

Technical Specifications

Flagstaff Ranger Station Wastewater System Improvements US Forest Service Region Three

August 2024

Prepared by:



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TECHNICAL SPECIFICATIONS

AUGUST 2024

FLAGSTAFF RANGER STATION WASTEWATER SYSTEM IMPROVEMENTS

U.S.D.A Forest Service Region Three
Coconino National Forest
Flagstaff Ranger District
Coconino County, Arizona

100% SUBMITTAL

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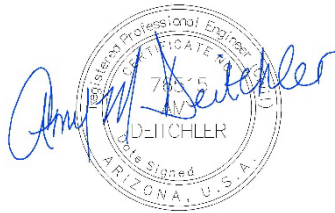


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SPECIAL PROVISIONS

SECTION 00910

SPECIAL PROVISIONS

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SP-01 **INCORPORATION OF THE MARICOPA ASSOCIATION OF GOVERNMENTS
UNIFORM STANDARD SPECIFICATIONS AND STANDARD DETAILS FOR
PUBLIC WORKS CONSTRUCTION (MAG)**

All provisions of the MARICOPA ASSOCIATION OF GOVERNMENTS (MAG) Standard Specifications, 2024 Revision to the 2020 Edition, hereafter collectively referred to as MAG, apply to the project, except where portions of MAG are modified or replaced by the Contract Documents. The entire Section from the MAG has not been rewritten for these modifications. Instead, modifications are indicted for a specific subsection, paragraph, sentence or drawing.

Where a modification to MAG does not exist for a particular Section of MAG it shall be assumed the work is to be completed in accordance with the appropriate MAG Section. When a modification to MAG does exist the requirements of that modification supersede the related MAG requirement. Where paragraphs are specifically deleted or modified, or new paragraphs added, all other parts of MAG will remain in effect unless otherwise modified by the Project Manual in accordance with the order of governance as specified in "Summary of Work". Forms included in the Project Manual will be used in lieu of similarly titled forms in MAG. Where Technical Specifications follow the modifications in later divisions of the Project Manual, those specifications replace same numbered specifications in MAG.

Delete MEASUREMENT AND PAYMENT in all sections of MAG. Bid Form. If an item is listed as a Bid Item, administrative and procedural requirements will be listed in Section 01275: Measurement and Payment. If an item is not listed as a Bid Item, the item is not required or is considered an incidental cost to other Bid Items.

SP-02 **INCORPORATION OF THE CITY OF FLAGSTAFF MUNICIPAL CODE**

All provisions of Title 13 Engineering Design Standards and Specifications for New Infrastructure of the City of Flagstaff Municipal Code shall take precedence over the latest revisions of MAG Specs and Details and over ADEQ criteria. The more restrictive criteria of design and construction stated in these regulations apply to the project, except where portions of MAG are modified or replaced by the Contract Documents. The entire Section from MAG has not been rewritten for these modifications. Instead, modifications are indicted for a specific subsection, paragraph, sentence or drawing. Chapter 13-21 lists the revisions to MAG Specs and Details and indicates the section of MAG Specs and details on which the change is made.

SP-03 **SUBSURFACE AND PHYSICAL CONDITIONS**

In the preparation of Drawings and Specifications, the USFS Consultants relied upon the following reports of exploration and tests of subsurface conditions at the Site:

1. *Geotechnical Evaluation Report, Flagstaff Ranger Station Wastewater Improvements*, prepared by Western Technologies,

In the preparation of Drawings and Specifications, the USFS Consultants relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site:

1. *Flagstaff- Elden Ranger Station, Flagstaff Arizona, Administrative Plan*, prepared by Spartan Technologies, 1987

These reports and drawings are not part of the Contract Documents, but the “technical data” contained therein upon which the Contractor may rely as identified and the above are incorporated therein by reference. Contractor is not entitled to rely upon other information and data utilized by USFS Consultants in the preparation of Drawings and Specifications.

SP-04 **GEOTECHNICAL SITE CONDITIONS**

Contractor shall familiarize themselves with the Geotechnical Report contained in the Appendix of the project manual and construct the project per the recommendations contained therein.

SP-05 **SPOIL**

Unless otherwise indicated on the Drawings or elsewhere in these specifications, place spoil in the confines of the existing easements or right-of-ways. In areas where confines limit the placement of spoil, the Contractor may have to haul the spoil out of the area until they are ready to backfill. The locations of spoil placement will be discussed at the preconstruction conference and will be subject to approval by the CO. The Contractor will be responsible for the disposal of all excess spoil.

No additional payment will be allowed the Contractor for this work. Refer to Section 01275: Measurement and Payment for more information.

SP-06 **BEST MANAGEMENT PRACTICES**

Dust Control – Dust control is to be considered an integral part of the Work. Dust Control shall be provided from the start of construction until the Work is complete. Fugitive dust as a result of construction shall be controlled at all times within the subject property. The Contractor shall have a water truck available for dust control prior to beginning any construction tasks. Wetting shall be done a minimum of twice per day in dry conditions or at the direction of the Government as required until the final construction activities are completed. Contractor shall be prepared to provide dust control until the final surface restoration is completed. All costs incurred to meet dust control requirements are incidental to other items of the contract and no separate payment shall be made.

Road and Parking Lot Cleaning – It shall be the sole responsibility of the Contractor to keep all roads and parking lots free from mud, gravel, cobbles or other contaminants generated as a result of construction activities. It shall be the responsibility of the contractor clean all foreign matter from roads and parking areas in a reasonable amount of time as determined by the Government. All costs incurred to meet road and parking lot cleaning requirements are incidental to other items of the contract and no separate payment shall be made.

Erosion Control Measures – Temporary erosion and sediment control measures includes the installation and maintenance of temporary structural control measures to reduce or eliminate the erosion of soil and transport of sediment offsite as result of construction activities. This may include, but not be limited to, silt fences, ditch checks, sediment basins, erosion control mats, stabilized construction entrance, temporary diversions, inlet protection, sediment traps, and slope drains. If erosion control measures are required, it shall be the responsibility of the contractor to install and maintain them throughout the construction.

Failure to Provide Service – If the Contractor fails to provide adequate service on the above listed items, the Government reserves the right to contract these activities to a third party, the cost of which will be deducted from the contract amount at the time of the next pay request.

SP-07 **WATER FOR CONSTRUCTION**

The Contractor may obtain water for construction purposes from the Flagstaff Ranger Station at no charge at discretion of the COR. All water used must be metered, recorded and this information provided to the Government upon project completion. The water will be made available from the metered fire hydrants as directed by the COR. The Contractor may operate the metered fire hydrants, however any damage sustained from the usage will be the responsibility of the Contractor to repair. The Contractor is responsible for providing all required fittings, meters, hoses, backflow assemblies, valves and other appurtenances required for obtaining water for construction from the COR.

Contractors permitted to use a metered fire hydrant need to know and understand proper metered fire hydrant operation procedures as they are the party ultimately responsible for improper hydrant connections or any other improper operation of a metered fire hydrant. The contractor is responsible to teach proper operation procedures to all employees using metered fire hydrants. This includes water truck drivers or any other employees of the company that operate metered fire hydrants for any reason.

Meter Hydrant Connection Procedures

1. Perform a safety check of the hydrant. Check the hydrant visually, and shake the hydrant with your hands to make sure it is rigid (do not use a movable hydrant – they are dangerous and serious injury to the operator may result). Check the hydrant to ensure the caps are tight.
2. Remove hydrant nozzle cap.
3. Attach metering device and hose and install brace support. All hydrant connections must include a RPZ backflow assembly or device acceptable to the Government at all times.
4. Open hydrant slowly. It should take more than 60 seconds to fully open to prevent surging on the water system. Open completely to shut off drip drain while hydrant is in use. Valves downstream of the hydrant shall not be used to control flow.
5. They discharge end of the hose should not be inserted under any circumstances, into a tank or container underwater or laid on the ground to make and lay in its own pool of water. There must be at all time an air gap between the end of the water hose and the container.
6. Upon filling the tank or upon completion of the permitted use, slowly close hydrant valve.
7. Remove hose
8. Replace nozzle cap and tighten securely.
9. No hydrant shall ever be left without the cap replaced and securely tightened.

The use of fire hydrants for construction water needs is a privilege, and the COR will not tolerate abuse of this privilege. This includes illegal connections, water theft, vandalism, tampering, failing to replace caps, or damage caused by neglect.

SP-08 **SITE RESTORATION**

Site Restoration is an important part of this project. Site Restoration is replacement or reconstruction of site improvements to rights-of-way, easements, public property, and private property that are affected or altered by construction operations, with improvements restored to condition which is equal to, or better than, that which existed prior to construction operations. These Site Restoration items include but are not limited to; concrete curb and gutter replacement, sidewalk replacement, concrete surfaces, asphalt replacement, gravel restoration, seeding, sod, and irrigation system repair.

Initial restoration (rough grading, temporary aggregate if necessary, removal of excess excavated material and debris) shall be done each day to the extent necessary to allow the movement of local traffic and permit access to all areas for emergency vehicles. Maintenance of streets, drives, sidewalks, etc. shall be the responsibility of the Contractor (including dust control, grading, stabilization, etc.) until the restoration is complete and has been accepted by the Government. Restoration of each street or section of utility line shall follow the construction in a timely fashion so as to minimize inconvenience to the COR and the general public. The manner in which this restoration is done by the Contractor will be a determining factor in the approval of partial payment requests.

After utility work is completed on underground utilities and submitted on monthly estimate for payment, complete site restoration for those utility segments before next monthly estimate for payment is submitted, unless extended in writing by Government and CO. If site restoration is not completed, the Contractor's partial payment request may be denied or additional retainage may be withheld.

For utility work requiring testing or post-installation TV inspection, completion of segment is not considered to include testing or TV inspection. Schedule for completion of site restoration is not determined by completion of testing or TV inspection.

SP-09 **PRIVATE ACCESS**

At all times during construction, afford property Governments access to their property to the highest degree possible. Ensure that businesses will have at least one approach open at all times, if possible, and open closed-off approaches as quickly as possible.

SP-10 **SEWER MAIN LANDSCAPED AREAS**

Repair any landscaped or vegetated areas on private or public land that are scarred or damaged during construction to an equal or better condition than that prior to the start of construction. This will include removing, replacing, and grading topsoil. Replace all landscaped and/or grass areas disturbed during the construction process with a minimum 6-inches of topsoil. Reseed all disturbed areas, private or public, unless otherwise indicated.

No additional payment will be allowed to the Contractor for this work if outside the pay limits depicted in the restoration details or detail in Section 01275: Measurement and Payment.

SP-11 **STAGING AREA**

Staging areas have been provided as shown on Sheet 4 of the drawings. Take care to protect, preserve and/or replace objects and structures encountered within the confines of the staging areas and restore all disturbed areas as close as possible to original condition as possible unless otherwise dictated in these specifications.

Storage of construction materials, equipment, and other items pertinent to the construction of the project will be allowed in the staging areas. However, bulk storage of petroleum based products stored in tanks will not be allowed. At all times, spill kits must be available on-site for any accidental spills of petroleum.

No payment will be allowed to the Contractor for any work, including restoration, with regards to the staging areas.

SP-12 **CONFLICTS WITH UTILITIES**

As shown on the Drawings, utilities may be in conflict with certain areas of the project. Utilities and other appurtenances may include but are not limited to the following: culverts; propane or gas mains and services; television cables; telephone lines and pedestals; electrical boxes and lines; street lights; telephone and power poles; water mains and services; sanitary sewer mains and services; and storm drain pipes and inlets.

Utility locations are based on the available information which has been provided to or discovered by the CO. There is no guarantee as to the accuracy and completeness thereof is expressly disclaimed. The Contractor must check with the Utilities Underground Location Center (800-782-5348) at least two full working days in advance of the planned work date so that all utilities are located prior to digging.

The Contractor shall coordinate work with all utility companies or private entities that may be affected by the project. For utilities shown on the Drawings, the Contractor shall be responsible for any charges associated with relocating, removing, replacing, crossing, working around, or supporting utilities or otherwise addressing utility conflicts as necessary to conduct construction operations and properly construct the project. The Contractor shall also be solely responsible for any damage to these utilities due to their operations. The Contractor shall work closely with the utilities to ensure their criteria are met and no problems result. For underground utilities not shown on the Drawings, the Contractor shall follow procedures of Underground Facilities of the General Conditions.

Unless identified as a bid item in the Bid Form, no separate payment will be made for this work, and the Contractor shall figure the cost of such work into other applicable bid items.

SP-13 **SEWER AND WATER MAIN CORSSINGS LESS THAN 24"**

Where there is not 24" minimum separation between water and sanitary sewer main, the Contractor is to center one standard length of new sanitary sewer main over the water crossing and encase the new sanitary sewer main in a minimum of 6" of flowable fill for a minimum of 10 feet on either side of the existing water crossing. Additionally, the crossing must have a 6" minimum vertical separation between water and sewer mains. Seals at the crossing must be constructed with slip-on or mechanical joint pipe complying with public water supply design standards and be pressure tested to 150 psi to assure watertightness. At crossings, one standard length of new pipe must be centered at approximately a 90-degree angle in respect to the existing pipe.

SP-14 **DEWATERING**

The Contractor will be responsible for any dewatering operations which may be necessary to adequately remove water such that construction activities can be completed as specified. The Contractor will be responsible for conveyance and disposal of water to surface watercourses. Make all necessary arrangements for infringements across private property and obtain and adhere to any necessary discharge permits from the City of Flagstaff and ADEQ.

SP-15 **QUALITY CONTROL TESTING OF SOIL, CONCRETE AND ASPHALT MATERIALS**

This Special Provision only applies to soil and asphalt materials. Refer to other applicable sections of the specifications for quality control testing requirements of other materials.

Complete testing of all components of the project will be required to the satisfaction of the Government. The Contractor is solely responsible for quality control (QC) testing.

The following table outlines the minimum frequency of quality control testing. All testing is the responsibility of the Contractor and must be conducted by an approved, certified testing laboratory or individual.

Contractor must remedy all defects and performance problems revealed by the testing to the satisfaction of the Government at no additional expense to the Government. The Government may conduct quality assurance testing in addition to the Contractor's quality control testing, and in the case of a conflict between quality control and quality assurance testing, the quality assurance testing will govern.

Minimum Quality Control Testing Frequency Table

SECTION	ITEM DESCRIPTION	TEST OR SUBMITTAL	FREQUENCY
TRENCH BACKFILL			
02221	Type 'A' Trench Backfill	Field Density/Moisture Content	1 test / 200 LF / lift
02221	Type 'B' Trench Backfill	Field Density/Moisture Content	1 test / 300 LF / lift
02221	Type 'C' Trench Backfill	Field Density/Moisture Content	1 test / 400 LF / lift
STREET, URBAN TRAIL, SIDEWALK, AND CURB AND GUTTER BACKFILL			
02230	Subgrade Preparation	Field Density/Moisture Content	1 test / 5,000 SF / lift
02230	Embankment Placement	Field Density/Moisture Content	1 test / 5,000 SF / lift
02230	Subexcavation Replacement	Field Density/Moisture Content	1 test / 5,000 SF / lift
02234	Sub-Base Course(s)	Field Density/Moisture Content	1 test / 2,500 SF / lift
02235	Base Course(s)	Field Density/Moisture Content	1 test / 2,000 SF / lift
MISCELLANEOUS BACKFILL			
02300	Select Fill/Structural Fill	Field Density/Moisture Content	1 test / 1,000 SF / lift
02300	Drainage Course	Field Density/Moisture Content	1 test / 1,000 SF / lift
02300	Filter Material	Field Density/Moisture Content	1 test / 200 LF / lift
ASPHALT (PLANT MIX BITUMINOUS SURFACE)			
02510	Asphalt Concrete Pavement	Field Density	1 test / roller pass
02510	Asphalt Concrete Pavement	Field Thickness	1 test / 3,000 SF
02510	Asphalt Concrete Pavement	In-Place Density and Thickness	1 core / 500 ton
CONCRETE (SURFACE)			
321623, 332228	Concrete	Field Strength	1 sample / 150 cubic yards, or 5,000 square feet of surface area
321623, 332228	Concrete	Compressive Strength	Cylinders should be tested for compressive strength at 7, 14, and 28 days, with two cylinders tested at each interval and one reserved for additional testing.

SP-16 **CONSTRUCTION STAKING**

The Contractor will be responsible for construction staking. The Government will supply files needed for the construction staking.

This item covers survey work required to set specific horizontal and vertical stringlines, stakes, and/or bluetops to ensure location specific compliance with the Plans and Specifications for each stage of construction. Contractor is responsible for the preservation of said stringlines, stakes, and/or bluetops until such time that they are no longer required for construction activities. Contractor is responsible for coordination efforts which will limit the amount of exposure to said stringlines, stakes, and/or bluetops. The Contractor will not be reimbursed for any additional survey work, including rental late fees or additional rental time that is required due to sequence of operations, operator error, or negligence. This item includes all labor, equipment (including rental fees), supplies, and incidentals associated with this work. Consider all costs associated with this provision incidental to performance of the work. Include the cost in the cost of other items.

SP-17 **PERMITS**

The Government will obtain the following permits at no expense to the Contractor. The Contractor will be required to carry out all provisions of these permits as part of this contract.

1. City of Flagstaff – Approval to Construct, Engineering Review, and Capacity Assurance forms.
2. Arizona Department of Environmental Quality Approval to Construct, an Engineering Review.
3. U.S. Army Corps of Engineers – Federal Clean Water Act (404 Permit).
4. Any Other Applicable Permits

The Contractor is responsible for obtaining all necessary permits, licenses, agreements, insurance, and approvals required by any government authority or agency for the performance of this work at his own expense. Government will allow Contractor access, as appropriate and necessary, for obtaining data in regard to permits and, at its own discretion, may assist Contractor, when necessary, in obtaining such permits. These Permits may include but are not limited to the following:

1. Storm Water Discharge Permit. The work requires a General Permit for Storm Water Discharges Associated with Construction Activities, and all discharges must be in accordance with the submitted Storm Water Pollution Prevention Plan (SWPPP). The Contractor is responsible for preparing and signing a SWPPP and submitting a complete Notice of Intent (NOI) package to the Arizona Department of Environmental Quality. The Contractor will be responsible for all fees associated with the permit application.

Implement and comply with the provisions of the NOI and SWPPP and the cost of this item will be distributed throughout the contract price. If the Contractor elects not to carry out the provisions of the NOI and SWPPP, then the Contractor shall be responsible for any damages or fines the City of Flagstaff and the State of Arizona may assess for non-compliance. At the end of the project, the Contractor will be responsible for submitting and signing a completed Notice of Terminations (NOT) form to the Department of Environmental Quality. The Contractor will be responsible for paying annual SWPPP permit renewal fees until the NOT is issued.

SP-18 **EASEMENTS, CONSTRUCTION LIMITS, AND RIGHT-OF-WAY**

Conduct construction operations within the easement, construction limits, and right-of-way limits. Obtain written permission from the adjoining private land Government prior to conducting any operations off the allowed easement. Take care to protect, preserve and/or replace objects and structures encountered within the confines of the easements and restore all disturbed areas restored to the original condition unless otherwise dictated in these specifications.

SP-19 **WINTER SHUTDOWN**

A shutdown due to inclement weather during the winter months may be requested by the Contractor. Indicate the number of calendar days being requested in the original shutdown request. This initial request may be extended during the shutdown period as long as such extension is justifiable and requested at least 14 days prior to the date the original extension was to elapse. Any extension of shutdown will require the Contractor to demonstrate that adequate operations can be maintained throughout the extended period. Shutdown extensions may require operation modifications and approval of the City of Flagstaff and ADEQ. Only one winter shutdown will be granted during the project.

The Government reserves the right to approve or disapprove any shutdown or extension requests. As a condition of approval of a shutdown, close all open excavations, provide for maintaining traffic, and provide for protection of public property at the work site. The Contractor will not be allowed to perform any work during the shutdown period unless prior approval is granted by the Government.

SP-20 **WORK WITHIN CITY OF FLAGSTAFF RIGHT-OF-WAY**

Sanitary sewer main installation will occur within City of Flagstaff right of way. Contractor shall complete all work and site restoration in City of Flagstaff right of way according to Title 13 of City of Flagstaff Municipal code including but not limited to flowable fill at utility crossings and pavement replacement. Contractor is responsible for providing City of Flagstaff approved traffic control plan for work occurring in City of Flagstaff right of way. This is paid for under Bid Item 01500-1.

SP-21 **WORKING HOURS**

Regular working hours are defined as an eight-hour period (plus 1 hour lunch allotment) within the bounds of 7:00 AM and 7:00 PM. Work during other hours may be permitted following written approval of the COR. Contractor shall provide the GOVERNMENT a request at least three (3) working days prior to working other hours, or in excess of 8 hours per day. GOVERNMENT shall provide a response to the request within 24 hours of receipt. Emergency work may be done without prior permission.

SP-22 **CONTRACTOR EMERGENCY CONTACT**

Provide a primary and secondary 24-hour, 7-day a week emergency contact.

SP-23 **SEEDING**

Furnish a dry land pasture seed mixture and approved fertilizer to be placed in all disturbed areas (not including landscaped areas in the community), containing Arizona fescue (2 lbs/acre), Squirreltail (2 lbs/acre), Western wheatgrass (1 lb/acre), Blue grama (1 lb/acre), Mountain muhly (1 lb/acre), Beebalm (0.5 lb/acre), and Lupine (0.5 lb/acre). Alternate mixes may be used, with CO's approval.

Sow seed in the areas described in the Contract Documents at the rate of 15 pounds per acre on a “pure live seed” basis. The necessary bulk seed can be calculated by:

$$\text{Necessary Bulk Seed} = \frac{\text{Total Pounds (kg) Pure Live Seed Required}}{(\% \text{ Germination}) \times (\% \text{ Purity})}$$

SP-24 **FIELD OFFICES**

Maintain a suitable field office at the site or off site, which will serve as headquarters for the project Superintendent. All communications, drawings, instructions, and other articles will be delivered to the Contractor’s field office or to the Contractor’s main office as appropriate. Communications delivered to either location will be deemed to have been delivered to the Contractor.

Maintain copies of record drawings, specifications, shop drawings, submittals, and all communications pertinent to the performance of the work at the field office and make them available to the Government or COR for use at all times.

The field office shall be weathertight, heated field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of at Project site. Keep office clean and orderly. Furnish and equip offices as follows:

- Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
- Furnish room with desk, work table, two chairs, plan rack, and locking storage for surveying equipment.
- The Contractor shall pay all electrical and heating bills.
- Provide an electric heater and air conditioner with thermostat capable of maintaining a uniform indoor temperature of 68 deg F.
- Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height.
- Provide two 110- to 120-V duplex outlets.

All electrical and heating bills for the field office are the responsibility of the contractor. No separate payment will be made for field offices. The cost of field offices will be included in the mobilization Bid Item for the base bid.

SP-25 **TRACER WIRE**

A tracer wire shall be installed on all sanitary sewer mains and on all sewer services within City of Flagstaff right of way. The tracer wire shall be taped to the top of sanitary sewer mains with ten (10) mil tape and shall be plastic covered No. 12 AWG type UF 600V. Plastic cover for tracer wires shall be green for sanitary sewer lines. All tracer wire splices shall be carefully soldered and wrapped. Wires are to be wrapped with Scotch 3M electrical tape and inserted into a direct burial splice, use Scotch 3M DBR-6 or equivalent. No splices will be allowed for wire lengths less than 500 feet.

A tracer wire connection station shall be installed for each 500 linear feet of sanitary sewer main as shown on the contract drawings. Tracer wire stations for sewers shall be located in conjunction with sewer services as shown on the contract drawings. Eight feet of tracer wire shall be loosely coiled inside a separate cast iron valve box top section without a valve. An approved type, 5lb magnesium anode shall be placed at a tracer wire connection station under the valve box for each 1,000 linear feet of tracer wire.

All tracer wire shall be successfully tested by the Contractor in the presence of the CO/COR. Contractor shall notify the GOVERNMENT three (3) working days in advance of the testing. The City of Flagstaff shall observe the tests of all tracer wire performed by the Contractor prior to paving and acceptance by the City to show that all sanitary sewer mains and services can be located by this means. These tests shall be witnessed by the City of Flagstaff. The City of Flagstaff shall be provided all information necessary to "as-built" the location of all tracer wire, anodes, and connection stations.

No separate payment will be made for this work. The cost of furnishing and installing the tracer wire system shall be incidental to the other appropriate bid items. See Section 01275: Measurement and Payment for more information.

SP-26 **DETECTABLE WARNING TAPE**

Six inch wide detectable warning tape will be installed on all new pipes and shall be 12 inches to 24 inches below finished grade. The detectable warning tape for sanitary sewer mains shall be green. The tape shall be permanently printed at least every thirty-six (36) inches with "BURIED SEWER LINE BELOW" for sewer mains.

The cost of furnishing and installing the detectable warning tape shall be incidental to the other appropriate bid items. See Section 01275: Measurement and Payment and the Drawings for more information. The warning tape must be installed as a condition for approval for payment for the related bid item. Warning tape for gravity sewer main, forcemain, and all service lines shall read "sewer".

SP-27 **PROGRESS MEETINGS**

The GOVERNMENT will schedule and conduct progress meetings at regular intervals to discuss the status of the project. The meetings will be conducted at the project site, unless otherwise indicated. The GOVERNMENT will prepare the meeting agenda and will distribute the agenda to all invited attendees.

In addition to representatives of Government, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

GOVERNMENT shall record significant discussions and agreements achieved and shall distribute the meeting minutes to everyone concerned within 7 calendar days of the meeting.

SP-28 **SERVICE REQUIREMENTS**

Maintain wastewater flows throughout the project, which may require temporary bypass pumping. Maintain service to existing service connections throughout construction, except that service connections may be taken out of service one time for a period of up to 8 hours for installation of new sewer services or service connections to new mainlines. Provide the Government with a written 24 hour notice before disrupting service.

Do not interrupt water service except as approved by the Government.

Existing septic systems (septic tanks, cesspools, drywells, etc.) cannot and shall not be abandoned until the sewer service connection is made, tested, and accepted.

The Contractor will be responsible for any damage that occurs to the Government and/or customers on the system due to interruption of service. No additional compensation shall be allowed for installation of any measures required to continue service. These costs shall be distributed within appropriate Bid Items in the contract.

SP-29 **TRAFFIC CONTROL**

Adhere to all traffic control requirements as set forth in the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*, latest edition, published by the U.S. Department of Transportation, Federal Highway Administration. Coordinate with the Government and City of Flagstaff to schedule road closures and/or detours and conduct construction activities so as not to interfere with the traffic control.

SP-30 **ABANDON SEPTIC TANK IN PLACE**

Once a property is connected to sewer, existing septic tanks, seepage pits and cesspools must be located, pumped and abandoned in accordance with A.A.C. R-18-9-A309(D) and the Coconino County Health Code. The septic shall be pumped out and disposed of by an ADEQ licensed sewage disposal provider. The license shall be provided to the COR prior to commencing of any pumping. A copy of all pumping receipts shall be submitted to the CO. Abandoning the septic tank shall include the following actions:

1. Disconnect and remove electrical and mechanical components;
2. Pumping of existing septic tanks.
3. Remove or collapse the top of any tank or containment structure.
4. Punch a hole in the bottom of the tank or containment structure if the bottom is below the seasonal high groundwater table;
5. Fill the tank or containment structure or any cavity resulting from its removal with earth, sand, gravel, concrete, or other approved material; and
6. Regrade the surface to provide drainage away from the closed area;
7. Cut and plug both ends of the abandoned sewer drain pipe between the building and the on-site wastewater treatment facility not more than 5 feet outside the building foundation if practical, or cut and plug as close to each end as possible; and
8. Notify the Arizona Department of Environmental Quality within 30 days of closure.

SP-31 **PREINSTALLATION CONFERENCE**

A pre-installation conference/meeting is required prior to each major work item being performed. Work items that will require a conference include but are not limited to start of pipe work and start of sewer service work. The GOVERNMENT may request a pre-installation conference for any item of work associated with the project.

SP-32 **SEWER SERVICE INSTALLATION**

All sewer service lines from gravity mains shall be 4-inch PVC piping as shown on the drawings from the main line to the edge of the right-of-way regardless of the service connection requiring a grinder pump. The connection will be made using an "Inserta Tee®" fitting manufactured by Advanced Drainage Systems or approved equal. Sewer saddles will not be accepted as an alternate product.

As part of the installation for each sewer service line, the Contractor is responsible to ensure that a minimum of 2% slope is feasible between the planned sewer main connection and service line connection before tapping the sewer main. If 2% is not possible at the proposed alignment, the Contractor shall notify the GOVERNMENT as soon as reasonably possible. The GOVERNMENT will coordinate with the Contractor to determine either a feasible location for tapping the sewer service or requiring the service to utilize a grinder pump.

If a minimum 2% grade cannot be met due to elevations, a grinder pump may be required. CO will work with the contractor if grinder pumps are necessary. The contractor will verify the power source if grinder pumps are needed.

SP-33 **SEWER SURFACE RESTORATION**

All sewer services will be backfilled to match the exiting conditions. A minim of 2-inches of topsoil shall be replaced under lawn, sod, seeding, or other landscaped areas and a minimum of 2-inches of crushed subbase under areas of concrete, asphalt, or other non-lawn landscaping elements. Trees, shrubs, sod, and other vegetation do not need to be replaced within 6 ft. either side of the centerline of the sewer service. Gravel, asphalt, grass seed (on areas of existing grass), pavers, decorative rocks, wood chips, any damaged yard irrigation repairs, and other non-vegetation landscaping elements need to be replaced within 6 ft. either side of the centerline of the pipe.

SP-34 **VISUAL COMPLETION OF SERVICE CONNECTION**

The Contractor will be responsible for verifying that the service connection for each property has all plumbing, piping, and drainage fixtures connected. Acceptable methods include flushing dye or water down fixtures in a structure and visually confirming flow through a cleanout between the connection point at the sewer main. Other methods are acceptable with approval of the Government.

END OF SECTION

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01110

SUMMARY OF WORK

PART 1- GENERAL

1.1 DESCRIPTION

- A. In general, the Work under this Contract includes, but is not necessarily limited to, the following major items of work as shown on the plans and as specified. The following descriptions are provided as an outline of major work items and shall not be construed as an inclusive or complete listing of all items of Work under this Contract.
 - 1. The project includes new sewer collection system includes connecting existing facilities, installing sewer mains and sewer manholes, and restoring surfaces to preconstruction conditions.

1.2 WORDING OF SPECIFICATIONS

- A. Throughout these specifications the abbreviation CO shall mean "Contracting Officer"
- B. Throughout these specifications the abbreviation COR shall mean "Contracting Officer Representative"
- C. Throughout these specifications the abbreviation Government shall mean "Project Administrator or Owner"
- D. Other reference standards are specified in Section 01420. The Contractor shall become thoroughly familiar with all reference specifications.

1.3 USE OF PREMISES

- A. General: Contractor shall have full access to grounds for construction operations during construction period, and limited access to facilities. Contractor's use of premises is limited by the Government's right to perform work or to retain other contractors on portions of Project site. Building access shall be coordinated with CO.
- B. Contractor shall conduct their operations to ensure the least inconvenience to the public and employees. Work is limited to the hours of 7am-7pm.
- C. Notify Contracting Officer at least 72 hours prior to start of work. Provide 24-hours' notice prior to any work occurring within buildings onsite.
- D. Confine storage of equipment and materials to areas as approved by the CO.
- E. Contractor shall provide adequate signing and barricades and take necessary safety measures to protect the public during all construction operations. Contractor shall minimize disturbance of work area.

- F. Preservation of Natural Features: Confines all operations to work limits of the project. Prevent damage to natural surroundings. Restore damaged areas, at no additional expense to the Government.
 - 1. Provide temporary barriers to protect existing trees and plants and root zones.
 - 2. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with CO and remove agreed-on roots and branches that interfere with construction.
 - 3. Do not fasten ropes, cables, or guys to existing trees.
 - 4. Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.
- G. Existing Utilities: Notify CO and utility companies of proposed locations and times for excavation.
 - 1. Contractor shall be responsible for locating and preventing damage to known utilities. Call the Utilities Underground Location Center at 1-800-782-5348, at least 2 business days in advance of excavation for the marking of underground utilities. If damage occurs, repair utility at no additional expense to the Government.
 - 2. Interruption of Existing Utility Service: Notify CO, 48 hours in advance of any interruption of existing utilities.
 - 3. Water service interruption shall be minimized and approved by the Contracting Officer in the construction schedule.

1.4 CONSTRUCTION SEQUENCE

- A. Contractor shall provide construction sequencing in the schedule that reduces service interruption to the existing facilities.
- B. The Contractor may use water utilities available onsite through metered fire hydrants. Power is not available for Contractor use during the project.

1.5 FIELD VERIFICATION

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering materials.

END SECTION

SECTION 01275

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1- Division16 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for measurement and payment.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the proposal costs/ quantites, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.
- B. Measurement and Payment: The Measurement and Payment sections do not necessarily name all incidental items required to complete the work. The cost of all such incidentals shall be included in the various related items of work. All estimated quantities stipulated in the Contract Documents are approximate and are to be used only as a basis for estimating the probable cost of the work and for the purpose of comparing the proposals submitted for the work. It is understood and agreed that the actual amounts of work performed, and materials furnished under unit price items may differ from such estimated quantities and the payment for such work and materials shall be based on the actual amount of work done and materials furnished in each case.
- C. The GOVERNMENT will determine the actual quantities and classifications of Unit Price Work performed by the Contractor.
- D. List of Bid Items: A list of unit Bid Items is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each Bid Item.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT AND PAYMENT

4.1 LIST OF BID ITEMS

A. Bid Items No. 01330-1 – MOBILIZATION

1. Description: **This item is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for payment of premiums for bonds and insurance for the project; and for any other work and operations which must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided for under the contract.**
2. Work Required: Work required under this section includes but is not limited to the following.
 - a. The movement of personnel, equipment, supplies and incidentals to the project site;
 - b. The establishment of all facilities necessary for the work on the project;
 - c. The costs of obtaining the required permits, bonds, and insurance; and
 - d. All other work and operations which must be performed, or costs incurred prior to beginning work on the various items of the project.
3. Unit of Measurement: Lump Sum
4. Measurement: Measurement for MOBILIZATION will be made as a percentage completed of the lump sum. 50% of the lump sum will be credited to the first progress payment, with the second 50% being credited to subsequent progress payments in proportion to total construction completed as a percentage of the contract unit price.
5. Payment: Payment for MOBILIZATION will be made at the contract unit price bid as a lump sum.

B. Bid Item No. 01172-1 – CONSTRUCTION SURVEY AND STAKING

1. Description: This item includes providing construction survey and staking necessary for construction of the project as shown in the Contract Documents.
2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Provide personnel, equipment and supplies required for construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, pipelines and other appurtenances required for the completion of the work and acceptance of the project;
 - b. All incidental materials, tools, equipment, and labor for the completion of this item.
3. Unit of Measurement: Lump Sum
4. Measurement: Measurement for CONSTRUCTION SURVEY AND STAKING will be made as a percentage completed of the lump sum. 50% of the lump sum will be credited to the first progress payment, with the second 50% being credited to subsequent progress payments in proportion to total construction completed as a percentage of the contract unit price.
5. Payment: Payment for CONSTRUCTION SURVEY AND STAKING will be made at the contract unit price bid as a lump sum.

C. Bid Items No. 340100-1– TRAFFIC CONTROL

1. Description: This item includes providing and maintaining all traffic control on the project as indicated on the Drawings and in the Contract Documents.

2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Furnishing, installing, maintaining, replacing, and operating necessary construction traffic control devices throughout the work period;
 - b. Preparing and submitting the traffic control plan and making adjustments as required for final approval; and
 - c. All incidental materials, tools, equipment, and labor for the completion of this item.
 3. Unit of Measurement: Lump Sum
 4. Measurement: Measurement for TRAFFIC CONTROL will be made as a percentage completed of the lump sum. 50% of the lump sum will be credited to the first progress payment, with the second 50% being credited to subsequent progress payments in proportion to total construction completed as a percentage of the contract unit price.
 5. Payment: Payment for TRAFFIC CONTROL will be made at the contract unit price bid as a lump sum.
- D. Bid Item No. 023701-1 – SOIL EROSION AND POLLUTION CONTROL:
1. Description: Prior to the start of construction, the Contractor shall submit a written plan for review that provides permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction. When erosion control measures are not functioning as intended, immediately take corrective action.
 2. Work required under this section shall include, but not be limited to the following:
 - a. Submit Erosion Control Plan;
 - b. Furnish and install of straw wattles (fiber rolls);
 - c. Furnish and install erosion control mats on slopes;
 - d. Temporary erosion control measures;
 - e. All labor, tools, equipment, materials, royalties and incidentals required to complete the work as specified.
 3. Unit of Measurement: Lump Sum
 4. Measurement: SOIL EROSION AND POLLUTION CONTROL shall be measured per lump sum.
 5. Payment: Payment shall be made per lump sum for SOIL EROSION AND POLLUTION CONTROL in place and approved. Payment shall include all costs of materials, tools, equipment and labor necessary to complete the work.
- E. Bid Items No. 02221-2 – PAVED STREET SURFACE RESTORATION (TYPE A)
1. Description: This item includes the surface restoration for trench excavations in paved streets, parking lots, and similar areas.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. If applicable, meeting requirements included in the Special Provisions and/or the City of Flagstaff city code;
 - b. Removing and disposing of existing asphalt;
 - c. Neatly saw cutting the edges of pavement removal before patching;
 - d. Furnishing and installing all base and leveling courses as specified and as may be required in the field;
 - e. Furnishing asphalt plant mix design with Marshall;
 - f. Furnishing and installing hot mix asphalt;

- g. Replacing any striping and/or paving markings disturbed during construction; and
 - h. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Lineal Foot.
 - 4. Measurement: Measurement for PAVED STREET SURFACE RESTORATION (TYPE A) will be made per lineal foot measured along the centerline of the trench excavation.
 - 5. Payment: Payment for PAVED STREET SURFACE RESTORATION (TYPE A) will be made at the contract unit price bid per lineal foot. The limits for payment extend 7 feet either side of the trench excavation centerline. Areas disturbed outside of the payment limits must be restored at the Contractor's expense.
- F. Bid Items No. 02221-3 – UNPAVED STREET SURFACE RESTORATION (TYPE B)
- 1. Description: This item includes the surface restoration for trench excavations in graveled alleys, side streets, parking lots, and similar areas.
 - 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Furnishing and installing aggregate base course;
 - b. Furnishing and installing aggregate surface course (as detailed); and
 - c. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Lineal Foot.
 - 4. Measurement: Measurement for UNPAVED STREET SURFACE RESTORATION (TYPE B) will be made per lineal foot measured along the centerline of the trench excavation.
 - 5. Payment: Payment for UNPAVED STREET SURFACE RESTORATION (TYPE B) will be made at the contract unit price bid per lineal foot. The limits for payment extend 8 feet (2.4 m) either side of the trench excavation centerline. Areas disturbed outside of the payment limits must be restored at the Contractor's expense.
- G. Bid Items No. 02221-4 – NATIVE GROUND SURFACE RESTORATION (TYPE C)
- 1. Description: This item includes the surface restoration for trench excavations in lawns, parks, pastureland, and similar areas.
 - 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Restoring, sodding or reseeding, and fertilizing any disturbed areas;
 - b. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Lineal Foot.
 - 4. Measurement: Measurement for NATIVE GROUND SURFACE RESTORATION (TYPE C) will be made per lineal foot measured along the centerline of the trench excavation.
 - 5. Payment: Payment for NATIVE GROUND SURFACE RESTORATION (TYPE C) will be made at the contract unit price bid per lineal foot. The limits for payment extend 8 feet (2.4 m) either side of the trench excavation centerline. Areas disturbed outside of the payment limits must be restored at the Contractor's expense.

- H. Bid Items No. 02910-1 – SEED AND FERTILIZE
1. Description: This item included seeding and fertilizing, with approved mixtures, all areas that the Contractor disturbs, which may include but is not limited to include haul roads, gravity main routes, spoil areas, equipment areas, borrow areas, and material storage areas.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Seed bed preparation;
 - b. Seeding and fertilizing the disturbed areas;
 - c. Protection of the seeded areas and reseeding as required during the maintenance period;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum
 4. Measurement: Measurement for SEED AND FERTILIZE will be made as a percentage completed of the lump sum.
 5. Payment: Payment for SEED AND FERTILIZE will be made at the contract unit price bid as a lump sum.
- I. Bid Item No. 02221-5 – URBAN TRAIL RESTORATION:
1. Description: This item shall meet the requirements of Section 340 of the Maricopa Association of Governments Standard Specifications and be constructed to the sizes and locations as shown on the City of Flagstaff standard detail drawing 14-01-010 provided in the drawings.
 2. The Contractor shall submit a concrete mix design to the CO for approval (see detail in plan set). Work required under this section shall include but not be limited to the following:
 - a. Removal and disposal of existing sidewalk;
 - b. Excavation and embankment as required to place base course at required grade;
 - c. Furnishing, installing and compacting crushed aggregate base course;
 - d. Fine grading and preparation of base;
 - e. Formwork;
 - f. Furnishing and installing concrete and reinforcing steel;
 - g. Furnishing concrete mix design;
 - h. Taking and breaking cylinders and taking slump tests;
 - i. Finishing and curing concrete;
 - j. Installation of construction joints;
 - k. All labor, tools, equipment, materials, royalties and incidentals required to complete the work as specified.
 3. Unit of Measurement: Linear Foot
 4. Measurement: Measurement for URBAN TRAIL RESTORATION will be made per Linear Foot measured along the centerline of the trench excavation.
Payment: Payment for URBAN TRAIL RESTORATION will be made at the contract unit price bid per Linear Foot as indicated in the Bid Form.
- J. Bid Item No. 02221-6 – CURB AND GUTTER RESTORATION:
1. Description: This item shall meet the requirements of Section 324 and 340 of the Maricopa Association of Governments Standard Specifications and be removed and constructed to the sizes and locations shown on the drawings.

2. Work required under this section shall include but not be limited to the following:
 - a. Removal and disposal of existing curb and gutter;
 - b. Excavation and embankment as required to place base course at required grade;
 - c. Furnishing, installing and compacting crushed aggregate base course;
 - d. Fine grading and preparation of base;
 - e. Formwork;
 - f. Furnishing and installing concrete and reinforcing steel;
 - g. Furnishing concrete mix design;
 - h. Taking and breaking cylinders and taking slump tests;
 - i. Finishing and curing concrete;
 - j. Installation of construction joints;
 - k. All labor, tools, equipment, materials, royalties and incidentals required to complete the work as specified.
3. Unit of Measurement: Lineal Foot
4. Measurement: Measurement for CURB AND GUTTER RESTORATION will be per Lineal Foot as indicated in the Bid Form and as shown on the plans.
5. Payment: Payment for CURB AND GUTTER RESTORATION will be made at the contract unit price bid per Lineal Foot as indicated in the Bid Form.

K. Bid Item No. 02232-1 – CLEARING AND GRUBBING

1. Description: This item includes removing and disposing of the trees and shrubs as indicated on the Drawings and in the Contract Documents.
2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Traffic control;
 - b. Removing all trees and shrubs called out on the Drawings;
 - c. Disposing of all removed trees and resultant debris;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
3. Unit of Measurement: Lump Sum
4. Measurement: Measurement for CLEARING AND GRUBBING will be made as a percentage completed of the lump sum.
2. Payment: Payment for CLEARING AND GRUBBING will be made at the contract unit price bid as a lump sum.

L. Bid Items No. 02730-1 and 010100-1 – 8” SEWER MAINS AND CROSSINGS

1. Description: This item includes furnishing and installing sewer mains in sizes, types, and classes indicated on the Drawings and in the Contract Documents.
2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Traffic control;
 - b. Excavation, backfill, and compaction;
 - c. Dewatering, sheeting, and shoring required for installation;
 - d. Furnishing and installing pipe with gaskets, lubricants, etc.;
 - e. Furnishing and installing pipe bedding;
 - f. Crossing existing utilities and maintaining the minimum horizontal and vertical separation per City of Flagstaff code and Maricopa Association of Governments Standard Specifications;
 - g. Furnishing and installing tracer wire system per City of Flagstaff code;

- h. Furnishing and installing detectable warning tape;
 - i. Site restoration;
 - j. Testing and cleaning;
 - k. TV inspection;
 - l. Maintaining service to all users; and
 - m. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
- 3. Unit of Measurement: Lineal Foot
 - 4. Measurement: Measurement for SEWER MAINS AND CROSSINGS will be made per lineal foot along the centerline of the pipe through all fittings.
 - 5. Payment: Payment for SEWER MAINS AND CROSSINGS will be made at the contract unit price bid per lineal foot. Partial payment for incomplete work may be approved.

M. Bid Items No. 02730-2 – 48” MANHOLES

- 1. Description: This item includes furnishing and installing new manholes in sizes and types indicated on the Drawings and in the Contract Documents.
- 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Traffic control;
 - b. Excavation, backfill, and compaction;
 - c. Dewatering, sheeting, and shoring required for installation;
 - d. Any necessary bypass pumping to maintain sewer service;
 - e. Removing and disposing of any existing manholes or structures being replaced;
 - f. Furnishing and installing concrete watertight manholes complete with monolithic base, gaskets, coatings, watertight connections, steps, frame and cover, and watertight frame and cover where specified;
 - g. Pouring and forming channels;
 - h. Furnishing and installing casting and cover;
 - i. Connecting manholes to piping;
 - j. Testing manholes for watertightness; and
 - k. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
- 3. Unit of Measurement: Each
- 4. Measurement: Measurement for 48” MANHOLES will be made by numerical count.
- 5. Payment: Payment for 48” MANHOLES will be made at the contract unit price bid per each.

N. Bid Items No. 02730-3 – CONNECT TO EXISTING MANHOLE

- 1. Description: This item includes the connection of existing manholes.
- 2. Required Work: Work required under this section includes but is not limited to the following.
 - a. Excavation, backfill, and compaction;
 - b. Dewatering, sheeting, and shoring required for installation;
 - c. Furnishing, placing, and compacting imported embankment;
 - d. Pumping the manhole dry and properly disposing of wastewater and sludge;
 - e. By-pass pumping;
 - f. Connecting existing manholes to piping;

- g. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Each
 - 4. Measurement: Measurement for CONNECT TO EXISTING MANHOLE will be made by numerical count.
 - 5. Payment: Payment for CONNECT TO EXISTING MANHOLE will be made at the contract unit price bid per each.
- O. Bid Item No. 02730-4 – DROP SEWER CONNECTION OUTSIDE MANHOLE
- 1. Description: This item covers the necessary preparation and installation of a new drop sewer connection inlet outside of new manholes per Maricopa Association of Governments Standard Specifications and Details.
 - 2. Work required under this section shall include, but not be limited to the following:
 - a. Providing material submittals;
 - b. Furnish and install required materials;
 - c. Cleaning of manholes;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Each
 - 4. Measurement: Measurement for DROP SEWER CONNECTION OUTSIDE MANHOLE shall be per each manhole where the stairs are replaced.
 - 5. Payment: Payment will be made at the contract unit price bid per each manhole where stairs are replaced for DROP SEWER CONNECTION OUTSIDE MANHOLE as indicated in the Bid Form.
- P. Bid Items No. 02730-5 – 4” SEWER SERVICE LATERALS
- 1. Description: This item includes furnishing and installing sewer service lines in sizes, types, and classes indicated on the Drawings and in the Contract Documents.
 - 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Traffic control;
 - b. Excavation, backfill, and compaction;
 - c. Dewatering, sheeting, and shoring required for installation;
 - d. Furnishing and installing in-line service wyes;
 - e. Furnishing and installing sewer service line, transition gaskets, couplings, and adapters for new and existing pipe;
 - f. Connecting to existing service lateral at the existing structure;
 - g. Furnishing and installing pipe bedding;
 - h. Repairing fences, lawns and other landscaped areas damaged by construction;
 - i. Replacing damaged trees and bushes; and
 - j. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Lineal Foot
 - 4. Measurement: Measurement for SEWER SERVICE LATERALS will be made per lineal foot along the centerline of the pipe through all fittings.
 - 5. Payment: Payment for the SEWER SERVICE LATERALS will be made at the contract unit price bid per lineal foot.

- Q. Bid Items No. 02730-6 – SEWER SERVICE CLEANOUTS (NON-TRAFFIC AREAS)
1. This item includes furnishing and installing sewer service cleanouts in sizes, types, and classes indicated on the Drawings and in the Contract Documents.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Excavation, backfill, and compaction;
 - b. Dewatering, sheeting, and shoring required for installation;
 - c. Furnishing and installing all fittings and pipe required for cleanout;
 - d. Repairing fences, lawns and other landscaped areas damaged by construction;
 - e. Replacing damaged trees and bushes; and
 - f. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Each
 4. Measurement: Measurement for SEWER SERVICE CLEANOUTS (NON-TRAFFIC AREAS) will be made by numerical count.
 5. Payment: Payment for SEWER SERVICE CLEANOUTS (NON-TRAFFIC AREAS) will be made at the contract unit price bid per each.
- R. Bid Items No. 02730-7 –SEWER SERVICE CONNECTION
1. Description: This item includes installing an in-line service wye on new sewer mains and connecting new sewer services at the edge of excavation for each residence or business. The type and class of existing pipe in the ground is not known in all cases. The Contractor will be responsible for verifying the types and classes of pipe to be connected to and will be prepared to tie to any type and class of pipe. No extra compensation will be allowed due to different types and classes of existing pipe. This item shall include all necessary fittings and pipe to connect new service laterals within ten (10) feet, horizontally, from the new main. Sewer service pipe installed beyond ten (10) feet, horizontally, from the new main will be paid separately under Bid Item No.02730-6.
 2. Work Required: Work required under this section will include but is not limited to the following.
 - a. Traffic control;
 - b. Excavation, backfill, and compaction;
 - c. Dewatering, sheeting, and shoring required for installation;
 - d. Locating and cleanly cutting existing services;
 - e. Furnishing and installing an in-line service wye on new sewer mains or a saddle on existing sewer mains;
 - f. Connecting to service wye or saddle on new sewer main;
 - g. Furnishing and installing sewer service lateral, transition gaskets, couplings, and adapters; and
 - h. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Each
- S. Measurement: Measurement for SEWER SERVICE CONNECTION will be made by numerical count.
- T. Payment: Payment for the SEWER SERVICE CONNECTION will be made at the contract unit price bid per each.

- U. Bid Item No. 02730-8 – ABANDON EXISTING SEPTIC TANK
1. Description: This item includes locating existing septic tanks and other objects adding existing wastewater, pumping and disposing of septage by a licensed septage hauler, and filling empty tank with acceptable fill material.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Disconnecting and removing any electrical and mechanical components;
 - b. Excavation, backfill, and compaction;
 - c. Furnishing and installing all materials necessary;
 - d. Pumping out the existing septic tank, and hauling and disposal of septage at acceptable facility;
 - e. Abandoning septic tanks per A.A.C. R18-9-A309(D);
 - f. Submittal of required documents;
 - g. Removal and disposal of the existing lids and risers;
 - h. Filling the empty structures with acceptable fill material;
 - i. Placing fill over the tank footprints, seeding and grading to restore natural contours; and
 - j. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Each
 4. Measurement: Measurement for ABANDON EXISTING SEPTIC TANK will be made by numerical count.
 5. Payment: Payment for ABANDON EXISTING SEPTIC TANK will be made at the contract unit price bid per each.
 - 6.
- V. Bid Item No. 010100-1-1– EXISTING WATER AND GAS MAIN CROSSING:
1. Description: This item involves hydro excavation and hand digging and well as any specialized equipment when crossing water lines or HP Gas lines. Existing water and gas main crossings shall be used for the crossings of Kinder Morgan/ El Paso High Pressure Gas lines. Contractor shall remove required amount of overburden for sewer main placement not less than 48 hours prior to pipe excavation. Crossings can be found in the plan set provide to the contractor.
 2. Work required under this section shall include but not be limited to the following:
 - a. Providing equipment/ material submittals;
 - b. Remove and dispose of excavated material;
 - c. All labor, tools, equipment, materials, royalties and incidentals required to complete the work as specified;
 3. Unit of Measurement: Each
 4. Measurement: Measurement for EXISTING WATER AND GAS MAIN CROSSING will be made by each crossing based upon excavation of the water or gas mains by the CO.
 5. Payment: Payment for EXISTING WATER AND GAS MAIN CROSSING will be made at the contract unit price bid as indicated in the Bid Form.
- W. Bid Item No. 03315-1– FLOWABLE FILL CONCRETE:
1. Description: This item involves backfill with flowable fill. Flowable fill shall be used for backfill up to finished road grade. Contractor shall remove required amount of non-shrink backfill for pavement placement not more than 24 hours prior to paving.

2. Work required under this section shall include but not be limited to the following:
 - a. Providing material submittals;
 - b. Remove and dispose of excavated material;
 - c. Furnish and install flowable fill at water and sanitary sewer crossings per Maricopa Association of Governments Standard Specifications;
 - d. All labor, tools, equipment, materials, royalties and incidentals required to complete the work as specified;
3. Unit of Measurement: Cubic Yard
4. Measurement: Measurement for FLOWABLE FILL CONCRETE will be made by the Cubic Yard based upon batch delivery tickets provided to the CO at the time of placement.
5. Payment: Payment for FLOWABLE FILL CONCRETE will be made at the contract unit price bid as indicated in the Bid Form.

END OF SECTION

SECTION 01330

SUBMITTALS

PART 1- GENERAL

1.1 DESCRIPTION

- A. Work Included:
 - 1. Submittals are required under this contract for the purpose of establishing the final specifications for: (1) quality assurance; (2) design configuration; (3) performance standards; (4) color, texture, or finish; and/or (5) other features necessary for a complete description of the Work to be performed.
- B. Submittals shall be approved by the Contracting Officer. The Contractor shall not purchase, order, ship, install, or otherwise incur costs for a product or other work subject to submittal approval until after approval is granted by the Contracting Officer; the Government shall not be responsible for payment for any work, product, design, etc., not approved.
- C. Rejection of any submittals by the Contracting Officer constitutes notice that a resubmittal is required for the same purpose; rejections shall be explained.
- D. The intent of the submittals is to provide complete information about the subject item sufficient for the Government to make a decision on that item's compliance with the purpose of the item and the general specification for that item. Descriptions contained in the approved submittals shall constitute an extension of the general specification concerning that item; and subsequent performance by the Contractor shall conform to submittal information except as allowed as substitutions in other sections as indicated.

1.2 RELATED WORK

- A. Individual requirements for submittals may also be described in pertinent sections of the Technical Specifications.

1.3 QUALITY ASSURANCE

- A. "Or Equal":
 - 1. Where the phrase "or equal" or "equal as approved by the Contracting Officer," or "but are not limited to" occurs in the contract documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been so specifically approved by the Contracting Officer.

PART 2 - PRODUCTS

2.1 REQUIRED SUBMITTALS

- A. It shall be the Contractor's responsibility to submit all items with such promptness as to cause no delay in the Work. Approvals must be obtained before starting any Work which involves them.

The following submittals are required following award of the contract for review and/or approval pursuant to contract provisions:

1. One copy of the Work Progress Schedule listing main types of Work and anticipated times for construction and completion.
- B. One copy of the list of subcontractors proposed for the principal parts of the Work.
- C. Copies of Certification and other documentation which establish the qualifications of proposed workers to perform the Work.

At a minimum the contractor shall provide project submittals as shown on the Submittal Log below. Submittal requirements are listed throughout these specifications and the Drawings.

Log No.	Incidental to Pay Item(s)	Description of Submittal	Type of Submittal	Requirement found in Specification No. /Drawings
1	01330-1	Schedule	Schedule	01330
2	01172-1	Construction Staking	Survey Log	010250, 01712
3	01330-1	List of Subcontractors	Listing	01330
4	01330-1	Qualifications of Proposed Workers	Listing	01330
5	01330-1	Contractor Quality Control Plan	Plan	01450
6	340100-1	Traffic Control Plan	Plan	340100
7	023701-1	Temporary Erosion and Sedimentation Control Plan	Sediment & Erosion Control Plan	023701
8	01330-1	Material Storage/Staging Plan	Plan and Description	Drawings
9	02730 (1-7)	HDPE Pipe, PVC Pipe, Fittings, Hydrants, Valve Boxes, and all Appurtenances (Including Tracer Wire)	Material Submittals	02730, Plans
10	02730 (1-3)	Pipe Bedding Material	Material Certifications	02221
11	02221-5 thru 6, 02730-9	Concrete Mix Material	Material Certifications, Drawings, QC Test Reports	03100, 03200, 03290, 03300, 321313, 321373, 321613, 321623

Log No.	Incidental to Pay Item(s)	Description of Submittal	Type of Submittal	Requirement found in Specification No. /Drawings
12	02221-6	Concrete Curb	Certificate of Conformance – Concrete Curb, QC Test Reports	02221
13	02221-2	Asphalt Mix Material	Product Data, Job Mix Design, Material Certificate	02221, 321216, 321640
14	02221-2	Pavement Markings	Product Data	02221, 321216, 321640
15	02730-2 thru 4	Manholes	Material Certifications	02730, 02954
16	01330-1	Closeout Documents	As-Built Drawings, O&M Manual Punchlist	01770

2.2 MANUFACTURER'S LITERATURE AND SHOP DRAWINGS

- A. One (1) electronic copy of applicable submittals shall be provided to the Government through email, ftp site, or other electronic method.

The information provided shall be adequate to determine compliance with the specifications. Literature which is not marked or otherwise designated to show the exact model, size, etc. which the Contractor proposes to use, will be returned by the Contracting Officer "without action." Circle or check applicable items on submittals. Do not use highlighter pens.

Submittals which are received from sources other than through the Contractor's office will be returned by the Contracting Officer "without notice."

Make submittals of Shop Drawings, Manufacturer's literature, tests, Schedules, samples, substitution requests, and other items in accordance with the provisions of this Section.

2.3 SAMPLES

- A. Submit two samples of each color, style, etc. One sample of selected color, etc. will be retained. All other samples and all hardware samples will be returned.

PART 3 - EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

- A. Consecutively number all submittals. Cross reference all submittals with the specific Section number of the specifications.

1. When material is resubmitted for any reason, transmit under a new letter of transmittal with a new submittal number.
- B. On submittals, cite the original submittal number for reference.

Accompany each submittal with letter of transmittal showing all information for identification and checking.

On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.

Where contents from manufacturers include data not pertinent to the submittal, clearly show which portions of the contents are being submitted for review.

Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. The submittal log shall be made available to the Contracting Officer for review upon request.

3.2 GROUPING OF SUBMITTALS

- A. Make construction drawing submittals in a group containing all associated items to assure that information is available for checking each item when it is received.
 1. Partial submittals may be rejected as not complying with the provisions of the contract.
- B. The Contractor may be liable for delays caused by rejected submittals.

3.3 TIMING OF SUBMITTALS

- A. Submit temporary erosion control plan at the Post Award Conference. No work shall be started on the project site until the erosion control plan is approved by the Contracting Officer.
- B. Make construction submittals for the first phases of Work within 15 calendar days of the date of the Notice-To-Proceed.

In scheduling, allow at least twenty (20) working days for review by the Contracting Officer following receipt of the submittal.

3.4 REVIEW OF SUBMITTALS

- A. The Contracting Officer will review submittals with reasonable promptness, indicating in writing the appropriate approval category ("Approved," "Disapproved," "Approved Subject to Corrections Shown") upon them. One (1) copy of the drawings or vendor's data shall be returned to the Contractor and when corrections are required, the Contractor shall make such corrections. The drawing (or other vendor's data) shall then be resubmitted by the Contractor for approval until an unqualified approval is obtained. After unqualified approval is obtained, the Contractor shall furnish the Contracting Officer with three (3) copies of the approved submittals.

Review by the Contracting Officer does not relieve the Contractor from responsibility for errors which may exist in the submitted data.

Revisions:

 1. Make revisions required by Contracting Officer.

- B. If the Contractor considers any required revision to be a change, the Contractor shall notify the Contracting Officer as provided for in the General Conditions.

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART 1- GENERAL

1.1 DESIGN STANDARDS AND CODES

- A. All work shall comply with the rules and regulations of federal, state, and local agencies having jurisdiction. The Contractor shall acquire all permits, licenses and approval needed to complete the project from applicable state and local officials.
- B. The construction methods shall meet the latest edition of all national, state and local codes. The following standards and codes are made part of the contract specifications. In case of conflict, the most stringent shall apply.

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADAABAAG	Americans with Disabilities Act-Architectural Barriers Act Accessibility Guidelines
AISC	American Institute of Steel Construction
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
FSORAG	USDA Forest Service Outdoor Recreation Accessibility Guidelines
FSTAG	USDA Forest Service Trail Accessibility Guidelines
IBC	International Building Code
ICBO	International Committee of Building Officials
IEC	International Electric Code
MUTCD	Manual on Uniform Traffic Control Devices (Department of Transportation)
NBS	National Bureau of Standards (Department of Commerce)
NEC	National Electric Code
OSHA	Occupational Safety and Health Administration (Department of Labor)
SSPC	Steel Structures Painting Council
UFAS	Uniform Federal Accessibility Standards
WWPA	Western Wood Products Association

1.2 REFERENCE SPECIFICATION

- A. At all times, keep the following documents on site and available for use by the Contractor, Subcontractors, if any, and Contracting Officer:
 - 1. American Concrete Institute Specifications for Structural Concrete (ACI 301-20).

1.3 VARIATIONS WITH REFERENCES

- A. Promptly notify the Contracting Officer of any observed conflict between drawings and referenced standard or specification.

- B. Assume responsibility for work known to be contrary to such requirements without notice.

END SECTION

SECTION 01420

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. “Indicated”: The term “indicated” refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as “shown,” “noted,” “scheduled,” and “specified” are used to help the reader locate the reference. Location is not limited.
- C. “Directed”: Terms such as “directed,” “requested,” “authorized,” “selected,” “approved,” “required,” and “permitted” mean directed by the Government, requested by the Government, and similar phrases.
- D. “Approved”: The term “approved,” when used in conjunction with the CO’s action on the Contractor’s submittals, applications, and requests, is limited to the CO’s duties and responsibilities as stated in the Conditions of the Contract.
- E. “Regulations”: The term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.
- F. “Furnish”: The term “furnish” means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. “Install”: The term “install” describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. “Provide”: The term “provide” means to furnish and install, complete and ready for the intended use.
- I. “Installer”: An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installations, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term “experienced,” when used with the term “installer,” means having a minimum of 5 previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of authorities having jurisdiction.

- A. Trades: Using terms such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter.” It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
- B. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialist must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
 - 1. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- C. “Project Site”: The space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- D. “Testing Agencies”: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- E. “CO”: Contracting Officer or Government.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on Construction Specifications Institute (CSI) numbering system.
- B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances.
- C. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpreted as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
- D. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others so noted. The words “shall be” are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publications Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer to the CO before proceeding for a decision on requirements that are different, but apparently equal; and where it is uncertain which requirement is the most stringent.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum acceptable. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the CO for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standard-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to "Gale Research Co." "Encyclopedia of Associations," available in most libraries.

END OF SECTION

SECTION 01430

QUALITY ASSURANCE

PART 1- GENERAL

1.1 DESCRIPTION

- A. Establish and maintain an effective quality control program and perform sufficient inspections and tests of all items of work, including those of subcontractors, to ensure compliance with the Contract Documents.

1.2 GENERAL

- A. Provide for procedures to ensure that the latest Contract Documents, standards, codes, shop drawings and instructions are used for fabrication, construction and testing.
- B. Furnish appropriate facilities, instruments and testing devices required for performance of the quality control program.
- C. Contractor is responsible for inspections and tests required in Divisions 2 and Section C, and the cost of same shall be included in the Contract Sum.
- D. Ensure that the work of related trades is properly coordinated.

1.3 QUALIFICATIONS

- A. Persons qualified by training and/or experience shall provide, install and/or perform all work. Qualifications and/or minimum years of experience are specified in the technical sections of these Specifications. At the Pre-Work Conference, provide documentation demonstrating that qualifications for each phase of work will be met.

1.4 PRE-INSTALLATION

- A. It is the Contractor's responsibility to be certain that all equipment and materials selected by the Contractor, subcontractors or material suppliers conform exactly to the requirements of the Contract Documents. Approval of a manufacturer's name by the CO does not relieve the Contractor of the responsibility for providing materials and equipment which comply with the Drawings and Specifications.
- B. Before the installation of every major unit of work that requires coordination with other work, ensure that the unit of work can be installed and function as intended and required in conjunction with other work which has preceded or will follow. If the installer reports unsatisfactory conditions for installation, do not proceed until these conditions have been corrected.

1.5 INSTALLATION

- A. Conform to testing and inspection requirements as specified. Coordinate enclosure of work with required inspections and tests, so as to avoid the necessity of uncovering work for that purpose.

- B. Unless otherwise noted or directed, install all work in accordance with Manufacturer's recommendations for best results. Do not omit any preparatory steps or installation procedures unless specifically modified or exempted by the Documents.
- C. Recheck measurements and dimensions of the Work, as an integral step of starting each installation.
- D. Any modification necessary for the proper installation and function of an approved substituted item shall be made by the Contractor at no additional cost to the Government. The Contractor shall bear the cost of any detailing or design required to accommodate the change.
- E. Protect newly installed work to ensure that it will remain without damage or deterioration during the remainder of the construction period. If damage or deterioration should occur, restore to new condition at no additional cost to the Government.

END SECTION

SECTION 01450

QUALITY CONTROL

PART 1- GENERAL

1.1 DESCRIPTION

- A. Contractor provided testing laboratory services.

1.2 RELATED WORK

- A. Section 01770, Closeout Submittals
- B. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.3 REFERENCES

- A. ANSI/ASTM D-3740: Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ANSI/ASTM E-329: Standard Specification for Agencies Engaged in Construction, Inspection, Testing or Special Inspection.

1.4 SELECTION AND PAYMENT

- A. Contractor will employ and pay for services of an independent testing laboratory to perform specified inspection and testing. Sampling and testing shall be provided to assure compliance with the requirements of the drawings and Specifications.
- B. Employment of testing laboratory shall in no way relieve the Contractor of obligation to perform work in accordance with requirements of contract documents.
- C. Under no circumstances shall a supplier of materials be allowed to act as an approved testing laboratory.
- D. No materials shall be placed or installed without prior acceptance by the Contracting Officer, based on test and inspection results.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM E-329 and ANSI/ASTM D3740.
- B. Laboratory shall maintain a full-time registered engineer on staff to review services.
- C. Laboratory authorized to operate in the State of Arizona.
- D. Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either NBS Standards or accepted values of natural physical constants.

1.6 CONTRACTOR SUBMITTALS

- A. General Contractor shall submit a Contractor Quality Control Plan prior to commencement of work.
- B. Prior to start work, submit testing laboratory name, address, and telephone number, and names of full-time registered engineer and responsible officer.
- C. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.7 LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Contractor.
- B. Provide qualified personnel at site after due notice; cooperate with the Contracting Officer and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of products.
- D. Ascertain compliance of materials and mixes with requirements of contract documents.
- E. Promptly notify the Contracting Officer and Contractor of observed irregularities or non-conformance of work or products.
- F. Perform additional inspections and tests required by the Contracting Officer.

1.8 LABORATORY REPORTS

- A. After each inspection and test, promptly submit two (2) copies of the laboratory report to the Contracting Officer. Include: Date issued, project title and number, name of inspector, date and time of sampling or inspection, identification of product and specifications section, location in the project, type of inspection or test, date of test, results of test, and conformance with contract documents. When requested by the Contracting Officer, provide interpretation of test results.

1.9 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of contract documents.
- B. Laboratory may not approve or accept any portion of the work.
- C. Laboratory may not assume any duties of the Contractor.
- D. Laboratory has no authority to stop work.

1.10 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.

- B. Cooperate with laboratory personnel and provide access to work.
- C. Provide incidental labor and facilities for access to work to be tested, to obtain and handle samples at the site or source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

END SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1- GENERAL

1.1 DESCRIPTION

- A. Work under this Section includes temporary facilities to facilitate the Work and construction controls to protect workers and the public from injury, harm or discomfort.

1.2 RELATED WORK

- A. Section 01330, Submittals

1.3 RULES AND REGULATIONS

- A. All construction methods and procedures shall be in compliance with the State of Arizona, Labor Department, Industrial Commission of Arizona.
- B. The Contractor shall familiarize himself/herself with current OSHA rules and observe these regulations at all times during the term of this Contract.

1.4 SAFETY AND NOISE CONTROLS

- A. Provide all labor, material, and equipment necessary for protection of public, personnel, vehicles and the environment from injury or damage.
- B. Erect all necessary barricades and guards. Post appropriate warning signs. Use a water truck as necessary to control dust.
- C. Comply with all applicable regulations and restrictions in regard to noise levels and noise-generating activities.

1.5 CLEANUP AND DISPOSAL

- A. Remove all temporary facilities and construction controls at the completion of the Work.
- B. Leave work area clean and free of all debris associated with this Section of Work.

END SECTION

SECTION 01660

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This work includes the protection of products scheduled for use in the work by means including, but not necessarily limited to, those described in this Section.

1.2 QUALITY ASSURANCE

- A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.3 MANUFACTURERS' RECOMMENDATIONS

- A. Except as otherwise approved by the Contracting Officer, determine and comply with manufacturers' recommendations on product handling, storage, and protection.

1.4 PACKAGING

- A. Deliver products to the job site in their manufacturer's original containers, with labels intact and legible.
- B. Maintain packaged materials with seals unbroken and labels intact until time of use.
- C. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Government.
- D. The Contracting Officer may reject as non-complying such material and products that do not bear identification satisfactory to the Contracting Officer as to manufacturer, grade, quality, and other pertinent information.

1.5 PROTECTION

- A. Protect finished surfaces, including columns, beams and fascias of openings used as passageways, through which equipment and materials are handled.
- B. Provide protection for finished surfacing in traffic areas prior to allowing equipment or materials to be moved over such surfaces.
- C. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Contracting Officer.

1.6 REPAIRS AND REPLACEMENTS

- A. In event of damage, promptly make replacements and repairs to the approval of the Contracting Officer and at no additional cost to the Government.

- B. Additional time required to secure placements and to make repairs will not be considered by the Contracting Officer to justify an extension in the Contract Time of Completion.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record documents.
 - 3. Operation and maintenance manuals.
 - 4. Instruction of Government's personnel.
 - 5. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
 - 2. Divisions 2 through Section C Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following or list items below that are incomplete in request. Also refer to the General Conditions for additional submittals and procedures for Substantial Completion.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Government of pending insurance changeover requirements in accordance with the General Conditions.
 - 3. Submit specific warranties, Performance bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Government unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and/or similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Government. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Government. Advise Government's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, construction tools, and similar elements.
 11. Submit changeover information related to Government 's occupancy, use, operation, and maintenance.
 12. Complete final cleaning requirements, including touchup painting.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Following the submittal of the preliminary documents described above, inspection of the Work shall be completed in accordance with the General Conditions.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment.
 2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit evidence that bonds shall be in effect until one year after the date when final payment becomes due or until completion of the correction period specified, whichever is later.
 5. Instruct Government 's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements.
1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of areas in sequential order.
 2. Organize items applying to each area by major element.

3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Page number.

1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Maintain Record Documents in accordance with the General Conditions.
- B. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is installer, Subcontractor, or similar entity, to prepare the marked-up Record Prints. Record Prints shall, at a minimum, meet the following requirements:
 1. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 2. Accurately record information in an understandable drawing technique.
 3. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 4. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 5. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 6. Mark important additional information that was either shown schematically or omitted from original Drawings.
 7. Note Work Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 8. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 2 - EXECUTION

2.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, broken pipe, sheeting, worn-out parts, rejected materials, concrete, asphalt and other foreign substances.
 - b. Remove excess piles of gravel or soil deposited throughout project.
 - c. Final grade in unpaved, graveled, and un-graveled areas with a motor grader.
 - d. Remove all loose rocks, boulders, and coarse gravel pushed into a berm by final grading.
 - e. Restore surface drainage to original condition unless otherwise detailed in the project plans and specifications.
 - f. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - g. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - h. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - i. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - l. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Replace parts subject to unusual operating conditions.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Government's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 01712

FIELD ENGINEERING

PART 1- GENERAL

1.1 DESCRIPTION

- A. All field engineering services required to complete the work shall be provided by the Contractor unless otherwise noted.

1.2 RELATED WORK

- A. Section 01700, Close Out Procedures

1.3 QUALITY ASSURANCE

- A. Cost of field engineering shall be considered incidental to the item being constructed.
- B. Survey work shall be completed by, or under the direct supervision of, a person experienced in construction surveying.
- C. Provide layout and grade staking according to professional engineering and surveying procedures for the type of work being performed.
- D. Provide structural design of shores, forms and similar items used by the Contractor as part of his/her means and methods of construction.
- E. During the course of construction, the Contractor shall make available a person to help the Contracting Officer with field checking of grades and control as may be necessary to assure proper construction.

1.4 REFERENCE POINTS

- A. Locate and protect monuments, benchmarks, and initial control point, or reference thereto, prior to commencing work. Establish additional reference points as needed during construction.
- B. Report to the Contracting Officer when reference points or initial control points are lost or destroyed during construction. Replace points immediately.

1.5 REQUIREMENTS

- A. Establish lines and levels to properly layout and construct the work to the dimensions and elevations shown on the Plans. Re-establish and restake survey bearings, traverse lines, stationing and points of intersection as required to construct the work to the horizontal and vertical alignments as detailed.
- B. Take measurements as far in advance of required installation as possible and verify measurements given on Drawings. Promptly report variations, discrepancies or non-closing dimensions with the Contracting Officer for further direction.

- C. Maintain construction lines and grade staking to assure accurate and proper control of the work and to verify final grades and construction lines.
- D. Periodically, verify layouts and elevations by methods as required. No extra will be paid to the Contractor for removal and replacement of work which is found to be incorrectly installed.

1.6 FIELD ADJUSTMENTS

- A. The Government reserves the right to field adjust layouts and grades for the purpose of avoiding obstructions and/or conforming to existing site features.
- B. The Contractor shall make adjustments as directed by the Contracting Officer at no additional cost to the Government.

1.7 SURVEY RECORDS

- A. Maintain a complete, accurate log of all control and construction survey work as it progresses.

END SECTION

SECTION 01730

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. General installation of products.
 - 2. Coordination of Government-installed products.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.
- B. Related Sections include the following:
 - 1. Division 1 Section "Contract Closeout" for submitting final property survey with Project Record Documents, recording of Government-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify CO/COR not less than two working days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without CO/COR 's written permission.

- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.2 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
- G. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.3 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Remove and properly dispose of excess material accumulated from demolition and construction (such as piles of gravel or soil, broken concrete, debris, papers, rejected materials, worn-out equipment parts, etc.) from the project site at the Contractor's expense. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.4 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01740

CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. All clean-up work including all materials, labor and equipment necessary for cleaning and debris removal.

1.2 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with local codes, ordinances and regulations.
- B. Dispose of all debris and materials at a site approved by the Government, Contracting Officer, and Local Authority.
- C. The Contractor shall be responsible for all costs and fees associated with disposal of waste materials and debris.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the work site and adjacent properties free from accumulations of waste materials and trash.
- B. Provide on-site containers for the collection of waste materials and trash.

3.2 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning as needed until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.3 FINAL CLEANING

- A. At the completion of the project, or prior thereto if so directed by the Contracting Officer, the Contractor shall be responsible for complete cleaning of those portions of the project and site which his work effects.
- B. Sweep and clean concrete slabs thoroughly and remove all marks, stains, fingerprints, dust, dirt, paint drippings and other construction residue from all surfaces. Clean and touch up all painted work. Clean site and remove excess debris, branches, rocks, and trash.
- C. Prior to final inspection by Contracting Officer, Contractor shall conduct his own inspection of exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean and ready for inspection and use by the Government.

3.4 RESTORATION OF DAMAGED PROPERTY

- A. To the extent that any roads, vegetation, structures, utilities or other items are damaged or displaced by the Contractor's operations, these shall be restored to their original or better condition prior to Final Inspection. This shall include both on-site and off-site items. Any damage which is severe enough to disrupt community travel or utilities shall be repaired by the Contractor immediately, when requested by the Contracting Officer.

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1- GENERAL

1.1 DESCRIPTION

- A. This Section describes an orderly and efficient transfer of the completed work to the Government.

1.2 QUALITY ASSURANCE

- A. Prior to requesting inspection by the Contracting Officer, use adequate means to assure that the work is substantially completed in accordance with the specified requirements and is ready for the requested inspection.

1.3 PROCEDURES

- A. Substantial Completion:
 - 1. Substantial completion is defined as that point at which the work is basically complete and ready for use. All specified products shall have been installed and are functionally operational. Remaining work shall be extremely minor or require seasonal opportunity to complete or subject to delayed completion items and shall not impair the functionality of the site.
- B. The Contractor shall notify the Contracting Officer, in writing as required by the General Conditions, as to the date when in its opinion all or a designated portion of the work will be substantially completed and ready for inspection.
- C. Within a reasonable time after receipt of such notice, the Contracting Officer will inspect to determine status of completion.
- D. Should the Contracting Officer determine that the Work is not substantially complete:
 - 1. The Contracting Officer promptly will so notify the Contractor in writing, giving the reasons therefore.
 - 2. The Contractor shall remedy the deficiencies and notify the Contracting Officer when ready for reinspection.
 - 3. The Contracting Officer will reinspect the Work.
 - 4. The Contractor shall be liable for expenses incurred by the Government for reason of such Substantial Completion Reinspection.
- E. When the Contracting Officer concurs that the Work is substantially complete:
 - 1. The Contracting Officer will prepare a Punch List of items to be completed or corrected, as verified by the CO.
 - 2. The Contracting Officer will submit the Punch List to the Contractor for their written acceptance of the responsibilities assigned to them in the Punch List.
 - 3. Once the Contractor executes the Punch List, the Contracting Officer must be notified in writing.

- F. Immediately following approval of Substantial Completion, the Contractor shall submit the following documents.
1. Final Pay Request with final adjustment of accounts stating all adjustments to the contract sum.
 2. Previous change orders.
 3. Deductions or uncorrected work.
 4. Other adjustments.
 - i. Contractor's Certificate and Release
 - ii. Operation and Maintenance Manuals (The Contractor shall prepare binder covers with the printed title "Operation and Maintenance Data", the title of the project, and all subject matter contained within the binder)
 - iii. As-Built Drawings and Submittals.
- G. Final Inspection: Final Inspection shall be defined as that period at which all work in the Contract is 100% complete and no minor details remain to be performed.
1. Final inspection shall not be made until all work under the contract is completed. The Contractor shall notify the Contracting Officer in writing, at least 4 working days prior to the date requested on which the work will be ready for final inspection.
 2. Following notification, the Contracting Officer will make an inspection of the Contractor's work and record any deficiencies on the Final Punch List. The Contractor shall immediately correct these deficiencies at her/his own expense and notify the Contracting Officer in writing when all items have been corrected. The Contracting Officer will re-inspect the work to assure correction of all deficiencies before release of amounts retained for minor, seasonal or delayed items. The Contractor shall be liable for all costs of reinspection when the Substantial Completion Punch List deficiencies have not been corrected at the time of the Final Inspection and reinspection is required.
 3. Any reasonable delay by the CO in making final inspection shall not relieve the Contractor of responsibility for the work nor shall the Government be held responsible for damages or claims for compensation on account of continuing overhead, maintenance, etc., occasioned by such a delay.
- H. Final Pay Request will be processed for payment upon final inspection and Contracting Officer's certification that work under the contract is 100% complete.

PART 2 - PRODUCTS

2.1 WARRANTY

- A. The Contractor warrants the products delivered under the contract to be free from defects in design, material or workmanship, and against damage caused prior to final inspection. Unless otherwise specified, this warranty extends for a period of one (1) year from the date of final acceptance. Provide any manufacturer's warranty documentation for any individual items supplied.

The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Contractor may elect to have any replaced item returned to his plant at his expense.

END OF SECTION

DIVISION 2

SITE CONSTRUCTION

SECTION 02221

TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

PART 1 - GENERAL

1.1 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.

1.2 REFERENCES

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

AASHTO T99	Moisture-Density Relations of Soils Using 2.5kg (5.5-lb) Rammer and 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³)(600 kn-m/m ³))
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 75 µm (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
ASTM D4253	Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

1.3 TESTING

- A. Field Density Testing
 - 1. Meet the quality control and quality assurance testing requirements in Sections 01430 and 01450, Contractor Quality Control and Government Quality Assurance.
 - 2. In-place field density tests for quality assurance are at Government expense meeting AASHTO T191 or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the CO's discretion.
 - 3. Retesting failing areas is at the expense of the Contractor.
 - 4. At the direction of the CO, provide the 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 CO.
- B. Laboratory Maximum Density and Optimum Moisture
 - 1. Quality assurance tests will be made by the CO 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.
- C. Material Submittals
 - 1. Submit to the CO material quality test results, including Type 1 Bedding gradation and plasticity index, and Type 2 Bedding gradation.
 - 2. Submit to the CO laboratory moisture-density relationship testing results of on-site and off-site borrow soils.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIALS

- A. Type 1 Pipe Bedding
 - 1. Type 1 Pipe Bedding includes the material placed from 4 inches (10 cm) below the bottom of the pipe to 6 inches (15 cm) over 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 and 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.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	100
3/4" (19.0 mm)	90 - 100
3/8" (9.5 mm)	20 - 55
No. 4 (4.75 mm)	5 - 10
No. 8 (2.36 mm)	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 one 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 the Special Provisions and details in the Drawings for other requirements.

B. Type 2 Pipe Bedding

1. Type 2 Pipe Bedding is used as directed by the CO 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 percent.

Percent by Weight Passing	
Sieve Size	Type B-Modified
3" (75 mm)	100
No. 4 (4.75 mm)	0 - 25
No. 8 (2.36 mm)	0 - 10

C. Separation Geotextile

1. The plans may require, or the CO may direct, the use of non-woven geotextile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as directed by the CO. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the CO.

2.2 TRENCH BACKFILL MATERIALS

- A. Materials from Trench Excavation
 - 1. 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.
- B. Imported Backfill Material
 - 1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the CO, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

2.3 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

3.1 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 the Contractor's expense.
 - 2. Contact utility owners using the Arizona 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 Government 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. No separate payment will be made for this work unless shown as a payment item. If the Government authorizes the relocation of mains or sewers, which are not indicated in the bid documents, and the CO determines the work was not included in the original contract, payment will be made under the applicable sections of the General Conditions.
 - 4. Cut and replace existing service lines interfering with trenching operations only with the CO's permission and at the Contractor's expense.
 - 5. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.

6. 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 Government 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. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.
 3. Such payment will be made only if the work is determined by the CO to be a change from the original contract work scope.
- 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 Owner.
- D. Existing Overhead Utilities
1. Use extreme caution to avoid conflict, contact, or damage to overhead utilities during the work.
- E. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion in the trench backfill or legally dispose of the surfacing material.
- F. When excavating across cultivated or sodded areas, remove full topsoil depth or a maximum 12-inch (30cm) depth, whichever is less, and stockpile for possible project use.
- G. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, according to Section 2910, to the CO's satisfaction.

3.2 MAINTENANCE OF FLOWS

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

3.3 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 CO. 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 a 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. Backfill over- excavations with Type 2 Bedding Material.
 8. No classification of trench excavated material materials will be made. Excavation and trenching work includes the removal and subsequent handling of all earth, loose or cemented gravel, loose or solid rock, and other materials excavated or otherwise removed in the performance of the contract work, regardless of the type, character, composition, or condition thereof. All materials excavated or otherwise removed, including asphalt, curb, gutter, sidewalk, soils, etc., will become the property of the Contractor, who will be responsible for environmentally sound disposal of said material in accordance with state and federal regulations.
 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.
 - b. If the trench is excavated wider than the specified minimum, provide Type 1 Pipe Bedding for the additional width to yield a consistent backfill for the entire width of the trench or take such other measures as the CO may direct to protect the pipe against the crushing forces of trench backfill at the Contractor's expense.
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 unstable material is encountered at the trench subgrade, which will not uniformly support the pipe, excavate the material to the depth directed by the CO and backfill to trench subgrade elevation with Type 2 Pipe Bedding.
- D. 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 price of trench excavation.
- E. Excavation 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.

3.4 DEWATERING

- A. General
 - 1. Furnish all necessary labor, equipment, and incidentals necessary to dewater the project site during construction.
 - 2. Keep all excavation dry and free from water during construction and the placement of materials. Do not place pipe, bedding, or backfill materials below the groundwater elevation established by dewatering operations. Do not allow groundwater or stormwater to enter or flow through the underground piping during installation.
 - 3. The cost of dewatering operations will be incidental to the cost of pipeline and appurtenance installation, and no additional payment will be made for dewatering. Consider shifts in the groundwater level caused by changing seasons or local conditions in estimating the cost of dewatering operations, as no additional payments will be made for fluctuating groundwater levels.
 - 4. Protect all structures that could be potentially impacted by dewatering operations. Repair any damage to structures caused as a result of dewatering at Contractor's expense.
- B. Discharge
 - 1. Do not discharge or dispose of water from dewatering operations in such a manner as to flood existing landscaped areas, graveled areas, or structures unless approved by CO. Written permission from the appropriate landowner shall also be required for discharge or disposal on private property.
 - 2. It is the Contractor's responsibility to comply with requirements and regulations of federal, state, and local agencies that govern areas affected by dewatering of the construction site and application for and maintenance of any required permits.

3.5 EXCAVATION STABILITY AND SAFETY

- A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the Contractor's responsibility. Meet

current OSHA regulations. This may require the design of temporary slopes and/or shoring by a licensed professional engineer.

3.6 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches as specified immediately after grade, alignment, and pipe jointing has been inspected and approved by the CO. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.
2. Storage of all imported backfill materials, including protecting said materials from adverse conditions that would disqualify them from use under these specifications, is the responsibility of the Contractor.

B. Pipe Bedding Placement

1. Type 1 Bedding.
 - a. Place Type 1 Pipe Bedding material 4 inches (10 cm) under, around the pipe, and to a point 6 inches (15 cm) above the top of the pipe in 6 inch (15 cm) lifts, using hand or other compaction methods without damaging or disturbing the pipe including mains and service lines and all appurtenances.
 - b. Place bedding material in equal lifts on both sides of the pipe for the full trench width. Thoroughly compact each lift of pipe bedding by tamping, vibration, slicing with a shovel, rodding, or by a combination of these methods. Take special care to assure complete compaction under the haunches of the pipe.
2. Type 2 Pipe Bedding.
 - a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the CO 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.
3. Separation Geotextile
 - a. Place Separation Geotextile where shown on the plans or where directed by the CO.

C. Trench Backfill

1. After the pipe bedding materials are placed and compacted as specified, backfill the trench.
 - a. Use backfill material free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious material.
 - b. From the top of the Type 1 Bedding to 6 inches (15 cm) below the ground surface, or the subgrade elevation, material containing stone up to 8 inches (20 cm) in the greatest dimension may be used.
 - c. Cost of screening, drying, or moistening excavated backfill to comply with specifications will be considered incidental to the Contractor's bid price per linear foot of pipe and service lines and unit prices for appurtenances, and no additional payment will be made for such work.
2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.

- a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.
 - b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.
 - c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.
 - 3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.
 - 4. Watering
 - a. 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.
 - b. 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.
 - c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Government or from other sources.
 - 5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the CO at the Contractor's expense.
 - 6. Trench backfill types are designated as follows:
 - a. Type A Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3 percent of optimum moisture content and compact to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 70 percent relative density as determined by ASTM D4253 and D4254.
 - b. Type B Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3 percent of optimum moisture content, and compact to at least 90 percent of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 50 percent relative density as determined by ASTM D4253 and D4254.
 - c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12-inch (30 cm) lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if so directed by the CO. In cultivated areas, place stripped topsoil uniformly over the backfilled trench to the original depth. Do not compact the topsoil, but grade to provide a smooth surface conforming to the adjoining ground surfaces.
 - d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the CO. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the CO, and at the expense of the Contractor.
- D. Replacement of Unsuitable Backfill Material
- 1. Remove and dispose of excavated soils that are saturated, contain deleterious materials, or have characteristics that, in the opinion of the CO, render the soils

unsuitable as backfill and/or which cannot be readily conditioned or dried to be made suitable.

2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor.
3. If suitable replacement material is not available within project limits, notify the CO. The CO will quantify the extent of any unsuitable soils to be removed and replaced with material from an approved source, to be paid for as Imported Backfill Material, and provide written notification of the approved quantities to the Contractor. Payment for Imported Backfill Material will not be approved if the Contractor fails to notify the CO and/or proceeds with removal and disposal of unsuitable material prior to receiving written notice from the CO.
4. Provide imported backfill material with a gradation as follows and a maximum plasticity index of 10, determined by AASHTO T89 and T90 or by ASTM D4318. Imported backfill may not contain rock measuring greater than 6 inches (15 cm) in the greatest dimension.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	70 - 100
No. 4 (4.75 mm)	40 - 80
No. 10 (2.00 mm)	25 - 60
No. 200 (0.075 mm)	2 - 35

5. Place and compact all imported material according to the applicable backfill specification requirements.
- E. Backfill of 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.
- F. Detectable Buried Warning Tape
1. Provide warning tape, as described in this Section. Bury tape a maximum of 18 inches (45 cm) below finish surface grade.

3.7 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 CO.
- B. Replace all Contractors disturbed or destroyed survey markers or monuments not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

3.8 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. Dispose of vegetation; coarse debris resulting from pavement or sidewalk removal; stones, junk, debris, and other materials encountered in excavation work; and other similar waste materials away from the site of the work at the Contractor's expense.

3.9 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 100 feet (30 m) in existing streets (and/or alleys) and 200 feet (60 m) in all other areas.
- D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.
- E. For each workgroup consisting of a trench excavator, a pipe laying crew, and a backfilling/compaction crew, the maximum allowable open ditch at any time is 200 feet (60 m) in existing streets (and/or alleys) and 400 feet (120 m) in all other 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.
- G. At the completion of each working day, fill all trenches and/or provide safety netting, Jersey barrier, and other barricades required for public safety.

3.10 DRAINAGE CROSSINGS

- A. Where trenches are constructed in or across roadway ditches or other watercourses, protect the backfill from surface erosion by adequate means. Where the grade of the ditch exceeds 1 percent, prevent erosion by a suitable method approved by the CO. Backfill trenches in such a manner that water will not accumulate in unfilled or partially filled trenches.
- B. Remove all material deposited in roadway ditches or other water courses crossed by the trench immediately after backfilling is completed and restore the Section, grades, and contours of such ditches or watercourses to their original conditions, in order that the surface drainage is obstructed no longer than necessary.

END OF SECTION

SECTION 02221

TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

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SECTION 02232

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including PART 200- EARTHWORK of the MAG 2024 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees and vegetation to remain.
 - 2. Removing trees and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Topsoil stripping.
 - 5. Removing above-grade site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 7. Disconnecting, capping or sealing, and removing site utilities.
- B. Related Sections include the following:
 - 1. Section 02300 "Earthwork" removing objectionable material from the right-of-way, easements and such other areas as may be specified in the special provisions

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Government's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings according to Division 1 Section "Closeout Procedures."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Government and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Work on adjoining properties is not included in the scope of this project.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Government's premises where indicated.
- D. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in PART 200 Section 215 "Earth Work."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Government.

3.2 TREE PROTECTION

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
 - 2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.

- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
 - 1. Cover exposed roots with burlap and water regularly.
 - 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
 - 3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 - 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by CO.
 - 1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.
- E. Transplant trees and vegetation indicated to be relocated to the location designated by the CO, in a manner approved by CO.
 - 1. Employ a qualified arborist or landscaping expert, licensed in jurisdiction where Project is located, to transplant trees and shrubs.
 - 2. Operation shall be completed in such manner as to protect the root wad of the tree or other vegetation.

3.3 UTILITIES

- A. Government will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Government will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify CO not less than two weeks in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without CO's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
 - 4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding 8-inch (200-mm) loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water.
 - 1. Do not stockpile topsoil within drip line of remaining trees.
 - 2. Dispose of excess topsoil as specified for waste material disposal.
 - 3. Stockpile surplus topsoil and allow for resspreading deeper topsoil.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Government 's property.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including PART 200- EARTHWORK of the MAG 2024 Specification Sections and Special Provisions apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade and lawns and grasses.
 - 2. Excavating and backfilling for buildings, structures and retaining walls.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subsurface drainage backfill for walls.
- B. Related Sections include the following:
 - 1. MAG PART 200 Section 201 "Clearing and Grubbing" removing objectionable material from the right-of-way, easements and such other areas as may be specified in the special provisions
 - 2. MAG PART 600 Section 601 "Trench Excavation, Backfilling and Compaction" furnishing all labor, equipment, appliances, materials, and performing all operations in connection with the excavation, backfilling and compaction of trenches for pipe installations
 - 3. MAG PART 200 Section 205 "Roadway Excavation" involved in the grading and construction of roadways, except structure excavation, trench excavation and any other excavation separately designated
 - 4. Section 03315 "Grout" for controlled low strength material.
 - 5. Section 321623 "Concrete Sidewalk and Steps" for granular course if placed over vapor retarder and beneath the slab-on-grade. PART 500 Section 505 Concrete Structures. Concrete bridges, culverts, catch basins, manholes, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformity with the plans and specifications
 - 6. Divisions 2 and MAG PART 200, 300 and 500 for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 DEFINITIONS

- A. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- B. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by CO. Authorized additional

excavation and replacement material will be paid for according to Section 01275 "Measurement and Payment or Contract provisions for changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by CO. Unauthorized excavation, as well as remedial work directed by CO, shall be without additional compensation.

- D. Fill: Soil materials used to raise existing grades.
- E. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1 cubic yard or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.
- B. When, in the opinion of the CO, the field soil conditions differ from those represented by the material test reports, new samples shall be taken by the Contractor and delivered to the testing agency for classification and laboratory compaction curve testing. All testing shall be based on the appropriate soil test results.

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by CO and then only after arranging to provide temporary utility services according to requirements indicated.
 1. Notify CO not less than two weeks in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without CO's written permission.

3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm)] in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
- D. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- E. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- G. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 3/4-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- K. Liner Subgrade: In-place native or borrow soil material naturally or artificially graded mixture of soil with 100 percent passing a 1/2 inch sieve and 40 percent passing a No. 200 Sieve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."-PART 200- EARTHWORK -Section 201 "Clearing and Grubbing".
- C. Protect and maintain erosion and sedimentation controls, which are specified in PART 200- EARTHWORK -Section 201 "Clearing and Grubbing"., during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. If required, install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized regardless of the character of surface and subsurface conditions encountered.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. If rock is encountered within excavations, cease work in the area where rock is discovered until a time and materials change order for the extra work can be agreed upon by the Contractor, Government and CO. The work in the affected area will again proceed after a change order is processed, and no shutdown time

or associated additional costs will be awarded other than those agreed upon in the change order.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 - 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 SUBGRADE INSPECTION

- A. Notify CO when excavations have reached required subgrade.
- B. If CO determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by CO, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by CO, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by CO.

1. Fill unauthorized excavations under other construction or utility pipe as directed by CO.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, damp proofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under grass and planted areas, use satisfactory soil material.
 2. Under steps and ramps, use Structural Fill.
 3. Under building slabs, use Structural Fill.
 4. Under footings and foundations, use Structural Fill.
 5. Under and adjacent to retaining walls, use Structural Fill.
 6. In utility trenches within 5 feet of any retaining wall or foundation, use Structural Fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm)] in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Where backfill is to extend higher on one side than on the other, as indicated on the Plans, structural floor beams or other means of restraint shall be installed before such backfill is placed. Should any deflection of the foundation wall result from the Contractor's failure to provide adequate bracing, the Contractor shall remove the backfill or embankment to relieve the deflection, properly brace the wall, and replace the backfill at no additional cost to the Government.
- D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures, building slabs and steps, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 97 percent.
 2. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus [1 inch (25 mm)]
- C. Grading inside Building and Structure Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.14 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick,

and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698

3.15 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade and under water storage reservoir floors as follows:
 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FINE GRAINED LINER SUBGRADE

- A. Install fine grained liner subgrade under PVC liner in Water Storage Reservoir underdrain system.
- B. Surface shall be smooth and free of all rocks and stones greater than ½ inch in diameter, sticks, sharp objects, or debris of any kind. The surface shall be smooth, flat, firm, unyielding foundation for the geomembrane with no sudden, sharp, or abrupt changes or break in grade.
- C. Compact soil materials to not less than the following 95 percent of maximum dry unit weight according to ASTM D 698

3.17 FIELD QUALITY CONTROL

- A. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by CO.
- B. Testing agency will test compaction of soils in place according ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 1000 sq. ft. or less of building slab, but in no case fewer than 3 tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each [100 feet (30 m)] or less of wall length, but no fewer than 2 tests.

- C. When testing reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by CO; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Government 's property.

END OF SECTION

SECTION 02730

SANITARY SEWER COLLECTION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install sewer pipe and fittings including manholes, service lines and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are shown on the plans, listed in the Contract Documents or specified herein.

1.2 CERTIFICATION BY MANUFACTURER

- A. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

1.3 REFERENCES

ASTM C76	Reinforced Concrete, Culvert, Storm, Drain, and Sewer Pipe
ASTM C361	Reinforced Concrete Low Head Pressure Pipe
ASTM C443	Joints for Concrete Pipe and Manholes using Rubber Gaskets
ASTM C478	Circular Precast Reinforced Concrete Manhole Sections
ASTM C655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
ASTM D1784	Standard Classification System and Basis for Specifications for Rigid Polyvinyl Chloride (PVC) compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM D2241	Polyvinyl Chloride (PVC) Pressure-Rated Pipe
ASTM D3034	Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM F714	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM D3350	Polyethylene Plastic Pipe and Fittings Material
ASTM C924	Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM F949	Polyvinyl Chloride (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM C1173	Flexible Transition Couplings for Underground Piping Systems
ASTM D5926	PVC Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C600

Installation of Ductile-Iron Water Mains and Their Appurtenances

CSA B602

Mechanical Couplings for Drain, Waste, Vent Pipe, and Sewer Pipe

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish sewer pipe and fittings as specified in the Contract Documents and meeting the materials and testing requirements of this Section. Furnish wye or tee branches and service line piping of the same material and design as the sewer pipe unless specified otherwise. Pipe strength classifications are shown on the plans and/or are listed in the Contract Documents.
- B. References made to ASTM, ANSI or AASHTO designation are the latest revision at the time of call for bids.
- C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal conditions of handling and storage.
- D. Furnish the joint type, class, thickness designation, castings, lining, marking, testing, etc. as specified.

2.2 PIPE MATERIALS

- A. Polyvinyl Chloride (PVC) Pipe
 - 1. General
 - a. Furnish PVC pipe produced by a continuous extrusion process, employing a prime grade of un-plasticized polyvinyl chloride. Assure the grade used is highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial wastes. Assure the material meets "Rigid Polyvinyl Chloride Compounds" - ASTM Designation D-1784 requirements. Assure the pipe has self-extinguishing flammability characteristics.
 - 2. Gravity Sewer Pipe
 - a. Furnish gravity sewer pipe meeting one of the following requirements:
 - 1) ASTM D-3034, "Standard Specifications for Polyvinyl Chloride Sewer Pipe and Fittings", with an SDR of 354"- 15" (10 cm - 38 cm).
 - 2) ASTM F949, "Standard Specification for PVC Corrugated (Open Profile) Sewer Pipe with a Smooth Interior and Fittings" larger than 12" (10cm).
 - b. Furnish pipe having nominal 12.5 feet (3.8 meters) laying lengths, except shorter lengths may be used adjacent to manholes, lampholes or other appurtenances. Assure each pipe section is marked, as a minimum, with size, SDR, "Sewer Pipe" and Code Number.
 - 3. Pipe Jointing

- a. Furnish each pipe length with a bell designed to provide a watertight joint when jointing the bell and spigot with a rubber ring.
 - b. Make a rubber gasket joint for PVC pipe and fittings using a rubber gasket compressed between the outer surface of the spigot and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow the manufacturer's recommendations when assembling the rubber ring joint.
 - 4. Fittings
 - a. Assure wye or tee fittings for connecting service lines are of the same material, construction and joint design as the main sewer pipe.
- B. High Density Polyethylene (HDPE) Pipe
 - 1. Pipe
 - a. Furnish non-profile wall HDPE pipe meeting ASTM D3350, having a cell classification of PE 34-5434C. Assure dimensions and workmanship meet ASTM F714 requirements.
 - 2. Fittings
 - a. Use wye or tee fittings for connecting service lines of the same material construction and joint design as the main sewer pipe.
 - 3. Pipe Jointing
 - a. Heat fusion weld all field joints to meet the manufacturer's recommendations.
- C. Ductile Iron Pipe (DIP)
 - 1. General
 - a. Furnish ductile iron pipe with that meets AWWA C151.
 - 1) 3 inches to 12 inches Pressure Class 350
 - 2) 14 inches to 20 inches Pressure Class 250
 - 3) 24 inch Pressure Class 200
 - 4) 30 inches to 64 inches Pressure Class 150
 - b. Assure the interior of the pipe shall be lined with 40 mils nominal of ceramic epoxy Induron Protecto 401 or approved equal.
 - c. Assure the outside pipe surface is coated with a minimum of 1 mil thickness of bituminous coal tar base coating.
 - d. Polyethylene encasement installation shall be per the Ductile Iron Pipe Research Association (DIPRA) Polyethylene Encasement Installation Guide.
 - 1) Furnish polyethylene encasement or V-Bio® enhanced polyethylene encasement in accordance with AWWA C105, "Polyethylene Encasement for Ductile Iron Pipe Systems".
 - 2) Optional for corrosion protection in corrosive soils - Polyethylene encasement for use with ductile iron pipe shall be V-Bio® enhanced polyethylene encasement as manufactured by Balcan Plastics Limited/First Film Extruding or Crayex Corporation.
 - 3)
 - 2. Pipe Jointing
 - a. For underground applications, assure joints are push-on joints or mechanical joints meeting AWWA C111.
 - b. For aboveground or submerged applications, assure joints are flanged joints meeting AWWA C115.

- D. Other Pipe Materials
 - 1. Other pipe materials may be specified at the discretion of the CO and Owner.

2.3 MANHOLES

- A. General
 - 1. Construct manholes from precast concrete sections having frames, covers, and steps meeting Standard Drawings.
- B. Precast Concrete Sections
 - 1. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.
- C. Steps
 - 1. Furnish non-corrosive steps, 12-inches (30 cm) in width, of 1/2-inch (13 mm) steel rod encased with polypropylene. Assure steps withstand 400 pound (180 kg) vertical loads and 1,000 pound (450 kg) pull-out resistance.
- D. Frames and Covers
 - 1. Furnish 2-hole type covers unless specified otherwise.
- E. Concrete Base
 - 1. Furnish precast concrete bases or field poured on undisturbed earth.

2.4 GRAVITY SEWER SERVICE COUPLINGS

- A. Provide coupling with a 0.012 inch (3 mm) minimum thickness stainless steel shield and stainless steel clamps.
- B. Assure coupling gaskets meet material requirements of CSA B602, ASTM D5926, and ASTM C1173.
- C. Furnish coupling as manufactured by Fernco (Strong Back RC Series) or an approved equivalent.

PART 3 - EXECUTION

3.1 PIPE AND SERVICE LINE INSTALLATION

- A. Excavation and Backfill
 - 1. Perform pipeline excavation and backfill meeting the applicable requirements of Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES AND APPURTENANT STRUCTURES.
- B. Responsibility for Materials
 - 1. Be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all

material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.

2. Be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

C. Handling of Pipe

1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.
2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.
3. Handle pipe to prevent damaging coating or lining. If any part of the coating or lining is damaged, make all repairs in a manner satisfactory to the CO.

D. Laying Pipe

1. Lay and maintain all pipe to the specified lines and grades with fittings, tees and manholes at the required locations. Establish line and grade using batter boards and string line, laser equipment or other approved methods. When batter boards and string line are used, use a minimum of three batterboards at all times.
2. Install wye or tee fittings in the mainline sewer for service line connections. Furnish wye or tee fittings of the same material, design and specifications as the sewer main pipe. Joint service pipe to tee branches or main line pipe other than PVC using special joint adapters manufactured specifically for joining the two types of pipe.
3. Use tools and equipment, satisfactory to the CO, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.
4. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the CO. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction.
5. Lay all pipe for gravity lines with the bell end of the pipe sections placed toward the uphill side of the slope.

E. Tolerances

1. Install the pipe within $\frac{1}{2}$ inch (13 mm) of the specified alignment and within $\frac{1}{4}$ inch (6 mm) of the specified grade for pipe 14 inches (35 cm) in diameter and smaller and within $\frac{1}{2}$ inch (13 mm) of the specified grade for pipe greater than 14 inches (35 cm) in diameter. These tolerances will apply to any point along the entire length of the pipe. The following are minimum slopes that must be provided, unless specifically indicated otherwise on the drawings:
- 2.

Minimum Slope in Feet			
Sewer Size	Per 100 feet	Sewer Size	Per 100 feet
4 inch	0.125		
6 inch	0.60	21 inch	0.10
8 inch	0.40	24 inch	0.08
10 inch	0.28	27 inch	0.067
12 inch	0.22	30 inch	0.058
14 inch	0.17	33 inch	0.052
15 inch	0.15	36 inch	0.046
16 inch	0.14	39 inch	0.041
18 inch	0.12	42 inch	0.037

3.2 MANHOLES

A. Construction

1. Construct manholes to the specified dimensions and condition per MAG 420-1. Make invert channels smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Make changes in flow direction with a smooth curve of as large a radius as the manhole size will permit. Make changes in channel grade and size gradually and evenly. The invert channels may be formed directly in the manhole base concrete or by laying half-pipe in the concrete. Make the floor of the manhole outside the channel smooth and slope toward the channel at 1 inch per foot (8 cm per meter).
2. Joint all connections between manhole walls and base and between wall sections adjusting rings and frame making the manhole watertight. For all horizontal joints located below the established high groundwater elevation, install a preformed rubber gasket joint. The established high groundwater level is shown on the plans or noted in the Special Provisions. For all sewer pipe to manhole joints, use gasketed, flexible, watertight connections that will accommodate differential settlement. Acceptable options for these connections to the manhole are as follows:
 - a. Adjacent Joints: Bell and spigot pipe joints with rubber sealing rings located within 12 inches (30 cm) of the manhole wall.
 - b. Compression-Type Flexible Connector: A resilient, flexible connection, cast into manhole wall, providing 10 degrees deflection.
 - c. Boot-Type Flexible Connector: A flexible, watertight connection consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp. Assure the expansion ring holds the gasket in the manhole wall, with the take-up clamp holding the gasket to the pipe.
 - d. Options (b) and (c) are limited to precast manhole base inverts and other installations where the flexibility of the connection is not compromised.
 - e. Construct manholes meeting ASTM C478, and the rejection criteria stated therein.
 - f. Keep manhole construction within one manhole distant behind sewer pipeline construction.

3. Install adjusting rings on each manhole to bring the manhole top elevation to match the existing or specified ground elevations. Use manhole rings with a 2-inch minimum (5 cm) and 6-inch (15 cm) maximum height. Furnish adjusting rings reinforced with the same percentage of steel as the riser and top.

3.3 SANITARY SEWER SERVICE LINES

- A. Install the service line to the property line. Plug the end of the service line with a stopper and gasket, using a gasket of the same type used for pipe jointing. Do not grout the plugs.
- B. Connect exiting services at closest possible point to the new main unless otherwise indicated on the Drawings or specified in the special provisions.

3.4 TESTS

- A. Make all tests after backfill is completed, but before any surface restoration or street surfacing. Be responsible for finding and repairing all breaks and leaks revealed by the tests. Additionally, perform all tests in the presence of the CO, resident inspector, or the Government's other designated representative.
- B. Light Test (Visual)
 1. After the trench has been backfilled and compacted as specified in Section 02221, perform a light test between manholes to check alignment and grade for pipe displacement. Excluding curved alignments shown on the plans, the completed pipeline is to permit a true circle of light to be visible from one manhole to the next. If alignment or grade is not that specified and displacement of pipe is found, remedy all defects.
- C. Leakage Test
 1. New sewer line will not be finally accepted until leakage tests are made assuring the CO that pipe laying and jointing are satisfactory.
- D. Water Test
 1. Where groundwater is at least 2 feet (0.6 m) above the sewer line, make tests by sealing off the section of lines between manholes and measuring the actual flow by collecting or pumping the discharge into barrels or other approved methods. Continue tests at a minimum of 4 hours for each section tested. Allow time to soak lines and manholes in advance of performing tests.
 2. When groundwater is not 2 feet (0.6 m) above the pipe, test as follows: On flat slopes where the depth over the centerline of the pipe in the lower manhole of the section being tested will be not more than 10 feet (3 m), fill the upper manhole to 2 feet (0.6 m) over the top of the pipe or 2 feet (0.6 m) above the groundwater elevation (whichever is higher), and block the lower manhole. When the above conditions cannot be met, the CO may order testing the line in sections between manholes. Measure the leakage by checking the water level drop in the manhole over a 4-hour period.
 3. The allowable infiltration or exfiltration cannot exceed 100 gallons per day per mile of sewer per inch of pipe diameter (92.5 Liters per day per kilometer of sewer per centimeter of pipe diameter). This does not exclude obvious and concentrated

leaks and physical defects, such as open joints, pinched gaskets, cracked barrels or bells, etc. Make repairs on concentrated leaks and as required to reduce infiltration or exfiltration leakage below the specified rate.

4. Water testing of manholes will only be allowed where groundwater is below the bottom of the manhole during testing. Hydrostatic testing shall be conducted by sealing all pipe penetrations to the manhole and filling the manhole to the top of the manhole cone with water. Water may be added over a 24-hour period to compensate for losses due to evaporation and absorption. Following the 24-hour saturation period any loss of water within a 30-minute period shall be a failed test and the manhole will be rejected.

E. Air Test (Alternative)

1. As an alternate method to water testing, the Contractor may utilize low pressure air to test the sewer mains. Use the test procedure described below: Plug both ends of the pipe under test with airtight plugs and brace to prevent slippage and blowout. Furnish one plug with an inlet tap or other provision for connecting an air hose.
2. Equip the air supply hose, connected between the air compressor and the plug, with a throttling valve, an air bleed valve and a high pressure shutoff valve for control. Equip the low pressure side of the throttling valve with a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.
3. If the pipeline is submerged under groundwater, the back pressure, caused by the water head, is measured and added to the standard test pressures to compensate for the groundwater effect on the air test.
4. Apply air slowly to the pipeline until the pressure reaches 4.0 pounds per square inch (27.6 kPa). Throttle the air supply to maintain the internal pressure between 4.0 and 3.5 pounds per square inch (27.6 and 24.1 kPa) for at least 2 minutes. During this time, check the plugs with soap solution to detect any plug leakage. Vacuum testing of manholes will be allowed and must conform to test procedures described in ASTM C 1244.
5. When the pressure reaches exactly 3.5 pounds per square inch (24.1 kPa), disconnect the air supply, start a stopwatch, and record the time for the pressure to drop to 2.5 pounds per square inch (17.2 kPa). The minimum time allowed for the pressure drop is computed on an air loss rate of 1.0 ft³/min (1.7 m³/min) or an air loss rate of 0.0015 ft³/min per square foot (0.0275 m³/min per square meter) of inner pipe surface area under test, whichever rate yields the least time for the pressure drop. Should the time of the pressure drop be less than the allowable specified time, make the necessary leakage repairs and repeat the air test.
6. Standard Drawing 02730-1 provides a nomograph which may be used to compute testing times for air testing. The nomograph computes results based upon English (U.S. Customary) units.
7. For test sections exceeding the maximum lengths, either shorten the test section to an allowable length or use the water test.

F. Number of Tests

1. Perform the number of leakage tests directed by the CO to assure that materials and workmanship are acceptable. Repair defective joints using only approved methods. Replace pipe having cracked or broken barrels. Do not exceed 800 feet (240 m) of sewer line per test unless otherwise approved.

G. T.V. Inspection

1. All sewer mains shall be inspected using a television camera before final acceptance. A sewer line is deficient and unacceptable if (1) the alignment is outside the specified limits, (2) water ponds in any section are equal to or greater than 2 times the grade tolerance specified herein under Section 02730.3.E.1, or (3) the pipe has visible defects such as open joints, pinched gaskets, cracked barrels or bell, or similar defects.
2. Pay all costs incurred in any television inspection performed solely for Contractor benefit.
3. Record all television inspections. Pull the camera through the sewer at 30 feet per minute (9 meters per minute maximum). If the camera is pulled by attaching to the hose of a hydraulic sewer cleaner, assure the hose is not active during the pulling process.

H. Deflection Testing

1. The CO may require deflection testing of all or any portion of a flexible pipe installation to assure the construction quality. Flexible pipe is pipe that will deflect at least 2% without any sign of structural distress.
2. Conduct deflection tests, when performed on PVC pipe, meeting ASTM D3034 and satisfy either of the following deflection limitations:

TABLE 3.2
DEFLECTION TESTING LIMITATIONS

Minimum Period Between Trench Backfilling & Testing	Minimum Mandrel Diameter as a Percent of Inside Pipe Diameter
7 Days	95.0
30 Days	92.5

3. Mandrels must have at least 9 arms. Perform the mandrel test without mechanical pulling devices.

I. Material and Equipment for Testing

1. Before final acceptance, Owner will require all sewers to be inspected using a television camera after leakage tests. Dewatering equipment must be shut down a minimum of 24 hours prior to the television inspection to allow groundwater to return to typical levels. Adequately flush the sewer lines prior to each television inspection. Television inspection of dry sewer lines is not acceptable. A sewer line is deficient and unacceptable if (1) the alignment is outside the specified limits, (2) water ponds in any section are equal to or greater than 2 times the grade tolerances specified herein under Section 02730.3.E.1, or (3) the pipe has visible defects such as open joints, pinched gaskets, cracked barrels or bells, or similar defects. Correct any deficiencies and re-inspect using a television camera. Sanitary sewer service lines may be subject to the same television inspection requirements as sanitary sewer mains at the discretion of the CO and Owner.
2. As with all other testing, the cost for televising the sewer line for final acceptance will be considered incidental to the Contractor's bid price per lineal foot of pipe, and no additional payment will be made for such work. All costs incurred in any television inspection performed solely for the Contractor's benefit will be the responsibility of the Contractor.

J. Hydrostatic and Leakage Testing for Force Mains

1. Perform hydrostatic and leakage testing in accordance with AWWA C600. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, at the highest point along the test section. Test to a hydrostatic pressure 2.0 times the normal operating pressure at the test point, but in no case less than a minimum gage pressure of 125 pounds per square inch (931 kPa) or greater than the pressure rating of the pipe being tested.
2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.
3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered during the pressure test with sound material and repeat the test.
4. Conduct the leakage test concurrent with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 pounds per square inch of the pressure test after the pipe has been filled with water and purged of air.
5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:

$$L = SD(P)^{1/2} \div 148,000$$

In which L equals the allowable leakage in gallons per hour; S is the length of pipe being tested, in feet; D is the nominal diameter of the pipe being tested, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge. Where the pipe being tested for leakage is thermally fused HDPE, the allowable leakage will be reduced to 25% of L, as calculated.

6. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.
7. Conduct the pressure and leakage tests with the CO present.

3.5 WATER AND SEWER MAIN SEPARATION

- A. Maintain 6' horizontal and 2' vertical separation between water mains and sewer mains. Per City of Flagstaff Engineering Design Standards and Specifications Division 13-09-002.

END OF SECTION

SECTION 02910

SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes ground surface preparation; furnishing and applying fertilizer; and furnishing and planting seed in areas described in the contract documents or directed by the CO.
- B. Any areas of newly disturbed soil where previously existing herbaceous vegetation is destroyed during project activities (by construction or staging of equipment) shall be revegetated according to these specifications.

1.2 SUBMITTALS

- A. Submit to the CO applicable seed mixture certifications, fertilizer descriptions and mulch certifications. Furnish duplicate signed copies of the vendors statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

PART 2 - PRODUCTS

2.1 SEED

- A. Furnish seed and seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.
- B. Seal and label all seed containers to comply with Arizona Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce.
- C. Do not use wet, moldy, or otherwise damaged seed in the work.
- D. Furnish seed mixture of the species described in the contract documents. Furnish seed in standard containers labeled with the seed name, lot number, net weight, percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species.

E. The following seed mixture shall be utilized on this project:

Common Name	Scientific Name	Pure Live Seed lbs./Acre
Arizona fescue	<i>Festuca arizonica</i>	2
Squirreltail	<i>Elymus Elymoides</i>	2
Western wheatgrass	<i>Pascopyrum smithii</i>	1
Blue grama	<i>Bouteloua gracilis</i>	1
Mountain muhly	<i>Muhlenbergia montana</i>	1
Beebalm	<i>Monardella sp</i>	.5
Lupine	<i>Lupinus sp</i>	.5
Total		8.0

2.2 TOPSOIL

- A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other undesirable material that would form a poor seedbed. Before striping topsoil, assure it has supported the growth of healthy crops, grass or other vegetable growth.

2.3 LIME

- A. Furnish ground limestone or other material deemed suitable by the CO containing a minimum 85% of total carbonate equivalent ground so that 90% will pass through a No. 100 mesh sieve. Coarser material may be acceptable, if the application rates are increased to provide at least the minimum quantities and depth specified using an approved Dolomitic lime or a high magnesium lime containing at least 10% magnesium oxide.

2.4 FERTILIZER

- A. Furnish standard commercial fertilizers supplied separately or in mixtures containing the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. Apply fertilizer at the specified rate and depth meeting the applicable State and Federal laws. Furnish fertilizer in standard containers clearly labeled with name, weight, and guaranteed analysis of contents. No cyanamide compounds of hydrated lime are permitted in mixed fertilizers.
- B. Fertilizers may be supplied in one of the following forms:
1. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
 2. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
 3. A granular or pellet form suitable for application by blower equipment.

2.5 SOILS FOR REPAIRS

- A. Use soil for filling and topsoiling repair areas of equal quality to the existing topsoil being repaired. Assure the soil is free of large stones, roots, stumps, or other materials that interfere with sowing, compacting, and establishing turf. Obtain approval from the CO before placing topsoil.

PART 3 - EXECUTION

3.1 TOPSOIL

- A. Place at least 6 inches (15 cm) of topsoil in all areas to be seeded. Import topsoil if sufficient topsoil is not available from excavated areas of the project.
- B. ALLOWABLE SEEDING MONTHS
 - 1. Preferred timing for seed application is in the fall before snowpack or persistent soil moisture develops, generally between Sept. 1st-Dec 15th. If construction timelines require, an alternate window for seed application is in the spring when soils are no longer saturated but before late spring dry down, generally between March 1st- April 30th. Seeding dates must be approved by the CO.

3.2 SEEDBED PREPARATION AND SOWING

- A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the CO to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.
- B. Sow seed in the areas described in the contract documents at the specified application rates.
- C. Sow seed using a force feed drill having a grass seed attachment, except of slopes steeper than three to one or on areas too small to be seeded with a force feed drill. In these areas, seed may be sown by power sprayers, blowers or other effective methods. Use equipment in good working order.
- D. Seed Kentucky Bluegrass at a depth of one-quarter inch or less and cultipack the seed.
- E. Do not sow seed in winds that prevent proper embedment into the surface.
- F. Scarify the top 2-4" of soil with discs, tiller, harrow, hand tools, or other apparatus capable of breaking up soil and improving water infiltration in this soil zone. Selected equipment shall be appropriately sized to minimize additional disturbance outside of the disturbed post-construction area.
- G. Seedbed preparation may be done on the same pass as seeding, if techniques result in the specifications described under 'Seeding.'

- H. Mix seed into the soil with a harrow, seed bed roller, hand tools or similar equipment such that the majority of seed is incorporated ¼” – 1” below the final soil surface.

3.3 Mulching and Compaction

- A. Apply 1 to 1 ½ tons/acre of weed free straw over seeded surfaces at a uniform rate to adequately cover the seed. The weed free straw shall be from a grain crop such as barley straw, wheat straw or oat straw. After application, incorporate straw into the top 1” of soil and gently compact the surface using a mulch crimper, seed bed roller, or cultipacker.

3.4 FERTILIZER

- A. Spread and work fertilizer into the soil during the final seedbed preparation. Apply fertilizer at the rate described in the contract documents.

3.5 CARE OF SEEDED AREAS

- A. Keep the seeded area moist until it has germinated and its continued growth is assured. Prevent erosion during watering. Water is incidental to the item “Seeding”.
- B. Protect all seeded areas from traffic or pedestrian use with warning barricades or other CO approved methods.
- C. Maintain the seeded area, performing any required watering and mowing until the seed is firmly established. Prevent weeds and other undesirable vegetation from establishing in the seeded area. Mow weeds and rake and remove the clippings from the areas.
- D. Replace any seeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. The contract warranty period applies to this item.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Seeding is measured by the square yard (square meter) and paid for at the unit price bid including topsoil salvage and/or importing, topsoil placement, seedbed preparation, and seeding, complete in place and accepted by the CO.
- B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

END OF SECTION

SECTION 02953

TELEVISION INSPECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all necessary labor, materials, equipment, services and incidentals required and visually inspect by means of closed-circuit television (CCTV) designated sewer line sections, including, but not limited to, all recording and playback equipment, materials, and supplies such as DVDs. Television inspection and sanitary sewer line assessments shall be in accordance with NASSCO PACP standards and performed by a NASSCO certified operator.
- B. The inspection shall be done one sewer line section (i.e. manhole to manhole) at a time and the section being inspected shall be suitably isolated from the remainder of the sewer system.
- C. Video recordings shall be made of the television inspections and copies of both the recordings and printed inspection logs shall be supplied to the Government.

1.2 DEFINITIONS

- A. NASSCO – National Association of Sewer Service Companies.
- B. PACP – Pipeline Assessment Certification Program.
- C. Television Inspection – Video inspection performed by the Contractor of sanitary sewer lines to confirm cleaning and to assess the condition of the line.
- D. Television Inspection Report – Information collected and recorded by each television operator for any Television Inspection effort that is submitted to the Government.
- E. Inspection codes and Sanitary Sewer Line Assessment codes shall be in accordance with NASSCO PACP standards.
- F. Pre-Installation TV Inspection – Video inspection by the Contractor of sanitary sewer lines specified for rehabilitation to confirm cleaning, location of active service connections, and constructability of line rehabilitation according to the Drawings and Specifications.
- G. Post-Installation TV Inspection – Video inspection to determine that rehabilitation and/or replacement of sanitary sewers has been completed according to the Drawings and Specifications.

1.3 RELATED WORK

- A. Sewer Line Cleaning is included in Section 02954.

1.4 SUBMITTALS

A. Certifications:

1. Contractor shall submit PACP certifications for all operators who will work on the Contract.
2. Contractor shall submit PACP certification for the closed circuit television inspection software.
3. Contractor shall provide Television Inspection Reports in hard copy and digital format to the Government as specified herein.
4. Contractor shall provide Television Inspection Reports, Video Recordings, and Photographs to the Government in Digital format on DVD.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The Contractor shall select and use closed-circuit television equipment that will produce a video recorded in digital format on DVD. The pipe inspection camera shall be a high-resolution color chip camera capable of producing a minimum 500-line resolution colored video picture. Picture quality and definition shall be to the satisfaction of the CO. Video tape recordings shall not be accepted.
- B. The Contractor shall produce video using a pan-and-tilt, radial viewing, pipe inspection camera that pans +/- 275 degrees and rotates 360 degrees. The television camera used for the inspection shall be specifically designed and constructed for such inspection. The camera shall operate in 100% humidity and submerged conditions. The Contractor shall use a camera with an accurate footage counter, which displays on the monitor the exact distance of the camera with camera height adjustment so that the camera lens is always centered at one-half the inside pipe diameter, or higher, in the pipe being televised. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The television equipment shall be capable of showing on the video the Ranger Station name, Service Area name, Contractor name, date, line size and material, line identification (Government's manhole numbers at both ends) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Government; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. No payment will be made for an unsatisfactory inspection.

2.2 DIGITAL RECORDINGS

- A. Digital video shall be supplied for all television work. All recordings shall be submitted to the Government recorded on DVD discs.
- B. The Contractor shall index all video inspection logs to the DVD containing the video segment.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION INSPECTION

- A. Notify the Government /CO 24 hours in advance of any CCTV inspection so that the Government /CO may observe inspection operations.
- B. The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition but in no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
- C. If during the inspection operation, the television camera will not pass through the entire pipe section due to blockage or pipe defect, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire pipe section, the inspection shall be considered complete and no additional inspection will be required at that time. Improper cleaning will not be a reason for incomplete televising of a line section.
- D. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones, radios, or other suitable means of communication shall be set up between two manholes of the sewer line being inspected to ensure that good communications exist between members of the crew.
- E. If during television inspection of a sanitary sewer line section, the wastewater flow depth exceeds 20 percent of the inside pipe diameter, the Contractor shall reduce the flow depth to an acceptable level by performing the television inspection during minimum flow hours, bypass pumping, plugging, or by pulling the camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Video inspection made while floating the camera is not acceptable unless approved by the Government.

3.2 RECORDING OF FIELD OBSERVATIONS

- A. Television Inspection Reports for each CCTV inspection provide a completely printed inspection report that clearly identified the location of defects and all recorded observations indexed in relation to adjacent manholes. Defects and observations that shall be recorded include structural deficiencies, service connections with estimations of extraneous flows, joints, infiltration sources, unusual conditions, material transitions, roots, storm sewer connections, fractured, cracked or collapsed sections, the presence of scales and corrosion, signs of previous leakage, pipes that the camera failed to pass through and reasons for failure, and other discernible features and data of significance. A hard copy of these records shall be supplied to both the Government and CO.
- B. Digital Photographs: All recorded observations shall be documented as digital still images and formatted.
- C. Digital Video Recordings: The purpose of digital recording shall be to supply a visual record of problem areas of the lines that may be replayed. A graphic label shall be imbedded in the recording describing the parameters of the line being inspected (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and

unusual conditions observed during the inspection. Video recording playback features may be supplied at the option of the Contractor. Once recorded, the DVD discs shall be labeled and become the property of the Government. The Contractor shall have all DVD's and necessary playback equipment readily accessible for review by the Government and CO.

- D. Pipeline Condition Rating Form: Provide each inspection report with a Pipeline Condition Rating Form. The Pipeline Condition Rating Form shall include the following:
 - 1. List the number of structural defects and the number of operation and maintenance defects per condition grade (Condition Grades 1 through 5)
 - 2. List the Structural Pipe Rating, Operations and Maintenance Pipe Rating, Overall Pipe Rating, and Pipe Rating Index.
- E. Manhole Observations: Manhole observation videos are required for each televised sanitary sewer line. The operator shall pan beginning and ending manholes to demonstrate that all debris has been removed and that pipe connections, inverts, benches, and sidewalls of the manholes are not leaking or defective.

3.3 POST-INSTALLATION INSPECTION

- A. Procedure
 - 1. Post-installation TV inspection shall not be completed until all work; including service lateral replacement and/or reactivation, and manhole restoration is complete on a section of line. The post-installation TV inspection reports and video recordings shall be submitted to the CO prior to substantial completion, or when requested.
 - 2. The post-installation TV inspection shall be completed to confirm completion of rehabilitation work and to verify that the work conforms to the requirements of the Drawings and specifications. Provide a color video recording showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Reports providing location of service connections along with location of any discrepancies.
 - 3. For post-installation TV inspection, exercise the full capabilities of the camera equipment to document the completion of the rehabilitation and replacement work and the conformance of the work to the Drawings and Specifications. Provide a full 360 degree view of pipe, joints, and service connections.

END OF SECTION

SECTION 02954

SEWER LINE AND MANHOLE CLEANING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all necessary labor, materials, equipment, services and incidentals required and perform high pressure water jetting, rodding, brushing, bucketing, and flushing of designated sewer lines and manholes prior to internal inspection by closed circuit television and rehabilitation operations.

1.2 RELATED WORK

- A. Television Inspection is included in Section 02953

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Hydraulic Sewer Cleaning Equipment
 - 1. The equipment used shall be of a moveable dam type and be constructed so that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The moveable dam shall be the same diameter at the pipe being cleaned and shall provide flexible scraper around the outer periphery to ensure total removal of grease. If sewer cleaning balls or other such equipment which cannot be collapsed instantly are used, special precautions against flooding of the sewers and public or private property shall be taken.
- B. High Velocity Jet (Hydro cleaning) Equipment
 - 1. All high velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines to be cleaned. Equipment shall also include a high velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a long distance solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel. All controls shall be located so the equipment can be operated above ground.
- C. Mechanical Cleaning Equipment
 - 1. Bucket machines shall be in pairs and with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive which could cause damage to the pipe shall not be acceptable.
 - 2. Power rodding machines shall be either sectional or continuous type capable of holding a minimum of 750-ft of rod. The rod shall be specifically treated steel. To ensure safe operation, the machine shall have a fully enclosed body and an automatic safety release clutch or relief valve.

3. Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Sewers damaged as a result of the Contractor's improper operations shall be promptly repaired by the Contractor at no cost to the Government.

PART 3 - EXECUTION

3.1 GENERAL

- A. Sewer line walls shall be cleaned adequately to provide for a camera used in internal inspection to discern structural defects, misalignment and infiltration/inflow sources. Cleaning shall be performed immediately prior to internal inspection to preclude the buildup of debris from infiltration/inflow sources and discharges from upstream pipeline sections.
- B. Cleaning shall be performed immediately before lining of the sanitary sewer line.
- C. Existing flows shall not be interrupted for periods longer than one hour. The Contractor shall take necessary precautions to prevent sewage backup and shall be responsible if damage results there from. Sewage diverted during cleaning operations shall be returned to the sanitary system and not discharged into the streams or storm drain system.

3.2 PERFORMANCE

- A. Each designated sewer manhole section shall be cleaned using hydraulically propelled, high velocity jet, or mechanically powered equipment. The equipment selected for cleaning shall be capable of removing dirt, grease, rocks, sand and other deleterious materials and obstructions from the sewer lines and manholes. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If successful cleaning cannot be performed from the second manhole, or the equipment fails to traverse the entire length between manholes, it will be assumed that a major blockage exists and the cleaning effort shall be abandoned. Blockages, if any, shall be reported to the CO immediately.
- B. During all sewer cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. The flow of sewage in the sewer lines shall be used to provide necessary pressures for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed so as to prevent its use in case of a fire in the area served by the hydrant, nor shall a hydrant be used for the purpose described unless a vacuum break is provided.

3.3 ROOT REMOVAL

- A. Roots shall be removed in the sewer sections where root intrusion is a problem and where authorized by the Government. Special attention should be used during the cleaning

operation to assure almost complete removal of roots from the joints. Any roots which could prevent the proper seating and application of the liner shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines, and winches using root cutters and porcupine, and equipment such as high-velocity jet cleaners. Chemical root treatment shall be used before or following the root removal operation, depending on the manufacturer's recommendation.

- B. If required to aid in the removal of roots, sewer sections that have root intrusion may be treated with an acceptable herbicide, as approved and specified by the CO. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. The active ingredients shall have no adverse effect on the performance of a wastewater treatment plant, and shall be registered with the Environmental Protection Agency. Any damaged vegetation so designated by the CO shall be replaced by the Contractor at no additional cost to the Government. All safety precautions as recommended by the manufacturer shall be adhered to concerning handling and application of the herbicide.

3.4 WASTE MATERIAL REMOVAL AND DISPOSAL

- A. All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid waste material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. When hydraulic cleaning equipment is used, a suitable dam or weir shall be placed in the downstream manhole to trap all such materials. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.
- B. Under no circumstances shall sludge or other debris removed during these operations be dumped or spilled into streets, ditches, storm drains, or other sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of properly.
- C. The Contractor shall keep his haul route and work areas neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accordance with applicable law and regulations. The Contractor shall immediately clean up any such spills or waste material release.

3.5 ACCEPTANCE OF CLEANING OPERATION

- A. Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the CO and Government. If the television inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line until the cleaning is shown to be satisfactory.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for concrete formwork, bracing, shoring, supports, and falsework, in accordance with the Contract Documents.
- B. Related Requirements:
 - 1. Section 03300 – “Cast in Place Concrete”.
 - 2. Section 03200 – “Reinforcement Steel”.
 - 3. Section 03290 – “Joints in Concrete”.

1.3 ACTION SUBMITTALS

- A. The Contractor shall, in accordance with the requirements in Section 01300 - Submittals, submit detailed Drawings of the formwork proposed to be used including means of protecting existing construction which supports formwork, and typical soil conditions.
 - 1. The calculations and drawings shall be performed, sealed, and signed by a licensed professional civil engineer registered in the State of Arizona.
- B. The Contractor shall, in accordance with the requirements in Section 01300 - Submittals, submit the following.
 - 1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
 - 2. Form gaskets.
 - 3. Form releasing agent.
 - 4. List of form materials and locations for use.

1.4 QUALITY ASSURANCE

- A. Tolerances: The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the CO, all lumber brought on the job site for use as forms, shoring, or bracing shall be in good condition without cracks, etc. All forms shall be smooth surface forms and shall be of the following materials:
 - 1. Walls: Steel or plywood panel.
- B. Form materials which may remain or leave residues on or in the concrete shall be classified as acceptable for potable water use by the Environmental Protection Agency within 30 days of application or use.

2.2 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 - 1. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
 - 2. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 - 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
- B. Unless otherwise indicated, exterior corners, exposed to view, in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

2.3 FORM TIES

- A. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burke Penta-Tie system by The Burke Company.
 - b. Richmond Snap-Tys by the Richmond Screw Anchor Company.
- B. Form ties for water-retaining structures shall have an integral waterstop that tightly fits the form so that it cannot be moved from the midpoint of the tie. Removable taper ties may be used when approved by the CO. A preformed neoprene or polyurethane tapered

plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burke Taper-Tie System by The Burke Company.
 - b. Taper- Ty by the Richmond Screw Anchor Company.

PART 3 - EXECUTION

3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at no increased cost to the CO. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the CO and shall be in sufficient number and properly installed. During concrete placement, continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

3.2 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.

3.3 CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the CO. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties:
1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03300 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 2 inches back from the formed face or faces of the concrete.
 2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with nonshrink grout for water bearing and below-grade walls. The hole shall be completely filled with nonshrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the CO. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CO.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Forms for all vertical walls shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the CO and ACI 347.

3.6 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the CO. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

END OF SECTION

SECTION 03200

REINFORCEMENT STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ACI Publications as listed throughout. The Contractor must have a current copy of ACI SP-15 "Field Reference Manual" for concrete construction on site.
- C. Maricopa Association Governments 2024 Section 727 "Steel Reinforcement"

1.2 SUMMARY

- A. This Section specifies cast-in place concrete reinforcement and accessories.
- B. Related Sections include the following:
 - 1. Section 03300 – "Cast in Place Concrete".
 - 2. Section 03100 – "Concrete Formwork".
 - 3. Section 03290 – "Joints in Concrete".

1.3 SUBMITTALS

- A. Steel Reinforcement Placing Drawings: Details of fabrication, bending, and field placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material grade, sizes, quantities, spacing, splice locations and laps, bending diagrams, arrangement, and supports of concrete reinforcement.
 - 1. Include elevation view(s) of walls.
 - 2. Include bar placement diagrams which clearly indicate the dimensions and locations of each bar splice.
- B. Material Certificates and /or Test Reports: Signed by manufacturers or qualified testing agency certifying that steel reinforcement and reinforcement accessories comply with the Project requirements, including AIS certifications.

1.4 QUALITY ASSURANCE

- A. Concrete reinforcement placement shall be specially inspected per the International Building Code 2018 edition table 1705.3.
- B. Preinstallation Coordination: Conduct meeting to comply with requirements in Division 01 Section "Project Coordination."
 - 1. Before concrete work begins, review subgrade approval, placement operations, inspections, tolerances, splicing requirements, and construction joints.

2. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Government's Design Representative (CO).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to keep clean (completely free of mud and oils) and prevent bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT STEEL

- A. Reinforcement Steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
 1. Bar reinforcement; shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement or as otherwise indicated.
- B. Accessories:
 1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice.
 2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
 - a. The use of concrete blocks (dobies) is prohibited in elevated concrete slabs.

PART 3 - EXECUTION

3.1 GENERAL

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.

3.2 FABRICATION

- A. General:
 1. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315, ACI 318, and CRSI's "Manual of Standard Practice" except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inch for No. 3 bars, 2 inch for No. 4 bars, and 2-1/2 inch for No. 5

- bars. Bends for other bars shall be made around a pin having a diameter not less than six times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
2. Fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be submitted in accordance with Section 01300 - Submittals.
- B. Fabricating Tolerances: Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:
1. Sheared Length: ± 1 inch.
 2. Depth of Truss Bars: $+0, - 1/2$ inch.
 3. Stirrups, Ties, and Spirals: $\pm 1/2$ inch.
 4. All Other Bends: ± 1 inch.

3.3 PLACING

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing and tying reinforcement.
- B. Reinforcement steel shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) may be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- C. Limitations on the use of bar support materials shall be as follows.
1. Concrete Dobies: Permitted at all locations except in elevated concrete slabs and where architectural finish is required.
 2. Wire Bar Supports: Permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 3. Plastic Bar Supports: Permitted at all locations except on grade.
- D. Tie wires shall be bent away from the forms in order to provide the indicated concrete coverage.
- E. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no increased cost to the Government.
- F. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- G. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to

exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the CO.

- H. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.
- I. Clean reinforcement of loose rust and mill scale, soil, ice, oils and other foreign materials.

3.4 SPACE OF BARS

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- B. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

- A. General: Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at other locations, the character of the splice shall be as acceptable to the CO.
- B. Splices of Reinforcement:
 - 1. The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318-14, Section 25.5.2 for a Class B splice.
- C. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the CO. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the CO.

3.6 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS (Where Approved)

- A. Hole Preparation:

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.
8. Underwater epoxy such as Hilti Hit-HY 200 or approved equal shall be used.

END OF SECTION

SECTION 03290
JOINTS IN CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section specifies the construction of the joints in concrete at the locations indicated, complete, in accordance with the Contract Documents.
- B. Related Sections include the following:
 - 1. Section 03200 – “Reinforcement Steel”.
 - 2. Section 03290 – “Concrete Formwork”.
 - 3. Section 03300 – “Cast in Place Concrete”.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Federal Specifications:
 - 1. TI-S-0227E(3) - Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures).
- B. U.S. Army Corps of Engineers Specifications:
 - 1. CRD-C572PVC - Waterstop.
- C. Commercial Standards:
 - 1. ASTM A 775 - Specification for Epoxy-Coated Reinforcing Steel Bars.
 - 2. ASTM C 920 - Specification for Elastomeric Joint Sealants.
 - 3. ASTM D 412 - Test Methods for Rubber Properties in Tension.
 - 4. ASTM D 638 - Test Method for Tensile Properties of Plastics.
 - 5. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 6. ASTM D 1056 – Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
 - 7. ASTM D 1752 – Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 8. ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 9. ASTM D 2240 – Test Method for Rubber Property – Durometer Hardness.
 - 10. ASTM D 2241 – Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe

1.4 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.
- B. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours; the joint shall be formed as indicated. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise indicated, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop as indicated.
 - 1. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
 - 2. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel as indicated.
- C. Contraction Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material as indicated below.

1.5 SUBMITTALS

- A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be provided under this contract. The balance of the material to be used under this contract shall not be produced until after the CO has reviewed the qualification samples.
- B. Joint Sealant: Prior to ordering the sealant material, submit for the CO's review sufficient data to show general compliance with the requirements of the Contract Documents.
- C. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished the CO before the sealant is used on the job.
- D. Joint Location: Submit placement shop drawings showing the location and type of all joints for each structure.
- E. Manufacturer's information demonstrating compliance of the following with indicated requirements:
 - 1. Bearing pad.
 - 2. Preformed joint filler.
 - 3. Backing rod.

4. Bond breaker.
5. Waterstop.

1.6 QUALITY ASSURANCE

- A. Waterstop Inspection: It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the CO to provide for the required inspections. Not less than 24 hours' notice shall be given to the CO for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the Contractor at no increase in cost to the Government.
- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
 1. Offsets at joints greater than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.
 4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
 5. Porosity in the welded joint as evidenced by visual inspection.
 6. Bubbles or inadequate bonding which can be detected with a penknife test. If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.
 7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.
 8. Any evidence of burned material.

1.7 GUARANTEE

- A. Furnish a 5-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the Contractor agrees to repair or replace, to the satisfaction of the Government, at no additional cost to the Government, any such defective areas which become evident within said 5-year guarantee period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All joint materials in direct contact with water shall be certified as compliant with NSF Standard 61.

2.2 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. Obtain from the waterstop manufacturer and furnish to the CO for review, current test reports dated within the last 3 years and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of COs Specification CRD-C572 and those listed herein.
- B. Flatstrip and Center-Bulb Waterstops: Flatstrip and center-bulb waterstops shall be as manufactured by: Greenstreak Plastic Products Co., St. Louis, Missouri; or equal; provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8 inch.
- C. Other Types of Waterstops: When other types of waterstops, not listed above are required and indicated, they shall be subjected to the same requirements as those listed herein.
- D. Waterstop Testing Requirements: When tested in accordance with the standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength – min (psi)	2,000	D638, Type IV
Ultimate Elongation – min (%)	350	D638, Type IV
Low Temp Brittleness – max (degree F)	-35	D746
Stiffness in Flexure – min (psi)	600	

Accelerated Extraction (CRD-C572)

Tensile Strength – min (psi)	1,500	D 638, Type IV
Ultimate Elongation – min (%)	300	D 638, Type IV

Effect of Alkalies (CRD-C572)

Change in Weight (%)	+0.25/-0.10	
Change in Durometer, Shore A	+5	D2240

Finish Waterstop

Tensile Strength – min (psi)	1,400	D638, Type IV
Ultimate Elongation – min (%)	280	D638, Type IV

2.3 SELF-EXPANDING WATERSTOPS

2.4 JOINT SEALANT

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements (73 degrees F and 50 percent R.H.):

Work Life	45-180 minutes
Time to Reach 20 Shore “A” Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM C 2240)	20-45 Shore “A”
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400%, minimum
Tear Resistance (Die C ASTM D 624)	75 lb/in of thickness, minimum
Color	Light Gray

- C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
 1. Sealant shall be two-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for two-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only "nonsag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing nontracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
 4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- D. All sealants, wherever shown, or required hereunder shall be PSI-270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation; or equal.

- E. Sealants for nonwaterstop joints in concrete shall conform to the requirements of Section 07920 – Joint Sealants.

2.5 JOINT MATERIALS

- A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D 2000 BC 420, 40 durometer hardness unless otherwise indicated.
- B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, Type 2C3-E1.
- C. Joint Filler:
 - 1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2Co-E1.
 - 2. Joint filler material in other locations shall be of the preformed nonextruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All nonextruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.

2.6 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8 inch larger in diameter than the joint width except that a 1-inch diameter rod shall be used for a 3/4-inch wide joint.

2.7 BOND BREAKER

- A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.8 SLIP DOWELS

- A. Slip dowels in joints shall be smooth epoxy-coated bars, conforming to ASTM A 775.

2.9 PVC TUBING

- A. PVC tubing in joints shall be Sch. SOR 13.5, conforming to ASTM D 2241.

PART 3 - EXECUTION

3.1 GENERAL

- A. Waterstops of the type indicated shall be embedded in the concrete across joints as indicated. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a noncenterbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. Setting Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the Work and to insure the proper embedment in the concrete. The symmetrical halves of the

waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.

- B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise indicated, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- E. Joint Location: Construction joints, and other types of joints, shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. Where joints are indicated spaced greater than 50 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the CO.
- F. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete. Except on horizontal wall construction joints, wall to slab joints or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as indicated herein.
- G. Construction Joint Sealant: Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
- H. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior

to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.

- I. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before Work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- J. Thorough, uniform mixing of two-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- K. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be resealed with the indicated joint sealant. All costs of such removal, joint treatment, resealing, and appurtenant work shall be at no additional cost to the Government.
- L. Self-Expanding (Hydrophilic) Waterstop:
 - 1. Where a hydrophilic waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations, except as modified herein.
 - 2. When requested by the CO, the Contractor shall arrange for the manufacturer to furnish technical assistance in the field.
 - 3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any intersecting joint.
 - 4. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
 - 5. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1- 1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.
 - 6. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop with single component water-swelling sealant as recommended by the manufacturer.
 - 7. The hydrophilic waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
 - 8. The concrete surface under the hydrophilic waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface

shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.

9. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive recommended by the manufacturer.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ACI Publications as listed throughout. The Contractor must have a current copy of ACI SP-15 "Field Reference Manual" for concrete construction on site.
- C. Maricopa Association Governments 2024 Section 725 "Portland Cement Concrete"

1.2 SUMMARY

- A. The following types of concrete shall be covered in this Section:
 - 1. Structural Concrete: Concrete to be used in all cases except where noted otherwise in the Contract Documents.
 - 2. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise shown.
 - 3. Lean Concrete: Concrete to be used for thrust blocks, anchor blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Drawings as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.
- B. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents.
- C. Contractor shall perform Hydrostatic Tests and perform concrete repair work as outlined in this Section and in Division 01650 – "Testing of Hydraulic Structures".
- D. Related Sections include the following:
 - 1. Division 03200 – "Reinforcement Steel".
 - 2. Division 03100 – "Concrete Formwork".
 - 3. Division 03290 – "Joints in Concrete".
 - 4. Section C "Earthmoving" and the Project "Geotechnical Engineering Report" for subgrade conditions and required preparation.
- E. The term "hydraulic structure" used in these Specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids. Concrete mix designs used in hydraulic structures shall also conform to the standards of Class "A" concrete as specified in this project.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications:

1. UU-B-790A (1) (2) - Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

B. Commercial Standards:

1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
3. ACI 301 - Specifications for Structural Concrete for Buildings.
4. ACI 304.2R - Placing Concrete by Pumping Methods.
5. ACI 305R - Hot Weather Concreting.
6. ACI 306.1 - Standard Specification for Cold Weather Concreting.
7. ACI 309 - Consolidation of Concrete.
8. ACI 315R-18 - Guide to Presenting Reinforcing Steel Design Details.
9. ACI 318 - Building Code Requirements for Reinforced Concrete.
10. ACI 350.1 – Tightness Testing of Environmental Engineered Concrete Containment Structures
11. ASTM C 31 - Practice for Making and Curing Concrete Test.
12. ASTM C 33 - Specification for Concrete Aggregates.
13. ASTM C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
14. ASTM C 94 - Specification for Ready-Mixed Concrete.
15. ASTM C 138 - Test Method for Unit Weight, Yield, and Air Content of Concrete.
16. ASTM C 143 - Test Method for Slump of Hydraulic Cement Concrete.
17. ASTM C 150 - Specification for Portland Cement.
18. ASTM C 156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete
19. ASTM C 231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
20. ASTM C 260 - Specification for Air-Entraining Admixtures for Concrete.
21. ASTM C 494 - Specification for Chemical Admixtures for Concrete.
22. ASTM E 1745 - Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 SUBMITTALS

- #### A. Mix Designs:
- Prior to beginning the Work and within 14 days of the notice to proceed, submit to the CO, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein in accordance with Section 01300 "Submittals". The mix design for use in hydraulic structures shall be additionally checked and certified to conform to these specifications by an independent testing laboratory as specified by the CO to be in conformance with these Specifications. All costs related to such checking shall be borne by the Contractor at no increased cost to the Government.

1. Indicate amounts of mix water to be withheld for later addition at Project site.
2. Provide concrete shrinkage test data for concrete mixes designs to be used on hydraulic structures.
3. For concrete mixes other than Class "A" concrete for hydraulic structures, concrete mix designs shall be submitted along with previous compressive strength test data showing

compliance in accordance with ACI 318 Chapter 5. If historical mix design test data is not available for these concrete mixes, trial batch mixing shall be performed in accordance with the requirements for concrete for hydraulic structures.

- a. Exception: Concrete shrinkage tests are only required for hydraulic structures.
- B. Delivery Tickets (Submitted upon request): Where ready-mix concrete is used, furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.
- C. Furnish the following submittals in accordance with ACI 301 and as required herein:
 1. Mill tests for cement and fly ash.
 2. Admixture certification. Chloride ion content must be included.
 3. Aggregate gradation and certification demonstrating conformance to ASTM C 33 and this Section.
 - a. Data submitted shall be obtained from tests performed within three months of the starting date of the Trial Batch and Laboratory Test.
 - b. Data shall demonstrate compliance with paragraph 2.1.D.3 below.
 4. Materials and methods for curing (include both hot and cold weather provisions).
- D. Concrete testing agency qualifications.

1.5 CONCRETE CONFERENCE

- A. A meeting to review the detailed requirements of the Contractor's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 14 days after the notice to proceed.
- B. All parties involved in the concrete work shall attend the conference, including the following:
 1. Contractor's representative.
 2. Testing laboratory representative.
 3. Concrete subcontractor.
 4. Concrete supplier.
 5. Project Engineer.
- C. The conference shall be held at a mutually agreed upon time and place. The CO shall be notified no less than 5 days prior to the date of the conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced and qualified installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician - Grade 1, according to ACI CP-01 or an approved equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI Concrete Laboratory Testing Technician - Grade II.
- D. Testing Agency for Trial Mixes and Shrinkage Tests: An independent testing agency qualified and certified to perform the specified concrete tests.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- F. Testing:
 - 1. General:
 - a. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
 - b. The cost of all laboratory tests for qualification of mix designs on cement, aggregates, and concrete, including strength and shrinkage testing will be borne by the Contractor. The cost of all field-testing during construction on cement, aggregate and subsequent concrete including strength and shrinkage will be borne by the Contractor. Also, the Contractor will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The laboratory must meet or exceed the requirements of ASTM C 1077.
 - c. Concrete for testing shall be supplied by the Contractor at no cost to the Government, and the Contractor shall provide assistance to the CO in obtaining samples, and disposal and cleanup of excess material.
 - 2. Field Compression Tests:
 - a. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as specified in Section 3.16 "Field Quality Control" to ensure continued compliance with these Specifications. Samples for concrete testing shall be taken at point of placement. Each set of test specimens will be a minimum of two sets of two cylinders.
 - b. Compression test specimens for concrete shall be made in accordance with section 9.2 of ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders or 4-inch diameter by 8-inch high cylinders. Specimens shall be tested using the proper sized compression plates for the specimen diameter.
 - c. Compression tests shall be performed in accordance with ASTM C 39.

- d. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 3. Evaluation and Acceptance of Concrete:
 - a. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality," and as specified herein.
 - b. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
 - c. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
 - d. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.
 - e. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the Government.
- 4. Shrinkage Tests:
 - a. Drying shrinkage tests will be made for the trial batch specified in the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests," the first placement of concrete for hydraulic structures, and during construction every 3 months, to insure continued compliance with these Specifications.
 - b. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: specimens shall be removed from molds at an age of 23 plus and minus 1 hours after trial batching, shall be placed immediately in water at 70 degrees F plus and minus 3 degrees F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus and minus 3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F plus or minus 3 degrees F and 50 percent plus or minus 4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
 - c. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be

considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 2, herein.

- G. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following non-cumulative construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	in 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown.	in 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the plumb.	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	Minus 1/4 inch; Plus 1/2 inch
Variations in the locations and sizes of slabs and wall openings.	Plus or Minus 1/4 inch

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. General:
1. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301, Sections 501.03.02 and 501.03.03 or the Standard Specifications.
- D. Materials for concrete shall conform to the following requirements:
1. Cement shall be standard brand Portland cement conforming to ASTM C 150 for Type II.
 2. Fly Ash: At the contractor's option, fly ash may be incorporated into the concrete mix designs at a maximum rate of 25% of the cementitious material by weight. Fly ash shall

- conform to ASTM C 618, Class F, except loss on ignition less than 1.0 percent and calcium oxide content less than 30 percent.
3. Blended hydraulic cement shall conform to the current revision requirements of ASTM C595 for Portland Pozzolan cement Type IP (MS) for moderate sulfate resistance or (HS) for high sulfate resistance, Portland Limestone cement Type IL (MS) for moderate sulfate resistance or (HS) for high sulfate resistance, or Ternary Blended cement Type IT (MS) for moderate sulfate resistance or (HS) for high sulfate resistance.
 4. Water for mixing and curing shall be potable and meet ASTM C94.
 5. Aggregates shall be obtained from pits acceptable to the CO, shall be nonreactive, and shall conform to the requirements of ASTM C 33, Class 3S coarse aggregate or better, graded. Maximum size of coarse aggregate shall be 1 inch or 3/4inch nominal. Lightweight sand for fine aggregate will not be permitted.
 6. Ready-mix concrete shall conform to the requirements of ASTM C 94.
 7. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.
 - a. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content within the ranges indicated in section 2.5 C. The CO and/or Government reserves the right, at any time, to sample and test the air- entraining agent received on the job. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement.
 - b. Set controlling and water reducing admixtures: Admixtures may be added at the Contractor's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the Government. The use of an admixture shall be subject to acceptance by the CO. Concrete containing an admixture shall be first placed at a location determined by the CO. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 - 1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the CO.
 - 2) Set controlling admixture shall be either with or without water- reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture may be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a noncorrosive, set-accelerating admixture may be used.
 - 3) Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
 - 4) High range water reducer shall conform to ASTM C 494, Type F or G. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.

- 5) If the high range water reducer is added to the concrete at the jobsite, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches +/- 1/2 inch prior to adding the high range water reducing admixture at the jobsite. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the jobsite system.
- 6) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high range water reducer.

2.2 CURING MATERIALS

- A. Materials for curing concrete as specified herein shall conform to the following requirements, ASTM C 156, and ASTM C 309:
 1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed.
 2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2).
 3. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard: Curing mats for use as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
 4. Evaporation retardant shall be compatible with any admixtures used in the fresh concrete mix.

2.3 NONWATERSTOP JOINT MATERIALS

- A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:
 1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.
 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the CO.

2.4 MISCELLANEOUS MATERIALS

- A. Dampproofing agent shall be an asphalt emulsion.
- B. Bonding agents shall be epoxy adhesives conforming to the following products for the applications specified:
1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concreive Liquid (LPL), as manufactured by Master Builders; BurkEpoxy MV as manufactured by The Burke Company; or equal.
 2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by The Burke Company; Concreive Paste (LPL) as manufactured by Master Builders; or equal.

2.5 CONCRETE DESIGN REQUIREMENTS

- A. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the Work will be determined by the trial batch for hydraulic structures and previous mix designs and test data for all other classes of concrete unless previous test data is unavailable. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Government. All changes shall be subject to review by the CO.
- B. Fine Aggregate Composition: In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight, shall be as indicated in the following table. For other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

<u>Fine Aggregate</u>	
<u>Fineness Modulus</u>	<u>Maximum Percent</u>
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

- C. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

<u>Type of Work</u>	<u>Min 28-Day</u>	<u>Max Agg.</u>	<u>Minimum</u>	<u>Max w/c</u>
	<u>Compressive</u>	<u>Size</u>	<u>Cement</u>	
	<u>Strength (psi)</u>	<u>(in)</u>	<u>(lb/yd³)</u>	<u>(by weight)</u>
Class "A" and Hydraulic Structures (includes mat slabs)	4,500	3/4	564	0.42
Class "B"	4,000	3/4	495	0.45

(Spread Footings)

Class "C" (Slab on Grade or Elevated Composite)	4,000	1	550	0.42
Sitework Concrete	4,000	1	550	0.45
Lean Concrete	2,500	1 1/2	376	0.60

Note: The Contractor is cautioned that the limiting parameters specified above are not a mix design. Additional cement, water reducing agent, or mix designs may be required to achieve workability demanded by the Contractor's construction methods and aggregates. The Contractor is responsible for any costs associated with furnishing concrete with the required workability.

- D. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

2.6 CONSISTENCY

- A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

<u>Type of Work</u>	<u>Slump (in)</u>
All Concrete, unless noted otherwise	3 inches, plus or minus 1 inch
With high-range water reducer added	7 inches, plus or minus 2 inches
Ductbanks	5 inches, plus or minus 1 inch

2.7 TRIAL BATCH AND LABORATORY TESTS

- A. Before placing any concrete, a testing laboratory designated by the CO shall prepare a trial batch of Class "A" concrete for hydraulic structures and each class of structural concrete that does not have a history of required test data, based on the preliminary concrete mixes submitted by the Contractor. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. All concrete shall conform to the requirements of this

Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and nine compression test specimens from each batch. The cost of not more than three laboratory trial batch tests for mix designs requiring batch tests will be borne by the Contractor and the Contractor shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed by the Contractor at no additional cost to the Government.

- B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days, 3 at 14 days, and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
- C. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve. Fine and coarse aggregate shall be tested for compliance with ASTM C 33 and as required herein.
- D. Cement shall be tested for compliance with ASTM C 150 and as required herein.
- E. See Section 1.6 "Quality Assurance" for qualified testing agency concrete trial batches and shrinkage tests.

2.8 SHRINKAGE LIMITATION

- A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.
- B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
- C. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Government, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.9 READY-MIXED CONCRETE

- A. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.

- B. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the CO in accordance with the paragraph in Part 1 entitled "Delivery Tickets."
- C. The use of nonagitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CO.

2.10 LIQUID SLAB SURFACE TREATMENTS (SURFACE APPLIED CONCRETE SEALANT)

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply until concrete has cured at least 28 days.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner to provide a smooth and non-porous surface.

2.11 FLOOR HARDENER (SURFACE APPLIED)

- A. Surface hardener shall be a light reflective nonoxidizing metallic aggregate dry shake surface hardener.
 - 1. Surface hardener shall be premeasured, premixed and packaged at the factory.
 - 2. Apply surface hardener at the manufacturer's suggested rate for type of application.
- B. Curing Compound shall meet the moisture retention requirements of ASTM C 309 and surface hardener manufacturer's recommendations.
- C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

PART 3 - EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.
- C. Slump: Maximum slumps shall be as specified herein.

- D. Retempering: Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CO, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum 1/4- inch amplitude.
- C. concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the CO.
- D. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the CO at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- E. All inserts or other embedded items shall conform to the requirements herein.
- F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the CO before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
- G. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CO.
- H. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the CO.

- I. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- J. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- K. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- L. Cleaning: The surfaces of all metal work to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 CONDUITS AND PIPES EMBEDDED IN CONCRETE FLOORS, WALLS AND ROOFS OF STRUCTURES

- A. Conduits, pipes, and sleeves of any material not harmful to concrete and within limitations of this Section shall be permitted to be embedded in concrete with approval of the CO, provided they are not considered to replace structurally the displaced concrete.
- B. Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- C. Conduits, pipes, and sleeves passing through a slab, wall, or beam shall not impair significantly the strength of the construction.
- D. Except when drawings for conduits and pipes are approved by the CO conduits and pipes embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:
 - 1. They shall not be larger in outside dimension than 1/3 the overall thickness of slab, wall, or beam in which they are embedded.
 - 2. They shall not be spaced closer than 3 diameters or widths on center.
 - 3. They shall not impair significantly the strength of the construction.
- E. Conduits, pipes, and sleeves shall be permitted to be considered as replacing structurally in compression the displaced concrete provided:
 - 1. They are not exposed to rusting or other deterioration.
 - 2. They are of uncoated or galvanized iron or steel not thinner than standard Schedule 40 steel pipe.
 - 3. They have a nominal inside diameter not over 2-inches and are spaced not less than 3 diameters on centers.
- F. Pipes and fittings shall be designed to resist effects of the materials, pressure, and temperature to which they will be subjected.

- G. No liquid, gas, or vapor, except water not exceeding 90 F nor 50 psi pressure, shall be placed in the pipes until the concrete has attained its design strength.
- H. In solids slabs, piping, unless it is for radiant heating shall be placed between top and bottom reinforcement.
- I. Concrete cover for pipes, conduits, and fittings shall not be less than 1-1/2 inch for concrete exposed to earth or weather, nor 3/4 inch for concrete not exposed to weather or in contact with ground.
- J. Reinforcement with an area not less than 0.002 times area of concrete section shall be provided normal to piping.
- K. Piping and conduit shall be so fabricated and installed that cutting, bending, or displacement of reinforcement from its proper location will not be required.

3.4 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the Government.
- C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the CO. Notify the CO in writing at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. Casting New Concrete Against Old: An epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where waterstop is installed; see Section 03290 - Joints in Concrete.

- F. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the CO. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.
- G. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the Work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- H. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick nor less than 50 degrees for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.
- I. Cold Weather Placement:
1. Placement of concrete shall conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.
 2. Remove all snow, ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.
 3. Maintain the concrete temperature above 50 degrees F for at least 3 days after placement.
- J. Hot Weather Placement:
1. Placement of concrete shall conform to ACI 305R - Hot Weather Concreting, and the following.
 2. Only set retarding admixture shall be used in concrete when air temperature is expected to be consistently over 80 degrees F.
 3. The maximum temperature of concrete shall not exceed 90 degrees F immediately before placement.
 4. From the initial placement to the curing state, concrete shall be protected from the adverse effect of high temperature, low humidity, and wind.

3.5 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

- B. Pumping Equipment: The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- D. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.6 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to the CO. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures and 3 days for all other structures before the contiguous unit or units are placed.
- B. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high-speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the CO.
- C. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- D. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Part 1, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified or as shown.
1. Surface holes larger than 1/2 inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
- C. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch. No further special finish is required.
 2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the CO.
 3. Finish U3 - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
 4. Finish U4 - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.
- D. Unformed surfaces shall be finished according to the following Schedule:

3.8 UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floors to be covered with grouted tile or topping grout.	U2
Slabs which are water bearing with slopes 10% and less.	U3
Sloping slabs which are water bearing with slopes greater than 10%.	U4
Slabs not water bearing.	U4

Interior slabs and floors to receive architectural finish.
Top surface of exposed walls.

U3
U3

A. Floor Hardener (Surface Applied):

1. Where hardener for floors is indicated, provide concrete with the following additional requirements:
 - a. Maximum slump of 4 inches when peak ambient temperatures are expected to be more than 65 degrees F, and no more than 3 inches when ambient temperatures are below 65 degrees F.
 - b. Maximum air content of 3 percent.
 - c. Do not use calcium chloride or set-accelerating admixtures containing calcium chloride.
 - d. Do not use admixtures that increase bleeding.
 - e. Do not use fly ash unless fly ash is shown to not negatively impact the selected manufacturer's surface applied hardener.
2. After the concrete has been leveled and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, float the surface of the slab with a mechanical float fitted with float shoes. Following floating, apply 1/2 to 2/3 of the total amount of dry shake surface hardener so that a uniform distribution of surface hardener is obtained. The use of a mechanical spreader is recommended. Once the shake has absorbed sufficient moisture (indicated by the darkening of the shake), float the surface. Immediately apply the remaining 1/3 to 1/2 of the shake and allow to absorb moisture. Do not place dry shake on concrete surface when bleed water is present.
3. Use finishing machines with detachable float shoes. Compact surface by a third mechanical floating if time and setting characteristics of the concrete will allow. Do not add water to the surface.
4. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively flat. Remove all marks and pinholes in the final raised trowel operation.
5. Follow all application instructions of the floor surface hardener manufacturer.
6. Cure finished floors using fill-forming curing compound recommended by surface hardener manufacturer. Uniformly apply curing compound over the entire surface at a coverage that will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperature of 50 degrees F or above during the curing period.
7. Keep floors covered and free of traffic and loads for a minimum of 10 days after completion.

3.9 CURING AND DAMPROOFING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than 10 days with the following materials:
 - a. Water.

- b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
- 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- D. Dampproofing: The exterior surface of all buried walls of dry areas shall be dampproofed as follows:
 - 1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in two coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.

3.10 PROTECTION

- A. Protect all concrete against injury until final acceptance by the Government.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the specified 72 hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40

degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the CO. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown and filled with sealant conforming to the requirements of Section 03290 - Joints in Concrete. This repair method shall be done on the water bearing face of members. Prior to

backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with nonshrink grout where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled "Treatment of Surface Defects."
3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless shown.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type waterstop material placed around the perimeter of the hole as specified in the Section 03290 - Joints in Concrete, unless there is an existing waterstop in place.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspection Agency: Contractor will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and inspections, and submit reports. Sampling and testing for quality control includes items specified below.

1. The CO shall review and approve the Testing Agency qualifications.
2. The Contractor must advise the Testing and Inspection Agency at least 36 hours in advance of concrete placement.
3. Inspection tasks are outlined in Structural General Notes on Plans. See also "Special Inspections" in the Project Manual.

B. Concrete Testing: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 10 cu. yd.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches.
2. Testing Location: Final fresh concrete properties shall be tested and recorded or samples taken at point of use; i.e. test materials as placed after all methods of transportation.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample at point of placement, but not less than one test for each day's pour of each concrete mix.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or when 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of concrete; one test for each composite sample at point of placement but not less than one test for each day's pour of each concrete mix.
 7. Compression Test Specimens: ASTM C 31/C 31M; cast; from material at point of placement, and laboratory cure two sets of two standard cylinder specimens for each composite sample.
- C. The concrete testing Technician must immediately inform the Contractor's Project Superintendent of sample test results.
1. Concrete incorporated in the Work that does not comply with all specified fresh concrete properties is subject to rejection and replacement at the Contractor's expense.
- D. Test results shall be reported in writing to CO, Concrete Manufacturer, and Contractor within 48 hours of testing. Reports of tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work by grid designation and elevation, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for 28 day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by CO but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by CO. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as approved by the CO.
- G. Government may also engage a second, independent Testing Agency to verify concrete test results. This independent Testing Agency shall meet all of the requirements of this Specification and shall also have access to the project site and materials as detailed in this Specification.

3.15 CARE AND REPAIR OF CONCRETE

- A. Protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Government. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and

replaced with acceptable concrete at the Contractor's expense.

END OF SECTION

SECTION 03315

GROUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonshrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.
 - 2. Cement Grout.
 - 3. Epoxy Grout.
 - 4. Pump and Motor Grout.
 - 5. Topping Grout and Concrete Fill (Flow Fill).
- B. Related Requirements:
 - 1. Section 03300 "Cast in Place Concrete"

1.3 INFORMATION SUBMITTALS

- A. Submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work.
- B. Provide Manufacturer's independent certification of ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)," compliance without modification of the standard methods certifying that the Class B or C grouts post hardening non-shrink properties are not based on gas expansion, grouts have strengths of 3500 psi at 1 day, 6500 psi at 3 days and 7500 psi at 28 days when cured at 72 degrees F as well as meeting the 3, 7 and 28 day strengths when tested and cured at the 45 degree and 95 degree limits and all other requirements of ASTM C 1107.

1.4 QUALITY ASSURANCE

- A. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 - Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.1 CEMENT GROUT

- A. Cement Grout: Cement grout shall be composed of one-part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 calendar days shall be 4,000 psi.
- B. Cement grout materials shall be as specified in Section 03300 - Cast-in-Place Concrete.

2.2 PREPACKAGED GROUTS

- A. Nonshrink Grout:
 - 1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application. All grouts (Grade A, B, C) shall be tested for height change of the hardened grout at 1, 3, 14, and 28 days in accordance with ASTM C 1090, "Test Method for Measuring Change in Height of Cylindrical Specimens for Hydraulic-Cement Grout," and shall be tested for compression at 1, 3, 7, and 28 days in accordance with the modified ASTM C109 testing procedure.
 - 2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of ASTM C 1107 when mixed to a flowable, plastic, or stiff consistency. When tested in accordance with ASTM C 1090, grout shall have a maximum of 4.0% expansion in the pre-hardened state.
 - 3. Class B or C high precision, fluid, extended working time, non-shrink grouts shall have a minimum 28 day compressive strength of 7500 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827 - Test Method for Early Volume Change of Cementitious Mixtures; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state; and when mixed to a fluid consistency of 20 to 30 seconds per ASTM C 939 - Test Method for Flow Grout for Preplaced Aggregate Concrete (Flow Cone Method) at temperature extremes of 45 to 90 degrees F shall have an extended working time of 30 minutes when tested in accordance with ASTM C 1107.
 - 4. Application:
 - a. Class A non-shrink grout shall be used for grouting railing posts in place. Class A non-shrink grout shall not be used for dry packing applications or repair of concrete.
 - b. Class B or C non-shrink grout shall be used for grouting under all base plates for structural steel members, grouting under all equipment base plates, and at all locations where grout is required by the Contract Documents except where epoxy grout is specifically required. Class B or C non-shrink grout may be used in place of Class A non-shrink grout for all applications. Class B or C non-shrink grout shall not be used for dry packing applications or repair of concrete.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
2. Epoxy grouts proposed for use shall have documentation verifying that the components and integrity of the epoxy grout will not be adversely affected by the chemicals used in the treatment process.
3. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
4. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
5. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
6. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by testing in accordance with ASTM C 1339, "Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts," for bearing area and flow.
7. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.
8. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications in the Contract Documents where grout type is not specifically indicated.

C. Grout for Pumps and Motors and Blowers:

1. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
 - a. Creep shall be less than 0.005 in/in when tested by ASTM C 1181 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 psi.
 - b. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17×10^{-6} in/in/degree F when tested by ASTM C 531.
 - c. The compressive strength shall be a minimum of 12,000 psi in 7 days when tested by ASTM C 579 Method 8, modified.
 - d. Bond strength of grout to Portland cement concrete shall be greater than 2,000 psi when using ASTM C 882 test method.
 - e. Grout shall pass the thermal compatibility test when overlayed on Portland cement concrete using test method ASTM C 884.
 - f. Tensile strength and modulus of elasticity shall be determined by ASTM D 638. The tensile strength shall not be less than 1,700 psi and the modulus of elasticity shall not be less than 1.8×10^6 psi.
 - g. Gel time and peak exothermic temperature shall be determined by ASTM D 2471. Peak exothermic temperature shall not exceed 110 degrees F when a specimen

6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.

- h. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 psi.
- 2. Primer, if required, shall conform to the written recommendations of the grout manufacturer.
- 3. Surface preparations shall conform to the written recommendations of the grout manufacturer.
- 4. Placement and Curing
 - a. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
 - b. A grouting performance demonstration/training session shall be conducted by the grout manufacturer's representative prior to foundation and baseplate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.

D. Grout for Repair of Concrete:

- 1. Grout for repair of concrete for vertical, overhead, and shotcrete applications shall not produce a vapor barrier, shall be one component, reoplastic, cement based, fiber reinforced, shrinkage compensated, non-expansive, gray concrete product. The grout shall be sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water. The grout shall be free of chlorides and other chemicals causing corrosion with the following properties:
 - a. Minimum Slant Shear Bond Strength: 3000 psi in 28 days when tested in accordance with ASTM C882, modified.
 - b. Minimum Compressive strength: 11,000 psi in 28 days when tested in accordance with ASTM C109.
 - c. Minimum Direct Shear Bond Strength: 650 psi when at 28 days.
 - d. Minimum Tensile Bond Strength: 700psi in 28 days per ASTM C307.
 - e. Minimum Flexural Strength: 1300 psi when tested in accordance with ASTM C348.
 - f. Modules of Elasticity: 5×10^8 psi when tested in accordance with ASTM C469.
 - g. Maximum Rapid Chloride Permeability: 772 coulombs when tested in accordance with ASTM C1202.
 - h. Manufacturers shall be Master Builders Technologies Co., EMACO.
- 2. Grout for repair of concrete for horizontal and formed applications shall not produce a vapor barrier, shall be one component, reoplastic, cement based, fiber reinforced, shrinkage compensated, non-expansive, gray concrete product. The grout shall be flowable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water. The grout shall be free of chlorides and other chemicals causing corrosion with the following properties:
 - a. Minimum Shear Bond Strength: 2150 psi in 7 days when tested in accordance with ASTM C1042.
 - b. Minimum Compressive Strength: 6000 psi in 7 days when tested in accordance with ASTM C109.
 - c. Minimum Flexural Strength: 770 psi in 28 days when tested in accordance with ASTM C78.

- d. Maximum Chloride Permeability: 1,000 coulombs when tested in accordance with ASTM C1202.
- e. Minimum Modulus of Elasticity: 4.8×10^6 psi when tested in accordance with ASTM C469.
- f. Manufacturers shall be Master Builders Technologies Co., EMACO S66-CR.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 - Cast-in-Place Concrete, shall apply except as noted otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete, as specified in Section 03300 - Cast-in-Place Concrete, may be used when accepted by the Engineer.
- C. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent by Weight Passing
2"	100
3/8"	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

- D. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3,000 psi.

2.4 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 -Cast-in-Place Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03300 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of nonshrink grout and epoxy grout shall provide onsite technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Engineer.

3.2 MANUFACTURER'S SERVICES

- A. The Contractor shall coordinate with the manufacturer all demonstrations, training sessions, and applicable site visits. The grout manufacturer shall conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurements, cube testing, application, and curing for each category and type of grout.

3.3 GROUTING PROCEDURES

- A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Base Plate Grouting:
 - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a 1-inch thickness of grout or a thickness as indicated on the Drawings.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted for acceptance by the Engineer.

C. Grout for Repair of Concrete:

1. All repair shall be performed in accordance with the manufacturer's recommendations and with ICRI's Guideline No 03730, "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion," and ICRI's Guideline No 03733, "Guide for selecting and specifying Materials for repair of Concrete Surfaces". These guidelines shall be followed for removal geometry, exposing and undercutting of reinforcing steel, cleaning and repair of reinforcing steel, and edge and surface condition of concrete and shall be followed regardless of the amount of corrosion present or not present in the reinforcing steel.
2. Remove unsound deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16-inch. Remove to provide for minimum thickness specified for mortar. If reinforcing is exposed in this process, then additional concrete shall be removed until the surface is a minimum of 1-inch or 1 bar diameter behind the exposed reinforcing.
3. Clean exposed reinforcing bars of rust and other deleterious materials which may prevent bonding of the repair product.
4. Keep surface at saturated surface dry (SSD) condition for a minimum of 24-hours prior to placement of repair material.
5. Place material in accordance with Manufacturer's written recommendations.
6. Cure material continuously for 7-days with water fog nozzles or other applications which provide a continuous wet curing of the repaired area in accordance with ACI 308, "Standard Practice for Curing Concrete".

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.5 REPAIRS AND PROTECTION

- A. All grout applications shall be free of any damage, deficiencies, or surficial imperfections at the time of Project completion.

END OF SECTION

DIVISION C

SPECIAL CONTENT

Section C - Description/Specifications/Statement of Work
GENERAL SPECIFICATIONS

1.1 SCOPE OF CONTRACT

- A. This project consists of constructing distribution and transmission mains in the Coconino National Forest at the Flagstaff Ranger District as shown on the Drawings.
- B. The work includes:
 - 1. Supplying and installing asphalt surfacing for City of Flagstaff/ADOT Highway.
 - 2. Abandonment of septic tanks on-site.

1.2 PROJECT LOCATION

- A. The Flagstaff Ranger Station is located in the Flagstaff Ranger District of the Coconino National Forest in Coconino County, Arizona. The ranger station is approximately four mile northeast of the Town of Flagstaff along Arizona Highway eighty nine (89) and can be accessed of this highway along the FSR 989C. Specifically, the site is located at:

Township/Range/Section: Township 21 North/ Range 08 East/ Section 06

Latitude/Longitude: 35° 13' 43.10" North / 111° 34' 54.66" West

1.3 INFORMATION AND LIMITATIONS

- A. The following site conditions are considered incidental to the contract and the Contractor will not be paid directly for any of the following items:
 - 1. Construction site will be closed to the public during construction. The Forest Service will issue a closure order to the public. The Contractor will be responsible for signing and limiting public access.
 - 2. Contractor will provide all materials and labor necessary to protect streams, wet or dry, during construction activities. The Contractor will be required to submit an erosion control plan and receive approval from the COR, in writing, prior to the beginning of construction.
 - 3. All construction equipment shall be pressure washed before entering National Forest System lands. The removal of mud and debris from treads, tracks and undercarriage, with emphasis on axles, frame, cross-members, motor mounts, and underneath steps, running boards, and front bumper/brushguard assemblies will be required. The purpose is to reduce or eliminate the transportation of noxious weeds, which is required by Federal and State regulations.
 - 4. Power is NOT available at the site.
 - 5. Contractor must be prepared to provide toilets.

1.4 TRAFFIC CONTROL AND CONSTRUCTION SIGNING

- A. No work that endangers, interferes, or conflicts with traffic or access to work sites shall be performed until a plan for satisfactory warning and handling of traffic has been submitted by the Contractor and approved by the government. Construction signing for traffic control shall conform to the Manual of Uniform Traffic Control Devices (MUTCD). All traffic control signs will be placed in areas adequate for a truck pulling a fifth wheel trailer to be turned around. Contractor shall not be paid directly for this item, rather it will be considered incidental to other items of work listed in the Schedule of Items.

1.5 WORK CAMPS, STAGING AND STORAGE AREAS

- A. Areas for staging operations and storage of materials shall be approved by the CO. The Contractor must request in writing for approval from the CO to stage trailers or housing on site.
- B. Camping: The Contractor may camp at the Campground at locations approved by the Flagstaff Ranger District. Requirements for camping include, but are not limited to, the following:
 - 1. The Contractor will need to pay the daily rate associated with the utilities based on site availability.
 - 2. All refuse, including garbage, rubbish and solid or liquid wastes from the Contractor's operations, including parking areas and equipment maintenance areas shall be stored, collected, and disposed of in a sanitary and nuisance-free manner at a county sanitary landfill or a commercial sanitary landfill or other means satisfactory to the CO.
 - 3. Camper trailers shall be equipped with holding tanks. Toilet waste shall be disposed of at a state-approved site.
 - 4. After completion of the contract work, the Contractor shall restore the camping site to its original condition.

1.6 WATER FOR CONSTRUCTION

- A. Water required to obtain compaction may be taken from metered hydrants, the engine filling station or at locations approved by CO. The Contractor shall minimize impacts to the ranger stations water supply.
- B. Contractor shall be responsible for any materials or labor to utilize water sources. No separate payment shall be made.

1.7 INSPECTION OF WORKSITE

- A. The Contractor acknowledges they have taken the necessary steps to ascertain the nature and location of work and have investigated and satisfied themselves as to the general and local conditions that can affect the work or its cost. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from the responsibility of estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expenses to the government.

1.8 START DATE

A. TBD

1.9 CONTRACT TIME

A. Base Bid: 180 Calendar days. Work shall be completed within one (1) field season.

1.10 SPECIFICATIONS

A. The following specifications are attached. Some sections in the schedule of items refer to other sections not listed and are subsidiary to, or are included in payment for other pay items in this contract. These items are considered incidental and no additional compensation will be made.

SECTION 010100 – HIGH PRESSURE GAS LINE CROSSING

SECTION 010250 - CONSTRUCTION STAKING

SECTION 011900 - MOBILIZATION

SECTION 023701- SEDIMENT AND EROSION CONTROL MEASURES

SECTION 024100- WASTE MATERIAL DISPOSAL

SECTION 060101- FLOWABLE FILL

SECTION 312225 - EXCAVATION & EMBANKMENT

SECTION 321216 - ASPHALT PAVEMENT

SECTION 321313 - CONCRETE PAVING

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

SECTION 321613 - CONCRETE CURB AND GUTTER

SECTION 321623 - CONCRETE SIDEWALK AND STEPS

SECTION 322640 - PAVEMENT MARKING

SECTION 340100 - MAINTENANCE OF TRAFFIC

END OF SECTION

SECTION 010100

HIGH PRESSURE GAS LINE CROSSINGS

PART 1 - GENERAL

Three existing Kinder Morgan (KM) high pressure gas main intercepting Highway N 89. This lines are referred to as #1200, #1204, and #1208 natural gas transmission pipelines which crosses Highway N 89 in Section 6 of T21N R08W. These 30"- 34" steel pipelines have a current MAOP of 800-psig, and are a loop source of natural gas to Flagstaff, AZ.

Whenever there is construction activity within 25' of the pipeline, which includes potholing to verify pipeline depth and location, these Construction Restrictions are to be enforced. Exposure of the pipeline will not be permitted between November 1st and April 1st without written approval from KM.

1.1 PRECONSTRUCTION INSPECTION

- A. Coordinate any construction activity in the vicinity of the natural gas pipeline with KM prior to beginning construction. Contact KM ROW Agent Steve Weatherhead at (520) 509-3265, joshua_metzger@kindermorgan.com or the Damage Prevention Specialist Josh Metzger at joshua_metzger@kindermorgan.com two weeks in advance of work start date to arrange a pre-construction on-site inspection.

1.2 MARK PIPELINE

- A. Verify the precise location of all existing underground utilities and the gas pipeline within the proposed construction limits prior to the commencement of construction related activities in accordance with Arizona One-Call regulations. Mark the location of the pipeline within this zone in a manner that ensures unobstructed visibility to all construction and site personnel to the satisfaction of KM and the Project Manager. Maintain the markings until project completion or as directed the Project Manager and approved by KM.

1.3 PROTECT PIPELINE

- A. Kinder Morgan must have an inspector on the project whenever work is being done within 25-feet of either side of the natural gas transmission pipeline. The KM inspector has the authority to immediate suspend work activities not in compliance with these provisions, or deemed potentially detrimental to the integrity of the gas line until the issue is resolved to the satisfaction of KM. KM's inspector will work through the project manager, but in an emergency situation, the KM's inspector has the authority to shut down a potentially hazardous operation near the gas line. The inspector will notify the project manager or district engineer/ COR immediately.
- B. The pipeline shall be protected during all project activities to ensure that the integrity of the pipeline is maintained. KM will review and provide concurrence for all proposed construction activities and material removal or placement within 25-feet of the pipeline.

- C. Power operated equipment will be allowed to dig only to the within 5' of the pipeline until the pipeline is exposed by "soft" (hand or vacuum) excavation. After which the power operated equipment will only be allowed to operate within 2' of the pipeline. Pipeline exposure and unsupported length will be limited to KM's construction standards to ensure the gas line is not deflected or damaged during construction. KM requires a 2-foot clearance or separation from other buried utilities without prior written approval. Exposed pipe shall be padded and bedded with clean sand. Vibratory rollers will not be allowed to vibrate within 25-feet of either side of the pipeline.
- D. Equipment, including vibratory rollers in the static mode, will only be allowed to cross over the pipeline at pre-approved locations where the pipeline has sufficient cover to disperse external stress on the pipeline. Pipeline location and depth will be verified at the crossing location. If necessary, a dirt ramp, air gap, or other approved methods, will be placed and maintained in accordance with KM's requirements. To design and approve a crossing location, KM will be provided with the list of equipment to cross the pipeline, and shall include:
 - 1. Brand, Model, and type of equipment
 - 2. Total laden weight
 - 3. Number of axles and wheels per axles

1.4 PAYMENT

- A. Payment for work related to "pot-holing" or exploratory excavation of this pipeline will be paid for under such bid item for Exiting Gas Main Crossing (Item 02730-9) with inspector documentation. Work related to installation of the sewer force main shall be paid for under the 8-inch Sewer line bid item. See Section 01275: Measurement and Payment and the Drawings for more information.
- B. Exploratory excavation of the pipeline crossing shall be completed prior to installation of the sewer main.

END OF SECTION

SECTION 010250
CONSTRUCTION SURVEY AND STAKING

PART 1 - GENERAL

1.1 SUMMARY

- A. This work shall consist of the construction staking of distribution and Transmission mains in accordance with the Drawings and Specifications. The work includes the furnishing of all labor, equipment, instruments, materials, transportation and other incidentals necessary to complete the construction staking in accordance with these specifications and acceptable engineering practice.

1.2 QUALITY CONTROL

- A. Construction staking shall be accomplished under the direction of a Civil Engineer, Engineering Technician, or Land Surveyor closely associated and familiar with construction staking; periodic visits to the project site are required.

1.3 MEASUREMENT AND PAYMENT

- A. Measurement shall be lump sum for surveying and staking the project through all phases of construction.

PART 2 - PRODUCTS

2.1 GOVERNMENT-FURNISHED SURVEY CONTROL SHEETS

- A. The Government will provide the Contractor with a set of survey control sheets showing horizontal and vertical control for site to be staked. The Government will provide the Contractor with layout information that will include:
 - 1. Control Points - Northing, Easting, Existing Elevations.
 - 2. Roads, Spurs, Parking Areas - Northing, Easting, and Finish Elevations for centerline and edge of roads, spurs, parking areas.
 - 3. Paths - Northing, Easting, and Finish Elevations for centerline.
 - 4. Buildings and Other Structures - Northing, Easting, and Finish Elevations for corners of buildings, other structures (fencing, etc).
 - 5. Water Well Location – Northing, Easting.
 - 6. Archeological Sites- – Northing, Easting.

2.2 STAKES

- A. Identification stakes and hubs shall be of sufficient length and width to provide a solid set in the ground and to provide space for marking above ground when applicable. Other dimensions and materials may be used, such as steel reinforcing bars, wire flagging and markers, and metal pins, if approved in writing by the Contracting Officer (CO). The top 2 inches of all slope, guard, reference, clearing, and structure stakes shall be painted or marked with plastic flagging. Colors used on stakes or for flagging shall be as follows:

- | | | |
|----|--|----------------------|
| 1. | Control Points | - Pink/White Striped |
| 2. | Roads, parking lots, and parking spurs | - Orange |
| 3. | Waterlines and potable water utilities | - Blue |
| 4. | Sanitary sewers and septic systems | - Green |
| 5. | Storm sewers and culverts | - Teal |
| 6. | Family Units, group units, and paths | - Red |
| 7. | Buildings, excavation and grading | - Yellow |
| 8. | Irrigation systems and reclaimed water | - Purple |

2.3 SURVEY NOTE PAPER AND BOOKS

- A. Paper for survey notes shall be moisture-resistant paper. Notes shall be contained in books with covers that will protect the contents and retain the pages in numerical sequence during field use. Field notebooks or notepaper shall be furnished by the Contractor.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall be required to provide all necessary staking and control for all phases of construction. The Contractor shall use the data and information shown on the project Drawings to establish the location of all facilities to be constructed under this contract. The Contractor may choose any method of establishing horizontal and vertical controls provided the following minimum precision and accuracy requirements are met.
- B. Accuracy requirements:
1. Minimum position close; 1/1000
 2. Vertical closure: 0.05 ft (vertical)/station (100 feet horizontal)
 3. Cross section and slope stake precision:
- C. Allowable deviation of cross section line projection from a true perpendicular to tangents, a true bisector of angle points, or a true radius of curves: +/-3 degrees.
- D. Cross section topography measurements shall be taken so that variations in ground form a straight line connecting the cross-section points will not exceed: 1.0 ft.
- E. Horizontal and vertical accuracy for slope stake, slope stake references, and clearing limits. In feet or percentage of horizontal distance measured from centerline or reference stake, whichever is greater. Slope reference stakes and slope stakes: 0.15 ft or 0.6%. Clearing limits: 1.0 ft.

3.2 ESTABLISHING AND REFERENCING IMPROVEMENT LOCATIONS

- A. Access Roads, Parking Spurs, and Turn Around Area:
1. Slope stakes (cut and fill catch points), clearing limits, and slope stake references shall be established on both sides of the centerline at each station established. Slope stakes and slope stake references shall be located on a line at right angles to tangents and on radial lines or curves. Slope stake catch points shall be located by using the grading plans and/or profiles, typical road section templates, as shown on the Drawings and the information provided with staking points.

2. Slope stakes shall be set at 50-foot intervals, at significant breaks in the ground profile, culvert locations, and widening transition points. Slope stakes shall be set at 25-foot intervals around curves having a radius less than 100 feet.

B. Family Units

1. Slope stakes shall be established at the corners of family units. Slope stakes shall be written to reference the finish grade of the unit or pad being staked.

C. Paths and Trails

1. Slope stakes (cut and fill catch points), clearing limits, and slope stake references shall be established on both sides of the centerline at each station established. Slope stakes and slope stake references shall be located on a line at right angles to tangents and on radial lines or curves. Slope stake catch points shall be located by using the grading plans and/or profiles, and typical path and trail section templates as shown on the Drawings.
2. Slope stakes shall be set at 10-foot intervals, at significant breaks in the ground profile, culvert locations, and widening transition points.

D. Culverts

1. Slope stakes and slope reference stakes shall be set at all culvert locations. A culvert reference stake and hub shall be set on the centerline of the culvert 10 feet from each end or beyond the clearing limit, whichever is greater. The following shall be recorded on these stakes:
 - a. The actual field measured length
 - b. The vertical and horizontal distance from hubs to the invert at the ends of the culvert.

E. Waterline & Other Utilities

1. Waterline and other Utilities shall be staked at the locations shown on the Drawings with the specified minimum burial depth. Waterline elevations shall be accurately staked to provide for drainage as indicated on the Drawings. Grade stakes shall be established as necessary to provide the control for the construction work.

F. Buildings

1. Slope stakes and slope stake references shall be established at each corner and as necessary to provide adequate construction control.

3.3 DISCREPANCIES

- A. The Contractor shall compare the staked centerline horizontal and vertical alignment with the design data. Differences between previously recorded and observed elevations of benchmarks shall be referred to the Contracting Officer. Differences in centerline profile elevations exceeding 1 foot at any two or more consecutive points shall be reported to the contracting Officer for evaluation and possible revision. Staking of these areas shall be deferred until the Contracting Officer resolves these differences.

3.4 VERTICAL CONTROL

- A. Vertical control for construction shall be as referenced on the Drawings.

3.5 MARKING STAKES

- A. All stakes shall be legibly marked, in the format agreed upon with the Contracting Officer, with a stake pencil that leaves an imprinted or with waterproof ink. Marking shall conform to the nomenclature below:

PI	Point of Intersection of tangents
PC	Point of curvature
POC	Point on curve
Pt	Point of tangency
POT	Point on tangent
RP	Reference point
P	P-line (preliminary location line)
L	L-line (final location line)
BM	Benchmark
TBM	Temporary benchmark
BT	Begin taper (any)
ET	End taper (any)
C	Cut
F	Fill
L	Centerline
D	Ditch
W	Width

3.6 SURVEY NOTES

- A. All survey data shall be neatly recorded in survey books. All survey notes shall become the property of the Forest Service. Errors shall be deleted by lining out. Date, crew names and positions, instrumentation, and weather shall be recorded in the notes at the beginning of each day's work. The party chief shall sign or initial each page of the notes immediately after the last entry for each day's work.
- B. Electronically recorded survey notes shall be consecutively numbered and headed to identify the contents. The notes shall be supported and accompanied by a bound book that records the project name and for each day identifies date, crew names and positions, instrumentation, weather, type of survey, stationing of sections between which survey was performed, and survey data or sketched that cannot be electronically recorded. The party chief shall sign or initial the electronically recorded notes and Day Book immediately after the last entry for each day's work.

END OF SECTION

SECTION 011900
MOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This item is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site; for payment of premiums for bonds and insurance for the project; and for any other work and operations which must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided for under the contract.

1.2 MEASUREMENT AND PAYMENT

- A. The measurement shall be lump sum for mobilization. Payment shall be as follows:
1. Bond premiums will be reimbursed after receipt of the evidence of payment.
 2. 50% of the lump sum, not to exceed 5% of the original contract amount, will be paid following completion of 5% of the original contract amount not including mobilization and bond premiums.
 3. Payment of the remaining portion of the lump sum, up to 10% of the original contract amount, will be paid following completion of 10% of the original contract amount not including mobilization and bond premiums.
 4. Any portion of the lump sum in excess of 10% of the original contract amount will be paid after final acceptance.
 5. Progress payments for mobilization and preparatory work shall be subject to retainage.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 023701

SEDIMENT AND EROSION CONTROL MEASURES

PART 1 - GENERAL

- 1.1 The work under this section consists of furnishing all necessary labor, equipment, materials, and performing all operations in connection with construction sediment and control measures.

A. General

1. All erosion and sediment control measures are to be placed prior to any disturbance caused by grading and or excavation and shall conform to the requirements of the appropriate regulatory agency for the State.
2. The Contractor shall be solely responsible for ensuring that erosion and sediment control measures are implemented and maintained at the site.
3. Soil disturbing activities include but are not limited to: Clearing and grubbing, excavation for utilities and foundations, roadway and parking lot construction, construction or modification of site drainage, grading, and preparation for final seeding.

1.2 SUBMITTALS

- A. The Contractor shall be required to submit a sediment and erosion control plan in accordance with this specification for approval by the Contracting Officer two calendar weeks prior to start of work.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement and/or payment will be made for this section. Payment shall be included with work shown in the schedule of items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. SYNTHETIC FILTER FABRIC FOR SILT FENCES.

1. Pervious sheet of polypropylene, nylon, or polyethylene fabric conforming to the following physical and hydraulic characteristics:

Physical Properties (Min.)	Requirement	Test Method
Grab Tensile, lbs.	W120/F100	ASTM-D-4632
Grab Elongation, %	15	ASTM-D-4632
Mullen Burst, psi	275	ASTM-D-3786
Puncture, lbs.	65	ASTM-D-4833
Trapezoidal Tear, lbs.	50	ASTM-D-4533
UV Resistance, %	80	ASTM-D-4355
AOS, US Sieve #	30/40	ASTM-D-4751
Permittivity gal/min-sq. ft.	90	ASTM-D-4491

2. Filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120 F.
3. Support Posts: 4 foot - 2 x 2 wood.

B. STRAW BALES

1. Oat or wheat straw, free from weeds, viable weed seeds, foreign matter detrimental to plant life, and dry.
2. Grass hay bales are not acceptable.
3. In order to prevent deterioration of the bindings, all bales shall be either wire-bound or string-tied so that bindings are oriented around the sides rather than along the tops and bottoms of the bales.

C. STRAW WATTLES OR ROLLS

1. Furnish straw wattles or rolls that are manufactured from weed free straw and wrapped in a tubular photodegradable plastic netting made from 85% high density polyethylene, 14% ethyl vinyl acetate and 1% color for UV inhibition. Conform to the following:
 - a. Diameter: 9 inches min.
 - b. Netting strand thickness: 0.030 inches
 - c. Netting knot thickness: 0.055 inches
 - d. Mass of netting: 0.315 to 0.385 ounces per foot

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. Install straw bales at local drainage ways to prevent silt intrusion upon adjacent drainage courses. Remove straw bales following establishment of vegetation cover and utilize as mulch at swales or on steep slopes.
- B. Prior to construction, install silt fence along the downhill construction limits to prevent silt intrusion upon adjacent land.
- C. Install sediment and erosion control measures on the down slope toe of all topsoil stockpiles.
- D. Maintain and remove all erosion controls as specified.
- E. Temporary seeding shall be placed on exposed surfaces that will not be brought to final grading or permanent cover treatment within 30 calendar days of the exposure to reduce erosion and sedimentation by stabilizing exposed soils. Seeded areas shall be checked regularly for bare spots, washouts, and healthy growth to assure that a good stand of grass is being maintained. Reseed areas that fail to establish vegetation cover as soon as such areas are identified.

3.2 DUST CONTROL

- A. In areas subject to surface and air movement of dust, where on-site or off-site damage is likely to occur, one or more of the following preventive measures shall be taken for dust control:
 1. Minimize the period of soil exposure using temporary ground cover and other temporary stabilization practices.

2. Sprinkle the site with water until surface is wet. Repeat as needed.

3.3 SILT FENCE

A. Silt fences are appropriate for the following general locations:

1. Immediately upstream of the point(s) of runoff discharge from a site before flow becomes concentrated.
2. Below disturbed areas where runoff may occur in the form of overland flow.
3. Along the down slope toe of all topsoil stock piles.

B. Materials.

1. Utilize standard strength synthetic filter fabric for sediment barriers. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.
2. The standard strength filter fabric shall be stapled or wired to the fence and 6 inches of the fabric shall be extended into the ground. Filter fabric shall not be stapled to existing trees.
3. Support posts shall be spaced at a maximum of 6 feet and driven securely into the ground a minimum of 24 inches.
4. Filter fabric shall be buried a minimum of 12 inches.
5. The height of a silt fence shall not exceed 36 inches. Higher fences may impound volumes of water sufficient to cause failure of the structure.

C. Maintenance.

1. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
2. Silt fences shall be inspected for depth of sediment, tears, and to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground. Any deficiencies shall be repaired immediately.
3. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
4. Sediment deposits should be removed after each storm event and/or when deposits reach approximately 1/3 the height of the barrier or when the deposits limit or prevent the flow of water through the fabric.
5. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared, and seeded.

3.4 STRAW BALE EROSION CONTROL FENCE

A. Straw bale erosion control fences are appropriate for the following general locations:

1. Sheet flow applications: Straw bales shall be placed in a single row, lengthwise on the contour with ends of adjacent bales tightly abutting one another.
2. Channel flow applications: Straw bales shall be placed in a single row, lengthwise and oriented perpendicular to the direction of flow with ends of adjacent bales tightly abutting one another. The barrier shall be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment laden runoff will flow either through or over the barrier but not around it.

- B. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked, the excavated soil shall be backfilled against the barrier. Backfill shall conform to the ground level of the downhill side and shall be built up to 4 inches against the uphill side of the barrier.
- C. Each bale shall be securely anchored by at least 2 stakes or rebar driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or rebar shall be driven a minimum of 12 inches into the ground or deep enough into the ground to securely anchor the bales, whichever is greater.
- D. The gaps between bales shall be chinked (filled by wedging with straw to prevent water from escaping between the bales). Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency.

3.5 STRAW WATTLE OR ROLL

- A. Straw wattles shall be installed in accordance to manufacturer's installation guidelines.
- B. At a minimum:
 - 1. The wattle shall be entrenched and backfilled. A trench shall be excavated the width of the straw wattle and the length of the proposed barrier to a depth of 2-3 inches.
 - 2. Each wattle shall be securely anchored by at least one 18-24 inch stake every 3-4 feet and with a stake on each end. Stakes shall be driven perpendicular to slope face through the middle of the wattle until 2-3 inches remains exposed above the wattle.
 - 3. After the wattles are staked, compact excavated soil against the uphill side of the barrier.
 - 4. Adjacent wattles should tightly abut.

3.6 MAINTENANCE

- A. Inspection shall be frequent, and repair or replacement shall be made promptly as needed. Straw bale carriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

END OF SECTION

SECTION 024100
WASTE MATERIAL DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the loading, handling, hauling, and placing of excess excavation material, unsuitable excavation material, clearing and grubbing debris, and construction and demolition debris.

1.2 MEASUREMENT AND PAYMENT

- A. There will be no separate measurement or payment for work in this Section. Waste material disposal is considered incidental to other items of work shown in the Schedule of Items.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 WASTE MATERIAL TO BE HAULED TO A LANDFILL

- A. All demolition materials, garbage, and other refuse generated shall be removed from the project site and legally disposed of off Government property in an approved landfill.
- B. The Contractor is responsible for all costs and permits associated with landfill disposal.
- C. The Government is not responsible for waste material upon its departure from the project site.

END OF SECTION

SECTION 60101
FLOWABLE FILL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work consists of furnishing and placing Flowable Fill to the lines and grades shown on the plans as backfill in trenches and/or at other locations. Flowable Fill is a self-compacting cementitious material using mineral aggregates (sand and/or gravel), native or processed materials, fly ash/cement, water, air-entraining solution, and (optionally) other admixtures. Flowable Fill is also known as Controlled Low-Strength Material (CLSM) and Controlled Density Fill (CDF). Flowable Fill is only permitted when specifically called out in the contract documents or approved by the Government.

1.2 REFERENCES

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

ASTM D4832	Preparation/Testing of Soil-Cement Slurry TestCylinders
ASTM C39	Test Method for Compressive Strength of Cylindrical Con- crete Specimens
ASTM D6023	Standard Test Method for Unit Weight
ASTM C150	Specification for Portland Cement
ASTM C618	Specification for Fly Ash
ASTM C494	Specification for Chemical Admixture for Concrete
ASTM E329	Practice for Use in the Evaluation of Testing and In- spection Agencies as Used in Construction
ASTM C1064	Temperature of Freshly Mixed Portland Cement Concrete
ASTM C117	Materials Finer Than 0.075 mm (No. 200) Sieve in Min- eral Ag- gregates by Washing
ASTM C136	Sieve Analysis of Fine & Coarse Aggregate

ASTM C117	Materials Finer Than No. 200 (0.075 mm) Sieve in Mineral Aggregates by Washing
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM C94	Ready Mix Concrete
ACI 301	Standard Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete

1.3 TESTING

- A. The Government may perform occasional quality assurance tests on the flowable fill consisting of slump, air content measurements, and casting 3 cylinders for compressive strength test. The required compressive strength test method and required range are described in section 2.4, Compressive Strength below.
- B. The Contractor is to provide the Government with a mix design by either trial batch or field experience methods to verify the required compressive strength of the flowable fill at the 28 day age. Mix design requirements are described in Section 2.3, Proportions; and in Section 2.4, Compressive Strength. Proportions shall be selected on the basis of unconfined, air-cured compressive strength test specimens.

PART 2 - PRODUCTS

2.1 MIXTURE OF MATERIALS

- A. Provide a mixture of the materials described below to produce a self-compacting cementitious material batched on a per cubic yard basis.

2.2 MATERIALS

- A. Portland Cement: Portland Cement shall conform to the requirements of ASTM C150, Type II.
- B. Fly Ash: Fly Ash shall conform to ASTM C618, Class C or F.
- C. Coarse Aggregate, Fine Aggregate, and Native Materials: Any aggregate gradation which produces performance characteristics of the flowable fill specified herein will be accepted, except as follows: The amount of material passing the #200 sieve shall not exceed 20 percent. Also, liquid limit and plasticity index shall not exceed 25 and 5, respectively.

- D. Water: Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.
- E. Chemical Admixtures: Chemical Admixtures shall conform to the requirements of ASTM C494

2.3 PROPORTIONS

- A. A variety of sand/gravel aggregates and/or native (or processed) materials meeting the above requirements in conjunction with appropriate amounts of Portland Cement and fly ash, air-entraining solution, and (optionally) other admixtures may be used to produce the required mix properties described herein.
- B. The Contractor shall submit to the Government a mix design based upon a trial batch or field experience, including the proportions and sources of all constituent materials, air-entraining, and (optionally) other admixtures, expressed as cubic yard batch weights. The mix shall contain a minimum of 50 pounds (23 kg) of cement and up to 250 pounds (114 kg) fly ash per cubic yard, with the remainder of the volumes composed of aggregates, water, and any approved admixtures. Measured compressive strength, air content, and yield for the mix design trial batch (or for the field experience-based mix design) shall be submitted.

2.4 COMPRESSIVE STRENGTH

- A. Flowable Fill shall be designed to achieve a 28-day compressive strength of 30 to 500 psi (0.2 to 3.4 mPa) when tested in accordance with ASTM C39. Excavatable mixes shall be designed to attain 28-day strengths in the range of 30 to 150 psi (0.2 to 1.0 mPa). Test specimens shall be made in accordance with ASTM D4832. Compressive strength tests shall be performed at frequencies of at least one test set per 150 yd³ (114m³) and at least one test set per day of placement.

2.5 CONSISTENCY

- A. Consistency of the fresh mixture shall be such that the mixture may be readily placed without segregation. High flowability material generally has a slump greater than 8 inches (20.3 cm). As an alternative to slump testing, desired consistency may be approximated by filling an open-ended 3 inch (76.2 mm) diameter cylinder, 6 inches (15.2 cm) high, with the mixture and cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximate 8 inch (20.3 cm) diameter circular type spread without segregation. Adjustments of the proportions of constituents may be made to achieve proper solid suspension and optimum flowability. However, strength requirements and proper yield shall be maintained for the actual batch weights.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. Comply with ACI 304 and ASTM C94 for Measuring, Mixing, Transporting, and Placing the Flowable Fill, and as herein specified.

3.2 LIMITATIONS OF PLACEMENT

- A. Do not place CLSM on frozen ground. Mix and place only when the air temperature is at least 35 degrees Fahrenheit (2°C) and rising. At the time of placement, Flowable Fill shall be at least 40 degrees Fahrenheit (4°C). Stop mixing and placement when the air temperature is 40 degrees Fahrenheit (4°C) and falling.
- B. Flowable backfill shall be placed by methods that preserve the quality of the material in terms of compressive strength, flow, homogeneity, plasticity, and workability. The material shall be transported, placed, and/or consolidated to flow easily around, adjacent to, and under structures. It shall have the flow, consistency, and workability such that the material is self-compacting.
- C. Protect freshly placed Flowable Fill from premature drying, excessive cold, or hot temperatures. The air in contact with the backfill surface shall be maintained at temperatures above freezing. Begin curing immediately following placement before the backfill has dried. Continue with curing until the backfill has attained the 28-day strength requirement. This strength is to be determined prior to any load applications or construction activity unless otherwise directed by the Government.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Payment is made under Flowable Fill – Per Cubic Yard (Cubic Meters).
- B. Payment shall include all labor, materials, equipment, and incidentals necessary to provide, load, haul, place, and consolidate the Flowable Fill.
- C. Measurement shall be based upon batch delivery tickets provided to the Government at the time of placement.

END OF SECTION

SECTION 312225
EXCAVATION & EMBANKMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This work consists of excavating material and constructing embankments. This work includes furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing earthen and rocky material; drainage excavation; removal of slide material; and excavation and disposal of unsuitable material.

1.2 DEFINITION

- A. Excavation - All material excavated from within the right-of-way or easement areas that is not included under other pay items listed in the Schedule of Items. Roadway excavation includes all material encountered regardless of its nature or characteristics.
- B. Borrow or Select Borrow - Material used for embankment construction that is obtained from outside the roadway prism from sources shown on the Drawings. Additional sources of borrow excavation will be subject to approval in advance by the Contracting Officer.
- C. Embankment Construction. Embankment construction consists of placing and compacting roadway or borrow excavation. This work includes:
 - 1. Preparing foundation for embankment;
 - 2. Constructing roadway embankments;
 - 3. Benching for side-hill embankments;
 - 4. Constructing dikes, ramps, mounds, and berms, and
 - 5. Backfilling sub excavated areas, holes, pits, and other depressions.
- D. Suitable Material - Granular material conforming to ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 24 inches in any dimension, debris, waste frozen materials, vegetation, and other deleterious matter.
- E. Unsuitable Material - ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1.3 SUBMITTALS AND QUALITY CONTROL

- A. Density Tests results in "Embankment Placing Methods" paragraph in Part 3.
- B. Testing frequency shall be as indicated below. Repeat tests shall be conducted in any areas where test results indicate noncompliance with specification requirements. All tests shall be conducted under the direction of a registered engineer or certified testing laboratory.

Type of Test	Frequency
Moisture-Density Relationship	1 for each soil type encountered
Density of Soil In-Place	1 for each 5000 square feet of subgrade, 1 for each

5000 square feet of select fill, and 1 per 1000 linear feet of embankment per lift

1.4 MEASUREMENT AND PAYMENT

- A. There will be no separate measurement or payment for work in this section. Payment will be included at the contract unit price for other items shown on the Schedule of Items see “Native Ground Surface Restoration”. Measurement and payment under those separate items shall include:
1. Roadway excavation.
 2. Rock and unsuitable material below the required grade and unsuitable material beneath embankment areas.
 3. Outlet (Furrow) ditches outside the roadway.
 4. Topsoil and other material removed and stockpiled as directed.
 5. Borrow material used in the work and generated from other areas on the project.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 CLEARING & GRUBBING

- A. Clearing and Grubbing shall be completed in accordance with specification Section 02232 “Site Clearing”.
- B. Clearing and grubbing shall be accomplished before excavation or embankment placement begins. Pioneering of roads, slash disposal, and grubbing of stumps may proceed concurrently with clearing and grubbing operation when approved by the Contracting Officer. Excavation and placement operations shall be conducted so slash material to be treated will not be incorporated in the roadway.

3.2 ROADWAY EXCAVATION AND EMBANKMENT SURFACE PREPARATION

- A. General: Do not disturb material and vegetation outside the construction limits. Incorporate only suitable material into embankments. At the end of each day’s operations, shape to drain and compact the work area to a uniform cross-section. Eliminate all ruts and low spots that could hold water.
- B. Rock Cuts: Excavate rock cuts to 6 inches below subgrade within the roadbed limits. Backfill to subgrade with suitable material.
- C. Earth Cuts: Scarify earth cuts to 6 inches below subgrade within the roadbed limits.
1. For buildings (e.g. toilets), scarify earth cuts to 12 inches below subgrade within the foundation limits.
- D. Embankments Surface Preparation: Remove topsoil and break up the ground surface to a minimum of 6 inches by plowing or scarifying.
1. For buildings, remove topsoil and break up the ground surface to a minimum of 12 inches by plowing or scarifying.

- E. All material shall be compacted according to “Embankment Placing Methods” paragraph in Part 3.

3.3 PIONEERING

- A. Pioneering operations for the top of excavation slopes, toe of embankments, or pioneer road construction shall prevent undercutting of the final excavation slope, depositing of materials outside of the roadway limits, and any restriction of drainage.

3.4 UTILIZATION OF EXCAVATED MATERIALS

- A. All suitable, excavated material shall be used in the construction of embankments, subgrades, shoulders, slopes, bedding, and backfill for structures and for other purposes as shown on the Drawings.
 - 1. Excess Excavation:
 - a. Designed excess excavation shall be disposed of as shown on the Drawings.
 - 2. Rock for Slope Protection:
 - a. Excavated rock suitable for protection of embankments may be conserved and used in lieu of a DESIGNATED materials source.
 - 3. Conserving Material:
 - a. Material encountered in the excavation, suitable for cushion, road finishing, or other purposes, may be conserved and utilized instead of materials from commercial sources. Excessively wet material that is otherwise suitable for embankment shall be field drained and dried before placement.
 - 4. Excavation of Unsuitable Material:
 - a. Unsuitable material shall be excavated and disposed of as shown on the Drawings or on site as directed by the Contracting Officer (CO). Excavated areas shall be backfilled with suitable material when necessary to complete the work. Frozen material shall not be placed in embankments. Rocks that are too large to be incorporated into the embankment shall be broken for incorporation into the embankment, maneuvered to the face of the embankment and embedded so that they will not roll.

3.5 DRAINAGE EXCAVATION

- A. Drainage excavation shall include construction of side ditches, minor channel changes, inlet and outlet ditches, furrow ditches, ditches constructed along the road but beyond the roadway limits, and other minor earth drainage structures as shown on the Drawings. Excavated material shall be utilized in accordance with “Utilization of Excavated Materials” paragraph above.

3.6 FINISHING ROADBED

- A. For roads receiving aggregate base or surface course, only rocks that do not protrude above the subgrade more than one-third of the depth of the base or surface course, or 3 inches, whichever is less, may remain in place.

- B. For unsurfaced roads, unless otherwise shown on the Drawings, the top 4 inches below the finished road surface shall not contain rocks larger than 4 inches in greatest dimension. Oversize material shall be removed, reduced to acceptable size, or covered by importing suitable material approved by the Contracting Officer.
- C. The subgrade shall be visibly moist during shaping and dressing. Low sections, holes, cracks, or depressions shall be brought to grade with suitable material approved by the Contracting Officer. Final compaction of the subgrade shall meet the requirements of the embankment placing method specified.

3.7 SNOW REMOVAL

- A. Snow or ice shall not be incorporated in the embankment. Snow shall be removed in advance of the work and deposited beyond the roadway limits in a manner that will not cause resource damage or waste material.

3.8 FINISHING SLOPES

- A. Finished slopes shall conform reasonably to the lines staked on the ground or shown on the Drawings. The finished slope shall be left in a roughened condition to facilitate the establishment of vegetative growth. The finish associated with template and stringline or hand-raking methods will not be allowed. Loose rock, loose debris, and other loose material, each of which is larger than 6 inches in diameter, shall be removed from the slope unless otherwise shown on the Drawings.
- B. The tops of excavations, excluding areas of solid rock, shall be blended with the adjacent terrain by rounding where shown on the Drawings. Decomposed rock that may be cut without blasting or ripping shall be rounded. Earth overlying rock shall be rounded above the rock.

3.9 OVERBUILDING & LANDSCAPE & STREAM PROTECTION

- A. Unless otherwise agreed to by the Contracting Officer, excavation or embankment material shall be confined within the roadway limits to avoid overbuilding and to protect the landscape and streams.

3.10 SUBGRADE TREATMENTS

- A. Subgrade treatment shall consist of soil modification by admixing aggregates, placing geotextiles, fiber mat, wood corduroy, rock blanket, or other similar materials.
- B. The subgrade shall conform to the lines and grades shown on the Drawings. Suitable material shall be utilized in the preparation of the subgrade. Subgrade shall be placed in compacted layers not exceeding 6 inches. Unless specified otherwise, subgrade shall be compacted to 95 percent of AASHTO T 99, method C or D.
- C. Suitable material for subgrade shall be granular material or fine compatible soil free of excess moisture, muck, frozen lumps, roots, sod, and other deleterious material. Remove all rock particles and hard earth clods larger than 3 inches in the longest dimension.
- D. If encountered, removal and disposal of unsuitable material shall conform to Section 312100.

3.11 EMBANKMENT PLACING METHODS

- A. All Methods: When an embankment is to be placed across swampy ground and removal of unsuitable material or subgrade treatment is not required, the lower part of the embankment shall be constructed in a single layer to the minimum depth necessary to support construction equipment.
- B. All Methods: Lift depth shall be a maximum of 6" unless otherwise specified in the Method utilized for a specific embankment placement.
- C. Specific Methods: All embankments shall be placed by Method 4 unless otherwise noted.
 - 1. Method 1. Side Casting and End Dumping: Embankment may be placed by side casting and end dumping. Where material containing a large amount of rock is used to construct embankments, working smaller rocks and fines in with the larger rocks and fines to fill the voids shall provide a solid embankment.
 - 2. Method 2. Layer Placement: Surfaces steeper than a ratio of 3 horizontal to 1 vertical (3:1) upon which embankment is to be placed, shall be roughened or stepped to provide permanent bonding of new and old materials.
 - a. Embankment shall be layer placed, except over rock surfaces, in which case material may be placed by end dumping to the minimum depth needed for operation of spreading equipment. Each embankment layer shall be leveled and smoothed before placement of subsequent layers. Hauling and spreading equipment shall be operated uniformly over the full width of each layer.
 - b. Suitable material shall be placed in layers no more than 12 inches thick, except when the material contains rock more than 9 inches in diameter, in which case layers may be of sufficient thickness to accommodate the material involved. No layer shall exceed 24 inches before compaction.
 - c. Placing individual rocks or boulders greater than 24 inches will be permitted provided the embankment would accommodate them. Such rocks and boulders shall be at least 6 inches below subgrade. They shall be carefully distributed and the voids filled with finer material to form a dense and compacted mass.
 - d. Where material containing large amounts of rock is used to construct embankments, the layers may be of sufficient thickness to accommodate the material involved. A solid embankment with adequate compaction shall be constructed by working smaller rock and fines in with the larger rocks to fill the voids and by operating hauling and spreading equipment uniformly over the full width of each layer as the embankment is constructed.
 - e. Material shall be at moisture content suitable to obtain a mass that will not visibly deflect under the load of the hauling and spreading equipment. Excessively wet material shall be handled in accordance with Subsection 3.3.1.3.
 - 3. Method 3. Layer Placement (Roller Compaction): Embankments shall be placed as specified in Method 2. Placement shall be in horizontal layers not exceeding 12 inches prior to compaction except when the material contains rock more than 9 inches in diameter, in which case layers may be of sufficient thickness to accommodate the material involved. Compaction equipment shall be operated over the full width of each layer until visible deformation of the layer ceases or in the case of the sheepsfoot roller, the roller "walks out" of the layer. At least three complete passes shall be made.

- a. Compaction equipment shall be capable of obtaining compaction requirements without detrimentally affecting the compacted material. The compacting units may be of any type, provided they are capable of compacting each lift of material as specified and meet the minimum requirements contained herein. Minimum requirements for rollers are as follows:
 - 1) Tamping or sheepfoot rollers shall meet the following minimum requirements:
 - a) Diameter - 40"
 - b) Completely filled with liquid.
 - 2) Grid rollers shall be capable of exerting a force of 250 pounds per inch of width of roller drum.
 - 3) Steel-wheel rollers, other than vibratory, shall be capable of exerting a force of not less than 250 pounds per inch of width of the compression roll or rolls.
 - 4) Vibratory steel-wheel rollers shall have a minimum weight of 6 tons. The compactor shall be equipped with amplitude and frequency controls and specifically designed to compact the material on which it is used.
 - 5) Pneumatic-tire rollers shall have smooth tread tires of equal size that provide a uniform compacting pressure for the full width of the roller and shall meet the following minimum requirements:
 - 6) Towed rollers:
 - a) Ballast density shall exceed 100 pounds per cubic foot;
 - b) Volume of ballast shall exceed 7 cubic feet per tire;
 - c) Tire pressure shall exceed 45 pounds per square inch
 - 7) Self-propelled rollers: Shall exert a force that exceeds 200 pounds per linear inch of rolling width.
- 4. Method 4. Controlled Compaction: Embankments shall be placed as specified in Method 2, except earth embankments shall be placed in horizontal layers not exceeding 6 inches (loose measure) and compacted. Material shall be at moisture content suitable for attaining the required compaction. Embankments and the top 1-foot of excavation sections shall be compacted to at least 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.
 - a. The density of the embankment material will be determined during the progress of the work in accordance with AASHTO T 191, T 205 or T 238; T 217, T 239, or T 255. Corrections for coarse particles will be made in accordance with AASHTO T 99, Note 7.
 - b. Density requirements will not apply to portions of rock embankments that cannot be tested in accordance with approved methods. When this condition exists, compaction shall be provided by working smaller rocks and fines in with the larger rocks to fill the voids and by operating equipment over the embankment materials.
- 5. Method 5. Controlled Compaction Using Density Control Strips. The embankment placement requirements for Method 4 shall apply for this method except that compaction shall be performed as shown below:
 - a. To determine target density, a control strip shall be constructed at the beginning of work on each type of material to be compacted. Each control strip, constructed to

acceptable density and surface tolerances, shall remain in place and become a section of the completed roadway. Unacceptable control strips shall be corrected or removed and replaced at the Contractor's expense. A control strip shall have an area of approximately 400 square yards and shall be of the same depth specified for the construction of the course that it represents.

- b. The materials used in the construction of the control strip shall meet the specification requirements. They shall be furnished from the same source and shall be of the same type and moisture content used in the remainder of the course represented by the control strip.
 - c. The base upon which a control strip is to be constructed will be approved by the Contracting Officer before placing control strip material.
 - d. The equipment used in the construction of the control strip will be approved by the Contracting Officer and shall be of the same type and weight as that to be used on the remainder of the course represented by the control strip.
 - e. Compaction of control strips shall commence immediately after the course has been placed to the specified thickness and shall be continuous and uniform over the entire surface. Compaction of the control strip shall be continued until no discernable increase in density can be obtained by additional compactive effort.
 - f. Upon completion of the compaction, the mean density of the control strip will be determined by averaging the results of 10 nuclear density tests taken at randomly selected sites within the control strip. The mean density of the control strip shall be the target density for the remainder of the course that it represents.
 - g. If the mean density of the control strip is less than 95 percent of the maximum density as determined in the laboratory compacted specimens, the Contracting Officer may request the construction of another control strip. The test procedure used to establish the maximum density will be shown on the Drawings.
 - h. A new control strip may also be requested by the Engineer or by the Contractor when:
 - i. A change in the material or job mix formula is made.
 - j. Ten days of production have been accepted without construction of a new control strip.
 - k. There is reason to believe that a control strip density is not representative of the material being placed.
 - l. The specified course shall be compacted to at least 95 percent of the target density. A portable nuclear moisture-density test device in accordance with AASHTO T 238 and T 239 will test density.
 - m. Where portions of rock embankment are constructed that cannot be tested in accordance with approved methods, each layer shall be rolled full width with the same number of passes as the adjacent embankment containing material represented by a control strip.
6. Method 6. Special Project Controlled Compaction: Embankments shall be placed and compacted to at least 90 percent of the maximum density determined by AASHTO T 180, Method C or D, except that compaction of not less than 95 percent of AASHTO T 180, Method C or D, shall be obtained for a minimum depth of 1 foot below subgrade for the width of the roadbed in both excavation and embankment sections.
- a. The density will be determined during the work in accordance with AASHTO T 191, T 205 or T 238; T 217, T 239 or T 255. Corrections for coarse particles will be made in accordance with AASHTO T 99, Note 7.

3.12 CONSTRUCTION TOLERANCES

- A. The tolerance class shall be:
1. Roads, spurs and parking areas: Class "C"
 2. Pathways: Class "C"
- B. Roadway ditches shall be constructed to flow in the direction shown on the Drawings.
- C. Deviations shall be uniform in the direction of change for a distance of 200 feet or more along the project centerline.

TOLERANCE CLASS **

Item	A	B	C	D	E	F	G	H	I	J
Roadbed Width (Ft)	+0.5	+0.5	+1	+1	+1	+1	+1	+1.5	+1	+2
Subgrade Elevation (Ft)	±0.1	±0.2	±0.2	±0.5	±0.5	±1	±1	±1.5	±2	±3
Centerline Alignment (Ft)	0.2	0.2	0.5	0.5	1	1	1	1.5	2	3
Slopes, Excavation and Embankment (Percent Slope)*	±3	±5	±5	±5	±5	±5	±10	±10	±10	±10

**Maximum allowable deviation from construction stakes and Drawings.

*Maximum allowable deviation from staked slope measured from slope stakes or hinge points.

END OF SECTION

SECTION 321216

ASPHALT PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work under this Section shall consist of constructing one or more courses of Asphalt Pavement. Furnish all labor, material, equipment, tools, transportation and supplies necessary to complete the work according to the contract including:
1. Furnish asphalt pavement composed of mineral aggregate, performance graded asphalt binder, recycled asphalt, mineral filler, anti-strip additives and, if applicable, manufactured warm mix asphalt (WMA) additive and/or WMA plant process modifications that are mixed in a central mixing plant and placed on a prepared surface(s) in accordance with these specifications and in conformance to the lines, grades, compacted thicknesses and typical cross sections shown on the contract drawings or as directed by the Contracting Officer (CO).
 2. The asphaltic concrete shall be as specified in Sections 409 and 1005 of the Standard Specifications, and Contracts and Specifications Stored Specs. "409AGGR" and "1005PG".

1.2 SUBMITTALS

- A. Job Mix Formula (JMF): The job mix formula shall be submitted in writing by the Contractor at least 30 days prior to the start of paving operations. The submittal shall be a signed statement prepared by the contractor's testing laboratory that certifies the proposed JMF meets the requirements of the contract and can be placed and compacted in the field during production. For each JMF submit the following:
1. Individual bin/stockpile percentages including average percent passing each specified sieve size, resulting blend gradations and proposed designated sieve Target Values (TV's) for specified gradation. Gradation shall be performed using AASHTO T-11 procedure B.
 2. Percent of performance graded asphalt binder (PGAB) required by the JMF to meet the specified design parameters.
 3. Performance graded asphalt binder Production Certificate of Compliance (COC) certifying the specified binder grade and properties are in accordance with AASHTO M 320 and R 26. State the type of modification, if applicable. The PAV test temperature shall be 2120F.
 4. Mixing temperature: Conform to recommendations of PGAB supplier. Do not heat above 3500F.
 5. Compaction temperature requirements for the asphalt binder grade specified for either hot mix asphalt (HMA) or WMA.
 6. Percent and type of anti-stripping additive, if required.
 7. At the time of JMF submittal, if requested by the CO, the Contractor shall provide samples of aggregates, binder, mineral filler, bag house fines (if used in the submitted JMF), and antistrip additive (if used in the submitted JMF). Provide sufficient quantity of each component for JMF verification by the CO. This may require up to 800 pounds of aggregates, proportioned according to individual bin combinations, five individual gallons of PGAB, and proportionate amounts of the other components necessary to

complete JMF verification. Confirm with the CO the actual quantities required before delivering samples for JMF verification. Allow the CO the opportunity to witness sampling and splitting of JMF submittal samples.

WMA – If proposed for use, include a full description of the WMA technology and the target dosage rate together with the submission of an MSDS for the additive, if applicable, and submission of either enough of the additive for the laboratory mix design verification, or the additive pre-blended in the PGAB at the correct dosage. If the additive is not pre-blended into the PGAB, include directions for properly incorporating the additive into the laboratory made mixture. Include documentation of at least three successful past WMA technology field applications including project type, project owner, tonnage placed, mix design, mixture volumetrics and performance, temperature range for laboratory mixing and compacting, asphalt binder performance grade test data over the range of WMA additive percentages proposed for use, if applicable, evidence of compatibility of WMA additive with asphalt binder and anti-strip agent, and the temperature range for field mix production, delivery, laydown and compaction.

8. The JMF shall identify the specific part of the work for which it is intended to be used (i.e. base course, intermediate course, surface course, etc.) and shall indicate minimum criteria listed above for each JMF. If multiple mixing plants are proposed to be used, submit a separate JMF for each plant.
9. Submit a list of materials proposed for use in the work under this sub- section including the name and address of the materials producers and the locations from which the materials are to be obtained.
10. Submit aggregate quality test results and furnish certificates of compliance signed by the materials producers or subcontractors and suppliers, stating that materials when tested according to specified test method(s) meet or exceed the specified contract requirements.

1.3 QUALITY ASSURANCE

- A. The Contractor is responsible for controlling the quality of materials and workmanship during production and placement.
- B. The CO will monitor the adequacy of the Contractor's QC activities during production and placement and may perform inspection, sampling and testing to verify conformance with contract requirements.
- C. The acceptance of plant produced and placed asphalt mixtures shall be determined by the CO in accordance with the requirements of subsection 3.07 "Acceptance Sampling and Testing."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Performance Graded Asphalt Binders: The asphalt binder shall be a Performance Graded Asphalt Binder (PGAB) which meets the specification requirements of AASHTO M320 and AASHTO R26. The PG binder shall be achieved by the use of Neat Asphalt with elastomer polymer modification if needed. The grade of asphalt for the PGAB will be as indicated in Table 32 12 16-1 for the project location.

Table 32 12 16-1
Performance Graded Asphalt Binder (PGAB)

State	Standard PG Grade	Notes/Exceptions:
AZ	PG 70-22 TR+	Below 4,000' not required

- B. Acceptance of the PGAB will be in accordance with AASHTO R26 “Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders”. PGAB shall be provided by an Approved Supplier (AS) under the Approved Supplier Certification (ASC) system. Provide a Certification of Compliance (COC) for the specified PGAB with each bulk delivery to the mixing plant during the production of asphalt. Sample in accordance with Table 32 12 16-5 and provide samples to the CO. Sample identification shall include: sample number, time and date of sampling, applicable copies of the PGAB bulk delivery COCs, and the quantity of material in the liquid asphalt storage tanks at the time of delivery.

The blending at the asphalt plants of PG binders from different suppliers is strictly prohibited.

The Certificate of Compliance for binder shall be a production certificate. All materials requiring a production certification shall require the manufacturer to furnish a production certification for each shipment of material. Include the following with each production COC:

1. Date and place of manufacture;
2. Lot number or other means of cross-referencing to the manufacturer’s inspection and testing system; and
3. Substantiating evidence that the material conforms to the contract quality requirements as required by FAR 46.105(a)(4), including all of the following:
 - a. Test results on material from the same lot and documentation of the inspection and testing system;
 - b. A statement from the manufacturer that the material complies with all contract requirements; and
 - c. Manufacturer’s signature or other means of demonstrating accountability for the certification.

All other manufactured non-project produced materials shall require Commercial Certification such as mineral filler, antistripping additives and WMA additives.

- C. Recycled Asphalt Pavement (RAP) Material:
1. General Requirements: RAP may be used as a component of the asphalt mixture if approved by the CO. Usage of RAP is subject to the following requirements: a maximum of 20 percent for surface courses; and a maximum of 25 percent for all other courses. Percent RAP is computed by mass.
- D. When required by the mix design (job mix formula) furnish lime conforming to AASHTO 303.
- E. Aggregates: Shall conform to the requirements of subsection 2.02 for the designated grading.
- F. WMA – If WMA is proposed, use a WMA technology that has been approved by the state in which the project is being constructed. Provide evidence of the state approval.

2.2 COMPOSITION OF ASPHALT MIXTURE (JOB MIX FORMULA)

- A. Furnish mixes of aggregate, asphalt binder, recycled asphalt pavement, and additives that meet applicable material specifications and the design requirements as designated in
- B. Table 32 12 16-2. Volumetric mix properties will be determined and approved at N_{des} according to AASHTO T-312 and R35 after all additives/technologies have been incorporated. This includes meeting PGAB specification requirements.

Table 32 12 16-2
Asphalt Pavement Design Requirements

De- sign ESAL ⁽⁵⁾ (Mil- lion)	Gyratory Compaction Level (% Theoretical Max- imum Specific Gravity, Gmm) AASHTO T 312 ⁽⁴⁾			Minimum Voids-in-the Mineral Ag- gregate (VMA), % ⁽¹⁾				Voids Filled with As- phalt (VFA), %	Dust- to- Binder Ratio ⁽³⁾	Mini- mum Tensile Strength Ratio, AASHT O T 283 ⁽⁴⁾
				Nominal Maximum Size Aggre- gate ⁽²⁾						
	Nini- tial	Nde- sign	Nmax	1 inch	¾ inch	½ inch	⅜ inch			
< 0.3	6 (≤91.5 %)	50 (96.0 %)	75 (≤98.0 %)	12.0	13.0	14.0	15.0	70.0 - 80.0	0.8 -1.6	0.8 0
0.3 to < 3	7 (≤90.5 %)	65 (96.0 %)	95 (≤98.0 %)					65.0 - 78.0		
3 to 30	8 (≤89.0 %)	100 (96.0 %)	160 (≤98.0 %)					65.0 - 78.0		

(1) When mineral filler or hydrated lime is used, include in the calculation for compliance with the VMA.

(2) The nominal maximum size aggregate is one size greater than the first sieve to retain more than 10 percent of the combined aggregate.

(3) Dust to binder ratio is the effective asphalt content divided by the total percent of material passing the No. 200 (75 µm) sieve. Dust includes lime, bag house fines, and other mineral matter. Use washed sieve analysis.

(4) Prepare specimens in accordance with AASHTO T-312. AASHTO T-283 specimens shall be 4-inches in diameter for freeze thaw. Use AASHTO T-166 regardless of the volume of water absorbed.

(5) The design requirements for < 0.3 million ESALs will be referred to as Level NPS-1, 0.3 to <3 million ESALs will be referred to as Level NPS-2, and the design requirements for 3 to 30 million ESALs shall be designated at Level NPS-3.

- C. Aggregate Gradation: Furnish nominal maximum size aggregate gradation(s) as specified in the contract and that conform to AASHTO M-323, Superpave Volumetric Mix Design, Table 3.
- D. Fractured Faces Coarse Aggregate, Uncompacted Void Content of Fine Aggregate (% min), Sand Equivalent (%min), and Flat and Elongated (% max) shall meet requirements specified in AASHTO M-323, Superpave Volumetric Mix Design, Table 5.

- E. Furnish hard durable particles or fragments of crushed stone conforming to state specifications.
- F. For the surface course, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue when tested according to ASTM D3040.
- G. WMA – Comply with the manufacturer’s recommendations for incorporating the WMA technology. Test specimens may be made from plant produced or laboratory prepared WMA. Test specimens must be made from plant produced WMA if adding the WMA technology in the laboratory does not simulate the production process.

PART 3 - EXECUTION

3.1 GENERAL

- A. Job Mix Formula (JMF): No asphalt mixtures shall be placed on the project site until a JMF has been submitted by the Contractor, approved by the CO and a prepaving meeting conducted.
- B. The Contractor shall place asphalt pavement at the locations, widths, thickness and to the grades shown on the Drawings.
- C. Maintain all equipment in safe and satisfactory operating condition.
- D. Protection and Restoration of Property and Landscape—follow the requirements of FAR Clause 52-236-9 Protection of existing Vegetation, Structures, Equipment, Utilities and Improvements. In addition:
 - 1. Protect adjacent work from contamination by paving materials and placement activities. Remove any stains or damage from adjacent work, structures, curbing, or other facilities, resulting from such contamination. Remove and dispose of all waste and spillage.
 - 2. Do not damage or disturb existing improvements, facilities, features or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.
 - 3. Restore damaged improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work.
 - 4. Check frames, covers, grates, water valve boxes and other miscellaneous castings that are located in the proposed pavement areas to ensure that they have been correctly positioned and set to the proper slope and elevation.
- E. Notification – Notify the CO at least 14 calendar days prior to beginning paving work. A prepaving conference will be scheduled at least 7 calendar days prior to starting placement. All CO, Contractor and supplier representatives critical to the paving operation will be required to attend this meeting. At this meeting be prepared to discuss work schedule, traffic control, proposed equipment to be used, control strip construction and acceptance, production and placement quality control, final acceptance procedures and requirements, and any other elements critical to the successful execution of paving operations.

3.2 CONTROL TEST SECTION

- A. After the JMF has been approved a Control Test Section (CTS) shall be placed, and accepted, prior to beginning full production. The purpose of the CTS is to demonstrate the contractors ability to produce, place and compact the mixture as designed, specified and approved. If necessary, during this time, adjustments to the mix design may be made according to Subsection 3.05(E). Target value adjustments to the JMF greater than those designated in Table 32 12 16-3 may require a complete new mix design submittal and verification, if requested by the CO.

Table 32 12 16-3
Allowable JMF Revision Limits

Test Property	Verification and Adjustment Limits, %
Asphalt Binder Content	+/- 0.4
Gradation: 2.36mm & Larger	+/- 3.0
600um & 300um	+/- 2.0
Gradation: 0.075mm	+/- 1.0
Voids in Mineral Aggregate, VMA,	Min. per Table 32 12 16 -2
Voids Filled with Asphalt, VFA,	Range per Table 32 12 16-2

- B. The CTS will be, unless otherwise recommended by the CO due to project configuration, a minimum of 500 feet long and two lanes wide, and will include a Longitudinal Joint-Wedge (if the placement thickness is equal to or greater than 1-1/2 inches) as described in 3.05 G(1). It shall be of the same depth, and placed on the same underlying material, as the work that it represents. The equipment used in construction of the CTS shall be the same type and weight(s) to be used on the remainder of the work.
- C. Take three (3) random samples from behind the laydown machine. The samples shall be split and the split portion shall be delivered to the CO for verification testing. Testing shall include: VMA, VFA, VTM, TSR, aggregate gradation and asphalt binder content. The contractor shall test his portion of the samples and report data to the CO. Test samples according to contract specified testing methods. PGAB shall be verified using approved documentation production COC meeting the specified grade.
- D. Take five (5) randomly selected cores from the finished pavement mat and five (5) randomly selected cores from the longitudinal joint in the CTS. Provide splits to the CO for evaluation. Test samples according to contract specified testing methods. Correlation of density equipment with cores will be as described in the QCP and approved by the CO. Provide correlation data between the density gauge and the cores to the CO.

All density gauges shall be calibrated in accordance with manufacturers' recommendations prior to use on the project. Provide calibration record to the CO.

- E. The Control Test Section shall be considered acceptable and allowed to remain in place if:
1. Mixture and Density. The mix and placed mat and longitudinal joint are acceptable if the mean of the multiple test results are within specification limits for: gradation, asphalt content, air voids, VMA, TSR and density; and, no single test result falls outside the specification limits as defined in Section 3.10.

2. Smoothness: Pavement mat is uniform in texture and smoothness, with no surface deviations in excess of 1/4-inch in 10 feet.
- F. If the initial CTS is unacceptable as described above, adjust the JMF, plant operations or placing and compacting procedures, as necessary and construct another CTS.

Additional CTSs, as required, shall be constructed and evaluated until an acceptable CTS is constructed. All unacceptable CTSs shall be removed at the Contractor's expense. Costs incurred by the Government, if any, for additional sampling, testing and inspection required due to unacceptable CTSs will be deducted from payments owed the contractor.

Full production shall not begin until an acceptable CTS has been constructed. However, production may begin, contingent upon the TSR results, if all other test results are acceptable, at the Contractor's risk.

3.3 EQUIPMENT

- A. Mixing Plant. Use mixing plants conforming to AASHTO M 156 supplemented as follows:
1. All plants.
 - a. Automated controls. Control the proportioning, mixing, and discharging of the mix automatically.
 - b. Dust collector. AASHTO M 156, Requirements for All Plants, Emission Controls is amended as follows: Equip the plant with a dust collector. Dispose of the collected material. In the case of bag house dust collectors, dispose of the collected material or return the collected material uniformly. Use of bag house fines in asphalt concrete mixes requires approval unless included as part of the approved job-mix formula.
 - c. Recycled asphalt pavement. When recycled asphalt pavement material is incorporated into the mixture, modify plants according to the plant manufacturer's recommendations to process reclaimed material, and according to any state specific specifications related to processing RAP.
 - d. WMA- when proposed and approved, modify the asphalt plant as required by the manufacturer to introduce the WMA technology.
 2. Drum dryer-mixer plants.
 - a. Bins. Provide a separate bin in the cold aggregate feeder for each individual aggregate stockpile in the mix. Use bins of sufficient size to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another.
 - b. Stockpiling procedures. Separate aggregate into at least 2 stockpiles with different gradations. As a minimum, stockpile mostly coarse material in one stockpile and mostly fine material in another.
 3. Batch and continuous mix plants.
 - a. Hot aggregate bin. Provide a bin with 3 or more separate compartments for storage of the screened aggregate fractions to be combined for the mix. Make the partitions between the compartments tight and of sufficient height to prevent spillage of aggregate from one compartment into another.
 - b. Load cells. Calibrated load cells may be used in batch plants instead of scales.
 - c. Recycled asphalt pavement. Modify batch plants so the recycled asphalt pavement is introduced into the mix after bypassing the dryer. Design the cold feed bin, conveyor system, and special bin adjacent to the weigh hopper, if used, to avoid segregation and sticking of the recycled asphalt pavement material. Heat aggregate

to a temperature that will transfer sufficient heat to the recycled asphalt pavement material to produce a mix of uniform temperature within the range specified in the approved job-mix formula.

- B. Hauling Equipment. Use vehicles with tight, clean, and smooth metal beds for hauling asphalt mixtures. Thinly coat the beds with an approved material such as a small amount of lime solution or an approved soap solution or detergent to prevent the mix from adhering to the beds. Do not use petroleum derivatives or other coating material that contaminates or alters the characteristics of the mix. Drain the bed before loading. Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mix from the weather and thermal segregation and during hauling. When necessary to maintain temperature, use insulated truck beds and securely fastened covers pinned on the sides. Provide a minimum of two (2) access port or holes for checking temperature of asphalt mix in the truck, located near the midpoint of the body, at least 12 inches above the bed.
- C. Pavers. Use pavers that are:
1. Self-contained, power-propelled units with adjustable vibratory screeds with full width screw augers;
 2. Heated for the full width of the screed;
 3. Capable of spreading and finishing courses of asphalt mix in widths at least 12 inches more than the width of one lane;
 4. Equipped with a receiving hopper having sufficient capacity to ensure a uniform spreading operation;
 5. Equipped with automatic feed controls, which are properly adjusted to maintain a uniform depth of material ahead of the screed;
 6. Operable at forward speeds consistent with satisfactory mix lay down;
 7. Capable of producing a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mix; and
 8. Equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope.
 9. Do not use diesel during paving operations as release agent on any parts that come in contact with the mix.
- D. Rollers. Rollers of the vibratory, steel wheel, oscillatory, and pneumatic-tired type may be used. They shall be in good condition, capable of reversing direction without backlash, and operating at slow speeds to avoid displacement of the asphalt mixture. Static rollers shall be operated at speeds not to exceed 3 mph and vibratory rollers shall be operated at a minimum of 10 to 12 impacts/ft. in vibratory mode. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

The Contractor shall exercise caution when using vibratory rollers so as not to cause damage to buried infrastructure or adjacent infrastructure. Damage to buried or adjacent infrastructure will be the responsibility of the Contractor. The new Oscillation type rollers are acceptable for use for compaction rolling. Oscillation rolling is allowed on bridge decks with a low frequency setting.

3.4 CONSTRUCTION

A. Preparation of the Underlying Surface

Immediately before placing the asphalt mixtures, the underlying course shall be thoroughly cleaned of all dust and debris by a self-propelled sweeper. Areas inaccessible by power

sweepers shall be broom swept manually until the surface is clean. Ensure that the surface to receive the asphalt mixture has been approved by the CO, is properly compacted and free from soft areas or other deficiencies that might affect the quality of the final pavement course.

Place all courses with an asphalt paver or device approved by the CO. On bridge decks or concrete pavement, remove excess crack and joint material by trimming the excess material flush with the pavement surface prior to placing the asphalt mixture. Remove all excess joint or crack material on any pavement surface in excess of 1/16 inch in depth prior to placing new asphalt pavement courses.

The Contractor shall furnish, set, and maintain all line and grade stakes, string lines or other controls necessary to guide and control the paving equipment.

Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to an internal temperature of 140° F (60° C) minimum.

Prevent damage by construction operations to gutters, catch basins, curbs, concrete structures, pavement surfaces and other facilities adjacent to the work. If damage occurs, repairs shall be made to the satisfaction of the CO at no additional cost to the Government.

B. Weather Limitations

Place HMA pavement on a dry, unfrozen surface when the air temperature in the shade is above 35° F and rising for minimum 2.1 inches; above 40° F and rising for minimum 1.5 inches; above 50° F and rising for less than 1.5 inches and, the temperature of the road surface in the shade conforms to Table 32 12 16-4.

Place WMA on dry, unfrozen surfaces and only when weather conditions allow for proper production, placement, handling and compaction for the specific WMA technology used.

Table 32 12 16-4

HMA Placement Temperature Compacted Lift Thickness Road Surface °F	<2 Inches	2.1-3 Inches	>3.1 Inches
	Minimum Lay-Down Temperature ⁽¹⁾ °F		
< 35	(2)	(2)	(2)
35 - 39.9	(2)	(2)	280
40 - 49.9	(2)	285	275
50 - 59.9	295	280	270
60 - 69.9	285	275	265
70 - 79.9	280	270	265
80 - 89.9	270	265	260
≥ 90	265	260	255

(1) Never heat the asphalt concrete mix above the temperature specified in the approved mix design.

(2) Paving not allowed.

Rain and Surface Conditions: Immediately cease transportation of asphalt mixtures from the plant when rain begins at the project. Do not place asphalt mixtures while rain is falling, or when there is water on the surface. Placing asphalt mixtures may continue, when the rain has

stopped and water has been removed from the tacked surface to the satisfaction of the CO and if the temperature of the asphalt mixture meets the specification requirements.

Information regarding the air temperature, average wind speed, overcast conditions, mix delivery temperature, and existing moisture conditions shall be evaluated by the CO and a Contractor's representative located at the paving operation prior to placement. The Contractor assumes responsibility for constructing the pavement to meet compaction, bonding to the underlying surface and specification requirements.

C. Production

Do not heat asphalt binder above 350⁰ F unless approved by the manufacturer.

Weigh or meter aggregates, additives and asphalt binder material and introduce into the mixer in the proportions specified by the JMF. Take corrective action as outlined in the QC plan when testing results indicate the material is not in compliance with the requirements of the contract and the approved JMF and when the test results fall outside of the action limits noted in Subsection 3.10B(1) Action Limits.

Mix the combined materials until the aggregate particles are uniformly coated with asphalt binder and thoroughly distributed throughout the mixture.

The temperature of the mixture shall be in accordance with the Performance Graded Asphalt Binder (PGAB) and, if applicable, WMA technology allowable mixing and compaction temperature range. The temperature of the mixture when discharged from the mixer or silo shall be + 25° F from the value stated in the JMF. Mixtures exceeding these limits shall be subject to rejection.

D. Aggregate Preparation

For batch plants, heat, dry, and deliver aggregate for pug mill mixing at a temperature sufficient to produce an asphalt concrete mix temperature within the approved range. Adjust flames used for drying and heating to prevent damage to and contamination of the aggregate.

Control plant operations so the moisture content of the asphalt concrete mix behind the paver is 0.5 percent or less according to AASHTO T 329.

Before starting asphalt concrete mix production, obtain approval of synchronized metering and weighing devices used to introduce a constant rate of lime and water.

When lime is used as an anti-strip, adjust the aggregate moisture to at least 4 percent by mass of aggregate. Mix the lime uniformly with the aggregate before introducing the aggregate into the dryer or dryer drum. Use calibrated weighing or metering devices to measure the amount of lime added to the aggregate.

Add lime to the aggregate by one of the following methods:

Method A: Add lime to the combined cold feed aggregate using an enclosed in-line cold feed mechanical pug mill mixer. Use a twin-shaft, continuous mixing pug mill with adjustable mixing paddles. Adjust the retention time of the mixture in the pug mill so no unmixed lime is visible after the lime and aggregate exit the pug mill.

Method B: Add lime to the produced aggregates during stockpiling using a pug mill. Distribute the lime per the stockpile ratios stated in the asphalt concrete mix design.

A minimum moisture content of two percent by dry weight for coarse aggregate and 4 percent by dry weight for fine aggregate is required at the time the aggregates and lime are mixed. Marinate treated aggregate in stockpiles from 24 hours to 60 days before using in asphalt concrete mix. Do not use aggregate marinated longer than 60 days.

Method C: Add lime to the combined cold feed aggregate by introducing the lime between aggregate layers as the aggregate flows from the cold feed bins. Mix the lime and aggregate on the conveyor belt by placing a minimum of six paddles over the conveyor belt. Make the paddles protrude into the aggregate flow and direct the aggregate to fold over itself causing the material to migrate from one side of the conveyor belt to the other. Space the paddles to provide complete mixing. Provide a water spray over the conveyor belt as necessary to control dust and to maintain minimum moisture content.

WMA – All metering devices will meet the current state agency requirement for liquid or mineral additives. Document the integration of plant controls and interlocks when using WMA additive metering devices.

E. Mix Design Revisions

During production, the Contractor may request target value revisions to the approved JMF. Proposed changes are subject to meeting the following requirements: (1) the changed target value(s) must be within the limits defined in Table 32 12 16-3, test results from the new asphalt mixtures indicate that the proposed JMF changes will produce asphalt mixtures with the specified VTM, VMA, VFA, TSR and F/A ratio, and the resulting mixture gradations are within the grading band for the specified nominal maximum size grading.

Proposed changes must include new and revised materials unit weights (T-209) for controlling mat density.

Any proposed changes to the approved JMF, along with supporting documentation, shall be submitted in writing to the CO for approval prior to placement on the project.

Approved JMF changes will not be used retroactively for determining acceptance of material already placed. Changes to the approved JMF may necessitate and require additional evaluation and verification of the mix by the CO prior to final approval.

F. Tack Coat

Materials shall conform to an Emulsified Asphalt. An equivalent anionic grade emulsion may be substituted for a cationic grade and vice versa. The sieve test in AASHTO M 140 and M 208 is not required.

Anionic emulsions. Conform to AASHTO M 140. For RS-1h and RS-2h, conform to AASHTO M 140 for RS-1 and RS-2, except conform to the following for the residue from distillation: Ductility, 77° F, 2 inches/min, AASHTO T 51 40 mm min.

Cationic emulsions. Conform to AASHTO M 208. For CRS-1h and CRS-2h, conform to AASHTO M 208 for CRS-1 and CRS-2, except conform to the following for the residue from distillation: Ductility, 77° F, 2 inches/min, AASHTO T 51 minimum shall be 40 mm.

Apply a uniform tack coat of asphalt emulsion to the contact surfaces of manholes, structures, existing pavement edges and surfaces and other abutting surfaces immediately prior to placing new asphalt mixtures. This includes freshly placed layers if one day has elapsed since placement, or if dust or debris has contaminated the fresh surface, or if traffic has been allowed on the surface to be paved.

A thin uniform coating of tack coat shall be applied to the pavement immediately before overlaying and be allowed sufficient time to break (set). This should be carefully applied by a distributor truck having calibrated nozzles set to provide a triple overlap of spray on the pavement surface that results in a uniform overlapping coverage at a target application rate of 0.07 +/- 0.02 gallons per square yard for a non-milled surface and a target application rate of 0.10 +/- 0.02 gallons per square yard for a milled surface. For areas where both milled and unmilled surfaces occur, the tack coat shall be a target application rate of 0.07 +/- 0.02 gallons per square yard. The CO must approve the material, equipment and the application rate prior to application. The material for tack coat shall not be heated above manufacturer's recommendations.

Allow tack coat to break or cure properly before placing asphalt mixtures.

The Contractor shall apply tack coat in a manner which will prevent traffic from driving on the applied tack coat material.

Tack coat will not be measured and paid for as a separate quantity but considered subsidiary to the work and included in the bid price for Asphalt Pavement.

G. Transportation, Placing and Finishing

Set stringline or other fixed controls to ensure proper alignment of pavement centerline, joints and edges.

Verify the depth of each layer at frequent intervals behind the laydown machine, and make adjustments if the compacted thickness does not meet the specified thickness. The average compacted depth will be verified by calculating yield using known bulk specific gravity values from the acceptance tests. Furnish daily calculated yields to CO at the end of each day for the day's production.

Asphalt mixture deliveries shall be scheduled so that placing and compacting is continuous, with minimal stopping and starting of the paver.

Coordinate trucks dispatched from the plant to ensure that all asphalt mixtures delivered to the project is placed and compacted during daylight hours. Provide for reliable two-way radio or cellular phone communication between the project site and the plant.

Do not use or combine asphalt mixes produced from different plants unless they are produced using the same JMF, are materials from the same sources, and have been approved. Construct a separate control section for each plant from which production is intended.

The temperature range of the asphalt mixture when delivered to the project site will be established in the Contractor Quality Control Plan utilizing the approved JMF. Monitor the temperature of the mixture for each load, in the haul vehicles, in the paver hopper, and behind the laydown. Use approved methods and instruments for measuring temperature. Record results on Inspector's Daily Reports. Visually inspect the delivered asphalt mixture for crusting or segregation. Reject material that is crusted, segregated, or which is not within the delivery temperature range established in the Contractor Quality Control Plan.

The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 6 inches. The joint in the top layer shall be at the designed centerline of the pavement. Transverse joints in one layer shall be offset by at least two (2) feet from transverse joints in the previous layer.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be placed using hand tools. Luting shall be performed in such a manner as to prevent segregation.

Unless otherwise permitted by the CO for special conditions and circumstances, only machine methods of placement shall be used.

Immediately after placement, and before the initial roller pass, the surface shall be checked, and any irregularities corrected. Irregularities in alignment and grade along outside edges shall be corrected by the addition or removal of mixture before the edges are rolled.

The newly placed pavement surface shall be free of visible segregation or other irregularities. Inspect the uncompacted mat behind the paver for longitudinal streaks, segregation or other irregularities. Correct as necessary before initial compaction.

If material segregation or irregularities in the mat behind the paver are noted, the Contractor shall review the production, transportation, and placement operations and take corrective action. The Contractor's Quality Control Plan shall fully outline procedures for inspecting the mat during placement, identifying and troubleshooting material segregation or temperature related segregation, and implementing corrective action.

1. Joints, Edges and Cleanup

- a. Transverse Joints: The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse paving joint. When necessary to form a temporary transverse paving joint, it shall be made by means of placing a bulkhead or by temporarily tapering the course, in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical face. In both methods, all contact surfaces shall be given a tack coat of asphaltic material before placing any fresh mixture against the joint.
- b. Longitudinal Joints-Wedge: For placement depths greater than or equal to 1-1/2 inches, use a Notched Wedge plate attachment on the screed such as the Trans Tech notch wedge, or approved equal. The attachment must provide, for the first paver pass, a 1/2" notch at the top of the wedge, followed by a diagonal slope down to the underlying surface where a step is formed equal to the nominal maximum aggregate size. The width of the joint shall be a minimum of 6 inches. The attachment will include a mechanism to provide compaction of the sloped surface of the notched wedge. If no mechanism exists in the attachment, the diagonal shall be compacted by other means satisfactory to the CO. The subsequent paver pass will place mix at a depth equal to the lane being matched, plus the appropriate roll-down, to result in a fully compacted joint meeting the smoothness requirement of these specifications.
- c. Longitudinal Joints-Confined Edge: For pavement depths less than 1-1/2 inches, use a confined-edge longitudinal joint. This is the most typically constructed longitudinal joint which attempts to confine the outside edge of the first paver pass of the mat as much as possible to create a near vertical edge.

H. Asphalt Pavement Compaction

1. Furnish rollers of sufficient size, number and type, to support the production rate and meet compaction requirements.

I. Pavement Uniformity and Roughness

1. Uniformity and Smoothness: The finished mat and surfaces of the pavement shall be smooth, dense and uniform in appearance, free from irregularities in contour and texture and shall present a smooth-riding surface.
Construct all pavement surfaces to meet the requirements per Subsection 3.08(A) (1) Straightedge Measurement.
2. Opening to Traffic: No vehicular traffic or construction loads shall be permitted on the newly completed pavement until the material has cooled to a temperature of 140oF or less.

3.5 CONTRACTOR QUALITY CONTROL

A. Description

The provisions of FAR Clause 52.246-12 Inspection of Construction shall apply in addition to the provisions of this Subsection. Provide and implement a Quality Control Plan (QCP) that will ensure all materials and workmanship meet contract requirements for the project. Provide qualified personnel and laboratory facilities to support the QCP. Provide laboratory facility accreditations/certification and evidence of qualifications for inspection and testing personnel.

B. Contractor Quality Control Plan

Provide and maintain a detailed Quality Control Plan as described in this Subsection for all items of work, addressing all elements of the work required by that item. The QCP will sufficiently document quality control (QC) processes and duties for all Contractor(s), subcontractor(s) and supplier(s) responsibilities.

C. Submittal Requirements

At the pre-construction conference, the Contractor shall be prepared to discuss the Quality Control Plan, and will provide three copies of the QCP to the CO. At a minimum, be prepared to discuss the QCP structure, individuals performing QC for each organization, qualifications and certifications applicable to the individuals and facilities performing QC sampling and testing, and suppliers and sources of all furnished materials. The Contractor shall not begin work on any items until the QC Plan has been reviewed by the CO.

D. QC Plan Review and Modifications

Review of the QC Plan will be based on the inclusion of the required information. Revisions to the QC Plan may be required prior to work startup for any part of the QC Plan that is determined by the CO to be insufficient. Review of the QC Plan does not imply any warranty by the CO that the QC Plan will result in completed work that complies with the specifications. It remains the responsibility of the Contractor to demonstrate such compliance. The Contractor shall modify the QC Plan as work progresses when circumstances necessitate changes in Quality Control personnel, laboratories, or procedures. In such case, the Contractor shall submit an amended QC Plan to the CO for review a minimum of three calendar days prior to the proposed changes being implemented. The CO may require changes or improvements to the QC Plan for initial review, or if during the progress of the work it becomes evident that the QCP is not resulting in work that conforms to contract requirements; work may be suspended on affected items if the CO determines that the QCP is not adequately being implemented for specification compliance.

The plan shall include the sampling process(es), procedures, and requirements to meet the sampling and testing requirements of Table 32 12 16-5, and shall serve as an outline for QC sampling, testing and evaluation of the Control Test Section.

Submit sample copies of all forms to be used for reporting data and information as required by the contract.

E. QC Plan Format and Contents

The QC Plan shall, at a minimum, include and address the elements shown below:

1. Scope and Applicable Specifications
2. Submittal Requirements
3. Quality Control Organization
 - a. QC Organizational Chart
 - b. QC Personnel
4. Quality Control Laboratories
 - a. Primary QC Laboratory, with qualification documents
 - b. Alternate QC Laboratories
5. Materials Control, as applicable for each item of work
 - a. Material Types and Source(s)
 - b. Material Properties & Mix Designs
 - c. Processing of Materials at the Production Site
 - d. Material Storage and Handling
 - e. Materials Certifications
6. Quality Control of Sampling and Testing
 - a. Frequency of sampling
 - b. Testing procedures
 - c. Random Sampling Plan
 - d. Sample Identification System and numbering
 - e. Quality Control Sampling & Testing
 - f. Split Sample procedures
 - g. Reporting
 - h. Sample Storage and Retention
7. Production Facilities
 - a. Production Facilities & Equipment lists with calibration records
 - b. Production Facility QC Activities, sampling, testing and inspection
 - c. Production Facility Control Chart(s)
 - d. Evaluation of test data from the production facility
 - e. Reporting
8. Field Operations
 - a. Placement Equipment and Procedures
 - b. Placement QC Sampling, Testing and Inspection process
 - c. Evaluation of test data from placement operations
 - d. Reporting

F. Quality Control Personnel Requirements

The Contractor's Quality Control organization shall, at a minimum, consist of the personnel outlined below that meet the described minimum qualifications. Include personnel by name in the QCP.

If changes in QC personnel occur, submit personnel qualifications for review.

1. Quality Control Manager

The Contractor's Quality Control activities shall be administered by a qualified Quality Control Manager (QCM). The QCM must be a full-time employee of the Contractor with full authority to exercise any and all actions necessary for the successful implementation of the QCP, including the authority to stop or to reject work. The QCM shall be available to communicate with the CO at all times.

Principal responsibilities of the QC Manager shall include managing the activities of all QC personnel, communicating on quality issues within the Contractor's organization and with the CO, and ensuring that all requirements outlined in the QCP are met.

2. Quality Control Technician(s)

All Contractor QC sampling, testing, and inspection performed at the production facility or at the project site shall be performed by qualified Quality Control Technicians (QCTs).

G. Quality Control Laboratory Facility Requirements

All Contractor QC testing shall be performed in certified laboratories either accredited through the AASHTO Accreditation Program (AAP), or meeting the requirements of ASTM D 3666 or state approved facilities. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. This includes providing required AASHTO and ASTM and agency reference documents and ensuring that all required equipment, sampling platforms and tools are properly functioning, calibrated and certified. Provide evidence of all certifications, accreditations and calibrations to the CO.

The CO shall be permitted unrestricted access to inspect and review the Contractor's laboratory facility. The CO will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. Deficiencies shall be grounds for the CO to order an immediate stop to incorporating materials into the work until deficiencies are corrected.

H. Quality Control Inspection

The Contractor shall perform QC inspection of all work required by this contract. At a minimum, schedule pre-work meetings with the CO, production and placement personnel and including subcontractors and suppliers at the following phases of the work: Preparatory (at least 7 days prior to beginning any work element), Start-Up (at beginning of each work type) and Production and Placement (periodically throughout the work).

The minimum frequency for QC inspections shall be as shown in the approved QCP. The results and findings of QC inspections shall be documented on Inspector Daily Reports (IDRs).

I. Quality Control Sampling and Testing Requirements

Perform QC sampling and testing at both the production facility and at the site of field placement. Take samples and test per Table 32.12.16-5 for quality assurance acceptance testing, verification (correlation) or other purposes and deliver split samples to the CO immediately after sampling and splitting. All sampling and testing shall be in accordance with applicable AASHTO, ASTM, or agency procedures as designated in the contract. Furnish industry standard containers for all material samples. Provide the CO the opportunity to monitor and witness all sampling, splitting and testing.

J. Quality Control Documentation and Reporting

1. Inspection, Sampling and Testing Reports: Document all QC inspection, sampling and testing activities on Inspectors Daily Report (IDR) forms and/or Test Report Forms

(TRF), as appropriate. Deliver to the CO within one working day of those activities occurring. The QC Manager shall review and evaluate IDRs and TRFs on a daily basis to assure that all work conforms to contract requirements. Include, at a minimum, the following information:

- a. Daily weather or environmental conditions
 - b. A summary of production or placement activities completed including equipment used and hours worked
 - c. Any non-conforming material or workmanship identified
 - d. Any corrective actions recommended or taken
 - e. Discussions with subcontractors or CO personnel
 - f. Visitors to the production facility or project site
2. Control Charts: Use Control Charts as part of the QCP. Include examples of the Control Charts to be used in the QCP. Plot test results for each subplot tested. Control charts during placement shall at a minimum include: gradations, density, VMA, air voids, VFA, binder content. Update Control Charts within 24 hours of completing tests for each subplot. Post Control Charts in an accessible location and submit to the CO on a daily basis.
 3. Corrective Action: Describe in the QCP what action will be taken when inspection or test results indicate that non-conforming work is being produced. Correct all areas of unacceptable pavement at no additional cost to the Government. Submit corrective plan to the CO for approval.

3.6 ACCEPTANCE SAMPLING AND TESTING - Materials and Placement

- A. General: In addition to performing QC testing during production and placement of asphalt pavement, the contractor shall perform acceptance testing as specified in Table 32 12 16-5. Contractor QC test results may be used by the CO for acceptance if through verification (correlation) and validation, the Contractor QC test results are deemed acceptable by the CO. The CO has sole discretion to include Contractor QC test results in the acceptance determination or to use only results from tests performed by the CO or the CO's agent. The CO shall have access at any time to all parts of the production and material storage facilities and to all parts of the project site, to perform inspections and tests, as deemed necessary to ensure the quality of the final product.

Utilize stratified random sampling of each lot produced and placed to assure that all material within the lot has an equal probability of being selected for testing. The CO will provide random numbers as required for each day's sampling, based on the anticipated production for that day. Adjustments in sampling locations and times necessary due to differences between anticipated and actual production quantities will be made by the CO. The CO may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of asphalt which is deemed unfit for use due to contamination, segregation, incomplete coating of aggregate, non-specification temperature, or other indication of defective material. Such rejection may be based on only visual inspection or temperature measurements. Similarly, the CO may at any time, notwithstanding field acceptance for mat or longitudinal joint density, reject and require the Contractor to correct any asphalt pavement that was placed with unacceptable mat uniformity or paving joints, due to low density, lack of bond, segregation, improper elevation, tearing or other material or workmanship defects. In the event of such rejection, the Contractor and CO may take split samples of the area(s), and if it can be demonstrated by testing that such material or constructed pavement was erroneously rejected, payment will be made for the material at the contract unit price.

All samples of PGAB, asphalt mixture and pavement cores shall be split samples and the split portion delivered to the CO. Samples shall be split in accordance with applicable AASHTO or ASTM procedures. Deliver to the CO all core samples taken from the compacted pavement after testing. Protect cores from damage before delivering to the CO. Contractor to fill all core holes by tack coating the periphery of the core hole, then lay in asphalt mix manufactured, polymer modified cold patch mix to a level that will yield a smooth final surface, compact to specification density, and then swab the surface with tack coat.

- B. Lots and Sublots: The entire quantity of production for each asphalt mixture type will be considered one lot and an individual subplot will be considered 500 tons.
- C. Contractor Furnished Samples: Furnish samples to the CO in industry standard containers for all required samples. Notify the CO in advance of sampling in order to provide the opportunity to observe and witness the sampling and splitting procedures.
- D. Selective Sampling: The CO may sample the work at any time to verify the quality of the work being performed. Work represented by these samples will be removed and replaced at no cost to the Government if, through further evaluation, the tests indicate that the represented work does not conform to contract requirements.
- E. Independent Assurance Sampling: The CO or their authorized agent may sample the work at any time to verify the quality of the sampling and testing and equipment used in the Acceptance determination.

Table 32 12 16-5
Sampling, Testing, and Acceptance Requirements during placement

Material or Product	Type of Acceptance (Subsection)	Characteristic		Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time	Remarks
Asphalt pavement	Action/Suspension – QC & Conformance - Acceptance	Asphalt		AASHTO	1 per	Behind	Yes	6 hours	—
		Content ⁽¹⁾		T 308	500 tons	the paver before compaction			
		Gradation		AASHTO	"	"	"	"	—
		Air voids		T 30 AASHTO T 312 & T 166	"	"	"	"	—
		VMA		AASHTO R 35	"	"	"	"	—
		Core density ⁽²⁾		AASHTO	"	In-place after	"	24 hours	
		Core density		T 166 AASHTO	"	Compacting	"	"	

		ty Long. Joint ⁽⁵⁾		T166					
		Cor e thick- ness ⁽⁶⁾		ASTM D 3549	“	“	Yes	24 hours	
As- phalt pave- ment	Measured and tested for con- formance	Placement Tempera- ture		—	First load and as determined by CO thereafter	Hauling vehi- cle prior to dumping, or windrow before pickup	—	Immedi- ately up- on com- pletion of measure- ment 24 hours	—
		Maxi- mum specific gravi- ty ⁽³⁾⁽⁴⁾		AASHTO T 209	Mini- mum 1 per day	Behind the paver before compac- tion	Yes		—
Asphalt Binder	Measured and tested for conformance	Quality		AASHTO M 320	After each delivery and mixing	In line between tank and mixing plant	2 – 1 quart (1 liter) samples	See re- marks	Test by Government

- (1) Use AASHTO T 308, Method A. Calculate the asphalt binder content by weighing the sample before and after the burn using a calibrated external balance.
- (2) Side by side cores will be obtained for core density testing. Submit one core to the CO for verification testing and the other to the Contractor for acceptance testing. Perform specific gravity and thickness tests on the cores and deliver to the CO after testing is completed. Use AASHTO T 166 regardless of the volume of water absorbed. Care should be taken to dry cores to constant mass at $125 \pm 5^{\circ}\text{F}$, before testing. 6 inch or 4 inch cores are acceptable. Nuclear gauge tests may be substituted for core density testing if that specific gauge has been correlated to at least five (5) cores taken from the project using the same HMA mix, and if the results of that correlation are acceptable to the CO.
- (3) After production paving has begun, use the average maximum specific gravity value (AASHTO T 209) for each day to adjust the percent compaction for the cores that represent that day's paving.
- (4) Do not use the supplemental procedure for mixtures containing porous aggregate (dry back method) of AASHTO T 209).
- (5) The six-inch or four-inch diameter core shall be taken on the centerline of the longitudinal joint. For the notched- wedge joint, the lower specification limit is 92.0 percent of the maximum specific gravity with the cores taken on the wedge portion of the joint with the core centered on the diagonal.
- (6) The core density samples may be used to determine core thickness, minimizing the number of total cores taken. If a properly correlated nuclear gauge is used for density acceptance, the thickness will be determined based on other methods acceptable to the CO. Submit proposed methods to the CO for approval if cores are not taken.

3.7 ACCEPTANCE SAMPLING AND TESTING - Smoothness

- A. Measure the completed paved surface after the final lift is placed and compacted, and prior to any surface seal is placed.
 - 1. Straightedge Measurement

Use a 10-foot metal straight edge to measure at right angles and parallel to the centerline. Defective areas are deviations between the surface and the bottom of the straightedge in excess of 0.25 inches, measured between any two contacts of the straightedge, or deviations in excess of 0.25 inches measured at the end of the straightedge. Correct defective areas according to Subsection 3.08(A)(2) Defective Area Correction.
 - 2. Defective Area Correction

Correct defective areas at no additional cost to the Government. Either grind, mill a minimum of one half the pavement depth and fill with an approved asphalt mix, or cut and remove the pavement and repave with an approved asphalt mix. When correction by any other method is proposed, submit a proposal to the CO for approval.

If grinding is proposed, use a diamond blade machine and specify the manufacturer and model of the equipment to be used. Identify the beginning and ending station of each grind location, the grinding depth and lateral extent of grinding. Specify the type of seal to be placed after grinding is completed. Place all seals in a manner acceptable to the CO. Limit grinding depth to 12.5 percent of the design pavement thickness unless it is accompanied by a minimum 1-inch overlay. The CO may take up to 7 days to approve, modify, or reject the proposal. Do not begin corrective work until CO approval is obtained.

After corrections are made, re-measure the pavement surface according to this subsection. The final pavement thickness after any corrective work shall be no less than 90% of the design pavement thickness.

3.8 ACCEPTANCE SAMPLING AND TESTING - Thickness

- A. Measure the full depth thickness, as specified in Table 32 12 16-5, after the final lift of asphalt pavement has been constructed. In addition, obtain cores randomly in parking areas, approach roads and pullouts as directed by the CO.
 - 1. Method of Correction: Correct all areas where the final pavement surface, prior to placement of any corrective layers, is less than 90% of the design pavement thickness. The method of correction to the final surface of the hot asphalt concrete pavement will meet or exceed the structural and roughness requirements for the contract. Obtain approval, in writing from the CO for the proposed method of correction.
 - a. Areas in reject due to insufficient pavement thickness will require a hot mix asphalt concrete pavement overlay. Minimal overlay thickness will be twice the nominal maximum aggregate size. Approval and acceptance for the hot mix asphalt concrete overlay and mix design will be in accordance with the contract requirements for the originally specified hot mix asphalt.

3.9 FINAL ACCEPTANCE OF WORK AND ANALYSIS

- A. General: Test results from random sampling will be used to determine acceptance as provided for in this Subsection. The materials acceptance parameters and characteristics as noted in 32 12 16-5 will be accepted based on the conformance tests, materials certifications and by visual acceptance for workmanship and material quality as provided in the contract.

RAP used in mixtures will be monitored for binder grading compliance using random testing of mixtures taken from samples at the paving site behind the paver. The Abson extracted (AASHTO T170) binder high temperature DSR will be compared to the original binder RTFO high temperature DSR. If the mixture Dynamic Shear (DSR), $G^*/\sin \Delta$, is less than a minimum value of 2.20 kPa, production will be suspended and the extent of the problem will be further evaluated. Non-conforming work will be removed and replaced. In lieu of removal and replacement, the Contractor may submit a corrective plan to the CO for approval. The CO has sole discretion to approve or deny corrective plans for non-conforming work.

- B. Acceptability of materials and workmanship will be according to the following Specification Limits. If test results fall outside of the Specification Limits described herein, make corrections as necessary to bring the applicable mix or pavement characteristic back into specification. If any individual test result falls outside of the Limits described herein, the material represented by that test result will be subject to rejection and replacement, at no additional cost to the government.

1. Acceptance Specification Limits:

Acceptance will be based upon the average of test results for the Lot for each quality characteristic.

- a. Asphalt content: The upper and lower specification limits are the approved JMF target value plus or minus 0.4 percent. No single test value shall be beyond ± 0.7 percent of the JMF target value.
- b. VMA: The lower specification limit is the value specified for the nominal maximum size aggregate designated. After the JMF has been verified the Contractor's combined coarse and fine bulk specific gravity of aggregate G_{sb} values shall be used to calculate VMA on field produced asphalt mixtures.
- c. Mat Density and Notched Wedge Longitudinal Joint Density: The lower specification limit is 92.0 percent and the upper specification limit is 97.5% of the maximum specific gravity (density) determined according to AASHTO T 166 and T 209. No single test value shall be beyond the range of 89.0% to 98%. The percent compaction will be determined using the average maximum specific gravity (AASHTO T 209) from all samples tested each day. The longitudinal joint cores shall be taken on the wedge portion of the joint with the core centered on the diagonal.
- d. Confined Edge Longitudinal Joint Density: For the confined edge joint, the lower specification limit is 90.0 percent and the upper specification limit is 97.5% of the maximum specific gravity (density) determined according to AASHTO T 166 and T 209. No single core test value shall be beyond the range of 88.0% to 98% of the maximum density. The percent compaction will be determined using the average maximum specific gravity (AASHTO T 209) from all samples tested each day. The six-inch diameter core shall be taken on the centerline of the longitudinal joint.
- e. Air voids: The upper and lower specification limits are 5.5 and 2.5 percent respectively. No single test value shall be outside the limit of 6.0 and 2.0 percent. Air voids are determined by AASHTO T 269, AASHTO T 209, and AASHTO T 166 of the compacted specimen.
- f. Pavement Smoothness: The evaluation for payment will be made in accordance with Subsection 3.08 Acceptance Sampling and Testing - Smoothness.
- g. Asphalt Binder Grading: CO will determine acceptability based upon sampling and conformance to specification limits for each test property. The CO may test split liquid asphalt samples taken as part of the contractor's required QC sampling and use those results as part of the final acceptance process.
- h. Gradation: The Allowable deviations (D) in Table 32 12 16-6 will apply:

Table 32 12 16-6
Allowable Deviations -- Gradations

Percent Passing		Allowable Deviation (D)
Minimum	Maximum	
70.1	89.9	4
60.1	70.0	5
55.1	60.0	6
45.1	55.0	7
40.1	45.0	6
30.1	40.0	5
21.1	30.0	4
8.1	21.0	3
0	8.0	2

- i. Pavement Thickness Allowable Deviations: The lower specification limits (LSL) will be the design pavement thickness for asphalt concrete pavement minus the allowable deviation. The allowable deviation will be 10% of the designed pavement thickness. No single sample shall be beyond 20% of the designed pavement thickness.

3.10 MEASUREMENT

- A. Tack Coat. Asphalt Emulsion for Tack Coat, as required by the plans or these specifications, will be measured separately for payment. See Section 32 12 13.13 "Asphalt Tack Coat."
- B. Asphalt Pavement. Asphalt pavement will be measured by square yardage. The contract bid price for the Asphalt Pavement mixtures will include:
 1. Anti-strip additive (if required by the job mix formula)
 2. Warm mix additives and technologies, if used
 3. Pre-construction conference
 4. Construction of control strip(s)
 5. Development and implementation of the qc plan, including revisions or modification as may be required
 6. Joint treatments
 7. Removal of cores and filling voids left by cores
 8. All sampling and testing required by the contract
 9. All materials, labor and equipment required to construct the hot mix asphalt pavement course(s).

3.11 BASIS OF PAYMENT

- A. Asphalt Pavement: The accepted work will be paid at the contract lump sum price for all work described in Section 321216 if all test parameters fall within the upper and lower specification limits.

END OF SECTION

SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).
- C. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.
- D. D. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.
- E. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.
- F. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction 2018.

1.2 SUMMARY

- A. Section Includes Concrete Paving. Including the Following:
 - 1. Curbs and gutters.
 - 2. Walks.
- B. Related Requirements:
 - 1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving Subcontractor.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Steel reinforcement and reinforcement accessories.
 3. Admixtures.
 4. Curing compounds.
 5. Applied finish materials.
 6. Bonding agent or epoxy adhesive.
 7. Joint fillers.
- B. Material Test Reports: For each of the following:
 1. Aggregates:
- C. Field quality-control reports.
- D. Joint Layout Plan: Submit joint layout plan for areas of concrete sidewalk to CO for approval.

1.7 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing readymixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- B. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.

- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- E. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project and in conformance with Arizona Department of Transportation (ADOT) Standards:
 - 1. Portland Cement: AASHTO M 85, with the fineness and the time of setting determined using AASHTO T 131 and AASHTO T153, respectively.
 - 2. Blended Hydraulic Cement: AASHTO M240, Type I (PM) or a Type IP containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition is 3.0 percent. Do not use ground iron blast furnace slag for blending. The requirement for manufacturer's written statement of the chemical composition is waived.
 - 3. Masonry Cement: ASTM C91, except the water retention and staining tests are waived.
- B. Normal-Weight Aggregates: ASTM C33/C33M or AASHTO M43, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C260/C260M or AASHTO M 154.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- E. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

- A. Use burlap cloth, sheet materials, liquid membrane forming compounds, or cotton mats in accordance with ACI 301.

2.6 RELATED MATERIALS

- A. Preformed Joint Fillers: AASHTO M 153. Bituminous fiber type shall meet AASHTO M 213, with the bitumen content determined per AASHTO T164. The weathering test is not required for either type of material.
- B. Joint Sealer: AASHTO D3405 as modified by MSMT 404. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If range of temperatures is recommended, the midpoint will be used as the pour point.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete in accordance with ADOT specifications and the following:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete as required for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): ADOT Class A3 (3,000 psi min)
 - 2. Maximum W/C Ratio at Point of Placement: 0.49
 - 3. Slump Limit: 0-3 inches
 - 4. Field Air Content: 6 +/- 2 .
 - 5. Coarse Aggregate Size: 57 or 67.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving subject to vehicular loading to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of ½ inch according to requirements in Section 02300 "Earthwork."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Sidewalk Paving: Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven calendar days and two specimens at 28 calendar days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 calendar days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to CO, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 calendar days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28- calendar day tests.

- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by CO but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by CO.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by CO.
- B. Drill test cores, where directed by CO, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 calendar days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Joint-sealant backer materials.
 - 3. Primers.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by jointsealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting jointsealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of joint-sealant backings.
 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 1. Place joint sealants so they fully contact joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 1. Remove excess joint sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants

are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

- C. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving:
 - 1. Joint Location:
 - a. Joints between concrete and asphalt paving
 - b. Joints between concrete curbs and asphalt paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Cold-applied Joint Sealants as specified in Part 2.2.
 - 3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION

SECTION 321613
CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes Concrete curb and gutter.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 32 13 13 – Concrete Pavement.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - b. M171, Standard Specification for Sheet Materials for Curing Concrete.
 - c. M182, Burlap Cloth Made from Jute or Kenef, and Cotton Mats.
 - d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
 - e. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 - 2. American Concrete Institute (ACI):
 - a. 305R, Hot Weather Concreting.
 - b. 306R, Cold Weather Concreting.
 - 3. ASTM International (ASTM):
 - a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. C33, Standard Specification for Concrete Aggregates.
 - c. C150, Standard Specification for Portland Cement.
 - d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LB/FT³).
 - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 4. Arizona Department of Transportation, Standard Specifications for Road and Bridge Construction 2021 Edition as amended to date.
 - 5. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.
 - 6. Concrete installer shall have successfully completed at least three (3) other projects of similar size and type.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 2. Mix design(s) in accordance with Section 1006 of Arizona DOT Standard Specifications for Class AE concrete or equivalent mix providing minimum 4000 psi 28 day strength.
 - 3. Drawings detailing all reinforcing.
 - 4. Test reports:
 - a. Concrete cylinder test results from field quality control.
- B. Samples:
 - 1. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. Master Builders Solutions.
 - c. Protex Industries.
 - d. W. R. Grace and Company.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Aggregates: ASTM C33, gradation size #67, 3/4 IN to #4.
- C. Water: Potable quality.
- D. Admixtures: Comply with Arizona DOT Specification Section 401.
- E. Reinforcing Bars: ASTM A615, Grade 60.
- F. Preformed Joint Filler:
 - 1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.
 - 2. AASHTO M153 or AASHTO M213.
- G. Hot-Poured Joint Sealing Material: FS SS-S-1614.
- H. Membrane Curing Compound: ASTM C309.
- I. Cover Materials for Curing:
 - 1. Burlap:
 - a. AASHTO M182.

- b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 - 2. Polyethylene film, AASHTO M171.
- J. Paper Subgrade Cover: Polyethylene film, AASHTO M171.
- K. Forms:
 - 1. Steel or wood.
 - 2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
 - 3. Free of distortion and defects.
 - 4. Full depth.
 - 5. Metal side forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-4 IN slump, 6% air.
- B. Comply with Arizona DOT Specifications Section 401.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
 - 1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 - 2. Scarify and recompact top 6 inches of fills and embankments which will be under concrete curb and gutters.
 - 3. Remove soft or spongy areas.
 - a. Replace with aggregate material.
 - 4. Compact to the following densities:
 - a. Cohesive soils: 95% per ASTM D698.
 - b. Non-cohesive soils: 75% relative per ASTM D4253 and ASTM D4254.
 - 5. Assure moisture content is within limits prescribed to achieve required compaction density.
 - 6. Following compaction, trim and roll to exact cross section.
 - 7. Check with approved grading template.
 - 8. Perform density tests on subgrade to determine that subgrade complies with the specification.
- B. Aggregate Course:
 - 1. Place material in not more than 6 inches thick layers.
 - 2. Spread, shape, and compact all material deposited on the subgrade during the same day.

3. Compact to 95% relative per ASTM D4253 and ASTM D4254.
- C. Loose and Foreign Material:
 1. Remove loose and foreign material immediately before application of paving.
- D. Appurtenance Preparation:
 1. Block out or box out curb inlets and curb returns.
 2. Provide for joint construction as detailed and dimensioned on Drawings.
 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 inches below design grade.
 4. Clean and oil forms.

3.2 INSTALLATION

- A. Concrete Production:
 1. Comply with ADOT Specification Section 1006.
- B. Forms:
 1. Form support:
 - a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.
 4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
 5. Previously finished pavement or sidewalk contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
 1. Lap nonwelded bars 12 IN minimum.
 2. Support:
 - a. Place bars securely on chairs at called-for height.
- D. Joints:
 1. Hold locations and alignment to within +1/4 IN.
 2. Finish concrete surface adjacent to previous section to within +1/8 IN, with tooled radius of 1/4 IN.
 3. Expansion joints:
 - a. Locate at 40 FT intervals and at all intersection curb returns.
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing curb and gutter or other structures.

4. Contraction joints:
 - a. Locate at 10 FT intervals.
 - b. Use steel template at least 1/4 IN thick, conforming to cross section of curb and gutter.
 - c. Remove template where concrete has set sufficiently to prevent spalling or adhesion of concrete.
 - d. If machine placed, use tooled joint formed in freshly placed concrete.
 - e. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 6. Thoroughly clean and fill joints with joint sealing material as specified.
 7. Upper surface of filled joint to be flush to 1/8 IN below finished surface.
- E. Place Concrete:
1. Comply with ADOT Specification Section 402.
 2. Construct driveway openings, ramps, and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature has risen to 40 DEGF.
 - c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost-damaged concrete.
 - h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation of water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
 - g. Finishing:
 - i. Bring combination curb and gutter to grade by running straightedge over steel templates with sawing motion.
 - ii. Float surface with a wood float to draw cement to surface.
 - iii. Broom finish after floating.
 - iv. Tool edges with suitable edger.
 - v. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with cement mortar.
 - vi. Assure that expansion joints are cleared of concrete, both at bottom of gutter and back of curb.

- G. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SQFT/GAL.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for 7 days.
 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
- H. Protection of Concrete:
1. Protect new curb and gutter and its appurtenances from traffic for minimum of 14 days.
 2. Repair or replace parts of curb and gutter damaged by traffic, or other causes, occurring prior to final acceptance.
- I. Opening to Traffic:
1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.
- J. Cleanup:
1. Assure cleanup work is completed within two weeks after work has been opened to traffic.
 2. No new work will begin until cleanup work has been completed or is maintained within two weeks after work has been opened to traffic.

3.3 FIELD QUALITY CONTROL

- A. Provide test cylinders for the first pour of each day and at 50 CUYD intervals thereafter for pours exceeding 50 CUYD. Contractor's testing firm shall take a minimum of 5 cylinder samples at each test. Field technician shall complete air and slump testing at the project locations.

END OF SECTION

SECTION 321623

CONCRETE SIDEWALK AND STEPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Concrete sidewalk and steps.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - b. M171, Sheet Materials for Curing Concrete.
 - c. M182, Burlap Cloth Made from Jute or Kenaf, and Cotton Mats.
 - d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Non-extruding and Resilient Bituminous Types).
 - e. M224, Use of Protective Sealers for Portland Cement Concrete.
 - f. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
2. American Concrete Institute (ACI):
 - a. 305R, Hot Weather Concreting.
 - b. 306R, Cold Weather Concreting.
3. ASTM International (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - b. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - d. C33, Standard Specification for Concrete Aggregates.
 - e. C150, Standard Specification for Portland Cement.
 - f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - h. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - i. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
4. Arizona Department of Transportation Standard Specifications for Road and Bridge Construction 2021 edition as amended.
5. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.
 - b. TT-S 00227 E(3), Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).

6. Concrete installer shall have successfully completed at least three other projects of similar size and type.

1.3 SUBMITTALS

- A. Shop Drawings:
 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 2. Mix design(s) in accordance with Section 1006 of the Arizona DOT Standard Specifications for Class AE concrete or equivalent mix providing minimum 4000 PSI 28 day strength.
 3. Qualifications of concrete installer.
 4. Drawings detailing all reinforcing.
 5. Concrete cylinder test results from field quality control.
- B. Samples:
 1. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. Master Builders Solutions.
 - c. Protex Industries.
 - d. W. R. Grace and Company.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Aggregates: ASTM C33, gradation size #67, 3/4 IN to #4.
- C. Water: Potable quality.
- D. Admixtures: Comply with Arizona DOT Specification Section 401.
- E. Reinforcing Bars: ASTM A615, Grade 60.
- F. Welded Wire Reinforcement:
 1. ASTM A185 or ASTM A1064.
 2. Flat.
 3. Clean, free from dirt, scale, rust.
- G. Preformed Joint Filler:
 1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.

2. Meet AASHTO M153 or AASHTO M213.
- H. Hot-Poured Joint Sealing Material: FS SS-S-1614.
- I. Sidewalk Joint Sealant:
1. Two compound, polyurethane sealant:
 2. Class A, Type 1.
 3. Self-leveling.
 4. Nontracking.
 5. FS TT-S 00227 E(3).
- J. Membrane Curing Compound: ASTM C309.
- K. Cover Materials for Curing:
1. Burlap:
 - a. AASHTO M182.
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 2. Polyethylene film: AASHTO M171.
- L. Paper Subgrade Cover: Polyethylene film, AASHTO M171.
- M. Forms:
1. Steel or wood.
 2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
 3. Free of distortion and defects.
 4. Full depth.
 5. Metal Side Forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-4IN slump, 6% air.
- B. Comply with Arizona DOT Specification Section 1006.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 2. Scarify and recompact top 6 IN of fills and embankments which will be sidewalk and step areas.

3. Remove soft or spongy areas.
 - a. Replace with aggregate material.
 4. Compact to the following densities:
 - a. Cohesive soils: 95% per ASTM D698.
 - b. Non-cohesive soils: 75% relative per ASTM D4253 and ASTM D4254.
 5. Assure moisture content is within limits prescribed to achieve required compaction density.
 6. Following compaction, trim and roll to exact cross section.
 - a. Check with approved grading template.
 7. Perform density tests on subgrade to determine that subgrade complies with the specification.
- B. Aggregate Course:
1. Place material in not more than 6 IN thick layers.
 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
 3. Compact to 95% relative per ASTM D4253 and ASTM D4254.
- C. Loose and Foreign Material:
1. Remove loose and foreign material immediately before application of paving.
- D. Appurtenance Preparation:
1. Block out or box out curb inlets and curb returns.
 2. Provide for joint construction as detailed and dimensioned on Drawings.
 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 IN below design grade.
 4. Clean and oil forms.

3.2 ERECTION, INSTALLATION AND APPLICATION

- A. Concrete Production: Comply with ADOT Specification Section 1006.
- B. Forms:
1. Form support:
 - a. Compact soil foundation and cut to grade to support forms.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.
 4. Set forms sufficiently in advance of work (minimum 2 HRS) to permit proper inspection.
 5. Previously finished pavement or curb and gutter contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
1. Lap mats one full space.

2. Tie end transverse member of upper mat securely to prevent curling.
 3. Lap nonwelded bars 12 IN minimum.
 4. Support:
 - a. Place bars securely on chairs at called-for height.
 - b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.
- D. Joints:
1. Hold locations and alignment to within + 1/4 IN.
 2. Finish concrete surface adjacent to previous section to within + 1/8 IN, with tooled radius of 1/4 IN.
 3. Metal keyway joints:
 - a. Form by installing metal joint strip, left in place.
 - b. Stake and support like side form.
 - c. Provide dowels or tie bars.
 4. Weakened plane joints:
 - a. Locate at 68 FT maximum intervals.
 - b. Tool groove in freshly placed concrete with tooling device.
 - c. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 6. Expansion joints:
 - a. Locate at 40 FT intervals and at all intersection curb returns.
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing sidewalks, steps, or other structures.
 7. Thoroughly clean and fill joints with joint sealing material as specified.
 8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- E. Place Concrete:
1. Comply with ADOT Specifications Section 402.
 2. Construct driveway openings and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature has risen to 40 DEGF.
 - c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost damaged concrete.
 - h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 2. Hot weather:

- a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation or water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
- G. Finishing:
 1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
 2. Maintain uniform ridge full width with first pass of first screed.
 3. Test with 6 FT straightedges equipped with long handles and operated from sidewalk.
 4. Draw excess water and laitance off from surface.
 5. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
 6. Broom finish after floating.
 7. Tool edges with suitable edger.
 8. Provide exposed aggregate surfaces in areas indicated on the Drawings.
 9. Provide method such as abrasive blasting, bush hammering, or surface retarder acceptable to the Engineer.
- H. Curing:
 1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a rate of minimum 200 SQFT per gallon.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for minimum of seven days.
 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
 5. Linseed oil sealant:
 - a. For concrete sidewalk and step, seal surface with linseed oil.
 - b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for 1 month.
 - c. Apply first application at rate of 67 SQYD per gallon.
 - d. Apply second application to a dry surface at rate of 40 SQYD per gallon.
- I. Protection of Concrete:
 1. Protect new sidewalk, steps, and their appurtenances from traffic for a minimum of 14 days.
 2. Repair or replace parts of sidewalk and steps damaged by traffic, or other causes, prior to final acceptance.
- J. Opening to Traffic:
 1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured cylinders have attained a compressive strength of 3000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.

- K. Cleanup:
 - 1. Assure cleanup work is completed within two weeks after sidewalk has been opened to traffic.
 - 2. No new work will begin until cleanup work has been completed or is maintained within 2 weeks after sidewalk has been opened to traffic.
- L. Handrails:
 - 1. Provide handrails where required and as per Drawing details.

3.3 FIELD QUALITY CONTROL

- A. Provide test cylinders for the first pour of each day and at 50 CUYD intervals thereafter for pours exceeding 50 CUYD. Contractor's testing firm shall take a minimum of 5 cylinder samples at each test. Field technician shall complete air and slump testing at the project locations.

END OF SECTION

SECTION 322640

PAVEMENT MARKING

PART 1 - GENERAL

1.1 SUMMARY

- A. This item shall consist of furnishing and applying the paint markings along the centerline and/or shoulders of the road, the individual lines for parking stalls, cross walks, directional arrows, letters, numerals, or signs on the roads for the control of traffic, at locations as shown on the drawings, marked in the field, or as directed by the Contracting Officer.
- B. All work shall comply with the direction in the Manual of Uniform Traffic Control Devices (MUTCD).

1.2 DEFINITIONS

- A. DOT: Department of Transportation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

- A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

1.6 MEASUREMENT AND PAYMENT

- A. Line Striping: The quantity of 4" wide striping, to be paid for shall be the number of linear feet of stripes measured along the center line of the painted strips completed and accepted with no deduction for the unpainted area caused by broken stripe.
- B. Directional Arrows: The quantity of directional arrows, to be paid for shall be the number of such symbols designated in the Schedule of Items, completed and accepted.
- C. Accessible Parking Symbol: The quantity of International Symbol of Accessibility symbols completed and accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type I or AASHTO M 248, Type N or F.
- B. Glass Beads: AASHTO M 247, Type 1.

2.2 COLORS

- A. Colors for commonly used lines, marking, and symbols are as follows:
 - 1. Parking Stall Lines: Normally white.
 - 2. Fog Lines on Edges of Road: White.
 - 3. Twelve-Inch-Wide Stop Lines: White.
 - 4. Road Traffic Lane Divider Lines: Yellow.
 - 5. Speed Bump: White
 - 6. International Symbol of Accessibility: White on Blue background.
 - 7. Directional Arrows: White.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall be responsible for preliminary spotting of the lines to be painted and approval by the Contracting Officer must be obtained before applying pavement-marking paint.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust. The area to be painted shall be dry, clean, and free of loose particles.
- D. Apply paint with mechanical equipment to produce pavement markings, of required dimensions, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm). The equipment shall include a mechanical bead dispenser that will distribute the glass beads uniformly into the wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).
- E. Stripes shall be 4 inches wide. Broken line segments (dashed or skip traffic strip) shall be 10 feet in length with 30-foot gaps, or 2 feet in length with 4-foot gaps.
- F. Arrows and letters shall be of the dimensions as shown on the drawings.
- G. The painted area shall be protected from traffic until the paint is thoroughly dry.
- H. All markings shall present a clean-cut, uniform appearance. All markings which fail to have a uniform appearance, either day or night, shall be corrected by the Contractor.

3.2 DISPOSAL

- A. Dispose of excess construction material in accordance with Section 024100 "Waste Material Disposal".

END OF SECTION

SECTION 340100
MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 –Specification sections, apply to work of this section.

1.2 RELATED SECTIONS

- A. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities maybe included.
- B. Division 32, Section 321640 "Pavement Marking" for pavement striping and symbols.

1.3 SUMMARY

- A. This work consists of creating temporary traffic control zones to manage the movement of roadway users by furnishing, installing, maintaining, relocating, and removing temporary traffic control devices and services as ordered for the control and protection of public traffic through the project construction zone.
- B. All requirements for maintenance of traffic shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and all reference documents.
- C. The Contractor shall keep the road open to all traffic in accordance with the Contract Documents during the progress of the work. The Contractor shall provide and maintain a safe condition of temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, and residences. The road and the intersections of the access points shall be maintained in a manner that will safely and adequately accommodate traffic.

1.4 SUBMITTALS

- A. Contractor is required to submit a traffic control plan to the Contracting Officer 14 days in advance of construction and will be responsible for ensuring that all relevant codes and regulations are followed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Changeable message sign, channelizing device, crash cushions, flaggers, longitudinal channelizing devices, temporary signage, temporary barriers, etc. as required to manage traffic or as directed by the Contracting Officer.

PART 3 - EXECUTION

3.1 MAINTENANCE OF TRAFFIC

A. Acceptance

1. Maintenance of traffic work will be evaluated under Division 1 Section “Temporary Facilities and Controls”

END OF SECTION

APPENDIX A

GEOTECHNICAL EVALUATION REPORT

FLAGSTAFF RANGER STATION WASTE WATER IMPROVEMENTS

5075 U.S. 89

Flagstaff, Arizona

WT Job No. 25-223591-0

PREPARED FOR:

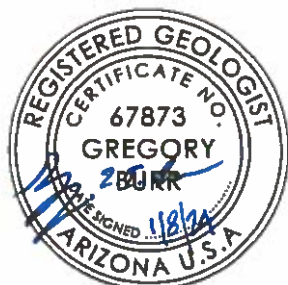
Great West Engineering

2501 Belt View Drive

Helena, Montana 59601

Attn: Mr. Dan Baum, P.E.

January 8, 2024



Gregory L. E. Burr, P.E., R.G.
Geotechnical Department Manager



Craig P. Wiedeman, P.E.
Senior Geotechnical Engineer

GEOTECHNICAL

ENVIRONMENTAL

INSPECTIONS

NDT

MATERIALS

2400 East Huntington Drive
Flagstaff, Arizona 86004

(928)-774-8700

wt-us.com



Western Technologies
An **RMA** Company

January 8, 2024

Great West Engineering
2501 Belt View Drive
Helena, Montana 59601

Attn: Mr. Dan Baum, P.E.

Re: Geotechnical Evaluation
Flagstaff Ranger Station Waste Water Improvements
5075 U.S. 89
Flagstaff, Arizona

Job No. 25-223591-0

Western Technologies Inc. has completed the geotechnical evaluation for the proposed new sewer line to be located in Flagstaff, Arizona. This study was performed in general accordance with our Proposal No. 25-223591-P dated August 18, 2023. The results of our study, including the boring location diagram, laboratory test results, boring logs, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. If design conditions change, or if you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us. We look forward to working with you on future projects.

Sincerely,

WESTERN TECHNOLOGIES, INC.

Geotechnical Engineering Services

Gregory L. E. Burr, P.E., R.G.
Geotechnical Department Manager

Copies to: Addressee (emailed)

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GEOTECHNICAL EVALUATION
FLAGSTAFF RANGER STATION WASTEWATER IMPROVEMENTS
5075 U.S. 89
FLAGSTAFF, ARIZONA
JOB NO. 25-223591-0

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed sewer line located along Forest Road 989C between the intersection with East Marketplace Drive and the existing ranger station in Flagstaff, Arizona. The purpose of these services is to provide information and recommendations regarding:

- anticipated excavation conditions
- manhole foundations
- earthwork, including backfill placement, and suitability of existing soils for backfill materials
- lateral earth pressures
- corrosivity
- existing pavement thickness

Results of the field exploration, field tests, and laboratory testing program are presented in the Appendices.

2.0 PROJECT DESCRIPTION

Based on information provided by Mr. Dan Baum, the proposed project will consist of approximately 1,700 linear feet of sewer line to be installed. The sewer line will be 8-inches in diameter along the entire alignment. Pipe invert elevations will be a maximum of about 6 feet below the lowest existing site grades. Should any of our information or assumptions not be correct, we request that the Client notify WT immediately.

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Five borings were each auger drilled to a depth of about 11 feet below existing site grades along the proposed alignment. The borings were at the approximate locations shown on the attached Boring Location Diagram. A field log was prepared for each boring.

These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thickness, and the locations where samples were obtained. The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A.

3.2 Laboratory Analyses

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable standard test methods. The following tests were performed and the results are presented in Appendix B.

- Water content
- Dry density
- Compression
- Optimum moisture/maximum density
- Remolded expansion potential
- Gradation
- Plasticity
- Corrosivity ASTM A674
- Soluble salt/sulfate/chloride content

Test results were utilized in the development of the recommendations contained in this report.

3.3 Analyses and Report

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as appropriate to the purpose. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site, discovery of underground storage tanks or other underground structures, or identification of contaminated or hazardous materials or conditions. If there is concern about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

4.0 SITE CONDITIONS

4.1 Surface

The borings were located along Forest Road 989C between the intersection with East Marketplace Drive and the existing ranger station. Roadway surfaces consisted of asphalt concrete pavement that appeared to be in variable condition. Adjacent land along the alignments consisted of a combination of developed lots and undeveloped residential areas. Vegetation surrounding the alignment consisted of a sparse to moderate growth of native ponderosa pine trees, grasses and weeds.

4.2 Subsurface

As presented on the boring logs, existing pavement sections encountered in the borings consisted of 4 to 5 inches of asphalt concrete. Native surface soils underlying the pavement sections and extending to the full depth of exploration in all borings were found to include non-plastic to low plasticity, medium dense to very dense Silty SANDS with variable amounts of gravel; low plasticity, very stiff to hard Sandy CLAYS with variable amounts of gravel; and low plasticity, medium dense to dense Silty, Clayey SANDS with variable amounts of gravel. Some of the soils encountered during construction will likely contain random amounts of cobbles and boulders. No free groundwater was encountered in any boring at the time of exploration. The logs in Appendix A show details of the subsurface conditions encountered during the field exploration.

The boring logs included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the borings may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.

5.0 GEOTECHNICAL PROPERTIES AND ANALYSIS

5.1 Laboratory Tests

Laboratory test results (see Appendix B) indicate that on-site subsoils located near anticipated manhole foundation levels exhibit low compressibility at existing water contents. Low to high additional compression occurs when the water content is increased. Near-surface soils are of nil to low plasticity. The site soils exhibit low expansion potential when recompacted, confined by loads approximating floor loads and saturated in accordance with standard Arizona test methods.

5.2 Field Tests

On-site subsoils located near anticipated manhole foundation levels exhibited moderate to high resistance to penetration using the ring-lined barrel sampler (ASTM D3550). The penetration resistance values also exhibited some variability between test locations and with depth.

6.0 RECOMMENDATIONS

6.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0 and the assumption that the soil and subsurface conditions are those disclosed by the explorations. Others may change the plans, final elevations and final alignments during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

6.2 Manhole Foundations

The soils encountered along the alignments are expected to exhibit moderate to high bearing capacity at anticipated manhole foundation depths. Other than removal of any soft, loose, unstable or disturbed soils from beneath manhole foundations, specialized treatment of soils beneath manholes is not anticipated.

6.3 Soil Corrosivity

Representative soils were tested for the following soil properties: resistivity, pH, redox potential, sulfides and moisture content. Laboratory test results indicate that the on-site soils exhibit low corrosive potential to ductile iron pipe. This information should be used as an aid in choosing the construction materials that will be in contact with these soils and corrosion protection methods. Pipe and material manufacturers' representatives should be contacted regarding the specific corrosivity resistance for their particular product.

The chemical test results indicate that the site soils are negligibly corrosive to concrete. However, in order to be consistent with standard local practice and for reasons of material availability, we recommend that Type II portland cement be used for all concrete on and below grade.

6.4 Lateral Design Criteria for Thrust Blocks

For any thrust block design, lateral loads may be resisted using a soil bearing pressure of 2000 pounds per square foot (psf). All backfill placed against or around thrust blocks should be compacted to densities specified herein under **Placement and Compaction**.

6.5 Excavations

We anticipate that excavations into the site soils for the proposed construction can be accomplished with conventional equipment. Excavations penetrating the underlying cobbles and boulders may require the use of heavy-duty, specialized equipment to facilitate removal. The speed and ease of excavation is dependent on the nature of the deposit, the type of equipment used, and the skill and experience of the equipment operator.

On-site soils may pump or become unworkable at high water contents. Workability may be improved by scarifying and drying. Over-excavation of wet zones and replacement with drier granular materials may be necessary. The use of lightweight excavation and compaction equipment may be required to minimize subgrade pumping.

6.6 Temporary Excavations

Temporary, non-surcharged construction excavations should be sloped or shored. The individual contractor should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. OSHA recommends a maximum slope inclination of 0.75:1 (horizontal:vertical) for Type A soils, 1:1 for Type B soils, and 1.5:1 for Type C soils.

6.7 Materials

All trench backfill, aggregate base course and pavement materials should meet current City of Flagstaff or Coconino County specifications. Frozen soils should not be used as fill or backfill.

6.8 Placement and Compaction

All trench backfill should be placed and compacted in accordance with current City of Flagstaff or Coconino County specifications for trench backfill. Fill soils should not be placed over frozen ground. All fill soils placed around and below any thrust blocks, where applicable, should be compacted to a minimum of 95 percent compaction relative to the standard proctor maximum value (ASTM 698). On-site clayey soils should be compacted with a moisture content in the range of 1 percent below to 3 percent above optimum. On-site and imported soils with low expansive potential and aggregate base course materials should be compacted with a moisture content in the range of 3 percent below to 3 percent above optimum.

7.0 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that a sufficient schedule of tests and observations will be performed during construction to verify compliance. At a minimum, these tests and observations should be comprised of the following:

- Observations and testing during site preparation and earthwork,
- Observation of excavations, and
- Consultation as may be required during construction.

Retaining the geotechnical engineer who developed your report to provide construction observation is the best way to verify compliance and to help you manage the risks associated with unanticipated conditions.

8.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **2.0 PROJECT DESCRIPTION**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced explorations. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between explorations, however variations can and often do exist. Whenever any deviation, difference, or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.

9.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the location of the explorations, and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.



Not to Scale



Approximate Test Boring Location



Western Technologies
An RMA Company

FLAGSTAFF RANGER STATION WASTEWATER LINE

Boring Location Diagram

Western Technologies Inc.

Job No.: 25-223591-0

Plate: 1

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified aggregate material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson/Drilled Shaft	A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson).
Concrete Slabs-On-Grade	A concrete surface layer cast directly upon base course, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand and Gravel Base Course	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.



DEFINITION OF TERMINOLOGY

PLATE

A-1

COARSE-GRAINED SOILS

LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE
GP	POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	
GM	SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES	
GC	CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES	
SW	WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE
SP	POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	
SM	SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES	
SC	CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES	

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS

MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
CL	LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY	
OL	ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY	
MH	ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
CH	FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY	
OH	ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY	
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	¾ in. – 3 in.
Fine	No. 4 – ¾ in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT
VERY SOFT	0 – 2
SOFT	3 – 4
FIRM	5 – 8
STIFF	9 – 15
VERY STIFF	16 – 30
HARD	OVER 30

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1½-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 – 7	LOW
8 – 20	MEDIUM
Over 20	HIGH

DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED



METHOD OF CLASSIFICATION

PLATE

A-2

The number shown in "**BORING NO.**" refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features.

"**DRILLING TYPE**" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"**R**" in "**BLOW COUNTS**" refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inches is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. An **X** within the symbol indicates no sample recovery. A half-filled **X** within the symbol indicates sample disturbance.

"**SAMPLE TYPE**" refers to the form of sample recovery, in which **R** = Ring-lined sample and **G** = Grab sample.

"**DRY DENSITY (LBS/CU FT)**" refers to the laboratory-determined dry density in pounds per cubic foot.

"**WATER (MOISTURE) CONTENT**" (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

"**USCS**" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.



BORING LOG NOTES

PLATE

A-3

Project: Flagstaff Ranger Station Wastewater Line Project Number: 25-223591-0		BORING NO. 1		 Western Technologies An RMA Company	
Date(s) Drilled 12/6/23		Logged By E. Martinez		Checked By J. Quinlan	
Drilling Method HSA		Drill Bit Size/Type 7 In.		Approximate Surface Elevation Not Determined	
Drill Rig Type CME-75		Drilling Contractor EDI			
Groundwater Level and Date Measured Not Encountered		Location See Location Diagram			

Water Content, %	Dry Unit Weight, pcf	Sample Type	Sample	Sampling Resistance, blows/ft	Depth (feet)	Soil Type	Graphic Log	MATERIAL DESCRIPTION
					0	Asphalt		ASPHALT (4 Inches Thick)
						SM		Silty SAND; with gravel, brown, medium dense to very dense, slightly damp
3.7	98		R	20				
5.0	103		R	22				
3.9	94		R	50/1"				
					11			Boring Stopped at 11 Feet

Figure A-4

Project: Flagstaff Ranger Station Wastewater Line Project Number: 25-223591-0	BORING NO. 2	 Western Technologies An RMA Company
Date(s) Drilled 12/6/23	Logged By E. Martinez	Checked By J. Quinlan
Drilling Method HSA	Drill Bit Size/Type 7 In.	Approximate Surface Elevation Not Determined
Drill Rig Type CME-75	Drilling Contractor EDI	
Groundwater Level and Date Measured Not Encountered	Location See Location Diagram	

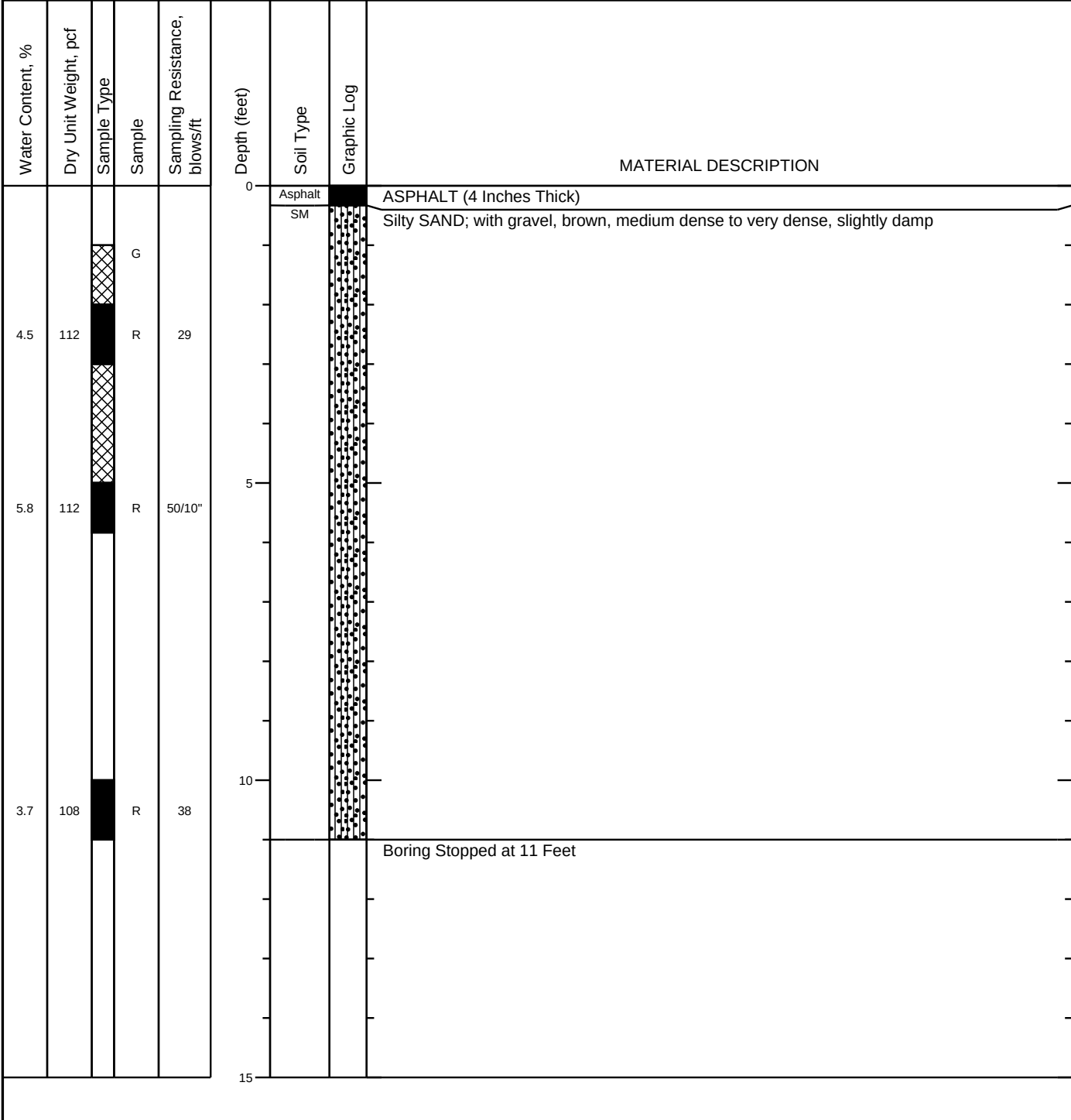


Figure A-5

Project: Flagstaff Ranger Station Wastewater Line	BORING NO. 3	 Western Technologies An RMA Company
Project Number: 25-223591-0		

Date(s) Drilled 12/6/23	Logged By E. Martinez	Checked By J. Quinlan
Drilling Method HSA	Drill Bit Size/Type 7 In.	Approximate Surface Elevation Not Determined
Drill Rig Type CME-75	Drilling Contractor EDI	
Groundwater Level and Date Measured Not Encountered	Location See Location Diagram	

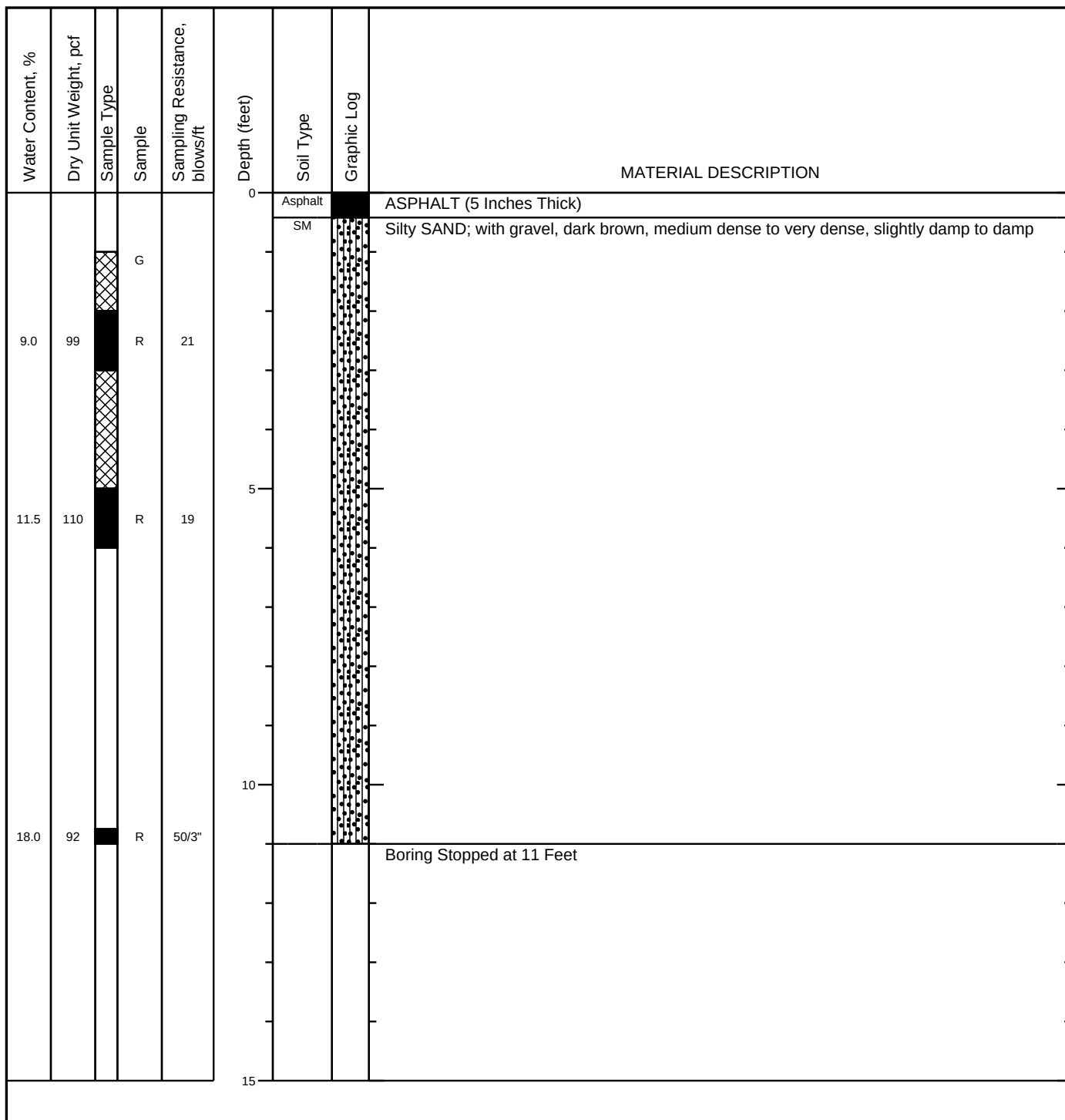


Figure A-6

Project: Flagstaff Ranger Station Wastewater Line Project Number: 25-223591-0		BORING NO. 4		 Western Technologies An RMA Company	
Date(s) Drilled 12/6/23		Logged By E. Martinez		Checked By J. Quinlan	
Drilling Method HSA		Drill Bit Size/Type 7 In.		Approximate Surface Elevation Not Determined	
Drill Rig Type CME-75		Drilling Contractor EDI			
Groundwater Level and Date Measured Not Encountered		Location See Location Diagram			

Water Content, %	Dry Unit Weight, pcf	Sample Type	Sample	Sampling Resistance, blows/ft	Depth (feet)	Soil Type	Graphic Log	MATERIAL DESCRIPTION
					0	Asphalt		ASPHALT (5 Inches Thick)
7.3	98		G	16		SM		Silty SAND; with gravel, dark brown, medium dense, slightly damp
9.9	104			18	5	CL		Lean CLAY; with sand, some gravel, dark brown, very stiff to hard, damp to slightly damp
7.2	88			50/5"	10			
								Boring Stopped at 11 Feet
					15			

Figure A-7

Project: Flagstaff Ranger Station Wastewater Line	BORING NO. 5	 Western Technologies An RMA Company
Project Number: 25-223591-0		

Date(s) Drilled 12/6/23	Logged By E. Martinez	Checked By J. Quinlan
Drilling Method HSA	Drill Bit Size/Type 7 In.	Approximate Surface Elevation Not Determined
Drill Rig Type CME-75	Drilling Contractor EDI	
Groundwater Level and Date Measured Not Encountered	Location See Location Diagram	

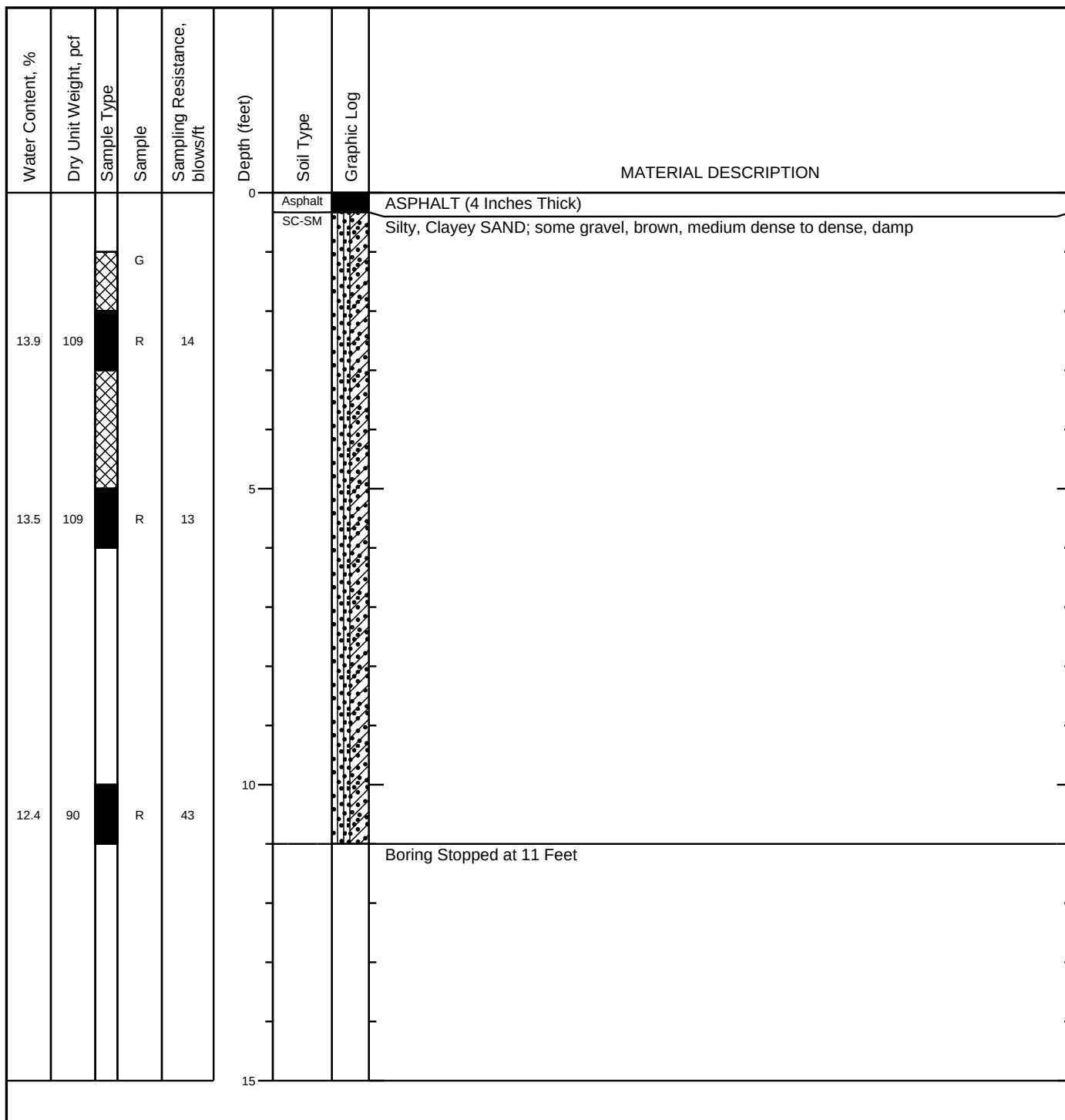


Figure A-8

Boring No.	Depth (ft)	USCS Class.	Particle Size Distribution (%) Passing by Weight							Atterberg Limits		Laboratory Compaction Characteristics			Remarks
			3"	¾"	#4	#10	#40	#200	2μ	LL	PI	Dry Density (pcf)	Optimum Moisture (%)	Method	
1	1-5	SM		100	82	66	49	30.4			NP				2
3	1-5	SM	100	99	83	67	51	31.6		21	3				2
5	1-5	SC-SM		100	92	82	68	49.2		21	4				2

NOTE: NP = Non-plastic
μ = microns (2μ = 0.002mm)

REMARKS

Classification / Particle Size / Moisture-Density Relationship

1. Visual
2. Laboratory Tested
3. Minus #200 Only
4. Test Method ASTM D698/AASHTO T99
5. Test Method ASTM D1557/AASHTO T180
6. From the ADOT Family of Curves

	PROJECT: FLAGSTAFF RANGER STATION WASTEWATER LINE	PLATE B-1
	JOB NO.: 25-223591-0	
SOIL PROPERTIES		

Boring No.	Depth (ft.)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Laboratory Compaction Characteristics			Expansion Properties		Plasticity		Soluble		Remarks
					Dry Density(pcf)	Optimum Moisture(%)	Method	Surcharge (ksf)	Expansion (%)	LL	PI	Salts (ppm)	Sulfate (ppm)	
5	1-5	SC-SM	113.2	9.9	118.9	13.2	A	0.1	0.5					1,2,3

Notes: Initial Dry Density and Initial Water Content are remolded.

Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.
3. Test Method ASTM D698/AASHTO T99
4. Test Method ASTM D1557/AASHTO T180
5. From the ADOT Family of Curves



PROJECT: FLAGSTAFF RANGER STATION WASTEWATER LINE
JOB NO.: 25-223591-0

SOIL PROPERTIES

PLATE
B-2

CORROSIVITY TEST RESULTS

The procedures for soil survey tests and observations can be found in Appendix X1.1 of ASTM A674-10 and includes five soil properties: earth resistivity • pH • redox potential • sulfides • moisture.

1(1-5):

<u>Analysis</u>	<u>Results</u>	<u>Points</u>
Resistivity (ohm-cm)	10,776	0
pH	7.84	0
Redox Potential (mV)	+85.6	3.5
Sulfides	trace	2
Moisture	fair	1
Total Points		6.5

5(1-5):

<u>Analysis</u>	<u>Results</u>	<u>Points</u>
Resistivity (ohm-cm)	4,398	0
pH	7.52	0
Redox Potential (mV)	+37.2	4
Sulfides	trace	2
Moisture	fair	1
Total Points		7

The test procedure states that if the sum of the points is greater than 10, the soil is considered corrosive to ductile iron pipe and special protection against exterior corrosion is necessary. This conclusion is limited to soil corrosion and does not include consideration of stray direct current.



PROJECT: FLAGSTAFF RANGER STATION WASTEWATER LINE
JOB NO. 25-223591-0

SOIL PROPERTIES

PLATE

B-3



Nortest Analytical
An **RMA** Company

Reported: 12/14/2023

Received: 12/12/2023

LABORATORY ANALYSIS REPORT

Project:

Lab Number

Sample ID

Test Parameter

<i>Test</i>	<i>Method</i>	<i>Result</i>	<i>Units</i>
Soluble Salts	ARIZ 237b	198	ppm
Sulfate	ARIZ 733b	4	ppm
Chloride	ARIZ 736b	8	ppm

COMPRESSION TEST REPORT

Applied Pressure (ksf)	Percent Strain (%)
0.1	0
0.3	0.5
1.0	1.2
1.0	7.0
3.0	8.5

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _r	Swell Press. (ksf)	Clpse. %	e ₀
Sat.	Moist.											
22.3 %	5.0 %	103.1			2.65						5.8	0.593

MATERIAL DESCRIPTION										USCS	AASHTO
SILTY SAND WITH GRAVEL										SM	

Project No. 25-223591-0 Client: GREAT WESTERN ENGINEERING										Remarks:		
Project: FLAGSTAFF RANGER STATION WASTE WATER IMPROVEMENT												
Source: RING SAMPLE Depth: 5-6 FEET Sample No.: BORING 1												
Western Technologies, Inc.												
Flagstaff, AZ												

Plate B-5

The graph illustrates the relationship between Applied Pressure (ksf) on the x-axis and Percent Strain on the y-axis. The x-axis is logarithmic, ranging from 0.1 to 10 ksf. The y-axis is linear, ranging from 0.0 to 4.0 percent strain. The curve shows a peak at 1.0 ksf, followed by a vertical drop labeled 'Water Added', and then a recompression path.

Applied Pressure (ksf)	Percent Strain
0.1	0.0
0.5	0.7
1.0	1.2
1.0	2.7
2.0	3.1

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _r	Swell Press. (ksf)	Clpse. %	e ₀
Sat.	Moist.											
60.7 %	11.5 %	110.3			2.65						1.4	0.500

MATERIAL DESCRIPTION	USCS	AASHTO
SILTY SAND WITH GRAVEL	SM	

Project No. 25-223591-0	Client: GREAT WESTERN ENGINEERING	Remarks:
Project: FLAGSTAFF RANGER STATION WASTE WATER IMPROVEMENT		
Source: RING SAMPLE	Depth: 5-6 FEET Sample No.: BORING 3	
Western Technologies, Inc. Flagstaff, AZ		

Plate B-6

The graph illustrates the relationship between Applied Pressure (ksf) on the x-axis and Percent Strain on the y-axis. The x-axis is logarithmic, ranging from 0.1 to 10 ksf. The y-axis is linear, ranging from 0.0 to 4.0 percent strain. The curve shows a peak at 1.0 ksf, followed by a vertical drop labeled 'Water Added', and then a steeper compression path.

Applied Pressure (ksf)	Percent Strain
0.1	0.0
0.5	0.9
1.0	1.6
1.0	1.8
2.0	3.6

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _r	Swell Press. (ksf)	Clpse. %	e ₀
Sat.	Moist.											
39.1 %	12.4 %	89.9			2.65						0.2	0.841

MATERIAL DESCRIPTION	USCS	AASHTO
SILTY CLAYEY SAND	SC-SM	

Project No. 25-223591-0 Client: GREAT WESTERN ENGINEERING	Remarks:
Project: FLAGSTAFF RANGER STATION WASTE WATER IMPROVEMENT	
Source: RING SAMPLE Depth: 10-11 FEET Sample No.: BORING 5	
Western Technologies, Inc.	
Flagstaff, AZ	Plate B-7

CONSTRUCTION PLANS

Y:\Shared\Helena Projects\1-22139-DHOC2USFS R3 ONF-KNF Water and Sewer Improvements\Coconino NF - Flagstaff RD Wastewater Improvements\CADD 1-22139\Sheets\1-22139-1 - COVER.dwg



U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION THREE

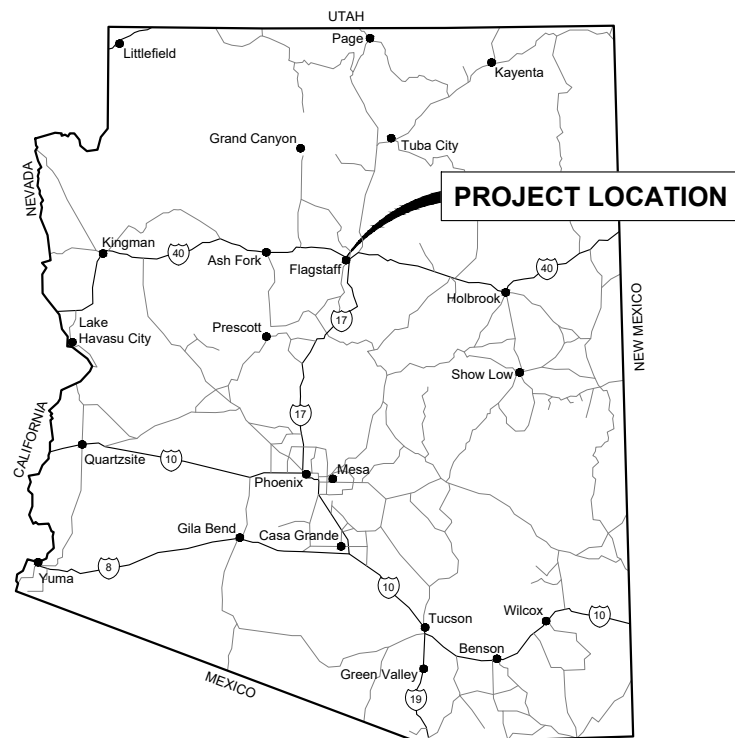


CONSTRUCTION PLANS FOR
**FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS**

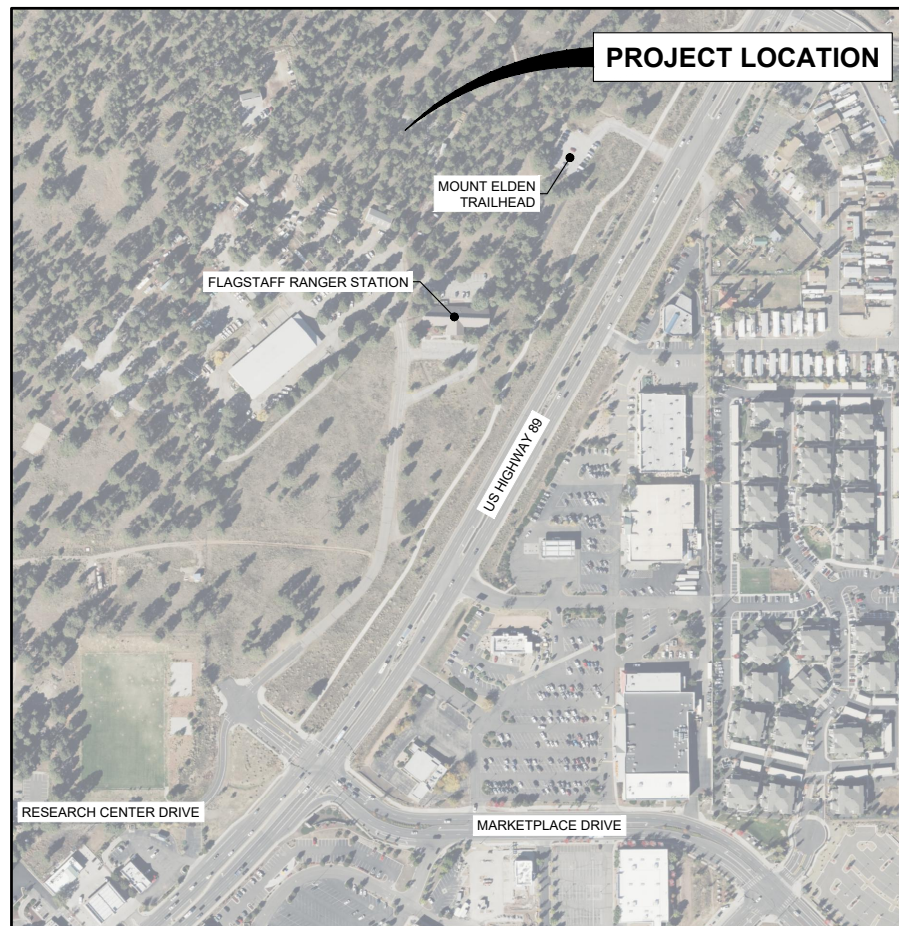
COCONINO NATIONAL FOREST
FLAGSTAFF RANGER DISTRICT
COCONINO COUNTY, ARIZONA



SECTION 06, TOWNSHIP 21 NORTH, AND RANGE 08 WEST
LATITUDE 35° 13' 43.10" NORTH AND LONGITUDE 111° 34' 54.66" WEST



LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

SHEET INDEX

PROJECT: 1-22139
DATE: AUGUST 14, 2024

SHEET 1	COVER
SHEET 2	GENERAL, NOTES, LEGEND AND ABBREVIATIONS
SHEET 3	ESTIMATED QUANTITIES AND PROJECT NOTES
SHEET 4	OVERALL SITE PLAN AND CONTROL DIAGRAM
SHEET 5	SEWER MAIN - STA. 0+00 TO STA. 10+50
SHEET 6	SEWER MAIN - STA. 10+50 TO STA. 20+00
SHEET 7	SEWER SERVICE CONNECTIONS
SHEET 8	STANDARD DETAILS
SHEET 9	STANDARD DETAILS
SHEET 10	STANDARD DETAILS
SHEET 11	STANDARD DETAILS

APPROVED BY:

LINE OFFICER
COCONINO NATIONAL FOREST

DATE

RECOMMENDED BY:

FOREST ENGINEER
COCONINO NATIONAL FOREST

DATE

RECOMMENDED BY:

REGIONAL WATER/WASTEWATER ENGINEER
REGION THREE

DATE

RECOMMENDED BY:

DIRECTOR OF ENGINEERING
REGION THREE

DATE

PLANS PREPARED BY:

DAN BAUM
PAUL KARCHER, E.I.
KRISTOPHER BOSCH, E.I.

APPROVED BY:
AMY DEITCHLER, P.E.



NOTE:
DRAWING SCALE IS ONLY ACCURATE
WHEN PLANS ARE PLOTTED ON 11" X 17"
(TABLOID)-SIZED PAPER.

NO.	REVISION DESCRIPTION	BY	DATE	SET NO.
△				SHEET NO. 1
△				
△				
△				
△				
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Y:\Shared\Helena Projects\1-22139-DHOC7USFS R3 ONF-KNF Water and Sewer Improvements\Coconino NF - Flagstaff RD Wastewater Improvements\CADD 1-22139-Sheets\1-22139-2-GENERAL NOTES, LEGEND AND ABBREVIATIONS.dwg

ABBREVIATIONS

⊙	AT	LPG	LIQUID PROPANE GAS
Δ	ANGLE OF DEFLECTION, DELTA ANGLE	LT	LEFT
<PT	ANGLE POINT	MAX	MAXIMUM
AB	ANCHOR BOLT	MD	MEASURE DOWN
ABDN	ABANDON	MFD	MANUFACTURED
AC	ASBESTOS CONCRETE	MFR	MANUFACTURE, MANUFACTURER
ADDN	ADDITIONAL	MH	MANHOLE
ADJ	ADJACENT	MIN	MINIMUM
AFF	ABOVE FINISHED FLOOR	MISC	MISCELLANEOUS
ALT	ALTERNATE	MJ	MECHANICAL JOINT
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	MOV	MOTOR OPERATED VALVE
APPROX	APPROXIMATE	MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
APVD	APPROVED	N	NORTH
ARCH	ARCHITECTURE, ARCHITECTURAL	NE	NORTHEAST
ASPH	ASPHALT	NG	NATURAL GAS
AVE	AVENUE	NIC	NOT IN CONTRACT
AVG	AVERAGE	NO	NUMBER
BFV	BUTTERFLY VALVE	NOM	NOMINAL
BLDG	BUILDING	NTS	NOT TO SCALE
BLK	BLOCK	NW	NORTHWEST
BLVD	BOULEVARD	OC	ON CENTER
BM	BEAM, BENCHMARK	OD	OUTSIDE DIAMETER
BOT	BOTTOM	OF	OVERFLOW
BRG	BEARING	OH	OVERHEAD
BRKT	BRACKET	OHP	OVERHEAD POWER
BVC	BEGIN VERTICAL CURVE	OHT	OVERHEAD TELEPHONE
C-C	CENTER TO CENTER	OPNG	OPENING
CHAN	CHANNEL	PC	POINT OF CURVATURE
CHK	CHECK	PCC	POINT OF COMPOUND CURVATURE
CI	CAST IRON	PE	PLAIN END, POLYETHYLENE
CIPC	CAST-IN-PLACE CONCRETE	PERP	PERPENDICULAR
CIRC	CIRCULAR	PI	POINT OF INTERSECTION
CJ	CONSTRUCTION JOINT, CONTROL JOINT	PL	PROPERTY LINE
☉	CENTER LINE	PNL	PANEL
CLR	CLEAR, CLEARANCE	PRC	POINT OF REVERSE CURVATURE
CMP	CORRUGATED METAL PIPE	PREFAB	PREFABRICATED
CMU	CONCRETE MASONRY UNITS	PRELIM	PRELIMINARY
CO	CLEANOUT	PREP	PREPARE, PREPARATION
COL	COLUMN	PROP	PROPERTY
CONC	CONCRETE	PRV	PRESSURE REDUCING VALVE
CONSTR	CONSTRUCTION	PSF	POUNDS PER SQUARE FOOT
CONT	CONTINUE, CONTINUED, CONTINUOUS	PSI	POUNDS PER SQUARE INCH
CONTR	CONTRACTOR	PT	POINT, POINT OF TANGENCY
COORD	COORDINATE	PVC	POLYVINYL CHLORIDE
CP	CONTROL PANEL, CONTROL POINT	PVI	POINT OF VERTICAL INTERSECTION
CPLG	COUPLING	PVMT	PAVEMENT
CTR	CENTER	R, RAD	RADIUS
CTV	CABLE TELEVISION	RC	REINFORCED CONCRETE
CU	CUBIC, COPPER	RCP	REINFORCED CONCRETE PIPE
CF	CUBIC FEET	RD	ROAD
CULV	CULVERT	RDCR	REDUCER
CY	CUBIC YARD	REBAR	REINFORCEMENT BAR
DET	DETAIL	REF	REFERENCE
DI	DUCTILE IRON, DRAIN INLET	REINF	REINFORCE
DIA, ∅	DIAMETER	REQD	REQUIRED
DIAG	DIAGONAL	RR	RAILROAD
DIM	DIMENSION	RST	REINFORCING STEEL
DR	DRIVE	RT	RIGHT
DWG	DRAWING	R/W	RIGHT-OF-WAY
E	EAST	S	SOUTH, SANITARY SEWER
EA	EACH	SAN	SANITARY
EL, ELEV	ELEVATION	SCH	SCHEDULE
ELB	ELBOW	SD	STORM DRAIN
ELEC	ELECTRIC, ELECTRICAL	SDWK	SIDEWALK
ENCLOS	ENCLOSE	SE	SOUTHEAST
ENGR	ENGINEER	SECT	SECTION
EOP	EDGE OF PAVEMENT	SF	SQUARE FOOT
EQ	EQUAL, EQUALLY	SHT	SHEET
EQ SP	EQUALLY SPACED	SIM	SIMILAR
EQUIP	EQUIPMENT	SLP	SLOPE
EQUIV	EQUIVALENT	SPEC	SPECIFICATION
EVC	END VERTICAL CURVE	SQ	SQUARE
EW	EACH WAY	SSTL	STAINLESS STEEL
EXC	EXCAVATE	STA	STATION
EXP	EXPANSION	SS	SANITARY SEWER SERVICE
EXP JT	EXPANSION JOINT	STD	STANDARD
EXST	EXISTING	ST	STREET
FCV	FLOW CONTROL VALVE	STL	STEEL
FD	FLOOR DRAIN	STRUCT	STRUCTURE
FDN	FOUNDATION	SW	SOUTHWEST
FES	FLARED END SECTION	SYM	SYMMETRICAL
FET	FLARED END TERMINAL	TB	THRUST BLOCK
FF	FINISHED FLOOR	TBC	TOP BACK OF CURB
FG	FINISH GRADE	TBM	TEMPORARY BENCH MARK
FHYD	FIRE HYDRANT	TEL	TELEPHONE
FJ	FLANGE JOINT	TEMP	TEMPORARY
FL	FLOW LINE	THRU	THROUGH
FLEX	FLEXIBLE	TYP	TYPICAL
FM	FORCEMAIN	UG	UNDERGROUND
FT	FOOT, FEET	UGP	UNDERGROUND POWER
FO	FIBER OPTIC	UGT	UNDERGROUND TELEPHONE
FTG	FOOTING, FITTING	UTIL	UTILITY
G	NATURAL GAS	V	VALVE, VOLT
GA	GAGE, GAUGE	VB	VALVE BOX
GAL	GALLON	VERT	VERTICAL
GALV	GALVANIZED	VOL	VOLUME
GND	GROUND	W	WEST, WATER
GVL	GRAVEL	WTR	WATER
HB	HOSE B/B	WD	WOOD
HDPE	HIGH DENSITY POLYETHYLENE	W/	WITH
HOR, HORIZ	HORIZONTAL	W/O	WITHOUT
HWY	HIGHWAY	WL	WETLAND
HYD	HYDRANT	WM	WIRE MESH, WATER METER
ID	INSIDE DIAMETER	WS	WATERSTOP, WATER SURFACE, WATER SERVICE
IE	INVERT ELEVATION	WT	WEIGHT
IN	INCH	WV	WATER VALVE
INV	INVERT	WWF	WELDED WIRE FABRIC
JB	JUNCTION BOX	WWM	WELDED WIRE MESH
JT	JOINT	XFMR	TRANSFORMER
K	RATE OF VERTICAL CURVATURE	X-ING	CROSSING
LBS	POUNDS	XS	CROSS SECTION
LF	LINEAR FEET	YD	YARD
LN	LANE		

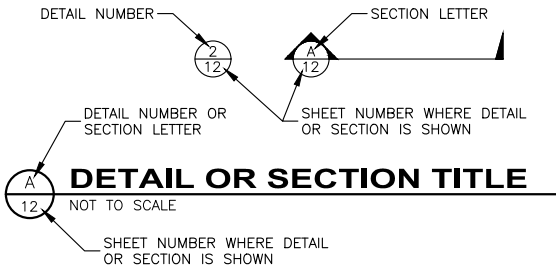
LEGEND

EXISTING	PROPOSED	DESCRIPTION	EXISTING	PROPOSED	DESCRIPTION
-----	-----	MAJOR CONTOUR	⊙	⊙	STUMP
-----	-----	MINOR CONTOUR	☼	☼	SHRUB/BUSH
----- OHT -----	----- OHT -----	OVERHEAD TELEPHONE	☼	☼	TREE--CONIFER
----- UGT -----	----- UGT -----	UNDERGROUND TELEPHONE	☼	☼	TREE--DECIDUOUS
----- CTV -----	----- CTV -----	CABLE TELEVISION	☼	☼	TREE LINE
----- FO -----	----- FO -----	FIBER OPTIC	☼	☼	COMMUNICATION MANHOLE
----- G -----	----- G -----	NATURAL GAS	☼	☼	COMMUNICATION VAULT
----- OHP -----	----- OHP -----	OVERHEAD POWER	☼	☼	TELEPHONE RISER
----- UGP -----	----- UGP -----	UNDERGROUND POWER	☼	☼	CABLE TV RISER
----- S -----	----- S -----	SANITARY SEWER	☼	☼	NATURAL GAS METER
----- SS ----- SS -----	----- SS ----- SS -----	SANITARY SEWER SERVICE	☼	☼	NATURAL GAS RISER
----- FM -----	----- FM -----	SANITARY SEWER FORCEMAIN	☼	☼	NATURAL GAS VALVE
----- SD -----	----- SD -----	STORM DRAIN	☼	☼	LIGHT POLE
-----	-----	STORM CULVERT	☼	☼	STREET LIGHT POLE
----- W -----	----- W -----	WATER	☼	☼	POWER RISER
----- WS ----- WS -----	----- WS ----- WS -----	WATER SERVICE	☼	☼	PAD MOUNTED TRANSFORMER
-----	-----	CHAINLINK FENCE	☼	☼	POWER VAULT
----- X ----- X -----	----- X ----- X -----	BARBED WIRE FENCE	☼	☼	UTILITY POLE
-----	-----	WOOD FENCE	☼	☼	GUY WIRE
-----	-----	PAVED ROAD	☼	☼	SANITARY MANHOLE
-----	-----	GRAVEL ROAD	☼	☼	SANITARY CLEANOUT
-----	-----	PROPERTY/LOT LINE	☼	☼	SANITARY LAMPHOLE
-----	-----	PROPERTY EASEMENT	☼	☼	STORM MANHOLE
-----	-----	PROPERTY SETBACK	☼	☼	STORM ROUND INLET
-----	-----	RIGHT-OF-WAY	☼	☼	STORM SQUARE INLET
-----	-----	CITY LIMIT/DISTRICT BOUNDARY	☼	☼	STORM CATCH BASIN
-----	-----	RAILROAD	☼	☼	11.25° ELBOW
-----	-----	DITCH	☼	☼	22.50° ELBOW
-----	-----	WATER EDGE	☼	☼	45° ELBOW
-----	-----	WETLAND	☼	☼	90° ELBOW
-----	-----	BUILDING	☼	☼	TEE
-----	-----	BENCHMARK	☼	☼	CROSS
-----	-----	CONTROL POINT	☼	☼	CAP
-----	-----	PROPERTY PIN	☼	☼	FIRE HYDRANT
-----	-----	BORING	☼	☼	GATE VALVE
-----	-----	MONITORING WELL	☼	☼	REDUCER
-----	-----	TEST PIT	☼	☼	WATER METER
-----	-----	BOLLARD	☼	☼	WELL
-----	-----	MAIL BOX	☼	☼	CURB STOP
-----	-----	SIGN	☼	☼	FROST FREE HYDRANT

GENERAL NOTES:

- THIS IS A STANDARD LEGEND AND ABBREVIATION LIST. THEREFORE, NOT ALL SYMBOLS AND ABBREVIATIONS MAY BE USED ON THIS PROJECT.
- UNLESS MODIFIED BY THE CONTRACT DOCUMENTS, ALL WORK WILL CONFORM TO THE CURRENT CITY OF FLAGSTAFF MUNICIPAL CODES AS STATED IN DIVISION 13-09-002.
- CITY OF FLAGSTAFF MUNICIPAL CODES SHALL TAKE PRECEDENCE OVER ADEQ CRITERIA SUCH AS IN ENGINEERING BULLETIN NO. 11.
- EXISTING UNDERGROUND UTILITIES SHOWN ARE FROM THE BEST INFORMATION AVAILABLE. THIS INFORMATION IS APPROXIMATE AND MAY BE INCOMPLETE. FOR ACCURATE LOCATION, THE CONTRACTOR SHALL CONTACT, PRIOR TO EXCAVATION, THE UTILITIES UNDERGROUND LOCATION CENTER AT: 1-800-782-5348.

GENERAL DESIGN DESIGNATIONS:



COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS
GENERAL, NOTES, LEGEND AND ABBREVIATIONS

SHEET NO.

2

OF 11

NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		

PROJECT: 1-22139	DESIGNED: DB, KB	DRAWN: PK, KB	CHECKED: AE	APPROVED: AD	DATE: AUGUST 14, 2024
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Y:\Shared\Helena Projects\1-22139-DHOC?USFS R3 ONF-KNF Water and Sewer Improvements\Coconino NF - Flagstaff RD Wastewater Improvements\CADD 1-22139-Sheets\1-22139-3-ESTIMATED QUANTITIES AND PROJECT NOTES.dwg

ESTIMATED QUANITIES**				
ITEM NO.	DESCRIPTION	UNIT	QUANTITY	REMARKS
01000-1	MOBILIZATION (10% OF TOTAL)	LUMP SUM	1	
01172-1	CONSTRUCTION SURVEY AND STAKING	LUMP SUM	1	
01500-1	TRAFFIC CONTROL	LUMP SUM	1	
02221-1	SOIL ERROSION AND POLLUTION CONTROL	LUMP SUM	1	
02221-2	PAVED STREET SURFACE RESTORATION (A)	LINEAL FOOT	600	
02221-3	UNPAVED STREET SURFACE RESTORATION (B)	LINEAL FOOT	12	
02221-4	NATIVE GROUND SURFACE RESTORATION (C)	LINEAL FOOT	2750	
02221-5	SEED AND FERTILIZE	LUMP SUM	1	
02221-6	URBAN TRAIL RESTORATION	LINEAL FOOT	30	
02221-7	CURB AND GUTTER RESTORATION	LINEAL FOOT	60	
02232-1	CLEARING AND GRUBBING	LUMP SUM	1	
02730-1	8-INCH SDR 35 PVC SEWER MAIN	LINEAL FOOT	1960	
02730-2	48-INCH CONCRETE MANHOLE	EACH	9	
02730-3	CONNECTION TO EXISTING MANHOLE	EACH	1	
02730-4	DROP SEWER CONNECTION OUTSIDE MANHOLE	EACH	1	
02730-5	4-INCH SDR 35 PVC SEWER SERVICE LATERAL	LINEAL FOOT	1390	
02730-6	SEWER SERVICE CLEANOUT (NON-TRAFFIC AREAS)	EACH	16	
02730-7	SEWER SERVICE CONNECTION	EACH	4	
02730-8	ABANDON EXISTING SEPTIC TANK	EACH	4	
02730-9	EXISTING WATER AND GAS MAIN CROSSING	EACH	6	
60101-1	FLOWABLE FILL CONCRETE	CUBIC YARD	30	

** INFORMATIONAL ONLY – NOT TO BE USED FOR BIDDING PURPOSES – REFER TO BID SCHEDULE

PROJECT NOTES:

1. CONTRACTOR TO AVOID ANY DISTURBANCES TO ARCHEOLOGICAL SITES. ARCHEOLOGIST TO BE ON-SITE DURING ALL TRENCHING ACTIVITIES. CONTRACTOR MUST STOP WORK IF ARCHEOLOGICAL SITES ARE DISCOVERED DURING ANY TRENCH EXCAVATION. CONTRACTOR TO NOTIFY THE USFS CONTRACTING OFFICER (CO)/CONTRACTING OFFICER REPRESENTATIVE (COR) IMMEDIATELY UPON DISCOVERY. WORK MAY RESUME PENDING THE APPROVAL OF THE CO/COR.
2. MATERIALS MAY BE STOCKPILED ON-SITE. A STAGING AND STORAGE AREA CAN BE ESTABLISHED AT THE LOCATION SPECIFIED IN THE CONTRACT DRAWINGS OR AT A LOCATION APPROVED BY THE CO/COR.
3. ALL PROJECT-GENERATED DEBRIS AND WASTE MATERIALS SHALL BE REMOVED AND DISPOSED OF LEGALLY BY THE CONTRACTOR.
4. GREEN PLASTIC COVERED NO. 12 AWG TYPE UF 600V TRACER WIRE SHALL BE INSTALLED WITH ALL SEWER PIPE. TRACER WIRE SHALL BE INSTALLED WITH SEWER MAINS AND SEWER SERVICES SUCH THAT IT IS CONTINUOUS. TRACER WIRE SHALL BE WRAPPED AROUND MANHOLES FOR SEWER MAINS.
5. A TRACER WIRE CONNECTION STATION SHALL BE INSTALLED FOR EACH 500-LINEAR FEET OF SEWER MAIN. A FIVE POUND MAGNESIUM ANODE SHALL BE INSTALLED EVERY 1,000-LINEAR FEET OF TRACER WIRE AT THE TRACER WIRE CONNECTION STATIONS UNDER THE VALVE BOX.
6. NEW SEWER MAINS TO HAVE MINIMUM 4-FEET BURY DEPTH OR AS SPECIFIED IN THE CONTRACT DRAWINGS.
7. EXISTING SEPTIC TANKS ARE TO BE ABANDONED FOLLOWING THE COMPLETION OF THE NEW SEWER COLLECTION SYSTEM.
8. EXISTING SEPTIC TANKS ARE TO BE PUMPED AND ABANDONED IN PLACE PER THE ADEQ REQUIREMENTS STATED IN A.A.C. R18-9-A309(D). EXISTING SEPTIC SYSTEM PIPING AND CLEANOUTS SHALL BE REMOVED AS NEEDED TO ALLOW FOR INSTALLATION OF THE NEW SEWER SERVICE CONNECTIONS.
9. ALL EQUIPMENT SHALL BE WASHED PRIOR TO ENTERING THE PROJECT SITE TO REMOVE VEGETATION TO AVOID THE SPREAD OF WEEDS.
10. STATIONING IS SHOWN ON MANHOLES FOR REFERENCE AND FOR USE WHILE CONSTRUCTION SURVEYING/STAKING. FINAL INSTALLED LOCATION MAY VARY.
11. EXISTING SEPTIC SYSTEM DEPTHS ARE UNKNOWN. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING SEPTIC SYSTEM DEPTHS AND CONNECTING NEW SEWER SERVICES, THIS WORK IS INDIRECT TO SEWER MAIN INSTALLATION (ITEM NO. 02730-5).
12. COORDINATE CONSTRUCTION SCHEDULE WITH THE CO/COR.
13. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE GAS COMPANY DURING THE PROJECT.
14. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE CITY OF FLAGSTAFF DURING THE PROJECT.
15. THE CONTRACTOR IS RESPONSIBLE FOR RESTORING DAMAGED LANDSCAPE AREAS THAT MAY RESULT FROM CONSTRUCTION OPERATIONS.
16. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE LOCAL POWER COMPANY TO PROTECT ANY OVERHEAD POWER POLES DURING EXCAVATION.
17. THE CONTRACTOR IS RESPONSIBLE FOR ACQUIRING ALL PERMITS THAT ARE REQUIRED FOR CONSTRUCTION OPERATIONS.
18. ALL NEW SEWER MAINS TO BE 8-INCH SDR35 PVC PIPE.
19. ALL NEW SEWER SERVICES TO BE 4-INCH SDR35 PVC PIPE.
20. LOCATION, DEPTH, AND SIZE OF EXISTING BURIED UTILITIES ARE SHOWN BASED ON THE BEST INFORMATION AVAILABLE. CONTRACTOR SHALL FIELD VERIFY LOCATIONS OF BURIED UTILITIES FOR THE NEW INSTALLATIONS AND CONNECTIONS. VERIFY BURIED UTILITY LOCATIONS WITH THE OWNER PRIOR TO COMMENCING EXCAVATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO REPAIR ALL UTILITIES IF DAMAGED DURING CONSTRUCTION AT THE CONTRACTOR'S EXPENSE.
21. MAINTAIN MINIMUM OF 2-FEET VERTICAL SEPARATION AND 6-FEET HORIZONTAL SEPARATION BETWEEN ALL WATER AND SEWER MAINS OR PROVIDE ADEQUATE PROTECTION AS SPECIFIED IN THE CONTRACT DRAWINGS.
22. AERIAL IMAGES PROVIDED ARE 2023 NAIP AERIAL WITH 96 DPI RESOLUTION.

COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS
ESTIMATED QUANTITIES AND PROJECT NOTES

SHEET NO.

3

OF 11



NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		
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PROJECT: 1-22139	DESIGNED: DB, KB
DRAWN: PK, KB	CHECKED: AE
APPROVED: AD	DATE: AUGUST 14, 2024



CONTROL POINT COORDINATE TABLE				
CONTROL PT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GWE CP1	1538526.30	799545.78	6900.58	REBAR W/ RPC
GWE CP2	1538743.09	799542.30	6912.88	REBAR W/ RPC
GWE CP3	1538748.64	799707.04	6908.79	REBAR W/ RPC
GWE CP4	1538412.82	799813.57	6886.44	REBAR W/ RPC
GWE CP5	1538555.06	800361.58	6876.91	REBAR W/ RPC
GWE CP6	1537796.36	799959.90	6863.20	REBAR W/ RPC
GWE CP7	1537521.25	799790.97	6858.10	REBAR W/ RPC
GWE CP8	1539304.88	800384.92	6909.21	REBAR W/ RPC
GWE CP9	1539362.84	800311.59	6915.95	REBAR W/ RPC
GWE CP10	1539223.07	800276.67	6912.39	REBAR W/ RPC
GWE CP11	1538895.57	800292.08	6893.62	REBAR W/ RPC
GWE CP12	1538174.23	800088.55	6870.55	REBAR W/ RPC
GWE CP99	1538548.55	800066.35	6886.45	REBAR W/ RPC

1. RPC=RED PLASTIC CAP
2. GWE CP99 WAS USED AS BASE STATION FOR SURVEY GRADE GPS. IT IS A RPC LOCATED APPROX. 100 FEET SOUTHEAST OF THE WAREHOUSE BUILDING IN THE FLAGSTAFF RANGER STATION.
3. HORIZONTAL CONTROL AND VERTICAL COORDINATES WERE ESTABLISHED USING ARIZONA STATE PLANE COORDINATES BROUGHT TO GROUND (INTERNATIONAL FEET), UTILIZING SURVEY GRADE GPS RECEIVERS AND OPUS STATIC SOLUTION.
4. TOPOGRAPHIC INFORMATION WAS COLLECTED BY LIDAR DRONE FLIGHTS AND SURVEY GRADE GPS RECEIVERS.
5. GPS AND LIDAR SURVEYING COMPLETED DECEMBER 2023. TOPOGRAPHIC INFORMATION UTILITY LOCATIONS ARE SUBJECT TO CHANGE SINCE SURVEY WAS COMPLETED.

1. BORE HOLES ARE SHOWN AS BH-1 THROUGH BH-5. BORE HOLES ARE LOCATED ALONG FOREST SERVICE ROAD 989C. SEE THE GEOTECHNICAL REPORT FOR INFORMATION REGARDING BORE HOLES COMPLETED FOR THIS PROJECT.

1. CONTRACTOR TO COORDINATE WITH THE U.S. FOREST SERVICE TO STORE MATERIALS ONSITE. CONTRACTOR IS RESPONSIBLE FOR STORING MATERIALS IN THE PROPOSED STAGING AREA SHOWN IN THE CONTRACT DRAWINGS. CONTRACTOR IS RESPONSIBLE FOR THE CONDITION OF MATERIALS STORED ONSITE. CONTRACTOR IS RESPONSIBLE FOR PROPER DISPOSAL OF EXCESS SPOILS AND FOR AVOIDING ARCHEOLOGICAL SITES. OTHER LOCATIONS FOR STORING MATERIALS ONSITE WILL REQUIRE PRIOR APPROVAL FROM THE CO/COR AND ARCHEOLOGIST.
2. PROPOSED MOUNT ELDEN TRAILHEAD EXPANSION PROJECT NOT INCLUDED IN THIS WASTEWATER SYSTEM IMPROVEMENTS AND IS SHOWN FOR REFERENCE PURPOSES ONLY. CONTRACTOR TO COORDINATE WITH THE U.S. FOREST SERVICE TO AVOID MOUNT ELDEN TRAILHEAD EXPANSION AREA.
3. CONTRACTOR TO MAINTAIN ACCESS TO MARKET PLACE DRIVE, RANGER STATION, AND OTHER BUSINESSES.

NO.	REVISION DESCRIPTION	BY	DATE
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PROJECT: 122139
DESIGNED: DB KB
DRAWN: PK KB
CHECKED: AE
APPROVED: AD
DATE: AUGUST 14, 2024



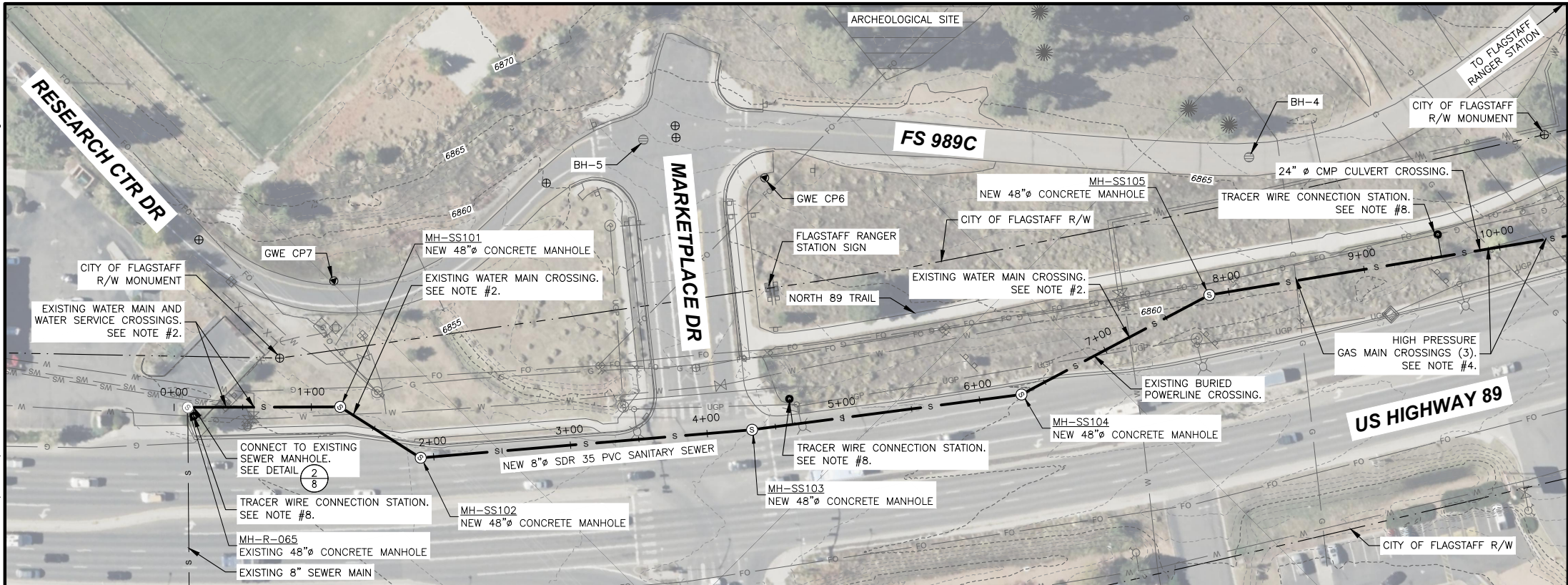
**COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS**

OVERALL SITE PLAN AND CONTROL DIAGRAM

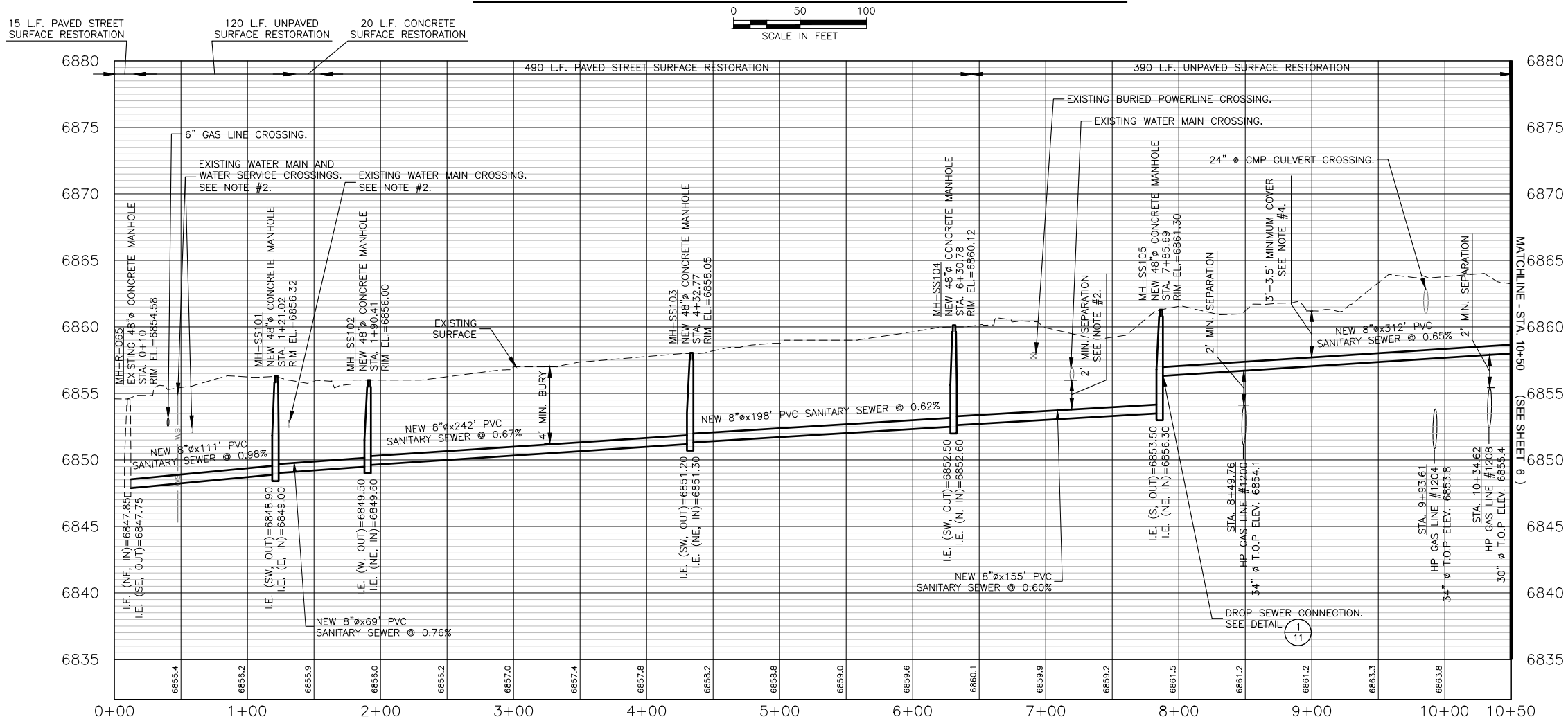
SHEET NO.

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OF 11

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PLAN VIEW OF SEWER MAIN - STA. 0+00 TO STA. 10+50



PROFILE VIEW OF SEWER MAIN - STA. 0+00 TO STA. 10+50

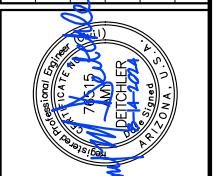
HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10'

GENERAL NOTES:

- UTILITY INFORMATION SHOWN ON THE DRAWINGS IS APPROXIMATE AND MAY BE INCOMPLETE. FOR ACCURATE LOCATION, THE CONTRACTOR SHALL CONTACT, PRIOR TO EXCAVATION, THE UTILITIES UNDERGROUND LOCATION CENTER: 1-800-782-5348
- VERIFY DEPTH AND LOCATION OF WATER MAIN CROSSINGS PRIOR TO INSTALLING NEW SEWER MAIN. PROVIDE 6' MINIMUM HORIZONTAL SEPARATION AND 2' MINIMUM VERTICAL SEPARATION OR PROVIDE ADEQUATE PROTECTION PER SHEET 9.
- INDIVIDUAL SEWER SERVICE LINE DEPTH ARE NOT SHOWN. CONTRACTOR IS RESPONSIBLE FOR VERIFYING SERVICE DEPTHS AND RECONNECTING SEWER SERVICES, INCIDENTAL TO WATER MAIN INSTALLATION.
- MINIMUM COVER 4' AS REQUESTED BY CITY OF FLAGSTAFF. COVER CAN BE 3'-3.5' FOR SECTIONS ABOVE HIGH PRESSURE GAS LINES IN ORDER TO MAINTAIN 2' VERTICAL SEPARATION.
- SEWER ALIGNMENT DRAWN TO ACCOMMODATE 6' HORIZONTAL SEPARATION. MUST MAINTAIN THIS HORIZONTAL SEPARATION PER CITY OF FLAGSTAFF AND ADEQ.
- MANHOLE NEEDED AT LEAST EVERY 400' PER ENGINEERING BULLETIN NO. 11.
- TRACER WIRE TO BE FASTENED ON TOP OF THE NEW SEWER MAIN BY 10MIL PVC TAPE PER TRENCH DETAIL 09-01-030 SHOWN ON SHEET 10.
- TRACER WIRE CONNECTION STATIONS SHALL BE INSTALLED PER DETAILS 09-01-020 AND 09-03-062 FOR EACH 500'-LINEAR FEET OF SEWER MAIN. A FIVE POUND MAGNESIUM ANODE SHALL BE INSTALLED EVERY 1,000'-LINEAR FEET OF TRACER WIRE AT THE TRACER WIRE CONNECTION STATIONS UNDER THE VALVE BOX. SEE SHEET 10.
- CONTRACTOR TO AVOID ANY DISTURBANCES TO ARCHEOLOGICAL SITES. ARCHEOLOGIST TO BE ON-SITE DURING ALL TRENCHING ACTIVITIES. CONTRACTOR MUST STOP WORK IF ARCHEOLOGICAL SITES ARE DISCOVERED DURING ANY TRENCH EXCAVATION. CONTRACTOR TO NOTIFY THE CO/COR IMMEDIATELY UPON DISCOVERY. WORK MAY RESUME PENDING THE APPROVAL OF THE CO/COR.
- CONTRACTOR TO MAINTAIN ACCESS TO MARKET PLACE DRIVE, RANGER STATION, AND OTHER BUSINESSES.

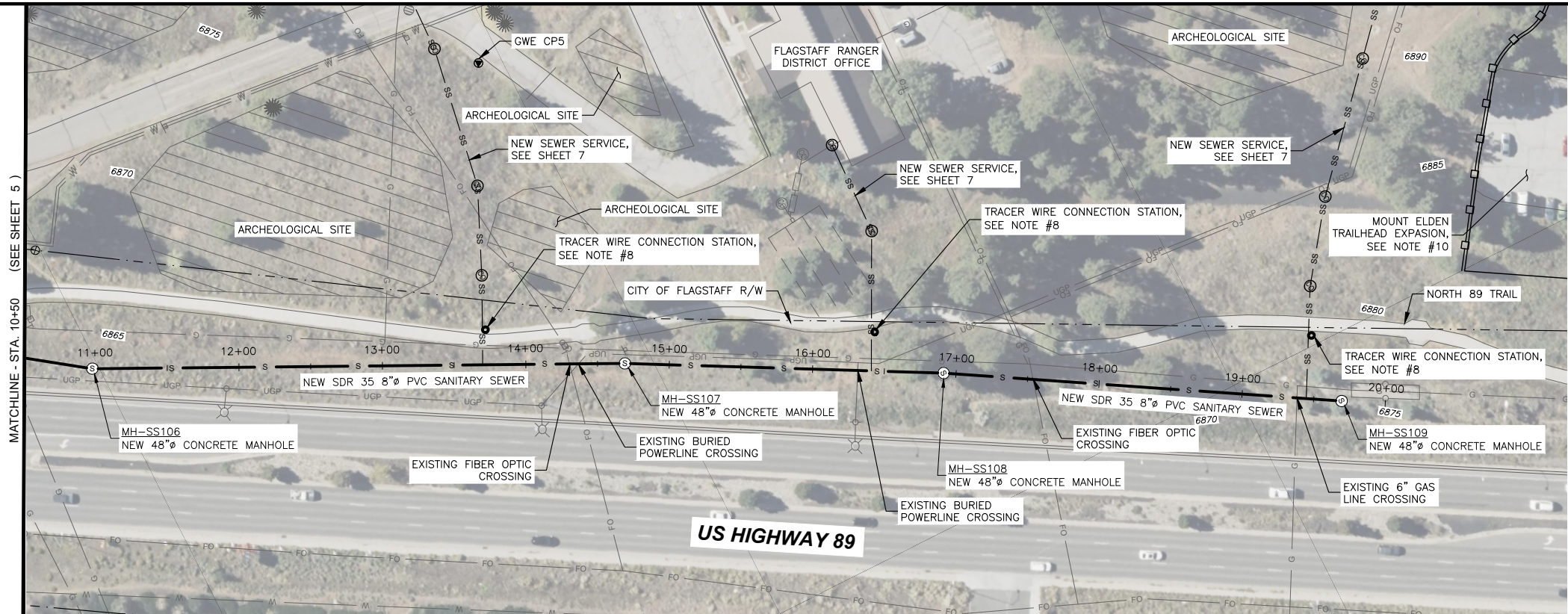
NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		

PROJECT: 1-22139	DESIGNED: DB, KB
DRAWN: PK, KB	CHECKED: AE
APPROVED: AD	DATE: AUGUST 14, 2024

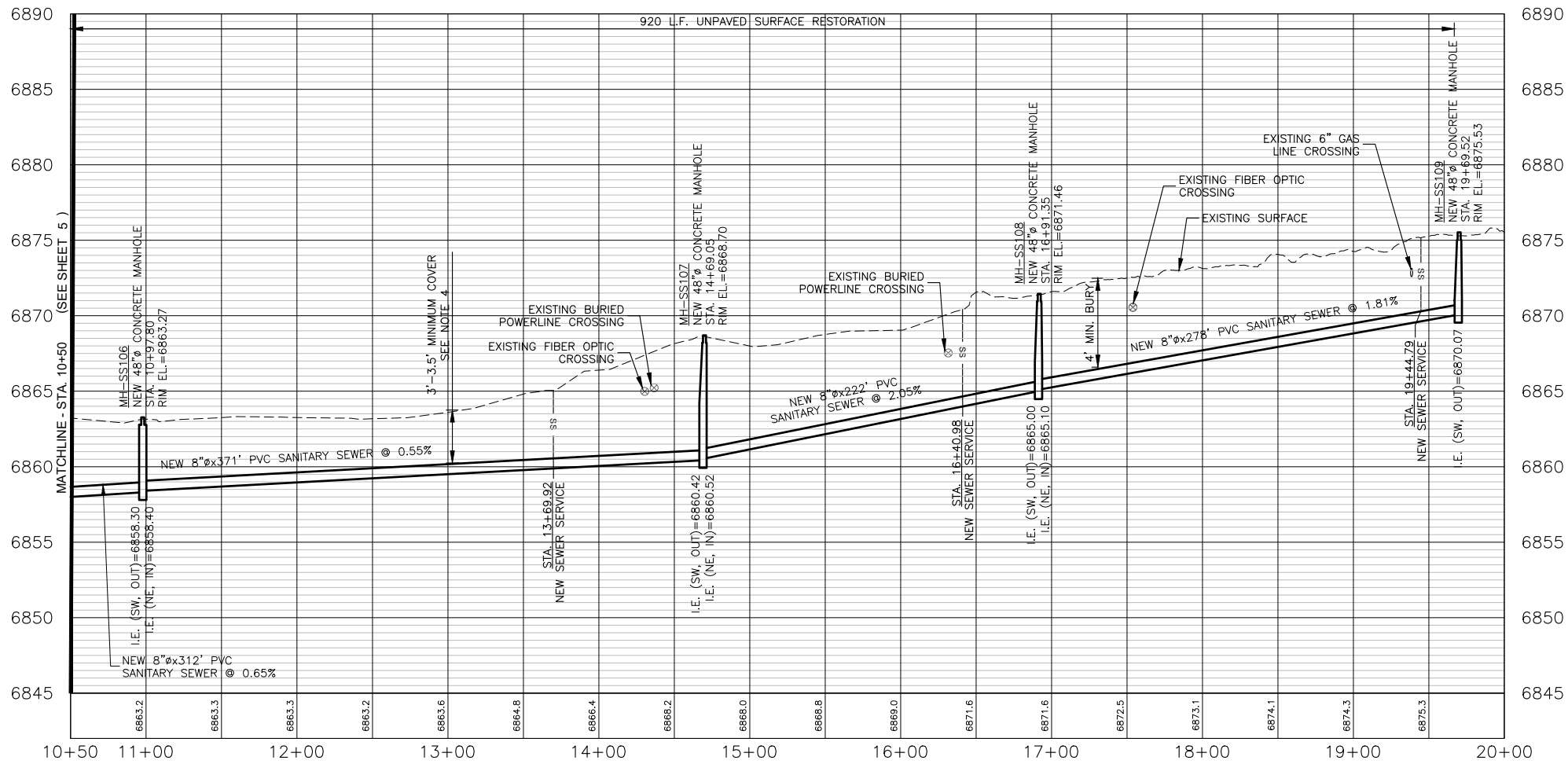
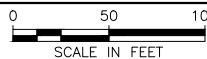


**COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS**

Y:\Shared\Helena Projects\1-22139-DHOCUSFS R3 CNF-KNF Water and Sewer Improvements\Coconino NF - Flagstaff RD Wastewater Improvements\CADD 1-22139\Sheets\1-22139-6-SEWER MAIN P&P STA 11+00 to STA 20+50.dwg



PLAN VIEW OF SEWER MAIN - STA. 10+50 TO STA. 20+00



PROFILE VIEW OF SEWER MAIN - STA. 10+50 TO STA. 20+00

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10'

GENERAL NOTES:

1. UTILITY INFORMATION SHOWN ON THE DRAWINGS IS APPROXIMATE AND MAY BE INCOMPLETE. FOR ACCURATE LOCATION, THE CONTRACTOR SHALL CONTACT, PRIOR TO EXCAVATION, THE UTILITIES UNDERGROUND LOCATION CENTER: 1-800-782-5348
2. VERIFY DEPTH AND LOCATION OF WATER MAIN CROSSINGS PRIOR TO INSTALLING NEW SEWER MAIN. PROVIDE 6' MINIMUM HORIZONTAL SEPARATION AND 2' MINIMUM VERTICAL SEPARATION.
3. INDIVIDUAL SEWER SERVICE LINE DEPTH ARE NOT SHOWN. CONTRACTOR IS RESPONSIBLE FOR VERIFYING SERVICE DEPTHS AND RECONNECTING SEWER SERVICES, INCIDENTAL TO WATER MAIN INSTALLATION.
4. MINIMUM COVER 4' AS REQUESTED BY CITY OF FLAGSTAFF. COVER CAN BE 3'-3.5' FOR SECTIONS ABOVE HIGH PRESSURE GAS LINES IN ORDER TO MAINTAIN 2' VERTICAL SEPARATION.
5. SEWER ALIGNMENT DRAWN TO ACCOMMODATE 6' HORIZONTAL SEPARATION. MUST MAINTAIN THIS HORIZONTAL SEPARATION PER CITY OF FLAGSTAFF AND ADEQ.
6. MANHOLE NEEDED AT LEAST EVERY 400' PER ENGINEERING BULLETIN NO. 11.
7. TRACER WIRE TO BE FASTENED ON TOP OF THE NEW SEWER MAIN BY 10MIL PVC TAPE PER TRENCH DETAIL 09-01-030 SHOWN ON SHEET 10.
8. TRACER WIRE CONNECTION STATIONS SHALL BE INSTALLED PER DETAILS 09-01-020 AND 09-03-062 FOR EACH 500'-LINEAR FEET OF SEWER MAIN. A FIVE POUND MAGNESIUM ANODE SHALL BE INSTALLED EVERY 1,000'-LINEAR FEET OF TRACER WIRE AT THE TRACER WIRE CONNECTION STATIONS UNDER THE VALVE BOX. SEE SHEET 10.
9. CONTRACTOR TO AVOID ANY DISTURBANCES TO ARCHEOLOGICAL SITES. ARCHEOLOGIST TO BE ON-SITE DURING ALL TRENCHING ACTIVITIES. CONTRACTOR MUST STOP WORK IF ARCHEOLOGICAL SITES ARE DISCOVERED DURING ANY TRENCH EXCAVATION. CONTRACTOR TO NOTIFY THE CO/COR IMMEDIATELY UPON DISCOVERY. WORK MAY RESUME PENDING THE APPROVAL OF THE CO/COR.
10. PROPOSED MOUNT ELDEN TRAILHEAD EXPANSION PROJECT NOT INCLUDED IN THIS WASTEWATER SYSTEM IMPROVEMENTS AND IS SHOWN FOR REFERENCE PURPOSES ONLY. CONTRACTOR TO COORDINATE WITH THE U.S. FOREST SERVICE TO AVOID MOUNT ELDEN TRAILHEAD EXPANSION AREA.

**COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS**

SEWER MAIN
STA. 10+50 TO STA. 20+00

SHEET NO.

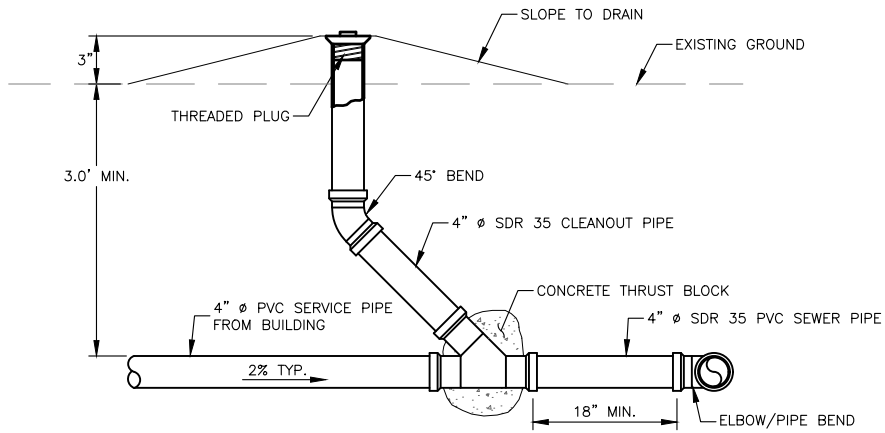
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OF 11

NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		

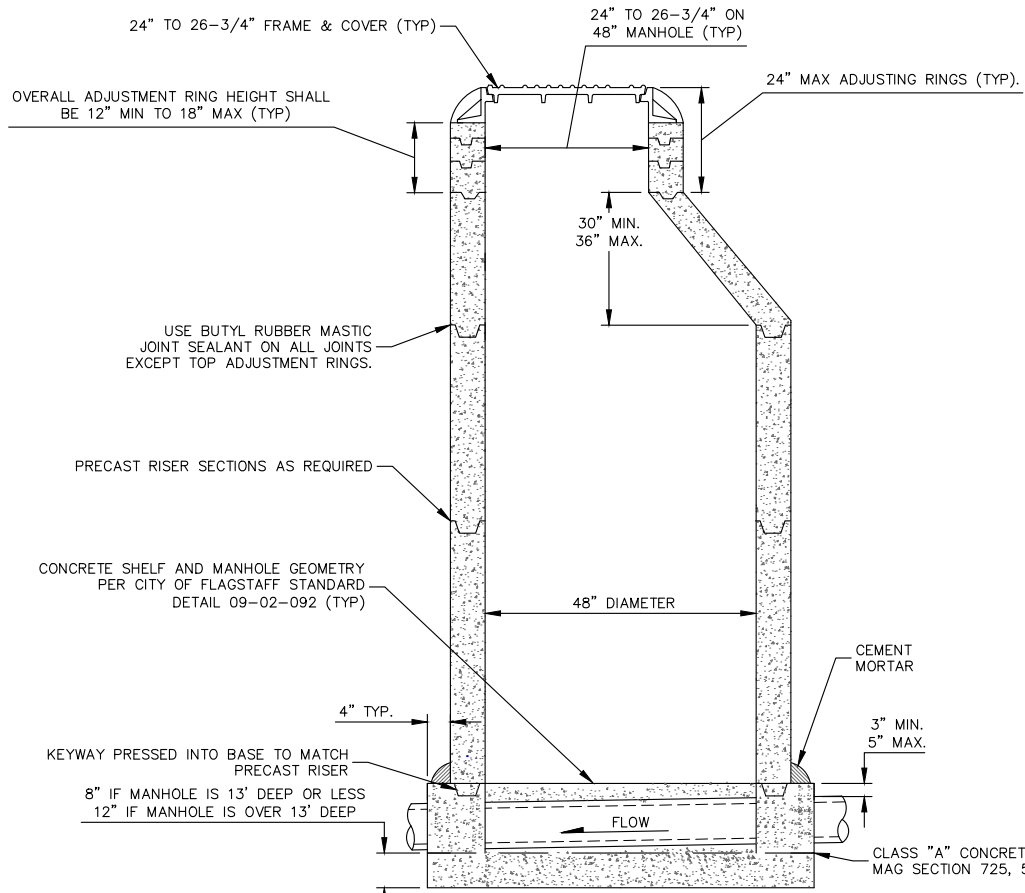
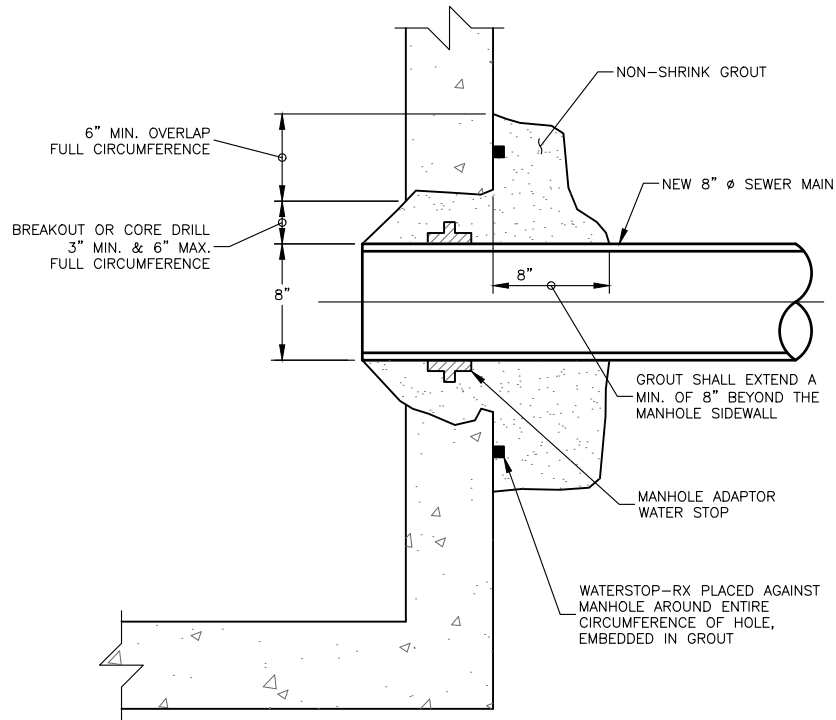
PROJECT: 1-22139	DESIGNED: DB, KB
DRAWN: PK, KB	CHECKED: AE
APPROVED: AD	DATE: AUGUST 14, 2024





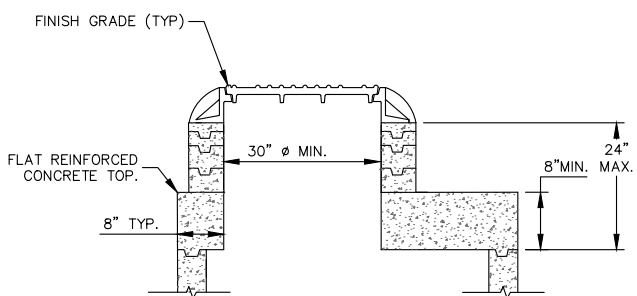
GENERAL NOTES:

1. PLEASE REFERENCE THE UNIFORM PLUMBING CODE, SECTION 707.0 CLEANOUTS, FOR SPECIFIC REQUIREMENTS.
2. A CLEANOUT MUST BE PLACED WITHIN 5 FEET OF THE BUILDING/HOUSE BEING SERVICED (OR WITHIN THE TIE IN POINT), UNLESS A CLEANOUT IS ALREADY LOCATED ON THE INSIDE OF THE BUILDING/TRAILER PAD.
3. SANITARY SEWER SERVICE LINES MUST HAVE A CLEANOUT EVERY 100 FEET.
4. WHEN AT ALL POSSIBLE, 90° BENDS ARE TO BE AVOIDED IN SANITARY SEWER SERVICE LINES. HOWEVER, IN SITUATIONS WHERE A 90° BEND MUST BE USED, A CLEANOUT WILL NEED TO BE PLACED AT EACH 90° BEND.
5. A CLEANOUT SHALL BE PROVIDED IN A SANITARY SEWER SERVICE LINE FOR EACH AGGREGATE HORIZONTAL CHANGE OF DIRECTION EXCEEDING 135° IN CUMULATIVE BENDS. (FOR EXAMPLE IF THREE 45° BENDS ARE USED IN ONE SERVICE LINE, THE CUMULATIVE AGGREGATE HORIZONTAL CHANGE EQUALS 135° AND A CLEANOUT MUST BE PLACED AT THE THIRD BEND.)



PRECAST ECCENTRIC CONICAL TOP MANHOLE

NOT TO SCALE

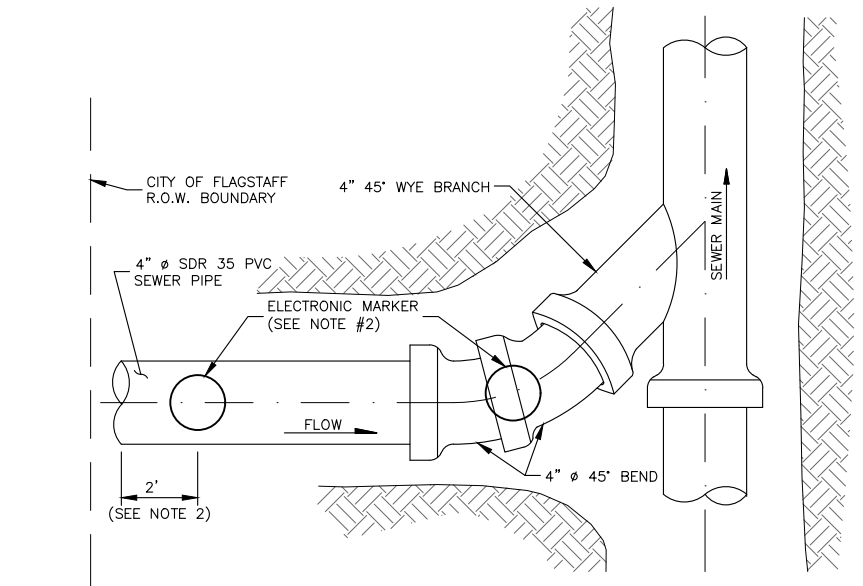


PRECAST FLAT TOP MANHOLE

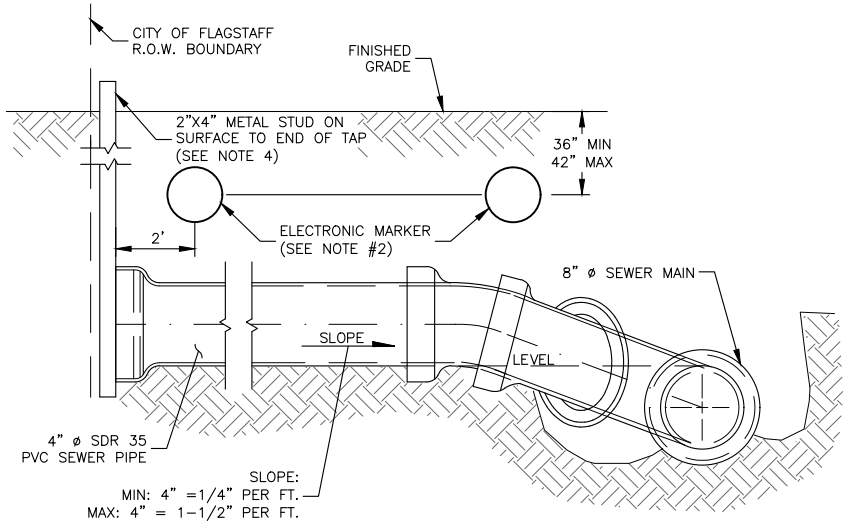
NOT TO SCALE

GENERAL NOTES:

1. PRECAST STEEL REINFORCED MANHOLE SECTIONS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C478 EXCEPT AS MODIFIED HEREIN.
2. THE MANHOLE ACCESS POINT SHALL BE ORIENTED IN SUCH A WAY THAT THE OPENING IS DIRECTLY ABOVE THE LOWEST INVERT, OR AS OTHERWISE DIRECTED BY THE PLANS OR THE CONTRACTING OFFICER.
3. MANHOLE RING AND COLLAR TO BE ADJUSTED PER CITY OF FLAGSTAFF DETAIL 09-03-062 SHOWN ON SHEET 10.
4. FOR MANHOLE BASE GEOMETRY, SEE CITY OF FLAGSTAFF STANDARD DETAIL 09-02-092 SHOWN ON SHEET 10.
5. FLAT TOP MANHOLES SHALL ONLY BE USED WITH APPROVAL FROM THE CO/COR.



PLAN VIEW



SECTION VIEW

GENERAL NOTES:

1. ELECTRONIC MARKER SHALL BE A 3M MODEL 1424-XR/ID [4" DIAMETER SELF LEVELING MARKER BALL GREEN IN COLOR] OR APPROVED EQUAL OR AS REQUIRED BY THE CITY OF FLAGSTAFF.
2. MARKER SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S DIRECTIONS, 2' BACK FROM THE END OF THE SEWER SERVICE STUB AND CINCH TIED TO PIPE OR ABOVE PIPE AS REQUIRED BY CITY OF FLAGSTAFF. AN ADDITIONAL MARKER SHALL BE INSTALLED AT EACH SERVICE STUB END.
3. ELECTRONIC MARKER SHALL BE RESTORED BY CONTRACTOR IF DISTURBED WHEN PRIVATE SERVICE LINE CONNECTION IS INSTALLED.
4. USING THE APPROPRIATE FITTINGS AS REQUIRED (I.E. 45',22.5') EXTEND THE SERVICE VERTICALLY AT THE R.O.W BOUNDARY. COVER THE END WITH A (NO-GLUE) CAP AND MARK WITH A BRICK AND WIRE. THE BRICK SHALL BE PLACED ON THE SURFACE AND CONNECTED TO THE SERVICE WITH 12 GA. (MIN.-) GALVANIZED STEEL OR A 12. GA. (MIN.) COPPER WIRE WITH GREEN INSULATION.
5. SIZE OF TAP SHALL BE DESIGNATED ON PLANS.
6. CONSTRUCT TAP AT MINIMUM SLOPE IF COVER WILL BE LESS THAN 5' AT CITY OF FLAGSTAFF R.O.W. BOUNDARY.
7. ALL FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321. THE CONTRACTOR MAY VARY FROM THE DRAWING TO USE THE APPROPRIATE WYES, TEE-WYES AND BENDS TO ENSURE NO MISALIGNMENT OF THE PIPE AND FITTINGS. BLOCK OR BRACE FITTINGS JOINTS TO ENSURE ZERO DEGREES ANGULAR JOINT DEFLECTION.
8. END OF TAP TO BE SEALED AND MARKED AS NOTED.

**NEW SEWER SERVICE LINE
MAG STANDARD DETAIL 440-1**



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PROJECT: 1-22139
DESIGNED: DB, KB
DRAWN: PK, KB
CHECKED: AE
APPROVED: AD
DATE: AUGUST 14, 2024



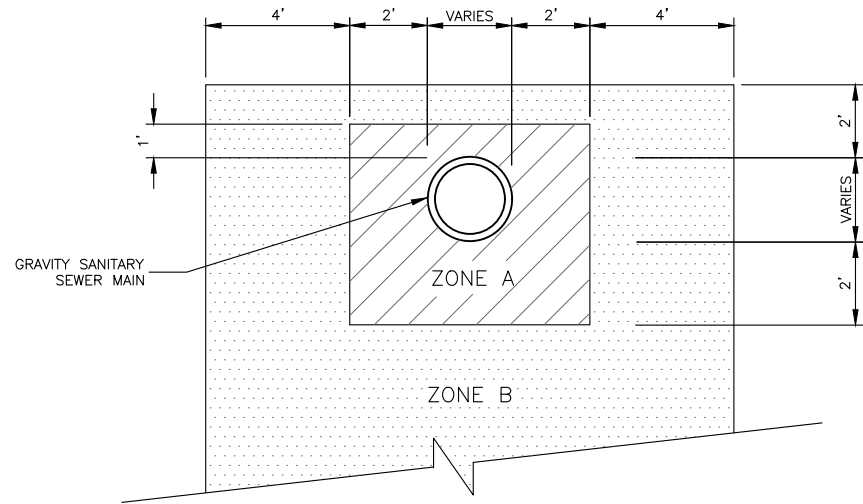
COCONINO NATIONAL FOREST FLAGSTAFF RANGER STATION WASTEWATER SYSTEM IMPROVEMENTS

SHEET NO.

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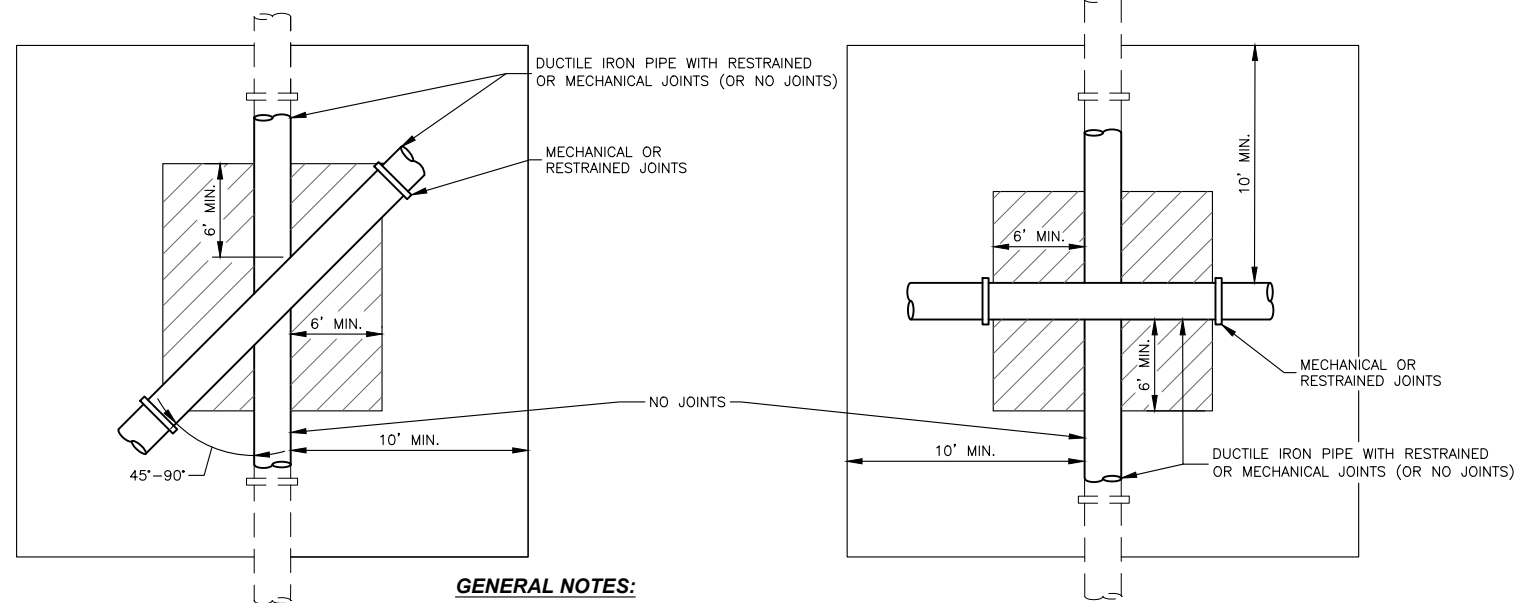


GENERAL NOTES:

1. ZONE A: NO WATER LINES ALLOWED/MINIMUM SEPARATION.
2. ZONE B: EXTRA PROTECTION REQUIRED FOR WATER LINES.
3. REFER TO MAG SECTION 610, WATER LINE CONSTRUCTION.

WATER AND SANITARY SEWER SEPARATION/ PROTECTION MAG STANDARD DETAIL 404-1

1
9 NOT TO SCALE

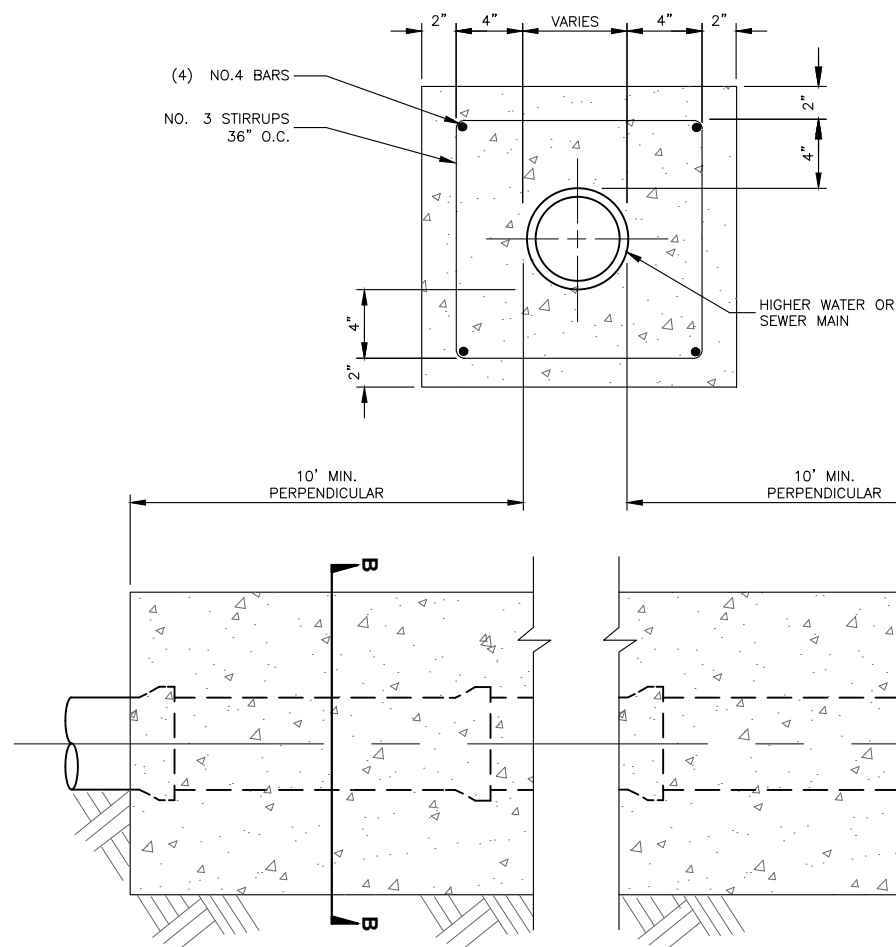


GENERAL NOTES:

1. REFER TO MAG SECTION 610, WATER LINE CONSTRUCTION.

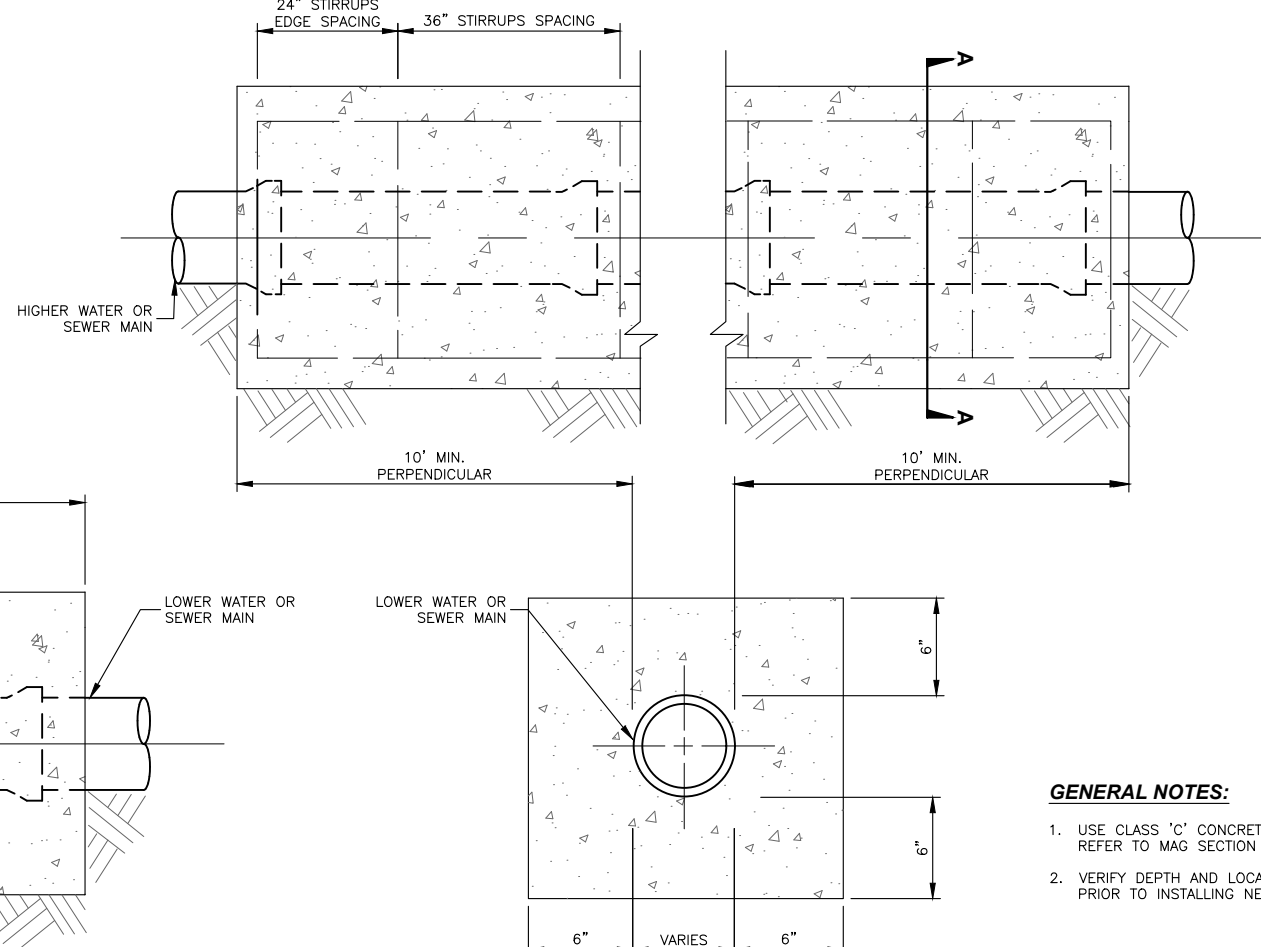
WATER AND SANITARY SEWER SEPARATION/ PROTECTION MAG STANDARD DETAIL 404-2

2
9 NOT TO SCALE



SECTION VIEW A - A

NOT TO SCALE



SECTION VIEW B - B

NOT TO SCALE

GENERAL NOTES:

1. USE CLASS 'C' CONCRETE AS PER MAG SECTION 725. REFER TO MAG SECTION 610, WATER LINE CONSTRUCTION.
2. VERIFY DEPTH AND LOCATION OF WATER MAIN CROSSINGS PRIOR TO INSTALLING NEW SEWER MAIN.

WATER AND SANITARY SEWER SEPARATION/ PROTECTION MAG STANDARD DETAIL 404-3

3
9 NOT TO SCALE

NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		
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PROJECT: 1-22139	DESIGNED: DB, KB	DRAWN: PK, KB	CHECKED: AE	APPROVED: AD	DATE: AUGUST 14, 2024
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**COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS**

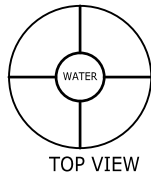
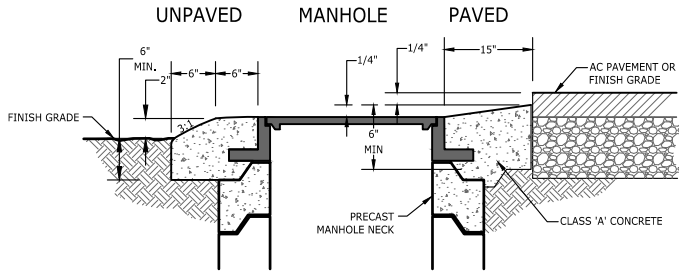
STANDARD DETAILS

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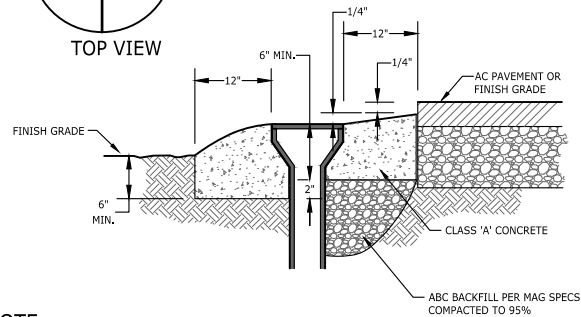
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OF 11

Y:\Shared\Helena Projects\1-22139-DHOC2USFS R3 ONF-KNF Water and Sewer Improvements\Coconino NF - Flagstaff RD Wastewater Improvements\CADD 1-22139-Sheets\1-22139-11-STANDARD DETAILS.dwg

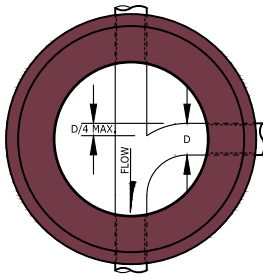


WATER VALVES, BLOWOFFS AND SURVEY HANDHOLES



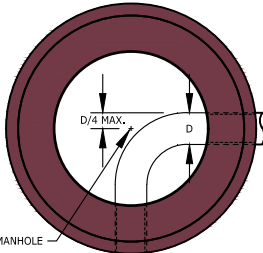
- NOTE:
1. TOP OF VALVE BOX AND CONCRETE RING MUST BE 1/4" BELOW FINISHED GRADE.
 2. CONCRETE RING FOR VALVES AND MANHOLES SHALL HAVE FOUR (4) STRESS JOINTS AT 90° ANGLES.
 3. DEPTH OF CONCRETE SHALL BE A MIN. 6" OR SAME AS AC AND ABC SECTION, NOT TO EXCEED 8".
 4. VALVES AND MANHOLES LOCATED UNDER CONCRETE PAVING SHALL HAVE A COLD JOINT OR EXPANSION JOINT CONCRETE COLLAR.

City of Flagstaff		RING, FRAME or COVER INSTALLATION		
	ENGINEERING DETAIL	DETAIL NO.	REVISION DATE:	1
		09-03-062	12/30/2017	1



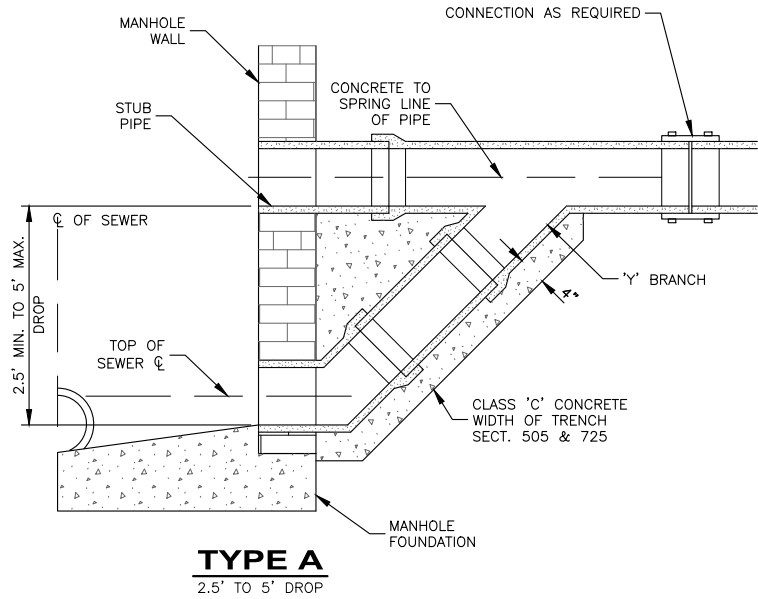
3 or 4 LEG INTERSECTION

- NOTES:
1. PIPE SIZE AND ELEVATION AS SHOWN ON PLANS
 2. MIN. FLOW LINE RADIUS ON 8" PIPE IS 2 FEET



2 LEG INTERSECTION

City of Flagstaff		MANHOLE BASE GEOMETRY		
	ENGINEERING DETAIL	DETAIL NO.	REVISION DATE:	1
		09-02-092	12/30/2017	1



DROP SEWER CONNECTION MAG STANDARD DETAIL 426
NOT TO SCALE

COCONINO NATIONAL FOREST
FLAGSTAFF RANGER STATION
WASTEWATER SYSTEM IMPROVEMENTS
STANDARD DETAILS

SHEET NO.

11

OF 11

NO.	REVISION DESCRIPTION	BY	DATE
1	90% SUBMITTAL		
2			
3			
4			
5			

PROJECT: 1-22139	DESIGNED: DB KB	DRAWN: PK KB	CHECKED: AE	APPROVED: AD	DATE: AUGUST 14, 2024
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**Water/Wastewater ▪ Transportation ▪ Grant Services ▪ Solid Waste ▪
Structural ▪ Bridges ▪ Natural Resources ▪ Planning**

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