

VC & UAB at the Fort Fisher State Historic Site

June 29, 2022

Project Name

CM Clarification #4

Date: June 29, 2022

Project: **Visitor Center & Underwater Archaeology Building
At the Fort Fisher State Historic Site**

The following items modify, add to or delete from the contract documents, plans, specifications and bid manual dated May 25, 2022, for this project. Acknowledge receipt of this CM Clarification in your proposal. Failure to do so may result in the disqualification of your bid. Wherein this Clarification varies or is in conflict with the Contract Documents, the requirements of this Clarification shall govern. In all other particulars, the requirements of the original Project Manual and Contract Documents, including any previous Addenda or Clarifications, shall govern.

This clarification consists of 12 items, 06 attachments, 44 sheets (8.5x11) and 00 sheets (24 x 36)

GENERAL and CLARIFICATION:

Item 01: Scope Clarification---All Trades

RFI inquiry: Please clarify when Composite Clean-up Crew requirements begin

CM Response: Composite Clean-up Crews begin once the building is enclosed with multiple trades working within

RFI inquiry: BP-03A Concrete, Scope Item General Concrete Notes #j--please clarify re-compaction of soil subgrade requirements for SOG

CM Response: Building pad subgrade will be compacted, tested and rough-graded by BP-31A prior to BP-03A acceptance. Each trade, which performs underground work within the building pad, is responsible for proper backfill and compaction of its work. BP-03A should anticipate some compaction work as part of its SOG preparation.

Item 02: Scope Clarification---BP-03A Building Concrete

RFI inquiry: BP-03A Concrete, Scope Item General Concrete Notes #g--please clarify temporary heating requirements for cold weather protection

CM Response: Delete temporary heating and enclosure of structure

RFI inquiry: UAB Foundations: Please advise if foundations can be raised from -6'-0" FFE; this depth requires significant over-excavation for access and safety in order to construct the footings & piers

CM Response: No, depth is set to protect foundations from scour/erosion

RFI inquiry: Spec 312000-2.1-F Drainage Course: Can the drainage course material below SOG be sand in lieu of #57 stone, especially for Visitor Center?

CM Response: A clean, fine graded material with at least 10%-30% of particles passing a No. 100 sieve but not contaminated with silt, clay, or organic material is acceptable. Manufactured sand from rock-crushing operations is acceptable. Clean sand with a uniform particle size such as concrete sand meeting ASTM C33 is NOT acceptable.

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Item 03: Scope Clarification---BP-03A Concrete and BP-31B Special Foundations

RFI inquiry: Please advise the elevation for ACP to be terminated for BP-03A to commence pile caps

CM Response: Augur cast piles should be terminated at -10'-0" FFE, with no more than +6" tolerance

Item 04: Scope Clarification---BP-05A Steel & BP-08A Glass

RFI inquiry: Please clarify which trade has the SST cable railings (i.e., Key Note #14, AE201 & Spec 057300)

CM Response: BP-05A has the "cable" railing (Scope Item 8.a.i.13); refer to AS103 & AE 201
BP-08A has the illuminated railing with cable infill at balcony (Spec 057300-1.2.A.2)

Item 05: Scope Clarification---BP-10A Specialties

RFI inquiry: Projection screens are noted in Spec 115213 & 115500; please advise which spec governs and which trade provides screens, etc.

CM Response: Delete Spec 115213 and Scope Item 6.a.vii requirement to provide projection screens; screens, etc. provided under a CM Allowance

Item 06: Scope Clarification---BP-21A Fire Suppression

RFI inquiry: Follow-up to CM Clarification 03, Item 14—Fire Pump

CM Response: Preliminary Design hydraulic calcs and floor plans are provided for information only.

Item 07: Scope Clarification---BP-23A HVAC / Mechanical

RFI inquiry: A1/MH101U & D3/AE701U: AHU-2-U wall louver U-L2 indicates a motor-operated louver while D3/AE701U indicates a fixed-blade louver; please clarify requirements and amend details accordingly

CM Response: These are motor operated louvers as indicated on MH101U

RFI inquiry: M601U--Lab Fan Schedule & Spec 233416: Please advise if lab fan requires a weatherhead; if so, does weatherhead require guy wires

CM Response: Yes; refer to key note #11 on drawing sheet MH101U, adjacent to utility fan

Item 08: Scope Clarification---BP-05A Steel

RFI inquiry: Alternate #1, Vol 2 Spec: Please provide section 055213 Pipe & Tube Railings in order to make Volume 2 stand-alone; refer to CM Clarification 03, Item 6

CM Response: Specification transmitted via this CM Clarification

Item 09: Scope Clarification---BP-12B Casework

RFI inquiry: AF601 Finish Legend: Please provide spec for the solid surface material (SSM1) indicated in the description

CM Response: Specification 0123661.16 transmitted via this CM Clarification

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Item 10: Scope Clarification---BP-08A Storefront & Glazing

RFI inquiry: Spec 088000-3.8 & 3.9 and Drawings AE701 & AE710--Glazing Type & Thickness:
1) Spec does not list GL-2 which is indicated at 1-5/16" insulated glass; please provide information; 2) IGU-1 & 2 do not appear on elevations; please advise location or deleted spec reference; 3) YKK & Kawneer standard glazing thickness for indicated metal frame is 1-1/8", glazing at 1-5/16" is too large for frame; please advise design intent.

CM Response: Glazing must meet the large missile impact requirement; provide IGU thickness that meets the requirement

Item 11: Additional Approved Bidders

The following company has been added as an approved Bidder:

BP-31B Special Foundations

Morris-Shea Bridge Co

Item 12: Scope Clarification---BP-31A Site Turnkey

RFI inquiry: Is a CAD file available?

CM Response: CAS file is available upon request

RFI inquiry: Unit Paving Spec 321400-2.2-A & B, Drawings L201, Key Note G & L302--Entry & Plaza Pavers: Spec indicates two types, three sizes & three colors; Drawings refer to specs with layout of linear pattern by Contractor. Please provide design intent for patterns and colors

CM Response: Revised spec is transmitted via this CM Clarification deleting the 30x5 pavers

Provide: Riviera 30x30: Approximately 15% of the total plaza pavers
Ivory 20x30: Approximately 85% of the total plaza pavers

End of CM Clarification No. 4

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer registered in the State of North Carolina, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- D. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.4 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Form Changes in Direction as Follows:
 - 1. As detailed.
- I. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- N. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.5 STEEL AND IRON FINISHES

- A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 4. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.4 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.5 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Final Acceptance.

END OF SECTION 055213

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SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
 - 1. Manufacturers: Subject to compliance with requirements provide Wilsonart solid surface material or provide an equivalent material by one of the following:
 - a. Dupont Corian.
 - b. Formica Everform.
 - 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
 - 4. Colors and Patterns: As indicated by manufacturer's designations listed in the Finish Schedule.
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top with 1 ½" laminated edge.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops:
 - 1. 3/4-inch-thick, solid surface material with front edge built up with same material.

- D. Backsplashes: 1/2-inch-thick, solid surface material.
- E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- F. Joints:
 - 1. Fabricate countertops in sections for joining in field.
 - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete pavers set in aggregate and mortar setting beds.
 - 2. Aluminum edge restraints.
 - 3. Cast-in-place concrete edge restraints.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete curbs and gutters serving as edge restraints for unit pavers.
 - 2. Section 321443 "Porous Unit Paving" for unit paving using grid pavers or pavers with openings between them.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Product Data: For the following:
 - 1. Pavers.
 - 2. Mortar and grout materials.
 - 3. Edge restraints.
- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.
- D. Samples for Initial Selection: For each type of unit paver indicated.
 - 1. Joint materials involving color selection.
 - 2. Exposed edge restraints involving color selection.

- E. Samples for Verification: For full-size units of each type of unit paver indicated. Assemble no fewer than five Samples of each type of unit on suitable backing and grout joints. Include Samples of the following:
 - 1. Joint materials.
 - 2. Exposed edge restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.
 - 1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C 67.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquids in tightly closed containers protected from freezing.
- E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.
 - a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CONCRETE PAVERS

- A. Concrete Slabs: Solid interlocking paving units complying with ASTM C 936/C 936M and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.
 - 1. Thickness: 2-1/4 inches (57 mm).
 - 2. Face Size and Shape: 30x30 and 20x30
 - 3. Basis of Design: Techo-bloc Travertina Raw HD2 Slabs
 - 4. Color:
 - a. Riviera (30x30) (Approximately 15%)
 - b. Ivory (20x30) (Approximately 85%)
- ~~B. Concrete Slabs: Solid interlocking paving units complying with ASTM C 936/C 936M and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.~~
 - ~~1. Thickness: 2-1/4 inches (57 mm).~~
 - ~~2. Face Size and Shape: 30x5~~

- ~~3. Basis of Design: Teeho-Bloc Borealis~~
- ~~4. Pattern: Linear~~
- ~~5. Texture: HD2 Wood~~
- ~~6. Color: Submit Standard Colors to Landscape Architect for Selection~~

2.3 CURBS AND EDGE RESTRAINTS

- A. Aluminum Edge Restraints: Manufacturer's standard straight, 3/16-inch- (4.8-mm-) thick by 4-inch- (100-mm-) high and L-shaped, 3/16-inch- (4.8-mm-) thick by 2-1/4-inch- (57-mm-) high extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches (300 mm) o.c. and aluminum stakes 12 inches (300 mm) long for each loop.
- B. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).

2.4 ACCESSORIES

- A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.
- B. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.5 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D 2940/D 2940M, subbase material, requirements in Section 312000 "Earth Moving" for subbase material.
- B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 2940/D 2940M, base material, requirements in Section 312000 "Earth Moving" for base course.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.
- D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 10.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.
 - 1. Provide sand of color needed to produce required joint color.
- F. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- G. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- H. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.6 MORTAR SETTING-BED MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Sand: ASTM C 144.
- D. Latex Additive: Manufacturer's standard, acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
- E. Thin-Set Mortar for Bond Coat: Latex-portland cement mortar complying with ANSI A118.4.
1. Provide prepackaged, dry-mortar mix containing dry, dispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 3. Provide product that is approved by manufacturer for application thickness of 5/8 inch (16 mm).
- F. Water: Potable.

2.7 MORTAR AND GROUT MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with

optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

- B. Mortar-Bed Bond Coat: Mix neat cement and water to a creamy consistency.
- C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C 270, Proportion Specification.
- D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.
- E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.
- F. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.
- G. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.
 - 1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1 to 10, by weight.
 - 2. Colored-Aggregate Grout: Produce color required by combining colored aggregates with portland cement of selected color.
- H. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after

deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 - 1. For concrete pavers, a block splitter may be used.
- D. Handle pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
- E. Joint Pattern: As indicated.
- F. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- G. Tolerances: Do not exceed[1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 - 2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.
 - 3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
 - 4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
 - 5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 100 percent of ASTM D 1557 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Construction Materials Testing consultant, and replace with compacted backfill or fill as directed.
- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).
- D. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- E. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).
- F. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- G. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- H. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- I. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
 - 1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
 - 2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900-mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
 - 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
 - 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

- J. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- K. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- L. Repeat joint-filling process 30 days later.

3.5 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch (1.6-mm) thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately 1/2 inch (13 mm).
- E. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- F. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- G. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- H. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each paver with a flat trowel.
- I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
- J. Spaced Joint Widths: Provide 3/8-inch (10-mm) nominal joint width with variations not exceeding plus or minus 1/16 inch (1.5 mm).

- K. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- L. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - 4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- M. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.6 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
 - 1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
 - 2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400

Cliff Merrill

From: Cliff Merrill
Sent: Friday, June 24, 2022 8:54 AM
To: Cliff Merrill
Subject: Fort Fisher Fire Pump Question
Attachments: Hydraulic calcs nodes.pdf; Dry zone 1 report.pdf; Wet zone floor 2 report (without QR reduction).pdf

This email trail has been abbreviated to remove non-essential parts

Subject: RE: Fort Fisher Question

Dennis,

We have reviewed the hydraulic calculations prepared during design and we believe that the sprinkler systems can be designed without requiring a fire pump. Please see the attached calculation reports and a PDF of the floor plans showing hydraulic nodes. We recognize that these are preliminary calculations that may not account for every fitting required, coordination with other trades, etc. However, these calculations do still have a safety factor.

Note that the water supply used in these calculations reflects the SCO requirement to deduct 10 psi from the waterflow test static and residual pressures, as well as 10% from the residual flow. These adjustments are very conservative in our opinion and results in both a lower and steeper water supply curve. Despite these adjustments, the calculations do still have an almost 10% safety factor.

Pipe sizing may be a little bit larger to make the system more hydraulically efficient. Additionally, although not reflected in these calculations the contractor has the option to utilize a larger sprinkler orifice to reduce the "end head" pressure. For example, the 2nd floor wet pipe system calculation uses a ½" orifice (K factor of 5.6) sprinkler. These are very common, but if the contractor utilized a K8.0 sprinkler (17/32" orifice) additional safety factor can be realized.

Please feel free to forward these documents for the contractor's orifice. Advise if any further questions, comments or concerns.

Sincerely,

Chris Born PE, LEED AP
Department Director - Fire Protection | Principal



CLARKNEXSEN

4525 Main Street Suite 1400
Virginia Beach, VA 23462
757.961.7933 Direct
757.455.5800 Office
cborn@clarknexsen.com
www.clarknexsen.com

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CN 7173-B

1/8" = 1' - 0"



0 5' 10' 15' 30'

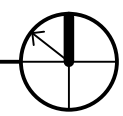
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1 SECOND FLOOR FIRE PROTECTION

1/8" = 1'-0"



GRAPHIC SCALE(S)

1/8" = 1'-0" 0 5' 10' 15' 30'

KEY NOTES

DEPARTMENT OF NATURAL
AND CULTURAL RESOURCES

**VISITOR CENTER
AND UNDERWATER
ARCHAEOLOGY BUILDING
AT THE FORT FISHER
STATE HISTORIC SITE**

1610 FORT FISHER BLVD S
KURE BEACH, NC 28449

SCD#: 16-16311-02A
CODE: 41614
ITEM: 4C01

DESIGNER



CLARK NEXSEN

333 FAYETTEVILLE STREET, SUITE 1000
RALEIGH, NORTH CAROLINA 27601
919-828-1876

CLARK NEXSEN LICENSE NUMBER: C-1028
PROFESSIONAL SEAL



NOT FOR CONSTRUCTION

SUBMITTAL

SEPTEMBER 18, 2019

DESIGN DEVELOPMENT

REVISIONS

SHEET

SECOND FLOOR FIRE
PROTECTION PLAN

FP102

DESIGN: KEK
DRAWN: AAR
REVIEW: CHB

CN 7173-B

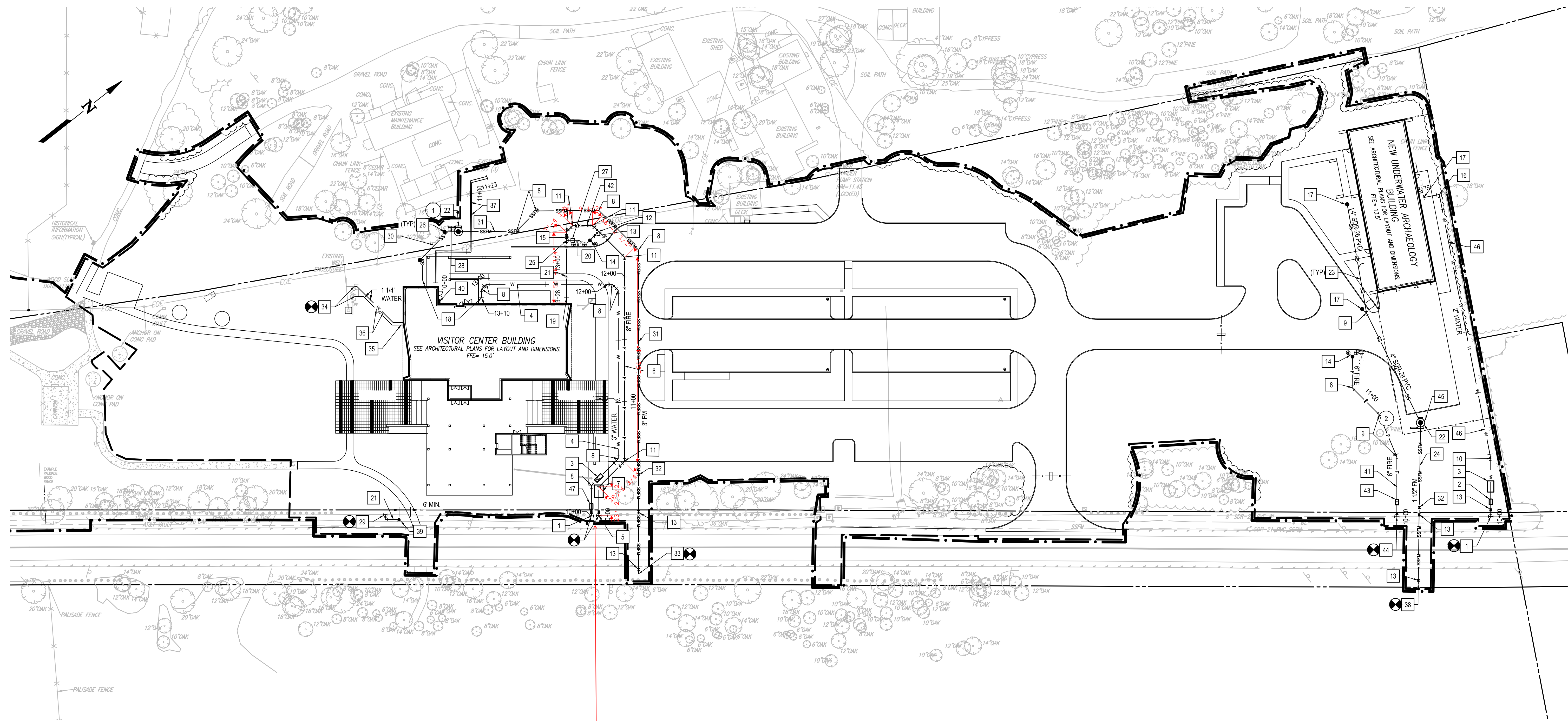
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D

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B

A



total length of pipe till
this point - 342'

SEE SHEETS ES101 AND ES102
FOR ELECTRICAL SITE WORK

UTILITY NOTES

1. LOCATE THE EXISTING FORCE MAIN WITHIN US HWY 421 RIGHT-OF-WAY AND VERIFY HORIZONTAL AND VERTICAL LOCATION, AND SIZE OF THE FORCE MAIN PRIOR TO CONSTRUCTION.
2. VERIFY THE LOCATION AND SIZE OF THE EXISTING WELL DISCHARGE PIPING PRIOR TO CONSTRUCTION.
3. VERIFY THE LOCATION OF THE EXISTING NON-POTABLE WATER DISTRIBUTION SYSTEM FROM THE EXISTING WELL HOUSE PRIOR TO SITE DEMOLITION.
4. VERIFY THE LOCATION OF THE EXISTING NON-POTABLE WATER FROM THE WELL HOUSE TO THE EXISTING UAB BUILDING PRIOR TO CONSTRUCTION. THE NON-POTABLE WATER SHALL BE RELOCATED AND SERVICE TO THE EXISTING UAB BUILDING RESTORED.
5. RELOCATE OR PROVIDE THE NECESSARY EQUIPMENT, ELECTRICAL, WIRING, AND PIPING TO RESTORE THE OPERATION OF THE EXISTING WELL AND THE NON-POTABLE WATER SYSTEM.
6. DOMESTIC WATER SERVICE PIPING SHALL BE REQUIRED TO HAVE A WARNING TAPE INSTALLED IN THE BACKFILL BETWEEN 6 INCHES AND 24 INCHES BELOW FINISHED GRADE. DIRECTLY OVER PIPING, NON-METALLIC PIPES, SHALL BE IDENTIFIED BY DETECTABLE WARNING TAPES, MINIMUM 2" WIDE, WITH LETTERING TO IDENTIFY BURIED LINES BELOW.
7. PLASTIC SEWER PIPING SHALL BE REQUIRED TO HAVE AN INSULATED COPPER TRACER WIRE OR OTHER APPROVED CONDUCTOR INSTALLED ADJACENT TO AND OVER THE FULL LENGTH OF THE PIPING. ACCESS SHALL BE PROVIDED TO THE TRACER WIRE OR THE TRACER WIRE SHALL TERMINATE AT THE CLEANOUT BETWEEN THE BUILDING DRAIN AND THE BUILDING SEWER. THE TRACER WIRE SIZE SHALL NOT BE LESS THAN 14 AWG AND INSULATION TYPE SHALL BE LISTED FOR DIRECT BURIAL.
8. COORDINATE WATER SERVICE AND FIRE MAIN CONNECTIONS WITH KURE BEACH WATER WORKS.

CONSTRUCTION NOTES

1. CONNECT TO EXISTING 8" WATER WITH 2" CORP STOP AND TAPPING SADDLE.
2. WATER METER AND METER BOX.
3. REDUCED PRESSURE PRINCIPAL BACKFLOW PREVENTER
4. 3" SCHEDULE 40 PVC DOMESTIC WATER SERVICE. SEE SHEET CU201 FOR PROFILE
5. CONNECT TO EXISTING 8" WATER WITH 8" x 8" TAPPING SLEEVE AND VALVE
6. 8" MECHANICAL JOINT DUCTILE IRON FIRE SERVICE. SEE SHEET CU201 FOR PROFILE
7. 8" DOUBLE DETECTOR CHECK BACKFLOW PREVENTER
8. 45° SCHEDULE 40 PVC BEND
9. 22 1/2" SCHEDULE 40 PVC BEND
10. 11 1/4" SCHEDULE 40 PVC BEND
11. 45° MJ DUCTILE IRON BEND
12. 8"x6" MJ DUCTILE IRON TEE
13. GATE VALVE AND VALVE BOX
14. FIRE HYDRANT ASSEMBLY WITH BOLLARDS
15. POST INDICATOR VALVE. PROVIDE TAMPER SWITCH FOR VISITOR CENTER.
16. 90° SCHEDULE 40 PVC BEND
17. FOR CONTINUATION SEE PLUMBING PLAN PE101U
18. FOR CONTINUATION SEE PLUMBING PLAN PE103
19. FOR CONTINUATION SEE FIRE PROTECTION PLAN FP101
20. FIRE DEPARTMENT CONNECTION (FDC)
21. 6" MJ DUCTILE IRON. RESTRAIN ENTIRE LENGTH
22. FIBERGLASS DUPLEX GRINDER PUMP STATION WITH CONTROL PANEL
23. 4" SDR-26 PVC, SLOPE MINIMUM OF 1.00%
24. 1 1/2" SCHEDULE 40 PVC FORCE MAIN. SEE SHEET CU201 FOR PROFILE
25. 6" x 6" MJ DUCTILE TEE
26. SANITARY CLEANOUT
27. 6" SWING CHECK VALVE AND VAULT

CONSTRUCTION NOTES

28. VISITOR CENTER PUMP STATION VENT
29. CONNECT TO EXISTING 8" WATER WITH 8" x 6" TAPPING SLEEVE AND VALVE
30. 4" SDR-26 PVC SLOPE A MINIMUM OF 1.00%
31. 3" SCHEDULE 40 PVC FORCE MAIN. SEE SHEET CU201 FOR PROFILE
32. FORCE MAIN CHECK VALVE
33. CONNECT 3" FORCE MAIN TO EXISTING 4" FORCE MAIN WITHIN THE RIGHT-OF-WAY. COORDINATE CONNECTION WITH KURE BEACH PUBLIC WORKS. VERIFY FORCE MAIN LOCATION BY LEVEL A UTILITY LOCATION METHODS PRIOR TO CONSTRUCTION.
34. CONNECT TO EXISTING NON-POTABLE WATER.
35. SEE SHEET CU502 FOR SCHEMATIC DIAGRAM OF NON-POTABLE PRESSURE TANK WATER PIPING. SEE SHEET PE103 FOR LOCATION OF PRESSURE TANK.
36. 1 1/4" SCHEDULE 40 PVC NON-POTABLE WATER.
37. CHILLED WATER PIPING AND CHILLED WATER COOLING TOWER. SEE MECHANICAL DRAWING M-401.
38. CONNECT 1 1/2" FORCE MAIN TO EXISTING 4" FORCE MAIN WITHIN RIGHT-OF-WAY. COORDINATE CONNECTION WITH KURE BEACH PUBLIC WORKS. VERIFY FORCE MAIN LOCATION BY LEVEL A UTILITY LOCATION METHODS PRIOR TO CONSTRUCTION
39. FIRE HYDRANT ASSEMBLY
40. WELL NEMA 4X PANEL. CONNECT EXISTING WELL PUMP TO NEW PANEL AND RECONNECT PRESSURE SWITCH TO THE WELL MATCHING EXISTING ELECTRICAL CONFIGURATION. PRESSURE SWITCH SHALL ENERGIZE THE WELL WHEN LOW PRESSURE IS SENSED AND TURN WELL OFF WHEN PRESSURE IS MET. SEE ELECTRICAL SHEET ES102
41. 6" MJ DUCTILE IRON FIRE SERVICE. SEE SHEET CU201 FOR PROFILE
42. 8"x6" MJ DUCTILE IRON ELBOW
43. 8" DOUBLE DETECTOR CHECK BACKFLOW PREVENTER
44. CONNECT TO EXISTING 8" WATER WITH 8"x6" TAPPING SLEEVE AND VALVE
45. 2" SCHEDULE 80 UAB VENT. SEE PE101U FOR CONTINUATION

CONSTRUCTION NOTES

46. 2" SCHEDULE 40 PVC DOMESTIC WATER SERVICE. SEE SHEET CU201 FOR PROFILE
47. WATER METER AND VAULT



1. CONTRACTOR IS RESPONSIBLE FOR CONTACTING APPROPRIATE PARTIES AND ASSURING THAT EXISTING UTILITIES ARE LOCATED PRIOR TO CONSTRUCTION.
2. CONTRACTOR IS RESPONSIBLE FOR PLACING BARRICADES USING FLAG MEN, ETC. AS NECESSARY TO ENSURE SAFETY TO THE PUBLIC.
3. ALL PAVEMENT CUTS, CONCRETE OR ASPHALT, ARE TO BE REPLACED ACCORDING TO STANDARDS OF THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION.
4. SHORING SHALL BE ACCORDING TO OSHA TRENCHING STANDARDS PART 1926 SUBPART P, OR AS AMENDED.

GRAPHIC SCALE(S)

1"=40'

0 20' 40' 80' 160'

DEPARTMENT OF NATURAL
AND CULTURAL RESOURCES

VISITOR CENTER AND UNDERWATER ARCHAEOLOGY BUILDING AT THE FORT FISHER STATE HISTORIC SITE

1610 FORT FISHER BLVD S.
KURE BEACH, NC 28449
SCO #: 16-16311-02A
CODE: 41614
ITEM: 4031

DESIGNER



CLARK NEXSEN

333 FAYETTEVILLE STREET, SUITE 1000
RALEIGH, NORTH CAROLINA 27601
919-828-1876

CLARK NEXSEN LICENSE NUMBER: C-1026
PROFESSIONAL SEAL



SUBMITTAL

APRIL 29, 2022

BID SET

REVISIONS

SHEET

UTILITY PLAN

CU101

DESIGN: CMM
DRAWN: ZTK
REVIEW: DMP

CN 7173

Hydraulic Calculations for

Project: 7173 FT FISHER VISITOR CENTER
Drawing no.:
Date: 6/24/2022

Design

Remote area number: 1
Remote area location:
Occupancy classification: light hazard
Density: 0.1
Area of application: 1950 SF
Coverage per sprinkler: 200 SF
Type of sprinklers calculated:
No. of sprinklers calculated: 11
In rack demand:
Hose streams: 100 GPM outside + none inside
Total water required (including hose streams): 322.03 gpm at 41.84 psi [4.09 psi safety margin]
Type of system: dry pipe
Volume of dry or preaction system:

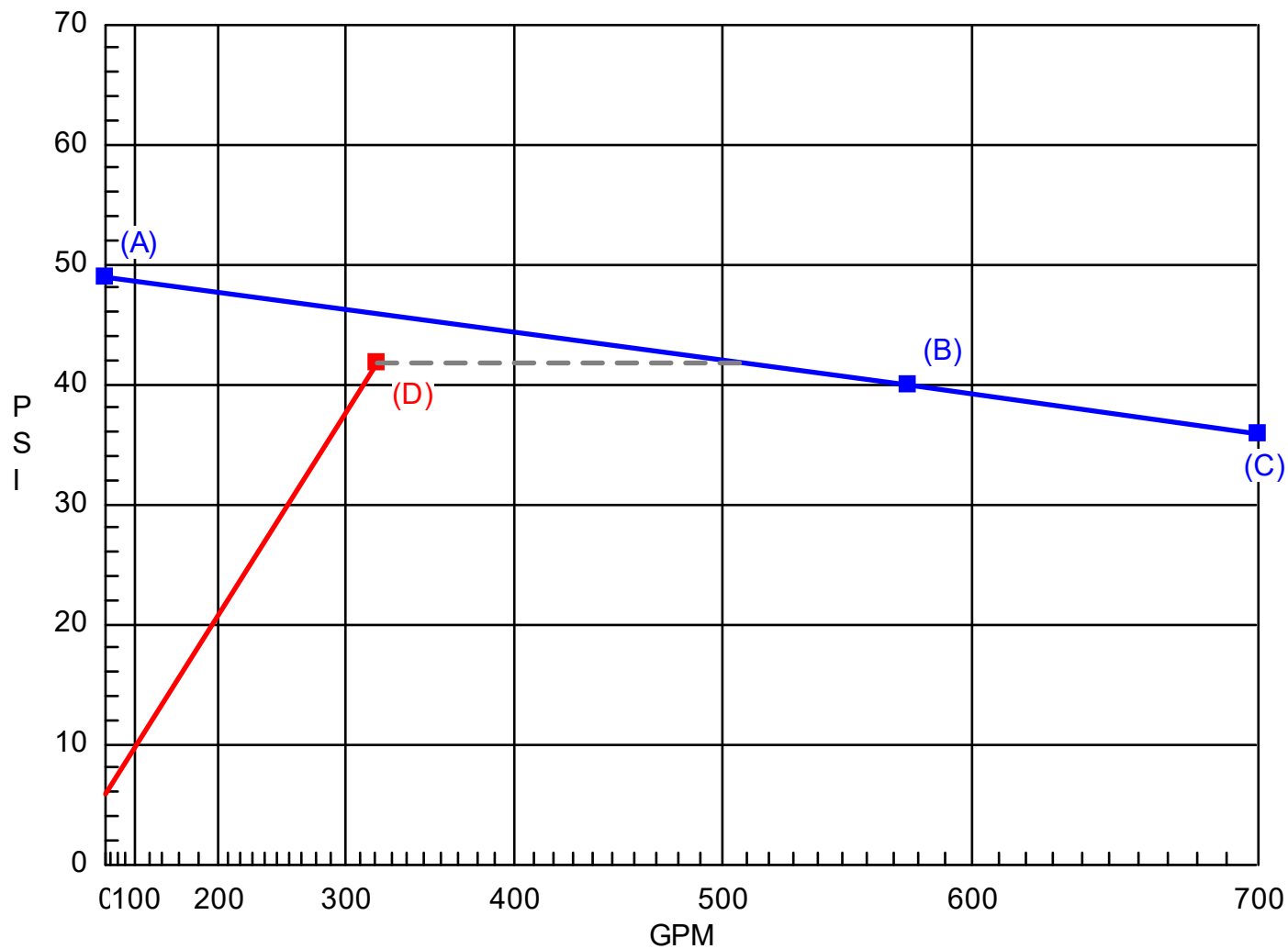
Water Supply Information

Date:
Location:
Source:

Contractor:
Name of designer:
Authority having jurisdiction:

Notes

Hydraulic Demand Graph



Water Source:

A) 49 psi Static

B) 576 gpm at 40 psi

C) 700 gpm at 36.09 psi

Demand at Source:

D) 322 gpm at 41.84 psi

Supply Analysis

Node at	Static Pressure [psi]	Residual Pressure [psi]	Flow [gpm]	Available Pressure [psi]	Total Demand [gpm]	Required Pressure [psi]
HYD	49.0	40.0	576.0	45.93	322.03	41.84

Node Analysis

Node Tag	Elev [ft]	Type	Pressure [psi]	Discharge [gpm]
HYD	-2.000	source	41.838	-322.035
S1H	12.000	K=5.60	13.154	20.310
S2H	12.000	K=5.60	12.849	20.074
S3H	12.000	K=5.60	12.765	20.008
S4H	12.000	K=5.60	13.013	20.201
S5H	12.000	K=5.60	12.711	19.966
S6H	12.000	K=5.60	12.628	19.900
S7H	12.000	K=5.60	13.112	20.278
S8H	12.000	K=5.60	12.808	20.041
S9H	12.000	K=5.60	12.724	19.975
S10H	12.000	K=5.60	13.630	20.674
S11H	12.000	K=5.60	13.541	20.607
S1	12.500	ref	13.701	0.000
S2	12.500	ref	13.380	0.000
S3	12.500	ref	13.291	0.000
S4	12.500	ref	13.553	0.000
S5	12.500	ref	13.234	0.000
S6	12.500	ref	13.146	0.000
S7	12.500	ref	13.657	0.000
S8	12.500	ref	13.336	0.000
S9	12.500	ref	13.248	0.000
S10	12.500	ref	14.202	0.000
S11	12.500	ref	14.108	0.000
A	12.500	ref	14.145	0.000
G	12.500	ref	18.952	0.000
C	12.500	ref	14.283	0.000
D	12.500	ref	14.513	0.000
B	12.500	ref	14.175	0.000
E	12.500	ref	17.922	0.000
F	12.500	ref	18.597	0.000
TOR	12.500	ref	19.932	0.000
BOR	1.000	ref	25.914	100.000
SUP	1.000	ref	26.005	0.000

Pipe Information

negative pipe flow (Q) indicates flow is from node 2 towards node 1

Node 1 Node 2	Elev [ft]	K-factor	Discharge & Flow [gpm]	Nom i.d. [in]	Fittings num & length [ft]	L [ft] F [ft] T [ft]	C factor psi/ft	total (Pt) elev (Pe) frict (Pf)	Notes
S1	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.701	Mat="S40"
S1H	12.000		Q= 20.310	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.188	Pf= 0.763	
S2	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.380	Mat="S40"
S2H	12.000		Q= 20.074	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.184	Pf= 0.747	
S3	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.291	Mat="S40"
S3H	12.000		Q= 20.008	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.182	Pf= 0.742	
S4	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.553	Mat="S40"
S4H	12.000		Q= 20.201	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.186	Pf= 0.756	
S5	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.234	Mat="S40"
S5H	12.000		Q= 19.966	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.182	Pf= 0.739	
S6	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.146	Mat="S40"
S6H	12.000		Q= 19.900	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.181	Pf= 0.735	
S7	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.657	Mat="S40"
S7H	12.000		Q= 20.278	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.187	Pf= 0.761	
S8	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.336	Mat="S40"
S8H	12.000		Q= 20.041	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.183	Pf= 0.745	
S9	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 13.248	Mat="S40"
S9H	12.000		Q= 19.975	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.182	Pf= 0.740	
S10	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 14.202	Mat="S40"
S10H	12.000		Q= 20.674	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.194	Pf= 0.789	
S11	12.500		q= 0.000	1	1T=3.568	0.500		Pt= 14.108	Mat="S40"
S11H	12.000		Q= 20.607	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.193	Pf= 0.784	
S1	12.500		q= 0.000	2		13.250		Pt= 13.701	Mat="S40"
S2	12.500		Q= 40.081	2.067		0.000	C=100	Pe= 0.000	
						13.250	0.024	Pf= 0.321	
S2	12.500		q= 0.000	2		13.250		Pt= 13.380	Mat="S40"
S3	12.500		Q= 20.008	2.067		0.000	C=100	Pe= 0.000	
						13.250	0.007	Pf= 0.089	
S1	12.500		q= 0.000	2	1E=3.568	5.000		Pt= 13.701	Mat="S40"
A	12.500		Q= -60.392	2.067		3.568	C=100	Pe= 0.000	
						8.568	0.052	Pf= -0.444	

Pipe Information, cont.

Node 1 Node 2	Elev [ft]	K-factor	Discharge & Flow [gpm]	Nom i.d. [in]	Fittings num & length [ft]	L [ft] F [ft] T [ft]	C factor psi/ft	total (Pt) elev (Pe) frict (Pf)	Notes
S4	12.500		q= 0.000 Q= 39.866	2 2.067		13.250 0.000		Pt= 13.553 Pe= 0.000	Mat="S40"
S5	12.500					13.250	0.024	Pf= 0.318	
S5	12.500		q= 0.000 Q= 19.900	2 2.067		13.250 0.000		Pt= 13.234 Pe= 0.000	Mat="S40"
S6	12.500					13.250	0.007	Pf= 0.088	
S4	12.500		q= 0.000 Q= -60.067	2 2.067	1T=7.137	5.000 7.137		Pt= 13.553 Pe= 0.000	Mat="S40"
B	12.500					12.137	0.051	Pf= -0.622	
S7	12.500		q= 0.000 Q= 40.017	2 2.067		13.250 0.000		Pt= 13.657 Pe= 0.000	Mat="S40"
S8	12.500					13.250	0.024	Pf= 0.320	
S8	12.500		q= 0.000 Q= 19.975	2 2.067		13.250 0.000		Pt= 13.336 Pe= 0.000	Mat="S40"
S9	12.500					13.250	0.007	Pf= 0.089	
S7	12.500		q= 0.000 Q= -60.295	2 2.067	1T=7.137	5.000 7.137		Pt= 13.657 Pe= 0.000	Mat="S40"
C	12.500					12.137	0.052	Pf= -0.627	
S10	12.500		q= 0.000 Q= 20.607	2 2.067		13.250 0.000		Pt= 14.202 Pe= 0.000	Mat="S40"
S11	12.500					13.250	0.007	Pf= 0.094	
S10	12.500		q= 0.000 Q= -41.281	2 2.067	1T=7.137	5.000 7.137		Pt= 14.202 Pe= 0.000	Mat="S40"
D	12.500					12.137	0.026	Pf= -0.311	
A	12.500		q= 0.000 Q= -60.392	4 4.026		15.000 0.000		Pt= 14.145 Pe= 0.000	Mat="S40"
B	12.500					15.000	0.002	Pf= -0.030	
B	12.500		q= 0.000 Q= -120.459	4 4.026		15.000 0.000		Pt= 14.175 Pe= 0.000	Mat="S40"
C	12.500					15.000	0.007	Pf= -0.108	
C	12.500		q= 0.000 Q= -180.754	4 4.026		15.000 0.000		Pt= 14.283 Pe= 0.000	Mat="S40"
D	12.500					15.000	0.015	Pf= -0.230	
D	12.500		q= 0.000 Q= -222.035	4 4.026	3E=21.411 1T=14.274	116.500 35.685		Pt= 14.513 Pe= 0.000	Mat="S40"
E	12.500					152.185	0.022	Pf= -3.409	
E	12.500		q= 0.000 Q= -222.035	4 4.026	1E=7.137	23.000 7.137		Pt= 17.922 Pe= 0.000	Mat="S40"
F	12.500					30.137	0.022	Pf= -0.675	
F	12.500		q= 0.000 Q= -222.035	4 4.026	1E=7.137	8.700 7.137		Pt= 18.597 Pe= 0.000	Mat="S40"
G	12.500					15.837	0.022	Pf= -0.355	

Pipe Information, cont.

Node 1	Elev	Discharge	Nom	Fittings	L [ft]	C factor	total (Pt)	
Node 2	[ft]	& Flow	i.d.	num & length	F [ft]	psi/ft	elev (Pe)	Notes
		[gpm]	[in]	[ft]	T [ft]		frict (Pf)	
G	12.500	q= 0.000	4	1E=7.137	36.600		Pt= 18.952	Mat="S40"
		Q=-222.035	4.026		7.137	C=100	Pe= 0.000	
TOR	12.500				43.737	0.022	Pf= -0.980	
TOR	12.500	q= 0.000	4	1DVN=21.004	9.500		Pt= 19.932	Mat="S40"
		Q=-222.035	4.026	1T=14.274	35.278	C=100	Pe= -4.979	
BOR	1.000				44.778	0.022	Pf= -1.003	
BOR	1.000	q= 100.000	6	1E=9.992	5.000		Pt= 25.914	Mat="S40"
		Q=-322.035	6.065		9.992	C=100	Pe= 0.000	
SUP	1.000				14.992	0.006	Pf= -0.091	
SUP	1.000	q= 0.000	6	4E=88.250	835.000		Pt= 26.005	Mat="CDI"
		Q=-322.035	6.28		88.250	C=140	Pe= -1.299	Pdev=-12.0 psi
HYD	-2.000				923.250	0.003	Pf= -2.533	

Material CodesPipe Material

CDI - Cement Lined Ductile Iron Thickness Class 50
 S40 - Schedule 40 Steel

Fittings

E - Standard 90 degree elbow
 T - Tee - Flow turn 90 degrees
 DVN - Victaulic Firelock NXT (2.5"-8") Dry Pipe Valve

Hydraulic Calculations for

Project: 7173 FT FISHER VISITOR CENTER
Drawing no.:
Date: 6/24/2022

Design

Remote area number: 1
Remote area location:
Occupancy classification: light hazard
Density: 0.1
Area of application: 1950 SF
Coverage per sprinkler: 200 SF
Type of sprinklers calculated:
No. of sprinklers calculated: 9
In rack demand:
Hose streams: 100 GPM outside + none inside
Total water required (including hose streams): 307.69 gpm at 43.05 psi [3.14 psi safety margin]
Type of system: dry pipe
Volume of dry or preaction system:

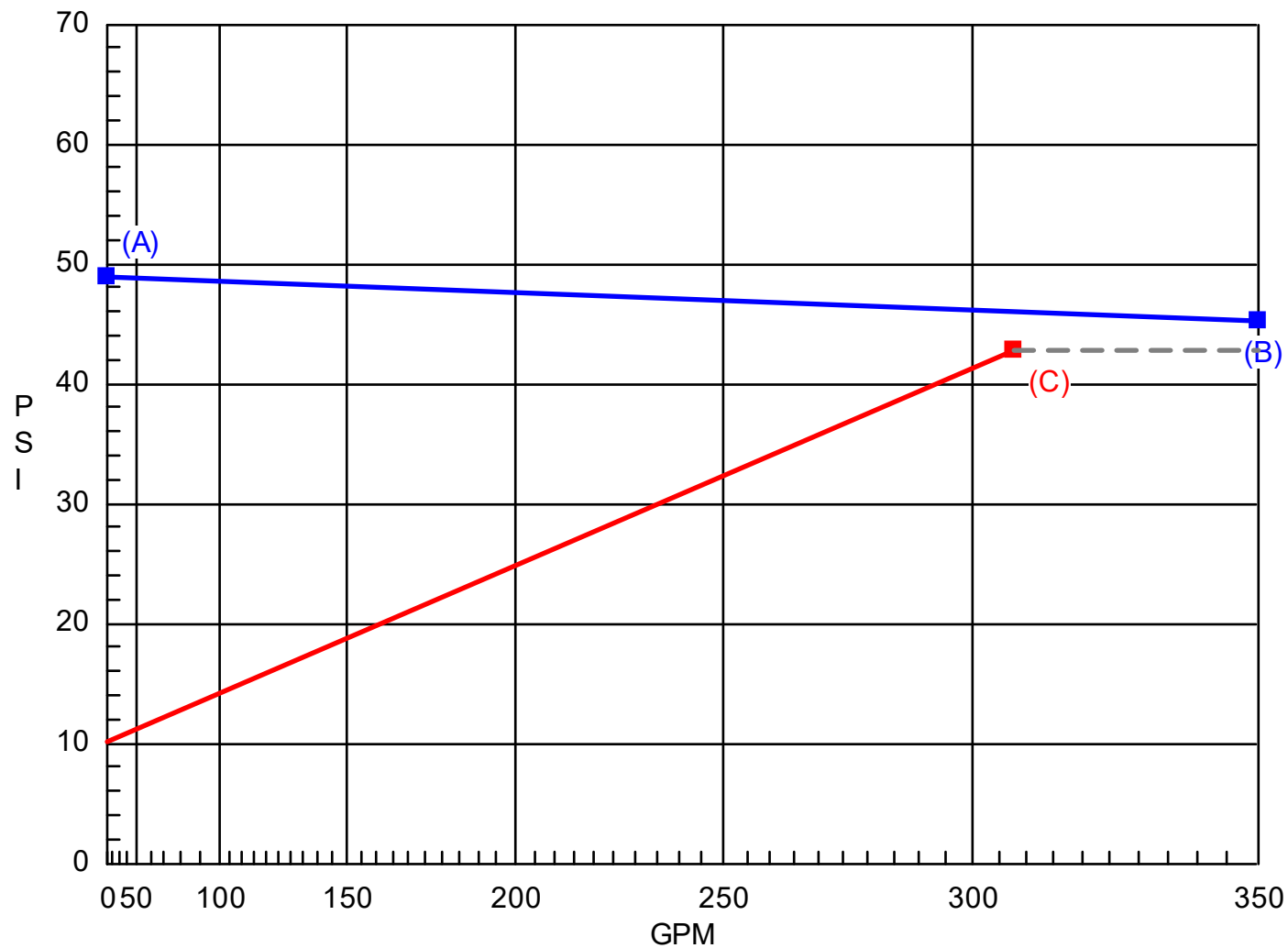
Water Supply Information

Date:
Location:
Source:

Contractor:
Name of designer:
Authority having jurisdiction:

Notes

Hydraulic Demand Graph



Water Source:

A) 49 psi Static

B) 350 gpm at 45.42 psi

Demand at Source:

C) 307.7 gpm at 43.05 psi

Supply Analysis

Node at	Static Pressure [psi]	Residual Pressure [psi]	Flow [gpm]	Available Pressure [psi]	Total Demand [gpm]	Required Pressure [psi]
HYD	49.0	40.0	576.4	46.18	307.69	43.05

Node Analysis

Node Tag	Elev [ft]	Type	Pressure [psi]	Discharge [gpm]
HYD	-2.000	source	43.047	-307.688
S1H	22.000	K=5.60	18.571	24.133
S2H	22.000	K=5.60	17.621	23.508
S3H	22.000	K=5.60	16.695	22.881
S4H	22.000	K=5.60	16.260	22.581
S5H	22.000	K=5.60	16.611	22.824
S7H	22.000	K=5.60	17.718	23.572
S8H	22.000	K=5.60	16.573	22.798
S9H	22.000	K=5.60	16.143	22.500
S10H	22.000	K=5.60	16.712	22.893
S1	21.000	ref	19.501	0.000
S2	21.000	ref	19.055	0.000
S3	21.000	ref	18.080	0.000
S4	21.000	ref	17.621	0.000
S5	21.000	ref	17.493	0.000
S7	22.500	ref	18.506	0.000
S8	21.000	ref	18.183	0.000
S9	21.000	ref	17.725	0.000
S10	22.500	ref	16.947	0.000
A	22.000	ref	19.183	0.000
B	22.000	ref	19.284	0.000
TOR2	22.000	ref	21.999	0.000
BOR	1.000	ref	33.105	100.000
SUP	1.000	ref	33.189	0.000

Pipe Information

negative pipe flow (Q) indicates flow is from node 2 towards node 1

Node 1 Node 2	Elev [ft]	K-factor	Discharge & Flow [gpm]	Nom i.d. [in]	Fittings num & length [ft]	L [ft] F [ft] T [ft]	C factor psi/ft	total (Pt) elev (Pe) frict (Pf)	Notes
S1	21.000		q= 0.000	1	1E=1.427	0.500		Pt= 19.501	Mat="S40"
S1H	22.000		Q= 24.133	1.049		1.427	C=100	Pe= 0.433	
						1.927	0.258	Pf= 0.497	
S2	21.000		q= 0.000	1	1T=3.568	0.500		Pt= 19.055	Mat="S40"
S2H	22.000		Q= 23.508	1.049		3.568	C=100	Pe= 0.433	
						4.068	0.246	Pf= 1.000	
S3	21.000		q= 0.000	1	1T=3.568	0.500		Pt= 18.080	Mat="S40"
S3H	22.000		Q= 22.881	1.049		3.568	C=100	Pe= 0.433	
						4.068	0.234	Pf= 0.952	
S4	21.000		q= 0.000	1	1T=3.568	0.500		Pt= 17.621	Mat="S40"
S4H	22.000		Q= 22.581	1.049		3.568	C=100	Pe= 0.433	
						4.068	0.228	Pf= 0.929	
S5	21.000		q= 0.000	1	1E=1.427	0.500		Pt= 17.493	Mat="S40"
S5H	22.000		Q= 22.824	1.049		1.427	C=100	Pe= 0.433	
						1.927	0.233	Pf= 0.449	
S7	22.500		q= 0.000	1	1T=3.568	0.500		Pt= 18.506	Mat="S40"
S7H	22.000		Q= 23.572	1.049		3.568	C=100	Pe= -0.216	
						4.068	0.247	Pf= 1.005	
S8	21.000		q= 0.000	1	1T=3.568	1.500		Pt= 18.183	Mat="S40"
S8H	22.000		Q= 22.798	1.049		3.568	C=100	Pe= 0.433	
						5.068	0.232	Pf= 1.177	
S9	21.000		q= 0.000	1	1T=3.568	1.500		Pt= 17.725	Mat="S40"
S9H	22.000		Q= 22.500	1.049		3.568	C=100	Pe= 0.433	
						5.068	0.227	Pf= 1.149	
S10	22.500		q= 0.000	1	1E=1.427	0.500		Pt= 16.947	Mat="S40"
S10H	22.000		Q= 22.893	1.049		1.427	C=100	Pe= -0.216	
						1.927	0.234	Pf= 0.451	
A	22.000		q= 0.000	2		5.000		Pt= 19.183	Mat="S40"
S2	21.000		Q= 91.794	2.067		0.000	C=100	Pe= -0.433	
						5.000	0.112	Pf= 0.562	
S2	21.000		q= 0.000	2		15.000		Pt= 19.055	Mat="S40"
S3	21.000		Q= 68.286	2.067		0.000	C=100	Pe= 0.000	
						15.000	0.065	Pf= 0.975	
S3	21.000		q= 0.000	2		15.000		Pt= 18.080	Mat="S40"
S4	21.000		Q= 45.405	2.067		0.000	C=100	Pe= 0.000	
						15.000	0.031	Pf= 0.458	
S4	21.000		q= 0.000	2		15.000		Pt= 17.621	Mat="S40"
S5	21.000		Q= 22.824	2.067		0.000	C=100	Pe= 0.000	
						15.000	0.009	Pf= 0.128	
S1	21.000		q= 0.000	2	1T=7.137	5.000		Pt= 19.501	Mat="S40"
A	22.000		Q= -24.133	2.067		7.137	C=100	Pe= 0.433	
						12.137	0.009	Pf= -0.115	

Pipe Information, cont.

Node 1 Node 2	Elev [ft]	K-factor	Discharge & Flow [gpm]	Nom i.d. [in]	Fittings num & length [ft]	L [ft] F [ft] T [ft]	C factor psi/ft	total (Pt) elev (Pe) frict (Pf)	Notes
B	22.000		q= 0.000 Q= 91.762	2 2.067		5.000 0.000		Pt= 19.284 Pe= 0.216	Mat="S40"
S7	22.500					5.000	0.112	Pf= 0.561	
S7	22.500		q= 0.000 Q= 68.191	2 2.067		15.000 0.000		Pt= 18.506 Pe= -0.649	Mat="S40"
S8	21.000					15.000	0.065	Pf= 0.973	
S8	21.000		q= 0.000 Q= 45.393	2 2.067		15.000 0.000		Pt= 18.183 Pe= 0.000	Mat="S40"
S9	21.000					15.000	0.031	Pf= 0.458	
S9	21.000		q= 0.000 Q= 22.893	2 2.067		15.000 0.000		Pt= 17.725 Pe= 0.649	Mat="S40"
S10	22.500					15.000	0.009	Pf= 0.129	
A	22.000		q= 0.000 Q=-115.926	4 4.026		15.000 0.000		Pt= 19.183 Pe= 0.000	Mat="S40"
B	22.000					15.000	0.007	Pf= -0.101	
B	22.000		q= 0.000 Q=-207.688	4 4.026	1E=7.137	130.000 7.137		Pt= 19.284 Pe= 0.000	Mat="S40"
TOR2	22.000					137.137	0.02	Pf= -2.715	
TOR2	22.000		q= 0.000 Q=-207.688	4 4.026	1T=14.274 1C=15.701	56.000 45.677		Pt= 21.999 Pe= -9.093	Mat="S40"
BOR	1.000				2E=14.274 1G=1.427	101.677	0.02	Pf= -2.013	
BOR	1.000		q= 100.000 Q=-307.688	6 6.065	1E=9.992	5.000 9.992		Pt= 33.105 Pe= 0.000	Mat="S40"
SUP	1.000					14.992	0.006	Pf= -0.083	
SUP	1.000		q= 0.000 Q=-307.688	6 6.28	4E=88.250	835.000 88.250		Pt= 33.189 Pe= -1.299	Mat="CDI"
HYD	-2.000					923.250	0.003	Pf= -2.328	Pdev=-6.23 psi

Material CodesPipe Material

CDI - Cement Lined Ductile Iron Thickness Class 50
 S40 - Schedule 40 Steel

Fittings

C - Check Valve
 E - Standard 90 degree elbow
 G - Gate Valve
 T - Tee - Flow turn 90 degrees