DESIGN AND CONSTRUCTION STANDARDS FOR POTABLE WATER, RAW WATER, RECYCLED WATER AND WASTEWATER INFRASTRUCTURE

(Latest update always posted at www.gwresources.com)

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Global Water Resources, Inc. ("Global Water") is responsible for the management of various utilities (hereafter "Utility" or "Utilities") and, on behalf of these Utilities, provides the following Standards for Planning and Design of Potable Water, Recycled Water & Wastewater infrastructure ("Standards"). These Standards shall be periodically reviewed and revised with the continued goals to standardize the design standards for the different utilities and to provide a clear and understandable working tool for Developers and Engineers developing within the Utilities' service areas. Global Water strives to maintain the highest level of professionalism and strong working relationships with all our business partners and encourages positive input or request for clarification regarding any of the information contained in this document.

DISCLAIMER

1. Information contained herein is subject to revision and/or modification by Global Water as necessary.

2. The information contained herein is intended as a guide for the Landowner, Developer, Builder, Contractor, and Engineer. Special circumstances may arise on a project where the information, design guidelines, and criteria may be altered at the discretion of Global Water.

3. Questions, clarifications, and/or comments on information contained herein are welcomed. Please contact Global Water should the need arise.

4. It is the responsibility of landowner, Developer, Builder, Contractor, and Engineer to ensure that they have the latest revision of these Standards prior to commencing design.

5. This document is prepared to compliment the Design Details and Operations Standards. Latest copy is available online at www.gwresources.com.

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GENERAL REQUIREMENTS

I. INTRODUCTION

This document has been developed as a guideline to provide minimum criteria for the planning and design of potable water, recycled water, and wastewater systems. It is the responsibility of the Developer, Engineer, and Contractor to comply with all regulatory requirements of Arizona Department of Environmental Quality (ADEQ), Title 18 of the Arizona Administrative Code (AAC), Arizona Department of Water Resources (ADWR), and the standards issued by any Authority Having Jurisdiction (AHJ) within the respective development's area. In the event of a conflict between the planning and design guidelines discussed herein and any applicable Federal, State, County, or local authority, the more stringent requirement shall take precedence.

Technical specifications shall conform to the current Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), American Society for Testing and Materials (ASTM) and the Standards provided herein.

II. GLOBAL WATER DESIGN STANDARDS

All developments must be in full compliance with all applicable Global Water Design Standards ("Design Standards").

The current Design Standards are located on www.gwresources.com.

III. SUBMITTAL REQUIREMENTS

All improvement projects which involve a Global Water Utility system shall be submitted to Global Water for review and acceptance prior to construction. Submittals shall be made in accordance with the policies and procedures established by Global Water Resources and the local governing AHJ in which the system is to be constructed. Refer to Appendix A-1 Flow Chart for Request and Approval of Water and Wastewater Service for information regarding the process for request and approval of service.

Global Water does not assume any responsibility of liability for accepting design and construction documents and tests. Such responsibility and liability remain with developer, engineer of record, surveyor and contractor.

A. Master Plans

Potable Water, Recycled Water and Wastewater Master Plans are required for all proposed

developments. Development master plans shall be prepared in accordance with Global Water planning and design guidelines and must conform to the Global Water - Master Plan. All master plans shall be signed and sealed by a professional Civil Engineer registered in the State of Arizona.

The report shall be submitted to Global Water Resources at 12410 N. 19th Ave. Suite 220, Phoenix, AZ 85027 for review and acceptance. Initial submittal shall include 1 copy in hard-copy format along with 1 copy in electronic format (.pdf for text and AutoCad compatible and .pdf for drawings on flash drive). Upon acceptance by Global Water, final copies shall be provided to Global Water in electronic and hard-copy format. Electronic copies of the approved Master Plan including hydraulic model including input and output files, all electronic AutoCAD and/or GIS files and copy of the master plan in PDF format shall be submitted on a USB flash drive for Global Water acceptance.

At a minimum, the Water and/or Wastewater Master Plan shall include the following:

- A brief description of the project location, site conditions, topographic conditions (on an approved vertical datum), and existing and proposed land use.
- A vicinity map and proposed land use plan which identifies proposed parcel boundaries, street locations, and lotting (if available).
- A description of the water/recycled water/wastewater system design criteria utilized.
- A figure which identifies the proposed and existing water/wastewater system infrastructure, service area, contour data (both existing and proposed), pressure zone boundaries (if applicable), and a phasing plan figure for the proposed development.
- For potable water master plans: Anticipated potable water demands created by the development, including both domestic and fire supply.
- For recycled water master plans: Anticipated recycled water demands required to serve the development.
- For wastewater master plans: Wastewater flows generated within the development.
- A description of the existing and proposed potable water/recycled water/wastewater system.
- A description, location within the project, and timeline of project phasing.
- Conclusions and recommendations of required potable water/recycled water/wastewater infrastructure improvements.
- A figure which labels all junctions/manholes and pipes utilized in the hydraulic model. Proposed pipe diameters shall be labeled and/or color coded which includes a legend defining symbology.
- Project phasing must be submitted to Global Water for review, acceptance and incorporation into the Global Water's existing model(s). (Note: Global Water cannot approve a meter prior to receipt of the approval of construction (AOC) from ADEQ/MCESD or other AHJ. If model homes are required prior to final infrastructure completion, they must be considered a

separate phase).

- A hydraulic model shall be prepared to verify that system design criteria are satisfied during each phase of development. The following data shall be included with the master plan(s):

B. Potable Water

- Model input data tables showing nodes to which demands have been assigned for each scenario: average day, maximum day, peak hour, and maximum day plus fire flow conditions.
- Model output tables for each scenario including discharge, velocity, head loss gradient per foot, and residual pressure for both residential and commercial use, if any. See Appendix A-2 for Global Water - Water System Design Criteria/Summary Output.
- Water System Design Criteria/Summary Output – See Appendix A-2 for sample output requirements.
- Electronic copies of the model shall be provided in a Bentley WATERCAD® or WaterGEMS® compatible format.

C. Wastewater

- Model input data tables showing manholes to which flows have been assigned for each scenario, average flow, and peak flow conditions.
- Model output tables for each scenario that summarize the upstream and downstream nodes, service acreage, number of dwelling units served, average and peak flows, lengths, slopes, inverts, diameters, ground elevations, pipe capacity, percentage of pipe capacity utilized, and peak daily flow velocity for each sewer segment.
- Sewer System Design Criteria/Summary Output – See Appendix A-2 for sample output requirements.
- Electronic copies of the model shall be provided in a SewerGEMS® format.

D. Recycled Water

- Model input data tables showing nodes to which demands have been assigned for each scenario: average day, maximum day and peak hour.
- Model output tables for each scenario including discharge, velocity, head loss gradient per foot, and residual pressure for both residential and commercial use, if any. See Appendix A-2 for Global Water - Water System Design Criteria/Summary Output.
- Water System Design Criteria/Summary Output – See Appendix A-2 for sample output requirements.

- Electronic copies of the model shall be provided in a WaterCad® or WaterGEMS® compatible format.

E. Construction Drawings

One (1-ea) full size (24”x36”) and one (1-ea) reduced size (11”x17”) copy of each construction plan, one (1-ea) copy of any project specifications and one (1-ea) design report (if required) shall be submitted to Global Water for initial and subsequent reviews. For all subsequent reviews, a comment/response form shall be included that identifies all previous comments/redlines and the resolution action taken. Upon final acceptance, two (2-ea) full size (24”x36”) copies and two (2-ea) reduced size (11’’x17’’) copies of all construction plans, one (1-ea) copy of any project specifications and one (1-ea) design report (if required) shall be submitted to Global Water. All plan documents shall be signed and sealed by a professional Civil Engineer registered in the State of Arizona.

All water transmission and distribution mains shall be located within the north or east side of the street. Contact Global Water for resolution of any conflicts.

Plans shall be shown in plan and profile format and shall include the following information:

1. General

- Signature approval block for the appropriate Utility on the cover sheet.
- Benchmark and datum information.
- Horizontal Control.
- Arrow showing accurate North orientation.
- The most current specific Global Water General Notes and Notes to the Contractor.
- Identification and dimensions of all easements and rights-of-way.
- Identification of all existing and proposed utility locations, including overhead utilities.
- Identification of limits of any floodplain, floodway, wash, jurisdictional delineation, Waters of the US, or drainage structure.
- Stationing and offset for all vertical and horizontal bends, valves, any other water main appurtenances, and sewer manholes.
- Identification of pipe size, material, and class.
- Both water and sewer shall be depicted in plan and profile at a minimum scale of 1” = 40’ horizontal and 1” = 4’ vertical and maximum scale of 1” = 20’ horizontal and 1” = 2’ vertical (preferred). Only water lines 12 inches and larger are required to be shown in profile, except when crossing other utilities, are in conflict with other utilities or, require vertical realignment.
- Plan symbols shall be per Global Water Standard Detail 110.

- Existing and proposed ground elevations at the centerline of the water or sewer main.
- Double plan and profile views are not allowed on the same sheet.
- Identification of pipe crossings showing proposed separation.

- For the purposes of clearances (MAG 404), recycled water mains shall be treated as pressure sewer relative to potable and raw water lines. Recycled water mains shall be treated as potable water lines relative to gravity sewer mains and sewer force mains. Storm drains shall be treated as sewers when crossing water, recycled or raw water mains.

2. **Potable Water/Recycled Water**

- Profiles for all vertical realignment sections which include station and elevation of the conflict, station and elevation of all vertical bends, length of ductile iron pipe and appropriate restraining lengths per MAG Standard Details No. 303-1 & 2, or under a set of joint restraint calculations sealed by an Arizona registered civil.
- Locations of water lines shall be per Global Water Standard Detail 404 for interior streets, arterial and collector streets.
- Locations and sizes of water service lines and meter locations.
- Trenching and backfill shall be per Global Water Standard Detail 200.

3. **Sewer**

- Locations and sizes of sewer service lines per Global Water Standard Detail 440.
- Slope, length, and invert elevation of main lines, manholes and stubs for future extensions shall be identified in profile views.
- Profiles shall be provided for each stub or cleanout.
- Locations of sewer lines shall be per Global Water Standard Detail 404 for interior streets, arterial and collector streets.
- Location of proposed sewer service laterals.
- Plans shall identify each sewer manhole diameter and identify watertight covers if required.
- Trenching and backfill shall be per Global Water Standard Detail 200.

IV. EASEMENTS

All pipelines, valves, manholes, or other facilities not located within Global Water-owned property shall be located within street right-of-way, within a dedicated easement, or within tracts designated for utilities. All Public Utility Easements (PUE's) shall be shown on the final plat. All easements shall be prepared on Global Water's standard utility easement form, executed by the

landowner and the Utility. Fully recorded easements within the applicable county shall be required prior to the facilities conveyance to the Utility. Failure to grant adequate easement and right-of-way shall be grounds for Utility to refuse service. (A.A.C. R14-2-405, as amended.)

Dedicated easements shall be a minimum width of 16 feet for water mains less than 12 inches in diameter and shall be a minimum of 20 feet for water mains 12 inches in diameter and larger. The easement requirements are based on water mains with less than 8 feet of cover. Water mains with greater than 8 feet in cover shall be evaluated on an individual basis by Global Water. In no case shall a water main be located within 5 feet of a property line, easement line, masonry block wall footing or within 10 feet of a building foundation.

Dedicated easements shall be a minimum width of 20 feet wide for sewers less than 15 feet in depth and a minimum of 30 feet wide for sewers greater than 15 feet in depth. Sewer depths shall be measured from finished grade to the flow line. The easement width shall be increased by 5 feet if parallel water and sewer mains are to be located within the same easement. In no case shall a sewer line be located within 10 feet of a property line, easement line, masonry block wall footing or within 15 feet of a building foundation.

Where possible, utilities shall be centered in an easement. If one or more parallel water and sewer mains are to be located within the same easement, the easement width shall be determined by overlaying the individual easements as described above and taking the overall limits.

Easements shall be free of obstructions and easily accessible to the Utility. No permanent structures shall be located within the easement. Trees shall not be planted within 10 feet of any water main. Easements shall not be located within storm water retention basins unless otherwise approved by Global Water. Manholes, valves, valve boxes, blow-offs, etc. shall not be located within storm water retention basins.

When Utility discovers that a customer or his/her agent is performing work or has constructed facilities adjacent to or within an easement or right-of-way and such work, construction or facilities poses a hazard or is in violation of federal, state or local laws, ordinances, statutes, rules or regulations, or significantly interferes with Utility's access to equipment, the Utility shall notify the customer or his/her agent and shall take whatever actions are necessary to eliminate the hazard, obstruction or violation at the customer's expense. (A.A.C. R14-2-405., as amended.)

v. DESIGN REPORTS

When a Developer is providing finished plant infrastructure, a design report may be required at

the discretion of Global Water depending on the scope and/or scale of the project. A report shall be required for all well, reservoir, water treatment, disinfection, booster pump station, sewer lift station, and wastewater treatment projects. Reports shall be signed and sealed by a professional Civil Engineer registered in the State of Arizona.

The design report shall include, at a minimum, the following information:

- A detailed site plan meeting requirements described in Section B.
- A detailed Process Flow Diagram.
- Hydraulic calculations (may include model output data as appropriate).
- Pump sizing and selection including pump performance curves, system curves, horsepower requirements, and product cut sheets. For Variable Frequency Drive (VFD) pumps, provide pump performance curves at reduced speeds. System pump curves should be provided demonstrating that the pumps can meet all anticipated demand scenarios, including project phasing.
- Layout drawings including piping, valves, and appurtenances.
- For proposed treatment systems provide water quality data (pre- and post-treatment), proposed treatment method, hydraulic calculations, system operation and maintenance data, including projected O&M costs.
- Required site size and facility layout including requirements for onsite retention, treatment, storage, electrical, and other required facilities, or structures.
- For disinfection systems, proposed disinfection process, generation, storage, environmental controls, storage and containment, and calculations.
- Odor control strategies (where applicable).
- Pump access and removal strategies (where applicable).

VI. MEETING REQUIREMENTS

Mandatory meetings shall include the following:

- Conference call to discuss initial expectations, standards, and requirements.
- A pre-design meeting, if deemed necessary, between the Developer, Developer's Engineer, Contractor and Global Water Engineering team to be conducted at the Global Water corporate Office located at 21410 N. 19th Ave., Suite 220, Phoenix, Arizona 85027 or the Engineering and Construction Department office located at 22590 N. Powers Parkway, Maricopa, AZ 85138
- An onsite pre-construction meeting per Global Water Design and Construction Standards. This meeting shall require attendance by Global Water, Contractor (site superintendent required), local governing authority, Engineer of record and others as required by the local

governing authority.

The Contractor must present copies of all applicable permits prior to the scheduling of the pre-construction meeting. Such applicable permits shall include, but not be limited to, an Approval to Construct and Discharge Authorization as issued by Arizona Department of Environmental Quality (ADEQ), Approval to Construct issued by the Maricopa County Environmental Services Department (MCESD) and/or any other permits required by the local governing authority. If the facilities are exempt from the requirement to obtain an Approval to Construct, a signed letter acknowledging the exemption is required from ADEQ, MCESD, and/or other AHJ.

It shall be responsibility of the Developer, Developer's Engineer, and/or Contractor to schedule the pre-design and pre-construction meetings.

VII. FINAL ACCEPTANCE

Final acceptance of potable water, recycled water or wastewater facilities shall be in accordance with Global Water requirements.

VIII. BILL OF SALE

All water facilities are not deemed fully accepted and the responsibility of the Utility for operations and maintenance until such time as the bill of sale conveyance process has been completed. Please refer to the line extension executed agreement which details the conveyance process and warranty period stipulations.

POTABLE/RAW WATER SYSTEM STANDARDS

I. WATER SYSTEM DESIGN CRITERIA

1. Water Demands

New domestic water systems or extensions shall be designed based on the following criteria:

Land Use	Unit	Average Daily Demand
Residential	Dwelling Unit	250 gpd
Commercial*	Square Foot of Building Acre of Commercial Property	0.125 gpd 2,800 gpd
Industrial*	Acre of Industrial Property	1,800 gpd
School	Student	50 gpd
Parks and Landscaped Open Space	Acre	1,800 gpd

*Does not include high water use commercial/industrial facilities such as restaurants, car washes, bottling plants, etc. Contact Global Water for high water use operations.

The maximum day flow shall be equal to 2 times the average day flow. The peak hour flow shall be equal to 1.7 times the maximum day flow. For preliminary design only, a density of 4.5 dwelling units per acre shall be utilized for single family residential properties without a land use plan. Final design shall be based on the actual density. For utilities within Maricopa County, MCESD standards shall apply.

2. Pressure Requirements

Working pressures within the distribution system shall be between 40 and 80 psi. System pressure shall not drop below 40 psi at any point within the distribution system during peak hour demand. The minimum allowable residual pressure under maximum day demand plus fire flow conditions is 20 psi at all nodes.

3. Fire Flow Requirements

Fire flow requirements shall be in accordance with the local fire department authority in each applicable municipality or the AHJ. The system shall be designed to deliver the required flow rate while maintaining residual pressure and shall provide the minimum required fire-storage volumes. At a minimum, the water system shall be designed to deliver a design fire flow in

accordance with the latest edition of the International Fire Code but not less than 1,000 gpm for residential building less than 3,600 square feet and not less than 1,500 gpm for other buildings and areas while maintaining a residual pressure of 20 psi or more.
Under conditions of Maximum Day Demand and Fire conditions, Global Water Resources is committed to providing a minimum flow of 1,000 gpm for residential areas and 1,500 gpm for other areas while maintaining a minimum residual pressure of 20 psi. Onsite fire suppression system shall be designed based on Global Water Resources minimum fire flow and residual pressure commitment. For fire suppression systems that needs higher flow and or pressure, designer should consider onsite provisions to accommodate fire suppression system needs.

4. Network Analysis

The network analysis for the distribution system shall be analyzed utilizing a hydraulic model such as WaterGEMS or WaterCAD. A model shall be constructed to demonstrate that the proposed system meets the design guidelines established by Global Water. Flow conditions shall be analyzed for average day, maximum day, peak hour, and maximum day plus fire flow.
Input parameters to the model shall include a Hazen-Williams coefficient (C) equal to 130. Water supply pressures shall be determined by a fire hydrant flow test performed as close to the point of connection as practicable. Fire hydrant flow tests are the responsibility of the developer or consulting engineer. The fire hydrant flow test must be scheduled with Global Water in advance and must be witnessed by Global Water personnel along with the AHJ Fire Marshall or associated representative.

The model output shall demonstrate that the water system meets the following criteria:

Under the maximum day scenario, the velocity shall not exceed 5 fps and the head loss gradient shall not exceed 6 feet per 1,000 feet of pipe.

- Under the peak hour scenario, the velocity shall not exceed 6 fps and the head loss gradient shall not exceed 8 feet per 1,000 feet of pipe.
- Under the maximum day plus fire flow scenario, the velocity shall not exceed 8 fps.
- All dead-end cul-de-sacs shall be served with a minimum 8-inch diameter line.

5. Backflow and Cross-Connection

Backflow and Cross Connection will be in accordance with the applicable Utility's Cross-Connection or Backflow Tariff and Design Standards. The Tariff is available at www.gwresources.com.

In any case requiring the installation of a backflow prevention device, the design Engineer shall ensure that head loss through the assembly is accounted for, and that requirements for residual

pressures are satisfied per the AHJ.

6. Galvanic Corrosion Control

galvanic corrosion is the disintegration of metals in the presence of an electrolyte. It can occur wherever dissimilar, joined metals become damp. Pipes, fitting and other water and wastewater systems components shall be protected against galvanic corrosion. Galvanic corrosion can be prevented through several methods:

- Electrically insulate the dissimilar metals. Plastic can be used to separate pipes, fittings, and other components of dissimilar metals.
- Shield the metal from ionic compounds. This is often accomplished by encasing the metals in epoxy or plastic or painting it. Coating or protection should be applied to the two metals.
- Choose metals that have similar potentials. Closely matched metals have less potential difference and, hence, less galvanic current. The best such solution is to build with only one type of metal.
- Electroplate the metals.
- Avoid threaded connections, as they are most severely weakened by galvanic corrosion.

II. WATER SYSTEM CONSTRUCTION STANDARDS

A. Wells

Global Water will assess any existing wells within the proposed development area for inclusion into Utility's potable/raw water inventory. The Developer shall submit all data required for this assessment including but not limited to driller's logs, down-hole video survey, production capacity, and water quality analysis data. Water quality analysis results shall be provided based on a sampling effort conducted after a minimum of a 24-hour flushing period. The Developer/Owner shall be responsible for all efforts and costs associated with providing this well assessment data. Should Global Water determine that any of the existing wells are deemed usable by Utility, the Developer shall be required to provide all necessary deeds and access easements to such sites and complete the transfer of title of the facilities to Global Water Resources Inc.

Well production shall be designed to provide redundant capacity to satisfy the maximum day water demand with the largest production well out of service. Prior to drilling and installing a

well, a “Notice of Intent to Drill” and “Application for a Drilling Permit” must be completed with ADWR. For new wells, design including site location, drilling method, casing material design, gravel/filter pack, sounding tubes, etc. shall be submitted to Global Water for approval.

For any existing or proposed wells deemed unusable by Utility, the Developer shall be responsible for properly abandoning wells in accordance with ADWR requirements. Such wells must be abandoned by ADWR licensed well drillers. Copies of abandonment documentation, including ADWR approval, shall be submitted to Global Water.
At a minimum, well site facilities shall be equipped with the following:

- The minimum well site footprint shall be 150’ x 150’. Larger well site footprint requirements as determined by Global Water Engineering Department may be required for any well that requires treatment.
- The well pump shall be a vertical line shaft turbine type pump.
- Motor control center with reduced current start (soft start) to minimize in-rush current.
- Backup power supply with a fuel reserve adequate for a minimum 12-hour runtime shall be required for mission-critical sites as determined by Global Water.
- Sodium Hypochlorite disinfection facilities if required by Global Water.
- Chlorine analyzers to meet requirements of EPAs Groundwater Rule if necessary.
- Flow metering assembly with a valved bypass.
- Telemetry, communications, control system, programming, integrated to Global Water SCADA systems per Global Water SCADA standards.
- Site security systems that include monitoring and surveillance equipment to allow real time monitoring of the site at all times.
- Perimeter masonry wall is required to be installed that is in accordance with local development codes and shall include an approved type of entry prevention mechanism on top of the wall that is also in accordance with local codes. There will also be a 20-foot access gate, with ability to see into the site, to allow ingress and egress to the site. A separate personnel entry gate shall also be provided.
- Isolation, pump control valves, and combination air valves.
- Instrumentation (pressure gauges, level transducer, flow switches, etc.) satisfactory to Global Water.
- Waste discharge control valve, retention basin, and drywell.
- Onsite drainage and retention in accordance with AHJ.
- Driveway access with area for vehicle space in front of the access gate that is in accordance with the AHJ.

All system components shall be approved listed under NSF/ANSI standard 61 “Drinking Water

System Components" and all chemicals and compounds used in the construction and/or operation shall be approved listed under NSF/ANSI standard 60 "Drinking Water Treatment Chemicals."

B. Booster Pump Station and Storage Facilities

Booster pumps shall be designed to maintain pressures within the minimum and maximum requirements for both domestic use and fire protection. Specifically, booster stations shall be designed to exceed the following criteria with the largest pump out of service (firm capacity):

- Maximum day demand plus fire flow.
- Peak hour demand.

At a minimum, pump stations and storage facilities shall be equipped with the following:

- Variable frequency drives (VFD) with an air-conditioned enclosure.
- Backup power supply with a fuel reserve adequate for a minimum 12-hour runtime.
- Sodium hypochlorite disinfection facilities with controls for flow paced feed system and residual chlorine confirmation. The sodium hypochlorite system shall have ability to feed at the inlet to the tank and prior to the EPDS discharge for residual chlorine level tuning. Peristaltic pump systems shall be provided.
- Chlorine analyzers to meet requirements of EPAs Groundwater Rule.
- Hydropneumatic tank with a pad mounted air compressor and automatic level control.
- Flow metering assembly with a valved bypass.
- Telemetry, communications, control system, programming, integrated to Global Water SCADA systems per Global Water SCADA standards.
- Site security systems that include monitoring and surveillance equipment to allow real time monitoring of the site at all times.
- Perimeter masonry wall is required to be installed that is in accordance with local development codes and shall include an approved type of entry prevention mechanism on top of the wall that is also in accordance with local codes. There will also be a 20-foot access gate, with ability to see into site, to allow ingress and egress to the site. A separate personnel entry gate shall also be provided.
- Isolation and silent type check valves for each pump assembly.
- Instrumentation (pressure gauges, flow switches, etc.) satisfactory to Global Water.
- Pressure relief valves. Pressure reducing valve assemblies.
- Onsite drainage, retention, and drywell in accordance with AHJ.

- Paved access drive in accordance with the AHJ, and paved entry and parking area inside the site. Decomposed granite rock of ¾-inch minus shall be provided on all areas of the site outside of the paved area.

The pump station shall be appropriately equipped to protect the water system from surges and/or water hammer. In addition to hydropneumatic tanks and VFD's, acceptable methods of protection include flow control valves on pump discharges, soft-start motor controllers, and surge anticipator valves.

Acceptable pump types include split case centrifugal and vertical turbine. Pump speeds shall not be greater than 1,800 rpm. Acceptable manufacturers shall include Goulds®, Fairbanks® Morse®, or other manufacturer's as deemed acceptable by Global Water Engineering.

Storage facilities shall be sized to provide a usable storage volume in excess of both of the following criteria:

- Usable capacity to provide 30% of the maximum day demand plus a fire flow reserve.
- Average daily demand during the peak month minus firm well production capacity in accordance with AAC R18-5-503.

The minimum fire flow reserve shall be equal to 120,000 gallons (1,000 gpm for 2 hours). The storage requirement shall be increased as required to conform to the fire flow requirements of the local fire authority or AHJ.

The usable storage volume of a storage facility shall not include any volume that may not be used under normal operating conditions. This includes but is not limited to the volume above the tank overflow level, or the volume below the tank level required for adequate Net Positive Suction Head (NPSHr) for all the pumps provided and operating concurrently.

Steel water storage tanks shall meet the requirements of the American Water Works Association D100. Global Water may require tanks to be equipped with a cathodic protection system. Non-corrosive bedding material shall be required for all tanks. Tanks shall be designed to provide actual useable volume at elevations which provide the NPSH required to the distribution pumps and the necessary freeboard required for overflow and other instrument requirements. Tanks shall be provided with bottom mounted suction pipes. Interior and exterior coating systems and color schemes are subject to approval by Global Water. Commissioning of Ground Storage Tank is controlled by Global Water Acceptance and Recommissioning of Ground Storage Tanks.

All system components shall be approved listed under NSF/ANSI standard 61 "Drinking Water

System Components" and all chemicals and compounds used in the construction and/or operation shall be approved listed under NSF/ANSI standard 60 "Drinking Water Treatment Chemicals."

Additional design criteria is provided in ADEQ Engineering Bulletin No. 10, "Guidelines for Construction of Water Systems" and Engineering Bulletin No. 8, "Disinfection of Water Systems."

All design and construction documents are subject to Global Water review and acceptance. Global Water's review and acceptance shall be based on life cycle costing analysis to be provided by the Engineer of Record.

C. Water Distribution and Transmission Mains

Water mains operate on a grid system and shall be sized as follows:

- 16-inch water mains are required on one-mile alignments (typically on section lines). No water services shall be allowed on 16-inch water mains.
- 12-inch water mains are required on half-mile alignments.
- All internal water mains shall be a minimum of 8-inch lines (with the exception of 6-inch fire hydrant connections) and shall form a looped network.
- Fire hydrants shall be located at the end of all permanent dead-end water lines. Caps with blow-offs as a substitute for fire hydrants are not acceptable.
- Potable water sampling stations shall be provided at locations where required by Global Water.
- Pressure sensors for distribution system monitoring shall be provided at each high elevation point in the system and at alternate two square mile interval locations.
- Fire Hydrants shall be provided on all potable water distribution and transmission lines.

All system components shall be approved listed under NSF/ANSI standard 61 "Drinking Water System Components" and all chemicals and compounds used in the construction and/or operation shall be approved listed under NSF/ANSI standard 60 "Drinking Water Treatment Chemicals."

Acceptable pipe material for potable water main pipe is poly wrapped ductile iron pipe (DIP) or as mandated by the AHJ. All polyethylene wraps shall conform to Global Water's color-coding standards and shall be installed in accordance with section 610.5 of the MAG Specifications. Potable waterlines will be wrapped in Blue poly, Recycled Waterlines wrapped in Purple poly, Sewer Line wrapped in Green poly, and Raw Waterlines wrapped in Black Poly. Pipe identification markings for recycled waterlines shall be in accordance with section 616.4 of MAG Specifications. Installation of polyethylene wrapped ductile iron pipe will be performed using a strap or PVC tape

to prevent damage to the polyethylene wrap. Proposals for alternate pipe materials may be considered by Global Water and shall be submitted in writing by the Engineer.

In no case shall the pressure class of any water main be less than the following:

Pipe Diameter	Minimum Pressure Class
12 inches and smaller	200 psi
14 inches and larger	150 psi

A higher design internal working pressure may be required to account for the occurrence of water hammer or higher working pressures as may be identified in the design report.

Joints shall be restrained when necessary, at a minimum, restrained joints shall be provided at all bends, tees, reducers, line valves, and dead ends. A sufficient length (greater than 10 feet or full pipe stick on vertical realignments) of ductile iron pipe (DIP) shall be installed on either side of each valve or fitting in accordance with MAG Standard Details 303-1 & 2. Field Lok 350 Gasket Joint Restraint as manufactured by US Pipe (or approved equal) shall be used for retrained joint DIP. Concrete thrust blocks as a substitute to restrained joints are not acceptable.

Any transition between pipe material or wall thickness shall be made at a mechanical-joint fitting using gaskets appropriate for each pipe material outside diameter. Transition at a bell shall not be allowed.

In general, 8-inch water mains on local streets including arterial and collector water mains shall be located on the north and east sides of the center line per Global Water Standard Detail No. 404. All water mains shall have a minimum cover of 4 feet over the top of pipe from finished grade.

Ductile iron pipe may be deflected at joints up to a maximum of ½ of the manufacturers recommended deflection angle.

Potable water mains shall maintain a minimum of six (6) feet horizontal and two (2) foot vertical separation from any raw water, recycled water, storm water, or sewer line. Water mains shall not be permitted to be located beneath any raw water, or pressure sewer lines. Raw water mains shall not be permitted to be located beneath any pressure sewer lines. A minimum of two (2) foot of horizontal separation shall also be maintained from any dry utility. All measurements of separation shall be made from the outsides of the pipes, conduit, or other utility infrastructure as shown in MAG 404-1. If minimum horizontal and/or vertical separation requirements cannot be met between potable water and non-potable water lines (sewer, recycled, raw water or storm drain), extra protection shall be provided in accordance with MAG Specification 610.5.5 and

MAG Standard Detail No. 404–3. All locations where extra protection is provided in lieu of adequate separation must be approved by Global Water.

D. Valves

The maximum spacing of water distribution system isolation valves shall be 500 feet. Isolation valves located on transmission mains with no services shall be located no more than 1,500 feet apart. Isolation valves shall also be provided for hydrant branches, wash crossings, railroad crossings, and major highway crossings. Isolation valves are required just prior to the drop fitting at all vertical realignments. Valves shall be treated as dead-ends for the purposes of restrained joint calculations.

At water main intersections, a valve shall be provided for each line at the intersection. Isolation valves at water main intersections shall be located within 10 feet from the center of fitting joining the water mains.

All valves 6-inch to 12-inch shall be U.S. Pipe®, American Flow S-2500®, Clow®, Mueller® or Kennedy® Resilient Seated Gate Valves in accordance with MAG specifications 630.3 and AWWA C509. Isolation valves larger than 12 inches shall be butterfly type in accordance with AWWA standards C504. Valves shall not be located in sidewalks, curbs, gutters, or driveways. Valves shall be located to provide easy access by personnel and heavy equipment. Valves greater than 5 feet in depth shall be provided with extensions.

Air release and vacuum/air relief valves shall be provided on all water system high points for lines 12-inches or greater. Requirements for locations on 8-inch lines within developments shall be determined by Global Water. Air valves shall be provided at vertical relocations. Air valve assemblies shall be constructed per MAG Section 630.6 and in accordance with Global Water standards. To reduce the number of air valves required, the Engineer shall evaluate pipe profiles to maintain constant depth and slope to the greatest extent possible.

E. PRV Stations

Pressure reducing valves (PRV) may be required to maintain pressure within acceptable ranges within the distribution system. Sizing of the PRV shall be based on manufacturer's recommendations and anticipated design flow. Pressure reducing valves are discouraged within the distribution system and typically allowed only for emergency service.

Where pressure zone breaks occur, a hydraulically actuated PRV valve shall be provided. The PRV station shall be provided with the following:

- SCADA remote valve position indication and control.
- SCADA Alarm of failure.
- Inlet and outlet isolations valves.
- All PRVs 8-inch diameter and larger shall be provided with a low flow bypass.
- Valve vault with H20 rated hatch approved by Global Water and stainless steel hardware.
- PRV shall be Bermad®, Cla-Val®, or approved equal.

F. Fire Hydrants

All fire hydrants shall conform to Global Water Standard Detail No. 360-1 or 360-2 as applicable. Refer to the fire hydrant detail for the elevation of the hydrant flange. All hydrants shall be Clow Medallion® or Mueller®, or as approved by Utility. Hydrants selected shall consider consistency within the same development and mixing of different hydrants within the same development is not acceptable unless approved in writing by GWR. Global Water Resources reserves the right to specify the make of the hydrant to be used. Screws and bolts used for hydrants shall be stainless steel. Hydrants shall have a supply line with a minimum of 3 foot bury depth, 5¼-inch main valve opening, one 4½-inch NST pumper connection, and two 2½-inch inch NST hose connections. No substitutions are allowed. All hydrant connections and piping shall be constructed of restrained DIP Hydrants in residential areas shall be installed with the 4½-inch inch pumper nozzle facing the sidewalk or street. All fire hydrants shall be supplied with a shear pad and break- off ring.

The spacing of fire hydrants shall be as approved by the local municipal fire agency or AHJ requirements. Where there is no local municipal fire agency or AHJ, fire hydrants shall be located at minimum of every 1500 feet.

For flushing purposes fire hydrants shall be placed at the end of all dead-end lines where no provisions for future extensions are required. Capped dead-end lines which will be extended in the future may be tapped with a flushing device per MAG Standard Detail 390-B in lieu of a fire hydrant.

Private fire lines, where required, shall be considered on-site facilities and shall require the installation of an approved backflow prevention assembly at each point of connection to the potable water system. All hydrants installed on an onsite fire line shall be painted red to dictate private ownership. Construction, testing and maintenance of onsite facilities shall be the sole responsibility of the Developer/property owner.

G. Service Lines

Water service lines shall be annealed Type K copper tubing. No splices shall be allowed in the service lines between the main and the meter unless required by service length and approved by Utility Inspector. Minimum cover for water service lines shall be 30 inches. Service lines shall have a minimum of 4 inches of sand bedding and backfill. All copper piping for potable services shall be installed with blue poly wrap or protected with a cross wrap of 10-mil tape.

For single services up to 1-inch in size, the saddle shall be 1-inch with a 1-inch corporation stop. For 1½- inch and 2-inch services saddles, corporation valve, and copper shall be the size of the meter to be installed. Service taps shall not be made within 18-inches of pipe bell, fitting, or adjacent service tap. Double services are not accepted by Utility.

Service lines within the right of way beyond the sidewalk shall be constructed outside the dwelling driveway or hardscape areas.

Water meter box locations and specification shall be per Global Water Standard Detail 310-1 or 310-2. The meter box shall not be located in concrete or paved areas. The meter box shall be installed level, with the top of the box 2-inches above finished grade or 1-inch above the adjacent sidewalk. The water meter box shall be installed to open on the street side to facilitate readings. Water meter boxes shall be a non-metal type to facilitate communication with the AMR system. All commercial facilities shall have an individual service connection and meter. Backflow prevention assemblies will be required for all potable water connections serving a commercial building, landscape, fire sprinkler and any area where an unprotected cross connection is possible per AAC R18-4-115. Backflow and Cross Connection will be in accordance with Global Water Design Standards and shall meet the specific backflow prevention tariffs per each Utility.

Meter sizing is the responsibility of the Builder's Architect or Engineer. Within Pinal County only, meters shall be sized based on the total fixture count in accordance with the International Plumbing Code (IPC), 2006. For areas outside of Pinal County, contact Global Water for requirements. Methods for sizing meters are provided in IPC Section 604.
The following table summarizes the capacity of typical meter sizes:

Water Meter Size	Continuous Flow Capacity	Maximum Flow Capacity
5/8-inch x ¾-inch	15 gpm	20 gpm
¾-inch x ¾-inch	15 gpm	30 gpm
1-inch	25 gpm	50 gpm

A ¾-inch x ¾-inch meter is typically the maximum size recommended for residential use. It shall be the responsibility of the Builders Engineer to notify Utility when a larger meter is required (i.e., for sprinkled

homes). All water meters shall be approved by and acquired through Utility. Water meters shall not be provided until applicable testing has been completed and accepted, and Approval of Construction granted by the AHJ where applicable.

Water service connections shall not be made into water mains 16-inches and larger or into lines designated as transmission mains by the Global Water.

Any residential or commercial property where the static pressure exceeds 80 psi shall require individual PRV's on the service line. The PRV shall be located on the customer side of the meter and shall not be the responsibility of Utility. The PRV shall require a separate meter box and cover supplied by the Builder.

Waterlines to be owned by a Global Water Utility shall not be installed on private property unless otherwise approved by Global. In cases where installation of waterlines on private property is necessary to provide service to an adjacent parcel or property, lines shall be installed within an adequate easement. Waterlines required to be installed within private property to provide fire protection shall be considered private fire lines and require installation of an approved backflow prevention device at each point of connection to the potable system. No service connections shall be allowed on such onsite fire lines.

H. Testing and Disinfection Requirements

Water lines shall be pressure and leakage tested in accordance with Global Water Resources Design Standard - Acceptance of Underground Utilities, Appendix "B," Testing. Water lines shall be disinfected per Global Water Design Standard - Construction and Acceptance of Underground Utilities, Appendix "B" Disinfection of Pipelines. Copies of all test results shall be submitted to the Global Water inspector for review and acceptance.

WASTEWATER SYSTEM STANDARDS

I. WASTEWATER SYSTEM DESIGN CRITERIA

A. Design Flows

All design flows used in hydraulic analysis and design shall be as per the latest Global Water Design Standards.

All sewers shall be designed for peak flow conditions. In the absence of flow data, new domestic sewage systems shall be designed based on the following criteria:

Land Use	Unit	Average Daily Demand	Peaking Factor
Residential	Dwelling Unit	234 gpd	Refer to Table 1 of AAC R-18-9-E301.D.1.a
Commercial*	Square Foot of Building Acre of Commercial Property	0.1 gpd 2,200 gpd	2.0 2.0
Industrial*	Acre of Industrial Property	1,200 gpd	2.0
School	Student	25 gpd	4.8

*Does not include high water use commercial/industrial facilities such as restaurants, car washes, bottling plants, etc. Contact Utility for high water use operations.

For preliminary design only, a density of 4.5 dwelling units per acre shall be utilized for single family residential properties without a land use plan. Final design shall be based on the actual density.

B. Hydraulic Design

The minimum allowable slope for an 8-inch sewer shall be equal to 0.0035 ft/ft unless otherwise approved by Global Water. For all other sewer sizes, the sewer lines shall be designed and constructed to provide a minimum velocity of 2.0 feet per second (fps) when flowing full. Hydraulic calculations shall be provided to demonstrate that a flushing velocity in excess of 1.5 fps is attained during peak flow conditions. Global Water may approve exceptions to the flushing velocity requirement in areas of low flow, or where slopes may not be reasonably increased to achieve an appropriate velocity. Increasing pipe diameter to reduce required minimum slope is unacceptable unless minimum velocity criteria can be met. A design Manning's Formula "n" value equal to 0.013 shall be utilized for all pipe materials. Peak design velocities shall be less than 8 fps.

Other than private services, no sewers shall be less than 8 inches in diameter.

The ratio of flow depth in the pipe to the pipe diameter (d/D) shall not exceed 0.75 in peak dry weather flow. Consequently, the maximum sewer design capacity shall be equal to 91% of the full flow capacity at the peak design flow.

All manholes shall have a minimum drop of 0.10 feet across the manhole for all sewers. Design engineer may submit in writing to Global Water for a waiver of this requirement. Global Water may waive this requirement at its own discretion.

Drop manholes shall be constructed in accordance with Global Water standards when the difference between the upstream and downstream sewer inverts is greater than 2 feet. The manhole bottom shall be shaped to prevent solids deposition. Only outside drops shall be acceptable unless the inside manhole diameter is 6 feet or greater.

II. SEWER COLLECTION SYSTEMS CONSTRUCTION STANDARDS

A. Sanitary Sewers

In general, all sewer lines within subdivisions shall be located 6 feet south or west of street centerlines. Horizontal curvilinear sewers shall not be allowed for sewers greater than 24 inches in diameter. For sewers greater than 24 inches, contact Utility.

All sewers with services shall be installed with a minimum cover of six (6) feet above the top of pipe to finished grade unless otherwise approved by Global Water. The depth shall be sufficient to allow for gravity drainage from the ultimate service area as well as allow for future extensions to adjacent service areas when necessary. The depth of the main sewer line and the sewer laterals shall be sufficient to avoid conflicts with water service connections and any dry utilities.

Acceptable pipe materials for gravity sanitary sewer lines shall include the following:

- Sewers 15 inches in diameter and smaller shall be polyvinyl chloride (PVC) SDR-35, SDR-26, or Protecto 401 Ceramic Epoxy lined Ductile Iron Pipe (DIP)
- Sewers larger than 15 inches in diameter shall be PVC, DIP, high density polyethylene (HDPE), or fiberglass reinforced polymer mortar (FRPM)
- All building and house service connections shall be PVC, minimum 4 inches in diameter,
- Approved compression type gasketed sewer fittings shall be used while installing all sewer mains and services except approved glue caps shall be used at the end of services, ol, as approved before construction begins.
- Sewer strap saddles shall not be approved.

The design Engineer shall ensure that depth of cover has been considered in the selection of pipe material and rating. In areas where depth exceeds the allowable capacity of PVC and HDPE pipe, a non-flexible pipe material such as DIP shall be utilized at the discretion of Global Water.

Proposals for alternate pipe materials may be considered by Global Water and shall be submitted, in writing, by the Engineer.

DIP shall include an approved polyurethane or ceramic epoxy interior lining system with a minimum thickness of 40 mils. Each section of pipe and fitting shall be Holiday tested. All DIP shall be wrapped with polyethylene material (encasement) per AWWA C105 and MAG standards. The polyethylene wrap shall conform to Global Water's color-coding standards and MAG 610.5. Potable waterlines will be wrapped in Blue poly, Recycled Waterlines wrapped in Purple poly, Sewer Line wrapped in Green poly, and Raw Waterlines wrapped in Black Poly. Installation of polyethylene wrapped ductile iron pipe will be performed using a strap or PVC tape to prevent damage to the polyethylene wrap.

Buoyancy and the potential for flotation of sewers shall be considered and prevented with appropriate construction where high groundwater levels are anticipated.

B. Manholes

Manholes shall be installed at the end of each line and at all changes in pipe grade, size, material, and alignment. At changes in pipe alignment, the horizontal angle between two intersecting sewer lines shall not be less than 90 degrees. Manholes shall also be used in lieu of a wye fitting for service connections 8 inches in diameter and larger.

Maximum sewer lengths between manholes shall be as follows:

Pipe Diameter (in)	Maximum Spacing (ft)
Less than 15 or less	500
18 to 36	600
Over 36	800

Manholes shall be precast concrete structures in accordance with Global Water Standard Detail 421 with the exception that manhole steps shall not be provided. Structural design of manhole components shall be appropriate to proposed depths; structural calculations may be required at

the discretion of Global Water. Subgrade under all manholes' bases shall be compacted to 95% minimum and a minimum of 4 inches (4") ABC bedding is used and shall be compacted to 95% minimum density to include an area of one (1) foot beyond the manhole diameter.
Hybrid PVC manholes shall be PREDL SYSTEMS^{R} Precast FRP-PVC hybrid manhole system (PREDL PVC Manhole). Hybrid manholes shall be reviewed and approved by the Project engineer of record for structural and durability.

Alternative hybrid manholes by other manufacturers shall be submitted to Global Water for review and acceptance as early as practicable but before finalizing sewer system design. Proposed alternative hybrid manholes reports shall be submitted to Global Water for review and acceptance. Reports shall include testing results, references, specifications, manufacturer requirements and installation recommendations, and other related information.

Global Water Accepted hybrid manholes are required in locations of high hydrogen sulfide potential. Such locations include deep trunk mains, manholes near lift stations, force mains discharge to manholes and manholes near wastewater treatment plants.

On a case-by-case basis, Global Water may require hybrid manholes at additional locations with high hydrogen sulfide potential.

Minimum manhole diameters shall be 48 inches for pipe diameters of 8 to 15 inches less than 10 feet in depth. Manhole diameters shall be 60 inches for pipe diameters greater than 15 inches or for manholes greater than 10 feet in depth measured from the flow line to the manhole rim. The minimum manhole frame and cover diameter shall be 24 inches for 48-inch manholes and 30 inches for 60-inch manholes. In areas where manholes may be subject to occasional flooding from surface runoff, installation of watertight manhole covers shall be required.

Manholes shall be located to be easily accessible by personnel and equipment and are free from obstruction. Manholes shall not be placed in washes, floodways, or drainage basins/structures.

A corrosion resistant coating such as sewer shield 100®, Raven 405®, Oldcastle Utilithane Polyurethane Coating® and Sauereisen Sewerguard-210® Trowelable coating shall be applied to all manholes. Other coatings maybe considered by Global Water on a case-by-case basis. Coatings shall be applied immediately after manhole is raised to final grade. Coatings shall be installed and tested in their entirety in accordance with manufacturer's recommendations.

After application of coatings, and prior to final acceptance, all manholes shall be treated with "Insecta" insect treatment in accordance with manufacturer's instructions. Documentation of treatment and a two-year warranty covering product and application is to be provided to Utility.

Cleanouts may be utilized in place of manholes at dead ends when the sewer length is less than 150 feet. Either a manhole or cleanout shall be provided at the end of all line extensions to allow for cleaning. Cleanouts or manholes shall also be provided at the end of all sewer line stubs for future extensions which are greater than one pipe length to allow for testing.
Manhole covers shall have Global Water Logo stamp as per Global Water Detail No. 199. Additional cover suppliers shall be approved by Global Water.

C. Sewage Force Mains and Pump Stations

Sewage pump stations shall be capable of pumping the peak design wastewater flow with the largest pump out of service. Force main velocities shall be between 3 and 6 fps. Force mains shall be identified by placing marking tape one foot above the pipe along its entire length.
Acceptable pipe materials for pressure sewer pipe include PVC and DIP Proposals for alternate pipe materials may be considered by Global Water and shall be submitted by the Engineer in writing. Pressure class of PVC pipe shall be in accordance with design calculations and shall be AWWA C-900 DR 14 Class 200 or AWWA C- 905 DR 25 Class 165. In no case shall the pressure class of pressured pipe be less than 150 psi.

For pressurized sewer installations, DIP shall include an approved polyurethane or ceramic epoxy interior lining system with a minimum thickness of 40 mils. Each section of pipe and fitting shall be Holiday tested. Encasement of DIP with a color-coded polyethylene wrap in accordance with material per MAG standards shall be required but may be waived at the discretion of Global Water.

Joints shall be restrained when necessary in accordance with MAG Standards. At a minimum, restrained joints shall be provided at all bends, tees, reducers, and dead ends. To provide required restrained joints, DIP shall be installed, and Field Lok 350® restraining gaskets as manufactured by US Pipe, or an approved equal, shall be installed. Thrust blocks as a substitute to restrained joints are not acceptable.

Odor control systems are required at every sewage pump station. The system design shall be submitted to Global Water for review and acceptance. From the perimeter wall of the facility, there shall be a minimum setback of 50’ from the property line of any residential or commercial property in proximity of the sewage pump station. Odor control requirements apply to both the wet well and air release valves.

Wet wells shall be lined with an approved coating system for corrosion protection. T-Loc systems are not acceptable.

Sewage pump station equipment shall be protected from flooding and shall be designed to remain operable during a 100-year storm event. All sewage pump stations shall include an automated backup power supply with a fuel reserve adequate for a 12-hour run time.

At a minimum, pump stations shall be equipped with the following:

- Electrical service per electric Utility requirements.
- Backup power supply with a fuel reserve adequate for a 12-hour runtime.
- Flow metering assembly with a valved bypass.
- Chemical treatment systems as required.
- Odor control system.
- Telemetry, communications, control system, programming, integrated to Global Water SCADA systems per Global Water SCADA standards.
- Site security systems that include monitoring and surveillance equipment to allow real time monitoring of the site at all times.
- Perimeter masonry wall is required to be installed that is in accordance with local development codes and shall include an approved type of entry prevention mechanism on top of the wall that is also in accordance with local codes. There will also be a 20-foot access gate to allow ingress and egress to the site as well as a pedestrian gate.
- Isolation and silent type check valves for each pump assembly.
- Isolation valves shall be eccentric type plug valves.
- Instrumentation (pressure gauges, flow switches, etc.) satisfactory to Global Water.
- Air release valves shall be installed at all high points in the discharge piping. Air release shall be vented into the wet well to minimize odors. Air release valves shall be ARI model D-020 or approved equal.

D. Service Connections

Residential sewer service connections shall be a minimum of 4 inches in diameter, and commercial service connections shall be a minimum of 6 inches. All service line connections shall be installed in accordance with Global Water standards. Taps for future connections shall be marked. Each house or dwelling unit requires a separate sewer service connection.

Service connections within the right of way beyond the sidewalk shall be constructed outside the dwelling driveway or hardscape areas.

Service connections 8 inches and larger in diameter shall be installed directly into a manhole. Direct service connections are not allowed for sewers 18 inches and larger and shall be installed into a manhole. No more than three service taps shall be made into any single manhole. Sewer service line inverts shall be a minimum of 6 inches above the crown of the outflow pipe.

Grease, oil, and/or sand interceptors shall be provided for all facilities when determined necessary by Global Water. For additional details refer to Global Water Design Standard - Wastewater Standards, Section II, Subsections E through N.

After the connection of the dwelling to Global Water sewer, a video inspection of the sewer lateral from the cleanout closest to dwelling to the sewer main.

E. Testing Requirements

Testing shall be performed in accordance with Chapter 9 of Title 18 of the Arizona Administrative Code and Global Water Design Standard, Appendix B-Acceptance of Underground Facilities.

Video inspections and recording shall be performed to all gravity sewer lines and laterals. The maximum allowable gauge depth is 5/8" for all pipe sizes. Inspection report including all Videos recordings shall be submitted to Global Water Resources on a commonly used digital storage device such as a flash drive. Report shall include an executive summary, date and time of inspections, and provided details on segments inspected, observations, recommended and taken actions, videos shall have a digital date and time stamp, and show all inspection stationing for mains and laterals. Inspection report shall be prepared and sealed by the Project Engineer of Record. In addition, after the connection of the dwelling to Global Water sewer, a video inspection of the sewer lateral from the cleanout closest to dwelling to the sewer main.

F. Commercial and Industrial Operations

Global Water Design Standards define the requirements for managing wastes discharged into the Utility's sanitary sewer collection system from commercial and industrial operations. The Requirements provide guidance related to discharge regulations, interceptors, and sampling, as well as record keeping and retention.

Operations regulated by Utility include, but are not limited to, RV parks, food services, dry cleaning, photographic imaging, auto wash and repair facilities, and dental and can be found at www.gwresources.com.

Contact Utility for the most current list of regulated operations or to determine the requirements of commercial and industrial operations which are currently not regulated by a Global Water Requirement.

Installation and maintenance of grease, oil, and sand interceptors shall be the responsibility of the property owner. The design shall be accepted by Global Water prior to installation and shall meet the requirements outlined in the Global Water Design Standards. Minimum maintenance requirements for interceptors are also provided in the Global Water Design Standards.

G. Interceptors and Traps

All non-domestic users of Global Water sewer system engaged in the preparation of any type of food, drink, maintenance/repair of motorized vehicles, wet manufacturing process which generates settable solids, floating solids, or liquids, etc., shall install and maintain, at their expense, pretreatment devices designed to prevent the pass through of pollutants, and/or the introduction of wastewater of the quality which may cause interference, and/or cause nuisances.

All Interceptors and Traps design and plans shall be approved and sealed by a Professional Engineer registered in Arizona.

H. Garbage Grinder/Disposal

Except for domestic sources, users shall not convert solid waste into liquefied waste and introduce such waste into the sewer system by means of a garbage grinder/disposal.

I. Installation of Lint, Sand/Oil, Oil Water Separators, and Hair Traps

Lint, sand/oil, oil/water interceptors, and/or hair traps shall be installed in compliance with the plumbing code and these Standards. Parking structures/areas which have potential to accumulate oils, sand/debris, and require washing shall be designed in such a manner to prevent any rainfall from entering the interceptor and/or trap. Consideration for such use will likely be considered on a case-by-case basis.

J. Installation of Grease Interceptors

Grease interceptors shall be required for all food preparation establishments which would contribute or cause to contribute, directly or indirectly, any wastewater which contains oil or grease, including but not limited to, restaurants, cafeterias, cafes, and fast-food outlets. Additionally, grease interceptors shall be required for all schools, fraternal organizations, churches, hospitals, and daycare centers which have the capability to engage in food preparation. Any food preparation facility that installs an automatic dishwasher shall install a grease interceptor.

Multiple use or “gang” interceptors maybe considered for acceptance by Global Water Resources. If multiple use interceptors are accepted by Global Water, the property owner shall:

1. get all applicable permits and approvals such as but not limited to City of Maricopa or other responsible local authority and Arizona Department of Environmental Quality.

2. Design each grease waste line with double sweep clean-outs at the outside wall of each commercial food source, within five feet of the upstream side of the interceptor and within five feet downstream of each interceptor regardless of the length of run. All other plumbing code requirements for changes in degrees, lengths of run and required clean-outs, shall also apply.

3. Enter into a written agreement with a licensed nonhazardous liquid waste (NHLW) hauler, for the cleaning of all interceptors located within the property. A copy of the written agreement shall be maintained by owner and filed with Global Water prior to start of commercial operations:

   a. A minimum frequency of every 90 days shall be required. More frequent cleaning maybe required by Global Water.

   b. Full pump-outs of interceptors shall be conducted each time.

   c. The NHLW hauler shall provide documentation for disposal of all waste removed from interceptors (manifests), which shall be provided to and maintained by owner and provided by owner to Global Water upon request.

4. Employ a firm that can hydrojet the grease waste lines from each source into each interceptor, at a minimum of every 180 days due to excessive run lengths of the grease lines. A copy of the hydro-jetting cleaning report and waste disposal manifest shall be maintained by Owner and filed with Global Water Resources within 30 days of performance of hydro-jetting.

5. Implement and provide Global Water with copies of the cleaning and maintenance agreements prior to startup of commercial operations.

6. Provide Global Water with copies of the new agreement(s) if any changes and/or modifications to the NHLW and/or hydro-jetting agreements are made within 10 business days of the modification.

7. In case of change of ownership of business, owner or operator shall provide Global Water with the new, revised, or modified agreements to reflect new ownership or business.

8. Maintain copies of all cleaning receipts, records, and manifests on-site at the property for a minimum of Three (3) years from the date of the service.

9. Stipulate in each lease/pad agreement that user is responsible for all maintenance and repairs to each interceptor within the development.

10. Stipulate in each lease that the use of enzymes, surfactants, bio-remediation type products, and any other type products presented/sold as a “maintenance” product shall be prohibited.

11. Prohibit the use of garbage disposals/grinders at all commercial food sources.

12. Report any sanitary sewer overflow (SSO) to Global Water within 15 minutes of becoming aware of the overflow that occurs within user property.

13. Be responsible for all cleanup costs associated with any sanitary sewer overflow within user property.

14. Enter into a written agreement with a firm that is capable of properly mitigating and sanitizing any SSO which may occur within the user property.

K. Interceptor Sizing

The interceptor shall be sized using drainage fixture-unit value as defined in the following table. Using the drain outlet or trap size, these sizes are converted to discharge rates on the basis that one fixture-unit equals 7.5 gpm.

Fixture Outlet or Trap Size (inches)	Drainage Fixture-Unit Value	GPM Equivalent
1 ¼	1	7.5
1 ½	2	15.0
2	2	22.0
2 ½	4	30.0
3	5	37.5
4	6	45.0
Floor drains (all sizes)	2	15.0
Dishwashers	Double Size	

Calculating Interceptor Size. The formula to calculate the size of the interceptor is:

1. Determine total Fixture-Unit value by multiplying fixture type count by drainage value.
2. Total all values.
3. Determine total flow by multiplying total value by flow rate of 3 GPM.
4. Multiply total flow by 12.
5. Round to the next nearest size interceptor.

Except for domestic sources, users shall not install or replace equipment designed to convert garbage or solid waste into liquefied waste and introduce such waste into the Sewer System by means of a garbage grinder/disposal.

L. Requirements for Interceptors

the interceptor shall be:

1. A minimum of 500-gallon capacity, 2-chamber concrete container. Fiber glass and/or other type material must be accepted by Global Water.
2. A maximum of 2500-gallon capacity.

3. When calculated to have a capacity of seven hundred fifty (750) gallons or more, the interceptor must have three (3) chambers, each with a manway.

4. Constructed with inlet piping with a 90-degree elbow and a minimum of an 18- inch down spout.

5. Constructed with the outlet piping with a tee connection and a threaded cover with a minimum of an 18-inch down spout.

6. Installed with a two-way clean-out within five (5) feet before and five (5) feet after the interceptor.

7. Constructed with the appropriate traffic rated cover. The cover(s) must not be marked with any wording indicating it is owned by Global Water.

M. Grease Trap Installation and Sizing

Grease traps are allowed only when there are four (4) or fewer than four (4) fixtures used for food preparation. Any facility installing a dishwasher shall install a grease interceptor. For the purpose of sizing a grease trap, a fixture means the entire unit; e.g., a 3-compartment sink is considered one unit. Grease traps must be installed as follows:

1. A grease trap shall be installed whenever a 3-compartment sink is required by the city and/or the county of jurisdiction.

2. The minimum size grease trap to be installed shall be rated no smaller than fifty (50) gallon-per-minute with a 100-pound grease capacity.

3. A flow restriction device valve shall be installed upstream of the grease trap and vented properly. If placed below floor level, the flow restriction valve must be installed in a manner which allows for inspection and maintenance. If the flow restriction valve is not accessible for inspection and maintenance purposes, the installation will not be accepted.

The following are examples of those facilities that may install a grease trap in lieu of a grease interceptor: Delicatessens, sandwich shops, coffee shops, and pizza take-out facilities (only pizza being served), and ice cream parlors. These facilities must have limited preparation of pre-cooked meals/food, minimal cooking, food preparation and where minimal cleanup from food service would take place. Each facility must obtain written approval from Global Water for the installation of any type of pretreatment device, including all interceptors and traps.

N. Maintenance

Maintenance of grease interceptors, grease traps, and grease receptacles shall be the sole responsibility of owner or operator to ensure proper operation in preventing any obstruction, interference, or damage to the sewage collection system or creating a stormwater violation due to runoff into onsite retention and/or flow of water not comprised entirely of stormwater into the storm drain system.

Use of Chemical or Bacteriological Additives in Interceptors and/or Traps

Enzymes, surfactants, bio-remediation type products, and any other type products presented/sold as a "maintenance" product shall be prohibited.
Global Water recommends that no chemical or bacteriological additive be introduced into the grease interceptors and/or traps. Although these products have beneficial uses in the correct conditions, contact time in pretreatment device, upstream use of disinfection products required by the health department, temperature of effluent flow, and contact with wetted surface area of piping should be considered prior to use of such products. At no time shall any additive be introduced that causes emulsification and/or saponification to occur.

Cleaning Methods

Global Water recommends that only mechanical cleaning take place. At no time shall any additive be introduced that causes emulsification and/or saponification to occur. Contents removed from the interceptor shall be hauled and disposed of off-site in accordance with all Global Water, City, County, State, and Federal regulations that may apply.

Cleaning Requirements

Traps

The contents of the trap shall be pumped at least every 30 business days. All liquid shall be removed from the trap and placed into a suitable container for disposal. The contents of the trap and any wash water shall not be pumped back into any private sanitary sewer, pretreatment device, or any other connection leading to the publicly owned treatment works (POTW). The sidewalls, bottom, and permanently installed baffles shall be scraped to remove all fats, oils, grease, and solids. Trap with removable baffles – the baffle(s) shall be removed, cleaned, inspected, and then re-installed. The cover gasket shall be inspected. If repairs are necessary, they must be made prior to placing the trap back into service. Self-cleaning of grease traps is allowed. Prior to self-cleaning a trap, the owner must produce a written standard operating

procedure and submit to Global Water for acceptance. An Environmental Compliance Inspector will review the procedures and conduct an inspection to review the procedure as the trap is being cleaned. Written documentation will be provided if the process in pace is deemed inadequate. Disposal of the trap contents shall be placed into a suitable storage container and disposed of into a solid waste container only if the trap owner has written permission from the solid waste disposal firm and owner of the solid waste container if the trap owner is not the owner of the solid waste container. If not self-cleaning, the owner of the trap must hire a nonhazardous liquid waste hauler (NHLWH) approved by the county of jurisdiction and permitted by ADEQ and assigned an ADEQ ID number. The NHLWH shall remove all liquid and solids from the trap and pump into the permitted vehicle. The sidewalls, bottom, and baffles shall be scraped to remove all fats, oils, grease, and solids. Trap with removable baffles – the baffle(s) shall be removed, cleaned, inspected and then re-installed. The cover gasket shall be inspected. If repairs are necessary, they must be made prior to placing the trap back into service. The contents of the trap and any wash water shall not be pumped back into any private sanitary sewer, pretreatment device, or any other connection leading to the publicly owned treatment works (POTW).

Fat, Oil and Grease (FOG) Interceptors

The contents of the interceptor shall be pumped at a minimum of at least every 90 business days or more frequently if the solids content reaches 25% of the interceptor volume, or when the final compartment contains more than three (3) inches of grease. At the time of cleaning, all liquid and solid contents shall be removed from ALL compartments of the interceptor. The contents of the interceptor shall be pumped into an approved NHLWH vehicle. The NHLWH shall scrape and rinse all side walls, baffles, and bottom of the interceptor. The rinse water and remaining solids shall be pumped into the approved NHLWH vehicle. Any damage caused by the NHLWH and/or observed by the NHLWH must be reported to Global Water at the time the damage is caused and/or observed. Notification to the owner of the interceptor is to also be made immediately after notifying Global Water. Only full pump outs are authorized. Skimming and partial pumping shall NOT be conducted. The contents shall not be pumped back into any sanitary sewer. The contents of the interceptor and any wash water shall not be pumped back into any sanitary sewer, pretreatment device, or any other connection to Global Water Sewer. After cleaning, the interceptor shall be filled with fresh water only, provided by normal facility discharge from permanently installed fixtures. The use of water hoses to fill the trap is prohibited as it may create a backflow hazard, if at any time the hose is allowed to be placed below the flood plain of the interceptor.

Sand and Oil Separator

The contents of a sand and oil water separator (interceptor) shall be pumped at a minimum of at

least every 180 business days or more frequently if any coating of oil and or sheen is visible in the final compartment and/or when the solids content reaches 25% of the interceptor volume.

Inspection of Pretreatment Device

An inspection of the interceptor and/or grease trap will be completed to ensure compliance with Global Water requirements. The frequency will be, at a minimum, every 12 months, unless Global Water determines, at its discretion, more or less frequent inspections are required. The inspection criteria will include, but is not limited to, the following:

- Location and accessibility
- Capacity in gallons Identification of inlet and outlet compartments and piping
- Identification of inlet and outlet piping systems
- Identification of chemical additives (bacterial or enzymatic uses)
- Approximate capacity (depth) of accumulated solids and grease layer
- Verification of maintenance records

Existing sources not connected to interceptors, or those sources connected to interior grease traps which contribute significant quantities of waste(s), shall be required to implement Best Management Practices (BMPs). In the event BMPs do not successfully reduce quantities of waste being introduced to the collection system, those sources shall be subject to the current installation requirements for upgraded interceptors. BMP inspections will include, but are not limited to, the following:

- Identification and description of plumbing fixtures
- Identification of facility waste reduction procedures
- Identification of facility grease rendering or oil recovery container, where applicable
- Identification of in-line flow control device on grease traps
- Verification of in-line interior grease trap maintenance records
- Identification of chemical use (bacterial or enzymatic uses)
- Facility hours of operation
- Facility schedule of routine drain line maintenance

Global Water will provide written notices to all facilities following inspections indicating if the above procedures are adequate and/or if improvement is required. For those facilities for which improvement is required, Owner/operator of the property shall hire a professional engineer registered in Arizona to identify the source/cause of the inadequacies as soon as practicable. Once the sources/causes of the inadequacies are identified, Global Water will request that the

facility correct the inadequacies as soon as practicable. In the case of cleaning, the action shall be within five working days. For mechanical correction such as plumbing/equipment change, Global Water and facility will reach a consensus, but the correction period shall not be longer than 120 days from the date of written notice. Follow-up inspections will be completed to ensure compliance. Failure to comply will result in further enforcement actions, which ultimately could result in the termination of sewer service.

RECYCLED WATER SYSTEM STANDARDS

I. RECYCLED WATER SYSTEM CONSTRUCTION STANDARDS

A. Recycled Water Distribution and Transmission Mains

Pipelines shall be constructed in accordance with the approved Recycled Water Masterplan. Infrastructure shall be constructed as per Global Water standards and details, MAG 616 and any other associated primacy agency. Valve boxes shall be constructed with square lids to delineate between potable (round) and recycled (square). Purple shall be used for identifying all pipes, DIP poly wrap, valves, meter boxes or any other equipment used for conveying recycled water.

B. Lake Level Control Vault

Lake level control vaults shall be constructed as per the Global Water Standard Detail #321. Installations shall match currently installed facilities with regard to metering, communication, radio's and any other equipment used for controlling the conveyance of recycled water.

DESIGN AND CONSTRUCTION STANDARDS
APPENDICES

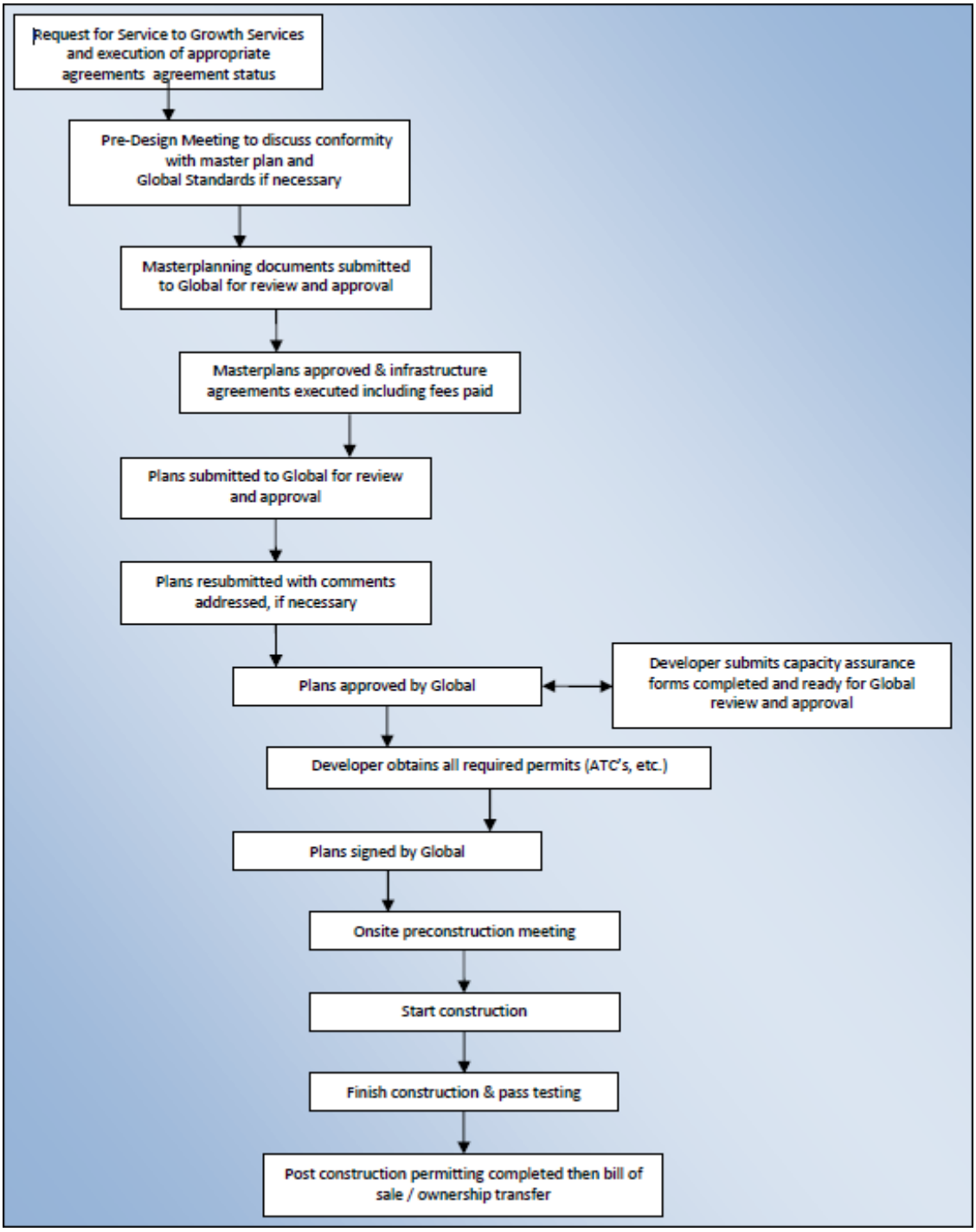
A-1 Flow Chart for Request and Approval of Water and Sewer Service

A-2 Water System Design Criteria/Summary Output

A-3 Sewer System Design Criteria/Summary Output

B ACCEPTANCE OF UNDERGROUND FACILITIES

A-1: FLOW CHART FOR REQUEST AND APPROVAL OF WATER AND WASTEWATER INFRASTRUCTURE



A-2: GLOBAL WATER RESOURCES WATER SYSTEM DESIGN CRITERIA/SUMMARY OUTPUT

COLUMN DESCRIPTION

Junc. # = pressure junction in model where demand is loaded.
Elev. = the elevation above sea level of the pipe junction (finished grade minus 4 ft.). EDU = equivalent dwelling units to be served based on land use plan
Pop. = population at 3.2 persons/EDU Pop.
Loading = demand loading due to population
Acreage = commercial / recreational / industrial acreage to be served based on land use plan Acreage
Loading = demand loading due to commercial / recreational / industrial taken from loading criteria
Calc. Demand = combined demand loading from residential and commercial plus upstream pipe flow HGL = hydraulic grade line
Press. = hydraulic grade line minus junction elevation converted to psi Pipe # = pipe number in the model
H-W C-factor = Hazen Williams roughness coefficient (130 for PVC and ductile iron pipe) Length = pipe length between junctions
Diam. = pipe diameter
Flow = pipe flow. Downstream flow equals the calculated demand at junction. Upstream flow equals flow before junction demand was added. Vel. = water velocity in pipe
HL Grad. = headloss gradient (friction loss in pipe per 1000 ft of pipe)

SCENARIOS:

1.) Average Day Demand = baseline loading criteria from land use plan
2.) Max Day Demand = Average Day Demand x 2.0
3.) Peak Hour = Average Day x 3.4
4.) Max Day Demand + Residential FF = Max Day Demand + 1,500-gpm at each residential junction separately
5.) Max Day Demand + Commercial FF = Max Day Demand + Engineer's recommended demand at each commercial junction separately *but not less than 1,500 gpm.*

JUNCTION SUMMARY										DOWNSTREAM PIPE SUMMARY							UPSTREAM PIPE SUMMARY						
Junc. #	Elev. (ft)	EDU	Pop.	Pop. Loading (gpd)	Acreage (acre)	Acreage Loading (gpd)	Calc. Demand (gpm)	HGL (ft)	Press. (psi)	Pipe #	H-W C-factor	Length (ft)	Diam. (inch)	Flow (gpm)	Vel. (fps)	HL Grad. (ft/1000ft)	Pipe #	H-W C-factor	Length (ft)	Diam. (inch)	Flow (gpm)	Vel. (fps)	HL Grad. (ft/1000ft)

NOTES:

1.) In the absence of an extended period simulation, the minimum residual fire flow pressure is 20 psi at the flowing junction since a 2-hour duration cannot be modeled.
2.) The greater of the fire flows for the local fire department, or GWR, shall govern.
3.) Minimum pipe diameter shall not be less than 8".
4.) Maximum pipeline velocity is 8 fps to avoid transients/scouring.
5.) Maximum headloss gradient is 6 ft/1000 ft.
6.) All junctions shall have a minimum cover of 4 ft.
7.) Junctions are to be placed at all intersections, 90 deg. bends and in the middle of pipe runs over 600 ft.
8.) Spatially allocate demands to junctions using "polygon distribution methods".
9.) HGL of parcel system shall match the existing HGL of the supply.
10.) When population density loading is used, per capita loading shall equal 150 gpcd.
11.) Average and Max Day pressures shall be between 40 psi and 80 psi.

A-3: GLOBAL WATER RESOURCES SEWER SYSTEM DESIGN CRITERIA/SUMMARY OUTPUT

MH# = sewer manhole where hydraulic loading occurs
Rim Elev. = the rim elevation of the MH above sea level. The Rim Elev. should be 6" above grade.
EDU = equivalent dwelling units to be served based on land use plan Pop. = population at 3.2 persons/EDU
Pop. Loading= sewer loading due to population (SEE TABLE A)
Acreage= commercial / recreational / industrial acreage to be served based on land use plan
Acreage Loading= sewer loading due to industrial, etc (SEE TABLE A)
Link No. = downstream pipe to behydraulically loaded
Total Average Line Flow= MH population loading + MH acreage loading + upstream flow
Peak Line Flow= Total Average Line Flow x PF
Line Size, D_2 = downstream pipe/link diameter
Flow Depth, d_2 = water depth in downstream pipe
d/D = depth to diameter ratio (Pipe <= 12" must be 0.5; Pipe > 12" must be 0.75)
Q/Q_{max} = flow capacity percentage of full pipe per ADEQ Bulletin No.11 Figure IV-3
Slope = downstream pipe slope (SEE TABLE B)
Pipe Length= sloped distance between up and downstream MH
Pipe Depth, D_1 = vertical distance between top of pipe at upstream MH and ground surface (SEE TABLE B)
Pipe Depth, D_2 = vertical distance between top of pipe at downstream MH and ground surface (SEE TABLE B)
Velocity, V_2 = downstream pipe velocity (SEE TABLE B)
Line Capacity= max line capacity @ d/D = 1
Number, Fr_2= downstream Froude Number used to indicate flow regime (SEE TABLE C)
Link No. = upstream pipe from MH
Flow Depth, d_1 = water depth in upstream pipe
Velocity, V_1 = upstream pipe velocity (SEE TABLE B)
Froude Number, Fr_1 = upstream Froude Number used to indicate flow regime (SEE TABLE C)

NOTE:

Manning's Equation to be used to determine sewer pipeline design.

$v = (1.486/n)*(A/P^2)^{/3}*(S^{1/2})$
Where:
v = flow velocity, fps
n = Manning's channel roughness coefficient (SEE TABLE D)
A = cross sectional area, ft^2
P = wetted perimeter, ft
S = channel slope or energy grade line, ft/ft

SCENARIOS:

1.) Average Day Demand = baseline loading criteria from land use plan
2.) Max Day Demand = Residential peak factor per AAC R-18-9-E301 Froude

MH#	Rim Elev. (ft)	EDU	Pop.	Pop. Loading (gpd)	Acreage (acre)	Acreage Loading (gpd)	Link No.	DOWNSTREAM: Total Average Line Flow (gpd)	Peak Line Flow (cfs)	Line Size D_2 (inch)	Flow Depth, d_2 (inch)	d/D	Q/Q_{max}	Slope (ft/ft)	Pipe Length (ft)	Pipe Depth, D_1 (ft)	Pipe Depth, D_2 (ft)	Velocity, V_2 (fps)	Line Capacity (cfs)	Froude Number Fr_2	UPSTREAM: Link No.	Flow Depth, d_1 (inch)	Velocity, V_1 (fps)	Froude Number, Fr_1	Is upstream Fr_1 > 1.73 and downstream Fr_2< 1? If so redesign pipes to avoid hydraulic jump in MH.

TABLE A - Sewer Loading Factors

Category	Unit	Value
Residential	gpcd	100
Schools	gpd/stu	d. 25
Commercial	gpd/ac	1500
Industrial	gpd/ac	1700
Light Industrial	gpd/ac	1200

TABLE B - Slope, Velocity and Depth Criteria

Pipe Dia. (inch)	Min Slope (ft/ft)	Max Slope (ft/ft)	Min Vel. (fps)	Max Vel. (fps)	Min. Cover (ft)	Max. Cover* (ft)
6	0.0068	0.105	2	10	6	15
8	0.0035	0.083	2	10	6	15
10	0.0028	0.062	2	10	6	15
12	0.0021	0.049	2	10	6	15
15	0.0018	0.036	2	10	6	15
>= 15	see GWR	see GWR	see GWR	see GWR	6	see GWR

* An approved "drop manhole" per MAG 426 must be used when connecting to a trunk line if existing stub does not match the slope of pipe, or if pipe slope to connect system does not meet design criteria w.r.t. slope/hydraulic jump, for sewer lines greater than 15 ft. deep.
* Main trunk lines greater than 30 ft. deep must requires approval from GWR prior to plan submittal.
* Gravity pipe material / wall thickness for installations greater than 15 ft. deep must be designed to withstand the soil loading.

TABLE C - Hydraulic Jump Coefficients for Circular Channels

d/D	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
C	0.41	0.112	0.198	0.293	0.393	0.494	0.587	0.674	0.745	0.748
C'	0.6	0.8	0.917	0.98	1.0	0.98	0.917	0.8	0.6	

$Fr = V/(g\ y)^{1/2}$
Where:
V = velocity, fps
g = acceleration of gravity,32.2 ft/S^2
y = hydraulic depth = (C/C')D, ft

TABLE D – Manning's Roughness Coefficients

Pipe Material	Manning's "n"
ABS	0.011
ACP	0.011
DIP (lined	0.013
HDPE	0.011
PVC	0.013
VCP	0.013

APPENDIX B: ACCEPTANCE OF UNDERGROUND FACILTIES

Appendix B is located in a separate document that can be located at link below.

https://www.gwresources.com/design-construction-standards