SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes all excavating, placing, filling, backfilling, compacting and grading at the site shown on the drawings and specified herein, including the following;
   1. Provide horizontal and vertical construction staking.
   2. Provide excavation, rough grading, subgrade preparation, filling, backfilling, compaction, import of borrow material and disposal of spoil material as shown on the drawings to meet lines and grades specified herein, or as specified to complete the work. Legally haul and dispose of all spoil material.
   3. Material excavated shall be defined as “unclassified excavation” and shall include all excavation performed under this item regardless of the material encountered, except for contaminated material requiring special handling and disposal.

B. Related Requirements:
   1. Section 312333: Trenching and Backfilling
   2. Section 033000: Cast-in-Place Concrete.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1.03 DEFINITIONS

A. Unauthorized Excavation: The term "unauthorized excavation", as used herein, consists of inadvertently or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of Contracting Officer. Unauthorized excavation as well as remedial work resulting from unauthorized excavation, as directed by Contracting Officer, shall be at Contractor’s expense.
   1. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Contracting Officer.
   2. Unauthorized excavation, including deposition of additional excavated materials and other work resulting from slides, cave-ins or remedial work, shall be at Contractor’s expense.

B. Subgrade: The term "subgrade", as used herein, designates the undisturbed earth or the compacted soil layer immediately below proposed foundations, slabs, or base course.

C. Structure: The term "structure," as used herein, refers to buildings, retaining walls, manholes, or other manmade stationary features occurring above or below ground surface.

D. Unclassified Excavation: The term “unclassified excavation,” as used herein, includes the excavation of all materials required for the work within construction limits of project, including bedrock, boulders, wasted sections of concrete, asphalt or other debris. This item also includes subsequent disposal or placement of materials removed.

E. Fill: The term "fill," as used herein, includes on-site materials or borrow materials placed in order to raise the grade above existing contours.

F. Backfill: The term "backfill," as used herein, includes on-site materials or borrow materials placed in authorized or unauthorized excavations.

G. Foundations: The term "foundations," as used herein, refers to footings, foundation walls and any other support placed on soil.

H. Topsoil: The term "topsoil," as used herein, refers to surface soil that support growth of vegetation and contains organic matter. Topsoil shall be free from subsoil, debris, and stone larger than 1- inch in diameter.

1.04 SUBMITTALS

A. Certificates and Testing for the following:
   1. In-place density tests for compacted subgrade material, fill, and backfill used.
   2. Subgrade soil inspection results.

3. Independent laboratory analysis of any material proposed for use as fill or backfill. Report shall include optimum moisture content and maximum density of all materials to be compacted, according to ASTM D698

1.05 QUALITY ASSURANCE

A. Codes and Standards: Comply with all applicable local, state and Federal rules, regulations and ordinances concerning sloping of excavation, trenching and safety of workers, including the latest OSHA requirements.

B. Testing and Inspection Service: The Contractor shall employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations; Contractor shall provide necessary means to assure cooperation with testing firm.

1. Meet the quality control and quality assurance testing requirements of Division 1.
2. In-place field density tests shall meet AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938), Nuclear Densometer Methods.
3. Field density testing frequency shall be as follows:
   a. Subgrade below building foundation and base course for new slabs and site pavement areas: One test every 1,000 square feet per lift.
   b. Backfill/fill at building exterior and site fill: One test at each lift every 1,000 square feet.

C. Verify that finished grade and slopes are within 0.1 ft. of grades indicated. Any conditions indicating a failure must be corrected, including, but not limited to:

1. Formation of pools of moisture where positive drainage is indicated on the drawings.
2. Settlement of fill.
3. Flow of moisture toward, or entrapment against, building foundations.

1.06 PROJECT CONDITIONS

A. Site Information: Test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration. Obtain Contracting Officer's approval of test site and return area to original condition.

B. Borrow Sources: Any off-site fill used in the construction of the facility must be weed free.

C. Heavy equipment to be used for project construction is required to be free of weed seeds, stems or flowers prior to being brought on site.

D. Stripped material consisting of vegetation and organic materials shall be used to re-vegetate landscaped areas or exposed slopes after completion of the grading operations, upon approval of the Contracting Officer.

E. The Contracting Officer should observe the site clearing and preparation to determine if any buried obstacles are present.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: All fill material, regardless of intended use category, must be clean and free from organic matter, roots, brush or other vegetation, trash, brick, debris, frozen material, or other detrimental substances, and rocks or unbroken lumps larger than 3 inches.

B. On-Site Materials: On-site native soil meeting the requirements of Part A above and approved by the testing agency may be used as fill and backfill material.

C. Engineered Fill/Base Course Material: Base course material shall meet the requirements of Section 321100 Crushed Base Course.

2.02 WEED MAT

A. General: Provide 3.6 oz/sy weed mat consisting of a nonwoven geotextile composed of polypropylene fibers.

B. The mat shall be UV stabilized and highly permeable to allow water to pass through easily.
C. Furnish “MIRAFI Mirascape E” or equal weed mat.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protection:
1. Protect existing surface and subsurface features on site and adjacent to site as follows:
   a. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   b. Protect and maintain bench marks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at Contractor’s expense to full satisfaction of Contracting Officer.
   c. Verify location and existence of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
      1) Take necessary precautions to protect existing utilities from damage due to any construction activity. Repair damages to utility items at Contractor’s expense.
      2) Active Utilities: Do not interrupt existing utilities serving facilities occupied and used by adjacent properties, except when permitted in writing by the local utility company. Remove or relocate utilities only as indicated or specified.
      3) Inactive Utilities: Report inactive or abandoned utilities encountered in excavating or grading operations, and remove, plug, or cap as required. In the absence of specific requirements, plug or cap such utility lines as required by local rules or regulations.
   d. Maintain roadways, sidewalks, curbs, gutter, structures and pavement free of damage. Any damaged items shall be repaired to original condition at Contractor’s expense.
   e. Provide full access to public and private premises, fire hydrants, access roads, sidewalks and other points to prevent serious interruption of travel.
   f. Maintain stockpiles and excavation in such a manner to prevent inconvenience or damage to structures on site or on adjoining property.
   g. Avoid surcharge or excavation procedures which can result in heaving, caving or slides.
2. Protection of Structures: Prevent new and existing structures from becoming damaged due to construction operations or other reasons. Prevent subgrade under new and existing foundations from becoming wet or undermined during construction due to the presence of surface or subsurface water and/or construction operations.
3. Frost Protection:
   a. Do not place foundations or fill material on frozen ground.
   b. When freezing temperatures may be expected, do not excavate to full depth indicated unless foundations or fill material can be placed immediately after excavation has been completed and approved.
   c. Protect excavation from frost if placing of concrete or fill is delayed.
   d. Protect subgrade under foundations from becoming frozen until structure is completed.

B. Dust Control: Provide dust control as required to alleviate dust nuisance to adjacent properties.

C. Erosion Control: Provide erosion control methods in accordance with requirements of authorities having jurisdiction. The Erosion Control measures shall be implemented throughout the construction period in order to protect adjacent properties, streets, drainage ways, and storm sewers from erosion and sediment deposition. Do not commence excavation and grading work until erosion control measures are in place. Contractor shall be responsible for daily monitoring, cleaning, and other work required for proper operation. Contractor shall modify/replace all erosion control measures to fit field conditions or as directed by the Contracting Officer.

D. Unanticipated Conditions: Notify the Contracting Officer immediately upon finding evidence of previous structures, filled materials which penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Contracting Officer's instruction before proceeding with further work in such areas.

E. Revegetation and Soils Conservation: Revegetate all areas disturbed by construction which are not paved, landscaped or occupied by structures, in accordance with the Contract Documents. Use the following revegetation methods:

1. Remove (scrape) vegetation and topsoil from the smallest usable space necessary within the project area. Leave small "islands" of native vegetation intact within close proximity to one another and to structures, to facilitate natural revegetation.
2. Stockpile all topsoil removed. Stockpiled material containing a viable native seed bank should be evenly distributed over the open areas within one year.
3. Prior to topsoil application, rip the open areas, to decrease soil compaction and increase water infiltration.

3.02 EXCAVATION

A. General:

1. Prior to any construction, topsoil, vegetation, trees, roots, construction debris, and fill material should be stripped and cleared from the site.
   a. This will require the removal of the top 4 to 6 inches of material prior to construction and additional grubbing to remove the large tree and bush roots.
   b. All exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.
2. Perform excavation as required by the Drawings to the subgrade elevations indicated.
3. Minimize disturbance of natural soils at subgrade.
4. Where solid rock is encountered in excavation, it shall be loosened and broken up such that no solid ribs, projections, or large fragments will be within 6" of the final subgrade.
5. When excavation has reached required subgrade elevations, have the independent geotechnical testing and inspection laboratory make an inspection of conditions. If tests determine that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and backfill over-excavation as directed by testing and inspection laboratory.
6. Place foundations or backfill as soon as possible after excavation is completed, inspected, and approved.
   a. Until concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen or soft due to weather, construction operations or other reasons.
7. Use of explosives: Blasting with any type of explosive is prohibited.

B. Subgrade Stabilization:

1. Proof roll exposed subgrade surfaces that have been disturbed or have loose material. Compact subgrade with a smooth drum, non-vibratory roller.

2. If subgrade under foundations or fill material exhibits pumping during proof-rolling, or is, or becomes, frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by the independent geotechnical laboratory.
3. Provide compaction and density tests of subgrade areas as specified.
4. Do not place further construction on the improved subgrades until they have been approved.

C. Shoring: Shore, slope, or brace excavations as required to prevent them from collapsing. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapsing.

D. Drainage and Dewatering:
1. During construction, control grading so that ground is sloped to prevent water from running into excavated areas or damaging existing structures.
2. Where foundations or fill material are to be placed, maintain excavations free of water.
3. Provide dewatering as required to keep excavated spaces clear of water during construction:
   a. Should groundwater be encountered, notify Contracting Officer.
   b. Where groundwater is or is expected to be encountered during excavation, install dewatering system to prevent softening and disturbance of subgrade and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
   c. Review soils investigation before beginning excavation and determine if and where groundwater is likely to be encountered during excavation.

3.03 FILL AND BACKFILL

A. General:
1. Subgrade to receive fill or backfill shall be stripped of vegetation, debris, organic matter, and free of undesirable material.
2. Prior to fill placement, the exposed native subgrade soils shall be scarified, compacted to a minimum depth of 8-inches and proof rolled using a smooth drum, non-vibratory roller.
3. If subgrade material exhibits pumping during proof-rolling, or is, or becomes, frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by the independent geotechnical laboratory.
4. Do not place fill or backfill when fill material is frozen or when subgrade is frozen, wet, loose, or soft.
5. Obtain approval of fill and backfill material, as well as optimum moisture and maximum density properties for proposed materials, from independent geotechnical laboratory prior to placing the material.

B. Fill: Construct embankments and fills as required by the Drawings.
1. Construct embankments and fills at locations and to line and grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
2. Provide fill material meeting the requirements of Part 2. Do not place material in layers greater than 8 inches loose thickness where compacted by heavy equipment, nor 4 inches where compacted by hand-operated tampers. Place layers horizontally and compact each layer prior to placing additional fill.
3. Compact by rollers or by other equipment as required to obtain specified density. Control moisture for each layer as necessary to meet requirements of compaction.

C. Backfill:

1. Provide on-site fill material meeting the requirements of Part 2. Do not place material in layers greater than 8 inches loose thickness where compacted by heavy equipment, nor 4 inches where compacted by hand-operated tampers. Place layers horizontally and compact each layer prior to placing additional fill.
2. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.
   a. Use vibratory equipment to compact granular material.
   b. Control moisture for each layer of on-site material as necessary to meet requirements of this section.
3. Place fill evenly on each side of foundations or provide bracing.

3.04 COMPACTION

A. General:
1. Compaction testing will be as necessary to assure compliance with Specifications. Such testing will be performed by an independent geotechnical testing and inspection laboratory employed by the Contractor and qualified to perform such work.
   a. Tests shall be performed at locations as directed by the Contracting Officer and at the frequency specified in Section 1.05.B.
   b. Testing laboratory personnel are to be on site during continuous fill and backfill placement and compaction operation.
2. Moisture density relations are required for all materials that are to be compacted prior to commencing compaction.

B. Subgrade Inspection:
1. Notify independent geotechnical laboratory as soon as excavation is completed in order that subgrades may be inspected.
2. Do not commence further construction until subgrade has been inspected and approved as being free of undesirable material, being of compaction density specified in this Section, and being capable of supporting the allowable design bearing pressure and superimposed foundation, fill and structure loads to be placed thereon.
3. Remove frozen, loose, wet or soft material and replace with approved material as directed by the Contracting Officer.

C. Compaction and Density Requirements:
1. Perform compaction of soils and all work associated with that effort with equipment designed for, and suitable to provide the compaction required.
2. Provide and maintain dewatering as necessary to meet compaction requirements.
3. Assure by testing that the compaction densities comply with the following requirements:

Location	Compaction Density
Subgrade below foundations, concrete slabs, gravel surfacing and asphalt surfacing section base course	95% of maximum dry density per ASTM D698 and within 2% of optimum moisture content
Fill below concrete slabs, gravel surfacing and asphalt surfacing section base course	98% of maximum dry density per ASTM D698 and within 2% of optimum moisture content
Backfill at foundation exterior and miscellaneous site fill	95% of maximum dry density per ASTM D698 and within 2% of optimum moisture content.

3.05 GRADING

A. General: Uniformly grade areas within project limits, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations or contours are indicated or between such points and existing grades.

B. Grade areas adjacent to structures to drain away from structures with a minimum fall of 3 inches in first five feet for unpaved areas.

C. Verify compaction of graded areas to depths and densities specified.

3.06 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Waste materials, including materials not allowed for fill, backfill or site grading as specified, trash, and debris, shall be removed from the project site and legally disposed of offsite. The Contractor is responsible for locating a legal offsite disposal site and for hauling of all excess excavated earth material.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

D. Settling: Where settling is measurable or observable at excavated or fill areas during general project warranty period, remove surface, add backfill material, and compact. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

SECTION 312333

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work is the excavation, trenching and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation, final grading, site dressing and cleanup.

B. Related Sections.

1. Section 312000 – Earth Moving

1.02 REFERENCES

A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T238 ASTM D2922)	(Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T239 (ASTM D3017)	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 75mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.03 TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements of Division 1.
2. In-place field density tests for quality assurance are at Contractor expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938), Nuclear Densometer Methods. Quality assurance field density testing frequency shall be as follows:
   a. For trenches up to eight (8) feet in depth, density tests shall be taken at twelve (12) inches above the pipe bedding, at one-half the trench depth and at the top of the backfill. For trenches greater than eight (8) feet in depth, density tests shall be taken at twelve (12) inches above the pipe bedding, at one-third and two-thirds the trench depth levels, and at the top of the backfill.
   b. The minimum density shall be 95% of maximum density determined by AASHTO T-99 or ASTM D698 and ASTM D2321-11. All locations shall have ±2% optimum moisture.
   c. Horizontal Frequency:
      1) Utility Mains and Services (to include all Storm Drain, Water, and Sanitary Sewer) – One set of tests every 100 feet.
      2) Open Pit – Minimum of one set of tests (Open Pit – at each manhole, water valve, storm inlet, etc.

3) Each test location shall be separated horizontally from a prior test location.

3. Re-testing failing areas is at the expense of the Contractor.
   a. If a failing test occurs, the contractor shall follow the following procedures for retesting.
      1) Excavate 8" into the backfill at the location of the failing test to find the last passing lift. For every 8" excavated, Contractor shall excavate along the pipe alignment 10' in both directions for the full trench width to the depth of the passing test. At the extents of the horizontal excavation, one test shall be performed at both 10' horizontal excavation limits. If this results in passing tests, no more horizontal excavation shall be necessary for that direction along the pipe alignment. If these limits do not pass, repeat this procedure until no more failing tests are found.
      2) While recompacting, perform tests at each location where failing test occurred.
4. At the direction of the Contracting Officer, provide necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Contracting Officer.

B. Laboratory Maximum Density and Optimum moisture
   1. Quality assurance tests will be made by the Contractor for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698 and ASTM D2321-11.

C. Materials Submittals
   1. Submit to the Contracting Officer material quality test results including Type 1 Bedding gradation and plasticity index; and Type 2 Bedding gradation.

PART 2 - PRODUCTS

2.01 PIPE BEDDING MATERIALS

A. Type 1 Pipe Bedding
   1. Type 1 Pipe Bedding includes the material placed from 4 inches below the bottom of the pipe, around the pipe, and up to 6 inches above the pipe.
   2. Provide Type 1 Bedding consisting of crushed stone or gravel, which is free of cementitious substances or thin, flat particles in an amount that would cause the material to cake, pack or otherwise form an unyielding support for the pipe.
   3. Provide imported granular material with a gradation as follows and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

TABLE OF GRADATIONS

PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

Sieve Size	% Passing
1 Inch	100
3/4 Inch	90-100
3/8 Inch	20-55
No. 4 Sieve	5-10
No. 8 Sieve	0-5

4. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50 percent of the material retained on the No. 4 sieve has at least on fractured face.
5. To prevent migration of material from around the pipe, do not use sand, sandy gravel or material composed mainly of sand for bedding material in the pipe zone where groundwater is or will be present or where existing material contains voids which would allow migration. Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be well graded, free-draining and non-plastic.
6. Refer to details on Construction Plans and Special Provisions for other requirements.

B. Type 2 Pipe Bedding
1. Type 2 Pipe Bedding is used as directed by the Contracting Officer to replace unsuitable material encountered in the trench bottom.
2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
3. Type 2 Bedding consists of granular material meeting the following gradation and having a maximum plasticity index of 6 and a maximum liquid limit of 25%.

TABLE OF GRADATIONS

PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

Sieve Size	% Passing
3 Inch	100
No. 4 Sieve	0-25
No. 8 Sieve	0-10

2.02 TRENCH BACKFILL MATERIALS

A. Materials From Trench Excavations
1. Native backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the execution Section of this specification.

2.03 DETECTABLE BURIED WARNING TAPE

A. Detectable buried warning tape is to have a minimum 6 inch (15cm) width and 5 mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36 inch (90cm) imprint.

PART 3 - EXECUTION

1.01 PROTECTION OF EXISTING PROPERTIES

A. General
1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways,

structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at Contractor's expense.

The Contractor will take necessary steps and precautions to keep trenching widths to a minimum and provide the necessary shoring required to protect adjacent buried utilities.

2. Contact utility Owners using the One Call System for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.
3. Re-locate existing water mains, sanitary sewers and storm drains shown on the plans that conflict with new pipelines or structures as indicated in the contract documents.
4. Cut and replace existing service lines interfering with trenching operations only with the Contracting Officer's permission and at the contractor's expense. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.
5. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

B. Privately Owned Utilities
1. If any existing private utility interferes with the work in either alignment or grade, and has to be moved, the work will be performed by the appropriate UTILITY Owner, unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.
2. It is the Contractor's responsibility to coordinate utility relocations with the utility owner.

C. Existing Structures
1. Prevent damage to existing buildings or structures in the work area. Repair all construction related damage to the satisfaction of the Government.

D. Existing Overhead Utilities
1. Use extreme caution to avoid conflict, contact or damage to overhead utilities during the work.

E. Exploratory Excavation
1. The location of existing buried utilities may need to be verified by exploratory excavation before construction.
2. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping
1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavations edge using a spade-bitted air hammer, concrete saw or other suitable equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.
2. For trenches passing through existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between trench and edge of pavement.
3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.

G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion as trench backfill or legally dispose of the surfacing material.

H. When excavating across cultivated or sodded areas, remove topsoil full depth or to a maximum 12 inch (30cm) depth, whichever is less, and stockpile for possible project use.

I. Re-sod or reseed, as specified in the contract documents, all established grass areas cut by trenching or damaged during the construction to the satisfaction of the Contracting Officer.

1.02 MAINTENANCE OF FLOWS

A. Maintain the flow of sewers, drains and water courses encountered during construction. Restore culverts, ditches, fences, crosswalks and structures disturbed by construction to their original condition upon completion of the work.

1.03 TRENCH EXCAVATION

A. General

1. Meet current OSHA Safety and Health Standards for all excavation, trenching, shoring, and related work.
2. Excavate at the specified locations for pipeline installations and appurtenant structures.
3. Crossings under sidewalks or curbs may be made by tunneling, if approved by the Contracting Officer. If a portion of a sidewalk or curb is removed, use a concrete saw to make joints, compact the backfill as specified, and replace the removed section with new concrete sidewalk or curb.
4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants, valves, manholes and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.
5. Remove and dispose of all excess or unsuitable excavated materials.
6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.
7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the excavation to the required length, depth and width for making the particular type of joint used.
8. No differentiation between common and rock trench excavation is made, except when listed as separate bid items on the bid proposal or bid form. Excavation includes removing and subsequent handling of all earth, gravel, bedrock or other material encountered regardless of the type, character, composition or condition of the material.
9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

B. Trench Dimensions

1. Excavate to the trench dimensions specified below.
2. Width.
   a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches (0.5m). Maximum trench width may be specified in the contract documents.
3. Depth.
   a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders or large stones are encountered at the bottom of the trench, excavate at least 6 inches (15cm) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unsuitable material is encountered at the trench subgrade, which will not uniformly support the pipe, excavate the material to the depth directed by the Contracting Officer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Pavement Damage Caused By Equipment

1. Equip all track mounted equipment operated on pavement surfacing with pads to prevent pavement damage.
2. Remove and replace all pavement damaged by construction to its original condition.

E. Shoring, Bracing and Sheeting

1. Provide all shoring, bracing and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the cost for trench excavation.

F. Excavations for Appurtenances

1. Make excavations for manholes, hydrants, structures and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

1.04 DEWATERING

A. Remove all ground water encountered in trench excavations. Do not place pipe, bedding or backfill materials below the groundwater elevation established by dewatering operations. The cost of dewatering operations is considered a part of the excavation cost.

1.05 EXCAVATION STABILITY AND SAFETY

A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the responsibility of the Contractor. Meet current OSHA regulations. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

1.06 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches with native on-site material as specified immediately after grade, alignment and pipe jointing has been inspected and approved by the Contracting Officer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.

B. Pipe Bedding Placement

1. Type 1 Bedding.
   a. Place Type 1 Pipe Bedding material 4 inches (10cm) under the pipe, around the pipe, and up to 6 inches above the pipe. Place in maximum lifts of 6 inches (15cm), using hand or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer. Use special care to assure compaction under the pipe haunches.
   b. Place bedding material in equal lifts (6-inch max. lifts) on both sides of the pipe for the full trench width. Take care to prevent migration of Type 1 Bedding into surrounding soils during placement and compaction. Compact Type 1 Bedding to at least 95 percent of maximum density determined by ASTM D698 and ASTM D2321-11.
2. Type 2 Pipe Bedding
   a. Use Type 2 Pipe Bedding as specified or as directed by the Contracting Officer to replace unsuitable material encountered.in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

C. Trench Backfill.

1. After the pipe bedding materials are placed and compacted as specified, backfill the trench. Use native backfill material from the site free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. From the top of the Type 1 Pipe Bedding to 6 inches (15cm) below the ground surface, or the subgrade elevation, material containing rock up to 8 inches (20cm) in the greatest dimension may be used.

D. Watering
   1. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
   2. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.
   3. The source of water required for compacting trench backfill shall be identified and obtained by the Contractor.

E. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Contracting Officer at the Contractor's expense.

F. Trench backfill compaction shall be as follows:
   1. Place trench backfill in maximum 8-inch compacted lifts within 2 percent of optimum moisture content, and compact to at least 98 percent of maximum density determined by ASTM D698 and ASTM D2321-11.

G. Backfill for Appurtenances
   1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes and other underground items without disturbing appurtenance alignments.
   2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.

H. Detectable Buried Warning Tape
   1. Provide warning tape as described in PRODUCTS Section 2.03. Bury tape a maximum 18 inches (45cm) below finish surface grade.
   2. The Contactor shall install blue warning tape directly above new waterlines, green tape directly above new sanitary sewer lines, red tape above electrical lines and orange tape above communications lines.

1.07 SURVEY MARKERS AND MONUMENTS

A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Contracting Officer.

B. Replace all Contractor disturbed or destroyed survey markers or monuments, not approved during construction, using a licensed land surveyor.

1.08 CLEANUP

A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.

B. During final cleanup, the Contractor shall be responsible for street sweeping and washdown of paved areas that may have been affected during construction.

C. All existing gravel surfaces contaminated by trench excavation material shall be removed to a minimum depth of 1-inch and replaced with crushed gravel surfacing.

1.09 TIME AND DISTANCE OF OPEN TRENCHES

A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.

B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.

C. The maximum permissible distance between backfilling/compaction operations and the end of newly installed pipe is 200 feet (60m) in all areas.

D. The maximum distance between the newly installed pipe and the excavator is 100 feet (30m) in all areas.

E. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling/compacting crew, the maximum allowable open ditch at any time is 300 feet (90m) in all areas.

F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement or pavement replacement.

END OF SECTION

SECTION 321100

CRUSHED BASE COURSE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work is the placing of one or more base courses composed of crushed gravel, stone or other similar materials meeting the gradation or maximum size specified herein.

1.02 REFERENCES

AASHTO T11	Amount Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T96	Resistance to Degradation by Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by Sand Cone Method
AASHTO T238 (ASTM D2922)	Density of Soil and Soil-Aggregate In-Place By Nuclear Method (Shallow Depth)
AASHTO T239 (ASTM D3017)	Moisture Content of Soil-Aggregate In-Place By Nuclear Method (Shallow Depth)

1.03 DENSITY CONTROL TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements of Division 1.
2. In-place field density tests for quality assurance are at Contractor's expense meeting ASTM D1556 Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field density testing frequency is 1 test per 500 square feet per lift.

   The Contractor shall submit test results performed by an independent testing laboratory on all crushed aggregate before material is brought on site. Failure of any or all tests shall be cause for rejection of the materials. A minimum of one test for gradation, plasticity indexes, liquid limit and fracture shall be provided for conformance. Submit test results at least 48 hours before material is brought to site.
3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture

1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

1.04 MATERIALS SUBMITTALS

A. Submit to the Contracting Officer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Contracting Officer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish aggregate base material meeting the applicable aggregate quality requirements.

2.02 CRUSHED BASE MATERIAL

A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings or other similar materials.

B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free in excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear not exceeding 50 at 500 revolutions when tested under AASHTO T96

C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50 percent of the material retained on the No. 4 sieve has at least one fractured face.

D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

E. Scoria base course will not be acceptable.

2.03 BASE COURSE GRADATION

A. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

For this project, gravel surfacing and crushed base course for placement beneath new sidewalks, concrete slabs and asphalt surfacing shall be 3/4” minus material meeting the gradation shown in the Table of Gradations below:

TABLE OF GRADATIONS

PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

Passing	¾” Minus
3/4 Inch	100
No. 4 Sieve	40-70
No. 10 Sieve	25-55
No. 200 Sieve	2-10

B. Up to 5% “oversized” material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No. 4 sieve shall be reasonable well graded.

C. Suitability of the aggregate is based on samples obtained during placement in the project within the limits allowed in the table for the particular grading specified.

D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60 percent of that portion passing the No. 40 sieve.

E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.04 WATERING

A. Use uncontaminated water.

PART 3 - EXECUTION

3.01 GENERAL

A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.

B. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

3.02 PLACEMENT AND SPREADING

A. Mix and place the material in maximum 8 inches (20 centimeters) compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.

B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth that when compacted, and making allowance for any filler to be blended on the road/parking lot, the layer has the specified thickness.

C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.

D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.

E. If segregation or moisture problems exist, or if the material was placed on the road/parking lot in windrows, thoroughly blade-mixed the material of the affected layer by alternately blading to the center and back to the edges of the road/parking lot.

F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

G. Apply water during the work to control dust and to maintain the base course in a damp condition.

3.03 FIELD DENSITY REQUIREMENTS

A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.

B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.

C. Provide the watering and rolling required to obtain a minimum field density of 95 percent of maximum dry density as determined by AASHTO T99. No separate compensation is made for rolling and watering the base course.

3.04 SURFACE TOLERANCES

A. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, shall not have a surface deviation from the straight edge exceeding 3/8-inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters)

B. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).

C. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Contracting Officer.

END OF SECTION