SECTION 331000

Water Utilities

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide the water distribution system needed for a complete and proper installation.

B. Cal-GREEN requirements, when applicable.

C. Related Sections:
   1. Division 01 General Requirements
   2. Contract General Conditions
   3. Section 210000 Fire Suppression
   4. Section 310000 Earthwork
   5. Section 32000 Exterior Improvements

1.2 REFERENCES

A. Geotechnical Engineering Report, if applicable.

B. Separation requirements per State Department of Health.

C. American Water Works Association (AWWA) requirements

D. Cal Poly Construction Campus Standard Specifications and Campus Standard Details:
   https://afd.calpoly.edu/facilities/planning-capital-projects/construction-standard/

1.3 General

A. All requirements of the Cal Poly Standards apply, notify Cal Poly representative if conflict exists.

B. Potable water pipeline installation must conform to these specifications and the American Water Works Association (AWWA) requirements.

C. Work must comply with section 310000

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications and Installer Qualifications:
   1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 Submittals

A. Comply with pertinent provisions of Division 01.

B. Product data, prior to beginning work submit and obtain approval for:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements; including installation procedures which, when approved by the Architect and University, will become the basis for accepting or rejecting actual installation procedures used on the Work.

3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.

1.6 CLOSEOUT SUBMITTALS

A. Comply with Section 016000.

B. Disinfection Report:
1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing in ppm for each outlet.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriologist Report:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards.

D. Water Quality Certificate:
1. Certify water conforms to quality standards suitable for human consumption.

1.7 Qualifications of Water Treatment and Testing Firms:

1. Water Treatment Firm: Company specializing in disinfecting water systems.
2. Testing Firm: Company specializing in testing potable water systems, approved by State of California.
3. Submit bacteriologist’s signature and authority associated with water testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 016000.

1.8 SEQUENCING

A. Sequence Work properly with adjacent work to allow unobstructed access to all areas.

B. Inspection: Request inspection by authority having jurisdiction and testing consultant before concealment.
1. Sequence work to permit installation to be inspected and approved prior to being concealed.
2. Ensure that subsequent installations are reported, properly installed,

and inspected.

PART 2- PRODUCTS

2.1 PIPE AND FITTINGS

A. General:
   1. All materials shall be NSF 61 approved.
   2. Pipe materials 4” size and larger: Use plastic (PVC C900) pipes unless otherwise approved in advance by the University.
   3. Pipe materials 3” size or less: shall be schedule 80 PVC or HDPE SDR 11 per Cal Poly Campus Standards and Specifications.
   4. Substitutions: Product substitutions must comply with Section 012500. Approval must be obtained by Cal Poly Facilities Planning and Capital Projects department and authority having jurisdiction for approved equivalent prior to installation.

B. Pipe
   1. Cast iron pipe:
      a. Comply with ANSI A-21.6 or ANSI A-21.8, with working pressure of not less than 150 psi unless otherwise shown or specified.
      b. Use cement mortar lining complying with ANSI A-21.4 or AWWA C205, standard thickness.
   2. Ductile iron pipe:
      a. Comply with ANSI A-21.51, with working pressure of not less than 350psi unless otherwise shown or specified.
      b. Use cement mortar lining complying with ANSI A-21.4 or AWWA C205, standard thickness.
   3. Water Main Pipe and laterals 4” and up:
      a. Use polyvinyl-chloride (PVC) complying with ANSI/AWWA C900, DR 18 (Class 235).
   4. Galvanized steel:
      a. Use schedule 40 steel pipe risers and fittings, with PVC couplings below grade to steel risers for hose bibs, and complying with ASTM A120.
   5. Fire Line and Dry Fire Line:
      a. Use polyvinyl-chloride (PVC) complying with ANSI/AWWA C900, DR14 (Class 305)
      b. Comply with all applicable standards included in the CFC 2016 section 905 for standpipe systems including annular space between PCC pads and pipe riser.
   6. Water Service Connections (2” or smaller):
      a. Use Copper, type K, soft or,
      b. Polyethylene, 200 psi, AWWA C901

C. Joints:
   1. Cast Iron or Ductile Iron Pipe
      a. Use mechanical joints of the stuffing-box type complying with ANSI A-21.11 as modified by ANSI A-21.51 for ductile iron pipe, with push-on joints complying with ANSI A-21.11 for cast iron, and ANSI A-21.51 for ductile iron or use rubber gaskets and lubricant complying with applicable requirements of ANSI A-21.11.
      b. All bolts and fittings shall be coated in bituminous tar mastic.

2. Plastic pipe:
    a. Use solvent cement for PVC joints complying with ASTM D2564
    b. Use solvent cement for ABS joints complying with ASTM D2235.

3. Steel pipe fittings 2-1/2” of less in diameter:
    a. Use malleable iron bonded screw fittings, manufactured to standards of ANSI B-16.3.
    b. Use unions, which are screwed, malleable iron, ground joint, 300 lb AAR, with bronze- to-iron seat.

4. Insulating Joints
    a. Provide between non-threaded ferrous and non-ferrous metallic pipe, fittings, and valves.
    b. Use sandwich type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts.
    c. Use full faced insulating gaskets with outside diameter equal to the flange outside diameter.
    d. Use full-length bolt insulating sleeves.
    e. Install in a manner to prevent metal-to-metal contact of dissimilar metallic piping elements.

5. Make connections between asbestos cement pipe and cast iron fittings and valves, with jointing materials, which comply with AWWA C603.

D. Fittings and Specials:

1. Cast iron pipe and ductile iron pipe:
    a. Use fittings and specials suitable for 150 psi pressure rating unless otherwise specified.
    b. For use with mechanical joint pipe, comply with ANSI A-21.10.
    c. For use with push-on joint pipe, comply with ANSI A-21.10 and ANSI A-21.11.
    d. Use cement mortar lining complying with ANSI A-21.4, standard thickness.

2. Plastic pipe:
    a. All fittings shall be ductile iron.
    b. Use fittings and specials suitable for schedule 40 rating, unless otherwise specified or directed.
    c. Use fittings and specials for PVC pipe complying with ASTM D2468.
    d. For threaded PVC fittings, use schedule 80.

3. Steel pipe: Comply with ANSI B-16.3, using fittings and specials made for steel pipe.

E. Valves:
1. Gate valves:
    a. All gate valves be shall non-rising stem with resilient wedge seats.
    b. Use spray head, resilient seated gate valves conforming to AWWA C-509, designed for a working pressure of 150 psi minimum.
    c. Provide connections as required for the piping in which they are installed.

d. Provide a clear waterway equal to the full nominal diameter of the valve, openable by turning counter clockwise.
e. Provide an arrow on the operating nut or wheel, cast in metal, indicating direction of opening.
f. Valves smaller than 3":
    1. Provide all bronze, screwed, single wedge disc, screw-in bonnet, packing gland, and nut, with non-rising stem.
    2. Buried valves: Provide 2" operating nuts and in a approved valve box with extension and marked cover.

2. Preferred Manufacturers per University Campus Standards and Specifications:
    a. Clow, Mueller , or Approved equal

3. Check valves:
    a. All backflow preventers shall meet AWWA standards.
    b. Preferred manufacturers Backflow preventer assemblies: Zurn, Wilkins, or approved equal.
    c. Reduced pressure devices for fire connection shall be double detector check valves, with lockable OS&Y stems, leak detection meters, and shall employ reduced pressure principle check valves.
    d. Use check valves designed for a working pressure of not less than 150 psi, or as indicated or directed, with a clear waterway equal to the full nominal diameter of the valve.
    e. Use valves designed to permit flow in one direction, when the inlet pressure is greater than the discharge pressure, and to close tightly to prevent return flow when discharge pressure exceeds inlet pressure.
    f. Distinctly cast on the body of each valve:
        1. Manufacturer's name, initials, or trademark for identification purposes
        2. Valve size
        3. Working pressure
        4. Direction of flow
    g. Valves 2" and smaller: Provide all bronze, designed for screwed fittings.
    h. Valves larger than 2":
        1. Provide iron body, bronze mounted, with flanged ends, of the non-slam type
        2. Provide class 125 flanges complying with ANSI B-16.1.
    i. All backflow preventers installed by the contractor shall be tested by a certified tester and documentation shall be turned over to campus representatives before lines are put into service. All tests shall be performed in the presence of a plumbing shop representative along with IOR. Backflow prevention devices are to be tested at the time of installation and no less than annually. For construction projects running multiple years, it is the contractor's responsibility to test at installation, annually, and finally at turnover of the project.
4. Fire Hydrants:
    a. Fire hydrant spacing shall comply with California Fire Code (CFC) and City of San Luis Obispo Fire Marshall and/or the Office of the State Fire Marshal (OSFM) requirements.

b. Buildings that are fully protected by fire sprinklers allow a 75% reduction in fire hydrant flow per CFC.
c. Reduced pressure principle back flow preventers (RP devices) are required at any connection that would potentially contaminate the water supply. The RP device shall be a double detector check valve assembly at the connections to the fire risers and stand pipes.
d. All fire hydrants shall comply with City of San Luis Obispo Public Works Engineering Standards. requirements and have solid bronze bodies, shall be wet barrel, with one 2-1/2", and two 4-1/2" connections.
e. Valves shall be arranged so that the system can be operated in a manner where no more than 5 fire protection apparatuses (hydrants, risers, stand pies, etc.) will be removed from service if repairs to the system are necessary.
f. Fire hydrants shall be placed at a maximum of 300' from all portions of the buildings per City of San Luis Obispo Fire Marshall's requirements.
g. Fire department connections shall be placed a maximum of 40' from a fire hydrant per City of San Luis Obispo Fire Marshall's requirements.
h. Backflow devices for fire connection shall be double detector check valves, with lockable OS&Y stems, leak detection meters, and shall employ reduced pressure principal check valves.

F. Water meter:
1. Water meters shall be installed at every water service connection per the plumbing narrative.
2. Preferred water meters shall be: Metron Farnier Spectrum series or approved equal.
3. All meters shall have a Bypass for maintenance and calibration.

G. Service Fittings:
1. PVC mains smaller than 2" in diameter:
a. Make ¾" maximum service with tees or plastic valve tees.
b. Acceptable products:
1. As manufactured by Mueller Company or approved equal.
2. PVC mains 2" to 3-1/2" in diameter: For ¾" service to 1" service, use bronze service clamp and bronze corporation stop designed for PVC pipe.
2. Service clamps and corporation stops:
a. Use bronze.
b. Provide service clamp with flattened straps and molded neoprene gaskets.
3. Services larger than those stated above: Make with standard tees on new lines, and tapping tees on existing lines.

H. Tracer Wire:
1. Electrically continuous type TW insulated number 12.

2.2 TAPPING SLEEVES

A. Coordinate requirements of tapping sleeves with gate valves and other fittings.

as required.

B. Provide sleeve type coupling for existing water mains, furnished with outlet flanged to American 125 standard (ASA series 15):
   1. Clow Corporation; boltless type or approved equal
      a. Model C1 series for existing cast iron mains, complying with AWWA class A;
      b. Model CA for class 150 and class 200 existing asbestos cement mains.

2.3 VALVE BOXES

A. Valves 3” and larger:

1. Use traffic rate service box of cast iron, extension type of the required length, with screw adjustment.
2. Provide the word “WATER” cast into cover.
3. Model G-5 Or approved equal complying with Section 010000 – General Requirements

B. Valves 2-1/2” and smaller:
1. Use precast concrete box with the word “WATER” cast into the cover.
2. Provide risers on pipeline to place valve within box depth.
3. Model G-5 Or approved equal complying with Section 011600 – Product Requirements.

2.4 CONCRETE FOR THRUST BLOCKS

A. Compressive strength of 2500 psi in 28 days.

2.5 DISINFECTION CHEMICALS

A. Chemicals:
1. Sodium Hypochlorite per AWWA B300.
2. Calcium Hypochlorite per AWWA B300.
3. Liquid Chlorine per AWWA B301.

PART 3- EXECUTION

3.1 PREPARATION

A. Surface Conditions: All existing utilities **shall be potholed prior to commencement of construction activities**.

3.2 FIELD MEASUREMENT

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.3 HANDLING

A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:
   1. Carry pipe into position; do not drag.
   2. Use pinch bars or tongs for aligning or turning the pipe only on the bare

end of the pipe.

B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Architect and University.
C. Before installation, inspect each piece of pipe and each fitting for defects;
   1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the University.

3.4 PIPE CUTTING

A. Cut pipe neatly and without damage to the pipe.
B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Architect and University, cut pipe with mechanical cutter only.
   1. Use wheel cutters when practicable.
   2. Cut plastic pipe square, and remove all burrs.

3.5 LOCATING

A. All water pipes shall be installed with a minimum of 36” of cover.
B. Water pipes shall comply with Title 22 and State Department of Health separation requirements. Water shall always be above the sanitary sewer.
   1. Locate water pipe at least ten feet away, horizontally, from sewer pipes.
   2. Where bottom of the water pipe will be at least 12” above the top of the sewer pipe, locate water pipe at least six feet min. horizontally from the sewer pipe.
C. Where water lines cross under gravity-flow sewer lines, fully encase the sewer pipe in concrete for a distance of at least ten feet each side of the crossing, or provide pressure pipe with no joint located within 36” of the crossing.
   1. Water lines above sewage force mains or inverted siphons shall be at least 24” above the sewer line.
   2. Encase in concrete those joints in the sewer main closer, horizontally, than 36” to the crossing.
D. Do not place water lines in the same trench with sewer lines or electric wiring.

3.6 JOINT DEFLECTION

A. Cast iron pipe:
   1. Maximum allowable deflection will be given in AWWA C600 and per manufacturer recommendations. If conflict between manufacturer and AWWA C600, more stringent shall apply.
B. Plastic pipe:
   1. Allowable deflection from a straight line or grade, and offsets is five degrees maximum.
   2. Exception: As recommended by pipe manufacturer.

3.7 PLACING AND LAYING

A. General:
   1. Trench, backfill, and compact for the work of this Section in strict accordance with the pertinent provisions of Section 310000 - Earthwork of Cal Poly Standards and Specifications.
   2. Pipe shall have minimum 12” sand encasement.
   3. Provide an electrically continuous type TW insulated #12 tracer wire in the trench along the pipe, fastened to the pipe at 20-foot intervals, and

terminating aboveground with a 12-inch lead taped around each riser.

4. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Architect and University.
5. Do not dump or drop any of the materials of this Section into the trench.
6. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
7. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
8. Take up and relay pipe that has the grade or joint disturbed after laying.
9. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
10. Securely close open ends of pipe, fittings, and valves when work is not in progress.
11. Where any part of coating or lining is damaged, repair to the approval of the Architect and University and at no additional cost to the University.
12. Warning/Identification Tape shall be installed as described below and in accordance with the Standards and Specifications.
    a. Tape shall be placed at the top of the pipe zone 12" above and centered over the utility intended for identification.
    b. Tape shall be installed with the printed side up and run continuously along the entire length of the utility intended for identification. Tape shall be installed on the main piping and all appurtenant laterals, including blowoffs, air valve assemblies, fire hydrants, and services. Tape splices shall overlap a minimum of 24” for continuous coverage.
    c. Tape shall be installed prior to placement of the Trench Zone Backfill.

B. Plastic pipe:
    1. Position the pipe and fittings in trench in a manner that identifying markings will be readily visible for inspection.
    2. Cutting and joining:
        a. Protect against abrasion from serrated holding devices.
        b. Remove burrs and glosses from surfaces to be jointed; use abrasive paper, file, or steel wool.
        c. Remove dirt, dust, and moisture by wiping clean with chemical cleaner or dry cloth.
        d. Using a pure bristle paintbrush, apply an even coat of the specified solvent cement in the fitting socket and on the surface of the pipe to be joined.
        e. Promptly insert pipe into bottom of the fitting socket; turn the pipe slightly to assure an even distribution of cement.
        f. Remove excess solvent cement from exterior of the joint.
        g. Should cement begin to dry before the joint is made, reapply cement before assembling.
        h. Allow at least one hour for the joint to gain strength before handling or installing the pipe.
    3. Do not thread plastic pipe; make connections only with the solvent cement or with special adapter fittings designed for the purpose.
    4. Align pipe system components without strain.
    5. Support piping at intervals of not more than four feet, at ends, branch fittings, and change of direction or elevation.
    6. Provide an electrically continuous type TW insulated number 12 tracer wire in the trench along the pipe, fastened to the pipe at 20-foot intervals, and

terminating aboveground with a 12” lead taped around each riser.

C. Connections: Use specials and fittings to suit the actual conditions where connections are made between new work and existing mains. Use only those specials and fittings approved by the University.

D. Sleeves:
   1. Where pipe passes through walls of valve pits or structures, provide cast iron wall sleeves one size larger than pipe diameter.
   2. Fill annular space between walls and sleeves with rich cement mortar.
   3. Fill annular space between pipe and sleeves with mastic.

3.8 JOINTING

A. Other Joints:
   1. Cast iron pipe, ductile iron pipe, mechanical joints, and push-on type joints: Install in accordance with AWWA C600, modified as necessary by the recommendation of the manufacturer to provide for special requirements of ductile iron pipe.
   2. Make connections between different types of pipe and accessories with transition fittings.
   3. Rubber gaskets: Handle, lubricate where necessary, and install in strict accordance with the recommendations of the manufacturer.

3.9 SETTING VALVES AND VALVE BOXES

A. General:
   1. Center valve boxes on the valves, setting plumb.
   2. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.
   3. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.
   4. Valve riser/sleeve shall be 8” diameter SDR-35 PVC unless otherwise authorized by the University.
   5. Valve sleeve shall come up half the depth of G5 minimum.

B. Service boxes:
   1. Where water lines are located below paved streets having curbs, install boxes directly back of curbs.
   2. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways.

3.10 THRUST BLOCKS

A. General:

   1. Provide thrust blocks, or metal tie rods and clamps or lugs, on plugs, caps, tees, and bends deflecting 22-1/2 degrees or more either vertically or horizontally, and on water lines 4” in diameter or larger.
   2. Provide concrete thrust blocking with a compressive strength of 2500 psi in 28 days.

B. Installation:
   1. Locate thrust blocking between solid ground and the fitting to be anchored.

2. Unless otherwise shown or directed, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
3. Sides of thrust blocking not subject to thrust may be placed against forms.
4. Place thrust blocking so the fitting joints will be accessible for repair
5. Protect steel rods and clamps by galvanizing or by coating with bituminous paint.

3.11 FIELD QUALITY CONTROL

A. Site Inspections: Comply with Division 01 requirements.

B. Inspection: Owner may engage and pay for services of independent testing consultant to perform quality control inspection.

C. Do not conceal work prior to required inspection.

D. Notify authority having jurisdiction and designated inspectors of work released for inspection.

E. Correct unacceptable installation, and request additional inspection, to verify compliance with this Section, at no additional cost to Owner.

F. The building official is authorized to make or require other inspections of any construction work to ascertain compliance with the provisions of this code and other laws that are enforced by the department of building safety (CBC110.3.9) and compliance with the provisions of the Cal Poly Construction Campus Standard Specifications and Campus Standard Details.

3.12 TESTING AND INSPECTIONS

A. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected and tested, and has been approved by the University and State Fire Marshall.

B. All following must be tested prior to service:
   1. Water pipe
   2. Water tubes
   3. Valves
   4. Joints and fittings
   5. Fire lines
   6. Services
   7. Other water facilities

C. Testing procedure for new water facility installations are:
   1. Install water sampling station and temporary blow-offs - (D)
   2. Flush new water facility - (E)
   3. Disinfect new water facility – (F)
   4. 30-hour chlorine test – (F)
   5. Flush new water facility – (E)
   6. 24-hour bacteria and chlorine test – (F)
   7. Two-hour pressure test – (G)
   8. Four-hour pressure test – (G)
   9. Remove sampling station and temporary facilities
   10. Provide the University with proposed testing and flushing methods as well as schedule for review and approval prior to starting testing work. Repeat testing procedure as directed by the University if any portions of the new water facility fail testing.

D. Sampling:
   1. Provide sample station. Sampling station may be a threadless hose bib or other flow-controlling valve connected to the new water facility at either: Fire hydrant, Blow-off, Backflow, or Corporation stop, located at the most remote point of the facility to be tested. Hose bib or another flow-controlling valve must be a minimum of 1 foot above grade. Notify the University at a minimum, two working days in advance of each sample need. Samples are taken between 8:00 A.M. and 1:00 P.M. Monday through Friday, excluding Campus holidays.

E. Flushing:
   1. Flush new water facilities as shown in table below to provide two cubic feet per second flush flow.

New Facility Diameter (inches)	Flush with (inches)
4	2½ hose
6 to 8	4-inch blow-off or 4½ hydrant
Larger than 8	6-inch blow-off

   2. Install temporary blow-off per engineering standards as needed to load or flush new water facilities. Submit temporary blow-off locations to the Engineer for review and approval prior to installation.
   3. Remove water and debris from new water facility by flushing and place into nearest sanitary sewer manhole, if chlorine concentration of water is less than one hundred parts per million; otherwise place into truck. Continue to flush new water facility until residual chlorine is one part per million or less. Provide air gap between sanitary sewer manhole and discharge hose.
   4. Do not allow any water or chlorine solution into the street and storm drains.

F. Disinfection
   1. Disinfect all new water facilities with chlorine. Introduce a uniform distribution of chlorine solution throughout the new water facility. Allow chlorine solution to remain in new water facilities for at least thirty hours.
   2. After thirty (30) hours, test chlorine levels. Chlorine levels must be greater than fifty parts per million in the most remote portion of the line.
   3. Flush water in compliance with Section E “Flushing”
   4. Load water facility with water. Wait at least twenty-four (24) hours and test water for:
      a. chlorine level which must be less than one (1) part per million
      b. bacteria contamination (non-spore forming)
   5. Repeat flushing and disinfection until all requirements of this section are achieved.

G. Pressure
   1. All new water facilities must be pressure tested, after water facilities:
      a. have been placed and isolated from the existing water system
      b. trenches have been backfilled
      c. concrete thrust blocks have cured for a minimum of 36 hours
      d. have passed disinfection testing
   2. You may pressure test a new water facility against an existing valve that is closed at your own risk. The existing valve cannot be guaranteed not to leak. If the valve leaks, resulting in a failed test, you are responsible to

modify the new pipe work by adding temporary blow-offs or other method, approved by the Campus Representative, to allow the testing to occur at no additional cost to the University.

3. If hydrants or blowoffs are not available for expelling air, taps must be made at points of highest elevation before any tests are made. After tests have been completed, insert plugs in the pipe taps.
4. Pressure test new water and recycled water facilities as follows:
    a. Pressurize new water facility to 225 psi (minimum of 215 psi and maximum of 235 psi);
    b. Maintain pressure for two hours.
    c. Evaluate leakage
    d. After steps a and b, pressurize new water facility to 150 psi (minimum of 145 psi and maximum of 155 psi) for potable facilities and 200 psi (minimum of 195 psi and maximum of 205 psi) for recycled water facilities; and
    e. Maintain pressure for four hours
    f. Evaluate leakage
5. New potable and recycled water facility will not be accepted until the leakage is less than the number of gallons as determined by the following table:

Diameter (inches)	4”	6”	8”	10”	12”	14”	16”	18”	20”	24”
PVC	0.006	0.010	0.013	0.016	0.020	0.023	0.026	0.030	0.033	0.040
Ductile Iron	0.007	0.011	0.014	0.018	0.022	0.025	0.029	0.033	0.036	0.044

6. The total allowable leakage is calculated by multiplying the leakage per joint in gallons per hour per 100 joints for the diameter of the pipe tested as obtained from the above table, by the duration of the test in hours and the total number of joints.

    $$Total\ Allowable\ Leakage = Allowable\ Leakage\ per\ Joint * Number\ of\ Hours * Number\ of\ Joints$$

7. The total allowable leakage must be greater than or equal to the measured leakage.

    $$Measured\ Leakage \leq Total\ Allowable\ Leakage$$

8. If the section under test contains joints of various diameters, the allowable leakage will be the sum of the computed leakage for each size joint.

9. Remove and replace any defective:
    a. Pipes, Fittings, Valves, hydrants, or, consumer water services discovered during pressure test and repeat test.
    b.

H. Tracer wire must be tested for continuity upon completion, prior to final acceptance.

END OF SECTION

SECTION 333000

Sanitary Sewage Utilities

1.1 SUMMARY

A. Section Includes:
1. Provide Sanitary Sewage system needed for a complete and proper installation.

B. Cal-GREEN requirements, when applicable.

C. Related Sections:
1. Division 01 General Requirements
2. Contract General Conditions
3. Section 310000 Earthwork
4. Section 32000 Exterior Improvements
5. Section 33100 Water Utilities

1.2 REFERENCES

A. Geotechnical Engineering Report, if applicable.

B. Separation requirements per State Department of Health.

C. American Water Works Association (AWWA) requirements

D. Cal Poly Construction Campus Standard Specifications and Campus Standard Details:
https://afd.calpoly.edu/facilities/planning-capital-projects/construction-standard/

E. Section 500-2.4 of the Standard Specifications for Publics Works Construction 2018 (Greenbook)

1.3 General

A. All requirements of the Cal Poly Standards apply, notify Cal Poly representative if conflict exists.

B. Work must comply with section 310000

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications and Installer Qualifications:
1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 Submittals

A. Comply with pertinent provisions of Division 01.

B. Product data, prior to beginning work submit and obtain approval for:
1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; including installation procedures which, when approved by the Architect and University, will become the basis for accepting or rejecting actual installation procedures used on the Work.
3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.
4. All underground sanitary sewage piping shall be video-recorded prior to connection to existing systems. These videos shall be presented to campus

building inspectors and representatives of the Plumbing Shop on a CD or in an electronic format.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 016000.

1.8 SEQUENCING

A. Sequence Work properly with adjacent work to allow unobstructed access to all areas.

B. Inspection: Request inspection by authority having jurisdiction and testing consultant before concealment.
   1. Sequence work to permit installation to be inspected and approved prior to being concealed.
   2. Ensure that subsequent installations are reported, properly installed, and inspected.

1.9 DESIGN CRITERIA

A. General**:**

1. All sanitary sewer laterals and mains shall be installed with a minimum of 36” of cover. Otherwise, encasement may be needed.
2. Curved sewer mains shall be installed with a minimum curvature in compliance with manufacturer’s recommendations. Joint deflections are not permissible.
3. All sanitary sewer mains shall have a minimum 8” diameter.
4. Sewer mains shall be designed with a minimum 2 fps and a maximum 10 fps half-full flow velocity and the following minimum slopes:

   a. 8” 0.50%
   b. 10” 0.35%
5. Force mains shall be designed with a minimum velocity of 4 fps and a maximum velocity of 8 fps.
6. Sewer laterals shall be 4” minimum diameter with a minimum slope of 2%.
7. Sewer mains shall have manholes at 300’ maximum spacing, at angle points, at the beginning or ending of curves, clean outs may be used at the beginning of runs less than 150’ long, otherwise a manhole is required.
8. Service laterals shall connect to the main with a wye pipe fitting and a clean out at the building connections and angle points. Laterals longer than 100’ long shall require an additional clean out at approximately mid-point or at 100’ maximum spacing. See Cal Poly standards for cleanout requirements.
9. Sewer pipes shall be installed a minimum of 12” below water lines in compliance with State Department of Health separation requirements.
10. Horizontal clearance between sewer and potable water mains shall be a minimum of 10’ from outside of pipe in compliance with State Department of Health separation requirements.

B. Lift Station Design Criteria

1. Pumps shall be an alternating duplex system with Individual pumps sized for PDD (250 gpm); Total dynamic head = ±120'. A triplex pumping system may be installed at the Design Builder's discretion and with University approval.
2. Accessories shall include an alarm system tied into a central monitoring station and odor control.
3. A stand by generator shall be included in the project to provide emergency power for the lift station. The generator must be sized to power both pumps in a duplex system or at least two pumps in a triplex system.

PART 2- PRODUCTS

2.1 PIPE, FITTINGS AND MANHOLES

A. Pipe Materials:

1. Transition from existing clay and cast iron pipe to PVC shall be made with Strongback coupling. With steel band (Strongback) or equal.
2. Provide documents or certified test results indicating the pipe furnished meets all specified requirements. Satisfactory documents include pipe manufacturer certificate indicating that the pipe has been:
    a. Sampled
    b. Tested
    c. Inspected
    d. In compliance with the ASTM specifications
3. New sewer force main pipeline material shall be fused HDPE, Schedule 80 PVC or C900 DR 14 PVC.. When repairing existing pipeline, comply with all sewer repair sections.
4. All gravity mains and laterals shall be SDR 35 PVC.
5. All Manholes shall be pre-cast concrete with eccentric cones, and H2O traffic rated covers and frames.
6. Lift station wet wells shall be precast or cast in place concrete lined with a minimum 125 mils of type B polyurethane coating. Manhole walls and cone shall be coated. Do not coat step or channel at the bottom, which prevents a slippery surface.
7. Lift station pumps shall be submersible pumps with oil filled, explosion proof motors with moisture sensors. Pumps shall be mounted to a factory provided rail system.

B. High Density Polyethylene Pipe (HDPE)

1. Use:
    a. Virgin grade, High molecular weight, Standard Dimension Ration (SDR) 17, Iron Pipe (IPS), High Density Polyethylene (HDPE) pipe made in diameter and tolerances in compliance with the latest version of ASTM D3035.
2. Furnish complete with all fabricated fittings, and other appurtenances as necessary, for a complete and functional system.
3. The pipe must be free of:

a. Visible cracks, Holes, Foreign inclusions, or, Other defects
b. Any pipe not meeting these criteria will be rejected.

4. The pipe must be clearly marked with the following:
    a. Name and trademark of manufacturer
    b. Nominal pipe size
    c. Dimension ration
    d. The letters PE followed by the polyethylene grade per the latest version ASTM D1248
    e. Hydrostatic design basis in psi
    f. Manufacturing standard reference
    g. A production code from which the date and place of manufacture can be determined.
5. The material must be listed by the Plastic Pipe Institute (PPI) with a designation PE 3408 and have a minimum cell classification of:
    a. 345434C
    b. D, or
    c. E, As described in latest version of ASTM D3350.
6. Provide pipe with interior wall color of:
    a. White
    b. Gray or
    c. Light green
7. Provide pipe with exterior wall color of:
    a. Black
    b. Gray or
    c. Light green
8. Provide submittals on furnished pipe from manufacturer certifying pipe is in compliance with:
    a. Specifications, Codes, Standards
9. Any pipe segment that has cut in the pipe wall exceeding 10 percent of the wall thickness must be cut out and removed from the site.
10. Store pipe so that it is not deformed or subject to UV exposure.

C. Polyvinyl Chloride (PVC) Pipe

1. Furnish pipe in 20-foot lengths with integral wall belled ends and elastomeric joint and solid wall. Pipe and fittings must be free of imperfections and clearly marked with name of manufacturer.
2. Minimum pipe stiffness (F/y) at 5 percent deflection is 46 psi for all sizes when calculated in compliance with ASTM Designation D 2412.
3. Pipe must have minimum Standard Dimension Ration (SDR) of 35 and pipe stiffness of 46 psi.
4. Pipe color must be green.
5. PVC Pipe 4 to 15 Inch Diameter
    a. PVC Pipe must conform to the requirement of latest version of ASTM specification D 3034.
6. PVC Pipe 18 to 27 Inch Diameter
    a. PVC Pipe must conform to the requirement of latest version of ASTM Standard Specifications F 679.
7. PVC Pipe 30 to 48 Inch Diameter
8. PVC Pipe must conform to the requirement of latest version of ASTM Standard Specifications F 794.

D. Ductile Iron Pipe

1. Ductile iron pipe must be:
    a. Centrifugally cast.
    b. Ductile iron pipe.
    c. Gasketed push on joints appropriate for use in a wastewater environment such as Polychloroprene, Ethylene Propylene Diene Monomer, or an approved equal.
    d. A pressure class 150 for pipe with 3 feet or less of cover.
    e. A pressure class of 350 for pipes with 3 feet or less of cover or exposed above grade.
    f. Coated on exterior.
    g. Lined with fusion bonded epoxy, polyurethane or approved equal.
2. Ductile iron pipe must be encase in polyethylene casing material. Casing material must be:
    a. Tube type
    b. Conform to the latest ANSI/AWWA C105 Standard.
3. Polyethylene casing must extend over:
    a. Tees
    b. Bends
    c. Couplers at the end of a Section of ductile iron where it connects to a different type of pipe
    d. Close casing at the end (dead end) of a pipe
    e. Exposure to air and sunlight must be kept to minimum for either type “A” or type “C” encasement material.

E. Sewer Lateral Pipe
1. New and repaired sewer lateral pipe may be:
    a. PVC SDR 35
    b. PVC Schedule 40
    c. HDPE SDR 17
2. Pipe joints must be glued or fused.

F. Joints and Fittings

1. HDPE Pipe and fittings must be in compliance with the latest version of:
    a. ASTM F714
    b. ASTM D3261
2. PVC pipe must have a rubber ring bell and spigot joints providing a water tight seal and allowing for contraction and expansion. The bell must consist of an integral wall Section stiffened with two PCV retainer rings that securely lock the solid cross Section rubber ring into position.
3. All PVC fittings and accessories must be as manufactured and furnished by the pipe supplier, or approved equal, and have bell and/or spigot configurations identical to that of the pipe. All fittings must be of the same material as the pipe and same SDR rating, unless specified otherwise.
4. Ductile Iron Fittings: Use restrained fittings for exposed ductile iron pipe, such as bridge crossings. Restrained fittings must be Flex-Ring by American Ductile Iron, TY FLEX by U.S. Pipe, or approved equal which use a factory weld as part of the restraining system.
5. Repair Joint. Use strong back RC couplings or equal meeting the following requirements:
    a. Comprised of an elastomeric sealing component

b. Type 316 series stainless steel tension components (end clamps and shear rings).
c. Shear rings must have a minimum thickness of 0.012 inches
d. End clamps must have “bolts” as their means of tightening (not worm gears).

6. Couplings must be appropriately sized for the pipe materials being joined, without the need for bushings.
7. HDPE Pipe with fused ends must be repaired with HDPE pipe with fused joints. Strong back couplings must not be used.
8. Sewer Lateral Joints (New and Replacement)
    a. Sewer lateral pipe must be joined using glued joints and fittings or fused

G. Concrete
1. Use 2500 psi mix for:
    a. Manholes, Pipe junctions, or jacketing
2. Precast concrete manhole Sections must comply with the most current version of ASTM specification C-478-61T or AASHTO-M170.
3. All manholes must be watertight, and the floor sloped for a smooth monolithic trowel finish. The interior finish of the manholes must be a smooth mortar surface.

H. Mortar
1. To make mortar, use one part of Type II Portland cement and two parts sharped grained particles that are:
    a. Clean
    b. Hard
    c. All passing a # 4 sieve
2. Mix mortar in a machine or water tight box. Accurately measure and thoroughly mix mortar to a uniform consistency. Use mortar immediacy after mixing. Do not remix mortar that begins to harden prior to placement.

PART 3- EXECUTION

3.1 PIPE INSTALLATION

A. Pipe Installation
1. Sanitary sewer lines must be water tight. Install pipe to ensure the system is water tight throughout the component parts, particularly at the pipe joint.
2. Do not:
    a. Cut, Gouge, Score or Damage pipes when unloading, handling, storing, installing
3. Lay the pipe in perfect conformity to the design line and grade obtained for each pipe by measuring down from a tightly stretched line running parallel with the grade.
4. Lay all pipes continuously uphill.
5. Install pipe and fittings for underground gravity sewers in compliance with the latest version of ASTM Standard D-2321. Lay bell and spigot pipe, with the bell of the pipe upgrade.

B. Pipe Bursting or Reaming
1. Install sewer pipe by pneumatic pipe bursting or pipe reaming. Install pipe in compliance with the pipe manufacturer’s recommendations. For pipe

busting installation, use pneumatically operated equipment with a pipe bursting head attached to HDPE pipe.

2. Locate, expose, disconnect and isolate existing sewer laterals from sewer main before pipe installation work begins. When pipe reaming, you must prevent drilling fluid from entering sewer laterals.
3. Submit to the Engineer for review and approval a sewer installation plan which includes insertion and reception pit location.
4. For pipe bursting work, use a constant tension pneumatic tool used in conjunction with a constant tension hydraulic winch. Size the winch based on the diameter and the depth of the pipe to be replaced. The constant tension winch must be sufficient sized to pull one continuous length of pipe between approved winching points.
5. The void created by the device must be sufficient in size to accommodate the pipe which is installed immediately after the void is formed. The void must not be so large that pipe displacement or pavement settling occurs. Allow new sewer pipe to relax for twelve hours prior to final connection to manholes.
6. If you cannot complete pipe bursting or reaming without damage to existing closely places lines or pavement, you may request authorization from the Engineer to place new pipe with traditional open-cut trenching. If you encounter an obstruction that prevents the bursting or reaming tool from continuing, you must:
    a. Stop the operation
    b. Notify a Cal Poly representative
    c. Excavate the obstruction
    d. Remove the obstruction.
7. Any pavement heaving, or utility damage caused by pipe bursting or reaming work must be repaired at no additional cost to the city or utility company.
8. If you use any material or method that is not approved by the Engineer or Campus Inspector, you must remove the work and replace as directed by the Engineer or Campus Inspector.
9. If an obstruction is found during testing, remove the obstruction. Remove and replace Section of pipe is damaged.

C. HDPE Pipe Joint
1. Join HDPE pipe by:
    a. Heat fusion welding
    b. Electrofusion fitting or
    c. Equal as approved by Cal Poly Representative.
2. All connections to the sewer pipe must be water tight, flush with the edges of the sewer pipe with clean uniform cuts.
3. Perform heat fusion welding in compliance with the pipe manufacturer’s recommendations and ASTM D2657. Fusion equipment used must be capable of meeting all conditions recommended by the pipe manufacturer including, but not limited to:
    a. Fusion temperature
    b. Alignment
    c. Fusion pressure
4. Fusion equipment must only be operated by technicians who have been certified by the pipe manufacturer or supplier. Document and furnish to the Engineer technicians certification in a submittal.

5. Use a fire-retardant bag or suitable enclosure for the heater plate to facilitate control of heating process and to protect the heater plate surfaces from dirt and other debris when not in use.
6. Clean heater plate surfaces regularly to prevent accumulation of fusion welding residues or other substances that may result in faulty pipe joining. The heater plate must be equipped with suitable means to measure the temperature of plate surfaces and to assure uniform heating such as thermometers or pyrometers.
7. Joint strength must be equal to that of the adjacent pipe. Clean the pipe ends with a cotton or non-synthetic cloth to remove:
    a. Dirt
    b. Water
    c. Grease
    d. Other foreign materials.
8. Cut pipe ends square and carefully aligned just prior to heating.
9. After achieving the proper melt pattern, bring the pipe ends together in a firm, rapid motion applying sufficient pressure to form a pipe bead (1/8 to 3/16 inch in height) around and inside the entire circumference of the pipe. Remove pipe bead before welding the next joint of pipe.
10. Use tools designed for and approved by the manufacturer and supplier for joining pipe.

D. Sand Traps
    1. Furnish and install sand traps or other debris catching measure approved by the Engineer during the work. Debris catching devices must always be installed during construction. You assume all costs associated with any damage resulting from construction materials entering the wastewater system or treatment facility.

E. Bypass Pumping
    1. Submit a bypass pumping plan for approval by Engineer at the pre-construction meeting or prior to work beginning. At a minimum the plan must include:
        a. Pump size and type
        b. Backup pump size and type
        c. Contingency plan for pump failure to ensure continuous bypass operations.
    2. The bypass system must be free from leaks. The bypass pumping plan must address access to:
        a. Driveways
        b. Cross streets
        c. Pedestrian crossings.

F. Manholes
    1. Construct manholes per Engineering Standards.

G. Existing Manholes
    1. Existing manholes must be:
        a. Adjusted to grade
        b. Remodeled or
        c. Abandoned
        d. As shown and in compliance with Engineering Standards and

Section 333000.

2. Existing manholes may have large cast in place concrete bases. No additional payment will be made for the removal of existing bases as needed to complete the work.
3. Oversize manholes may require a manufactured concrete reduction ring prior to setting the new manhole ring and cover.

H. Abandonment of Sewer lines
   1. Sewer facilities taken out of service must be abandoned in compliance with engineering Standard 6050.
   2. Provide the Engineer 48-hour notice prior to abandoning sewer laterals. Cut off the sewer lateral at the main and plug pipes with class 3 concrete a minimum of 12-inches into the pipe, away from the sewer main pipe. Provide a minimum five-foot by five-foot excavation with shoring at the sewer main, adequate for the University to remove the existing wye and replace it with new section of pipe. Provide for the excavation:
      a. Backfill
      b. Compaction
      c. Surface restoration

I. Repair
   1. Repair cut sewer facilities using new pipe of material the same diameter. If the existing sewer pipe material complies with materials, use that same pipe material.
   2. Center a continuous Section of new pipe at the repair location. Repair must be water tight and placed at the same grade. Prior to backfilling excavation, place level on repaired portion of sewer, in the presence of the Engineer, to confirm line and grade. Backfill, compact and restore surface improvements.
   3. Repair must be documented with:
      a. Location
      b. Repairs made
      c. Photos
      d. Guarantee letter
      e. Interior video inspection of pipeline, when directed by Cal Poly Representative.
   4. Provide hardcopy of all documents to owner.

3.12 TESTING AND INSPECTIONS

A. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected, tested, and has been approved by the University.

B. Testing:
   1. All tests on sanitary sewer shall be performed in the presence of Cal Poly Representative.
   2. Air Test: After the pipeline is in place and the joints made, you must air test the sewer in the presence of the Engineer or Campus Inspector. Air test procedure is as follows:
      a. A maximum of 400 feet of sewer pipe will be tested at one time.
      b. Plug and brace securely all outlets.
      c. Introduce air into test Section until internal pressure is 4.0 psi. If sewer pipe is placed in ground water, calculate ground water pressure and add that additional pressure to internal pressure used

for test.

d. Maintain an internal test pressure by adding air as need for a minimum time of 2 minutes.
e. Measure the time required for pressure to drop from 3.5 psi to 2.5 psi. Do not introduce new air into test Section during measurement.
f. Minimum permissible pressure discharge time as follows in seconds (time to drop pressure from 3.5 psi to 2.5 psi)

Sewer Main		4-inch Sewer Lateral				
Diameter	Length	Sewer Lateral Length				
Inches	Feet	0 feet	100 feet	200 feet	300 feet	400 feet
6 & 8	0	0 seconds	20 seconds	40 seconds	50 seconds	70 seconds
	50	40 seconds	50 seconds	70 seconds	90 seconds	80 seconds
	100	70 seconds	90 seconds	100 seconds	100 seconds	90 seconds
	150	110 seconds	120 seconds	110 seconds	100 seconds	100 seconds
	200	140 seconds	120 seconds	110 seconds	110 seconds	100 seconds
	300	140 seconds	130 seconds	120 seconds	110 seconds	110 seconds
	400	140 seconds	130 seconds	120 seconds	120 seconds	110 seconds
10	50	50 seconds	70 seconds	90 seconds	100 seconds	90 seconds
	100	110 seconds	130 seconds	120 seconds	110 seconds	110 seconds
	200	170 seconds	150 seconds	140 seconds	130 seconds	120 seconds
	300	170 seconds	160 seconds	150 seconds	140 seconds	130 seconds
	400	170 seconds	160 seconds	150 seconds	150 seconds	140 seconds
12	50	80 seconds	100 seconds	110 seconds	110 seconds	110 seconds
	100	160 seconds	170 seconds	150 seconds	140 seconds	130 seconds
	200	200 seconds	180 seconds	170 seconds	160 seconds	150 seconds
	300	200 seconds	190 seconds	180 seconds	170 seconds	160 seconds
	400	200 seconds	190 seconds	180 seconds	180 seconds	170 seconds
15	50	120 seconds	140 seconds	160 seconds	140 seconds	130 seconds
	100	250 seconds	220 seconds	190 seconds	170 seconds	160 seconds
	200	260 seconds	230 seconds	220 seconds	200 seconds	190 seconds
	300	260 seconds	240 seconds	230 seconds	220 seconds	210 seconds
	400	260 seconds	240 seconds	230 seconds	220 seconds	220 seconds

Sewer Main		4-inch Sewer Lateral				
Diameter	Length	Sewer Lateral Length				
Inches	Feet	0 feet	100 feet	200 feet	300 feet	400 feet
6 & 8	0	0 seconds	20 seconds	40 seconds	50 seconds	70 seconds
	50	40 seconds	50 seconds	70 seconds	90 seconds	80 seconds
	100	70 seconds	90 seconds	100 seconds	100 seconds	90 seconds
	150	110 seconds	120 seconds	110 seconds	100 seconds	100 seconds
	200	140 seconds	120 seconds	110 seconds	110 seconds	100 seconds
	300	140 seconds	130 seconds	120 seconds	110 seconds	110 seconds
	400	140 seconds	130 seconds	120 seconds	120 seconds	110 seconds
10	50	50 seconds	70 seconds	90 seconds	100 seconds	90 seconds
	100	110 seconds	130 seconds	120 seconds	110 seconds	110 seconds
	200	170 seconds	150 seconds	140 seconds	130 seconds	120 seconds
	300	170 seconds	160 seconds	150 seconds	140 seconds	130 seconds
	400	170 seconds	160 seconds	150 seconds	150 seconds	140 seconds
12	50	80 seconds	100 seconds	110 seconds	110 seconds	110 seconds
	100	160 seconds	170 seconds	150 seconds	140 seconds	130 seconds
	200	200 seconds	180 seconds	170 seconds	160 seconds	150 seconds
	300	200 seconds	190 seconds	180 seconds	170 seconds	160 seconds
	400	200 seconds	190 seconds	180 seconds	180 seconds	170 seconds
15	50	120 seconds	140 seconds	160 seconds	140 seconds	130 seconds
	100	250 seconds	220 seconds	190 seconds	170 seconds	160 seconds
	200	260 seconds	230 seconds	220 seconds	200 seconds	190 seconds
	300	260 seconds	240 seconds	230 seconds	220 seconds	210 seconds
	400	260 seconds	240 seconds	230 seconds	220 seconds	220 seconds

C. PVC Joints

1. Joint tightness is measured by assembling two Sections of pipe in compliance with the manufacturer's recommendations.
2. Subject the joint to an internal hydrostatic pressure of 25 psi for one hour. Consider any leakage a failure of the test requirements.

D. Testing of Force Mains

1. Test force mains according to the following procedure:
    a. Fill each section of pipe with water and expel all air. Allow pipe to set for a minimum of 24 hours. Refill pipe and pressure pipe to:
        i. 150 psi, or
        ii. Service pressure plus an additional 50 psi
    b. Whichever is greater. Maintain pressure for two hours. Replace any portion of line that fails and retest. Maximum allowable leakage is 4.17 gallons per hour per mile per nominal inch of diameter.

E. Manhole Vacuum Testing

1. Vacuum test all newly constructed manholes prior to placing any backfill around manhole and again after manhole is raised to finish grade. Finish grade shall include a collar around the manhole ring to limit movement. Provide the Engineer 24-hour notice prior to each test.
2. You must prepare the manhole as follows:
    a. Plug all inlets to the manhole
    b. Place a test head in the top of the manhole
    c. Inflate a seal
3. Place a vacuum of 10 inches of mercury on the manhole and measure the

time for the vacuum to drop to 9 inches of mercury. The manhole meets requirements if the measured time for the vacuum drop meets or exceeds the value from the following table:

Manhole Depth	Manhole Diameter	
	4 feet	5 feet
4 feet	10 seconds	13 seconds
6 feet	15 seconds	20 seconds
8 feet	20 seconds	26 seconds
10 feet	25 seconds	33 seconds
12 feet	30 seconds	39 seconds
14 feet	35 seconds	46 seconds
16 feet	40 seconds	52 seconds
18 feet	45 seconds	59 seconds
20 feet	50 seconds	65 seconds

4. If the manhole fails the vacuum test, provide the necessary repairs to make the manhole pass the vacuum test. Retest accordingly.

F. Tracer Wire

1. Tracer wires shall be #12 coated, stranded wire with waterproof connections.
2. They need to be run on all pipelines and manholes
3. Wires shall be run and terminated at the manhole ring, inside at the last grade ring.
4. Provide tracer wire for all non-metallic pipe.
5. Tracer wire must be tested for continuity upon completion, prior to final acceptance.

G. Deflection

1. Verify Deflection following the:
    a. Placement
    b. Backfill
    c. Compaction
2. Prior to permanent pavement, clean and measure pipe for obstruction such as:
    a. Deflections
    b. Joint offsets
    c. Lateral pipe intrusions.
3. Allowable internal diameter is determined using appropriate size mandrel. Prior to use, the mandrel must be certified by the Engineer or by another entity approved by the Engineer. Use of an:
    a. Uncertified mandrel or
    b. An altered mandrel

    Will invalidate test. If the mandrel fails to pass, the pipe will be deemed to be over deflected.

4. The mandrel must:
    a. Be rigid
    b. Be nonadjustable
    c. Have an odd-numbering-legs (9 legs minimum)
    d. Have an effective length not less than its nominal diameter
    e. Be fabricated of steel or aluminum
    f. Be fitted with pulling rings at each end
    g. Be stamped or engraved indicating the:
    h. Pip material specification
    i. Nominal size
    j. Mandrel outside diameter.
5. Using the manufacturer's specified internal diameter of pipe, maximum vertical deflection must not exceed:
    a. 95 percent – for nominal diameter pipe less than or equal to 12 inches
    b. 96 percent – for nominal diameter pipe less than or equal to 30 inches
    c. 97 percent – for nominal diameter pipe greater than 40 inches
6. For pipes equal to or smaller than 24 inches in internal diameter, pull the mandrel through the pipe by hand. For pipes greater than 24 inches in internal diameter, deflections may be determined by mandrel or by a method submitted to and approved by the Engineer. If a mandrel is selected it must conform to the requirements in this section.
7. Any over deflected pipe must be uncovered to remove the compact soil loading. Once uncovered if the pipe can pass the mandrel it may remain. If not, remove and replace the damaged pipe. In all cases, the Engineer will determine whether the pipe may remain or must be replaced. Any pipe subjected to any method or process other than uncovering, even if successful to remove over deflection, must be removed and replaced with a new Section of pipe.
8. All costs incurred by Contractor (typ.) attributable to:
    a. Mandrel testing
    b. Deflection testing
    c. Repairs
    d. Any delays

    Are borne by Contractor at no cost to the University.

F. Cleaning
1. After the final air test has been satisfactorily completed, sewer shall be cleaned using High-Velocity (Hydro-cleaning) equipment only. Cleaning shall be with clean water with a minimum 2,000 psi @ 50 gpm standard cleaning nozzle. Cleaning shall be performed starting at the furthest upstream segment (manhole to manhole) proceeding downstream. Each segment shall be cleaned from its downstream manhole. All debris shall be vacuumed and removed from each set-up location.
2. All foreign material must be removed from:
    a. Pipes
    b. Manholes
    c. Cleanouts

    Prior to being placed into service. Remove all material from sand traps or debris catchers in manholes prior to removing the sand trap or debris catcher.

3. Sewer shall be cleaned PRIOR to CCTV being conducted.

G. Television Inspection (Video Inspection)

1. CCTV shall be provided to the University for all public sewer pipe systems prior to acceptance. Provide the Engineer three weeks' notice prior to placement of final paving or surface restoration. Allow one working day per 2,000 linear feet of sewer main to be video inspected. Installations which do not conform to the requirement must be reconstructed and re-video inspected at your expense.
2. Furnish video on flash drive. CCTV reports shall be National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certified with no modifications. Every section of sewer (manhole to manhole) shall be identified by audio and alphanumeric on the video display and shall include:
    a. Project name
    b. Municipality
    c. Street name
    d. University designated GIS manhole numbers
    e. Sewer diameter and length
    f. Date of inspection
3. Video inspection recordings and reports must be completed for gravity conveyance systems per the following requirements:
    a. The pipeline video inspection must be submitted on USB drive.
    b. The inspection recording must be of adequate resolution to display pipe, potential pipe defects, and pipe joints.
    c. Audio and written notes must be recorded in the video.
    d. A 1-inch cylindrical gauge may be required in the video inspection to determine if the pipe segment has a grade deficiency.
    e. General convention of the recording will travel downstream and must automatically track the pipeline length (in feet) from the start of the inspection to the end of the inspection.
    f. Inspection report must include the project location, a scaled plan of the pipe segment(s), and a summary of inspection findings.

END OF SECTION

SECTION 334000

Storm Drainage Utilities

1.1 SUMMARY

A. Section Includes:
   1. Provide Storm Drainage Utility system needed for a complete and proper installation.

B. Cal-GREEN requirements, when applicable.

C. Related Sections:
   1. Division 01 General Requirements
   2. Contract General Conditions
   3. Section 310000 Earthwork
   4. Section 32000 Exterior Improvements
   5. Section 33100 Water Utilities

1.2 REFERENCES

A. Geotechnical Engineering Report, if applicable.

B. Separation requirements per State Department of Health.

C. American Water Works Association (AWWA) requirements

D. Cal Poly Construction Campus Standard Specifications and Campus Standard Details:
   https://afd.calpoly.edu/facilities/planning-capital-projects/construction-standard/

E. Regional Water Quality Control Board Requirements

1.3 General

A. All requirements of the Cal Poly Standards apply, notify Cal Poly representative if conflict exists.

B. Work must comply with section 310000

C. Storm water management systems must meet RWQCB post-construction requirements as listed in the Post-Construction Storm water management Requirements for Development Project in the Central Coast Region (Resolution No. R3-2013-0032).

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications and Installer Qualifications:
   1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 Submittals

A. Comply with pertinent provisions of Division 01.

B. Product data, prior to beginning work submit and obtain approval for:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer’s specifications and other data needed to prove compliance

with the specified requirements; including installation procedures which, when approved by the Architect and University, will become the basis for accepting or rejecting actual installation procedures used on the Work.

3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.
4. All underground storm drain utility piping shall be video-recorded prior to connection to existing systems. These videos shall be presented to campus building inspectors and representatives of the Plumbing Shop on a CD or in an electronic format.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 016000.

1.7 SEQUENCING

A. Sequence Work properly with adjacent work to allow unobstructed access to all areas.

B. Inspection: Request inspection by authority having jurisdiction and testing consultant before concealment.
   1. Sequence work to permit installation to be inspected and approved prior to being concealed.
   2. Ensure that subsequent installations are reported, properly installed, and inspected.

1.8 DESIGN CRITERIA

A. General**:**

1. Project storm drain systems shall be designed for the 25-year design storm with 1’ of freeboard at inlets, and overland relief shall be provided for the 100-year design storm.
2. Pipes less than 18” in diameter shall be SDR 35 PVC at a minimum of 0.5% slope; all pipe 18” or greater shall be dual wall type S Corrugated Polyethylene Pipe (CPP) with water tight joints at a minimum of 0.5% slope. All pipes shall have a minimum cover of 36”, otherwise, encasement may be needed. All pipes within the street shall be a minimum of 18” diameter.
3. Manholes or catch basins are required at angle points, at beginning or ending of curves, or on runs longer than 300’.
4. Provide minimum cover on all pipes in accordance with manufacturer’s recommendations and not less than 12”.
5. Provide a minimum of 12” of clearance to all other underground utilities.
6. Provide a minimum of 12” of cover from bio-retention swale gravel beds to top of pipes.
7. All manholes, catch basins, and junction boxes shall be concrete with cast iron lids or grates. All grates and lids shall be ADA compliant, bicycle friendly, and shall be traffic rated where there is a potential for vehicular traffic, including on sidewalks. Galvanized grates and lids are not allowed to prevent heavy metal contamination of storm water.

8. The bio-retention swale overflow inlets and drain pipe shall be designed to have adequate capacity to convey the 100-year storm with a minimum of 12” of free board in the swale.
9. Roof drains down spouts shall not directly connect to the storm drain system and the runoff should be directed to vegetated areas where possible. The intent of the storm drain system is to allow for bio-filtration of the storm water runoff and infiltration. Drainage should be conveyed in surface swale or by sheet flow where possible and pipes should be avoided unless necessary.
10. Storage can be provided in high porosity aggregate or perforated pipes or storm chambers surrounded by high porosity aggregate. Storage can also be provided in the aggregate under porous pavers. The system should be designed to infiltrate completely in 48 hours or less. Excess runoff to these systems shall be connected to the storm drain collection system.
11. Contractors are responsible for preparing a Storm Water Control Plan (SWCP) in accordance with Post-Construction Storm water management Requirements for Development Project in the Central Coast Region (Resolution No. R3-2013-0032), to be approved by the RWQCB.
12. Provide tracer wire for all non-metallic pipe.
13. Tracer wires shall be #12 coated, stranded wire with waterproof connections.
14. They need to be run on all pipelines and manholes
15. Wires shall be run and terminated at the manhole ring, inside at the last grade ring.

PART 2- PRODUCTS

2.1 PIPE, FITTINGS AND MANHOLES

A. Pipe Materials:

1. All storm sewer lines 4” or larger shall be SDR-35 PVC, lines 3” and smaller shall be DWV PVC or cast iron.
2. All manholes shall meet Cal Poly Engineering Standards.
3. All Manholes shall be pre-cast concrete with eccentric cones, and traffic rated covers and frames.

B. Joints and Fittings

1. Transition from existing clay and cast iron pipe to PVC shall be made with strong back coupling.

3.1 TESTING AND INSPECTIONS

A. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected, tested, and has been approved by the University.
B. Testing:
   1. All tests on Storm Drain Utilities shall be performed in the presence of Cal Poly Representative.
   2. Low pressure air test the system per the following:

a. Brace plugs and bulkheads to prevent release during the low-pressure air test. Locate gauges, air piping manifolds, and valves above the ground. Do not allow anyone to enter a manhole or inlet of a plugged pipe when it is under pressure.
b. Equip the air testing apparatus with a pressure release device, such as a rupture disk or a pressure relief valve, designed to relieve pressure in the pipe at 6 psi when under test.
c. Storm drains, side storm drains, and fittings must be open, clean, and free draining upon final completion of the work.
d. Start the test after the pressure is stabilized at or above an internal pressure of 3.5 psi greater than the average back pressure of the groundwater that could submerge the pipe.
e. Start recording the time when the internal pressure drops to 3.5 psi.
f. The tested portion of the pipe passes the field leakage test when the pressure drop is less than 1 psi for the time period calculated for the size and length of the pipe to be tested as shown in the following table:

Minimum Test Time for Pressure Drop

Nominal pipe diameter (inches)	Time for pressure drop (minutes/100 feet)
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8

g. If test fails, repair and retest at no additional cost to the University.

C. Deflection

1. Verify Deflection following the:
   a. Placement
   b. Backfill
   c. Compaction
2. Prior to permanent pavement, clean and measure pipe for obstruction such as:
   a. Deflections
   b. Joint offsets
   c. Lateral pipe intrusions.
3. Allowable internal diameter is determined using appropriate size mandrel. Prior to use, the mandrel must be certified by the Engineer or by another entity approved by the Engineer. Use of an:
   a. Uncertified mandrel or
   b. An altered mandrel

   Will invalidate test. If the mandrel fails to pass, the pipe will be deemed to be over deflected.

4. The mandrel must:
    a. Be rigid
    b. Be nonadjustable
    c. Have an odd-numbering-legs (9 legs minimum)
    d. Have an effective length not less than its nominal diameter
    e. Be fabricated of steel or aluminum
    f. Be fitted with pulling rings at each end
    g. Be stamped or engraved indicating the:
    h. Pip material specification
    i. Nominal size
    j. Mandrel outside diameter.
5. Using the manufacturer's specified internal diameter of pipe, maximum vertical deflection must not exceed:
    a. 95 percent – for nominal diameter pipe less than or equal to 12 inches
    b. 96 percent – for nominal diameter pipe less than or equal to 30 inches
    c. 97 percent – for nominal diameter pipe greater than 40 inches
6. For pipes equal to or smaller than 24 inches in internal diameter, pull the mandrel through the pipe by hand. For pipes greater than 24 inches in internal diameter, deflections may be determined by mandrel or by a method submitted to and approved by the Engineer. If a mandrel is selected it must conform to the requirements in this section.
7. Any over deflected pipe must be uncovered to remove the compact soil loading. Once uncovered if the pipe can pass the mandrel it may remain. If not, remove and replace the damaged pipe. In all cases, the Engineer will determine whether the pipe may remain or must be replaced. Any pipe subjected to any method or process other than uncovering, even if successful to remove over deflection, must be removed and replaced with a new Section of pipe.
8. All costs incurred by Contractor (typ.) attributable to:
    a. Mandrel testing
    b. Deflection testing
    c. Repairs
    d. Any delays

    Are borne by Contractor at no cost to the University.

END OF SECTION

SECTION 335100

Natural Gas Distribution System

1.1 SUMMARY

A. Section Includes:
   1. Provide Sanitary Sewage system needed for a complete and proper installation.

B. Cal-GREEN requirements, when applicable.

C. Related Sections:
   1. Division 01 General Requirements
   2. Contract General Conditions
   3. Section 310000 Earthwork
   4. Section 32000 Exterior Improvements

1.2 REFERENCES

A. Geotechnical Engineering Report, if applicable.

D. Cal Poly Construction Campus Standard Specifications and Campus Standard Details:
   https://afd.calpoly.edu/facilities/planning-capital-projects/construction-standard/

1.3 General

A. All requirements of the Cal Poly Standards apply, notify Cal Poly representative if conflict exists.

B. Work must comply with section 310000

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications and Installer Qualifications:
   1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 Submittals

A. Comply with pertinent provisions of Division 01.

B. Product data, prior to beginning work submit and obtain approval for:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; including installation procedures which, when approved by the Architect and University, will become the basis for accepting or rejecting actual installation procedures used on the Work.
   3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 016000.

1.7 SEQUENCING

A. Sequence Work properly with adjacent work to allow unobstructed access to all areas.

B. Inspection: Request inspection by authority having jurisdiction and testing consultant before concealment.
   1. Sequence work to permit installation to be inspected and approved prior to being concealed.
   2. Ensure that subsequent installations are reported, properly installed, and inspected.

1.8 DESIGN CRITERIA

A. General**:**

1. Cal Poly owns and maintains the underground natural gas distribution systems throughout the campus. Gas distribution pressure is 5-8 PSI and 20- 40 psi. The Southern California Gas Companies also has a 60 PSI distribution system.
2. Provide a gas regulator and meter at each new building.
3. For new buildings to be connected to the campus natural gas system, the anticipated additional gas demand should be identified early during preliminary planning. This anticipated gas demand should be submitted to the Principal Engineer for Cal Poly Physical Planning and Construction. Improvements to the campus system may be required to accommodate the additional demand. The Principal Engineer shall identify a suitable point of connection to the campus system and what system improvements may be necessary to accommodate the new building.
4. Provide tracer wire for all non-metallic pipe.
5. Regulate gas before entering buildings from 5 PSI to 7 inches water column. Size the building gas distribution system based on a pressure of 7 inches water column. For some special high gas use applications such as large boilers, a 2 PSI mechanical room gas pressure may be allowed when approved by the University Representative and permitted by code.
6. Gas Regulators should be specified to include an under pressure shut off feature to automatically shut off the gas in the event of a downstream pipe rupture.
7. Provide seismic gas shut off valves on gas services to all buildings which are intended to be used for student housing or as a residence. Seismic gas shut off valves are not required on non-residential buildings.
8. Gas meters may be either diaphragm bellows or turbine type as appropriate for the application. Gas meters shall record in cubic feet.
9. Except where covered under c., below, provide valving and connections to allow for the use of a temporary meter bypass (3/4 inch hose) when removing the meter for servicing. This bypass should be configured such that the meter may be removed while still supplying limited gas service to keep pilot lights lit.
10. For large academic buildings (greater than 30,000 gross square feet), commercial kitchens, and gas service which supplies an emergency generator, provide valuing and permanent piping for a full sized bypass of the meter. The bypass shall be configured to allow for meter removal

without disruption of gas service.
11. Gas piping shall not be routed under building floor slabs.

PART 2- PRODUCTS

2.1 General

A. Materials:

1. All underground gas piping shall be polyethylene SDR-11 yellow and installed by a contractor/employee with current certifications in the type of fusion they are using.
2. All underground isolation valves for gas lines shall be polyethylene with 2” operating nut. Accessible through a G5 concrete box.
3. Above Grade 2" and smaller: Schedule 40 black steel pipe with treaded 150 pound black malleable iron fittings or Mega Press. Paint all exterior and exposed piping to prevent rust.
4. Above Grade 2-1/2" and larger: Schedule 40 black steel pipe with welded steel fittings or Viega Mega Press. Paint all exterior and exposed piping to prevent rust.
5. Provide tracer wire for all new non-metallic pipe.
6. Tracer wires shall be #12 coated, stranded wire with waterproof connections.

2.2 Execution

A. General

1. Design criteria in 1.8(A) above apply to execution.
2. Gas Regulators should be specified to include an under pressure shut off feature to automatically shut off the gas in the event of a downstream pipe rupture.
3. Provide seismic gas shut off valves on gas services to all buildings which are intended to be used for student housing or as a residence. Seismic gas shut off valves are not required on non-residential buildings.
4. Gas meters may be either diaphragm bellows or turbine type as appropriate for the application. Gas meters shall record in cubic feet.
5. Except where covered under c., below, provide valving and connections to allow for the use of a temporary meter bypass (3/4 inch hose) when removing the meter for servicing. This bypass should be configured such that the meter may be removed while still supplying limited gas service to keep pilot lights lit.
6. For large academic buildings (greater than 30,000 gross square feet), commercial kitchens, and gas service which supplies an emergency generator, provide valuing and permanent piping for a full sized bypass of the meter. The bypass shall be configured to allow for meter removal without disruption of gas service.
7. Gas piping shall not be routed under building floor slabs.
8. Prior to installing new gas appliances in existing buildings, verify the gas

pressure with the University Representative. In some cases, the gas pressure has been increased to medium pressure to compensate for under sized gas piping. Provide an additional gas regulator near the appliance in the event that the existing building gas pressure exceeds the listing on the regulator to be furnished with the gas appliance. (Note: Gas appliances are often furnished with regulators which are only listed for a maximum inlet gas pressures of either 9 or 14 inches water column.) Provide regulator with a flow limiting orifice or with vent piped to outdoors as required by code. Review regulator location and safety issues with the University's Representative on a case by case basis. As a general rule, medium pressure gas should be reduced to low pressure prior to piping through spaces which are normally occupied. Medium pressure gas shall not be permitted in occupied spaces used for student housing or a residence.

B. Valves
   1. Gas piping systems shall be provided with manual isolation valves at the following locations:
      a. At building points of entry.
      b. At each floor where branch piping connects to a riser.
      c. At each gas appliance.
      d. At branch connections to underground system mains.
   2. Gas meters to be installed with all boilers, generators, engine, etc., that may need a permit to operate, and that use natural gas, to allow for gas reporting requirements.

3.1 TESTING AND INSPECTIONS

A. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected, tested, and has been approved by the University.
B. Testing:
   1. All tests on Natural Gas Systems shall be performed in the presence of a Cal Poly representative. Test to be done per California Plumbing code requirements.
   2. Tracer wire must be tested for continuity upon completion, prior to final acceptance.

END OF SECTION