DESIGN GUIDE

FOR

WATER AND WASTEWATER FACILITIES

AMERICAN WATER

MILITARY SERVICES GROUP

1 WATER STREET

CAMDEN, NJ 08102

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1. GENERAL GUIDELINES

1.1. GENERAL INFORMATION

This Design Guide provides a summary of the design standards, overall project submission and approval process that all parties/projects must follow for any proposed expansion, modification, replacement, or connection to American Water (AW) owned utilities, unless otherwise directed by the AW Project Manager. The standard is intended primarily for use by internal and external engineering resources responsible for the project to develop project-specific design, plans and specification that conform to these standards. This design guide is a supplement to applicable requirements of the local, State, and Federal Agencies having jurisdiction.

All new construction projects must adhere to the full requirements as set forth in AW's Standard Specifications for Construction of Water and Wastewater Facilities. If the project does not meet AW's requirements, acceptance of the constructed facilities may not be agreed to by AW. It's recognized that it is not possible to address all situations that may arise and prescribe standards to every situation. However, it is expected that this guidance document will apply to majority of cases and shall be complied with, unless specifically exempted by AW.

The project must integrate into AW's overall system operation and design. AW reserves the right to specify the point of service, the size of service, the type of service, and the layout of the overall system. AW may impose other requirements based on its review of the project, and overall long term planning and construction of its utilities, or as required under its Contract. AW will rely upon governing regulations, project design standards, and industry standards, as well as AW's expertise in owning and operating utility systems to determine system layouts. Where conflicts exist, AW will determine the solution.

It is incumbent upon system designers and construction contractors to engage AW in the initial stages of a project to discuss project criteria, and work out a solution acceptable to all parties. AW must be involved in the conceptual level, design, coordination, planning, and key project phases of utility improvements because these changes can have larger implications to the overall performance of the system.

Before construction, the Contractor shall schedule a meeting with the AW Project Manager to discuss coordination efforts that shall be required between the Contractor and AW and/or any of AW's engineering consultants over the course of construction.

Some elements of a project may be proprietary in development, and in maintaining functionality of existing systems. AW reserves the right to direct design and construction of operational related devices or systems, not limited to facilities such as:

a. SCADA system
b. Meters
c. Water pump stations
d. Sewage lift stations
e. Water meters/vaults
f. Backflow preventers
g. Water tanks
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1.2. SHOP DRAWINGS AND REQUIRED SUBMITTALS

Shop drawings/submittals for all water and wastewater construction items shall be submitted to AW for review and approval prior to construction. Shop drawings shall be provided for, but not limited to, all mechanical equipment, pipes and piping appurtenances, valves, fire hydrants, and pumps.

For certain projects, AW will require the following submittals in addition to the project plans: For any lift station or booster station, hydraulic calculations, signed and sealed by a Professional Engineer registered in the State the station is to be constructed, shall be provided. The calculations shall include but not limited to, system demand and fire flow requirements, hydraulic analysis of the lift station (or booster station) and force main, pump information including the operating point and pump curves, buoyancy calculations, including a transient analysis for water hammer and electrical power requirements for all lift station electrical equipment.

Progress plans and any calculations or technical reports required at intervals normally submitted in the project (30%, 60%, 90% complete) shall be provided to AW for review. Two sets of design plans and other required documentation shall be submitted to the AW Project Manager in hard copy or PDF electronic format. The turnaround time for a review memo from AW is typically 14 business days.

As a minimum plan requirement, the following shall be included in the design drawings:

1. Existing conditions showing AW owned utilities based on field survey or information provided from AW mapping.
2. All existing and proposed materials shown and clearly labeled: pipe, valves, fire hydrants, water meters, fittings, manholes, services, length, material, slopes, invert elevations, etc.; with associated elevations, sizes, types, composition, and appurtenances; and approximate topographical location of existing utilities.
3. POD where ownership/operation responsibility changes between AW and the Government.
4. Plan and profile sheets shall include all design information including pipe size, length, material, slope, invert elevations, etc., show existing and proposed grades, the location of all proposed utility, and all utility crossings.
5. Detailed architectural, mechanical and electrical plans for any proposed structures, lift stations, or booster stations.
6. Site plan for any proposed water and sewer facility.
7. Water and sewer construction details, both AW required and that unique to the project.
8. Include all applicable State and local requirements for construction and development.
9. Maintenance and protection of traffic plans shall be prepared where the proposed work will be within a roadway or other areas where the normal flow of traffic will be impacted.

The requirements of the traffic control plan shall be coordinated with the base DPW during the design phase.

The following standard water and wastewater construction notes shall be included on all plans submitted to AW for approval:

- All materials, workmanship, and testing shall conform to AW's Standard Specifications for Construction of Water and Wastewater Facilities.
- Contractor to coordinate all shut downs and utility connections with AW. Contractor is advised that AW has Contract limitations on providing notice to affected customers and Contractor shall coordinate and follow these limitations for service interruption.
- Contractor shall provide minimum 3 working days' notice to the AW Project Manager prior to any water or wastewater facility construction starting or any inspections needed.

1.3. GUIDELINES FOR VARIANCES

The Capital Project Manager, or his designated representative, may permit variances to American Water's standard specifications and standard details when strict adherence would less adequately provide for the maintenance, efficiency, and effectiveness of AW's water and sanitary sewer systems. Deviations in design approach must be identified in the consultant's proposal to be considered by American Water.

Variances may be allowed when:

1. A substitution for a change in standard material results in the use of a material that can be demonstrated to be equal or superior in quality;
2. A strict adherence to a standard specifications or standard detail would be impractical or impossible because of field conditions such as existing utilities;
3. An emergency situation prohibits strict adherence to a standard specifications or standard detail.

Variance, when granted, is for one application for a specific project. If a similar variance is needed for another project within the same base, a new variance shall be obtained.

1.4. PERMITS

The Contractor or the engineering consultant is responsible for identifying all permits and preparing applications as required for the project. Construction cannot start unless all required permits have been received by AW. Any special conditions are attached to the permit will be the responsibility of the Contractor to ensure compliance, including any close-out provisions.

For projects that require a permit from a local, State or Federal permitting agency, AW shall be the Permittee on the application, unless it has to be the land owners or others per regulations. The Contractor shall complete and submit the Request For Signature Transmittal Form along with the 100% final construction plans to AW for approval. Refer Appendix A for a copy of the Request For Signature Transmittal Form. After AW approves the designs, the project designer shall provide to AW two (2) sets of the 100% final construction plans; including one (1) hardcopy drawing and one (1) digital vectorized drawing on compact disk; 100% final construction plans

shall be labeled "For Construction" and signed and sealed by the Design Engineer. AW shall review the 100% final construction plans and return the hardcopy set to the project designer signed when approved by AW.

The Contractor or the engineering consultant shall submit required number of copies of the AW approved plans, specifications, design or engineering reports, and permit application to the State reviewing agency on behalf of AW. The Contractor shall duplicate as required, the State approved set and return the originally approved State set to AW for their records. Only State approved and permitted sets shall be used for construction. Signed permit applications will be returned to the Contractor for their submission to the State. AW shall not be responsible for the submission of any permit applications, plans and specifications to State agencies.

1.5. NEW UTILITY INFRASTRUCTURE CONNECTION OPTIONS AND PROCESSES

If a new connection to the AW utility system is needed, there are several contracting processes that can be used to accomplish this:

1. The military installation can submit a description of work, a government cost estimate, and funding directly to DLA Energy so the new utility infrastructure connection can be executed through the Utilities Privatization (UP) contract. The Contracting Officer (KO)/Contract Specialist (CS) will request a proposal from the American Water, and after evaluating the proposal, the KO will incorporate the new requirements into the UP contract, via a contract modification. AW will install and connect the new utility infrastructure to its utility system. In this case, AW will own the new utility infrastructure after completing the installation.

2. The prime construction contractor enters into a contract with AW, for AW to install and connect the new utility infrastructure from the new facility's point of demarcation to AW's utility system. In this scenario, the prime construction contractor will pay AW directly. A Connection Charge Agreement (CCA) will need to be signed between the prime construction contractor and AW. AW will own the new utility infrastructure after completing the installation.

3. The prime construction contractor installs the new utility infrastructure and AW only inspects or completes a final connection of the new utility infrastructure to its utility system. The prime construction contractor needs to enter into a CCA with AW for the inspection and final connection (tie-in) of the new utility infrastructure to AW's utility system. AW shall be integrated from the design phase of the construction. AW shall be given the opportunity to inspect the new infrastructure before connecting it to its utility system. This is very important because AW must make sure that the new utility infrastructure meets its standards. Under this scenario, the Government will accept ownership of the new utility infrastructure most likely by completing a Form DD 1354. After AW connects the new utility infrastructure to its system, the Government Program Manager will commence the conveyance process which shall be completed via Bill of Sale (BoS).

In all scenarios, the installation of water and wastewater assets pursuant to a connection charge, falls within the utility services provisions of Federal Acquisition Regulation (FAR) Part 41 and thus, is not a construction sub-contract. Therefore, the terms and conditions of the Utilities Privatization Contract shall govern the relationship between AW and the prime construction contractor.

1.6. POINTS OF DEMARCATION

AW's Utility Privatization Contract includes defined Points of Demarcation (PODs) where ownership changes from AW to the Federal Government. Each AW Contract has different PODs that may change over time. The ability to create a new POD is subject to approval by AW and its contracting officer. Generally, creation of unique PODs outside the Contract is not pursued.

PODs must be considered when planning the project, as any unique elements relative to the project must be discussed with AW. For example, if a fire pump is needed, but fire pumps are excluded from AW's Contract, the fire pump must be located beyond the Contract POD, or if not possible, a unique POD would have to be approved through a Contract modification to AW's Contract. These instances require that a detailed description of asset responsibility is set forth in writing and agreed upon between all parties involved.

1.7. EXCLUDED FACILITIES

AW's Utility Privatization Contract excludes certain facilities from its responsibilities. Any project proposing to incorporate an excluded facility must place the excluded facility beyond AW's POD. Any approvals required for design would be by others.

AW retains the right to require conditions on the non-AW owned asset if it may have an impact on AW's utilities. For example, a septic system, oil-water separator or grease trap may impact water quality, or a fire pump may cause too great a demand on existing infrastructure and a dedicated fire tank may need to be constructed.

Governing regulations such as the State Department of EPA, project design standards, and industry standards must be incorporated such that AW utilities and the responsibility of permitted infrastructure are not jeopardized by the new facility. Facilities including but not limited to, oil wells, fuel storage facilities, geothermal systems, glycol based systems, storm drains, industrial systems, etc., may not be placed in such proximity to AW utilities to create undue burden and/or non-compliance.

1.8. HYDRAULIC MODEL

AW will determine if the hydraulic model analyses of its utility system are required for planning or design decisions related to the new project. AW will perform the modeling analysis, and the cost may be borne by the project, AW, or the Government as determined by AW and its CO.

If a hydraulic model of the utility system does not exist or is under development, the project designers may be required to perform field tests such as metering, fire hydrant flow tests, pressure recordings, manhole surveys, etc., as determined necessary by AW for planning and design decisions.

1.9. AS-BUILT DRAWINGS

AW requires as-built drawings upon completion of all utility system improvement projects. The content and formats of the as-built drawings shall be furnished in accordance with AW

Specification. Dependent on the scope of the project, the Contractor shall be required to furnish as-builts in one of the three possible formats per AW:

1. Red-line markups – Required on smaller projects where all project information can fit on one drawing (i.e., service connection to a building)
2. Construction Drawing Set – Required for most non-phased construction projects (i.e., utility line construction typically less than 5,000 LF).
3. GIS Mapping Format As-Builts – Required for multi-phased projects constructed over large areas of the military installation over several months or years. These projects require coordination between AW and the Contractor to deliver accurate as-builts that adhere to the military requirements and meet AW quality standards.

The required format for each project shall be detailed in the project's Request for Proposal and shall be made known to the Contractor prior to the award of a Contract. Retainage and final project invoices shall be withheld until all related as-builts have been received and approved by AW.

1.10. CONSTRUCTION INSPECTION

At a minimum, utility line installation and connections to the existing utility systems shall be inspected prior to backfill. Contractors shall provide AW and AW'S COR notice of an inspection 3 days in advance to arrange required inspections.

Depending on availability, AW Project Inspectors may be hired to conduct these inspections. The associated costs shall be borne by the project. Coordinate these inspections with AW Project Manager.

More intensive inspections may be required by AW after review of the project details and complexity (lift stations, structures, congested utility corridors, etc.) or if required by State agencies. The designers shall include inspection requirements on the construction drawings and/or project specifications.

Where applicable, the Contractor shall maintain survey instruments on the project site to allow field verification of slab elevations, floor elevations, and other measurements, when requested by inspection personnel.

The Contractor is required to have a copy of all applicable AW specifications, AW Design Guide, AW Details, project shop drawings, and signed and sealed construction plans on the site at all times. The Contractor is also required to have a copy of all permits on the project site at all times. Permits to include: Dig permits, Traffic Control permits, Hot Works permit, SWPPP, Confined Space Entry permits, State Construction permit, etc.

1.11. PAINTING OF ABOVEGROUND PIPING AND EQUIPMENT

In a number of applications, AW will require construction of non-buried facilities such as booster stations, valve vaults etc. These non-buried facilities are required to be painted in order to provide additional protection from the atmospheric elements. Color scheme shall adhere to industry standard, and Ten-State Standards. Contractors shall follow the guidance below on AW owned non-buried piping and equipment:

Repairing factory finished surfaces - Factory finished surfaces damaged prior to acceptance by AW shall be spot primed and recoated with materials equivalent and compatible with the original coatings. If in the opinion of AW, the spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

Equipment or materials not painted and/or not primed - Contractor shall have these items painted with a prime coat and a minimum of two finish coats. The paint system shall be suitable for the environment in which the equipment or materials are installed, and recommended by the paint manufacturer as acceptable or suitable for that environment or particular use.

Aluminum and dissimilar metals contact surface isolation - When aluminum is embedded in or comes in contact with concrete and/or masonry, the aluminum shall be coated with two coats of coal-tar paint (Tnemec Series 46H-413 or equal) with 20 mils dry film thickness (DFT). Aluminum shall be neatly painted a minimum of 1-inch above the concrete/masonry embedment.

1.12. REDUCTION OF LEAD IN DRINKING WATER ACT COMPLIANCE

The Reduction of Lead in Drinking Water Act was enacted on January 4, 2011. The Act was an amendment of Section 1417 of the Safe Drinking Water Act regarding the use of lead pipes, plumbing fittings or fixtures, solder, and flux. As of January 4, 2014, the 2011 amendments are in effect and all pipe, fittings, fixtures, solders, and flux must be "lead free". The definition of "lead free" as of January 4, 2014 means:

1. Not containing more than 0.2% lead when used with respect to solder and flux; and
2. Not more than a weighted average of 0.25% lead when used with respect to the wetted surface of pipes, pipe fittings, plumbing fittings, and fixtures.
3. Any pipe, fitting, or fixture i.e., corporation stops, curb stops, gate valves less than 2 inches diameter, backflow prevention devices, water meters, hose bibs, etc., installed or requiring replacement within an MSG project as of January 4, 2014 must be "lead free", in accordance with the Section 1417 amendment referenced above.

It should also be noted that State and local jurisdictions may have additional limitations or requirements regarding the use or sale and distribution of pipes, pipe or plumbing fixtures, or fixtures that contain lead. These more stringent State or local requirements would take precedence.

1.13. SAFETY

Safety is an integral part of AW facilities operations and capital improvements from the commencement of design through construction. Designers of new facilities for AW should provide the best practice designs that make these facilities accessible, safe, and efficient to operate. In addition, any company providing construction for major maintenance activities on AW military installations must become a member of ISN, a contractor and supplier information management company, and obtain "A" or "B" grade status prior to any work being awarded. Our scorecard criteria in ISNetworld is aligned with our contractor management goals and helps identify contractor companies that meet and exceed industry, regulatory, and AW-specific

standards in the areas of health, safety, quality, insurance, training, cybersecurity, social and environment.

FALL PROTECTION

a) Fall hazards along unprotected sides or edges that are at least 4 feet above a lower-level need fall protection.
b) All new fixed ladders and replacement ladder/ladder sections that are permanently attached to a structure, building, or equipment, excluding step bolts, or manhole steps, need to have ladder safety or personal fall arrest systems for fixed ladders that extend more than 24 feet., and phases the use of cages or wells for fall protection.
c) For existing ladders, install a cage, well, ladder safety system, or personal fall arrest system on fixed ladders that do not have any fall protection.
d) All access openings with a drop of 4 ft or more shall have a safety grating to prevent personnel from falling into the vault. This fall protection system shall be easily removed for servicing and entry and removal shall offer no additional hazard to the workers.

1.14. CONFINED SPACE

During the design stage, efforts should be made to limit the number of confined spaces present on a site; minimize the number of systems that will require confined space entries and reduce the risks, and of any confined spaces as much as possible.

Engineering practices that will minimize the hazards associated with Confined Spaces include:
e) Surface mounted isolation valves will be used wherever possible to ensure that an underground space with piping can be isolated in the event of a pipe break without entering a confined space.
f) Only those utilities and controls needed for operations in a sub-grade structure will be in that structure. Controls or utility runs will not be installed in such a sub-grade structure.
g) All access openings with a drop of 4 ft or more shall have a safety grating to prevent personal from falling into the vault. This fall protection system shall be easily removed for servicing and entry and removal shall offer no additional hazard to the workers.
h) All appliances installed in any confined space that may become flooded (even if it is not specifically designed as a wetwell) will be specified to withstand full immersion for extended periods.
i) Any confined space that will require entry will be designed such that if a tripod and harness is to be used there is adequate space for use of the hoist and that there is a “straight line pull” for the hoist to remove an entrant if needed.
j) All confined spaces will be identified and properly labeled as either a “Confined Space” or a “Permit Required Confined Space” during design and construction. Before the facility becomes operational an inventory of all these spaces will be completed using input from design, construction, operations and safety personnel. All spaces will have the correct signage installed prior to the plant becoming operational.

All personnel involved in or having responsibility for design of confined spaces must be thoroughly familiar with permit entry and rescue procedures. Regulations governing entry into confined spaces are specified by OSHA 29CFR, 1910.146.

1.15. FENCING AND SECURITY

Unless noted, any existing fences shall be replaced in-kind; and constructed to equal or better condition to that removed. If the fences are in poor condition that it cannot be rebuilt with the same material, it shall be replaced with new fence. No fence shall be placed over manholes, valve boxes or other structures. Fence design shall be considered to fit the surrounding land uses when directed by AW Project Manager and per the base Installation Design Guide.

If assets such as hydrants, PIVs or other above grade assets are determined by AW to be at high-risk areas, they must be protected with bollards. Bollards shall be located so that they do not block any hydrant outlets.

1.16. FACILITY ACCESS

Water and wastewater facilities shall be designed so that access is readily available 24/7 to AW personnel for maintenance or during emergency events.

Facilities including, but not limited to, lift stations and related ancillary equipment such as stand-by generators, control panels, motor control cabinets, power disconnects, etc. shall not be located within areas or buildings that would require other entities to provide access.

Building permanent structures above any AW asset or within 10 ft horizontal clearance is prohibited.

1.17. SITE LIGHTING

Sufficient permanent area lighting shall be provided at all AW facilities to allow AW personnel to safely perform work activities during an after-hours response. The lighting provided shall enable identification of all critical facility components and work at night, specifically near the building entrance, control panel, wetwell, valve vault, and generator.

a) Yard light shall be 72W LED or Halogen floodlight, or 100W High Pressure Sodium light; with photo cell or as specified by AW Project Manager.
b) Where there is no building, a lamp shall be mounted on a pole at least 15 ft high with an independent pole mounted switch. The pole and the mounting method shall be in accordance with the lamp manufacturer's recommendation.
c) Lighting switch wiring and switch enclosure shall be weather proof and shall meet the minimum NEC requirements.

1.18. STANDBY POWER

Standby power can include permanent generators, portable generators, or secondary electrical feeds from an independent power grid.

1. For permanent generators, a diesel or natural gas-powered generator shall be provided with an automatic transfer switch.
2. Determining the engine generator's size depends upon the requirements of starting and operating the pumps at average load and all ancillary equipment in the sewage pump station that needs to operate during a power outage.

3. Permanent engine generators shall be located inside a building or other weather-tight enclosure. Block heaters are required to ensure reliable startup in cold weather.
4. Permanent generators shall be installed on permanent access reinforced concrete platform with 4000 psi concrete strength. Concrete pad must extend 1' beyond the plan dimension of the generator enclosure.
5. Standby generator control and access panels shall be readily accessible from the ground surface. For large standby generators where the height of the sub base fuel tank or skid base place these panels out of reach, a permanent access platform with handrails shall be constructed around the generator.

1.19. ENVIRONMENTAL COMPLIANCE

As each AW military installation has its own unique environmental requirements, the base DPW must be contacted prior to the commencement of the design process to determine what environmental considerations and/or requirements are applicable for a proposed project.

1.20. RECLAIMED WATER DISTRIBUTION SYSTEM

All reclaimed water distribution systems (or untreated irrigation water, or raw water or non-potable) shall be designed and constructed such that the reclaimed water does not come into contact with or otherwise contaminate a potable water system.

In-ground reclaimed water lines shall be installed and maintained to achieve minimum separation distance, measured edge-to-edge, and configurations as follows:

a. No reclaimed water line shall pass within 50 ft of a potable water supply well, spring or intake, or as stipulated by the State or local regulations.

b. Reclaimed water line shall be separated horizontally by at least 10 ft from a potable water main. When the required clearance cannot be maintained, the reclaimed water line may be laid closer provided that the potable water main is in a separate trench or in undisturbed earth, and the bottom of the potable water main is at least 18 inches above the top of the reclaimed water line.

c. Reclaimed water line shall be separated horizontally by at least 2 ft from a sewer line. When the required clearance cannot be maintained, the reclaimed water line may be laid closer provided that the sewer line is in a separate trench or in undisturbed earth, and the bottom of the reclaimed water line is at least 12 inches above the top of the sewer line.

d. When the vertical separation cannot be obtained, the reclaimed water line shall be constructed of water pipe material and pressure tested in place without leakage prior to backfilling; or the sewer line shall be encased in concrete 10 ft on each side of the reclaimed water main.

e. Reclaimed water line shall cross under a potable water main such that the top of the reclaimed water line is at least 18 inches below the bottom of the water main.

f. Where reclaimed water line crosses over a potable water main, the reclaimed water line shall: Have at least 18 inches of separation between the bottom of the reclaimed water line and the top of the potable water main; be constructed of approved water pipe and pressure tested in

place without leakage prior to backfilling; have adequate structural support to prevent damage to the potable water main; have joints placed equidistant and as far as possible from the potable water main joints; and be encased in concrete 10 ft on either sides of the potable water main.

g. Sewer line shall cross under reclaimed water pipeline such that the top of the sewer line is at least 12 inches below the bottom of the reclaimed water line. When the required clearance cannot be maintained, the sewer line shall be encased in concrete 10 ft on each side of the reclaimed water line.

h. Where sewer line crosses over line that conveys reclaimed water, the sewer line shall: Have at least 12 inches separation between the bottom of the sewer line and the top of the reclaimed water line; have adequate structural support to prevent damage to the reclaimed water line; have joints placed equidistant and as far as possible from the reclaimed water line joints; be encased 10 ft on either sides of reclaimed water line from the crossing location.

i. No reclaimed water pipeline shall pass through or come into contact with any part of a sewer manhole and shall be separated horizontally by at least 2 ft whenever possible. The distance shall be measured from the edge of the pipe to the edge of the manhole structure. When local conditions prohibit this horizontal separation, the manhole shall be of watertight construction and tested in place.

1.21. LIQUID CHEMICAL SYSTEM

The chemical feed system shall be designed such that it minimizes risks to consumers, workers, and the environment by following standardized, proven method of storing, feeding, and containing liquid chemicals. The design and procedures shall comply with all applicable Federal, State, and local regulations governing chemical feed and storage requirements. The following guidelines provide the required features of liquid chemical systems.

1. Materials of Construction: Materials used in chemical systems for tanks, piping/tubing, fittings, gaskets, hoses, protective coatings, in-situ instrumentation, etc. must be appropriately selected for each chemical.
2. Safety Requirements: It is a high priority that all safety requirements be met.
    - Identification of chemicals and availability of MSDS.
    - Signage for hazardous chemicals shall be in accordance with NFPA 704.
    - Storage tanks and tank fill lines shall be identified with signage identifying the usable capacity and contents of the tank, chemical hazards, and recommended safety gear.
    - Piping shall be color coded according to State, local or Ten State Standards and identified with labels indicating the chemical with arrows pointing in the normal direction of flow.
    - Emergency showers and/or eyewashes with tepid water shall be provided for all liquid chemicals, and located adjacent to the chemical equipment. Exterior eyewash or shower shall be freeze-proof models.
    - Proper protective clothing such as aprons, gloves, and eye protection must be provided.

3. Bulk Storage Tanks: Bulk storage tanks shall be sized for 31 days of storage at a maximum dose and average treated water flow, or average dose and maximum treated water flow, whichever is larger.
    - Bulk storage tanks shall be constructed of high density cross linked polyethylene (HDXLPE) or be an appropriately lined steel tank, with appropriate bolt and gasket materials.
    - Storage tanks shall be equipped with a fill line, vent line, overflow, and discharge connection.
    - Low level and high level alarms shall be provided.
    - Tank overflow must be directed to secondary containment.
    - All chemicals with the potential for corrosive or injurious vapors or mists are to be vented to the exterior. The vent line shall not function as the overflow.
4. Transfer Pumps: Redundant installed pumps are required for disinfectants and other chemicals, when specified. Transfer pumps shall be sized to fill the day tank within two to five minutes.
5. Day Tanks: Day tanks shall be smaller storage vessels than a bulk storage tank, which directly supplies metering pumps.
    - Day tanks are required when bulk storage is provided. Day tank sizing is to be based on 125% (including freeboard) of the daily volumetric requirements of the maximum dose for the average daily treated water volume, or the average dose for the maximum treated water volume.
    - Day tanks are to be equipped with a vented fill line, vent line, overflow, drain, and discharge connection.
    - Day tanks may be constructed of chemically compatible material.
    - All chemicals with the potential for corrosive or injurious vapors or mists are to be vented to the exterior.
    - Tank overflow must be directed to secondary containment.
    - Continuous level and weight monitoring with alarms for high and low level in the day tank shall be provided.
    - The day tank fill line is to be piped and vented to prevent the possibility of gravity flow or siphonage from the bulk tank to the day tank.
6. Metering Pumps: Redundant installed metering pumps are required for disinfectants and other chemicals, when specified.
    - A calibration cylinder is to be provided on the suction side of the metering pumps.
    - Metering pumps that have the ability to produce pressures higher than the piping system can withstand, such as motor driven positive displacement metering pumps, must have a pressure relief valve on the discharge of each pump head.
    - No valve may be located between the pump and the pressure relief valve.

7. Special Valves: Special valves shall be provided to prevent siphonage, maintain backpressure, and provide pressure relief. A four function valve which provides anti-siphon, backpressure, priming, and pressure relief action may be used when available. It is imperative that the integrity of the valve seals be checked on a regular basis.
8. Feeding Drums: In low capacity systems where both bulk tanks and day tanks are not used, the chemical may be fed directly from a non-refillable drum. A weighing scale or reliable level monitoring device shall be used to monitor the quantity of material remaining in the drum. The system shall be equipped with a low weight alarm.
9. Inventory Monitoring: A reliable and accurate means of monitoring inventory shall be provided for bulk tanks, day tanks, and drums. A continuous level probe in tanks or a sight glass shall be used for this purpose.
10. Secondary Containment: A structure designated to hold spillage or leakage shall be provided for all bulk tanks, day tanks, batch tanks, drums, metering pumps, and transfer pumps. Minimum secondary containment volume shall be determined based on 110 % of the largest storage tank capacity within the containment area. Freeboard should be added to the calculated minimum containment volume.
11. Leak Detection: Both manned and unmanned chemical feed systems shall be equipped with a sump equipped with a level switch to signal the occurrence of a leak. Appropriate personnel shall be alerted of a leak as soon as possible.
12. Continuous Analyzers: Chlorine residual analyzers shall be provided wherever chlorine or chlorination chemicals are added. Continuous pH monitoring is necessary where caustic soda is fed for post-filtration pH adjustment.

1.22. CONNECTION CHARGE AGGREMENT PROJECTS

All costs associated with the provision of water and wastewater facilities executed through a CCA, or facilities constructed by AW that are not part of its current Contract shall be borne by those parties.

Following are the general guidelines for acceptance of work by AW, but not limited to:

1. All materials and construction must comply with State and local regulations, as well as AW Standard Specifications, Details, and this Design Guide.
2. Prior to construction submit for approval all water and wastewater utility plans, alignment changes, request for information, and shop drawings for all materials used in the project.
3. Coordinate all inspection of water and wastewater work with AW Project Manager or AW Inspector 72 hours in advance.
4. No inspection will be scheduled outside of AW's normal business hours between Monday and Friday 8 am to 4 pm. The contractor should plan to start all tests within a time frame to ensure the test is completed no later than 4 pm. Weekend work will not be permitted without the permission of AW Project Manager. Depending on availability, AW Project Inspectors may be hired to conduct these inspections. The associated costs shall be borne by the project. Coordinate these inspections with AW Project Manager.

5. Retests or inspections will be scheduled no sooner than 48 hours after a failed or cancelled test or inspection, unless permitted by AW Project Manager.
6. Mandatory inspections that require the presence of the AW Inspector or AW representative are as follows:
    a. Daily installation of water and wastewater facilities. The Contractor is required to formally notify AW of any changes to the routine once construction commences.
    b. Onsite test of new water and wastewater facilities, including but not limited to hydrostatic testing, low pressure air test, vacuum test, mandrel test, leak test, and any other special testing that may be required.
    c. Pre-flushing and disinfection of waterlines per AWWA C651-05 including demonstration to the AW inspector of chlorine residual using one of the two acceptable methods: DPD Drop Dilution Method or High Range Chlorine Test Kit; and flushing and discharge of chlorinated water.
    d. Water and wastewater tie-ins.
    e. Sewer by-pass operation.
7. If any of the required inspections were conducted in the absence of the AW project Manager or Inspector, the contractor will be required to remove and reinstall that portion of the project.
8. Submit any outage requests three weeks in advance.
9. Use of fire hydrants may be permitted upon completion of any required permit for its use.
10. Only AW personnel may operate existing valves or hydrants in the existing system.
11. Bacteriological sampling and testing is Contractors responsibility.
12. Tie-ins to AW System shall be planned to minimize the duration of the outage. Contractor shall have all necessary materials and spare parts including disinfection materials and equipment ready prior to work. Contractor shall pre-assemble and pre-clean piping and fittings, pre-measure all pipe cuts, plan for contingencies like groundwater traffic, nighttime work, sufficient personal and equipment.
13. For all water services (domestic and fire) a permanent double check valve preventer / backflow prevention device shall be installed prior to any use. This includes water service to commercial buildings, residential, trailers, or any other equipment. Contractor shall arrange inspection(s) for the installed device(s). Upon successful inspection AW personnel will turn on the water to the facility or equipment.
14. Backflow prevention device shall, at a minimum, be 12 inches above ground, or as stipulated by the State and local regulations.
15. AW will be responsible for SCADA programming the new unit into the master control RTU station.

1.23. SCADA RTUS

All pumping stations and holding tanks shall include an RTU and associated instrumentation for monitoring the status of these systems as determined by AW. Programming the new unit into the master control station and all RTU equipment shall meet the requirements of AW's existing SCADA system, or as directed by the AW Project Manager.

The following table summarizes various site locations where SCADA may be used. AW may or may not require SCADA at these locations (or other unlisted locations).

A. Water Distribution System
SCADA monitoring at wells or booster pump stations shall include:

- Flow metering
- Suction Pressure
- Discharge Pressure
- Pump Status (Off/On)
- Pump Run Times
- VFD Speed
- Well Start/Stop Points
- Emergency Generator Status (On/Off)
- ATS Status (On/Off)
- Chemical Level Monitoring
- Cl2 leak
- Pump Failure
- Power Failure
- Phase Loss
- Well Building Alarms -Intrusion
- Water Level
- Water Level Low Level Alarm
- Altitude Valve – Percent Open
- PRV Pressure (Inlet/Outlet)
- Over-Flow Level
- Effluent Chlorine Residual

SCADA control at wells or booster pump stations shall include:
Booster pump (On/Off)

B. Water Storage Tanks or Reservoir
SCADA monitoring at water storage tanks or reservoir shall include:

- Flow Metering
- Building Alarms - Intrusion
- Water Level
- Water Level Low Level Alarm
- Over-flow level

SCADA control at water storage tanks or reservoir shall include:
Booster pump (On/Off)

C. Water Treatment Plant
SCADA monitoring at water treatment plant depends on various components at the plant, and shall be provided as specified by AW Project Manager.

D. Wastewater Lift Stations
SCADA monitoring and control at various different types of wastewater lift stations are discussed in their respective sections in this document.

E. The following Table summarizes the minimum standards for SCADA assets and software.

ASSET/SOFTWARE	STANDARD ASSET
Circuit	SCADA ATT Circuit
Remote Access	SCADA RAS Website
Remote site communications	ATT remote sites sim cards
Internet	Business Circuit/Modem/Lease Lines
Server	Stratus Technologies
Desktop	Dell
Laptop	Dell
Thin Manager	Rockwell
Thin Client	Dell/Rockwell
Modems	Sierra MP70 or RV55
Operating system for Desktop/Laptop	VMWare windows 11 or latest
Operation system for Server	VMWare windows Server 2019 or latest at the time of installation
Switches	Hirschmann Greyhound
Firewalls	Fortinet Each site gets two firewalls
Router	Cisco 4300 or newer
Backup Server	Synology 3200 or newer
Backup software	Acronis
Antivirus	McAfee
Patching software	Bigfix
PLC Change Management for Rockwell	Asset Centre
SCADA Traffic Monitoring	TenableOT Sensor
SCADA preferred software	Ignition
Fiber Cables	Ortronics

Network cabling	Ortronics
Network Rack	Ortronics, IBM, or Great Lakes specific.
Network Monitoring for SCADA	Hivew
Network drawing	Visio
network jack locks	
UPS	APS 1500 or better with network capabilities
Microsoft office	2016 or better with off line licensing
Printer	Canon
Alarming	Modem gateway from Verizon

Additional details regarding other SCADA standards are in Appendix, such as SCADA Ignition Server and Commissioning Standard in Appendix C, Installation of the McAfee Agent onto a Windows computer on SCADA Network in Appendix D, and AW Infrastructure Cabling Bid Specification in Appendix E.

1.24. OTHER DESIGN ELEMENTS

BUILDINGS

Appropriate 10-pound (type ABC) type fire extinguishers shall be provided for all buildings (electrical buildings, lifts station buildings, pump station buildings, etc.). Fire extinguishers shall be attached to walls using stainless steel fire extinguisher supports/holders using stainless steel toggle bolts or SST anchor bolts as appropriate.

1.24.1 CONCRETE WORK - DESIGN CONSIDERATION

All concrete surfaces (new and patches), which may experience pedestrian traffic including drives and building floors, shall have broom finish.

1.24.2 ELECTRICAL - MOTOR DESIGN CONSIDERATION

Motors shall not be allowed to operate in the motor service factor during the operation of the equipment. The motor service factor shall be 1.15, unless otherwise specified by AW.

The motors, provided with pumps (or other equipment), shall not be overloaded or exceed the horsepower capacity of the provided motor, at any point on the pump operation curve.

An auto-reverse feature on certain motor-operated water and wastewater equipment, including but not limited to, mixers, bar screens, and comminutors, should be

included as part of the engineering design to prevent motor damage in the event the equipment gets jammed during normal operation.

This feature, or any other fail-safe mechanism, shall be discussed with AW prior to final design.

Motors ≥ 10 Hp shall include appropriately sized current transformer clamp meter (CT clamps) to measure Amps through the live wire. The output shall be integrated into the SCADA system to provide real-time status for normal operation and troubleshooting issues. SCADA systems shall use data for measuring and monitoring of amps for programmed conditions such as high amps, low amps, no current voltage or imbalanced power, shut off during dry runs, etc.; which could prevent damage and extend asset life.

1.24.3 OPERATIONS AND MAINTENANCE

During the design, consideration shall be given to Operations and Maintenance (O&M) needs.

O&M Manuals shall be provided in a properly labeled (cover sheet and spine label) 3-ring binder. Labeling shall include: 1) equipment – type and brand, 2) date, 3) Contractor's name, 4) project name, 5) AW Project number.

At a minimum contractor shall provide three final copies of the O&M Manuals – one for record file, one for the Operation Supervisor, and one for the site location. A PDF /electronic copy shall also be provided by the Contractor.

The O&M manual at a minimum shall be provided as part of the project and shall include provisions for:

1. Detailed descriptions of all operating processes.
2. Design data for equipment or process, such as pumps, motors, force main, emergency power, overflow point and elevation(s).
3. Calculations, such as system curve and the pump curve with design operating point(s).
4. Startup and shutdown processes.
5. Breakdown of critical safety issues.
6. Inventory of critical components, such as nameplate information for pumps and motors, etc.
7. Contingency plan, including redundancy considerations.
8. As-Built Drawings.
9. List of recommended spare parts and maintenance schedule.
10. As applicable provide:
    - A trouble-shooting chart
    - Exploded drawing of the equipment
    - Electrical schematic
    - Wiring diagram

1.25. ELECTRICAL SAFETY

1.25.A INSTALLATION OF SERVICEABLE OR REMOVABLE DEVICES

The National Electric Code requires conductivity to be maintained around all serviceable or removable devices including meters, filters, backflow preventers, valves, etc. Conductivity is maintained through the application of a permanently attached BONDING jumper wire around such devices.

In case of meters, the presence of a setter maintains electrical continuity as long as the setter has not been cut or otherwise broken.

Serviceable or removable devices set in pits or enclosures away from the building shall have a minimum of 10 feet of metallic pipe between the building and device to provide adequate grounding of the buildings electrical system, if not permanent bonding jumper is required.

If the existing plumbing is plastic on either side of the device, no bonding jumper required.

When permanent bonding is required, the permanent bonding jumper wire size shall be as follows:

- Install #2 AWG copper wire for all services up to, and including 350 amps.
- Install #1/0 AWG copper wire for all services larger than 350 amps.
- Install #1/0 AWG copper wire if the service amperage cannot be verified.

Ensure the grounding connectors are contacting bare (not painted or coated), pipe for a metal-to-metal contact. The wire should be installed so that the device may be changed without contacting the permanent bonding jumper wire.

If a permanent bonding jumper is not already installed or needs to be replaced, then an approved temporary jumper must be installed across the device connections. An approved temporary jumper consists of an insulated cable no less than #4 AWG in size, solidly attached to two clamps rated no less than 200 amps

1.25.B SERVICE LINES OR WATER METERS

Protection against electrical exposures is needed during water meter and service line activities, and certain water main excavations. Service line repairs within 10 feet of a building or a structure shall utilize metallic pipe if the existing service is metallic and ensure a minimum of 10 feet of metallic pipe installed between the building and the repair.

If the entire service line is being replaced, determination shall be made if the existing lines serves as a permanent ground for the building or structure. Install a new permanent electrical ground prior to service line replacement, if necessary. This work must be performed by a licensed electrician.

When repairing or replacing a metallic service line with non-metallic material, the temporary bonding jumper must join metal on one side of the non-conductive section to metal on the other side of the non-conductive section for the entire duration of the work.

The need for water main bonding shall be evaluated by the AW operations staff or by the

Engineering lead when underground electrical conductor is within 24” of the excavation or worksite is in a known electrical hazard area.

2. WATER SYSTEM DESIGN GUIDELINES

2.1. OVERVIEW

This section of the Design Guide provides the minimum AW guidelines for the design of potable water systems, including distribution systems, service lines, pump stations, wells, and associated appurtenances. All water system designs shall be performed in accordance with generally accepted engineering standards and practices, AW Standard Specifications for construction of Water Facilities, and all applicable local and State regulations.

Where Unified Facilities Code, NFPA, or other design code is required to meet funding criteria, a review of applicability shall be evaluated with AW prior to project design. AW will determine resolution of conflicts in the best interest of the proposed system improvement.

2.2. DESIGN FLOWS

The distribution system shall be sized to provide, at a minimum, the maximum daily domestic demand plus fire demand while maintaining a minimum residual pressure of 20 psi throughout the existing distribution system, or as stipulated by the State or local regulations. Peaking factors for peak hourly flows shall be in accordance with applicable State regulations or local governing criteria.

2.3. LOCATION OF WATER MAINS

If local or State separation guidelines are more stringent, they shall take precedence. Water mains shall be located outside of paved areas wherever possible unless ground topography or a roadway crossing dictates otherwise. Water mains shall be constructed a minimum of 3 ft from pavement or sidewalks. A minimum of 10 ft horizontal clearance, measured edge to edge, is required between water mains and sanitary sewer mains and manholes, or stormwater mains, and 3 ft between water mains and all other utilities such as, other water mains, gas, telephone, electric, etc. Water mains shall maintain a minimum of 10 ft horizontal clearance from the edge of any building or structure. Water mains shall not be permitted under structures, but if they must, the POD will be as defined in AW's Contract.

Mains and water service lines shall be installed at least 3 ft horizontally, and 18 inches vertically, from all other utilities; unless AW determines this cannot be achieved due to routing of other conflicting utility, water mains, service, etc. In that case, AW will define any requirements to allow a waiver including but not limited to concrete encasement.

Water mains and service lines shall be located a minimum of 25 ft horizontally from sewage leech fields, cesspool, seepage pit, underground hazardous material storage tanks, groundwater water recharge projects or septic tanks. Water mains shall not be installed within 100 ft horizontally from the nearest edge of any sanitary landfill, waste disposal pond, or hazardous waste disposal site.

2.4. WATERMAIN DEPTH

All water mains and water service lines shall have a minimum cover depth in compliance with State and/or local requirements. Deeper cover depth may be required by AW depending on local frost line depth, type of vehicular traffic, and other service factors. Water lines 6 inches and larger shall have a minimum of 36 to 42 inches of cover, unless local frost lines require more depth. Mains installed deeper than 5 ft to top of pipe require approval by AW, and may require different material of construction.

2.5. WATERMAIN AND SERVICE LINES - SIZE AND LENGTH

A main is defined as any pipe that will have more than one service line connected to it or has the potential to serve more than one facility. Service lines shall be sized based on service peak demand and AWWA Manual M-22.

The minimum allowable size for all water main extensions is 8 inches, unless AW determines a waiver from this is technically justified. All distribution system expansions shall be designed with a minimum of two feed lines in order to create a looped distribution system.

2.6. PIPE LOCATING SYSTEM

All installed pipe shall be provided with marking tape, and tracer wire, in accordance with AW's Standard Details and Specifications.

2.7. TRENCHING, PIPE BEDDING & BACKFILL

All trenching shall comply with applicable OSHA regulations. The width of all trenches shall be sufficient to allow all piping to be laid and joined properly and to allow the backfill to be placed and compacted.

All water mains shall be provided with bedding in accordance to AW Specifications and Standard Details. Full stone backfill is not required under paved areas. Waivers from bedding may be provided by AW if it can be demonstrated that native material is of similar nature to the specified bedding.

2.8. SERVICE LINES

Service lines shall be provided with a corporation stop and curb stop with isolating valve near the water main connection point. Service lines shall also have a curb stop with isolating valve located at the AW POD. All domestic and fire service taps must be approved by AW prior to taps are made on the main. Domestic and fire service taps shall be separate.

All lead service lines and galvanized service lines downstream in the direction of flow of a lead service line, or unknown lead status service lines shall be replaced from the main to the building concurrent with water main replacement or repair. This applies to planned service line replacements or as lead service lines are discovered in the course of

work. The "main to building" requirement supersedes any conflicting contract language that specifies partial service line replacement or "reconnect existing service". Changes in quantities will be handled in accordance with applicable contract clauses.

2.9. MATERIALS OF CONSTRUCTION

The following sets forth the allowable material of construction for water piping systems. All newly installed water mains shall comply with material and installation standards of applicable AWWA standards. AW reserves the right to require specific material of construction in parts of the whole project based on various factors.

WATER PIPE

TYPE OF SERVICE	ACCEPTABLE MATERIALS
Service lines	Type K copper * PVC C-900 PVC SDR 21 HDPE with minimum SDR 11 rating (min 200 psi)
Buried mains	HDPE with minimum SDR 11 (min 200 psi) PVC C900 200 psi rating PVC C-905 200 psi rating DIP pressure class 300 (required for pipe larger than 16”Ø)
Above ground mains	DIP
Potable water conveyance	PVC SCH 40 or SCH 80, and Asbestos Cement Pipe are **NOT** permitted for conveying potable water
Buried mains in areas of high risk of hydrocarbons contact with pipe.	Ductile iron pipe with gaskets** that are impermeable to hydrocarbons
*For systems with non-corrosive water (i.e. pH≥7) or systems with corrosion controls to balance water system acidity. **Needs approval by the AW Project Manager.	

2.10. PIPE DEFLECTION

All water main pipes shall be permitted to deflect in accordance with the following tables:

DIP PIPE

SIZE OF PIPE	DEFLECTION ANGLE	MAXIMUM DEFLECTION	
		(18-FT. LENGTH)	(20-FT. LENGTH)
3”-12"	5 degrees	19"	21"
14"-42"	3 degrees	11"	12"
48"-64"	3 degrees	N/A	12"

PVC PIPE

SIZE OF PIPE	DEFLECTION ANGLE	MAXIMUM DEFLECTION
		(20-FT. LENGTH)
4”-12"	2 degrees	8"
14" +	1.5 degrees	6"

2.11. FIRE HYDRANTS

Fire hydrants shall conform to AWWA C502, Standard for Dry Barrel Fire Hydrants (Latest Edition). Hydrants shall open counterclockwise. AW’s system needs uniformity in fire hydrants due to maintenance and spare parts inventory purposes. The standard is Mueller Model Super Centurion 250. Waivers from this type hydrant will be considered on a case by case basis. All hydrants shall be furnished with 6 inches isolation gate valves and valve box. All fire service taps must be received and approved by AW prior to taps are made on the main. The minimum allowable size of a hydrant lateral is 6 inches and shall not exceed 85 ft in length unless AW determines a waiver is technically justified.

Hydrant bodies shall be painted a color in accordance with the local base requirements. Bonnets shall be painted or reflective marking tape used as approved by AW. The bonnet shall be color coded for flow availability according to the following table:

FLOW AVAILABILITY	BONNET COLOR
Less than 500 GPM	Red
500-999 GPM	Orange
1000-1499 GPM	Green

1500 GPM & Above	Light Blue

All hydrants shall include a brass identification tag with the Hydrant's ID number based on AW's numbering system, date of installation, and physically attached to the hydrant. Hydrant numbers must be called-out on plans.

Hydrants shall be placed at or near street intersections, and at the end of dead end lines. For residential areas, spacing shall not exceed 500 ft, or less if required by local fire department. Spacing of fire hydrants shall not exceed 300 ft in areas where hydrants are protecting warehouses per UFC 3-600-01. For commercial and industrial construction, no point on any proposed structure shall be unreachable with 350 LF of hose, measured around all obstacles, i.e. fences, walls, etc. No obstructions or permanent structures shall be located within 10 ft of any fire hydrant. Hydrants in areas determined by AW to be at high risk must be protected with bollards. Bollards shall be located so that they do not block any hydrant outlets.

Post Indicating Valves (PIVs) must be installed on all fire service lines, located as directed by the Base fire department, and subject to AW's PODs. No other valves shall be installed upstream or downstream of a PIV.

If a dedicated fire system must be provided, it will typically be owned and operated by others. Design review will not be provided except as indicated in the Excluded Facilities Section of this Design Guide.

2.12. FLUSHING

A flushing valve, fire hydrant or blowoff shall be provided at the end of each newly installed dead-end water main. The flushing valve or blowoff shall not discharge directly to the sanitary sewer without an air gap separation between the sewer and the valve or blowoff. The flushing velocity in the main shall not be less than 2.5 ft/s unless it is determined that conditions do not permit the required flow to be discharged to waste.

2.13. AUTO FLUSHING UNITS

Auto flushing units shall offer safe, economic, reliable, automatic, programmable, controlled and consistent flushing of the stagnant areas of the distribution system for maintenance. The units shall be installed to maintain consistent chlorine residual levels, conserves water, reduces chlorine consumption, address taste and odor concerns, discolored water complaints and improves customer satisfaction, while requiring minimal supervision by utility personnel. The size of the pipe and control valves will vary based on the required maximum flow rate.

Review State and local regulations to check if a general permit and/or a facility specific NPDES permit is necessary for the discharge, and whether dechlorination is required.

The location and circumstances of automatic flush unit installation shall be approved by AW prior to installation. The units shall be installed only in areas not susceptible to flooding. Barriers should be installed around the devices to prevent damage from

vehicular traffic or when directed by AW. The water discharged would be sent to a nearby sewer or daylight to drain.

Every auto flushing units shall consist of the following features:

- A built-in residual chlorine analyzer, which measures disinfectant residual levels and directs the valve to flush, if needed, until the desired residuals are attained; and with the ability to set timed flushing as a backup.
- Oversized diffusing vents designed to dissipate energy without the potential for clogging
- Atmospheric discharge with air-gap
- Dechlorination, per AW Project Manager
- UV protected splash plate to help minimize erosion and provide stability
- All key system management components shall be located above ground for ease of access.
- Includes sample port
- Remote, handheld or SMART controller/programmer, per AW Project Manager
- Corrosion, UV, impact, and weather resistant, enclosure. The units shall not allow for any water being held or freezing in the housing
- Removable, lockable cover on bolt down base
- Check vale on the drain line.
- Operates on battery, solar or electric power

2.14. VALVES

Water distribution mains shall be equipped with a sufficient numbers of valves to minimize service interruptions and safety hazards during repairs. The appropriate number of valves at each water main intersection shall be determined using an N-1 formula, provided there are no other intersections between the valve and subject main that do not meet an N-1 configuration. For example: at a four way intersection, a minimum of three valves are required. Existing gate valves within 500 ft of the pipe intersection can be used to fulfill this requirement.

Distribution main valve spacing shall typically not exceed 500 ft within residential areas and 1,000 ft in commercial areas. For transmission mains, valves shall be provided at a maximum of 1,000 ft intervals. If local valve spacing guidelines are more stringent, they shall take precedence.

Gate valves shall be of the resilient-seated type and shall be in conformance with AWWA C509, open counterclockwise. Gate valves shall be used on all water mains 8 inches and smaller, and up to 16 inches in diameter. Gate or butterfly valves on mains 10 - 14 inches depending on bury depth and AW discretion. On water mains greater than 16 inches, butterfly valves shall be used in accordance with AWWA C504. For water lines deeper than 5 ft, a valve nut extension nut shall be installed.

No gate valves are permitted upstream of a PIV. If a wet tap must be done, a valve box is not to be installed over the tapping valve, it should be buried instead.

2.15. WATER METERS

The requirement to install a water meter is at the discretion of the Base. If AW is to own the meter, it must be located within its Contract defined POD, or a clear definition of the demarcation on each side of the meter must be agreed upon by affected parties.

Unless a compound meter or fire service meter is required by either AW or the Government, turbine meter shall be used in accordance with AW Standard Specifications.

On applications where the water service cannot be interrupted, a meter bypass shall be installed. For water meters installed inside concrete vaults, the access openings shall be fitted with a frame and cover as manufactured by Halliday Products or approved equal.

2.16. BACKFLOW PREVENTION

AW requires backflow prevention be provided on all residential, and commercial connections, including apartments, barracks, and fire service lines, etc., that connect to the water distribution system as required by State regulations. In the absence of clearly defined State regulation on backflow requirements or specific AW guidance for the base location, the following guidelines shall be followed.

If State regulations do not require backflow preventers on domestic service lines, unless a meter with a check valve is installed, AW requires that a minimum of a Double Check Valve (DCV) be installed. This is consistent with the goal of protection of public water supplies, as outlined in Army Guidance "Public Works Technical Bulletin 420-49-16 16 July 2001 Cross-Connection Control at Army Installations".

The location of the backflow prevention devices shall be in accordance with AW's Contract, which may vary from installation to installation. Typically, if the backflow prevention device is to be retained by the Government, the device shall be located inside the building's mechanical room. If the backflow prevention device is to be owned by AW, the device will be placed as close as possible to the POD, per AW Standards.

For all new domestic water service lines where a meter with a check valve will not be installed, a double check valve device must be installed downstream of the AW POD if backflow devices are not part of AW's contract. For fire service lines, where the entire system is water-only, a double check valve device is required. For all fire service lines and other service lines where chemicals may be introduced to the pipe, a reduced pressure differential (RPZ) device is required.

The type of protection to prevent backflow into the water system shall commensurate with the degree of hazard present at the location. The type of protective device required listed in the increasing level of protection includes, double check valve, reduced pressure principle backflow device, and air gap. Details of the devices depending on the hazard present and locations will be determined during the review process on a case-by-case basis.

Devices must be installed by a State licensed person, and a certification of device installation and start-up checklist must be provided to AW before water service is enabled. Related forms are included in AW's Cross Connection Control Practice.

2.17. CORROSION PROTECTION

All open-cut construction of metallic pipe and fittings shall be encased in polyethylene wrapping in accordance with AW Specifications and AWWA standard C-105.

2.18. AIR RELEASE VALVES

Air release valves shall be provided at all high points along the water main alignment. The air release valve assemblies shall be located within concrete vaults or manholes, as per AW's Standard Details and AWWA Standard C512-04 and Manual M51. Air release valves shall be vented to atmosphere, above grade, above the calculated 100 yr. flood water level or the highest known flood elevation, whichever is higher, and protected with bollards in traffic areas. Concrete vaults shall be fitted with an access frame and cover, and constructed to prevent exposure to rainwater or runoff, vandalism, birds, insects, rodents or other animals.

2.19. PRESSURE REDUCING VALVES STATION

When a pressure reducing valve (PRV) station is required consider the following:

a. Isolation valves shall be located on either sides of the PRV.
b. When variable flow conditions maybe encountered, provisions shall be made to provide two separate parallel PRV lines to accommodate low and high flow conditions.

2.20. CONNECTION TO EXISTING WATER MAIN

Connections to existing water mains shall be performed in such a manner to provide the least amount of interruption to water service. A tapping sleeve and valve is the preferred method of connecting to an existing water main. Size on size taps are permitted up to 12 inches. No taps shall be made within 5 ft of a joint. For water mains larger than 12 inches, a tee must be cut in.

If connection to an existing water main requires the closing of valves that will cause an AW customer to lose water service, provisions shall be made by the Contractor to provide temporary service for potable water in sufficient quantity for customer needs. The method used is subject to approval by AW. A minimum of 72-hour notice shall be provided to AW prior to any tap installation.

Dead end lines will not be permitted without approval by AW. If a dead end line is approved, the main must be provided with either a flushing hydrant or automatic flushing station. The cover shall not include any identification indicating "Fire Hydrant". The standard below grade flushing hydrant shall be the Mueller model A-412 $2^1/_8$ inches flush type hydrant with a single $2^1/_8$ inches hose nozzle equipped with a nozzle lock. Above

grade flushing hydrants shall be Mueller Model A-412 $2^{1}/_{8}$ inches post type hydrant. Flushing hydrants shall be located not more than 1,250 apart. Above grade flushing hydrants shall not be located near airfields.

2.21. ACCEPTANCE TESTING FOR NEW AND REPAIRED MAINS

Newly installed water mains and water mains taken out of service for maintenance or repair, shall be disinfected prior to use in accordance with AW Standards and AWWA C651-05. Coliform bacteria samples from the new mains shall be negative prior to the new main being placed into service.

Prior to connecting a new main or service line to the existing AW system, the following items are required:

1. All pressure tests have been successfully completed for all pressurized mains.
2. All bacteriological clearances for potable water mains have been received.

Refer to AW Standard Specifications for pressure and Bac-T testing requirements. Provide compaction testing of new or repaired water main, and water service connections installed. Modifications to the required compaction testing frequency due to small scale of the project requires preapproval in the form of a variance request, from AW prior to start of construction.

2.22. THRUST RESTRAINT

Thrust restraint shall be provided at all changes in direction. Thrust restraint shall be provided by concrete thrust block whose size meets the AW Standard Details. Alternate thrust restraint such as “mega-lugs” may be used.

2.23. ABANDONMENT OF MAINS AND SERVICES IN PLACE

Abandonment of mains and services shall be done in accordance with AW Standard Specification. Generally, services shall be excavated at the curb stop or corporation stop and the valve closed off completely. If the valve fails to completely close, contact AW to schedule replacement of the valve, or remove the valve and tap and replace main section with sleeve. The service shall be physically separated from the main. AW is responsible to identify the service line or water line connection location to be cut and capped at or near the main. The location of the disconnection shall be provided to AW on project as-built drawings.

Generally, mains shall be cut and depressurized, then capped with a mechanical cap or concrete cover. Valve shall be closed, and the valve boxes removed. All fire hydrants shall be fully removed, per AW Standard Specifications. Upon request from AW, the fire hydrant shall be salvaged and moved to a location as determined by AW. Unsalvaged fire hydrants shall be disposed of in accordance with the local policy.

In certain circumstances where failure of an abandoned main may cause problems with settlement, the main must be filled with flowable fill per AW Specifications.

Asbestos cement pipe shall be abandoned in accordance with the EPA Guidance document on Demolition Practices for ACP which has been provided as a supplemental Specification Section.

2.24. ROAD AND RAILROAD CROSSINGS

All crossings of railroads and multi-lane roadways shall be made by either the jack and bore method or directional drilling, or as directed by the owner of the road or railroad. Where casing pipes are determined necessary by AW or the road or railroad owner, casing pipe material shall be a minimum of SCH 40 steel, with $^3/_8$ inches wall thickness, more if engineering calculations, the railroad, or highway owner requires more stringent carrier pipe requirements.

For two lane roadways, open cutting is not permitted without approval by the Base DPW. If open cutting is not permitted, the roadway crossing shall be performed by boring or tunneling.

All permits required for the crossing must be obtained by the Contractor from the State or local regulatory agency.

2.25. WELLS

New wells may be permitted if AW determines connection to the existing distribution system is not practical. New wells may also be required to supplement existing supplies in the area. The design, development, permitting, and construction of new wells shall follow local and State regulatory agency requirements and AW Specifications. The spacing between sewer lines and potable supply wells shall be a minimum horizontal spacing of 50'.

Disinfection using chemicals as determined by AW is required. Wells shall be provided with chlorine contact chambers meeting the requirements of the EPA Groundwater Rule for 4-log reduction of pathogens.

Newly constructed well, repaired well, or a well that has not been in operation for more than three months shall be sampled for bacteriological quality in accordance with AWWA C654-03, prior to being placed in service. If the results for the bacteriological testing are positive for coliform bacteria, the well shall be disinfected again per AWWA standards, and resampled for bacteriological quality. The test results shall be submitted to AW and, to the State DEP if required by State regulations, for review and approval prior to the well being placed in service.

Other chemical feed systems or treatment processes may be required based on raw water quality and regulatory requirements.

In addition to regulatory agency requirements for new well construction, the following well appurtenances are required:

1. EPA approved chlorine residual analyzers.
2. A sampling tap shall be provided for raw water.

3. When disinfection is accomplished at the well head a sampling tap for finished water shall be provided.
4. A flow meter.
5. A check valve to prevent back flow into the well and an isolation valve shall be provided. Valves shall be provided within the building.
6. Each well shall be equipped with appurtenances for measuring the change in the elevation of the water level in the well.
7. SCADA RTUs meeting AW system requirements.

A masonry walled building with architectural features per the base Installation Design Guide shall house the well and all supporting appurtenances. Adequate HVAC, heating, and cooling shall be provided. Provision shall be made to facilitate removing pumps, motors, and other mechanical and electrical equipment.

2.26. GROUNDWATER DISINFECTION TREATMENT PRACTICE

1. Disinfection that provides a measurable residual will be applied to all ground water sources before the water enters the distribution system and maintained such that a detectable disinfectant residual can be measured at all points in the distribution system.
    a. Treating multiple ground water sources at a single location is acceptable provided that the water is combined prior to reaching the first customer and that the disinfectant residual analyzer required in item 2 below is located after the point of mixing.
    b. Disinfection treatment will be provided for sources that are not typically used for production (e.g., emergency sources, back-up sources, temporary sources, etc.) before the source is placed into service.
2. All ground water treatment plants will provide analyzers and data loggers or recorders to record disinfectant residual levels and alarms to notify operators of issues with the disinfection feed system.
    a. Analyzers are to be installed at the entry point to the distribution system (preferably after any provided contact time).
    b. Analyzers will be incorporated into control system logic (e.g., Supervisory Control and Data Acquisition (SCADA), plant shutdown, etc.) or equipped to sound an alarm and / or page an operator in the event that the disinfection residual falls below preset low-level limits or goes above a preset high-level limit.
3. All ground water treatment plants will provide disinfection contact time as follows:
    a. Ground water treatment plants will meet the requirements of any relevant Federal and State regulations for disinfection contact time.
    b. Ground water treatment plants that do not provide 4-log virus removal / inactivation of viruses (4-log treatment) will:

    Evaluate the necessity of and options for achieving 4-log treatment whenever an engineering analysis of the treatment plant is performed.

Implement on-going monitoring for E. coli from its sources on a routine basis as specified by the State.

2.27. CHLORINE GAS DISINFECTION

GENERAL DESIGN

- The design of gas chlorine facilities should consider operator and public safety and long term plant operation. Design of chlorine facilities shall be such that chlorine can be contained in the chemical room. Doors and windows shall be gas-tight to minimize chlorine exposure to the atmosphere.
- Chlorine gas disinfection systems shall be vacuum-type only. Pressurized chlorine gas disinfection systems are not permitted.
- All ventilation and duct work from the chlorine feed and storage areas shall be separate from domestic building ventilation system.
- Fire sprinkler system should not be installed in chlorine storage room.
- Floor drains are prohibited.
- All chlorine feed rooms should be provided with independent heat and a thermostat that is capable of maintaining the room temperature of at least at 60°F. Cylinders and gas lines should be protected from temperatures above that of the feed equipment.
- Permanent chlorine gas feed room heating units should not be adjacent to chlorine containers.
- Chlorine feed lines shall not carry chlorine gas beyond this facility.
- The chlorine facility shall be located on the prevailing downwind side of the building and shall be away from any entrances, windows, louvers, or walkways.
- The chlorine facility shall not be located below grade.

BUILDING

- When chlorine gas is used for disinfection, the chlorination equipment shall be located in separate structure or a separate sealed room.
- Scales shall be made of durable material able to with stand aggressive environment and should be able to easily and accurately read through the viewing glass, to minimize entry into the chlorine room.
- The chlorine facility shall be provided with a shatter resistant inspection window installed in an interior wall, constructed in such a manner that all openings between the facility and the remainder of the plant are sealed.

VENTILATION

- Separate switches for the ventilating fan and for the lights shall be located outside of the facility and at the inspection window. A signal light indicating ventilating fan operation shall be provided at each entrance when the fan can be controlled from more than one point.
- Chlorine gas feed and storage rooms require emergency ventilation systems that it exhaust directly to the exterior atmosphere. Each chlorine room shall have a ventilating fan with a capacity to provide one complete air change per minute when the room is occupied. The ventilating fan shall take suction near the ceiling, with the point of discharge so located near the floor, as far as practical from the door, as not to contaminate air inlets to any rooms or structures.

- Air inlets shall be through corrosion resistant louvers near the ceiling. Louvers for chlorination facility intake and exhaust shall be airtight closure. Vents from feeders and storage shall be screened and shall discharge to the outside atmosphere, above grade.

STORAGE

- If 150 pound cylinders are used as chlorine source, a supply source or as the backup cylinders, shall be stored in the chlorine storage area.
- Full and empty cylinders of chlorine gas shall be isolated from operating areas, restrained in position to prevent upset, stored in locked and secure areas separated from any other chemicals, and protected from direct sunlight or exposure to excessive heat.

LEAK DETECTION/TREATMENT

- At a minimum, include intrusion and leak alarms, via SCADA RTU communicating with AW's SCADA system, or a land-line of cell technology based auto-dialer.
- In the event of a chlorine leak, the leak detector shall sound alarm when the chlorine level of 1 ppm is detected in the room.
- In the event of a chlorine leak, ventilated air containing chlorine may be a hazard to people and animals in the vicinity of the chlorine gas facility. In such a situation, and/or when required by AW, State or the local agency, ventilated air should be routed to a treatment system designed to reduce the concentration of chlorine discharged to the atmosphere.
- Such equipment shall be designed as part of the chlorine gas storage and feed areas to automatically engage in the event of any measured chlorine release. The equipment shall be sized to treat the entire contents of the largest storage container on site.
- The treatment system should be capable of reducing the concentration of chlorine to one-half of the IDLH level (Immediately Dangerous to Life or Health) at the point of discharge. The IDLH for chlorine is 10 parts per million.

SAFETY

- The emergency ventilation system should be used prior to each time workers enter the chlorine gas feed or storage room and during the time workers are in the room.
- Maximum withdrawal from a vacuum regulated 150 lb cylinder shall not exceed 50 lbs/day.
- Gas monitor shall be mounted outside the chemical room, with sensor in the chemical room near the floor. The gas monitor shall automatically lock out exhaust fan when in alarm state and start the chlorine gas scrubber (if equipped).
- All chlorine cylinders shall be adequately restrained. Access door shall be properly labeled with appropriate warning signs.
- All doors must open out and be equipped with a panic bar on the inside.
- To prevent the room from being classified as permit-entry confined space, there shall be more than one access to the room. OSHA will require two means of egress in chlorine storage rooms, where the maximum egress travel distance exceeds 25 feet.
- The interior and exterior doors shall clearly indicate the room contains chlorine.
- Chlorine room and storage area shall be designed so that they are vandal resistant, and include proper locks and signs.

- An emergency eye wash and emergency shower shall be provided adjacent to and upwind of the chlorine room.
- Emergency power shall be available to handle exhaust system, and scrubber system. When there is a leak the scrubber will automatically come on and alarm signal(s) sent out.
- Outside switches shall be protected from vandalism.

2.28. SODIUM HYPOCHLORITE DISINFECTION

SAFETY

- Appropriate safety, regulatory, and emergency response information be prominently displayed near each chemical system.
- Tanks, piping, valves, chemical unloading connections, and other equipment are to be labeled to make operators, maintenance personnel, and other workers aware of the chemicals being handled.
- Entry doors should be labeled with room contents and should be equipped with
- NFPA diamond labels identifying the type of hazard and degree (numeric value).
- Access to the fill connection for bulk tanks must be restricted to prevent unintentional filling or mixing of chemicals with catastrophic consequences. Each bulk tank must be equipped with an individual fill line.
- Rubber gloves, face shields, rubber aprons should be kept near the storage area for use.
- An emergency eye wash station and or emergency shower should be available near sodium hypochlorite handling area. Showers and eyewash stations must be clearly identified, well lit, free from obstruction, in line of sight and no further than 10 seconds travel time of the potential hazard.
- Tempered water is to be provided for emergency eyewashes and showers per ANSI Z358.1 – 2014 and OSHA guidance with a temperature between 60 °F and 100° F. Note that 85 of water is considered optimum for flushing of eyes.
- All rooms must be laid out such that tripping hazards are avoided. Door sweeps should be used in lieu of thresholds that could interfere with hand truck/dolly operation.
- Provisions should be included in the design of the building to allow for removal/replacement of bulk chemical storage, if applicable.

MATERIALS OF CONSTRUCTION

- Materials used for tanks, piping, fittings, gaskets, hoses, protective coatings, in-situ instrumentation, etc. must be appropriately selected for highest practical level of compatibility.
- Tanks should be constructed of NaOCl compatible high-density polyethylene (HDLPE), cross-linked polyethylene (XLPE) or corrosion resistant fiberglass-reinforced plastic (FRP).
- In general, the valve materials should match the piping system. Valves shall be of PVC, PTFE lined or chlorinated PVC quarter turn plug or ball valve type.

CHEMICAL STORAGE

- Sodium hypo-chlorite should be stored in a shaded enclosure to avoid direct sunlight, in vented containers and in temperature controlled environment (to avoid heat).
- Storage tanks shall be sized to store no more than the required 30 days of on-site storage at a time.

BULK STORAGE TANKS AND DAY TANKS

- Tanks should be installed in dark shaded enclosures and temperature controlled dry (60 to 70 degree F) environment with good airflow to slow degradation.
- The day tank fill line must be piped and vented to prevent the possibility of gravity flow or siphonage from the bulk tank to the day tank. Tanks should be vented with screens to release any oxygen / gas buildup that occurs during storage. Vent sizing shall be designed to accommodate the venting rate required due to decomposition, and to prevent vacuum or pressure when discharging or filling. Typically, the vent size is 2 to 4 times the diameter of the fill line. Vent piping should be secured to prevent vibration.
- Bulk storage tanks are typically used where the chemical consumption and economics justifies bulk storage over drum storage.
- Bulk storage tanks shall have a low point screened drain to drain sediments from the storage tank periodically.
- A useful tool in sizing of day tanks is to calculate 125% of the daily volumetric requirements of the maximum dose for the average daily treated water volume, and the average dose for the maximum treated water volume.
- For remote facilities that are not visited on a daily basis, it is acceptable to size a day tank for up to 3 days of projected maximum daily usage.
- Continuous level or weight monitoring is recommended, with alarms for high and low level in the day tank.
- Provide storage tanks with appropriate overflow pipes directed away from the operations.
- Level sensor: Level sensors shall be non-intrusive ultrasonic level sensor or tank weighing platform type. Tanks should be equipped with high level alarms.
- Chemical storage tanks should not be buried.
- Connections to the tanks should be solvent-welded.

FEEDING FROM DRUMS

- Chemicals may be fed directly from non-refillable drums in low capacity systems.
- Where drums are used, it is recommended that proper drum handling equipment be provided to minimize the risks associated with moving drums.
- As with day tanks, it is prudent to limit the volume of chemical directly connected to the water supply in case of accidental release.
- A weighing scale or reliable level monitoring device should be used to monitor the quantity of material remaining in the drum. The system should also be equipped with a low weight alarm.

- Adequate ventilation should be provided for drum feed areas.

METERING PUMPS

- Where facilities cannot be taken off line, redundant installed metering pumps are required for disinfectants. Where only one pump is installed, a second pump is recommended to be held in inventory as a spare.
- Metering pumps must be fully capable of operating over a feed range corresponding to max day/max dosage down to min day/min dosage.
- Metering pumps should be located near the day tanks.
- Metering pumps (especially diaphragm type) shall be located below the elevation of the storage tank to ensure a flooded suction at all times to alleviate any gasification problems, unless otherwise approved. Diaphragm metering pumps have the ability to operate with a suction lift, but are more reliable with a flooded suction.
- Positive displacement chemical metering pumps should have a downstream pressure relief valve located prior to the first shut-off valve. The pressure relief valve should discharge to the chemical day tank.
- An anti-siphon and backpressure control valve should also be provided on the discharge of all pumps.
- Pulsation dampeners should be provided on the pump discharge side.
- A bleed valve should be provided with the discharge directed into the chemical storage tank.
- A pressure gauge should be placed on the discharge of each metering pump to set any pressure relief valves, backpressure valves and to monitor for calcification buildup, scaling or other blockages on the feed line.
- Calibration cylinders should be provided on the suction side of the chemical metering pump between the chemical tank and the metering pump to allow for routine checks and calibration of chemical feed pump outputs. Calibration cylinders should be vented to the chemical day tank.
- Peristaltic type metering pumps are gaining acceptance for low pressure (< 30 psi) chemical feed applications, typically in the treatment plants. They inherently prevent siphoning because the tubing is always compressed. They also can pump the gas bubbles that are present in sodium hypochlorite systems without losing prime.
- While pumps could be installed at or near floor level, metering pumps should be elevated at least 30-inches off the floor to facilitate operation and maintenance, as well as reduce the chance of submergence if a leak occurs. Pumps are to be installed so that adequate suction conditions are maintained. It may be necessary to elevate day tanks to maintain adequate pump suction conditions.
- A strainer should be provided on the suction side of the pump.
- Pump Control: Metering pump control includes start/stop and feed rate adjustment. Start/stop control must have safeguards to prevent feeding of chemicals without water flow.
- The use of a single parameter to indicate flow to start/stop metering pumps is not allowed at partially attended or remotely operated facilities.

- The minimum feed rate should be based on the minimum chemical dosage and minimum daily flow. The maximum feed rate should be based on the maximum chemical dosage and maximum day flow (typically plant capacity). The metering pumps should have a sufficient turndown ratio to cover the minimum and maximum feed rates rate against the maximum head conditions found at the point of chemical application.

PIPING AND TUBING

- It is good design practice to minimize the length of chemical feed piping, but it is not always possible. Providing spare feed lines to primary application points is good design practice.
- In most cases, chemical piping and tubing will require replacement numerous times in the life of a facility, and should be installed in such a manner as to allow for replacement.
- PVC or CPVC piping and fittings shall be used for transporting solutions.
- PVC and CPVC pipe should be joined by solvent welding. Connections to the tanks should be solvent-welded. Avoid threaded joints if at all possible. Large PVC/CPVC unions are difficult to seal so flanged connections should be used instead of union connections for pipe diameters of three inches (3 in) and greater.
- Flexible plastic tubing can be used where continuous runs are required. The plastic tubing should be accessible and be easily replaced
- Chemical hoses can be used as primary piping inside a rigid casing pipe.
- When changing piping direction provide gradual radius sweeps and avoid sharp bends.
- Hoses may need support for strain relief at injection points.
- Pipe sizing should be selected such that the velocity is between 1.5 to 7 ft/sec.

VALVES

- Diaphragm metering pumps require at least 15 psi backpressure to function properly. If sufficient backpressure is not continuously available, then backpressure valves should be used to maintain a minimum of 15 psi backpressure to ensure accurate delivery.
- The valves also prevent siphonage or gravity flow of chemicals from the day tank through the metering pumps.
- Pressure relief valves must be used where positive displacement metering pumps are capable of producing sufficient pressure to cause damage. The pressure relief valve must be installed upstream of the first valve on the metering pump discharge. Isolation valves are not allowed between the metering pump and the pressure relief valve. The discharge of the pressure relief valve should be directed to the day tank or drum, or to the pump suction line upstream of individual isolation valves if only a single day tank is present.
- A “Four-Way Valve”, “4-in-1,” “4-function,” or “multi-function” valve that combines the functions of anti-siphon, backpressure, pressure relief and bleed valve functions may be used.

- Large PVC/CPVC ball valves can be difficult to operate. It is suggested that butterfly valves be used in sizes 3 inch and larger.
- Valves must be accessible for operation and testing. It is recommended that the piping design and installation not allow valves to be located more than five (5) feet above finished floor.
- Ball valves in sodium hypochlorite service are to have vented balls with a 1/8 inch diameter hole located in the ball on the downstream side to relieve internal pressurization caused by degradation of the sodium hypochlorite.
- Chemical injection valves should have a check valve to prevent back flow.
- Foot valves should be provided on the end of the suction line for metering pumps utilizing suction lift. Foot valves should be located 3-6 inches from the bottom of the solution tank, or as recommended by the manufacturer, to prevent solids from entering the metering pump.

SECONDARY CONTAINMENT

- Secondary containment must be provided for all bulk tanks, day tanks, batch tanks, metering pumps, transfer pumps, and chemical unloading areas. To the extent possible, bulk tanks and day tanks should be in the same containment.
- Minimum secondary containment volume is to be determined based on 110 percent of the largest storage tank capacity within the containment area plus allowances for fire sprinkler water, stormwater contribution, or reasonable freeboard as appropriate. State or local regulations may dictate the amount of capacity necessary for secondary containment.
- All metering pump suction piping should be located in the containment area.
- Penetrations of conduit and piping through containment walls or floors is not permitted.
- Secondary containment must also be provided for all drums/carboys.
- Secondary containment should be provided for buried chemical solution lines to minimize the potential for accidental releases to the environment.
- Secondary containment for reinforced flexible tubing should be provided with schedule 80 solvent welded PVC, CPVC or continuous HDPE piping.
- Secondary containment for exposed chemical feed lines within buildings is not required because the building should provide an adequate level of containment, leaks are readily evident, and chemical feed flow rates are generally low.
- Floor drains are not allowed in secondary containment areas.

LEAK DETECTION

- Chemical feed systems should have a sump within the secondary containment area equipped with a level switch to signal the occurrence of a leak. It is important that personnel be alerted of a leak as soon as possible.

CONTINUOUS ANALYZERS AND WARNING SYSTEMS

- Water quality should be monitored downstream of the chemical addition point to protect the consumer from accidental chemical over- or under-feeds.
- Chlorine residual must be monitored to ensure that the correct disinfectant concentration is present.

- Chlorine analyzers should have at least two alarm contacts that can be set for alarm conditions. These contacts may be used to interlock the chemical feed system with other system equipment to prevent overfeed or underfeed of critical chemicals.
- In a manned station, alarms from these analytical devices should warn the operator through SCADA so appropriate countermeasures can be taken.
- In an unmanned facility, alarms should be provided to alert the operator via SCADA or autodialer of a potential problem.

PROVISIONS FOR MAINTENANCE

- Provide means for draining chemical piping to allow for maintenance. Connections should also be available to flush suction and discharge chemical piping. Where tubing is used, it must be easily accessible and removable for replacement.
- Facilities must have the capability to drain chemical storage tanks.
- Provisions for disposal of cleaning/wash down and safety shower test water within secondary containment areas should be considered in the design phase of improvements.
- All instrumentation and valves must be accessible for maintenance and repair.

INSTRUMENTATION AND CONTROLS

- It is expected that SCADA will continuously monitor chemical inventories. SCADA can also use algorithms to calculate usage by the loss in weight or level in day tanks.
- SCADA will present status of pumps and valves.
- All alarms are to be sent to SCADA and logged.

2.29. WATER STORAGE TANKS

Where water tanks may be required for domestic and/or fire protection, the details of the tank shall be based on sizing requirements of AWWA M31 or Unified Facilities Code. AW will determine tank size and location during the review process.

All storage tanks shall be welded steel, pre-stressed, or composite; constructed in accordance with AWWA D100, D110/D115 and D107 respectively. Bolted steel tanks are not permitted. Any designs and logos to be applied to water storage tanks shall be approved in writing by AW and the base DPW/CES. Location of design or logo shall be field approved by DPW prior to painting.

At a minimum, water storage tanks shall include the following features:

1. Designed and constructed to prevent surface runoff, subsurface flow, or drainage into the tank.
2. Valve vault with level control valve, or as per State and local regulations
3. Isolation valves upstream and downstream of the valve vault, designed to allow the continued distribution of water when the tank is taken out of service.
4. The isolation valves shall be located within 100 ft of the tank.

5. Equipped with controls to maintain and monitor the water levels.
6. SCADA RTU with input/output points including alarms as specified by AW.
7. Security fence with pedestrian and vehicular access gates, and paved driveway, as required by local directive.
8. Roof hatch with locks
9. OSHA-compliant manway
10. At least one sampling tap (protected from freezing) to enable a representative sampling of the water in the tank that will be entering the distribution system.
11. Overflow pipe with insect screen, and means of overflow control.
12. Fully coated interior and exterior surfaces in accordance with AW and manufacturer's instruction
13. FAA-compliant checkerboard pattern (where applicable)
14. OSHA-compliant ladders and balcony railings or personal fall protection system
15. Aviation warning lights
16. Roof vents with insect screens designed to prevent rainwater or runoff entry, birds, insects, rodents and other animals
17. All effluent pipe shall be located underground (no heat tracing).
18. A dedicated drain line shall be provided that allows the tank to be fully drained and all residual sediment removed
19. Designed to allow authorized access and adequate lighting of the interior and exterior for inspection, cleaning, repair and maintenance

2.30. DISINFECTION OF WATER TANKS AND RESERVOIRS

Newly installed reservoir or water tank, or an existing water tank or reservoir taken out of service for maintenance, inspection or repair shall be disinfected and sampled for bacteriological sampling in accordance with applicable AWWA standards. If the results of the bacteriological sampling are positive for coliform bacteria, the reservoir shall be resampled for bacteriological quality. The test results shall be submitted to AW and, to the State DEP if required by State regulations, for review and approval prior to the water tank or reservoir is placed in service.

2.31. WATER PUMP STATIONS

Water pump stations shall be above grade, housed in a masonry building or a pre-fabricated building meeting base architectural design guidelines and AW requirements as defined through the planning and design stage. Pumping system review plans must include hydraulic calculations, signed and sealed by a Professional Engineer. The calculations must include flow projections, hydraulic analysis of the pump station and connected delivery mains, pump information including the operating point and pump curves, and electrical power requirements for all electrical equipment. AW will

consider if the station must be designed for future expansion and if so, the design shall be based on that condition.

They shall provide for redundancy of service, meet average and peak design flows, and include the following at a minimum:

1. Multiple pumps shall be provided for redundancy. Where only two pumps are provided, they shall be of the same size. Pumps shall have capacity such that, with the largest pump out of service, the remaining pump(s) will have capacity to handle the pump station requirements. Pumps must be capable of providing the varying demands and minimum pressures for the full range of system flows.
2. Flow meter
3. SCADA RTU with input/output points including alarms as specified by AW
4. High efficiency motors.
5. Investigate surge potential for all pumps. When surge potential for flow or velocity is present provide surge analysis. A surge analysis is required for large lift stations, i.e. flows greater than 3,200 gpm.
6. Where appropriate to prevent water hammer, install soft start/soft stop electrical equipment, pressure relief valves, air release valves, etc.
7. All above grade piping 4 inches and larger in diameter shall be constructed using DIP. Above ground pipe smaller than 4 inches shall be stainless steel.
8. Permanent Emergency power with automatic transfer switch and sufficient fuel storage to allow generator to operate pumps for 24 hours. The generator can be located in the exterior.
9. All controls and power supplies to meet AW defined operation criteria
10. Fully painted interior walls, piping, pumps, etc.
11. Security fence with pedestrian and vehicular access gates, with paved driveway
12. Necessary operational and maintenance appurtenances such as hoists, run time meters, etc.
13. Chemical feed facilities when required by AW
14. All other required utilities such as electricity, telephone/SCADA, gas, etc.

2.32. BULK WATER FILL STATION

Bulk water fill stations shall offer a safe and secure access, and cost-effective method to handle bulk water sales.

Each unit shall include all the piping, meter, valves and fittings, redundant back flow prevention (air gap and reduced pressure), all electrical wiring including the electrical service entrance panel, and safety tools to ensure protection of the water supply system from any potential contamination. The size of the pipe and control valves will vary based on the required maximum flow rate. Every unit shall also accurately record the

amount of water dispensed. Barriers should be installed around the devices to prevent damage from vehicular traffic or when directed by AW.

The terminal shall store the information such as, date and time, amount dispensed, and customer information. This information should be easily accessible, able to be downloaded to a computer to generating reports.

The stations shall be corrosion, UV, impact, and weather resistant; self-serving type enclosure, and capable of operating 24 hours a day. Stations shall include a smart card, or key operated type control system, or have the ability to control access by issuing haulers an access number and PIN number combination.

2.33. WATER PRESSURE SENSORS

Water pressure sensors shall continuously and remotely monitor pressure at any installed point within a potable water distribution system. Prior to the installation, strategic installation points should be identified and approved by AW.

Accurate pressure data allows system operators to reduce leakage, energy costs, system maintenance costs, customer complaints, and water quality problems. The units shall be strategically installed to optimize infrastructure investments, to better understand conditions within the distribution system, and for data acquisition. The data shall be used to alter or modify the system operation, and to make better decisions concerning the existing water infrastructure and plan for the future. The units can be installed for analyzing water hammer, negative pressure events, fire flow testing, pressure loss tests, investigating pressure, routine pressure monitoring, hydrant capacity testing, calibrating hydraulic models, response to water quality issues, improved customer satisfaction, reduces customer complaints, mitigates risks and reduces operational costs.

Data from all deployed pressure sensors should be available to view and download to a computer. The system shall be capable of transmitting data via cellular communication to a smart phone, desktop, or SCADA System. It should have capability to send high- and low-pressure alerts to these devices.

2.34 FIRE BOOSTER STATIONS

All fire booster stations will be designed with the minimum requirements of NFPA 20 or the latest revision.

- Electric pumps with a backup generator. A waiver may be granted if the backup generator is deemed redundant by American Water.
  - The generator will be Diesel.
    - Generac Generators are prohibited.
  - Fire pumps powered exclusively by combustible fuel sources are forbidden such as diesel, propane, gas or natural gas.

- Building walls should have a minimum clearance of three feet internally of all piping, flanges, pumps, motors, and backflow devices.
  - External building clearances should be 10 feet from any obstruction and not hinder fire department connections.
  - Piping should not run under the building but should enter the facility from the exterior.
- The building should be insulated and electric heaters should be installed and sized to maintain a minimum temperature of 40 degrees internal temperature when exterior temperatures are at 5 degrees Fahrenheit.
  - Heaters should be thermostat controlled.
- Building should have exhaust fans on thermostat-controlled vents with actuated louvers to displace excessive heat and maintain an ambient temperature that corresponds with external temps during summer periods or to vent excessive heat generate by the pumps, transformers and controls.
- LED lighting will be provided with switches at each entrance or exit to the building.
  - Exterior wall pack(s) will be provided and controlled via photocell over each entrance/exit door of the building.
  - Emergency lights will be LED.
- All exterior piping or appurtenances exposed to adverse climate conditions will be insulated and heat taped.
- Horizontal split case fire pumps with a soft start controller or VFD should be provided.
  - Use of Vertical Shaft Turbines should be limited.
- A bypass and test header will be incorporated into the design.
- Adequately sized floor drains should be incorporated into the design.
- A Monaco or like system as required by the base Fire Department will be incorporated.
- Building should be constructed of a non-combustible material.
- Internal smoke detectors will be incorporated into the design of the building.
- BFPs will be incorporated as required by the State agencies with jurisdiction.
  - BFPs will be protected against adverse climate to include heated hotboxes if necessary.
- Necessary operational and maintenance appurtenances such as rails, hoists, etc., for removal of heavy equipment.

2.35 – FIRE PROTECTION DELUGE TANK

Deluge tanks provide water storage primarily for fire protection.

- Welded steel tanks will be utilized.
  - Glass lined bolted tanks are prohibited.
- Tank will be top fill with an air gap.

- BPFs will be incorporated as required by the State agencies with jurisdiction.
- BFPs will be protected against adverse climate by including heated hotboxes if necessary, and/or when directed by American Water.

- Tank will have a manual level indicator on the exterior.
- Tank will be labeled as non-Potable on the exterior.
- Tank will have telemetry/SCADA with call out ability and integrate into America Waters existing SCADA system, it will monitor/control the following:
  - Level
  - Water Temp
  - GPM
- The perimeter of tank and booster station will be fenced according to American Water or the base's fencing standards, whichever is more stringent.
- The facility will be well lit, as required by American Water.
- Exterior control appurtenances will be insulated and heated as required to protect against adverse climate conditions.
- Tank will be constructed to American Water and the State standards, or agencies with jurisdiction.
- Tank overflow will be constructed to prevent erosion in the event of discharge.

3. SEWER DESIGN GUIDELINES

3.1. OVERVIEW

This Design Guide section provides the minimum AW guidelines for the design of sanitary sewer systems, including collection systems, force mains, and lift stations. All sewer system design shall be performed in accordance with generally accepted engineering standards and practices, AW Standard Specifications for construction of Wastewater Facilities, and all applicable local and State regulations. Certain projects may be required to meet the minimum standards of Unified Facilities Code, and its applicability shall be reviewed with AW Project Manager prior to project design.

3.1. DESIGN FLOWS

Design flows for all proposed sanitary sewer system expansions shall be based upon building occupancy and use, plumbing fixtures, and other industry standard methods, submitted for review by AW.

Peaking factors for peak hourly flows shall be in accordance with the actual observed peaking factors, when available or as applicable State regulations or local governing criteria. In the absence of such criteria, peaking factors for peak hourly flows shall be in accordance with the following table:

AVERAGE DAILY FLOW (MGD)	0.010	0.03	0.06	0.10	0.3	1.0	4.0	10.0
PEAKING FACTOR	4.2	4.0	3.9	3.8	3.5	3.0	2.5	2.0

For unique situations where the preceding peaking factors are not applicable for facilities with non-typical water domestic use patterns such as a sports stadium, banquet hall, dining facility, etc., the designer shall coordinate with AW for an appropriate peaking factor to be utilized.

3.2. SIZE AND DEPTH

All sewers shall be designed to convey planned ultimate peak design flow while flowing 75% of the maximum pipe capacity at the minimum slope. The proposed peak design flow should not surpass the flow capacity of any pipeline. The diameter of proposed sanitary sewers shall not exceed the diameter of the existing or proposed outlet, whichever is applicable.

Sanitary sewer mains flowing via gravity shall have a minimum diameter of 8 inches. Sanitary sewer service laterals shall have a minimum diameter of 4 inches for residential connections and 6 inches for multiple residential, commercial and industrial connections, and shall be installed with a minimum grade of 1/4" per foot.

All gravity sewer and force mains shall have a depth of cover in compliance with State or local requirements. The minimum depth of a sewer main shall be designed so that laterals connected to them have a minimum of 4' of cover. Greater depths may be required when it is necessary to extend the main line sewer to serve other areas or for future growth.

3.3. PIPE LOCATING SYSTEM

All installed pipe shall be provided with tracer wire and marking tape as shown in AW's Standard Details and Specifications, except pipe bursting projects.

WASTEWATER PIPE

TYPE OF SERVICE	ACCEPTABLE MATERIALS
Gravity Mains, < 3 ft cover (Existing non-compliant sewers)	DIP pressure class 300, with interior epoxy coating for sewer service
Gravity Mains, < 10 ft cover, < 15" Ø pipe	PVC SDR 35
Gravity Mains, 10 to 15 ft cover, < 15" Ø pipe	PVC SDR 26
Gravity Mains, < 10 ft cover, > 15" Ø pipe	PVC PS 46
Gravity Mains, 10 to 15 ft cover, > 15" Ø pipe	PVC PS 115
Gravity Mains, >15 ft cover, up to 24" Ø pipe	DIP pressure class 300, with interior epoxy coating for sewer service.
Gravity Mains, > 24" Ø pipe	AW will review and approve pipe materials on a case-by-case basis. Pipe types considered are: Pro 21, cement lined mortar pipe, fiber glass reinforced thermosetting plastic, etc.
Force Mains, < 4" Ø pipe	HDPE, minimum SDR 11 (min 200 psi) PVC SDR 21 PVC SDR 26
Force Mains, > 4" Ø pipe	HDPE, minimum SDR 11 (min 200 psi) PVC C-900 200 psi rating DIP pressure class 300, with interior epoxy coating for sewer service
Above ground	DIP with interior epoxy coating for sewer service

Inside wetwell of lift stations	DIP with interior epoxy coating Stainless steel No plastic or galvanized piping
Wastewater conveyance	PVC Schedule 40 or 80 is not permitted for conveying wastewater
Buried mains in areas of high risk of hydrocarbons contact with pipe.	Ductile iron pipe with gaskets* that are impermeable to hydrocarbons
*Needs approval by the AW Project Manager.	

Waivers from the above pipe standards may be obtained with the submission of engineering justification.

3.4. TRENCHING, PIPE BEDDING & BACKFILL

All trenching shall comply with applicable OSHA regulations. The width of all trenches shall be sufficient to allow all pipes to be laid, joined properly, backfilled, and compacted as needed. The trench width shall be pipe diameter plus 12 inches each side of the pipe unless authorized by a professionally engineer.

All sewer mains shall be provided with bedding in accordance to AW Standard Specifications and Details. Full stone backfill is not required under paved areas. Waivers from bedding may be provided by AW if it can be demonstrated that native material is of similar nature to the specified bedding.

3.5. GRAVITY SEWERLINE SLOPE

Gravity sanitary sewers shall be designed to provide a minimum velocity of 2 ft/sec when flowing half full. Design calculations shall be based on the Manning's formula using an n-value in agreement with local, and State Standards. Minimum slopes shall meet local or State regulations for mains and international building code for service lines. The maximum allowable slope for all gravity sewers shall be such that the velocity within the pipe does not exceed 10 ft/sec, as calculated using Manning's Formula, or as stipulated by the State or local regulations.

3.6. SEWER LOCATIONS

Sewer mains shall be located outside of paved areas wherever possible unless ground topography or a roadway crossing dictates otherwise. Sewer mains shall be constructed a minimum distance of 3 ft from pavement or sidewalks. Sewer mains shall maintain a minimum of 10 ft horizontal clearance from the edge of any building or structure.

When a new main is installed, place wye fittings as part of the main run when service line locations are known. Service line stub shall be capped until complete installation of the sanitary lateral.

It is preferred that gravity sewers be constructed in straight alignment runs between manhole. If required, deflection of the horizontal alignment of the gravity sewer in between manholes is permitted in accordance with the following tables:

PVC PIPE

SIZE OF PIPE	DEFLECTION ANGLE	MAXIMUM DEFLECTION (20-FT. LENGTH)
4”-12"	2 degrees	8"
14" +	1.5 degrees	6"

DIP PIPE

SIZE OF PIPE	DEFLECTION ANGLE	MAXIMUM DEFLECTION	
		(18-FT. LENGTH)	20-FT. LENGTH)
3”-12"	5 degrees	19"	21"
14"-42"	3 degrees	11"	12"
48"-64"	3 degrees	N/A	12"

3.7. MINIMUM SEPARATION REQUIREMENTS

Sewer mains shall be located to maintain the minimum required distance between the water and sewer lines and other utility lines in strict accordance with all AW Standard, Federal, State, and local requirements and all right-of-way limitations for both horizontal and vertical separation requirements.

3.8. CLEAN-OUTS

Service lines shall be provided with a clean-out located at the AW POD and every 75 ft or change in direction, unless otherwise specified by AW. Depending on service line length and layout, AW may require manholes to be installed. Ninety-degree bends are not permitted on service lines. Sanitary cleanouts are not permitted to directly connect to MHs, instead shall be connected to the sewer line.

Force main cleanouts shall be spaced no greater than 800 ft apart, or as stipulated by the State Regulation. They shall also be placed at major change in direction or vertical alignment and where one force main connects to another.

3.9. ABANDONMENT OF SEWER CONNECTION SERVICES IN PLACE

Abandonment of sewer mains and services shall be done in accordance with AW Standard Specification for sewer facilities. The sanitary sewer service shall be physically separated from the sewer main. AW is responsible to identify the sewer service line or lateral connection location to be cut and capped at the sewer main. The location of the disconnection shall be provided to AW on project as-built drawings.

3.10. MANHOLES

Manholes are required at all changes in grade, pipe size, direction, pipe material, terminus of all sewer lines and sewer junctions. Additional manholes are required at all sanitary sewer intersections. Sanitary sewer manholes shall be constructed with precast or cast-in-place concrete. Fiberglass Reinforced Plastic Manholes may be acceptable on an individual basis. Brick construction is not permitted. Provide manhole sections, base sections, and related components conforming to ASTM C478. The minimum internal diameter of a manhole shall be 4 ft. When pipe larger in diameter than 20 inches is used in any manhole the manhole diameter shall be as noted in the table below:

MINIMUM MANHOLE DIAMETER

PIPE SIZE	MINIMUM MANHOLE DIAMETER
20-36 inch	5 ft
39-60 inch	6 ft
> 60 inch	TBD by Project Engineer and approved by AW Project Manager

The maximum distance between manholes shall be as specified by the State regulation for wastewater collection system. AW Project Manager may require shorter spacing due to operational efficiencies or other reasons and will be defined in the project scope. In the absence of clearly defined allowable maximum distance between manholes by the State regulation, the following spacing guidelines shall be followed:

MAXIMUM MANHOLE SPACING: PIPE SIZE	MAXIMUM MANHOLE SPACING
<18 inch	500 ft
18-30 inch	800 ft
> 30 inch	1000 ft

Manhole design shall follow the following guidance:

a. The sizing of manhole openings shall be determined by local or State regulations.

b. A minimum of 2 inches drop across the manhole, from the invert in to the invert out, is required. All manholes shall have a poured, formed, smooth flow channel.

c. All manhole drop connections shall be outside drops. Internal drops are not permitted. Outside drops shall be provided when the invert elevation into the manhole is 24 inches greater than the manhole invert.

d. Doghouse manholes shall be constructed at the intersection of a new sanitary sewer line with an existing sanitary sewer line.

e. Sanitary sewer laterals must connect directly to an existing main via a saddle. Laterals may not connect to a manhole without prior approval from AW.

f. Manholes that receive a force main or are located within 1,000 ft down-stream of such a discharge shall be provided with a fiberglass liner or sewer gas resistant epoxy coating to help prevent the deterioration of the manhole.

g. Provide an external vent pipe for manholes on every third manhole when three or more consecutive water tight frame and covers are installed.

h. Adequate provisions shall be made for ventilation of deep MHs. Gravity sewers must be adequately vented through holes in MH covers when infiltration/inflow is not a problem, or through other means.

3.11. ACCEPTANCE TESTING

All sewer and manhole testing requirements shall comply with AW Standard Specifications. Prior to placing a sewer main or service line into service, the following items are required per AW specifications:

1. All pressure and leakage, or vacuum tests have been successfully completed for all gravity mains, pressurized mains, and manholes, valves and other appurtenances installed.
2. Mandrel testing of the mains.
3. If any mandrel testing fails, televising of mains will be required to verify no obstructions exist.

   Provide compaction testing of sewer lines, and sewer laterals installed. Modifications to the required compaction testing frequency due to small scale of the project requires preapproval in the form of a variance request, from AW prior to start of construction.

3.12. SIPHONS

Siphons are permitted when no alternatives exists. All designs and details of siphons shall be provided to AW for review and approval.

3.13. AERIAL CROSSINGS

Aerial crossings may be permitted on a case by case basis when no viable alternative exists. Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion joints shall be provided between above ground and below ground sewers.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 50-year flood, or as stipulated by the State or local regulations.

3.14. SEPTIC SYSTEMS

New septic systems may be permitted if AW determines connection to the existing collection system is not practical. The design, development, permitting, and construction of new septic systems shall follow local and State regulatory agency requirements. All field test information, design calculations, and systems designs shall be submitted to AW for review and approval.

Pumping of raw sewage into septic tanks is not permitted unless engineered baffle walls and access ports for pumping are provided. This avoids suspension of settled solids due to high pump rates.

Septic tanks shall be designed to receive the discharge of sewage and provide first stage of treatment through physical settling, floatation, and the anaerobic digestion of sewage. The tank shall also allow storage of both digested and undigested solids until they are removed. The effluent may be discharged to a succeeding tank, treatment unit, or soil dispersal system.

General septic system design shall consider the following conditions:

- The septic tank(s) shall be located near the main source of sewage.
- The tank location shall meet all the building setback requirements.
- The tank shall be located where it is easy to remove solids and liquids from the tank
- The tank depth shall not exceed the tank manufacturer's maximum designed depth
- Septic tanks shall not be located in floodways, drainage ways, or swales.
- The tank shall not be located in areas subject to vehicular traffic unless it's designed for the anticipated load.
- Septic tanks must be placed on firm and evenly compacted soil. The soil beneath the tank must be capable of bearing the weight of the tank and its contents. Anti-buoyancy collar shall be provided depending on the tank location, water table level and periodic saturated soil conditions.
- Grease traps should be included in residential or commercial connections that produce high levels of organics and fats, oils, and grease.

The septic tank design shall consider the following conditions:

- The length-to-width ratio and the length-to-depth ratio must facilitate settling of solids.
- A length to width ratio of at least 3:1 is preferable, with a recommended liquid depth of 3 feet.
    - The design liquid depth shall be at least 30 inches and not greater than 84 inches
    - The tank shall have a minimum of six feet between the inlet and outlet where possible.
- The inlet and outlet shall be located on opposite wall along the axis of maximum dimension, where possible.
- Baffles must be installed at each inlet and outlet of septic tanks.
- Inlet invert at least two inches above the outlet invert
- Effluent screens, such as Zabel Filter or approved equal, shall be used as the outlet baffle on the final septic tank.

3.15. OIL-WATER SEPARATORS

Oil-water separators are required for wastewater sources with petroleum products for removal of free and emulsified oils and greases, usually as a pretreatment method before discharge to the sanitary sewer or septic system. They shall be engineered for peak flow, and provide ease of access for cleaning and inspection, and accounting for vehicle access.

The wastewater velocity shall be kept very low, typically less than 3 ft/min to prevent turbulent mixing. Key parameters that shall be considered in the design of conventional oil/water separators include flow rate, minimum wastewater temperature, oil-fraction specific gravity, oil concentration, relative fractions of free and emulsified oils, quantity of solids to be removed, effluent oil concentration limits to be met, and detention time. Systems that discharge to a sanitary sewer line must meet pretreatment requirements per the local standards. All design calculations and systems designs shall be submitted to AW for review and approval.

The systems shall be pre-manufactured, pre-cast concrete units specific for the application, other materials may be allowed upon AW approval. Where available, a yard hydrant shall be provided at the oil-water separator for operational and maintenance purposes.

3.16. GREASE TRAPS

All design calculations and systems designs shall be submitted to AW for review and approval. All interceptors shall be of a type and capacity approved by AW and shall be located such that it is readily and easily accessible for cleaning and inspection. Grease traps are required where wastewater sources contain animal and vegetable

derived grease products. All grease traps shall be externally located, pre-cast concrete units designed for the specific application (other materials may be allowed upon AW approval), with a gasketed bolt-down manhole frame and cover. Grease traps shall not be located under pavement but shall be located within 5 ft of a paved vehicle access for cleaning and inspection whenever possible.

Grease traps shall be engineered for peak flow and sized based on required retention time. Retention time shall be based on the manufacturer's recommendation for operational discharge or as stipulated by the State regulations for allowed concentration of fat/oil grease during peak flows. Only waste from grease producing sources shall flow through the grease trap, and the sanitary waste and other wastes shall flow through a separate lateral and connect to the receiving main.

3.17. HOLDING TANKS

Holding tanks are permitted upon specific approval from AW. Pumping and hauling is not considered a long-term solution to wastewater management, and may be considered for use on a project for a duration of less than 1 year.

Holding tanks shall be water tight, include a high level instrumentation and alarm via SCADA RTU communicating with AW's SCADA system or a land-line of cell technology based auto-dialer. Holding tanks shall provide a minimum of three days of average daily flow storage measured at the 85% of full volume capacity. They shall be engineered, and provide ease of access for cleaning and inspection, accounting for vehicle access.

4. LIFT STATION DESIGN GUIDELINES

4.1. DESIGN CONSIDERATION

The type, size, and general requirements for lift stations will be determined on a case by case basis by AW. This section provides general guidelines for the lift station design, the different lift station classifications and their basic requirements.

Pumping system review plans must include hydraulic calculations, signed and sealed by a Professional Engineer. The calculations must include flow projections, hydraulic analysis of the lift station and force main, pump information including the operating point and pump curves, buoyancy calculations, water hammer calculations and electrical power requirements for all lift station electrical equipment. AW will provide guidance when the design of the lift station must be based on future expansion.

4.1.1. GENERAL DESIGN

1. Lift station structure, electrical and mechanical equipment shall be elevated minimum three feet above 100 year flood elevation, or the highest known flood elevation, whichever is higher, or as stipulated by the State regulations.
2. Equipment located in the wetwell shall be suitable for use under corrosive conditions.
3. Suitable shutoff and check valves shall be placed on the discharge line of each pump.
4. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for handling wastewater and shall be of swing-check valve type, placed on the horizontal portion of discharge piping. Ball check valves shall not be allowed. Swing check valves should be supplied with an outside lever with spring or counter weight to prevent valve slam. Check valves should be designed to automatically close when there is a power failure.
5. Valves and piping shall be capable of withstanding normal working pressure (min 100 psi) and water hammer.
6. Valves required shall be located in a separate valve vault. Provisions shall be made to remove or drain accumulated water from the valve vault.
7. Each pump shall have an individual intake. Wetwell and suction design should be such as to avoid turbulence near the intake.
8. Appropriate protection from clogging such as use of bar screens to be considered during design, depending on the size of the size of the sewer main and nature of wastewater.
9. Water level sensing devices should be so located as not to be unduly affected by turbulent flows entering the well or by the turbulent suction of the pumps.
10. Level control device and float switch shall be fully accessible without the need for personnel to enter the wet well.
11. Water level sensing devices shall be as specified by AW Project Manager.
12. Provide locking mechanism for all access hatches as specified by AW Project Manager.
13. The wetwell floor shall have a minimum slope of 1 to 1 to the hopper bottom, or fillet bottom.

14. Provision shall be made to facilitate removing pumps, motors, and other mechanical and electrical equipment without entering the wetwell.
15. Lift stations and portable equipment shall be supplied with a complete set of operational instructions, including emergency procedures, maintenance schedules, tools and such spare parts as may be necessary.

4.1.2. SITE DESIGN FACTORS

1. Yard hydrant/Water service, shall be installed at each lift station adjacent to the wetwell.
2. Adequate lighting shall be provided at all lift stations.
3. The lift station shall be readily accessible by maintenance vehicles during all weather conditions.

4.1.3. PUMP DESIGN AND SIZING

1. The design peaking factor shall be such that one pump in a duplex system can handle the variation of inflow into the wetwell during the day, and in accordance with Section 3.1 and Section 3.2.
2. If the inflow rates vary greatly, variable drive units may be considered to match the incoming flow rates.
3. Force main friction losses shall be based on the Hazen-Williams equation. All elbows, fittings, entrances, exits, and pipe lengths should be used to determine friction losses.
4. The operating point for the selected pump should coincide as closely as possible with the design flow and best efficiency point of the pump. Pump efficiency shall be an important factor in the pump selection process.
5. Multiple pumps shall be provided for redundancy. Where only two pumps are provided, they shall be of the same size. Pumps shall have capacity such that, with the largest pump out of service, the remaining pump(s) will have capacity to handle the peak design hourly flow.
6. The design of the pump station shall be such that under normal operating conditions the pumps will operate under a positive suction head (not with suction lift pump).
7. Submersible pumps shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter. This requirement excludes grinder pumps.
8. For grinder pumps, the pump inlet velocity shall not exceed 4 ft/sec or as recommended by the specified pump manufacturer to prevent jamming of the cutter mechanism.
9. The effective volume of the wetwell shall be based on design average flow and a filling time not to exceed 30 minutes or as mandated by the State.
10. The minimum pump cycle time shall also be considered in sizing the wetwell. The pump manufacturer's duty cycle recommendations shall be used in designing the pump cycle time.
11. The motor size shall be selected so that entire pump curve is non-overloading and within the manufacturer’s recommended limits, and so that the pump does not operate in the motor service factor.

12. Suction lift stations should be designed to alternate pumps daily instead of each pumping cycle.
13. Guide-rail connection assemblies shall be provided to set and remove the pumps without entering the wetwell. A base plate should be provided at submersible stations for removal of equipment with a portable winch.
14. Hydromatic brand pumps are not permitted in any lift station.

4.1.4. FORCE MAIN DESIGN

1. The force main shall be designed to maintain a minimum velocity of 3 ft/sec and maximum velocity of 6 ft/sec at design flow. Different velocities, if permitted by State regulations may be approved by AW.
2. A force main shall be a minimum of 4 inches in diameter, unless used in conjunction with a grinder system.
3. Crossing of a new force main under an existing waterline shall be enclosed in a continuous sleeve within 10 ft of the watermain.
4. A combination air relief/vacuum valve shall be placed at all high points in the force main to exhaust air and prevent vacuum formation.
5. The air vacuum and/or air release valve assemblies shall be located within concrete vaults or manholes.
6. Evaluation of the force main discharge manhole and downstream sewer system, with respect to hydraulic capacity, corrosion, and serviceability.
7. The force main shall enter the receiving manhole with a smooth flow transition to the gravity sewer system at no more than two ft above the flow line of the receiving manhole, or as stipulated by the State or local regulations.
8. Ninety degree bends are not permitted on force mains. Forty-five degree bends shall be provided in lieu of ninety-degree bends. Large radius fittings are allowed for HDPE force mains; however, the minimum radius of curvature for the long sweep shall be 5ft.
9. Force mains 4 inches and greater in diameter shall have valves located in precast valve vaults spaced at no more than 2,000 ft intervals to facilitate initial testing and subsequent maintenance and repairs.
10. Force mains shall be provided with tracing wire and test stations as shown in AW's standard detail and specifications.
11. Sewer force mains shall be green in color or have green stripes for HDPE pipe, for appropriate identification.

4.1.5. GENERAL ELECTRICAL DESIGN

1. All design, materials, and installation shall comply with the NEC, NFPA, UBC, and other applicable local Codes.
2. Designers are responsible for arranging for electric power (and other support utilities) to be brought to the station.
3. A fused disconnect switch located above ground shall be provided for the main power feed for all pumping stations. The disconnect switch shall be located above the 100-year flood elevation.
4. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wetwell.
5. Lightning and surge protection systems shall be considered for all lift stations.

6. Submersible pumps and motors shall be designed specifically for raw wastewater use and shall meet the requirements of the NEC.
7. An effective method to detect shaft seal failure or potential seal failure shall be provided.
8. Electrical power shall be designed and constructed in accordance with NEC requirements, as supplemented here:
    a. No junction boxes are permitted in the wetwell
    b. Junction boxes shall be NEMA 4X stainless steel with stainless steel quick release latches.
    c. All electrical construction within the wetwell shall be NEMA 7 or 8.
    d. All conduits entering lift station should be sealed air tight at the wetwell and at the control panel. Once above grade, these conduits shall also have an air gap immediately below the control panel. Conduit shall be sealed air tight on either side of the air gap.

4.2. GRINDER LIFT STATIONS

Flow typically less than 0.7 gpm (500 gallons/day) shall be serviced by a grinder pump system meeting the requirements of AW Grinder Lift Stations Specification, and in accordance with State and local regulations. Lift stations of this size shall be simplex only. If a duplex system is determined to be required, then comply with the Small Lift Station Specifications requirements.
In addition to the design considerations listed in Section 4.1, Lift Station Design Considerations, grinder lift stations shall be engineered to meet the following conditions:

1. Wetwell shall be fiberglass or HDPE or other approved material.
2. An audio-visual alarm is required. SCADA systems are not required.
3. Power shall be provided from a dedicated circuit or direct feed from a dedicated independent service, and wire and conduit installed up to the control panel location.
4. If the grinder lift station is to tie-in to an existing force main, an isolation valve on the lateral at the main connection is required.
5. Control panels shall include the following:
    a) Ground fault receptacle with circuit breaker
    b) NEMA starters
    c) Local dry contacts for alarms specified elsewhere
    d) Lightning arrestor
    e) H-O-A switch for pump
    f) Contacts for hermetically sealed level sensor
    g) Pump failure with dry contact
    h) Provide stainless steel float hanger brackets.

4.3. SMALL LIFT STATIONS

Small list stations shall be duplex stations with total pumping capacity of less than 80 gpm, which meets the requirements of AW Small Lift Stations Specification. In addition to the design considerations listed in Section 4.1, Lift Station Design Considerations, small size lift stations shall be engineered to meet the following conditions:

1. Wetwell and valve vault basin shall be fiberglass or approved material, with access hatches and safety grating for the wetwell access hatches.
2. Wetwell shall have a minimum diameter of 4 ft.
3. Submersible duplex grinder pumps shall be provided. Chopper type pumps may be allowed if grinder pumps are not suitable for the type of application.
4. Power shall be provided from a dedicated circuit or direct feed from a dedicated independent service, and wire and conduit installed up to the control panel location.
5. At a minimum, audio-visual alarm systems are required in lieu of a SCADA system depending upon location, station holding capacity and inspection frequency. The need for a SCADA system will be determined on a case by case basis, and per the State and local regulations.
6. If SCADA system is required, then the SCADA monitoring shall include at a minimum but not limited to the following:
    1. Pump Status (On/Off)
    2. Pump Run Times
    3. Totalized Flow
    4. Pump Station Alarms
        - High WW level
        - Low WW level
        - Pump Failure
        - Power Failure
7. Control panel shall be provided as part of pump station package. Base panel shall include all circuitry to control pumps including contacts, microprocessor, starters, circuit breakers, etc. Exterior control panels shall be stainless steel. Interior control panels may be fiberglass.
8. Control panels shall include the following:
    a) Ground fault receptacle with circuit breaker.
    b) Reduced voltage starters with under voltage release and overload coils for each phase
    c) NEMA starters
    d) Local/remote dry contacts for alarms specified elsewhere
    e) Sequential, selectable alternator

f) Lightning arrestor

g) Elapsed time meter for each pump, non-resettable

h) Time delay between pumps

i) H-O-A switches for each pump

j) Contacts for hermetically sealed level sensor and one pressure transducer or ultrasonic level sensor

k) Pump failure with dry contact

l) Generator interlock

m) Phase loss monitor

n) Provide stainless steel float hanger brackets.

4.4. MEDIUM LIFT STATIONS

Medium lift stations are either duplex or triplex stations with total pumping capacity between 80 gpm to 1050 gpm, which meets the requirements of AW Medium Lift Stations Specification. In addition to the design considerations listed in Section 4.1, Lift Station Design Considerations, medium lift station must be engineered to meet the following conditions:

1. Wetwell and valve vault basin shall be pre-cast concrete type, with access hatches, and safety grating for the wetwell access hatches.
2. Wetwell shall have a minimum diameter of 6 ft.
3. Valve vault shall also contain a bypass pump connection.
4. Sewage grinder, chopper, submersible or suction lift (non-vacuum pump assisted) pumps.
5. Adequate mechanical ventilation shall be provided for all pump stations. Wetwell ventilation may be either continuous or intermittent. Ventilation, if continuous as mandated by the State or AW, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Air shall be forced into the wetwell by mechanical means. The air change requirements shall be based on 100 percent fresh air.
6. Security fencing and access hatches with locks shall be provided.
7. Interior surface of the wetwell and exterior of discharge piping in the wetwell shall be coated with hydrogen sulfide resistant coating.
8. Permanent Emergency power with automatic transfer switch and sufficient fuel storage to allow generator to operate pumps for 24 hours. The generator can be located in the exterior.
9. Generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station.

10. If SCADA system is required, then the SCADA monitoring shall include at a minimum but not limited to the following:

    a. Pump Status (On/Off)
    b. Pump Run Times
    c. Totalized Flow
    d. Power Failure
    e. Emergency Generator Status (On/Off)
    f. Pump Station Building Alarms - Intrusion
    g. Pump Station Alarms
        - High WW level
        - Low WW level
        - Pump Failure
        - Power Failure
        - Emergency Generator Failure
        - Comminutor Failure
        - Phase loss

11. Control panel shall be provided as part of pump station package with single source manufacturer responsibility. Base panel shall include all circuitry to control pumps including contacts, microprocessor, starters, circuit breakers, etc. Exterior control panels shall be stainless steel. Interior control panels may be fiberglass.

12. Control panels shall include the following:
    a) Ground fault receptacle with circuit breaker.
    b) Reduced voltage starters with under voltage release and overload coils for each phase (each pump).
    c) NEMA starters.
    d) Local/remote dry contacts for alarms specified elsewhere.
    e) Sequential, selectable alternator.
    f) Lightning arrestor.
    g) Elapsed time meter for each pump, non-resettable.
    h) Time delay between pumps.
    i) H-O-A switches for each pump.
    j) Contacts for hermetically sealed level sensor and one pressure transducer or ultrasonic level sensor
    k) Pump failure with dry contact.
    l) Generator interlock.
    m) Phase loss monitor.
    n) Provide stainless steel float hanger brackets.

13. Each pump and motor unit shall have a separate electrical supply, motor starter, motor sensor and alarm, electrical components, and instrumentation and control components. Each wetwell shall have instrumentation and control module for operation of the pumps and alarm conditions as designed.

14. Emergency storage in the form of extra wetwell depth or wetwell overflow to a holding basin, shall be considered for remote sewage pump stations where emergency response times may be long.

4.4.1. COMMINUTOR

Raw wastewater entering a medium lift station shall flow through a comminutor.

a) The comminutor shall be sized such that it grinds the coarse solids to a size of 1/4 inch to 3/4 inch in the influent stream to help eliminate problems caused downstream especially the clogging in pumps.

b) The comminutor shall run continuously.

c) Provide a spare comminutor.

d) The comminutor shall be a hydraulically driven assembly.

e) Provision shall be made to facilitate servicing of the comminutor in place, and removal from their location.

f) When comminutor is installed in channels, it shall be provided with an emergency screened bypass channel to a bar screen. Flow exceeding the operating capacity of the comminutor shall be automatically diverted to the emergency bypass. The channels shall be parallel with provision for slide gates or similar devices to permit isolating and draining of the channels. In the event flow backs up upstream of the grinder the influent channel wall has an overflow notch just upstream of the bar screen.

4.4.2. ODOR CONTROL

There is no single process to eliminate odor. Enclosing an odorous process, ventilation of the enclosed space, and treatment of the air are very effective means of controlling odors and emissions. The selection of an odor control technology depends largely on the characteristics of the air stream to be treated, site considerations, and the degree of odor reduction required.

Technology selection and design are dependent on the system performance requirements, and AW preference. Provision shall be made to install an odor control system in populated areas, on a case-by-case basis, and per AW preference.

4.4.3. ALARM SYSTEM

The control building (if provided) shall have an intrusion alarm system integrated with the existing alarm systems. The alarm system will integrate the station alarms identified below. The alarms shall connect to the SCADA RTU to be provided with the pump control panel. Pumping station alarms shall include identification of the alarm condition.

a) Power failure.
b) Loss of phase (if three phase power).
c) Pump failure.
d) Pump run status.
e) High wetwell level.
f) Station power failure.
g) Low wetwell level.
h) Generator start failure.
i) Others as determined by AW during design.
j) Unauthorized entry.

4.4.4. FLOW METER

Flow meter for measuring wastewater flow shall be provided in a vault when warranted, or when requested by AW. Elapsed time meters used in conjunction with annual pumping rate tests may be acceptable for pump stations provided sufficient metering is configured to measure the duration of individual and simultaneous pump operation.

Flow meters shall be calibrated by the manufacturer and confirm calibration on-site. Flow meters shall have integral and remote signal converter availability and grounding rings or grounding electrode. Measurement shall be largely independent of flow profile. The meter and transmitter shall be NEMA 6P for submersible service with remote amplifier. Amplifier shall produce digital signal for flow receiver/indicator/recorder.

Flow meters shall be installed to provide the required amount of straight-run pipe upstream and downstream of the meter to ensure accurate flow measurement per the manufacturer's recommendation.

4.4.5. BUILDINGS

If determined to be necessary, AW shall require a masonry building to house electrical equipment and valves. Aesthetic design shall be considered to fit the surrounding land uses per the base Installation Design Guide. The engineer should review station requirements with AW prior to design. Building door locks shall be keyed according to the base's requirements.

All equipment shall have adequate clearance from other equipment and walls to allow performance of maintenance and repair work. All electrical, control, and instrument panels shall have the minimum clearance in front of the panels, as required by NEC. The seismic factor for the design of the wastewater lift stations shall be in accordance with the Uniform Building Code and applicable local standards.

4.4.6. OPERATIONS AND MAINTENANCE

During the design of sewer pump stations, consideration shall be given to Operations and Maintenance (O&M) needs. The O&M manual at a minimum shall include provisions for:

1. Detailed descriptions of all operating processes.
2. Design data for pumps, motors, force main, emergency power, overflow point and elevation(s).
3. Calculated system curve and the pump curve with design operating point(s).
4. Startup and shutdown processes.
5. Breakdown of critical safety issues.
6. Inventory of critical components, including nameplate information for pumps and motors, etc.
7. Contingency plan, including redundancy considerations.
8. As-Built Drawings.
9. List of recommended spare parts and maintenance schedule.

4.5. LARGE LIFT STATIONS

Large lift stations are either duplex or triplex stations with total pumping capacity of greater than 1050 gpm. Large lift stations may require special design criteria, review and approval by AW.

In addition to the design considerations listed in Section 4.1, Lift Station Design Considerations and Section 4.4 Medium Lift Station; large lift station must be engineered to provide the following at a minimum:

1. Pre-cast concrete wetwell, shall have a minimum diameter of 8 ft, with access hatches and safety gratings.
2. The SCADA system shall include at a minimum but not limited to the following:

   SCADA monitoring at large lift stations shall include,

- Pump Status (On/Off)
- Pump Run Times
- Totalized Flow
- VFD Speed
- Emergency Generator Status (On/Off)
- Pump Station Building Alarms - Intrusion
- Pump Station Alarms
  - High WW level
  - Low WW level
  - Pump Failure
  - Power Failure
  - Emergency Generator Failure
  - Comminutor Failure
  - Phase loss

SCADA control at large lift stations shall include:

- Adjust wet well levels
- Adjust VFD speed

3. Control panels shall include the following:

   a) Ground fault receptacle with circuit breaker.
   b) Reduced voltage starters with under voltage release and overload coils for each phase (each pump).
   c) NEMA starters.
   d) Local/remote dry contacts for alarms specified elsewhere.
   e) Sequential, selectable alternator.
   f) Lightning arrestor.
   g) Elapsed time meter for each pump, non-resettable.
   h) Time delay between pumps.
   i) H-O-A switches for each pump.
   j) Contacts for hermetically sealed level sensor and one pressure transducer or ultrasonic level sensor.
   k) Pump failure with dry contact.
   l) Generator interlock.
   m) Phase loss monitor.
   n) Provide stainless steel float hanger brackets.

APPENDIX: A

REQUEST FOR SIGNATURE TRANSMITTAL FORM

AMERICAN WATER
Military Services

REQUEST FOR SIGNATURE TRANSMITTAL FORM

- ***SAVE TO YOUR LOCAL DRIVE BEFORE COMPLETING***
- ***CHECK COMPLETION AGAINST GUIDELINES ON PAGE 1; improperly completed forms will be returned for corrections before processing***

Our absolute latest deadline date we can receive the signed documents is:
NOTE: Requests are processed as quickly as possible; this helps us ensure we process your request on time if signatory will be unavailable.

Insert Date	**Insert local Time, if not COB**
Click or tap to enter a date.	

INSTALLATION MAKING THE REQUEST:

Document/project description/name:

SPECIAL INSTRUCTIONS: (e.g. indicate exactly where to sign, check request, etc.)

Only a scanned (PDF) VERSION of the document(s) will be emailed to you.
To receive *paper documents with "wet ink" signature(s), complete the following section.*

☐ **I NEED PAPER ORIGINALS** (Include details in *SPECIAL INSTRUCTIONS*, above)

☐ Please **NOTARIZE**

Return/Send SIGNED PAPER ORIGINALS to:
(Verify your recipient's address is still valid)

Government Entity/Company	
Attention	
Street	
Building, Suite, etc. #	
City	
State	
Zip Code	
Telephone	

APPENDIX: B

REQUIREMENTS PER BASE LOCATION

In addition to the requirements set forth in the Design Guide the following section incudes additional requirements for project at the following base locations. If conflicting information is listed, information presented in this Appendix shall supersede specific information in the respective section of the Design Guide. The remaining requirements of the sections in the Design Guide shall apply.

HILL AIR FORCE BASE

DESIGN GUIDE SECTION 2.11

The minimum water main size, serving a fire hydrant lateral, shall be 8 inches in diameter unless a hydraulic analysis indicates that required flow and pressures can be maintained by 6-inch lines.

The water system design shall meet the following requirement:

(a) 20 psi during conditions of fire flow and fire demand experienced during peak day demand.

(b) 30 psi during peak instantaneous demand; and

(c) 40 psi during peak day demand.

DESIGN GUIDE SECTION 2.14

Valves shall be located at not more than 500 foot intervals in commercial districts and at not more than one block or 800 foot intervals in other districts. Where systems serve widely scattered customers and where future development is not expected, the valve spacing shall not exceed one mile.

APPENDIX C

SCADA IGNITION SERVER AND COMMISSIONING STANDARD

APPENDIX D

IGNITION HMI STANDARDS SPECIFICATIONS

APPENDIX E

SOP SCADA MCAFEE INSTALLATION

APPENDIX F

INFRASTRUCTURE WIRING BID SPECIFICATION

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