



GLOBAL WATER

**STANDARDS FOR THE PLANNING,
DESIGN AND CONSTRUCTION OF
WATER AND WASTEWATER SYSTEMS**

**March 2005
Rev July 2005
Rev Dec 2006
Rev July 2007**

**Global Water
21410 North 19th Avenue, Suite 201
Phoenix, Arizona 85027
Phone: 623.580.9600
Fax: 623.580.9659**

DISCLAIMER

- 1.) The information contained herein is subject to revision and/or modification by GLOBAL WATER as necessary to insure compliance with all applicable rules and regulations.
- 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.
- 3.) Questions, clarifications, and/or comments on the information contained herein are welcome. Please contact GLOBAL WATER.
- 4.) It is the responsibility of landowner, developer, builder, contractor, and engineer to insure that they have the latest revision of this Manual prior to commencing design.

TABLE OF CONTENTS

WATER SYSTEM STANDARDS

| | |
|---|---------|
| I. GENERAL REQUIREMENTS..... | Page 5 |
| A. Introduction | |
| B. Code of Practices | |
| C. Submittal Requirements | |
| 1. Master Plans | |
| 2. Construction Drawings | |
| 3. Design Reports | |
| D. Meeting Requirements | |
| E. Final Acceptance | |
| II. WATER SYSTEM INFRASTRUCTURE..... | Page 8 |
| A. Wells | |
| B. Booster Pump Stations and Storage Facilities | |
| C. Water Distribution and Transmission Mains | |
| D. Valving | |
| E. Fire Hydrants | |
| F. Service Lines | |
| G. Easements | |
| H. Testing and Disinfection Requirements | |
| III. WATER SYSTEM DESIGN CRITERIA..... | Page 14 |
| A. Water Demands | |
| B. Pressure Requirements | |
| C. Fire Flow Requirements | |
| D. Network Analysis | |

WASTEWATER SYSTEM STANDARDS

| | |
|------------------------------|---------|
| I. GENERAL REQUIREMENTS..... | Page 16 |
| A. Introduction | |
| B. Code of Practices | |
| C. Submittal Requirements | |
| 1. Master Plans | |
| 2. Construction Drawings | |
| 3. Design Reports | |
| D. Meeting Requirements | |
| E. Final Acceptance | |

II. SEWER COLLECTION SYSTEMS.....Page 19
A. Sanitary Sewers
B. Manholes
C. Design Flows
D. Hydraulic Design
E. House and Building Service Connections
F. Commercial and Industrial Operations
G. Easements
H. Testing Requirements

III. SEWAGE PUMP STATIONS.....Page 23

APPENDICES

A. FLOW CHART FOR REQUEST AND APPROVAL OF WATER AND SEWER SERVICE

GLOBAL WATER WATER SYSTEM STANDARDS

I. GENERAL REQUIREMENTS

A. Introduction

This document has been developed as a guideline to provide minimum criteria for the planning, design, and construction of water systems. It is the responsibility of the developer/engineer to comply with the requirements of the Arizona Department of Environmental Quality (ADEQ) in Title 18 of the Arizona Administrative Code (AAC), the Arizona Department of Water Resources (ADWR), and the standards issued by an authority having jurisdiction. In the event of a conflict between the Global Water Resources (GLOBAL) design guidelines discussed herein and any applicable federal, state, county, or local authority, the more stringent requirement shall take precedence.

Technical specifications and standard details shall conform to the current Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), any GLOBAL supplements thereto, and as modified herein.

B. Codes of Practice

All development must be in compliance with current GLOBAL Codes of Practice (COP).

C. Submittal Requirements

All improvement projects which involve the GLOBAL water system shall be submitted for GLOBAL review and approval prior to construction. Submittals shall be made in accordance with the policies and procedures established by the local governing authority in which the system is to be constructed. Refer to Appendix A for additional information regarding the process for request and approval of service.

1. Master Plans

A Water Master Plan is required for all proposed developments. Development master plans shall be prepared in accordance with GLOBAL design guidelines and must conform to the GLOBAL Water Master Plan for the region. A minimum of 3 copies shall be submitted to GLOBAL prior to final plan submittal. Hydraulic model output files along with AutoCAD files shall be submitted on a CDR disk with the master plan.

At a minimum, master plans 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 system design criteria utilized.
- A figure which identifies the proposed and existing water system infrastructure, water service area, contour data, and pressure zone boundaries (if applicable).
- Anticipated water demands created by the development, domestic and fire supply.
- A description of the existing and proposed water system.
- A description, location within the project, and timeline of project phasing.
- Verification that adequate pressures and flows are available under anticipated peak demand conditions through the use of a hydraulic model (preferably WaterCAD).
- A figure which labels all junctions and pipes utilized in the hydraulic model. Proposed pipe diameters shall be labeled as well.
- Model output tables for average day, maximum day, peak hour, and maximum day plus fire flow conditions including discharge, velocity, head loss gradient per foot, and residual pressure for both residential and commercial use, if any. Refer to Paragraph A of Section III for requirements.

All master plans shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

2. Construction Drawings

All water mains shall be located to the north or east side of the street. Contact GLOBAL for resolution of any conflicts.

Water main plans shall be shown in plan and profile format and shall include the following information:

- Water main stationing and offset for all bends.
- Signature approval block for the appropriate water utility provider on the cover sheet.
- Benchmark and datum information.
- Profiles for all dip 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 303-1 & 2.
- GLOBAL standard water notes.

- Existing and proposed ground elevations at the centerline of the water main.
- Locations and sizes of water service lines and meter locations.
- Identification of pipe crossings showing proposed separation.
- Identification of existing and proposed utility locations.
- Identification and dimensions of easements and right-of-ways.
- Both water and sewer in plan and profile with a scale of 1"= 40' horizontal and 1"= 4' vertical. Only water lines 12" and larger need to be shown in profile, except when smaller lines are in conflict with other utilities and require vertical realignment.

All plan documents shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

3. Design Reports

A design report may be required at the discretion of GLOBAL depending on the scale of the project. A report shall be required for all booster pump station projects. Reports shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

D. Meeting Requirements

Mandatory meetings shall include the following:

- A pre-design meeting between the developer, engineer, GLOBAL, and the local governing authority.
- An onsite pre-construction meeting between the contractor, the GLOBAL inspector, and the local governing authority.

The contractor must present all applicable permits prior to or during the pre-construction meeting including, but not limited to, all ADEQ permits and any permits required by the local governing authority.

It shall be responsibility of the developer, engineer, and/or contractor to schedule the pre-design and pre-construction meetings.

Refer to Appendix A for additional information related to meeting requirements.

E. Final Acceptance

Final acceptance of water mains shall be in accordance with GLOBAL Code of Practice GLOBAL-CP-01-008 Acceptance of Underground Facilities, provided in Appendix A.

No new utilities will be accepted by GLOBAL until the following occurs:

- All installed facilities have been inspected, tested, and approved.
- A copy of all test reports, including trench compaction tests, and inspections has been provided to GLOBAL.
- All punchlist items required by the GLOBAL inspector have been addressed.
- Sealed as-built drawings (by the Engineer of Record or a Registered Land Surveyor) have been submitted to and approved by GLOBAL.
- A signed ADEQ “Certificate of Approval of Construction” has been provided to GLOBAL.
- Developer has furnished copies of the contract, copies of all checks paid to the Contractor, and UNCONDITIONAL LIEN WAIVERS from the Contractor.
- Any other outstanding issues.

Approved as-built drawings provided to GLOBAL shall consist of three 11”x 17” hardcopy sets and one CDR disk in dwg format.

II. WATER SYSTEM INFRASTRUCTURE

A. Wells

GLOBAL will assess existing wells in the development area for inclusion in the utility’s potable/raw water inventory.

Well production shall be designed to meet the maximum day water demand with one well out of service. Well sites shall be equipped with a backup power supply sized for a 12 hour run time.

Prior to drilling and installing a well, a “Notice of Intent to Drill” and “Application for a Drilling Permit” must be completed with the ADWR.

Developers shall be responsible for properly abandoning wells in accordance with ADWR requirements. All wells must be abandoned by ADWR licensed well drillers.

B. Booster Pump Station and Storage Facilities

Storage facilities shall be sized to exceed both of the following criteria:

- 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.

Steel water storage tanks shall meet the requirements of the American Water Works Association D100. Tanks may be equipped with a cathodic protection system at the

discretion of GLOBAL. Non-corrosive bedding material shall be required for all tanks. Interior and exterior coating systems and color schemes are subject to approval by GLOBAL.

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 both of 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 12 hour runtime.
- Disinfection facilities.
- Hydropneumatic tank with a pad mounted air compressor and automatic level control.
- Flow metering with a valved bypass assembly.
- Telemetry and control system integrated to GLOBAL SCADA systems.
- Six foot high perimeter masonry wall with a 12 foot access gate.
- Isolation and silent type check valves for each pump assembly.
- Instrumentation (pressure gauges, flow switches, etc) satisfactory to GLOBAL.

The pump station shall be equipped appropriately 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. Pumps speeds shall not be greater than 1800 rpm.

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".

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 looped 8 inch lines (with the exception of 6 inch fire hydrant connections).

- Fire hydrants shall be located at the end of all permanent dead end water lines. Caps with blowoffs as a substitute for fire hydrants are not acceptable.

Acceptable pipe materials for water main pipe include polyvinyl chloride (PVC) and poly wrapped ductile iron pipe (DIP). Proposals for alternate pipe materials may be considered by GLOBAL and shall be submitted in writing by the Engineer. The minimum pressure class of PVC pipe shall be AWWA C-900 DR 14 Class 200 (12 inches in diameter and less) or AWWA C-905 DR 25 Class 165 (larger than 12 inches in diameter). In no case shall the pressure class of any water main be less than the following:

| Pipe Diameter | 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.

Joints shall be restrained when necessary in accordance with MAG Standards. Field Lok 350 Gasket Joint Restraint shall be used for DIP. At a minimum, restrained joints shall be provided at all bends, tees, reducers, line valves, and dead ends. Concrete thrust blocks as a substitute to restrained joints are not acceptable unless otherwise approved by GLOBAL.

In general, 8 inch water mains on local streets shall be located on the north and east sides of the right-of-way a minimum of 1.5 feet behind the sidewalk. Arterial and collector water mains shall be located on the north and east sides of the right-of-way per GLOBAL standard detail No. 404. All water mains less than 12 inches in diameter shall have a minimum cover of 3 feet over the top of pipe from finished grade. All water mains 12 inches and larger shall have a minimum cover of 4 feet over the top of pipe from finished grade.

All water lines shall be marked with locator tape (blue in color). The tape shall be located within the water main trench approximately 1 foot above the pipe. All DIP shall be wrapped with polyethylene material (encasement) per AWWA C105 and MAG standards. The encasement material shall be blue in color for potable water mains.

Allowable deflections are as follows:

| Type | Size | Max. Joint Deflection | Max. Offset Per joint | Min. Radius |
|-------------|-------------|------------------------------|------------------------------|--------------------|
| PVC | 8"-12" * | N/A | N/A | 300 feet |
| PVC | 14"-24" | 1.5 Degrees | 6.25 inches | 764 feet |
| DIP | 8"-12" | 2.5 Degrees | 9.4 inches | 413 feet |
| DIP | 14"-16" | 2.0 Degrees | 7.5 inches | 516 feet |
| DIP | 18"-24" | 1.5 Degrees | 5.7 inches | 688 feet |

* Note: Deflection at the joint of PVC water mains 12 inches or less is not allowed. The curve shall be accomplished by bending the pipe rather than deflecting the joints. There shall be no deflection in the joints upon completion to avoid over-stressing the bell and preventing possible breakage and/or leaks.

If deflection criteria can not be met, an appropriate fitting shall be installed.

In the event that minimum horizontal and/or vertical separation requirements cannot be met between water and sewer, the water main shall be constructed of restrained joint DIP or both the water and sewer shall be concrete encased in accordance with MAG 404-1 and 2.

D. Valving

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 valving shall also be provided for hydrant branches, wash crossings, railroad crossings, and major highway crossings.

At water main intersections, the minimum number of valves required shall be one less than the total number of water lines. At the discretion of GLOBAL, the total number of valves required may be equal to the total number of water lines.

All valves shall conform to MAG specifications. All 12 inch and smaller isolation valves shall be resilient wedge gate valves. Isolation valves 16 inches and larger shall be either gate valves or butterfly valves.

Valves shall not be located in sidewalks, curbs, or driveways. Contractor shall furnish one valve key of suitable length for all valves prior to final acceptance. Valves greater than 5 feet in depth shall be provided with extensions.

Air release and vacuum/air relief valves shall be provided at all water system high points in accordance with MAG Section 630.6 and shall be constructed in accordance with GLOBAL standards.

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.

E. Fire Hydrants

All fire hydrants shall conform to GLOBAL Detail No. 360. Refer to the fire hydrant detail for the elevation of the hydrant flange. Within Pinal County service areas, all hydrants shall be CLOW MEDALLION with a minimum of 3 foot bury depth, 5-1/4 inch main valve opening, one 4-1/2 inch NST pumper connection, and two 2-1/2 inch NST

hose connections. No substitutions are allowed. Fire hydrants within service areas outside of Pinal County shall be in accordance with the local fire authority.

All hydrant connections shall be constructed of restrained DIP. Hydrants in residential areas shall be installed with the 4-1/2 inch pumper nozzle facing the sidewalk or curb.

The spacing of fire hydrants shall not be more than 800 feet unless a shorter distance is required by the local fire authority.

Fire hydrants shall be placed at the end of all dead end lines (with no plans for future extensions) for flushing purposes. 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.

F. Service Lines

Water service lines shall be Type K soft copper tubing with no splices in the service lines between the main and the meter. Minimum cover for water service lines shall be 30 inches.

Service saddles for PVC water main shall be wide-strap full circle bronze as manufactured by Mueller Model H-13000 or an equal approved by GLOBAL. For both single and double services, the saddle shall be 1 inch with a 1 inch corporation stop. Adjacent service saddles shall be a minimum of 18" apart on the main line.

The water meter box location and specification shall be per GLOBAL detail 310. The meter box shall not be located in concrete or paved areas. The meter box shall be 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.

All commercial facilities shall have their own service connection and meter. Backflow prevention assemblies will be required for all commercial building potable water connections, landscape, fire sprinkler and any area where the possibility of an unprotected cross connection is possible per AAC R18-4-115.

Within Pinal County only, meters shall be sized based on the total fixture count in accordance with the International Plumbing Code (IPC), 2000. For areas outside of Pinal County, contact GLOBAL for requirements. Methods for sizing meters are provided in IPC Section 604. Meter sizing is the responsibility of the builder's engineer.

The following table summarizes the capacity of typical meter sizes:

| Water Meter Size | Continuous Flow Capacity | Maximum Flow Capacity |
|-------------------------|---------------------------------|------------------------------|
| 5/8 inch x 3/4 inch | 15 gpm | 20 gpm |
| 3/4 inch x 3/4 inch | 15 gpm | 30 gpm |
| 1 inch | 25 gpm | 50 gpm |

A 3/4 inch x 3/4 inch meter is typically the maximum size recommended for residential use. It shall be the responsibility of the builders engineer to notify GLOBAL when a larger meter is required (i.e. for sprinkled homes). All water meters shall be manufactured by AMCO and shall only be acquired through GLOBAL.

Water service connections shall not be made into water mains 14 inches and larger or into lines designated as transmission mains by GLOBAL.

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 GLOBAL. The PRV shall require a separate meter box and cover supplied by the builder.

G. Easements

All water mains shall be located within street right-of-way, within a dedicated easement, or within tracts designated for utilities. All PUE's shall be shown on the final plat.

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. If parallel water and sewer mains are to be located within the same easement, the easement width shall be based on sewer depth as follows:

| Parallel Sewer Depth | Easement Width |
|-----------------------------|-----------------------|
| Less than 15 feet | 25 feet |
| Greater than 15 feet | 30 feet |

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.

Easements shall be free of obstructions and easily accessible to GLOBAL. No permanent structures shall be located within the easement. Trees shall not be planted within 10 feet of any water main. Valves, valve boxes, blowoffs, etc. shall not be located within storm water retention basins.

H. Testing and Disinfection Requirements

Water lines shall be pressure and leakage tested in accordance with MAG Section 610.14. Water lines shall be disinfected per ADEQ Engineering Bulletin No. 8 or AWWA C651-86. Copies of all test result shall be given to the GLOBAL inspector.

III. WATER SYSTEM DESIGN CRITERIA

A. Water Demands

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

- Demands for residential development shall be equal to:
 - Average day demand = 250 gpd per dwelling unit
 - Maximum day demand = 495 gpd per dwelling unit.
 - Peak hour demand = 841 gpd (0.584 gpm) per dwelling unit.
- The average day demand for commercial facilities shall be based on 0.125 gallons per square foot of building area. For master planning purposes, it shall be assumed that the building area occupies 50% of the total commercial land area to account for open space and parking. Accordingly, the average day demand shall be equal to 2,800 gpd per acre of commercial property. Contact GLOBAL for high water use operations such as restaurants, car washes, etc.
- The average day demand for a school facility shall be based upon 50 gallons per day per student.
- Parks and open space tracts shall be assumed to create an average day water demand equal to 1,800 gpd per acre.

The maximum day flow shall be equal to 1.8 times the average day flow with a 10% allowance. Consequently, the maximum day flow shall be equal to 1.98 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 3.5 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. 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 pressure under maximum day demand plus fire flow conditions is 20 psi.

C. Fire Flow Requirements

Fire flow requirements shall be in accordance with the local fire department authority. At a minimum, the water system shall be designed to deliver a fire flow of 1,000 gpm for 2 hours without reducing the system to below 20 psi residual pressure.

D. Network Analysis

The network analysis for the distribution system shall be analyzed utilizing a hydraulic model such as WaterCAD. A model shall be constructed to demonstrate that the proposed system meets the design guidelines established by GLOBAL. 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.

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.

GLOBAL WATER WASTEWATER SYSTEM STANDARDS

I. GENERAL REQUIREMENTS

A. Introduction

This document has been developed as a guideline to provide minimum criteria for the planning, design, and construction of wastewater collection and pumping systems. It is the responsibility of the developer/engineer to comply with the requirements of the Arizona Department of Environmental Quality (ADEQ) in Title 18 of the Arizona Administrative Code (AAC), and the standards issued by an authority having jurisdiction. In the event of a conflict between the Global Water Resources (GLOBAL) design guidelines discussed herein and any applicable federal, state, county, or local authority, the more stringent requirement shall take precedence.

Technical specifications and standard details shall conform to the current Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), any GLOBAL supplements thereto, and as modified herein.

B. Codes of Practice

All development must be in compliance with current GLOBAL Codes of Practice.

C. Submittal Requirements

All improvement projects which involve the GLOBAL sanitary sewer collection system must be submitted for GLOBAL review and approval prior to construction. Submittals shall be made in accordance with the policies and procedures established by the local governing authority in which the system is to be constructed. Refer to Appendix A for additional information regarding the process for request and approval of service.

1. Master Plans

A Wastewater Master Plan is required for all proposed developments. Development master plans shall be prepared in accordance with GLOBAL design guidelines and must conform to GLOBAL Master Wastewater Plan for the region. A minimum of 3 copies shall be submitted to GLOBAL prior to final plan submittal. AutoCAD files shall be submitted on a CDR disk with the master plan.

At a minimum, master plans 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.
- A description of the wastewater system design criteria utilized.
- A map which identifies the proposed wastewater infrastructure and the wastewater service area with contour data, both existing and proposed.
- Anticipated wastewater flows generated within the development.
- A description of the existing and proposed wastewater system.
- A description and timeline of project phasing.
- A spreadsheet which summarizes 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.

All master plans shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

2. Construction Drawings

Gravity sewer plans shall be shown in plan and profile format and shall include the following information:

- Sewer stationing and offset.
- Signature approval block for the appropriate wastewater utility provider.
- Benchmark and datum information.
- Plan view and profile format.
- GLOBAL standard sewer notes.
- Existing and proposed ground elevations at the centerline of the sewer.
- Locations and sizes of sewer service lines per GLOBAL details 404 and 440.
- Slope, length, and invert elevation of main lines, manholes and stubs for future extensions.
- Identification of pipe crossings and proposed separations.
- Identification of existing utility locations.
- Identification and dimensions of easements and right-of-ways.
- Both water and sewer in plan and profile with a scale of 1"= 40' horizontal and 1"= 4' vertical. Only water lines 12" and larger need to be shown in profile, except when smaller lines are in conflict with other utilities and require vertical realignment.

All plan documents shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

3. Design Reports

A design report may be required at the discretion of GLOBAL depending on the scale of the project. A report shall be required for all proposed lift station projects. Reports shall be signed and sealed by a professional civil engineer registered in the State of Arizona.

D. Meeting Requirements

Mandatory meetings shall include the following:

- A pre-design meeting between the developer, engineer, GLOBAL, and the local governing authority.
- An onsite pre-construction meeting between the contractor, the GLOBAL inspector, and the local governing authority.

The contractor must present to GLOBAL all applicable permits prior to or during the pre-construction meeting including, but not limited to, all ADEQ permits and any permits required by the local governing authority.

It shall be responsibility of the developer, engineer, and/or contractor to schedule the pre-design and pre-construction meetings.

Refer to Appendix A for additional information related to meeting requirements.

E. Final Acceptance

Final acceptance of gravity sewers, force mains, and manholes shall be in accordance with GLOBAL Code of Practice GLOBAL-CP-01-008 Acceptance of Underground Facilities.

No new utilities will be accepted by GLOBAL until the following occurs:

- All installed facilities have been inspected, tested, and approved.
- A video survey of the entire infrastructure has been completed and approved by GLOBAL.
- A copy of all test reports, including trench compaction tests, and inspections has been provided to GLOBAL.
- All punchlist items required by the GLOBAL inspector have been addressed.
- Sealed as-built drawings (by the Engineer of Record or Registered Land Surveyor) have been submitted to and approved by GLOBAL.
- A signed ADEQ "Certificate of Approval of Construction" has been provided to GLOBAL.

- Developer has furnished copies of the contract, copies of all checks paid to the Contractor, and UNCONDITIONAL LIEN WAIVERS from the Contractor.
- Any other outstanding issues.

Approved as-built drawings provided to GLOBAL shall consist of three 11"x 17" hardcopy sets and one CDR disk in dwg format.

Water meters will NOT be installed to any water service location until the sewer system is acceptable per GLOBAL Code of Practice GLOBAL-CP-01-008, all easements have been signed and recorded, and a video tape (mainline and services) has been reviewed and approved by GLOBAL.

II. SEWER COLLECTION SYSTEMS

A. Sanitary Sewers

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

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. 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 side (house) sewers shall be sufficient to avoid conflicts with water service connections and 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 or ductile iron (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.

Proposals for alternate pipe materials may be considered by GLOBAL 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.

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.

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 12 | 500 |
| 12 to 15 | 500 |
| 18 to 36 | 600 |
| Over 36 | 800 |

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.

Manholes shall be precast concrete structures in accordance with MAG standard detail with the exception that manhole steps shall not be provided. Minimum manhole diameters shall be 48 inches for pipe diameters of 8 to 15 inches. 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.

Manholes located in washes shall be constructed in accordance with Standard Detail No. 3. The top of sewer pipe located within washes shall be located a minimum of two feet below the scour depth.

C. Design Flows

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:

- Residential flows shall be based upon 234 gpd per dwelling unit and a dry peaking factor based upon tributary population in accordance with Table 1 of AAC R-18-9-E301.D.1.a.

- Commercial average day flows shall be based on 0.10 gallons per square foot of building area. For master planning purposes, it shall be assumed that the building area occupies 50% of the total commercial land area to account for open space and parking. Accordingly, the average day flow shall be equal to 2,200 gpd per acre of commercial property. The commercial peak flow shall be equal to 2.0 x average day flow.
- School average day flows shall be based upon 25 gallons per day (10 hour day) per student with a peaking factor of 2.0 x average day flow.
- Open space tracts shall be assumed to generate no wastewater flow.

For preliminary design only, a density of 3.5 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.

D. Hydraulic Design

The minimum allowable slope for an 8 inch sewer shall be equal to 0.0035 ft/ft unless otherwise approved by GLOBAL. 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. 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.

Manholes shall have a minimum drop of 0.10 feet across the manhole for all sewers with intersecting angles. When sewers with different diameters enter a manhole, the upstream pipe shall not have its crown lower than the crown of the downstream pipe.

Drop manholes shall be constructed in accordance with MAG 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.

E. House and Building 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 MAG standards. Taps for future connections shall be marked. Each house or dwelling unit requires a separate sewer service connection.

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. Refer to Paragraph F of Section II “Commercial and Industrial Operations” for additional details.

F. Commercial and Industrial Operations

Codes of Practice (COP) define the requirements for managing wastes discharged into the GLOBAL sanitary sewer collection system from commercial and industrial operations. The COP provides guidance related to discharge regulations, interceptors, sampling, and record keeping and retention.

Operations regulated by GLOBAL include RV parks, food services, dry cleaning, photographic imaging, and dental care. Contact GLOBAL 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 COP.

Installation and maintenance of grease, oil, and sand interceptors shall be the responsibility of the property owner. The design shall be approved by GLOBAL prior to installation and shall meet the requirements outlined in the COP. Minimum maintenance requirements for interceptors are also provided in the COP.

G. Easements

All sewer lines shall be located within street right-of-way, within a dedicated easement, or within a “tract” designated for utilities. Easements shall be shown on the final plat.

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 shall be located within 10 feet of a property line, easement line, masonry block wall footing or within 15 feet of a building foundation.

Dedicated easements shall be free of obstructions and easily accessible to GRW. No permanent structures shall be located within the easement. Easements shall not be located within storm water retention basins unless otherwise approved by GLOBAL. If approved by GLOBAL, manholes in retention basin areas are to be constructed per GLOBAL detail 420.

H. Testing Requirements

Testing shall be performed in accordance with GLOBAL Code of Practice, GLOBAL-CP-01-008.

Deflection testing shall be done on all sewer lines comprised of flexible materials. The entire length of sewer shall be tested for uniform slope. PVC sewer lines shall be low-pressure air tested utilizing the more stringent of ASTM Method F 1417-92 or MAG 615.10.

Water tightness of sewers and manholes shall be determined by exfiltration or low-pressure air testing. Water tightness testing of the sewer line shall be performed to show that leakage does not exceed 200 gpd per inch diameter per mile of pipe. Exfiltration from manholes shall be limited to 0.1 gallons per hour per vertical foot of manhole.

Trench compaction and settlement testing shall be performed in accordance with the recommendations of a registered professional geotechnical engineer in the State of Arizona and as determined necessary by GLOBAL. Test results shall be provided to the GLOBAL inspector and shall be sealed by a registered professional geotechnical engineer in the State of Arizona.

The contractor shall be responsible for an initial video inspection of the entire sewer line.

III. SEWAGE 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 and shall be submitted in writing. Pressure class of PVC pipe 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.

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 loose type of polyethylene material per MAG standards may be required in corrosive soil environments at the discretion of GLOBAL.

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. Thrust blocks as a substitute to restrained joints are not acceptable.

Isolation valves shall be eccentric type plug valves.

Odor control requirements will be evaluated on an individual project basis and may be required at the discretion of GLOBAL. Odor control requirements apply to both the wetwell and air release valves.

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

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

APPENDIX A

FLOW CHART FOR REQUEST AND APPROVAL OF WATER AND WASTEWATER SERVICE

