1. General
    a. The Design and Construction Standards (Standards) apply to all District mains, private laterals, and individual service lines.
    b. Additional administrative requirements and terminology are addressed in the District's current Policies, Rules, and Regulations.
    c. The overall distribution system (mains, laterals, service lines, and appurtenances) shall comply with the State of Colorado Design Criteria for Potable Water Systems (current edition).
    d. Privately owned and maintained laterals may utilize their own design and construction standards provided they meet the basic requirements of the distribution system (e.g. pressure, flow, etc.; See Section 5), do not pose a threat to the integrity of the overall distribution system (mains, laterals, service lines, and appurtenances), and comply with federal, state, and local standards.
    e. All materials in contact with water shall meet National Science Foundation/American National Standards Institute (NSF/ANSI) 61: Drinking Water System Components – Health Effects.
    f. All design and construction shall be in accordance with generally accepted practices and industry standard of care.
    g. Where there are conflicts between these Standards and any referenced standard, the more stringent and protective approach shall prevail.
    h. All District owned mains shall be designed to provide fire protection unless otherwise requested of and approved by the District.
2. Reviews and Approvals
    a. Mains and private laterals shall be designed by a licensed professional engineer in the State of Colorado and installed by a qualified licensed contractor in the State of Colorado.
    b. The Lookout Mountain Water District (District) Engineer (District Engineer) must review and approve all main and lateral designs and specifications prior to construction.
    c. Designs and specifications must also receive approval from the responsible entity for the lateral (if applicable), be that a homeowners association, corporation, tenants-in-common, or other entity.
    d. The District Engineer shall be allowed access to the site during construction to observe proper installation.
    e. The District Engineer shall be notified of pressure testing schedule and allowed to witness beginning and ending pressure readings and verify amount of leakage.
    f. Only District authorized operators can open/close valves and approve final connection to the existing distribution system.
3. Permits
    a. Contractors shall obtain all necessary county, state, and federal permits required to complete installation.
    b. Typical permits include right-of-way permits, street cut permits, stormwater discharge permits, and discharge of potable water.

4. Mains
    a. Mains shall be 8-inches nominal internal diameter. Mains of 6-inch, 12-inch, and 16-inch will be reviewed on a case-by-case basis by the District Engineer.
    b. Mains shall create a looped distribution system. Dead end lines of less than 500 feet will be reviewed on a case-by-case basis by the District Engineer.
    c. Mains shall provide fire protection and fire hydrants shall provide a minimum flow of 1500 gallons per minute.
    d. Polyvinyl chloride (PVC) pipe shall meet the current standards of American Water Works Association (AWWA) C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inch Through 60-inch.
        i. PVC shall further meet the following requirements:
            1. For installations above 7,400 feet elevation, DR-18 with a pressure rating of 235 pounds per square inch (psi) shall be used.
            2. For installations above 7,250 feet and below 7,400 feet elevation, DR-14 with a pressure rating of 305 psi shall be used.
            3. PVC pipe shall not be used for any installations below 7,250 feet elevation.
    e. Ductile iron pipe (DIP) shall meet the current standards of AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast and C150 – Thickness Design of Ductile-Iron Pipe.
        i. DIP shall further meet the following requirements:
            1. For all water main and laterals, DIP shall be Class 50 with a pressure rating of 350 psi. DIP may be used for any installation above 7,150 feet elevation. Installations below 7,150 feet elevation will be reviewed on a case-by-case basis by the District Engineer.
            2. For all fire hydrant lines, DIP shall be Class 52.
            3. DIP shall be lined per the current standards of AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
            4. DIP shall be coated with shop-applied asphaltic coating.
    f. Other pipe material will be considered on a case-by-case basis by the District Engineer.
5. Lateral Pipes
    a. Lateral pipes shall meet the following minimum pressure ratings.
        i. For installations above 7,400 feet elevation, a pressure rating of 235 pounds per square inch (psi) shall be used.
        ii. For installations above 7,250 feet and below 7,400 feet elevation, a pressure rating of 305 psi shall be used.
        iii. For installations above 7,150 feet and below 7,250 feet elevation, a pressure rating of 350 psi shall be used.
        iv. Installations below 7,150 feet elevation will be reviewed on a case-by-case basis by the District Engineer.
    b. Minimum pipe size for laterals without fire protection is 3-inch diameter. Minimum pipe size for lateral with fire protection is 6-inch diameter. Recommended size for laterals is 8-inch diameter.
    c. PVC pipe and DIP 4-inch diameter and larger shall comply with the material requirements for mains as specified in these Standards.

6. Fittings
    a. Fittings shall be ductile iron and meet the current standards of AWWA C110 – Ductile-Iron and Gray-Iron Fittings.
        i. Fittings shall be rated to 350 psi.
        ii. Fittings shall utilize mechanical joints and be restrained per the standard details.
        iii. Fittings shall be lined per the current standards of AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
7. Valves
    a. Gate valves shall meet the current standards of AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service and be suitable for buried service.
        i. Gate valves shall be manufactured by Mueller (or District Engineer approved equal).
        ii. Gate valves shall be rated to 350 psi.
        iii. Gate valves shall utilize mechanical joints and be restrained per the standard details.
        iv. Gate valves shall open to the left (counter-clockwise).
    b. Butterfly valves shall meet the current standards of AWWA C504 – Rubber-Seated Butterfly Valves and be suitable for buried service.
        i. Butterfly valves shall be manufactured by Mueller (or District Engineer approved equal).
        ii. Butterfly valves shall be rated to 350 psi.
        iii. Butterfly valves shall utilize mechanical joints and be restrained per the standard details.
        iv. Butterfly valves shall open to the left (counter-clockwise).
    c. Valve boxes shall be Tyler Union 6860 Screw Type Valve Box with #160 Base.
    d. Valves shall be included at the following locations:
        i. Tees (minimum of two valves, three valves preferred)
        ii. Crosses (minimum of three valves, four valves preferred)
        iii. Every 1,000 feet or less along distribution mains and laterals
        iv. Every 2,500 feet for transmission mains
        v. Before or after fire hydrant lines
        vi. Before and after vaults of any kind
8. Fire Hydrants
    a. Fire hydrants shall meet the current standards of AWWA C502-73 – Dry-Barrel Fire Hydrants.
        i. Fire hydrants shall be manufactured by Mueller (or District Engineer approved equal), Super Centurion Model A-423 with a 4-1/2-inch pumper connection and two 2-1/2-inch hose connections.
        ii. Fire hydrants shall be rated to 350 psi.
        iii. Fire hydrants shall open to the left (counter-clockwise).
        iv. Fire hydrants shall be painted red.
    b. Fire hydrants shall be included at the following locations:
        i. Road intersections
        ii. Ends of dead end mains and laterals (may be used in lieu of a blowoff)

iii. Every 1,000 feet or less along distribution mains and laterals in areas along roads or adjacent to active customers.
iv. At roads and other accessible areas for transmission mains (no maximum distance specified)

9. Blowoffs
    a. Blowoffs shall be installed at all low points in the distribution system and at any dead end lines.
    b. Blowoffs shall terminate above grade and include a duckbill-type check valve to prevent backflow and contamination of the distribution system.
10. Specialty Valves
    a. Pressure Reducing Valves (PRV).
        i. PRVs shall meet the current standards of AWWA C530 – Pilot-Operated Control Valves.
        ii. PRVs shall be installed in a horizontal position and located in an underground concrete vault.
        iii. The PRV build shall utilize all stainless steel for tubing, fittings, valves, and other relevant appurtenances.
        iv. PRVs shall be rated to 350 psi.
        v. PRVs shall be set for a pressure drop of no more than 50 psi. Where additional pressure drop is required, multiple PRVs in series shall be used.
    b. Air/Vacuum Release Valves (ARV).
        i. ARVs shall meet the current standards of AWWA C512 – Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
        ii. ARVs shall be installed in a vertical position and located in an underground concrete vault.
        iii. ARVs shall be rated to 350 psi.
11. Concrete Vaults
    a. All PRVs, ARVs, and master water meters shall be located within precast concrete vaults.
    b. Vaults shall be watertight and/or equipped with a floor drain as suitable for the given location.
    c. Vaults shall include appropriate isolation valves such that the relevant piece of equipment (PRVs, ARVs, master water meters, etc.) can be removed and replaced without interrupting water service.
12. Restraints
    a. Mechanical joints shall be restrained per the standard details.
        i. PVC mechanical joint restraints shall be EBBA Iron 2000PV MegaLug.
        ii. PVC pipe restraints shall be EBAA Iron 1700 MegaLug Harness.
        iii. DIP mechanical joint restraints shall be EBBA Iron 1100 MegaLug.
        iv. DIP restraints shall be EBBA Iron 1900 Split Serrated Restraint Harness.
13. Service Lines
    a. Service lines shall be run perpendicular to the main or lateral and no bends or deflections are allowed until after the water meter.
    b. Service lines for residential customers shall be 1-inch diameter from the main to the water meter. 1-inch or 1½-inch diameter will be allowed after the water meter.

c. Service lines for non-residential customers shall be sized based on the water demands, but shall not be larger than 2-inch diameter unless approved by the District Engineer.
d. Service lines ¾-inch to 2-inch diameter shall be seamless Type K copper tubing in accordance with ASTM B88 (no exceptions).
e. Fire service lines shall be 4-inch diameter DIP Class 52 with cement mortar lining and asphaltic coated as specified in Section 4.e.
f. Service lines shall be bedded in well graded sand or squeegee as specified in these Standards.
g. Service lines shall be less than 150 feet in length unless otherwise approved by the District Engineer.
h. Service lines shall be buried a minimum of 6 feet below grade.
i. Service lines shall use a bronze double strapped tapping saddle for the connection to the main or lateral. Alternate connections to small diameter laterals will be reviewed by District Engineer.
j. Service lines shall include a corporation stop at the main that is angled at 45° above horizontal and utilize a tapping saddle.
k. Service lines shall include a curb stop at the property line. The curb stop shall be of the stop and waste type and include a cast iron valve box to grade with extended operating rod.

14. Water Meters
    a. All residential service connections shall include an inside water meter assembly or outside water meter pit and assembly (see Water Meter Details Drawing D1.0).
    b. Outside water meter pits shall be precast concrete in traffic areas. Alternative materials may be used in non-traffic areas (i.e. yard, landscaping, etc.).
    c. The water meter assembly shall include the following components:
        i. Shutoff valves before and after the components listed here.
        ii. A pressure reducing valve rated to 300 psi and set to reduce pressure into the home to a maximum of 75 psi.
        iii. Meter yoke/setter.
        iv. Water meter (provided and installed by District, paid for by customer). The District uses a 1-inch Badger M55 water meter and either a radio or cellular transmitter.
        v. Check valve.
    d. All master meter service connections shall include an appropriately sized and District-approved water meter and be located within an underground concrete vault.
15. Plumbing Requirements
    a. All connections after the water meter shall follow applicable plumbing codes.
    b. All toilets installed for new construction or remodeling projects shall be low flow and use less than 1.5 gallons per flush.
    c. Backflow prevention devices are required on the following connections:

Connection Type	Backflow Prevention Device
Hose Bib	Vacuum Breaker
Irrigation System	Pressure Vacuum Breaker or Reduced Pressure Principle Backflow Assembly

Fire Sprinkler System Solar Heating Systems	Double Check Valve Assembly or Reduced Pressure Principle Backflow Assembly
Photographic Processors and Developers	Reduced Pressure Principle Backflow Assembly
Boilers	Reduced Pressure Principle Backflow Assembly
Water Filling Stations	Air Gap (2 times pipe diameter)

16. Installation
    a. Installation shall be per the standard details and in compliance with the current standards of AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
    b. Bedding material shall be well graded sand or squeegee sand meeting the following gradations:

Well Graded Sand	
Sieve Size	**Percent Passing by Weight**
3/8-inch	100
No. 4	70 – 100
No. 8	36 – 93
No. 16	20 – 80
No. 30	8 – 65
No. 50	2 – 30
No. 100	1 – 10
No. 200	0 – 3
Squeegee Sand	
Sieve Size	**Percent Passing by Weight**
3/8-inch	100
No. 200	0 – 3

    c. Bedding shall be compacted to 95% Standard Proctor in platted streets and rights-of-way and 90% Standard Proctor in easements. Contractor is responsible for compaction testing and providing verification to the District.
    d. Minimum cover shall 6 feet from finished grade to top of pipe.
    e. Tracer wire shall be 12-gauge copper wire (coated) and used on all pipe installations. Test stations shall be set up at a minimum of 500-foot intervals and at every fire hydrant.
    f. Warning tape shall be labeled “Caution: Water Line Below” or equivalent with black lettering on a blue background and be placed on top of bedding material.
    g. Polyethylene wrap shall meet the current standards of AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems and be 8-mil thickness, to be used on all DIP, fittings, and valves. Polyethylene wrap shall be taped tightly with at least three layers of 2-inch wide tape suitable for such use.
    h. Pipe, fittings, valves, and fire hydrants shall be restrained per the standard details.
    i. Fittings, fire hydrants, and plugs shall be protected using concrete thrust blocks per the standard details and in addition to restraints.

17. Disinfection
    a. All pipe shall be disinfected with sodium hypochlorite in accordance with the current standards of AWWA C651 – Disinfecting Water Mains.
    b. Contractor shall provide all necessary connections to perform disinfection.
    c. All pipe disinfection shall be coordinated and verified through the Jefferson County Health Department through bacteriological testing.
    d. Following successful disinfection, the pipe shall be flushed to remove high strength chlorinated water. High strength chlorinated water must be neutralized if discharged to the surface.
18. Pressure Testing
    a. All pipe shall be pressure tested in accordance with the current standards of AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
    b. Contractor shall provide all necessary connections to perform pressure testing.
    c. Pressure testing shall be performed on pipe sections less than 2,000 feet in length.
    d. Pressure testing shall be at a minimum of 150 psi or 150% of static pressure, whichever is greater, but no more than the rated pressure of the pipe.
    e. Pipe shall be filled in a manner to remove all air from the pipe. Pipe shall also be filled slowly to allow air to vent and prevent pressure surges.
    f. The pipe alignment shall be visually inspected for sign of leakage.
    g. Once pressurized, the test shall run for two (2) hours, with allowable leakage rates as follows:

Allowable Leakage		
Pipe Size (inches)	**Gallons per 1,000 feet per hour**	**Gallons per 1,000 feet per 2 hours**
6	0.50	1.00
8	0.66	1.32
12	0.99	1.98
16	1.32	2.64