662.52 feet, along said Northerly line, tangent to the last-described curve, to a point on the centerline of a 15-foot sewer right-of-way accepted by Ordinance No. 12349 and recorded as Document No. A-944476, in Book B-4256, at Page 179, filed February 3, 1949 and the "true point of beginning" of the tract of land to be herein described;

Thence continuing South 62°28'55" West 53.89 feet;

Thence continuing Southwesterly and Westerly along said Northerly line, being a curve to the right, from the last-described course as a tangent, having a radius of 409.28 feet and a central angle of 21°53'45", a distance of 156.41 feet to a point on the Northerly line of a tract conveyed to Centralized Yards, Inc. by deed dated January 27, 1940, filed for record and recorded under Document No. A-650085, in Book B-3425, at Page 574;

Thence North 60°35'05" West 531.70 feet along said Northerly line;

Thence South 78°28'55" West 1,146.52 feet, along said Northerly line, to a point on the Southeasterly right-of-way line of Riverfront Road, as proposed by Shafer, Kline & Warren in February, 1997;

Thence Northeasterly, along said Southeasterly right-of-way line, being a curve to the right, from

Tract I (cont.)

the last-described course as a non-tangent curve, having a radius of 1,536.00 feet and a central angle of 24°07'09", a distance of 646.59 feet;

Thence North 74°15'40" East 721.29 feet along said Southeasterly right-of-way line;

Thence continuing Northeasterly, along said Southeasterly right-of-way line, being a curve to the left, from the last-described course as a tangent, having a radius of 2,560.00 feet and a central angle of 08°57'22", a distance of 400.16 feet, to a point on the centerline of said 15-foot sewer right-of-way accepted by Ordinance No. 12349;

Thence South 13°47'06" East 613.78 feet, along said centerline, to the "true point of beginning" of the tract herein described, containing 460,687 square feet or 10.5759 acres, more or less.

Subject to all easements and restrictions of record.

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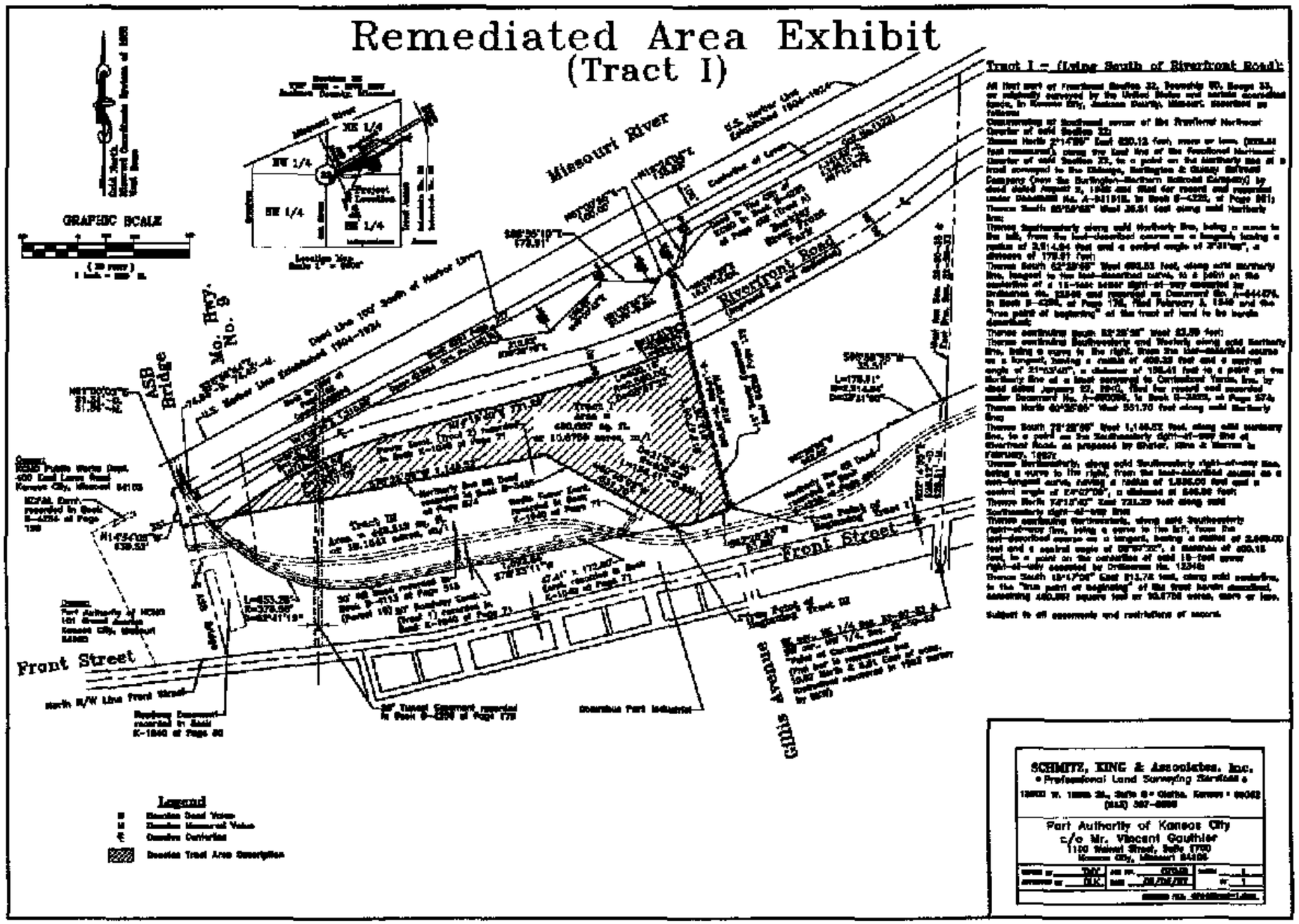
Remediated Area Exhibit
(Tract I)



Tract III:

All that part of Fractional Section 32, Township 50, Range 33, as originally surveyed by the United States and certain accredited lands, all in Kansas City, Jackson County, Missouri, being more particularly described as follows:

Commencing at Southeast corner of the Fractional Northeast Quarter of said Section 32;

Thence North 2°14'55" East 620.12 feet, more or less, (626.31 feet, measured), along the East line of the Fractional Northeast Quarter of said Section 32, to a point on the Northerly line of a tract conveyed to the Chicago, Burlington & Quincy Railroad Company (now the Burlington-Northern Railroad Company) by deed dated August 2, 1948 and filed for record and recorded under Document No. A-931618, in Book B-4228, at Page 681;

Thence South 65°59'55" West 35.51 feet along said Northerly line;

Thence Southwesterly along said Northerly line, being a curve to the left, from the last-described course as a tangent, having a radius of 2,914.94 feet and a central angle of 3°31'00", a distance of 178.91 feet;

Thence South 62°28'55" West 716.41 feet along said Northerly line, tangent to the last-described curve;

Thence continuing Southwesterly and Westerly along said Northerly line, being a curve to the right, from the last-described course as a tangent, having a radius of 409.28 feet and a central angle of 21°53'45", a distance of 156.41 feet to a point on the Northerly line of a tract conveyed to Centralized Yards, Inc. by deed dated January 27, 1940, filed for record and recorded under Document No. A-650085, in Book B-3425, at Page 574, and the "true point of beginning" of the tract of land to be herein described;

Thence South 78°33'11" West 1,092.66 feet;

Thence Southwesterly, Westerly and Northwesterly along a curve to the right, tangent to the last-described course, having a radius of 578.80 feet and a central angle of 62°41'19", an arc distance of 633.28 feet, to a point on the Southeasterly right-of-way line of Riverfront Road, as proposed by Shafer, Kline & Warren in February, 1997;

Thence North 48°53'25" East 67.10 feet, along said Southeasterly right-of-way line, to a point on said Northerly line of a tract conveyed to Centralized Yards, Inc. by deed dated January 27, 1940, filed for record and recorded under Document No. A-650085, in Book B-3425, at Page 574;

Tract III (cont.)

Thence North 78°28'55" East 1,146.52 feet along said Northerly line;

Thence South 60°35'05" East 531.70 feet, along said Northerly line, to the "true point of beginning" of the tract herein described, containing 441,078 square feet or 10.1258 acres, more or less.

Subject to all easements and restrictions of record.

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Remediated Area Exhibit
(Tract III)

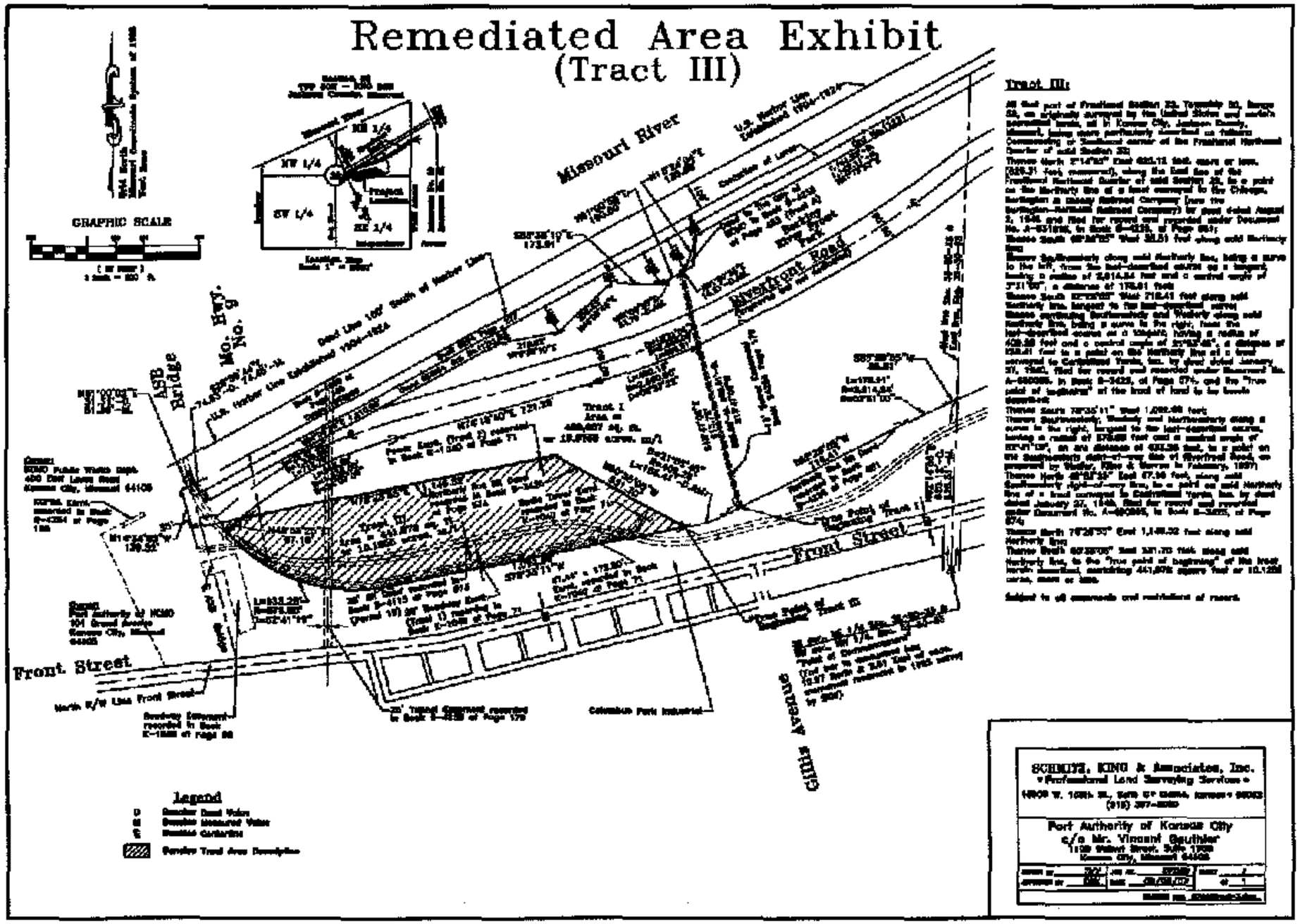


Exhibit B
Soil Disturbance Contingency Plan

SOIL DISTURBANCE CONTINGENCY PLAN
Riverfront Development Site
August, 2007

Plan Purpose

This Soil Disturbance Contingency Plan has been prepared to guide the proper handling of soil that is potentially impacted by arsenic, lead, and/or polynuclear aromatic hydrocarbons (PAHs) at the Riverfront Development Site. The location and legal description of the Site are presented in detail in other sections of this plan.

The Port Authority of Kansas City, Missouri entered into a Voluntary Cleanup Agreement with the Missouri Department of Natural Resources (MDNR) Brownfields/Voluntary Cleanup Program (BVCP) to investigate and remediate the Site. Site Investigations and remedial actions have been completed to the satisfaction of the MDNR VCP. Two Remedial Action Reports, dated October 17, 2003 and March 20, 2007, were prepared and submitted to MDNR. Both Reports are incorporated by reference into this Soil Disturbance Contingency Plan. The MDNR's Certificate of Completion for the cleanup requires that a Soil Disturbance Contingency Plan be incorporated as a long-term stewardship measure for low-level contaminants in subsurface soil at the site.

Future site development activities may require special material management procedures. Contractors/developers responsible for subsurface construction at the site will follow the general material management procedures developed in this plan. Material management procedures may include excavating, stockpiling, testing, and handling procedures for potentially impacted material during site development. The contractors/developers must employ or retain competent environmental professionals to assist with these activities. These activities include, but are not limited to; site grading, utility construction, utility maintenance, road construction, and building construction.

Plan Summary

- At the completion of remediation activities, the top three feet of soil over the site as defined by the elevations shown on Table 2 and the Cross Sections in Appendix D was classified as clean fill and does not require any special handling procedures. New soil imported to the site and placed above the current soil must be documented to meet current clean fill requirements (currently MRBCA DTLs).

- Soil excavated from two subsurface zones, 3 to 9 ft and 9 to15 ft below the current site finish grade elevation, must be handled using one or both of the two following options:

  1) Soil excavated from either zone shall be returned to the same zone.

  2) If the soil is not to be reused on site as described in 1) above, then the soil must be tested to determine appropriate disposal.

- Soil that is removed at depths greater than 15 feet below the current finish grade and is not impacted by the smear zone must be tested to determine eligibility for re-use or appropriate

disposal.

- If material from the smear zone (as defined below) is excavated, the material must be secured and tested to determine appropriate disposal methods. The material can not be used for backfill. Scenarios that may require removal of smear zone material could include deep utility construction or augured piers for building foundations.

Zone Specific Disturbance Requirements

Refer to the attached maps and cross-sections for vertical and horizontal locations of controlled soils.

Top 3 Feet (Minimum) of Soil and Future Imported Fill

Soil from the shallow horizon (0-3 ft) at the completion of remediation is considered clean fill and may be moved or reused freely onsite. Any soil imported to the Site for use as fill material above the 3 foot zone must be sampled to document results below current Missouri clean fill/unrestricted use standards, such as the MRBCA DTLs or equivalent. The samples must be collected at a maximum rate of 1 composite sample for every 5,000 cy consisting of one aliquot per 1000 cy and must be sampled and analyzed at a minimum for the following:

- Eight RCRA total metals by method 6010/700 or equivalent
- PAH method 8270C or equivalent
- TPH DRO and GRO by methods 8270C and 8260B or equivalent

Soil Below the 3 Feet Minimum Depth and Above the 15 Feet Depth

Soil that is removed from this zone must be replaced within the same zone. This soil will not require any testing for re-use at its original depth. If not to be replaced at original depth, the soil may be tested as described above and reused or disposed of according to test results.
Soil Below the 15 Feet Depth and Above the Smear Zone

Soil removed from this depth that is not impacted by the smear zone must be tested prior to re-use. The soil must be sampled at the same rate and for the same analyses as the top 3 feet zone. However, the allowable levels will be the MRBCA RBTLs for residential subsurface Type 2 soil, or equivalent prevailing standards.

Smear Zone

The smear zone as defined in the S.S. Papadopulos & Associates, Inc. Memorandum, dated May 20, 2002, is shown on the attached drawings. The smear zone is associated with hydrocarbon residues at the top of the fluctuating groundwater surface, and generally occurs at depths from approximately 12 to15 feet below current land surface at the southern property limits and increases in depth towards the River. The approximate elevations and thickness of the smear zone are shown on the cross sections in Appendix B.

Based on the anticipated types of project development, construction activities that may encounter the smear zone material are anticipated to be minimal. These activities may include the construction of deep sewer systems or drill cuttings from construction of drilled pier foundations for buildings.

A project specific material management plan will be required for these activities. The project specific plan will provide a comprehensive plan for a minimum of the following categories:

- A Health & Safety Plan to protect site workers
- A plan for collection and handling of material, including both soil and groundwater
- A sampling and analytical plan to determine appropriate disposal methods
- A plan to secure and properly dispose of the material

Such plans must be submitted to MDNR for approval prior to implementation of the plan.

Disposal Options

Special Waste

Soil anticipated to be disposed of as special waste will be stockpiled on site. Samples from the stockpiles will be collected and analyzed in accordance with the specific landfill requirements. Kingston used Courtney Ridge Landfill, in Kansas City, Missouri to dispose of the soil excavated to complete the RAPs. Courtney Ridge Landfill requires that one sample be collected for every 700 cy. Each sample was a composite of one aliquot per every 100 cy (7 aliquots per sample). Each sample was analyzed for TCLP semivolatiles, TCLP volatiles, and TCLP metals. However, these were the requirements for completion of the RAP (2003) and are subject to revision by the Landfill chosen to dispose of the waste.

Hazardous Waste

For samples that fail the requirements for special waste, additional analyses may be required to develop a waste profile and dispose of the material as a hazardous waste. Kingston used Peoria Disposal Company (PDC) for disposal of a small amount of hazardous waste during site remediation. However, it is anticipated to be very unlikely that additional material will require disposal as a hazardous waste.

Plan Changes

This Soil Disturbance Contingency Plan may be modified with approval of the MDNR Brownfields/Voluntary Cleanup Program.

SIGNATURES

09/13/07

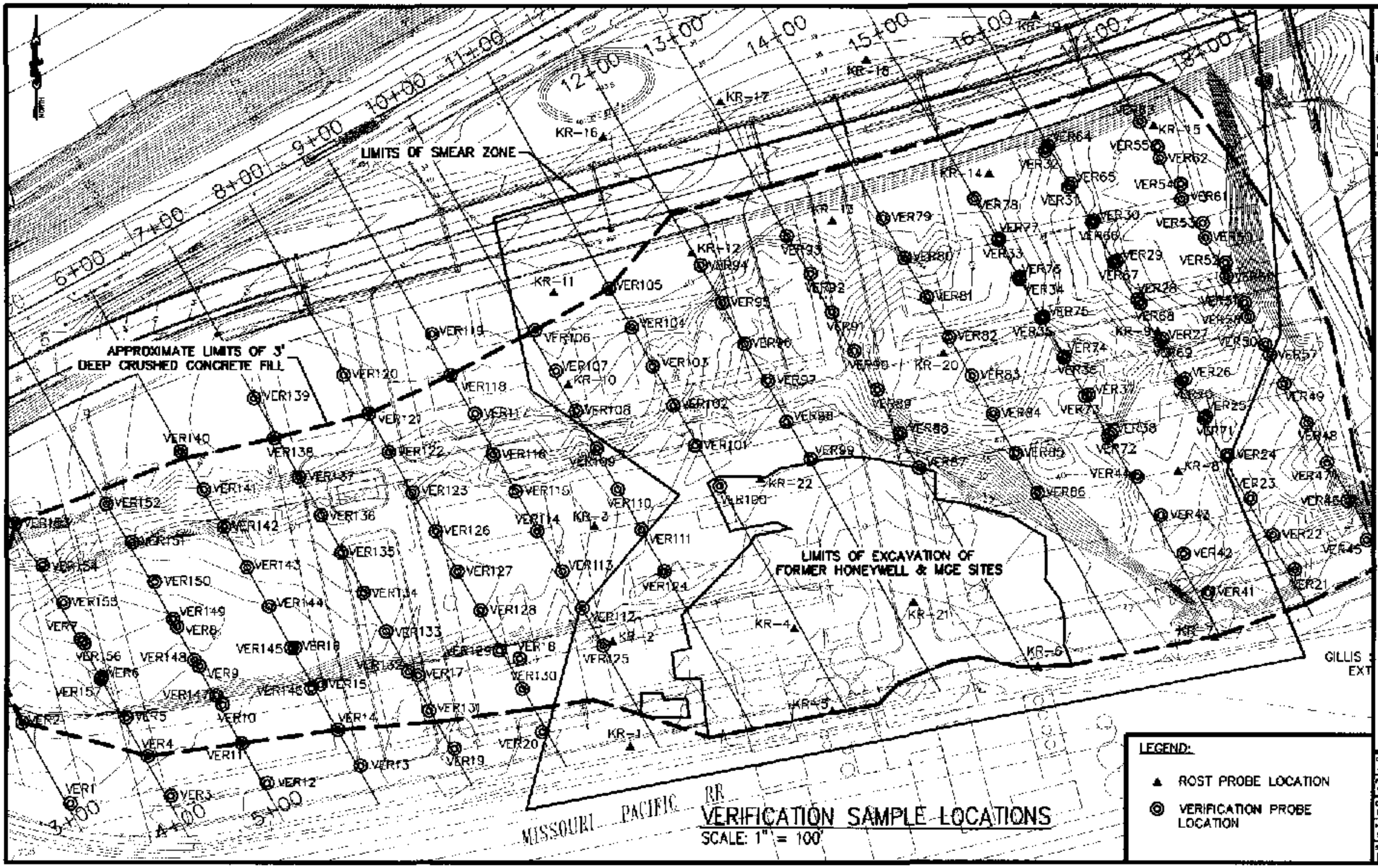
PORT AUTHORITY OF KANSAS CITY — DATE

8/27/07

Chris Cady, Ph.D.
MISSOURI DEPARTMENT OF NATURAL RESOURCES — DATE

Attachment 1

Plan View and Cross Sections



VERIFICATION SAMPLE LOCATIONS
SCALE: 1" = 100'

Kingston Environmental Services, Inc.
12450 MANGAR ROAD
KANSAS CITY, MO
(816) 524-8811

RIVERFRONT DEVELOPMENT SITE
PORT AUTHORITY OF KANSAS CITY
KANSAS CITY, MO

DRAWN BY: JNC
PROJECT: 99R145
DATE: 02-22-2007
FILE NAME: 99R145 008-1
SHEET NUMBER: FIGURE 3
SHEET: 3

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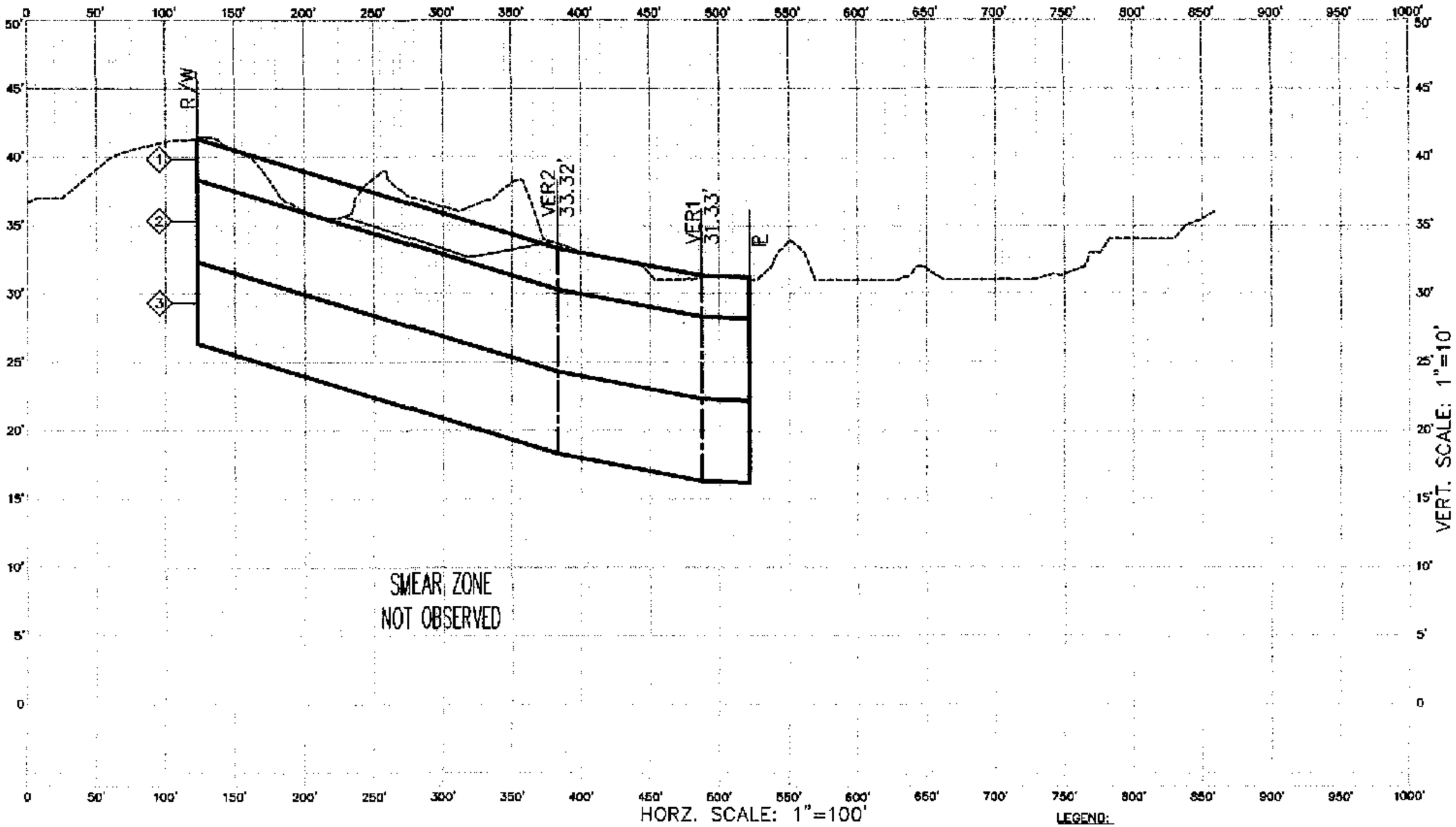
04/23/2007 7:14:55 PM

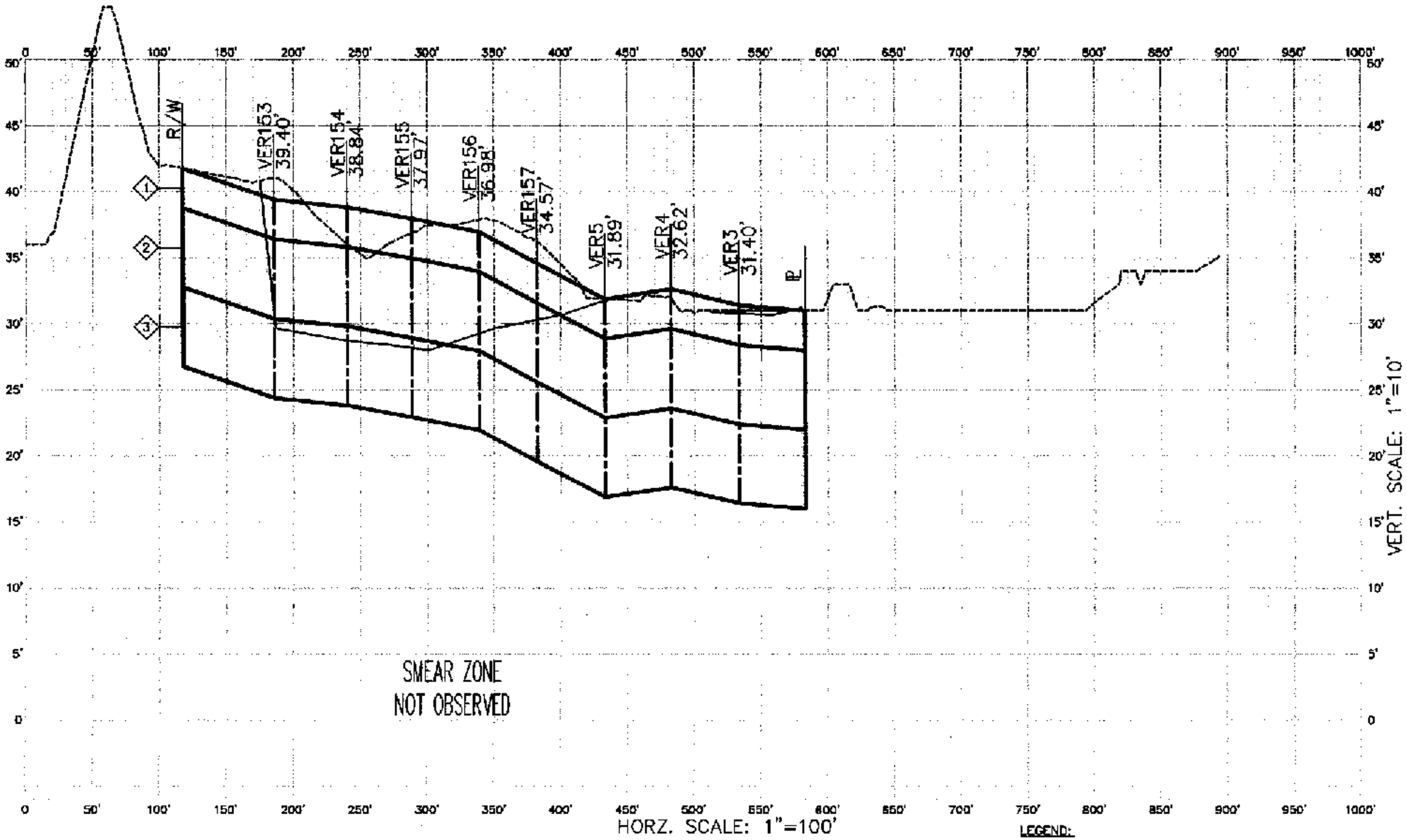


1. SURFACE SOIL ZONE FROM FINISHED GRADE SURFACE TO 3 FEET DEEP OF "CLEAN" CRUSHED CONCRETE AND SOIL.
2. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 3 TO 9 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.
3. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 9 TO 15 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.

LEGEND:

- -------- PRE-REMEDIATION GROUND LINE
- ——— APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)

CROSS-SECTION 3+00



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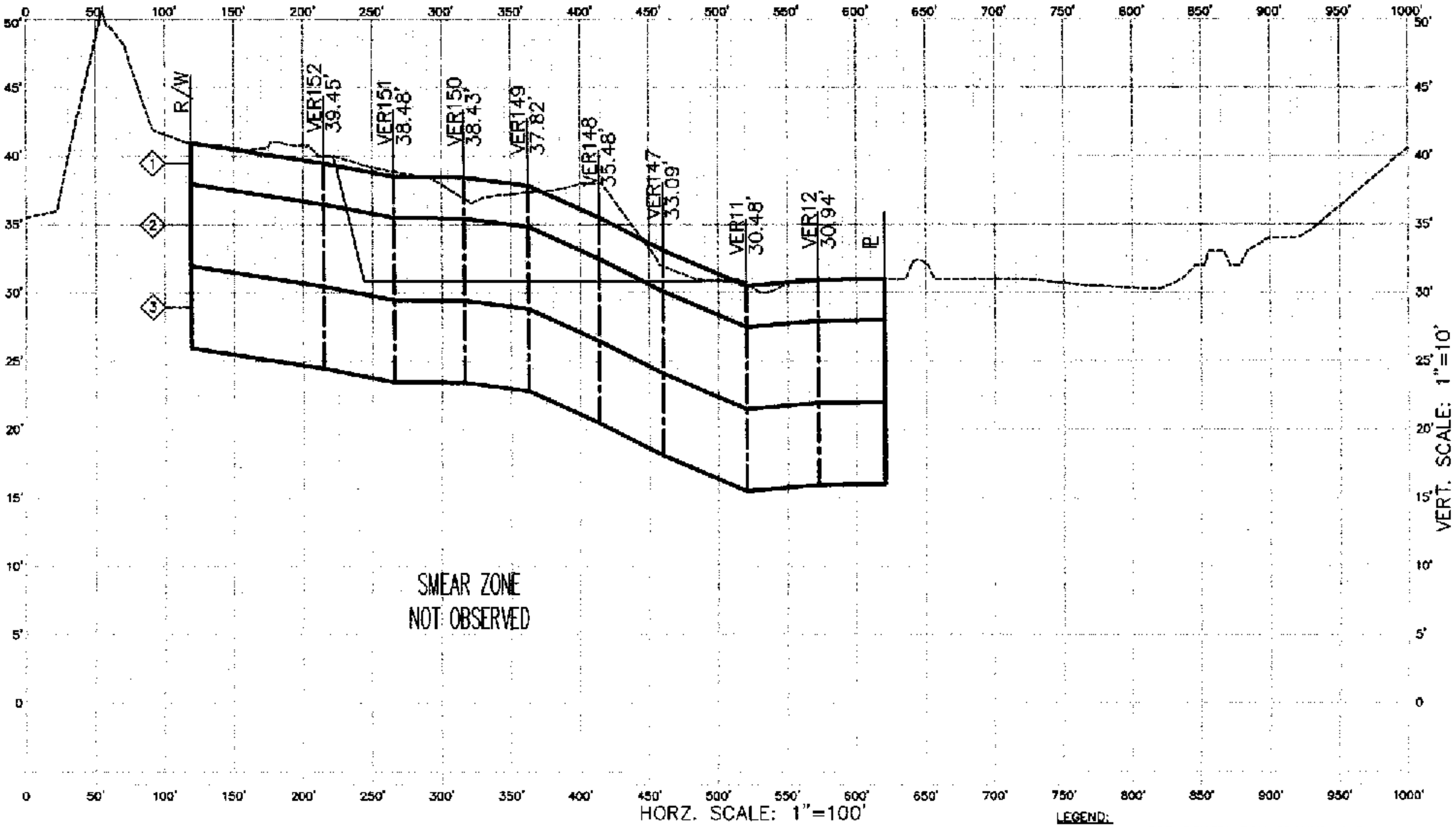
CROSS-SECTION 4+00



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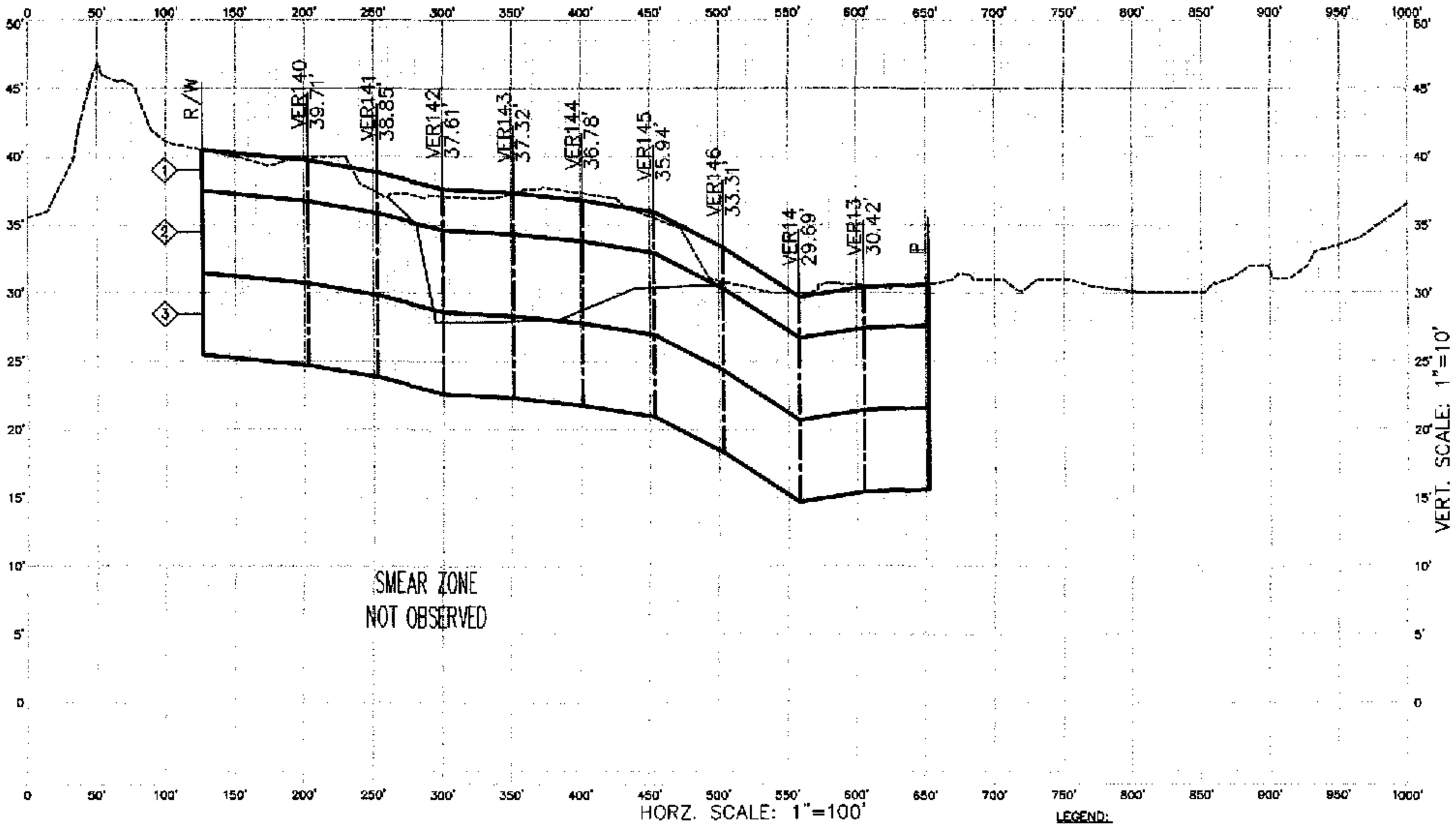
- VER124 / 33.27' VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KOMO CITY DATUM)

CROSS-SECTION 5+00



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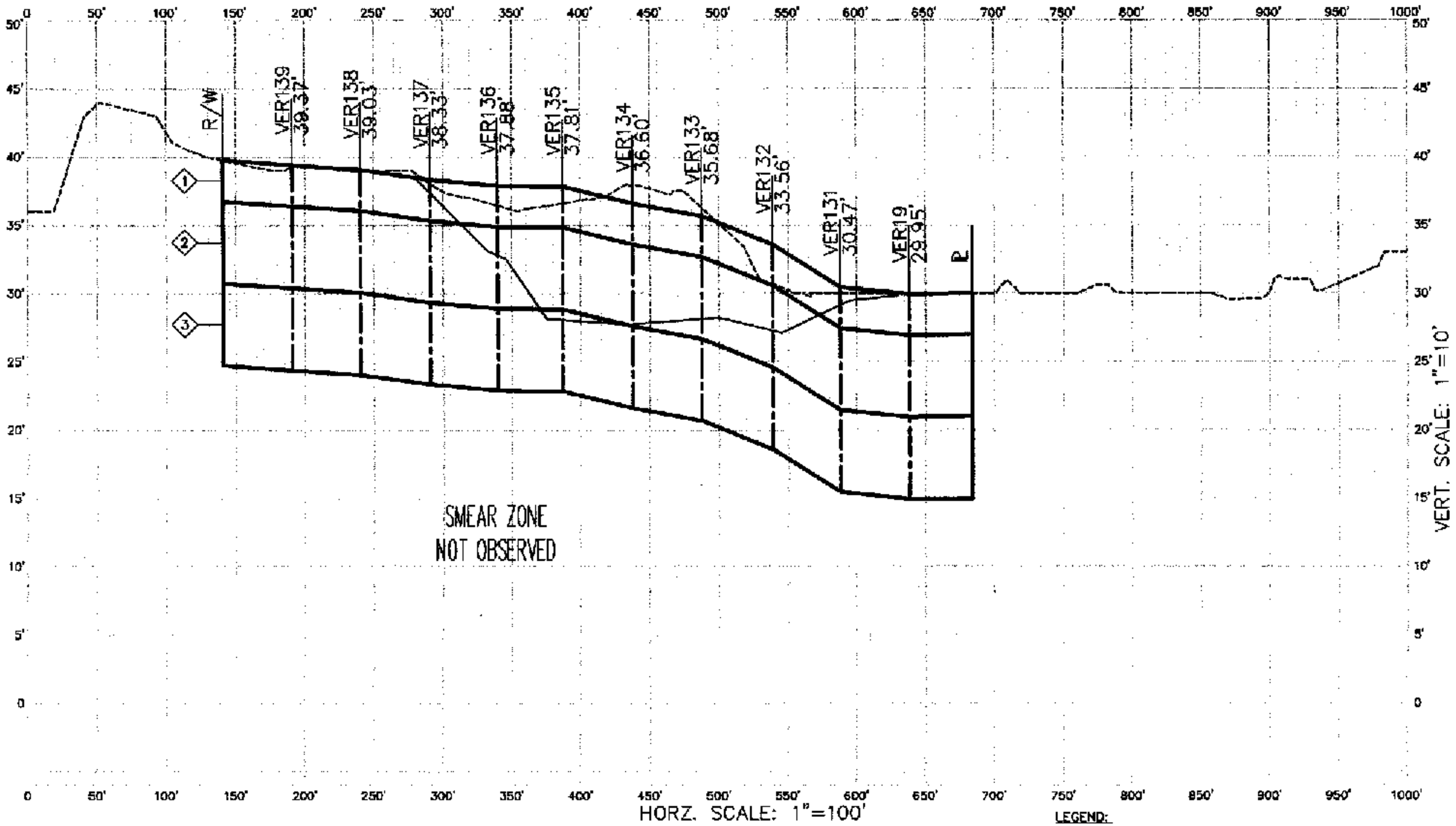
CROSS-SECTION 6+00



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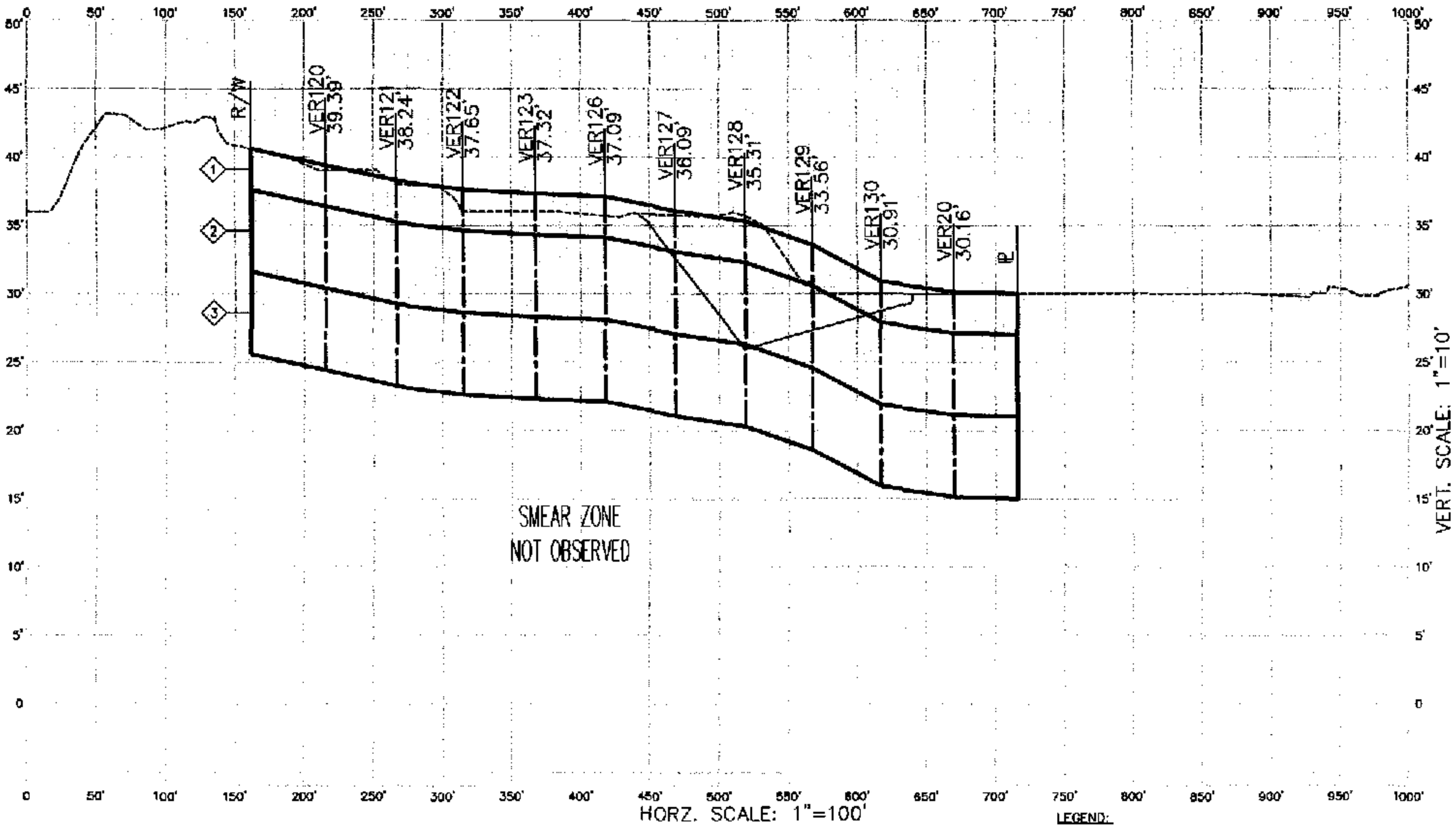
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)

CROSS-SECTION 7+00



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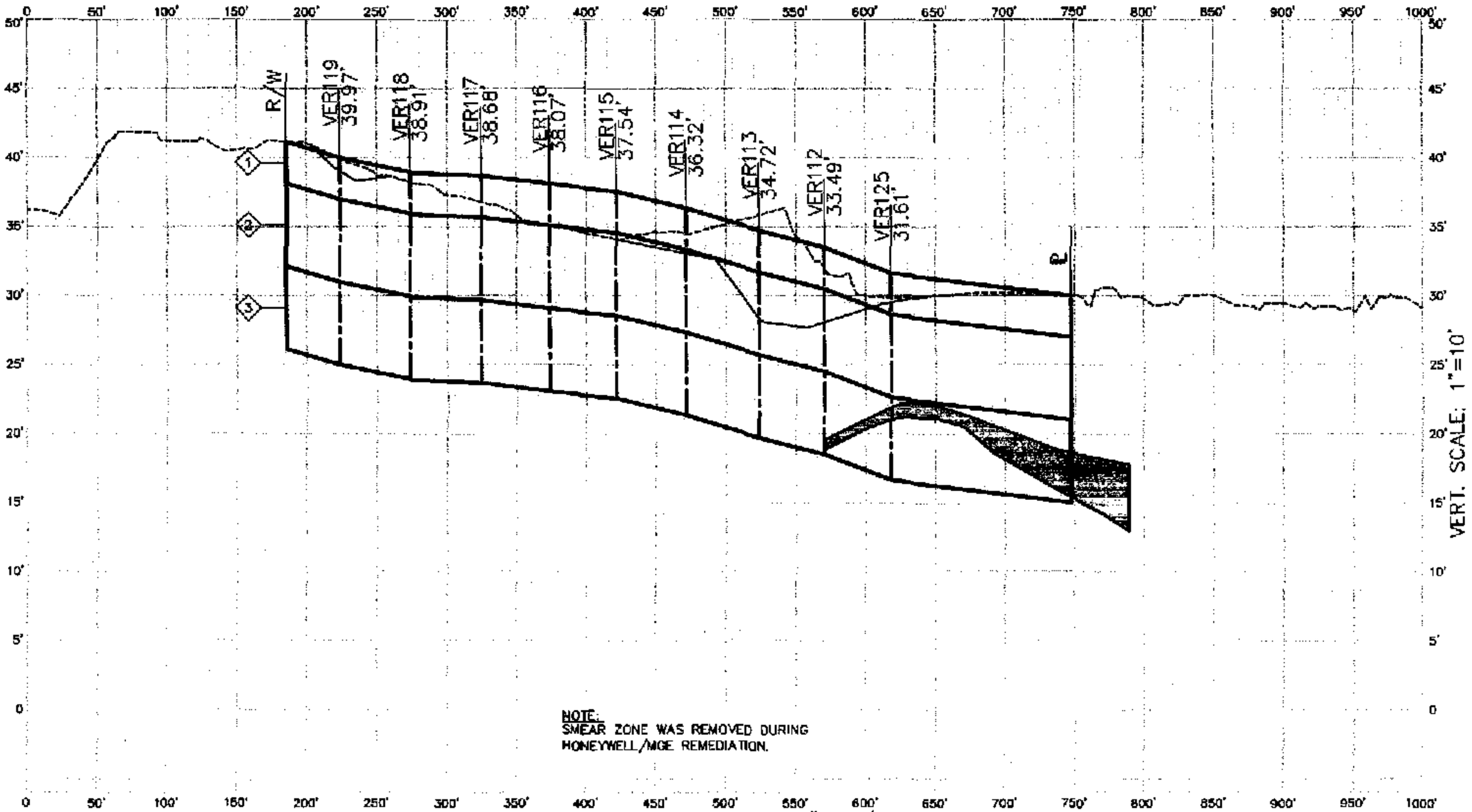
CROSS-SECTION 8+00



NOTE:
SMEAR ZONE WAS REMOVED DURING HONEYWELL/MGE REMEDIATION.

LEGEND:

- PRE-REMEDIATION GROUND LINE
- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

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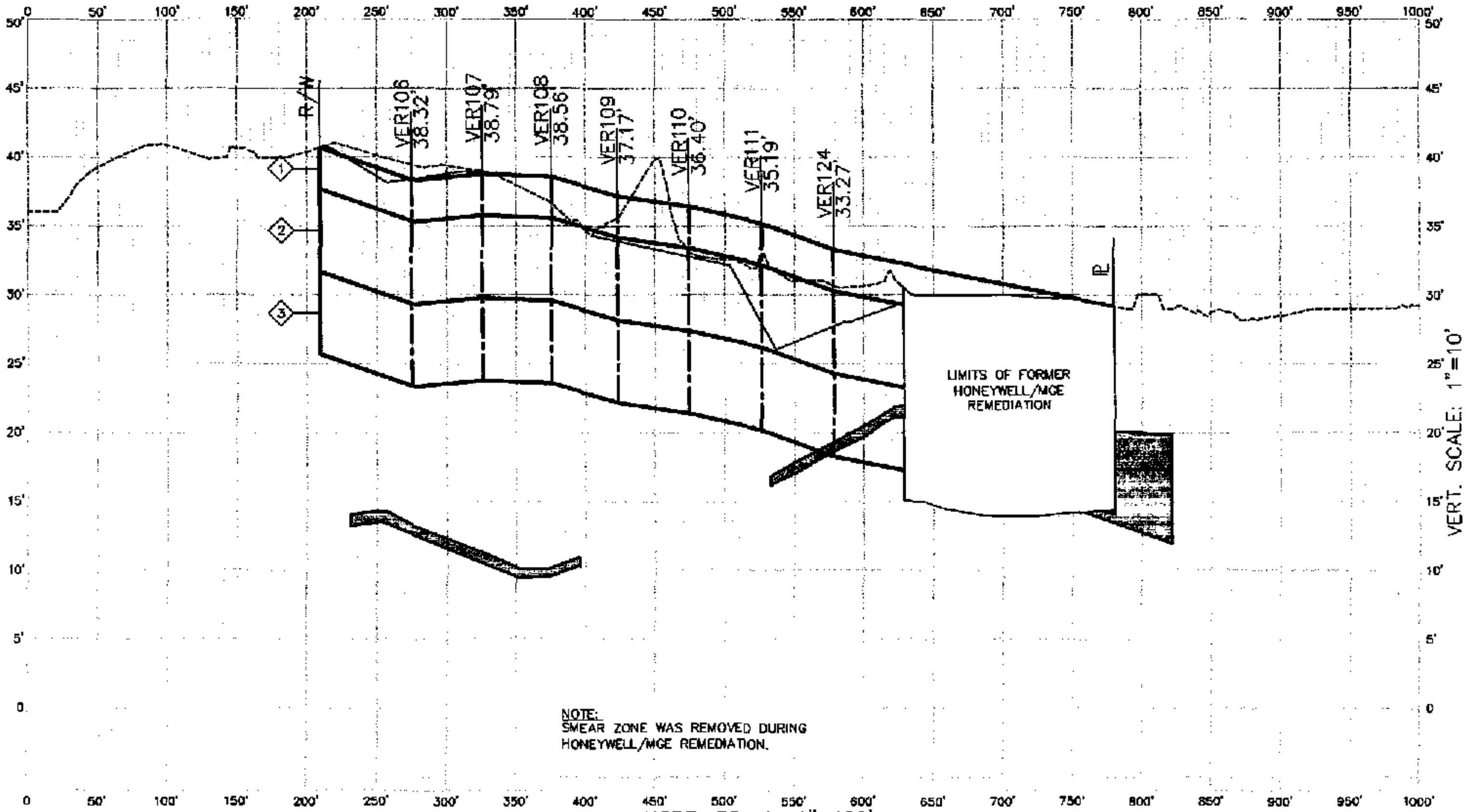
CROSS-SECTION 9+00



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- SMEAR ZONE (MARCH 2002)

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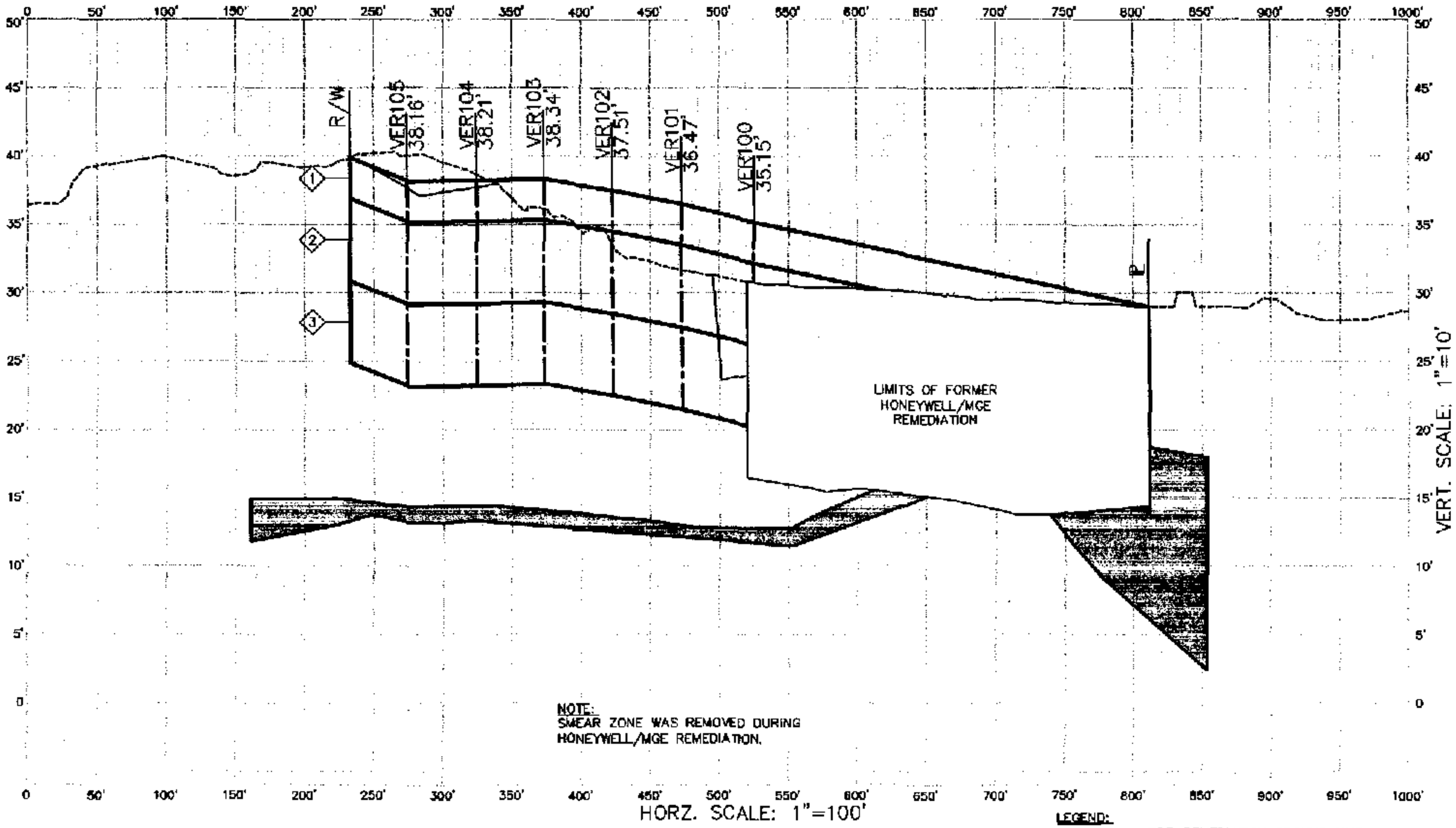

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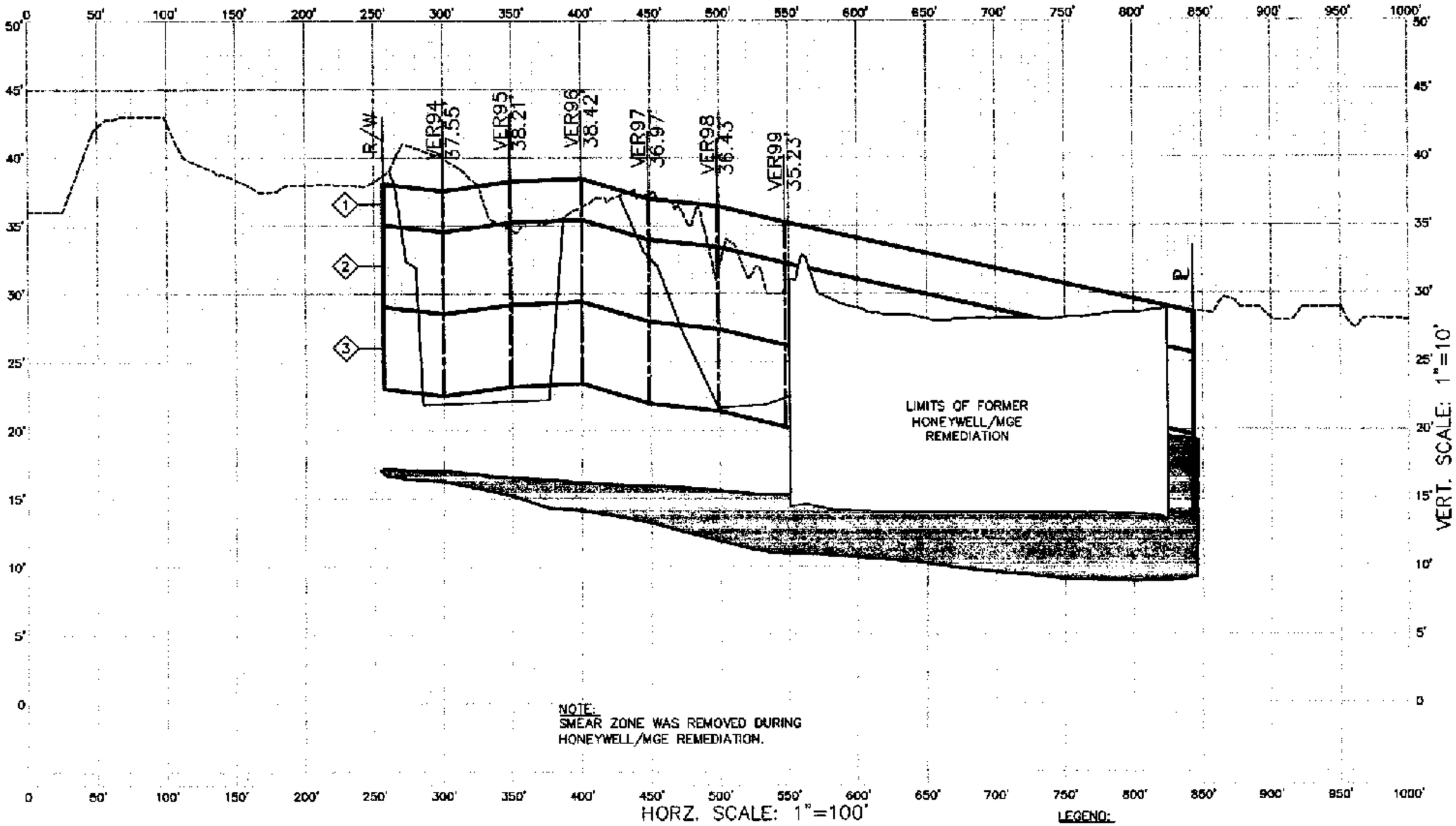
CROSS-SECTION 11+00



LEGEND:

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- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KOMO CITY DATUM)
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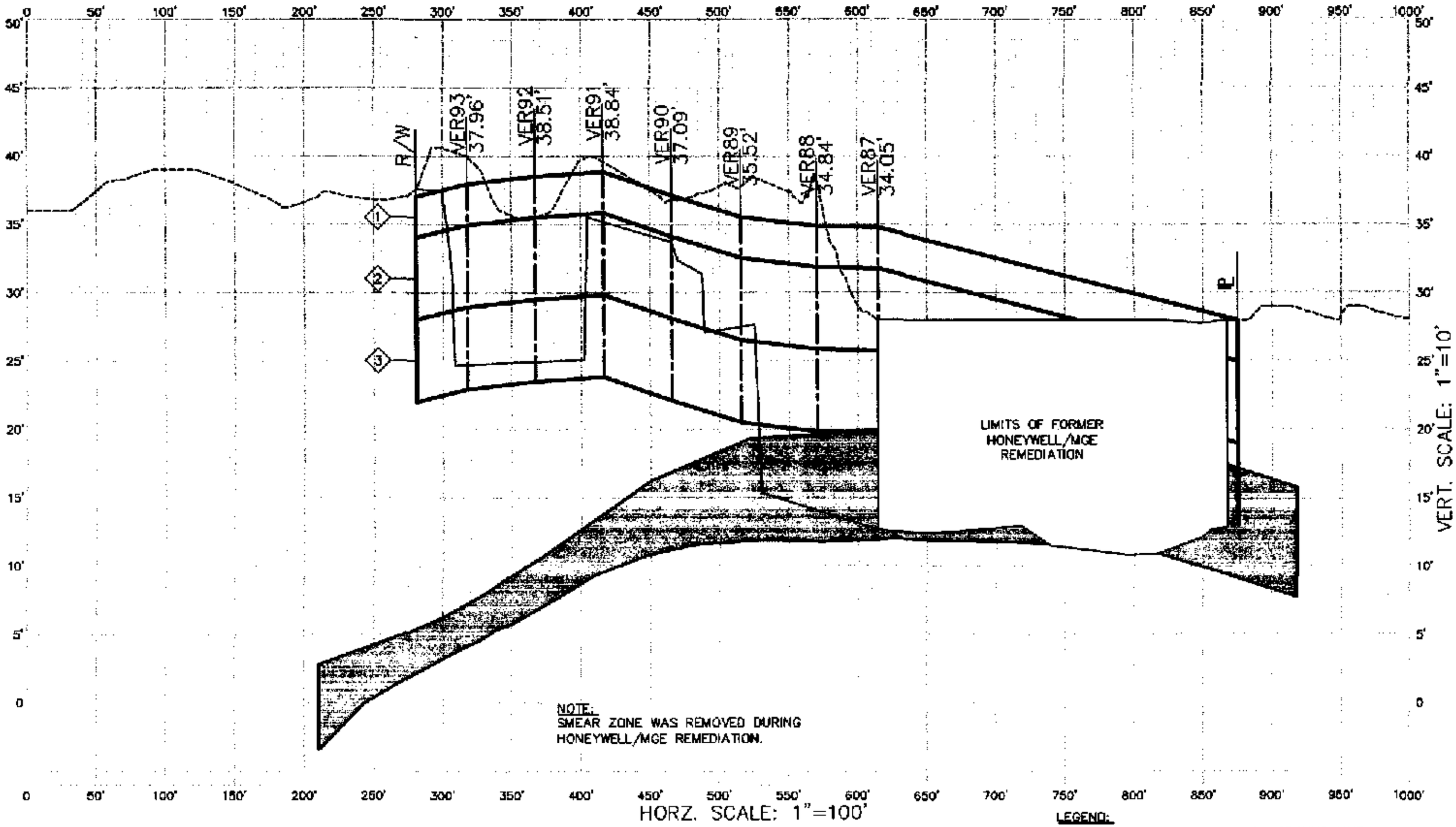
CROSS-SECTION 12+00



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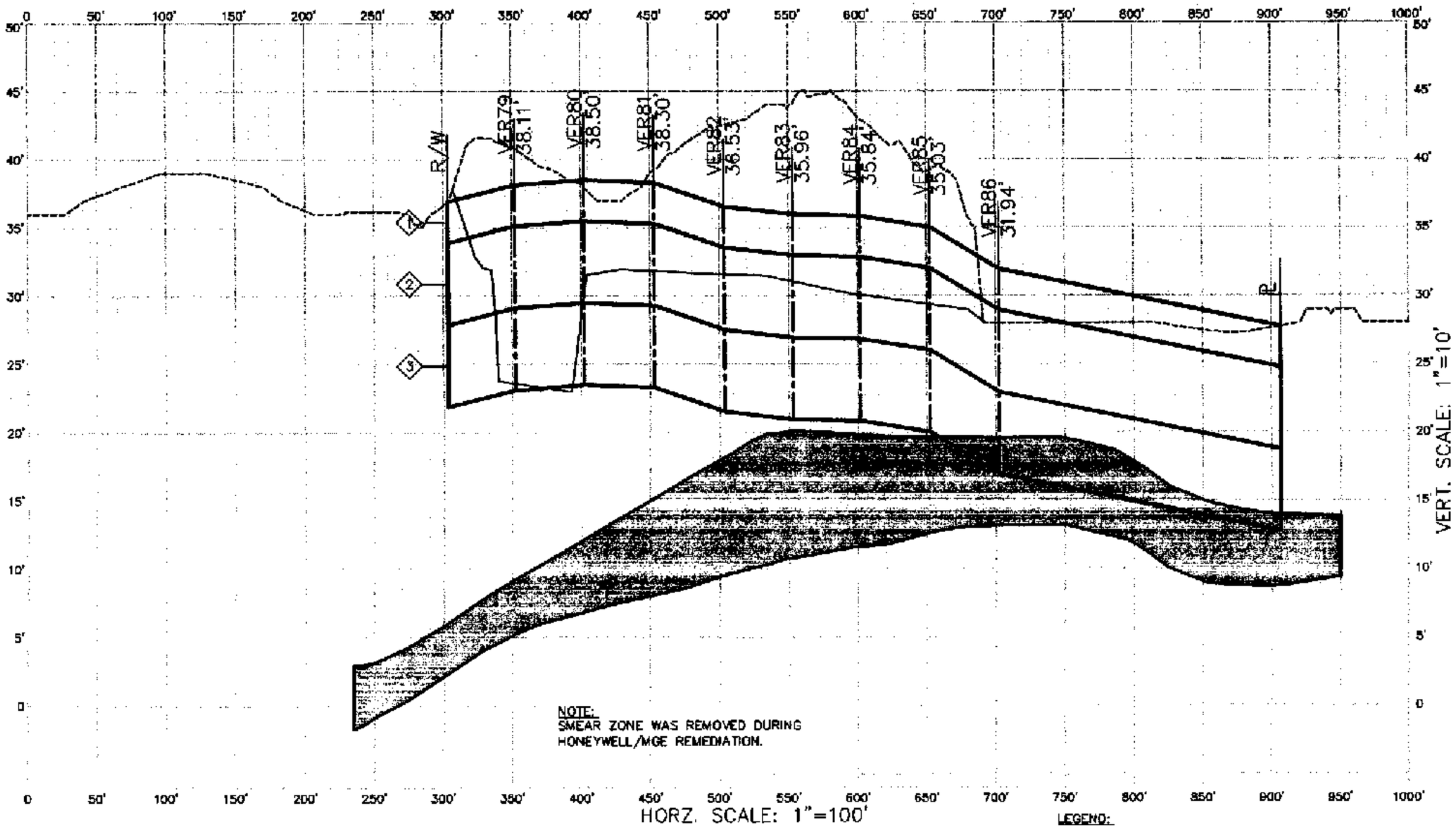
LEGEND:

- PRE-REMEDIATION GROUND LINE
- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

CROSS-SECTION 13+00

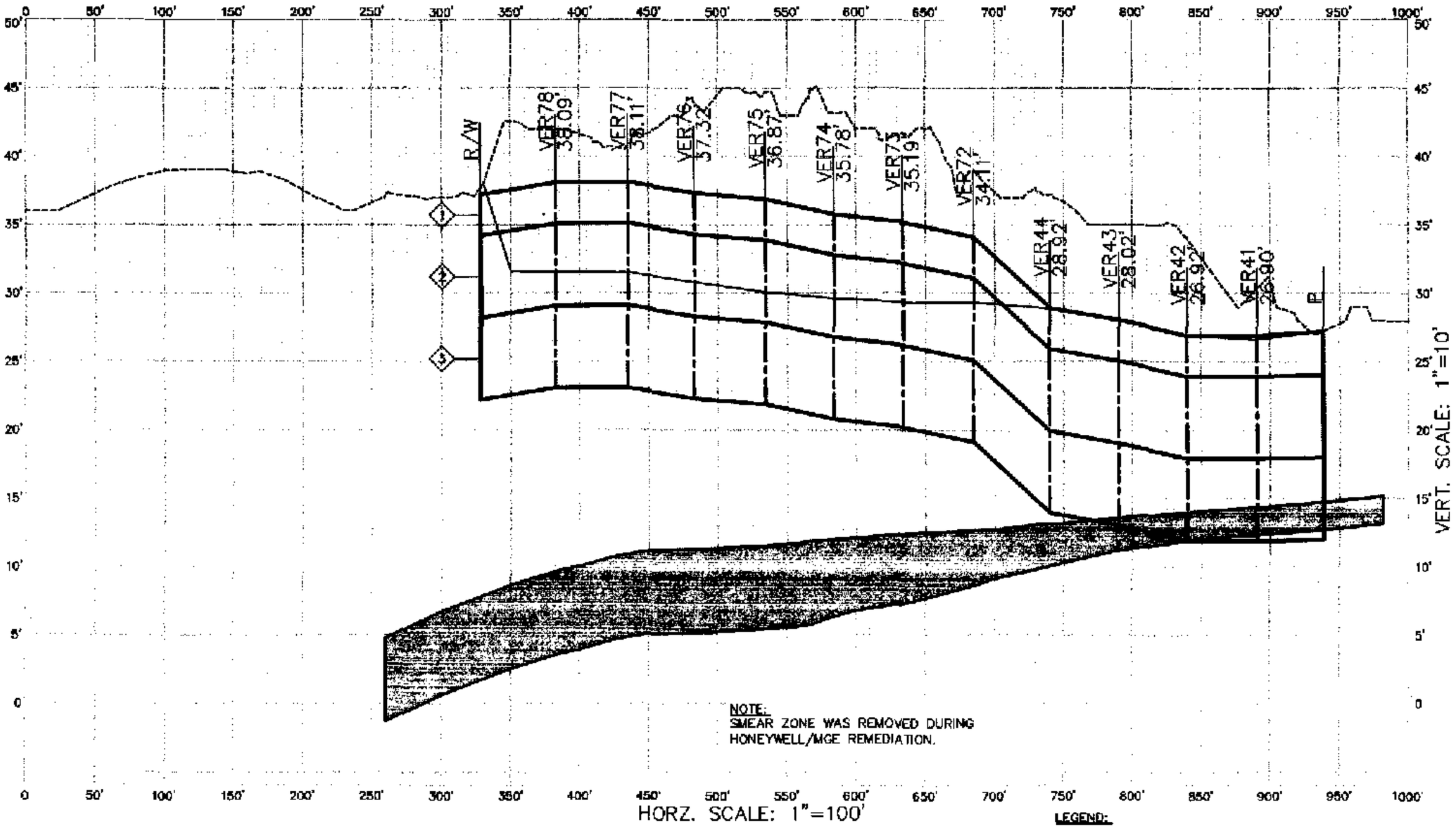


LEGEND:

- PRE-REMEDIATION GROUND LINE
- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

1. SURFACE SOIL ZONE FROM FINISHED GRADE SURFACE TO 3 FEET DEEP OF "CLEAN" CRUSHED CONCRETE AND SOIL.
2. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 3 TO 9 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.
3. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 9 TO 15 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.

CROSS-SECTION 14+00

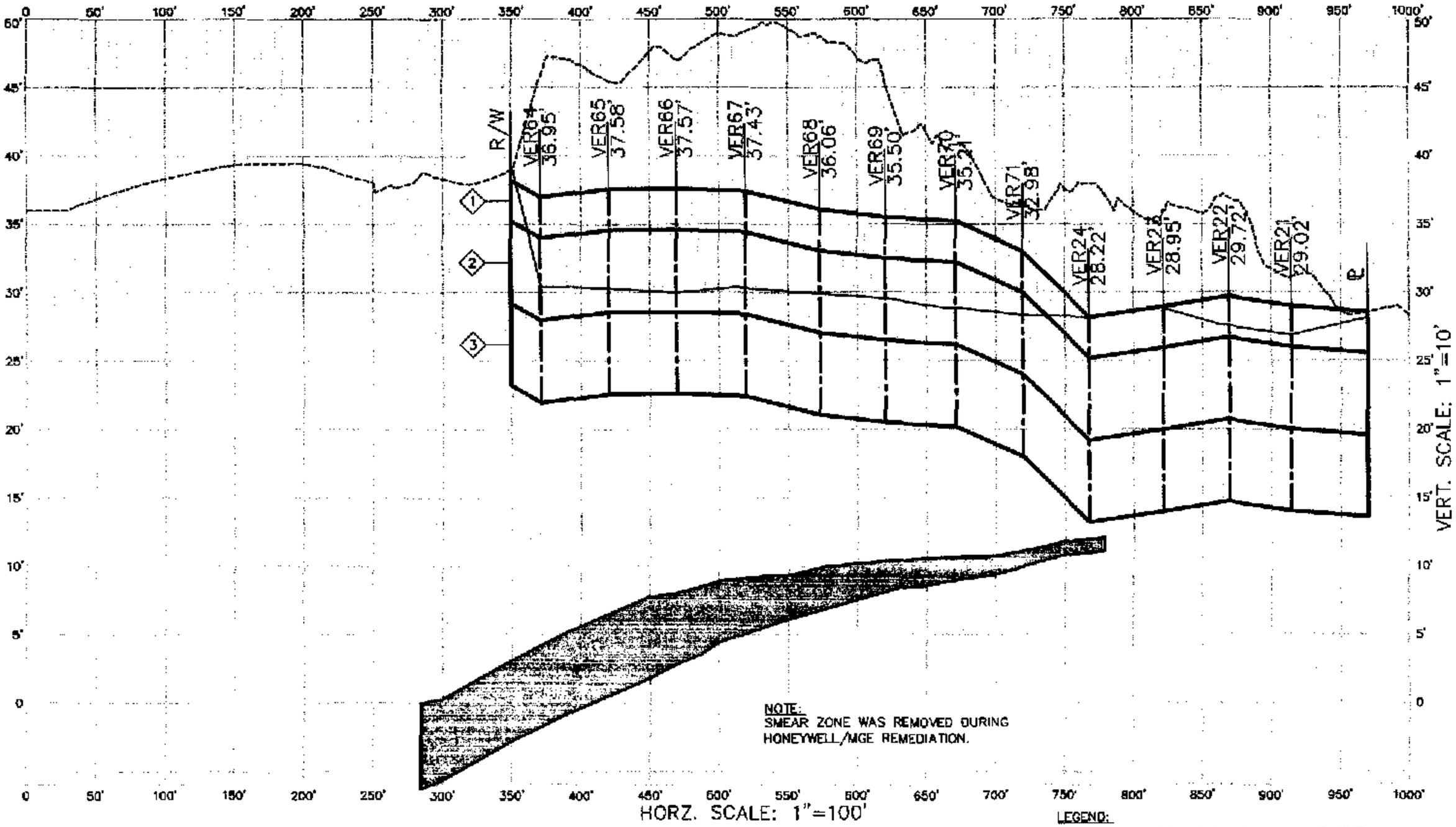


1. SURFACE SOIL ZONE FROM FINISHED GRADE SURFACE TO 3 FEET DEEP OF "CLEAN" CRUSHED CONCRETE AND SOIL.
2. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 3 TO 9 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.
3. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 9 TO 15 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.

LEGEND:

- -------- PRE-REMEDIATION GROUND LINE
- ——— APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

CROSS-SECTION 15+00



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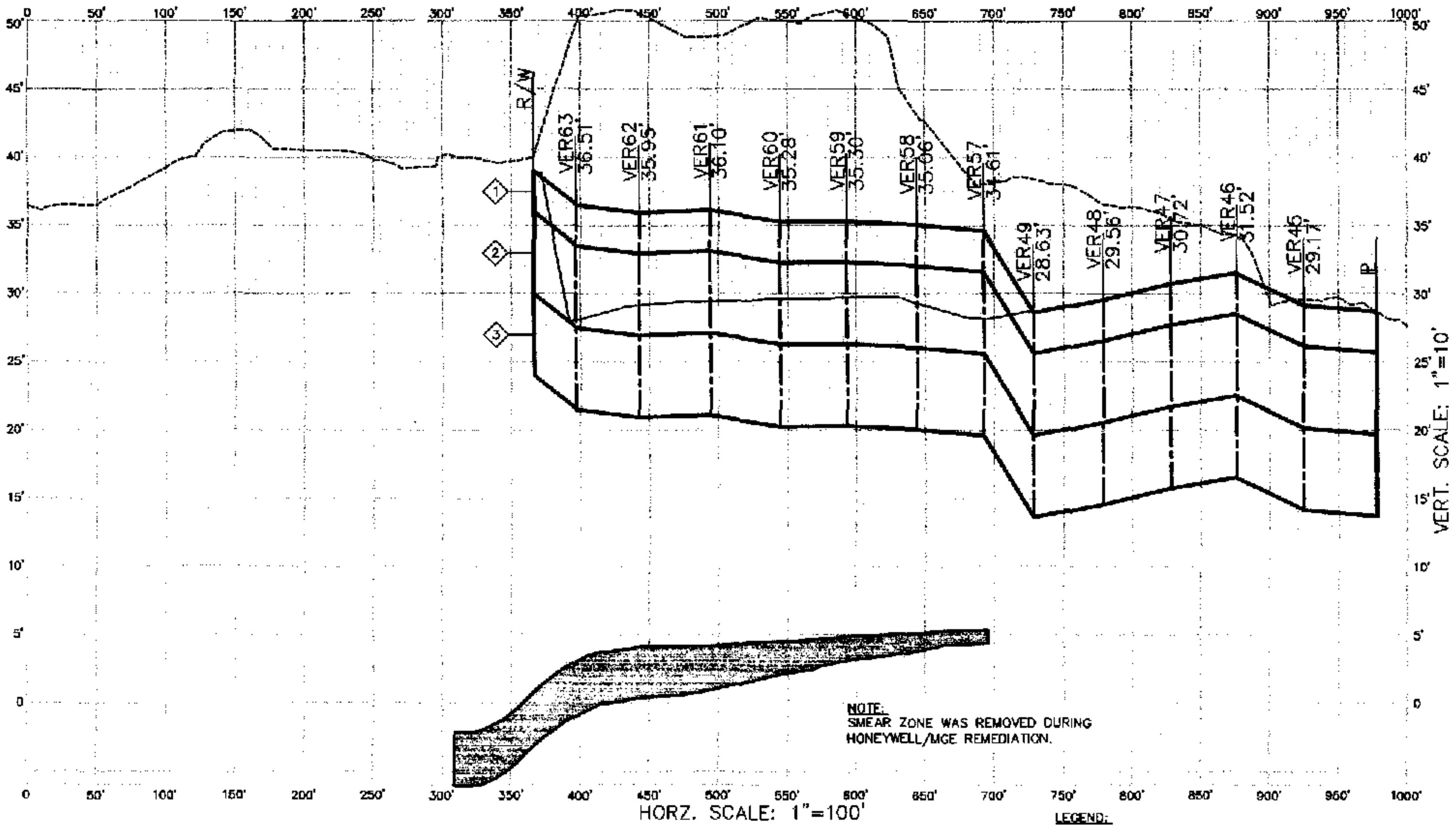
2. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 3 TO 9 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.
3. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 9 TO 15 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.

LEGEND:

- PRE-REMEDIATION GROUND LINE
- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

CROSS-SECTION 16+00



LEGEND:

- PRE-REMEDIATION GROUND LINE
- APPROXIMATE LIMITS OF REMOVAL
- VER124 / 33.27' — VERIFICATION SAMPLE PROBE LOCATION & SURFACE ELEVATION (BASED ON KCMO CITY DATUM)
- SMEAR ZONE (MARCH 2002)

1. SURFACE SOIL ZONE FROM FINISHED GRADE SURFACE TO 3 FEET DEEP OF "CLEAN" CRUSHED CONCRETE AND SOIL.
2. SUBSURFACE SOIL ZONE OF VERIFICATION SAMPLES FROM 3 TO 9 FT BELOW FINISHED GRADE SURFACE. THIS ZONE IS EITHER IMPACTED OR POTENTIALLY IMPACTED WITH PAH, ARSENIC, OR LEAD ABOVE THE DTL.
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CROSS-SECTION 17+00

Exhibit C
Institutional Control Contract

BROWNFIELDS/VOLUNTARY CLEANUP PROGRAM (BVCP)

INSTITUTIONAL CONTROL CONTRACT

The Port Authority of Kansas City has entered into a Letter of Agreement pursuant to the Voluntary Cleanup Program, §260.565, *et seq.*, RSMo, with the Missouri Department of Natural Resources (the department) for the Riverfront Development Site, a site of environmental contamination located on Riverfront Drive in the city of Kansas City, Jackson County, Missouri.

The site has been remediated to a level safe for its current or intended use as specified in a department-approved Remedial Action Plan, provided that certain risk reduction and exposure control measures remain in effect. Since residual contamination remains in place, the department has an obligation to protect human health and the environment and to assure that all of the risk reduction and exposure control measures specified in the department-approved remedial action plan (and any amendments thereto) remain intact, functional, and able to serve their intended purposes.

NOW THEREFORE, the Port Authority of Kansas City, 1100 Walnut St., Suite 1700, Kansas City, MO, (hereafter referred to as "Owner") hereby agrees that:

1. Owner shall pay to the department a one-time fee of $5000 to fund the department's long-term stewardship record-keeping functions and regular inspections of the risk reduction and exposure control measures implemented at the site for as long as necessary.

2. The Owner agrees to execute and file with the Jackson County Recorder of Deeds a Restrictive Covenant and Grant of Access pertaining to management of the residual contamination.

3. The Owner shall file this Agreement and the Restrictive Covenant and Grant of Access with the Jackson County Recorder of Deeds within five (15) days of execution of this Agreement and provide to the department evidence of such recording, to include a true copy of the documents as filed and stamped by the

Jackson County Recorder of Deeds.

3. A copy of the Certificate of Completion for the site shall be filed by the Owner with the Jackson County Recorder of Deeds in the chain of title for this property.

If the department determines that the Owner has failed to comply with the terms of this Agreement or the Restrictive Covenant and Grant of Access or fails to comply with the terms of the Letter of Agreement or fails to comply with the department-approved remedial action plan, the Certificate of Completion Letter as provided by the department pertaining to this site may be rescinded and deemed null and void at the discretion of the department. In this event, a notice shall be filed by the department with the Jackson County Recorder of Deeds in the chain of title for this site confirming the rescission of said Certificate of Completion Letter.

The undersigned person executing this Agreement on behalf of the Owner represent and certifies that they are truly authorized and have been fully empowered to execute and deliver this Agreement.

IN WITNESS WHEREOF, the Owner of the site has caused this Agreement to be executed on this 13TH day of SEPTEMBER, 2007.

Signed in the presence of Property Owner subscribed and acknowledged.

Signature of Owner

Subscribed and acknowledged before me this 13th day of September, 2007

Melissa L Lloyd
Notary Public Notary Seal
State of Missouri County of Platte
My Commission Expires 07/11/2011
Commission # 07117790

Melissa L. Lloyd
Notary Public

My commission expires 7-11-11.

IN WITNESS WHEREOF, the Missouri Department of Natural Resources has caused this Agreement to be executed on this 28th day of August, 2007.

Signed in the presence of the Missouri Department of Natural Resources subscribed and acknowledged.

Jim Belcher

Jim Belcher, Chief
Brownfields/Voluntary Cleanup Program
Hazardous Waste Program
Missouri Department of Natural Resources

Subscribed and acknowledged before me this 28th day of August, 2007.

Desiree Pigford

Desiree Pigford, Notary Public

My commission expires May 29, 2010.

STATE OF MISSOURI NOTARY SEAL

DESIREE M. PIGFORD
Notary Public, State of Missouri
Callaway County
My Commission #06892137
Expires May 29, 2010

NEW SOIL BORINGS

Surface Elevation 761.0 | Completion Date: 3/17/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in brown, lean, silty clay	5-10 -50/3"	SS1
		1-2-1	SS2
5		1-5-4	SS3
		5-7-8	SS4
10	SAND - brown, medium, loose to medium dense - SP		
		3-3-8	SS5
15			
		2-4-6	SS6
20			
25			
		2-2-3	SS7
30	SAND - gray, fine, loose to very loose - SP ▽		
35			
		2-2-2	SS8
40	SILT - gray, soft, clayey, trace sand - ML		
45			
	SAND - gray, medium to coarse, medium dense - SP		
		7-9-7	SS9
50	Boring terminated at 50 feet.		
55			

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

60

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-201

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J024061.01 UNION BERKLEY.GPJ GTINC 0638301.GPJ 4/23/15

Surface Elevation 760.4 | Completion Date: 3/22/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete and brick in brown and gray, sandy clay, lean, trace organics	9-10-4	SS1
5		106	ST2
		4-44-14	SS3
	SAND - tan, fine to medium, medium dense - SP	6-11-11	SS4
10			
15		7-8-10	SS5
20		4-6-6	SS6
	SILT - gray, soft to medium stiff, clayey, trace sand - ML		
25		2-1-2	SS7
30		2-3-2	SS8
35			
40		1-2-3	SS9
	SAND - gray, fine to coarse, medium dense - SP		
45			
50		7-10-11	SS10
	Boring terminated at 50 feet.		
55			

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

58

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 26 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 25 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-202

Project No. J024061.01

Surface Elevation 758.3 | Completion Date: 3/21/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in dark gray, lean, silty clay, trace sand	10-7-12	SS1
5		2-10-8	SS2
		3-5-8	SS3
	SAND - tan, fine to medium, loose to medium dense - SP	10-6-4	SS4
10			
15		5-7-7	SS5
20		6-10-8	SS6
25	SILT - gray and black, soft to stiff, clayey, some sand - (ML)	1-2-2	SS7
			ST8
30		4-8-6	SS9
35	SAND - gray, fine to coarse, medium dense, trace organics - SP		
40		11-11-6	SS10
45		3-4-7	SS11
	Boring terminated at 45 feet.		
50			
55			

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 43 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-203

Project No. J024061.01

Surface Elevation 763.7 | Completion Date: 3/18/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in lean, silty clay with trace sand	3-4-7	SS1
		4-5-5	SS2
5		5-5-4	SS3
		5-6-15	SS4
10			
	SAND - brown, fine to medium, medium dense - (SP)	7-8-7	SS5
15			ST6
		3-5-8	SS7
20			
25	SAND - gray, fine to medium, loose to medium dense - (SP)		
		2-3-6	SS8
30			
35			
		8-6-4	SS9
40			
45			
	dense	11-14-17	SS10
50			
55	SAND - gray, coarse, medium dense - SP		
		11-10-8	SS11

GRAPHIC LOG

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ● LL

10 20 30 40 50

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-204

Project No. J024061.01

Surface Elevation 763.7 | Completion Date: 3/18/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	SAND - gray, coarse, medium dense - SP *(continued)*			
65				
	SILT - gray, very stiff, clayey with sand seams - ML		0-5-11	SS12
70				
75				
	SAND - gray, fine to medium, medium dense - SP		8-10-10	SS13
80				
			20-17-11	SS14
85	Boring terminated at 85 feet.			
90				
95				
100				
105				
110				
115				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-204

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J024061.01 UNION BERKLEY.GPJ GTINC 0638301.GPJ 4/23/15

Surface Elevation 757.8 | Completion Date: 3/21/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL - crushed brick, rock, and concrete in brown and gray, lean, silty clay	8-8-11	SS1
		3-5-11	SS2
5		4-6-6	SS3
		3-5-5	SS4
10	SAND - tan, fine, loose to medium dense - (SP)		
		3-5-6	SS5
15			
		4-6-4	SS6
20	SAND - dark gray to black, fine to medium, medium dense - (SP)		
25			
		3-7-6	SS7
30			
35			
		9-12-14	SS8
40	SAND - gray, fine to coarse, medium dense to dense, with gravel and trace organics - (SW)		
45			
		10-15-13	SS9
50			
55			
		15-21-16	SS10

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-205

Project No. J024061.01

Surface Elevation 757.8 | Completion Date: 3/21/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	SAND - gray, fine to coarse, medium dense to dense, with gravel and trace organics - (SW) *(continued)*			
65				
70			5-6-5	SS11
75				
80			10-16-11	SS12
	Boring terminated at 80 feet.			
85				
90				
95				
100				
105				
110				
115				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-205

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 757.4 | Completion Date: 3/21/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in brown and gray, lean silty clay with trace sand	4-4-4	SS1
5		3-2-3	SS2
		3-3-4	SS3
	SAND - tan, fine to medium, loose to medium dense - SP	3-3-3	SS4
10			
15		4-6-9	SS5
		2-4-3	SS6
20	SILT - gray, medium stiff to very soft, clayey, with trace organics - ML ▽	2-3-2	SS7
25			
30		1-1-0	SS8
	SAND - gray, fine to medium, dense - SP		
35			
40		8-16-20	SS9
	SAND - gray, fine to coarse, medium dense, trace gravel - (SP)		
45			
50		7-9-7	SS10
55			
		8-9-10	SS11

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

ENCOUNTERED AT 21 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 25 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-206

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 757.4 | Completion Date: 3/21/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	SAND - gray, fine to coarse, medium dense, trace gravel - (SP) *(continued)*		9-14-16	SS12
65	Boring terminated at 65 feet.			
70				
75				
80				
85				
90				
95				
100				
105				
110				
115				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

ENCOUNTERED AT 21 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 25 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-206

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 764.2 | Completion Date: 3/23/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in brown and gray, lean silty clay	4-4-6	SS1
		4-4-4	SS2
5		14-12-5	SS3
		4-4-5	SS4
10	SAND - tan, fine to medium, medium dense - (SP)		
		10-13-10	SS5
15			
		6-9-9	SS6
20			
25			
		2-1-2	SS7
30	CLAY - gray, soft to medium stiff, silty, lean, trace sand - (CL)	1-2-3	SS8
35			
		7-3-3	SS9
40	SAND - gray, fine to coarse, medium dense to dense - SP		
45			
		8-10-13	SS10
50			
55			
		5-8-23	SS11

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/24/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-207

Project No. J024061.01

Surface Elevation 764.2 | Completion Date: 3/23/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	SAND - gray, fine to coarse, medium dense to dense - SP *(continued)*		9-14-13	SS12
65	Boring terminated at 65 feet.			
70				
75				
80				
85				
90				
95				
100				
105				
110				
115				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ● LL

10 20 30 40 50

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/24/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-207

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J024061.01 UNION BERKLEY.GPJ GTINC 0638301.GPJ 4/23/15

Surface Elevation 760.4 | Completion Date: 3/20/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - clay, brown and gray, lean to fat, with rock, brick and concrete	2-2-4	SS1
		12-33-22	SS2
5	FILL - rock, concrete, and brick in gray, lean, silty clay, trace sand no split-spoon sample recovery tube sampler refusal, drove split-spoon	9-20-23	SS3
10		7-11-11	SS4
	SAND - tan, fine to medium, medium dense to loose - (SP)	4-7-7	SS5
15			
20		4-4-6	SS6
25			
	SILT - gray, soft, clayey, trace sand - ML	1-2-1	SS7
30			
35			
	SAND - gray, fine to medium, medium dense, silty - (SM)	7-9-9	SS8
40			
45			
	SAND - gray, medium to coarse, loose to medium dense - SP	4-3-7	SS9
50			
55		9-8-10	SS10

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

55

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-208

Project No. J024061.01

Surface Elevation 760.4 | Completion Date: 3/20/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	SAND - gray, medium to coarse, loose to medium dense - SP *(continued)*		10-12-13	SS11
65	Boring terminated at 65 feet.			
70				
75				
80				
85				
90				
95				
100				
105				
110				
115				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-208

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 758.7 | Completion Date: 3/23/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - brown and gray, lean to fat, clay	2-4-4	SS1
5		4-10-8	SS2
		6-5-7	SS3
		5-10-11	SS4
10	SAND - tan, fine to medium, medium dense to loose - (SP)		
15		4-5-5	SS5
		2-3-4	SS6
20			
25			
	SILT - gray, medium stiff, clayey - ML	4-3-3	SS7
30			
35			
	SAND - gray, fine to coarse, medium dense, trace silt - (SP-SM)	9-11-14	SS8
40			
45			
		9-7-6	SS9
50			
55		10-9-9	SS10

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/24/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-209

Project No. J024061.01

Surface Elevation 758.7 | Completion Date: 3/23/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL, 10, 20, 30, 40, 50, LL)
	SAND - gray, fine to coarse, medium dense, trace silt - (SP-SM) *(continued)*				
65					
	SAND - gray, fine to medium, dense to very dense - SP		29-32-34	SS11	66
70					
75					
			20-18-20	SS12	
80	Boring terminated at 80 feet.				
85					
90					
95					
100					
105					
110					
115					

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 28 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS: Settlement monitoring rod, 1/2-inch diameter, installed to the bottom of the borehole.

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/24/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

CONTINUATION OF LOG OF BORING: B-209

Project No. J024061.01

Surface Elevation 769.1 | Completion Date: 3/18/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - crushed rock, concrete, and brick in brown, lean, silty clay	5-6-4	SS1
		3-7-6	SS2
5		2-4-10	SS3
		6-6-7	SS4
10	FILL - gray, lean, silty clay with sand- to gravel-size rock and brick fragments	4-5-4	SS5
		4-7-11	SS6
15	SAND - brown, fine to medium, medium dense - SP		
		5-8-8	SS7
20			
25			
		4-6-8	SS8
30			
35	SILT - gray, medium stiff, clayey - ML		
		2-4-4	SS9
40			
45			
50	SAND - gray, fine to coarse, medium dense - SP	2-3-12	SS10
55			
		6-8-7	SS11
60	Boring terminated at 60 feet.		

GRAPHIC LOG

SHEAR STRENGTH, tsf: △ - UU/2 ○ - QU/2 □ - PP/2 (0.5, 1.0, 1.5, 2.0, 2.5)

STANDARD PENETRATION RESISTANCE (ASTM D 1586): ▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %: PL ● LL (10, 20, 30, 40, 50)

GROUNDWATER DATA

ENCOUNTERED AT 39 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 40 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-210

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 765.1 | Completion Date: 3/20/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - clay, brown and gray, fat, with some brick fragments	2-4-21	SS1
		4-3-5	SS2
5		5-13-12	SS3
	FILL - crushed rock, concrete, and brick in gray, lean clay, trace sand	4-4-8	SS4
10			
		2-5-7	SS5
15			ST6
	tube sampler refusal		
	SAND - tan and gray, fine to medium, medium dense - SP	8-11-11	SS7
20			
25			
	SILT - gray, medium stiff, clayey - ML	3-2-2	SS8
30			
35			
	SAND - gray, fine to coarse, loose to dense - SP	1-3-3	SS9
40			
45			
		12-18-28	SS10
50			
		5-9-14	SS11
55	Boring terminated at 55 feet.		

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 30 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-211

Project No. J024061.01

Surface Elevation 759.0 | Completion Date: 3/22/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
	FILL - brown, lean to fat, silty clay	3-3-4	SS1
		2-4-4	SS2
5		3-4-7	SS3
10		4-4-12	SS4
	SAND - tan, fine to medium, medium dense - SP	7-10-13	SS5
15			
20		3-5-7	SS6
25	SILT - gray and black, medium stiff to stiff, clayey, trace sand and organics ▽	3-3-4	SS7
30		6-6-8	SS8
	SAND - tan and gray, fine to coarse, medium dense, trace gravel.		
35			
40		13-14-13	SS9
45			
50		8-10-11	SS10
		10-14-14	SS11
55	Boring terminated at 55 feet.		

GRAPHIC LOG

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 26 FEET ▽

DRILLING DATA

___ AUGER 3.75" HOLLOW STEM

WASHBORING FROM 25 FEET

BCS DRILLER VJE LOGGER

CME 550 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: AWR	Check by: SDG	App'vd by: MHM
Date: 3/27/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF BORING: B-212

Project No. J024061.01

Surface Elevation 761.6 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - gravel- to cobble-sized limestone and concrete fragments in light brown, lean, silty clay				
	FILL - gravel- to cobble-sized limestone, concrete, and brick fragments in dark gray, lean, silty clay				
5					
10	Test pit terminated at 10 feet.				
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-201

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 762.5 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (Δ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - brown, lean, silty clay				
	FILL - cobble- to boulder-sized limestone and concrete fragments in brown, lean, silty clay				
5					
	FILL - gravel-sized brick and concrete fragments in brown and gray, lean, silty clay				
	Test pit terminated at 8.5 feet at the end of the practical reach of the equipment.				
10					
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS: Initial rest pit terminated at 4.5 feet due to concrete obstruction. Subsequent test pit offset 5 feet south.

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-202

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 763.0 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (Δ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - cobble- to boulder-sized concrete with occasional scrap metal in brown, lean, silty clay				
5					
	FILL - gravel- to cobble-sized concrete and brick fragments in gray, lean, clay				
10	Backhoe refusal at 9.5 feet on horizontal slab.				
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-203

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 768.6 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL - gravel- to cobble-sized limestone, concrete, and brick fragments in brown, lean, clay			
	FILL - gravel-sized limestone, concrete, and brick fragments in dark gray, lean, sandy clay			
5				
	Backhoe refusal at 9 feet on horizontal slab.			
10				
15				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-204

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 758.2 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL - brown, lean, silty clay with trace gravel-sized limestone and brick fragments			
5				
	FILL - gravel- to cobble-sized limestone, concrete, and brick fragments in dark gray, lean, clay with trace organics			
10	Test pit terminated at 10 feet.			
15				

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 □ - PP/2

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL 10 20 30 40 50 LL

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-205

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 758.7 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - cobble- to boulder-sized limestone and concrete fragments in brown, lean, clay				
	FILL - gravel- to cobble-sized concrete and brick fragments in brown, lean, clay				
5					
	FILL - gravel-sized limestone, concrete and brick fragments in gray, lean, clay				
10	Test pit terminated at 10 feet.				
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-206

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 759.7 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - gravel- to cobble-sized limestone and concrete fragments in light brown, lean, silty clay				
	FILL - gravel- to cobble-sized concrete and brick fragments in dark gray, lean, silty clay				
5					
	SAND - tan, fine to medium, loose to medium dense - SP				
10	Test pit terminated at 10 feet.				
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-207

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J024061.01 UNION BERKLEY.GPJ GTINC 0638301.GPJ 4/23/15

Surface Elevation 784.5 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL, 10, 20, 30, 40, 50, LL)
	FILL - gravel- to cobble-sized limestone and concrete fragments in brown, lean, clay				
5	Test pit terminated at 5 feet.				
10					
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-208

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 780.6 | Completion Date: 3/16/15

Datum NAVD 88

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (△ - UU/2, ○ - QU/2, □ - PP/2; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL 10, 20, 30, 40, 50 LL)
	FILL - gravel- to cobble-sized limestone and concrete fragments in brown and gray, lean, clay with trace organics				
5	Test pit terminated at 5 feet.				
10					
15					

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

BCS DRILLER VJE LOGGER

JD 310 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: VJE	Check by: SDG	App'vd by: MHM
Date: 3/19/15	Date: 4/10/15	Date: 4/23/15

GEOTECHNOLOGY INC
FROM THE GROUND UP

Union Berkley
Kansas City, Missouri

LOG OF TEST PIT: TP-209

Project No. J024061.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

BORING LOG: TERMS AND SYMBOLS

GENERAL NOTES

1. *Information on each boring log is a compilation of subsurface conditions based on soil or rock classifications obtained from the field as well as from laboratory testing of samples. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those ob - served at the times and places indicated, and may vary with time, geologic condition or construction activity.*
2. *Relative composition and Unified Soil Classification designations are based on visual estimates and are approximate only. If laboratory tests were performed to classify the soil, the unified designation is show in parenthesis.*
3. *Value given in Unit Dry Weight/SPT Column is either a unit dry weight in pounds per cubic foot, if adjacent to a ST sample designation, or blows per 6-inch increment if adjacent to a SS sample designation.*

ABBREVIATIONS

UU/2	*Shear Strength from Unconsolidated – Undrained Triaxial Test (ASTM D2850)*
QU/2	*Shear Strength from Unconfined Compression Test (ASTM D2166)*
SV	*Shear Strength from Field Vane (ASTM D2573)*
PL	*Plastic Limit (ASTM D4318)*
LL	*Liquid Limit (ASTM D4318)*

LEGEND

CS	Continuous Sampler
GB	Grab Sample Taken From Auger Cuttings Or Wash Water Return
NX 100/42	NX Rock Core with Percent Recovery/R.Q.D. Given In Adjacent Column
PST	Three Inch Diameter Piston Tube Sample
SS	Split Spoon Sample (Standard Penetration Test)
ST	Three Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
SV	Field Vane Test

SPLIT – BARREL SAMPLER DRIVING RECORD

Blow Per Foot (N-Value)	*Description*
25	*25 blows drove sampler 12 inches after initial 6 inches of seating.*
75/10"	*75 blows drove sampler 10 inches after initial 6 inches of seating.*
50/S3"	*50 blows drove sampler 3 inches during initial 6 inch seating interval.*

NOTES: *1. To avoid damage to sampling tools, driving is limited to 50 blows during any six inch interval.*
2. N-Value (Blow Count) is the standard penetration resistance based on the total number of blows, using a 140-lb hammer with 30-inch free fall, required to drive a split spoon the last two of three, 6-inch drive increments. (Example: 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on grid plot and may be shown as 4/7/9 in Unit Dry Weight – SPT column.

RELATIVE COMPOSITION

Trace……..0-10 %
With/Some……..11-35 %
Soil modifier such……. > 35 %
As silty, clayey, sandy, etc.

DENSITY OF GRANULAR SOILS

Descriptive Term:	***N—Value***
Very Loose	*0 - 4*
Loose	*5 - 10*
Medium Dense	*11 - 30*
Dense	*31 - 50*
Very Dense	*> 50*

STRENGTH OF COHESIVE SOILS

Consistency	***Undrained Shear Strength Tons Per Sq. Ft.***	***Field Test***	***Approximate N-Value Range***
Very Soft	*less than 0.12*	*Thumb will penetrate soil more than 1"*	*0 - 1*
Soft	*13 to 0.25*	*Thumb will penetrate soil about 1"*	*2 - 4*
Medium Stiff	*0.26 to 0.50*	*Thumb will penetrate soil about ¼"*	*5 – 8*
Stiff	*0.51 to 1.00*	*Thumb hardly indents soil*	*9 – 15*
Very Stiff	*1.01 to 2.00*	*Thumb will not indent soil, but readily indented with thumbnail*	*16 – 30*
Hard	*greater than 2.00*	*Thumbnail will not indent soil*	*> 30*

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12"	3"	¾"	4	10	40	200

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

300	76.2	19.1	4.76	2.00	0.42	0.074	0.002

SOIL GRAIN SIZE IN MILLIMETERS

SOIL STRUCTURE

Calcareous *– Having appreciable quantities of carbonate.*
Fissured *– Containing shrinkage or relief cracks, often filled with sand or silt; usually more or less vertical.*
Slickensided *– Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along those planes.*
Layer *-- Inclusion greater than 3 inches thick.*
Seam *– Inclusion 1/8 inch to 3 inches thick extending through the sample*
Parting *– Inclusion less than 1/8 inch thick.*
Pocket *– Inclusion of material of different texture that is smaller than the diameter of the sample.*
Interlayered *– Soil samples composed of alternating layers of different soil types.*
Intermixed *– Soil samples composed of pockets of different soil types and a layered or laminated structure is not evident.*
Laminated *– Soil sample composed of alternating partings or seams of different soil type.*

GEOTECHNICAL LABORATORY TEST DATA

Borehole	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Class-ification	Qu (tsf)	Strain %	Pocket Pen. (tsf)
B-201	1.0	11.2									
B-201	3.5	23.5		37	19	18					
B-201	6.0	23.5									
B-201	38.5	36.6									
B-202	1.0	14.7									
B-202	3.5	15.5	106.0	37	21	16					
B-202	6.0	15.0									
B-202	25.0	33.7									
B-203	1.0	11.8									
B-203	3.5	15.7		36	20	16					
B-203	6.0	19.2									
B-203	23.5	38.8									
B-203	25.5	29.6		31	25	6					
B-203	28.5	41.4									
B-204	1.0	17.3									
B-204	3.5	21.1		42	20	22					
B-204	6.0	17.8									
B-204	13.5	2.7									
B-204	15.5	2.1					3	SP			
B-204	38.5						5	SP			
B-204	68.5	34.9									
B-205	1.0	15.4									
B-205	3.5	19.2		34	17	17					
B-205	6.0	15.8									
B-205	18.5						4	SP			
B-205	48.5						5				
B-206	1.0	16.4									
B-206	3.5	15.7		33	17	16					
B-206	6.0	18.2									
B-206	20.0	26.2									
B-206	28.5						95				
B-206	48.5						4	SP			
B-207	1.0	17.5									
B-207	3.5	17.0									
B-207	6.0	10.1		36	18	18					
B-207	8.5	20.8									
B-207	13.5	4.1									
B-207	18.5						4	SP			
B-207	28.5	41.2									
B-207	30.0	37.1		48	22	26					
B-207	38.5	32.9									
B-208	3.5	26.6		49	19	30					

GEOTECHNOLOGY INC
FROM THE GROUND UP

Summary of Laboratory Results

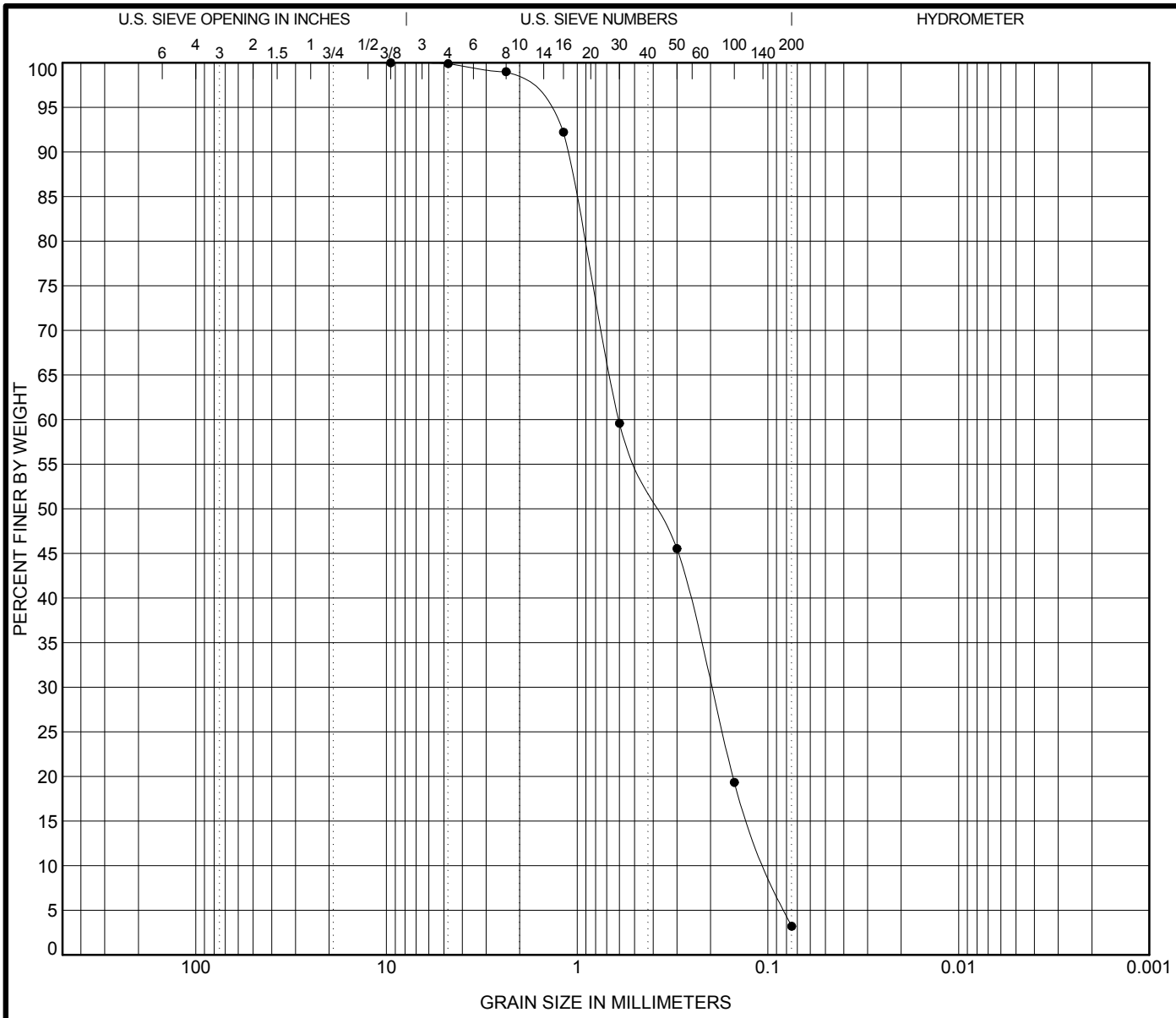
Union Berkley
Kansas City, Missouri
J024061.01

Borehole	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Class-ification	Qu (tsf)	Strain %	Pocket Pen. (tsf)
B-208	9.0	11.5									
B-208	18.5						2	SP			
B-208	28.5	33.9									
B-208	38.5						18				
B-209	1.0	20.2		50	19	31					
B-209	3.5	20.3									
B-209	6.0	16.3									
B-209	13.5						5	SP			
B-209	28.5	27.5									
B-209	38.5						8				
B-210	10.0	11.3		29	19	10					
B-210	28.5	4.6									
B-210	38.5	26.8									
B-211	13.5	13.8									
B-211	15.5	15.6		38	18	20					
B-212	1.0	25.2									
B-212	3.5	23.0		52	19	33					
B-212	6.0	23.4									
B-212	25.0	31.8									

GEOTECHNOLOGY INC
FROM THE GROUND UP

Summary of Laboratory Results

Union Berkley
Kansas City, Missouri
J024061.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-204**	**at 15.5'**	**POORLY GRADED SAND(SP)**				**0.65**	**6.03**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-204**	**at 15.5'**	**9.5**	**0.605**	**0.199**	**0.1**	**0.1**	**96.7**	**3.2**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

PARTICLE SIZE DISTRIBUTION

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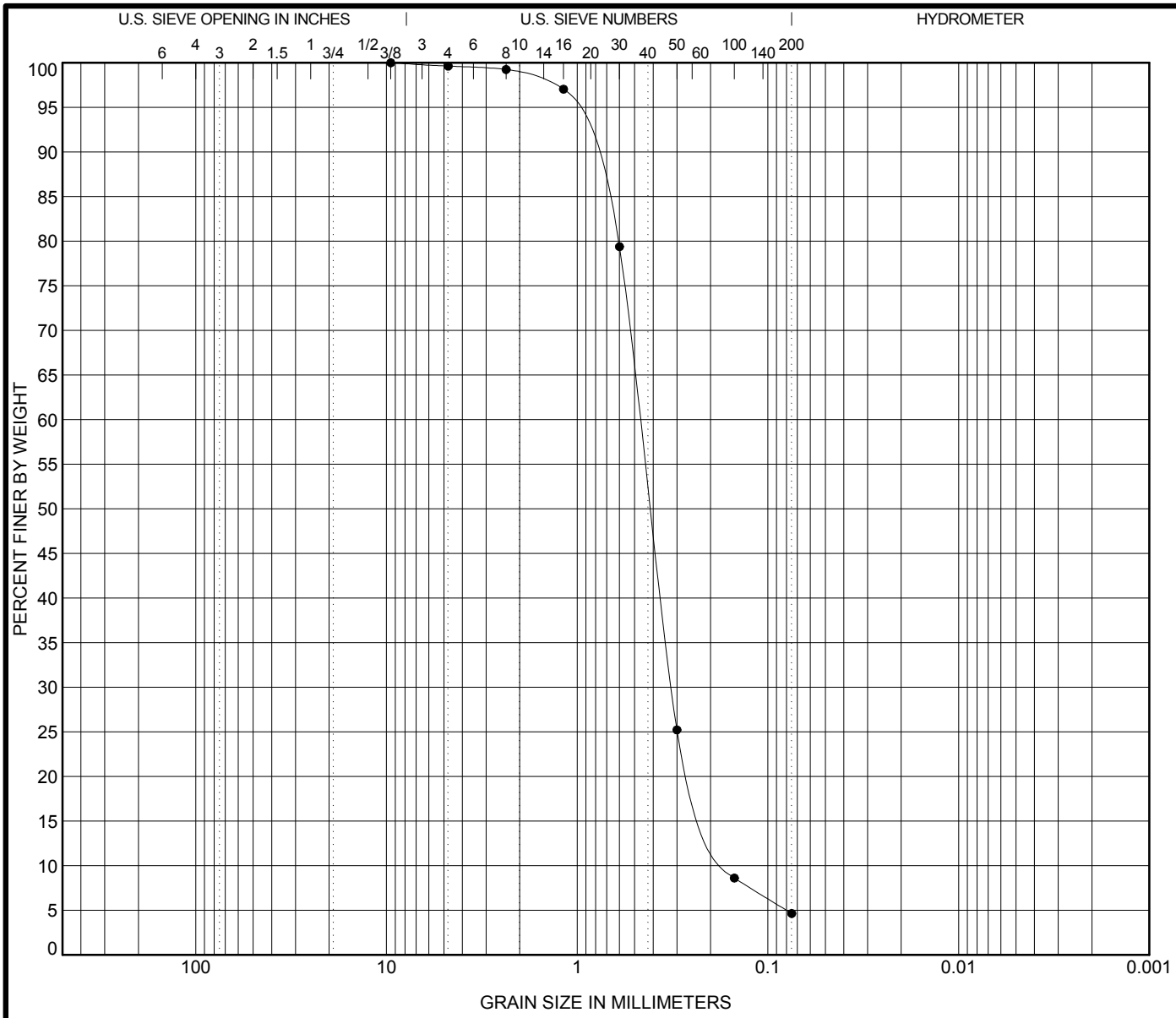
US_GRAIN_SIZE J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-204**	**at 38.5'**	**POORLY GRADED SAND(SP)**				**1.37**	**2.95**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-204**	**at 38.5'**	**9.5**	**0.468**	**0.319**	**0.159**	**0.4**	**95.0**	**4.6**	

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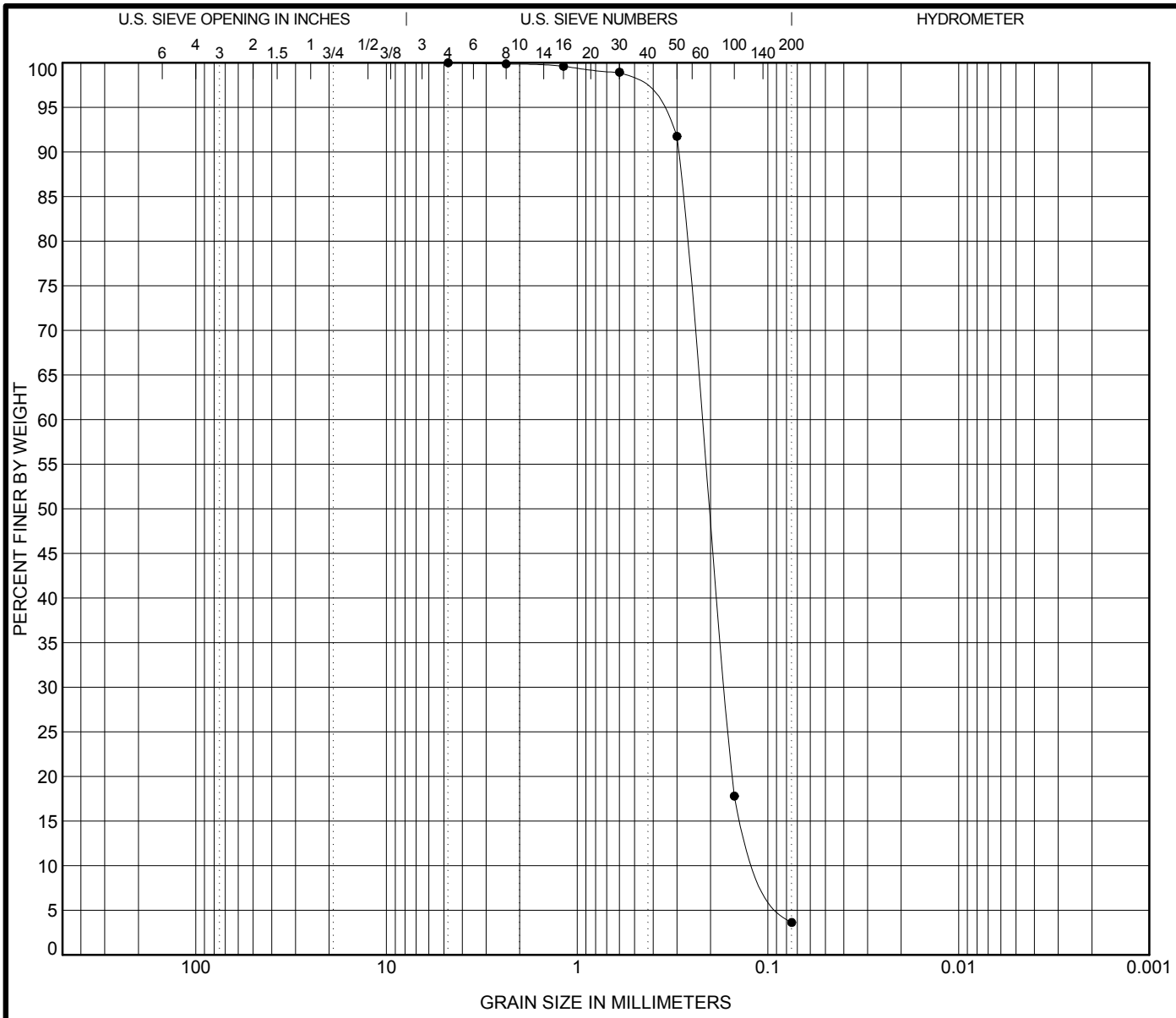

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-205**	**at 18.5'**	**POORLY GRADED SAND(SP)**				**1.24**	**2.18**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-205**	**at 18.5'**	**4.75**	**0.223**	**0.168**	**0.102**	**0.0**	**96.4**	**3.6**	

GEOTECHNOLOGY INC
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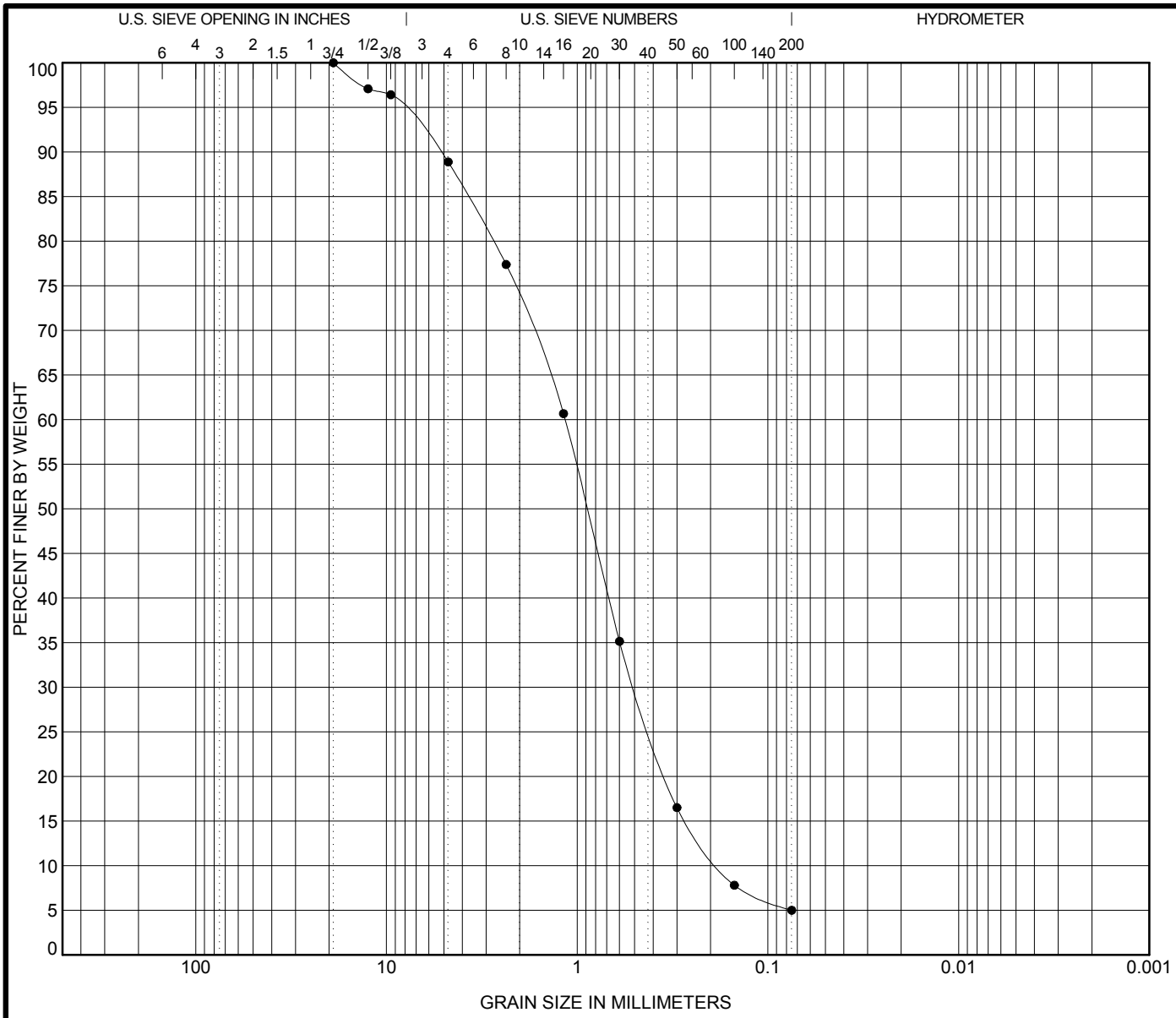

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-205**	**at 48.5'**	**WELL-GRADED SAND(SW)**				**1.19**	**6.49**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-205**	**at 48.5'**	**19**	**1.159**	**0.495**	**0.179**	**11.1**	**83.9**	**5.0**	

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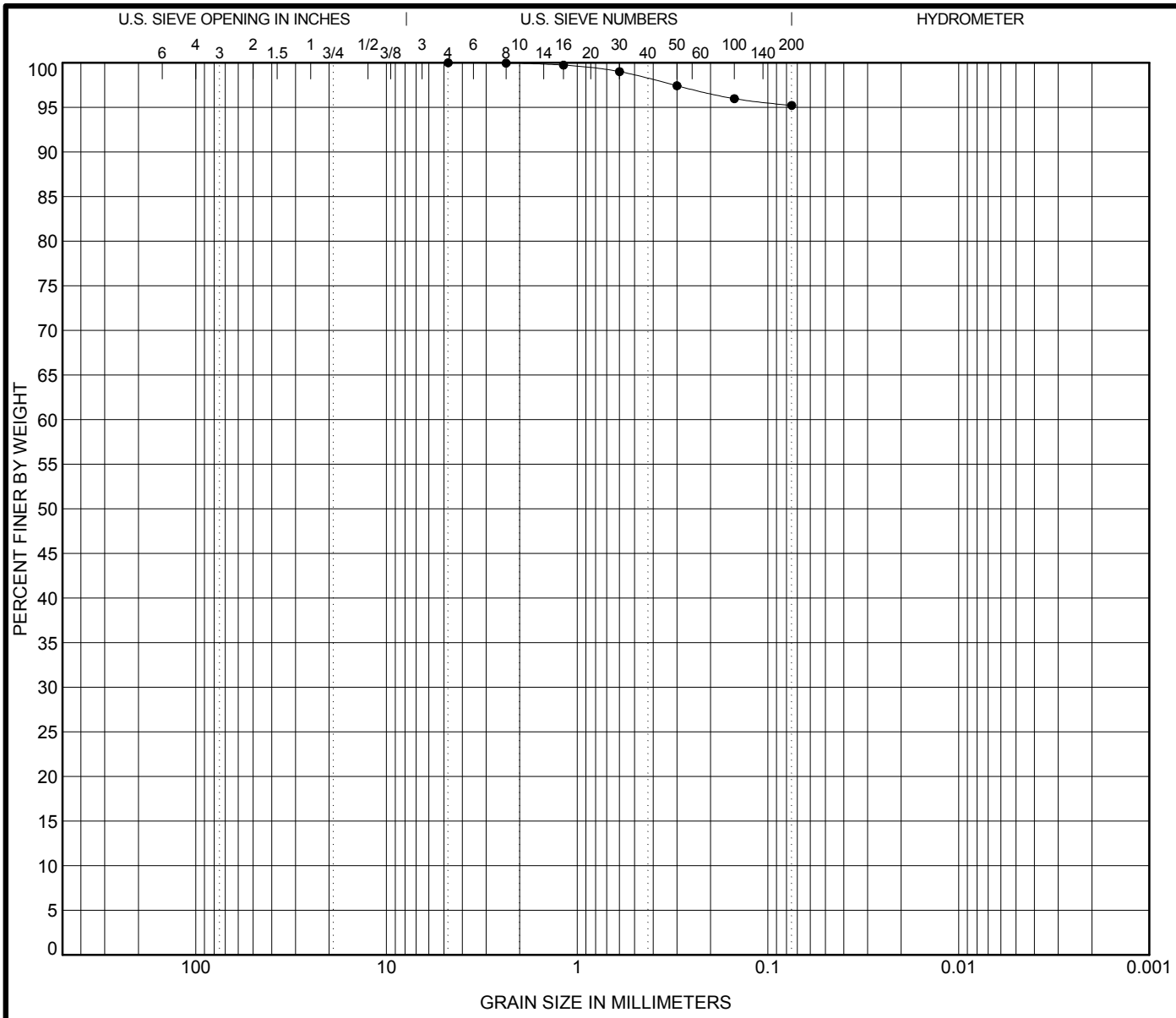

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-206 at 28.5'**						

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-206 at 28.5'**	**4.75**				**0.0**	**4.8**	**95.2**	

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PARTICLE SIZE DISTRIBUTION

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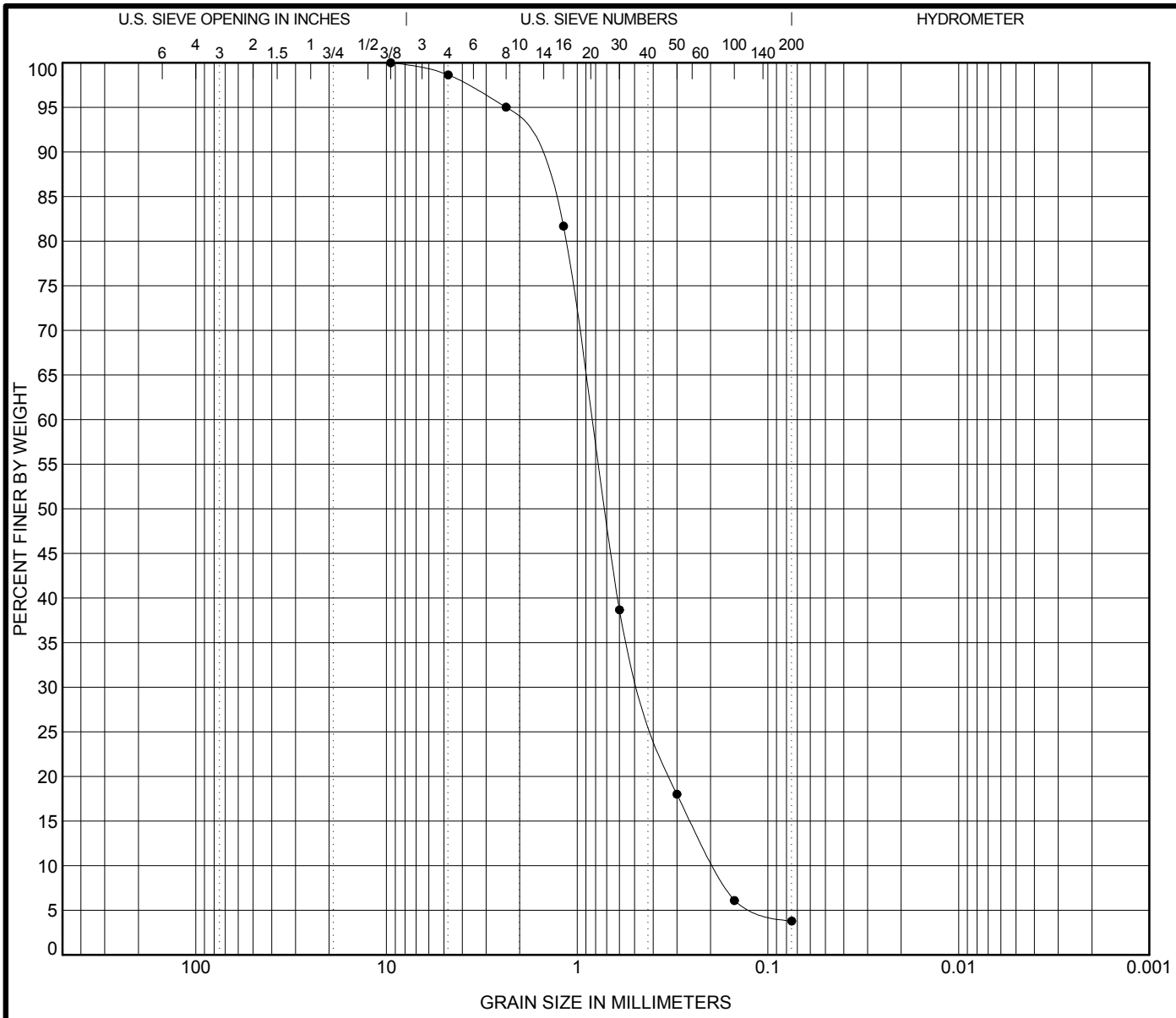

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-206**	**at 48.5'**	**POORLY GRADED SAND(SP)**				**1.27**	**4.46**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-206**	**at 48.5'**	**9.5**	**0.839**	**0.448**	**0.188**	**1.4**	**94.8**	**3.8**	

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PARTICLE SIZE DISTRIBUTION

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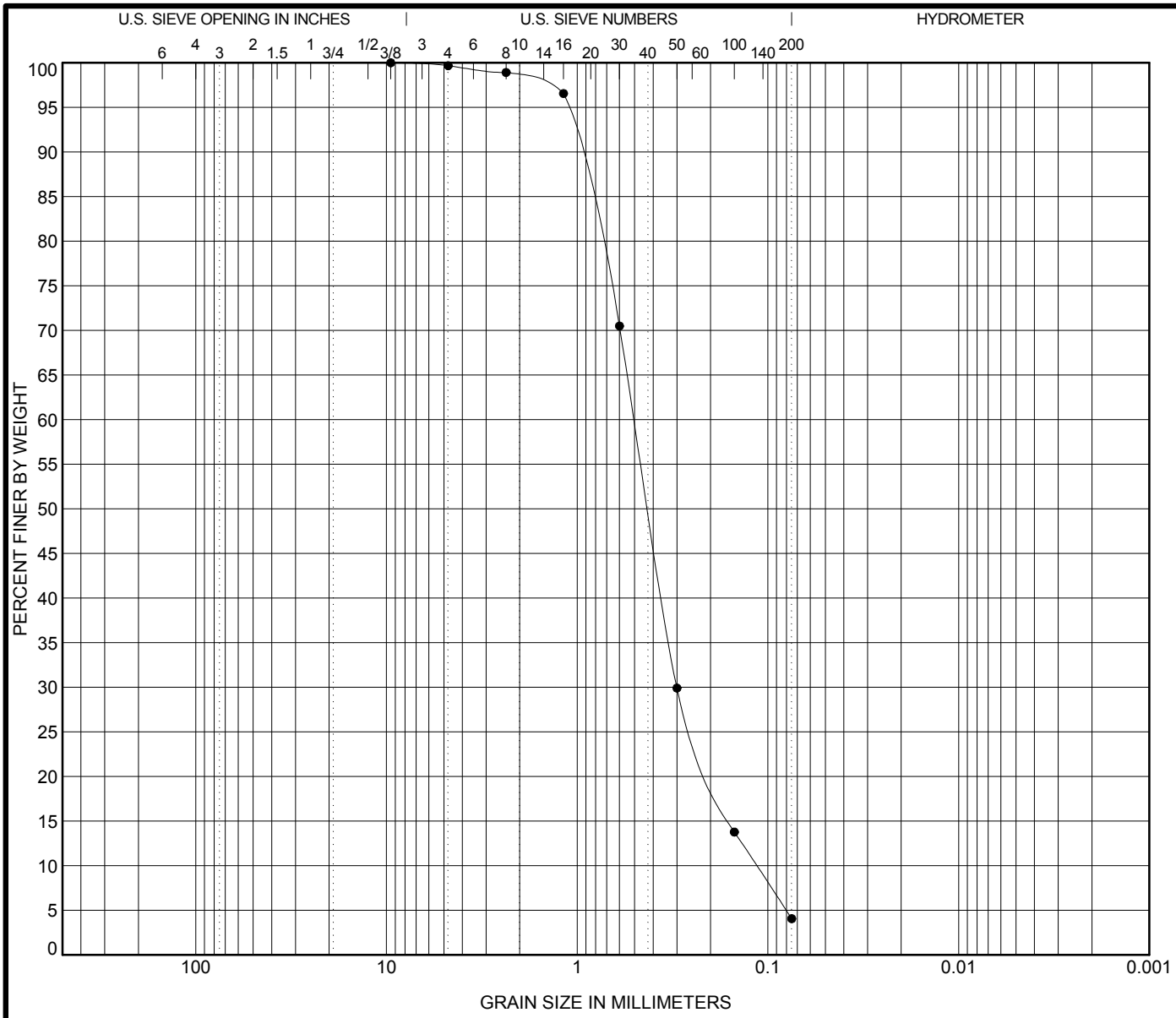

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-207**	**at 18.5'**	**POORLY GRADED SAND(SP)**				**1.57**	**4.38**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-207**	**at 18.5'**	**9.5**	**0.502**	**0.3**	**0.115**	**0.3**	**95.6**	**4.1**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

PARTICLE SIZE DISTRIBUTION

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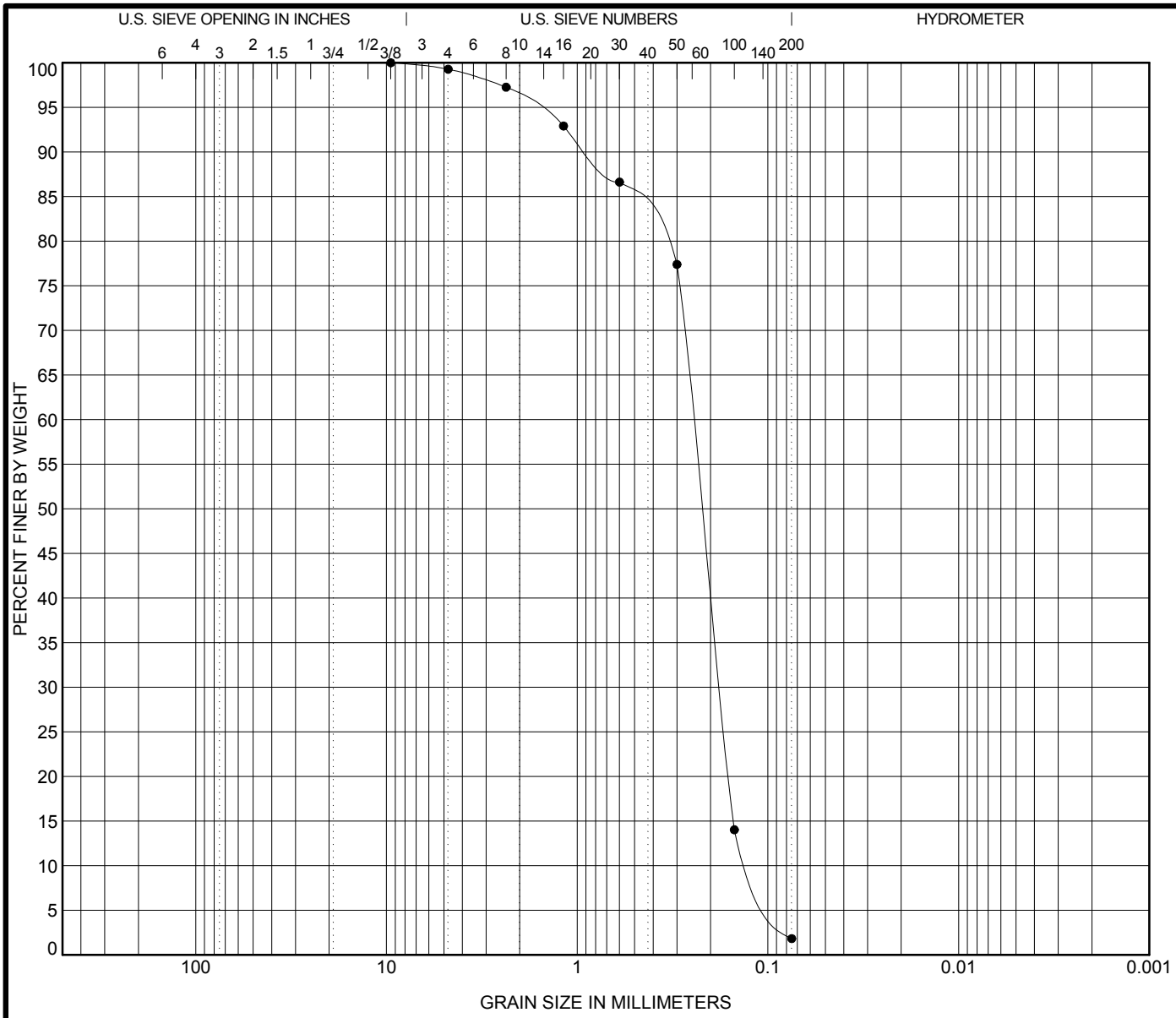
Kansas City, Missouri
J024061.01

US_GRAIN_SIZE J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-208**	**at 18.5'**	**POORLY GRADED SAND(SP)**				**1.08**	**2.08**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-208**	**at 18.5'**	**9.5**	**0.248**	**0.179**	**0.119**	**0.7**	**97.5**	**1.8**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

PARTICLE SIZE DISTRIBUTION

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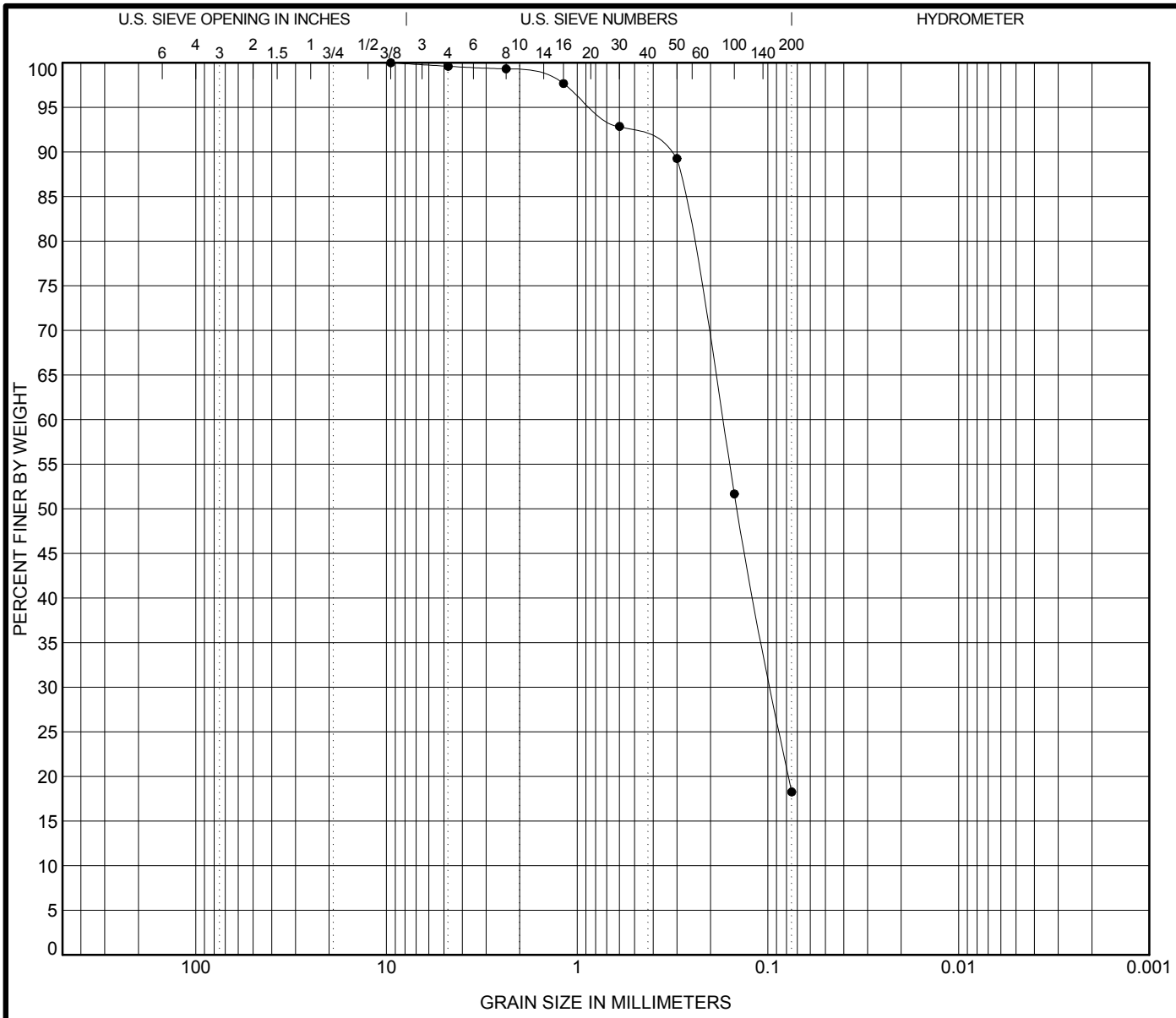
J024061.01

US_GRAIN_SIZE J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-208**	**at 38.5'**	**SILTY SAND(SM)**					

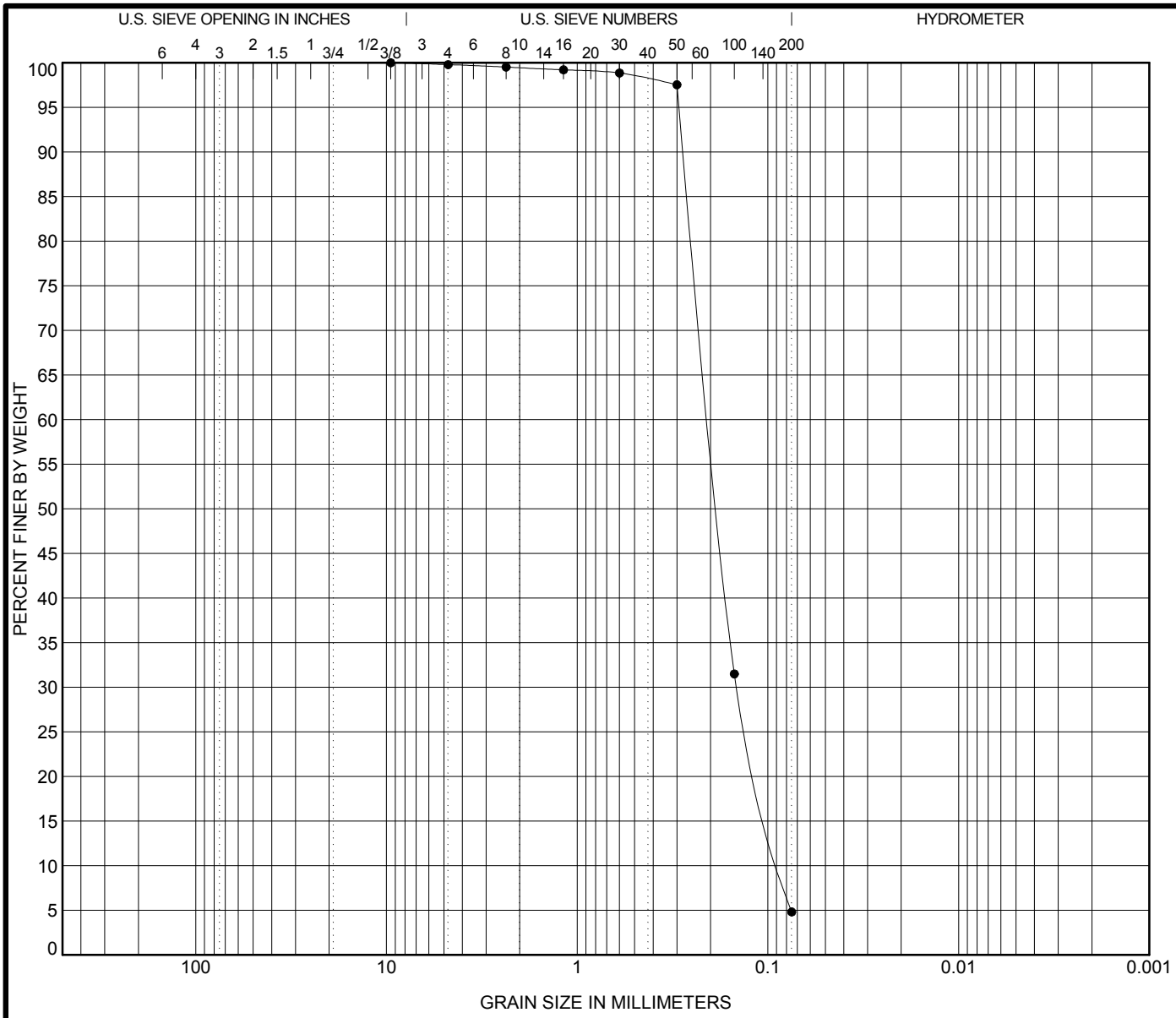
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-208**	**at 38.5'**	**9.5**	**0.175**	**0.096**		**0.4**	**81.3**	**18.3**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

PARTICLE SIZE DISTRIBUTION

Union Berkley
Kansas City, Missouri
J024061.01

US_GRAIN_SIZE_J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-209**	**at 13.5'**	**POORLY GRADED SAND(SP)**				**1.20**	**2.36**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-209**	**at 13.5'**	**9.5**	**0.202**	**0.144**	**0.086**	**0.2**	**95.0**	**4.8**	

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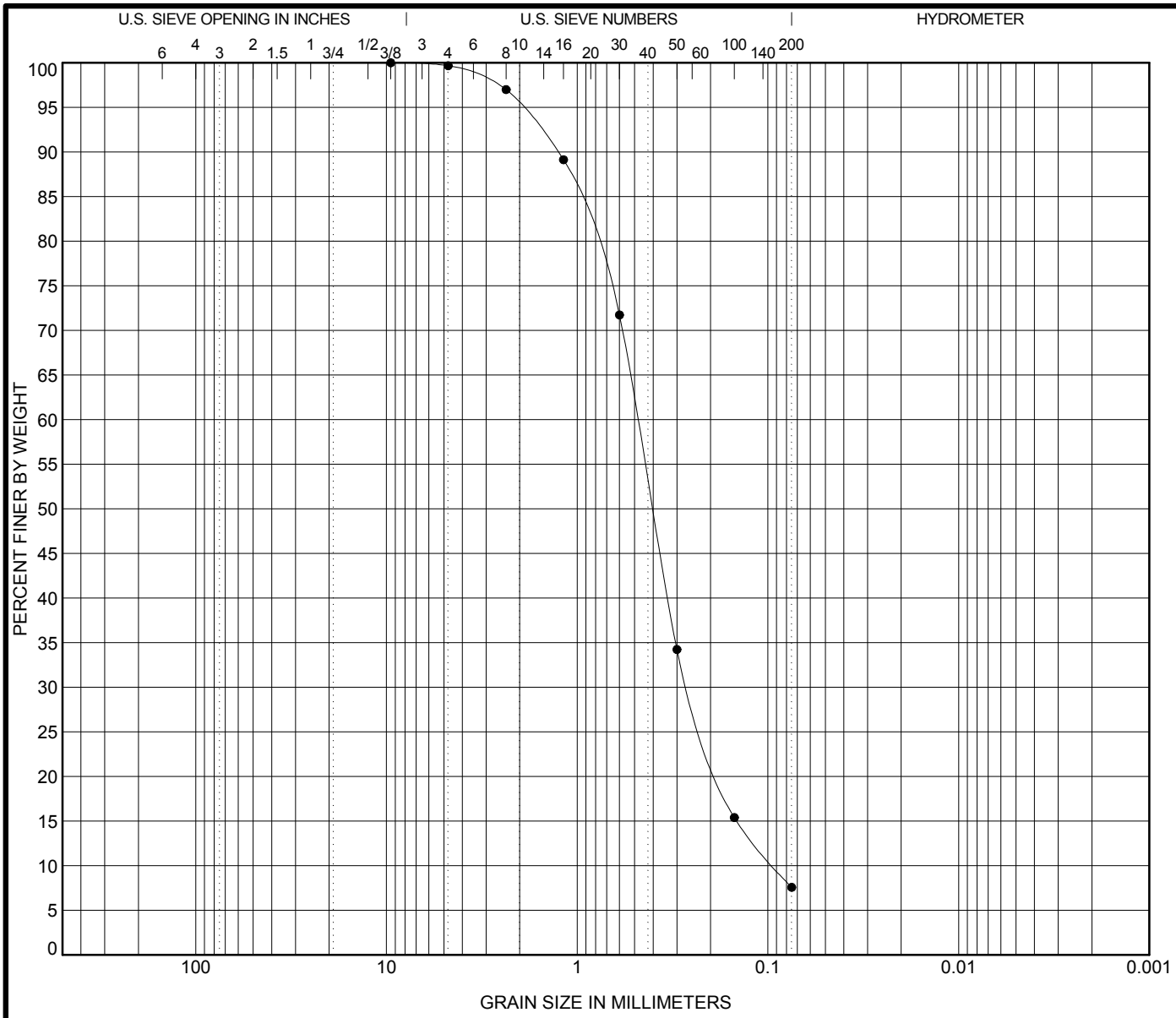
Kansas City, Missouri
J024061.01

US_GRAIN_SIZE J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-209**	**at 38.5'**					**1.47**	**5.19**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-209**	**at 38.5'**	**9.5**	**0.483**	**0.257**	**0.093**	**0.3**	**92.1**	**7.6**	

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PARTICLE SIZE DISTRIBUTION

Union Berkley
Kansas City, Missouri
J024061.01

US_GRAIN_SIZE_J024061.01 UNION BERKLEY.GPJ US_LAB.GDT 4/22/15

ENVIRONMENTAL LABORATORY TEST DATA

Pace Analytical Services, Inc.
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Lenexa, KS 66219
(913)599-5665

April 13, 2015

Sheryl Gallagher
Geotechnology Inc
5055 Antioch Rd
Overland Park, KS 66214

RE: Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Dear Sheryl Gallagher:
Enclosed are the analytical results for sample(s) received by the laboratory on March 31, 2015. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Sherri Rosenstangle

Sherri Rosenstangle
sherri.rosenstangle@pacelabs.com
Project Manager

Enclosures

cc: Chris Brown, GEOTECHNOLOGY, INC.

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CERTIFICATIONS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Kansas Certification IDs
9608 Loiret Boulevard, Lenexa, KS 66219
WY STR Certification #: 2456.01
Arkansas Certification #: 13-012-0
Illinois Certification #: 003097
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212008A
Oklahoma Certification #: 9205/9935
Texas Certification #: T104704407
Utah Certification #: KS00021

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SAMPLE SUMMARY

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60190815002	**SOIL COMP**	Solid	03/10/15 00:00	03/31/15 11:41
60190815004	**WATER COMP**	Water	03/23/15 00:00	03/31/15 11:41
60190815005	**DECONATMINATION WATER**	Water	03/23/15 00:00	03/31/15 11:41

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SAMPLE ANALYTE COUNT

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Lab ID	Sample ID	Method	Analysts	Analytes Reported
60190815002	**SOIL COMP**	EPA 6010	JGP	7
		EPA 7470	TDS	1
		EPA 8270	JMT	18
		EPA 8260	TJT	13
60190815004	**WATER COMP**	EPA 6010	JGP	7
		EPA 7470	TDS	1
		EPA 8270	JMT	18
		EPA 8260	TJT	13
		EPA 1010	RAB	1
60190815005	**DECONATMINATION WATER**	EPA 6010	JGP	7
		EPA 7470	TDS	1
		EPA 8270	JMT	18
		EPA 8260	TJT	13
		EPA 1010	RAB	1

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: SOIL COMP **Lab ID: 60190815002** Collected: 03/10/15 00:00 Received: 03/31/15 11:41 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP, TCLP	Analytical Method: EPA 6010 Preparation Method: EPA 3010								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Arsenic	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:24	7440-38-2	
Barium	ND	mg/L	2.5	100	1	04/02/15 11:00	04/03/15 16:24	7440-39-3	
Cadmium	ND	mg/L	0.050	1	1	04/02/15 11:00	04/03/15 16:24	7440-43-9	
Chromium	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:24	7440-47-3	
Lead	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:24	7439-92-1	
Selenium	ND	mg/L	0.50	1	1	04/02/15 11:00	04/03/15 16:24	7782-49-2	
Silver	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:24	7440-22-4	
7470 Mercury, TCLP	Analytical Method: EPA 7470 Preparation Method: EPA 7470								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Mercury	ND	mg/L	0.0020	.2	1	04/02/15 01:00	04/02/15 16:05	7439-97-6	
8270 MSSV TCLP Sep Funnel	Analytical Method: EPA 8270 Preparation Method: EPA 3510								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
1,4-Dichlorobenzene	ND	ug/L	100	7500	1	04/02/15 00:00	04/06/15 23:57	106-46-7	
2,4-Dinitrotoluene	ND	ug/L	100	130	1	04/02/15 00:00	04/06/15 23:57	121-14-2	
Hexachloro-1,3-butadiene	ND	ug/L	100	500	1	04/02/15 00:00	04/06/15 23:57	87-68-3	
Hexachlorobenzene	ND	ug/L	100	130	1	04/02/15 00:00	04/06/15 23:57	118-74-1	
Hexachloroethane	ND	ug/L	100	3000	1	04/02/15 00:00	04/06/15 23:57	67-72-1	
2-Methylphenol(o-Cresol)	ND	ug/L	100	200000	1	04/02/15 00:00	04/06/15 23:57	95-48-7	
3&4-Methylphenol(m&p Cresol)	ND	ug/L	200	200000	1	04/02/15 00:00	04/06/15 23:57		
Nitrobenzene	ND	ug/L	100	2000	1	04/02/15 00:00	04/06/15 23:57	98-95-3	
Pentachlorophenol	ND	ug/L	500	100000	1	04/02/15 00:00	04/06/15 23:57	87-86-5	
Pyridine	ND	ug/L	100	5000	1	04/02/15 00:00	04/06/15 23:57	110-86-1	
2,4,5-Trichlorophenol	ND	ug/L	500	400000	1	04/02/15 00:00	04/06/15 23:57	95-95-4	
2,4,6-Trichlorophenol	ND	ug/L	100	2000	1	04/02/15 00:00	04/06/15 23:57	88-06-2	
Surrogates									
Nitrobenzene-d5 (S)	85	%	60-113		1	04/02/15 00:00	04/06/15 23:57	4165-60-0	
2-Fluorobiphenyl (S)	89	%	64-106		1	04/02/15 00:00	04/06/15 23:57	321-60-8	
Terphenyl-d14 (S)	87	%	71-111		1	04/02/15 00:00	04/06/15 23:57	1718-51-0	
Phenol-d6 (S)	79	%	46-108		1	04/02/15 00:00	04/06/15 23:57	13127-88-3	
2-Fluorophenol (S)	82	%	48-101		1	04/02/15 00:00	04/06/15 23:57	367-12-4	
2,4,6-Tribromophenol (S)	70	%	54-119		1	04/02/15 00:00	04/06/15 23:57	118-79-6	
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Benzene	ND	ug/L	50.0	500	1		04/06/15 14:27	71-43-2	
2-Butanone (MEK)	ND	ug/L	1000	200000	1		04/06/15 14:27	78-93-3	
Carbon tetrachloride	ND	ug/L	50.0	500	1		04/06/15 14:27	56-23-5	
Chlorobenzene	ND	ug/L	50.0	100000	1		04/06/15 14:27	108-90-7	
Chloroform	ND	ug/L	200	6000	1		04/06/15 14:27	67-66-3	
1,2-Dichloroethane	ND	ug/L	50.0	500	1		04/06/15 14:27	107-06-2	
1,1-Dichloroethene	ND	ug/L	50.0	700	1		04/06/15 14:27	75-35-4	
Tetrachloroethene	ND	ug/L	50.0	700	1		04/06/15 14:27	127-18-4	
Trichloroethene	ND	ug/L	50.0	500	1		04/06/15 14:27	79-01-6	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: SOIL COMP **Lab ID: 60190815002** Collected: 03/10/15 00:00 Received: 03/31/15 11:41 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Vinyl chloride	ND	ug/L	50.0	200	1		04/06/15 14:27	75-01-4	
Surrogates									
1,2-Dichloroethane-d4 (S)	100	%	82-123		1		04/06/15 14:27	17060-07-0	
Toluene-d8 (S)	99	%	80-120		1		04/06/15 14:27	2037-26-5	
4-Bromofluorobenzene (S)	100	%	80-120		1		04/06/15 14:27	460-00-4	

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: WATER COMP **Lab ID: 60190815004** Collected: 03/23/15 00:00 Received: 03/31/15 11:41 Matrix: Water

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP, TCLP	Analytical Method: EPA 6010 Preparation Method: EPA 3010 Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Arsenic	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:26	7440-38-2	
Barium	ND	mg/L	2.5	100	1	04/02/15 11:00	04/03/15 16:26	7440-39-3	
Cadmium	ND	mg/L	0.050	1	1	04/02/15 11:00	04/03/15 16:26	7440-43-9	
Chromium	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:26	7440-47-3	
Lead	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:26	7439-92-1	
Selenium	ND	mg/L	0.50	1	1	04/02/15 11:00	04/03/15 16:26	7782-49-2	
Silver	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:26	7440-22-4	
7470 Mercury, TCLP	Analytical Method: EPA 7470 Preparation Method: EPA 7470 Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Mercury	ND	mg/L	0.0020	.2	1	04/02/15 01:00	04/02/15 16:07	7439-97-6	
8270 MSSV TCLP Sep Funnel	Analytical Method: EPA 8270 Preparation Method: EPA 3510 Leachate Method/Date: EPA 1311; 04/01/15 00:00								
1,4-Dichlorobenzene	ND	ug/L	100	7500	1	04/02/15 00:00	04/07/15 00:18	106-46-7	
2,4-Dinitrotoluene	ND	ug/L	100	130	1	04/02/15 00:00	04/07/15 00:18	121-14-2	
Hexachloro-1,3-butadiene	ND	ug/L	100	500	1	04/02/15 00:00	04/07/15 00:18	87-68-3	
Hexachlorobenzene	ND	ug/L	100	130	1	04/02/15 00:00	04/07/15 00:18	118-74-1	
Hexachloroethane	ND	ug/L	100	3000	1	04/02/15 00:00	04/07/15 00:18	67-72-1	
2-Methylphenol(o-Cresol)	ND	ug/L	100	200000	1	04/02/15 00:00	04/07/15 00:18	95-48-7	
3&4-Methylphenol(m&p Cresol)	ND	ug/L	200	200000	1	04/02/15 00:00	04/07/15 00:18		
Nitrobenzene	ND	ug/L	100	2000	1	04/02/15 00:00	04/07/15 00:18	98-95-3	
Pentachlorophenol	ND	ug/L	500	100000	1	04/02/15 00:00	04/07/15 00:18	87-86-5	
Pyridine	ND	ug/L	100	5000	1	04/02/15 00:00	04/07/15 00:18	110-86-1	
2,4,5-Trichlorophenol	ND	ug/L	500	400000	1	04/02/15 00:00	04/07/15 00:18	95-95-4	
2,4,6-Trichlorophenol	ND	ug/L	100	2000	1	04/02/15 00:00	04/07/15 00:18	88-06-2	
Surrogates									
Nitrobenzene-d5 (S)	91	%	60-113		1	04/02/15 00:00	04/07/15 00:18	4165-60-0	
2-Fluorobiphenyl (S)	95	%	64-106		1	04/02/15 00:00	04/07/15 00:18	321-60-8	
Terphenyl-d14 (S)	96	%	71-111		1	04/02/15 00:00	04/07/15 00:18	1718-51-0	
Phenol-d6 (S)	88	%	46-108		1	04/02/15 00:00	04/07/15 00:18	13127-88-3	
2-Fluorophenol (S)	88	%	48-101		1	04/02/15 00:00	04/07/15 00:18	367-12-4	
2,4,6-Tribromophenol (S)	76	%	54-119		1	04/02/15 00:00	04/07/15 00:18	118-79-6	
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Benzene	ND	ug/L	50.0	500	1		04/06/15 14:43	71-43-2	
2-Butanone (MEK)	ND	ug/L	1000	200000	1		04/06/15 14:43	78-93-3	
Carbon tetrachloride	ND	ug/L	50.0	500	1		04/06/15 14:43	56-23-5	
Chlorobenzene	ND	ug/L	50.0	100000	1		04/06/15 14:43	108-90-7	
Chloroform	ND	ug/L	200	6000	1		04/06/15 14:43	67-66-3	
1,2-Dichloroethane	ND	ug/L	50.0	500	1		04/06/15 14:43	107-06-2	
1,1-Dichloroethene	ND	ug/L	50.0	700	1		04/06/15 14:43	75-35-4	
Tetrachloroethene	ND	ug/L	50.0	700	1		04/06/15 14:43	127-18-4	
Trichloroethene	ND	ug/L	50.0	500	1		04/06/15 14:43	79-01-6	
Vinyl chloride	ND	ug/L	50.0	200	1		04/06/15 14:43	75-01-4	

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: WATER COMP **Lab ID: 60190815004** Collected: 03/23/15 00:00 Received: 03/31/15 11:41 Matrix: Water

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Surrogates									
1,2-Dichloroethane-d4 (S)	100	%	82-123		1		04/06/15 14:43	17060-07-0	
Toluene-d8 (S)	100	%	80-120		1		04/06/15 14:43	2037-26-5	
4-Bromofluorobenzene (S)	100	%	80-120		1		04/06/15 14:43	460-00-4	
1010 Flashpoint,Closed Cup	Analytical Method: EPA 1010								
Flashpoint	**>210**	deg F	78.0		1		04/08/15 08:00		

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: DECONATMINATION WATER **Lab ID: 60190815005** Collected: 03/23/15 00:00 Received: 03/31/15 11:41 Matrix: Water

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP, TCLP	Analytical Method: EPA 6010 Preparation Method: EPA 3010								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Arsenic	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:28	7440-38-2	
Barium	ND	mg/L	2.5	100	1	04/02/15 11:00	04/03/15 16:28	7440-39-3	
Cadmium	ND	mg/L	0.050	1	1	04/02/15 11:00	04/03/15 16:28	7440-43-9	
Chromium	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:28	7440-47-3	
Lead	ND	mg/L	0.50	5	1	04/02/15 11:00	04/03/15 16:28	7439-92-1	
Selenium	ND	mg/L	0.50	1	1	04/02/15 11:00	04/03/15 16:28	7782-49-2	
Silver	ND	mg/L	0.10	5	1	04/02/15 11:00	04/03/15 16:28	7440-22-4	
7470 Mercury, TCLP	Analytical Method: EPA 7470 Preparation Method: EPA 7470								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
Mercury	ND	mg/L	0.0020	.2	1	04/02/15 01:00	04/02/15 16:09	7439-97-6	
8270 MSSV TCLP Sep Funnel	Analytical Method: EPA 8270 Preparation Method: EPA 3510								
	Leachate Method/Date: EPA 1311; 04/01/15 00:00								
1,4-Dichlorobenzene	ND	ug/L	100	7500	1	04/02/15 00:00	04/07/15 00:38	106-46-7	
2,4-Dinitrotoluene	ND	ug/L	100	130	1	04/02/15 00:00	04/07/15 00:38	121-14-2	
Hexachloro-1,3-butadiene	ND	ug/L	100	500	1	04/02/15 00:00	04/07/15 00:38	87-68-3	
Hexachlorobenzene	ND	ug/L	100	130	1	04/02/15 00:00	04/07/15 00:38	118-74-1	
Hexachloroethane	ND	ug/L	100	3000	1	04/02/15 00:00	04/07/15 00:38	67-72-1	
2-Methylphenol(o-Cresol)	ND	ug/L	100	200000	1	04/02/15 00:00	04/07/15 00:38	95-48-7	
3&4-Methylphenol(m&p Cresol)	ND	ug/L	200	200000	1	04/02/15 00:00	04/07/15 00:38		
Nitrobenzene	ND	ug/L	100	2000	1	04/02/15 00:00	04/07/15 00:38	98-95-3	
Pentachlorophenol	ND	ug/L	500	100000	1	04/02/15 00:00	04/07/15 00:38	87-86-5	
Pyridine	ND	ug/L	100	5000	1	04/02/15 00:00	04/07/15 00:38	110-86-1	
2,4,5-Trichlorophenol	ND	ug/L	500	400000	1	04/02/15 00:00	04/07/15 00:38	95-95-4	
2,4,6-Trichlorophenol	ND	ug/L	100	2000	1	04/02/15 00:00	04/07/15 00:38	88-06-2	
Surrogates									
Nitrobenzene-d5 (S)	87	%	60-113		1	04/02/15 00:00	04/07/15 00:38	4165-60-0	
2-Fluorobiphenyl (S)	93	%	64-106		1	04/02/15 00:00	04/07/15 00:38	321-60-8	
Terphenyl-d14 (S)	88	%	71-111		1	04/02/15 00:00	04/07/15 00:38	1718-51-0	
Phenol-d6 (S)	85	%	46-108		1	04/02/15 00:00	04/07/15 00:38	13127-88-3	
2-Fluorophenol (S)	89	%	48-101		1	04/02/15 00:00	04/07/15 00:38	367-12-4	
2,4,6-Tribromophenol (S)	73	%	54-119		1	04/02/15 00:00	04/07/15 00:38	118-79-6	
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Benzene	ND	ug/L	50.0	500	1		04/06/15 14:58	71-43-2	
2-Butanone (MEK)	ND	ug/L	1000	200000	1		04/06/15 14:58	78-93-3	
Carbon tetrachloride	ND	ug/L	50.0	500	1		04/06/15 14:58	56-23-5	
Chlorobenzene	ND	ug/L	50.0	100000	1		04/06/15 14:58	108-90-7	
Chloroform	ND	ug/L	200	6000	1		04/06/15 14:58	67-66-3	
1,2-Dichloroethane	ND	ug/L	50.0	500	1		04/06/15 14:58	107-06-2	
1,1-Dichloroethene	ND	ug/L	50.0	700	1		04/06/15 14:58	75-35-4	
Tetrachloroethene	ND	ug/L	50.0	700	1		04/06/15 14:58	127-18-4	
Trichloroethene	ND	ug/L	50.0	500	1		04/06/15 14:58	79-01-6	

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ANALYTICAL RESULTS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Sample: DECONATMINATION WATER **Lab ID: 60190815005** Collected: 03/23/15 00:00 Received: 03/31/15 11:41 Matrix: Water

Parameters	Results	Units	Report Limit	Reg. Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV TCLP	Analytical Method: EPA 8260 Leachate Method/Date: EPA 1311; 04/03/15 00:00								
Vinyl chloride	ND	ug/L	50.0	200	1		04/06/15 14:58	75-01-4	
Surrogates									
1,2-Dichloroethane-d4 (S)	100	%	82-123		1		04/06/15 14:58	17060-07-0	
Toluene-d8 (S)	100	%	80-120		1		04/06/15 14:58	2037-26-5	
4-Bromofluorobenzene (S)	100	%	80-120		1		04/06/15 14:58	460-00-4	
1010 Flashpoint,Closed Cup	Analytical Method: EPA 1010								
Flashpoint	**>210**	deg F	78.0		1		04/08/15 08:00		

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

QC Batch: MERP/9453 Analysis Method: EPA 7470
QC Batch Method: EPA 7470 Analysis Description: 7470 Mercury TCLP
Associated Lab Samples: 60190815002, 60190815004, 60190815005

METHOD BLANK: 1543409 Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	mg/L	ND	0.0020	04/02/15 15:25	

LABORATORY CONTROL SAMPLE: 1543410

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	mg/L	.005	0.0054	107	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1543411 1543412

Parameter	Units	60190491001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	mg/L	ND	.015	.015	0.016	0.015	104	102	75-125	1	20	

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

QC Batch: MPRP/31298 | Analysis Method: EPA 6010
QC Batch Method: EPA 3010 | Analysis Description: 6010 MET TCLP
Associated Lab Samples: 60190815002, 60190815004, 60190815005

METHOD BLANK: 1543222 | Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/L	ND	0.50	04/03/15 15:47	
Barium	mg/L	ND	2.5	04/03/15 15:47	
Cadmium	mg/L	ND	0.050	04/03/15 15:47	
Chromium	mg/L	ND	0.10	04/03/15 15:47	
Lead	mg/L	ND	0.50	04/03/15 15:47	
Selenium	mg/L	ND	0.50	04/03/15 15:47	
Silver	mg/L	ND	0.10	04/03/15 15:47	

LABORATORY CONTROL SAMPLE: 1543223

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/L	1	0.96	96	80-120	
Barium	mg/L	1	1.0	104	80-120	
Cadmium	mg/L	1	0.99	99	80-120	
Chromium	mg/L	1	1.0	100	80-120	
Lead	mg/L	1	1.1	107	80-120	
Selenium	mg/L	1	0.99	99	80-120	
Silver	mg/L	.5	0.47	94	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1543224 1543225

Parameter	Units	60190491001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/L	ND	10	10	10.1	10.2	101	101	75-125	0	20	
Barium	mg/L	ND	10	10	10.6	10.7	105	106	75-125	1	20	
Cadmium	mg/L	ND	10	10	10.2	10.2	102	102	75-125	0	20	
Chromium	mg/L	ND	10	10	10.2	10.2	102	102	75-125	0	20	
Lead	mg/L	ND	10	10	10.6	10.6	106	106	75-125	0	20	
Selenium	mg/L	ND	10	10	10.6	10.5	105	105	75-125	0	20	
Silver	mg/L	ND	5	5	4.9	4.9	97	97	75-125	0	20	

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

QC Batch: MSV/68636 Analysis Method: EPA 8260
QC Batch Method: EPA 8260 Analysis Description: 8260 MSV TCLP
Associated Lab Samples: 60190815002, 60190815004, 60190815005

METHOD BLANK: 1545095 Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1-Dichloroethene	ug/L	ND	50.0	04/06/15 12:39	
1,2-Dichloroethane	ug/L	ND	50.0	04/06/15 12:39	
2-Butanone (MEK)	ug/L	ND	1000	04/06/15 12:39	
Benzene	ug/L	ND	50.0	04/06/15 12:39	
Carbon tetrachloride	ug/L	ND	50.0	04/06/15 12:39	
Chlorobenzene	ug/L	ND	50.0	04/06/15 12:39	
Chloroform	ug/L	ND	200	04/06/15 12:39	
Tetrachloroethene	ug/L	ND	50.0	04/06/15 12:39	
Trichloroethene	ug/L	ND	50.0	04/06/15 12:39	
Vinyl chloride	ug/L	ND	50.0	04/06/15 12:39	
1,2-Dichloroethane-d4 (S)	%	101	82-123	04/06/15 12:39	
4-Bromofluorobenzene (S)	%	100	80-120	04/06/15 12:39	
Toluene-d8 (S)	%	99	80-120	04/06/15 12:39	

LABORATORY CONTROL SAMPLE: 1545096

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1-Dichloroethene	ug/L	1000	1010	101	65-129	
1,2-Dichloroethane	ug/L	1000	952	95	76-122	
2-Butanone (MEK)	ug/L	5000	4830	97	66-122	
Benzene	ug/L	1000	991	99	75-119	
Carbon tetrachloride	ug/L	1000	980	98	68-135	
Chlorobenzene	ug/L	1000	936	94	77-117	
Chloroform	ug/L	1000	961	96	72-125	
Tetrachloroethene	ug/L	1000	951	95	69-125	
Trichloroethene	ug/L	1000	1000	100	73-124	
Vinyl chloride	ug/L	1000	880	88	53-137	
1,2-Dichloroethane-d4 (S)	%			104	82-123	
4-Bromofluorobenzene (S)	%			102	80-120	
Toluene-d8 (S)	%			97	80-120	

MATRIX SPIKE SAMPLE: 1545097

Parameter	Units	60190893012 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
1,1-Dichloroethene	ug/L	ND		937			
1,2-Dichloroethane	ug/L	ND		867			
2-Butanone (MEK)	ug/L	ND		3930			
Benzene	ug/L	ND		886			

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

MATRIX SPIKE SAMPLE: 1545097

Parameter	Units	60190893012 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Carbon tetrachloride	ug/L	ND		861			
Chlorobenzene	ug/L	ND		859			
Chloroform	ug/L	ND		867			
Tetrachloroethene	ug/L	ND		878			
Trichloroethene	ug/L	ND		891			
Vinyl chloride	ug/L	ND		803			
1,2-Dichloroethane-d4 (S)	%				99	82-123	
4-Bromofluorobenzene (S)	%				100	80-120	
Toluene-d8 (S)	%				99	80-120	

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

QC Batch: OEXT/48788 Analysis Method: EPA 8270
QC Batch Method: EPA 3510 Analysis Description: 8270 TCLP MSSV
Associated Lab Samples: 60190815002, 60190815004, 60190815005

METHOD BLANK: 1543197 Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,4-Dichlorobenzene	ug/L	ND	100	04/06/15 18:37	
2,4,5-Trichlorophenol	ug/L	ND	500	04/06/15 18:37	
2,4,6-Trichlorophenol	ug/L	ND	100	04/06/15 18:37	
2,4-Dinitrotoluene	ug/L	ND	100	04/06/15 18:37	
2-Methylphenol(o-Cresol)	ug/L	ND	100	04/06/15 18:37	
3&4-Methylphenol(m&p Cresol)	ug/L	ND	200	04/06/15 18:37	
Hexachloro-1,3-butadiene	ug/L	ND	100	04/06/15 18:37	
Hexachlorobenzene	ug/L	ND	100	04/06/15 18:37	
Hexachloroethane	ug/L	ND	100	04/06/15 18:37	
Nitrobenzene	ug/L	ND	100	04/06/15 18:37	
Pentachlorophenol	ug/L	ND	500	04/06/15 18:37	
Pyridine	ug/L	ND	100	04/06/15 18:37	
2,4,6-Tribromophenol (S)	%	72	54-119	04/06/15 18:37	
2-Fluorobiphenyl (S)	%	92	64-106	04/06/15 18:37	
2-Fluorophenol (S)	%	84	48-101	04/06/15 18:37	
Nitrobenzene-d5 (S)	%	87	60-113	04/06/15 18:37	
Phenol-d6 (S)	%	81	46-108	04/06/15 18:37	
Terphenyl-d14 (S)	%	86	71-111	04/06/15 18:37	

METHOD BLANK: 1543200 Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,4-Dichlorobenzene	ug/L	ND	100	04/06/15 18:57	
2,4,5-Trichlorophenol	ug/L	ND	500	04/06/15 18:57	
2,4,6-Trichlorophenol	ug/L	ND	100	04/06/15 18:57	
2,4-Dinitrotoluene	ug/L	ND	100	04/06/15 18:57	
2-Methylphenol(o-Cresol)	ug/L	ND	100	04/06/15 18:57	
3&4-Methylphenol(m&p Cresol)	ug/L	ND	200	04/06/15 18:57	
Hexachloro-1,3-butadiene	ug/L	ND	100	04/06/15 18:57	
Hexachlorobenzene	ug/L	ND	100	04/06/15 18:57	
Hexachloroethane	ug/L	ND	100	04/06/15 18:57	
Nitrobenzene	ug/L	ND	100	04/06/15 18:57	
Pentachlorophenol	ug/L	ND	500	04/06/15 18:57	
Pyridine	ug/L	ND	100	04/06/15 18:57	
2,4,6-Tribromophenol (S)	%	67	54-119	04/06/15 18:57	
2-Fluorobiphenyl (S)	%	83	64-106	04/06/15 18:57	
2-Fluorophenol (S)	%	77	48-101	04/06/15 18:57	
Nitrobenzene-d5 (S)	%	78	60-113	04/06/15 18:57	

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

METHOD BLANK: 1543200 Matrix: Water
Associated Lab Samples: 60190815002, 60190815004, 60190815005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phenol-d6 (S)	%	74	46-108	04/06/15 18:57	
Terphenyl-d14 (S)	%	79	71-111	04/06/15 18:57	

LABORATORY CONTROL SAMPLE: 1543198

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,4-Dichlorobenzene	ug/L	500	397	79	53-102	
2,4,5-Trichlorophenol	ug/L	500	518	104	57-124	
2,4,6-Trichlorophenol	ug/L	500	479	96	54-120	
2,4-Dinitrotoluene	ug/L	500	421	84	44-105	
2-Methylphenol(o-Cresol)	ug/L	500	419	84	50-107	
3&4-Methylphenol(m&p Cresol)	ug/L	1000	833	83	47-112	
Hexachloro-1,3-butadiene	ug/L	500	413	83	46-107	
Hexachlorobenzene	ug/L	500	392	78	57-107	
Hexachloroethane	ug/L	500	430	86	41-104	
Nitrobenzene	ug/L	500	440	88	53-111	
Pentachlorophenol	ug/L	500	477J	95	34-144	
Pyridine	ug/L	500	297	59	10-116	
2,4,6-Tribromophenol (S)	%			76	54-119	
2-Fluorobiphenyl (S)	%			95	64-106	
2-Fluorophenol (S)	%			84	48-101	
Nitrobenzene-d5 (S)	%			86	60-113	
Phenol-d6 (S)	%			82	46-108	
Terphenyl-d14 (S)	%			91	71-111	

MATRIX SPIKE SAMPLE: 1543199

Parameter	Units	60190491001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
1,4-Dichlorobenzene	ug/L	ND	500	417	83	51-101	
2,4,5-Trichlorophenol	ug/L	ND	500	516	103	44-133	
2,4,6-Trichlorophenol	ug/L	ND	500	477	95	40-131	
2,4-Dinitrotoluene	ug/L	ND	500	414	83	42-107	
2-Methylphenol(o-Cresol)	ug/L	ND	500	431	86	41-114	
3&4-Methylphenol(m&p Cresol)	ug/L	ND	1000	864	86	39-117	
Hexachloro-1,3-butadiene	ug/L	ND	500	425	85	46-104	
Hexachlorobenzene	ug/L	ND	500	387	77	53-109	
Hexachloroethane	ug/L	ND	500	449	90	38-107	
Nitrobenzene	ug/L	ND	500	448	90	49-115	
Pentachlorophenol	ug/L	ND	500	490J	98	30-146	
Pyridine	ug/L	ND	500	273	55	10-116	
2,4,6-Tribromophenol (S)	%				77	54-119	
2-Fluorobiphenyl (S)	%				92	64-106	

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QUALITY CONTROL DATA

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

MATRIX SPIKE SAMPLE: 1543199

Parameter	Units	60190491001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
2-Fluorophenol (S)	%				87	48-101	
Nitrobenzene-d5 (S)	%				88	60-113	
Phenol-d6 (S)	%				85	46-108	
Terphenyl-d14 (S)	%				91	71-111	

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QUALIFIERS

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: UNION BERKLEY DEVELOPMENT
Pace Project No.: 60190815

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60190815002	**SOIL COMP**	EPA 3010	MPRP/31298	EPA 6010	ICP/23288
60190815004	**WATER COMP**	EPA 3010	MPRP/31298	EPA 6010	ICP/23288
60190815005	**DECONATMINATION WATER**	EPA 3010	MPRP/31298	EPA 6010	ICP/23288
60190815002	**SOIL COMP**	EPA 7470	MERP/9453	EPA 7470	MERC/9405
60190815004	**WATER COMP**	EPA 7470	MERP/9453	EPA 7470	MERC/9405
60190815005	**DECONATMINATION WATER**	EPA 7470	MERP/9453	EPA 7470	MERC/9405
60190815002	**SOIL COMP**	EPA 3510	OEXT/48788	EPA 8270	MSSV/15795
60190815004	**WATER COMP**	EPA 3510	OEXT/48788	EPA 8270	MSSV/15795
60190815005	**DECONATMINATION WATER**	EPA 3510	OEXT/48788	EPA 8270	MSSV/15795
60190815002	**SOIL COMP**	EPA 8260	MSV/68636		
60190815004	**WATER COMP**	EPA 8260	MSV/68636		
60190815005	**DECONATMINATION WATER**	EPA 8260	MSV/68636		
60190815004	**WATER COMP**	EPA 1010	WET/53981		
60190815005	**DECONATMINATION WATER**	EPA 1010	WET/53981		

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Sample Condition Upon Receipt

WO#: 60190815
60190815

Client Name: Geotechnology

Optional
Proj Due Date:
Proj Name:

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Other ☐ Client ☐

Tracking #: _____ Pace Shipping Label Used? Yes ☐ No ☐

Custody Seal on Cooler/Box Present: Yes ☐ No ☐ Seals intact: Yes ☐ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☐ Other ☐

Thermometer Used: T-239 / T-194 **Type of Ice:** Wet Blue None (circle one) ☐ Samples received on ice, cooling process has begun.

Cooler Temperature: _____

Temperature should be above freezing to 6°C

Date and initials of person examining contents:

Chain of Custody present:	☐Yes ☐No ☐N/A	1.
Chain of Custody filled out:	☐Yes ☐No ☐N/A	2.
Chain of Custody relinquished:	☐Yes ☐No ☐N/A	3.
Sampler name & signature on COC:	☐Yes ☐No ☐N/A	4.
Samples arrived within holding time:	☐Yes ☐No ☐N/A	5.
Short Hold Time analyses (<72hr):	☐Yes ☐No ☐N/A	6.
Rush Turn Around Time requested:	☐Yes ☐No ☐N/A	7.
Sufficient volume:	☐Yes ☐No ☐N/A	8.
Correct containers used:	☐Yes ☐No ☐N/A	
Pace containers used:	☐Yes ☐No ☐N/A	9.
Containers intact:	☐Yes ☐No ☐N/A	10.
Unpreserved 5035A soils frozen w/in 48hrs?	☐Yes ☐No ☐N/A	11.
Filtered volume received for dissolved tests?	☐Yes ☐No ☐N/A	12.
Sample labels match COC:	☐Yes ☐No ☐N/A	
Includes date/time/ID/analyses Matrix:		13.
All containers needing preservation have been checked.	☐Yes ☐No ☐N/A	
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes ☐No ☐N/A	14.
Exceptions: VOA, Coliform, O&G, WI-DRO (water)	☐Yes ☐No	Initial when completed / Lot # of added preservative
Trip Blank present:	☐Yes ☐No ☐N/A	
Pace Trip Blank lot # (if purchased): _____		15.
Headspace in VOA vials (>6mm):	☐Yes ☐No ☐N/A	16.
Project sampled in USDA Regulated Area:	☐Yes ☐No ☐N/A	17. List State:

Client Notification/ Resolution: Copy COC to Client? Y / (N) Field Data Required? Y / (N)

Person Contacted: Vance Silvers Date/Time: 3.31.15

Comments/ Resolution:
Date hans for sample collection soils ~~3/10~~ 3/10 thru 3/20
Waters 3/23

Project Manager Review: _____ Date: 3.31.15

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

Section A
Required Client Information:

Company:	Geotechnology
Address:	5055 Antioch Rd.
	Overland Park, KS 66214
Email To:	s_gallagher@geotechnology.com
Phone: (913) 438-1900	Fax:
Requested Due Date/TAT:	

Section B
Required Project Information:

Report To:	Sheryl Gallagher
Copy To:	
Purchase Order No.:	40814
Project Name:	Union Berkley Development
Project Number:	J024061.01

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	Sherri Rosenstangle
Pace Profile #:	192.7

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED Composite Start Date	COLLECTED Composite Start Time	COLLECTED Composite End/Grab Date	COLLECTED Composite End/Grab Time	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N): TCLP RCRA Metals	TCLP VOC's	TCLP SVOC's	FLASHPOINT	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	SOIL		C															x	x	x		N	24) WGFU 01
2	WATER		C															x	x	x	x		(22) AG2U 03
3	DECONTAMINATION WATER		C															x	x	x	x		(2) AG2U 05
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							

6019685

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
LAB WILL NEED TO COMPOSITE SAMPLES FOR ANALYSIS				[illegible]	5/26	1500	11.7	N	N	Y
							12.5	N	N	Y

SAMPLER NAME AND SIGNATURE	
PRINT Name of SAMPLER:	
SIGNATURE of SAMPLER:	DATE Signed (MM/DD/YY):

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-Feb-2007

OLD SOIL BORINGS

URS

GRAPHIC BORING LOG

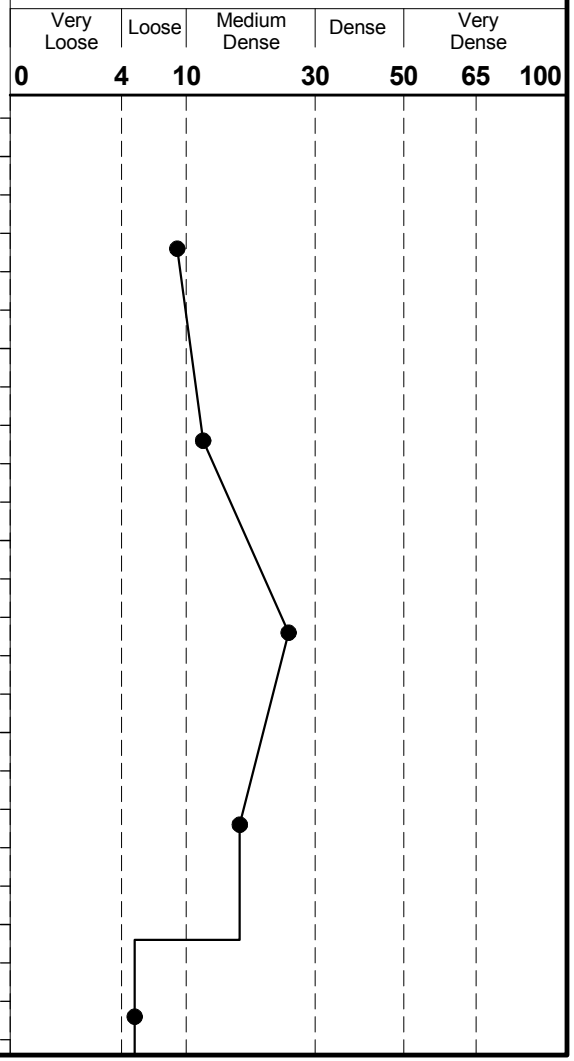
B- 3

PROJECT NAME:	Riverfront-Mass Grading-East and West	**PROJECT NO:**	16530076	**SHEET**	1 **OF** 2
PROJECT LOCATION:	Kansas City, Missouri	**SURFACE ELEVATION:**	31.6 ft.	**RIG:**	CME-75
LOGGED BY:	P.E.Cossins	**GROUNDWATER ENTRY:**		**ELEVATION DATUM:**	City Datum	**EAST:**	2768659 ft.
DRILLING CO:	B.Bolin	**DELAYED GROUNDWATER:**		**DATE:**	4/24/1996	**NORTH:**	1074318 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Poorly graded coarse GRAVEL (GP) (fill) With limestone cobbles (6"-8")		30
											3.0		
											Loose, dry to moist, poorly graded fine SAND (SP) (alluvium)		
5	SS				6 4 5	9					Becoming light brown		25
10	SS				7 6 6	12					Becoming medium dense, with traces of black precipitates @ 9.6' With a 1/2" coarse sand seam @ 10.3' Becoming very stiff, reddish brown, high plastic		20
15	SS				8 11 14	25					Becoming, moist, medium to fine grained, with traces of coarse sand Becoming dark reddish brown		15
20	SS				5 8 9	17					Becoming fine grained		10
											22.0 Loose, wet, light brown to gray, poorly graded Silty fine SAND (SM) (alluvium)		
											24.0		
25	SS				1 2	5							

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



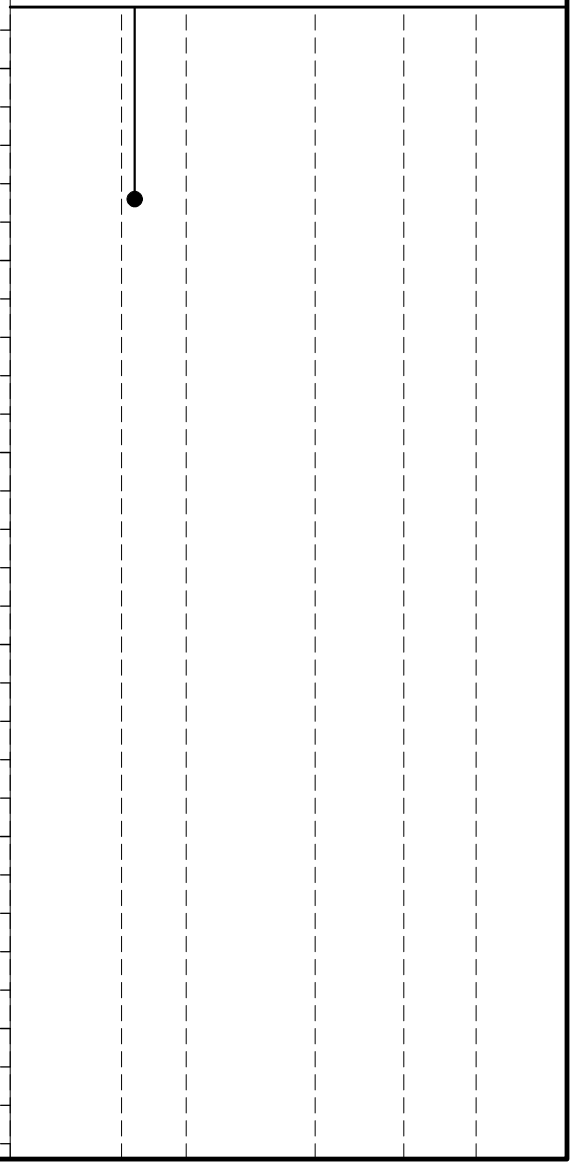
OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B- 3**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25	ST				3 P								5
30	C				P				0.2				0
	SS				3 2 3	5					31.2 Loose, wet, black to gray with white, poorly graded Silty medium SAND (SM)		
											BOTTOM OF BORING B- 3 AT 31.5 FEET		
35													-5
40													-10
45													-15
50													-20
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

Very Loose	Loose	Medium Dense	Dense	Very Dense
0	4	10	30	50 65 100



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

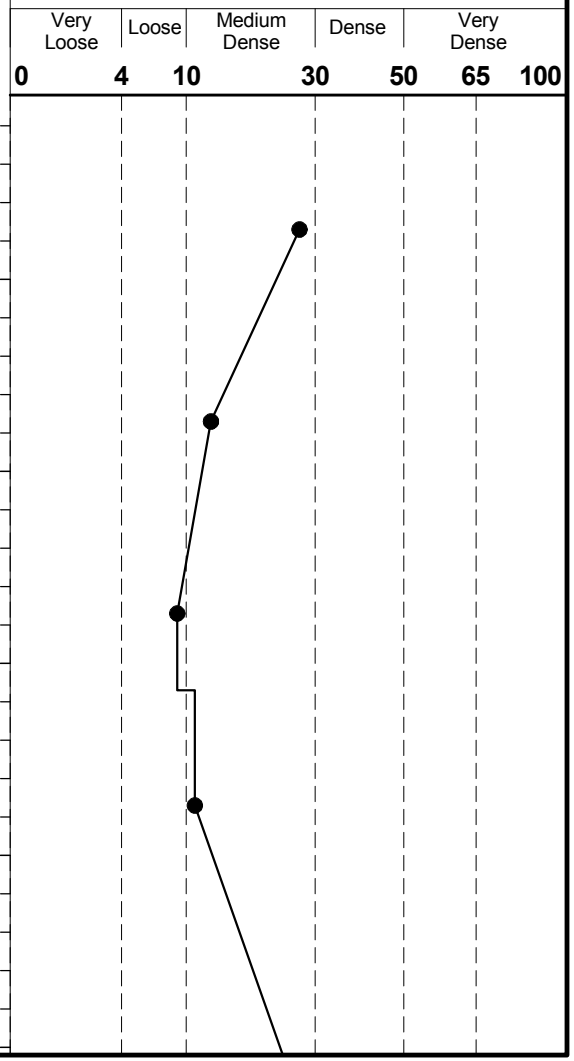
B- 4

PROJECT NAME:	Riverfront-Mass Grading-East and West	**PROJECT NO:**	16530076	**SHEET**	1 **OF** 2
PROJECT LOCATION:	Kansas City, Missouri	**SURFACE ELEVATION:**	29.8 ft.	**RIG:**	CME-75
LOGGED BY:	P.E.Cossins	**GROUNDWATER ENTRY:**		**ELEVATION DATUM:**	City Datum	**EAST:**	2768652 ft.
DRILLING CO:	B.Bolin	**DELAYED GROUNDWATER:**		**DATE:**	4/26/1996	**NORTH:**	1074012 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Poorly graded, coarse to fine GRAVEL (GP) with soft, moist, red, low plastic silty clay (fill)		
											With light brown to brown, coarse to fine sand; traces of red, silty clay (3.0)		
5	SS				8 12 15	27					Loose to medium dense, moist, light brown, poorly graded medium to fine SAND (SP) with traces of black precipitates (alluvium)		25
10	SS				3 6 7	13					Becoming loose, fine grained		20
15	SS				3 3 6	9					Becoming light brown to brown, with traces of black silt (15.5)		15
											Soft, moist, light brown with dark gray, low plastic Silty CLAY (CL) with some fine sand (alluvium) (18.5)		
20	SS				3 5 6	11					Medium dense, moist to wet, black to gray, poorly graded Silty fine SAND (SM) with an 8" seam of soft, low plastic, silty clay from 18.5'-19.2' (alluvium)		10
25	C				P								5

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

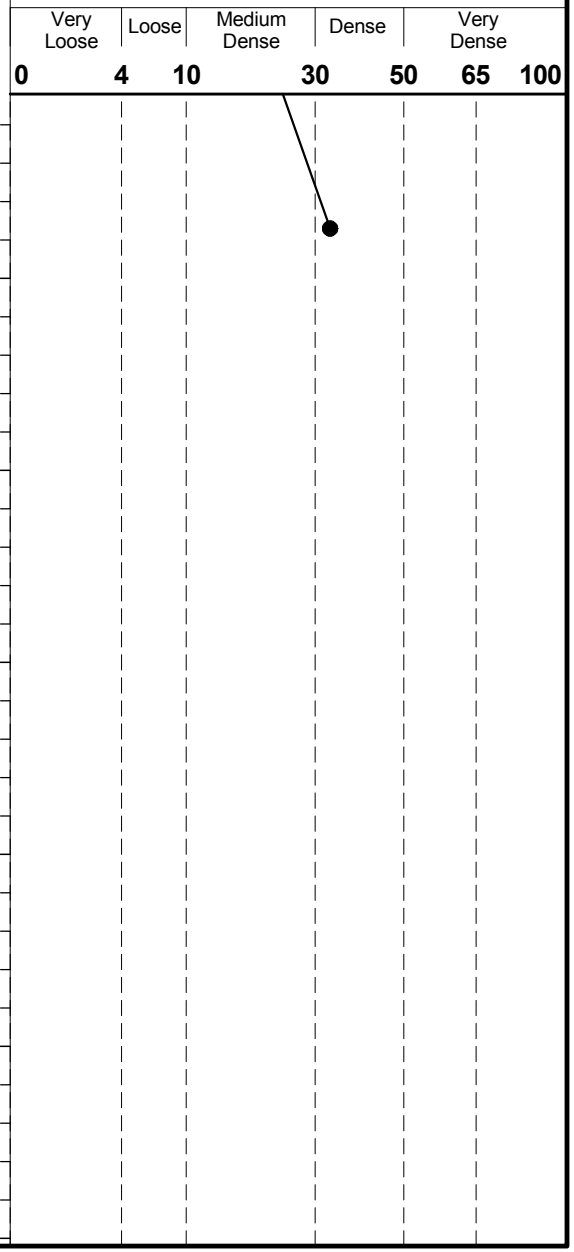


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B- 4**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25											Same: Loose, moist to wet, black to gray, poorly graded Silty fine SAND (SM) Medium dense, moist to wet, black to gray, poorly graded Silty fine SAND (SM) with an 8" seam of soft, low plastic, silty clay from 18.5'-19.2' (alluvium)(Continued)		
	SS				13 16 17	33							0
30											**BOTTOM OF BORING B- 4 AT 30.0 FEET**		
35													-5
40													-10
45													-15
50													-20
55													-25

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

B- 5

PROJECT NAME:	Riverfront-Mass Grading-East and West	**PROJECT NO:**	16530076	**SHEET**	1 **OF** 1
PROJECT LOCATION:	Kansas City, Missouri	**SURFACE ELEVATION:**	47.6 ft.	**RIG:**	CME-75
LOGGED BY:	P.E.Cossins	**GROUNDWATER ENTRY:**		**ELEVATION DATUM:**	City Datum	**EAST:**	2768357 ft.
DRILLING CO:	B.Bolin	**DELAYED GROUNDWATER:**		**DATE:**	4/25/1996	**NORTH:**	1074290 ft.

DEPTH (feet)	SAMPLE DATA: DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0	C				P						1.0 Stiff, moist, light brown to reddish brown with some gray, low plastic Silty CLAY (CL) with organics (roots and grass), traces of coarse sand to fine gravel (fill)		45
											Concrete with some brick (fill)		
5													40
10													35
15											With a possible seam or void		30
											19.0		
20	SS										Loose, moist, light brown, poorly graded fine SAND (SP) (alluvium)		
											BOTTOM OF BORING B- 5 AT 20.5 FEET		25
25													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

Very Loose	Loose	Medium Dense	Dense	Very Dense
0 – 4	4 – 10	10 – 30	30 – 50	50 – 65 – 100

OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

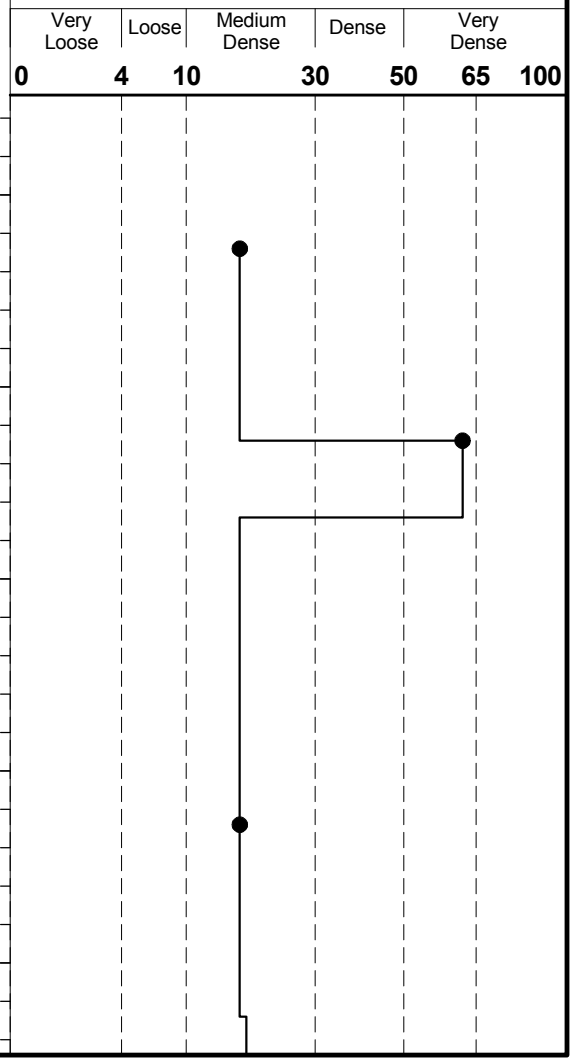
B- 7

PROJECT NAME:	Riverfront-Mass Grading-East and West	**PROJECT NO:**	16530076	**SHEET**	1 **OF** 2
PROJECT LOCATION:	Kansas City, Missouri	**SURFACE ELEVATION:**	42.6 ft.	**RIG:**	CME-75
LOGGED BY:	P.E.Cossins	**GROUNDWATER ENTRY:**		**ELEVATION DATUM:**	City Datum	**EAST:**	2767627 ft.
DRILLING CO:	B.Bolin	**DELAYED GROUNDWATER:**		**DATE:**	5/2/1996	**NORTH:**	1073880 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Vegetation-covered light brown to red, low plastic, Silty, Sandy CLAY (CL) with pieces of asphalt from 1"-1' on the surface and in the soil (1.5)		
	C				P				0.2				40
											Loose, moist, light brown, poorly graded medium to fine SAND (SP) with soft, moist, dark brownish gray, low plastic silty clay with organics (fill)		
5	SS				3 6 11	17					Becoming loose to medium dense, fine grained. with traces of coarse sand to fine gravel		
											With 1.5" seam of brown to dark brownish gray, silty clay @ 5.3' (9.0)		35
10	SS				17 16 50	66					Medium dense to very dense, moist, medium to fine SAND (highly weathered concrete) with fine gravel (fill) (11.0)		
											Soft, moist, olive gray, low plastic Sandy CLAY (CL) with medium to fine sand (fill) (14.0)		30
15	C				P				0.8		Soft, moist, dark greenish gray, low plastic Silty CLAY (CL) with fine sand, black precipitates, and limestone aggregate @ 15' (fill) (19.0)		25
20	SS				8 12 5	17					Loose, moist, light greenish gray, poorly graded medium to fine SAND (SP) with black to greenish gray, low plastic silty clay with iron staining and black precipitates up to 1" (24.0)		20
25	C				P				0.3				

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B- 7**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25											Soft, moist, dark greenish gray, low plastic Silty CLAY (CL) with black precipitates, brick fragments, medium to fine sand, with iron staining(Continued)		15
											29.0		
30	SS				3 6 12	18					Loose to medium dense, black with reddish to light brown, poorly graded coarse to fine Silty SAND (SM) with an oily sheen (upper 7" of sample light olive green to light blue, silty, sandy clay), with		10
											BOTTOM OF BORING B- 7 AT 30.5 FEET		
35													5
40													0
45													-5
50													-10
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

Very Loose	Loose	Medium Dense	Dense	Very Dense
0 – 4	4 – 10	10 – 30	30 – 50	50 – 65 – 100

OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

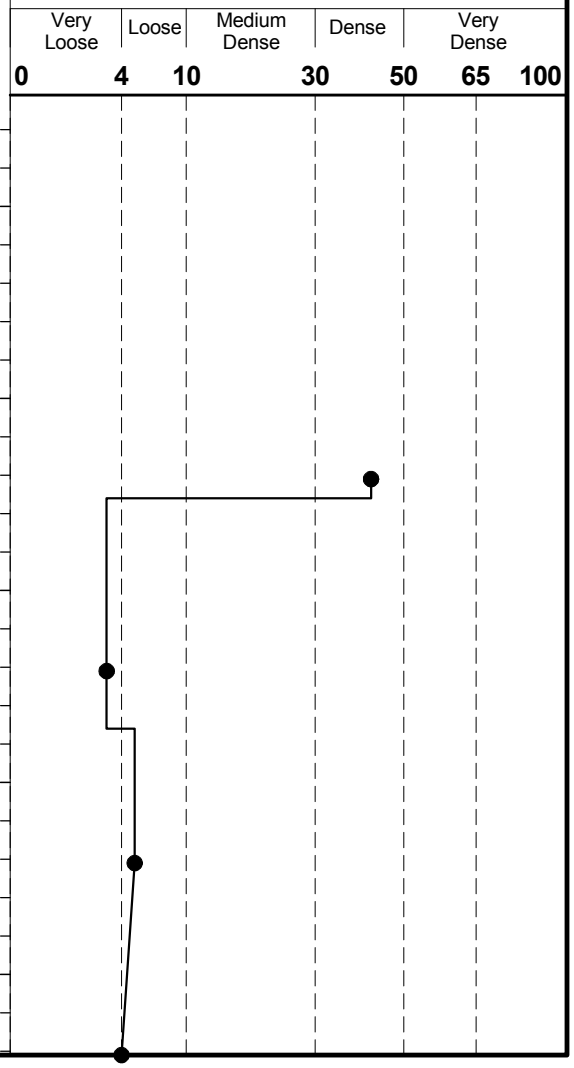
B- 8

PROJECT NAME:	Riverfront-Mass Grading-East and West	**PROJECT NO:**	16530076	**SHEET**	1 **OF** 2
PROJECT LOCATION:	Kansas City, Missouri	**SURFACE ELEVATION:**	42.9 ft.	**RIG:**	CME-75
LOGGED BY:	P.E.Cossins	**GROUNDWATER ENTRY:**		**ELEVATION DATUM:**	City Datum	**EAST:**	2767635 ft.
DRILLING CO:	B.Bolin	**DELAYED GROUNDWATER:**		**DATE:**	5/15/1996	**NORTH:**	1073676 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Concrete spoils with coarse to fine gravel to ~ 5'		
											Possible clay/dust seam @ 3' to 3.3'		40
5	SS										With medium to fine sand		
											With layers of concrete fill, coarse to fine gravel, medium to fine sand		35
											With moist, light brownish gray, medium to fine sand		
10	SS				35 21 21	42					10.5 Becoming light green, with medium to fine sand and clay-like concrete fill		
											Soft, moist, dark brownish gray, low plastic Silty CLAY (CL) with medium to fine sand, black precipitates, with a 1/2" light brown, medium to fine sand seam; strong petroleum odor @ 10.5' (fill)		30
15	SS				2 1 2	3					15.0 Loose, olive green, moist, medium to fine poorly graded SAND (SP) (fill)		
											16.5 Soft, moist, black to olive gray, low plastic Silty CLAY (CL) with black precipitates, oily product and medium to fine sand; with a strong petroleum odor (fill)		25
20	SS				2 2 3	5					Becoming soft, dark greenish gray, with coarse to fine sand, fine gravel, pieces of brick (?), slight petroleum odor		20
25													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

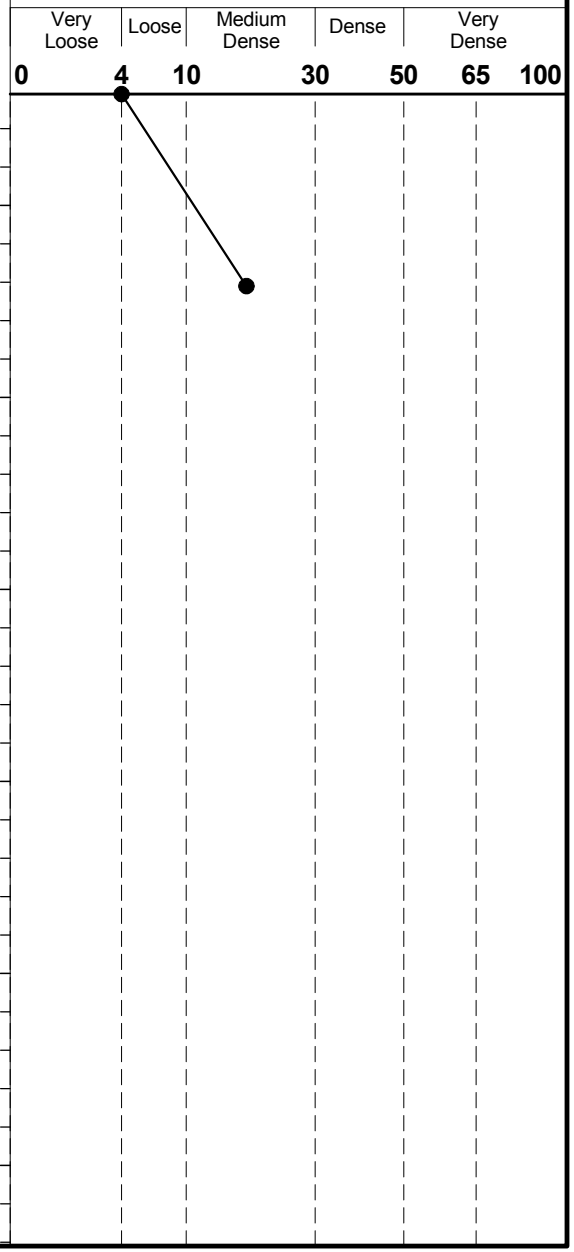


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B- 8**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25	SS				2 1 3	4					Same: Soft, moist, dark brownish gray to dark greenish gray, low plastic Silty CLAY (CL), with coarse to fine sand, fine gravel, pieces of brick, strong petroleum odor (fill)		
											Soft, moist, black to olive gray, low plastic Silty CLAY (CL) with black precipitates, oily product and medium to fine sand; with a strong petroleum odor (fill)(Continued)		15
30	SS				3 6 12	18					With dark greenish gray, medium to fine silty sand		
											Becoming stiff, light brown, silty, sandy, with pieces of brick up to .5"		10
											Becoming orange to olive green, altered silty clay		
											Becoming dark greenish gray to olive green to black with dark green alterations; strong odor		
35											**BOTTOM OF BORING B- 8 AT 31.5 FEET**		5
40													0
45													-5
50													-10
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

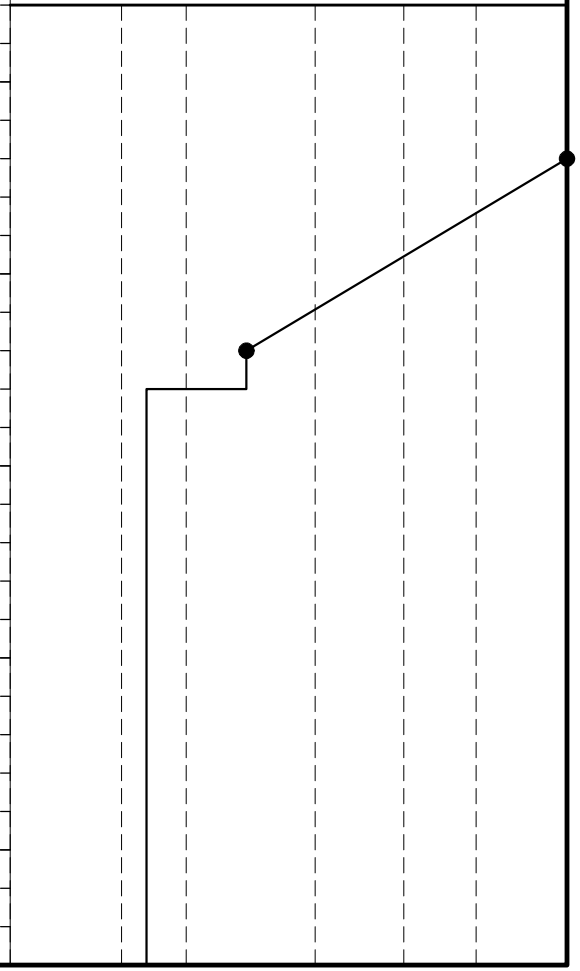
B-103

PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 2
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	42.0 ft.	RIG:	CME-75
LOGGED BY:	G. Papinako	GROUNDWATER ENTRY:	13.0 ft.	ELEVATION DATUM:	City Datum	EAST:	2767624 ft.
DRILLING CO:	Woodward-Clyde	DELAYED GROUNDWATER:		DATE:	3/30/1999	NORTH:	1073792 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Miscellaneous construction rubble - concrete, bricks, asphalt, isolation fabric (includig some possible asbestos fragments), with small quantity of sandy CLAY in the interstices (FILL)		40
5	SPT			50	100						With fragments of coal		35
10	SPT			11 7 11	18						10.0 Firm, moist, dark olive gray, sandy, low plastic CLAY with large pieces of rotten wood, brick and charcoal fragments		30
15	C			P							15.0 Dense, moist, dark gray, fine, poory graded, Clayey SAND (SC) (FILL) With wood and slag fragments		25
20	C			P							20.0 With several layers (2.5 inch thick) of black cinders Firm, moist, light olive and dark gray (intermixed) sandy, low plastic CLAY (CL) (FILL) With fragments of brick and broken glass		20
25	C			P					1.0		25.0		

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

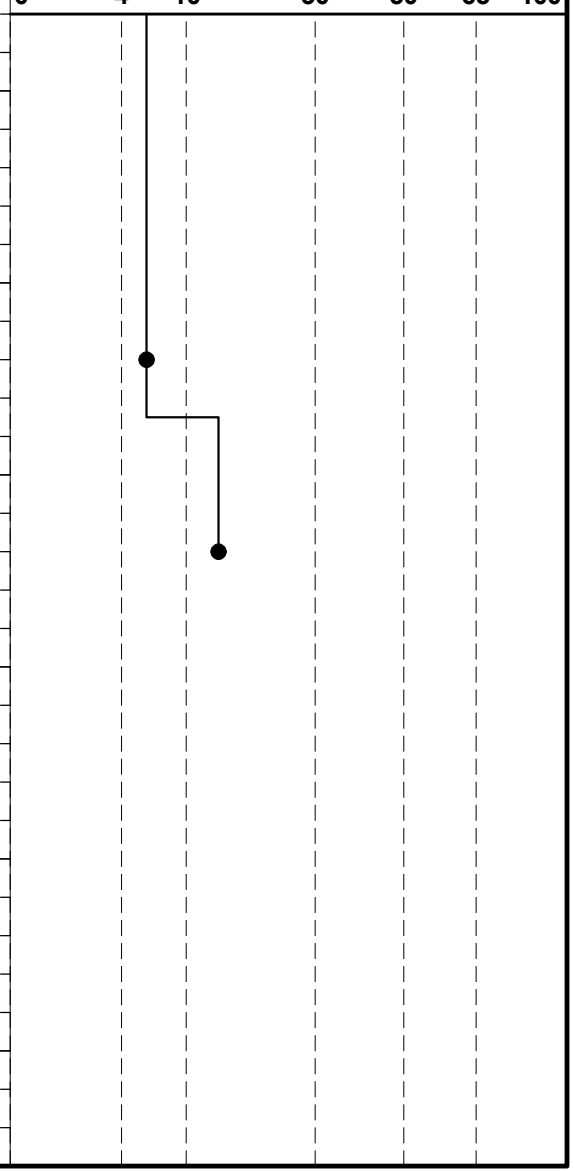


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B-103**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25											Dense, saturated, light olive gray to light gray, slightly plastic SILT (ML) (Alluvium)		15
											With little very fine and fine sand		
30	C				P								
											Quantity of sand increasing		10
											32.0 Loose, saturated, light to medium gray fine, poorly graded SAND (SP) (Alluvium)		
35	SPT			6 4 2		6					Becoming black (some petroleum staining) with strong odor (possibly diesel fuel)		
											35.5 Soft, saturated, dark olive gray to black, low plastic CLAY (CL) (Alluvium)		5
											37.0 Medium dense, saturated, dark gray to medium gray, very fine and fine, poorly graded Silty SAND (SM) (Alluvium)		
40	SPT			4 6 8		14							0
											BOTTOM OF BORING B-103 AT 43.0 FEET		
45													-5
50													-10
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

B-104

PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 3
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	45.0 ft.	RIG:	CME-75
LOGGED BY:	G. Papinako	GROUNDWATER ENTRY:	34.0 ft.	ELEVATION DATUM:	City Datum	EAST:	2768143 ft.
DRILLING CO:	Woodward-Clyde	DELAYED GROUNDWATER:		DATE:	3/25/1999	NORTH:	1074130 ft.

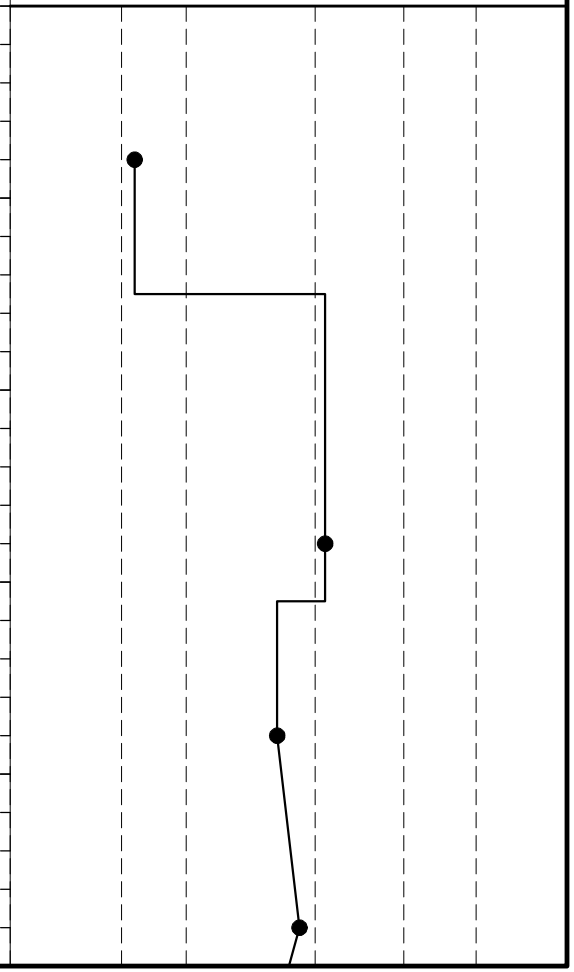
SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION
0											0.3 Topsoil (3 inches)
											Loose, moist, dark gray, fine, poorly graded SAND (SP) and soft, moist, medium brown low plastic CLAY (CL) (FILL)
											With coarse limestone gravel, brick and wood fragments
5	SPT	X			1 2 3	5					
											Becoming mostly soft, moist, fine, poorly graded Clayey SAND (SC) with little gravel and several asphalt fragments
											7.5 Very hard, dry to moist, light brown, low plastic CLAY (CL) with trace of fine sand (FILL)
10	C	X			P				9.0		
											13.5 Dense, moist, coarse, angular, clayey gravel (GC) (limestone fragments) with some low plastic clay (Possible Fill)
15	SPT	X			28 21 11	23					15.5 Dense, moist, light yellowish gray and light grayisih yellow, fine, poorly graded SAND (SP) (Alluvium)
20	SPT	X			17 11 12	23					With trace of fine gravel
25	SPT	X			10 12	27					

SYMBOL

ELEVATION (feet): 45, 40, 35, 30, 25, 20

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

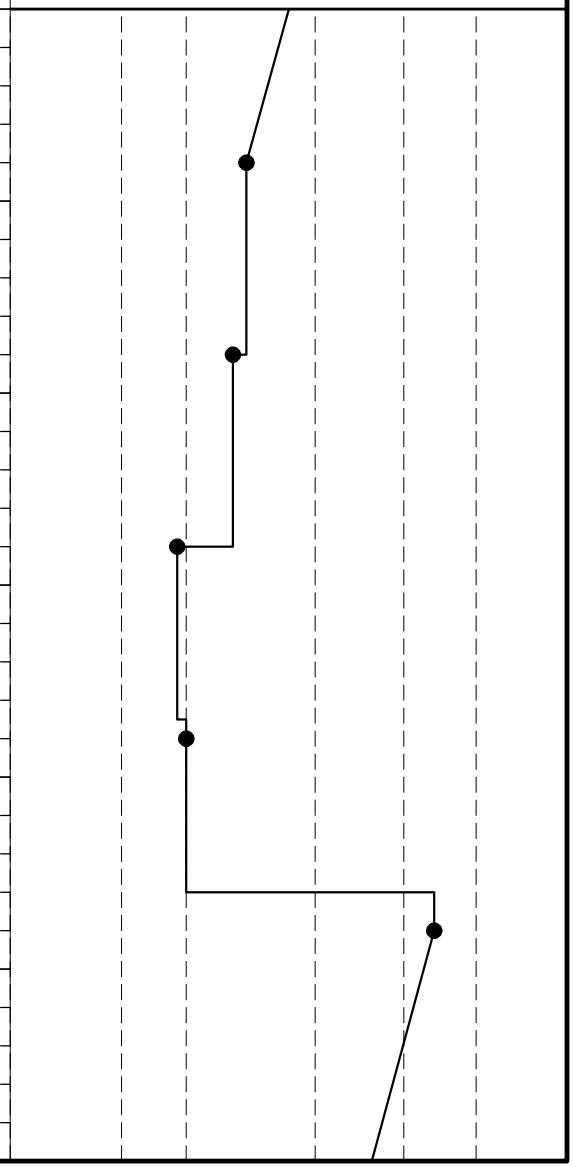


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 3 **B-104**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25					15						Dense, moist, light yellowish gray and light grayisih yellow, fine, poorly graded SAND (SP) (Alluvium)(Continued)		20
30	SPT				5 10 8	18					With seams and partings of medium sand With iron oxide bands (iron staining)		15
											34.0		
35	SPT				8 8 8	16					Medium dense, wet, miedium gray, fine, poorly graded, Silty SAND (SM) with some silt		10
											39.0		
40	SPT				1 4 5	9					Loose, saturated, medium olive gray, Sandy SILT (ML) (Alluvium) With some fine sand		5
											43.5		
45	SPT				3 4 6	10					Firm, moist, dark gray and medium brownish gray, silty, low plastic CLAY (CL) (Alluvium) Becoming soft, wet With little fine sand		0
											48.0		
50	SPT				15 24 34	58					Dense, wet, light gray and medium gray, fine, poorly graded SAND (SP) (Alluvium)		-5
55													-10

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

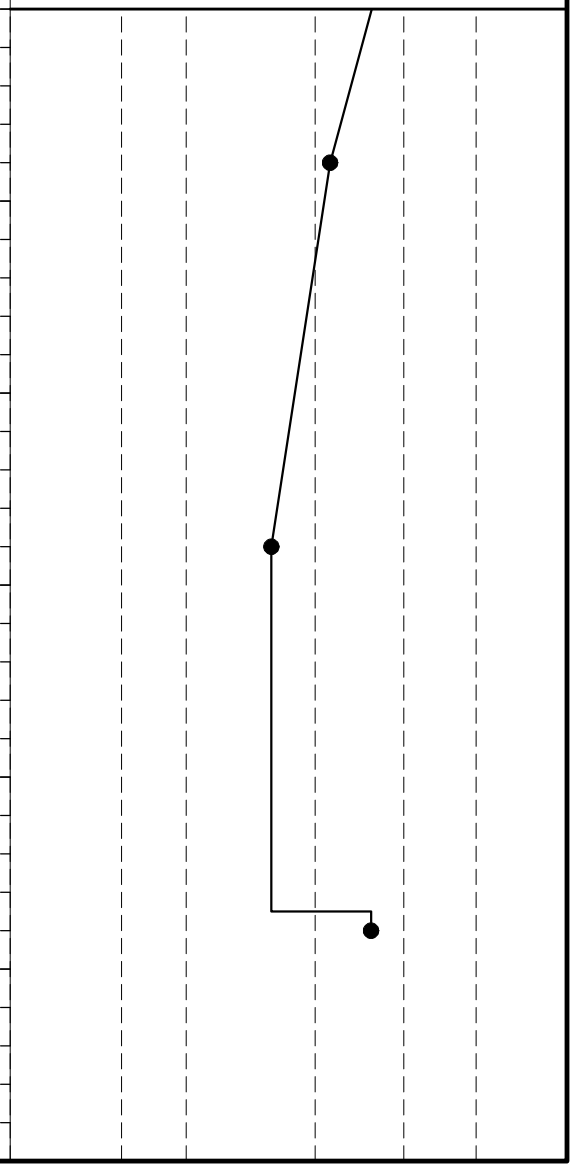


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 3 OF 3 **B-104**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
55											Dense, wet, light gray and medium gray, fine, poorly graded SAND (SP) (Alluvium)(Continued) Becoming light gray and multi-colored, fine and medium sand		-10
60	SPT	X			13 18 15	33					With trace coarse sand With trace fine, subrounded gravel		-15
65													-20
70	SPT	X			10 12 10	22							-25
75													-30
											78.5 With trace coarse sand		
80	SPT	X			18 22 20	42					Very dense, saturated, medium gray, very fine and fine, Silty SAND (SM) with some silt (Alluvium)		-35
											BOTTOM OF BORING B-104 AT 80.5 FEET		
85													-40

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

B-105

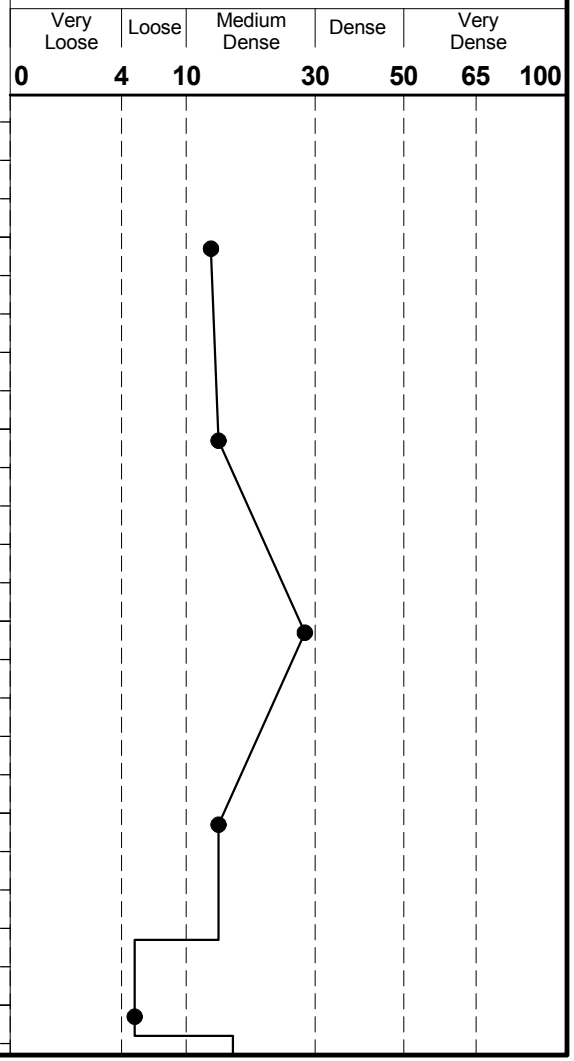
PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 3
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	38.7 ft.	RIG:	CME-75
LOGGED BY:	G. Papinako	GROUNDWATER ENTRY:	19.0 ft.	ELEVATION DATUM:	City Datum	EAST:	2768564 ft.
DRILLING CO:	Woodward-Clyde	DELAYED GROUNDWATER:		DATE:	3/19/1999	NORTH:	1074178 ft.

Observations: Delayed groundwater levels obscured by drilling fluids

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Medium dense, moist, light yellowish gray to light grayish yellow, fine, well sorted, Poorly Graded SAND (SP) (Alluvium)		
5	SPT				5 6 7	13							35
10	SPT				8 6 8	14							30
15	SPT				8 14 14	28					Becoming fine and medium sand, thinly layered		25
											Becoming light grayish brown, very fine and fine sand, with zones of iron oxide staining		20
20	SPT				4 6 8	14					Becoming wet		
											22.0 Loose, saturated, light grayish olive, slightly plastic SILT (ML) with little fine sand (Alluvium)		15
25	SPT				1 2	5					24.5		

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



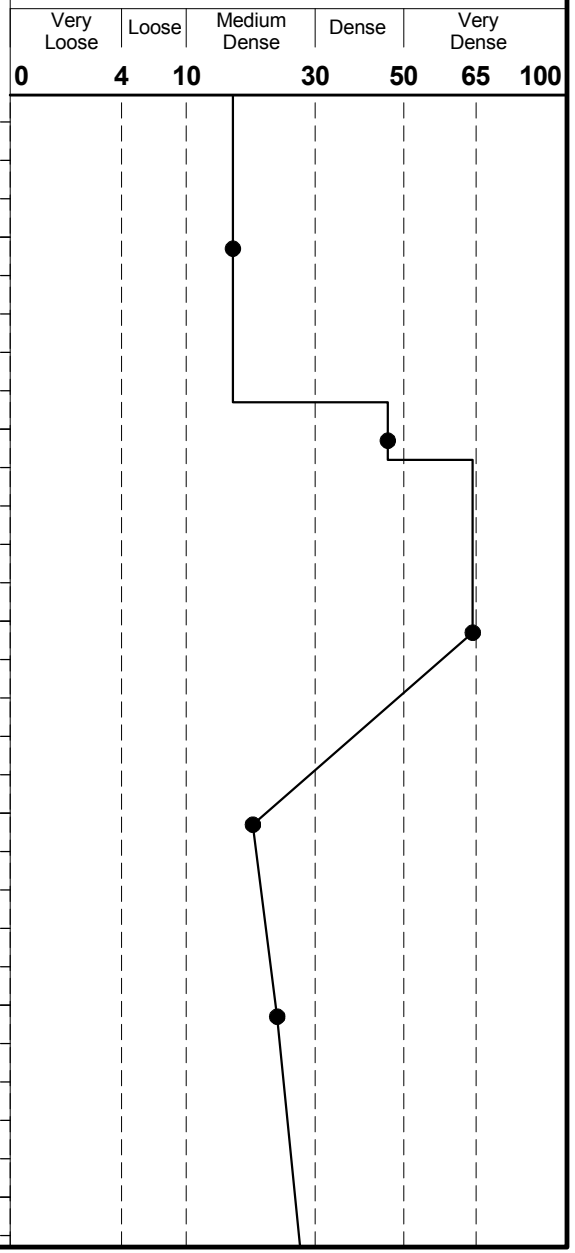
OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 3 **B-105**

Observations: Delayed groundwater levels obscured by drilling fluids

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25					3						Loose, saturated, light brown, Poorly Graded SAND (SP) with little silt (Alluvium)(Continued)		
											With abundant disseminated particles of carbonaceous matter		
											28.5		10
30	SPT				6 8 8	16					Medium dense, saturated, medium olive gray , very fine and fine, poorly graded Silty SAND (SM) with silt (Alluvium)		
											33.0		5
											Soft, wet, medium olive gray, silty, low plastic Silty CLAY (CL) (Alluvium)		
											34.5		
35	SPT				2 22 24	46					Dense, saturated, medium gray, fine to medium, Poorly Graded SAND (SP) (Alluvium)		
											Becoming medium gray and multi-colored, fine, medium and coarse (nearly SW)		0
40	SPT				12 26 43	69					With trace coarse subrounded gravel		
											Becoming medium dense, medium gray, fine		-5
45	SPT				9 10 9	19					With trace coarse sand With trace fine gravel		
													-10
50	SPT				11 12 11	23							
													-15
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



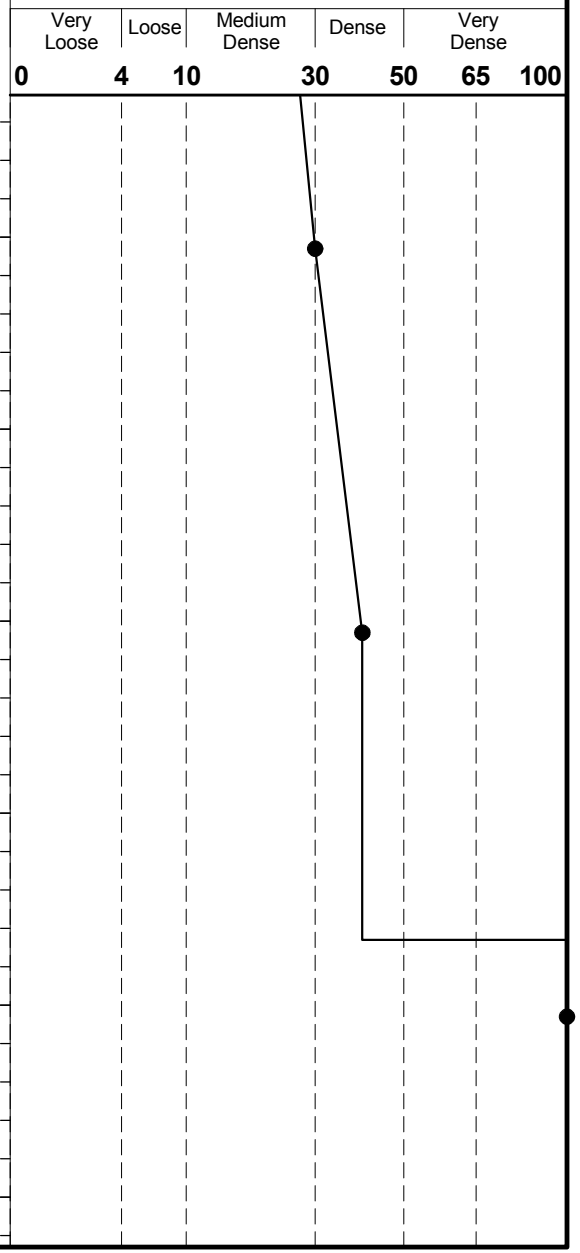
OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 3 OF 3 **B-105**

Observations: Delayed groundwater levels obscured by drilling fluids

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
55											Dense, saturated, medium gray, fine to medium, Poorly Graded SAND (SP) (Alluvium)(Continued)		
											Becoming medium olive gray, very fine and fine		-20
60	SPT			19 12 18	30								
											Becoming dense		-25
65													
													-30
70	SPT			12 17 23	40								
													-35
75													
											77.0 Dense, saturated, multi-colored, fine to coarse, Poorly Graded SAND with Clay and Gravel (SP-SC) With seams and partings of low plastic clay With little coarse gravel		-40
80	SPT			23 26 50/4"	100								
											BOTTOM OF BORING B-105 AT 80.3 FEET		-45
85													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

B-106

PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 3
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	29.7 ft.	RIG:	CME-75
LOGGED BY:	G. Papinako	GROUNDWATER ENTRY:	15.0 ft.	ELEVATION DATUM:	City Datum	EAST:	2768741 ft.
DRILLING CO:	Woodward-Clyde	DELAYED GROUNDWATER:		DATE:	3/28/1999	NORTH:	1073862 ft.

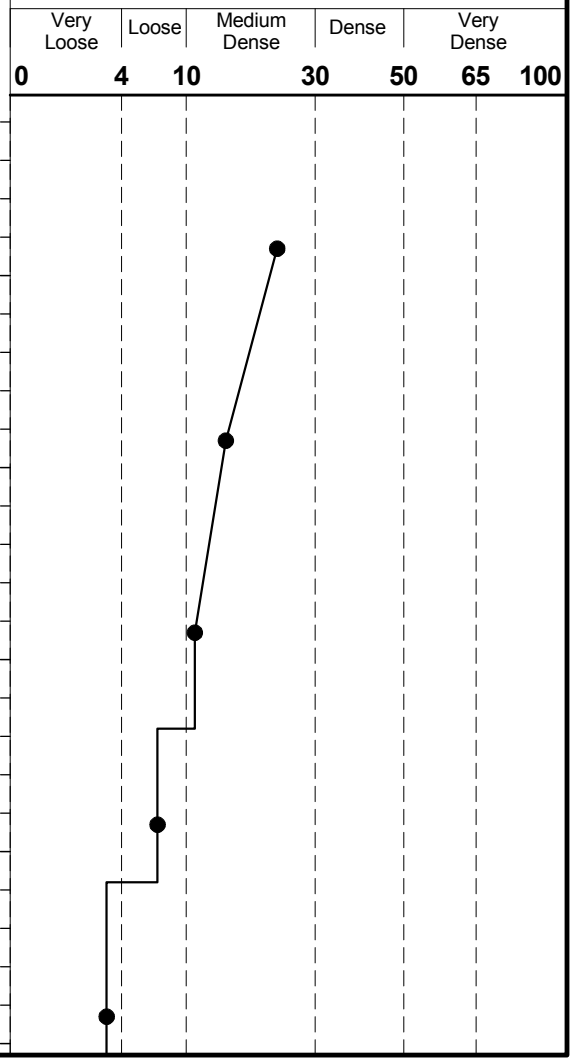
SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION
0											0.5 Loose, dry, light gray, fine limestone gravel (Fill)
											Medium loose, dry to moist, light brownish yellow, fine grained, poorly graded SAND (SP)
5	SPT			11 12 11		23					Becoming medium dense, light yellowish gray
10	SPT			5 6 9		15					With seams and partings of carbonaceous matter
15	SPT			3 5 6		11					Becoming wet, light brownish gray, with seams of coarse sand
											16.5 Medium loose, saturated, dark bluish gray, fine grained, poorly graded Clayey SAND (SC)
											18.5 Medium stiff, moist, medium bluish gray, low plastic Silty CLAY (CL) with disseminated wood fibers
20	SPT			2 3 4		7					20.5 Loose, saturated, dark olive gray, fine grained, poorly graded Silty SAND (SM)
											23.0 Loose, saturated, dark olive gray, slightly plastic SILT (ML)
25	SPT			1 1		3					25.0

SYMBOL

ELEVATION (feet): 25, 20, 15, 10, 5

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

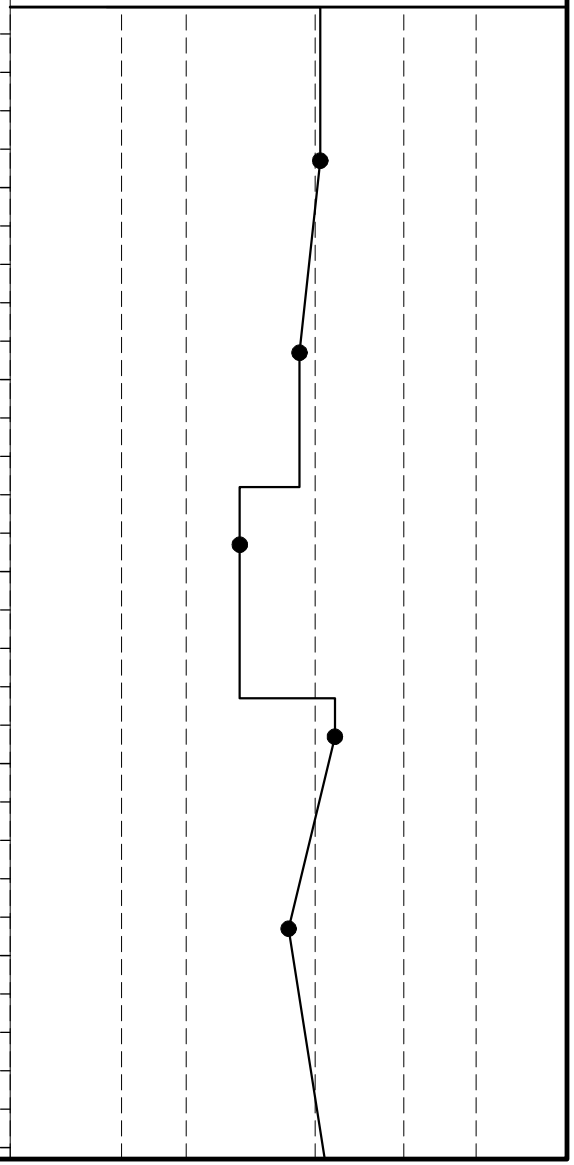


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 3 **B-106**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25					2						Soft, wet, dark olive gray, low plastic Silty CLAY (CL)		
											26.0 Dense, wet, light brown, very fine to fine grained, poorly graded SAND (SP) with trace silt		
30	SPT				13 17 14	31							0
											Becoming light brown and multicolored, fine, medium and coarse grained, with fine sand prevailing		
35	SPT				10 16 11	27							-5
											37.5 Medium dense, saturated, dark olive gray, very fine and fine grained, poorly graded Silty SAND (SM)		
40	SPT				6 8 9	17							-10
											43.0 Dense, saturated, light gray and multicolored, fine and medium grained, poorly graded SAND (SP)		
45	SPT				11 15 19	34							-15
											Becoming mostly fine sand		
50	SPT				14 14 11	25							-20
55													-25

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



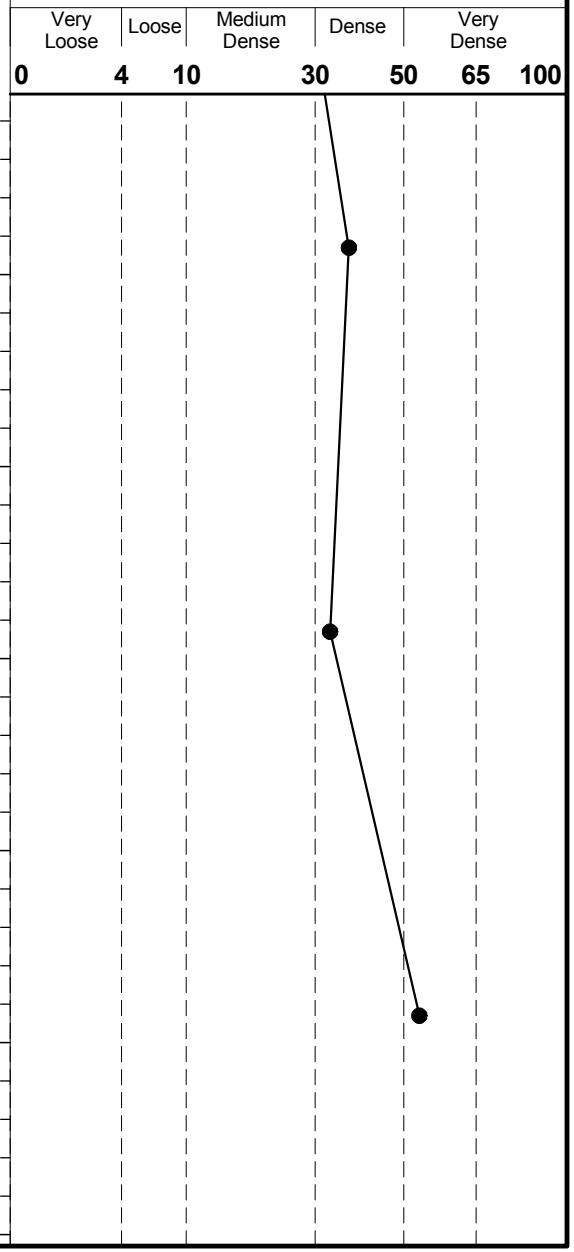
OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 3 OF 3 **B-106**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
55											Dense, saturated, light gray and multicolored, fine and medium grained, poorly graded SAND (SP)(Continued)		
											With trace to little fine, subrounded gravel		
60	SPT	X			12 17 20	37							-30
65											Becoming medium olive gray, very fine to fine grained		-35
70	SPT	X			12 18 15	33							-40
75													-45
80	SPT	X			15 30 24	54					Becoming medium gray, fine grained, with trace coarse, angular limestone gravel		-50
											BOTTOM OF BORING B-106 AT 80.5 FEET		
85													-55

SAMPLE DATA

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

B-25/E28

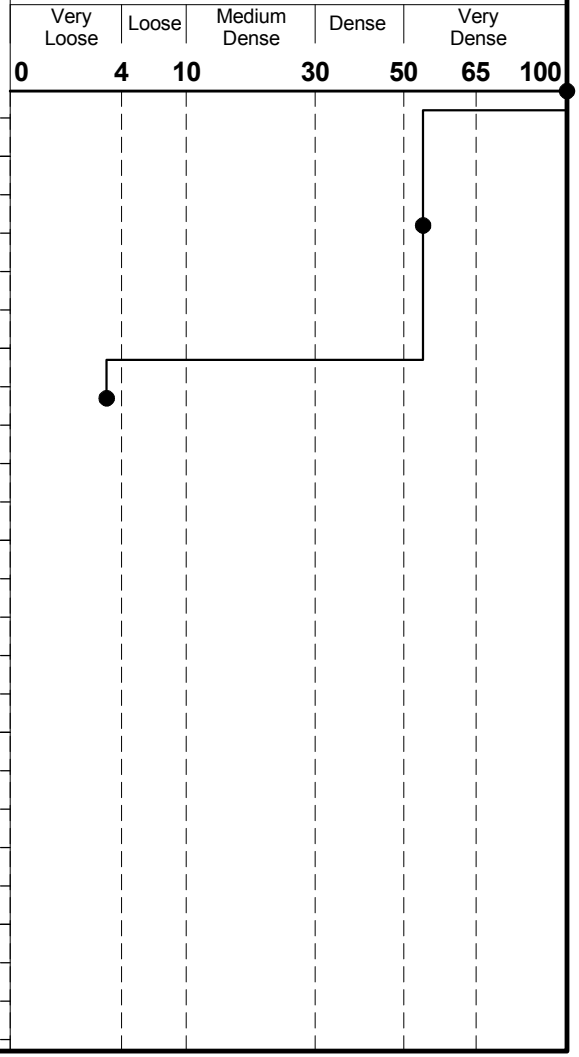
PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 1
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	36.7 ft.	RIG:	CME-75
LOGGED BY:	P.E.Cossins	GROUNDWATER ENTRY:		ELEVATION DATUM:	City Datum	EAST:	2767726 ft.
DRILLING CO:	B.Bolin	DELAYED GROUNDWATER:		DATE:	5/16/1996	NORTH:	1074318 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL
0	SS					100					0.5 Soft, moist, dark brownish gray, low plastic Silty CLAY (CL) with coarse to fine gravel, some organics (fill)	
											Concrete fill	
											3.0 Soft, moist, reddish brown to brown, low plastic Silty CLAY (CL) With coarse to fine sand, fine gravel, brick fragments, fragments of powdery concrete	
5	SS				3 5 50	55						
											7.0 Loose, moist, poorly graded medium SAND (SP) Becoming light brown to red, with coarse gravel	
10	SS				3 2 1	3						
											BOTTOM OF BORING B-25/E28 AT 10.0 FEET	
15												
20												
25												

ELEVATION (feet)

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

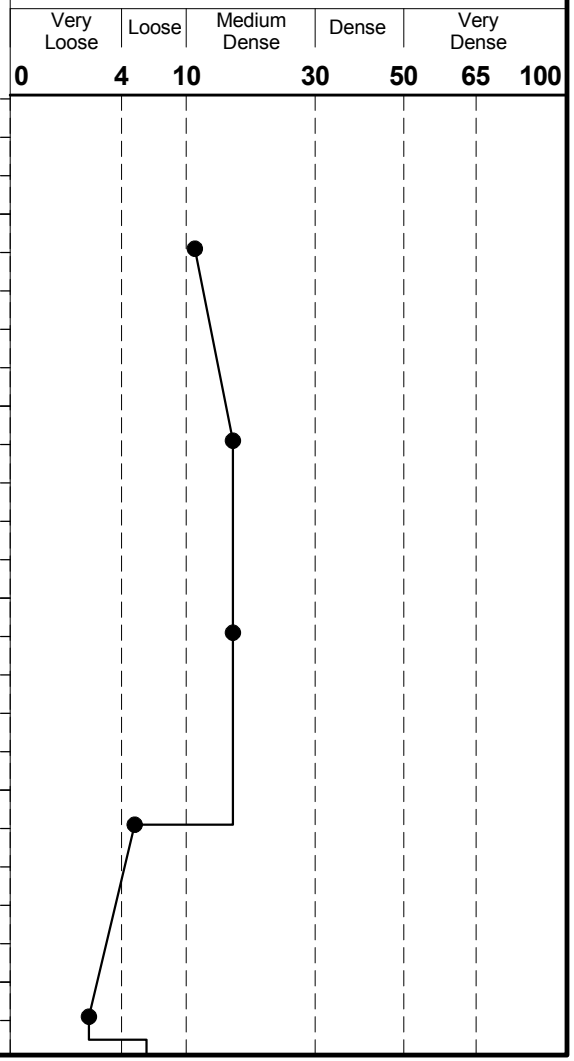
B-30

PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 2
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	28.1 ft.	RIG:	CME-75
LOGGED BY:	P.E.Cossins	GROUNDWATER ENTRY:		ELEVATION DATUM:	City Datum	EAST:	2768191 ft.
DRILLING CO:	B.Bolin	DELAYED GROUNDWATER:		DATE:	5/16/1996	NORTH:	1073490 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Soft, moist, dark brownish gray, low plastic Silty CLAY (CL) with organics, fine sand (fill)		
											Becoming dark brownish gray to brown, with fine to coarse gravel		25
5	SS				3 3 8	11					Becoming brown to reddish brown, with medium to fine sand, cement and limestone fragments, black precipitates, fine gravel		20
10	SS				6 7 9	16					Becoming dark greenish gray, with fine sand, brick fragments, petroleum and creosote odors,		15
											Becoming gray to black, sandy, with a strong odor (14.0)		
15	SS				7 8 8	16					Loose, moist, light brown to reddish brown, poorly graded fine SAND (SP) with trace of medium to coarse sand (alluvium?)		10
											Becoming black (19.0)		
20	SS				2 2 3	5					Soft, moist, gray to dark greenish gray, low plastic Silty CLAY (CL) with fine sand @ 20.3'-20.5'; slight sewage odor (alluvium?)		5
											Becoming black, with fine sand, creosote odor		
25	SS				1 1 1	2					(24.6)		

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B-30**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25					1						25.5 Same: Loose, moist, dark greenish gray to gray, poorly graded, fine Silty SAND (SM) Loose, moist, dark greenish gray to gray, poorly graded, fine Silty SAND (SM)(Continued)		0
											29.0 Soft, moist to wet, grayish black, low plastic Silty CLAY (CL) with creosote odor		
30	SS				2 3 3	6					29.8 Loose, moist, dark greenish gray to gray, poorly graded fine SAND (SP) with oily product on outside of sample		
											Soft, moist, dark greenish gray to gray, low plastic Silty CLAY (CL) with trace medium to fine sand, creosote odor		-5
											BOTTOM OF BORING B-30 AT 30.5 FEET		
35													-10
40													-15
45													-20
50													-25
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

Very Loose	Loose	Medium Dense	Dense	Very Dense
0 – 4	4 – 10	10 – 30	30 – 50	50 – 65 – 100

OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS

GRAPHIC BORING LOG

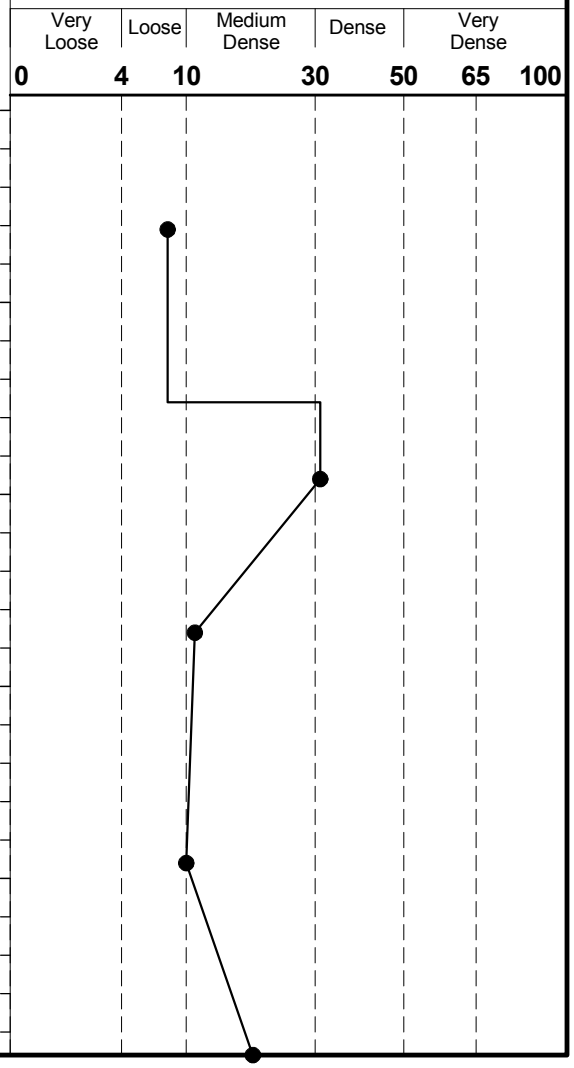
B-31

PROJECT NAME:	Riverfront-Mass Grading-East and West	PROJECT NO:	16530076	SHEET	1 OF 2
PROJECT LOCATION:	Kansas City, Missouri	SURFACE ELEVATION:	30.4 ft.	RIG:	CME-75
LOGGED BY:	P.E.Cossins	GROUNDWATER ENTRY:		ELEVATION DATUM:	City Datum	EAST:	2768011 ft.
DRILLING CO:	B.Bolin	DELAYED GROUNDWATER:		DATE:	5/15/1996	NORTH:	1074310 ft.

SAMPLE DATA

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
0											Soft, moist, dark brownish gray, low plastic Silty CLAY (CL) with thin layer of vegetation on surface (fill)		30
											2.0 Limestone aggregate		
											3.0 Soft, moist, reddish brown, low plastic Silty CLAY (CL) (fill)		
5	SS				2 3 5	8					Becoming red, low to medium plastic, with traces of sand		25
											8.0 Concrete fill		
10	SS				8 16 15	31					10.0 Loose to medium dense, moist, light brown, poorly graded, fine Silty SAND (SM) (alluvium)		20
15	SS				4 6 5	11					Becoming loose, moist, light brown, medium to fine sand		15
20	SS				3 5 5	10					Becoming wet, dark gray with organics		10
25													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH

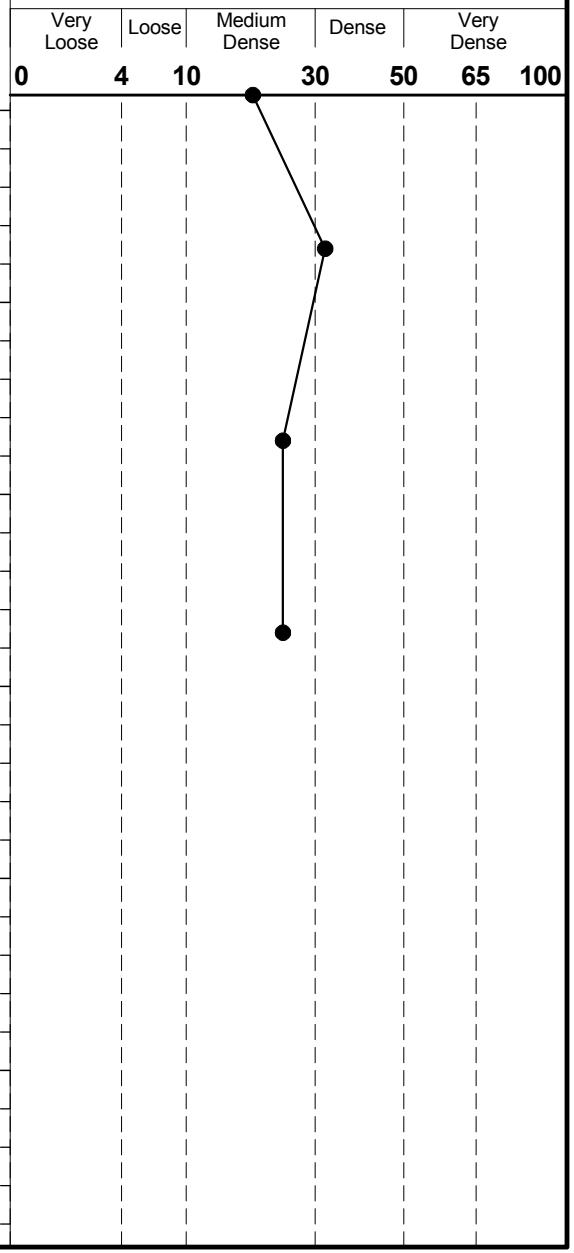


OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

URS PROJECT NAME: Riverfront-Mass Grading-East and West SHEET 2 OF 2 **B-31**

DEPTH (feet)	DRILLING AND SAMPLING	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	BLOW COUNT	WATER (%)	γ_d (pcf)	PP (ksf)	q_u (ksf)	MATERIAL DESCRIPTION	SYMBOL	ELEVATION (feet)
25	SS				5 8 11	19					Same: Loose, moist, dark gray, poorly graded, fine Silty SAND (SM)		5
											Loose to medium dense, moist, light brown, poorly graded, fine Silty SAND (SM) (alluvium)(Continued)		
											Becoming light brown		
30	SS				11 13 19	32					Becoming medium dense		0
35	SS				6 11 13	24					Becoming loose to medium dense, gray		-5
40	SS				7 12 12	24							-10
											BOTTOM OF BORING B-31 AT 40.5 FEET		
45													-15
50													-20
55													

BLOW COUNT (N-VALUE) AND RELATIVE DENSITY VERSUS DEPTH



OVP 4 LETTER LANDSCAPE W/SPT E RIVERFRONT2014TRIM.GPJ OVP1.GDT 10/21/14

RECOMMENDED EARTHWORK SPECIFICATIONS

FOR MASS GRADING OPERATIONS AT

UNION BERKLEY PARK

RECOMMENDED EARTHWORK SPECIFICATIONS FOR MASS GRADING OPERATIONS AT UNION BERKLEY PARK

1.1 FIELD QUALITY CONTROL

A. The contractor shall proof roll all fill areas using equipment such as a soil compactor having a minimum weight of 10,000 lbs. or a loaded dump truck having supporting a maximum axle load of 18,000 lbs.

B. The Geotechnical Engineer or his representative shall observe proof rolling operations, evaluate the stability of the subgrade, and provide recommendations for remedial earthwork if necessary.

C. The contractor shall compact fill surface areas within apartment building footprint areas using utility trench compactor such as those provided by Arrow-Master Incorporated (http://www.arrowmaster.com/hammer.shtml).

D. The contractor shall allow the geotechnical engineer or his representative to test and evaluate each subgrade and each fill or backfill layer. The contractor shall not proceed with placement of additional lifts of fill until test results for previously completed earthwork indicate compliance with project contract documents.

E. The Geotechnical Engineer or his representative shall observe, test, and evaluate earthwork operations on a full-time basis unless the engineering technician can observe and test each lift before the next lift is placed.

F. Fill shall not be placed on frozen ground, and no frozen fill shall be placed at the site.

1.2 METHOD OF TESTING AND REQUIRED DENSITIES

A. The Standard Optimum Water Content and Maximum Standard Dry Unit Weight of each cohesive fill material shall be determined in accordance with ASTM D-698. The contractor shall place the fill in loose lifts having a maximum thickness of 8 inches, adjust the soil water content to within the appropriate range, then compact each lift to at least the following percentages of the material's Maximum Standard Dry Unit Weight:

Fill Type	Percent of Maximum Standard Dry Unit Weight	Percentage Points Relative to Standard Optimum Water Content
Structural Fill	95	-1 to +3

B. Aggregate fill lacking a well-defined moisture-density relationship shall be tested in accordance with ASTM D 4253 and ASTM D 4254, respectively, to determine the material's Maximum and Minimum Index Density. These two test procedures collectively define the basis for evaluating the material's relative density.

C. Aggregate fill shall be placed in uniformly thick layers having a maximum loose thickness of 8 inches and shall be compacted to a minimum relative density of 65 percent.

1.3 ACCEPTABLE FILL MATERIALS

A. Structural Fill may consist of low and high plastic clays having a liquid limit less than 60 and an organic matter content less than 3 percent.

B. Structural Fill may consist of highly weathered shale having a liquid limit less than 50 and clay-like properties. The shale fragments should be no larger than 4 inches and should exhibit some softening compared to unweathered, hard shale. The shale shall be weathered to the point that the fissile nature of the unweathered shale is largely broken down and the shale behaves as a cohesive soil. The shale fragments should be incorporated into a clay matrix.

C. Structural Fill may also consist of crushed limestone and combinations of limestone, concrete, shale, and soil that, after being processed through a crusher, has a workable texture, well-graded particle sizes, and a maximum particle size less than 4 inches.

D. Other materials offered for use as structural fill will be evaluated for acceptability by the Geotechnical Engineer.

1.4 UNACCEPTABLE FILL MATERIALS

A. Fill containing construction debris or limestone fragments larger than 4 inches in diameter should not be transported to the site.

B. Unweathered, hard shale is not an acceptable fill material for this project and should not be transported to this site.

1.5 TESTING FREQUENCY AND PROCEDURE

A. The Geotechnical Engineer or his representative shall identify test locations and perform in-place density tests at the following frequencies:

1. Structural Fill: Approximately one test per 5000 square feet per 8-inch lift.
2. Utility Trench Backfill, Structural: One test per 100 linear feet per 8-inch lift.
3. The Geotechnical Engineer can decrease testing frequency if test results consistently meet project specificaitons, and fill materials remain consistent with those for which tests are available.

B. A unique number shall be assigned to each test. All failing tests shall be reported along with a reference for a subsequent successful test (retest). Each retest shall reference the unsuccessful test that it replaces.

C. In the event that test results fail to meet project specifications, the contractor shall scarify, dry, wet, and otherwise adjust the soil water content to within the proper range for compaction, then compact the soil until the project specifications are met.