

Commissioning, Startup, and Training of Booster Pump Stations: *Lessons Learned from Recent Pump Stations*

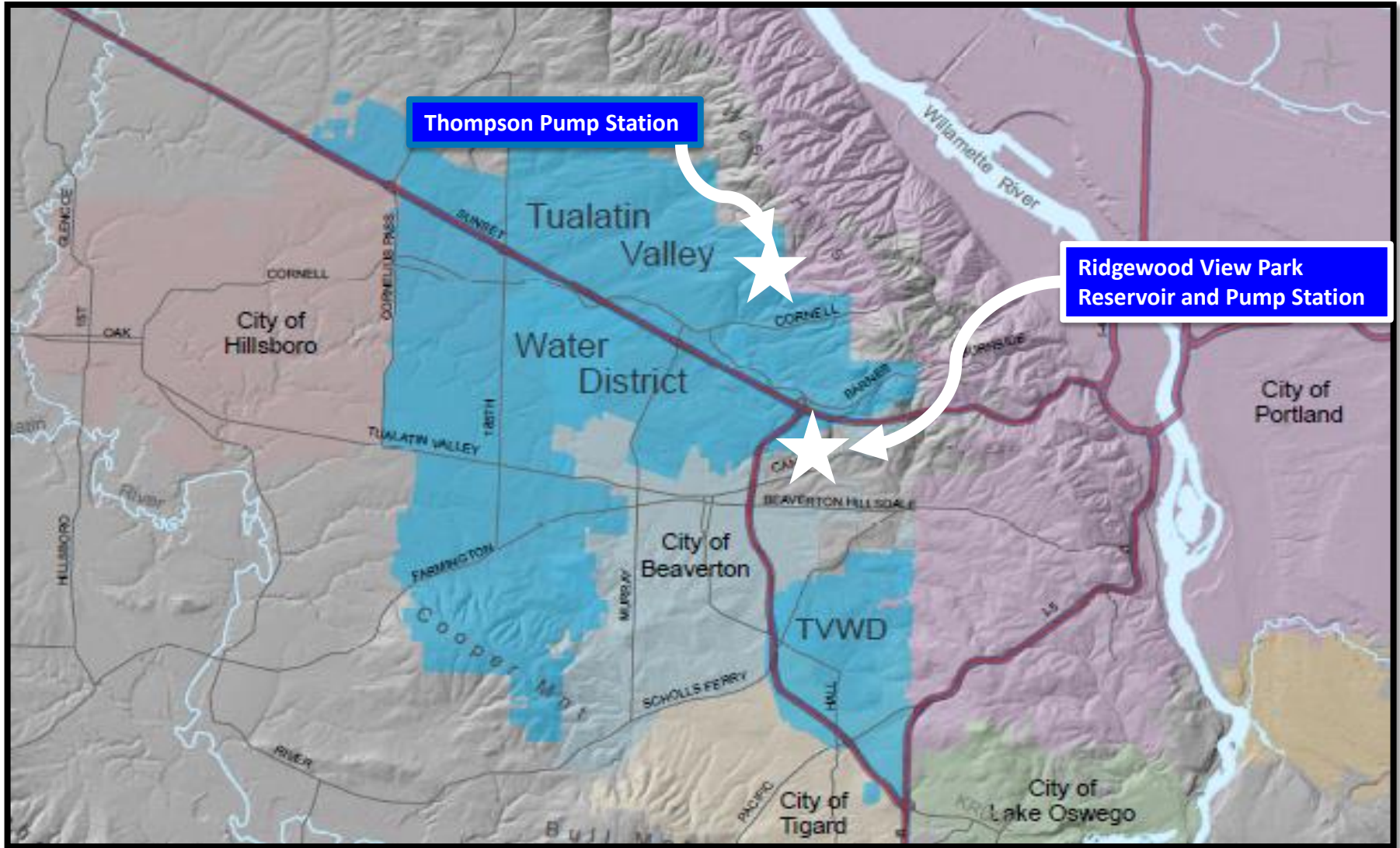
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Tualatin Valley Water District



Delivering the Best Water 💧 Service 💧 Value

Project Location



Thompson Pump Station (Future Site)

- Pump Station Design
 - Site Selection
 - System Operations / Design Functions
 - Neighborhood impacts
 - Future Expansion



Testing, Startup, & Commissioning - Overview

- Terminology
 - Planning
 - Functional Testing
 - Startup
 - Commissioning



Testing, Startup, & Commissioning - Planning

- Timing of plan – Final form well in advance
- Proper schedule – Does it follow the plan?
- Responsibilities
- Operator training – is it included in the plan and schedule?

34	HVAC System Testing (PMC)	9 days	Wed 11/13/13	Wed 11/20/13	
35	Control Meeting with Engineer/MSI/Davis/Trane (RFI-040A) 9:00am	1 day	Wed 11/13/13	Wed 11/13/13	
36	Trane/PCMC Controls on site for Final wiring	2 days	Thu 11/14/13	Fri 11/15/13	
37	Functional Testing	1 day	Mon 11/18/13	Mon 11/18/13	
38	System Balancing	2 days	Tue 11/19/13	Wed 11/20/13	
39					
40	Standby Generator ATS Testing (Peterson Power Systems)	10 days	Thu 10/31/13	Thu 11/14/13	
41	Initial Start up Check out / 1-Hour Functional Testing	2 days	Thu 10/31/13	Fri 11/1/13	
42	4-hour full load test	1 day	Thu 11/14/13	Thu 11/14/13	
43					
44	Protect Security Systems	15 days	Mon 11/4/13	Mon 11/25/13	
45	Security system Installation / Test(Needs Network connection and two phone lines)	15 days	Mon 11/4/13	Mon 11/25/13	
46					
47	System I Testing	35 days	Fri 10/25/13	Fri 12/13/13	
48	Performance Testing	15 days	Fri 10/25/13	Fri 11/15/13	
49	Commissioning	20 days	Mon 11/18/13	Fri 12/13/13	
50					

Testing, Startup and Commissioning Planning

- Schedule
 - Complete & Independent of Project Schedule
 - Details for each phase
- Understanding startup for each piece of equipment
 - Surge anticipator device
 - Surge tank
 - Seismic valving
 - Main and secondary generators w/ additional battery backup

Functional Testing

- Planning for functional testing
 - Coordination with all equipment and component reps
 - Integrator
- Functional testing
 - Appurtenances
 - Equipment
 - Pumps
 - Systems- moving into startup



Functional testing- Items to consider

- Checklists
 - Testing items
 - System checks
 - Responsibilities
 - Contractor
 - Commissioning agent / integrator
 - Engineer
 - Owner / Operator

Pre-Startup Verification with Contractors: Completed?: Date: [Click here to enter text.](#)

#	Panel Work	Yes	No	Comments
	Panel installation complete	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	All conduits and wiring path complete	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	Power and Lighting Panel finalized	<input type="checkbox"/>	<input type="checkbox"/>	
Notes:				
Electrical				
	Controls and field instruments wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	Control Panel terminations complete	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	Instruments and field devices ready for Power up	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
Notes:				
Mechanical				
	Mechanical installation complete	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	Power Distribution complete and Power Tested	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	MCC complete and Ready for Energization	<input type="checkbox"/>	<input type="checkbox"/>	
	Field Devices and Instrumentations ready	<input type="checkbox"/>	<input type="checkbox"/>	
	Station Ready for Startup	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
	Click here to enter text.	<input type="checkbox"/>	<input type="checkbox"/>	Click here to enter text.
Notes:				

Startup

- Startup
 - Systems
 - HVAC, Electrical (Including backup power), Water Quality, Pumping, etc.
 - Full functionality
 - Verification of design
 - Training of operators
 - Extreme Events

Table 1. Pump Design Criteria		
Parameter	Initial phase	Ultimate phase
Thompson Reservoir Pump Station		
Total firm capacity ¹ (mgd)	3.0	4.2
820 Pressure Zone Pumps		
Type	Vertical turbine	
Quantity	2 duty, 1 standby	
Installed capacity (mgd)	4.7	7.0
Design flow per pump and drive type (mgd)	1 @ 1.3 mgd w/soft start 1 @ 1.7 mgd w/soft start 1 @ 1.7 mgd w/VFD	1 @ 2.1 mgd w/soft start 1 @ 2.1 mgd w/VFD 1 @ 2.8 mgd w/VFD
Total dynamic head (feet of water)	390	435
Motor size (hp)	1 @ 125 2 @ 150	2 @ 250 1 @ 300

¹ With largest pump out of service

Pump No. 1:			
Capacity	MGD	1.3	Constant Speed w/Soft Start
Capacity	gpm	903	Min. Eff. 84%
Total head	ft	390	Rated Capacity
Total head	ft	390	Run Out
NPSHA	ft	29.5	@ CL of Suciton inlet Piping
Motor	HP	125	480v, Type2, TEFC Prelum
Speed	rpm	1770	
Impeller	in	9.125	
Stages	no.	7	
Suction	in	8	
Discharge	in	8	
Bowl size	in	12.5	
Pump Can Diameter	in	18	

Commissioning

- Commissioning
 - Operators to spend additional time at the site
 - Attention to details
 - Is there anything out of the ordinary?
 - Anything that “bugs” the operators?



Supplementary Systems- Lessons Learned

- Schedule
- Checklists
- Generator
-



Lessons Learned

- Pumps
 - Vibration
 - Flow
 - Pump Shut-off / power outage simulation
- Valve Testing
 - Motorized
 - Specialty valves



Lessons Learned

- Appurtenances
 - Sensors
 - Pressure
 - Level



Lessons Learned

- What went well with Thompson:
 - Pump efficiency testing
 - Pressure testing (motorized valve, leak in reservoir)
 - Plan was executed
 - No major issues during startup or commissioning
- What could be better:
 - Checklists
 - Detailed schedule with responsibilities



Things to remember

- Multi-functional testing
- Resiliency & Training
- Surge testing
- Vibration testing
- Flushing / clean pipe prior to firing pumps
- Responsibilities
- Full Schedule – Specifications requirements
- Checklists!



Questions??

