Progressive Design Build Project
Piney Neck Wastewater Facility
Diversion Transmission System
Dagsboro, Delaware

16701 Melford Boulevard
Suite 221
Bowie, Maryland 20715

GHD Project No. 12644261

60% Design Submittal

September 2025

TABLE OF CONTENTS

PROGRESSIVE DESIGN BUILD PROJECT
PINEY NECK WASTEWATER FACILITY
DIVERSION TRANSMISSION SYSTEM
DAGSBORO, DELAWARE

PAGE

TECHNICAL PROVISIONS

DIVISION 2 – SITE WORK

SECTION 02012

TEST PITS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Test pits shall include, but not necessarily be limited to, excavation to determine the exact horizontal location and/or elevation of underground structures, utilities, and other obstructions; the backfill and compaction of the excavation; and the stabilization of the surface, in accordance with the Contract Documents.

B. Prior to construction it shall be the Contractor's responsibility to establish the location and/or elevation of existing utilities and structures that may affect the proposed work. Contractor should consult design and record drawings for existing infrastructure, but verification of all information remains solely with Contractor.

1.02. QUALITY ASSURANCE

A. It is intended that all suitable materials removed from test pit excavations, exclusive of paving materials, be used for backfill. Owner reserves the right to inspect all material proposed for use as backfill to determine the material's suitability for use as such.

PART 2 MATERIALS

2.01. USE OF EXCAVATED MATERIAL

A. All suitable material excavated from test pits shall be used, as far as practicable, for backfill. Contractor shall properly store or stockpile and protect all materials that are to be reused in the Work. All unsuitable material shall be removed from test pit excavations and disposed of off-site in accordance with local, state and federal regulations by and at the expense of Contractor.

2.02. OFF-SITE MATERIALS

A. Off-Site material for test pit backfill shall meet the requirements of Section 02223 (Backfilling).

B. Graded aggregate subbase for test pit backfill shall meet the gradation requirements specified in Section 02223 (Backfilling).

PART 3 EXECUTION

3.01. GENERAL

A. It shall be Contractor's responsibility to determine the location and/or elevation of underground structures and utilities by the use of test pit excavations prior to initiating excavation operations for the installation of the proposed facility.

3.02. TEST PITS

A. Contractor shall provide all necessary traffic control in accordance with the applicable regulations.

B. Surface preparation, excavation, backfill, compaction, and maintenance of the backfilled excavation shall be as specified in Section 02222 (Excavating), Section 02223 (Backfilling), Section 02225 (Trenching), and Section 02228 (Compaction).

C. Restoration shall be as specified in Section 02980 (Site Rehabilitation).

END OF SECTION

SECTION 02030

DEMOLITION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Submittals

B. Salvage

C. Regulatory requirements

D. Hazardous environmental conditions

E. Demolition coordination meetings

F. Demolition of site, structural, and architectural

1.02. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings

a. Submit a proposed demolition plan separately for each structure requiring demolition together with diagrams and/or drawings, Supplementing other requirements, at a minimum, Shop Drawings shall include:

1) Demolition, removal, and abandonment of items identified in the Contract Documents.

2) Temporary facilities needed to maintain structural integrity during demolition work.

3) Location of temporary barricades, fences, and signs.

4) Disposal locations of items to be removed from the Site.

5) Provisions for hazardous materials (if any).

1.03. REGULATORY REQUIREMENTS

A. Conform to applicable codes for demolition of structures, protection of adjacent structures, dust control, runoff control, and disposal of materials.

B. Obtain required permits from authorities.

C. Notify affected utility companies before starting demolition operations and comply with their requirements.

D. Do not close or obstruct roadways, sidewalks, hydrants, parking areas, and egress widths to exits without permission from Owner.

E. Conform to applicable regulatory procedures if a hazardous environmental condition is encountered at site or if hazardous material disposal is required.

1.04. HAZARDOUS ENVIRONMENTAL CONDITIONS

A. If an unknown unforeseeable hazardous environmental condition is encountered at the Site, or if Contractor or anyone for whom Contractor is responsible creates a hazardous environmental condition, immediately:

1. Secure or otherwise isolate such condition.

2. Stop all work in connection with such condition and in any area affected thereby; and

3. Notify Owner and Engineer (and promptly thereafter confirm such notice in writing).

B. Resume work in connection with such condition or in an affected area only after Owner has obtained any required permits related thereto and delivered to Contractor a written notice specifying under what special conditions related work may be resumed safely.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. DEMOLITION

A. General Requirements

1. All new associated materials and equipment to be installed must be on Site and ready for installation prior to demolition of existing equipment.

2. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

3. Provide all necessary appurtenances to adequately support remaining piping, conduits, and duct banks after required portions are removed.

4. Provide, erect, and maintain temporary barriers, signs, and security devices prior to commencing demolition work.

5. Provide all signs, lights, railings, barricades, and other items as necessary to meet safety regulations. Provide adequate protection of persons and property at all times.

6. Conduct operations with minimum interference to public or private accesses. Maintain egress and access at all times.

7. Provide adequate ventilation in all areas of demolition work.

8. Remove temporary barricades, partitions, signs, etc. upon completion of each area of demolition.

9. Disconnect, cap, and identify utilities within demolition areas.

10. Remove and dispose of demolished materials as Work progresses. Do not burn materials; do not bury materials unless otherwise specified herein.

11. Remove temporary barricades, partitions, signs, etc.

12. Upon completion of demolition operations, leave areas in a clean condition.

B. Protection of Property

1. Demolish in an orderly, careful manner, protecting existing facilities, including supporting structural members, walls, equipment, and all other existing items.

2. Repair all damaged facilities at no additional cost to Owner.

3. Cease operations immediately if adjacent structures appear to be in danger. Notify Owner and Engineer. Do not resume operations until directed.

4. Dust Control

C. Coordination with Owner

1. Conduct operations to minimize interference with adjacent and occupied building areas. Maintain protected egress and access at all times.

2. Coordinate demolition with Owner's operating procedures. All demolition material shall be picked up and disposed of at the end of each day.

D. Removal from Site

1. All demolished materials shall be completely removed from the Site and properly disposed at Contractor's expense. Neither storage of demolition materials nor sale of removed materials will be permitted at the Site.

2. Dispose of designated hazardous materials in accordance with the nature of the material, required handling and disposal procedures, regulatory requirements, and applicable permits.

3. Remove and dispose of debris, trash, and other scrap upon completion of each area of demolition.

4. No burning of debris will be allowed at the Site.

3.02. SCHEDULES

A. Demolish or abandon in place all items indicated in the Contract Documents and those items required to complete the Work.

B. Site and Structural Demolition

1. Demolish and remove all structures, portions of structures, pavement, , and other items as required by the Specifications, shown on the Drawings, or as required to accomplish the Work.

1. Remove foundation walls and footings to a minimum of two feet below finished grade.

C. Architectural Demolition: Demolish and remove all items as required by the Contract Documents and/or as necessary to accomplish the Work.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Removal of surface debris and rubbish.

B. Removal of paving, curbs, walks

C. Removal of trees, shrubs, and other plant life.

D. Removal of stumps and root system of trees and shrubs.

E. Disposal of excess materials, trash, and debris.

F. Topsoil excavation and salvage.

1.02. REGULATORY AND DISPOSAL REQUIREMENTS

A. Coordinate clearing work with utility companies.

B. Conform to applicable local, state and federal codes for environmental requirements, disposal of debris, and stockpiling

C. Make all arrangements for disposal sites unless specifically identified in the Contract Documents.

D. Follow standard horticultural practice for cutting and/or pruning of trees, brush, and shrubs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. PREPARATION

A. Verify that existing plant life designated to remain is tagged or identified.

B. Mark limits of clearing by flagging, fencing, or other approved methods.

C. Vehicles used to haul soft or wet material over streets and pavements shall be sufficiently watertight to prevent deposits on the streets and pavements. In all cases where materials are dropped from vehicles of Contractor, clean up the same, and keep the crosswalks, streets, and pavement areas clean and free from debris.

D. Identify on Site waste or salvage areas for temporarily placing removed materials.

3.02. PROTECTION

A. Locate, identify, and protect existing utilities that are to remain, including notification and review of Site by Miss Utility.

B. Install temporary fences (minimum 3 feet high) to protect trees, plant growth, and features designated to remain as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

D. Where trees are to be protected or preserved, no excavation and grubbing, except as directly required for construction, shall be performed within the radius of spread of tree branches.

E. No storage of topsoil materials or construction equipment will be permitted within the radius of spread of such tree branches.

3.03. CLEARING

A. Clear areas required for access to the Site and execution of Work.

B. Partially remove paving as indicated. Neatly saw cut edges at right angle to surface.

C. Remove trees and shrubs as indicated. Remove stumps, root system to a depth of 24 inches.

D. Clear undergrowth and deadwood without disturbing subsoil.

E. Remove debris, extracted rock, and plant life.

F. Prune branches and/or roots of trees to be preserved or where they interfere with or obstruct construction operations.

1. If exposed, bend and relocate main lateral roots and tap roots.

2. Engage a state-certified arborist or qualified tree surgeon to cut roots and/or branches. Use sharp pruning instruments without breaking or chopping roots and branches.

3. Qualified personnel shall paint all cuts with standard tree paint or equivalent which is waterproof, antiseptic, elastic, and free of kerosene, coal, tar, creosote, and other harmful substances.

4. Where required, extend pruning procedures to restore the natural shape of the entire tree or shrub.

3.04. DISPOSAL OF MATERIAL

A. All material shall be treated as surplus material and shall be disposed of off Site in a legal manner.

3.05. TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated re-landscaped, or regraded

B. All topsoil, loam, or other natural organic materials covering such areas shall be removed; and when suitable for reuse as topsoil shall be stockpiled. Stockpiles shall be established only at approved locations and shall be maintained to prevent erosion and contamination until reuse. To prevent intermixing, topsoil shall not be stockpiled immediately adjacent to other stockpiled materials. All excavated materials shall be stockpiled at locations which will not create public endangerment or inconvenience. Stockpiles shall be kept clear of Fire Department and police facilities and equipment and, where possible, clear of driveways, sidewalks, and crossings.

C. Protect from erosion. Remove excess topsoil not being reused to a location designated by Owner.

D. No topsoil shall be removed from the Site without Owner's permission.

END OF SECTION

SECTION 02141

REMOVAL OF WATER

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Providing equipment, materials and labor required to successfully complete the work included in this section.

B. Maintaining and operating pumps and related equipment, including standby equipment, of sufficient capacity to adequately perform dewatering as required by this section.

C. Lowering the groundwater table elevation.

D. Controlling groundwater flow that may adversely affect excavation or construction activities.

E. Collecting, removing and disposing of all excess groundwater.

F. Collecting, removing, and disposing of all wastewater.

G. Removing and/or disposing of spoil, excess materials, equipment, trash and debris used for or resulting from the work included in this section.

1.02. REGULATORY REQUIREMENTS

A. Conform to applicable local, state and federal codes for legal disposal of water.

B. Temporary water supplies shall meet requirements of local, state and federal regulatory agencies.

C. Conform to applicable OSHA standards.

1.03. SUBMITTALS

A. Submittals shall include, but not be limited to, the following when applicable to the Project:

1. Shop Drawings: Proposed wellpoint dewatering systems

2. Water sampling and analysis results

3. Temporary water system documentation

1.04. PERMITS

A. Contractor shall be responsible for obtaining discharge permits for discharging groundwater from dewatering operations.

1.05. EROSION AND SEDIMENT CONTROL DRAWINGS

A. Coordinate removal of water with dewatering requirements included on Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. PREPARATION

A. Review the subsurface investigation report and conduct appropriate investigations to become familiar with the groundwater conditions at the Site. Allocate sufficient time and use appropriate procedures based on these conditions for dewatering excavations.

B. Examine adjacent structures and utilities, both existing and under construction, for possible settlement, movement or other adverse effects resulting from dewatering methods or water removal. Take necessary precautions to protect such structures and utilities.

C. Should the drawdown of groundwater levels by removal or dewatering systems critically reduce or disrupt public or private water supplies, Contractor shall be prepared to:

1. Provide adequate potable water to the owners or users of the affected water supplies until groundwater levels have recovered, so as to sufficiently restore those deficient water supplies.

2. Provide documentation to confirm that temporary water supplies meet the requirements of Local, State and Federal Regulatory Agencies.

3.02. REMOVAL OF WATER

A. Assume responsibility for Site, surface and subsurface drainage. Maintain such drainage as specified herein during the life of the Contract.

B. Supply all supervision, labor, material, equipment, including standby equipment, necessary to maintain a dry excavation as may be necessary to construct the Project.

C. Maintain groundwater in or below the bearing strata at a safe level at all times by methods which prevent loss of fines, which preserves the undisturbed state of subgrade soils and which sufficiently lowers the groundwater level in permeable strata at or below excavation and fill levels such that blowing or unstable conditions do not develop in the bottom or sides of excavation or fill areas.

D. Protect all adjacent structures, existing and under construction, from settlement, flotation, damage or other adverse effects resulting from water removal or dewatering methods.

E. Install all drains, ditching, sluiceways, pumping and bailing equipment, wicking, sumps, wells, well points, cutoff trenches, curtains, sheeting and all other equipment and structures necessary to create and maintain a dry excavation and a groundwater level at a minimum of two feet below excavation subgrades.

F. As part of any dewatering system, observation wells or piezometers shall be provided and installed, as required, to effectively and efficiently monitor drawdown to required levels.

G. Discharge water removed from the Site to natural water courses; storm drains or channels.

1. Large quantities of water shall not be discharged as overland flow. Overland flow is not permitted onto private property.

2. No unpolluted water shall be discharged to sanitary sewers.

3. Wastewater shall be disposed of in a manner satisfactory to the local authority having jurisdiction.

4. Dewatering operations shall cease when all foundations, structures, pipe installations and other excavated areas have been properly backfilled and compacted, and are safe from damage, flotation, settlement and displacement.

3.03. MAINTENANCE

A. Operate and maintain dewatering and removal operations on a 24-hour basis for the time required to complete that portion of the work which requires dewatering prior to its construction, and which requires protection from flotation or displacement of such work until proper backfilling and compaction is completed.

3.04. REMOVAL

A. After groundwater levels have returned to elevations appropriate for conditions and time of year, without causing damage to the Work, remove all dewatering equipment and related equipment from the Site and restore site to original conditions or rehabilitate Site to meet requirements of Contract Documents.

END OF SECTION

SECTION 02161

SHEETING AND BRACING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Sheeting and bracing installation, removal, and left in place

B. Regulatory codes and requirements

C. Design requirements

D. Submittals

E. Materials

1.02. GENERAL REQUIREMENTS

A. Use sheeting at locations shown on the Drawings and where required to complete the Work.

1.03. REFERENCES

A. ASTM A6/A6M, Standard Specifications for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling, latest edition

B. ASTM A36/A36M, Standard Specification for Carbon Structural Steel, latest edition

C. ASTM A328/A328M, Standard Specification for Steel Sheet Piling, latest edition

D. AWC, American Wood Council

1.04. REGULATORY REQUIREMENTS

A. All work shall comply with Title 29, Code of Federal Regulations, Part 26, Subpart P (and other applicable sections) of Occupational Safety and Health Regulations for Construction as supplemented by the Maryland Occupational Safety and Health (MOSH) – Division of Labor and Industry.

1.05. QUALITY CONTROL

A. All sheeting and bracing shall be designed and monitored by a professional engineer licensed in the State of Delaware

1.06. DESIGN REQUIREMENTS

A. Design shall include all loading conditions to which the sheeting and bracing will be subjected during construction.

B. Design sheeting and bracing systems against failure from the maximum loads that will occur during construction, including surcharge loads and additional loading due to construction equipment.

C. Design sheeting and bracing systems to enable safe construction of structures, utilities and appurtenances, and prevent excessive ground loss, displacement of adjacent foundations, and displacement of the bottom of the excavation.

D. Steel Sheet Piling: Continuous interlocking type, ASTM A328, Z-sheet piling, provided with at least one 2-1/2 inch diameter handling hole on the centerline of the web located at least 6 inches from each of the sheet piles.

1.07. SUBMITTALS

A. Submit in accordance with the requirements of Section 01300, Submittals as supplemented herein.

1. Certified design calculations signed and sealed by a licensed professional engineer as required herein.

2. Shop Drawings of sheeting proposed to be left in place as specified herein.

PART 2 PRODUCTS

2.01. MATERIALS

A. Wood: Tongue and groove, #3 Common Douglas Fir or Hemlock or Utility grade Southern Pine; AWC grading or equal, meeting the requirements of the AWC.

B. Steel:

1. ASTM A6

2. ASTM A36 as required by ASTM A328

C. Trench Boxes: Fabricated steel or aluminum

PART 3 EXECUTION

3.01. PROTECTION

A. When so designated on the Drawings or stated in the Specifications, or to comply with local, state (MOSH), or federal (OSHA) regulations, or when sloped excavations are not feasible, not possible or allowed or if excavations endanger adjacent facilities, sheeting and bracing shall be installed by Contractor.

3.02. INSTALLATION

A. Provide all materials, equipment and labor necessary to construct and maintain all required excavation support systems.

B. Sheeting and bracing support systems shall include, but shall not be limited to, wall support such as wood sheeting, ringwales, lagging, soldier piles, steel sheeting, trench boxes and bracing members such as stringers, wales, struts, rakers, shores, tieback anchors, etc. necessary to prevent damage to the Work and for the safety of workers, the general public or adjacent property.

C. No excavation shall be performed below a line drawn down and away at a slope of two horizontal and one vertical from the nearest footing or grade beam of the existing building or as shown on the Drawings without providing sheeting, shoring and bracing to provide lateral support for soils beneath the foundations of the building and to prevent damage to the building.

D. Design of bracing shall be such as to permit proper construction of the walls and footings and proper installation of the utilities as shown on the Drawings.

E. Sheeting shall not be driven while concrete is being placed, or within 24 hours after placement, nor during pile load testing.

F. Do not brace to concrete without written approval of Engineer.

G. Install sheeting and bracing systems in a logical sequence as excavation operations are performed.

H. If a prefabricated mobile shield is used, the bottom of the shield shall be maintained as high as possible (preferably above the spring line of the pipe, maximum 2 feet) to prevent disturbance of the bedding material and tension forces on pipe joints.

I. Openings or troughs created by the use of a shield shall be filled and compacted in accordance with Sections 02223, Backfilling; 02225, Trenching; and 02228, Compaction.

3.03. MAINTENANCE

A. Maintain sheeting and bracing systems as functional on a 24-hour basis.

B. Provide a means of determining movement of excavation walls, and adjacent soil, buildings and structures and utilities.

1. If movement or damage occurs, immediately cease all construction activities, install temporary measures to prevent further movement or damage and notify Engineer.

2. Movement or damage due to failure of sheeting and bracing systems shall be permanently repaired as soon as possible, at no cost to Owner and no extension of Contract Times.

3.04. REMOVAL

A. Remove sheeting and bracing as the Work progresses in a manner which shall prevent damage to finished Work, adjacent structures and property.

B. All voids created by removal of sheeting and bracing shall be filled and compacted in accordance to the guidelines of Sections 02223, Backfilling; 02225, Trenching; and 02228, Compaction.

C. Sheeting to be left in place shall be new and unused material. Where shown on the Drawings, specified or approved, sheeting shall be cut off as specified, or a minimum of 2-1/2-feet below proposed final grade.

1. Contractor may elect to leave sheeting and bracing in place (cut off as previously described) if he elects to do so at his own expense and with Engineer’s approval.

2. Provide to Engineer a drawing of cut-off sheeting locations. Drawing should show Site plan with dimensioned locations of sheeting, type of material remaining, and depths or elevations to top and bottom of remaining sheet.

END OF SECTION

SECTION 02205

PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Location of facilities

B. Notification of owners and authorities

C. Coordination and preparation

D. Protection of facilities

E. Relocation of facilities

F. Protection of sewers and storm drains

G. Protection of water mains near sewers

H. Abandonment of utilities

I. Restoration of property markers

1.02. SUBMITTALS

A. Restoration of Property Marker maps when required as specified herein.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. LOCATION OF FACILITIES

A. Prior to construction, verify location of existing underground facilities near or adjacent to Project.

1. Consult with appropriate Underground Facilities Protection Organization (UFPO) and owners of facilities and arrange for field stake-out or other markings to show locations.

2. Perform exploratory excavation at key junctures and other critical points to aid in ascertaining locations.

B. Report field stake-out findings and results of exploratory excavations to Engineer if possible changes in project location or design are indicated because of suspected interferences with existing facilities. Allow Engineer sufficient time to determine magnitude of changes and to formulate instructions in that regard.

C. If location of an existing underground facility is uncertain, apply careful excavation and probing techniques during construction to locate and avoid damage to same.

3.02. NOTIFICATIONS OF OWNERS AND AUTHORITIES

A. Prior to construction, notify owners of existing facilities, of general scope, nature and planned progress schedule of the Work.

B. Notify owners of nearby underground facilities when excavating [or blasting] is to take place in a particular area, allowing them reasonable time to institute precautionary procedures or preventive measures which they deem necessary for protection of their facilities.

C. When existing utilities, such as sewer, water, gas, telephone or electric power are damaged or disturbed during construction, immediately notify affected owner and Project Owner.

D. Notify Police and Fire Departments, including affected owners, immediately if hazardous conditions are created or have the potential for occurring, as a result of damage to an existing facility or as a result of other activities at the Site. Hazardous conditions could be created from: fire, explosion, escape of gas, escape of fuel oil, gasoline or industrial fluids, downed electrical wires, and disrupted underground electrical cables.

3.03. COORDINATION AND PREPARATION

A. Discuss anticipated work schedule with local authorities and owners of utilities at preconstruction meeting, including procedures to be followed if one or more utilities are damaged or disrupted. Develop contingency plans to address Contractor’s role in repair of damaged utilities.

B. Make preparations beforehand to repair and restore damaged utilities, including arrangements for standby materials and equipment to be promptly assembled at Site and utilized immediately.

C. Adjust work schedules and personnel assignments as necessary to conform with requirements of utility owner whose utility is to be temporarily interrupted during construction. Cooperate with utility owner in this regard to minimize the time of interruption.

D. Make preparations for and conform to applicable federal, state, and local regulations regarding use of proper safeguards and procedures when excavation [and/or blasting] is to take place in close proximity to existing facilities and structures.

3.04. PROTECTION OF FACILITIES

A. Plan and conduct construction operations so that operation of existing facilities near or adjacent to the Work, including electric, telephone, sewer, water, gas or drainage utilities, are sustained insofar as the requirements of the Project will permit.

B. Protect existing facilities from damage or movement through installation of adequate support systems and use of proper equipment, including application of careful excavation and backfilling techniques in sensitive areas.

C. Existing utilities and other facilities which are damaged by the Contractor’s construction operations shall be promptly repaired by Contractor to the satisfaction of the affected owner or, if he so elects, that owner will perform the repairs with his own forces. Under either arrangement, such repair work shall be done at Contractor's expense.

D. When aboveground visible facilities such as poles, wires, cables, fences, signs or structures constitute an unavoidable interference, notify Engineer and consult with affected owner regarding temporary removal and later restoration of the interfering item. Arrange with that owner to remove and later restore the interfering item to the satisfaction of the owner, subject to approval of the Project Owner; or allow affected owner to perform such work with his own forces. Under either arrangement, such work shall be done at Contractor's expense.

E. Take all necessary precautions to prevent fires at or adjacent to the work, buildings, and other facilities. No burning of trash or debris is permitted. If permanent fire extinguishers are used, they shall be recharged and in "new" condition when turned over to Owner.

3.05. RELOCATION OF FACILITIES

A. If the location or position of an existing gas or water pipe, public or private sewer or drain, conduit or structure be such as, in the opinion of Engineer, to require its removal, realignment or change, such alteration shall be without cost to the Contractor for the work of removal, realignment or change only provided such work is not already required by the Contract Documents.

B. Uncovering, supporting and sustaining such facility before its removal or before and after its realignment or change, shall be the Contractor's responsibility as part of the Work of its Contract.

3.06. PROTECTION OF SEWERS AND STORM DRAINS

A. Where existing sanitary sewers or storm drain systems are being replaced or interrupted, provide temporary bypass pumping or piping to maintain flow around that segment of the Work such that no back-ups occur in existing systems.

B. [Existing sanitary sewer laterals damaged in the work or temporarily disconnected shall be restored to operation by the end of each workday. Existing sanitary sewer laterals crossing over new pipelines to be restored in accordance with details shown on the Drawings.

C. Maintain existing manholes, catch basins, and other utility structures in their pre-work condition. Any material or debris entering same due to the Contractor's operation shall be promptly removed.

3.07. PROTECTION OF WATER MAINS NEAR SEWER

A. The following applies to gravity sanitary sewers, storm sewers, sanitary and storm sewer manholes, and sanitary force mains.

B. Where a minimum 10-foot horizontal separation or minimum 18-inch vertical separation (bottom of water pipe to top of sewer pipe) cannot be maintained between a water main and sewer line, one or more of the following remedies shall be incorporated in the work:

1. The sewer lines shall be encased in 4,000 psi mix concrete for a length of 10 feet on either side of the water main.

2. Both the water main and sewer line shall be constructed of pressure type joints of ductile iron pipe rated for an internal pressure of 100 psig or the existing working pressure (whichever is greater) and shall be pressure tested to 100 psi to assure watertightness.

3. One full length of water main shall be centered over the sewer line, so that both joints will be as far from the sewer as possible.

4. Relocate water main to obtain 18-inches minimum vertical separation.

3.08. ABANDONMENT OF UTILITIES

A. Remove existing utilities to be abandoned within limits of trench excavation or impinging on trench limits.

B. Open ends of abandoned utilities, or those scheduled for abandonment, shall be bulkheaded by brick masonry or 4,000 psi mix concrete: or by cast iron plugs or caps in small diameter water mains.

C. Abandoned manholes and water valve casings shall be backfilled to grade with approved trench backfill material.

D. Frames, covers, grates, water valve casing, sections of water piping, hydrants (including standpipe and boot) valves and other items to be abandoned shall, if ordered by Owner, be salvaged for reuse and be delivered to Owner's property yard.

3.09. RESTORATION OF PROPERTY MARKERS

A. Property corner markers, boundary monuments, etc., disturbed or moved by the Contractor's operation shall be restored, in conformance with the property deed description, by a licensed land surveyor. Restoration of the property corner markers or boundary monuments shall be certified by said surveyor on a map prepared by him which shows the work accomplished. One copy of the map shall be given to the property owner and one copy given to the Project Owner.

END OF SECTION

SECTION 02222

EXCAVATING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. This section covers all excavation. Section 02222 (Trenching) supplements the requirements specified herein as related to trenching.

1.02. FIELD MEASUREMENTS

A. Verify that survey benchmark[s] and intended elevations for the Work are as indicated.

1.03. REGULATORY REQUIREMENTS

A. Excavations shall be in accordance with details of applicable codes, rules, Laws and Regulations, including the Occupational Safety and Health Administration (OSHA) Title 29 Code of Federal Regulations (CFR) Part 1926, Subpart P – Excavations [as amended by the Maryland Occupational Health and Safety (MOSH)]. Designate a “Competent Person” who shall be responsible for inspections of excavations on a daily basis and document and maintain daily trenching and excavation logs per OSHA 29 CFR 1926.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. PREPARATION

A. Review subsurface investigation reports and other available Site information.

B. Identify required lines, levels, contours, and datum.

C. Prior to start of construction, notify Miss Utility and have all underground utilities staked or marked. Utilities include water, gas, electrical, telephone, cable, storm sewer, sanitary sewers, sanitary laterals, and water service connections. In the event such locations indicate a possible interference, or when needed to locate points of connection to existing facilities, perform exploratory excavations to determine the utilities’ location and elevation. Provide Engineer with the results of the exploratory excavations for review. Allow Engineer sufficient time to determine if any changes are required as a result of such exploratory excavations prior to start of related construction activities.

D. Identify known above ground, and aerial utilities. Stake and flag locations.

E. Notify utility owners to remove and relocate utilities when required by Work.

F. Protect above and below grade utilities which are to remain.

G. Protect plant life, lawns, [rock outcropping,] and other features remaining as a portion of final landscaping.

H. Protect control points, benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic. Preserve the control points and accurately replace any such point, which is damaged or moved.

3.02. CLASSIFICATION OF EXCAVATED MATERIAL

A. Excavated material will not be classified under this section.

3.03. UNAUTHORIZED EXCAVATION

A. Contractor shall not be entitled to additional compensation for unauthorized excavations carried beyond or below the lines and subgrades prescribed in the Contract Documents. Contractor shall refill such unauthorized excavations at his own expense, with material specified in Section 02223 (Backfilling), or such other material as may be approved by Engineer. All associated costs, including testing, shall be borne by Contractor.

B. Excavation below subgrade which is ordered by Engineer because the normal subgrade has been disturbed by Contractor's operations will be considered unauthorized excavation.

3.04. EXCAVATING

A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.

B. Excavate subsoil required to accommodate paving, site structures, and construction operations.

C. If unsuitable subgrade material is encountered at structural excavations, over excavate to remove unsuitable material from the Site

D. Machine-slope banks to angle which is safe for specific material in which excavation is madeas recommended by the subsurface investigation report.

E. Excavation cut not to interfere with normal 45 degree bearing splay of foundation. Undercutting of excavation faces will not be permitted.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation.

G. Hand trim excavation to required undisturbed subgrade. Remove loose material.

H. Remove lumped subsoil, boulders, and rock under 1 cubic yard, measured by volume. Refill voids with material specified in Section 02223 (Backfilling).

I. Notify Engineer of unexpected subsurface conditions, or of questionable soils encountered at required subgrade elevations, and discontinue excavation work in area until notified to resume operations.

J. Should Contractor, through negligence or otherwise carry his excavation below the designated subgrade, material specified in Section 02223 (Backfilling), or other such materials as may be approved by Engineer, shall be furnished and placed as backfill in sufficient quantities to re-establish the designated subgrade surface.

K. Stockpile excavated material in areas designated on the Drawings and remove excess material not being reused.

3.05. MAINTENANCE OF EXCAVATIONS

A. All excavations shall be properly and legally maintained while they are open and exposed. Sufficient and suitable barricades, warning lights, flood lights, signs, etc., to protect life and property shall be installed and maintained at all times until the excavation has been backfilled and graded to a safe and satisfactory condition. All signs, markers, barricades shall conform to the requirements of the manual of Uniform Traffic Control Devices where located in public roadways. All barricades, signs and markers shall be reflectorized.

3.06. DISPOSAL OF MATERIAL

A. All excavated material except reusable topsoil and reusable material shall be classified as surplus material and disposed of off Site

B. All unsuitable materials removed from excavations shall be removed from the Site; mixing with suitable soils will not be allowed.

C. Reuse of excavated material as on Site backfill shall conform with Section 02223 (Backfilling).

D. Reuse of excavated material as on Site fill shall conform with Section 02224 (Embankment).

3.07. FIELD QUALITY CONTROL

A. Provide visual inspection of bearing surfaces.

B. Additional field inspection shall be performed under provisions of Section 01400 (Quality Control).

3.08. PROTECTION

A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

B. Roll all cut areas to “seal” the exposed excavation at the end of each day.

C. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

D. Exposed subgrade surfaces shall remain undisturbed, drained, and maintained as uniform, plane areas, shaped to receive the foundation components of the building or structure.

END OF SECTION

SECTION 02223

BACKFILLING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. This section covers backfilling of general excavations and trenches.

1.02. DEFINITIONS

A. Subgrade: As used in this section, subgrade shall mean the existing material at the bottom of excavations and backfill material extending to the bottom of granular material underneath structural foundations and precast concrete (or the bottom of the foundation or precast concrete if no granular material is required), backfill material extending to the subbase of a roadway or paved surface, and backfill material extending to topsoil in other areas.

1.03. TERMINOLOGY

A. The requirements of “backfill” specified in this section shall also apply to “fill” unless different requirements are specifically identified for “backfill” and “fill” materials.

1.04. REFERENCES

A. AASHTO – American Association of State Highway and Transportation Officials, Standard Specifications for Transportation Materials and Methods of Sampling and Testing, latest edition

B. ASTM D4491/D4491M, Standard Test Methods for Water Permeability of Geotextiles by Permittivity, latest edition

C. ASTM D4533/D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles, latest edition

D. ASTM D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method, latest edition

E. ASTM D4632/D4632M, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles, latest edition

F. ASTM D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile, latest edition

G. ASTM D4833/D4833M, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products, latest edition

H. ASTM D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles, latest edition

I. ASTM D1140, Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing, latest edition

J. Delaware Department of Transportation (DelDOT), Standard Specifications for Road and Bridge Construction.

1.05. QUALITY CONTROL

A. Engineer reserves the right to inspect proposed source of off-site granular material and to order such tests of the materials as deemed necessary to ascertain its quality and gradation of particle size. Contractor shall, at his own expense, engage an approved testing laboratory to perform such test, and submit certified test results to Engineer.

B. No granular materials shall be used on this Project for fill, backfill, sub-base, or other purpose until approval is obtained from Engineer.

1.06. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings:

a. For each on Site and off-site material proposed, identify the proposed source of the material and material testing results demonstrating compliance with field testing requirements specified in Section 02228 (Compaction). Material testing results shall be provided at least 10 days prior to the date of anticipated use clearly stating intended use of material submitted.

b. For each on Site or off-Site material proposed, furnish to Engineer for approval a certified gradation analysis at least 10 days prior to the date of anticipated use of such material. For each on Site and off- Site material proposed, notify Engineer of the source of the material and furnish to the Engineer for acceptance, a representative sample weighing approximately 50 pounds at least 10 days prior to the date of anticipated use of such material].

c. Off Site Materials: Certified sieve analysis, proctor test, and moisture content all completed within the last 6 months for all off Site materials.

d. Geotextiles: Include manufacturer’s specifications of average roll characteristics for standard ASTM geotextile tests for each geotextile proposed.

e. Where job excavated materials are proposed in lieu of off-site materials, submit the proposed methods of excavation, location of stockpiles, quantities of required job excavated materials needed, estimated excavation quantities, and proposed excavation limits.

2. Samples:

a. Geotextiles: Submit a one square foot sample of each geotextile to be used, clearly indicating where each product will be used.

1.07. QUALITY CONTROL

A. Engineer reserves the right to inspect proposed source of off-site granular material and to order such tests of the materials as he deems necessary to ascertain its quality and graduation of particle size. Contractor shall, at his own expense, engage an approved testing laboratory to perform such test, and submit certified test results to Engineer. If similar tests of

the material from a particular source were performed previously, submit results of these tests to the Engineer for consideration.

B. No granular materials shall be used on this Project for fill, backfill, subbase, or other purpose until approval is obtained from Engineer, and only material from approved sources shall be used.

PART 2 PRODUCTS

2.01. CLASSIFICATION OF EXCAVATED MATERIALS FOR BACKFILLING

A. Type A Excavated Material: Material under this classification shall be derived solely from excavations necessary to construct the Project to the lines and grades specified. If the excavated material on Site is approved for reuse and is suitable, it shall be used for backfilling purposes where other materials are not required. Contractor may, at his own expense, substitute other types of material in place of Type A Excavated Material, provided such substitution is approved in advance by Engineer.

1. Type A-1: Referred to as “excavated material” and from which all frozen material, boulders, trash, brush, logs, stumps, foreign debris, and other objectionable material greater than 3 inches in any dimension has been removed.

2. Type A-2: Referred to as “select excavated material” and from which all frozen material, humus, peat, roots, vegetation, ashes, trash, debris, and rocks and stones greater than 2 inches in any dimension have been removed.

B. Type E: Borrow Material:

1. “Borrow material” is defined as approved [on-site or] off site material required for backfill in excess of the quantity of available approved material designated as Type “A” material.Approval of all borrow material must be obtained from Engineer, and only material from approved sources shall be used.

2. Classification of Borrow Material:

a. Type E-1: Referred to as “common borrow material,” shall comply with the requirements of Type A-1 excavated material.

b. Type E-2: Referred to as “select borrow material” shall comply with the requirements of Type A-2 select excavated material.

2.02. OFF SITE MATERIALS

A. Acquire materials from a licensed commercial Supplier.

B. Within the following specifications, where grain size distribution requires a maximum of 10 percent or less material capable of passing the #200 mesh sieve, the percentage of material finer (than the #200 sieve) by weight shall be determined by wet screening in accordance with ASTM Standard D1140.

1. It is the intent to allow the use of granular materials from local suppliers.

2. No [crusher run aggregate, bank run gravel, graded base aggregate, stone, or sand] material shall be used on this Project until acceptance is obtained from Engineer. Field quality control testing requirements are specified in Section 01400 (Quality Control) and Section 02228 (Compaction).

3. Material shall be angular crusher run aggregate delivered unsorted from the crusher. Limestone material shall be used, and shall be well graded, durable and composed of rock pieces, chips and fines. The amount of fine material shall be sufficient to fill all voids between large stones when the material is compacted.

C. Bank Run Gravel

1. A mixture of hard, durable gravel and sand in accordance [DelDOT] requirements.

2. Free from organic matter, trash, shale, debris, snow ice and other frozen or mechanically deleterious material.

D. Stone

1. Shall be AASHTO No. 57 stone.

2. Shall be free from organic matter, trash, debris, snow, ice and other frozen or mechanically deleterious material.

E. Sand:

1. Shall be a mixture of natural fine gravel and sand.

2. Shall be free from organic matter, trash, debris, snow, ice and other frozen or mechanically deleterious material.

3. Sand bedding shall meet the requirements of AASHTO M6.

F. Clay:

1. Conforming to Uniform Soil Classification GD, SC, CH, or CL

2. At least 30% passing a #200 sieve

2.03. REINFORCING AND SEPARATION GEOTEXTILE

A. Shall be composed of polyester and/or polypropylene polymers meeting the criteria listed in the table that follows.

B. Separation geotextile shall be a needle-punched geotextile specifically designed for drainage and separation applications.

C. Reinforcing Geotextile shall be a woven geotextile specifically designed for reinforcement applications.

MINIMUM ACCEPTANCE CRITERIA – GEOTEXTILES

Test Description	Test Method (ASTM)	Criteria
[Separation Geotextile		
Mass per unit area	D-5261	> 8 oz./SY
Apparent opening size (AOS)	D-4751	< No. 70 sieve
Puncture resistance	D-4833	> 110 lb.
Grab tensile strength	D-4632	> 160 lb.
Tensile strength	D-4595	> 50 lb./in.
Permittivity	D-4491	> 1 sec^{-1}
Trapezoid Tearing Strength	D-4533	> 80 psi]
Reinforcing Geotextile		
Mass per unit area	D-5261	> 8 oz./SY
Puncture resistance	D-4833	> 150 lb.
Grab tensile strength	D-4632	> 400 lb.
Tensile Strength (at 5% strain)	D-4595	> 200 lb./in.
Trapezoid Tearing Strength	D-4533	> 120 psi
Apparent Opening size (AOS)	D-4751	<No. 30 sieve

D. Minimum acceptance criteria shall apply to both the machine direction (MD) and the cross machine direction (XMD).

E. Separation Geotextile

1. TenCute Mirafi [180N]
2. Propex Geotex [861]
3. Skaps GE [180]
4. [Or equal]

F. Reinforcing Geotextile:

1. TenCate Mirafi [FW403]
2. Propex Geotex [4X4]
3. Carthage Mills [ ]
4. [Or equal]

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine spaces to be filled beforehand and remove all unsuitable materials and debris including sheeting, forms, trash, stumps, plant life, etc.

B. Inspect backfill and fill materials beforehand and confirm compliance with material specifications.

C. No backfill or fill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments.

D. Spaces to be filled shall be free from standing water so that placement and compaction of materials can be accomplished in “dry” conditions.

E. Verify backfill materials to be used are approved.

F. Verify that all subsurface installations for the Project have been inspected and are ready for backfilling.

G. Verify that foundation walls are properly shored and braced to withstand lateral soil pressures created when backfilled material is placed against such walls.

H. Verify that over excavation limits are at least 5 feet beyond the footprint of structures in all directions and subgrade has been verified by heavy proof rolling, inspection, testing, and is ready for backfilling.

I. Verify that underground tanks are anchored to their own foundation to avoid flotation after backfilling.

3.02. PREPARATION

A. Inspect spaces to be backfilled and remove all unsuitable materials including sheeting, bracing, forms and debris prior to commencing backfilling operations.

B. Compact subgrade to density requirements for subsequent backfill materials.

C. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with specified foundation and/or subgrade material compact in accordance with Section 02228 (Compaction) as required for subsequent backfill material.

D. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by backfilling operations.

E. Areas to receive compacted fill shall be graded to prevent surface runoff and ponding in accordance with Section 02110.

3.03. GENERAL BACKFILLING REQUIREMENTS

A. Backfilling shall be started as soon as practicable and after structures or pipe installations have been completed and inspected, concrete has acquired a suitable degree of strength, and subgrade waterproofing materials have been in place for at least 48 hours. Backfilling shall be carried on expeditiously thereafter. Backfill shall be started at the lowest section of the area to be backfilled. Natural drainage shall not be obstructed at any time.

B. Backfill spaces shall be inspected prior to backfilling operations and all unsuitable materials, including sheeting, bracing forms and debris, shall be removed. No backfill shall be placed against foundation walls on structural members unless they are properly shored and braced or of sufficient strengths to withstand lateral soil pressures.

C. No backfill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments when placed. Material incorporated in the backfilling operation which is not in satisfactory condition shall be subject to rejection and removal at the Contractor’s expense.

D. No calcium chloride or other chemicals shall be added to prevent freezing.

E. If Contractor fails to stockpile and protect on-site excavated material acceptable for backfill, then Contractor shall provide an equal quantity of acceptable off-site material at no expense to Owner.

3.04. BACKFILLING

A. Backfill areas to required contours, grades, and elevations with approved unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Backfill material shall be inspected prior to placement for conformance with required material specifications. Stones shall not be allowed to form clusters with voids.

D. Backfill material shall not be placed when moisture content is more than two percent above optimum or is otherwise too high to allow proper compaction. When material is too dry for adequate compaction, water shall be added to the extent necessary.

E. Place and compact backfill materials in continuous layers, starting at the deepest portion of the excavation, to meet requirements of Section 02228 (Compaction).

F. As backfill progresses, the surface shall be graded so as to drain off during incidence of rain such that no ponding of water shall occur on the surface of the backfill.

G. Remove all water, snow, ice and debris from surfaces to accept backfill materials and from backfill materials. Do not place backfill on snow, ice, or soil that was permitted to freeze prior to compaction. Remove these unsatisfactory materials prior to backfill placement.

H. Do not disturb or damage adjacent walls, drainage systems, damp-proofing, waterproofing, protective coverings, utilities in trenches, underground conduits, or tanks.

I. Maintain optimum moisture content of backfill materials to attain required compaction density.

J. Do not backfill against unsupported foundation walls.

K. Slope grade away from buildings a minimum 6 inches in 10 feet unless noted otherwise or shown on the Drawings.

L. Rough grade all backfilled areas to meet subsequent topsoiling or paving requirements. Make gradual grade changes. Blend slopes into existing undisturbed surfaces.

M. Leave fill material stockpile areas completely free of excess backfill materials

3.05. TOLERANCES

A. Top Surface of Backfilling Under Pavement Subgrade: $\pm$1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: $\pm$1/2 inch from required elevations.

C. Top Surface of General Backfilling: $\pm$1 inch from required elevations.

3.06. FIELD QUALITY CONTROL

A. Material Testing:

1. Engineer reserves the right to order testing of materials at any time during the work.

2. Testing shall be done by a qualified, independent testing laboratory in accordance with this section

3. Contractor shall aid Engineer in obtaining representative material samples to be used in testing.

4. For each material which does not meet specifications, the Contractor shall reimburse the Owner for the cost of the test and shall supply an equal quantity of acceptable material, at no additional compensation.

5. Contractor shall anticipate these tests and incorporate the time and effort into procedure.

B. Stockpiled material may be tested in accordance with material testing specified herein.

C. No fill or backfill materials may be used without prior approval of Engineer.

D. Crushed gravel stockpiles which have undergone excessive particle segregation shall be remixed and approved by the Engineer prior to placement.

E. All crusher run aggregate shall undergo a minimum of handling from the source to installation in order to minimize segregation of particles by size. Stockpiles which have undergone excessive particle segregation shall be remixed and approved by the Engineer prior to using.

3.07. PERIODIC CLEAN-UP AND BASIC RESTORATION

A. When work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbances of existing features in or across streets, rights-of-way, easements or private property, Contractor shall (as the work progresses) promptly backfill, compact, grade and otherwise restore the disturbed area to a basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or function consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders and debris shall be removed so that the site presents a neat appearance.

B. Perform clean-up work on a regular basis and as frequently as required. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

3.08. PROTECTION OF FINISHED WORK

A. Protect finished Work in accordance with the Contract Documents.

B. Re-grade and re-compact disturbed backfill areas subjected to vehicular traffic.

BACKFILLING SCHEDULE

A. Backfilling shall be as follows unless otherwise indicated:

1. Pipe and Buried Utility Foundations: To be approved by Engineer and used as required when unsuitable soils are encountered.

   a. No.57 Stone.

   b. Other Materials with prior approval.

2. Pipe Bedding:

   a. No.57 Stone: All piping unless otherwise specified, extending 12-inches below the outside diameter of the pipe barrel

3. Haunching:

   a. Crusher Run Aggregate: All piping unless otherwise specified

   b. Sand: PVC and HDPE

4. Initial Backfill:

   a. No.57 Stone : All piping unless otherwise specified

   b. Sand: PVC and HDPE

5. Final Backfill:

   a. Outside Roadways: Type A-1, Type A-2 select excavated material, Select Backfill and any materials accepted within roadways as specified.

   b. Within Roadways: Borrow Type C (including material excavated that meets Borrow Type C requirements), Select Backfill, and Graded Aggregate Base Course as specified.

6. Under Structures: Crusher Run Aggregate

7. Side Backfill Adjacent to Structures: Bank Run Gravel extending 2feet horizontally from walls to subgrade

8. Over-Excavated Areas:

   a. Underneath Structures: Type A-2 select excavated material or Type E-2 select borrow material.

   b. Other Areas: Crusher Run Aggregate.

9. Other Areas: Type A-1 excavated material or Bank Run Gravel

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. This section supplements the requirements of Section 02222 (Excavating) as related to pipe and utility trenches.

1.02. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings: Metallic Tape

a. Product data

b. Schedule of utility names on tape corresponding to pipe designations on Drawings

2. Samples: One section metallic tape for each type of utility showing proposed utility names.

PART 2 PRODUCTS

2.01. METALLIC TAPE

A. Non-Electrical Service

1. Minimum Overall Thickness: 5.0 mils

2. Minimum Solid Aluminum Foil Core: 0.35 mils

3. Minimum Tensile Strength: 5,000 psig

4. Indicate use (e.g. STORM DRAIN, POTABLE WATER, SANITARY SEWER, etc.)

5. Manufacturer: Pro-Line Safety Products “Detectable Tape” or equal

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that all trench subgrades have been compacted, approved, and are ready for backfilling (including installation of geotextiles where required).

3.02. PREPARATION

A. Preparation shall be in accordance with Section 02222 (Excavating) as supplemented herein.

B. When the Project consists of reconstructing sanitary sewers and reconnection of existing sanitary laterals, only reconnect live laterals, unless otherwise shown on the Drawings. Verify whether the lateral is alive or abandoned and the source of the lateral using such methods as necessary including dyeing, flushing with water, rodding, pipe locators, and exploratory excavations.

C. Abandoned pipes and laterals shall be plugged in with 12 inches of concrete or non-shrink grout

D. Conduct the operations such that no interruptions to the existing utility system shall occur. Where existing sanitary sewers or storm drain systems are being replaced or interrupted, provide temporary bypass pumping or temporary piping to maintain flow around the work site such that no backups occur in these sewer systems.

E. Existing sanitary sewer laterals damaged or temporarily disconnected shall be restored to operation by the end of each work day. Existing sanitary sewer laterals where crossing over new pipelines shall be restored in accordance with details shown on the Drawings.

F. Maintain existing manholes, catch basins, and other utility structures above and below grade which are to remain in their pre-work condition. All material and debris entering same due to construction activities shall be promptly removed.

G. Cut out soft areas of subgrade not capable of in-situ compaction.

3.03. EXCAVATION CLASSIFICATION

A. Classification of excavated material will be in accordance with Section 02222 (Excavating).

3.04. TRENCH EXCAVATION

A. Trenches for underground piping, ductwork, drains, and similar utilities shall be excavated and maintained as shown on the Drawings and specified herein. Trench widths shall be held within the minimum [and maximum limits] shown on the Drawings.

B. If a prefabricated, mobile shield is utilized in lieu of conventional sheeting and bracing in pipe trenches, the bottom of the shield shall be maintained as high as possible (preferably above the spring line of the pipe) so as to prevent disturbance of the pipe foundation material and to avoid forces which would tend to pull pipe joints apart when the shield is dragged forward. Gouged openings or troughs left by the shield shall be filled with additional material specified in Section 02223 (Backfilling) and shall be thoroughly compacted.

C. Excavation shall be such that a flat bottom trench of allowable width is established at the required subgrade elevation for subsequent installation of pipe bedding material.

D. Operations shall result in stable trench walls and a stable base free from standing water.

E. In general, trenches shall not be opened for more than 50 feet in advance of installed pipe. Excavation of the trench shall be fully completed at least 5 feet in advance of pipe laying operations. No more than 40 feet of trench shall be left opened overnight. Trenches shall not be left opened overnight.

F. If indicated on the Drawings, or when directed by Engineer as a result of unsuitable soil conditions, trench excavation shall be carried below the required subgrade and foundation material installed in conformance with the Contract Documents. Over excavate soft areas of subgrade not capable of in situ compaction down to suitable subgrade or a minimum of 2

feetbelow the bottom of the trench, whichever is greater. Once suitable subgrade is reached, place single layer of reinforcing geotextile to cover the entire area of over excavation and backfill. If more than 100 cubic yards of over excavation is required to reach suitable subgrade, Contractor shall notify Engineer immediately, and Contractor shall provide recommended corrective actions to Engineer from a geotechnical engineer licensed in the State of Delaware for review prior to proceeding further with over excavation.

3.05. PIPE TRENCHES

A. Unless otherwise shown on the Drawings, the minimum total finished cover over the top of the pipe barrel of all pressure pipe shall be 3 feet.

B. Bedrock, boulders and cobbles greater than six inches in diameter shall be trimmed back or removed on each side of the trench so that no rock protrudes within 6 inches of the installed pipe. Rock shall also be trimmed back across the bottom of the trench so that no rock, boulder or cobble protrudes within [four] inches of the installed pipe.

C. All pipes, fittings or specials which are to be installed in the open trench excavation shall be properly bedded in, and uniformly supported on pipe foundations of the types required by the Contract Documents. Flat-bottom trenches [of required width] shall be excavated to the necessary depth [as shown on the Drawings] and maintained in accordance with the Contract Documents. Trenches shall be dewatered and all work performed in a dry trench.

D. Specified bedding, haunching, initial backfill, and final backfill material shall be furnished, placed, and compacted in the trench for its full width. Suitable holes shall be provided in the trench bottom to permit adequate bedding of bells, couplings, or similar projections. The minimum allowable width of pipe trenches shall be outside diameter of the pipe plus 1'-0" on each side of the pipe.

3.06. REINFORCING GEOTEXTILE FABRIC

A. When specifically called for on the Drawings, or when ordered by Engineer, provide reinforcing geotextile fabric. Extend fabric upwards to the top of the initial backfill where it can then be placed flat with a minimum overlap of 6 inches. Longitudinal overlaps shall be a minimum of 2 feet. Fabrics shall be installed and stretched tight and have no wrinkles so that the fabric will be in tension when placing the pipe foundation material.

3.07. SEPARATION GEOTEXTILE FABRIC

A. When specifically called for on the Drawings, or when ordered by Engineer, provide separation geotextile fabric.

3.08. MAINTENANCE OF EXCAVATIONS

A. To maintain traffic and safety, temporary plating over trenches consisting of steel plates shall be used to temporarily bridge trench excavations. Plates shall be of size and positioned to provide adequate bearing at plate edges, shall be securely anchored, and shall be fitted in place in a manner to minimize noise when crossed by traffic. Plates shall be of sufficient thickness to safely carry heavy traffic without detrimental deflection. Unless otherwise specified, the minimum thickness of plates shall be 1-inch.

B. Plate edges exposed to traffic shall be feathered with asphalt mix as part of trench excavation work. Work includes surveillance and adjustment of plating over trenches which shall be provided by Contractor during non-working hours, weekends, and holidays.

C. Work shall be done in such a manner as to cause minimum traffic interruption, both pedestrian and vehicular. Utilities such as hydrants and valves, etc. shall be accessible at all times. Unless specifically waived by the authority having jurisdiction, provisions shall be made to maintain vehicular traffic on all streets in which work is in progress, and suitable walkways shall be maintained for pedestrian travel.

END OF SECTION

SECTION 02228

COMPACTION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Compaction requirements and test methods.

1.02. TERMINOLOGY

A. The requirements of “backfill” specified in this section shall also apply to “fill” unless different requirements are specifically identified for “backfill” and “fill” materials.

1.03. REFERENCES

A. ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)), latest edition

B. ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass, latest edition

C. ASTM D2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), latest edition

D. ASTM D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth), latest edition

1.04. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings: Written description of equipment and methods proposed for compaction.

1.05. QUALITY ASSURANCE

A. Contractor shall adopt compaction methods which will produce the degree of compaction specified herein, prevent subsequent settlement, and provide adequate support for the surface treatment, pavement, structure, and piping to be placed thereon, or therein, without damage to the new or existing facilities.

B. The natural subgrade for all footings, mats, slabs-on-grade for structures, and pipes shall consist of firm undisturbed natural soil, at the grades shown on the Drawings.

C. After excavation to subgrade is completed, the subgrade shall be compacted if it consists of loose granular soil or if its surface is disturbed by the teeth of excavating equipment.

1. This compaction shall be limited to that required to compact loose surface material and shall be terminated in the event that it causes disturbance to underlying fine-grained soils, as revealed by weaving or deflection of the subgrade under the compaction equipment.

2. If the subgrade soils consist of saturated fine or silty sands, silts, clay or varved clays, no compaction shall be applied.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01. PREPARATION

A. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by compaction operations.

B. Proof-roll all subgrade surfaces to accept backfill and fill materials.

C. Install geotextile where needed.

3.02. COMPACTION

A. Each layer of fill shall be compacted to the specified density the same day it is placed.

B. The moisture content of the material shall be within [three] percentage points of the optimum moisture content and shall be adjusted within these limits, if necessary, to achieve the required degree of compaction.

C. Compact each lift in accordance with Table 1 (Compaction Requirements) included herein.

D. Match compaction equipment and methods to the material and location being compacted in order to obtain specified compaction, with consideration of the following guidelines:

1. Rubber-tired rollers are preferred for most areas to prevent bridging of softer materials.

2. Double smooth drum rollers may be used provided that careful inspection can prevent bridging.

3. Compaction roller should be lighter in weight than proof-rolling equipment, with a minimum compaction force of 350 pounds per linear inch (PLI).

4. Vibratory compaction is preferred for dry, granular materials.

5. Hand compaction equipment such as impact rammers, plate or small drum vibrators, or pneumatic buttonhead compactors should be used in confined areas.

6. Hydraulic compaction by ponding or jetting will not be permitted except in unusual conditions, and then only upon written approval by the Engineer and after a demonstration of effectiveness.

7. Backhoe mounted hydraulic or vibratory tampers are preferred for compaction of backfill in trenches under pavements over 4 feet in depth. The upper 4 feet shall be compacted as detailed above or with hand-guided or self-propelled vibratory compactors or static roller.

E. Compaction shall be done systematically, and no consideration shall be given to incidental compaction due to construction vehicle traffic.

F. Contractor may employ alternate methods of compaction if the desired degree of compaction can be successfully demonstrated to Engineer's satisfaction.

G. Plastic Piping:

1. For plastic piping 4-inch in diameter and greater, do not compact backfill material from the springline to one foot above the top of the pipe.

H. Backfill to a depth of 12 inches over top of concrete encasement before beginning compaction with mechanical equipment.

TABLE 1
COMPACTION REQUIREMENTS

CONSTRUCTION ELEMENT	MAXIMUM COMPACTION LAYER THICKNESS (INCHES)	ASTM	MINIMUM COMPACTION (MODIFIED PROCTER)
I. STRUCTURES*			
a. Backfill beneath foundation elements and under slabs-on-grade - hand-guided compaction equipment	6	D1557	95%
Backfill beneath foundation elements and under slabs-on-grade - self-propelled compaction equipment	8	D1557	95%
b. Backfill around structures and above footings	8	D1557	95%
II. TRENCHES**,***			
a. Backfill under pipelines and pipe bedding	8	D1557	95%
b. Pipe side fills and top 4 feet of pipe backfill under pavements (see top 1' below)	12	D1557	95%
c. Backfill below 4 feet under pavement	18	D1557	92%
d. Backfill under lawns, gardens and cultivated fields	24	D1557	90%
e. All other trenches	36	D1557	85%
III. EMBANKMENTS AND FILLS			
a. Fill under streets, parking lots, and other paved areas	12	D1557	95%
b. Embankments not supporting pavement or structures	18	D1557	90%
c. Rough site grading	24	D1557	85%
IV. PAVEMENT SUBGRADE			
a. Top 2' below pavement Subbase (GABC) – hand-guided equipment	4	D1557	97%
b. Top 2' below pavement Subbase (GABC) – self-propelled equipment	8	D1557	97%
c. Fill at depth greater than 1' below pavement – see I above.			

** Where structural loads are carried by piles, caissons or other deep foundations, minimum

compaction may be reduced to 92 percent.

** The first 1 foot above pipelines shall have a compacted thickness of 12 inches.

*** For cross-country pipelines, lifts may be compacted with a backhoe bucket or other means, and slightly mounded at the surface provided that regrading is performed within the guarantee period.

3.03. FIELD QUALITY CONTROL

A. Compaction Testing

1. Engineer reserves the right to order the qualified independent testing laboratory to conduct in-place density tests of compacted lifts at any location during the Work.

2. At minimum, compaction testing shall be conducted at the following locations, per lift:

a. At two locations for each lift under each structure less than 500 square feet; at three locations under each structure between 500 and 2,000 square feet; and at five locations under each structure over 2,000 square feet in area.

b. At one location for each lift for every 50 linear feet of trench backfill placed.

c. At one location for each lift for every 1,000 square feet of pavement placed.

d. At one location for each lift for every 250 square feet of walkway placed.

e. At one location for each lift for every 100 cubic yards of fill or backfill placed.

3. For each test which does not meet the requirements of the Contract Documents, Contractor shall retest at its own cost. If the retest does not meet the requirements of the Contract Documents, Contractor shall replace and re-compact material at no additional cost to the Owner.]

4. Anticipate these tests and incorporate the time and effort into procedures.

5. Nuclear moisture density testing by “probe” methods will be acceptable for compacted layers not exceeding 12 inches in thickness.

a. Nuclear “backscatter” methods will be acceptable only for testing asphalt paving layers not in excess of 3 inches in thickness.

b. Only certified personnel will conduct nuclear testing.

c. If the nuclear method is utilized, the results shall be checked by at least one in-place density test method described above.]

3.04. PROTECTION

A. Prior to terminating work for the day, the final layer of compacted backfill, after compaction, shall be rolled with a smooth-wheel roller if necessary to eliminate ridges of soil left by tractors or equipment used for compaction or installing the material.

END OF SECTION

SECTION 02605

MANHOLES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish, install, and test manholes complete with all required accessories in accordance with the Contract Documents.

1.02. REFERENCES

A. American Concrete Institute

1. ACI 304, ACI Standard Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete, latest edition

B. ASTM International

1. ASTM A48 / A48M - 03(2016), Standard Specification for Gray Iron Castings

2. ASTM A536 – 84(2014), Standard Specification for Ductile Iron Castings

3. ASTM C33 / C33M – 18, Standard Specification for Concrete Aggregates

4. ASTM C307 – 03(2012), Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

5. ASTM C443 – 12(2017), Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

6. ASTM C478 – 18, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

7. ASTM C531 – 00(2012), Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete]

8. ASTM C579 – 01(2012), Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

9. ASTM C580 – 02(2012), Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

10. ASTM C642 – 13, Standard Test Method for Density, Absorption, and Voids in Hardened Concrete

11. ASTM D395 – 16e1, Standard Test Methods for Rubber Property—Compression Set

12. ASTM D412 – 16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

13. ASTM D573 – 04(2015), Standard Test Method for Rubber—Deterioration in an Air Oven

14. ASTM D672

15. ASTM D695 – 15, Standard Test Method for Compressive Properties of Rigid Plastics

16. ASTM D2240 – 15e1, Standard Test Method for Rubber Property—Durometer Hardness

1.03. SUBMITTALS

A. Provide in accordance with Section 01300 (Submittals) as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Shop Drawings:

a. Typical wall sections and bases proposed for this Project, including joint design and related details for field assembly. Include certification of conformance with Contract Documents and ASTM specifications.

b. Certified design calculations signed and sealed by a licensed professional engineer registered in the state

c. Manhole frames and covers

2. Field testing results

1.04. QUALITY ASSURANCE

A. Precast reinforced concrete wall sections and bases for manholes shall be manufactured in a plant approved by Engineer and the DelDOT for manufacture of concrete pipe.

B. Aggregate used in producing concrete shall be from DelDOT approved sources.

C. Completed manholes shall be watertight and shall be tested.

1.05. QUALITY CONTROL INSPECTION

A. The quality of all materials, the process of manufacture and the finished sections shall be subject to inspection by Engineer. Such inspection may be made at the place of manufacture, and/or at the work Site after delivery. Manhole sections shall be subject to rejection if they fail to meet the Specification requirements, even though Sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the Site shall be tagged and removed from the job Site immediately. All sections which have been damaged after delivery will be rejected, or if already installed, shall be removed and replaced at Contractor’s expense.

B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured and free of blisters, cracks, roughness, exposure of reinforcement, damaged joints, and dimensional distortions or other irregularities.

C. Frames and covers shall be manufactured true to pattern and shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Covers shall seat uniformly in any position in the frame without rocking.

PART 2 PRODUCTS

2.01. ANTI-FLOTATION DESIGN REQUIREMENTS

A. Designs shall include anti-flotation collars to withstand flotation under full hydrostatic head with a 1.25 factor of safety for all manholes.

1. 4-Foot Inner Diameter: Flotation collars shall be minimum of 4-inch

2. 5-Foot Inner Diameter: Flotation collars shall be minimum of 6-inch

3. Greater than 5-Foot Inner Diameter: Flotation collars reviewed on a case-by-case basis

2.02. PRECAST CONCRETE BASES

A. Design and manufacture of precast concrete bases for manholes shall conform to the requirements of this section and ASTM C478. [Bases shall conform to the dimensions indicated on the Drawings, and the horizontal] [The horizontal] joint at the top of the base shall be compatible with that of the precast wall section. [Precast bases shall be sized as follows based on the largest size connecting sewer pipe:

1. 10” – 21” Diameter: 48” diameter precast base

2. 24” – 30” Diameter: 60” diameter precast base

3. 33” – 48” Diameter: 72” diameter precast base

4. 54” – 60” Diameter: 96” diameter precast base

B. For base sections greater than 60” diameter, provide precast transition slabs to transition to 48” diameter risers.

C. Precast bases shall be manufactured to contain openings in the wall, of minimum size, to receive the ends of the installed sewer pipe. Openings shall be accurately positioned to conform with line and grade of the connecting sewer.

D. For sanitary sewer manholes, the top of the manhole base shall extend at least 10 inches above any pipe openings in the base.

2.03. MONOLITHIC CAST-IN-PLACE CONCRETE BASES

A. Cast-in-place concrete bases are not permitted, except when constructing a new manhole on existing concrete sewers or if specifically shown on the Drawings.

2.04. PRECAST CONCRETE WALLS AND MANHOLES TOPS

A. Design and manufacture of precast concrete walls shall conform to the requirements of this Section and ASTM C478.

B. Precast concrete walls shall be made with straight, circular pipe sections and eccentric cone sections if manhole steps are required and concentric cone sections where no steps are required. The total height of precast wall required for each manhole shall be determined in the field, and shall be such that the vertical distance between the top of the assembled precast units and the bottom of the installed manhole frame is a minimum of 4 inches and a maximum of 12 inches, to allow for grade adjustment rings.

C. If required, manhole steps shall be cast integrally with or grouted solid into the precast wall units as specified herein. [Lifting holes that extend completely through the manhole are not permitted in the precast units and no more than two lift inserts shall be cast in any section. No lifting holes are permitted in the precast units.

D. All joints in the precast wall, including the joint at the top of the base, shall be made up using "Snap-On" type O-ring gasket, conforming to ASTM C443; except that joint taper shall not exceed 3-1/2 degrees.

a. The precast sections shall be provided with a special groove (cast into the male end) to receive and hold the gasket in position during joint assembly.

b. The gap between sections shall be packed on the inside and outside with grout after joint assembly. The grout shall be "A-H® Axpandcrete S Hi-Flow" by Anti-Hydro International, Inc., "Masterflow 713" by BASF Master Builders Solutions, or "Five Star® Grout" by Five Star Products, Inc., [or equal.] [; no or equal] [or substitutions] [are allowed].

c. Grout shall be troweled smooth so that no projections remain on the inside.

d. There shall be concrete to concrete bearing between the various sections, and the gasket shall not support the weight of the section.

E. If required, precast reinforced concrete slab tops and transition slab tops for manholes shall be manufactured in accordance with ASTM C478, except that thickness and reinforcing shall be as shown on the Drawings. Openings shall be of the proper diameter to receive the frame specified.

F. Manhole tops shall be cast with four threaded inserts to accommodate frame hold-down bolts.

2.05. FRAMES AND COVERS

A. Frames and covers shall be of the make, style, opening, height, weight, and other designation specified herein [or shown on the Drawings.

B. Material shall be gray cast iron conforming to ASTM A48, Class 30; or shall be ductile cast iron conforming to ASTM A536, Grade 60-40-18.

C. Unless otherwise scheduled, frames and covers shall be heavy duty, non-penetrating pickhole type of non-rocking design, and shall have machined bearing surfaces to prevent rocking and rattling under traffic loads. Covers shall have cast in, 1-1/2-inch wide, raised letters, the words "SANITARY SEWER" or "STORM SEWER" depending on use.

D. Unless otherwise noted, all sanitary sewer manhole covers shall be self sealing and shall be furnished with O-ring rubber gaskets.

E. Surface finish shall be smooth and well-cleaned by shot-blasting or by some other approved method.

F. Frames and covers shall have clear opening of 30-inch diameter.

G. Rubber gasketed watertight frames and covers shall be provided for all manholes into which pressure sewer discharges, all meter pit manholes,[and where shown in the Manhole Schedule at the end of this section.

H. Vented covers shall be used on air release manholes when no vent pipe is provided. A minimum of four 1-inch holes are required.

I. Acceptable manufacturers and pattern numbers for self-sealing frames and covers are:

1. East Jordan Iron Works Product No. 001148064L01 or approved equal.

2.06. MANHOLE STEPS

A. Manhole steps are to be provided in all manholes designated in the Manhole Schedule included at the end of this section]. Steps shall be cast in or grouted solid into the precast units at intervals of 12 inches. Steps shall be in conformance with OSHA requirements having drop front or equivalent. Bolted-on type are not acceptable.

2.07. GRADE RINGS

A. Grade adjustment for a manhole shall not exceed 12 inches.

B. Precast Concrete Grade Rings

1. Precast concrete grade rings for leveling units shall be manufactured in compliance with the requirements of ASTM C478; and shall be as thick as necessary to provide the required grade adjustment but not less than 3 inches in height.

2. Split grade rings are unacceptable.

3. Broken or cracked concrete grade rings will not be acceptable.

C. Rubber Grade Rings

1. Rubber grade rings (rubber adjustment riser) for leveling units shall comply with the following:

Physical Properties	Test Results	Test Method
Density	$\pm$1.098 g/cm^3	ASTM C6420
Durometer Hardness Molded surface Interior surface	 75A $\pm$ 10 points 73A $\pm$ 10 points	Based on ASTM D2240
Tensile strength	1.6 MPa (232 psi) (not less than 1 MPa)	ASTM D412
Compression deformation Initial deformation Final deformation	Under 1 MPa (145 psi) 6 $\pm$4 percent 6 $\pm$4 percent	Based on ASTM D575

Physical Properties	Test Results	Test Method
Compression set	0.4 percent (no more than 4 percent) under 1 MPa (145 psi)	Based on ASTM D395
Freeze and thaw when exposed to deicing chemicals	No loss after 50 cycles	ASTM C672
Coefficient of thermal expansion	1.08 x 10^{-4} mm/mm/°C (6 x 10^{-5} in/in/°F)	ASTM C531
• Weathering (70 hours at 70 degrees C) Hardness retained • Compressive strength retained • Tensile strength retained • Elongation retained	• 100 ± 5 percent • 100 ± 5 percent • 100 ± 5 percent • 100 ± 5 percent	ASTM D573

2. Rubber grade rings shall only be used in paved areas.

3. Tapered rubber grade rings shall be used to accommodate sloped paved surfaces.]

2.08. CEMENT GROUT

A. Cement grout shall be non-shrink, non-metallic.

B. Use Type I cement where grout is not in contact with sewage.

C. Use Type II (sulfate resistant) where grout is in contact with sewage.

2.09. PIPE SEALS

A. Sanitary sewer connections between manholes and pipes shall be made with flexible rubber sleeves in the manufactured sizes available, with stainless steel straps and bolts. Elastomeric waterstop gaskets are not permitted.

B. For storm sewer manholes where polyethylene, plastic or PVC pipe is utilized, sewer connections between manholes and pipes shall be made with flexible rubber sleeves in the manufactured sizes available, with stainless steel straps and bolts. Provide an elastomeric waterstop gasket around exterior of all plastic polyethylene or PVC pipe, and where sleeve sizes are not commercially available either due to the size of pipe or due to outside diameter not allowing proper sleeve fit.

C. The ends of the pipe shall be accurately positioned in the openings, properly secured against movement, and the remaining annular space between the pipe wall and the base completely packed with “A-H® Axpandcrete S Hi-Flow” by Anti-Hydro International, Inc., “Masterflow 713” by BASF Master Builders Solutions, or “Five Star® Grout” by Five Star Products, Inc., [or equal.] [; no or equal] [or substitutions] [are allowed]. Before the grout has set, the Contractor shall recheck invert elevations of the ends of the pipe and perform any adjustments which are necessary to establish the required line and grade of the sewer.

D. Glass fiber reinforced polyester manholes shall be connected to pipe with a rubber gasket sleeve and stainless steel straps and bolts.

2.10. CAST-IN-PLACE CONCRETE

A. Cast-in-place concrete used in constructing manhole bench walls shall be Type II and conform to the following mix design:

28-day compressive strength, psi	2,500 (minimum)
Maximum aggregate size, per ASTM-C33	#467
Minimum cement content, lbs/CY	470
Maximum water/cement ratio, by weight	0.57
Entrained air content, by volume	6% (±1%)
Slump - Adjust as necessary, but not exceeding	3 inches

B. Measuring, mixing, transporting and placing of concrete shall conform to ACI 304.

2.11. WATERPROOFING

A. Provide manholes waterproofed over the entire exterior surface that will be below finished grade [and as indicated in the Manhole Schedule included at the end of this section]. The waterproofing shall not mar or interfere with the specified exterior finish for these structures. Waterproofing shall be accomplished prior to structure installation for precast sections, and shall be applied to dry surfaces under proper weather conditions.

B. Waterproofing shall consist of a two-coat application of epoxy coal tar, “Bitumastic 300 M” by Carboline, “Series 46H-413 Hi-Build Tneme-Tar” by Tnemec, [or equal] [; no or equals] [or substitutions] [are allowed.]

C. Waterproofing shall be applied according to manufacturer’s specification. Total thickness of the two-coat application shall not be less than 16 mils.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that subgrade elevations for manhole bases are correct and excavation is dewatered.

B. Verify that rejected (tagged) units have been removed from the Site.

3.02. PREPARATION

A. Provide foundation mat of run-of-crusher stone per Section 02223 (Backfilling) to support manhole base. Mat shall be 6 inches minimum depth and shall bear on sound undisturbed earth; excavate and remove subgrade material as necessary to reach sound stratum.

B. Mat diameter shall be a minimum of 2 feet greater than outside diameter of manhole base, and shall be compacted to a uniform, level surface.

3.03. INSTALLATION

A. Manholes

1. Precast base shall be accurately located and uniformly supported on the foundation mat in a level position.

2. Install required manhole wall sections in properly oriented position; follow manufacturer's instructions for joining together each section using the "snap-on" O-ring gasket joint. Pack joints with grout.

3. All precast units shall be laid-up plumb and level to form a vertical manhole structure at each location.

4. When grade adjustment exceeds 12 inches, barrel sections corresponding to the manhole diameter shall be used.

B. Pipe Seals: Connect ends of sewer pipe to manholes with flexible rubber sleeves, straps and bolts as shown on Drawings and specified herein.

C. Channels and Benches

1. Construct flow channels and bench walls in bottom of manholes [as specified herein] [as specified herein and as shown on the Drawings]. Flow channels shall match inverts and size of pipes, creating a channel of gradual slope and curvature such that smooth, uninterrupted flow through the manhole is assured. Extend channel wall vertically up to top of highest (flowing) pipe so as to form the bench wall. Bench surface shall extend horizontally to manhole walls, with slight pitch toward flow channel (no less than 1 percent).

2. Flow channels and bench walls shall be constructed of cast-in-place concrete, although half-sewer pipe sections may also be utilized to form portions of the flow, channel. All exposed concrete surfaces shall receive a steel troweled finish except horizontal surface of bench walls shall then be brushed finished.

3. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage.

4. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

D. Grade Rings

1. Furnish and install grade rings at manhole top so as to adjust and support frame to finished grade.

2. When grade adjustment of less than 3 inches is required, rubber grade rings shall be used.

3. Joints between precast concrete grade rings for leveling units shall be made with two-bead preformed plastic sealing compound and shall be 1/2 inch thick and troweled or trimmed smooth on the inside of the manhole. In addition, the leveling units shall be sealed on the outside surface using non-shrink grout.

4. Joints between rubber grade rings and rubber precast concrete grade rings or frame shall be made with polyurethane marine sealant compound.

5. The joint between the bottom of the frame and the top of precast concrete grade rings, or the top manhole section as applicable, shall be sealed on the outside surface using non-shrink grout.

E. Frames and Covers

1. Frames and covers shall be firmly seated and be positioned to conform to the adjacent finished grade, or to the specific elevation shown on the Drawings.

2. Frames shall be set parallel to surface slopes.

3. Covers shall seat uniformly in any position in the frame without rocking.

4. In pavements and shoulder areas, set frame 1/2 inch below finished grade.

5. Attach frame to manhole using four stainless steel bolts, nuts, and washers. If threaded inserts are not provided with manhole top, furnish and install bolts using epoxy bonding compound.

3.04. BACKFILLING

A. Carry out backfilling operations in conformance with Section 02225 (Backfilling), being careful to provide full support under connecting pipes using compacted bedding material specified for the sewer piping.

B. Backfill around glass fiber reinforced polyester manholes to ground surface or pavement subgrade to consist of a minimum of 24-inch wide course of run-of-crusher stone placed and compacted in a uniform manner so as to maintain the stability and alignment of the manhole structure.

3.05. ACCEPTANCE TESTING

A. All visible leaks shall be permanently sealed in an approved manner.

B. Sanitary sewer manholes shall be watertight. Repair of manhole sections using grout, either cementitious or polyurethane, is not permitted.

END OF SECTION

SECTION 02740
FORCE MAINS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. This section defines the minimum requirements for supply and installation of High-Density Polyethylene (HDPE) pressure piping and associated appurtenances.

1. All jointing and gasketing materials, harnessing, and other miscellaneous appurtenances and accessories shall be provided.

1.02. RELATED SECTIONS

A. Section 02222 – Excavation

B. Section 02223 – Backfilling

C. Section 02225 – Trenching

D. Section 02228 - Compaction

E. Section 02741 – Pressure Tests of Force Mains.

F. Section 02930 – Directional Drilling.

1.03. QUALITY ASSURANCE

A. Manufacturers Qualifications: Piping for each service or system specified herein shall be provided by a manufacturer who has thoroughly familiarized himself with the design intent of the system and will provide piping suitable for the service intended.

B. Source Quality Control: All pipe shall be marked with a class designation thereon. The name or trademark of the manufacturer shall also be marked on the pipe.

C. Each type of pipe shall be obtained from no more than one manufacturer.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM D 2657, Standard Practice for Heat Joining Polyethylene Pipe and fittings.

2. ASTM D 2683, Standard Specifications for socket type Polyethylene fittings for outside diameter-controlled Polyethylene Pipe and Tubing.

3. ASTM D 2837, Standard Testing Methods for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

4. ASTM D 3261, Specifications for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Plastic Pipe and Tubing.

5. ASTM D 3350, Standard Specifications for Polyethylene Plastic Pipe and Fitting Materials.

6. PPI TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stress for Thermoplastic Pipe Materials.

7. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.

8. ANSI/NSF, Standard No. 61 for Drinking Water Systems Components- Health Effects.

9. AWWA C901, Standards for Polyethylene (PE) Pressure Pipe and Tubing 1/2 inches through 3 inches for Water Service.

10. AWWA C906, Standards for Polyethylene (PE) Pressure Pipe and Tubing 4 inches through 63 inches for Water Service.

E. Shop Tests:

1. Piping manufacturer shall maintain a continuous quality control program. All Polyethylene molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of AWWA C901 or AWWA C906.

1.04. SUBMITTALS

A. Shop Drawings: CONTRACTOR shall submit for approval Shop Drawings showing the following:

1. Detailed procedures to be used in jointing and installing piping system including manufacturer's recommendations.

2. Interfacing of piping system to equipment, appurtenances, and other types of pipe.

3. Detail requirements for burial, supports, anchors, guides, expansion joints, and all accessories required for a satisfactory piping system.

4. Affidavit of Compliance in accordance with AWWA C901 or AWWA C906.

PART 2 PRODUCTS

2.01. GENERAL

A. Identification: Each pipe segment, fitting, and special shall be clearly marked with the following:

1. Manufacturer’s name and trademark.

2. Nominal pipe size and class.

3. Material designation.

B. All products included in this section shall conform to the requirements of the standard specifications referenced herein.

C. Pipe material, pipe class, and pipe sizes shall be furnished and installed as listed in the pipe

schedule or as shown on the drawings.

D. The underground process piping system shall be installed as shown on the Drawings.

2.02. HIGH DENSITY POLYETHYLENE PIPE (HDPE)

A. High Density Polyethylene Pipe for Sewer Force Mains

1. Materials used in the manufacture of the HDPE pipe shall be PE 4710, high density polyethylene meeting the requirements of ASTM D 3350, cell classification of 445474C.

2. The material shall have a minimum hydrostatic design basis of 320 psi at 73 degrees Fahrenheit when tested in accordance with PPI TR-3 and shall be listed in the name of the pipe manufacturer in PPI TR-4.

3. HDPE pipe shall be manufactured in accordance with AWWA C901 for sizes 1/2 inches through 3 inches and in accordance with AWWA C906 for sizes 4 inches through 63 inches.

4. The pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

5. All piping and tubing furnished for use on this project shall meet the following requirements, unless indicated otherwise on the Contract Drawings:

a. Iron Pipe Size (IPS) PE4710

b. All HDPE forcemain and lateral piping installed via open cut and HHD methods shall be DR 9.

6. Restrained joints for polyethylene piping shall be accomplished by completion of butt fusion joints.

7. Restrained polyethylene pipe connections to stainless steel or carbon steel mechanical joint fittings shall be accomplished by use of a HDPE adapter piece which must be butt fused to the plain end of the HDPE piping. The adapter piece shall be PE 4710, with the same DR rating as the HDPE piping which it will be fused to.

8. When transitioning from one pipe material to HDPE pipe, flex-restraints are required, and an electrofusion flex restraint by Central Plastics shall be used with a concrete collar to prevent pull outs from expansion of HDPE pipe or approved equal.

9. Product and manufacturer: HDPE piping shall be manufactured by:

a. Plexco

b. ISCO Industries

c. Or equal

B. Butt Fusion Fittings:

1. Fittings shall be made of HDPE material with a minimum material designation of PE 4710 and with a minimum Cell Classification as noted in B.1. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by the OWNER/ENGINEER. All fittings shall meet the requirements of AWWA C901 or AWWA C906.

   a. Molded fittings shall comply with the requirements of ASTM D 32610

   b. All fabricated elbows, tees, reducing tees, and end caps shall be produced and meet the requirements of ASTM F 2206, holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F 2206 Section 10 including nominal size and fitting EDR, which will meet or exceed the pipe DR identification for the project. Fabricated fittings shall be manufactured using a McElroy DataLogger to record fusion pressure and temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of OWNER/ENGINEER. Test results validating ASTM Section 7.3 and 9 shall be provided to OWNER/ENGINEER upon request.

   c. Socket fittings shall meet ASTM D 2683.

C. Magnetic Tape Marker:

1. All Polyethylene (HDPE) pipe installed via open cut methods shall have a magnetic tape marker laid directly above the pipe for the full length of the pipe and approximately 18 inches below ground surface. At each concrete structure, cleanout, and/or valve box, the CONTRACTOR shall install the tape in such a manner where the tape runs up the exterior wall of the structure and is affixed at the top. The tape shall be affixed in such a fashion where the OWNER can attach his detection device to the tape to produce a stronger signal for pipeline detection.

2. Tape shall be 3 inches wide consisting of two (2) exterior plies of polyethylene with an aluminum alloy foil core.

3. Tape shall be manufactured by Paul Potter Warning Tape, Alarm Tape, or approved equal.

4. Tape shall be green color and shall be labeled "Sewer" in black letters.

5. Splices, where needed, shall be made in accordance with manufacturer's recommendations.

6. At completion of the project, before final payment, the CONTRACTOR shall test the entire length of the pipe using pipe location equipment. Tests shall be made only in the presence of the OWNER and ENGINEER. Any section of tape not continuous or that is undetectable shall be removed and relayed.

D. Tracer Wire:

1. All Polyethylene (HDPE) pipe installed shall have a tracer wire attached to the HDPE piping for the full length of the pipe installed. At each concrete structure,

cleanout, and/or valve box, the CONTRACTOR shall install the tracer wire in such a manner where the wire runs up the exterior wall of the structure and is affixed at the top. The wire shall be affixed in such a fashion where the OWNER can attach his detection device to the wire to produce a stronger signal for pipeline detection. Tracer wires shall be connected to the adjacent tracer tape installed for the adjacent pipe installations.

2. Tracer wire in trenchless applications shall be green in color, extra high strength 12-gauge (AWG), copper clad steel (CCS) wire. Wire shall have a minimum break load of 1,150 pounds, a 45 mil HDPE jacket and shall be rated for HDD applications.

   a. Two (2) tracer wires shall be installed in all trenchless applications.

3. Tracer wire in non-trenchless applications shall be green in color, 18-gauge (AWG), copper clad steel (CCS) wire.

4. Splices, where needed, shall be made in accordance with the manufacturer's recommendations.

5. At completion of the project, before final payment, the CONTRACTOR shall test the entire length of the tape markers and tracer wires using pipe location equipment. Tests shall be made only in the presence of the OWNER and ENGINEER. Any section of tape or tracer wires not continuous or that is undetectable shall be removed and relayed or replaced per the manufacturer's recommendations.

2.03. DUCTILE IRON PIPE (DIP)

A. Ductile iron pipe shall conform to ANSI/AWWA C151/ANSI A21.51.

   1. Provide restrained joint pipe where indicated on the drawings.

   2. Pipe and fittings are to be restrained at each fitting, including valve connections and on pipe joints to distances shown on the drawings.

   3. Restrain using Megalug as manufactured by EBAA Iron, Inc. of Eastland, Texas or approved equal.

B. Provide Class 350 pressure class pipe.

C. Fittings 24 inches in diameter and less shall conform to ANSI/AWWA C110/A21.10 (Full Body Fittings) or ANSI/AWWA C153/A21.53 (Compact Fittings). Fittings greater than 24- inch diameter shall conform to ANSI/AWWA C110/A21.10 (full body fittings).

   1. Fitting manufacturers should be ISO 9000 certified.

   2. Provide minimum 250 psi rated fittings unless noted otherwise.

D. Joints - Unless otherwise specified in this section, fittings shall be furnished with mechanical joints and pipe shall be furnished with push-on joints conforming to ANSI/AWWA C111/A21.11. The type of joint shall meet the following standard requirements:

   1. Push-On Joint - Rubber gasket joint conforming to AWWA Standard C111.

2. Mechanical Joint - Gasketed and bolted joint of the stuffing box type conforming to AWWA Standard C111.

3. Flanged Joint - Flanged and bolted joint conforming to AWWA Standard C110.

4. Restrained Push-On Joint - Rubber gasket restrained joint conforming to AWWA Standard C111.

5. Protective exterior coatings for ductile iron pipe shall be an asphaltic coating approximately 1 mil thick and conform to requirements of ANSI 21.51/AWWA C151.

6. Ductile iron pipe and fittings shall be internally lined as follows:

   a. Amine cured Novalac Epoxy polymeric lining, 40-60 mils nominal thickness. Standards of quality for the lining are based upon Protecto 401 by Vulcan Painters or Corrosion-Clad Polymer Lining No. 210 by Saureisen Cements.

7. All mechanical joint pipe and fittings shall be furnished with ductile iron retainer glands.

8. If required, supply flange joints for use in cleanout manholes or air relief valve manhole to conform to ANSI 21.10/AWWA C110.

9. Manufacturers shall be:

   a. American Pipe Product.

   b. U.S. Pipe Product.

   c. Griffin Pipe Product.

   d. McWane Group.

   e. Or equal.

10. Restrained joint pipe and fittings shall conform to ANSI 21.11/AWWA C111. Manufacturers shall be:

    a. American Pipe Product – Flex-Ring, Lok-Ring or Fast Grip.

    b. U.S. Pipe Product – TR Flex, HP-Lok or Field Lock.

    c. Griffin Pipe Product – SNAP-LOCK.

    d. McWane Group – Super-Lok.

2.04. POLYVINYL CHLORIDE (PVC)

A. Plastic Pipe for Non-Potable Water

1. ANSI/AWWA C900 PVC pressure pipe material conforming to ASTM D1784 Cells Class 12454, minimum class 235 psig, (DR18) push-on joint conforming to ASTM D3139 with elastomeric gaskets conforming to ASTM F477.

   a. For piping 3” and smaller, comply with ASTM D2201 for PVC 1120, SDR 21, pressure rating of 160 psi at 73 degrees F.

b. Color of pipe is to be green.

c. Provide pipe with integral bell or coupling type with elastomeric gaskets, factory installed and integral to the pipe.

2. Where indicated, joints shall be restrained. Restraints for push-on joints shall be Series 2500 Restraint Harness and restraints for mechanical joints shall be Series 2000PV as manufactured by EBAA Iron, Inc., or equal.

3. Fittings for use on PVC pressure pipe of 4-inch nominal inside diameter or greater shall be ductile iron with mechanical joints as described in ANSI 21.10/AWWA C153. The coatings and linings of the fittings shall be as specified for ductile iron pipe.

4. Supply flange joints for use in meter pits or valve manholes in conformance with ANSI 21.11/AWWA C111.

5. Provide adapter glands, gaskets, etc. needed to accommodate differences in pipe and fitting dimensions.

6. Where required to join plain pipe ends, coupling for restraining plain ends of pipe shall be Series 3800 MEGA-COUPLING as manufactured by EBAA, or equal.

2.05. PIPE ACCESSORIES

A. Fittings

1. Same materials, class, coatings and linings as pipe unless under Article 2.02 unless it was specifically described otherwise.

2. Fittings molded or formed to suit pipe size and end design and in required tee, bends, elbow, couplings, adapters, and other configurations.

B. Couplings & Adapters

1. Couplings and adapters are to be provided where needed to make piping connections and where shown on drawings.

2. Use mechanical joint ductile iron sleeves, full length, minimum 12”.

3. Provide cutting in sleeves here installing fittings in an existing line.

a. Furnish mechanical joint, ductile iron.

4. Provide restrained joint couplings where shown on drawings or as specified.

C. Provide Cor-Ten steel head bolts for use on mechanical joints complying with ASTM A242.

D. Pipe openings in existing walls shall be precast or core drilled and completely sealed against water seepage with a mechanical type seal consisting of interlocking synthetic rubber links and nuts with pressure plates wider at ends, the seal shall be a link seal manufactured by Thunderline Corporation, Wayne, MI, or equal.

E. Wall fittings capable of accepting pipe joints being used shall be installed in new construction.

F. For connections to manholes, vaults and utility boxes, provide rubber boot-type connectors

with all stainless steel hardware as manufactured by NPC, Inc., Model Kor N' Seal; Press Seal Gasket Corporation, Model PSX; or equal as shown on the drawings.

2.06. GATE VALVES

A. General

1. Smooth unobstructed waterway free of cavities and depressions in the seat area.

2. Gate valves 2 inches and smaller shall be Lunkenheimer Figure 2127, or equal, with rising stem, double wedge disc, screwed bonnet, screwed ends, 125-pound rating and shall be repackable under pressure in full open position.

3. All other gate valve shall resilient seated type in accordance with AWWA C509 or C515, and shall comply with the following:

a. Materials

1) Body, Bonnet, Stuffing Box, O-Ring Plate: Cast iron or ductile Iron

1) Stems: Cast copper alloy with integral collars

2) Stem Nuts: Copper alloy

b. Construction

1) Pressure Rating: 250 psig

2) Sealing rubber permanently bonded to wedge in accordance with ASTM D429

3) O-rings at all pressure retaining joints. Flat gaskets are not allowed.

1) Non-rising stem.

2) 2-inch square operating nut with the word "OPEN" to indicate direction to open.

3) Stem O-rings shall be replaceable with valve fully opened and subject to full pressure.

4) Fusion-bonded epoxy coating on body, bonnet, and stuffing box applied in accordance with AWWA C550 and NSF 61 certified.

5) Prior to shipment, each valve shall be factory tested by hydrostatic pressure equal to the requirements of AWWA C509.

6) 125-pound ANSI flange ends, unless otherwise indicated on the Drawings.

7) All interior gate valves shall be equipped with handwheel or chain and wheel operators unless otherwise specified.

c. Manufacturer

1) American or approved equal.

2.07. AIR RELEASE AND VACUUM VALVES

A. Provide single body universal type with compound lever system.

1. Design valve to automatically exhaust large amounts of air and gases while the pipeline or system is being filled.

2. Design valve to release accumulated pockets of air while the pipeline is in operation.

3. Design valve to re-open to admit air during draining or when a negative pressure exists in the system.

B. Body to be reinforced nylon.

C. All non-sealing internal metal components shall be 316 stainless steel.

D. Provide valve with minimum 3” inlet, or larger, if shown on the drawings.

E. Provide air and vacuum valves of the size listed in the schedule or shown on the plans with threaded inlet and outlet to 3” size and ANSI B16.1 Class 125 flanged inlet and threaded outlet in larger sizes.

F. Provide inlet Type 316 stainless steel ball valve with T-handle operator.

G. All piping, nipples, etc., to be Schedule 40, Type 316L stainless steel.

H. Provide ARI, Inc. Model D-025 Short Version or preapproved model.

I. Air release and vacuum valve box:

1. Provide polymer concrete box and top.

2. Provide straight wall, open bottom box.

3. Size to the 30”x48”x36”.

4. Design flat slab top sections for Tier 22 traffic loadings.

5. Weight load rating of 22,000 lbs and test load of 33,750 lbs.

6. Provide Model PF3048BA36 as manufactured by Quazite (Hubbell Power Systems).

2.08. VALVE BOXES

A. Provide at each buried valve.

B. Cast iron extension type, suitable for minimum cover of 3’6” over the pipe.

C. Minimum inside diameter at the top of 5", minimum wall thickness 3/16" and thickness at the top of 11/16”.

D. Have the word "WATER"; "SEWER"; "SLUDGE", etc., as applicable, cast into the cover.

E. Provide Tyler Series 6850.

F. Where depth requires more than a two piece box use adjustable cast iron extensions.

G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.09. IDENTIFICATION

A. Each pipe length and fitting shall be clearly marked with:

1. Manufacturer's name and trademark.

2. Nominal pipe size and class.

3. Material designation.

PART 3 EXECUTION

3.01. EXAMINATION

A. For trench installation verify that trench cut, excavated base and pipe bedding are ready to receive pipe and that excavations and pipe bedding dimensions and elevations are as shown on Drawings.

B. For HDD installation, verify that completed bore is ready to receive pipe and that bore geometry is as shown on Drawings.

C. All pipe or fittings which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked, and removed from the site the work.

1. Any pipe or fitting which the Engineer suspects is improper for the job shall be temporarily rejected, marked, and set aside for subsequent investigation to determine its conformity with the specifications.

D. All pipe fittings and specials shall be carefully inspected in the field before lowering into the trench. Cracked, broken, gouged, warped, out-or-round, damaged pipe joints including damaged pipe lining or coatings or specials, as determined by the Engineer, shall be culled out and not installed.

1. Such rejected pipe shall be clearly tagged in such manner as not to deface or damage it, and the pipe shall then be removed from the job site by the Contractor at his own expense.

E. The drawings and specifications may contain information relating to conditions below the ground surface at the site of proposed work, but such information is furnished without guarantee as to it being complete or correct. The Contractor shall assume all risk and responsibilities and shall complete the work in whatever manner and under whatever conditions he may encounter or create without extra cost to the Owner. Location of existing underground facilities at or contiguous to the site is based upon information and data furnished to the Engineer by owners of such underground facilities or others, and Owner and Engineer do not assume responsibility for the accuracy or completeness thereof.

1. The Contractor shall perform exploratory excavations in advance of this work to verify the location, depth, size, and material of existing utilities which may interfere with the work to be performed under this contract. All damage to existing utilities shall be the Contractor's cost to repair or replace.

3.02. PREPARATION

A. The Contractor shall have on the job site with each pipe laying crew, all the proper tools, gauges, pipe cutters, lubricants, etc. to handle, cut and join the pipe.

B. Flat-bottom trenches of required width shall be excavated to the necessary depth as required and maintained in accordance with Section 02221 – Trenching and Backfilling for Utilities.

C. Prior to installing the pipe foundation material, trenches shall have all water removed and all work performed in a dry trench. Pipe installation in frozen trench bottom is not permitted.

D. All pipes, fittings and specials which are to be installed in the open trench excavation shall be properly bedded in and uniformly supported on pipe foundations of the type specified in Section 02225 – Trenching and Backfilling for Utilities and shown on the Drawings.

1. In particular, stones 2 inches and larger shall be removed from the bearing surface of the pipe foundation.

E. Pipe foundation bedding material shall be spread in maximum 8-inch layers and each layer shall be compacted up to the spring line of the pipe.

F. Compaction methods include hand tamping with T-bars, flat heads, shovel slicing as well as mechanical compactors.

G. The Contractor shall perform his bedding operations with care to maintain line and grades.

H. Suitable holes or depressions shall be provided in the pipe bedding to permit adequate bedding of bells, couplings, or similar pipe projections.

I. For HDD installations, pipe shall be prepared in accordance with Section 02930 - Directional Drilling.

J. For Open-Cut trench installations, pipe shall be prepared in accordance with Section 02221 – Trenching and Backfilling for Utilities.

3.03. LINES AND GRADES

A. The Contractor shall furnish all labor, materials, surveying instruments, and tools to establish and maintain all lines and grades shown on the Drawings. The Contractor shall have personnel on duty or on standby call, at all times, who are qualified to check line and grade of pipe lines as they are installed.

B. During construction, the Contractor shall be responsible for field stakeout.

C. The Contractor shall carefully preserve bench marks, reference points and stakes established by the Engineer or Owner, and in case of willful or careless destruction by his own operations he will be charged with the resulting expense to reestablish such destroyed control data and shall be responsible for any mistakes or delay that may be caused by the unnecessary loss or disturbance of such control data.

D. The Contractor may use laser equipment to assist in setting the pipe provided he can demonstrate satisfactory skill in its use.

E. The use of string levels, hand levels, carpenter's levels, or other relatively crude devices for transferring grade or setting pipe are not to be permitted.

3.04. TOLERANCES

A. Pipes shall be installed at the lines and grades shown on the Drawings.

B. Minimum depth of cover shall be maintained shown on the Drawings or as described herein.

3.05. INSTALLATION

A. Installation of ductile iron pipe or plastic pipe to be in conformance with AWWA C600, C605 or ASTM D2774, respectively, except as modified in this Section or referenced Sections or as shown on the Drawings.

B. The Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from storage areas to the trench shall be restricted to operations which can cause no damaged to the pipe or lining or castings.

C. The pipe shall not be dropped from trucks onto the ground or into the trench.

D. Each pipe section shall be placed into position in the trench on the pipe bedding in such manner and by such means required to cause no injury to the pipe, persons or to any property.

E. The method of laying and jointing the pipe shall be in accordance with the recommendations of the manufacturer and as approved by the Engineer. Each pipe shall be aligned with that already in place, forced home completely with horizontal axial movement and held securely in position. The bell of each pipe length to be laid in the same direction the installation is proceeding.

F. At the joints, enough depth and width shall be provided to permit the pipe layer to reach entirely around the pipe so that the joints may be made in accordance with the manufacturer's recommendations. Mechanical type joints shall be tightened within the AWWA recommended torque range.

G. Pipes, fittings, and specials shall be firmly bedded in the pipe foundation and shall have full bearing throughout their entire length, which shall be accomplished by combination of shaping the bedding and adequately compacting the pipe bedding and backfill under and around the pipe to the spring line of the pipe. The remaining backfill placed in 12-inch lifts to 1-foot above the crown or the pipe in accordance with minimum compaction requirements. The remaining backfill installed in accordance with Section 02221 – Trenching and Backfilling for Utilities.

H. Pipe laid in normal trench excavation shall not be laid on wood blocking.

I. Backfill material within 12 inches of the pipe shall be free of stones greater than 2 inches in any dimension.

J. Unless otherwise shown on the Drawings, the minimum total finished cover over the top of the pipe barrel of all pressure pipe shall be 3 feet.

K. Refer to Section 02351 – Excavation Backfill Trenching, for other installation guidelines and requirements.

L. Record installed pipe elevation every 100' and submit elevations to Engineer on a weekly basis.

M. To deflect a pipe joint, first join the pipe in the proper manner and then deflect the pipe within the allowable deflection recommended by the manufacturer.

N. Restrained joints are to be installed in strict accordance with the manufacturer's instructions.

O. Manufactured pipe plugs or temporary bulkheads shall be placed in the open ends of sewer pipes whenever pipe installation is stopped overnight, over weekends, or whenever dirt or debris could enter the pipe during construction. Newly installed pipe shall not be used to remove groundwater from trench.

P. Installation of polyethylene sleeves to be performed in accordance with the manufacturer's instructions and ANSI A21.4/AWWA C105.

Q. For HDD installations, pipe shall be prepared in accordance with Section 02930 - Directional Drilling.

3.06. TEMPORARY PLUGGING

A. At all times when pipe laying is not actually in progress, the open ends of the pipes shall be closed temporarily with pipe plugs or by other means such that there is no possibility of any water or foreign material entering the line. If water is in the trench when work is resumed, the plugs shall not be removed until the water has been removed and work can proceed in a dry stable trench.

3.07. CLEANING PIPELINE

A. At the conclusion of the work, the Contractor shall thoroughly clean all new pipes by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered during the construction period.

1. If, after this cleaning, any obstructions remain, they shall be corrected to the satisfaction of the Engineer. Pipes shall be flushed at a rate of 2.5 feet per second for a suitable duration.

B. Where required the Contractor shall use mechanical methods to clean pipes when flushing does not remove all obstructions or material.

3.08. TESTING

A. Testing of the force main pipelines shall be performed in accordance with Section 02741 – Pressure Tests of Force Mains.

B. Any section of pipe that fails the pressure or leakage test shall be dug up and replaced or permanently repaired as approved by the Engineer. The replaced or repaired section shall be retested.

3.09. ENCASEMENT

A. All piping shown on the Contract Drawings as concrete encased, and all buried process piping below structures or with less than 3 feet of cover below roadways shall be encased in concrete.

B. If a new buried pipe is within 12 inches (vertical direction) of another buried pipe (new or existing), then both pipes shall be encased to 1 foot beyond the limits of the larger pipe at that particular point.

C. Concrete cover shall be a minimum of 8 inches thick around the perimeter of the pipe and shall be reinforced with #4 bars at 12 inches on center each way. When the top of the

encasing is within 12 inches of the bottom of a cast-in-place slab, the encasement shall be tied into the base slab with reinforcing.

D. Concrete shall have minimum 28-day compressive strength of 3000 psi.

E. Where shown on the Drawings, pipes shall be encased in a polyethylene sleeve.

1. Damage to wrapping during pipe laying or backfilling operations shall be repaired with additional sleeve material and adhesive tape.

3.10. TRACER WIRE TESTING

A. General

1. Use locating/testing devices approved by the manufacturer.

2. Should a break or interference from adjacent utilities be found, take required actions to remedy issues and successfully complete tests.

3. Provide certificates of successful completion to the Engineer and Owner.

3.11. INSTALLATION OF AIR RELEASE VALVES

A. Compact backfill thoroughly over pressure sewer.

B. Install gravel drainage bed as shown on drawings.

C. Set valve plumb, using a bronze nipple between pressure sewer and valve.

D. Install air release valve containment structure plumb and level.

3.12. INSTALLATION OF PIPE BOOT FOR CORED OPENINGS

A. Following manufacturer’s instructions for complete and proper installation.

B. Conduct vacuum testing in accordance with ASTM C-1244-02.

C. Adjust pipe to line and grade. Use proper bedding, backfill materials, and techniques so that pipe deflection and deformation are minimized. Installation of the concrete structure shall be such that differential settlement between the structure and the pipeline shall be less than 10% of pipe diameter for pipes less than 20” and shall be less than 5% of pipe diameter for pipes between 20 and 60 inches in diameter.

D. Any pipe stubs installed in the manhole must be restrained from movement per ASTM-C923.

3.13. PROXIMITY TO WATER MAINS

A. Whenever possible, pressure sewers shall be laid with a minimum of 10 feet horizontal separation between the sewer and potable water lines. Should a lateral separation of 10 feet not be possible, the following methods of protection must be employed:

1. Lay sewer and water main in separate trench.

2. Lay the sewer and water main in same trench with the water main at one side on a bench of undisturbed earth.

3. In both above cases, the water main invert shall be 18 inches above the sewer crown and there shall be a minimum of 3+ feet of horizontal separation between the pipe outside diameter.

B. Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstruct the sewer line (per water line standards) with mechanical-joint, ductile iron pipe for a distance of 20 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible. The sewer shall not be located above the water main.

END OF SECTION

SECTION 02741

PRESSURE TESTS OF FORCE MAINS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Pressure testing of underground force mains.

B. Test requirements.

C. Required replacement or repair if test fails.

D. Project records.

1.02. RELATED SECTIONS

A. Section 02740 - FORCE MAINS

1.03. REFERENCES

A. AWWA C-600 - Installation of Ductile Iron Water Mains and Their Appurtenances

B. AWWA C-605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Orientated Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C. AWWA C906-99 – Polyethylene Pressure Pipe and Fittings

1.04. TEST REQUIREMENTS FOR HDPE, DIP and PVC FORCE MAINS

A. All force mains shall be tested in accordance with AWWA Standard C-600, C-605, and C906-99. The following procedure shall be used:

1. All newly installed pipe or any section thereof (including fittings and valves), shall be subjected to a hydrostatic pressure 50 percent in excess of the working pressure at any point in the section being tested, but in no case less than 150 pounds per square inch for a period of two hours.

2. The Contractor shall accomplish the required tests by individually testing each section of the installed force main. The maximum length of section permitted to be tested at any one time will be determined by the Engineer.

B. Test Pressure Restrictions - Test pressure shall:

1. Not exceed pipe or thrust restraint design pressures.

2. Be of at least two-hour consecutive duration.

3. Not vary by more than $\pm$5 psi.

4. Not exceed twice the rated pressure of the valves when the pressure boundary of the test section includes closed valves.

C. Leakage Test

1. All leakage tests shall be conducted concurrently with the pressure test.

2. Leakage Defined - Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula(s):

1) Ductile iron piping:

$L = S \times D \times \sqrt{P} / 133{,}200$; where

L = allowable leakage in gallons per hour;

S = length of pipe tested in feet;

D = nominal diameter of pipe in inches; and

P = average test pressure psi gauge.

2) PVC piping:

$L = N \times D \times \sqrt{P} / 7400$; where

L = allowable leakage in gallons per hour;

N = number of joints in pipeline being tested;

D = nominal diameter of pipe in inches; and

P = average test pressure psi gauge.

b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size will be allowed.

3. If the section of force main tested does not meet the test pressure requirement within 5 psi or the allowable leakage rate is exceeded, the test shall be considered a failure and the section shall be retested.

D. Test Pressure Restrictions - Test pressure shall:

1. Not exceed pipe or thrust restraint design pressures.

2. Not vary by more than $\pm$5 psi.

3. Not exceed twice the rated pressure of the valves when the pressure boundary of the test section includes closed valves.

4. The time required to pressurize, expand and stabilize, hold test pressure, and depressurize the system shall not exceed 8 hours.

5. If retesting is required, the section shall be depressurized for a minimum of 8 hours prior to retesting the section to be tested.

1.05. SUBMITTALS

A. For each test, submit a completed “Flushing and Testing of Force Main Tabulation Sheet” (provided by the Engineer) attached at the end of this section.

1.06. PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01700.

B. Contractor to complete and submit for each test the “Flushing and Testing of Force Main Tabulation Sheet” for recording data for flushing and testing pressure pipe (see form at end of this Section). Contractor shall fill out form and both Contractor and Engineer shall sign upon completion.

1.07. REGULATORY REQUIREMENTS

A. Submit proof of testing as required by local, county or state agencies and this section of the specifications.

1.08. FIELD MEASUREMENTS

A. Measure length of test section.

B. Measure quantity of water used to maintain test pressure during test period.

C. Measurements required to complete the Tabulation Sheet.

1.09. COORDINATION

A. Contractor is responsible for obtaining water for flushing and pressure test.

B. Provide 48-hour notice to local water department (Owner) when water for flushing and testing is required.

C. Owner of existing water system to operate all valves and hydrants unless Contractor has been authorized by Owner to operate water systems valves and hydrants.

PART 2 PRODUCTS

2.01. WATER SUPPLY

A. All water for flushing shall be furnished and disposed of in accordance with all federal, state, and local requirements by the Contractor at his expense.

B. A back flow preventer shall be installed at any connection point to a source of water supply.

PART 3 EXECUTION

3.01. EXAMINATION

A. Backfilling of the pressure pipe trench to ground surface or road surface shall be in place and completed, except for final paving, for seven calendar days or as approved by the Engineer prior to start of testing of each section of force main.

3.02. PREPARATION

A. The Contractor shall supply all plugs, pumps, weirs, gauges, etc., necessary to conduct the tests, including means to accurately measure the quantity of water used to maintain test pressure during the test period.

B. Flush all piping systems with water prior to testing. Flushing shall be sufficient to remove all dirt/debris from force main.

3.03. TESTING

A. Pressure and leakage tests shall be conducted on all force main pipe.

B. The Engineer shall witness all tests.

C. All test results shall be recorded on the appropriate form attached at the end of this section.

D. Contractor is responsible for temporary connections to facilitate filling of force main, release of air from force main, and pressure testing. Connection devices shall be reviewed by Engineer before starting testing. All temporary connections shall be plugged after a successful test.

E. Pressurization - Each valved section of pipe shall be slowly filled with water. The specified test pressure, based on the elevation of the lowest point of the pipe or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe.

F. Air Removal - Before applying the specified test pressure, air shall be expelled completely from the pipe and valves.

G. Examination - Any exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, or valves that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated.

H. All visible leaks, regardless of the amount, shall be repaired.

I. If the section being tested fails to pass the pressure or leakage test, the Contractor shall determine, at his own expense, the source or sources of leakage, and he shall permanently repair or replace all defective materials and/or workmanship. The extent and type of repair as well as results shall be subject to the approval of the Engineer. The completed pipe installation shall then be retested and required to meet the pressure and leakage requirements of this test.

J. Testing and retesting shall be completed prior to final paving.

K. The use of sealants, applied from outside or inside of pipe, is not acceptable.

FLUSHING AND TESTING OF FORCE MAINS
TABULATION SHEET

Job No._____ Location _____
Contract No. _____ Contractor _____
Project _____
Contractor's Representative _____
Observed by_____

FLUSHING

Date_____ Weather _____ Temperature _____
Section Flushed_____ft. of ____-inch diameter pipe
Line Flushed_____hrs. _____ min. @ _____ gal/min.
Line Flushed Through_____Manhole #_____

PRESSURE AND LEAKAGE TESTING

Date _____ Weather _____
Section Tested _____
____-ft. of ___-inch diameter _____ pipe in ___-ft laying lengths
Time Started _____ Time Finished _____ Elapsed Time _____
Test Pressure: Start _____ psi Finish _____ psi
Allowable leakage, as calculated _____ gallons
Actual leakage _ gallons

Pass _____ Fail _____

Ductile Iron Pipe

$$L = \frac{SD\sqrt{P}}{148{,}000} *$$

PVC Pipe

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

L = Allowable leakage in gallons/hour
S = Length of pipe tested (linear feet)
D = Nominal diameter of pipe (inches)
P = Average pressure during test, psi
N = Number of joints

*Refer to C600 for additional allowance leakage against closed metal-seated valves.

WITNESS:	**WITNESS:**
OWNER/ENGINEER _____	CONTRACTOR_____
Name _____	Name _____
Title _____	Title _____
Signature _____	Signature _____

END OF SECTION

SECTION 02780

CASING PIPES FOR UTILITIES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Casing pipe, casing spacers, accessories, and materials.

B. Installation.

1.02. RELATED SECTIONS

A. Section 02740 – Force Mains.

1.03. REFERENCES

A. American National Standard Institute (ANSI).

B. American Water Works Association (AWWA).

C. American Society for Testing Materials (ASTM).

1.04. SUBMITTALS

A. Product Data - Provide data describing conformance to ANSI/AWWA/ASTM codes, materials, sizes, class, dimensions, accessories, etc.

B. Manufacturer's Installation Instructions - Indicate special procedures required to install products specified. Manufacturer's recommended installation instructions shall supersede conflicting information with this specification.

C. Results of shop tests, if required.

D. Manufacturer's Certificate - Certify that products meet or exceed specified requirements.

1.05. PROJECT RECORD DOCUMENTS

A. Submit marked-up record plans, including record location if different from plan, variations in specified depth of more than +/- 6 inches.

B. Identify and locate on record drawings the exposed unmapped utilities or services.

C. Record drawing to be submitted on a weekly basis. Any uncompleted record drawing to be received no later than 30 days upon completion of project.

1.06. REGULATORY REQUIREMENTS

A. Conform to requirements of regulatory agencies having jurisdiction over the work.

B. Conform to permit requirements obtained by Owner.

C. Conform to all local, municipal, state, and federal regulations when performing work.

1.07. FIELD MEASUREMENTS

A. Prior to start of construction, verify by field measurements that existing conditions and structures are as shown on Drawings. Notify Engineer of specific discrepancies or potential interferences.

B. Prior to the start of construction, verify by exploratory excavations that existing underground utility locations and elevations are as shown on the Drawings or to confirm marked location and elevation of underground utilities.

C. Where connections are to be made to existing pipes, confirm the type of material and the outside dimensions of pipes.

1.08. COORDINATION AND SHUTDOWNS

A. Coordinate field work under provisions of field engineering, maintenance of traffic, access to private driveways, and emergency vehicle access.

B. Coordinate work with local utility companies (private and municipal) for location of existing utilities and protection thereof.

C. Coordinate shutdowns of existing systems with local authorities. Notify affected property owners and industries at least 24 hours prior to shutdown including duration of shutdown.

PART 2 PRODUCTS

2.01. CASING PIPE FOR DRY BORES

A. Pipe material, sizes, classes, etc. shall be furnished and installed as listed herein and as shown on the drawings.

B. Steel casing pipe, complying with ASTM A139, Grade B with a minimum yield strength of 35,000 psi.

C. Casing pipe ends are to be suitable for field welding.

D. Minimum wall thickness of casing pipe is to be as follows:

Diameter of Casing (Inches)	Minimum Wall Thickness (Inches)
20 and 22	3/8

2.02. SPACERS

A. Provide for all piping installed in a casing pipe.

B. For PVC and HDPE pipe there should be a minimum of 1 spacer provided per 6 LF of pipe.

C. Spacer shell shall be minimum 14 gauge T304 stainless steel.

1. PVC shell liner minimum thickness of 0.090”, ribbed pvc extrusion, with a minimum hardness of 85-90 durometer.

D. 5/16” minimum diameter stainless steel connecting bolts and lock nuts.

E. Runners are to be constructed from 2” wide ultra high molecular weight polymer. Runners shall have a high resistance to abrasion and al ow coefficient of friction (0.12).

F. Risers are to be constructed from T304 stainless steel, minimum 14, gauge, reinforced and welded to the shell.

G. Bottom risers 6” and over in height will be reinforced.

H. Shall be configured in the Centered and Restrained position.

I. All metal surfaces are to be fully passivated.

J. Approved manufacturer of pipeline casing spacers is Cascade Manufacturing or approved equal.

2.03. END SEALS

A. Provide 1/8” thick rubber end seals to seal the ends of each casing.

B. Provide T304 stainless steel bands to secure casing and carrier pipe.

C. Approved manufacturer of end seals is Cascade Manufacturing or approved equal.

PART 3 EXECUTION

3.01. EXAMINATION

A. Contractor shall verify all existing conditions.

B. The drawings and specifications may contain information relating to conditions below the ground surface at the site of proposed work, but such information is furnished without guarantee as to it being complete or correct. The Contractor shall assume all risk and responsibilities and shall complete the work in whatever manner and under whatever conditions he may encounter or create without extra cost to the Owner. Location of existing underground facilities at or contiguous to the site is based upon information and data furnished to the Engineer by owners of such underground facilities or others, and Owner and Engineer do not assume responsibility for the accuracy or completeness thereof. The Contractor shall perform exploratory excavations in advance of this work to verify the location, depth, size, and material of existing utilities which may interfere with the work to be performed under this contract. All damage to existing utilities shall be the Contractor’s cost to repair or replace.

C. All materials which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked, and removed from the site of the work. Any materials which the Engineer suspects is improper for the job shall be temporarily rejected, marked, and set aside for subsequent investigation to determine its conformity with the specifications.

D. All materials shall be carefully inspected in the field before entering them into construction. Such rejected materials shall be clearly tagged in such manner as not to deface or damage it, and the pipe shall then be removed from the job site by the Contractor at his own expense.

3.02. PREPARATION

A. The Contractor shall have on the job site with each pipe laying crew, all the proper tools for execution of the work.

3.03. LINES AND GRADES

A. The Contractor shall furnish all labor, materials, surveying instruments, and tools to establish and maintain all lines and grades. The Contractor shall have personnel on duty or on standby call, at all times, who are qualified to check line and grade of water mains as they are installed.

B. Centerlines necessary for locating the work are shown on the Drawings.

C. During construction, the Contractor shall provide the Engineer, at his request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, including the furnishing of one or two rodmen or chainmen as needed at intermittent times.

D. The Contractor shall carefully preserve benchmarks, reference points and stakes established by the Engineer or Owner, and in case of willful or careless destruction by his own operations he will be charged with the resulting expense to re-establish such destroyed control data and shall be responsible for any mistakes or delay that may be caused by the unnecessary loss or disturbance of such control data.

E. The Contractor may use laser equipment to assist in setting the pipe provided he can demonstrate satisfactory skill in its use.

F. The use of string levels, hand levels, carpenter's levels, or other relatively crude devices for transferring grade or setting pipe are not to be permitted.

3.04. TOLERANCES

A. Pipes shall be laid to the lines and grades shown on the Drawings.

B. Minimum depth of cover shall be maintained as shown on the Drawings or as described herein.

3.05. INSTALLATION

A. Installation of pipe, fittings and appurtenances are to be in compliance with the applicable AWWA standards and manufacturer's requirements and recommendations.

B. The Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from storage areas to the trench shall be restricted to operations which can cause no damaged to the pipe or lining or castings.

C. The materials shall not be dropped from trucks onto the ground or into the trench.

D. Provide watertight joints by welding.

E. Locate entry pits to avoid interference with traffic, structures, etc.

F. Maintain pits in a dry condition. Utilize pumps, drains or other approved methods as required.

G. Casing ends are to be installed in compliance with manufacturer's instructions.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02930

DIRECTIONAL DRILLING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Furnish, install, and test horizontal directional drilled (HDD) portions of the sanitary sewer force main complete with tracer wire, conductor casings, and other appurtenances in accordance with the Contract Documents for a complete and operational pipeline.

B. Disposal of all drill fluids and spoils from the HDD construction at an approved offsite disposal area, excavation and backfill of entry and exit pits, and rough grading of the construction work zones.

C. At least 10 workdays before starting the authorized work, Contractor shall coordinate a preconstruction meeting. The meeting must include the General Contractor, HDD Contractor (if different), Engineer, and Owner.

1.02. RELATED SECTIONS

A. Section 02740 – FORCE MAINS

1.03. SUBMITTALS

A. Submittals shall include the following:

1. Shop Drawings.

a. Equipment Certification –Fusion equipment shall be suitable for assembly of HDPE DR-9 pipe for the lengths shown on the Contract Drawings.

b. Drawings showing connection mechanism and arrangement between swivel and product pipe, and where necessary for pull back operations, anchor wall structural details and connection arrangement to the rig.

2. Qualifications of Key Personnel: Provide experience records.

a. Drilling Superintendent.

b. Drill Rig Operator.

c. Tracking Specialist.

d. Drill Fluid Specialist.

e. HDPE Pipe Fusion Technician.

f. Contractor’s Surveyor.

3. Construction Plan – Submit 10 workdays prior to HDD mobilization. Include proposed modifications to the design and work methods herein. Include reason for the modification and potential impact.

   a. Construction work plan including:

      1) Conductor casings: conductor casings installation method, casing length, sidewall, casing material properties, leading edge treatments, and welding procedure.

      2) HDD; tooling diameters by pass, anticipated schedule by pass (i.e. pilot hole, reaming, and swabbing), final bore hole size, pipe pullback tooling and connection details.

   b. Pipe assembly and fusion plan including length of fused pipe per pull, ballasting during pullback, relaxation time after pullback, pullback fused pipe lengths per pull advance in the case of fusion weld(s) during pullback, expected duration of each pull and fusion weld, and overall pull timetable.

   c. Certificates of Compliance for product pipe.

   d. Manufacturer's recommended safe pull strength (SPS) for the product pipe. The SPS shall not be exceeded during pullback installations.

   e. Installation procedure to meet specification requirements including measurable drill mud properties and maximum anticipated pullback force as measured by hydraulic pressure. Submit dead pull weight of carriage as witnessed by Owner immediately before pullback.

   f. Contingency plans for correction for each of the following potential conditions:

      1) Borehole collapse.

      2) Drilled steel or carrier pipe cannot be advanced or retrieved by the drill rig onsite.

      3) Drill tool becomes lost in the hole.

      4) Guidance control system fails to provide accurate information.

      5) Loss of steering or inability to steer.

      6) Installation forces start to increase rapidly, raising concerns about completing the pipe pull back installation.

      7) Swivel breaks during carrier pipe installation.

      8) Inadvertent Return (or frac-out) and Surface Spill Contingency Plan.

      9) Obstructions encountered.

      10) Utility strike.

      11) Loss of drill fluid circulation.

12) Deviation from design bore path exceeds tolerances.

13) Pipe collapses or pipe deformations exceed maximum allowable tolerances.

14) Hydrolock.

g. Initial drill fluid design based upon the anticipated ground conditions including all anticipated additives, product information, material specifications, handling procedures, Material Safety Data Sheet (MSDS) and special precautions. Include design properties of pH, viscosity, and density.

h. Layout drawings including drill rig, entry and exit pits, entry and exit angles, guidance system, and pipe laydown and fusion areas.

i. Guidance and steering to meet requirements herein. Including the down hole assembly details and surface loop details.

j. Pipe manufacturer's written recommendations for fusion welding including weather protection, fusion technician qualifications, and pipe cool down following welding.

k. Fusion equipment manufacturer's written recommendations for fusion welding including fusion technician qualifications and fusion data recording.

l. Pipe manufacturer's written recommendations for pipe handling and HDD installation.

m. Pipe pullback plan that protects the carrier pipe from damage include pipe lifting equipment and pipe rollers.

n. Instrumentation System for HDD drill forces and drill fluid monitoring.

o. Guidance and Steering System Submittal including data on the proposed guidance system, and the accuracy of the guidance system at the design drill depths. The system shall be capable of providing horizontal and vertical steering data along the entirety of each drill path, for the depths shown on the Contract Documents, plus an additional 10 feet. Walk over tracking systems are permitted on this project.

p. Evidence of any reasonably foreseeable ground conditions that may influence guidance system readings, including but not limited to:

1) Buried metal structures;

2) Buried or surface utilities, including electrical cables;

3) Native magnetic geologic conditions; and

4) Any other sources of magnetic interference.

4. Butt Fusion Joining Equipment Certificate of Compliance that demonstrates the butt fusion machine is suitable for the required pipe.

5. Submit a Drill Fluid Management Plan prior to start of directional drilling work.

1.04. PERFORMANCE REQUIREMENTS

A. The HDD alignments shall be constructed as shown in the Contract Documents and measured from design centerline to installed centerline.

1. Installation tolerance shall be a 2.5 foot radius circle around the design drill path centerline.

2. Exit tolerance shall be right/left 2.5 feet.

3. Exit length shall be 0.0 feet short and 10.0 feet long.

B. Boring logs are to be provided to the engineer. The logs represent minimum information; if additional information or investigations are required by the Contractor for a reasonable purpose, it shall be the Contractor's responsibility to request and provide such services. The bores included under this contract are not anticipated to encounter bedrock.

C. Guidance and steering system shall be capable of tracking the drill progress during pilot hole excavation continually across the drill path.

1. Provide horizontal and vertical steering data along the entire drill path for each crossing to an accuracy of ±0.5 degrees in any plane with regards to the drilled length, and 2.0 percent of the depth of the actual position of the steering device, for the depths shown in the Contract Documents, plus an additional 10.0-feet.

2. Provide guidance information and record data at least once per drill stem and no less than once every 30 feet. The guidance system tolerance shall be calculated based upon a moving three-rod average.

3. Magnetic steering tool shall use inclinometers and magnetometers to determine angle and direction.

D. As-Built drawings: Provide As-Built drawings within 2.0 feet of actual vertical and horizontal alignment throughout the directionally drilled portion of force main.

E. Provide 2-way communication between crews and workers that are not in the line of sight or within 25 feet of a co-worker.

1.05. QUALITY ASSURANCE

A. Experience requirements outlined below shall be met at the time of bid and remain in force through completion of the project. Subcontracted work does not qualify as experience.

1. The Contractor shall have demonstrated experience in constructing pipelines with similar pipe diameters, installation lengths, and depths using HDD. At least four (4) years of recent experience constructing HDD projects is required in similar ground conditions, as measured by soil type, N value and hydrostatic head, as anticipated for this project. The Contractor shall have demonstrated experience using similar HDD equipment proposed for use on this project.

2. Superintendent(s), HDD rig operator, drilling fluid and separation plant specialist, and guidance technician. The project superintendent shall have completed at least five (5) projects with a carrier pipe of between 2- and 12-inches diameter with pull lengths of between 300 and 600 feet in similar soil conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years. At

least two (2) of the projects must be a highway crossing. The drill rig operator must have completed at least three (3) projects of between 2- and 12-inches diameter with pull lengths of between 300 and 600 feet in similar soil conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years. At least one (1) of the projects must be a highway crossing. The drilling fluid and separation plant specialist must have at least five (5) years of experience in the design of drilling fluid mixes and separation plants based on anticipated ground conditions. The drilling fluid and separation plant specialist must have completed at least three (3) projects of between 2- and 12-inches diameter with pull lengths of between 300 and 1,000 feet in similar ground conditions, as measured by soil type, N value and hydrostatic head, as anticipated on this project, in the last five (5) years.

3. FPVC Fusion Technician shall have completed five projects in each of the last two years using butt fused FPVC pipe. Each project shall have completed at least 20 welds on pipe sizes between 2-inches and 16-inches diameter. Technician has used fusion equipment as submitted for this project.

4. Contractor's surveyor shall be a Professional Land Surveyor registered in the State of Delaware

5. Experience records shall list the five (5) most recent HDD projects, including all HDD projects completed for the OWNER, and all projects demonstrating the specified experience. The experience record shall include name of project; owner of the project; names of contacts including all contact information; pilot bore diameter, carrier pipe diameter, ground conditions as measured by soil type, N value, and hydrostatic head; longest reach planned and completed; and total footage planned and completed.

6. The ENGINEER will be the sole judge in determining if the prospective contractor, HDD project superintendent, HDD operator and surveyor meet the aforementioned work and project experience requirements.

B. If an automated HDD operational data acquisition system is provided with the HDD equipment, operate the automated data acquisition system for the duration of the project.

C. Surveying:

1. Establish survey control points sufficiently far from the HDD excavation so as not to be affected by ground movement or damaged.

2. The position of the drill head shall be continuously tracked and capable of maintaining the design tolerances specified herein.

3. All surveying equipment shall be inspected and calibrated by the equipment manufacturer within one (1) year prior to use on the Project.

D. Contractor's Work Plan: at a level of detail sufficient for the Owner to understand the construction process as performed by the Contractor.

1. Provide an as-built record in both CAD and table for the pilot hole before commencing of the next installation step. Include as-planned alignment, easements, and rights-of-way at a level of detail that demonstrates installation is within the design tolerances stated within this specification.

E. The final excavated hole shall not be greater than 1.50 times the installed conduit OD unless otherwise accepted by the Owner.

F. Inadvertent Return Contingency Plan:

1. Describe procedures for preventing drilling fluid losses or spills into marsh area and/or fluid returns to the surface.

2. Address roles and responsibilities of involved parties for monitoring, prevention, containment, cleanup, and documentation procedures, and observations to be made and plans for containment and cleanup, if spills or inadvertent returns occur.

3. Address changes that will be made to Contractor's operations to avoid recurrences.

4. Containment and cleanup equipment shall be provided at both entry and exit locations. Kit shall contain at a minimum: heavy weight plastic gravel filled and sealed bags, Geotek filter bags, 5 5-gallon hard plastic pails, heavy duty push brooms, squeegees, flat blade and spade shovels, silt fence, straw bales or waddle, portable pump, and vacuum hose. A vacuum truck shall be available for response within one (1) hour of an event.

5. Plan shall fully describe procedures to shutdown drilling operations immediately upon discovery or detection of a potential inadvertent return. The HDD operation shall not resume drilling operations until after the spill or inadvertent return is fully contained, clean-up has commenced, and at least four (4.0) hours have passed. Procedure for restarting the drilling operations shall not commence until the drilling operations have been reviewed and the revised work plan accepted by the Owner.

6. Means and methods for stopping downhole drill fluid loss.

G. Daily Production Records:

1. Drill fluid:

a. Drill fluid mix.

b. Drill fluid test data.

c. Drill Fluid Specialist recommendations.

d. Drill fluid pumping rates and pressure.

e. Drilling fluid loss and return rates.

f. Observations for inadvertent returns.

2. As-Drilled data, including plan and profile, in table and CADD format.

a. Daily activities, including summary of progress for the drilling operations.

b. Status of drilling operations with respect to key items in the project schedule and mitigation measure if behind schedule.

c. Problems that occurred during the day and resolution of problem or required action item.

d. List of equipment and personnel at the site.

e. Tracking System data submittal.

3. Pipe assembly data logs.

4. Daily activities for HDD production:

a. Daily production records.

b. Daily observation records.

c. Waste disposal records demonstrating legal disposal.

5. HDD daily logs with data recorded at least once per ripe joint:

a. Pilot hole daily logs including make-up of the down the hole assembly (DHA) and per drill rod advancement including three-rod averages. Record 360 degree test roll results. Record the average and maximum force and torque for each drill rod advanced from the drill rig pressure gages and provide calibration factors to convert pressure to force for each gear. Provide spoils volume.

b. Reaming daily logs including tooling, diameters, advance rates, torque, and spoils volume.

c. Swab pass daily logs including tooling, diameters, advance rates, torque, and spoils volume.

d. Pullback including tooling, diameters, advance rates, torque, and spoils volume.

H. As-Built Drawings: Submit before final payment and not more than 30 work days following completion.

1. After installation, submit a record of the actual As-Built bore path, including plan and provide views, horizontal and vertical deviations, indicating the relation to the designed path.

2. Submit, once per drill rod segment of the pilot bore, drill path locations and HDD operational information. Provide these measurements at the end of each workday to the Owner and the Engineer.

3. All surface tracking data points shall be saved and submitted to Engineer at the end of each workday of pilot drilling.

4. Pressure test results for the pipes both before and after installation.

5. Butt fusion data logging sheets on each workday of fusion welding.

6. Locations where the Owner can access tracer wire terminals.

7. Complete disposal record demonstrating all spoils, drill fluids, and other wastes are legally disposed. Include vehicle, location, quantity (tonnage or volume), date, and signature.

PART 2 PRODUCTS

2.01. MATERIALS

A. HDD Machine

1. Be in proper working order.

2. Sized as to thrust, pullback, and torque by the Contractor.

3. Demonstrated capacity to complete the proposed drilling operations, and pipe pullback.

4. At a minimum, be equipped with instrumentation adequate to continuously monitor the following:

a. Thrust/Pullback.

b. Torque.

c. System Hydraulic Pressure.

d. Drill Fluid annular pressure during the pilot drilling operations, measured at a distance of no more than one drill rod length behind the drill head.

e. Drilling fluid injection pressure and volume.

f. Drilling fluid return volume.

g. All standard engine functions including RPM, coolant temperature, oil temperature, oil pressure, and hours of operation. HDD Instrumentation System:

h. Provide manufacturer’s written operation, maintenance, and performance requirements.

5. Drill head that is steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets suitable for the conditions indicated in the Contract Documents.

6. Anchorage system to anchor drilling machine to the ground to resist thrust and pull forces during operation.

B. Drilling Fluids (Mud/Slurry) System

1. Potable water.

2. All additives other than soda ash and those required for brackish water shall be NSF 060 clean water approved with approval not based upon removal.

3. No American Petroleum Institute (API) approved additives.

4. Select appropriate drill fluid cleaning equipment for the drill production rate and for the anticipated site soil and groundwater conditions or vacuum equipment to remove the drill fluid. Note that brackish water may be present. The Drill Fluid Specialist is

responsible for assessing project water supply and project conditions and for the design and implementation of drill fluid and water treatments for project specific conditions.

5. The Drill Fluid Specialist shall be on site at all times during drilling, reaming, and pipe pullback operations.

6. Provide and use additives as necessary to permit use in saltwater and brackish environments when encountered.

7. Drill fluid parameters (pH, density, viscosity and sand content) shall be measured and recorded every two hours, or after a noticeable change in fluid returns. This information shall be attached to the daily drilling report provided by the Contractor to the Engineer.

8. Any spilled drill fluid shall be fully contained and cleaned-up before resuming drill operations.

C. Mixing System

1. A self-contained, closed drill fluid mixing system shall be of sufficient size to mix and deliver the drill fluid.

2. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure adequate mixing.

3. Drill fluid reservoir tank shall be of adequate size for the Work.

4. Mixing system shall continually agitate the drill fluid during drilling operations.

5. Shall monitor fluid pumping pressures and flow rates.

D. Mud/Slurry Motors: Shall be of adequate power to operate the required drilling devices, if used.

E. Guidance System: Shall be capable of providing guidance as specified herein.

F. Pipe Rollers

1. Pipe rollers shall be of sufficient size to fully support the weight of the pipe during butt-fusion, pressure testing, and/or pullback operations.

2. Pipe rollers shall have a minimum of two points of contact on the pipe and be rated for the size of pipe being installed.

G. Tracer wire shall be classified as extra high strength made specifically for the directional drilling industry.

1. Tracer wire shall be the product Pro-Trace HDD-CCS PE45, as manufactured by Pro-Line Safety Products Co., SoloShot EHS, as manufactured by Copperhead Industries, LLC, or equal.

2. Tracer wire ends are to be pulled up through test boxes. Test boxes shall be Bingham & Taylor Model P202CNG Test Box or approved equal. Test boxes shall be labeled on lids as “HDD TRACER WIRE TEST STATION.

3. For each drill, the American Wire Gauge of the selected tracer wire shall be in accordance with the manufacturer's recommendations. All HDD segments must use AWG #8 at a minimum.

4. The tracer wire shall be installed so that electrical continuity is maintained throughout the pipe system. As few connections as possible shall be made in the tracer wire and all exposed wire will be wrapped thoroughly with electrical tape.

5. Tracer wire connections will be made by stripping the insulation back one inch and joining the two ends using a mechanical connector and a split bolt connector; twisting the wire will not be acceptable.

6. Contractor may elect to use a stainless steel aircraft cable tracer wire during pipe pull-back operations, provided it does not interfere with operations to pull the pipe and required tracer wire as specified herein.

PART 3 EXECUTION

3.01. GENERAL

A. General

1. Perform all work in accordance with accepted submittals. Notify Owner immediately if any changes to the work plan are required or any contingency plan is implemented. Confirm notification to Owner in writing within 1 working day of change.

2. Owner's representative(s) shall be permitted access to the work area and equipment to observe all HDD operations and verify operational data.

3. Dewatering of pits and excavations shall be in accordance with Section 02512, Dewatering.

4. Notifications: Provide written notification to the Engineer and MDE a minimum of 3 workdays before mobilizing onto the site. Provide written notification 2 work days in advance of drilling. Provide written notification 2 workdays in advance of pressure tests and acceptance verification tests on the product pipe.

5. Provide positive containment for all drilling fluids and drainage from drill cuttings and prevent any of the drill fluid or drainage fluids or other drill fluid contaminated material or fluid from entering nearby wetlands either by topping or breaching including under storm conditions. Prevent storm water from entering the drill fluid system.

6. Establish a secure and contained construction work area at the drill rig and exit pit.

7. Excavate and verify all utilities within 15 feet of the drill path and leave exposed until after completion of the pilot drill. All utilities shall be exposed in accordance with Section 02012, Test Pits.

8. Maintain the work site in a clean and safe manner.

9. The entry and exit pits are the only acceptable locations to start or end directional drilling. Intermediate pits are not allowed.

B. Preparation

1. Notify the Engineer of circulation losses greater than 25% of downhole pump volumes and for all observable bentonite slurry releases at the earliest opportunity, confirm in writing by the end of the work shift, and include in the Daily Report.

2. Use electronic survey instrumentation to monitor and steer the drill head along the designed drill path. Perform a 360 degree test roll and calibrate accordingly.

3. Do not exceed allowable bending radius of the product pipe or drill rods. Vertical path of the pilot hole must not establish new high points not shown on the Contract Drawings.

C. Directional Drilling Operations

1. Pilot Hole Boring: Notify the Engineer immediately in writing when forward motion of operation is stopped by an obstruction and before implementation of a contingency plan.

2. Installing Pipe Product:

a. The pull force shall be monitored continuously and recorded twice per rod. The data can be recorded manually by the rig operator in the form of a log table or automatically recorded with a pull force recording device that outputs directly to an electronic file.

b. Inspect the outside wall for gouges and scraps and pressure test carrier pipe before installation.

c. A swivel shall be installed between the reamer and the pipe connection to minimize torsional stress imposed on the pipe and allow the reamer to turn without rotating the pipe.

d. The product pipe being pulled into the borehole shall be protected and supported on pipe rollers so that it moves freely and is not damaged by stones and debris on the ground during installation. The pipe shall be inspected prior to and during pullback. Pipe which exhibits external damage due to handling shall, at the discretion of the Engineer, be removed from the pipe string and replaced at the Contractor’s expense.

e. Pullback forces shall not exceed the allowable pulling forces for the product pipe.

f. The product pipe shall be filled with water during the pulling installation process. The water fill level shall not exceed the ground elevation at the point that the pipe enters the ground. The pipe on the rollers should remain free of ballast water.

g. All pipe pulled through the pilot holes shall have two (2) continuous tracer wires securely fixed to the pipe.

1) The wire ends are to be pulled up to the top, looped and continued through the valve boxes for future County access. Where possible, the tracer wire connections should be located within the vaults that are being constructed as a part of this project.

2) If the tracer wire is not ready to be connected to another section of the force main, then a minimum 5 foot of additional tracer wire will be coiled, buried and terminate at the end of the HDD segment. Of the 5 foot tracer wire section at the ends of the pipeline, one foot of insulation will be stripped back, prior to burial.

3) The Contractor shall test the tracer wire to demonstrate electrical continuity throughout the length of the HDD segment installed. Any discontinuity shall be located. If possible, the tracer wire discontinuity shall be repaired and retested at the Contractor's expense until continuity is achieved.

h. Before pullback and immediately after pullback perform inspection of the leading edge of the pipe for significant external damage. If the pipe is deemed by the Engineer to have suffered significant damage, the damaged pipe shall be cut off and additional pipe pulled through the hole.

i. The pullback shall be conducted in one continuous operation with only the pre-approved or emergency stops.

j. Upon completion of pullback and inspection and before commencing with any tie-in or cutting of pipe, the pipe shall be relaxed for a period of no less than 24 hours. The pipe shall be pulled at least10.0 feet past the exit tie-in point to accommodate contraction.

D. Settlement or displacement of existing grade and/or adjacent facilities shall be monitored closely. Notify Engineer immediately if settlement or displacement is detected. The Contractor shall make provisions to maintain safe conditions and prevent damage.

END OF SECTION

SECTION 02980

SITE REHABILITATION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Site rehabilitation of lawns, existing cultivated or landscape items

B. Restoration of uncultivated lands.

C. Topsoil, fertilizer, seeding, mulching and planting.

D. Site rehabilitation of walls, terraces, fences, ditches, drains, culverts, drives, posts, patios, outdoor recreational equipment, garden decorations and appurtenances, small structures, and all other artificial features.

E. Site modifications and development to meet new conditions.

F. Removal and disposal of all excess materials, equipment, trash and debris used for, or resulting from, the work included in this Section.

1.02. REFERENCES

A. American Nursery & Landscape Association

B. ANSI Z60.1-2014, American Standard for Nursery Stock

C. Delaware Erosion and Sediment Control Handbook, latest edition as revised, amended, or updated

1.03. QUALITY ASSURANCE

A. Areas and Features to be Restored

1. All areas, including natural features occurring thereon, which are damaged or disturbed by the Contractor's operations, shall be restored, repaired or replaced to the same or superior condition which existed prior to construction or as modified herein or as shown on the Drawings.

2. Artificial features shall be restored equal to a new condition or as modified herein or as shown on the Drawings.

1.04. SUBMITTALS

A. Submittals shall include, but not be limited to, the following:

1. Shop Drawings.
   a. Source of nursery for all plantings
   b. Sieve analysis and characteristics of topsoil
   c. Seed mixture data

1.05. QUALIFICATIONS

A. All planting material to be furnished from a nursery which meets the requirements of the American Nursery and Landscape Association.

1.06. PACKING AND SHIPPING

A. All seed furnished for this Project shall be delivered in standard size unopened bags of the vendor, showing weight, mixture, vendor's name and guaranteed analysis.

1.07. STORAGE

A. Seed shall be properly stored in dry conditions at the Site.

B. Seed damaged or spoiled during storage shall be replaced by Contractor at no additional cost to Owner.

1.08. SCHEDULE

A. Seeding dates are included with Erosion and Sediment Control Notes on the Drawings.

PART 2 PRODUCTS

2.01. MATERIAL

A. Topsoil

1. Topsoil specifications are included with Erosion and Sediment Control Notes on the Drawings.

2. Topsoil may be from previously excavated, stockpiled and protected materials, provided the materials meet the requirements for topsoil.

B. Fertilizer

1. Fertilizer and lime specifications are included with Erosion and Sediment Control Notes on the Drawings.

C. Seeding

1. Seeding specifications for lawns and cultivated (landscaped) areas are included with Erosion and Sediment Control Notes on the Drawings.

D. Mulching:

E. Mulching specifications are included with Erosion and Sediment Control Notes on the Drawings.

PART 3 EXECUTION

3.01. EXAMINATION

A. Determine that surface area is ready for fine grading and/or to receive topsoil and seeding or plantings.

1. Remove trash, debris, large stones and other foreign materials from surface areas to be restored or rehabilitated.

2. Topsoil shall be free of frozen fragments, debris, large stones, and other foreign materials.

3.02. PREPARATION

A. Refer to the Sediment and Erosion Control Notes on the Drawings for preparation.

3.03. INSTALLATION

A. Contractor shall reestablish all existing cultivated or landscape items, trees, shrubs, vines and ground covers as practicable and shall provide additional or modify existing vegetation, as shown on the Drawings.

B. Existing trees, plants, shrubs, saplings, ground cover, vines, etc., which are disturbed or damaged by the Contractor's operations shall be replaced with new plant materials.

3.04. TOPSOILING

A. Topsoil requirements are included with the Sediment and Erosion Control Notes on the Drawings.[

3.05. FERTILIZING

A. Fertilizing requirements are included with the Sediment and Erosion Control Notes on the Drawings.

3.06. SEEDING

A. Seeding requirements are included with the Sediment and Erosion Control Notes on the Drawings.

3.07. MULCHING AND PROTECTION

A. Seeding requirements are included with the Sediment and Erosion Control Notes on the Drawings.

B. Protect and maintain seeded areas to assure a full even stand of grass.

3.08. MAINTENANCE

A. Any portion of seeded areas failing to produce a full uniform stand of grass from any cause, shall be reseeded at full rate and refertilized at one-half rate and protected and maintained until such a full stand has been obtained.

3.09. RESTORATION OF UNCULTIVATED LANDS

A. Areas of uncultivated land shall be restored as follows:

1. The disturbed surfaces shall be rough-graded to the original elevations (±1 inch) and general appearance which existed prior to construction (or to the new elevations and grades which are required), all debris, loose stones over 1 inch, boulders, etc., being removed in the process.

2. The surface shall then be seeded with perennial rye grass, being spread at the rate of 1 lb. per 800 square feet.

3.10. SPECIAL CONDITIONS

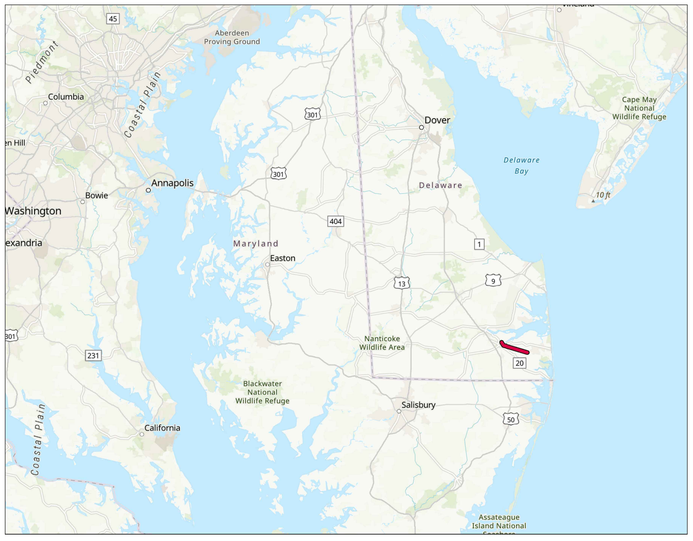
A. Vegetation which is damaged by Contractor activities and deemed non-functional by Owner and/or Engineer, shall be replaced by Contractor with vegetation of the same caliper, genus, and species at no additional cost to Owner.

END OF SECTION

PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

AUGUST 2025

GHD PROJECT NO: 12644261



LOCATION MAP

N

VICINITY MAP

N

811 Know what's **below.** **Call** before you dig.

FOR AGENCY REVIEW

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG**	Drafting Check **PD**	Project Manager **PD**	
Designer **CM**	Design Check **PD**	Project Director **BG**	

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client	**SUSSEX COUNTY, DELAWARE**	
Project	PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM	
Project No. **12644261**	Date **MM/DD/YYYY**	Scale **AS SHOWN**
Title	**COVER SHEET**	Size **ANSI D**
		Sheet No. **GN-001**

Plot Date: 26 August 2025 - 3:45 PM
Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Gen\12644261-GHD-00-00-DGN-GN-D001.dwg

SHEET NUMBER	SHEET TITLE
	GENERAL
GN-001	COVER SHEET
GN-002	LIST OF DRAWINGS
GN-003	ABBREVIATIONS, NOTES, LEGEND, AND SYMBOLS
	CIVIL: GENERAL
CI-001	KEY MAP
CI-002	PROPOSED CONSTRUCTION STAKING PLAN
	CIVIL: PLAN AND PROFILE
CI-201	PLAN AND PROFILE - STATION 0+00 TO 12+50
CI-202	PLAN AND PROFILE - STATION 12+50 TO 26+50
CI-203	PLAN AND PROFILE - STATION 26+50 TO 40+50
CI-204	PLAN AND PROFILE - STATION 40+50 TO 53+50
CI-205	PLAN AND PROFILE - STATION 53+50 TO 66+00
CI-206	PLAN AND PROFILE - STATION 66+00 TO 79+50
CI-207	PLAN AND PROFILE - STATION 79+50 TO 93+00
CI-208	PLAN AND PROFILE - STATION 93+00 TO 107+00
CI-209	PLAN AND PROFILE - STATION 107+00 TO 121+00
CI-210	PLAN AND PROFILE - STATION 121+00 TO 135+00
CI-211	PLAN AND PROFILE - STATION 135+00 TO 149+00
CI-212	PLAN AND PROFILE - STATION 149+00 TO 163+00
CI-213	PLAN AND PROFILE - STATION 163+00 TO 177+00
CI-214	PLAN AND PROFILE - STATION 177+00 TO 191+00
CI-215	PLAN AND PROFILE - STATION 191+00 TO 205+50
CI-216	PLAN AND PROFILE - STATION 205+50 TO 219+50
CI-217	PLAN AND PROFILE - STATION 219+50 TO 234+50
CI-218	PLAN AND PROFILE - STATION 234+50 TO 248+50
CI-219	PLAN AND PROFILE - STATION 248+50 TO 262+50
CI-220	PLAN AND PROFILE - STATION 262+50 TO 276+50
CI-221	PLAN AND PROFILE - STATION 276+50 TO 290+00
CI-222	PLAN AND PROFILE - STATION 290+00 TO 295+08.03
	CIVIL: ESC AND STORMWATER MANAGEMENT
CI-400	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT KEY PLAN
CI-401	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-402	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-403	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-404	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-405	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-406	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-407	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-408	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-409	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-410	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
CI-411	EROSION & SEDIMENT CONTROL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
	CIVIL: DETAILS
CI-501	CIVIL DETAILS - PIPE TRENCHING
CI-502	CIVIL DETAILS - FORCE MAIN (1 OF 2)
CI-503	CIVIL DETAILS - FORCE MAIN (2 OF 2)
CI-506	EROSION CONTROL NOTES
CI-507	EROSION CONTROL - DETAILS (1 OF 3)
CI-508	EROSION CONTROL - DETAILS (2 OF 3)
CI-509	EROSION CONTROL - DETAILS (3 OF 3)
CI-510	TRAFFIC CONTROL - DETAILS (1 OF 2)
CI-511	TRAFFIC CONTROL - DETAILS (2 OF 2)

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **LIST OF DRAWINGS**

Size **ANSI D**

Sheet No. **GN-002**

Plot Date: 26 August 2025 - 3:45 PM Plotted By: Trevor Germsheid Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Gen\12644261-GHD-00-00-DGN-GN-D002.dwg

ABBREVIATIONS

Ø, DIA	=	DIAMETER
AOBE	=	AS ORDERED BY ENGINEER
ASPH	=	ASPHALT
AHD	=	AHEAD
A/V	=	AIR/VACUUM
BOB	=	BOTTOM OF BANK
BC	=	BOTTOM OF CURB
BDY	=	BOUNDARY
BV	=	BUTTERFLY VALVE
BLDG	=	BUILDING
BLVD	=	BOULEVARD
BM	=	BENCHMARK
BTD	=	BLACK TOP DRIVE
BK	=	BACK
C/C	=	CENTER TO CENTER
CATV	=	CABLE TV
CB	=	CATCH BASIN
CFS	=	COMPOST FILTER SOCK
CIP	=	CAST IRON PIPE
CL	=	CENTERLINE
CMP	=	CORRUGATED METAL PIPE
CO	=	CLEANOUT
CONC	=	CONCRETE
CONST	=	CONSTRUCTION
CP	=	CONTROL POINT
CR	=	COUNTY ROAD
CSD	=	CRUSHED STONE DRIVE
CSP	=	CARBON STEEL PIPE
CSPA	=	CORRUGATED STEEL PIPE ARCH
CT	=	COPPER TUBING PIPE
CULV	=	CULVERT
DI	=	DRAINAGE INLET
DIP	=	DUCTILE IRON PIPE
DIA, Ø	=	DIAMETER
DN	=	DOWN
E	=	EAST
EC	=	ELECTRIC
EL	=	ELEVATION
EP	=	EDGE OF PAVEMENT
EPS	=	EDGE OF PAVED SHOULDER
ES	=	EDGE OF SHOULDER
FND	=	FOUNDATION
FS	=	FAR SIDE
FT	=	FOOT, FEET
GAR	=	GARAGE
GM	=	GAS METER
GP	=	GUY POLE
GRAV	=	GRAVEL
GSB	=	GAS SERVICE BOX
GV	=	GAS VALVE (MAIN LINE)
GS	=	GATE SERVICE
GW	=	GAS WELL
HC	=	HANDICAP
HDPE	=	HIGH DENSITY POLYETHYLENE PIPE
HP	=	HIGH POINT
HPG	=	HIGH PRESSURE GAS
HSE #	=	HOUSE NUMBER
HW	=	HEADWALL
HWY	=	HIGHWAY
HYD	=	HYDRANT
INV	=	INVERT
IB	=	IRON BAR
IP	=	IRON PIPE OR IRON PIN
LF	=	LINEAR FOOT
LP	=	LIGHT POLE
LPG	=	LOW PRESSURE GAS

LT	=	LEFT
MH	=	MANHOLE
MON	=	MONUMENT
N	=	NORTH
NE	=	NORTH EAST
NW	=	NORTH WEST
NITC	=	NOT IN THIS CONTRCT
PAVT	=	PAVEMENT
PCCP	=	PRESTRESSED CONCRETE CYLINDER PIPE
PCSP	=	PERFORATED CORRUGATED STEEL PIPE
PS	=	PUMP STATION
PVC	=	POLYVINYL CHLORIDE PIPE
PP	=	POWER POLE
RCP	=	REINFORCED CONCRETE PIPE
RIB	=	RECORDED IRON BAR
RD	=	ROAD
RP	=	REFLECTOR POST
RR	=	RAILROAD
ROW	=	RIGHT OF WAY
RT	=	RIGHT
RTE	=	ROUTE
R	=	RADIUS
STA	=	STATION
SA	=	SANITARY MANHOLE (SYMBOL)
SAN	=	SANITARY SEWER
SSMH	=	SANITARY MANHOLE
SHDR	=	SHOULDER
SIB	=	SET IRON BAR
SH	=	STATE HIGHWAY
S	=	SOUTH
SE	=	SOUTH EAST
SF	=	SILT FECE
SBD	=	STRAW BALE DIKE
SPK	=	SPIKE
STP	=	STEEL PIPE
STM	=	STORM SEWER
STM MH	=	STORM MANHOLE
STK	=	STAKE
ST	=	STREET
STY	=	STORY
SWK	=	SIDEWALK
SW	=	SOUTH WEST
TB	=	TEST BORE
TOB	=	TOP OF BANK
TBM	=	TEMPORARY BENCH MARK
TC	=	TOP OF CURB
TEL P	=	TELEPHONE POLE
TGL	=	THEORETICAL GRADE LINE
UP	=	UTILITY POLE
UGE	=	UNDERGROUND ELECTRIC
UGT	=	UNDERGROUND TELEPHONE
VCP	=	VITRIFIED CLAY PIPE
VTP	=	VITRIFIED TILE PIPE
WAT	=	WATER
W	=	WEST
WP	=	WATER PIPE
WM	=	WATER METER
WV	=	WATER VALVE
WS	=	WATER SERVICE (HSE. LINE)

SURVEY

FEATURE	EXISTING	PROPOSED
LIMIT OF SURVEY		
PROPERTY LINE		
CENTER LINE		
EASEMENT		
500 YEAR BASE FLOOD ELEVATION		
CONSTRUCTION STAKEOUT POINT		01
MONUMENT	MONUMENT	
SIB	SIB	
IB	IB	
RIB	RIB	
IRON PIPE	IP	
CUT-CROSS	CC	
NAIL	NAIL	
DRILL HOLE	DH	
BENCHMARK	BM	
TEMPORARY BENCHMARK	TBM	
CONTROL POINT	CP	CP
PERMANENT SURVEY MARKER		

TOPOGRAPHY

FEATURE	EXISTING	PROPOSED
PAVEMENT		
CONC SIDEWALK		
GRAVEL PAVEMENT		
MILL AND OVERLAY PAVEMENT		
>25% SLOPES		
15%-25% SLOPES		
SPLASH BLOCK		
MAIL BOX		
FENCE	X X X	X X X
STRUCTURE		
TREE LINE		
HEDGE		
TREE		
MAIL BOX		
BOLLARD		
SPOT ELEVATION		
WATER ELEVATION	WATER EL	WATER EL
GATE		
POST	103.00 TOP	
STREAM OR RIVER		
TOP OF SLOPE		103.00
TOE OF SLOPE		
TEST BORE HOLE	BH-1	BH-1

EROSION CONTROL

FEATURE	EXISTING	PROPOSED
SILT FENCE		SF
COMPOST FILTER SOCK		CFS
LIMITS OF DISTURBANCE		LOD
INLET PROTECTION		CIP
STABILIZED CONSTRUCTION ENTRANCE		SCE

SANITARY (GRAVITY)

FEATURE	EXISTING	PROPOSED
SANITARY SEWER	SAN	
SANITARY SEWER MH	SAN MH	
CLEAN OUT	CO	
VENT	V	
LATERAL		
END CAP		
MANHOLE DEMOLITION		

SANITARY (FORCEMAIN)

FEATURE	EXISTING	PROPOSED
SANITARY SEWER FORCEMAIN	FM	FM
BORING / RECEIVING PIT		
11.25° BEND		
22.5° BEND		
45° BEND		
90° BEND		
CROSS		
TEE		
GATE VALVE		

SANITARY FORCEMAIN PIPE TYPE AND INSTALATION METHOD

FEATURE	EXISTING	PROPOSED
10" / 12" PVC / OPEN CUT		FM
12" HDPE DR9 / OPEN CUT		FM
12" HDPE DR9 / JACK & BORE		FM
12" HDPE DR9 / HDD		FM

STORM & DRAINAGE

FEATURE	EXISTING	PROPOSED
STORM SEWER	STM	
STORM MANHOLE	STM MH	
STORM CATCH BASIN	CB	
CULVERT/ENDSECTIONS		
SWALE/DITCH		
YARD DRAIN	YD	YD
FLOW ARROW		
STORM PIPE		

WATER

FEATURE	EXISTING	PROPOSED
WATER MAIN	W	W
WATER GATE VALVE		
WATER BUTTERFLY VALVE		
HYDRANT VALVE		
HYDRANT		
CURB STOP	CS	
WATER METER	WM	
AIR RELIEF VALVE		
WELL	W	
SERVICE		
SERVICE RECONNECT		
BLOWOFF / SAMPLE POINT		
TAPPING SLEEVE		
WATER SERVICE BOX		
SPRINKLER HEAD		
VALVE CHAMBER		
END CAP		

NATURAL GAS

FEATURE	EXISTING	PROPOSED
GAS	G	
GAS VALVE		
GAS METER	GAS	
GAS MAIN MARKER		
GAS SERVICE BOX		
GAS WELL	G	
END CAP		

POWER / COMMUNICATIONS

FEATURE	EXISTING	PROPOSED
ELECTRIC UNDERGROUND	E	E
ELECTRIC OVERHEAD	P/A	
TELEPHONE UNDERGROUND	UT	
TELEPHONE OVERHEAD	OT	
COMMUNICATION UNDERGROUND	UC	
COMMUNICATION OVERHEAD	OC	
UTILITY POLE		
GUY WIRE ANCHOR		
STREET LIGHT		
BURIED CABLE MARKER		
TRANSMISSION TOWERS		
PULL BOX STREET LIGHTS		
TERMINAL BOX	T	
UTILITY MANHOLE	UTIL MH	
HANDHOLE	H	H
INSPECTION POST		
UTILITY MARKER		
PEDESTAL		
POLICE OR FIRE CALL BOX		

TRAFFIC

FEATURE	EXISTING	PROPOSED
TRAFFIC SIGNAL	SIGNAL	
PULL BOX TRAFFIC SIGNAL	T	
SIGNAL POLE W/CONTROL		
ROAD SIGNS		Þ
MILE MARKER		
RAISED PAVEMENT MARKER		

RAILROAD

FEATURE	EXISTING	PROPOSED
RR TRACKS SMALL SCALE		
RR SIGNAL		
RR SIGNAL CONTROL BOX		
RR SWITCHSTAND		
RR FROG POINT		
RR BUMPER		

MISC

FEATURE	EXISTING	PROPOSED
ABANDONED PIPE		
DEMOLITION		
TREE REMOVAL		R
CASING PIPE		
TANK FILLER	F	
CONTRACTOR TEST PIT		T
POST INDICATOR VALVE		
PUMP		
VALVE OPERATOR **		
CHECK VALVE		
COMBINATION A/V VALVE ASSEMBLY		
ACCESS PORT ASSEMBLY		
DEWATERING ASSEMBLY		

MATERIAL SYMBOLS

FEATURE	EXISTING	PROPOSED
CLAY		
APPROVED BACKFILL		
SAND		
SEDIMENT		
COMPACT STONE SUBBASE		
SELECT FILL		
FILL		
RIP-RAP / CRUSHED STONE		
BEDROCK		
WETLAND OR MARSH		
TOPSOIL		
ASPHALT		
CONCRETE		
CONCRETE MASONRY UNIT		
ROCK SURFACE		
EARTH SURFACE		
PIPE BEDDING		
TOP COURSE		
BINDER COURSE		
GRANITE		
PEA GRAVEL		
EASEMENT		
ROCK OUTCROPPING		
TO BE ABANDONED IN PLACE (AP)		
TO BE DEMOLISHED (D)		
TO BE RELOCATED (R)		

FOR AGENCY REVIEW

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

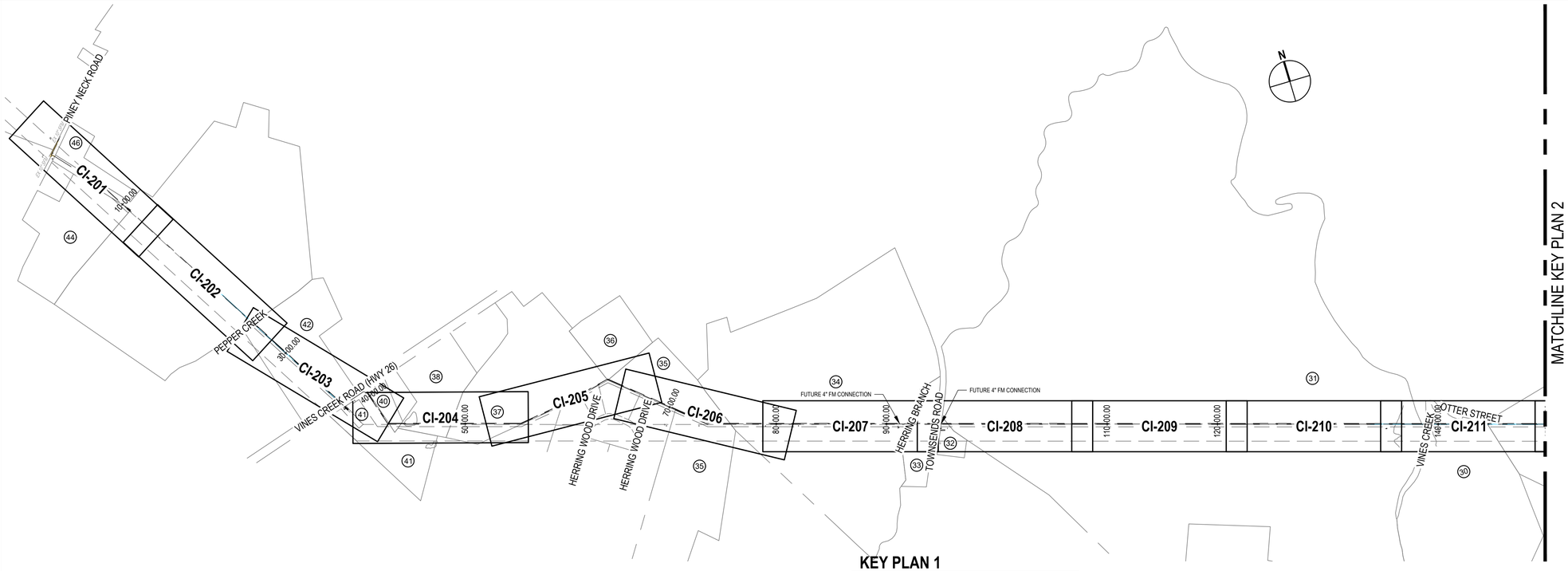
Project No. **12644261** Date **MM/DD/YYYY** Scale **N.T.S.**

Title **ABBREVIATIONS, NOTES, LEGEND, AND SYMBOLS**

Size **ANSI D**

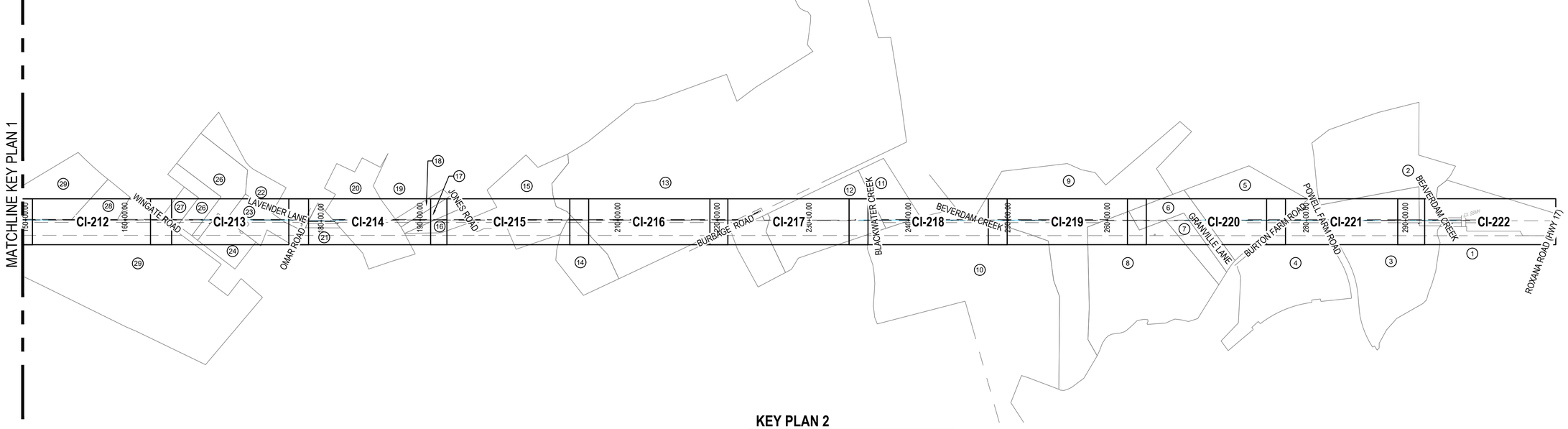
Sheet No. **GN-003**

Plot Date: 26 August 2025 - 3:45 PM Plotted By: Trevor Germsheid Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Gen\12644261-GHD-00-00-DGN-GN-D003.dwg



KEY PLAN 1

SCALE Custom



KEY PLAN 2

SCALE Custom

Number	Property ID	Record Owner
1	134-15.00-93.01	DHIC - Tupelo Sands LLC
2	134-15.00-91.02	ASF MBTS LLC
3	134-15.00-91.00	D P Powell Properties LLC
4	134-15.00-19.00	ASF MBTS LLC
5	134-15.00-19.02	Powell, James R & Judy R
6	134-15.00-7.12	Sharon Davis, Cameron Powell and Richard Powell
7	134-15.00-7.11	Sharon Davis, Cameron Powell and Richard Powell
8	134-15.00-7.00	Sharon Davis, Cameron Powell and Richard Powell
9	134-15.00-6.06	Timothy Sudowsky
10	134-15.00-17.14	Bennett, Jeffrey M Trustee
	134-15.00-5.04	Beth L Webb
11	134-15.00-5.03	Beth L Webb
12	134-15.00-5.02	Sussex County
12R or 13	134-15.00-5.01	Sussex County
	134-15.00-5.00	Beth L Webb
13	134-15.00-1.00	Townsend, Charles P Jr
	134-14.00-21.00	David I Wingate
14	134-14.00-21.01	Delaware Electric Cooperative Inc
	134-14.00-21.02	Amy Beth Zingarelli
	134-14.00-21.03	Eduardo Rojas Ramirez
15	134-14.00-21.07	Umstead, Terry
16	134-10.00-94.02	Dean Fenwick and Teressa Lynn Disharoon
17	134-10.00-94.01	Dean Fenwick and Teressa Lynn Disharoon
18	134-10.00-93.00	William E Miller
19	134-10.00-92.00	Ernestine Hall
20	134-10.00-88.00	Werner, William M and Anita West-Werner
	134-10.00-88.01	Werner, William M and Anita West-Werner
	134-10.00-63.00	Gary and Angela H Matthews
21	134-10.00-62.10	PFAB HANS
22	134-10.00-62.08	Erickson, Laf P & Gundula V
23	134-10.00-62.05	Matthews, Gary W & Angela H
24	134-10.00-62.03	Matthews, John
	134-10.00-62.00	Keith T and Wendy L Murray
25	134-1.00-62.09	Sturgill, James Samuel
26	134-10.00-62.14	Mattson, Jacklyn C
27	134-10.00-62.06	Matthews, Gary & Angela H
29	134-10.00-52.00	P W Rickards Farms Family Limited
28	134-10.00-52.02	P W Rickards Farms Family Limited
30	134-10.00-51.00	Bayshore Inc
	134-10.00-48.00	Bayshore Inc
31	433-2.00-1.00	Townsend, Charles P Jr.
32	433-2.00-7.02	Layton, Ross E & Beverly S
33	433-2.00-2.00	Ronald L Culver & Melissa A Culver
34	233-12.00-28.00	Townsend, Charles P Jr.
	233-11.00-198.02	Herring Wood Homeowners Association Inc
35	233-11.00-198.00	Toomey Farm LLC
36	233-11.00-196.00	Conti Daniel A III
37	233-11.00-181.00	Lynch, Robert C Trustee
38	233-11.00-176.00	LEXCORP DEVELOPMENT LLC
39	233-11.00-171.00	Robert C Lynch Trustee
40	233-11.00-175.01	LEXCORP DEVELOPMENT LLC
41	233-11.00-172.00	ES MOTORS LLC
42	233-11.00-109.00	EILEEN MCCAFFERY
	233-11.00-83.00	SUSSEX COUNTY
44	233-11.00-78.01	ARTHUR EDWARD DAVIDSON
46	233-11.00-80.00	AMELIA LYNCH TRUSTEE

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **N.T.S.**

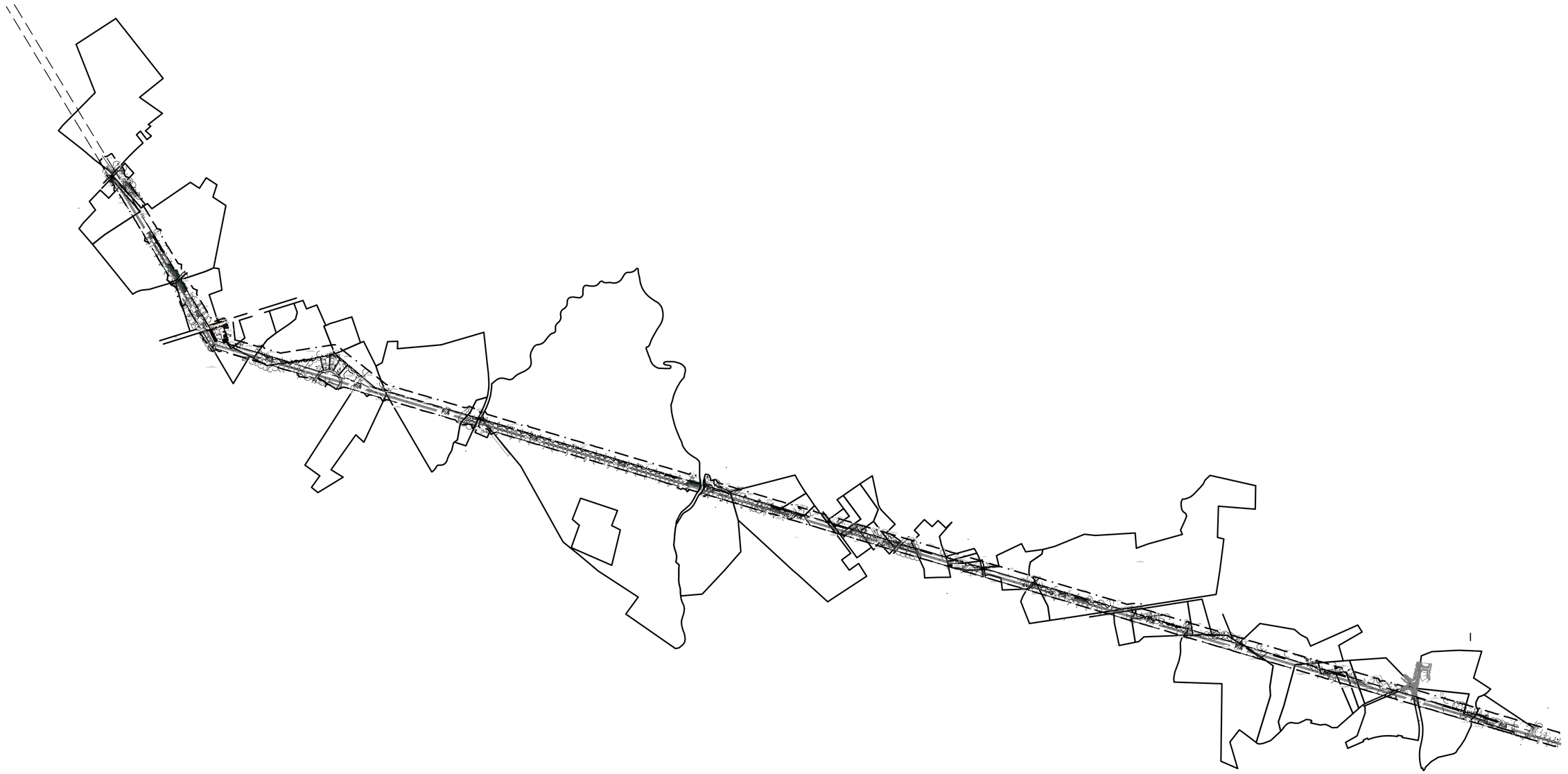
Title **KEY MAP**

Size **ANSI D**

Sheet No. **CI-001**

Plot Date: 26 August 2025 - 3:49 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D001.dwg



No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY, DELAWARE 1869

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

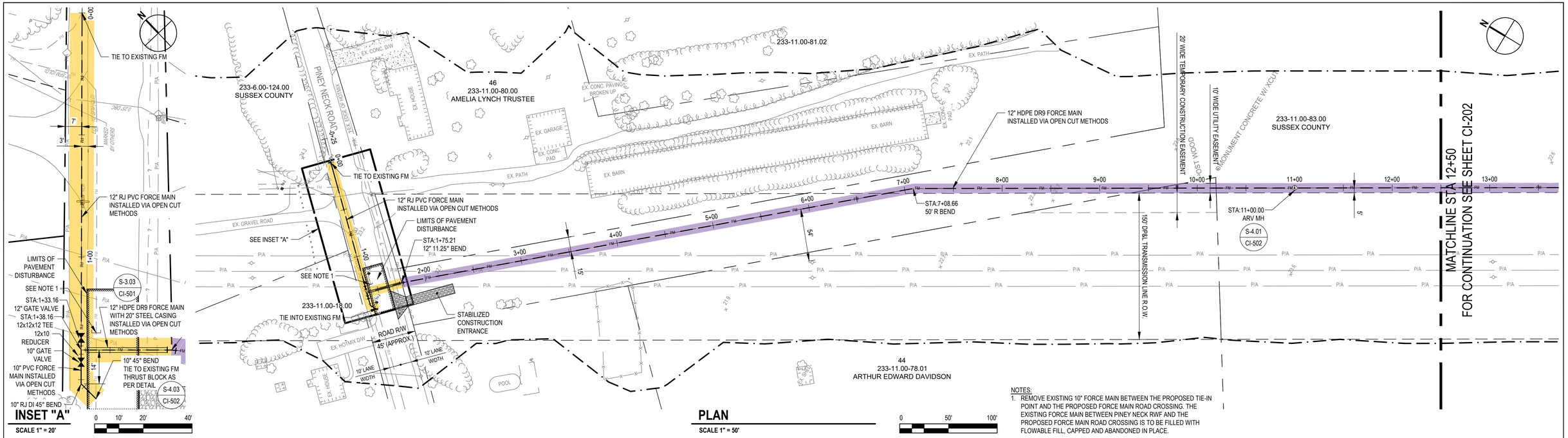
Title **PROPOSED CONSRUCTION STAKING PLAN**

Size **ANSI D**

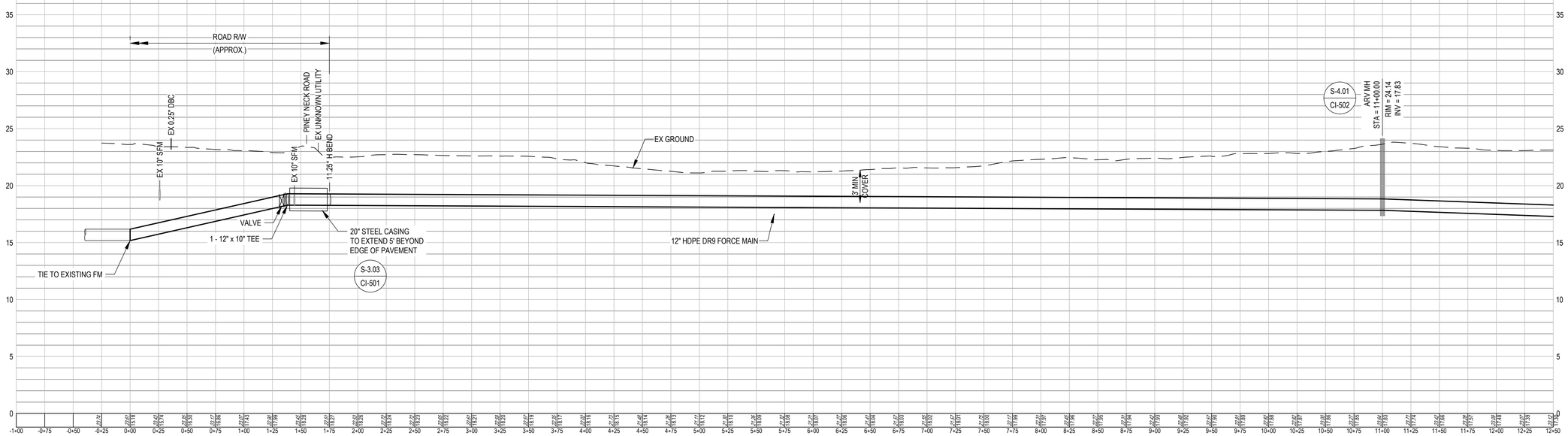
Sheet No. **CI-002**

Plot Date: 26 August 2025 - 3:49 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D002.dwg



NOTES:
1. REMOVE EXISTING 10" FORCE MAIN BETWEEN THE PROPOSED TIE-IN POINT AND THE PROPOSED FORCE MAIN ROAD CROSSING. THE EXISTING FORCE MAIN BETWEEN PINEY NECK RWF AND THE PROPOSED FORCE MAIN ROAD CROSSING IS TO BE FILLED WITH FLOWABLE FILL, CAPPED AND ABANDONED IN PLACE.



PROFILE
SCALE H:1" = 50' V: 1" = 5'
H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**
Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

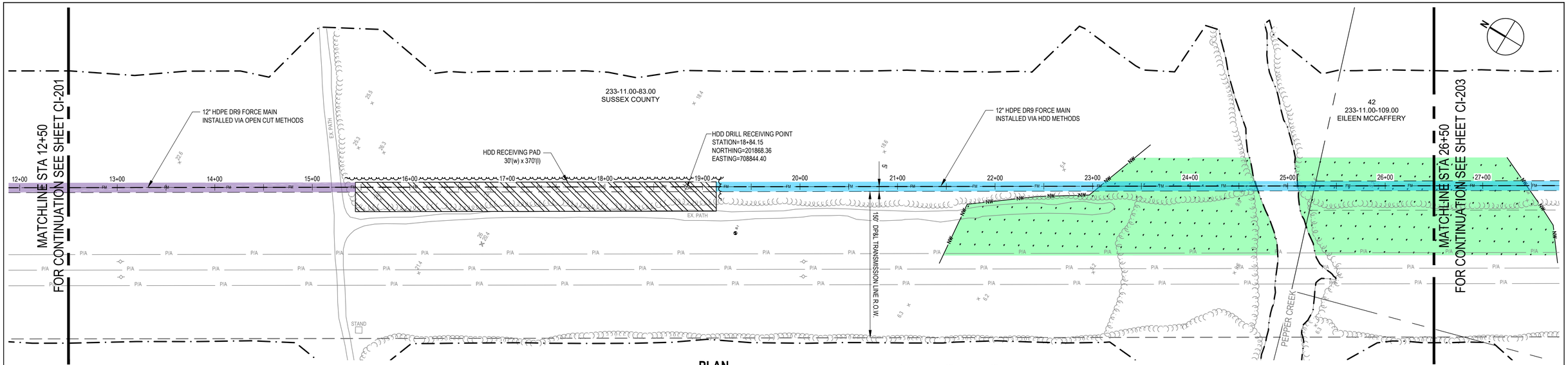
PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY
GHD
GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**
Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 0+00 TO 12+50**
Size **ANSI D**
Sheet No. **CI-201**

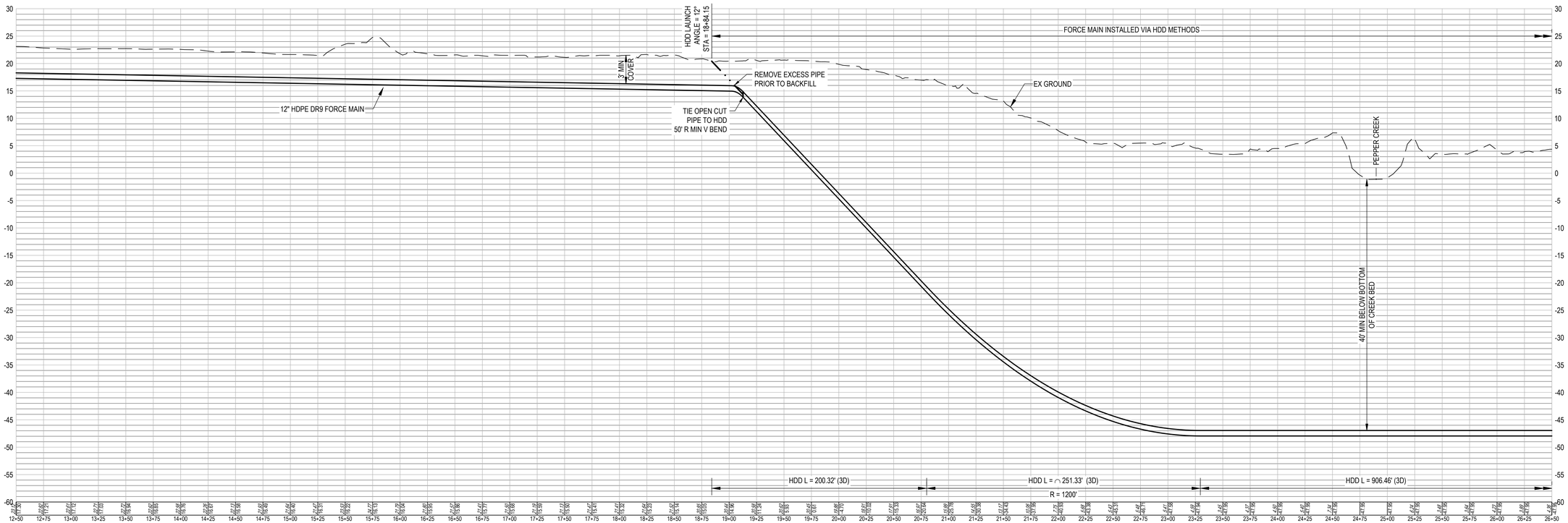
Plot Date: 29 August 2025 - 2:51 PM Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D201.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY DELAWARE 1869

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

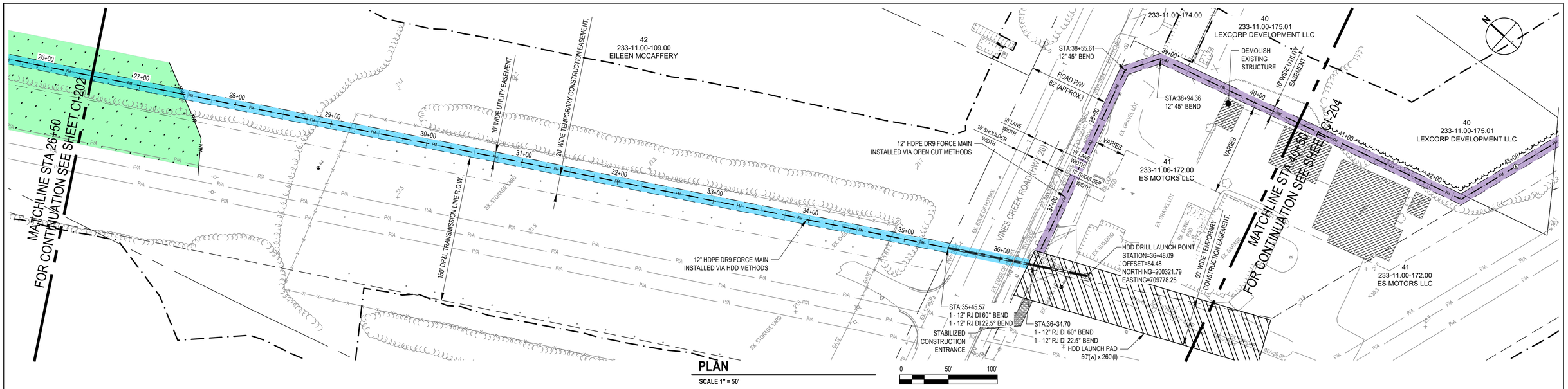
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 12+50 TO 26+50**

Size **ANSI D**

Sheet No. **CI-202**

Plot Date: 26 August 2025 - 3:50 PM Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D202.dwg



PLAN

SCALE 1" = 50'

0 50' 100'

PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**
Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on
original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN
LICENSE
No. 30151
DELAWARE
PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

1683

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK
WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

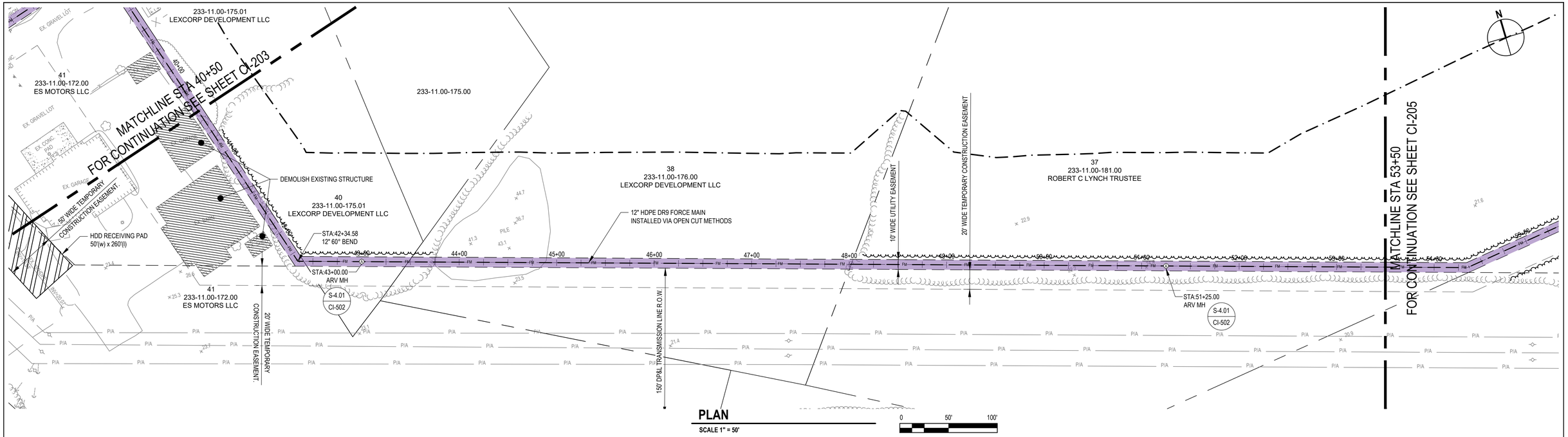
Title
PLAN AND PROFILE
STATION 26+50 TO 40+50

Size **ANSI D**

Project No.	Date	Scale
12644261	MM/DD/YYYY	AS SHOWN

Sheet No. **CI-203**

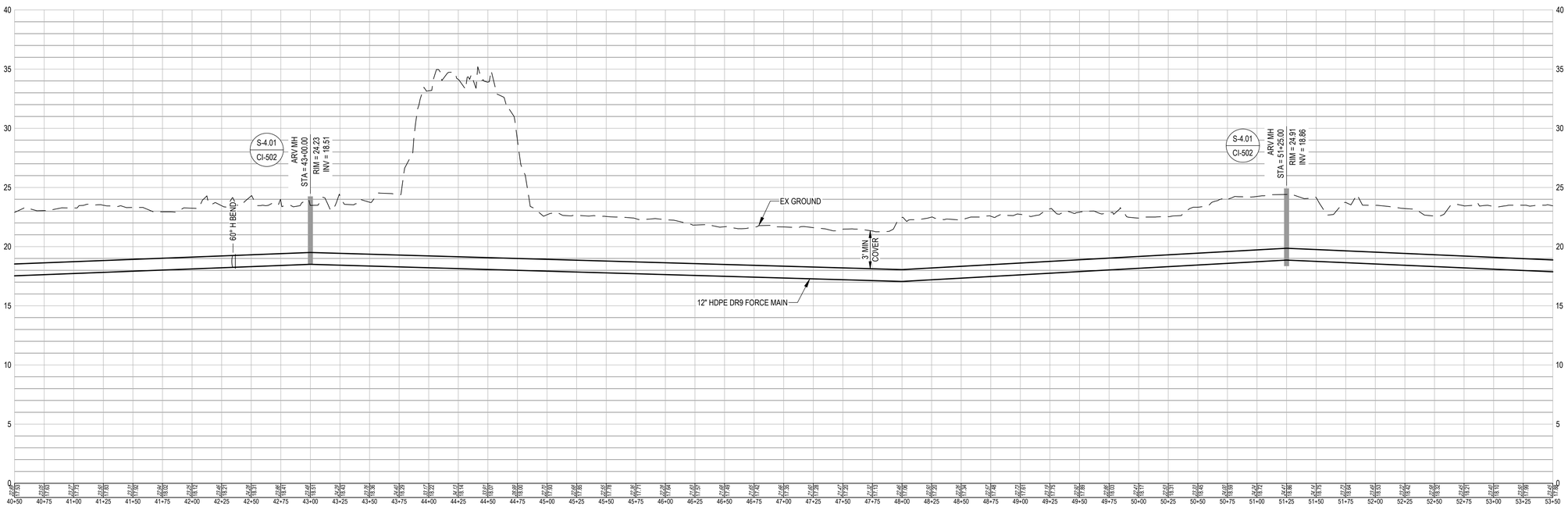
Plot Date: 26 August 2025 - 3:50 PM Plotted By: Trevor Germsheid Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D203.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY DELAWARE 1789

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

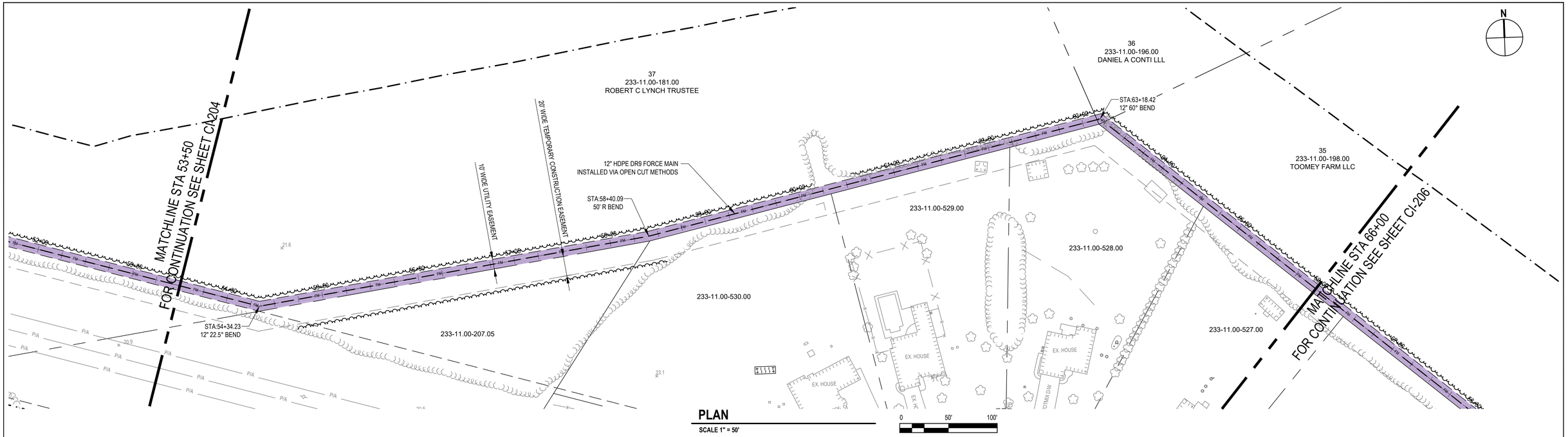
Title **PLAN AND PROFILE STATION 40+50 TO 53+50**

Size **ANSI D**

Sheet No. **CI-204**

Plot Date: 26 August 2025 - 3:51 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D204.dwg



PLAN

SCALE 1" = 50'

0 50' 100'

PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100'

V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG**
Drafting Check **PD**
Project Manager **PD**
Designer **CM**
Design Check **PD**
Project Director **BG**

Bar is one inch on
original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN
LICENSE
No. 30151
DELAWARE
PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

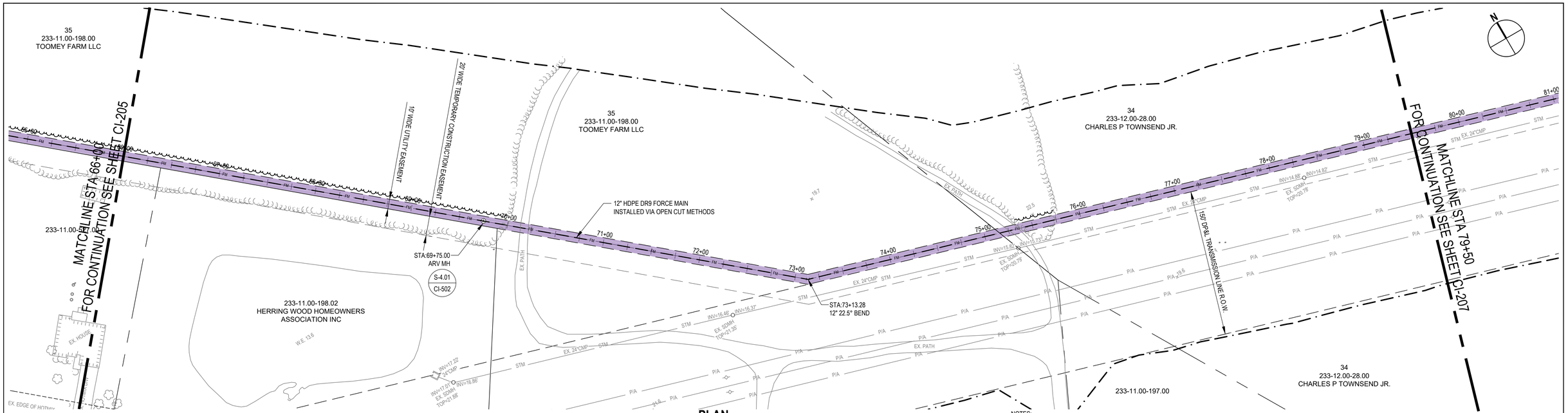
Project No. **12644261**
Date **MM/DD/YYYY**
Scale **AS SHOWN**

Title
PLAN AND PROFILE
STATION 53+50 TO 66+00

Size **ANSI D**

Sheet No. **CI-205**

Plot Date: 26 August 2025 - 3:51 PM
Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D205.dwg

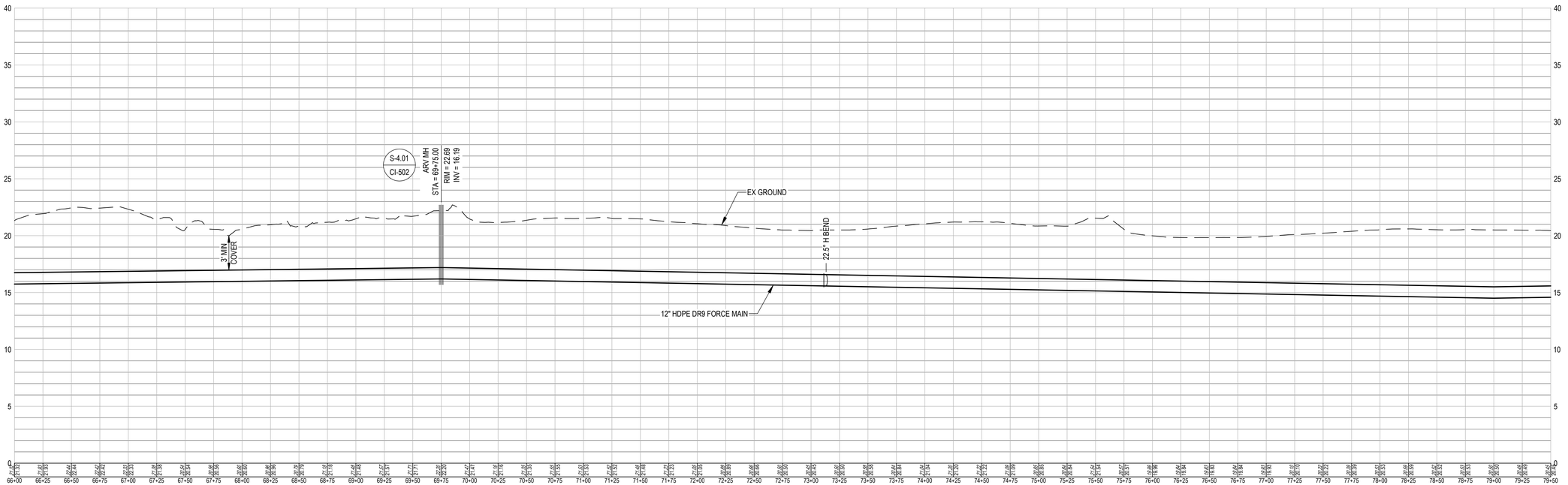


PLAN

SCALE 1" = 50'

0 50' 100'

NOTES:
1. PROPERTY 35 TO HAVE A 6" VALVE CONNECTION INSTALLED ON THE MAIN LINE. COORDINATE IN THE FIELD WITH PROPERTY OWNER FOR EXACT LOCATION.



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

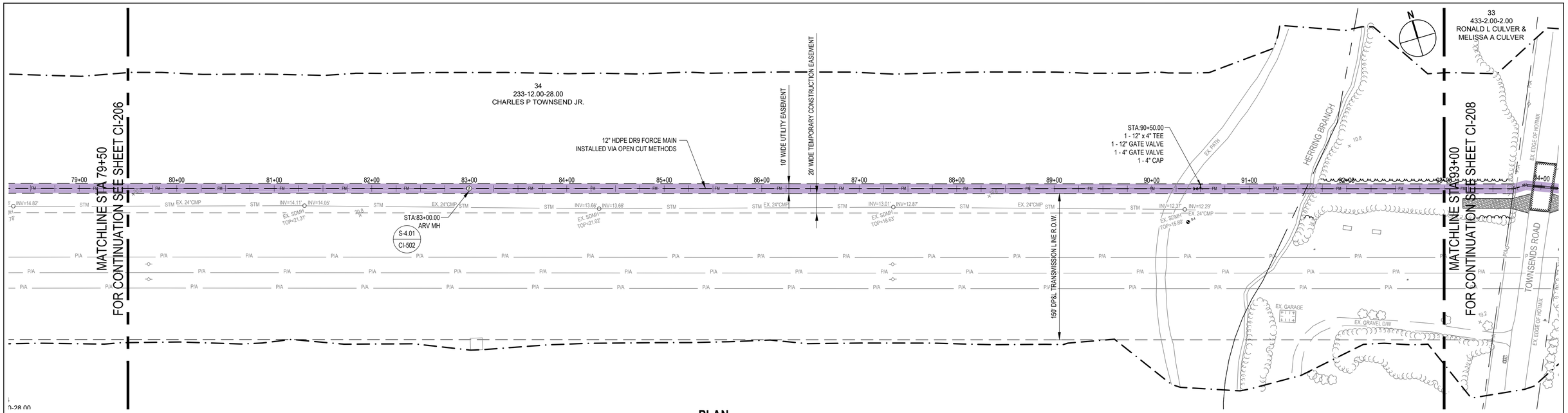
Title **PLAN AND PROFILE STATION 66+00 TO 79+50**

Size **ANSI D**

Sheet No. **CI-206**

Plot Date: 26 August 2025 - 3:52 PM Plotted By: Trevor Germsheid

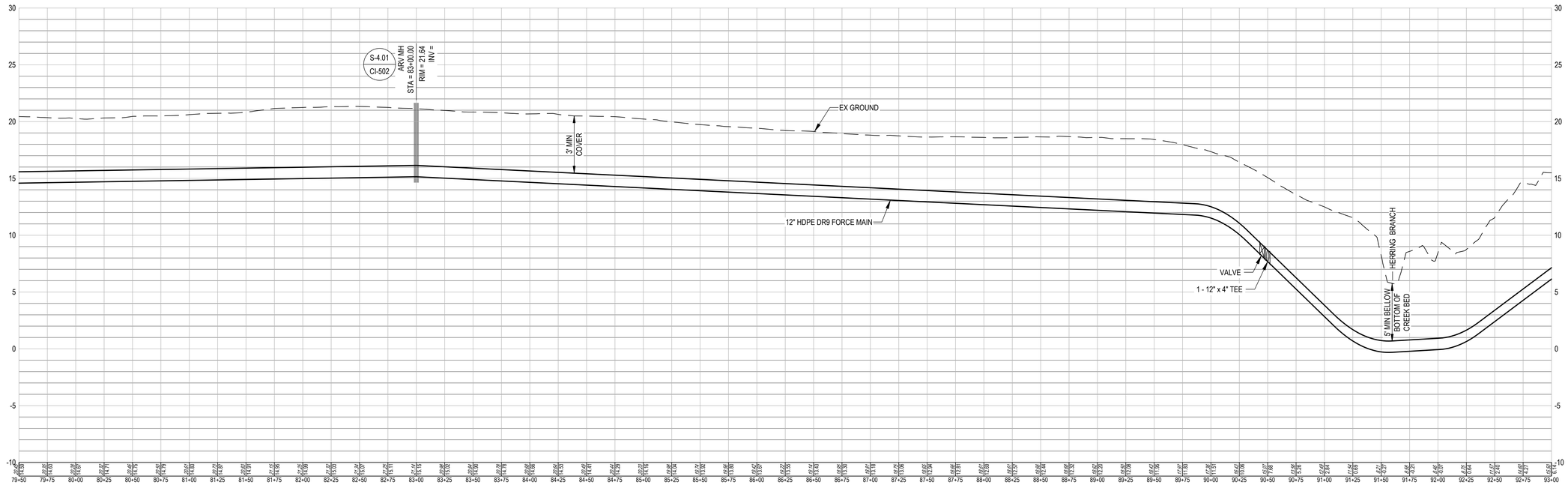
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-0206.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 79+50 TO 93+00**

Size **ANSI D**

Sheet No. **CI-207**

Plot Date: 26 August 2025 - 3:52 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D207.dwg

33
433-2.00-2.00
RONALD L CULVER &
MELISSA A CULVER

31
433-2.00-1.00
CHARLES P TOWNSEND JR.

32
433-2.00-7.02
ROSS E & BEVERLY S LAYTON

MATCHLINE STA:93+00
FOR CONTINUATION SEE SHEET CI-207

MATCHLINE STA:107+00
FOR CONTINUATION SEE SHEET CI-209

10' LANE WIDTH

10' LANE WIDTH

ROAD R/W
54' (APPROX.)

LIMITS OF PAVEMENT DISTURBANCE

12" HDPE DR9 FORCE MAIN
WITH 20" STEEL CASING
INSTALLED VIA OPEN CUT METHODS

S-3.03
CI-501

STA:93+84.01
12" 22.5° BEND

STA:93+71.23
12" 22.5° BEND

STA:94+24.86
1 - 12" 11.25° BEND
1 - 12" GATE VALVE
1 - 12" x 6" TEE
1 - 6" GATE VALVE
1 - 6" CAP

10' WIDE UTILITY EASEMENT

20' WIDE TEMPORARY CONSTRUCTION EASEMENT

12" HDPE DR9 FORCE MAIN
INSTALLED VIA OPEN CUT METHODS

150' DP&L TRANSMISSION LINE R.O.W.

STABILIZED CONSTRUCTION ENTRANCE

TOWNSENDS ROAD

EX. EDGE OF HOTMIX

EX. PATH

EX. CONC. PAD

EX. BARN

EX. HOUSE

93+00 95+00 96+50 97+50 98+50 100+00 101+50 102+50 104+00 105+50 107+00

PLAN

SCALE 1" = 50'

0 50' 100'

ROAD R/W
(APPROX.)

TOWNSENDS ROAD

22.5° H BEND

22.5° H BEND

11.25° H BEND

EX GROUND

COVER
3' MIN

1 - 12" x 6" TEE

VALVE

20" STEEL CASING
TO EXTEND 5' BEYOND
EDGE OF PAVEMENT

S-3.03
CI-501

12" HDPE DR9 FORCE MAIN

30 25 20 15 10 5 0 -5 -10

93+00 93+25 93+50 93+75 94+00 94+25 94+50 94+75 95+00 95+25 95+50 95+75 96+00 96+25 96+50 96+75 97+00 97+25 97+50 97+75 98+00 98+25 98+50 98+75 99+00 99+25 99+50 99+75 100+00 100+25 100+50 100+75 101+00 101+25 101+50 101+75 102+00 102+25 102+50 102+75 103+00 103+25 103+50 103+75 104+00 104+25 104+50 104+75 105+00 105+25 105+50 105+75 106+00 106+25 106+50 106+75 107+00

PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

A	FOR AGENCY REVIEW	TG	PD	2025-08-06
No.	Issue	Checked	Approved	Date

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 93+00 TO 107+00**

Size **ANSI D**

Sheet No. **CI-208**

Plot Date: 26 August 2025 - 3:53 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D208.dwg

MATCHLINE STA 107+00
FOR CONTINUATION SEE SHEET CI-208

MATCHLINE STA 121+00
FOR CONTINUATION SEE SHEET CI-210

12" HDPE DR9 FORCE MAIN
INSTALLED VIA OPEN CUT METHODS

10' WIDE UTILITY EASEMENT

20' WIDE TEMPORARY CONSTRUCTION EASEMENT

31
433-2.00-1.00
CHARLES P TOWNSEND JR.

150' DP&L TRANSMISSION LINE R.O.W.

STA:108+50.00
ARV MH
S-4.01
CI-502

PLAN

SCALE 1" = 50'

0 50' 100'

EX GROUND

3' MIN COVER

12" HDPE DR9 FORCE MAIN

S-4.01
CI-502
ARV MH
STA = 108+50.00
RIM = 21.80
INV = 14.61

PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Author	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD		2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

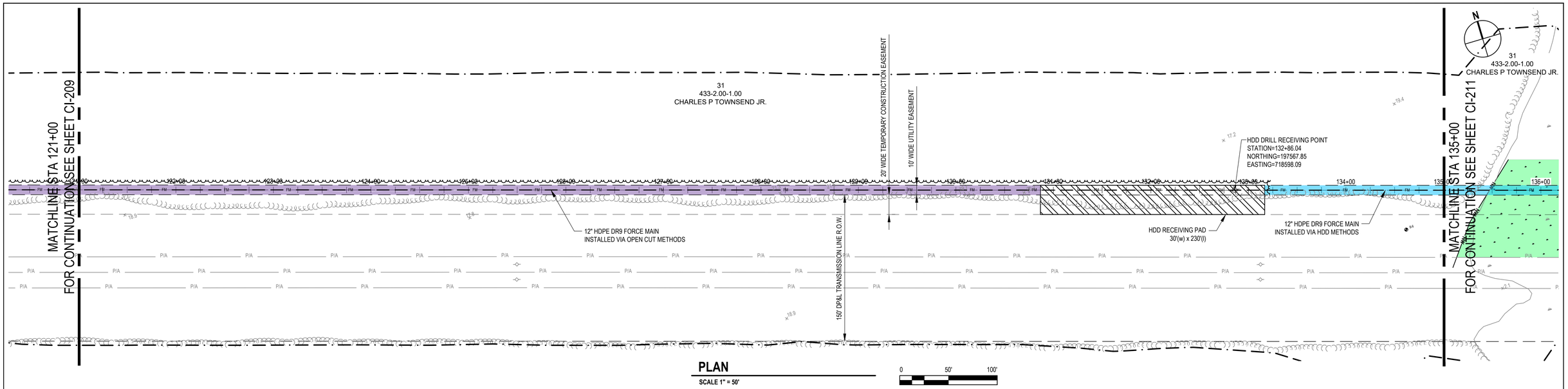
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 107+00 TO 121+00**

Size **ANSI D**

Sheet No. **CI-209**

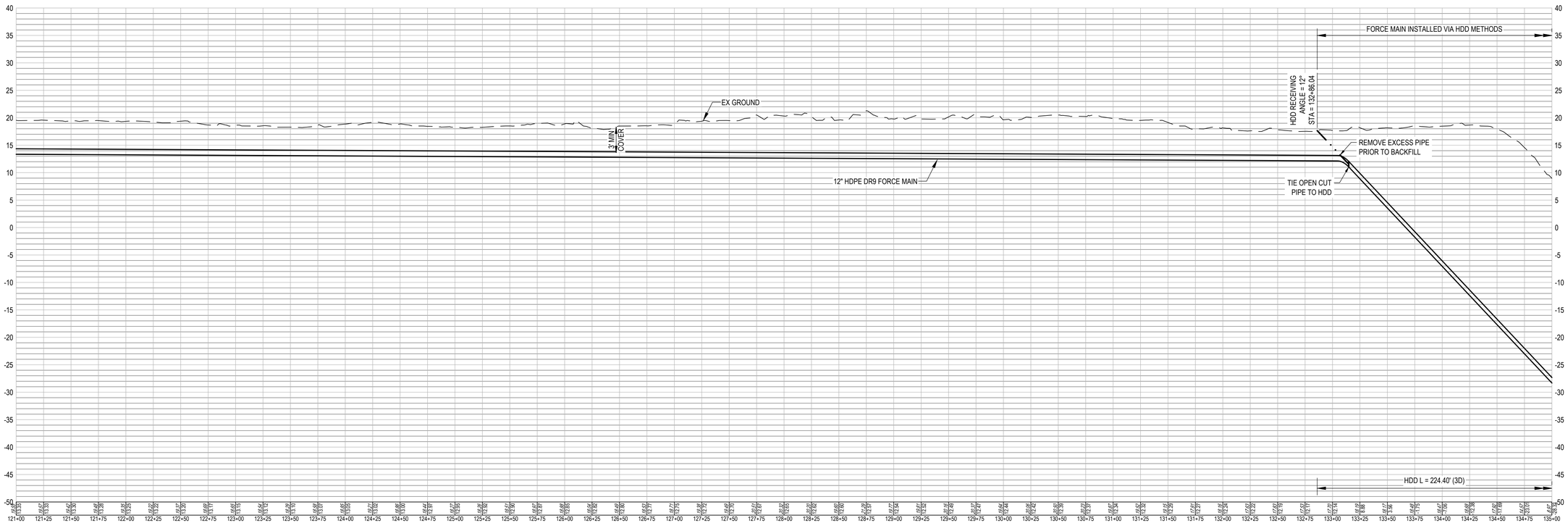
Plot Date: 26 August 2025 - 3:53 PM Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-0209.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

No.	Issue	Drawn	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD		2025-08-06

Author **TG**	Drafting Check **PD**	Project Manager **PD**	
Designer **CM**	Design Check **PD**	Project Director **BG**	

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY DELAWARE 1869

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261**

Date **MM/DD/YYYY**

Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 121+00 TO 135+00**

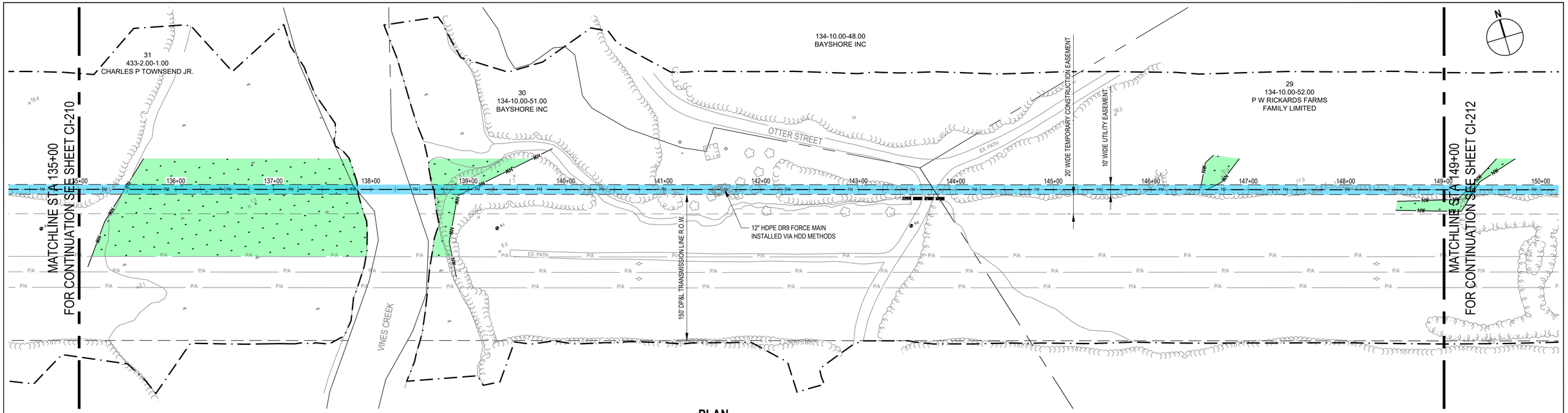
Size **ANSI D**

Sheet No. **CI-210**

Plot Date: 26 August 2025 - 3:53 PM

Plotted By: Trevor Germsheid

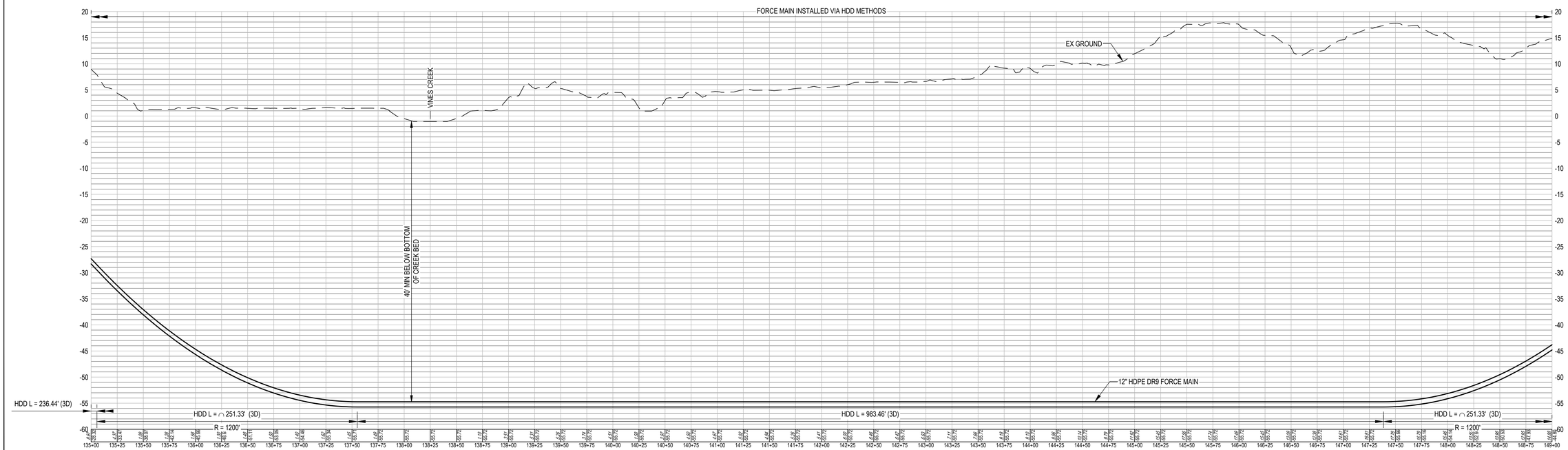
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D210.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

No.	Issue	Author	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD		2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY DELAWARE 1683

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

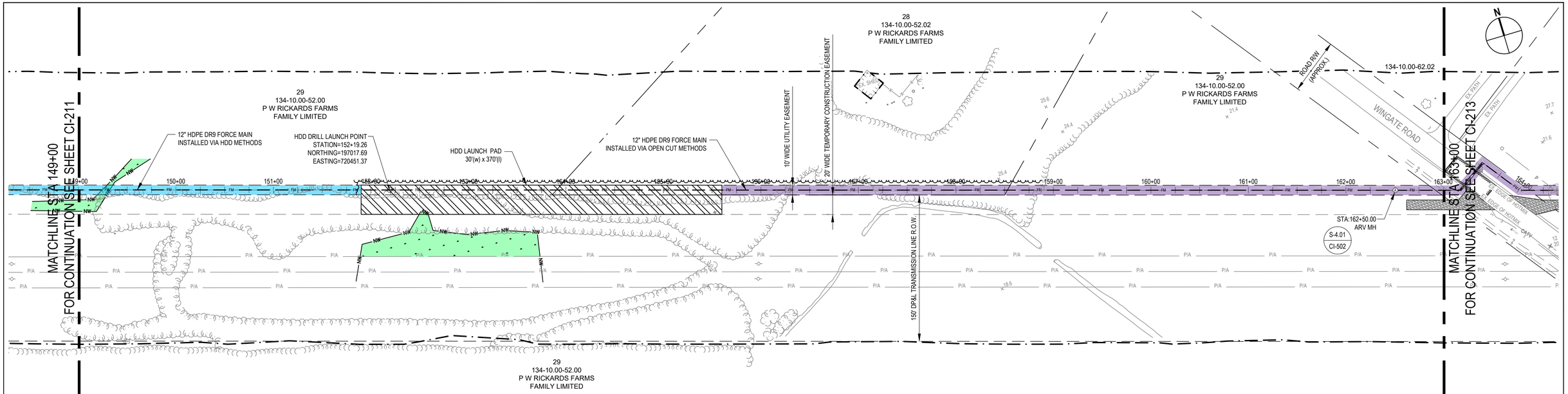
Title **PLAN AND PROFILE STATION 135+00 TO 149+00**

Size **ANSI D**

Sheet No. **CI-211**

Plot Date: 26 August 2025 - 3:54 PM Plotted By: Trevor Germsheid

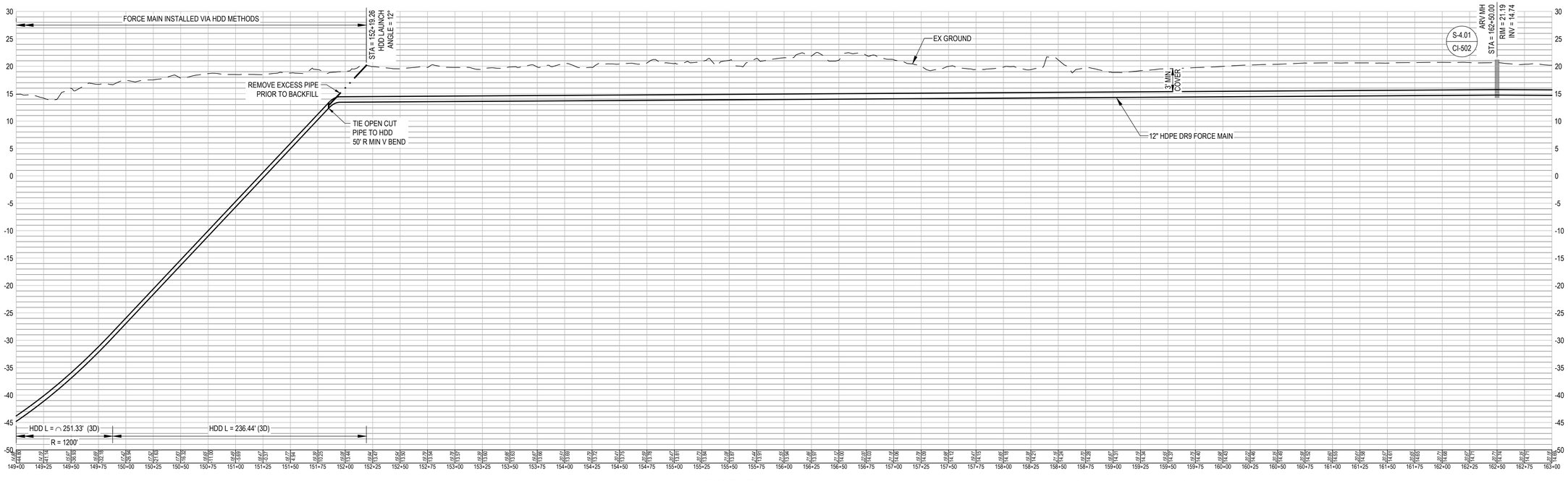
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D211.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Title **PLAN AND PROFILE STATION 149+00 TO 163+00**

Size **ANSI D**

Project No. **12644261**

Date **MM/DD/YYYY**

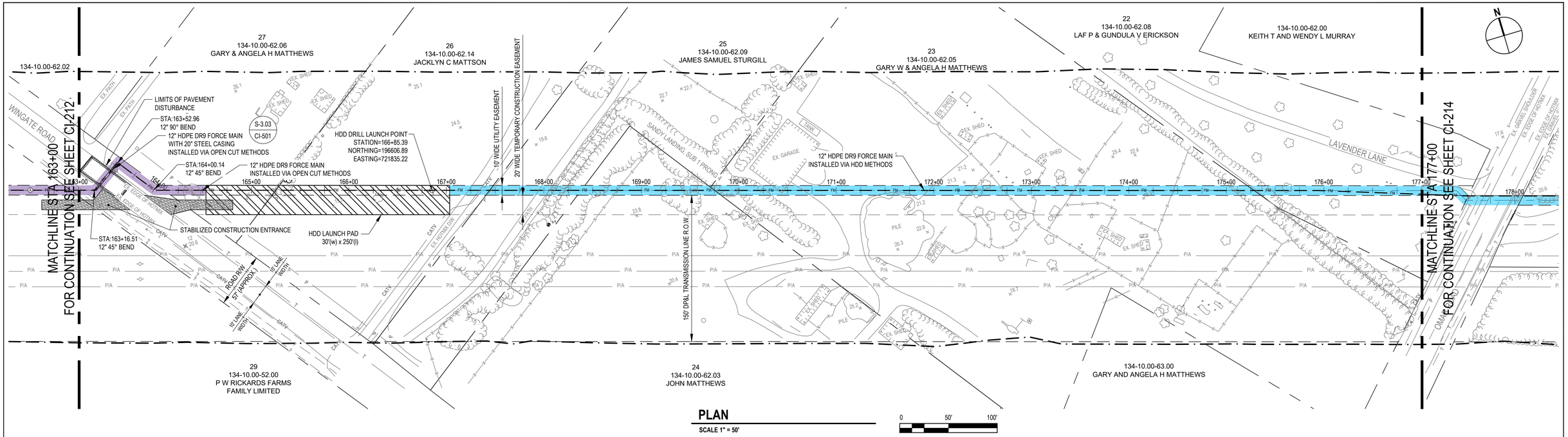
Scale **AS SHOWN**

Sheet No. **CI-212**

Plot Date: 26 August 2025 - 3:54 PM

Plotted By: Trevor Germsheid

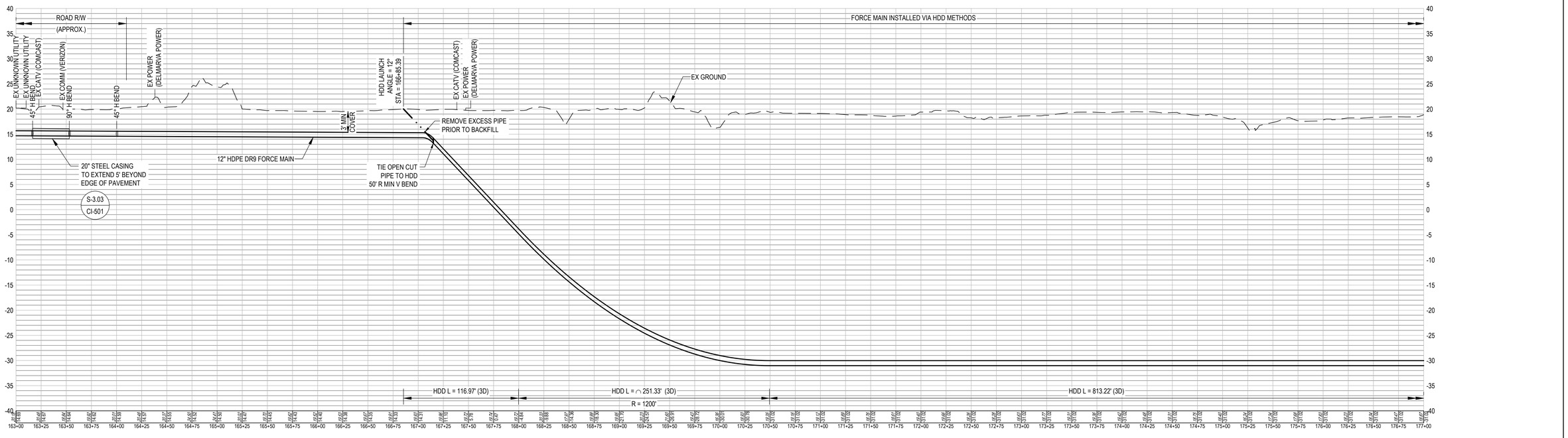
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D212.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

A	FOR AGENCY REVIEW	TG	PD	2025-08-06
No.	Issue	Checked	Approved	Date

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY, DELAWARE

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 163+00 177+00**

Size **ANSI D**

Sheet No. **CI-213**

Plot Date: 26 August 2025 - 3:55 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D213.dwg

MURRAY

MATCHLINE STA 177+00
FOR CONTINUATION SEE SHEET CI-213

MATCHLINE STA 191+00
FOR CONTINUATION SEE SHEET CI-215

134-10.00-88.01
WERNER, WILLIAM M AND
ANITA WEST-WERNER

20
134-10.00-88.00
WERNER, WILLIAM M AND
ANITA WEST-WERNER

19
134-10.00-92.00
ERNESTINE HALL

21
134-10.00-62.10
PFAB HANS

18
134-10.00-93.00
WILLIAM E MILLER

17
134-10.00-94.01
DEAN FENWICK AND
TERESSA LYNN DISHAROON

16
134-10.00-94.02
DEAN FENWICK AND
TERESSA LYNN DISHAROON

LAVENDER LANE

OMAR ROAD

ROAD R/W
51' (APPROX.)

10' SHOULDER WIDTH

10' LANE WIDTH

12' SHOULDER WIDTH

10' LANE WIDTH

EX. GRAVEL SHOULDER

EX. EDGE OF PAVEMENT

EX. GRAVEL SHOULDER

EX. DITCH

EX. GARAGE

EX. DIRT LOT

12" HDPE DR9 FORCE MAIN
INSTALLED VIA HDD METHODS

HDD DRILL RECEIVING POINT
STATION=182+14.39
NORTHING=196174.12
EASTING=723293.06

HDD RECEIVING PAD
30'(w) x 230'(l)

12" HDPE DR9 FORCE MAIN
INSTALLED VIA OPEN CUT METHODS

10' WIDE UTILITY EASEMENT

20' WIDE TEMPORARY CONSTRUCTION EASEMENT

150' DP&L TRANSMISSION LINE R.O.W.

P/A

FM

177+00 178+00 179+00 180+00 181+00 182+00 183+00 184+00 185+00 186+00 187+00 188+00 189+00 190+00 191+00

PLAN

SCALE 1" = 50'

0 50' 100'

NOTES:
1. PROPERTY 20 TO HAVE A 6" VALVE CONNECTION INSTALLED ON THE MAIN LINE. COORDINATE IN THE FIELD WITH PROPERTY OWNER FOR EXACT LOCATION.

ROAD R/W
(APPROX.)

FORCE MAIN INSTALLED VIA HDD METHODS

EX CATV (COMCAST)
EX POWER (DEC)
OMAR ROAD
EX COMM (VERIZON)
EX UNKNOWN UTILITY

STA = 182+14.39
HDD RECEIVING
ANGLE = 12°

EX GROUND

3' MIN COVER

REMOVE EXCESS PIPE
PRIOR TO BACKFILL

TIE OPEN CUT
PIPE TO HDD
50' R MIN V BEND

12" HDPE DR9 FORCE MAIN

HDD L = 813.22' (3D)

HDD L = ∩ 251.33' (3D)
R = 1200'

HDD L = 104.67' (3D)

40 35 30 25 20 15 10 5 0 -5 -10 -15 -20 -25 -30 -35 -40

177+00 177+25 177+50 177+75 178+00 178+25 178+50 178+75 179+00 179+25 179+50 179+75 180+00 180+25 180+50 180+75 181+00 181+25 181+50 181+75 182+00 182+25 182+50 182+75 183+00 183+25 183+50 183+75 184+00 184+25 184+50 184+75 185+00 185+25 185+50 185+75 186+00 186+25 186+50 186+75 187+00 187+25 187+50 187+75 188+00 188+25 188+50 188+75 189+00 189+25 189+50 189+75 190+00 190+25 190+50 190+75 191+00

PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
Author	TG	Drafting Check	PD	Project Manager	PD
Designer	CM	Design Check	PD	Project Director	BG

Bar is one inch on original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN
LICENSE
No. 30151
DELAWARE
PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY, DELAWARE

Client: SUSSEX COUNTY, DELAWARE

Project: PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

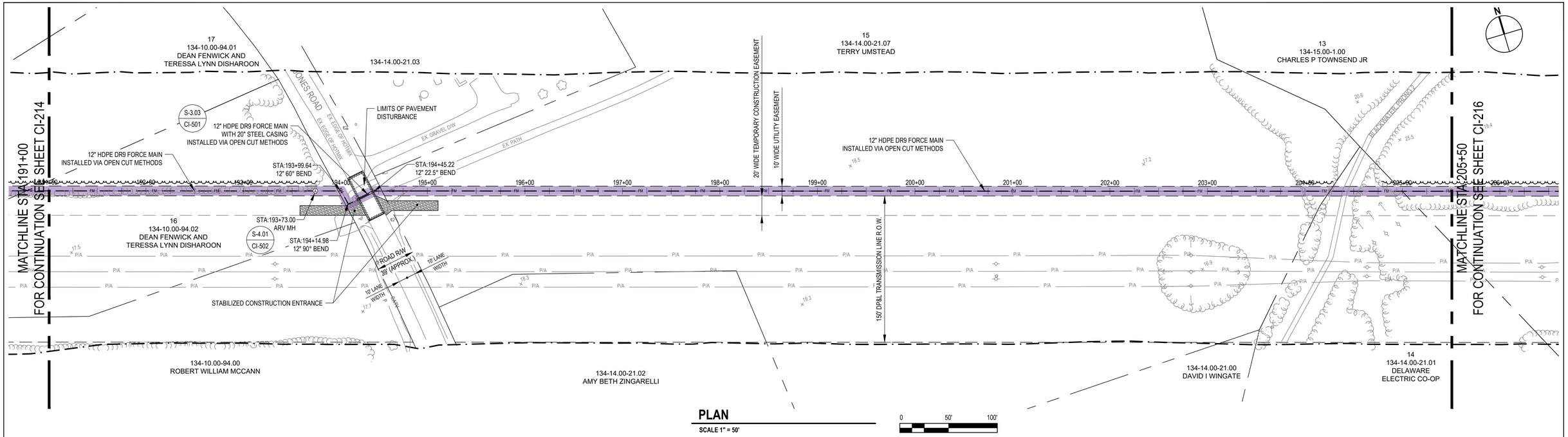
Title: PLAN AND PROFILE
STATION 177+00 TO 191+00

Size: ANSI D

Project No.	Date	Scale
12644261	MM/DD/YYYY	AS SHOWN

Sheet No. CI-214

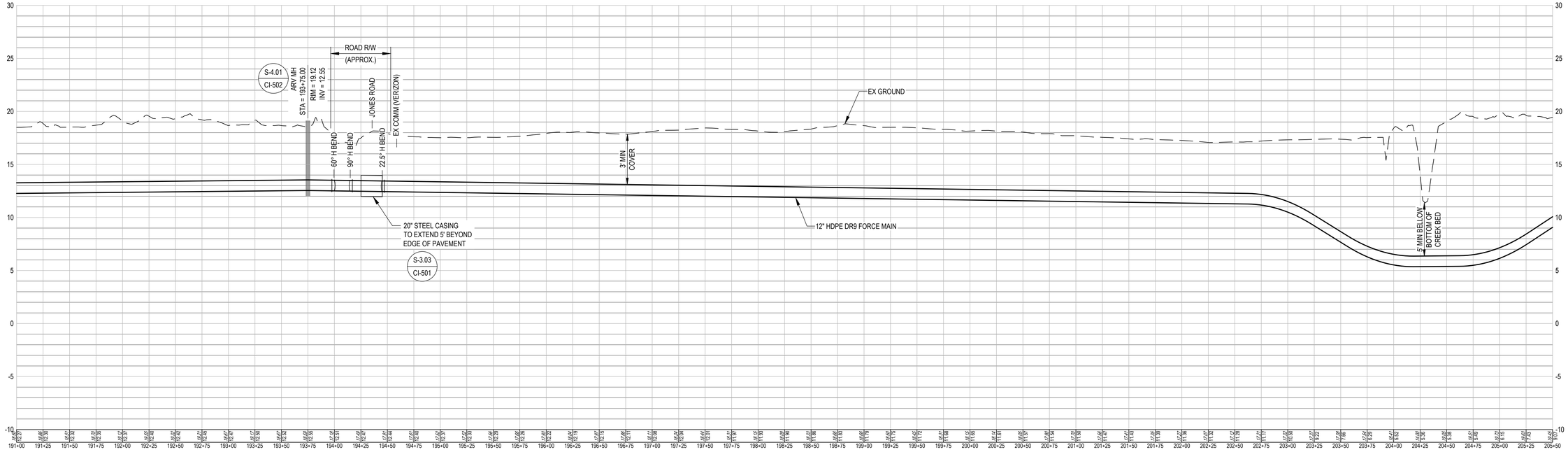
Plot Date: 26 August 2025 - 3:55 PM
Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D214.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

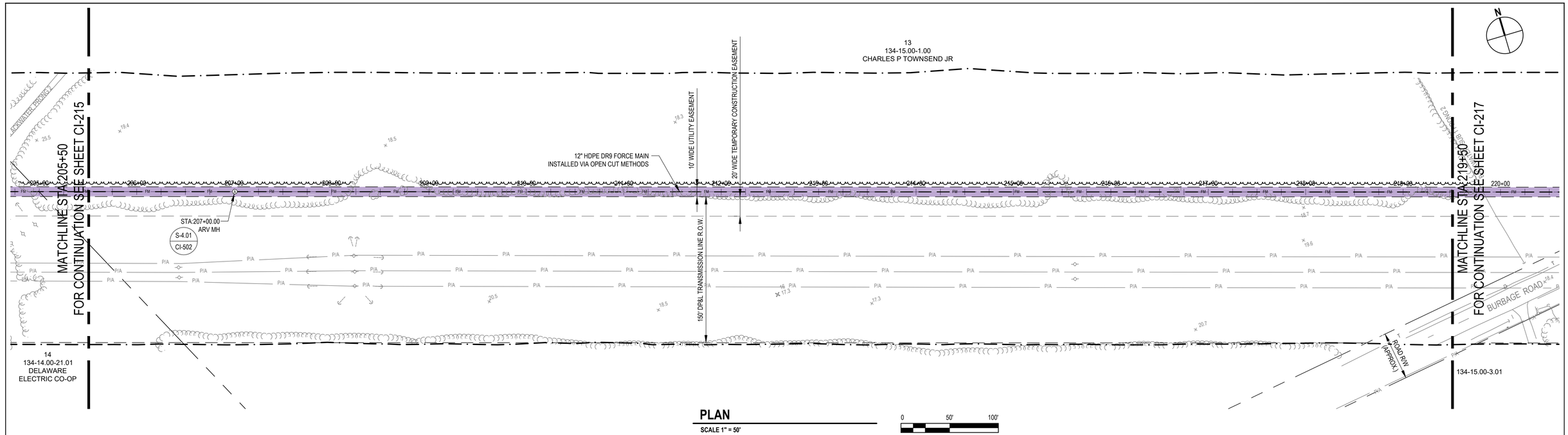
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 191+00 TO 205+50**

Size **ANSI D**

Sheet No. **CI-215**

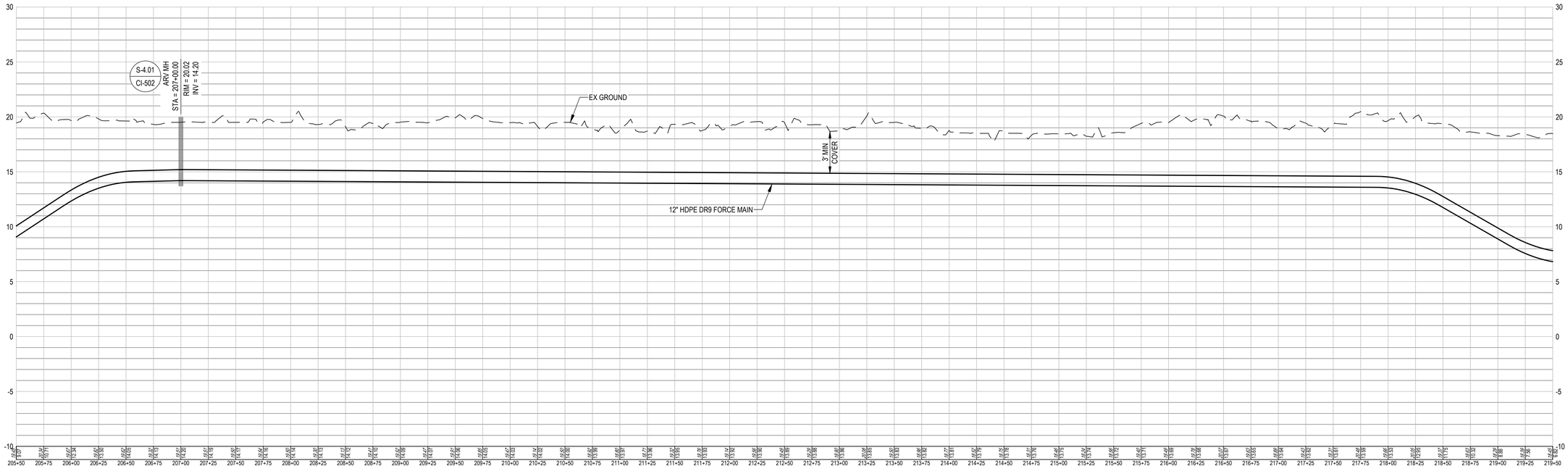
Plot Date: 26 August 2025 - 3:55 PM Plotted By: Trevor Germsheid Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D215.dwg



PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

A	FOR AGENCY REVIEW	TG	PD	2025-08-06
No.	Issue	Checked	Approved	Date

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

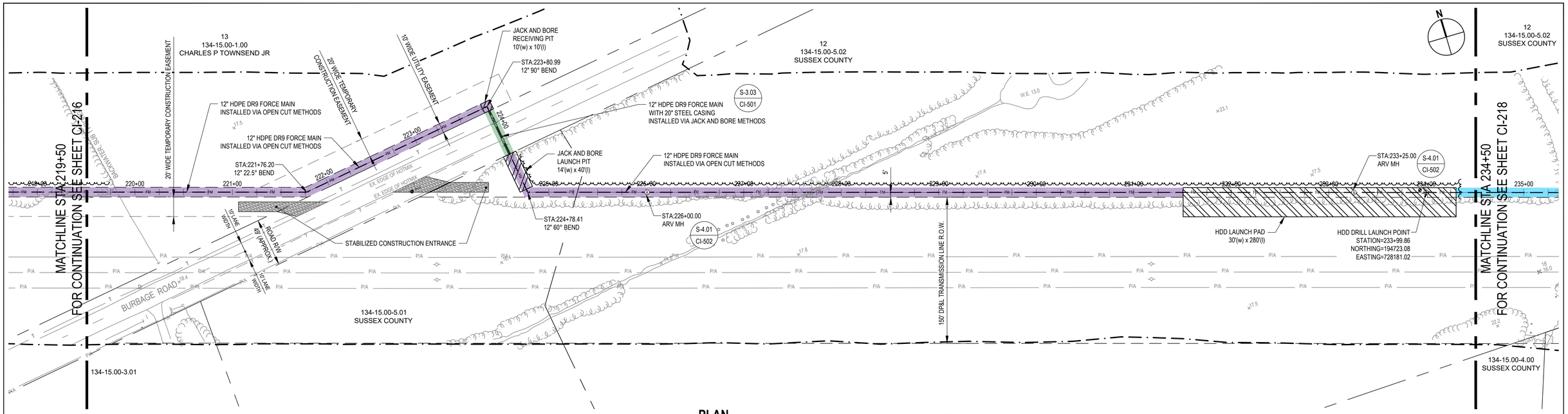
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 205+50 TO 219+50**

Size **ANSI D**

Sheet No. **CI-216**

Plot Date: 26 August 2025 - 3:56 PM Plotted By: Trevor Germsheid Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D216.dwg



No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY DELAWARE 1789

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Title **PLAN AND PROFILE STATION 219+50 TO 234+50**

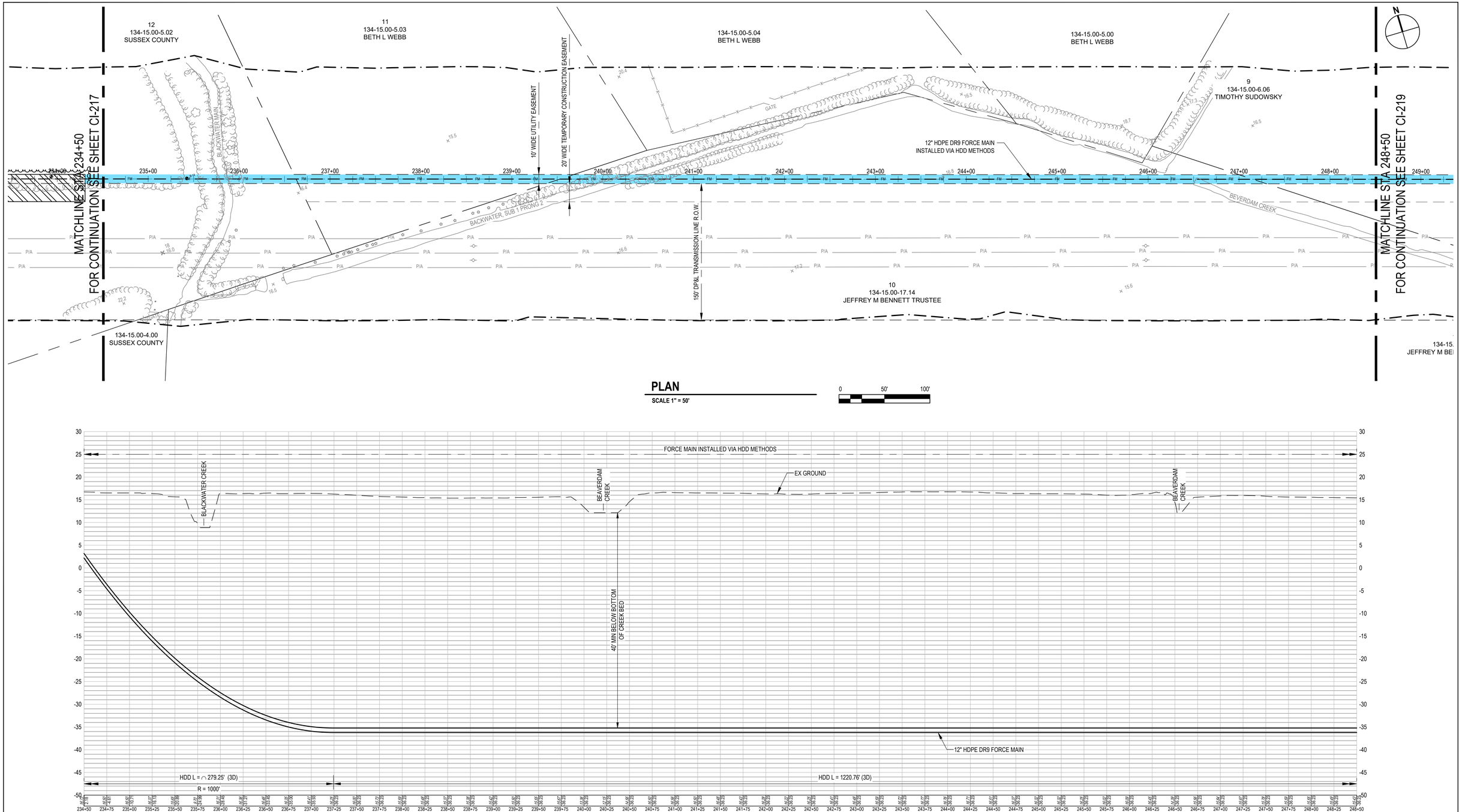
Size **ANSI D**

Project No.	Date	Scale
12644261	**MM/DD/YYYY**	**AS SHOWN**

Sheet No. **CI-217**

Plot Date: 26 August 2025 - 3:57 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D217.dwg



PLAN

SCALE 1" = 50'

0 50' 100'

PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

Bar is one inch on original size sheet

0 1"

Conditions of Use

This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

No.	Issue	Author	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD		2025-08-06

Author TG Drafting Check PD Project Manager PD
Designer CM Design Check PD Project Director BG

Client SUSSEX COUNTY, DELAWARE

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. 12644261 Date MM/DD/YYYY Scale AS SHOWN

Title PLAN AND PROFILE STATION 234+50 TO 248+50

Size ANSI D

Sheet No. CI-218

Plot Date: 26 August 2025 - 3:57 PM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D218.dwg

MATCHLINE STA 248+50
FOR CONTINUATION SEE SHEET CI-218

MATCHLINE STA 262+50
FOR CONTINUATION SEE SHEET CI-220

9
134-15.00-6.06
TIMOTHY SUDOWSKY

10
134-15.00-17.14
JEFFREY M BENNETT TRUSTEE

8
134-15.00-7.00
SHARON DAVIS, CAMERON POWELL AND
RIGHARD POWELL JR.

HDD DRILL RECEIVING POINT
STATION=253+14.74
NORTHING=194178.14
EASTING=730016.73

12" HDPE DR9 FORCE MAIN
INSTALLED VIA OPEN CUT METHODS

12" HDPE DR9 FORCE MAIN
INSTALLED VIA HDD METHODS

HDD RECEIVING PAD
30'(w) x 230'(l)

10' WIDE UTILITY EASEMENT

20' WIDE TEMPORARY CONSTRUCTION EASEMENT

150' DP&L TRANSMISSION LINE R.O.W.

EX. GARAGE
EX. SHED
EX. SHED
EX. SHED
CHIRPING BIRDS LN
EX. GRAVEL
EX. CONC. PAD
EX. GARAGE

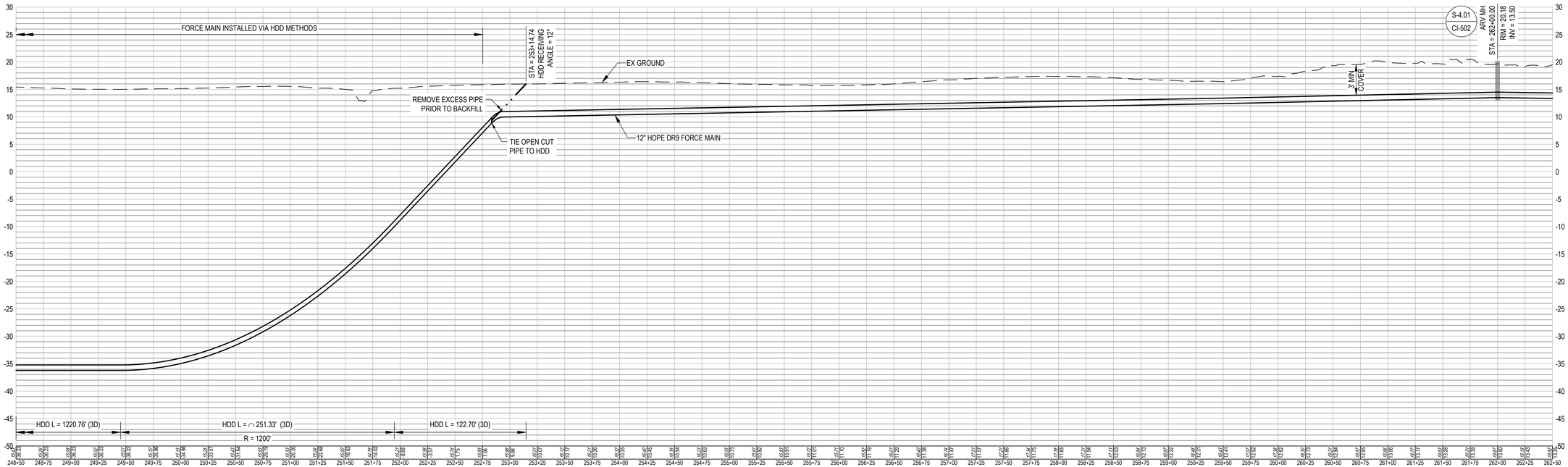
STA:262+00.00
ARV MH
S-4.01
CI-502

PLAN

SCALE 1" = 50'

0 50' 100'

NOTES:
1. PROPERTY 9 TO HAVE A 6" VALVE CONNECTION INSTALLED ON THE MAIN LINE. COORDINATE IN THE FIELD WITH PROPERTY OWNER FOR EXACT LOCATION.



PROFILE

SCALE H:1" = 50' V: 1" = 10'

H: 0 50' 100' V: 0 10' 20'

No.	Issue	Drafting Check	Checked	Approved	Date
A	FOR AGENCY REVIEW		TG	PD	2025-08-06
Author	TG	PD	Project Manager	PD	
Designer	CM	PD	Project Director	BG	

Bar is one inch on original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY
GHD
GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client SUSSEX COUNTY, DELAWARE

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. 12644261 | Date MM/DD/YYYY | Scale AS SHOWN

Title PLAN AND PROFILE STATION 248+50 TO 262+50

Size ANSI D

Sheet No. CI-219

Plot Date: 26 August 2025 - 3:58 PM
Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D219.dwg

6
134-15.00-7.12
SHARON DAVIS, CAMERON POWELL AND
RIGHARD POWELL JR.

5
134-15.00-19.02
JAMES R & JUDY R POWELL

7
134-15.00-7.11
SHARON DAVIS, CAMERON POWELL AND
RIGHARD POWELL JR.

MATCHLINE STA 262+50
FOR CONTINUATION SEE SHEET CI-219

MATCHLINE STA 276+50
FOR CONTINUATION SEE SHEET CI-221

HDD DRILL RECEIVING POINT
STATION=266+85.83
NORTHING=193787.95
EASTING=731331.12

12" HDPE DR9 FORCE MAIN
INSTALLED VIA OPEN CUT METHODS

HDD RECEIVING PAD
30'(w) x 230'(l)

12" HDPE DR9 FORCE MAIN
INSTALLED VIA HDD METHODS

10' WIDE UTILITY EASEMENT

20' WIDE TEMPORARY CONSTRUCTION EASEMENT

150' DP&L TRANSMISSION LINE R.O.W.

GRANVILLE LANE

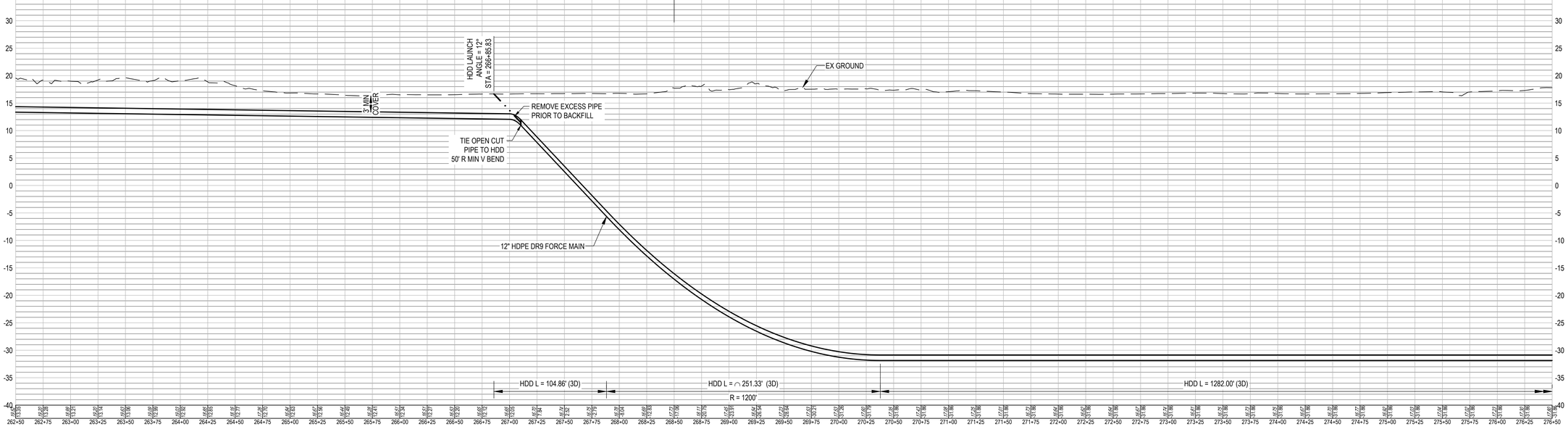
ROAD R/W
(APPROX.)

EX. GARAGE
EX. SHED
EX. PATH
EX. EDGE OF HOTMIX
EX. GRAVEL
TANK
GATE
PILE
RUINS
P/A
FM

PLAN

SCALE 1" = 50'

0 50' 100'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**
Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet
0 1"

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN LICENSE No. 30151 DELAWARE PROFESSIONAL ENGINEER

GARNEY
GHD
GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

SEAL OF SUSSEX COUNTY, DELAWARE

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

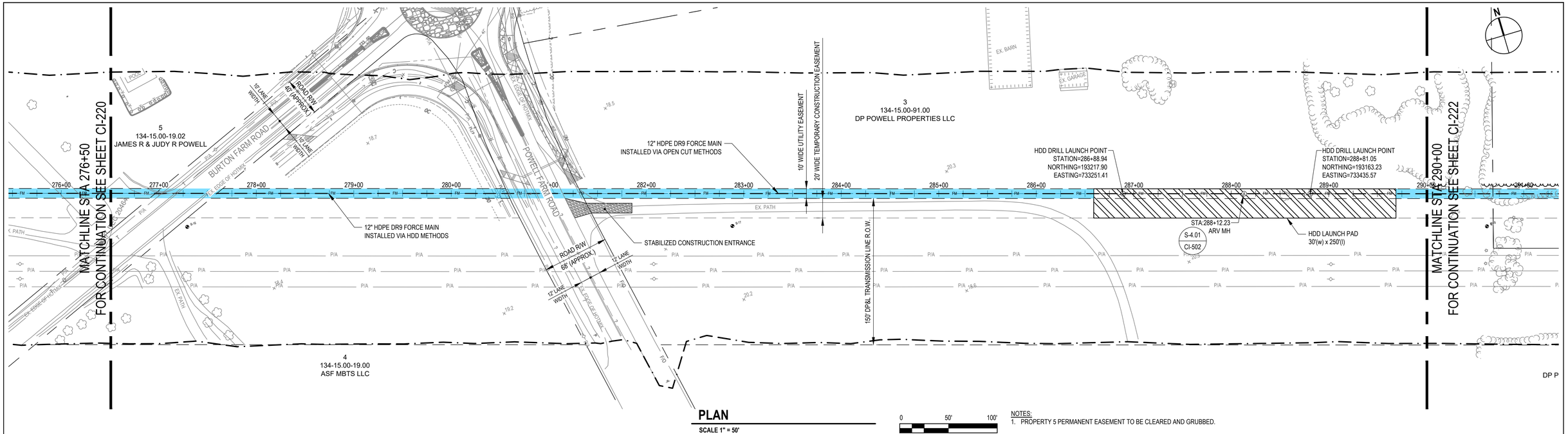
Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

Title **PLAN AND PROFILE STATION 262+50 TO 276+50**

Size **ANSI D**

Sheet No. **CI-220**

Plot Date: 27 August 2025 - 10:19 AM Plotted By: Trevor Germsheid
Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D220.dwg

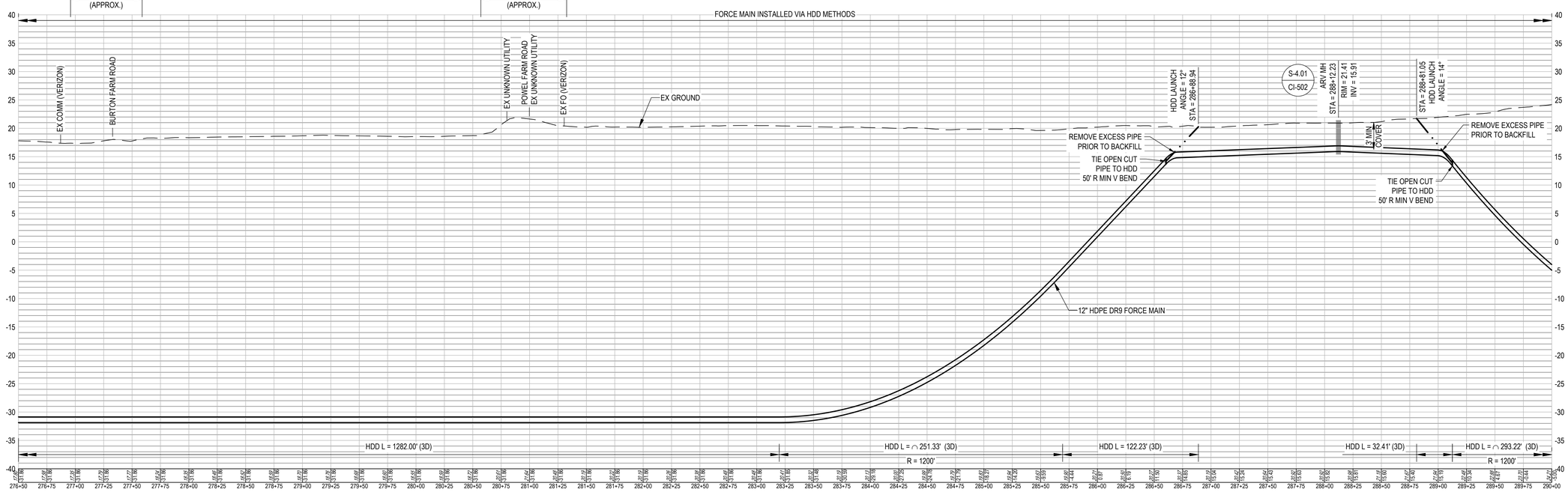


PLAN

SCALE 1" = 50'

0 50' 100'

NOTES:
1. PROPERTY 5 PERMANENT EASEMENT TO BE CLEARED AND GRUBBED.



PROFILE

SCALE H:1" = 50' V: 1" = 5'

H: 0 50' 100' V: 0 5' 10'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author **TG** Drafting Check **PD** Project Manager **PD**

Designer **CM** Design Check **PD** Project Director **BG**

Bar is one inch on original size sheet

0 1"

PHILLIP PAUL DIECKMANN LICENSE No. 30151 PROFESSIONAL ENGINEER DELAWARE

GARNEY

GHD

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client **SUSSEX COUNTY, DELAWARE**

Project PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Title **PLAN AND PROFILE STATION 276+50 TO 290+00**

Size **ANSI D**

Project No. **12644261** Date **MM/DD/YYYY** Scale **AS SHOWN**

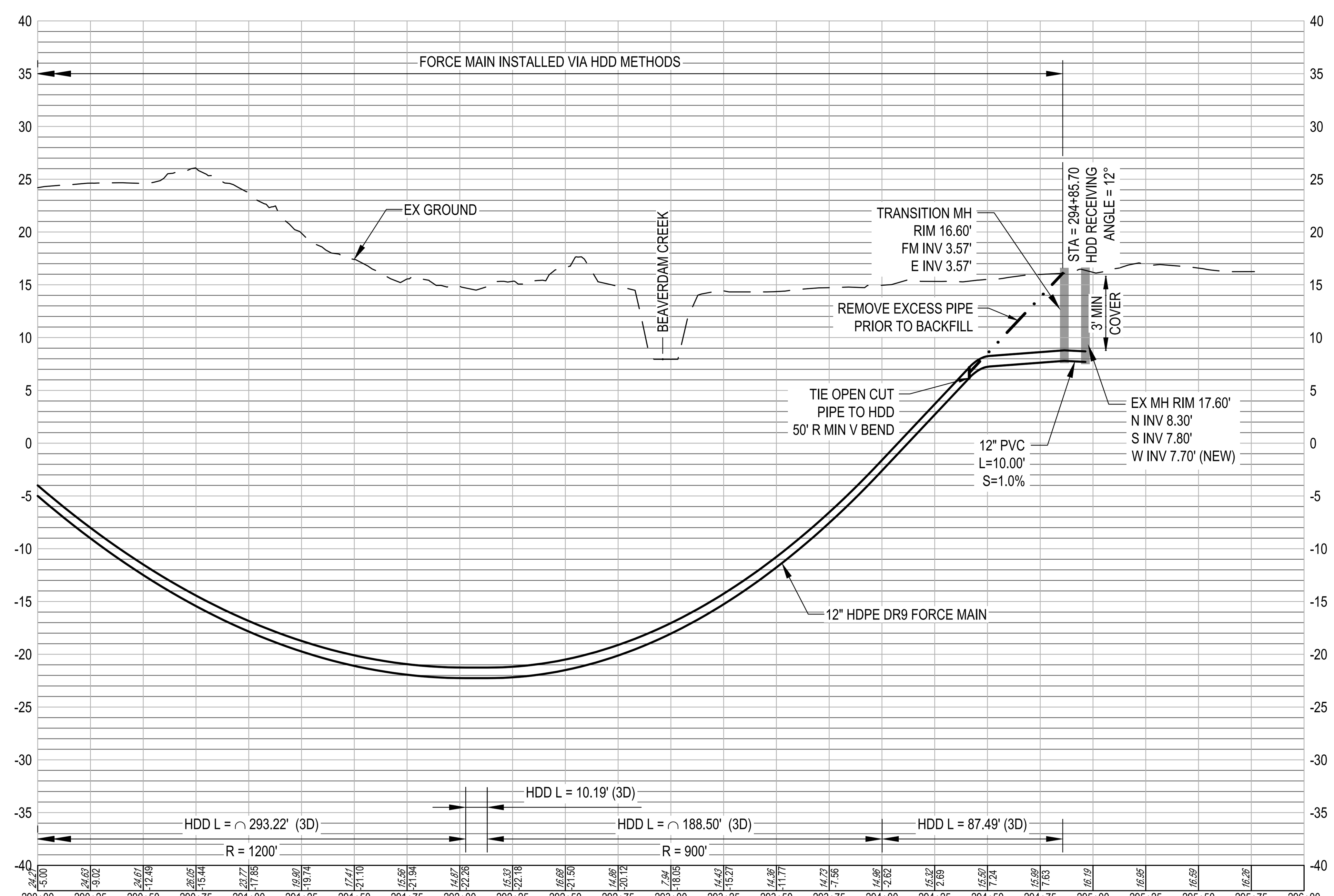
Sheet No. **CI-221**

Plot Date: 27 August 2025 - 10:18 AM Plotted By: Trevor Germsheid

Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D221.dwg

PLAN

SCALE 1" = 50'



PROFILE

SCALE H:1" = 50' V: 1" = 5'

No.	Issue	Checked	Approved	Date
A	FOR AGENCY REVIEW	TG	PD	2025-08-06

Author TG — Drafting Check PD — Project Manager PD
Designer CM — Design Check PD — Project Director BG

Bar is one inch on original size sheet

Conditions of Use
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

PHILLIP PAUL DIECKMANN — LICENSE No. 30151 — DELAWARE — PROFESSIONAL ENGINEER

GARNEY

GHD Inc.
16701 Melford Boulevard Suite 221
Bowie Maryland 20715 USA
T 240 206 6810

Client: **SUSSEX COUNTY, DELAWARE**

Project: PROGRESSIVE DESIGN-BUILD PROJECT FOR PINEY NECK WASTEWATER FACILITY DIVERSION TRANSMISSION SYSTEM

Project No. 12644261 — Date MM/DD/YYYY — Scale AS SHOWN

Title: **PLAN AND PROFILE STATION 290+00 TO 295+08.03**

Size ANSI D

Sheet No. CI-222

Plot Date: 27 August 2025 - 10:19 AM — Plotted By: Trevor Germsheid — Path and Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\12644261-Garney Co Piney Neck FM\Project Files\01 WIP\Civil\Sheets\12644261-GHD-00-00-DGN-CI-D222.dwg

Garney Co Piney Neck FM Design-Build	08/19/25	12644261
Project	Date	Job No.
Proposed Minimum Velocity in Force Main	M. McClinchie	P. Dieckmann
Title	Comp. By	Checked By

Pump Operation:

Objectives: To establish the design parameter for the new Piney Neck FM system

Approach: Two existing 10" force mains are poropsoed to be combined and teed into the a new 12" force main. Each 10" force main requires a minimum velocity of 2 ft/s, which corresponds to a minimum flow rate of 490 gpm. Combined, this results in a minimum flow of 980 gpm entering the 12" force main. When converted to velocity, this flow equates to apprroximately 2.78 ft/s, which meets the minimum velocity requirement for a 12" force main.

10" Force Main

Minimum Velocity	=	**2.00**	**ft/s**
Diameter	=	10.00	in
Diameter	=	0.83	ft
Minimum Flow	=	**490**	**gpm**

12" Force Main

Minimum Flow	=	**979**	**gpm**	Two 10" force mains at minimum velocity
Diameter	=	12.00	in	
Diameter	=	1.00	ft	
Minimum Velocity	=	**2.78**	**ft/s**	