

Pump Station Design Manual

Prepared for
Placer County Environmental
Engineering
Placer County, California
June 30, 2016

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This document is a living Design Manual intended for periodic update and revision to reflect the most current preferences of sewer lift and pump stations to be operated by Placer County.

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials	NEMA	National Electrical Manufacturers Association
ADWF	average dry weather flow	NFPA	National Fire Protection Association
ANSI	American National Standards Institute	NPSHA	net positive suction head available
AOR	allowable operating region	NPSHR	net positive suction head required
AQMD	Air Quality Management District	O&M	operation and maintenance
ATS	automatic transfer switch	OSHA	Occupational Safety and Health Act
AVRV	air vacuum release valve	PF	peaking factor
BEP	best efficiency point	PG&E	Pacific Gas and Electric Company
BMP	best management practice	PLC	programmable logic controller
BOV	blow-off valve	psi	pound(s) per square inch
Cal/OSHA	California Division of Occupational Safety and Health	PVC	polyvinyl chloride
CARV	combination air release valve	PWWF	peak wet weather flow
CDRA	Community Development Resources Agency	RCP	reinforced concrete pipe
CIP	capital improvement program	rpm	revolution(s) per minute
CCR	California Code of Regulations	RPPA	reduced-pressure backflow preventer assembly
County	Placer County	RTU	remote terminal unit
CPVC	chlorinated polyvinyl chloride	RVSS	reduced-voltage soft start
DI	ductile iron	SCADA	supervisory control and data acquisition
DIP	ductile iron pipe	SF	safety factor
District	Sewer Maintenance District 1	SSO	sanitary sewer overflow
EDU	equivalent dwelling unit	STEP	septic tank effluent pump
EE	Environmental Engineer	System Evaluation	South Placer Regional Wastewater and Recycled Water System Evaluation
FEMA	Federal Emergency Management Agency	TCU	telemetry control unit
fps	foot/feet per second	TDH	total dynamic head
gpd	gallon(s) per day	TM	technical memorandum
gph	gallon(s) per hour	UBC	Uniform Building Code
GV	gate valve	UL	Underwriters Laboratories
HDPE	high-density polyethylene	UV	ultraviolet
HI	Hydraulic Institute	VFD	variable-frequency drive
hp	horsepower		
HVAC	heating, ventilation, and air conditioning		
I/O	input/output		
lb	pound(s)		
LED	light-emitting diode		
mgd	million gallons per day		
MTS	manual transfer switch		
NEC	National Electric Code		

Section 1

General Requirements for Approval and Acceptance

The purpose of this Pump Station Design Manual is to outline the design process and minimum requirements for pump stations to be operated and maintained by Placer County (County). The purpose of this section is to define the general requirements and the process for the County to approve the design, and ultimately accept ownership, of any pumping station.

1.1 Definition of Terms

The term *engineer*, as used in this document, plans, and notes, refers to the Director of the County Department of Public Works and Facilities, or an authorized agent appointed by the Director. For simplicity, these standards use the term *pump station* to refer to both pump and lift stations. The term *contractor* is used in this document to refer to the individual or entity with whom the County has contracted for construction or modification to the pump station.

1.2 General Requirements

Wherever possible, the use of a pump station is to be avoided in favor of a gravity sewer collection system. However, in cases where constraints such as topography dictate, a pump station may be necessary. Installation of any pump station shall conform to specifications and instructions provided within this document; all applicable federal, state, and local regulations; applicable industry standards and guidelines; as well as the installation and operations instructions of all applicable equipment manufacturers. Upgrades or modifications to existing pump stations shall also conform to the same requirements as new pump stations to the maximum extent practicable. Any variation or deviation from the requirements specified in this document shall be approved by the engineer in writing. The engineer shall resolve any conflict between this document and other project-related documents.

1.3 Equipment Requirements

Critical pieces of pumping station equipment, such as pumps, standby power equipment, and control systems, shall be provided with single-source responsibility by manufacturers that can demonstrate the minimum experience required.

1.3.1 Single-Source Responsibility

Equipment requiring the coordination and assembly of components provided from various manufacturers shall be assigned a single-source responsibility that can respond to any performance or maintenance issues. Single-source responsibility means that the County can hold only one individual or entity responsible for the performance and reliability of the systems that make up a piece of equipment. Typically, this will apply to pumps supplied with motors, variable-frequency drives (VFDs), reduced-voltage soft starters (RVSSs), and control modules. Other pump station equipment that may require single-source responsibility to be assigned include, but are not limited to, grinders, standby generators, chemical injection systems, and programmable logic controllers

(PLCs). The contractor shall supply documentation that all applicable pump station equipment is National Electrical Manufacturers Association (NEMA)-rated and Underwriters Laboratories (UL)-listed along with the required equipment and component submittals.

1.3.2 Experience

The manufacturer(s) of pump station components shall demonstrate a minimum of 10 years of experience in this specific field, and shall supply with the required submittals previously completed typical installations with reference telephone numbers. The manufacturing facilities including the electrical shop shall be accessible for inspection by the County.

1.4 Property Requirements

The County shall be the sole owner of property upon which a pump station is located. County ownership shall extend to the fence line of the pump station site. The County shall be provided easements for access to the pump station property where necessary, along with any easements required for maintenance of force main piping and utility services. Any required modifications to land use necessary for construction of the pump station shall be completed prior to the County taking ownership of the property.

1.5 Hazardous Materials Plan Requirements

Each pump station shall include all necessary signage, spill kits, fire extinguishers, safe chemical storage areas with containment, National Fire Protection Association (NFPA) placards, and first aid kits. Each station shall be equipped with a non-freezing emergency shower and eyewash, regardless of whether use of chemicals is planned at the site.

1.6 Naming Convention

This section describes the Placer County pump station naming convention.

1.6.1 Pump Station

The pump station shall be named using the following convention.

XXX – LS(ZZZ)

Where

XXX = County sewer map book page number where pump station is located

LS = lift station or pump station

ZZZ = location description

The name of the street where the pump station is accessed typically will be used for location description. A different description, with County approval, can be used if the street name has already been assigned or used for another pump station. The alternate description shall be unique and easily identifiable.

Example: AD1 – LS (Bell Road)

1.6.2 Sewer Nodes

See Table 1-1 for Placer County sewer nodes naming conventions.

Table 1-1. Naming Conventions for Placer County Sewer Nodes			
Table Name	Primary Field	Secondary Field	Description
COMPSMN	Line type		Description
	FORCE	--	Force main
	GRAV	--	Gravity main
	LOW	--	Low-pressure main
	LPS	--	Low-pressure main/solids handling
	SIPHON	--	Siphon
	VENT	--	Vent lateral
COMPSMH	MH Type		Description
	DROP	IN	Inside drop manhole
	DROP	OUT	Outside drop manhole
	SIPHON	START	Beginning of siphon sewer main
	SIPHON	END	End of siphon sewer main
	STANDARD	--	Standard manhole
	VAULT	--	Standard vault
COMPSV	Valve Type	(New field)	Description
	ARV	BOX	Air relief valve/in box
	ARV	MH	Air relief valve/in manhole
	ARV	VLT	Air relief valve/in vault
	AVRV	BOX	Air vacuum release valve/in box
	AVRV	MH	Air vacuum release valve/in manhole
	AVRV	VLT	Air vacuum release valve/in vault
	BOV	BOX	Blow-off valve/in box
	BOV	MH	Blow-off valve/in manhole
	BOV	VLT	Blow-off valve/in vault
	BV	BOX	Ball valve/in box
	BV	MH	Ball valve/in manhole
	BV	VLT	Ball valve/in vault
	CV	BOX	Check valve/in box
	CV	MH	Check valve/in manhole
	CV	VLT	Check valve/in vault
	GV	BOX	Gate valve/in box
	GV	MH	Gate valve/in manhole
	GV	VLT	Gate valve/in vault
	PRV	BOX	Pressure relief valve/in box
PRV	MH	Pressure relief valve/in manhole	
PRV	VLT	Pressure relief valve/in vault	

Table 1-1. Naming Conventions for Placer County Sewer Nodes				
Table Name	Primary Field	Secondary Field		Description
COMPSND	Node type			Description
	CO	BOX		Cleanout/in box
	CO	BUR		Cleanout/buried
	CO	MH		Cleanout/in manhole
	CO	VLT		Cleanout/in vault
	ELB	90		Elbow/90-degree
	ELB	45		Elbow/45-degree
	ELB	22.5		Elbow/22.5-degree
	ELB	11.25		Elbow/11.25-degree
	EOL	MH		End of line/in manhole
	EOL	VLT		End of line/vault
	EOL	BOX		End of line/box
	EOL	BUR		End of line/buried
	L	BOX		Launch/in box
	L	MH		Launch/in manhole
	L	VLT		Launch/in vault
	RL	BOX		Receive-launch/in box
	RL	MH		Receive-launch/in manhole
	RL	VLT		Receive-launch/in vault
	RED	--		Reducer
	TEE	--		Tee
	VENT	AIR		Air vent
WYE	--		Wye	
COMPSMTR	Meter type			
	FLODAR	Temporary		
	GATOR	Temporary		
	FLUME	Permanent		
COMPSP	Pump type			Description
	LSP	WET		Lift station pump/wet
	LSP	DRY		Lift station pump/dry
	SHP	WET		Solids handling pump/wet
	SHP	DRY		Solids handling pump/dry
	STEP	WET		Solids tank effluent pump/wet
	STEP	DRY		Solids tank effluent pump/dry
COMPLS	LS type		Check Box Field	Description
	LS	--	Online	Lift station

Descriptions denote the location, typically the street name, or unique easily identifiable.

1.7 Applicable Regulations

Sewage pump stations must satisfy the regulations of all agencies having jurisdiction. Other regulations governing facilities and construction shall be adhered to, including but not limited to regulations published by the California Division of Occupational Safety and Health (Cal/OSHA), NFPA, Uniform Building Code (UBC), NEMA, California Code of Regulations (CCR), and others as applicable.

1.8 Drawings and Details

The designer will be required to contact the County for the version of AutoCAD required for the electronic deliverable. The County will provide any standards (borders, line weights, etc.). A national standard may be used. See Appendix A for Plan Preparation Standards.

The following Standard Details are attached in Appendix B:

- Lift Station Details 1: Circular Wetwell and Valve Vault Plan and Section
- Lift Station Details 2: Pump Station Site Layout, Emergency Storage Tank, and Pole Base with Antenna
- Lift Station Details 3: Electrical Control Building and Odor Control Chemical Containment

Section 2

Site Criteria

This section describes the minimum criteria for siting of a pump station within a development.

2.1 Topography

Adjacent areas or future sewersheds potentially served by the pump station must be considered. Site selection shall be compatible with suitable site access and soil capability with respect to land grading and site development.

2.2 Access

All pump stations shall be sited to allow access by all-weather surface roads that accommodate H-20 design vehicles. Provisions shall be made for safe entry into the traffic, nose first, with sufficient site distances. Center medians may require modification for ease of access to pump stations from all directions. Driveway widths must accommodate Sewer Maintenance District (District) vehicles, including vector trucks and heavy-duty utility trucks with trailers.

2.3 Floodplain

Pump stations will be required to be located outside of the 100-year floodplain (according to the Federal Emergency Management Agency's [FEMA] current National Flood Insurance Program Flood Insurance Rate Map). Pump station wet well top slab, influent manhole rims, vault lids, and electrical building finished floor elevations must be at the same level as, and be accessible from, roadways that have a drivable surface that is at a minimum 1 foot above the 100-year flood level.

2.4 Land Use

Pump stations will be located where allowed by County land use zoning, and will adhere to the setbacks and others applicable requirements required under such zoning.

2.5 Aesthetics

Natural screening and remoteness of the site are primary elements of site selection wherever possible. Facilities' architecture shall blend into the local surroundings. All aboveground pipes shall be painted gunmetal gray. All concrete surfaces shall have a broom finish. If landscaping is to be used for screening or aesthetic purposes, it shall be located on property that is separate from the pumping station such that maintenance of landscaping is not the responsibility of the County.

2.6 Noise

Pump stations will comply with the requirements of the most recent Placer County Noise Ordinance.

2.7 Odors

The effect of odor on the neighboring properties, both at the pump station site and at the point of discharge from the pump station force main, shall be assessed. Every effort shall be made during the site selection to reduce potential odor pollution. Duration and intensity of odors are important

considerations that must be evaluated. The County reserves the right to require odor control facilities, including but not limited to chemical odor control. County standards for sizing of chemical feed and storage facilities are provided in Appendix C. If the designer proposes to eliminate chemical odor control, detailed calculations shall be provided demonstrating that odors at the pump station discharge are not anticipated, and shall be subject to review and approval by the engineer.

2.8 Overhead Clearance

Overhead clearance will be sufficient to allow for a crane to remove pumps from the wet well, and to remove any other skid-mounted equipment such as a standby generator or chemical storage and injection system.

2.9 Protection from Vehicle Impact

Pump stations located adjacent to high-speed or heavily traveled roads, or in areas otherwise susceptible to vehicle impacts, shall have impact mitigation devices (e.g., bollards spaced 3 to 4 feet apart) to protect the pump stations from vehicles. Locate impact mitigation devices between travel ways and the pump station equipment along the perimeter of the pump station site. These devices shall be placed outside or beyond the roadway Clear Recovery Zone. In addition, a turnout to allow County vehicles to access the site safely may be required.

Section 3

Hydraulic Design Criteria for Collection and Transmission Systems

Flow projections for any new pump station shall be based on County standards for flow per equivalent dwelling unit (EDU). These standards are, by design, conservative estimates. While appropriate for sizing of trunk sewers (which are sized for ultimate needs), it may tend to overestimate equalization and pumping facilities (which can be phased). The criteria for projecting flow for new pipelines and pump stations shall be based on the average dry weather unit flow factors and peaking factors ranging from 2.4 to 3.6 depending on the acreage of the contributing sewer service area. The peaking factor curve, along with instructions for use in sizing infrastructure facilities, is provided in Appendix G of the South Placer Regional Wastewater and Recycled Water Systems Evaluation (RMC, 2009). The document can be found on the South Placer Wastewater Authority's (SPWA's) website,

(http://www.roseville.ca.us/eu/wastewater_utility/south_placer_wastewater_authority.asp).

For phased construction of a pumping station, the wet well, emergency storage, and electrical building footprint shall be sized to accommodate equipment capable of handling the ultimate buildout peak flows. The initial phase of the pump station may include pumps, emergency generators, grinders, and other equipment sized for peak flows anticipated at a 20-year planning horizon. For modifications, expansions, or improvements to existing pump stations, use actual flow data (average and peak flows) and add new growth with appropriate peaking factors more consistent with modern sewer construction standards. This approach will provide for better estimates of the equalized flow.

When estimating peak flows for existing collection systems with trunk sewers of 15 to 18 inches in diameter or larger, a calibrated collection system model shall be used. A design storm representing a 10-year, 24-hour event shall be used, with an additional assumption that several smaller storms have preceded the event and created saturated ground conditions. An example design storm and acceptable approach to projecting peak flows can be found in Appendix F of the SPWA System Evaluation report referenced above. Approval of the appropriate design storm shall be pending review and acceptance by the engineer. All pump stations connecting to existing wastewater collection facilities shall be designed to accommodate the projected peak flows without causing a sanitary sewer overflow (SSO).

Design of any new pump station, or modifications to an existing pump station, shall include submittal of hydraulic calculations to the County for review and approval as part of the Pump Station and Forcemain Design Report. A proposed outline and requirements for the report are provided in Appendix D. Pump station and system calculations shall include, at a minimum, the following:

- Constant-speed versus variable-speed pumps. The designer shall provide a life-cycle analysis to justify the selection of either constant-speed or variable-speed pumps. The analysis shall include equipment purchase costs, utility power costs, and typical maintenance costs.

- Variable-speed pumps requirements, such as induction-rated motors, minimum allowable speed, and a description of the control strategy for selecting pump speed.
- Calculation of pumping head and hydraulic losses within the pump station and force main piping, including a clear statement of all assumptions used in developing loss calculations.
- Maximum and minimum pipe velocities, including any special operating procedures required to maintain solids in suspension within the force mains.
- Wet well sizing calculations and criteria, including minimum cycle times, level alarms and control settings, and pipe invert elevations for influent sewers and emergency storage facilities.
- Net positive suction head available (NPSHA) calculation and calculation of safety factor (SF) when compared to manufacturer's net positive suction head required (NPSHR).
- Pump and system curves plotted on a figure with head provided on the y-axis and flow provided on the x-axis, including:
 - System curves based on a range of maximum and minimum specific/specified estimated friction losses
 - Selection of proposed manufacturer's pump curve
 - Identification of pump manufacturer's preferred operating range and allowable operating range relative to each pump's best efficiency point (BEP)
 - Confirmation that each pump will operate as close as possible to its BEP during normal dry weather operations, and will operate within the allowable operating region (AOR) at all other times
 - Where multiple pumps are required to provide the peak flow capacity, the figure shall include a pump curve for both pumps operating in parallel
 - Where variable-speed pumps are required, reduced-speed pump curves shall be included with the minimum required speed identified
- Pump manufacturer information such as efficiency versus flow plots for proposed pump at operating speed(s) including AORs, recommended motor sizing, specified impeller size, pump dimensions, installation instructions, and any other pertinent information.
- Mass elastic systems and critical speed calculations.
- Force main transient surge analysis may be required, including a detailed description of the method used to determine anticipated maximum and minimum pressures during a transient surge event, and any recommended mitigation measures that should be implemented at the pump station or on the force main. A transient surge analysis is required for any pump station and force main meeting all of the following conditions:
 - Design flowrate is 1,000 gpm or greater
 - Force main diameter is 10 inches or greater
 - Total force main length is 1,000 feet or greater (not applicable to force mains with diameter of 8 inches or less)

Section 4

Civil

The section describes the minimum civil standards for a pump station.

4.1 Site Design

All practices and procedures, materials, and placement of materials shall conform in every respect to the current editions of the Placer County Land Development manual, general specifications, and standard plates.

4.1.1 Site Layout

The project applicant is required to provide preliminary sizing analysis of the proposed pump station site during the project entitlement process to ensure that the proposed site is adequate to accommodate all the required pump station equipment and appurtenances. Prior to beginning construction, the contractor shall verify all dimensions and site conditions and immediately report any deviation from these specifications to the engineer. The Standard Pump Station Details provided in Appendix B include a typical site layout for the pump station.

4.1.2 Vehicular Access

The fenced pumping station site will allow a vehicle to completely pull off road in front of the vehicle access gate. Vehicle access gates shall be sized for a minimum clear width of 16 feet, although the County prefers a width of 20 feet when feasible. Sufficient room will be provided within the fenced site to allow for two tractor trucks and three service trucks to enter, park, turn around, and exit, with either a hammerhead or pull through. All surfaces, including temporary all-weather aggregate base roadways, asphalt concrete surfaces, concrete pads, and vaults and hatch covers, shall have H-20 load ratings. Temporary access roads must also conform to these standards. The access road and route to the pump station from the maintenance yard must be accessible during a 100-year flood and have a drivable surface that is at a minimum elevation of 1 foot above the 100-year flood elevation.

4.2 Perimeter Fence and Gates

All pump stations shall have at minimum an 8-foot-high fence that discourages unauthorized access. The fence shall be chain-link with privacy slats at a minimum. Other types of fencing may be required for aesthetic reasons. The perimeter fence will include a 3-foot-wide man-gate and two sets of 10-foot-wide motorized swinging gates (20 feet total) with a key pad and access code. Twenty-foot-wide motorized sliding gates may be allowed in lieu of swinging gates if circumstances warrant. All gates shall achieve full open position with a single human operator (starting force 50 pounds [lb] or less for opening and closing, rolling force of 40 lb or less). All gates shall have a hatch mechanism or chain for multiple locks to suit a minimum of three padlocks. In addition, all gates shall have drop-bolt type gate stops with receiver sleeves installed in both the open and closed position for both gates.

4.3 Potable Water

A water service is required for each pumping station. All water pipes, including wash down supply and water supply to the emergency eyewash/shower that are installed through a concrete slab, shall be of a rigid material as approved by the engineer. Service lines from the water distribution main to the property line or edge of the easement shall be installed at the time the main is constructed. Services from mains installed in private roads shall extend 1 foot beyond the edge of the pavement. Provide a water meter in accordance with the local water agency having jurisdiction. The size of water meter shall not be less than the size of the lateral unless approved by the local water supply agency. A reduced-pressure backflow preventer assembly (RPPA) from the most recent list of approved RPPAs by the State of California Department of Health Services shall be provided. A potable water hose bib and rack shall be provided near the wet well, mounted on the exterior wall of the electrical control building. The hose bib shall have a threaded spigot for a 1-inch-diameter hose. All exposed portions of the water service and site piping shall be insulated to protect from freezing.

4.4 Grading

Pump station site grading shall prevent local ponding and provide positive drainage away from structures. The site shall be graded so that a low point is not created in relation to the adjoining properties. A minimum slope of 1 percent shall be maintained for site drainage, and the slope shall not exceed 2 percent.

4.5 Stormwater

Stormwater runoff from the pump station site shall comply with the local jurisdiction. Stormwater shall not drain into the wet well, with the exception of any small areas provided for equipment wash down or spill containment. Any permanent best management practices (BMPs) required on site for treatment or containment of stormwater runoff shall conform to requirements of the local jurisdiction. The project shall comply and conform with all requirements and mandates from the 2013 NPDES Municipal Permit (MS4-General Permit No. CAS0000004). Any permanent best management practices (BMPs) required on site for treatment or containment of stormwater runoff shall conform to standards and guidelines from the West Placer Post Construction Stormwater Design Manual. This manual and additional information regarding the NPDES permit can be found on the County of Placer website at:

<http://www.placer.ca.gov/departments/communitydevelopment/planning/lowimpactdevelopment>

4.6 Landscaping

No landscaping will be maintained by the County. Landscaping may be included on adjacent property for which the homeowners association is responsible for maintenance. Deep-rooted vegetation will not be allowed over the approach pipeline or force main.

4.7 Exterior Lighting

Exterior lighting will be provided with lights mounted on the electrical building exterior and a minimum of one light pole near the wet well. Exterior lights will use light-emitting diode (LED) bulbs, and will be automatically controlled with a photocell. The exterior light pole shall include, at a minimum, one 200-watt holophane high pressure sodium light in a cobra head fixture on a 3-foot-long minimum mast arm mounted to a 20-foot-tall anodized steel pole (antenna/light pole). The cobra head shall be installed with a flat-bottom lens provided with a photocell. The pole will be mounted to a concrete foundation and a combination switch with a 110-volt outlet provided for the

light in an all-weather box mounted either on the pole or on the control panel, and shall be appropriately labeled. The location of the light shall provide the best possible illumination of the bottom of the wet well and the control panels for night work. The location shall be approved by the engineer in the field.

4.8 Approach Manhole Pipe

Sewage shall be intercepted by an upstream manhole and an approach pipe laid on a gradient of 2 percent to the point of discharge. The approach pipe type shall comply with the Placer County Standard Specifications for sewer pipe. The approach pipe invert elevation shall be located as shown in the Standard Pump Station Details, provided in Appendix B. Pipe penetrations into the manhole and wet well shall be bored or blocked out and sealed with Link-Seal or an approved equal. The approach pipe shall be used for the inlet to the wet well, and is considered part of the wet well and not part of the collector system. The approach pipe may serve as supplemental emergency storage.

4.9 Wet Well

The following sections describe the requirements for the wet well. Wet wells shall be as hazard-free as possible, and all materials and equipment used in wet wells shall be corrosion-resistant.

4.9.1 Sizing

Wet well sizing criteria shall assume constant-speed pumps with a maximum six starts per hour at buildout; anything more complex (i.e., VFDs to reduce working volume) will require submittal of design calculations to the County. An analysis of VFD versus constant-rate pumps will be required to demonstrate that VFDs will not provide long-term operational benefit. The station wet well shall be 60-inch-diameter or greater. The station shall have the ability to accommodate the size and number of pumps with rails and pipe, and be deep enough to accommodate passive filling and draining of emergency storage tanks. Pump spacing and clearances shall be in accordance with the most recent version of the American National Standards Institute/Hydraulic Institute (ANSI/HI) standards 9.8.

4.9.2 Materials

Prefabricated wet wells will be fiberglass or polyvinyl chloride (PVC)-lined reinforced concrete. Fiberglass wet wells shall be manufactured of a minimum 3/8-inch-thick Koppers specialty polyester resins (or other equivalent chemical-resistant fiberglass resin material approved by the engineer) with a minimum compressive strength of 28,400 pounds per square inch (psi) and flexural strength of 31,400 psi. The fiberglass wet well shall incorporate wall-reinforcing ribs to double as anchors into the concrete footing when installed.

The contractor also has the option of using a precast concrete wet well with a PVC or high-density polyethylene (HDPE) T-lock liner. PVC or HDPE liners shall be terminated a minimum of 2-feet above the pump floor to allow the installation of concrete base and drainage of potential moisture accumulating behind the liner. If reinforced concrete pipe (RCP) is used for the riser sections of the wet well, refer to Section 4.11.1 for joint testing and grouting requirements. Where seasonal groundwater elevations are above the elevation of the wet well base, waterproof coating shall be provided on all wet well exterior concrete surfaces. The coating materials shall be "Xypex" or approved equivalent.

Wet well top slab shall be precast concrete with access hatch frames embedded. The underside of the top slab, interior to the wet well, shall include a cast-in plastic liner as described above for the precast wet well walls. Wet well access hatches shall be Occupational Safety and Health Act (OSHA)-compliant aluminum or steel non-skid deck plate with powder-coated, non-reflective finish reinforced

to support American Association of State Highway and Transportation Officials (AASHTO) H-20 loading. Access hatches shall be provided with spring-assist as necessary such that no more than 50 lb force is required for opening any hatch door. Wet well access shall include fall protection grates, and shall be provided with a recessed lock box. Safety netting will not be allowed at any wet well. All hardware and mounting brackets inside the wet well shall be stainless steel minimum grade 316.

The wet well base shall be precast concrete, and shall be sized to provide resistance to buoyancy forces associated with a groundwater level elevation equal to the finished grade elevation. A minimum 12-inch-thick layer of aggregate base shall be used for bedding underneath the base, or as appropriate for the geotechnical conditions at the site.

4.9.3 Classifications

The interior wet well space and limited exterior space around vents and openings shall be classified as Class 1, Division 1 hazardous areas per NFPA 820. All equipment located within these Class 1 Division 1 spaces shall be approved for hazardous classification and shall be explosion-proof. Conduits from the wet well shall be sealed at an above grade sump termination panel (Tessconnex or equal) mounted on the exterior of the electrical control building as described in the Pump Station Standard Details provided in Appendix B. No conduits shall connect the wet well with any control panel without an explosion-proof seal.

4.9.4 Calculations

The wet well supplier shall submit calculations and information providing dimensions, weights, and reinforced concrete collar/footing dimensions required such that buoyant uplift can be prevented. Weight of the wet well plus the submerged weight of the backfill and collar/footing must be greater than, or equal to, 115 percent of the buoyant uplift when empty. The weight of the pumps cannot be included in the calculations.

4.10 Vaults

Vaults will be required to have H-20-rated, hinged lids. Valve and pig launch, bypass, and magnetic meter vaults shall be concrete and designed for H-20 loadings. Each vault shall have a minimum of 2 feet of horizontal working clearance, and a 1-foot-high vertical clearance from the finished floor to the outermost dimension of any pipe, flange, valve, or other piece of equipment. Provide a minimum of 5 feet of separation from the exterior wall of the valve vault and the wet well concrete top slab for future access to the buried pump discharge piping and couplings. Exposed piping within vaults shall be provided with pipe supports to allow for removal of valves and flow meter for maintenance. A pipe support shall also be provided to support the 90-degree fitting and Cam-Lok connection for bypass pumping connections within the valve vault. All vaults shall be provided with a 2-inch drain to a single pipe-run connected to the wet well. The drain shall include cleanouts at each vault connection and as needed at fittings, and a check valve.

4.11 Emergency Storage

Emergency storage is required for all pump stations and shall meet the requirements provided in Table 4-1.

Table 4-1. Emergency Storage Requirements

Average Dry Weather Design Flow < 0.5 MGD ^a		
Dual redundant force main	No dual redundant force main	Sensitive/special condition
4 hours of PWWF at full buildout	8 hours of PWWF at full buildout	See note ^b

- a. Pump stations with ADWF >0.5 MGD shall require dual redundant force mains and 4 hours of PWWF storage at full buildout. Exceptions to the requirement of dual force mains may be permitted by engineer under special circumstances.
- b. To be evaluated and determined on a case-by-case basis. A safety factor of up to 2 may be applied to the calculated storage volume under normal conditions.

The sensitive or special condition represents system configurations where an SSO would have significant impacts to the adjacent area or environment, such as environmentally sensitive areas, or remote/restricted locations where additional emergency response time is necessary. In these circumstances, additional storage or the requirement for dual force mains may be warranted. Examples for some of these locations or situations are stream, creeks, or river crossings, major highways or major highway crossings, construction restrictions or limitations, etc. Designation of sensitive/special conditions shall be on a case-by-case basis as determined by the engineer. Requirements for dual redundant force mains are provided in Section 4.15.

The peak wet weather flow (PWWF) is calculated using the flow factors provided in the South Placer Regional Wastewater and Recycled Water System Evaluation (System Evaluation), which can be found on the SPWA website referenced in Section 3.0. . These flow factors are shown on Table 1 and Figure 1 in Technical Memorandum (TM) 3a of the System Evaluation. A SF of 1 is used to determine the average dry weather factored flow for estimating the peaking factors for PWWF. The following is an example for determining PWWF for a 100-dwelling residential development:

$$\text{Average dry weather flow (ADWF)} = 190 \text{ gallons per day (gpd)/EDU}$$

$$\text{PWWF} = \text{ADWF} \times \text{SF} \times \text{PF}$$

$$\text{PWWF} = (190 \times 100) \times 1 \times 3.5 = 66,500 \text{ gpd} = 2,771 \text{ gallons per hour (gph)}$$

The required emergency storage tank volume may be reduced for any station with an ADWF greater than 0.5 million gallons per day (mgd); however, a special study will be required to demonstrate that reduced storage will provide sufficient protection against an SSO. Any reduction of emergency storage from the calculation method provided above will require approval from the engineer.

4.11.1 Emergency Overflow Storage Tanks

Emergency overflow storage tank(s) shall be constructed of RCP with a plastic T-lock liner. The tank shall be watertight with prefabricated end plugs. All RCP bell-and-spigot joints shall be double-gasket with 1/4-inch test ports. All joints shall be pressure tested during assembly prior to grouting. If a joint fails the pressure test the contractor shall make all necessary corrections and re-test the joint until it passes before installing the remainder of the tank. All interior and exterior joints shall be grouted using a structural non-shrink grout. A hydraulic non-shrink grout is required if there is ground water, as well as external wall waterproof coating using “Xypex” or equivalent. Holiday testing of the plastic T-lock liner and field welded strips at joints and penetrations shall, including access manholes, shall be required prior to acceptance.

Access ports shall be provided on each end of each tank using 48-inch-diameter manholes, with a minimum 24-inch-diameter manhole access cover, and conforming to all applicable County standards for sanitary sewer manholes. Tanks shall drain by gravity to the wet well, with cleanouts

provided in the drain line. For multiple emergency storage tanks, provide a cross-connection pipe between each tank at the midpoint (spring line).

Where possible, the tank shall be passively filled through the same pipeline that will drain the tank into the wet well, and the invert elevation of the drain pipeline at the wet well should be located above the high water alarm float elevation as shown in the Pump Station Standard Details in Appendix B. The tank will then fill only when the lead pump fails to operate, or when incoming flow into the wet well exceeds the capacity of the pump. The designer must be able to show that the tank(s) can completely fill without causing a surcharge in the collection system that will cause an SSO at the lowest manhole. A wet well water surface elevation equivalent to the invert of the fill/drain pipe shall trigger a supervisory control and data acquisition (SCADA) system alarm to indicate that the emergency storage tank is filling. The fill/drain pipe shall be equipped with a gate valve (GV) to allow the tank to be isolated from the wet well for maintenance.

The tank shall also connect to a bypass pipeline connection to the influent manhole upstream of the pump station wet well with a normally closed GV. The bypass pipeline shall allow the emergency storage tank to fill when the main gravity sewer influent pipeline valve is closed, allowing temporary bypass of the station. Bypass pipeline slope and diameter shall be selected to allow diversion of the full design flow of the station, and the invert elevation at the influent manhole shall be set at an elevation that will avoid surcharge of the collection system and creation of an SSO at the lowest manhole.

4.12 Bypass Provisions

Bypass provisions shall be provided for all pumping stations, and shall include the ability to bypass the existing pumps through the use of a diesel-powered trailer-mounted bypass pump, as well as the ability to bypass the wet well for cleaning.

Provisions for bypassing the pumps shall be provided by including the necessary fittings to allow a Cam-Lok connection to the force main piping downstream of the valve vault, as shown in the Pump Station Standard Details provided in Appendix B. A GV and wafer-style check valve shall be provided between the Cam-Lok connection fitting and the force main. The connection shall be located either above ground or within a concrete vault for ease of access.

Provisions for bypassing the wet well shall be provided by installing a gravity bypass pipe from the wet well inlet manhole to the nearest emergency storage tank with a GV in the center. The bypass pipe shall enter the emergency storage tank at or above the 3/4 full elevation. The designer must be able to show that allowing the water surface elevation to rise to the invert elevation of the bypass pipe shall not cause a surcharge in the collection system that will create an SSO in the lowest manhole.

4.13 Pressurized Pipeline/Force Main

Pump discharge piping within the wet well for vertical pump risers shall be PVC C900 at stations where the discharge piping size is 6 inches in diameter or less, and the total depth of the wet well is less than 20 feet. For all other wet well configurations, the pump discharge piping shall be ductile iron pipe (DIP) with Protecto 401 ceramic lining and epoxy coating. Pump discharge pipe material shall continue to the buried flexible coupling adapter between the wet well and the valve vault, as shown in the Standard Pump Station Details provided in Appendix B.

Piping from the buried flexible coupling adapter upstream of the valve vault, through all 3 vaults, to the GV after the meter vault, shall be DIP within the pumping station site unless otherwise approved by the engineer. All DIP and ductile iron (DI) fittings shall be provided with a 401 Protecto ceramic

lining. Exposed DIP or DI above ground or within vaults shall be coated with an epoxy paint. Buried DIP or DI shall be coated with a coal tar epoxy. All connecting hardware including nuts, bolts, and washers shall be Type 316 stainless steel. Force main piping outside of the pumping station site may transition to PVC C900 or HDPE, as approved by the engineer. All angle points in the force main shall use restrained joints to the extents necessary to prevent pipe movement under any operating condition, as approved by the engineer. Force mains shall be cleaned using a pig prior to final acceptance by the County.

Combination air release valves (CARVs) designed for use in raw sewage conveyance systems shall be provided at all high points along the force main. Blow-off valves (BOVs) shall be provided to allow draining of the pipeline at all low points. GVs shall be provided at a maximum spacing of 2,000 feet to allow isolation and maintenance of force main sections. CARVs and BOVs shall be provided adjacent to GVs as necessary to allow isolated sections of force main to fully drain independent of adjacent sections. Location of CARVs, GVs, and BOVs shall minimize the number of appurtenances on the force main while providing the necessary spacing distances to facilitate maintenance. Dual CARVs may be required at locations where continuous functioning of the CARV is critical for protection of the force main. In these locations, each CARV shall be capable of handling the full air release and vacuum release required so that the force main will be fully protected when one CARV is not in service.

4.14 Dual Force Mains

Dual force mains may be used to achieve required hydraulic criteria described in Section 3.0 under phased construction, or where abnormally large peaking factors are anticipated during wet weather events. Dual redundant force mains may be required to satisfy emergency storage requirements or due to sensitive or special conditions, and are described in Section 4.15. The designer must provide sufficient engineering analysis to justify the use of dual force mains, which will require approval of the engineer. In locations where the PWWF is much greater than the ADWF, such that sizing pumps and a single force main to meet the full ranges of flows is not possible, a dual force main may be considered. Similarly, in locations where development within the sewershed is to be phased, and the initial phase will produce much less flow than ultimate buildout, providing a single force main with provisions for an ultimate dual force main may be justified.

In all locations where a dual force main is justified, all operating parameters must be achieved. Where dual force mains will operate in parallel with both pipes open continuously, a minimum velocity of 2.5 feet per second (fps) must be maintained, with a flushing velocity of 3.5 fps reached at least once per day. In dual force main systems that will use only one pipe during dry weather flows, or that will alternate between a smaller and bigger pipe, provisions must be made to achieve a flushing velocity of 3.5 fps in each pipe at least once per day. The flushing velocity must be maintained for sufficient duration to completely pump 1.5 times the equivalent volume of the force main. Pipes shall be installed with a minimum 1-foot separation, outside to outside, between the force mains.

4.15 Dual Redundant Force Mains

Dual redundant force mains may be required to meet emergency storage requirements provided in Section 4.11 when insufficient space exists at the pump station site to meet the full emergency storage requirement. Dual redundant force mains may also be required to protect sensitive or special conditions within or adjacent to the pump station and force main system, if determined to be necessary by the engineer. The intent is to provide a fully redundant force main system where each individual pipe is designed to handle and operate at the full ultimate buildout peak flow condition for

the pump station. The sewer flow will alternate between the pipes at regular intervals to be determined by County Utilities staff, and the system is not meant for both force mains to operate in parallel. A minimum of 1' clear space is required between the force main pipes. Dual redundant force mains requires an alternative piping configuration within the pump station vaults, which is described in the Pump Station Standard Details provided in Appendix B.

Section 5

Mechanical Standards

This section covers the mechanical standards for the pump station.

5.1 Pump Selection

Pump selection is subject to the review and approval of the engineer. The preferred pump assembly shall be a duplex pump system with each pump sized to be capable of independently pumping the peak design flow at the specified total dynamic head (TDH). The duplex station shall operate pumps in a duty + standby configuration, with the duty pump designation alternating between pumps following each pumping cycle. Peak design flow shall be equivalent to the anticipated peak flow during a 10-year, 24-hour design storm imposed on the collection system at full buildout during the diurnal daily peak flow.

VFDs or RVSSs are preferred for the pumping systems for energy efficiency, but are not required. The designer shall provide analysis, subject to the approval of the engineer, to demonstrate that inclusion of a VFD or RVSS is not cost-effective over the anticipated life cycle of the equipment, if these features will not be included in the pumping station.

5.1.1 Pumps

Sewage pumps shall be heavy-duty non-clog type capable of handling sewage and passing 3-inch solids with a minimum 4-inch discharge. Pumps shall be submersible type with stainless-steel shafts unless otherwise specifically accepted by the engineer. At pump stations where ragging has proved to be a persistent problem, grinder pumps may be approved by the engineer. The following should be provided to the engineer:

- Type: manufacture _____-inch model _____
- Motor: ____ horsepower (hp)/____ revolutions per minute (rpm)/ 3-phase/60-cycle/____volts
- Impeller size: _____ inch
- Pump curve plotted on system curve
- Preferred and allowable operating range per ANSI/HI 9.3
- Efficiency at expected operating point
- NPSHR
- Variable-speed curves if a VFD is proposed
- Proposed pump control strategy narrative

5.1.2 Motors

The pump motor shall be a squirrel-cage induction shell-type design, with an oil-filled watertight chamber and a service factor of 1.15 based upon nameplate rating. The stator winding and stator leads shall be insulated with moisture-resistant insulation. The motor shall be designed for continuous duty, capable of sustaining a minimum of 12 starts per hour. Motors shall be Factory Mutual or UL-listed in accordance with UL 674 and 1207 for Class I, Group D hazardous atmospheres. The junction chamber, containing the terminal board, shall be hermetically sealed

from the motor. Connection between the cable conductors and stator leads shall be made with a threaded compressed-type binding post permanently affixed to a terminal board.

The pumps shall have a moisture and thermal detection system whereby the presence of moisture in the seal cavity can be detected at the control panel and trigger a SCADA alarm. The pumps shall be equipped with double mechanical seals with a leak sensor at the low point of the housing. All pumps and motors shall be capable of running dry for extended periods without damage to the motor or seals.

5.1.3 Materials

The pumps shall be cast iron with all parts coated with a two-part fusion-bonded epoxy and finished with enamel or other coatings as specifically accepted by the engineer. All exposed hardware shall be stainless steel minimum grade 316. The pump guiderail system shall be 2-inch minimum Schedule 40 Type 316 stainless steel dual rail with any required adapters to be compatible with approved pumps.

5.1.4 Hazardous Duty Classifications

The pumps shall be capable of operating within an NFPA Class 1 Division 1 hazardous location, such as the pumping station wet well. All motors shall be explosion-proof and electrical installations per National Electric Code (NEC) Article 501. Pump controls shall be isolated from combustible gases such that hazardous duty classified equipment is not required.

5.1.5 Appurtenances for Submersible Pump Removal

Submersible pumps shall be fitted with a Type 316 stainless-steel pump chain sized per the manufacturer's requirements, and a stainless-steel grip eye lifting system. The minimum chain size shall be $\frac{3}{4}$ inch and able to accommodate the required working loads. The design shall be such that the pumping units will have a quick-disconnect sealing flange that automatically connects to the discharge piping by positively locking the volute into position to prevent any movement when lowered into place. Guiderail systems shall be compatible with approved pumps. Intermediate rail supports shall be provided as required.

5.2 Valves

The County prefers specific valve types for certain operational functions. Designers may select alternative valves for use in pumping stations and force mains, but shall provide a detailed justification for their use, which will be subject to the review and approval of the engineer.

5.2.1 Valves

Check valves shall be placed in an accessible location within the valve vault or above ground on each individual pump discharge pipeline. Each check valve shall be a stainless steel wafer type flanged Keystone (or equal) flapper valve, fitted with an external lever, and spring or weight designed to handle raw sewage. Check valves shall be mounted horizontally per the manufacturer's instructions. Valves shall be fusion-bonded, epoxy-lined, and coated.

GVs shall be placed in an accessible location within the valve vault or above ground for isolation on each pump discharge downstream of the check valve. At the bypass vault the check valve shall be located between the GV and Cam-Lock fitting. The GVs shall be flanged and of resilient seat type with a 2-inch operator nut. GVs shall also be used for isolating sections of the force main, and for isolating the bypass pump and pig launcher connections. A GV shall be installed between the wet well and the first upstream manhole to allow isolation of the wet well for maintenance. Isolation of

the emergency storage tanks will require a GV on the bypass fill piping from the influent manhole, and on the fill/drain piping connected directly to the wet well.

5.2.2 Piping

Valves and internal piping shall be sized such that velocities do not exceed 10 fps. Piping within the wet well shall be fully supported with Type 316 stainless-steel hardware to the wet well walls. A minimum of two flexible coupling adapters shall be positioned on the buried discharge piping from each pump to allow differential settlement between the wet well and the valve vault as shown on the Standard Pump Station Details provided in Appendix B. A geotechnical engineer should provide recommendations for the anticipated settlement at the site, to determine the minimum spacing allowable between the two flexible couplings. All exposed piping, with the exception of small diameter piping within the wet well, shall be DIP as described in section 4.13 above and as shown in the Standard Pump Station Details provided in Appendix B.

5.3 Additional Design Guidelines

Other piping system design guidelines shall include the following:

- All piping consisting of similar metallic materials shall have bonding for continuity and shall be grounded as required by code.
- Pump discharge piping, valves, flow meters, and other appurtenances may be installed aboveground in lieu of buried vaults upon approval of the engineer. If above ground piping is approved, a concrete containment pad shall be placed beneath all piping, sloped towards a drain that is piped to connect to the wet well below grade.
- All aboveground piping and equipment shall be protected from freezing as appropriate.
- Nylon insulation bushings shall be installed between all dissimilar metals in piping (e.g., brass fittings connected to manifolds), between pumps and inlet, pipes and valves, and discharge piping so as to insulate from the inductance current caused by motors.
- Short-sweep 90-degree elbows shall not be allowed on raw sewage piping.
- All piping for future use that penetrates the wet well shall be plugged as required by the engineer to prevent escape of hydrogen sulfide gas.
- All aboveground piping shall be painted gunmetal gray. All exposed ductile iron piping inside the valve, bypass and meter vaults and all aboveground piping shall be coated with material that will inhibit corrosion and degradation from the elements.

Section 6

Electrical

Electrical equipment shall be based primarily on the ability to meet the process demands of the pump station. All equipment shall be required to meet the most recent applicable standard limits for vibration, audible noise, harmonic voltage, and current and electrical surge immunity. Electrical design will follow the most current version of the Pacific Gas and Electric Company (PG&E) Greenbook standards. Arc flash analysis and signage will be required.

6.1 Power Supply

All stations shall be equipped with a manual transfer switch (MTS) and a generator receptacle plug. Sufficient room shall be provided to allow a portable trailer-mounted generator to be placed at the station without disrupting operations or traffic on neighboring public rights-of-way.

A permanent generator shall be required for all sites that require 100 kW or greater. Pump station sites requiring less than 100 kW of power may be designed to utilize a temporary portable power generator, pending approval of the engineer based on the site location and characteristics. Those sites relying on temporary portable generators may be required to pay a fair share to contribute funds toward a portable temporary generator to be purchased and maintained by the County. The project applicant shall evaluate and determine if a standard temporary portable generator is available to accommodate the required power for the site, and proposed an equitable project share of the cost for District approval.

Emergency generators shall be diesel-powered and sized to supply sufficient power to operate the pumps, controls, and site lighting at full flow capacity. Each generator shall be equipped with a belly tank or day tank sized to allow continuous operation of the station at full load for a minimum of 24 hours. ATS of the standby power unit shall be an integral part of the station controller. Permanent generator installations shall be housed within an enclosure to protect the equipment from weather and rodents, and to provide sound attenuation to allow compliance with the County Noise Ordinance at the pumping station site boundary.

The generator/standby power unit, if specified on the plans, is to be sized, tested, and supplied as part of the total package. It shall be a make and model approved by the engineer and shall meet all applicable air quality and noise limitation regulations.

6.2 Minimum Controls

A generator inlet receptacle shall be incorporated in the control center with a double-throw safety switch or mechanically isolated breakers. The generator inlet receptacle shall be a six-prong Burton El Segundo P/N 513 weather-tight portable generator hook-up receptacle or approved equivalent receptacle conforming to those used by the County.

6.3 Motor Starters

All motor starters shall be adjustable electronic overloads, and shall comply with NEMA standards:

- Provide a reduced-voltage non-reversing starter (soft starter) for pump motors larger than 30 hp.

- Provide a full-voltage non-reversing starter for pump motors less than 30 hp, unless the design engineer demonstrates the need for a reduced-voltage non-reversing starter.
- Provide a circuit breaker equipped with adjustable magnetic trip breaker motor circuit protector for combination motor starters.

6.4 Conduits

A separate dedicated conduit shall be provided from the control panel to the wet well for each pump wiring. The conduit size shall be specified in the required submittal. All buried conduits shall be Schedule 40 chlorinated polyvinyl chloride (CPVC) and all vertical transitions from below to above ground shall be PVC coated rigid steel (O-CAL). Once aboveground, conduits may change from O-CAL to galvanized rigid steel. Explosion-proof fittings are required on all conduits from the station wet well to the electric room. Conduits seals and explosion-proof fittings shall be required between the wet well and the sump termination panel mounted at the exterior of the electrical control building. Disconnect switches shall also be mounted on the exterior of the electrical building, as close as possible to the wet well. The contractor shall submit electrical duct bank locations and a conduit and conductor schedule for approval by the engineer. The contractor shall submit any changes to the duct bank or control panel locations a minimum of 3 working days in advance for review. Construction may not commence until the locations have been approved by the engineer.

6.5 Grounding

Provide electrical system grounding electrode conductors, equipment grounding conductors for equipment grounding and raceways, grounding electrodes, grounding electrode conductors, connections, and bonding in compliance with NEC Article 250 and the National Electrical Safety Code.

6.6 Interior Lighting

Lighting within the electrical and chemical building shall be energy-efficient and shall provide sufficient light within the building to facilitate safe repair of all equipment, and the ability to read and interpret operations manuals, record drawings, and/or design documents that may help troubleshoot issues promptly after they arrive.

Section 7

SCADA, Controls, and Instrumentation

The designer will be required to contact the County for the most recent SCADA standard requirements at the beginning of design.

7.1 PLC

Level sensing shall be accomplished by a data flow PLC, and a pressure transducer mounted within the wet well. A dedicated 1.5-inch conduit shall be provided for the transducer from the wet well to an above ground sump termination panel (Tesconnex or equal) mounted on the exterior of the electrical building. The PLC shall be a Data Flow Systems telemetry control unit (TCU) pump controller, or approved equivalent complete with operator interface and all other accessories as required for complete operation of the PLC. The control panel shall have:

- NEMA-rated full-size circuit breakers
- Magnetic starters with adjustable overload protection
- Hand-off-automatic switches
- Alternator
- Run lights
- Elapsed time meters
- Pump moisture-sensing relays and warning lights
- All necessary relays to perform the above functions
- Terminal blocks clearly labeled for the connection of the transducer, switches, transmitter, and other accessories

The County will provide the standard programming and set points for the TCU pump controller. For systems that require complicated pump control strategies beyond the standard duplex pumping station, a detailed pump control strategy shall be prepared for review and approval by the engineer. A system integrator will be required to program any PLC that will not rely on the County's standard programming.

7.2 SCADA System and Remote Terminal Units (RTUs)

The control system shall be in a free-standing weatherproof NEMA 3 and UL-listed enclosure, equipped with a lockable, vandal-proof outer door (if applicable). All panels and controls shall be built in accordance with the NEC. The control system shall be supplied by three-phase power from an appropriate power supply. Size the main to provide a minimum of 60 amps above the required loads for the system and provide space within the control panel for future breakers and upgrades.

7.3 Programming

All programming shall be performed by the panel builder and approved by the engineer.

7.4 Control Strategies

The pump controller shall perform the following functions:

- Turn all pumps on and off at set adjustable levels
- Turn lead pump on at lead pump on level, alternating pumps each cycle
- If water continues to rise, turn on lag pump at lag pump on level
- If water reaches high water alarm level, a transmitter activates to signal an alarm to the County

Five redundant internally weighted mechanical float switches shall be provided for backup. They shall be equipped with intrinsically safe relays and shall operate the pumps and alarms in the event that the controller fails to operate. A separate power source shall provide power to the backup system. The floats shall be located at the following locations: one float for low alarm/redundant off, one float for off, one float for lead on, one float for lag on, and one float for high water alarm (which must activate the radio signal). Alarm floats shall be “dry contacts.” A dedicated 2-inch conduit shall be provided from the control panel to the wet well for the mechanical floats. The high water alarm float shall be wired to, and get its power directly from, the alarm panel (not the control panel). A line diagram showing the controls and alarms shall be submitted with the shop drawings. Floats shall be installed in each overflow tank to indicate when tank is 3/4 full and full via the SCADA system.

7.5 Spare Conduit

Three spare conduits shall be installed for ease of installing future instrumentation or controls into the wet well, valve pits, and between the RTU cabinet and telephone service. There shall be one 1.5” and two 1” spare conduits.

7.6 Surge Protection

Fusing shall be applied to segregate loads. Fuse holders should be blown-fuse-indicating type to facilitate further troubleshooting. Metal oxide varistor surge suppression shall be applied to all 24-volt direct current circuits leaving the control panel. Standard terminal block arrangements should be applied.

Section 8

Electrical Control Building

This section describes various design parameters and requirements for the electrical control building.

8.1 Sizing

Room will be provided for future odor control chemical storage, including secondary containment, in the electrical control building. Building size requirements will be based on minimum electrical clearances around panels, and a minimum of 24 inches from all other equipment and tanks. The designer shall size the dimensions of the building to fit the proposed control panel and chemical feed pump and tanks sizes. The designer shall submit calculations for sizing the future odor control chemical tank, which will require the approval of the engineer. The tank shall be sized assuming that the odor control chemical to be used is hypochlorite. The chemical room shall be completely separate from the electrical control room.

8.2 Materials

The building shall be a precast concrete or masonry building with a standing-seam roof. The designer shall check with the developer/owner to determine if another style of building is desired, because of aesthetics of the proposed development. If special colors or architectural finishes are requested, samples shall be submitted to the engineer for review and approval.

8.3 Doors and Security

The chemical room will include a roll-up door sized to accommodate the installation and removal of the chemical tank. The designer shall specify the type of roll-up door. The control room will include a double door or roll-up door and man door to provide easy access into the room, while providing means for removal of all equipment. If necessary, a removable transom may be used to provide sufficient clearance for tall and narrow equipment. The roll-up door or double door will be sized such that electrical panels can be removed without turning the panels on their side. The partition between the chemical room and control room shall be airtight. All doors shall be equipped with standard cylinder-type lock-sets.

8.4 Heating, Ventilation, and Air Conditioning (HVAC)

The building shall be provided with heating and cooling as necessary to maintain temperatures within the operating range of equipment and optimum storage temperatures for odor control chemicals. Venting of the chemical room shall be separate from the electrical control room.

8.5 Chemical Storage Room

The chemical storage building shall be sized to contain the chemical tank and other accessory equipment, include a containment sump to provide 120 percent of the chemical tank capacity, and shall be approved by the engineer. Electricity and potable water shall be supplied. An emergency eyewash/shower system shall be installed inside the building in an area approved by the engineer. A wall with a window that does not open shall separate the chemical storage portion of the building

from the control portion of the building. The containment sump shall have the ability to drain to the wet well or upstream manhole, without creating a hazardous environment within the chemical storage room. The buried containment sump drain pipe can be PVC with a normally closed PVC ball valve located outside the chemical building. A valve riser and G-5 valve access box shall be provided in an accessible location, as shown in the Standard Pump Station Details provided in Appendix B. Standard criteria for sizing the chemical storage and building, along with specifications for chemical feed equipment and appurtenances, are provided in Appendix C.

Section 9

Septic Tank Effluent Pump Stations

In some locations of the county, septic tank effluent pump (STEP) systems are more economical than providing a centralized station. If a STEP system is desired, the designer will be required to submit justification why the STEP system is required.

9.1 Minimum STEP Requirements

STEP tanks and pumps will be installed by the developer/homeowner on private property and maintained by the County. The tank shall be located within 50-feet of the roadway's centerline in an area that is easily accessible to maintenance staff. Residences located at a lower elevation than the road, where a gravity line from the house to the STEP tank is not feasible, shall install a second tank housing a grinder pump to lift the house wastewater up to the STEP tank location. Grinder pumps and tanks, when required, shall be installed and maintained by the developer/homeowner.

9.2 Threshold for Providing a Central Pump Station

Allowance of a STEP system will be based on the number of total EDUs served by the STEP system in the sewershed:

- Less than 25 EDUs: STEP system will be allowed
- 25 to 50 EDUs: STEP system will be considered by County
- More than 50 EDUs: STEP system will not be allowed, and a centralized pump station will be considered

9.3 Additional Submittal Requirements for Stations Fed by STEP Systems

In locations where a centralized pumping station will be required to accept STEP system discharge, the station must comply with the standards provided within this manual and, additionally, a biofilter will be required for the treatment of odorous gases in the influent sewer. The biofilter shall include a blower to pull four air from the wet well headspace, and into the biofilter media. The designer shall provide calculations for sizing of the biofilter, which shall be reviewed by the engineer and approved if adequate. The biofilter shall be located within the pumping station site so that County maintenance staff has full access at all times.

Section 10

Preferred Equipment Table

The County has compiled a list of preferred equipment types, and in some cases has provided specific manufacturers that are preferred. In all instances, products may be submitted as equivalents to the equipment specifically described below, and will be subject to the engineer's approval as an equivalent item. In some locations, a County-owned pumping station that serves as an example of a particular installation is provided. The list of preferred equipment is as follows:

- Submersible pump guide rails: Type 316 stainless steel
- Wet well fall protection: safety grates at all hatch openings with corrosion-resistant coatings
- Hatch covers: aluminum cover with non-slip heat-resistant coating (similar to Kemper Road Station)
- Wet well water surface level monitoring: KPSI (pressure transducer)
- Locks: Master Lock padlocks and rekeying of any entry doors provided by the County
- Motor starters (full-voltage non-reversing): Cutler-Hammer
- Motor starters (reduced-voltage soft start): Cutler-Hammer
- Pressure gauge: Ashcroft
- Non-clog wastewater pump: Vaughan for chopper; Myers, Barns, Chicago, HOMA
- Security system: GE Interlogix or equivalent
- Sewer air and vacuum relief valve: ARI
- Ball valve: Spears
- Swing check valve: Keystone wafer or equivalent
- Isolation GV: Muller or equivalent
- Magnetic flow meter (force main): Siemens Sitrans FM MAG 5100W or equivalent
- Electrical breakers: Cutler-Hammer or equivalent
- Electrical meter: main disconnect at meter
- ATS: ASCO or equivalent
- MTS: ASCO or equivalent
- Electrical wire: "RHW" or "THW" copper conductor, or approved equal
- Telemetry system: telemetry requirements are subject to change; request current telemetry specification from County engineer
- PLC module: data flow controller
- PLC programming: data flow
- Surge protector: PolyPhaser
- Backup system separate from primary operating system
- Power and grounding terminal blocks: solderless box lug type

Section 11

Design Acceptance Process

Prior to construction, pump station design documents must be approved by Placer County Environmental Engineering. Two different types of project designs require approval: pump stations designed as part of a development, and those initiated by the County as part of the ongoing capital improvement program (CIP). Each type of design follows its own process for County review and acceptance.

11.1 Developer Projects

The sewer facilities and pump station design approval process shall generally follow the County Community Development Resources Agency (CDRA) requirements or guidelines. A preliminary sewer facilities study is required as part of the project entitlement process. The study shall provide the preliminary sizing of the pump and force main requirements, wet well and emergency storage requirements, other required critical appurtenances, and an approximate layout and size of the proposed pump station site. This study can be submitted for review along with the preliminary project plans and tentative maps during the entitlement application process. At least three submittals are required for this study:

1. Draft at 60 percent complete
2. 90 percent complete
3. Final

Once the study is complete during the entitlement process, a “Will Serve Requirements Letter” is issued, and the project is entitled to sewer services within one of the County sewer maintenance districts.

The next phase of the project permit process is project improvement plans development. Sewer facilities improvement plans shall be developed or prepared as part of the project improvement plans. A Pump Station and Forcemain Design Report is required. See Appendix F for Lift Station Design Report Requirements. The plans and report shall be submitted for review and approval. Typically, the following submittals are required:

1. Draft Pump Station and Forcemain Design Report
2. Final Pump Station and Forcemain Design Report
3. 60 percent plans, specifications, and updated report
4. 90 percent plans, specifications, and updated report
5. Final plans, specifications, and report

Placer County Environmental Engineering will review and provide comments on each submittal where the design is not in accordance with the requirements described in this design manual.

11.2 CIP Projects

The acceptance process for CIP projects will be per the project scope agreed upon by the County and described in the executed agreement. The default CIP acceptance process will include preparation and submittal of the following design documents:

1. 30 percent design including a preliminary design report
2. 60 percent design drawings and specifications
3. 90 percent design drawings, specifications, relevant calculations

Each design submittal shall also include an engineer's estimate of probable construction costs.

11.3 Permits

The designer and/or contractor shall obtain all required permits at no cost to the County. This includes, but is not limited to, any required encroachment permits, an Air Quality Management District (AQMD) permit for generator, an OSHA excavation permit, an erosion/sediment control plan with Environmental Engineering (EE), any necessary environmental permits, and an electrical permit from the Placer County CDRA, Building Division prior to performing any electrical work and coordinating with the applicable electrical utility for inspection and approval. The designer/contractor shall coordinate the connection of power to the sewer pump station with the applicable utility company. The power box with electric meter shall have a service disconnect.

Section 12

Testing

Prior to final, the contractor shall provide all required safety measures, equipment, and signage during construction. The contractor shall submit testing procedures for the engineer's review and approval a minimum of 10 working days prior to all testing. A representative of the engineer must be present for all testing. The contractor shall provide a minimum of 3 working days' notification before beginning testing. Any remedial action because of testing failure and re-testing shall be at the contractor's expense.

12.1 Pump Station Operation

The contractor shall operate the pump station using clean water for three (3) full working day test periods, or until all critical operational issues are resolved. The testing plan shall provide for testing of pumps to simulate the full range of operating conditions ranging from dry weather diurnal low flow to PWWF. Testing shall simulate all SCADA alarm conditions and simulate the desired data collection during station operations. After the engineer approves the three (3) full-day functional clean water tests, the startup with sewage may commence. Testing and startup of the pump station and pertinent equipment including, but not limited to, the generator, sewage handling pumps, sump pumps, chemical feed pumps, grinders, VFDs, radio equipment, magnetic flow meter, and motor control shall be conducted per County requirements. A manufacturer's representative for all pertinent equipment shall be present for the testing and startup per County requirements. The contractor shall submit the testing and startup procedures for County review and approval prior to conducting the procedures.

The contractor shall complete a "Pump Station Checklist and Station Startup Data Form" to be provided by the engineer. Phase 3 of this form must be completed and signed off by the engineer as a condition to begin the extended warranty period. The Contractor shall operate the new pump station under normal sewer flow and operating conditions for 3 days startup and testing period before County Utility staff takes over the pump station operation.

12.1.1 Locator Wire Testing

The contractor shall provide all labor, equipment, and materials required to perform a continuity test of the locator wire at each valve, ARV, and other locations where the locator wire is required.

12.1.2 Cleaning and Flushing of the Force Mains

The contractor shall clean and flush the force mains using the following criteria and procedures:

- The contractor shall provide all labor, equipment, and materials required to clean and flush the force mains to the satisfaction of the engineer.
- The contractor shall submit to the engineer for review the equipment it plans to use that is capable of performing the required cleaning prior to the start of cleaning.
- The contractor shall insert a flexible polyurethane foam "pig" (2 lb per cubic foot density) complete with rear polyurethane drive seal, into the first section of the pipe. Pigs shall be manufactured of an open-cell polyurethane foam body. Pigs shall be able to pass through reductions of up to 60 percent of their actual diameter, and be able to return to normal size

when space allows. Pigs shall be able to traverse standard piping configurations such as 90-degree elbows, tees, wyes, GVs, and ball valves.

- The contractor shall clean and flush the lines by propelling the pig up the pipeline to the exit point with potable water or recycled water. Surface water is not acceptable for this use. The cleaning procedure shall be submitted as a shop drawing.
- The contractor shall continue to send pigs through the pipeline and flush the system until the water is completely clear, as determined by the engineer.
- A minimum of 10 working days prior to the start of the cleaning and flushing work, the contractor shall submit to the engineer for acceptance evidence of qualifications to do this work. This evidence shall include, at a minimum, a list of all projects of equal or greater scope that have been completed within the last 3 years. Specific information for each project shall include dates of the project, total length of pipe cleaned, diameter(s) of the pipes, pipe material, project cost, project location, and a contact person with telephone number.

12.1.3 Overflow Tank Vacuum Testing for Tanks without T-Lock Liner

Overflow tanks without T-lock liner shall pass a vacuum test consisting of the following criteria and procedures:

- The test shall be performed after assembly of the overflow tank and access manholes, but prior to backfilling. The contractor shall perform the test and supply all test equipment. A representative from the engineer must be present for all testing.
- A vacuum of 10 inches of mercury shall be drawn and held with a loss of no more than 1 inch of mercury in the time as determined by the following equation. Time (seconds) of the test is equal to $1.25 \times \text{diameter (inches)}$ (time [seconds] = 1.25 diameter [inches]).
- If the overflow tank fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until the elapsed times are satisfactory to the engineer.
- After passing the vacuum test, all joints shall be mortared, inside and out. Outside mortared joints shall be allowed to dry prior to backfilling.

12.1.4 Overflow Tank Testing for Tanks with T-Lock Liner

Overflow tanks with T-lock liner shall pass individual joint tests and liner testing consisting of the following criteria and procedures:

- All joints shall be pressure tested during assembly prior to grouting.
- If a joint fails the pressure test the contractor shall make all necessary corrections and re-test the joint until it passes before installing the remainder of the tank.
- After passing the pressure test, each joint shall be grouted using a non-shrink grout, and in locations where groundwater is present, a hydraulic non-shrink grout shall be required.
- Holiday testing of the plastic T-lock liner and field welded strips at joints and penetrations shall, including access manholes, shall be required prior to acceptance.

12.2 Record Drawings and Shop Drawings

The pump station designer is required to submit electronic as-built drawings on a compact disc or thumb drive.

The contractor shall submit equipment/component shop drawings, electrical diagrams, and cut sheets to the engineer for review and acceptance prior to construction of the sewage pump station.

All submittals shall include specification sheets and supporting data/calculations. Submittals shall include, but are not limited to, the following:

- Site plan to include electrical duct bank locations
- Conduit and conductor schedule
- Wet well including valve vault, bypass vault, metering vault, access doors, safety grates, cover—both specification sheets and structural calculations
- Building structural calculations and materials
- Pumps and motors with applicable pump curves
- Control system
- Generator and sound reduction cabinet, if applicable
- Generator receptacle, if applicable
- RTU equipment and antenna
- Antenna-light pole and light
- Overflow tanks and end plugs
- Factory test results for all pumps, meters, and appurtenances
- Detailed startup and testing procedures including completed data forms
- Eyewash/shower station
- Valves
- Cam-Lok with valve for maintenance bypass feature
- Siemens Sitrans FM Mag 5100W, or as approved equivalent by the engineer, with additional input/output (I/O) slots to allow for additional outputs from a remote system
- Control wiring
- Arcflash analysis, signage, and required safety procedures and training
- Operation and maintenance (O&M) manual
- As-built plans

The contractor shall provide the engineer four copies of the submittal packages for review and acceptance. The contractor shall provide the engineer with four copies of the final accepted submittal with all required modifications included. The contractor shall supply the County with four copies of a complete O&M manual for the station.

12.3 Extended Warranty

Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the owner and County against defects in workmanship and materials for a period of 5 years under normal use, operation, and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the approved drawings.

The developer or sub-developer of residential subdivisions shall provide the County a 3-year warranty on all pump stations. The warranty period shall begin after the completion of the 3 day sewer flow startup and testing period and when all items have been signed off for Phase 3, as required in the “Pump Station Checklist and Station Startup Data Form.” All critical operational punch list items shall be completed as determined by the engineer. Upon completion, the County will provide an acceptance letter documenting the warranty period. Non-critical punch list items shall be completed at the contractor’s earliest convenience, not to exceed 6 months after the start of the warranty period.



Section 13

Limitations

This Pump Station Design Manual provides only general guidelines and does not replace the requirement for sound engineering judgment from a professional engineer with experience in the design and construction of wastewater pumping stations. This manual is a “living document” that is subject to periodic revisions and updates, and it is the designer’s responsibility to confirm that the most current version of the manual is being used.

Appendix A: Plan Preparation Standards

Appendix B: Pump Station Design Manual List of Standard Details

Lift Station Details 1: Circular Wetwell and Valve Vault Plan and Section

Lift Station Details 2: Pump Station Site Layout, Emergency Storage Tank and Pole Base with Antenna

Lift Station Details 3: Electrical Control Building and Odor Control Chemical Containment

Appendix C: Chemical Feed Building Requirements

Appendix D: Pump Station and Forcemain Design Report Requirements
