

Proposal Manual for:

**Indiana Department of Natural Resources
Jefferson County, Indiana
Brooksburg Boat Ramp**

Project No. ENG#2002871394

February 24, 2020

Documents Prepared By:



HWC

ENGINEERING

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Project ENG#2002871394
Contract for: Brooksborg Boat Ramp

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DIVISION 01
GENERAL REQUIREMENTS

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - Description
 - Bid
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 - Site Access Prior to Bidding
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1.2 DESCRIPTION

- A. This project consists of the construction of a boat ramp and parking lot along the Ohio River. The site is located at the Town of Brooksburg in Jefferson County, Indiana.
- B. The Contractor shall perform all work required to complete the project in accordance with the contract documents.

1.3 BID

- A. The Base Bid shall include all work and requirements indicated by the Bidding Documents.
- B. The Contractor shall not be allowed extra compensation by reason of any matter or thing concerning which the Contractor could have fully informed himself prior to bidding. No verbal agreement, understanding or conversation with an agent or employee of the Owner, either before or after the execution of this contract, shall affect or modify the terms or obligations herein contained.
- C. There is one alternate bid included with this project.

1. Alternate 1 – Bid includes paving the area as shown within the plan set with 165#/SY HMA Surface Type B, on 275#/SY HMA Intermediate Type B, on 10" Compacted Aggregate No. 53, on Subgrade Treatment Type 1B.

1.4 NOTIFICATIONS

- A. Upon notice of bid award, the Contractor shall notify the Project Manger to establish communications for the above project(s). The notification may be by mail or email to the Project Manger's following mail or e-mail address:

Project Manager: Todd Stearns
Phone: (317)-499-2714
Address: Indiana Government Center
South 402 W Washington Street,
Room W299 Indianapolis, IN 46204
Email: Tstearns@dnr.in.gov

1.5 SITE ACCESS PRIOR TO BIDDING

- A. Bidders may obtain access to the construction site for on-site inspection prior to bidding at the pre-bid meeting as indicated in the Notice to Bidders.

1.6 USE OF CONTRACT DOCUMENTS

- A. The Contractor shall examine all Specifications and Drawings for the Work, including those that may pertain to Work Contractor does not normally perform with its own forces.
- B. The Contractor shall use all of the Project Drawings and Specifications:
 1. For a complete understanding of the Project.
 2. To determine the type of construction and systems required.
 3. For coordination with other contractors.
 4. To determine what other work may be involved in various parts or phases.
 5. To anticipate and notify others when work by others will be required.
 6. And all other relevant matters related to the project.
- C. Contractor is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its work, as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.7 COMMENCEMENT AND COMPLETION OF WORK

- A. The Contractor shall start the project within ten (10) days after the date of the execution of the Contract, except that no earthwork or work below the ordinary high-water mark will begin until after all regulatory permits are approved.
- B. All work required by the Contract Documents shall be completed by **December 31, 2020**.
- C. This project, or portion thereof, will not be ready for substantial completion review until test and performance evaluations are completed, all items are installed, and area is clear of construction rubbish and debris.

1.8 BUILDER'S RISK INSURANCE

- A. The Builders Risk insurance requirements as specified in the General Conditions (11.2.5) are waived for this project.

1.9 SUBMISSION OF POST-BID INFORMATION

A. The Contractor shall submit the following information within ten (10) days of receipt of Notice to Proceed:

1. Designation of the work to be performed by the Contractor with his own forces.
2. A list of Subcontractors.
3. A list of manufacturers and suppliers.
4. A Progress schedule for the work in relation to the entire Project. The Progress schedule shall be revised and updated at least monthly.
5. A Schedule of Values. This schedule, when approved by the Owner shall be used as a basis for the Contractor's Applications for Progress and Final Payments.

1.10 MEASUREMENT AND PAYMENT- LUMP SUM

A. Payment for Lump Sum projects will be based on the accepted schedule of values for the project. No separate measurement for payment will be performed for Lump Sum Work. All Work described in the Specifications and /or shown on the Drawings shall be included in the Lump Sum Bid.

1.11 REMEDIATION ALLOWANCE

A. Section 01 20 00, Allowances, if included with this specification, contains information which will directly affect the amount of the contractor's bid. The amount of any such allowances must be added to the contractor's determined cost for performing the work, and included in the bid price for the project. **If any portion of the allowance is not used during the project, that portion will revert to the owner and will not be included in the contractor's final payment.**

1.12 WORKING HOURS

- A. Contractor shall perform all construction activity between sunrise and sunset and shall not be performed on Saturdays, Sundays, or during the period beginning at 12:00 noon on the last weekday (Monday through Friday) proceeding and continuing until Sunrise on the day following New Years Day, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas, unless previous arrangements are made with the Owner.
- B. All work performed at other times shall be only by approval from the Owner, confirmed in writing, and shall not constitute a change in the contract amount.

1.13 PROGRESS MEETINGS

A. Progress meetings will be held throughout progress of the Work at intervals agreed to by Owner, Engineer, and Contractor.

1.14 EXISTING SITE CONDITIONS

- A. Data on the drawings pertaining to present conditions, dimensions, type of construction, obstructions on or near site, location of utilities, etc. have been obtained from sources believed reliable, but accuracy of such data is not guaranteed and is furnished solely for accommodation of the Contractor.
- B. Before starting excavations, Contractor shall locate existing underground utilities in all areas of the work.

1.15 UTILITIES

A. The status of all utility companies and organizations potentially involved with the work to be performed are described below as known at the time.

1. The facilities of **Town of Brooksbury Sanitary** exist within the project limits. They have a 6 inch gravity outfall pipe from the plant to the river and a force main coming to the plant. Their facilities are not expected to be affected by the proposed construction. If questions arise, **Scott Williams** of the utility may be contacted at **812-801-1389** scottwilliams99@hotmail.com

2. The facilities of **Canaan Utilities** exist within the project limits. They have a 3 inch main running south from SR 56 approximately 20 foot west of Main St, then turns west along the north side of Riverside Dr approximately 25 foot north of the roadway, along with multiple services that cross under Main St. Their facilities are not expected to be affected by the proposed construction. If questions arise, **Rob Kring** of the utility may be contacted at **812-839-4000** rkringcanaanwater@gmail.com

3. The facilities of **Frontier Communications** exist within the project limits. They have aerial facilities along the north side of SR 56 and along the west side of Main St on SEI REMC poles. It is anticipated that they will adjust their facilities after SEI REMC completes their relocation. Frontier requires 30 days for reconstruction and 10 days on site. If questions arise, **Robin Branson** of the utility may be contacted at **574-875-3789** robin.n.branson@ftr.com

4. The facilities of **SEI REMC** exist within the project limits. They have aerial facilities along SR 56, the west side of Main St and the south side of Riverside Dr. It is anticipated that they will adjust their pole on the southwest corner of Main St/Riverside Dr and remove the support pole prior to construction. The estimate for the SEI REMC relocation is \$5, 542.29 and they require 60 days for pre-construction and 30 days on site. If questions arise, **Perry Hardy** of the utility may be contacted at **812-689-4111** perryh@seiremc.com

5. The facilities of **Spectrum (Charter)** exist within the project limits along SR 56, but are not expected to be affected by the proposed construction. If questions arise, **Kevin Mercer** of the utility may be contacted at **502-817-5055** kevin.mercer@charter.com

1.16 CONSTRUCTION AND STORAGE AREA

A. The Contractor shall confine the construction operations and storage of materials within the project construction work limits.

B. Except for permanent site improvements provided under the Contract, Contractor shall restore property disturbed during the Work to the conditions which previously existed.

C. Parking and Deliveries:

1. Contractor is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of Contractor shall be in areas subject to approval of Owner.
3. Access to the site for delivery of construction material of equipment shall be subject to approval of Owner

1.17 PROTECTION OF FACILITIES AND PREMISES

- A. The Contractor shall be responsible for the protection of all facilities during the entire period of service. Any damages to the existing facilities, roads, laws, driveways, or other State-owned property caused by the contractor shall be repaired by the Contractor at his/her expense and in a manner and schedule approved by the Owner.
- B. The Contractor shall power wash any mechanical equipment or vehicle to be used on the job site to remove all mud and debris prior to unloading on the site. This is necessary to prevent contamination by invasive species seeds that may be attached to the equipment.

1.18 ROADWAY PROTECTION

- A. The Contractor shall, at his expense, be responsible to repair any and all damage to the property's roads and drainage structures caused by his equipment and/or personnel.
- B. The ingress and egress to the project site shall be approved by the Designer.
- C. The CONTRACTOR shall, at its expense, be responsible to repair, **to pre-construction conditions**, any and all damage to the property's roads and drainage structures, caused by his equipment and/or personnel.
- D. Preconstruction Video Taping:

Prior to mobilization at the site, the CONTRACTOR shall furnish to the OWNER and ENGINEER a high resolution color audio-video DVD recording of all planned construction areas, including but not limited to roads and visible utilities. The purpose of the video taping is to document existing conditions and to provide a fair measure of required restoration. Care should be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard. The DVDs shall include an audio soundtrack to provide a detailed description of location being viewed referenced to Contract Drawings (i.e., campsite number, etc.). The direction of camera view, date, time, temperature and the environmental conditions at time of taping shall be provided. Taping shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc. Submit one copy of the video taping to the OWNER and the ENGINEER accompanied with a detailed log of the contents of each DVD. The log should include location descriptions to facilitate the quick location of information contained the DVDs. Upon final acceptance, the DVDs will become permanent property of the OWNER. Costs for the preconstruction video taping shall be included in the CONTRACTOR's lump sum bid.

1.19 SUBSTITUTIONS

- A. Substitutions shall be made in accordance with the requirements of Article 7 of the General Conditions.

1.20 ARCHAEOLOGICAL AND HISTORICAL ARTIFACTS

- A. If any objects are uncovered during construction which could possibly be of historic archeological importance, this shall be immediately reported to Owner. Work at that spot shall not proceed further until Owner has evaluated the object and the area where it was found and approved continuation of the work.
- B. If any construction time is lost due to such objects being found, an equal number of calendar days will be added to the project completion time given in the specifications.

C. Contractor is not to do any cut operations as shown in Appendix B – Sensitive Area.

1.21 SALVAGE RIGHTS

A. Unless stated otherwise in these specifications or on the plans, all equipment and materials removed as part of this project and not being reused shall become the property of the Contractor and removed from the site.

1.22 REGULATORY REQUIREMENTS

- A. All work including site, safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the “Occupational Safety and Health Act”.
- B. Contractor shall comply with roadway weight restrictions including seasonal weight restrictions.
- C. The following permits will be obtained by the Owner: Construction in a Floodway, 404/401 Clean Water Act, Rule 5 Erosion Control. Permits being obtained by Owner shall be provided when approved. Contractor shall comply with all provisions of the permits. Contractor shall obtain all other permits required for the Work.
- D. Trees greater than 5 inches dbh (diameter at breast height) cannot be cut from April 1 through September 30.
- E. Work in the waterway from April 1 through June 30 is not allowed unless approved by the Owner in writing.

1.23 DIGITAL FILE TRANSFER AGREEMENT

A. Auto-Cad files related to the project can be obtained from the Engineer, HWC Engineering. HWC requires an Electronic Document Transfer Agreement to be signed before sharing electronic CAD files. Upon execution of the transfer agreement, HWC will share the CAD file with participating contractors.

HWC Contact: Daniel Warren, PE, Project Engineer
dwarren@hwcengineering.com

812-913-6419

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Remediation Allowance

1.2 REMEDIATION ALLOWANCE

- A. Contractor shall include an allowance of **\$5,000** in the Base Bid for remediation of unforeseen constraints. This amount shall be included as a separate item in the Schedule of Values adding up to the total bid price.
- B. Such constraints may include but are not necessarily limited to unforeseen subsurface conditions particular to this construction site; improperly recorded or unrecorded physical properties and conditions at the site; obstruction of or delays to reasonable work sequences by the Property, or the Owner; uncommon adverse weather or site conditions; and conflict within or omissions from the Contract Documents.
- C. All remediation work shall be proposed to and authorized in writing prior to execution, jointly documented by Contractor and Designer, and recorded in Contractor as-builts and Designer project record documents.
- D. **If any portion of the allowance is not used during the project, that portion will revert to the owner and will not be included in the contractor's final payment.**

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date for receiving Bids or date of Owner-Contractor Agreement when there are no Bids except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- E. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

DIVISION 03
CONCRETE

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 05 50 00 - Metal Fabrications: Product requirements for metal fabrications for placement by this Section.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
 - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. American Society of Mechanical Engineers:
 - 1. ASME A17.1 - Safety Code for Elevators and Escalators.
- E. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 2. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing in accordance with **ACI 318** to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum 1 perm when tested in accordance with ASTM E96/E96M.

1.5 SUBMITTALS

A. Shop Drawings:

1. Submit formwork, shoring, and reshoring shop drawings.
2. Indicate the following:
 - a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Means of leakage prevention for concrete exposed to view in finished construction.
 - c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
 - d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
 - e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
 - f. Procedure and schedule for removal of shores and installation and removal of reshores.

B. Product Data: Submit data on void form materials and installation requirements.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347, 301, 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.

1.7 QUALIFICATIONS

- A. Design formwork under direct supervision of Project Manager.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Products storage and handling requirements.
- B. Deliver void forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.9 COORDINATION

- A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

2.2 PREFABRICATED FORMS

- A. Manufacturers:
 1. As approved by the Project Manager.
- B. Preformed Steel Forms: Minimum 16gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

- D. Pan Type: Steel of size and profile required.
- E. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, sizes as indicated on Drawings
 - 1. Manufacturers:
 - a. As specified by the Contractor's Licensed Structural Engineer.
- F. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.
- G. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.
- H. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.3 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, metal, fixed length, cone type, free of defects capable of leaving holes larger than 1 inch in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within **1 inch** of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Corners: Chamfer, wood strip type, 1" x 1" size; maximum possible lengths.
- F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- G. Flashing Reglets: Galvanized steel, 22gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- H. Vapor Retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.
- I. Bituminous Joint Filler: ASTM D1751.
- J. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- K. Water Stops:
 - 1. Polyvinyl chloride
 - 2. Minimum 2,020 psi tensile strength
 - 3. Minimum 50 degrees F to plus 175 degrees F working temperature range
 - 4. 6 inch wide x 3/16" thick dumbbell style
 - 5. Maximum possible lengths,
 - 6. Preformed corner sections, tie water stops between last rib and edge with ties spaced at 12 inches on center.
 - 7. All joints in water stops shall be field welded together using an indirect heating element.
 - 8. Concrete shall be thoroughly vibrated around water stops to prevent honeycombing.
 - 9. Manufacturers:
 - a. Greenstreak
 - b. Substitutions: Section 01 60 00 - Product Requirements

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Earth forms are not permitted.
- B. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
 - 1. Use steel, plywood or lined board forms.
 - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full size sheets of form lines and plywood wherever possible.
 - 5. Tape joints to prevent protrusions in concrete.
 - 6. Use care in forming and stripping wood forms to protect corners and edges.
 - 7. Level and continue horizontal joints.
 - 8. Keep wood forms wet until stripped.
- D. Architectural Form Liners:
 - 1. Erect architectural side of formwork first.
 - 2. Attach form liner to forms before installing form ties.
 - 3. Install form liners square, with joints and pattern aligned.
 - 4. Seal form liner joints to prevent grout leaks.
 - 5. Dress joints and edges to match form liner pattern and texture.
- E. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.
- F. Framing, Studding and Bracing:
 - 1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
 - 2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Construct beam soffits of material minimum of 2 inches thick.

4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.
- G. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- H. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- I. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.
- J. Install fillet and chamfer strips on external corners of beams joists columns and exposed edges.
- K. Install void forms in accordance with manufacturer's recommendations.
- L. Do not reuse wood formwork more than four times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- H. Form Ties:
 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 2. Place ties at least 1 inch away from finished surface of concrete.
 3. Leave inner rods in concrete when forms are stripped.
 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- J. Construction Joints:
 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.

2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 4. Arrange joints in continuous line straight, true and sharp.
- K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 2. Coordinate work to avoid cutting and patching of concrete after placement.
 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 2. Slope slabs to drain where required or as shown on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- N. Screenshot Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
 2. Staking through membrane is not be permitted.
- O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Notify Project Manager after placement of reinforcing steel in forms, but prior to placing concrete.
- C. Schedule concrete placement to permit formwork inspection before placing concrete.

3.9 SCHEDULES

- A. Areas Not Exposed To View: Site fabricated plywood coated with form oil.
- B. Areas Exposed To View: Site fabricated plywood coated with form oil, or steel forms.
- C. Other: As specified on drawings.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars.
 - 2. Welded wire fabric.
 - 3. Reinforcement accessories.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 03 35 00 - Concrete Finishing: Reinforcement for concrete floor toppings.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI 530.1 - Specifications for Masonry Structures.
 - 4. ACI SP-66 - ACI Detailing Manual.
- B. ASTM International:
 - 1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - 3. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 4. ASTM A496/A496M - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - 5. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 7. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 - 8. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 9. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 10. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 11. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - 12. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 - 13. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

- C. American Welding Society:
 - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
 - 1. CRSI - Manual of Standard Practice.
 - 2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices and splice locations and lap lengths.
- B. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - 1. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301.
- B. Prepare shop drawings in accordance with ACI SP-66.

1.5 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 40 or 60 ksi yield grade as shown on the drawings, deformed billet bars, uncoated finish.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel type; size and shape to meet Project conditions.
- D. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice and ACI 318 .
- B. Form standard hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with applicable code.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form ties and stirrups from the following:
 - 1. For bars No. 10 and Smaller: No. 3 deformed bars.
 - 2. For bars No. 11 and Larger: No. 4 deformed.

- F. Weld reinforcement in accordance with AWS D1.4
- G. Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.
- H. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Engineer.

2.4 SOURCE QUALITY CONTROL

- A. Make completed reinforcement available for inspection at manufacturer’s factory prior to packaging for shipment. Notify Project Manager at least seven days before inspection is allowed.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
 - 1. Do not weld crossing reinforcement bars for assembly except as permitted by Project Manager.
- B. Do not displace or damage vapor retarder.
- C. Accommodate placement of formed openings.
- D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.
 - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- E. Maintain concrete cover over and around reinforcement in accordance with ACI 318.
- F. Provide the minimum concrete cover over reinforcement as required by ACI 318 for fire resistive construction.
- G. Splice reinforcing where indicated on Drawings in accordance with splicing device manufacturer’s instructions.

3.2 ERECTION TOLERANCES

- A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

- B. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with ACI 318.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Reinforcement Inspection:
 - 1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
 - 2. Welding: Inspect welds in accordance with AWS D1.1.
 - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
 - 4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.

5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
6. Periodic Weld Inspection: Other welded connections.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes Cast-in-Place Concrete for Following Items:
 - 1. Building frame members.
 - 2. Beams, lintels, and columns.
 - 3. Shear walls.
 - 4. Elevator shaft walls.
 - 5. Retaining walls.
 - 6. Foundation walls.
 - 7. Footings.
 - 8. Supported slabs.
 - 9. Slabs on grade.
 - 10. Control, expansion, and contraction joint devices.
 - 11. Equipment pads.
 - 12. Light pole base.
 - 13. Flagpole base.
 - 14. Thrust blocks.
 - 15. Manholes.
- B. Related Requirements:
 - 1. Section 03 10 00 - Concrete Forming and Accessories: Formwork and accessories, Placement of joint devices in formwork, Placement of joint device anchors in formwork.
 - 2. Section 03 20 00 - Concrete Reinforcing: Requirements for reinforcing steel and supports.
 - 3. Section 03 35 00 - Concrete Finishing: Finishing of concrete floor surfaces.
 - 4. Section 03 39 00 - Concrete Curing: Curing of concrete floor surfaces.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305R - Guide to Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 - Specification for Curing Concrete.
 - 5. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
17. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
20. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
 31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 33. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- C. California Department of Health Care Services:
1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (includes Addendum 2004).
- D. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.4 SUBMITTALS

- A. Product Data: Submit data on joint devices, attachment accessories, and admixtures
- B. Design Data:
1. Submit concrete mix design for each concrete strength.
 2. Submit separate mix designs if admixtures are required for following:
 - a. Hot and cold weather concrete Work.
 - b. Air entrained concrete Work.
 3. Identify mix ingredients and proportions, including admixtures.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301, ACI318.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.

D. Acquire cement and aggregate from one source for Work.

1.7 AMBIENT CONDITIONS

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.
- B. Maintain high-early strength concrete temperature after installation at minimum 50 degrees F for minimum three days.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96.

2.2 MATERIALS

- A. Concrete:
 - 1. Cement:
 - a. Comply with ASTM C150 Type I – Normal.
 - b. Type: Portland.
 - 2. Normal Weight Aggregates:
 - a. Comply with ASTM C33
 - b. Coarse Aggregate Maximum Size: According to ACI 318
 - 3. Water:
 - a. Comply with ACI 318
 - b. Potable, without deleterious amounts of chloride ions.
- B. Admixtures:
 - 1. Air Entrainment: Comply with ASTM C260
 - 2. Chemical:
 - a. Comply with ASTM C494
 - b. Type A - Water Reducing.
- C. Joint Devices and Filler:
 - 1. Joint Filler
 - a. Description: Asphalt-impregnated fiberboard or felt.
 - b. Comply with ASTM D1751
 - c. Thickness: 1/2inch
 - d. Profile: Tongue-and-groove.
 - 2. Sealant and Primer: as specified in Section 07 90 00 - Joint Protection.

2.3 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 2.
- B. Performance and Design Criteria:

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MATERIAL AND PROPERTY	TYPE A	TYPE B	TYPE C
Compressive Strength (28-day)	4,000 psi	4,000 psi	3,000 psi
Cement Type	ASTM C150-I	ASTM C150-1	ASTM C150-1
Cement Content (minimum)	6 bags minimum per cu. yd.	6 bags minimum per cu. yd.	6 bags minimum per cu. yd.
Aggregate Type	Normal weight	Normal weight	Normal weight
Water-Cement Ratio (maximum)	0.45	0.40	as required
Aggregate Size (maximum)	1.5 in	1.5 in	0.5 in
Air Content (+/- 1%)	4.5% (+/- 1.0%)	0%	0%
Admixture	None	Water Reducing Agent	None
Maximum Slump	4	4	5

C. Type of Concrete (Where Applicable) - Unless otherwise noted on the drawings.

1. Use Type A for:
 - a. Foundation Walls
 - b. Column Piers
 - c. Exterior concrete
2. Use Type B for:
 - a. Interior Slabs & Footings
 - b. Miscellaneous interior concrete
3. Use Type C for:
 - a. Masonry Fill

D. Admixtures:

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1. Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.
 2. Cold Weather:
 - a. Use accelerating admixtures in cold weather.
 - b. Use of admixtures will not relax cold-weather placement requirements.
 3. Hot Weather: Use set-retarding admixtures.
 4. Do not use calcium chloride or admixtures containing calcium chloride.
 5. Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing or deicing chemicals.
 6. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fumes, and slag content as required by applicable code.
- E. Average Compressive Strength Reduction: Permitted according to ACI 318.
- F. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.
- G. Site-Mixed Concrete: Mix concrete according to ACI 318.

2.4 ACCESSORIES

- A. Vapor Retarder:
1. Description: Clear polyethylene film.
 2. Comply with ASTM E1745, Class A.
 3. Thickness: 6 mils.
 4. Type: As recommended for below-grade application.
 5. Joint Tape: As recommended by manufacturer.
- B. Non-shrink Grout:
1. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
 2. Comply with ASTM C1107.
 3. Minimum Compressive Strength: 5,000 psi in 28 days.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.
- C. Pre-Pour Inspection
1. Notify the Owner three days prior to beginning schedule pour. The Owner, accompanied by the contractor's superintendent and the Owner's inspectors will inspect the following:
 - a. Subgrade preparation
 - b. Reinforcement placement

- c. Water stop placement and securement
 - d. Reinforcement supports, chairs, etc.
 - e. Joint layout
2. Correct deficiencies in the Work prior to placing concrete.

3.2 PREPARATION

- A. Previously Placed Concrete:
 1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
 2. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.3 INSTALLATION

- A. Placing Concrete:
 1. Place concrete according to ACI 301.
 2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
 4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
 5. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends or taping edges and ends as recommended by manufacturer.
 6. Repairs:
 - a. Repair vapor retarder damaged during placement of concrete reinforcement.
 - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.
 7. Joint Filler:
 - a. Separate slabs on grade from vertical surfaces with 1/2-inch-thick joint filler.
 - b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
 - c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
 - d. Finish Joint Sealer Requirements: As specified in Section 07 90 00 - Joint Protection.
 8. Deposit concrete at final position, preventing segregation of mix.
 9. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
 10. Consolidate concrete.
 11. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.

12. Place concrete continuously between predetermined expansion, control, and construction joints.
 13. Do not interrupt successive placement and do not permit cold joints to occur.
 14. Saw-Cut Joints:
 - a. Saw-cut joints within 12 hours after placing.
 - b. Use 3/16 inch thick blade.
 - c. Cut into 1/4 depth of slab thickness.
 15. Screeding:
 - a. Screed floors and slabs on grade level.
 - b. Surface Flatness: maximum 1/8 inch in 10 feet.
- B. Concrete Finishing:
1. Provide formed concrete surfaces to be left exposed with smooth-rubbed finish.
 2. Finish concrete floor surfaces as specified in Section 03 35 00 - Concrete Finishing.
 3. Wood float surfaces receiving quarry tile, ceramic tile, and terrazzo with full-bed setting system.
 4. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin-set quarry tile, and thin-set ceramic tile.
 5. Steel trowel surfaces indicated to be exposed.
 6. In areas with floor drains, maintain floor elevation at walls and pitch surfaces uniformly to drains at 1/8 inch per foot nominal unless otherwise indicated on Drawings.
- C. Finishing Slabs
1. Tolerance: Finished slabs shall have a maximum deviation in surface elevation of 1/4 inch to ten feet.
 2. Initial finishing: Immediately after screeding, bull float slabs before any excess moisture or bleeding water is present on the surface. After initial set, tool joints and edges. When the water sheen disappears and the concrete will adequately support the operation, float the surface by hand or machine with float shoes. Do no finishing while free water is present on surface. Retool joints and edges as required.
 3. Final finishing: After the above work, finish slabs in accordance with the following finish schedule and descriptions:

<u>LOCATION</u>	<u>TYPE FINISH</u>
Interior Slabs, Exterior Pads	Hard Trowel
Tank Floors	Light Broom/Float

- a. Hard Trowel Finish: Follow the first steel troweling with a second steel troweling to produce a dense, smooth surface after the surface has become hard enough to give a ringing sound from the trowel. Retool joints and edges as required.
- b. Light Broom Finish: After bull floating, draw a broom over the surface to produce a light coarse texture.

- D. Curing and Protection:
 - 1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 2. Protect concrete footings from freezing for minimum of five days.
 - 3. Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.
 - 4. Cure concrete floor surfaces as specified in Section 03 39 00 - Concrete Curing.

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall engage a testing laboratory to complete the work of this sub-section.
- B. Perform inspection and testing according to ACI 318.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- E. Strength Test Samples:
 - 1. Sampling Procedures: Comply with ASTM C172.
 - 2. Cylinder Molding and Curing Procedures:
 - a. Comply with ASTM C31.
 - b. Cylinder Specimens: Standard cured.
 - 3. Sample concrete and make one set of four cylinders for every 100 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
 - 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
 - 5. Make one additional cylinder during cold weather concreting and field cure.
- F. Field Testing:
 - 1. Slump Test Method: Comply with ASTM C143.
 - 2. Air Content Test Method: Comply with ASTM C173 or C231.
 - 3. Temperature Test Method: Comply with ASTM C1064.
 - 4. Compressive Strength Concrete:
 - a. Measure slump and temperature for each sample.
 - b. Measure air content in air-entrained concrete for each sample.
- G. Cylinder Compressive Strength Testing:
 - 1. Test Method: Comply with ASTM C39.
 - 2. Test Acceptance: According to ACI 318.
 - 3. Test one cylinder at 7 days and test two cylinders at 28 days.
 - 4. Retain one cylinder for 30 days for testing when requested by Engineer.
 - 5. Dispose of remaining cylinders if testing is not required.

- H. Core Compressive Strength Testing:
 - 1. Sampling and Testing Procedures: Comply with ASTM C42.
 - 2. Test Acceptance: According to ACI 318.
 - 3. Drill three cores for each failed strength test from failed concrete.
- I. Patching:
 - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
 - 2. Honeycombing or Embedded Debris in Concrete:
 - a. Not acceptable.
 - b. Notify Project Manager upon discovery.
 - 3. Patch imperfections as directed by Engineer.
- J. Defective Concrete:
 - 1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
 - 2. Repair or replacement of defective concrete will be determined by Engineer.
 - 3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Project Manager for each individual area.

3.5 ATTACHMENTS

- A. Schedule - Concrete Types:
 - 1. Use Type A Mix Design for:
 - a. Foundation Walls
 - b. Column Piers
 - c. Exterior Concrete
 - 2. Use Type B for:
 - a. Interior Slabs and Footings
 - b. Miscellaneous interior concrete
 - 3. Use Type C for:
 - a. Masonry Fill

END OF SECTION

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finishing concrete floors and floor toppings.
 - 2. Floor surface treatment.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
 - 2. Section 03 39 00 - Concrete Curing.
 - 3. Section 07 90 00 - Joint Protection.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.

1.3 SUBMITTALS

- A. Product Data: Submit data on sealer, compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit data on maintenance renewal of any applied coatings.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1.
- B. Perform Work in accordance with federal, state and local standards.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator/Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

1.9 COORDINATION

- A. Coordinate the Work with concrete floor placement and concrete floor curing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. [Manufacturers:](#)
 - 1. Euclid Chemical Company
 - 2. L&M Construction Chemicals
 - 3. Sika Corporation
 - 4. Substitutions: Section 01 60 00 - Product Requirements

2.2 COMPOUNDS - SEALERS

- A. Sealer: Polyurethane coating, Euclid Eucothane or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Steel trowel surfaces which are indicated to be exposed.
- C. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

3.3 FLOOR SURFACE TREATMENT

- A. Apply hardener or sealer as scheduled on floor surfaces.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Surface Flatness For Exposed Concrete Floors: 1/8 inch in 10 ft.
- C. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION

SECTION 03 39 00 - CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
 - 3. ACI 308.1 - Standard Specification for Curing Concrete.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
 - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

1.3 SUBMITTALS

- A. Product Data: Submit data on curing compounds, mats, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301, ACI 302.1, and ACI 318.
- B. Perform Work in accordance with Specifications, Plans and Contract Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Membrane Curing Compound: ASTM C309, Type 1D, Class A & B.
 - 1. Manufacturers:
 - a. Euclid Chemical Company
 - b. L&M Construction Chemicals
 - c. Substitutions: Section 01 60 00 - Product Requirements
- B. Absorptive Mats: ASTM C171, burlap-polyethylene, minimum 9 oz./sq. yd. bonded to prevent separation during handling and placing.
 - 1. Manufacturers:
 - a. Reef Industries
 - b. Substitutions: Section 01 60 00 - Product Requirements
- C. Water: Potable, not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

- A. Cure concrete in accordance with ACI 308.1.
- B. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for **7** days.
- C. Membrane Curing Compound: Apply curing compound in two coats with second coat applied at right angles to first.

3.3 INSTALLATION - VERTICAL SURFACES

- A. Cure concrete in accordance with ACI 308.1.
- B. Membrane Curing Compound: Apply compound in two coats with second coat applied at right angles to first.

3.4 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over unprotected floor surface.

END OF SECTION

DIVISION 05

METALS

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Shop-fabricated metal items.
 2. Fabricated architectural details.

1.2 REFERENCE STANDARDS

- A. ASTM International:
1. ASTM A36 - Standard Specification for Carbon Structural Steel. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 2. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 3. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
 4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 5. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 6. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
 7. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 8. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 9. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
 10. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 11. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 12. ASTM A709 – Standard Specification for Structural Steel Bridges.
 13. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. ASTM A992 - Standard Specification for Structural Steel Shapes. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings. ASTM B177 - Standard Guide for Engineering Chromium Electroplating. ASTM B209 - Standard Specification for Aluminum

and Aluminum-Alloy Sheet and Plate. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

14. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
15. ASTM F436 - Standard Specification for Hardened Steel Washers.
16. ASTM F593 – Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs
17. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.

B. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
4. SSPC SP 1 - Solvent Cleaning.
5. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.4 QUALITY ASSURANCE

- A. Finish joints according to NOMMA Guideline 1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept metal fabrications on-Site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel:
1. Structural W Shapes: ASTM A992.
 2. Structural Shapes: ASTM A36.
 3. Channels and Angles: ASTM A36.
 4. Steel Plate: ASTM A709.
 5. Hollow Structural Sections: ASTM A500, Grade B.
 6. Steel Pipe: ASTM A53, Grade B, Schedule 40.
 7. Sheet Steel: ASTM A653, Grade 33 Structural Quality.

8. Bolts: ASTM F593; Group 1, Allow 304
 9. Nuts: ASTM A563; heavy-hex type.
 10. Washers: ASTM F436; Type 1.
 11. Welding Materials: AWS D1.1; type required for materials being welded.
- B. Stainless Steel:
1. Bars and Shapes: ASTM A276; Type 302.
 2. Tubing: ASTM A269; Type 304.
 3. Pipe: ASTM A312, seamless; Type 304.
 4. Plate, Sheet, and Strip: ASTM A240; Type 302.
 5. Bolts, Nuts, and Washers: ASTM F593, Group 1, Allow 304
 6. Welding Materials: AWS D1.6; type required for materials being welded.
- C. Bolts, Nuts, and Washers for Equipment and Piping:
1. Carbon Steel:
 - a. Structural Connections: ASTM A307, Grade A, hot-dip galvanized.
 - b. Anchor Bolts: ASTM A307, Grade A, hot-dip galvanized.
 - c. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7.
 2. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts.

2.2 FABRICATION

- A. Fit and shop-assemble items in largest practical sections for delivery to Site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Fabrication Tolerances:
 1. Squareness: 1/8-inch maximum difference in diagonal measurements.
 2. Maximum Offset between Faces: 1/16 inch.
 3. Maximum Misalignment of Adjacent Members: 1/16 inch.
 4. Maximum Bow: 1/8 inch in 48 inches.
 5. Maximum Deviation from Plane: 1/16 inch in 48 inches.

2.3 FINISHES

- A. Steel:
1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
 3. Prime-paint items with one coat except where galvanizing is specified.
 4. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.
 5. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153.
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
 6. Sheet Steel: Galvanized.
 7. Bolts: Hot-dip galvanized.
 8. Nuts: Hot-dip galvanized.

9. Washers: Hot-dip galvanized.
 10. Shop Primer: SSPC Paint 15, Type 1, red oxide.
 11. Touchup Primer: Match shop primer.
- B. Stainless Steel:
1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.
 2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where Site welding is required.
- B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Field-weld components indicated on Shop Drawings.
- D. Perform field welding according to AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- C. Maximum Variation from Level: 1/16 inch in 3 feet and 1/4 inch in 10 feet.
- D. Maximum Offset from Alignment: 1/4inch.
- E. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds according to AWS D1.1.
- B. Replace damaged or improperly functioning hardware.
- C. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.
- D. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 90 00 - JOINT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes sealants and joint backing and accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- B. California Department of Health Services:
 - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- C. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168-January 7, 2005 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

- A. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- B. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 COORDINATION

- A. Coordinate Work with sections referencing this section.

PART 2 - PRODUCTS

2.1 JOINT SEALERS

A. Products Description:

1. General Purpose Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T; single or multi- component.
 - a. Type: MasterSeal NP2 manufactured by BASF.
 - b. Color: Standard colors matching finished surfaces.
 - c. Elongation Capacity: 25 percent
 - d. Service temperature Range -40 to 180 degrees F
 - e. Shore A Hardness Range 20 to 35
 - f. Applications: Use for:
 - 1) Exterior pedestrian traffic bearing joints.
 - 2) Control, expansion, and soft joints in masonry.
 - 3) Joints between concrete and other materials.
 - 4) Joints between metal frames and other materials.
 - 5) Other exterior nontraffic joints for which no other sealant is indicated.
2. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
 - a. Type: Latex 834 manufactured by Tremco.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.
3. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.
 - a. Type: 786 manufactured by Dow Corning.
 - b. Elongation Capacity: 25 percent
 - c. Service temperature Range -35 to 140 degrees F
 - d. Applications: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between kitchen and toilet room counter tops and wall surfaces.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate surfaces and joint openings are ready to receive work.
- B. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.
- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Perform acoustical sealant application work in accordance with ASTM C919.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect sealants until cured.

END OF SECTION

DIVISION 31
EARTHWORK

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.

1.2 REFERENCES

- A. Indiana Department of Transportation Standard Specifications: latest edition.
- B. Section 32 05 13 – Soils for Exterior Improvements: Topsoil
- C. Geotechnical Report – Appendix B

1.3 SUBMITTALS

- A. Materials Source: Submit name of imported materials source.
- B. Manufacturer's Certificate: Certify Products meet or exceed Indiana Department of Transportation Standard Specifications, at time of construction.

1.4 QUALITY ASSURANCE

- A. Furnish each subsoil material from single source throughout the Work.
- B. Perform Work in accordance with Indiana Department of Transportation Standard Specifications, latest edition.

PART 2 - PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1: Excavated and re-used material, graded, free of lumps larger than 3 inches, rocks larger than 2 inches, and debris; conforming to ASTM D2487.
- B. Subsoil Type S2: Imported material, graded, free of lumps larger than 3 inches, rocks larger than 2 inches, and debris; conforming to ASTM D2487

2.2 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with Indiana Department of Transportation Standard Specifications, at time of construction.
- B. When tests indicate materials do not meet specified requirements, change material and retest.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials.
- C. Remove excess excavated materials and subsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated designated by Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil 8 feet high maximum.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

3.4 SOIL TYPE SCHEDULE

SOIL TYPE	DESCRIPTION	USE
S1	Natural Subsoil	Earthwork, unless recommended otherwise in geotechnical report.
S2	Imported Soil	Earthwork

END OF SECTION

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coarse aggregate materials.
 - 2. Fine aggregate materials.

1.2 SUBMITTALS

- A. Materials Source: Submit name of imported materials supplies. Provide materials from same source throughout the work. Change of source requires Project Manager approval.
- B. Manufacturer's Certificate: Certify products meet or exceed specified design requirements

1.3 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. The Contractor shall employ a Testing Agency and the Testing Agency shall:
 - 1. Perform the following tests during progress of the work:
 - a. Gradation Test: Verify samples from supply source meets requirements of Indiana Department of Transportation for the type of material specified.
 - b. In place density of Subgrades: Verify in place density of subgrade prior to placement of fill at locations per direction of Owner/Engineer.
 - c. In place density of compacted fill and backfill: Verify density of fill at locations per direction of Engineer.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate CA1: Class 1 RipRap Conforming to INDOT Standard Specifications.
- B. Course Aggregate CA2: Class 2 RipRap Conforming to INDOT Standard Specifications.
- C. Coarse Aggregate CA3: #2 Crushed Limestone Conforming to INDOT Standard Specifications.
- D. Coarse Aggregate CA4: #53 Crushed Limestone Conforming to INDOT Standard Specifications.

2.2 FINE AGGREGATE MATERIALS

- A. Fine Aggregate FA1: "B" Borrow or acceptable Structural Fill conforming to Geotechnical Report provided within the Contract Documents. Materials used shall conform to Indiana Department of Transportation Standard Specifications.

2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with INDOT Standard Specifications
- B. Fine Aggregate Material - Testing and Analysis: Perform in accordance with INDOT Standard Specifications.
- C. When tests indicate materials do not meet specified requirements, change material and retest.
- D. The Contractor shall employ a Testing Agency and the Testing Agency shall

1. Perform the following tests during progress of the work:
 - a. Gradation Test: Verify samples from supply source meets requirements of Indiana Department of Transportation for the type of material specified
 - b. In place density of Subgrades: Verify in place density of subgrade prior to placement of fill at locations per direction of Owner/Project Manager
 - c. In place density of compacted fill and backfill: Verify density of fill at locations per direction of Project Manager

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate aggregate materials from on-site locations indicated or as designated by Project Manager as specified in Section 31 22 13.
- B. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.
- C. Remove excess excavated materials, coarse aggregate materials and fine aggregate materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for coarse aggregate materials and fine aggregate materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated or as designated by Engineer.
- B. Stockpile in sufficient quantities or arrange for the delivery of materials as needed to meet project schedule and requirements. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- C. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- D. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

3.4 AGGREGATE PLACEMENT

- A. Proof roll subgrade with roller as per Indiana Department of Transportation Standard Specifications.
- B. Spread aggregate over prepared substrate to a total compacted thickness as shown on the drawings
- C. Place aggregate in maximum layers per INDOT Specifications and roller compact
- D. Level and contour surfaces to elevations and gradients indicated
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment

3.5 TOLERANCES

- A. Flatness: Maximum variation of 2 inch measured with 10 foot (3 m) straight edge
- B. Scheduled Compacted Thickness: Within 2 inch
- C. Variation from True Elevation: Within 2 inch

3.6 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with INDOT Standard Specifications.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.

3.7 SOIL TYPE SCHEDULE

SOIL TYPE	DESCRIPTION	USE
CA1	Class 1 RipRap	Embankment Stabilization Cover
CA2	Class 2 RipRap	Embankment Stabilization Cover
CA3	#2 Crushed Limestone	Embankment Stabilization Subbase
CA4	#53 Crushed Limestone	Embankment Stabilization Subbase
FA1	"B" Borrow	Structural Backfill

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing designated paving, curbs, and site concrete.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
 - 5. Excavating topsoil.

1.2 PROJECT CONDITIONS

- A. See Special Provisions and Bid Items for distribution of work performed under this Section.
- B. The Contractor may perform his own soils investigation to satisfy himself as to soil types and ground water conditions in the project area. No pleas of ignorance will be accepted by the Owner as to differing soil type or ground water conditions. Documentation of effort to determine soil conditions by the Contractor prior to bidding the project is recommended. No extra compensation for differing soil conditions will be considered by the Owner unless it is determined that the soil conditions materially differ from what is anticipated and adequate pre-bid Contractor effort was made.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the Project Manager

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify area for placing removed materials.

3.2 PREPARATION

- A. Call Local Utility Line Information service
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots,

skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

- A. Furnish equipment, tools and labor to remove brush, trees, stumps and other materials which will interfere with construction operations.
- B. Completely remove trees and shrubs within marked areas or where indicated on plans.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove paving, curbs, and site concrete.
- C. Neatly saw cut edges at right angle to surface.
- D. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- F. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
- B. Do not excavate wet topsoil.
- C. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion until disposal.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating subsoil.
 - 2. Cutting, grading, filling, rough contouring, compacting site for site structures, building pads.

1.2 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance Indiana Department of Transportation Standard Specifications

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Subsoil Fill: Per Section 31 05 13 Soils for Earthwork.
- B. Structural Fill: Per Section 31 05 16 Aggregates for Earthwork.
- C. Granular Fill: Per Section 31 05 16 Aggregates for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove or relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact in accordance Indiana Department of Transportation Standard Specifications.

- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Install Work in accordance with Per Indiana Department of Transportation Standard Specifications

3.4 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.5 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D698.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil densification.

1.2 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with Indiana Department of Transportation Standard Specifications

1.4 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Project Manager

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility companies to remove or relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

- A. Excavate subsoil to accommodate construction operations.
- B. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- C. Trim excavation. Remove loose matter.
- D. Remove lumped subsoil, boulders, and rock. Remove larger material as specified in Section 31 23 23.
- E. Notify Engineer of unexpected subsurface conditions.
- F. Correct areas over excavated with structural fill.
- G. Remove excess and unsuitable material from site.

H. Repair or replace items indicated to remain damaged by excavation.

3.3 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 23 - FILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fill for over-excavation.

1.2 REFERENCES

- A. Indiana Department of Transportation Standard Specifications:
- B. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- C. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Materials Source: Submit name of imported fill materials suppliers.
- B. Manufacturer's Certificate: Certify Products meet or exceed Indiana Department of Transportation Standard Specifications:

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Indiana Department of Transportation Standard Specifications:

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

2.2 FILL MATERIALS

- A. Subsoil Fill: Per Section 31 05 13 Soils for Earthwork.
- B. Structural Fill: Per Section 31 05 16 Aggregates for Earthwork.
- C. Granular Fill: Per Section 31 05 16 Aggregates for Earthwork.
- D. Concrete: Structural concrete as specified in Section 03 30 00.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface and air dry satisfactory soil material that is too wet.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.2 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place geotextile fabric if required per Construction Documents prior to placing next lift of fill.
- D. Place fill material in continuous layers and compact.
- E. Employ placement method that does not disturb or damage other work.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Make gradual grade changes. Blend slope into level areas.
- H. Remove surplus backfill materials from site.
- I. Leave fill material stockpile areas free of excess fill materials.

3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of General Backfilling: Plus or minus 1/2 inch from required elevations.

3.4 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D698.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and ret

3.5 SCHEDULE

- A. Section 31 05 16 – Aggregates for Earthwork.

END OF SECTION

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Erosion and Sedimentation Control activities
 - 2. Temporary Seeding.
 - 3. Dust Control.

1.2 REFERENCES

- A. Indiana Department of Transportation Standard Specifications, latest edition.
- B. Indiana Storm Water Quality Manual, latest edition.
- C. IDEM Soil Erosion and Sedimentation Control regulations.
- D. County Soil and Water Conservation Districts.

1.3 SUBMITTALS

- A. Product Data: Submit data for erosion and sedimentation control techniques and construction.
- B. Materials Source: Submit name of all products and suppliers utilized in erosion and sedimentation control activities.
- C. Manufacturer's Certificate: Certify Products meet or exceed Indiana Department of Transportation Standard Specifications.

1.4 GUIDELINES

- A. The Contractor shall include in his bid costs for the installation of all necessary erosion control items for the project per INDOT Standard Specifications. It is the Contractor's responsibility that all design criteria, standards and specifications are met and that all land disturbing activities are in accordance with the erosion/sediment control plan.
- B. The Contractor shall retain existing vegetation on the construction site wherever possible. If existing vegetation must be cleared, retain and protect it until the area must be disturbed.
- C. The Contractor shall maintain a buffer strip of existing vegetation around the perimeter of the site to reduce off-site erosion and sedimentation, if available.
- D. The Contractor shall minimize the extent and duration that bare soil is exposed to erosion by wind and water. Use staged clearing and grading to reduce the amount of disturbed area to the absolute minimum needed for immediate construction activities
- E. The Contractor shall keep sediment on the construction site as much as possible. Retain sediment from unavoidable erosion on-site by trapping it with sediment basins or filtering it out of runoff with vegetative or man-made barriers. The Contractor shall install any needed sediment traps, basins and/or man-made barriers before construction activity begins.
- F. The Contractor shall divert off-site runoff away from disturbed areas, if possible. The installation of these measures shall take place prior to clearing and grading to reduce the potential for erosion.
- G. The Contractor shall stabilize disturbed areas as soon as possible. Stabilizing measures, such as seeding temporary or permanent vegetation, sodding, mulching, sediment basins, erosion control blankets, or other protective practices shall be installed within seven days after the land has been disturbed.
- H. The Contractor shall keep velocity of runoff leaving the site low
- I. The Contractor shall install drain inlet protection for the existing storm system and as soon as the proposed storm sewer system is functional

- J. The Contractor shall assign someone the responsibility for routine, end-of-day inspection/maintenance checks of all erosion and sediment control measures. All measures shall be inspected for damage after each storm event. Damaged measures shall be repaired immediately.
- K. The Contractor shall remove the interim measure when all areas protected are stabilized. The Contractor shall then establish permanent stabilization protection before the entire site may be considered permanently stabilized.
- L. The Contractor shall be responsible for the maintenance, repair, and/or replacement of all required control measures with all disturbed areas being stabilized to the satisfaction of the local SWCD, County Surveyor, Owner, or Project Manager.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with INDOT Standard Specifications, Indiana Storm Water Quality Manual, IDEM Soil Erosion and Sedimentation Control regulations and Local SWCD requirements.

PART 2 - MEASURES

2.1 FILTER TUBE/FILTER SOCK

- A. Install Per manufacturer recommendations.
- B. Ensure installation meets Section 31 25 00 REFERENCES requirements.

2.2 EROSION CONTROL BLANKET

- A. Install Per manufacturer recommendations.
- B. Ensure installation meets Section 31 25 00 REFERENCES requirements.

2.3 TEMPORARY SEEDING

- A. Requirements
 - 1. Site and Seedbed Preparation
 - 2. Plant Species

Seed Species	Rate / Acre	Planting Depth	Optimum Dates
Wheat or Rye	150 pounds	1 to 1.5 inches	9/15 to 10/30
Spring Oats	100 pounds	1 inch	3/1 to 4/15
Annual Ryegrass	40 pounds	¼ inch	3/1 to 5/1 8/1 to 9/1
German Millet	40 pounds	1 to 2 inches	5/1 to 6/1
Sudangrass	35 pounds	1 to 2 inches	5/1 to 7/30

- 3. Mulch
 - a. Clean grain straw, hay, wood fiber, etc., to protect seedbed and encourage growth.
 - b. From November 1 to March 1, mulching alone shall be used to stabilize disturbed areas.
- 4. Seeding Frequency. Seed as often as possible following construction activity. Daily seeding of rough graded areas when the soil is loose and moist is usually most effective

2.4 DUST CONTROL

- A. Road Surfaces: Apply calcium chloride, as needed, at a rate that will keep surface moist
- B. Street Cleaning: Brush, sweep or scoop street. Do not flush unless flow can be directed into an inlet, sediment trap or basin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted stabilized soil is acceptable and ready to support all imposed loads.
- B. Verify gradients and elevations of base or foundation for other work are correct.

3.2 TEMPORARY SEEDING

- A. Site Preparation
 - 1. Install practices needed to control erosion, sedimentation, and water runoff, such as temporary and permanent diversions, sediment traps or basins, silt fences, and straw bale dams
 - 2. Grade the site as specified in the construction plans
- B. Seedbed Preparation
 - 1. Fertilize by applying 18 pounds / 1000 square feet of 12-12-12 analysis, or equivalent, fertilizer
 - 2. Work the fertilizer into the soil 2-4 inches deep with a disk or rake operated across the slope
- C. Seeding
 - 1. Select a seeding mixture and rate from Section 2.2, plant at depth and on dates shown.
 - 2. Apply seed uniformly with a drill or cultipacker-seeder or by broadcasting and cover to the depth shown in Section 2.2.
 - 3. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.
 - 4. Mulch seeded areas to increase seeding success. Anchor all mulch by crimping or tackifying. Use netting or erosion control blankets if required for stabilizing and anchoring temporary seeding.

3.3 DUST CONTROL

- A. Apply as needed to prevent wind-borne dust, which could create a health and/or visibility hazard downwind, from leaving the construction area.

3.4 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.
 - 2. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 92 19 permanent seeding specifications.
- D. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.5 FIELD QUALITY CONTROL

- A. Inspect erosion control devices on a weekly basis and after each rainfall event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.6 CLEANING

- A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- B. Do not damage structure or device during cleaning operations.
- C. Do not permit sediment to erode into construction or site areas or natural waterways.
- D. Clean channels when depth of sediment reaches approximately one half channel depth.

END OF SECTION

DIVISION 32
EXTERIOR IMPROVEMENTS

SECTION 32 05 13 - SOILS FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Topsoil materials.
- B. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork.
 - 2. Section 31 23 23 - Fill.
 - 3. Section 32 92 19 - Seeding and Soil Supplements.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m^{3 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m^{3 - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).}}

1.3 SUBMITTALS

- A. Materials Source: Submit name of imported materials source.

1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.

PART 2 - PRODUCTS

2.1 TOPSOIL MATERIALS

- A. Topsoil Type TS1: Conforming to Indiana Department of Transportation Standard Specifications, latest edition.

2.2 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
- B. Testing and Analysis of Topsoil Material: Analyze to determine percentage of nitrogen, phosphorus, potash, soluble salt, organic matter, and pH.
- C. When tests indicate materials do not meet specified requirements, change material and retest.
- D. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations designated by Landscape Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil 8 feet high maximum.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

3.4 SOIL TYPE SCHEDULE

SOIL TYPE	DESCRIPTION	USES
TS1	Basic INDOT Standard	Topsoil for Turf Areas

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic concrete paving.
- B. Pavement marking.

1.2 REFERENCES

- A. Indiana Department of Transportation Standard Specifications

1.3 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's detailed literature in accordance with Section 01.
 - 2. Submit mix design with laboratory test results supporting design.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with the latest edition of Indiana Department of Transportation Standard Specifications, at time of construction
- B. Mixing Plant: Conform to the latest edition of Indiana Department of Transportation Standard Specifications, at time of construction
- C. Acquire materials and aggregate from same source for all work

PART 2 - PRODUCTS

2.1 PAVEMENT MATERIALS

- A. All materials shall conform to the requirements of latest edition of the Indiana Department of Transportation Standard Specifications, at time of construction

2.2 PAVEMENT MARKING MATERIALS

- A. Pavement markings shall be paint or thermoplastic, as referenced on the drawings. Materials shall be as specified in Indiana Department of Transportation standard specifications for Road Construction:
 - 1. Indiana White or Indiana Yellow per INDOT Standard Specifications
 - 2. Handicapped spaces shall be Blue per INDOT Standard Specifications

2.3 SOURCE QUALITY CONTROL

- A. Provide mix design for asphalt under provision of Section 01
- B. Submit proposed mix design for each class of mix for review prior to commencement of work

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify base conditions and the requirements of the Indiana Department of Transportation Standard Specifications, latest edition at time of construction
- B. Verify that compacted granular base is dry and ready to support paving and imposed loads

C. Verify gradients and elevations of base are correct.

3.2 SUB-BASE AND SUBGRADE

A. Prepare sub-base and aggregate subgrade in accordance with the Indiana Department of Transportation Standard Specifications, latest edition at time of construction

3.3 PREPARATION

A. Apply tack coat and primer in accordance with the Indiana Department of Transportation Standard Specifications, latest edition at time of construction.

B. Apply tack coat to contact surfaces of curbs, gutters and pavement.

3.4 INSTALLATION

A. Install work in accordance with the Indiana Department of Transportation Standard Specifications, latest edition at time of construction

3.5 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury until acceptance of project by Owner

3.6 SCHEDULES

A. Asphalt as shown on the drawings or herein specified

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete sidewalks.
- B. Concrete stair steps.
- C. Concrete integral curbs and gutters.
- D. Concrete parking areas and roads.
- E. Control, expansion and contraction joint devices associated with concrete work, including joint sealants

1.2 SUBMITTALS

- A. Product Data: Provide data on joint devices, attachment accessories, and admixtures.
- B. Samples: Submit two, inch long samples of expansion/contraction joint and control joint.
- C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.
- D. Submit drawings and technical literature in accordance with specification 01.
- E. Submit ready mix concrete supplier's mix design for each type of mix for Project Manager's approval. Submit this data twenty-one days before concrete placement is scheduled to begin.
- F. Submit copies of manufacturer's technical literature on admixtures used in the mix design. Submit this data along with the mix design submission.
- G. Submit copies of manufacturer's technical literature on each waterstop and joint sealant material for Project Manager's approval.
- H. Submit shop drawings of reinforcing steel for approval by the Engineer prior to fabrication.
- I. Submit proposed method to meet temperature requirements of this Section and method of curing concrete for Project Manager's approval.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301
- B. Maintain one copy of each document on site
- C. Acquire cement and aggregate from same source for all work
- D. Conform to INDOT Standards when concreting during hot weather
- E. Conform to INDOT Standards when concreting during cold weather
- F. All Testing shall be per INDOT Standards

1.4 COORDINATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

1.5 AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS

- A. Paved areas shall be provided to conform with ADA requirements. ADA requirements supersede Technical Specifications in this Section. Conform to ADA Accessibility Guidelines for Buildings and Facilities, and other applicable sections; and State and Local Codes.

PART 2 - PRODUCTS

2.1 CONCRETE PAVING

- A. Performance / Design Criteria:
 - 1. Per INDOT Standard
- B. Form Materials:
 - 1. Per INDOT Standard
- C. Reinforcement:
 - 1. As shown in Plans per INDOT Standard

2.2 MIXES

- A. Concrete Mix - By Performance Criteria:
 - 1. Mix and deliver concrete in accordance with INDOT Standards

2.3 FINISHES

- A. Shop Finishing - Reinforcement:
 - 1. Galvanized Finish for Steel Bars: Per INDOT Standard
 - 2. Epoxy Coated Finish for Steel Bars: Per INDOT Standard.
- B. Epoxy Coated Finish for Steel Wire: Per INDOT Standard

2.4 PAVEMENT MARKING MATERIALS

- A. Pavement markings shall be paint or thermoplastic, as referenced on the drawings. Materials shall be as specified in Indiana Department of Transportation standard specifications for Road Construction:
 - 1. Indiana White or Indiana Yellow per INDOT Standard Specifications
 - 2. Handicapped spaces shall be Blue per INDOT Standard Specifications

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement
- B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete
- C. Verify gradients and elevations of base are correct.
- D. Pre-Pour Conference
 - 1. Arrange a meeting with the Project Manager, ready mix suppliers, and Contractor's testing agency to review testing and sampling procedures for this job. At that meeting, be prepared to discuss temperature control and back-up delivery availability, etc. Schedule this meeting at least two weeks prior to first pour
- E. Pre-Pour Inspection
 - 1. Notify the Project Manager three days prior to beginning scheduled pour. The Project Manager, accompanied by the contractor's superintendent will inspect the following:
 - a. Subgrade preparation
 - b. Reinforcement placement
 - c. Water stop placement and securement
 - d. Reinforcement supports, chairs, etc
 - e. Joint layout

2. Correct deficiencies in the Work prior to placing concrete

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. Moisten substrate to minimize absorption of water from fresh concrete.
- C. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- D. Notify Project Manager minimum 24 hours prior to commencement of concreting operations.

3.3 INSTALLATION

- A. Place Concrete in accordance with INDOT Standards
- B. Notify Engineer in writing, minimum 36 hours prior to commencement of operations
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement
- D. Separate slabs on grade from vertical surfaces with 1/2-inch thick joint filler
- E. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete
- F. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface
- G. Install joint devices in accordance with manufacturer's instructions
- H. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete
- I. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish
- J. Install joint covers in one piece, longest practical length, when adjacent construction activity is complete
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken
- L. Place concrete continuously between predetermined expansion, control, and construction joints
- M. Do not interrupt successive placement; do not permit cold joints to occur
- N. Place floor slabs in pattern indicated
- O. Saw cut joints within 24 hours after placing. Use 3/16-inch thick blade, cut into 1/4 depth of slab thickness
- P. Screed slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft

3.4 CONCRETE FINISHING

- A. Finishing Formed Surfaces
 1. Honeycombed areas: Inspect honeycombed areas with the Owner. Patch minor areas and replace areas as directed by the Owner
 2. Exposed Unpainted Surfaces: Remove fins and projections, fill holes, and clean with a slurry consisting of one part cement and one and a half parts sand where needed to produce a uniform color. A mortar binder may be used in place of the slurry mix. Sikatop121 or equal
- B. Finishing Slabs
 1. Tolerance: Finished slabs shall have a maximum deviation in surface elevation of 1/4 inch to ten feet

2. Initial finishing: Immediately after screeding, bull float slabs before any excess moisture or bleeding water is present on the surface. After initial set, tool joints and edges. When the water sheen disappears and the concrete will adequately support the operation, float the surface by hand or machine with float shoes. Do no finishing while free water is present on surface. Retool joints and edges as required
3. Final finishing: After the above work, finish slabs in accordance with the following finish schedule and descriptions:
 - a. Hard Trowel Finish: For Exterior Pads, follow the first steel troweling with a second steel troweling to produce a dense, smooth surface after the surface has become hard enough to give a ringing sound from the trowel. Retool joints and edges as required
 - b. Light Broom Finish: For Sidewalks, Etc., after one steel troweling, draw a broom over the surface to provide a coarse texture. Retool joints and edges

3.5 FIELD QUALITY CONTROL

- A. Clean joints thoroughly with compressed air, wire brushing, or sandblasting. Install materials in accordance with manufacturer's instructions.

3.6 PATCHING

- A. Allow Project Manager to inspect concrete surfaces immediately upon removal of forms
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Project Manager upon discovery
- C. Patch imperfections, as directed, in accordance with INDOT Standards

3.7 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements
- B. Repair or replacement of defective concrete will be determined by the Project Manager
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Project Manager for each individual area

3.8 SCHEDULES

- A. Concrete types and finishes as shown on the drawings or herein specified

END OF SECTION

SECTION 32 17 13 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete parking bumpers.
 - 2. Parking bumper anchors.
- B. Related Requirements:
 - 1. Section 32 12 16 - Asphalt Paving.
 - 2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 5. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate the Work with pavement placement and parking striping.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product data along with unit configuration, with dimensions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with City/Town standards.

PART 2 - PRODUCTS

2.1 CONCRETE BUMPERS

- A. Concrete and Reinforcement Materials: Specified in Section 03 20 00 and 03 30 00.
- B. Concrete Mix: Minimum 5000 psi, 28 day strength, air entrained to 5 to 7 percent.
- C. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
- D. Embed reinforcing steel, and drill or sleeve for two dowels.
- E. Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

2.2 CONFIGURATION

- A. Nominal Size: 5 inches high, 9 inches wide, 72 inches long.
- B. Profile: Rectangular cross section with sloped vertical faces, square ends, with drainage slots.

2.3 ACCESSORIES

- A. Dowels: Steel, galvanized finish; 1/2 inch diameter, 18 inch long, pointed tip.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 2 dowels for each bumper.

END OF SECTION

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparation of subsoil.
 - 2. Placing topsoil.
- B. Related Sections:
 - 1. Section 32 05 13 - Soils for Exterior Improvements: Topsoil material.
 - 2. Section 32 92 19 - Seeding

1.2 COORDINATION

- A. Coordinate with other on-site utility work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Topsoil: As specified in Section 32 05 13 - Soils for Exterior Improvements.

2.2 SOURCE QUALITY CONTROL

- A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.
- C. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this section.

3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to depth of 4 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.
- D. Break up clods, pulverizing the top two inches of subgrade.
- E. Contour subgrade for positive drainage, and to required crossfall.
- F. Limit additional compaction to soils by controlling traffic.

3.3 PLACING TOPSOIL

- A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading. Foreign non-organic material includes: stones larger than 1 inch in any dimension, sticks, roots, rubbish, and other extraneous matter. Legally dispose of the foreign non-organic materials off the owner's property.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install edging at periphery of seeded areas in straight lines to consistent depth.

END OF SECTION

SECTION 32 92 19 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Seeding.
 - 3. Hydroseeding.
 - 4. Mulching.
 - 5. Maintenance.
- B. Related Sections:
 - 1. Section 32 05 13 - Soils for Exterior Improvements: Topsoil material.
 - 2. Section 32 91 13 - Soil Preparation

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.3 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

- A. Product Data: Submit data for seed mix, fertilizer, mulch, hydroseeding, and other accessories.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.7 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience or approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.9 MAINTENANCE SERVICE

- A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for three cuttings.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

- A. Seed Mixture: Seed mixture shall conform to the plan set.

2.2 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil to the following proportions: Nitrogen 10 percent, phosphoric acid 10 percent, and soluble potash 10 percent.
- C. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.
- E. Erosion Fabric: Jute matting, open weave.
- F. Stakes: Softwood lumber, chisel pointed.
- G. String: Inorganic fiber.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this section.

3.2 FERTILIZING

- A. Apply lime at application rate recommended by manufacturer's instructions. Work lime into top 6 inches of soil.
- B. Apply fertilizer at application rate recommended by manufacturer's instructions.
- C. Apply after smooth raking of topsoil and prior to roller compaction.
- D. Do not apply fertilizer at same time or with same machine used to apply seed.
- E. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Apply seed at rate of 8 lbs. per 1000 sq. ft., or per manufacturer's recommendations, evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: when temperatures are between 65-80 degrees Fahrenheit, or at the direction of Project Manager.
- D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- E. Immediately following seeding, apply mulch to thickness of 1/8 inches. Maintain clear of shrubs and trees.

- F. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

- A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 90 lbs. per 1000 sq. ft. evenly in one pass.
- B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.5 SEED PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 18 inches. Space stakes at 72 inches.
- B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.
- D. Secure outside edges and overlaps at 36-inch intervals with stakes.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- F. Immediately reseed areas showing bare spots.
- G. Repair washouts or gullies.
- H. Protect seeded areas with warning signs during maintenance period.

3.7 SCHEDULE

- A. All areas disturbed by construction shall be planted by grass seed, unless otherwise noted as sod, and maintained until growth is established according to requirements given herein.

END OF SECTION

APPENDIX A
SPECIAL PROVISIONS

SP 01 – SHELTER HOUSE -16X24

SHELTER SYSTEM AND MATERIALS

A. MANUFACTURERS:

1. The product shall be designed, produced, and finished at a facility operated and directly supervised by the supplier who has a minimum of (10) years in the business of making pre-manufactured shelters.
2. Bidder shall submit Manufacturer information with Bid.

B. PRODUCT REQUIREMENTS AND MATERIALS:

1. GENERAL: The pre-engineered package shall be pre-cut unless otherwise noted and pre-fabricated which will include all parts necessary to field construct the shelter. The shelter shall be shipped knocked down to minimize shipping expenses. Field labor will be kept to a minimum by pre-manufactured parts. Onsite welding is not necessary.
2. REINFORCED CONCRETE:
 - a. Concrete shall have minimum 28-day compressive strength of 3,000 psi and slump of 4" (+/- 1"), unless otherwise noted on the drawings.
 - b. Reinforcing shall be ASTM A615, grade 60.
3. STEEL COLUMNS:
 - a. Hollow structural steel tube minimum ASTM A500 grade B with a minimum wall thickness of 3/16".
 - b. Unless columns are direct buried, columns shall be anchored directly to concrete foundation with a minimum of four anchor rods to meet OSHA requirement 1926.755(a)(1).
4. STRUCTURAL FRAMING:

Hollow Structural Steel tube minimum ASTM500 grade B. "I" beams, tapered columns, or open channels shall not be accepted for primary beams.
5. COMPRESSION MEMBERS:

Compression rings of structural channel or welded plate minimum ASTM A36 or compression tubes or structural steel tube minimum ASTM A500 grade B shall only be used.
6. CONNECTION REQUIREMENTS:
 - a. Anchor bolts shall be ASTM F1554 (Grade 36) unless otherwise noted.
 - b. Structural fasteners shall be zinc plated ASTM A325 high strength bolts and A563 high strength nuts.
 - c. Structural fasteners shall be hidden within framing members wherever possible.
 - d. No field welding shall be required to construct the shelter.
 - e. All welds shall be free of burrs and inconsistencies.
 - f. Exposed fasteners shall be powder coated by manufacturer prior to shipment to match frame or roof colors as applicable.
 - g. Manufacturer shall provide extra structural and roofing fasteners.
7. ROOFING MATERIALS:
 - a. PRIMARY ROOF DECK: MEGA RIB METAL ROOFING (MG):
 - 1) Roofing shall be 24 gauge ribbed galvalume steel sheets, with ribs 1 1/2" high and 7.2" on center.

- 2) Roof panels shall be factory pre-cut to size and angled to provide ease of one-step installation.
 - 3) Metal roofing trim shall match the color of the roof and shall be factory made of 26 gauge Kynar 500 painted steel.
 - 4) Trim shall include panel ridge caps, hip caps, eave trim, splice channels, rake trim, roof peak cap, and corner trim as applicable for model selected. Trim may need to be cut to length and notched. Installation drawings shall have detailed information on how to cut and affix roof trim. Note: rake trim is optional on curved MG roofs.
 - 5) Ridge, hip, and valley caps shall be pre-formed with a single central bend to match the roof pitch and shall be hemmed on the sides.
 - 6) Roof peak cap shall be pre-manufactured.
 - 7) Manufacturer shall supply painted screws and butyl tape.
- b. PRIME COAT FINISH:
- 1) Steel shall be cleaned, pre-treated, and finished at a facility owned and directly supervised by the manufacturer.
 - 2) Steel shall be shot blasted to SSPC-SP10 near-white blasting. SSPC-SP2 hand tool cleaning will not be an acceptable alternative.
 - 3) Frame shall be prime coated with an off gray Super Durable TGIC powder coat.
 - 4) Primer shall not have any VOC emissions.
 - 5) Red oxide primer will not be an acceptable alternative.

Structural steel shall be detailed, fabricated, and erected in accordance with the latest edition of the American Institute of Steel Construction (AISC) specification manual and per the manufacturer's details and specifications. All welding is performed by American Welding Society certified welders and conforms to the latest edition of AWS D1.1 or D1.3 as required. For proper field installation of the building it is recommended that the primary frame installer and the roof installer have a minimum five (5) years documented experience installing this type of product. For proper field installation of the building it is recommended that electric wiring, if required, be run through the structural members before the building is erected.

SP 02 – LED FLOODLIGHT/AREA LIGHT

The floodlight will provide a minimum of 4032 Lumens and will be supplied complete with a metal lockable battery box, rechargeable batteries, a 140 Watt solar panel, a 20' steel pole, rebar anchor kit and hardware to allow the entire system to be fitted on the top of the pole.

The solar panel must be installed in a location where it can receive full direct sunshine (when available) and usually set facing South at an appropriate angle (where adjustment options allow). The solar panel must not be installed in a shaded or part shaded location and never indoors.

Light Fixture

System to include one heavy duty, weatherproof floodlight fixture.

Provide approx. 400 watts of incandescent light.

The floodlight fixture will be weather rated to I.P 65.

The floodlight fixture hardware may be positioned at any point on the pole above or below the

hardware kit.

Product dimensions (main floodlight body) approx. 11" x 12" x 4" (LxWxD).

Post / Pole

The pole will be made of galvanized steel.

The pole will include base plates and all hardware required for installation into a concrete base.

The CONTRACTOR will follow the manufacturers installation guidelines when installing the pole for the floodlight to attach to.

Battery Box

The LED Floodlight will include a battery box which is lockable (padlock not included).

Solar Panel

Aluminum framed 140 watt solar panel fitted with cable/cord.

Will include mounting frames to attach to the pole.

The hardware kit will allow the solar panel to be adjusted to a variety of different angles to suit the geographic location of the site.

140 watt solar panel dimensions approx. 44" x 39" x 2" (LxWxD). Size may vary depending upon solar panel wattage.

SP 03– PROPERTY BOUNDARY

The contractor is to place boulders between the parking area and the adjacent property to act as a visual boundary and to deter vehicles from pulling off into the grassy area. The CONTRACTOR will coordinate with the OWNER and ENGINEER on their size and placement on site. An approximate location can be found on sheet 8 of the plan set.

SP 04 – AREA WHERE EXCAVATION IS PROHIBITED

Please reference APPENDIX C Figure C-1 for areas where the contractor can not do any excavation activities. HWC will supply the CONTRACTOR with information regarding the location of the area. The CONTRACTOR is responsible for staking this area and ensuring that none take place within the limits as shown. This will not be paid for directly but will be included in the lump sum bid for the project.

SP 05– GEOTECHNICAL REPORT

Contrary to the Geotechnical report, the following geotechnical recommendations are NOT to be included in the Construction unless otherwise noted:

- Deep Foundations – The boat ramp will not be constructed on deep foundations.
- Pavement Drainage Considerations – These considerations will not be included in the Contractor's Base Bid. These considerations will be included in Alternate 1.

APPENDIX B
GEOTECHNICAL REPORT



Geotechnical Engineering Report

**Brooksborg Boat Ramp
E. Brooksborg River View Drive and S. Main Street
Brooksborg, Jefferson County, Indiana**

September 25, 2019
Terracon Project No. 57195038

Prepared for:
HWC Engineering
New Albany, IN

Prepared by:
Terracon Consultants, Inc.
Louisville, Kentucky



September 25, 2019

HWC Engineering
303 Scriber Dr., Suite 201
New Albany, IN 47150



Attn: Mr. Daniel Warren, P.E. – Project Engineer
P: (812) 913 6419
E: dwarren@hwcengineering.com

Re: Geotechnical Engineering Report
Brooksborg Boat Ramp
E. Brooksborg River View Drive and S. Main Street
Brooksborg, Jefferson County, Indiana
Terracon Project No. 57195038

Dear Mr. Warren:

We have completed the Geotechnical Engineering services for the above-referenced project. This study was performed in general accordance with Terracon Proposal No. P57195038 dated May 14, 2019 and authorized on June 11, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed boat ramp construction.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Suraj Khadka, EIT
Staff Engineer

Benjamin W. Taylor, PE
Senior Associate, Office Manager



REPORT TOPICS

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the [GeoReport](#) logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLAN
EXPLORATION RESULTS
SLOPE STABILITY ANALYSIS RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report
Brooksborg Boat Ramp
E. Brooksborg River View Drive and S. Main Street
Brooksborg, Jefferson County, Indiana
Terracon Project No. 57195038
September 25, 2019

INTRODUCTION

This report presents the results of our subsurface exploration, laboratory testing, and geotechnical engineering services performed for the proposed boat ramp to be located south of the intersection of E. Brooksborg River View Drive and S. Main Street in Brooksborg, Jefferson County, Indiana. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- foundation design and construction
- pavement subgrade parameters
- short-term groundwater conditions
- seismic site classification per IBC

The geotechnical engineering Scope of Services for this project included the advancement of eight test borings to depths ranging from approximately 26½ to 51½ feet below existing site grades.

Maps showing the site and boring locations are presented by the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on select soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of select publicly-available geologic and topographic maps.

Item	Description
Parcel Information	The project is located south of the intersection of Ohio River Scenic Byway (IN-56) and S. Brooksborg Main Street in Brooksborg, Jefferson County, Indiana. The boat Ramp will be constructed at the Ohio River near the Indian Kentuck Creek. See Site Location Latitude/Longitude 38.732459°N/-85.246073°W (approximate)
Existing Improvements	The site is undeveloped and currently serving as access to the Ohio River.
Current Ground Cover	Generally grassed, tree-lined along Ohio River and Indian Kentuck Creek. Refer to the Photography Log for site photos at the time of our work.
Existing Topography (from Schematic Plans dated 9/25/2018)	Based on the project design plans dated September 25, 2018 provided by HWC Engineering, grades along the existing roadway range from approximately elevation 458 feet near its confluence with the IN-56 to around 455 feet near the proposed pavilion. Grades along the proposed boat ramp range from a high elevation of 445 feet to an elevation of approximately 413 feet at the end of the boat ramp.
Subsurface Conditions	Based on the USDA Soil Survey Map of Jefferson County, Indiana, the surficial soils at the site are mapped as Rahm silty clay loam and Huntington silt loam. Bedrock at this location is expected to be at depths greater than 100 feet, becoming shallower further east and north of the river.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Information provided via email correspondence with Mr. Daniel Warren of HWC Engineering on April 11, 2019 consist of the following: <ul style="list-style-type: none"> ■ Project Design Plans IDNR-Brooksborg Boat Ramp 9-25-18.pdf ■ Alt 2-Default-000.pdf
Project Description	Construction of a new access road, boat ramp, parking lot, and a viewing pavilion. The design plans currently show a grade supported Portland Cement concrete pavement (PCCP) for the boat ramp. However, due to potential flooding and scour at the Ohio River, Terracon has provided recommendations for a deep foundation support of a structural slab. Based on the information provided, erosion protection to stabilize the river and creek banks near the proposed boat ramp is proposed using articulated concrete block mats.
Proposed Structure	The boat ramp and immediately adjacent pavement is expected to be PCCP, parking and access road are currently planned to be asphalt paved. The proposed viewing pavilion is expected to be an open-air, prefabricated metal shell covered shelter with a 4-inch slab-on-grade.
Structural Loading	Structural loading for the viewing pavilion building was not available at the time of this report. We understand that the foundations will be lightly loaded and assume that structural loads will not exceed 20 kips for columns and 50 psf for the slab. Considering boat ramp will be designed as a pile supported structural slab, Terracon should be provided with structural loading for additional analysis and to revise our recommendations, accordingly.
Grading/Slopes	Up to 5 feet of cut and 2 feet of fill will be required to develop grades along the access road and proposed boat ramp. Final grades along the boat ramp are currently set at 16 percent.

Geotechnical Engineering Report

Brooksborg Boat Ramp ■ Brooksborg, Jefferson County, Indiana

September 25, 2019 ■ Terracon Project No. 57195038



Item	Description
Pavements	<p>The boat ramp itself is planned to be an 8-inch PCCP with immediately adjacent drive areas planned to be 6-inch PCCP. Other pavement, including the access road and parking lot will be asphalt paved, current plans call for "Full Depth HMA pavement":</p> <ul style="list-style-type: none">■ 1½ inches (165 lbs per square yard) HMA Surface Type 'B'■ 2½ inches (275 lbs per square yard) HMA Intermediate, Type 'B'■ 10 inches compacted aggregate (No. 53)■ 14 inches chemical stabilization INDOT Subgrade treatment Type 1B <p>At the time of this report, neither traffic loading nor design life criteria have been provided for pavement thickness design recommendations. Therefore, Terracon has proposed to provide estimated traffic loading that the pavements would be structurally suitable to support based on the encountered geotechnical conditions.</p>
Estimated Start of Construction	2019

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Stratum	Layer Name	General Description
1	Clayey Sand and Sandy Clay	Clayey SAND (SC), very loose to loose Sandy Lean CLAY (CL), with silt, soft to medium stiff
2	Lean Clay	Lean CLAY (CL), with silt and fine sand, very soft to stiff
3	Poorly Graded Sand w/ Gravel	SAND (SP) with gravel, trace fines, loose to medium dense

The boreholes were observed immediately after completion of drilling for the presence and level of groundwater. Groundwater was observed in Borings B-1 and B-2 at respective depths of about 29 and 32 feet below the existing ground surface. No water was observed in the remaining six borings when observed after drilling. However, this doesn't necessarily mean the borings terminated over groundwater table or water levels observed in the borings B-1 and B-2 are stable groundwater levels. Due to the low permeability of the cohesive soils encountered in the borings, a relatively extended period may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells, sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, Ohio River water level and other factors not evident at the time the borings were performed. Based on the Profile Sheet of the project design plans dated September 25, 2018 provided by HWC Engineering, we understand that minimum pool of the Ohio River is at about elevation 420 feet. From review of the FEMA Flood Insurance Study for Jefferson County, IN version 1.1.1.0 we understand the 10% annual chance flood is at about elevation 456 feet. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Eight test borings were drilled to depths of 11½ to 51½ feet below existing site grades for the project. The test borings encountered sandy lean clay and clayey sand over lean clay and poorly graded sand with gravel. Our exploration did not encounter bedrock, which is expected at depths greater than 100 feet below the site.

The **Shallow Foundations** and **Floor Slab** sections address foundation and slab support for the lightly loaded viewing pavilion building.

The design plans currently indicate a grade-supported Portland Cement Concrete pavement (PCCP) for the boat ramp. However, based on the encountered geotechnical conditions and due to potential flooding and scour at the Ohio River, Terracon recommends that the boat ramp be constructed as a structural concrete slab bearing on deep foundations. The **Deep Foundations** section addresses preliminary design parameters for driven piles bearing within at least medium dense poorly-graded sand stratum encountered below a depth of about 40 feet. If the boat ramp is designed as a pile supported structural slab, Terracon should be provided with structural loading for additional analysis and to revise our recommendations, accordingly.

Preliminary slope stability analyses indicate adequate factors of safety along the proposed boat ramp. However, the slope along Indian Kentuck Creek will require stabilization to increase the factor of safety to recommended levels for static (1.5) and rapid-drawdown (1.3).

Final slope stability analyses and foundation recommendations for the boat ramp should consider input of scour analysis by others and lateral loading provided by the Structural Engineer.

The **Pavement** section discuss the proposed pavement design based on subgrade parameters for the proposed roadway with soil support value based on soil-index properties.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and pavements.

Site Preparation

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed construction areas. The subgrade should be proof-rolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proof-roll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by using stabilization techniques (moisture conditioning, undercutting and replacement, or chemical stabilization). Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Soil Type ¹	USCS Classification	Acceptable Location for Placement
Lean clay	CL (LL < 40)	All locations and elevations
Well graded granular or silty gravel	GW, GM ²	All locations and elevations
On site soils; clayey sand and sandy lean clay	SC and CL	On-site natural soils appear suitable for reuse as structural fill, provided moisture content is adjusted to near optimum moisture.

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used. Fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Similar to granular material such as sand, gravel or crushed stone containing no more than 10% low plasticity fines.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Description
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Compaction Requirements¹ (Structural Fill Areas)	Minimum 98% of the material's Standard Proctor maximum dry density (ASTM D 698)
Compaction Requirements¹ (General Fill Areas)	Minimum 95% of the material's Standard Proctor maximum dry density (ASTM D 698) provided future long-term plans do not include a structure.
Water Content Range²	Low plasticity cohesive: -3% to +3% of optimum Granular: -2% to +2% of optimum

1. Maximum density and optimum water content as determined by the Standard Proctor test (ASTM D698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted at least 70% relative density (ASTM D4253 and ASTM D4254).

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

Groundwater could affect over-excavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for

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construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

Shallow Foundation Design

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Item	Description
Maximum Net Allowable Bearing pressure ^{1, 2}	2,000 psf
Required Bearing Stratum ³	All foundations should bear on at least stiff native lean clay, lean concrete, or engineered fill as described in Earthwork .
Minimum Foundation Dimensions	Columns: 24 inches
Minimum Embedment below Finished Grade ⁴	30 inches
Estimated Total Settlement from Structural Loads ²	About 1 inch

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Factor of safety of 3 has been applied in this calculation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.

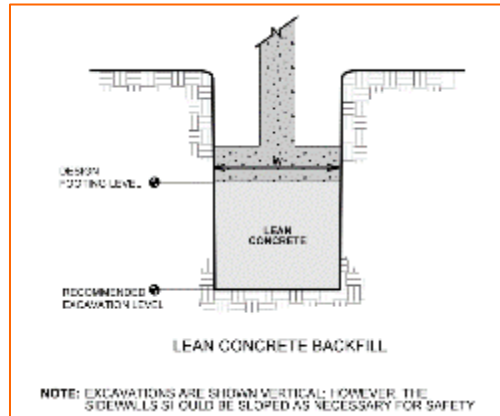
Shallow Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/soft/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

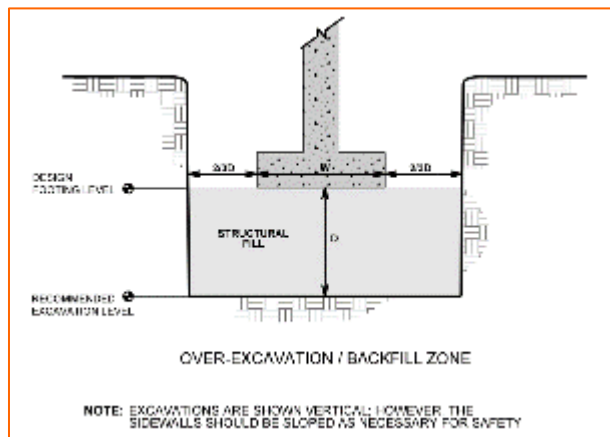
If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.

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Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with approved on-site soil or engineered fill, as recommended in the **Earthwork** section.



DEEP FOUNDATIONS

The design plans currently indicate a grade-supported Portland Cement Concrete pavement (PCCP) for the boat ramp. However, based on the encountered geotechnical conditions and due to potential flooding and scour at the Ohio River, Terracon recommends that the boat ramp be constructed as a structural concrete slab bearing on deep foundations. This section addresses preliminary design parameters for driven piles bearing within at least medium dense poorly-graded sand stratum encountered below a depth of about 40 feet.

Scour analysis should be performed to determine appropriate length of pile to be disregarded in the capacity calculations. The values provided do not consider scour depth which would require that the soil surrounding the piles is protected from future scour and erosion.

Considering the boat ramp will be designed as a pile supported structural slab, Terracon should be provided with structural loading for additional analysis and to revise our recommendations, accordingly.

Preliminary Driven Pile Design Parameters

The following design parameters are applicable to estimate capacities for individual pipe piles. The values are adequate for estimation of allowable load carrying capacity for driven piles to depths of 40 to 45 feet beneath the existing ground; pile depths will depend on results of scour analysis by the hydraulic engineer. Actual bearing depths of each pile should be determined in the field based on driving embedment criteria and observation by a representative of the geotechnical engineer.

Factors of safety of 2 and 3 have been used for allowable skin friction and allowable end bearing, respectively. Piles should be spaced no closer than three times the pile diameter, center-to-center to reduce the potential for group effects. The pile spacing is a function of the bearing capacity of the supporting stratum.

Approximate Depth (ft)	Stratum ²	Allowable Skin Friction (psf) ^{1, 3}	Allowable End Bearing Pressure (psf) ^{1, 4}
0 to 10 ⁵	1		Ignore
10 to 40	2	250	N/A
40 to 50	3	1,000	5,000

Approximate Depth (ft)	Stratum ²	Allowable Skin Friction (psf) ^{1, 3}	Allowable End Bearing Pressure (psf) ^{1, 4}
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1. Design capacities are dependent upon the method of installation and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
2. See test boring logs and **Geotechnical Characterization** for more details on Stratigraphy
3. Applicable for compressive loading only. Reduce to 2/3 of values shown for uplift loading. Effective weight of pile can be added to uplift load capacity.
4. Piles should extend at least one pile diameter into the bearing stratum for end bearing to be considered.
5. Recommend disregarding the upper 10 feet in calculations due to potential disturbance of these soils during construction.

Driven Pile Lateral Loading

The following table lists input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on strength; however, non-default values of k_h should be used where provided, in particular for the sand strata. Since deflection or a service limit criterion will likely control lateral capacity design, no safety/resistance factor is included with the parameters.

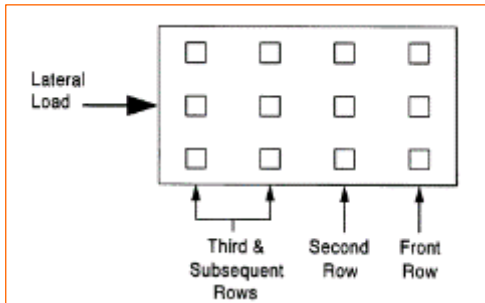
Approximate Depth (ft)	Stratum ¹	L-Pile Soil Model	S_u (psf) ²	ϕ ²	γ (pcf) ^{2, 3}	ϵ_{50} ²	K (pci) ²
0 to 10	1	Soft Clay (Matlock)	500	-	115	0.01	-
10 to 40	2	Stiff Clay (Matlock)	1000	-	120	0.007	-
40 to 50	3	Sand (Reese)	-	35°	120	-	90 above water 60 below water

1. See test boring logs and **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
 - S_u : Undrained shear strength
 - ϕ : Internal friction angle
 - γ : Moist unit weight
 - ϵ_{50} : Non-default E50 strain
 - K: Horizontal modulus of subgrade reaction
3. Buoyant unit weight values should be used below water table. Note that groundwater levels encountered by our borings are at a lower elevation than the minimum pool of the Ohio River is at about elevation 420 feet indicated on the Profile Sheet of the project design plans dated September 25, 2018 provided by HWC Engineering.

When piles are used in groups, the lateral capacities of the piles in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent pile. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pile foundations within a pile group are as follows:

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- Front row: $P_m = 0.8$
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the piles should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piles may be increased by increasing the diameter (for pipe piles) and/or length.

Driven Pile Construction Considerations

The contractor should select a driving hammer and cushion combination which can install the selected piling without overstressing the pile material. The hammer should have a rated energy in foot-pounds at least equal to 15 percent of the design compressive load capacity in pounds. The contractor should submit the pile driving plan and the pile hammer-cushion combination to the engineer for evaluation of the driving stresses in advance of pile installation. During driving a maximum of 10 blows per inch is recommended to reduce the potential of damage to the piles.

Pile driving conditions, hammer efficiency, and stress on the pile during driving could be better evaluated during installation using a Pile Driving Analyzer (PDA). A Terracon representative should observe pile driving operations. Each pile should be observed and checked for buckling, crimping and alignment in addition to recording penetration resistance, depth of embedment, and general pile driving operations.

The pile driving process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the pile installation process including soil/rock and groundwater conditions encountered, consistency with expected conditions, and details of the installed pile.

SEISMIC CONSIDERATIONS

Design of building and other structures subject to earthquake motions requires classification of the upper 100 feet of the site profile in accordance with Chapter 20 of ASCE 7. The Site Class types are basically defined by an average value of either shear wave velocity, standard penetration resistance, or undrained shear strength.

- A. Hard Rock
- B. Rock
- C. Very dense soil and soft rock
- D. Stiff Soil
- E. Soft Clay soil
- F. Soil Vulnerable to potential failure

Based on the results of our site characterization program, we conclude that Site Class **D** is appropriate for the subject site. Note that the scope of services did not include site profile determination to a depth of 100 feet. Exploration for this project extended to a maximum depth of 51½ feet below existing grade and the site classification assumes that materials encountered at the bottom of the deepest exploration continue to a depth of 100 feet.

PRELIMINARY SLOPE STABILITY

Mechanics of Stability

Slope stability analyses take into consideration material strength, presence and orientation of weak layers, water (piezometric) pressures, surcharge loads, and the slope geometry. Mathematical computations are performed using computer-assisted simulations to calculate a Factor of Safety (FS). Minor changes to slope geometry, surface water flow and/or groundwater levels could result in slope instability. Reasonable FS values are dependent upon the confidence in the parameters utilized in the analyses performed, among other factors related to the project itself.

Geometric Analysis Results

Slope stability analyses were performed for the cross-section geometries obtained from Grading Plan Boat Ramp & Parking Lot sheet of the project design plans dated September 25, 2018 provided by HWC Engineering . Parameters for the analyses were derived from our exploratory borings, experience, and laboratory tests. Stability analyses were conducted using the computer program SLIDE2 2018, Version 8 developed by Rocscience, Inc.

Unstable or Potentially Unstable Slopes

The stability of the slopes at the cross-section locations shown on the **Exploration Plan** were analyzed based on the provided topography, proposed grading, soil properties derived from our geotechnical exploration, laboratory test results and our experience with similar soil conditions. Soil properties used in the analyses are shown below:

Material	Moist Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)	RD Cr ¹ (psf)	RD PhiR ¹ (degrees)
Clayey Sand	115	20	28	500	28	-	-
Lean Clay	115	100	22	750	0	200 ¹	19 ¹
Lean Clay	115	50	20	450	0	200 ¹	5 ¹
Sand w/ Gravel	120	10	35	10	35	-	-

1. Rapid drawdown (RD) undrained strength used with RD total stress R linear envelope.

Based on our analyses, the calculated Factor of Safety (FS) for the critical surface identified in each section is shown below. Typically, a minimum FS of 1.5 is considered acceptable for long-term slope stability supporting improvements. We have additionally analyzed short-term slope stability for rapid-drawdown conditions due to flooding along the Ohio River and Indian Kentuck Creek; a minimum FS of 1.3 is recommended for rapid drawdown condition.

Cross-Section	Calculated Factor-of-Safety for Slopes	
	Long-term (Drained)	Rapid Drawdown (Undrained)
1	2.1	1.7
2	1.1	1.1

The calculated FS for global stability at cross-section 1 along the boat ramp is greater than recommended factor of safety for long-term and short-term rapid drawdown conditions. However, the calculated factor-of-safety at cross-section 2 along Indian Kentuck Creek are not adequate indicating potential for slope instability; stabilization is recommended to increase the factor of safety.

Surficial Slope Stability

Surface instability and erosion was observed on the slope along Indian Kentuck Creek adjacent to the proposed improvements during our site visits. Refer to photos 5 through 8 of our **Photography Log**. Surficial slope instability typically impacts the upper 5 feet of the subsurface profile, predominantly during extended wet periods. Regular maintenance should be anticipated to identify and address changes in natural drainage creating potential for soil creep or erosion near improvements. This includes replacing or replanting trees and grasses, as necessary, and grading the slope to reduce soil creep and erosion. If future surficial slope erosion occurs near the crest of slopes, we recommend the slope face be restored as soon as practical. We recommend irrigated landscaping be setback a minimum of 30 feet from the crest of the slopes.

FLOOR SLABS

Design parameters for the viewing pavilion floor slab assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support	Minimum 6 inches of free-draining (less than 5% passing the U.S. No. 200 sieve) crushed aggregate compacted to at least 95% of ASTM D 698 ^{1, 2}
Estimated Modulus of Subgrade Reaction ¹	100 pounds per square inch per inch (psi/in) for point loads

1. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
2. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and engineered fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

PAVEMENTS

General Pavement Comments

The provided project design plans included a planned design pavement section as noted in **Project Description** summarized below:

The boat ramp itself is planned to be an 8-inch PCCP with immediately adjacent drive areas planned to be 6-inch PCCP. Other pavement, including the access road and parking lot will be asphalt paved, current plans call for "Full Depth HMA pavement":

- 1½ inches (165 lbs per square yard) HMA Surface Type 'B'
- 2½ inches (275 lbs per square yard) HMA Intermediate, Type 'B'
- 10 inches compacted aggregate (No. 53)
- 14 inches chemical stabilization INDOT Subgrade treatment Type 1B

At the time of this report, neither traffic loading nor design life criteria have been provided for pavement thickness design recommendations. Therefore, Terracon has proposed to provide estimated traffic loading in Equivalent Single Axle Loads (ESALs) that the pavements would be structurally suitable to support based on the encountered geotechnical conditions.

A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

A subgrade CBR of 3 was used for the AC pavement designs, and a modulus of subgrade reaction of 110 pci was used for the PCCP pavement designs. The values were empirically derived based

upon our experience with the clayey sand and sandy lean clay subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. Assumed CBR and modulus of subgrade values should be confirmed during construction.

Design Pavement Section - Traffic Conditions

Based on our understanding of the design pavement thicknesses, we expect the design pavement section thicknesses adequate to support the following ESAL traffic loading conditions:

- Proposed 6-inch PCCP, assuming 6-inches of aggregate base course – 250,000 ESALs
- Proposed asphalt pavement – 2,000,000 ESALs

Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction area. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils to improve trafficability temporarily. Thus, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend the moisture content and density of the top 9 inches of the subgrade be evaluated and the pavement subgrades be proof rolled the day prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills.

After proof-rolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and developed as recommended in **Earthwork** section of this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

Pavement Drainage Considerations

The pavement subgrade should be shaped and sloped to a perforated catch basin to promote drainage of the aggregate base. Four-inch diameter finger drains, radiating out from the catch basins, should be utilized. These finger drains and any other trenches in the pavement subgrade should be backfilled with granular soil. Perimeter drains should be provided along the edge of pavement, where surface grades slope down toward the pavement without a curb and gutter. A goal should be to provide adequate drainage of the pavement aggregate base. Water beneath the pavement is the primary cause of premature pavement failure.

Flat grades should be avoided, and positive drainage provided away from the pavement edges. Backfilling of curbs should be accomplished as soon as practical to prevent ponding of water. Final grade adjacent to parking lots and drives should slope down from pavement edges at a minimum 2 percent grade. Subsurface drainage systems should be considered for any potential low elevation or poorly-drained areas, and in vicinity of any landscaping systems with sprinklers. The pavement subgrade should slope toward the sub-drain lines.

Pavement Maintenance

Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
3	26½ to 51½	Boat-ramp
5	11½	Access road

Boring Layout and Elevations: Terracon personnel provided the boring layout. Coordinates and elevations at the boring locations were obtained with a handheld GPS unit

Subsurface Exploration Procedures: We advanced the soil borings with a track-mounted drill rig using continuous-flight-hollow-stem augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels immediately after the completion of drilling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

Geotechnical Engineering Report

Brooksburg Boat Ramp ■ Brooksburg, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038



- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

PHOTOGRAPHY LOG



Photo 1: Site , Near Boring B-4 (North)



Photo 2: Site, Near Boring B-4 (Northeast)

Geotechnical Engineering Report

Brooksborg Boat Ramp ■ Brooksborg, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038



Photo 3: Ohio River Bank, Near Boring B-1 (Southwest)



Photo 4: Ohio River Bank, Near Boring B-1 (West)

Geotechnical Engineering Report

Brooksburg Boat Ramp ■ Brooksburg, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038



Photo 5: Slope along Indian Kentuck Creek (Northeast)



Photo 6: Slope along Indian Kentuck Creek (East)

Geotechnical Engineering Report

Brooksburg Boat Ramp ■ Brooksburg, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038

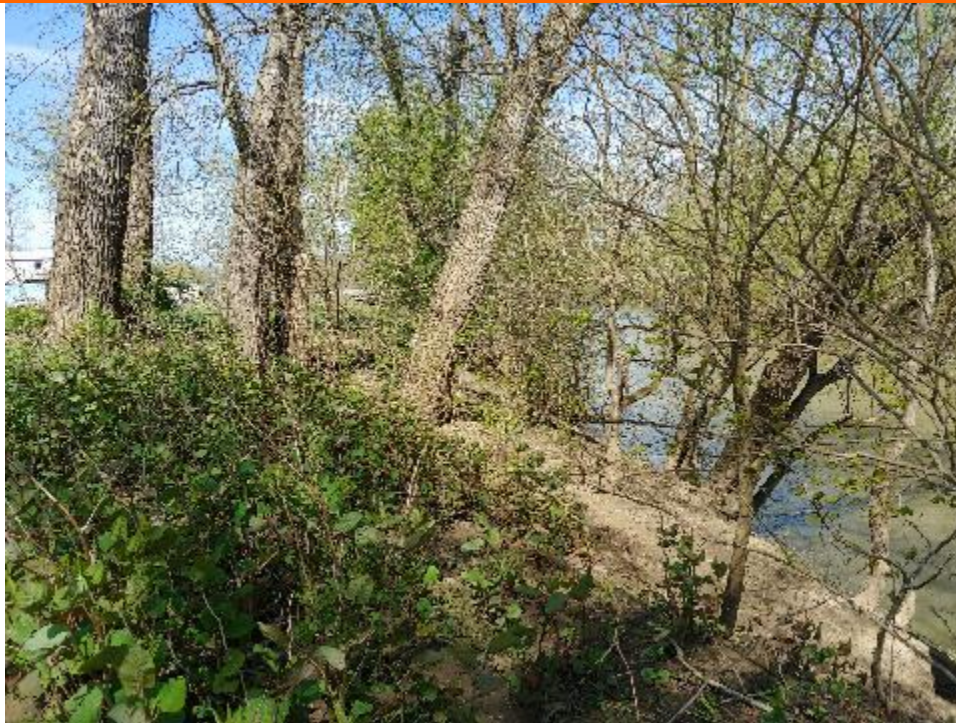


Photo 7: Slope along Indian Kentuck Creek (Northeast)



Photo 8: Slope along Indian Kentuck Creek (East)

SITE LOCATION

Brooksbury Boat Ramp ■ Brooksbury, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038



EXPLORATION PLAN

Brooksborg Boat Ramp ■ Brooksborg, Jefferson County, Indiana
September 25, 2019 ■ Terracon Project No. 57195038

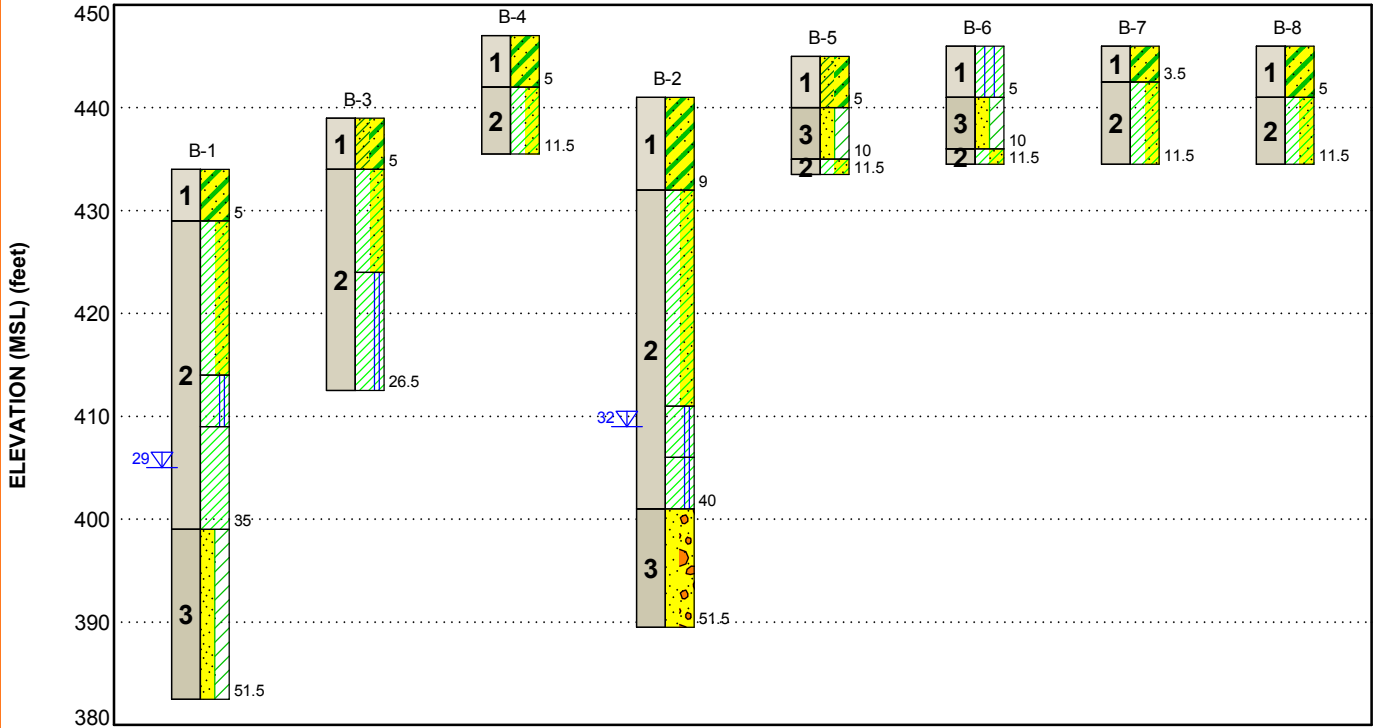


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

GEOMODEL

Brooksburg Boat Dock ■ Brooksburg, IN
Terracon Project No. 57195038



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Clayey Sand or Sandy Lean Clay	with silt, soft to medium stiff or very loose to loose
2	Lean Clay	with fine sand or silt, very soft to stiff
3	Poorly Graded Sand with Gravel	trace/with fines, loose to medium dense

LEGEND

- Clayey Sand
- Lean Clay
- Sandy Lean Clay/Clayey Sand
- Lean Clay with Sand
- Poorly-graded Sand with Clay
- Silty Clay
- Lean Clay with Silt
- Poorly-graded Sand with Gravel

Second Water Observation

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

BORING LOG NO. B-1

PROJECT: Brooksburg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksburg River View Drive and S. Main Street
Brooksburg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.73207° Longitude: -85.24612°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS
										LL-PL-PI
1		CLAYEY SAND (SC) , with silt, dark gray, loose	5.0			61	3-3-3 N=6		18	
			429+/-			89	4-2-3 N=5		14	
2		LEAN CLAY (CL) , with fine sand, dark gray, medium stiff to stiff	5			67	3-4-5 N=9	2 (HP)	24	
			10			56	0-4-5 N=9	2.5 (HP)	24	
			15			89	4-6-8 N=14	2.5 (HP)	25	
			20			78	3-3-4 N=7	3 (HP)	20	
		LEAN CLAY (CL) , with silt, brown, medium stiff	20.0			28	3-5-6 N=11	3 (HP)	22	
		LEAN CLAY (CL) , with silt, light gray to dark gray, very soft to medium stiff	25.0			100	4-3-4 N=7	1 (HP)	27	36-19-17

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling

Groundwater observed at 29' after drilling



Boring Started: 07-01-2019

Boring Completed: 07-01-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL-57195038 BROOKSBURG BOAT D - COPY.GPJ TERRACON_DATA\TEMPLATE.GDT 8/28/19

BORING LOG NO. B-1

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.73207° Longitude: -85.24612° Approximate Surface Elev: 434 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
2		LEAN CLAY (CL) , with silt, light gray to dark gray, very soft to medium stiff (<i>continued</i>)	30	▽	X	100	0-0-0 N=0	0.5 (HP)		
		35.0	35		X	72	8-6-6 N=12			
			40		X	56	5-6-10 N=16			
3		POORLY GRADED SAND (SP) , with clay, trace gravel, fine grained, brown and gray, medium dense	45		X	44	2-3-9 N=12			
			50		X	17	7-9-12 N=21			
		51.5	51.5							
		Boring Terminated at 51.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling

▽ Groundwater observed at 29' after drilling



Boring Started: 07-01-2019

Boring Completed: 07-01-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-2

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732375° Longitude: -85.24569° Approximate Surface Elev: 451 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (sf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		SANDY LEAN CLAY (CL) , with silt, dark gray, soft to medium stiff	9.0		X	56	2-3-2 N=5		16	32-22-10
			5		X	44	3-2-1 N=3		14	
			5		X	83	2-1-2 N=3		17	
			5		X	67	2-2-2 N=4		14	
			10		X	83	2-3-5 N=8	2 (HP)	25	
			15		X	72	2-2-5 N=7	2 (HP)	27	
			20		X	67	5-8-10 N=18	4 (HP)	23	
			25		X	28	3-3-6 N=9	4 (HP)	21	
			442+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling

∇ Groundwater observed at 32' after drilling



Boring Started: 07-01-2019

Boring Completed: 07-01-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-2

PROJECT: Brooksburg Boat Dock

**CLIENT: HWC Engineering
New Albany, IN**

**SITE: E. Brooksburg River View Drive and S. Main Street
Brooksburg, IN**

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MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732375° Longitude: -85.24569° Approximate Surface Elev: 451 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		LEAN CLAY (CL) , with fine sand, dark gray and brown, medium stiff to very stiff (<i>continued</i>)	30.0	421+/-	30	X	100	3-3-2 N=5	2 (HP)	
2		LEAN CLAY (CL) , with silt, iron oxide stains, brown and gray, medium stiff	35.0	416+/-	35	X	100	9-2-6 N=8	2 (HP)	
		POORLY GRADED SAND WITH GRAVEL (SP) , trace silt and clay, fine grained, brown and gray, medium dense	40.0	411+/-	40	X	28	5-8-8 N=16		
3			45.0	411+/-	45	X	56	8-8-9 N=17	1	
			50.0	399.5+/-	50	X	56	5-7-9 N=16		
		Boring Terminated at 51.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling
 Groundwater observed at 32' after drilling



Boring Started: 07-01-2019

Boring Completed: 07-01-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

BORING LOG NO. B-3

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732333° Longitude: -85.246°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS
										LL-PL-PI
		Approximate Surface Elev: 451 (Ft.) +/- ELEVATION (Ft.)								
1		SANDY LEAN CLAY (CL) , dark gray, medium stiff	5.0		X		3-4-4 N=8		16	
			446+/-		X		2-3-4 N=7		22	
		LEAN CLAY (CL) , with fine sand, dark gray and brown, medium stiff	15.0		X		3-3-4 N=7	1.5 (HP)	21	33-20-13
			436+/-		X		3-4-3 N=7	1.5 (HP)	22	
			10		X		2-3-5 N=8		31	
2		LEAN CLAY (CL) , with silt, trace fine sand and iron oxide stains, brown and gray, medium stiff to stiff	15.0		X		4-4-4 N=8	2.5 (HP)	24	
			436+/-		X		4-4-5 N=9	3.5 (HP)	22	
			20		X		3-5-7 N=12	4 (HP)	21	
			26.5		X					
		Boring Terminated at 26.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling
No groundwater observed after drilling



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-4

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732548° Longitude: -85.246115° Approximate Surface Elev: 451 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		SANDY LEAN CLAY (CL) , dark gray, medium stiff	5.0		X		6-5-3 N=8		10	
2		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, medium stiff	11.5		X		2-3-2 N=5		16	
			5		X		2-2-2 N=4		20	
			10		X		2-2-3 N=5	2.5 (HP)	21	
			11.5		X		4-4-5 N=9	2.5 (HP)	23	
		Boring Terminated at 11.5 Feet	446+/-							
			439.5+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling
No groundwater observed after drilling



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-5

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732552° Longitude: -85.24581° Approximate Surface Elev: 452 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		SANDY LEAN CLAY (CL) , dark gray, medium stiff	5.0		X		5-4-3 N=7		14	
3		POORLY GRADED SAND (SP) , with clay, fine grained, brown and gray, loose	10.0		X		3-3-4 N=7		19	
2		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, medium stiff	11.5		X		3-3-3 N=6		25	
		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, medium stiff	447+/-		X		2-3-3 N=6			
		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, medium stiff	442+/-		X		3-4-3 N=7	0.75 (HP)		
		Boring Terminated at 11.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling
No groundwater observed after drilling



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-6

PROJECT: Brooksburg Boat Dock

**CLIENT: HWC Engineering
New Albany, IN**

**SITE: E. Brooksburg River View Drive and S. Main Street
Brooksburg, IN**

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.732794° Longitude: -85.245982° Approximate Surface Elev: 456 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		SILTY CLAY (CL-ML) , dark gray, medium stiff to stiff	5.0		X		7-5-4 N=9		10	21-17-4
3		POORLY GRADED SAND (SP) , with clay, trace gravel, fine grained, brown and gray, loose to medium dense	5		X		4-3-3 N=6	3.5 (HP)	18	
2		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, stiff	10.0		X		6-5-6 N=11			
			10		X		4-4-4 N=8			
			11.5		X		4-5-6 N=11	4 (HP)	19	
		Boring Terminated at 11.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

*No groundwater observed during drilling
No groundwater observed after drilling*



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

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BORING LOG NO. B-7

PROJECT: Brooksborg Boat Dock

CLIENT: HWC Engineering
New Albany, IN

SITE: E. Brooksborg River View Drive and S. Main Street
Brooksborg, IN

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.733505° Longitude: -85.245432° Approximate Surface Elev: 456 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		CLAYEY SAND (SC) , dark gray, very loose to loose	3.5		X		0-0-0 N=0			
2		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, stiff to very stiff	11.5		X		6-3-4 N=7		18	
			5		X		4-3-4 N=7	2.5 (HP)	22	
			10		X		3-4-6 N=10	3 (HP)	21	
			11.5		X		6-4-4 N=8	2.5 (HP)	22	
		Boring Terminated at 11.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

No groundwater observed during drilling
No groundwater observed after drilling



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

Driller: C. Coldiron

Project No.: 57195038

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL- 57195038 BROOKSBURG BOAT D - COPY.GPJ TERRACON_DATATEMPLATE.GDT 8/28/19

BORING LOG NO. B-8

PROJECT: Brooksburg Boat Dock

**CLIENT: HWC Engineering
New Albany, IN**

**SITE: E. Brooksburg River View Drive and S. Main Street
Brooksburg, IN**

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.734017° Longitude: -85.245012° Approximate Surface Elev: 456 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (sf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		CLAYEY SAND (SC) , dark gray, very loose to medium dense	5.0		X	0	0-0-0 N=0		20	
2		LEAN CLAY (CL) , with fine sand, trace iron-oxide stains, dark gray and brown, stiff to very stiff	11.5		X	44	3-5-6 N=11	3 (HP)		
			5		X	56	4-4-6 N=10	1.5 (HP)		
			10		X	56	6-6-5 N=11	3 (HP)	20	
			11.5		X	56	7-8-13 N=21	3.5 (HP)	20	
		Boring Terminated at 11.5 Feet	444.5+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch continuous-flight-hollow-stem augers
2-inch split-barrel sampler

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: GPS Survey

WATER LEVEL OBSERVATIONS

*No groundwater observed during drilling
No groundwater observed after drilling*



Boring Started: 07-02-2019

Boring Completed: 07-02-2019

Drill Rig: D-50

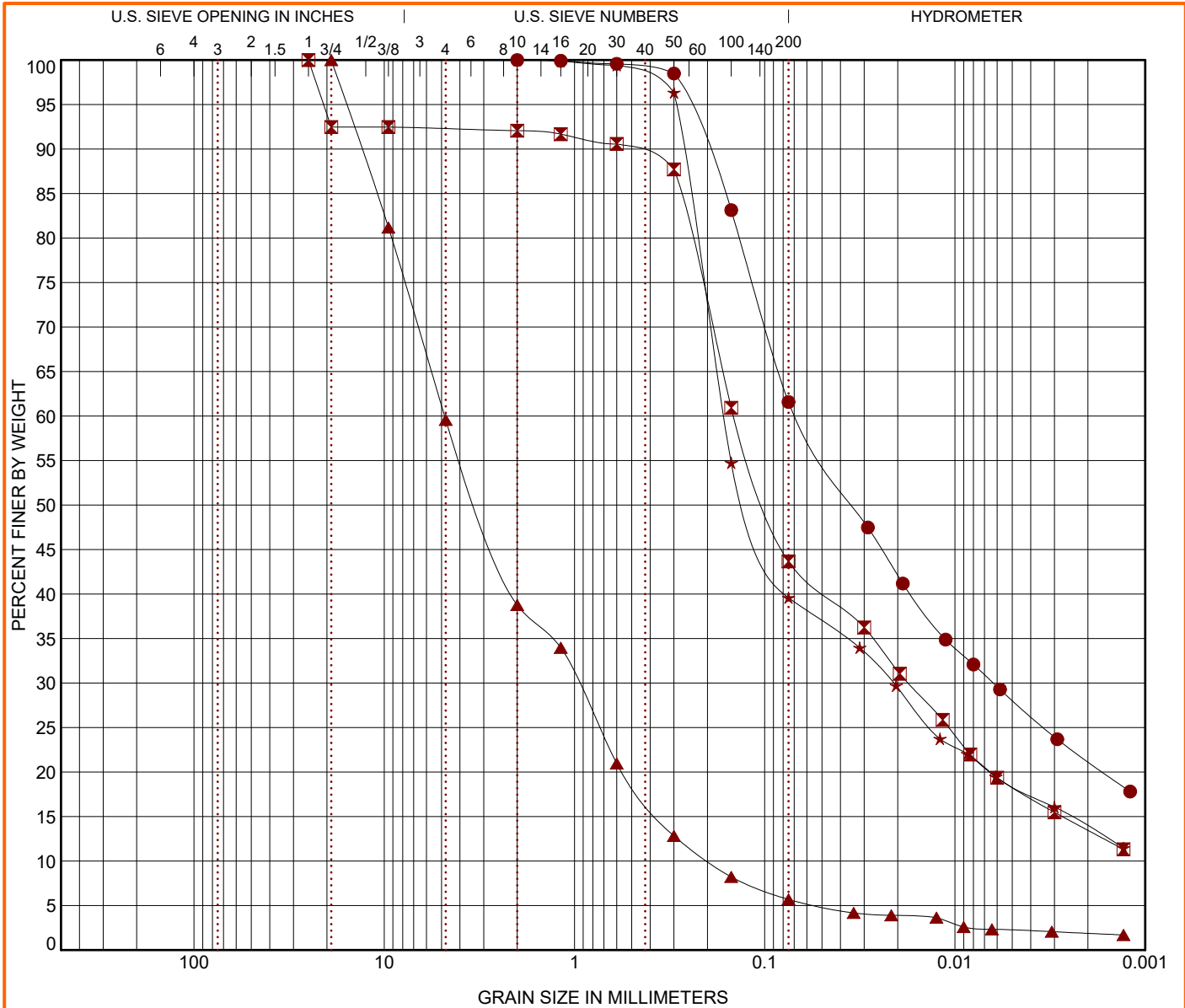
Driller: C. Coldiron

Project No.: 57195038

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 57195038 BROOKSBURG BOAT D. - COPY.GPJ TERRACON_DATA\TEMPLATE.GDT 8/28/19

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B-1	2.5 - 4	SANDY LEAN CLAY	14					
■ B-2	2.5 - 4	CLAYEY SAND, TRACE GRAVEL	14					
▲ B-2	45 - 46.5	POORLY GRADED SAND WITH GRAVEL					0.98	24.57
★ B-5	2.5 - 4	CLAYEY SAND	19					

Boring ID	Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-1	2.5 - 4	2	0.067	0.006		0.0	38.4	33.5		28.1
■ B-2	2.5 - 4	25	0.145	0.018		7.7	48.6	25.3		18.3
▲ B-2	45 - 46.5	19	4.816	0.96	0.196	40.4	53.9	3.5		2.2
★ B-5	2.5 - 4	2	0.164	0.021		0.0	60.4	21.1		18.5

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 57195038 BROOKSBURG BOAT D - COPY.GPJ TERRACON_DATATEMPLATE.GDT 8/6/19

PROJECT: Brooksburg Boat Dock

SITE:
Brooksburg, IN



PROJECT NUMBER: 57195038

CLIENT: HWC Engineering
New Albany, IN

SLOPE STABILITY ANALYSIS CROSS-SECTIONS

Brooksburg Boat Ramp ■ Brooksburg, IN

September 25, 2019 ■ Terracon Project No. 57195038

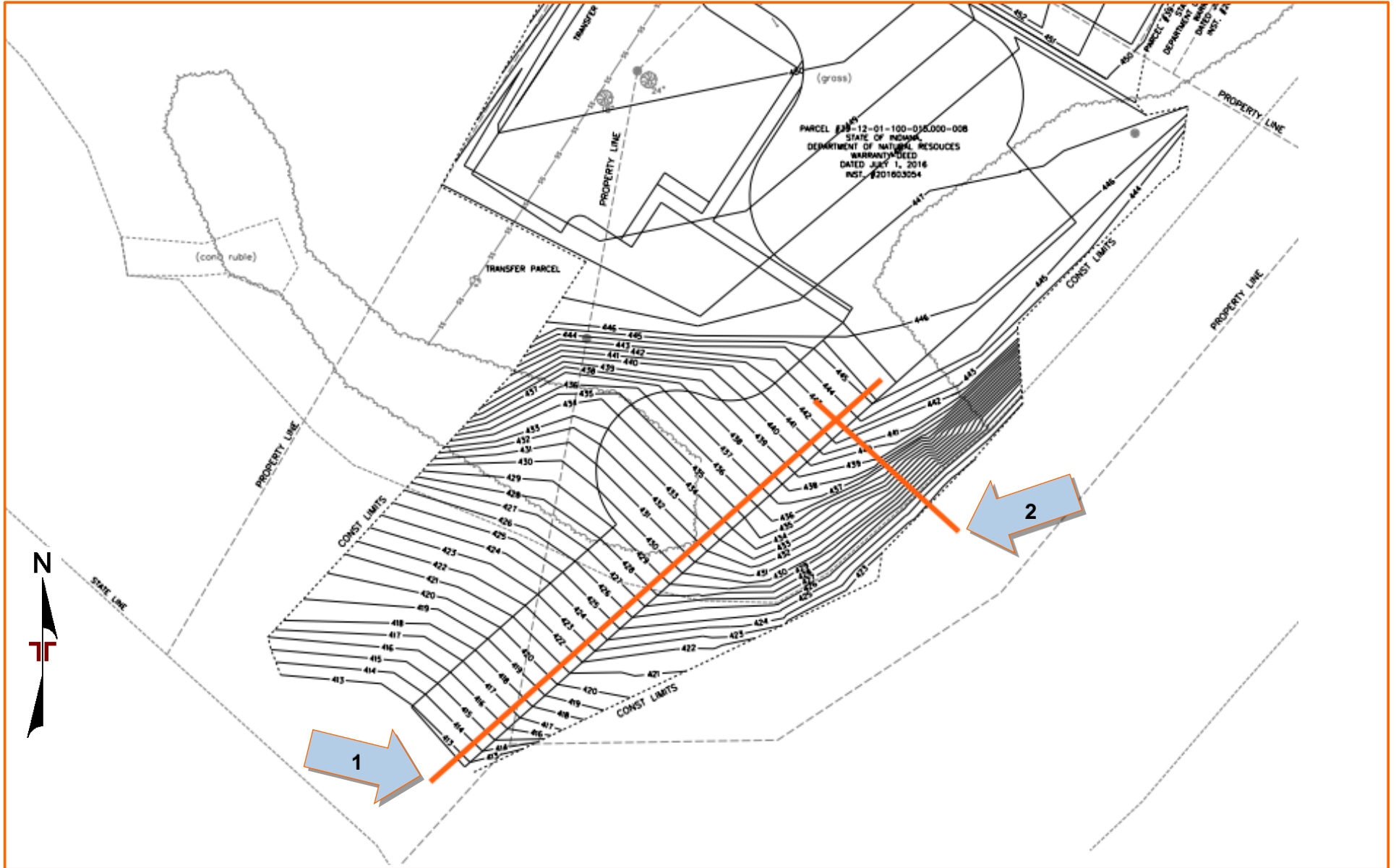
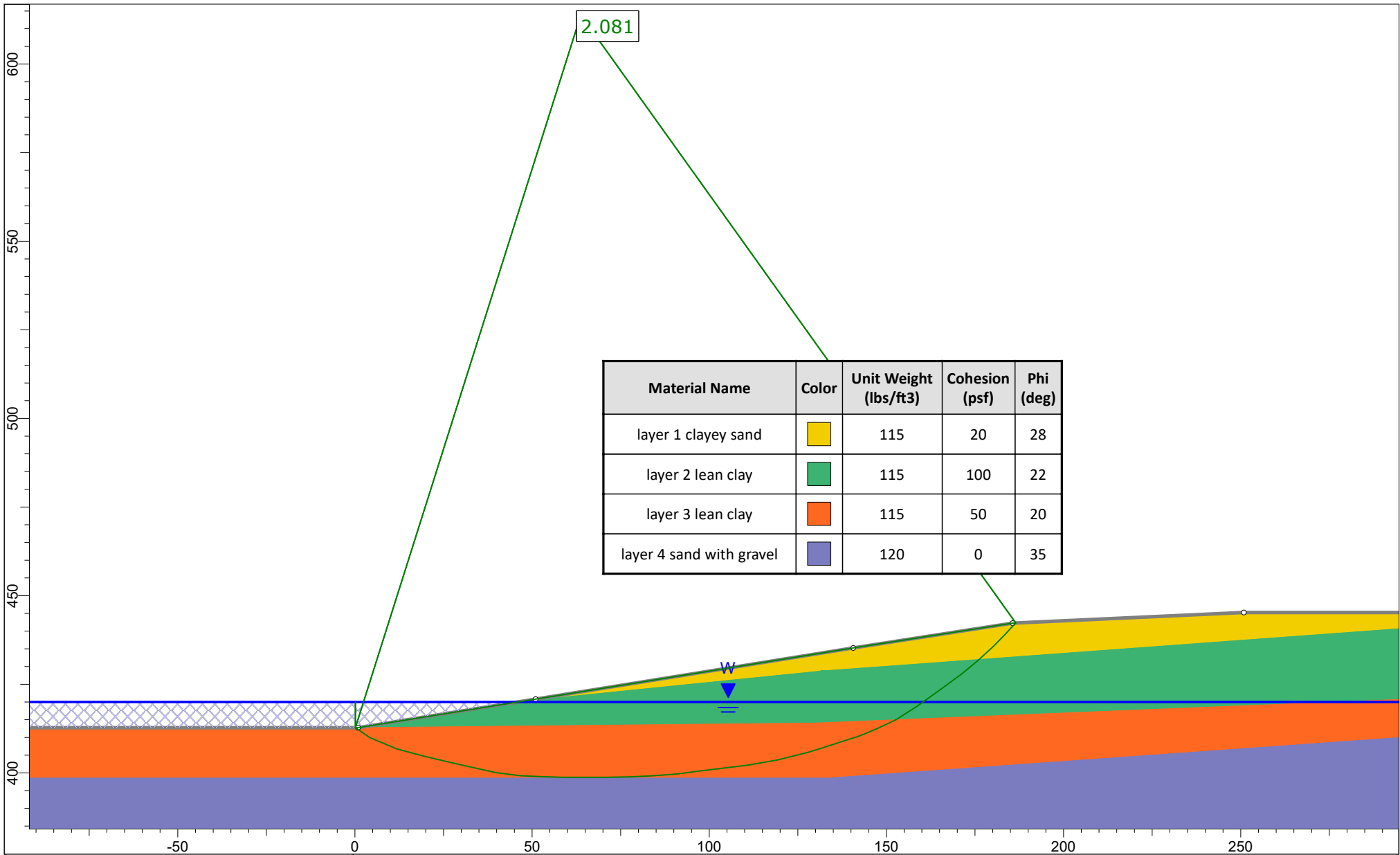



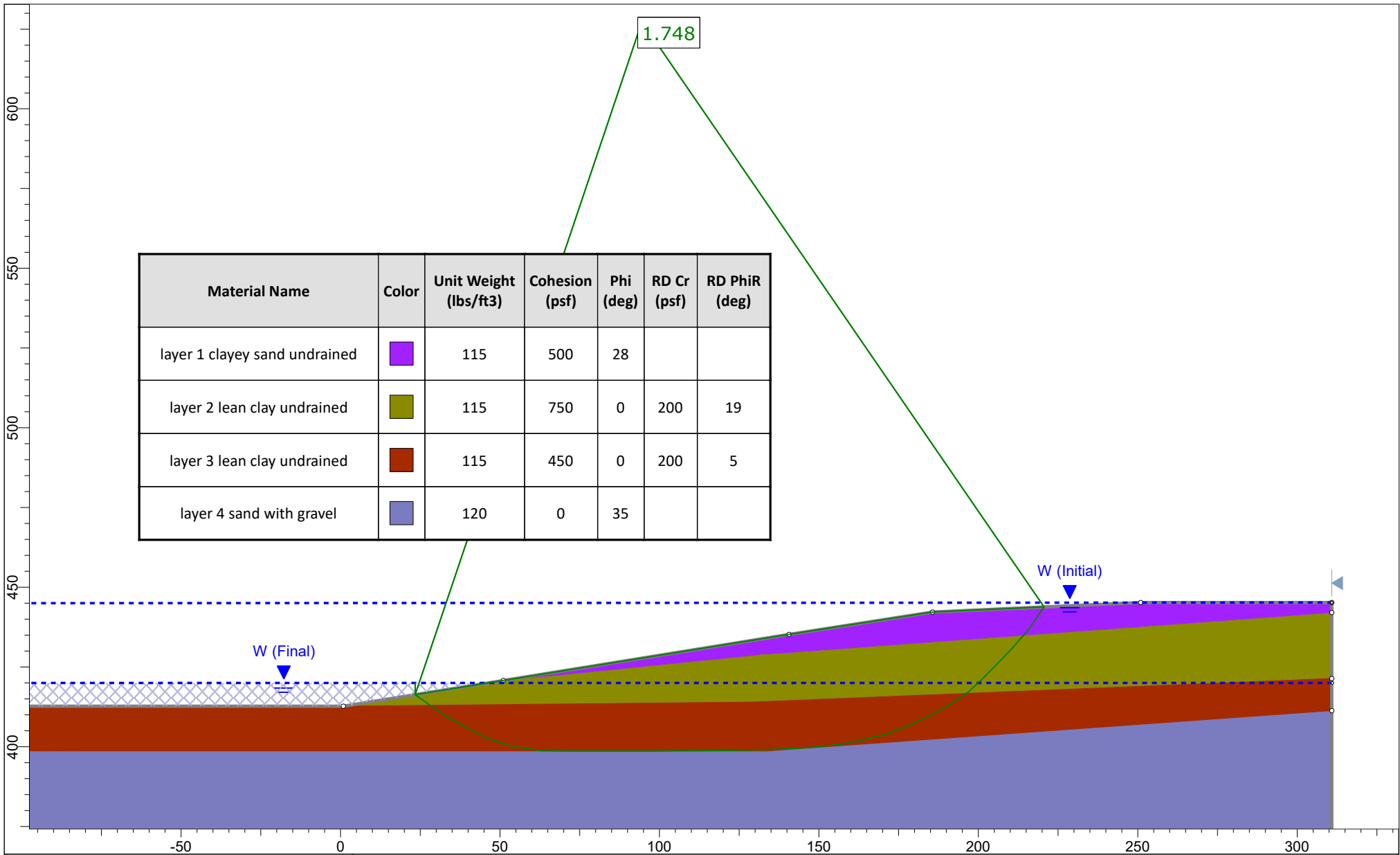
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES





TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: MADISON EAST, IN (1/1/1994) and CARROLLTON, KY (1/1/1994).




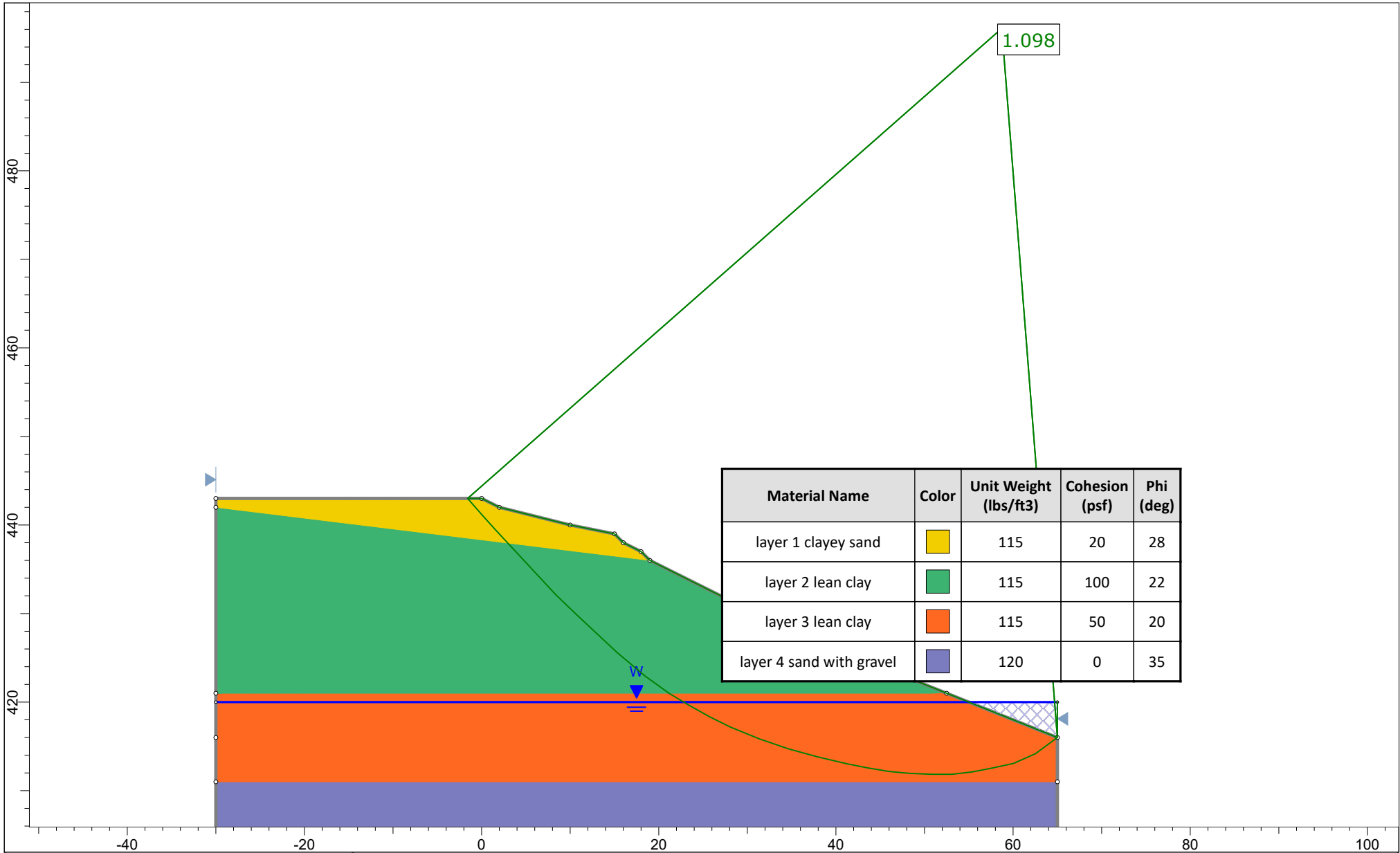
Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
layer 1 clayey sand	Yellow	115	20	28
layer 2 lean clay	Green	115	100	22
layer 3 lean clay	Orange	115	50	20
layer 4 sand with gravel	Purple	120	0	35





	<i>Project</i> Geotechnical Engineering Report 57195038 Brooksburg Boat Ramp E. Brooksburg River View Drive and S. Main Street Brooksburg, Jefferson County, Indiana		
	<i>Analysis Description</i> Cross-section 1 Long-Term		
	<i>Drawn By</i> L. Duan	<i>Scale</i> 1:450	<i>Company</i> Terracon
	<i>Date</i> 9/12/2019	<i>File Name</i> 57195038.slmd	
	<small>SLIDEINTERPRET 8.018</small>		




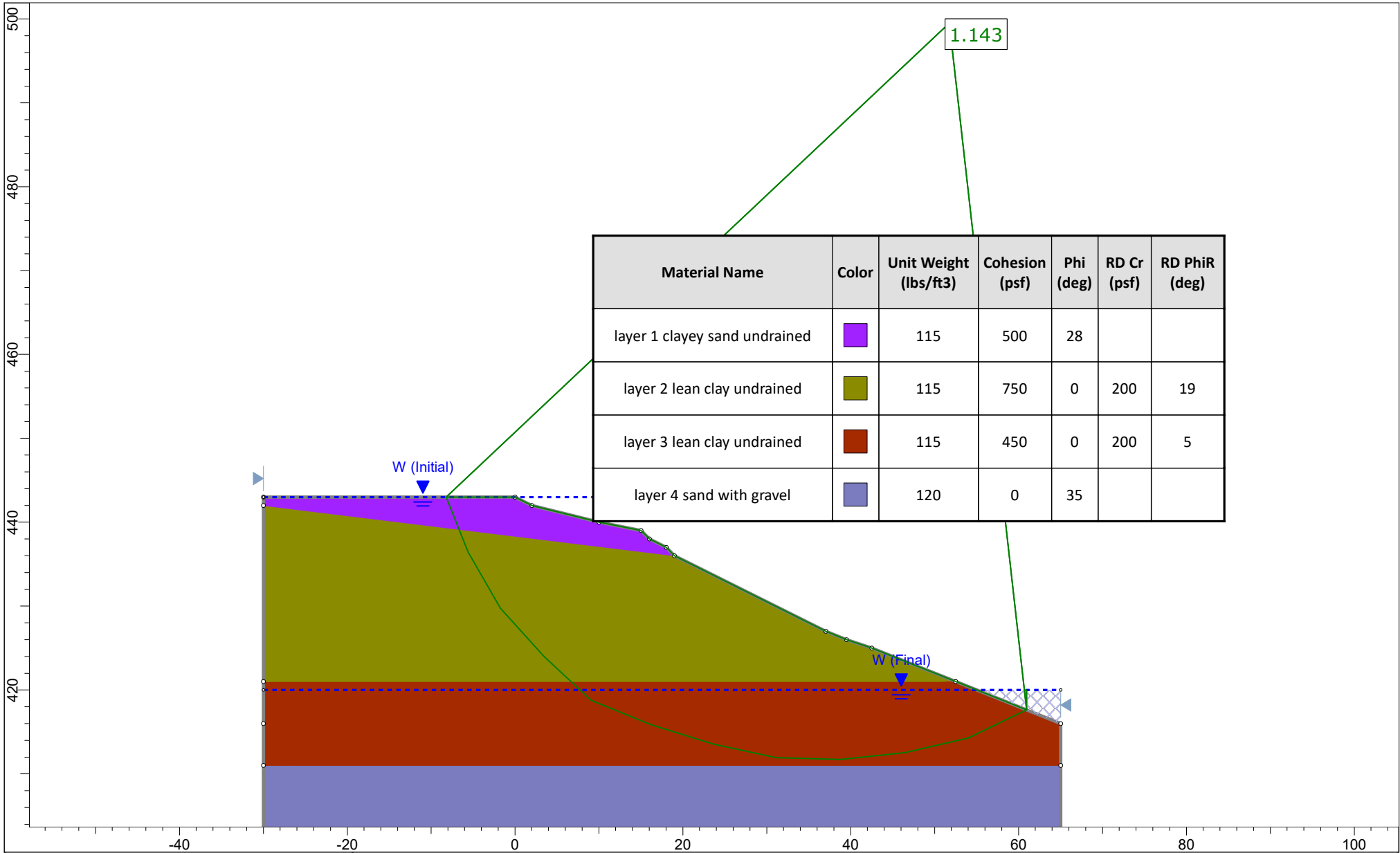
Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)	RD Cr (psf)	RD PhiR (deg)
layer 1 clayey sand undrained		115	500	28		
layer 2 lean clay undrained		115	750	0	200	19
layer 3 lean clay undrained		115	450	0	200	5
layer 4 sand with gravel		120	0	35		





	<i>Project</i> Geotechnical Engineering Report 57195038 Brooksburg Boat Ramp E. Brooksburg River View Drive and S. Main Street Brooksburg, Jefferson County, Indiana		
	<i>Analysis Description</i> Cross-section 1 Rapid Drawdown		
	<i>Drawn By</i> L. Duan	<i>Scale</i> 1:500	<i>Company</i> Terracon
	<i>Date</i> 9/12/2019		<i>File Name</i> 57195038.slmd
	<small>SLIDEINTERPRET 8.018</small>		




Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
layer 1 clayey sand		115	20	28
layer 2 lean clay		115	100	22
layer 3 lean clay		115	50	20
layer 4 sand with gravel		120	0	35

	<i>Project</i> Geotechnical Engineering Report 57195038 Brooksburg Boat Ramp E. Brooksburg River View Drive and S. Main Street Brooksburg, Jefferson County, Indiana		
	<i>Analysis Description</i> Cross-section 2 Long-Term		
	<i>Drawn By</i>	<i>Scale</i> 1:180	<i>Company</i>
	<i>Date</i> 9/12/2019, 9:30:45 AM	<i>File Name</i> 57195038-section 2.slmd	



Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)	RD Cr (psf)	RD PhiR (deg)
layer 1 clayey sand undrained		115	500	28		
layer 2 lean clay undrained		115	750	0	200	19
layer 3 lean clay undrained		115	450	0	200	5
layer 4 sand with gravel		120	0	35		





	Project Geotechnical Engineering Report 57195038 Brooksborg Boat Ramp E. Brooksborg River View Drive and S. Main Street Brooksborg, Jefferson County, Indiana		
	Analysis Description Cross-section 2 Rapid Drawdown		
	Drawn By	Scale 1:190	Company
	Date 9/12/2019, 9:30:45 AM	File Name 57195038-section 2.slmd	

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Brooksborg Boat Dock ■ Brooksborg, IN

Terracon Project No. 57195038

SAMPLING	WATER LEVEL	FIELD TESTS
 Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time	(N) Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer (UC) Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer
	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

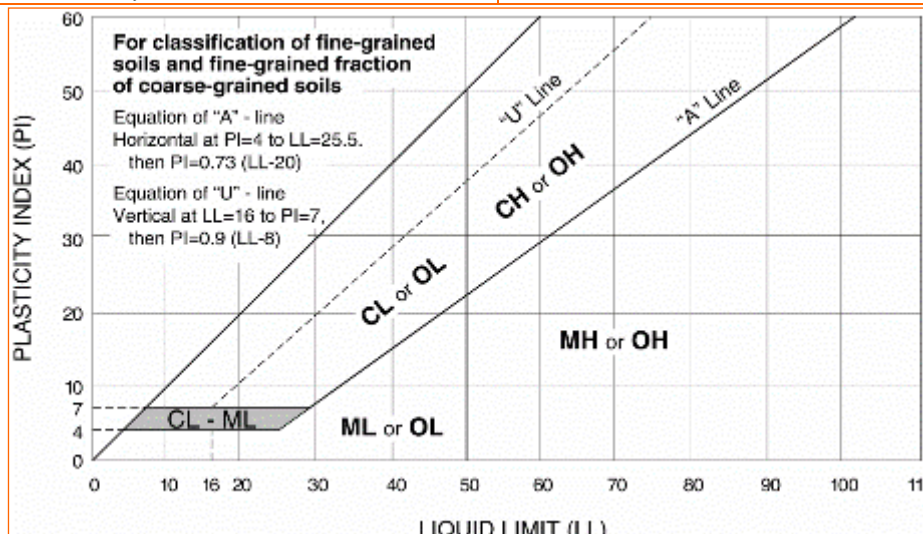
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



APPENDIX C
SENSITIVE AREA



Area to avoid excavation activities. Fig.C-1