December

2015

City of Pittsburg

Water System Master Plan

FINAL

AKEL
ENGINEERING GROUP, INC.

CITY OF PITTSBURG

2015

WATER SYSTEM MASTER PLAN

FINAL

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Smart Planning Our Water Resources

December 31, 2015

City of Pittsburg
65 Civic Avenue
Pittsburg, CA 94565-3814

Attention: Walter Pease
Director of Water Utilities

Subject: Water System Master Plan – Final Report

Dear Walter:

We are pleased to submit the final report for the City of Pittsburg Water System Master Plan. The master plan summarizes the City's existing distribution system infrastructure, and documents the City's acceptable design criteria and current growth assumptions.

The master plan documents the capacity evaluation of the existing system and lists facility improvements needed to meet the water demand needs of existing users, as well as the needs of planned future developments. Finally, the master plan includes a capital improvement program and a cost allocation analysis.

We extend our thanks to you, Fritz McKinley, City Engineer; Dana Hoggatt, Former Planning Manager; and other City staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal

Enclosure: Report
CC: Fritz McKinley, City Engineer

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Acknowledgements

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Fritz McKinley, City Engineer

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Keith Halvorson, Former City Engineer

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City of Pittsburg
Water System Master Plan

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EXECUTIVE SUMMARY

This executive summary presents a brief background of the City's water system, the need for this domestic water system master plan, and proposed improvements intended to mitigate existing deficiencies, as well as improvements to provide adequate services to future developments. The capital improvement program is included at the end of this chapter.

ES.1 STUDY OBJECTIVES

The City of Pittsburg recognizes the importance of planning, developing, and financing the City's domestic water system facilities. In order to continue to provide reliable and enhanced domestic water service to existing customers and to serve anticipated future developments, City staff initiated the preparation of this water system master plan.

This master plan provides the City with a tool for planning the domestic water infrastructure facilities through the project buildout. The objective of this master plan is to evaluate the City's domestic water distribution system and recommend capacity improvements necessary to service the needs of existing users and future developments. Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following elements:

- Summarize the City's existing domestic water system facilities.
- Document growth planning assumptions and known future developments.
- Update the domestic water system performance criteria.
- Project future domestic water demands.
- Update the water hydraulic model.
- Evaluate the capacity adequacy of the transmission mains and booster stations to meet existing and projected demand requirements and fire flows.
- Document the capacity analysis of major transmission mains, by segments, in tables.
- Perform a storage capacity analysis, by pressure zone.
- Complete a City-wide fire flow analysis.
- Recommend a capital improvement program (CIP) with an opinion of probable costs
- Perform a capacity allocation between existing and future developments. Capacity allocation was identified for each known development, and may be used for cost sharing.

- Develop a Domestic Water System Master Plan.

ES.2 STUDY AREA

The City of Pittsburg is located on the eastern side of California's San Francisco Bay in Contra Costa County (**Figure ES.1**). It is bound on the north by the Suisun Bay, the City of Antioch on the east, and is surrounded by undeveloped hills to the south and the Concord Naval Weapons Station on the west.

The area included in this study is outlined by the City of Pittsburg urban limit line (ULL). The City currently provides domestic water service to the currently developed areas within the ULL and plans to provide service to the anticipated growth areas when they become developed.

ES.3 WATER SYSTEM OVERVIEW AND PRESSURE ZONES

The City's municipal water system consists of a water treatment facility, groundwater wells, storage reservoirs, pump stations, over 215 miles of transmission and distribution mains, fire hydrants, and pressure reducing valves (**Table ES.1**).

The City's service area is currently divided into five existing pressure zones servicing elevations from sea level in Zone 1 to 510 feet in Zone 4 West, and will eventually be expanded to twelve pressure zones to service anticipated future developments in the southeast and southwest hills. The existing pressure zones are interconnected and include 8 storage reservoirs and 7 booster stations. In addition, 5 major PRVs provide increased supply reliability for Zone 1 (**Figure ES.2**).

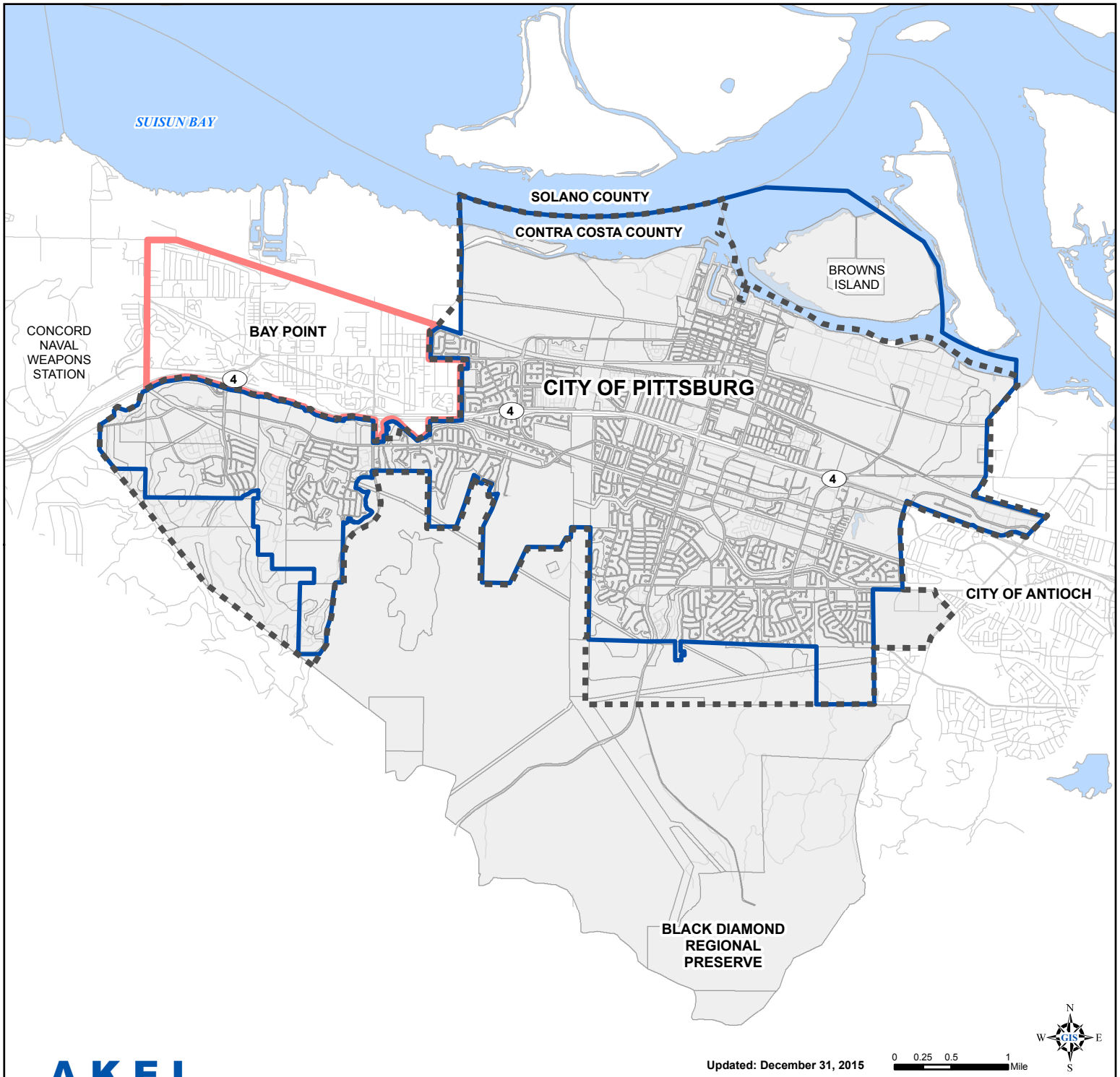
ES.4 SOURCE OF SUPPLY

The City has two sources of supply: surface water from the Contra Costa Canal, and groundwater extracted from two active wells in the central part of the City. Water from both sources is conveyed to the City's water treatment plant where it is first treated, and then conveyed to the distribution system. The City receives water from the Contra Costa Canal in accordance with an agreement with the Contra Costa Water District (CCWD).

The City's water treatment plant has a hydraulic design capacity of 32 million gallons per day (MGD), and is currently limited by the California Department of Public Health (CDPH) to 12 MGD when the water temperature is less than 10 degrees Celsius (50 degrees Fahrenheit), which has not occurred; and 28 MGD when the water temperature is less than 20 degrees Celsius (68 degrees Fahrenheit), which usually occurs between the months of November and April. The City's water treatment plant currently operates at 6 to 18 MGD.

ES.5 DOMESTIC WATER DEMANDS

The existing water demands used in this master plan were based on the City's 2012 water billing consumption records and water treatment plant production records. The water billing consumption



ES.1
Planning Area
Water System Master Plan
City of Pittsburg

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SUISUN BAY

PS-1
Vista del Mar

PS-5
Oak Hills

PRV-8
San Marco at
West Leland

PRV-1
Birchwood

PRV-10
Santa Lucia

PS-6
Shady Brook

T-5
New West Leland
3.0 MG [385']

T-8
Oak Hills
2.0 MG [491']

T-9
Shady Brook
1.75 MG [628']

PS-2
WTP

PS-3
WTP

WTP

T-3
Stoneman
2.5 MG [385']

T-1
WTP
5.0 MG [195']

T-2
WTP
1.0 MG [195']

PS-4
Buchanan

T-7
Hillview
3.0 MG [490']

PRV-7
Leland and Railroad

PRV-2
Stoneman Park

PRV-5
Delta Hawaii
Mobile Home Park

PRV-3
Loveridge

PRV-4
College

PRV-6
Buchanan

PRV-9
Oakdale Pl

Updated: December 31, 2015

0 0.25 0.5 1 Mile

N W GIS E S

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Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs

Pipes

- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 4 West
- Street Centerlines
- Water Bodies

ES.2
Existing System by Pressure Zone

Water System Master Plan
City of Pittsburg

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Table ES.1 Existing Model Pipe Inventory

Water System Master Plan

City of Pittsburg

Pipe Diameter	Pipe Length by Material							
	A.C.P. (ft)	C.I. (ft)	D.I.P. (ft)	P.V.C. (ft)	Steel (ft)	unknown (ft)	Total (ft)	(miles)
2"	0	2,489	0	392	0	4,223	7,104	1.3
2.5"	0	0	0	0	0	2,332	2,332	0.4
3"	0	1,502	0	0	0	396	1,898	0.4
4"	27,241	6,132	868	3,125	0	3,271	40,637	7.7
6"	237,787	13,950	972	29,535	0	33,461	315,704	59.8
8"	176,008	3,040	436	202,786	0	31,795	414,066	78.4
10"	47,345	0	0	23,721	0	7,059	78,125	14.8
12"	39,003	603	16,560	12,643	0	3,610	72,418	13.7
14"	35,941	0	2,522	1,924	0	1,519	41,906	7.9
16"	23,779	0	35,287	17,089	0	3,061	79,217	15.0
18"	27,789	0	1,954	0	0	2,687	32,430	6.1
20"	4,041	0	40,920	1,236	0	2,470	48,667	9.2
24"	19	0	101	0	0	2,349	2,469	0.5
30"	0	0	0	0	0	0	0	0.0
36"	0	0	0	0	0	277	277	0.1
42"	0	0	0	0	0	361	361	0.1
48"	0	0	0	0	0	161	161	0.0
Total	618,952	27,716	99,620	292,452	0	99,033	1,137,773	**215**

Note:

3/19/2015

1. The water system pipe inventory was extracted from the City's GIS-based hydraulic model.

records included the individual monthly demands for each customer account and the land use category for each account.

Using GIS, each customer account was geocoded and spatially joined within its existing pressure zone. The accounts were then sorted by pressure zone and the total demand in each zone was calculated. The City's existing average day domestic water demand is calculated at 9.04 MGD.

Future demands were projected using the unit factors for residential and non-residential land uses and for each planned development (**Table ES.2**). The City's future developments were grouped into the following four major growth areas: Southwest Hills, Southeast Hills, Zone 1 and 2 infills, and annexations. The average day domestic water demands from these future developments is calculated at 4.38 MGD.

The maximum day and peak hour demands for the existing and future demands were calculated using the average day demands and City peaking factor criteria. The maximum day to average day ratio of 1.8, and peak hour to average day ratio of 2.8, were applied to the average day demands to obtain estimates of the higher demand conditions.

The existing maximum day and peak hour demands are calculated at 16.27 MGD and 25.31 MGD, respectively. The projected additional maximum day and peak hour demands anticipated from future developments are calculated at 8.66 MGD and 13.47 MGD, respectively. The projected total maximum day demand and peak hour demand are 24.93 MGD and 38.78 MGD respectively.

ES.6 RECYCLED WATER DEMANDS

Several irrigated areas within the City are now to be serviced by an expanded recycled water system. The City currently serves the landscape irrigation requirements of four park areas with recycled water and was recently expanded to serve the landscape of the City Park, City Hall, Mariner Park, Stoneman North Park, and Delta View Golf Course. The recycled water system includes the irrigation demands.

ES.7 HYDRAULIC MODEL AND PERFORMANCE CRITERIA

During the development of this master plan, the City's hydraulic model was updated using GIS and Innovyze's H_2OMap software. The calibrated hydraulic model was updated with system operational controls, and system operations at tanks and pump stations was verified for SCADA data obtained for 2013. The hydraulic model was thus validated for consistency with 2013 SCADA operations.

The criteria used for evaluating the capacity adequacy of the domestic water distribution system facilities (transmission mains, storage reservoirs, and booster stations) are discussed in the System Performance and Design Criteria chapter and summarized on **Table ES.3**.

Table ES.2 Future Land Use Inventory

Water System Master Plan
City of Pittsburg

Development Name	Residential Dwelling Units		Commercial	Industrial	Loveridge Industrial	School		Park
	Single Family (DU)	Multi-Family (DU)	(AC)	(AC)	(AC)	(AC / students)[7,8]		(AC)
Southwest Hills[1]								
Alves Ranch	167	393	5.1					
Bailey Estates	249							2.0
Bay Point/ BART Expansion and Annex		1,000	1.1					
De Bonneville	120							
Faria[11,12]	1,500							
Golf Course[14]	482[10]							
San Marco[11,13,15]	1,587					6.3[9]	Acres	17
The Villas at San Marco[14,15]		471	0.6					
Toscana at San Marco[15]	252							
San Marco Village C[15]		516						
Esperanza at San Marco[15]		300						
San Marco Village O[15]		58						
Smith[10]	150							
Spilker	89							
Vista del Mar[16]	469					11.3	Acres	
West Coast Transit Village		525						
Southeast Hills[2]								
Montreux	356							3.0
Thomas Ranch	255							
Tuscany Meadows	917	365						5.4
Sky Ranch	415							1.5
Zones 1 and 2 Infills[3,4,5]								
Zone 1	595	2,330	-5.8	14		650	Students[8]	
Zone 2	60	142	4.0			838	Students[8]	
Loveridge Sub-Area[6]					233			
Ambrose Park								12.3
NRG Power Plant				170				
Total	**7,663**	**6,100**	**6**	**184**	**233**			**41**

Notes: 1/6/2016

1. Source: Information received from City staff, 1/22/09, and Stetson Engineers
2. Source: 2000 Water System Master Plan, Amendment No. 3, June 2007, and
3. Zone 1 Infill Sources:
   a. List of developments under construction and General Plan allowances from Sewer Master Plan Update Table from City Planning 2/14/09
   b. Appendix C of the 2007 WWCSMP
4. General Plan allowances replaced WWCSMP Land Use changes for basins listed in Sewer Master Plan Update Table from City Planning 2/14/09
5. Zone 2 Source:
   a. Information received from City staff, email dated 4/3/09
6. Source: Loveridge Sub-Area Master Plan, RBF Consulting, October 2008
7. Acreage for planned school
8. Planned increase in student population for respective zone infills
9. The San Marco school site is no longer planned and is currently in use.
10. These proposed residential units are currently located on designated "Open Space" the proposed intensity.
11. Park acreages may be designated to the Faria development to total 17 acres. This is based on the City parkland dedication requirements.
12. Rdige Farms 1 and 2 have been merged into Faria.
13. Montecito and Faria have been combined per City staff email 5/14/2014.
14. The Golf Course Project listed in this table was not included in the development of capital improvements and capacity allocations. However, this master plan identifies the water system facilities (transmission mains, booster stations, and storage reservoirs) that may require resizing or need to be added to service this project.
15. San Marco and San Marco Villages B, C, M, and O unit counts as provided by the City 2/14/2014.
16. Per City staff email dated 2/14/14, the following building permits were issued (mostly towards the end of 2013): 808 in San Marco, 330 in San Marco Village B, and 337 in Vista del Mar developments.

Table ES.3 Planning and Design Criteria Summary
Water System Master Plan
City of Pittsburg

Design Parameter	Criteria
Supply	Supply = Maximum Day Demand + Standby
Storage	Zones 1 and 2: Total Required Storage = Operational + Fire + Emergency
	Zones 3 and above: Total Required Storage = Operational + Fire + Emergency + Time-of-Use
	Operational Storage: 25% of Maximum Day Demand
	Emergency Storage: 50% of Maximum Day Demand
	Fire Storage: New Residential, SF = 0.12 MG; Residential, SF = 0.18 MG; Residential, MF = 0.24 MG; Commercial/School = 0.54 MG; Industrial = 0.63 MG; Special Zone 1 Industrial = 0.65 MG; Loveridge Sub-Area = 0.48 MG
	Time-of-Use Storage (Zones 3 and above): 6-hours of Maximum Day Demand
Distribution Mains	Distribution mains should be designed to meet the greater of: 1) Peak Hour Demand, or 2) Maximum Day Demand + Fire Flow
	Criteria for existing and future pipelines include [1]: If pipe diameter ≤ 12", maximum pipeline velocity is 5 feet per second
	If pipe diameter ≥ 14", maximum headloss is 2 feet/1,000 feet
Pump Stations	Zones 1 and 2: Meet Maximum Day Demand with largest unit out of service
	Zones 3 and above: Meet Partial-Peak Time-of-Use Pumping (18-hour pumping) with largest unit out of service
	Hydropneumatic systems to meet Maximum Day Demand plus fire flow
PRVs	PRVs should be designed to meet the greater of: Peak Hour Demand, or Maximum Day Demand + Fire Flow
Service Pressures	Maximum Pressure: 100 psi
	Existing System Minimum Pressure (during Maximum Day): 40 psi
	Future System Minimum Pressure (during Peak Hour)[2]: 40 psi
	Existing System Minimum Pressure (during Peak Hour): 35 psi
	Minimum Residual Pressure (during Fires): 20 psi
Demand Peaking Factors	Maximum Month Demand: 1.5 x Average Day Demand
	Maximum Day Demand: 1.8 x Average Day Demand
	Peak Hour Demand: 2.8 x Average Day Demand
Fire Flows	Residential, New Single Family[3]: 1,000 gpm for 2 hours
	Residential, Single Family: 1,500 gpm for 2 hours
	Residential, Multi Family: 2,000 gpm for 2 hours
	East Contra Costa Court House[4]: 2,186 gpm
	Commercial: 3,000 gpm for 3 hours
	Schools[5]: 3,000 gpm for 3 hours
	Industrial: 3,500 gpm for 3 hours
	Zone 1 Special Industrial User[6]: 3,625 gpm for 3 hours
	Loveridge Sub-Area[6]: 4,000 gpm for 2 hours
Demand Coefficients	Residential, SF: 340 gpd/DU
	Residential, MF: 270 gpd/DU
	Commercial: 1,700 gpd/AC
	Schools: 1,000 gpd/AC
	20 gpd/student
	Park: 3,825 gpd/AC
	Heavy Industrial and High Intensity Commercial: 1,000 + gpd/AC
	Loveridge Sub-Area[6]: 1,200 gpd/AC

Note: 6/18/2014

1. Pipeline headloss criteria and fire flow requirements during maximum day demands might be relaxed on a case by case basis, at the discretion of City staff, and depending on the redundancy and reliability of the considered design. In no case shall the criteria listed in this table be relaxed without the review and approval of the City Engineer.
2. Minimum pressure criteria for future system is extracted from Section 64602 of the Title 22 California Code of Regulations.
3. New single-family homes are required to have fire sprinklers installed for suppression purposes. Homes over 3,600 sq ft require an increased fire flow.
4. The East Contra County Courthouse fire flow duration was not provided in the final fire protection plan received 5/13/2014.
5. Fire Flows for Delta View Elementary School, located in Pressure Zone 4 West, was reduced to 1,500 gpm for 2 hours due to fire sprinklers provisions, per letter from Fire Marshal dated February 2, 2010.
6. Source: CCCFPD Fire Inspector emails received 2/25/2014 and 3/4/2014.

ES.8 FIRE FLOW ANALYLSIS

The fire flow analysis consisted of simulating the maximum day demand in the hydraulic model and applying hypothetical fire flows. The magnitude and duration of each fire flow was based on the governing land use type within proximity to the fire location. The criteria for fire flows were also summarized in the System Performance and Design Criteria chapter.

The hydraulic model indicates that the City's existing distribution system performed reasonably well during the fire flow analysis with few exceptions noted in the Evaluation and Proposed Improvements chapter.

ES.9 STORAGE ANALYLSIS

Existing storage requirements were identified for each existing pressure zone and included the operation, fire, and emergency storage components. The total City-wide required storage for existing domestic water demands is calculated at 14.86 MG.

Future storage requirements were identified based on the known future developments, in each existing and future pressure zone. These known future developments will require an additional 9.84 MG of storage capacity.

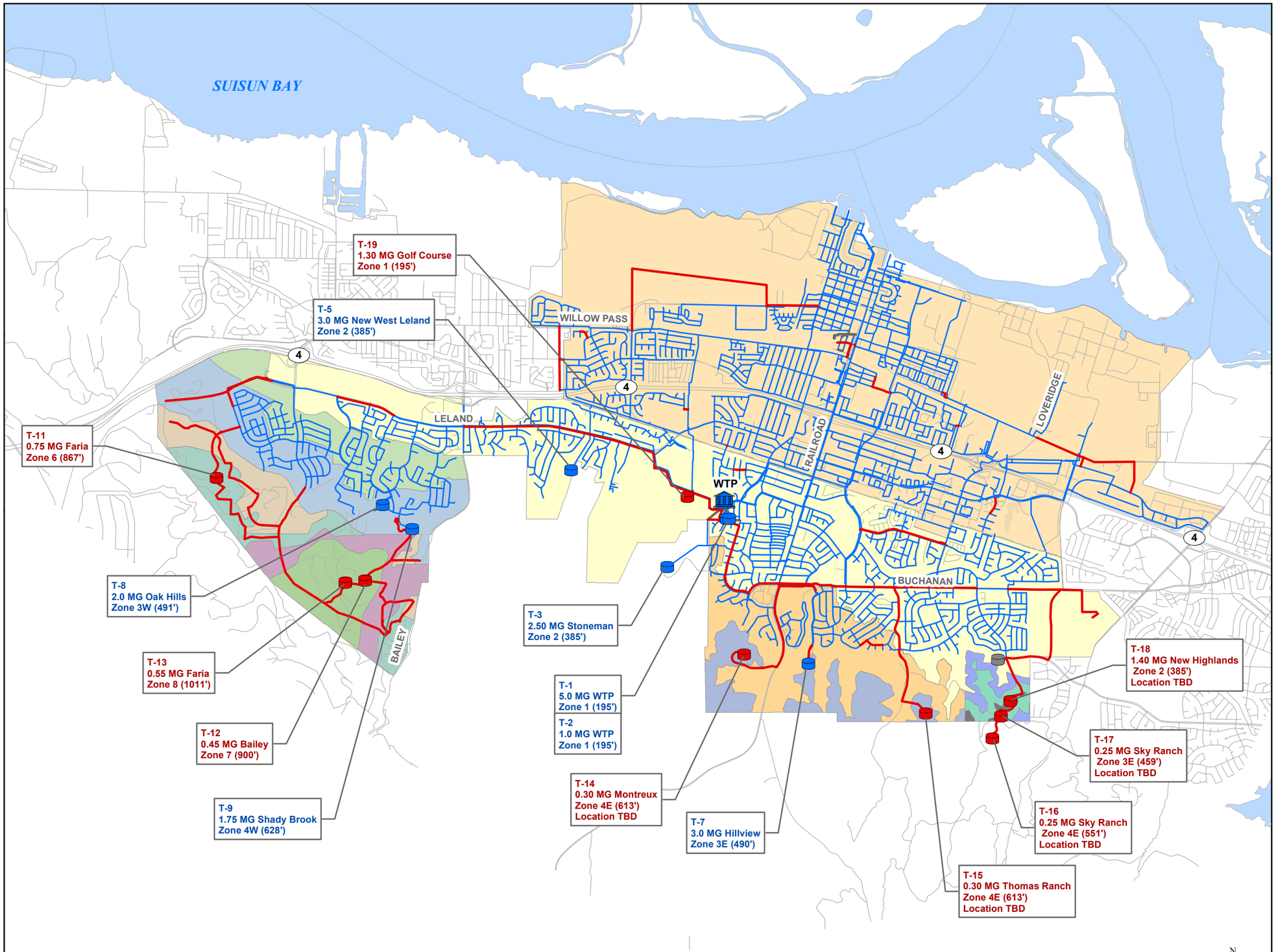
The proposed new storage reservoirs are shown on **Figures ES.3** and summarized as follows:

- Proposed 1.30 MG Pressure Zone 1 (Golf Course) reservoir
- Proposed 1.40 MG Pressure Zone 2 (New Highlands) reservoir
- Proposed 0.25 MG Pressure Zone 3 East (Sky Ranch) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Montreux) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Thomas Ranch) reservoir
- Proposed 0.25 MG Pressure Zone 4 East (Sky Ranch) reservoir
- Proposed 0.75 MG Pressure Zone 6 West (Faria) reservoir
- Proposed 0.45 MG Pressure Zone 7 West (Bailey) reservoir
- Proposed 0.55 MG Pressure Zone 8 West (Faria) reservoir

Proposed pump stations required to boost pressures to service higher zones, and proposed PRVs, are shown on **Figure ES.4**.

ES.10 TRANSMISSION MAINS

The hydraulic model was also used to determine if the existing domestic water distribution system pressures meet the City's System Performance and Design Criteria. Two main areas were found to not meet the minimum pressure criteria during either maximum day demands or during peak hour demands and this master plan included recommendations for mitigating these low pressure areas.



*Note: Future Sky Ranch pressure zones are based on contour elevations.

Updated: December 31, 2015

Legend

Proposed
- Storage Tanks
- Pipes

To Be Abandoned
- Tank

Existing
- WTP
- Storage Tanks
- Pipes

Pressure Zones
- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'
- Street Centerlines
- Water Bodies

T-3
2.50 MG Stoneman
Zone 2 (385')
Existing Storage Reservoirs

T-12
0.60 MG Bailey
Zone 7 (900')
Proposed Storage Reservoirs

*Note: Elevations shown are zone high water line.

ES.3
Existing and Proposed Storage Reservoirs
Water System Master Plan
City of Pittsburg

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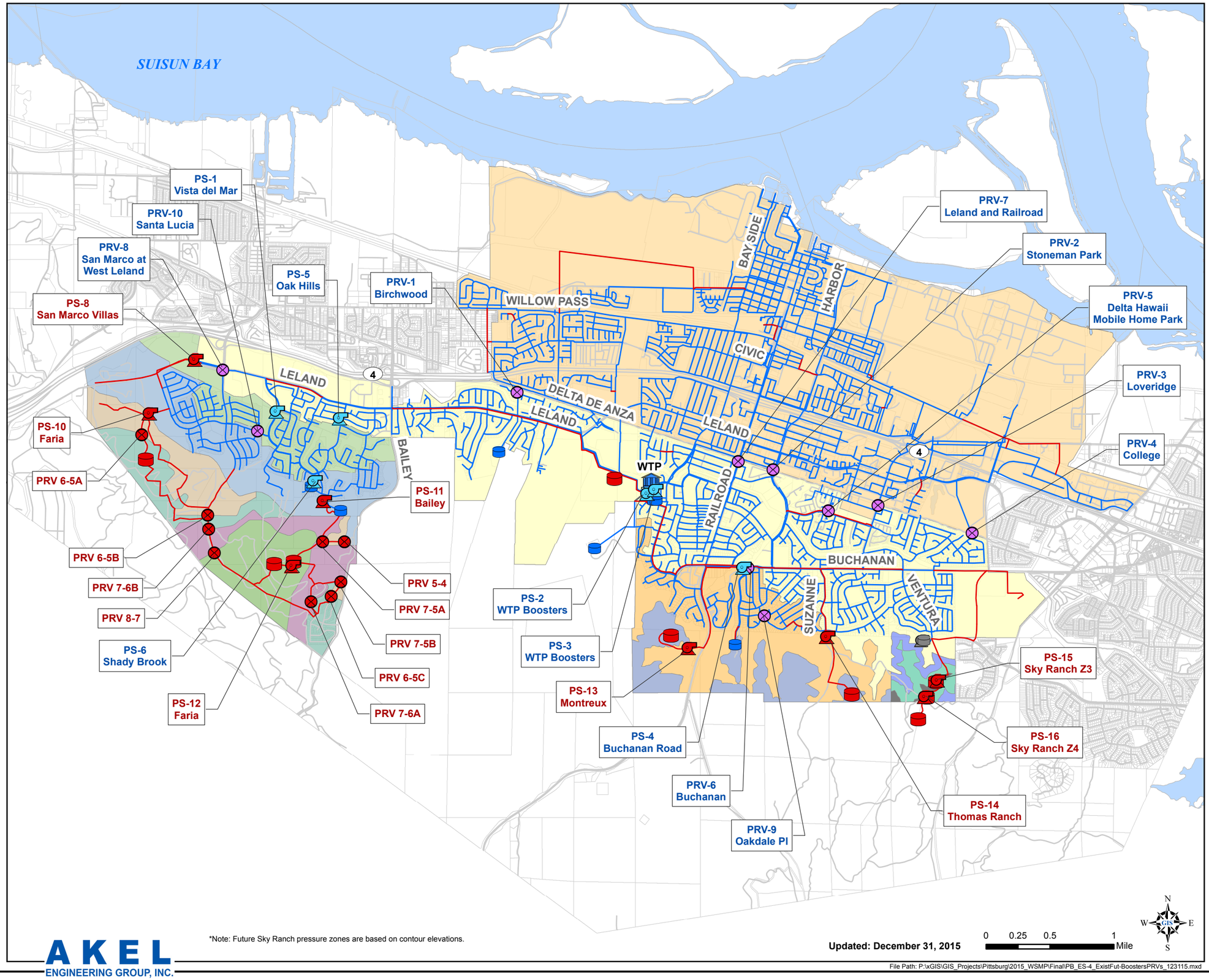

Legend

Proposed
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned
- Tank
- Booster Station

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Pressure Zones
- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'
- Street Centerlines
- Water Bodies

PS-6 Shady Brook — Existing Booster Stations

PS-10 Faria — Proposed Booster Stations

*Note: Future Sky Ranch pressure zones are based on contour elevations.

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ES.4
Existing and Proposed Booster Stations and PRVs
Water System Master Plan
City of Pittsburg

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The Evaluation and Proposed Improvements chapter includes descriptions of proposed transmission main improvements to mitigate existing deficiencies and to extend service to anticipated future developments. These improvements are listed on **Table ES.4** and shown on **Figure ES.5**.

ES.11 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program (CIP) listed on **Table ES.4** provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and for accommodating anticipated future growth. The cost estimates presented in the CIP were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

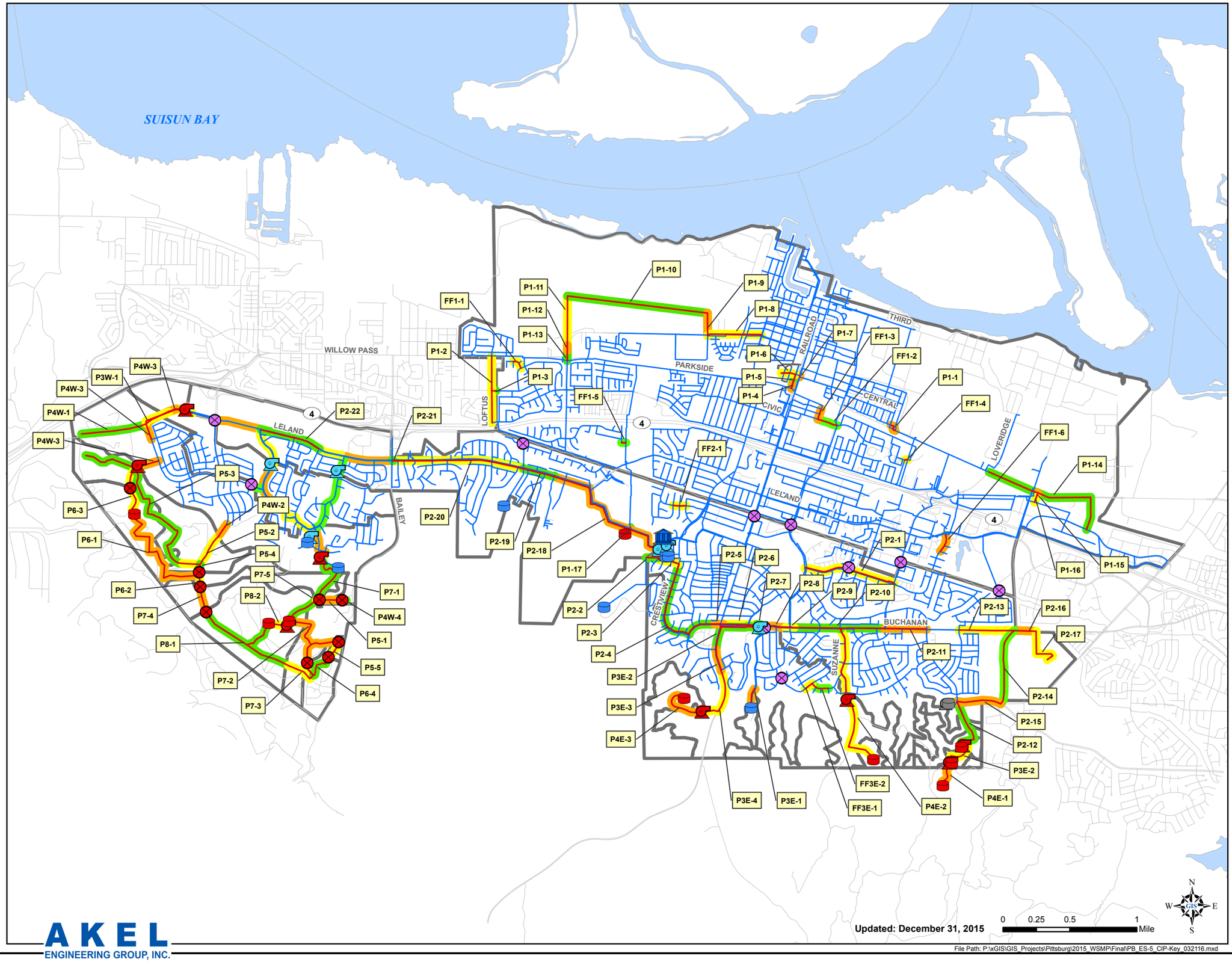
In the absence of bid tabulations, the estimated construction cost includes a **30 percent** contingency allowance to account for unforeseen events and unknown field conditions. In the absence of bid tabulations, the project related costs were estimated by applying an additional **30 percent** to the estimated construction costs.

The Capital Improvement Program has been divided into the following phases, subject to revisions by City staff:

- **Imminent:** This immediate term phase includes improvements that are in the bid process and are planned for fiscal years 2014 and 2015.
- **Phase 1:** This short-term phase includes improvements that are allocated based on annual fiscal budgets between 2016 and 2020.
- **Phase 2:** This intermediate phase includes improvements that are allocated based on a 5-year period between 2021 and 2025.
- **Phase 3:** This long term phasing plan includes improvements that are allocated beyond 2025.

The costs in this Water System Master Plan were calculated using a 20-City national average ENR CCI of 9,800, reflecting a date of June of 2014. In total, the CIP includes 9 storage reservoirs, 8 pump stations, and over 25 miles of new water distribution and transmission mains with an approximate cost totaling over $75,000,000.

Construction triggers for storage reservoirs, booster stations, and critical transmission mains were identified in the Capital Improvement Program chapter.



Legend

Proposed

- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Water Bodies

Updated: December 31, 2015

ES.5
CIP Facility Locations
Transmission Mains

Water System Master Plan
City of Pittsburg

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Table ES.4 Capital Improvement Program

Water System Master Plan

City of Pittsburg

Improvement Number	Pressure Zone	Type of Improv.	Street	Limits	Pipeline and Appurtenances Costs: Diam. (in)	Length (ft)	Unit Cost[5] ($)	Pipe Cost ($)	Other Infrastr. Costs[2] ($)	Baseline Constr. Cost ($)	Estimated Constr. Cost[3, 5] ($)	Land Acquisition Cost[5] ($)	Capital Improv. Cost[4, 5] ($)	Phasing: Imminent 2014-2015 ($)	Phase 1 2016-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-Buildout ($)	% Benefit: Existing Users	Future Users	Cost Sharing: Existing Users ($)	Future Users ($)
Improvements to Correct Existing Deficiencies																					
East Leland Subarea - Pipe Looping to Enhance Pressures																					
P2-1	Zone 2	Pipe	Stoneman Avenue	Harbor St. to Loveridge Rd.	12	3,300	150	495,000		495,000	643,500		836,550		836,550			100%		836,550	
East Central Subarea - Connections to Transmission Main																					
P1-1	Zone 1	Pipe	Columbia Street	Pittsburg Antioch Hwy. to Columbia St.	8	375	118	44,250		44,250	57,525		74,783		74,783			100%		74,783	
West Central Subarea - Western Loop																					
P1-2	Zone 1	Pipe	Loftus Road	Schooner Wy. To Willow Pass Rd.	16	2,800	181	506,800		506,800	658,840		856,492	856,492				100%		856,492	
P1-3	Zone 1	Pipe	Hanlon Way	e/o Loftus Rd.	8	300	118	35,400		35,400	46,020		59,826	59,826				100%		59,826	
P2-2	Zone 2	Pipe	WTP site	Hillsdale Dr. to existing 14"	12	460	150	69,000		69,000	89,700		116,610	116,610				100%		116,610	
Downtown Subarea - Cornwall Street Improvements																					
P1-4	Zone 1	Pipe	Cornwall Street	Dual Crossing under the railroad	8 / 10	140	754	105,560		105,560	137,228		178,396		178,396			100%		178,396	
P1-5	Zone 1	Pipe	Cornwall Street	Leslie Dr. to Central Ave.	16	300	181	54,300		54,300	70,590		91,767		91,767			100%		91,767	
P1-6	Zone 1	Pipe	Central Avenue	Cornwall St. to Industrial Complex	16	570	181	103,170		103,170	134,121		174,357		174,357			100%		174,357	
P1-7	Zone 1	Pipe	Central Avenue	Connection across Railroad Ave between 14" and 16"	16	60	181	10,860		10,860	14,118		18,353		18,353			100%		18,353	
										Subtotal - Existing Deficiencies			**2,407,135**	**1,032,928**	**1,374,207**					**2,407,135**	
Improvements to Meet Fire Flow Criteria																					
FF1-1	Zone 1	Pipe	Marlin Drive	Commodore Ct. to Trident Dr.	8	460	118	54,280		54,280	70,564		91,733		91,733			100%		91,733	
FF1-2	Zone 1	Pipe	School Street	Somers St. to Harbor St.	8	800	118	94,400		94,400	122,720		159,536		159,536			100%		159,536	
FF1-3	Zone 1	Pipe	Somers Street	From School St. to 16th St.	8	420	118	49,560		49,560	64,428		83,756		83,756			100%		83,756	
FF1-4	Zone 1	Pipe	El Pueblo Avenue	Diane Ave. to 120 ft e/o Diane Ave.	8	125	118	14,750		14,750	19,175		24,928		24,928			100%		24,928	
FF1-5	Zone 1	Pipe	Vacant Field	Zone 1 20-inch to Bodega Dr.	8	170	118	20,060		20,060	26,078		33,901		33,901			100%		33,901	
FF1-6	Zone 1	Pipe	Gladstone Drive	E Leland Rd. to Diokno Ct.	12	700	150	105,000		105,000	136,500		177,450		177,450			100%		177,450	
FF2-2	Zone 2	Pipe	Atherton Avenue	Orinda Ln. to Ravine Dr.	8	525	118	61,950		61,950	80,535		104,696		104,696			100%		104,696	
FF3E-1	Zone 3E	Pipe	Diehl Way	El Arroyo Pl. to Foothill Wy.	8	350	118	41,300		41,300	53,690		69,797		69,797			100%		69,797	
FF3E-2	Zone 3E	Pipe	Foothill Way	Diehl Wy. to Skyline Pl.	8	715	118	84,370		84,370	109,681		142,585		142,585			100%		142,585	
										Subtotal - Existing Deficiencies			**888,382**		**888,382**					**888,382**	
Mirant Power Plant and Loveridge Specific Plan																					
Mirant Power Plant Annexation - Transmission Main Loop																					
P1-8	Zone 1	Pipe	10th Street	Montezuma St. to Willow Pass Rd.	16	2,185	181	395,485		395,485	514,131		668,370		668,370				100%		668,370
P1-9	Zone 1	Pipe	Utility Rd	890 ft n/o Willow Pass Rd and Tenth St.	16	890	181	161,090		161,090	209,417		272,242		272,242				100%		272,242
P1-10	Zone 1	Pipe	Eastern Alignment	5570 ft e/o Utility Rd. intersection	16	5,570	181	1,008,170		1,008,170	1,310,621		1,703,807		1,703,807				100%		1,703,807
P1-11	Zone 1	Pipe	Southern Alignment	2045 ft s/o of Eastern Alignment to Railroad Crossing	16	2,050	181	371,050		371,050	482,365		627,075		627,075				100%		627,075
P1-12	Zone 1	Pipe	Easement	Cross under Santa Fe RR	16/36	300	468	140,400		140,400	182,520		237,276		237,276				100%		237,276
P1-13	Zone 1	Pipe	Southern Alignment	200 ft s/o of Railroad Crossing to Parkside Dr.	16	120	181	21,720		21,720	28,236		36,707		36,707				100%		36,707
Loveridge Specific Plan - Transmission Main Loop																					
P1-14	Zone 1	Pipe	Loveridge Development	Loveridge Specific Plan alignments	18	5,500	195	1,072,500		1,072,500	1,394,250		1,812,525		1,812,525				100%		1,812,525
P1-15	Zone 1	Pipe	Loveridge Development	Loveridge Specific Plan alignments	18	280	195	54,600		54,600	70,980		92,274		92,274				100%		92,274
P1-16	Zone 1	Casing[1]	Loveridge Development	Loveridge Specific Plan alignments	18/38	120	494	59,280		59,280	77,064		100,183		100,183				100%		100,183
										Subtotal - Mirant and Loveridge			**5,550,459**		**5,550,459**					**5,550,459**	
Expansion Improvements - Southeast Hills and Infills																					
Transmission Main from WTP to Highlands Ranch and Southeast Developments																					
P2-3	Zone 2	Pipe	Hillsdale Drive	WTP site to Crestview Dr.	24	1,325	520	689,000		689,000	895,700		1,164,410	1,164,410				63%	37%	729,654	434,756
P2-4	Zone 2	Pipe	Crestview/W. Buchanan	Hillsdale to Railroad Ave. (Seg. 1E)	16	4,975	181	900,475		900,475	1,170,618		1,521,803		1,521,803			63%	37%	953,607	568,196
P2-5	Zone 2	Casing[1]	W. Buchanan Road	Cross under Railroad Rd.	16/36	200	468	93,600		93,600	121,680		158,184	158,184				63%	37%	99,123	59,061
P2-6	Zone 2	Pipe	W. Buchanan Road	Railroad Ave. to PS-4 (Seg. 2E)	16	1,400	181	253,400		253,400	329,420		428,246	428,246				51%	49%	219,246	209,000
P2-7	Zone 2	Pipe	W. Buchanan Road	PS-4 to Buchanan Rd. PRV (Seg. 3E)	12	300	150	45,000		45,000	58,500		76,050	76,050				11%	89%	8,397	67,653
P2-8	Zone 2	Pipe	W. Buchanan Road	Buchanan Rd. PRV to Harbor St. (Seg. 4E)	12	1,100	150	165,000		165,000	214,500		278,850	278,850				44%	56%	122,021	156,829
P2-9	Zone 2	Casing[1]	W. Buchanan Road	Cross under Harbor St.	12/32	300	416	124,800		124,800	162,240		210,912	210,912				44%	56%	92,292	118,620
P2-10	Zone 2	Pipe	W. Buchanan Road	Harbor St. to Loveridge Rd. (Seg. 5E)	12	3,700	150	555,000		555,000	721,500		937,950	937,950				44%	56%	410,435	527,515
P2-11	Zone 2	Pipe	W. Buchanan Road	Loveridge Rd. to Ventura Rd. (Seg. 6E)	12	1,700	150	255,000		255,000	331,500		430,950	430,950					100%	0	430,950
P3E-1	Zone 3E	Pipe	Hillview Dr.	From end of Hillview Dr.to T-7 (Seg. 7E)	12	770	150	115,500		115,500	150,150		195,195			195,195			100%	0	195,195
P3E-2	Zone 3E	Pipe	Kirker Pass Road	From PS-4 to Castlewood Dr. (Seg. 8E)	12	3,500	150	525,000		525,000	682,500		887,250			887,250			100%	0	887,250
Proposed New Zone I Tank																					
T-19	Zone 1	Tank	New Zone 1 Tank	Servicing Zone 1	1.3 MG				2,080,000	2,080,000	2,704,000	1,045,440	4,874,272		4,874,272				100%		4,874,272
P1-17	Zone 1	Pipe	Future Road	From existing 20" to T-19	20	1,100	223	245,300		245,300	318,890		414,557		414,557				100%		414,557
Highlands Storage Tank																					
P2-12	Zone 2	Pipe	Highlands Ranch	Connection to Highlands Ranch Tank	16	1,030	181	186,430		186,430	242,359		315,067		315,067			47%	53%	147,661	167,406
T-18	Zone 2	Tank	Highlands Ranch	Servicing Zone 2	1.4 MG				2,240,000	2,240,000	2,912,000	784,080	4,804,904		4,804,904			47%	53%	2,251,887	2,553,017
Tuscany Meadows Subdivision																					
P2-13	Zone 2	Pipe	W. Buchanan Road	From Meadows Ave. to the Standard Oil ROW	16	2,175	181	393,675		393,675	511,778		665,311		665,311				100%		665,311
P2-14	Zone 2	Pipe	Standard Oil ROW	From W. Buchanan Rd. to James Donlon Blvd.	12	3,050	150	457,500		457,500	594,750		773,175		773,175				100%		773,175
P2-15	Zone 2	Pipe	James Donlon Boulevard	From the Standard Oil ROW to Ventura Dr.	12	1,725	150	258,750		258,750	336,375		437,288		437,288				100%		437,288
P2-16	Zone 2	Pipe	W. Buchanan Road	From the Standard Oil ROW to approx. 860 ft e/o ROW	16	860	181	155,660		155,660	202,358		263,065		263,065				100%		263,065
P2-17	Zone 2	Pipe	Tuscany Meadows Property	Jogging along future road to service High Density Res.	12	1,850	150	277,500		277,500	360,750		468,975		468,975				100%		468,975
Sky Ranch Subdivision																					
PS-15	Zone 4E	Pump Sta.	Sky Ranch Pump Sta.	230 gpm Duty + 230 gpm Standby	2 x 230 gpm				367,944	367,944	478,327	50,000	686,825			686,825			100%		686,825
P3E-2	Zone 4E	Pipe	Extension of Ventura Drive	PS-15 to PS-16 and to T-17	12	1,750	150	262,500		262,500	341,250		443,625			443,625			100%		443,625
T-17	Zone 4E	Tank	Sky Ranch	Servicing Zone 3 (Sky Ranch)	0.25 MG				500,000	500,000	650,000	784,080	1,864,304			1,864,304			100%		1,864,304
PS-16	Zone 4E	Pump Sta.	Sky Ranch Pump Sta.	130 gpm Duty + 130 gpm Standby	2 x 130 gpm				238,719	238,719	310,335	50,000	468,435			468,435			100%		468,435
P4E-1	Zone 4E	Pipe	Extension of Ventura Drive	PS-16 to T-16	12	1,100	150	165,000		165,000	214,500	72,424	373,001			373,001			100%		373,001
T-16	Zone 4E	Tank	Sky Ranch	Servicing Zone 4 (Sky Ranch)	0.25 MG				500,000	500,000	650,000	784,080	1,864,304			1,864,304			100%		1,864,304
Thomas Ranch Subdivision																					
PS-14	Zone 4E	Pump Sta.	Thomas Ranch Pump Sta.	150 gpm Duty + 150 gpm Standby	2 x 150 gpm				266,081	266,081	345,905	50,000	514,677			514,677			100%		514,677
P4E-2	Zone 4E	Pipe	Suzanne Dr. extension	Buchanan Rd. to Thomas Ranch Tank	12	6,000	150	900,000		900,000	1,170,000		1,521,000			1,521,000			100%		1,521,000

Table ES.4 Capital Improvement Program

Water System Master Plan

City of Pittsburg

Improvement Number	Pressure Zone	Type of Improv.	Street	Limits	Pipeline and Appurtenances Costs: Diam. (in)	Length (ft)	Unit Cost[5] ($)	Pipe Cost ($)	Other Infrastr. Costs[2] ($)	Baseline Constr. Cost ($)	Estimated Constr. Cost[3, 6] ($)	Land Acquisition Cost[6] ($)	Capital Improv. Cost[4, 6] ($)	Phasing: Imminent 2014-2015 ($)	Phase 1 2016-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-Buildout ($)	% Benefit: Existing Users	% Benefit: Future Users	Cost Sharing: Existing Users ($)	Cost Sharing: Future Users ($)
T-15	Zone 4E	Tank	Thomas Ranch	Servicing Zone 4 (Thomas Ranch)	0.30 MG				600,000	600,000	780,000	784,080	2,033,304				2,033,304		100%		2,033,304
Montreux Subdivision																					
PS-13	Zone 4E	Pump Sta.	Montreux Pump Sta.	140 gpm Duty + 140 gpm Standby	2 x 140 gpm				252,518	252,518	328,274	50,000	491,756				491,756		100%		491,756
P3E-3	Zone 3E	Pipe	Kirker Pass Road	Castlewood Dr. to Pheasant Dr.	10	875	136	119,000		119,000	154,700		201,110				201,110		100%		201,110
P3E-4	Zone 3E	Pipe	Kirker Pass Road	Pheasant Dr. to PS-13	12	2,275	150	341,250		341,250	443,625		576,713				576,713		100%		576,713
P4E-3	Zone 4E	Pipe	Kirker Pass Road	PS-13 to T-14	12	2,025	150	303,750		303,750	394,875		513,338				513,338		100%		513,338
T-14	Zone 4E	Tank	Montreux	Servicing Zone 4 (Montreux)	0.30 MG				600,000	600,000	780,000	784,080	2,033,304				2,033,304		100%		2,033,304
										Subtotal Expansions Improvements (Excluding Southwest Hills)			**32,892,107**	**3,685,552**	**9,249,587**	**5,288,829**	**14,668,139**			**5,034,322**	**27,857,785**
Expansion Improvements - Southwest Hills																					
Transmission Main from WTP Southwest Hills Pump Station PS-2																					
P2-18	Zone 2	Pipe	W. Leland Road (Seg. 1W)	WTP to John Henry Johnson Pkwy	20	5,850	223	1,304,550		1,304,550	1,695,915		2,204,690		2,204,690				100%		2,204,690
P2-19	Zone 2	Pipe	W. Leland Road (Seg. 2W)	John Henry Johnson Pkwy to West Leland Tank 20"	20	1,250	223	278,750		278,750	362,375		471,088		471,088				100%		471,088
P2-20	Zone 2	Pipe	W. Leland Road (Seg. 3W)	W. Leland Tank 20" to Bailey Rd.	20	5,000	223	1,115,000		1,115,000	1,449,500		1,884,350		1,884,350				100%		1,884,350
P2-21	Zone 2	Casing[1]	W. Leland Road (Seg. 3W)	Cross under Bailey Rd.	20/40	200	520	104,000		104,000	135,200		175,760		175,760				100%		175,760
P2-22	Zone 2	Pipe	W. Leland Road (Seg. 6W)	Woodhill Dr. to Tomales Bay Dr.	20	2,450	223	546,350		546,350	710,255		923,332		923,332				100%		923,332
Transmission Mains - Future Southwest Hills Subdivisions																					
P3W-1	Zone 3W	Pipe	Future Road	New Zone 3 Developments	12	2,100	150	315,000		315,000	409,500		532,350			532,350			100%		532,350
P4W-1	Zone 4W	Pipe	W. Leland Road	1,925 feet west of flow split to flow split	12	1,925	150	288,750		288,750	375,375		487,988			487,988			100%		487,988
P4W-2	Zone 4W	Pipe	San Marco Boulevard	Extension to PS-9	16	500	181	90,500		90,500	117,650		152,945			152,945			100%		152,945
P4W-3	Zone 4W	Pipe	Future Road	PS-8 to Aragon Dr. and Santa Teresa Dr. to PS-10	16	3,150	181	570,150		570,150	741,195		963,554			963,554			100%		963,554
P4W-4	Zone 4W	Pipe	Future Road	Zone 4 Smith Pipe	12	150	150	22,500		22,500	29,250		38,025			38,025			100%		38,025
P5-1	Zone 5	Pipe	Future Road	Zone 5 Smith Pipe	12	900	150	135,000		135,000	175,500		228,150			228,150			100%		228,150
P5-2	Zone 5	Pipe	Future Road	From Zone 4 Boundary to future road west	12	1,350	150	202,500		202,500	263,250		342,225			342,225			100%		342,225
P5-3	Zone 5	Pipe	Future Road	Future road to the west from San Marco Blvd to end of pipe	12	8,100	150	1,215,000		1,215,000	1,579,500		2,053,350			2,053,350			100%		2,053,350
P5-4	Zone 5	Pipe	Future Road	PRV6-5a to future road to the west from San Marco Blvd	12	275	150	41,250		41,250	53,625		69,713			69,713			100%		69,713
P5-5	Zone 5	Pipe	Future Road	Bailey Estate Zone 5 Pipe	12	700	150	105,000		105,000	136,500		177,450				177,450		100%		177,450
P6-1	Zone 6	Pipe	Future Road	T-11 connection to end of Zone 6 pipe	12	5,200	150	780,000		780,000	1,014,000		1,318,200				1,318,200		100%		1,318,200
P6-2	Zone 6	Pipe	Future Road	Zone 7 boundary to PRV 6-5a	12	570	150	85,500		85,500	111,150		144,495				144,495		100%		144,495
P6-3	Zone 6	Pipe	Future Road	PS-10 to PRV 6-5A	16	200	181	36,200		36,200	47,060		61,178				61,178		100%		61,178
P6-3	Zone 6	Pipe	Future Road	PRV 6-5A to T-11	16	1,950	181	352,950		352,950	458,835		596,486				596,486		100%		596,486
P6-4	Zone 6	Pipe	Future Road	Bailey Estates Zone 6 Pipe	12	1,650	150	247,500		247,500	321,750		418,275				418,275		100%		418,275
P7-1	Zone 7	Pipe	Future Road	PS-11 to T-12 and to PS-12	16	3,850	181	696,850		696,850	905,905		1,177,677			1,177,677			100%		1,177,677
P7-2	Zone 7	Pipe	Future Road	From 16" to flow split and to Zone 5 and Zone 6	12	3,750	150	562,500		562,500	731,250		950,625				950,625		100%		950,625
P7-3	Zone 7	Pipe	Future Road	PRV 7-6 to Zone 8-7 emergency connection	12	1,775	150	266,250		266,250	346,125		449,963				449,963		100%		449,963
P7-4	Zone 7	Pipe	Future Road	PRV 8-7 to end of Zone 7 pipe	12	925	150	138,750		138,750	180,375		234,488				234,488		100%		234,488
P7-5	Zone 7	Pipe	Future Road	Connection to Smith development	12	120	150	18,000		18,000	23,400		30,420				30,420		100%		30,420
P8-1	Zone 8	Pipe	Future Road	T-13 to flow split and PRV 8-7 to Zone 7 Bailey boundary	12	5,125	150	768,750		768,750	999,375		1,299,188				1,299,188		100%		1,299,188
P8-2	Zone 8	Pipe	Future Road	PS-12 to T-13	16	700	181	126,700		126,700	164,710		214,123				214,123		100%		214,123
Pressure Reducing Valves - Future Southwest Hills[7]																					
PRV 5-4	Zone 4W	PRV	Smith Development	Zone 5 to Zone 4W	3 / 6				94,000	94,000	122,200		158,860			158,860			100%		158,860
PRV 7-5A	Zone 5	PRV	Smith Development	Zone 7 to Zone 5	4 / 6				101,000	101,000	131,300		170,690			170,690			100%		170,690
PRV 6-5A	Zone 5	PRV	Faria	Zone 6 to Zone 5	8				86,000	86,000	111,800		145,340				145,340		100%		145,340
PRV 6-5B	Zone 5	PRV	Faria	Zone 6 to Zone 5	8				86,000	86,000	111,800		145,340				145,340		100%		145,340
PRV 6-5C	Zone 5	PRV	Bailey	Zone 6 to Zone 5	3 / 6				94,000	94,000	122,200		158,860				158,860		100%		158,860
PRV 7-5B	Zone 5	PRV	Bailey	Zone 7 to Zone 5	3 / 6				94,000	94,000	122,200		158,860				158,860		100%		158,860
PRV 7-6A	Zone 6	PRV	Bailey	Zone 7 to Zone 6	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
PRV 7-6B	Zone 6	PRV	Faria	Zone 7 to Zone 6	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
PRV 8-7	Zone 7	PRV	Faria	Zone 8 to Zone 7	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
Storage Reservoirs - Southwest Hills																					
T-11	Zone 6	Tank	Faria	Servicing Zone 5 and 6 West	0.75 MG				1,500,000	1,500,000	1,950,000	784,080	3,554,304				3,554,304		100%		3,554,304
T-12	Zone 7	Tank	Bailey	Servicing Zone 7 West and subsequent lower zones	0.50 MG				1,000,000	1,000,000	1,300,000	784,080	2,709,304			2,709,304			100%		2,709,304
T-13	Zone 8	Tank	Faria	Servicing Zone 8 West	0.60 MG				1,200,000	1,200,000	1,560,000	784,080	3,047,304				3,047,304		100%		3,047,304
Pump Stations - Southwest Hills																					
PS-8	Zone 4W	Pump Sta.	San Marco Villas Pump Sta.	1,000 gpm Duty + 1,000 gpm Standby	2 x 1,000 gpm				1,121,460	1,121,460	1,457,897	50,000	1,960,267		1,960,267				100%		1,960,267
PS-10	Zone 6	Pump Sta.	Faria Pump Sta.	560 gpm Duty + 560 gpm Standby	2 x 560 gpm				722,495	722,495	939,243	50,000	1,286,016				1,286,016		100%		1,286,016
PS-11	Zone 7	Pump Sta.	Bailey Pump Sta.	680 gpm Duty + 680 gpm Standby	2 x 680 gpm				837,096	837,096	1,088,224	50,000	1,479,692			1,479,692			100%		1,479,692
PS-12	Zone 8	Pump Sta.	Faria Pump Sta.	380 gpm Duty + 380 gpm Standby	2 x 380 gpm				538,435	538,435	699,966	50,000	974,956				974,956		100%		974,956
										Subtotal - Expansion Improvements-Southwest Hills			**33,914,914**		**7,619,485**	**10,564,521**	**15,730,908**			**0**	**33,914,914**
Capital Improvement Summary																					
										City-Wide Total			**75,652,997**	**4,718,480**	**24,682,120**	**15,853,350**	**30,399,048**			**8,329,839**	**67,323,158**

Note:
1. Proposed casings size and carrier pipe size.
2. Tank and pump station pricing can vary widely with site conditions.
3. Baseline construction costs plus 30% to account for unforeseen events and unknown conditions.
4. Estimated construction cost plus 30% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.
5. Cost estimates are based on the Engineering News Record (ENR) construction cost index (CCI) of 9800 for the 20 cities for June 2014.
6. A land acquisition fee for the construction of storage reservoirs and pump station was assumed based on City provided data for tanks, and the previous master plan for pump stations.
7. Costs for PRVs with bypass assume full unit cost of larger PRV and half unit cost of smaller PRV.

ES.12 CAPACITY ALLOCATION ANALYSIS

This master plan includes a capacity allocation analysis that was based on the domestic water requirements for the proposed developments. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments.

The Capital Improvement Program chapter includes cost allocation tables for the transmission mains, booster stations, and storage reservoirs.

ES.13 SITE PLACEMENT CRITERIA

This master plan also includes a chapter that summarizes the City's criteria for the siting of storage reservoirs and booster stations. The criteria include the visual aspect and biological resource for reservoirs and booster pump stations. A noise element is also included for booster pump stations.

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the City's domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.0 BACKGROUND

The City of Pittsburg (City) provides potable water service to approximately 18,500 residential, commercial, industrial, and institutional accounts. The City operates a domestic water distribution system that consists of a water treatment plant, two groundwater wells, storage reservoirs, booster stations, pressure reducing valves, and over 215 miles of transmission and distribution pipelines.

Domestic water obtained from the Contra Costa Canal and the groundwater wells is conveyed to the treatment plant where it is treated, then pumped to the different pressure zones within the City to service each customer account.

Recognizing the importance of planning, developing, and financing water system facilities to provide enhanced service and reliability for existing customers and to serve anticipated growth, the City initiated updating the 2010 Water System Master Plan. On June 25th 2013, the City of Pittsburg authorized Akel Engineering Group Inc. to prepare this 2015 Water System Master Plan.

1.1 OBJECTIVE

This master plan provides the City with a tool for planning the domestic water infrastructure facilities through the project buildout. The objective of this master plan is to evaluate the City's domestic water distribution system and recommend capacity improvements necessary to service the needs of existing users and future developments. Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following elements:

- Summarize the City's existing domestic water system facilities.
- Document growth planning assumptions and known future developments.
- Update the domestic water system performance criteria.
- Project future domestic water demands.
- Update the water hydraulic model.

- Evaluate the capacity adequacy of the transmission mains and booster stations to meet existing and projected demand requirements and fire flows.
- Document the capacity analysis of major transmission mains, by segments, in tables.
- Perform a storage capacity analysis, by pressure zone.
- Complete a City-wide fire flow analysis.
- Recommend a capital improvement program (CIP) with an opinion of probable costs
- Perform a capacity allocation between existing and future developments. Capacity allocation was identified for each known development, and may be used for cost sharing.
- Develop a Domestic Water System Master Plan.

1.2 STUDY AREA DESCRIPTION

The City of Pittsburg is located on the eastern side of California's San Francisco Bay in Contra Costa County, as shown in **Figure 1.1**. It is bound on the north by the Suisun Bay, the City of Antioch on the east, and is surrounded by undeveloped hills to the south and the Concord Naval Weapons Station on the west.

The area included in this study is outlined by the City of Pittsburg urban limit line (ULL), as depicted in **Figure 1.2**. The City currently provides domestic water service to the currently developed areas within the ULL and plans to provide service to the anticipated growth areas when they become developed.

1.3 PREVIOUS MASTER PLANS

City staff have historically maintained updated master plans in order to address the existing water system's requirements and identify improvements needed to service proposed developments. The major master plan update milestones include:

- 1987 and 1993 Water System Master Plans. These plans identified existing deficiencies and recommended improvements to service growth.
- 2000 Water System Master Plan (2000 WSMP). This master plan included the development and calibration of a new hydraulic model used for evaluating the existing system. The City issued Amendment No. 1 in December 2001, Amendment No. 2 in August 2004, and Amendment No. 3 in October 2006. Each of the amendments was intended to provide updated planning assumptions, and corresponding recommendations. Amendment No. 3 updated and consolidated the City-wide planning assumptions for the Southwest and Southeast growth areas.
- 2010 Water System Master Plan (2010 WSMP). This master plan updated the detailed analysis from the 2000 WSMP Amendment No. 3, and which included the capacity

Legend

- Cities
- Highways
- Voter Approved Urban Limit Line
- City Limits
- General Plan Area

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Updated: December 31, 2015

0 0.5 1 2 Miles

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Figure 1.1
Regional Location Map
Water System Master Plan
City of Pittsburg

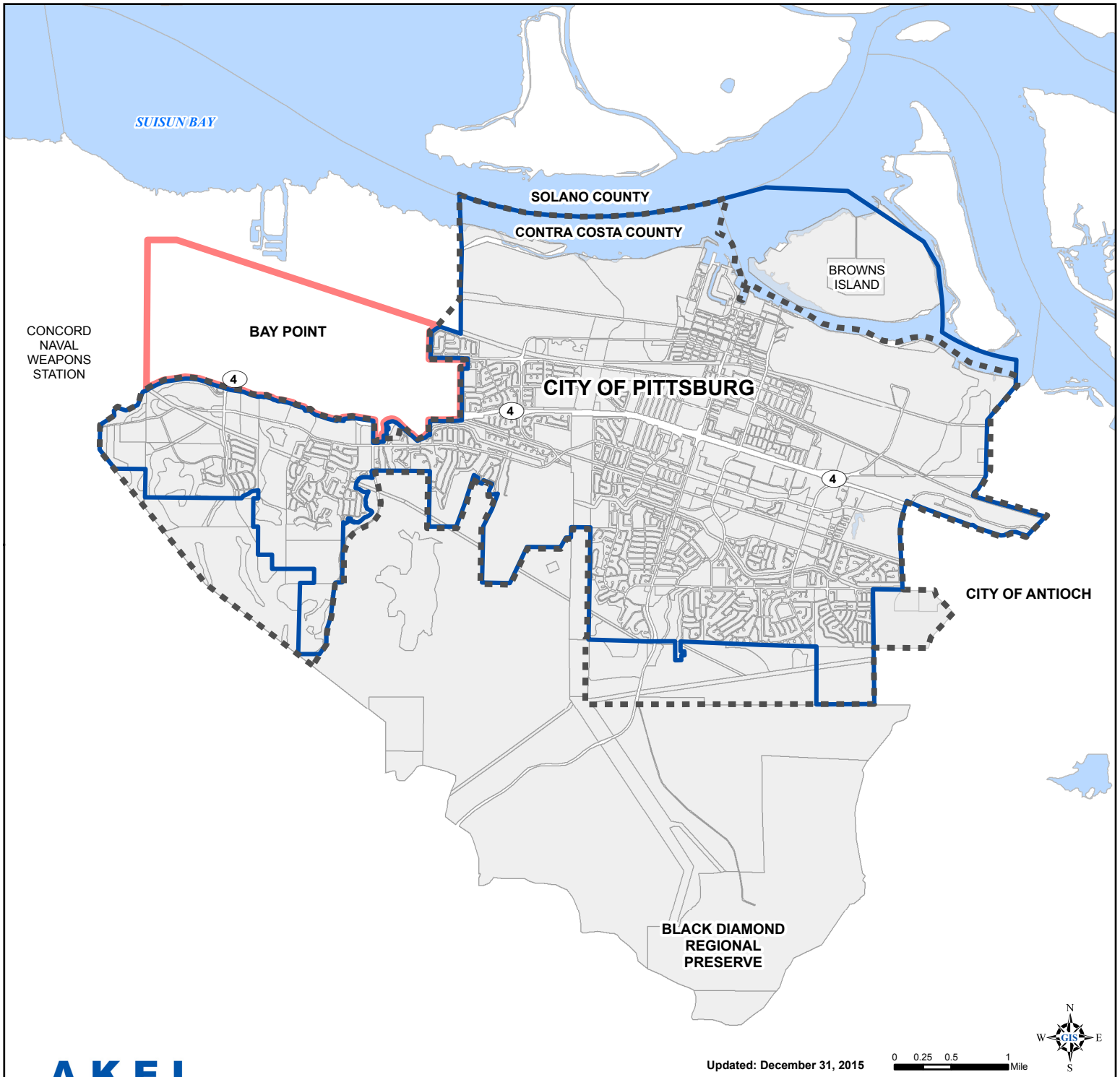

Figure 1.2
Planning Area
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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allocation analysis for each proposed development in the southeast and southwest hills. This master plan included developing a new hydraulic model in Innovyze software's H2OMap Water, updating the City's planning and design criteria, and documenting major changes in the proposed developments throughout the City. This master plan was published and adopted in October 2010.

1.4 REPORT ORGANIZATION

The water system master plan report contains the following chapters:

Chapter 1 - Introduction. This chapter provides a brief background of the City's domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

Chapter 2 - Existing Domestic Water Facilities. This chapter provides a description of the City's existing domestic water system facilities including the transmission and distribution mains, storage facilities, booster stations, and the existing pressure zones.

Chapter 3 - Planning Areas Characteristics. This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. The planning area is divided into several planning sub-areas, as established by the City's planning division.

Chapter 4 - System Performance and Design Criteria. This chapter presents the City's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed transmission mains, storage reservoirs, and booster stations.

Chapter 5 - Domestic Water Demands. This chapter summarizes existing domestic water demands, identifies the recycled water demands, and projects the future domestic water demands.

Chapter 6 - Hydraulic Model Development. This chapter describes the development and calibration of the City's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

Chapter 7 - Evaluation and Proposed Improvements. This chapter presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies as well as improvements needed to expand the system and service growth.

Chapter 8 - Capital Improvement Program. This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and for accommodating anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the capital improvement program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

Chapter 9 - Site Placement Criteria. This chapter presents City criteria for the siting of storage reservoirs and booster stations. The criteria includes the visual aspect and biological resource for reservoirs and booster pump stations. A noise element is also included for booster pump stations.

1.5 ACKNOWLEDGEMENTS

Obtaining the necessary information to successfully complete the analysis presented in this report, and developing the long term strategy for mitigating the existing system deficiencies and for accommodating future growth was accomplished with the strong commitment and very active input from dedicated team members including:

- Joe Sbranti, City Manager
- Walter Pease, Director of Water Utilities
- Fritz McKinley, City Engineer
- Keith Halvorson, Former City Engineer
- Dana Hoggatt, Former Planning Manager
- Richard Abono, Senior Civil Engineer
- Ron Nevels, Senior Civil Engineer
- Sean Williams, Civil Engineer II
- John Roe, Water Utilities

1.6 UNIT CONVERSIONS AND ABBREVIATIONS

Engineering units were used in reporting flow rates and volumes pertaining to the design and operation of various components of the domestic water distribution system. Where it was necessary to report values in smaller or larger quantities, different sets of units were used to describe the same parameter. Values reported in one set of units can be converted to another set of units by applying a multiplication factor. A list of multiplication factors for units used in this report is shown on **Table 1.1**.

Various abbreviations and acronyms were also used in this report to represent relevant water system terminologies and engineering units. A list of abbreviations and acronyms is included in **Table 1.2**.

1.7 GEOGRAPHIC INFORMATION SYSTEMS

This master planning effort made extensive use of Geographic Information Systems (GIS) technology, for completing the following tasks:

- Developing the physical characteristics of the hydraulic model (pipes and junctions, reservoirs, pump stations, PRVs)

Table 1.1 Unit Conversions

Water System Master Plan

City of Pittsburg

Volume Unit Calculations		
To Convert From:	**To:**	**Multiply by:**
acre feet	gallons	325,851
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259
cubic feet	gallons	7.481
cubic feet	acre feet	2.296×10^{-5}
cubic feet	million gallons	7.481×10^{-6}
gallons	cubic feet	0.1337
gallons	acre feet	3.069×10^{-6}
gallons	million gallons	1×10^{-6}
million gallons	gallons	1,000,000
million gallons	cubic feet	133,672
million gallons	acre feet	3.069
Flow Rate Calculations		
To Convert From:	**To:**	**Multiply By:**
ac-ft/yr	mgd	8.93×10^{-4}
ac-ft/yr	cfs	1.381×10^{-3}
ac-ft/yr	gpm	0.621
ac-ft/yr	gpd	892.7
cfs	mgd	0.646
cfs	gpm	448.8
cfs	ac-ft/yr	724
cfs	gpd	646300
gpd	mgd	1×10^{-6}
gpd	cfs	1.547×10^{-6}
gpd	gpm	6.944×10^{-4}
gpd	ac-ft/yr	1.12×10^{-3}
gpm	mgd	1.44×10^{-3}
gpm	cfs	2.228×10^{-3}
gpm	ac-ft/yr	1.61
gpm	gpd	1,440
mgd	cfs	1.547
mgd	gpm	694.4
mgd	ac-ft/yr	1,120
mgd	gpd	1,000,000

4/9/2014

Table 1.2 Abbreviations and Acronyms

Water System Master Plan
City of Pittsburg

Abbreviation	Expansion	Abbreviation	Expansion
2000 WSMP	2000 Water System Master Plan	FY	Fiscal Year
2010 WSMP	2010 Water System Master Plan	GIS	Geographic Information Systems
AACE International	Association for the Advancement of Cost Engineering	gpd	gallons per day
AC	acre	gpdc	gallons per day per capita
ACP	Asbestos Cement Pipe	gpm	gallons per minute
ADD	average day demand	hp	horsepower
Akel	Akel Engineering Group, Inc.	HGL	hydraulic grade line
CCI	Construction Cost Index	HWL	high water level
CCWC	California Cities Water Company	in	inch
CCWD	Contra Costa Water District	LAFCO	Local Agency Formation Commission
CDPH	California Department of Public Health	LF	linear feet
cfs	cubic feet per second	MDD	maximum day demand
CI	cast iron pipe	MG	million gallons
CIB	Capital Improvement Budget	MGD	million gallons per day
CIP	Capital Improvement Program	MMD	maximum month demand
City	City of Pittsburg	NFPA	National Fire Protection Association
DIP	Ductile Iron Pipe	PHD	peak hour demand
DU	dwelling unit	PRV	pressure reducing valve
EBMUD	East Bay Municipal Utilities District	psi	pounds per square inch
EDU	equivalent dwelling unit	ROW	Right of Way
ENR	Engineering News Record	SCADA	Supervisory Control and Data Acquisition
EPA	Environmental Protection Agency	SOI	Sphere of Influence
EPS	Extended Period Simulation	TBD	to be determined
FRC	Facility Reserve Charge	ULL	Urban Limit Line
ft	feet	WSMP	Water System Master Plan
fps	feet per second	WTP	Water Treatment Plant

- Allocating existing water demands, as extracted from the water billing records, and based on each user's physical address
- Calculating and allocating future water demands, based on projected future developments water use
- Extracting ground elevations along the distribution mains from available contour maps
- Generating maps and exhibits used in this master plan

CHAPTER 2 - EXISTING DOMESTIC WATER FACILITIES

This chapter provides a description of the City's existing domestic water system facilities including the transmission and distribution mains, storage facilities, booster stations, and the existing pressure zones.

2.1 EXISTING WATER SYSTEM OVERVIEW

The City's municipal water system consists of a water treatment facility, groundwater wells, storage reservoirs, pump stations, transmission and distribution mains, fire hydrants, and pressure reducing valves. A simple schematic of the water distribution infrastructure facilities is shown in **Figure 2.1**.

The City's service area is currently divided into five existing pressure zones and will eventually be expanded to twelve total pressure zones to service anticipated future developments in the southeast and southwest hills. The pressure zones are interconnected through booster stations and pressure reducing valves to allow the distribution of water throughout the City.

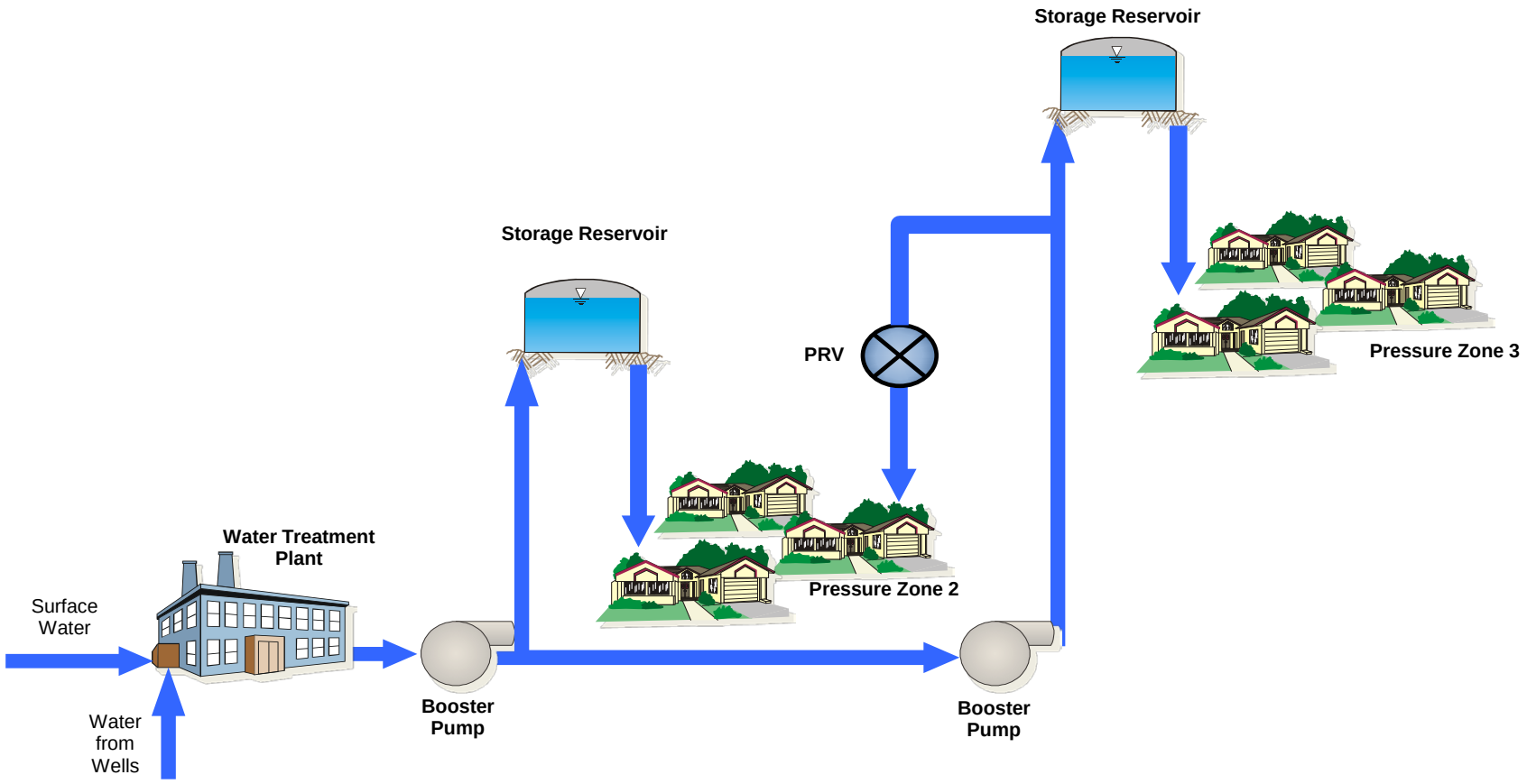
The City's existing domestic water distribution system is shown in **Figure 2.2**, which displays the existing system by pipe size. **Figure 2.3** displays the existing system by pressure zone. This figure provides a general color coding for the transmission mains, and identifies existing storage facilities and their sizes, as well as existing booster stations.

2.2 SOURCE OF SUPPLY

The City has two sources of supply: surface water from the Contra Costa Canal, and groundwater extracted from two active wells in the central part of the City. Water from both sources is conveyed to the City's water treatment plant where it is first treated, and then conveyed to the distribution system. The City receives water from the Contra Costa Canal in accordance with an agreement with the Contra Costa Water District (CCWD).

The City operates its own surface water treatment plant, groundwater wells, and associated infrastructural facilities to service customers within the City service area. Water service to Bay Point, in the northwest, and other unincorporated areas is provided by California Cities Water Company (CCWC), who also receive their water from the CCWD.

The City's water treatment plant has a hydraulic design capacity of 32 million gallons per day (MGD), and is currently limited by the California Department of Public Health (CDPH) to 12 MGD when the water temperature is less than 10 degrees Celsius (50 degrees Fahrenheit), which has not occurred; and 28 MGD when the water temperature is less than 20 degrees Celsius (68 degrees Fahrenheit), which usually occurs between the months of November and April. The City's water treatment plant currently operates at 6 to 18 MGD.



LEGEND

Storage Reservoir

PRV

Booster Pump

Transmission Main

AKEL ENGINEERING GROUP, INC

April 9, 2014

Figure 2.1
Water System Schematic

Water System Master Plan
City of Pittsburg

SUISUN BAY

PS-1
Vista del Mar

PS-5
Oak Hills

PRV-8
San Marco at
West Leland

PRV-1
Birchwood

PRV-7
Leland and Railroad

PRV-2
Stoneman Park

PRV-5
Delta Hawaii
Mobile Home Park

PRV-3
Loveridge

PRV-4
College

PRV-10
Santa Lucia

PS-6
Shady Brook

T-8
Oak Hills
2.0 MG [491']

T-9
Shady Brook
1.75 MG [628']

T-5
New West Leland
3.0 MG [385']

PS-2
WTP

PS-3
WTP

WTP

T-3
Stoneman
2.5 MG [385']

T-1
WTP
5.0 MG [195']

T-2
WTP
1.0 MG [195']

PS-4
Buchanan

T-7
Hillview
3.0 MG [490']

PRV-6
Buchanan

PRV-9
Oakdale Pl

Updated: December 31, 2015

0 0.25 0.5 1 Mile

N
W GIS E
S

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Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs

Pipes

- 4" and Smaller
- 6"
- 8"
- 10" and Larger
- Street Centerlines
- Water Bodies

Figure 2.2
Existing System by Pipe Sizes
Water System Master Plan
City of Pittsburg

AKEL
ENGINEERING GROUP, INC.

SUISUN BAY

PS-1
Vista del Mar

PS-5
Oak Hills

PRV-8
San Marco at
West Leland

PRV-1
Birchwood

PRV-10
Santa Lucia

PS-6
Shady Brook

T-5
New West Leland
3.0 MG [385']

T-8
Oak Hills
2.0 MG [491']

T-9
Shady Brook
1.75 MG [628']

PS-2
WTP

PS-3
WTP

WTP

T-3
Stoneman
2.5 MG [385']

T-1
WTP
5.0 MG [195']

T-2
WTP
1.0 MG [195']

PS-4
Buchanan

T-7
Hillview
3.0 MG [490']

PRV-7
Leland and Railroad

PRV-2
Stoneman Park

PRV-5
Delta Hawaii
Mobile Home Park

PRV-3
Loveridge

PRV-4
College

PRV-6
Buchanan

PRV-9
Oakdale Pl

Updated: December 31, 2015

0 0.25 0.5 1 Mile

N W GIS E S

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Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs

Pipes

- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 4 West
- Street Centerlines
- Water Bodies

Figure 2.3
Existing System
by Pressure Zone
Water System Master Plan
City of Pittsburg

AKEL
ENGINEERING GROUP, INC.

2.3 TRANSMISSION AND DISTRIBUTION PIPELINES

Treated water is conveyed from the City's water treatment plant via 214 miles of transmission and distribution pipelines. For the purpose of this analysis, transmission mains are defined as pipes 16-inch in diameter and larger that convey water from the treatment plant to ground storage and pump stations, or from pump stations to the higher pressure zones. The distribution mains are generally smaller than 16 inches in diameter and convey water to the consumers' service connections.

An inventory of existing pipes, extracted from the GIS-based hydraulic model and used in this analysis, is included in **Table 2.1**. For each pipe diameter, the inventory lists the length in feet for each pipe material, as well as the total length in units of feet and miles.

2.4 PRESSURE ZONES

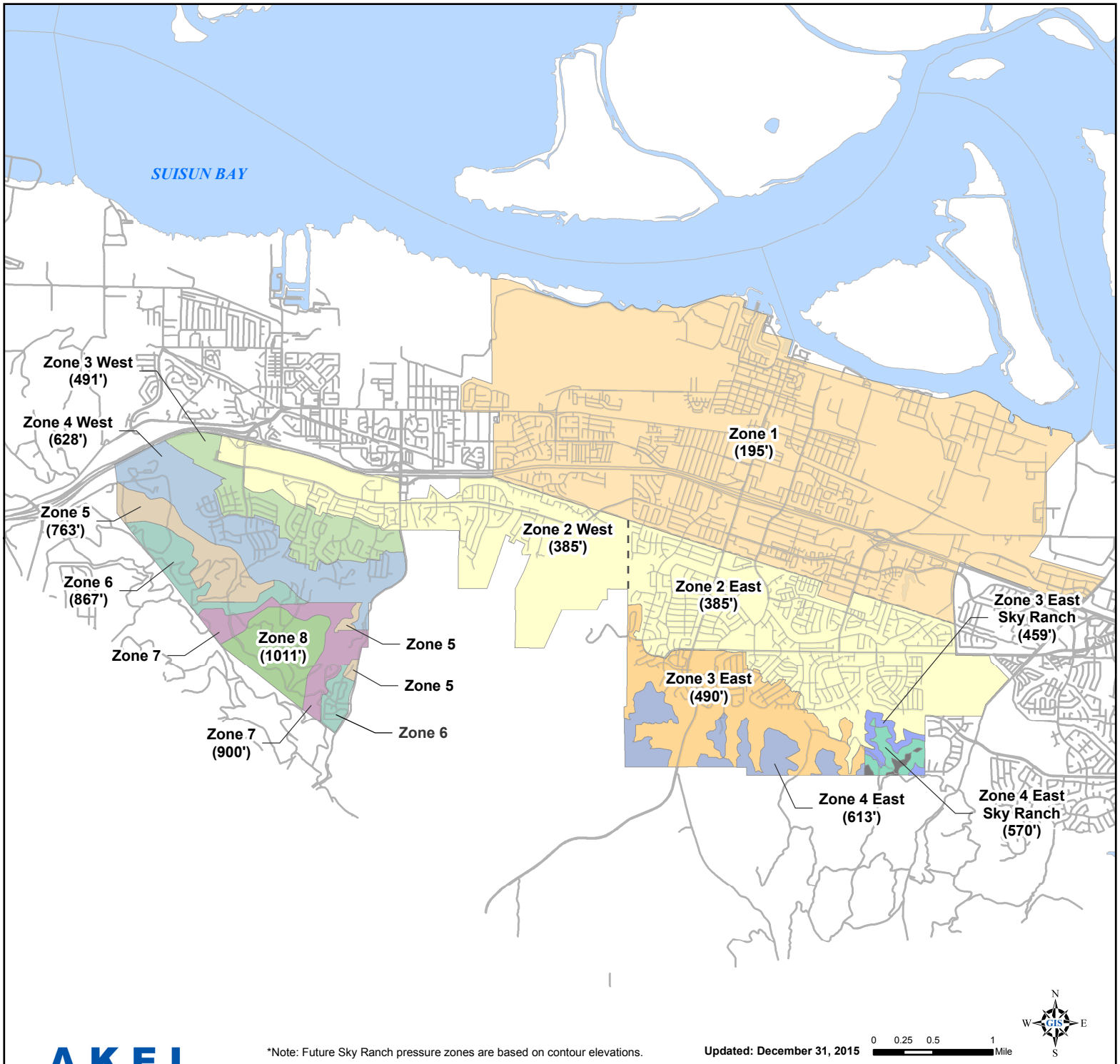
The City's existing water system serves lands ranging in elevation from less than 5 feet (above sea level) in the Marina area to over 500 feet in the southwest portion of the City. The City is divided into several pressure zones, each of which services a range of elevations.

The creation of multiple pressure zones allows operating pressures to be maintained within a reasonable range of 40 to 100 pounds per square inch (psi) for each zone. **Figure 2.4** shows, in addition to the existing pressure zones, planned future pressure zones needed to service the higher elevations in the southeast and southwest hills. The numbers displayed in parentheses delineate each pressure zone's high water level (HWL). As an example, Pressure Zone 1 has a high water level of 195 feet and is displayed as "(195')".

Pressure Reducing Valves (PRVs), constructed at pressure zone interconnections, allow the conveyance of water from higher pressure zones to the lower zones in the City. There are five major PRVs which provide interconnections between Pressure Zone 2 (385') to Pressure Zone 1 (195') as listed in **Table 2.2**. These PRVs may provide supplementary supply to Zone 1 (195') to meet the higher than expected peak hour demands or to respond to fire flow requirements.

Other PRVs, like the one located at Buchanan Road Booster Station, were designed for emergency purposes and will activate when the lower zone experience a planned operational scenario or an emergency outage.

The City's domestic water system hydraulic profile schematic was developed and shown on **Figure 2.5**. The hydraulic profile schematic delineates, for each existing pressure zone, the existing storage reservoir names and capacities, booster stations and capacities, service elevations, and inter-zone connectivity. The schematic also includes a useful inventory of existing storage reservoirs, booster stations, and PRVs.



Legend

Pressure Zones

- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'

(195') HWL

Street Centerlines

Water Bodies

*Note: Future Sky Ranch pressure zones are based on contour elevations.

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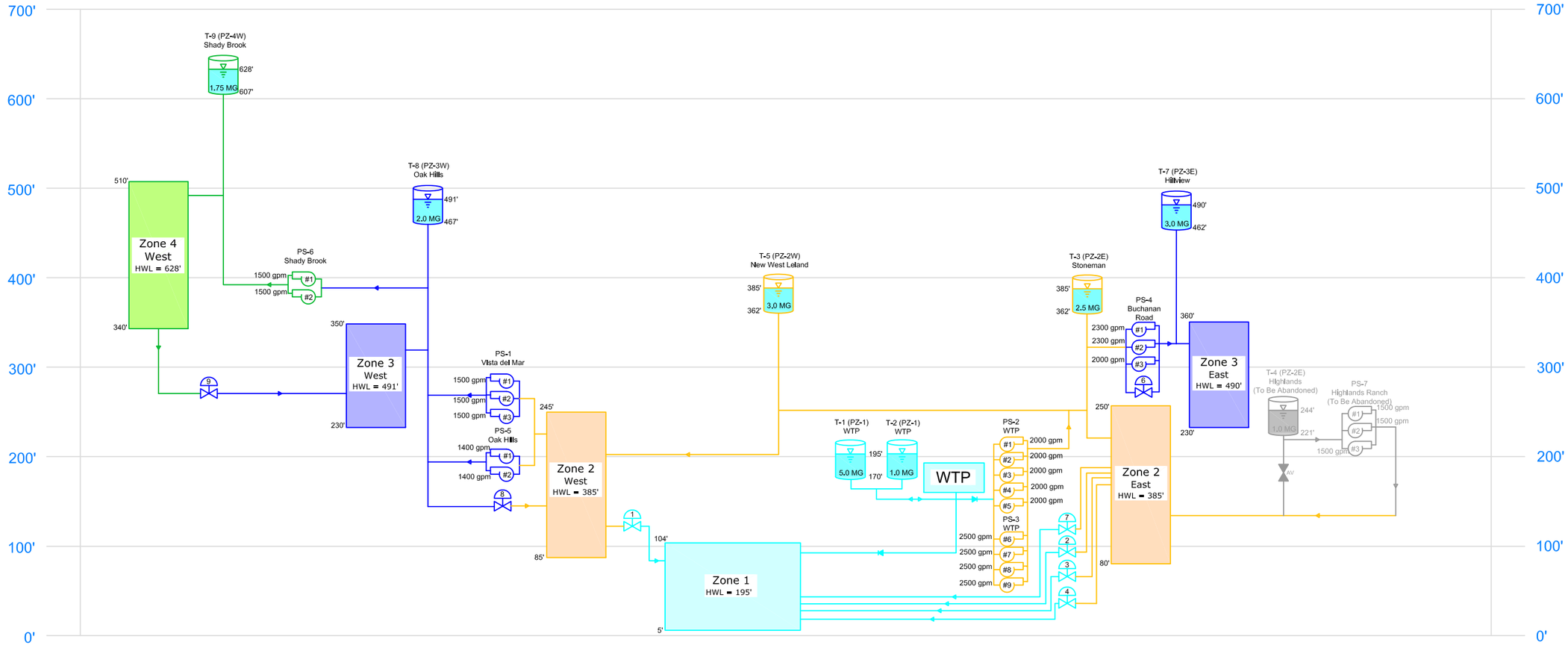
Figure 2.4
Existing and Future Pressure Zones
Water System Master Plan
City of Pittsburg



Existing Pressure Reducing Valves

No.	Description	Status	Size (in)	PRV Elevation (ft)	Pressure Zone		Downstream Setpoint (psi)
					Upstream	Downstream	
PRV-1	Birchwood	Operational	6	118	2W	1	35
PRV-2	Stoneman Park	Operational	8	105	2E	1	40
PRV-3	Loveridge	Operational	8	78	2E	1	40
PRV-4	College	Operational	12	93	2E	1	42
PRV-5	Delta Hawaii	Operational	12		2E	Mobile Home Park	
PRV-6	Buchanan	Operational	8		3E	2E	
PRV-7	Leland & Railroad	Operational	6		2E	1	
PRV-8	San Marco 1	Operational	20" & 8"		3W	2W	
PRV-9	San Marco 2	Operational	8		4W	3W	

Existing Booster Pumping Stations

No.	Name	Pump Elevation (ft)	Pumped From Column	Pumped to Pressure Zone No.	Total Pump Capacity (gpm)	Total Pump Capacity (mgd)	Pump Station Horsepower (hp)	Number of Pumps	Pump Number	Pump Status	Individual Horsepower (hp)	Design Capacity-Head (gpm @ ft)
PS-2	Water Treatment Plant Boosters	158	1 (195')	2 (385')	10,000	14.4	1000	5	1	Duty	200	2000 @ 300
									2	Duty	200	2000 @ 300
									3	Duty	200	2000 @ 300
									4	Duty	200	2000 @ 300
									5	Standby	200	2000 @ 300
PS-3	Water Treatment Plant Boosters	158	1 (195')	2 (385')	10,000	14.4	800	4	1	Duty	200	2500
									2	Duty	200	2500
									3	Duty	200	2500
									4	Standby	200	2500
PS-4	Buchanan Road	175	2E (385')	3E (490')	6,600	9.5	600	3	1	Duty	200	2300
									2	Standby	200	2300
									3	Duty	200	2000
PS-5	Oak Hills	205	2W (385')	3W (491')	2,800	4.0	200	2	1	Duty	100	1400 @ 175
									2	Standby	100	1400 @ 175
PS-6	Shady Brook	421	3W (491')	4W (628')	3,000	4.3	200	2	1	Duty	100	1500 @ 164
									2	Standby	100	1500 @ 164
PS-7	Highlands Ranch (To Be Abandoned)	221	2E (385')	2E (385')	4,500	6.5	300	3	1	Duty	100	1500 @ 182
									2	Duty	100	1500 @ 182
									3	Standby	100	1500 @ 182
PS-1	Vista Del Mar	252	2W (385')	3W (491')	4,500	6.5	450	3	1	Duty	150	1500 @ 255
									2	Duty	150	1500 @ 255
									3	Standby	150	1500 @ 255

Existing Storage Reservoirs

Pressure Zone	HWL Zone	Reservoir	Volume Existing (MG)	Construction Type	Height (ft)	Diameter (ft)	Bottom Elevation (ft)
Zone 1	195	WTP	5.0	Concrete (DYK)	26	181	170.25
	195	WTP	1.0	Concrete (DYK)	26	81	170.5
Zone 2	385	Stoneman	2.5	Concrete (DYK)	24	133	362
	385	Highlands (To Be Abandoned)	1.0	Steel	24	84	221
	385	New West Leland	3.0	Concrete (DYK)	24	146	362
Zone 3 East	490	Hillview	3.0	Steel	29	133	462
Zone 3 West	491	Oak Hills	2.0	Concrete (DYK)	25	117	467
Zone 4 West	628	Shady Brook	1.75	Concrete (DYK)	22	116	607

Legend

- Reservoir — HWL: HIGH WATER LEVEL (ft); # MG: RESERVOIR CAPACITY (MG); LOW: BOTTOM ELEVATION (ft)
- Booster Pumping Station
- Pressure Regulating Valve
- Check Valve
- Altitude Valve
- Transmission Main
- Pressure Zone — HWL: Zone High Water Level; High: Highest Service Elevation, ft.; Low: Lowest Service Elevation, ft.

Figure 2.5
Existing System
Hydraulic Profile Schematic
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

Updated: December 31, 2015

Table 2.1 Existing Model Pipe Inventory

Water System Master Plan

City of Pittsburg

Pipe Diameter	Pipe Length by Material							
	A.C.P. (ft)	C.I. (ft)	D.I.P. (ft)	P.V.C. (ft)	Steel (ft)	unknown (ft)	Total (ft)	(miles)
2"	0	2,489	0	392	0	4,223	7,104	1.3
2.5"	0	0	0	0	0	2,332	2,332	0.4
3"	0	1,502	0	0	0	396	1,898	0.4
4"	27,241	6,132	868	3,125	0	3,271	40,637	7.7
6"	237,787	13,950	972	29,535	0	33,461	315,704	59.8
8"	176,008	3,040	436	202,786	0	31,795	414,066	78.4
10"	47,345	0	0	23,721	0	7,059	78,125	14.8
12"	39,003	603	16,560	12,643	0	3,610	72,418	13.7
14"	35,941	0	2,522	1,924	0	1,519	41,906	7.9
16"	23,779	0	35,287	17,089	0	3,061	79,217	15.0
18"	27,789	0	1,954	0	0	2,687	32,430	6.1
20"	4,041	0	40,920	1,236	0	2,470	48,667	9.2
24"	19	0	101	0	0	2,349	2,469	0.5
30"	0	0	0	0	0	0	0	0.0
36"	0	0	0	0	0	277	277	0.1
42"	0	0	0	0	0	361	361	0.1
48"	0	0	0	0	0	161	161	0.0
Total	618,952	27,716	99,620	292,452	0	99,033	1,137,773	**215**

Note: 3/19/2015

1. The water system pipe inventory was extracted from the City's GIS-based hydraulic model.

Table 2.2 Existing Pressure Reducing Valves

Water System Master Plan
City of Pittsburg

Location	PRV ID	Size (in)	Pressure Zone		Downstream Setpoint (psi)
			Upstream	Downstream	
Birchwood[1]	PRV-1	6" with 2" Bypass	2W	1	35
Stoneman Park[1]	PRV-2	8	2E	1	40
Loveridge[1]	PRV-3	8	2E	1	40
College[1]	PRV-4	12	2E	1	42
Delta Hawaii Mobile Home Park (Private)[2]	PRV-5	8" with 2" Bypass	2E	Mobile Home Park	50 (Main)/ 55 (Bypass)
Buchanan[2]	PRV-6	8	3E	2E	38
Leland[2]	PRV-7	6" with 3" Bypass	2E	1	78[3]
San Marco[2]	PRV-8	20" with 6" Bypass	3W	2W	70[3]
4330 Oakdale Pl[2]	PRV-9	10" with 4" Bypass	3E	2E	47[3]
Santa Lucia[2.]	PRV-10	8	4W	3W	37

6/2/2015

Note:

1. Downstream setpoint per 2000 Water System Master Plan, 2000 WSMP
2. Downstream setpoint per email received from City Staff June 1, 2015.
3. Manual bypass open, per email received from City Staff June 1, 2015.

2.4.1 Pressure Zone 1 (195')

This pressure zone starts in the north part of the City and currently services elevations from sea level to an elevation of approximately 100 feet. The existing storage reservoirs at the water treatment plant establish the high water level in this zone at 195 feet.

The southern boundary of this pressure zone generally follows the East Bay Municipal Utilities District (EBMUD) aqueduct corridor. Water to this zone is conveyed from the water treatment plant via two 20-inch transmission mains.

2.4.2 Pressure Zone 2 (385')

This pressure zone is bound by Pressure Zone 1 on the north, and currently services elevations ranging from approximately 80 feet to 250 feet. The water treatment plant booster station pumps water to the transmission system and storage tanks in this zone. The Stoneman Reservoir and New West Leland Reservoir establish the high water level in both the east and the west sections of this pressure zone.

2.4.3 Pressure Zone 3E (490') and 3W (491')

These pressure zones currently service elevations ranging from approximately 230 feet to 360 feet for Pressure Zone 3E and 230 feet to 350 feet for Pressure Zone 3W. The Hillview Reservoir establishes the high water level in Pressure Zone 3E, servicing the southern portions of the Woodland and Buchanan planning sub-areas. The Oak Hills Reservoir establishes the high water level in Zone 3W (491') in the Southwest Hills planning sub-area.

2.4.4 Pressure Zone 4W (628')

This pressure zone currently services elevations ranging from approximately 340 feet to 510 feet, mainly in the Southwest Hills sub-area. The Shady Brook Reservoir currently establishes the high water level at 628 feet, and services customers in this area.

2.5 BOOSTER PUMP STATIONS

Water is conveyed from the lower pressure zones to the higher pressure zones via a series of booster pump stations (**Table 2.3**). The Water Treatment Plant Zone 2 Pump Stations extract water from the 5.0 MG and 1.0 MG finished water reservoirs to supply Pressure Zone 2 (385') and fill the 3.0 MG New West Leland tank and the 2.5 MG Stoneman tank. The Buchanan Road Booster Station extracts water from Pressure Zone 2 (385') to supply water to Pressure Zone 3E (490') on the east side of the City, and to fill the 3.0 MG Hillview Reservoir.

The Oak Hills and Vista del Mar Pump Stations extracts water from Pressure Zone 2 (385') to supply water to Pressure Zone 3W (491') and to fill the 2.0 MG Oak Hills Reservoir. The Shady Brook Booster Station pumps water from Pressure Zone 3W (491') to fill the 1.75 MG Shady Brook Reservoir in Pressure Zone 4W (628').

Table 2.3 Existing Booster Pumping Stations

Water System Master Plan
City of Pittsburg

Name	Booster Station ID	Elevation	Installation Year	Source Pressure Zone	Destination Pressure Zone	Total Pump Capacity		Pump Station Horsepower	Number of Pumps	Pump Number	Classification	Individual Horsepower	Design Capacity - Head	Operational Controls (Reservoir Levels)			
														Reservoir	Operational Priority	On	Off
		(ft)	(yr)			(gpm)	(mgd)	(hp)				(hp)	(gpm @ ft)			(ft)	(ft)
Domestic Water System																	
Vista del Mar	PS-1	252	2009	2W (385')	3W (491')	4,500	6.5	450	3	1	Duty	150	1,500 @ 255	Oak Hills	Lead	14.0	22.5
			2009							2	Duty	150	1,500 @ 255	Oak Hills	Lag 1	12.0	19.0
			2009							3	Standby	150	1,500 @ 255	Oak Hills	Lag 2	10.0	17.0
Water Treatment	PS-2	158	1988	1 (195')	2 (385')	10,000	14.4	1,000	5	1	Duty	200	2,000 @ 300	Stoneman	Lead	8.0	18.0
Zone 2			1988							2	Duty	200	2,000 @ 300	Stoneman	Lag 1	7.0	17.0
Pump Station #1			1988							3	Duty	200	2,000 @ 300	Stoneman	Lag 2	6.0	16.0
			1988							4	Duty	200	2,000 @ 300	Stoneman	Lag 3	5.0	15.0
			1988							5	Standby	200	2,000 @ 300	Stoneman	Lag 4	0.0	0.0
Water Treatment	PS-3	158	2009	1 (195')	2 (385')	10,000	14.4	800	4	6	Duty	200	2,500	West Leland	Lead	10.0	18.0
Zone 2			2009							7	Duty	200	2,500	West Leland	Lag 1	8.0	16.0
Pump Station #2			2009							8	Duty	200	2,500	West Leland	Lag 2	6.0	14.0
			2009							9	Standby	200	2,500	West Leland	Lag 3	5.0	12.0
Buchanan Road	PS-4	175	1975	2E (385')	3E (490')	6,600	9.5	600	3	1	Duty	200	2,300	Hillview	Lead	14.0	24.0
			1975							2	Standby	200	2,300	Hillview	Lag 1	12.0	22.0
			1975							3	Duty	200	2,000	Hillview	Lag 2	8.0	18.0
Oak Hills	PS-5	205	1990	2W (385')	3W (491')	2,800	4.0	200	2	1	Duty	100	1,400 @ 175	Oak Hills	Lead	12.3	18.4
			1990							2	Standby	100	1,400 @ 175	Oak Hills	Lag 1	10.0	17.0
Shady Brook	PS-6	421	1998	3W (491')	4W (628')	3,000	4.3	200	2	1	Duty	100	1,500 @ 164	Shady Brook	Lead	8.0	17.0
			1998							2	Standby	100	1,500 @ 164	Shady Brook	Lag 1	7.0	13.0
Highlands Ranch	PS-7	221	1999	2E (385')	2E (385')	4,500	6.5	300	3	1	Duty	100	1,500 @ 182	-		-	-
(To Be Abandoned)			1999							2	Duty	100	1,500 @ 182	-		-	-
			1999							3	Standby	100	1,500 @ 182	-		-	-
Raw Water [1,2]			1953	n/a	n/a	7,960	11.5		3	1	Duty		3,800	-	-	-	-
Pump Station A			1953							2	Duty		2,080	-	-	-	-
			1953							3	Standby		2,080	-	-	-	-
Raw Water [1,2]			1975	n/a	n/a	17,700	25.5		3	1	Duty		5,900	-	-	-	-
Pump Station B			1990							2	Duty		5,900	-	-	-	-
			1975							3	Standby		5,900	-	-	-	-
Wet Wells [1,2]																	
Treated Water			1953	n/a	n/a	7,632	11.0		3	1	Duty		3,472	-	-	-	-
Wet Well North			1953							2	Duty		2,080	-	-	-	-
			1953							3	Standby		2,080	-	-	-	-
Treated Water			1975	n/a	n/a	15,600	22.5		3	4	Duty		5,900	-	-	-	-
Wet Well South			1990							5	Duty		3,800	-	-	-	-
			1975							6	Standby		5,900	-	-	-	-
Backwash Water Recycle						500	0.7		1	1	Duty		500	-	-	-	-

Note:

1. These pump stations were included for completeness, however, were not included in the hydraulic analysis of the distribution system.
2. The Raw Water Pump Stations are controlled by flow and are not included in this analysis.

6/18/2014

Table 2.3 lists the elevation, total capacity, horsepower, and individual pump information at each pump station. Operational controls for the booster pumps are controlled to turn “on” or “off” depending on their assigned storage reservoirs, as listed in this table.

2.6 STORAGE RESERVOIRS

Storage reservoirs are incorporated in the water system to provide water supply for operation during periods of high demand, for meeting fire flow requirements, and for other emergencies, as defined in the City’s planning criteria.

The City’s existing storage reservoirs are summarized in Table 2.4, along with their volumes, construction type, height, diameter, and bottom elevations. These reservoirs are also shown on the hydraulic profile schematic (Figure 2.5), with the HWL, and bottom tank elevations.

Table 2.4 Existing Storage Reservoirs

Water System Master Plan

City of Pittsburg

Pressure Zone	Tank Number	Installation Year (yr)	Volume (MG)	Zone HWL	Reservoir	Construction Type	Height (ft)	Diameter (ft)	Bottom Elevation (ft)
Zone 1	T-1	1998	5.0	1 (195')	WTP	Concrete (DYK)	26	180.9	170.25
	T-2	1998	1.0	1 (195')	WTP	Concrete (DYK)	26	80.9	170.5
Zone 2	T-3	1986	2.5	2E (385')	Stoneman	Concrete (DYK)	24	133.2	362
	T-4 (To Be Abandoned)	1999	1.0	2E (385')	Highlands	Steel	24	84.2	221
	T-5	2009	3.0	2W (385')	New West Leland	Concrete (DYK)	24	145.9	362
Zone 3 East	T-7	1975	3.0	3E (490')	Hillview	Steel	29	132.7	462
Zone 3 West	T-8	1990	2.0	3W (491')	Oak Hills	Concrete (DYK)	25	116.7	467
Zone 4 West	T-9	1998	1.75	4W (628')	Shady Brook	Concrete (DYK)	22	116.4	607

3/18/2015

CHAPTER 3 - PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. The planning area is divided into several planning sub-areas, as established by the City's planning division.

3.1 STUDY AREA

Both the Urban Limit Line and the Planning Area for the City of Pittsburg were outlined in the City's 2004 General Plan. As part of the master plan update, City staff provided updated general plan land use, which is depicted in the planning area diagram (**Figure 3.1**). This figure shows the 2007 Voter Approved Urban Limit Line (ULL) that will be used for the purposes of this master plan.

The City's Planning Division has established planning sub-areas within the ULL as shown on **Figure 3.2**. The City has plans to provide domestic water service to the planning sub-areas that are within the ULL including: Southwest Hills, West Central, West Leland, Downtown, Railroad, East Central, East Leland, Buchanan, Woodlands, and Loveridge. Significant portions of the Northwest River and Northeast River also fall within the boundaries of the ULL and were included in this study.

The Bay Point sub-area does not lie within the ULL and was not considered for the purposes of this study. Only small portions of open space area within the Black Diamond sub-area are included in the ULL boundary.

3.2 LAND USE

The land use designations used in this master plan are consistent with the Land Use Element of the City's General Plan, and as received from the City's planning division. The City's General Plan land use diagram depicts the land uses that are implemented within the planning area boundary (**Figure 3.1**). The General Plan Land Use map was obtained from the City on January 30, 2014, and reflects the most recent updates to the General Plan. **Figure 3.3** shows areas in which the land uses have been amended since the 2010 WSMP.

The land uses shown in the 2004 General Plan land use diagram (**Figure 3.1**) along with the land uses described in the amendments (**Figure 3.3**) constitute the most current information received from the City's planning division, and were used in this study. The following planning sub-areas were identified in the General Plan, with each being characterized by a unique mix of land uses.

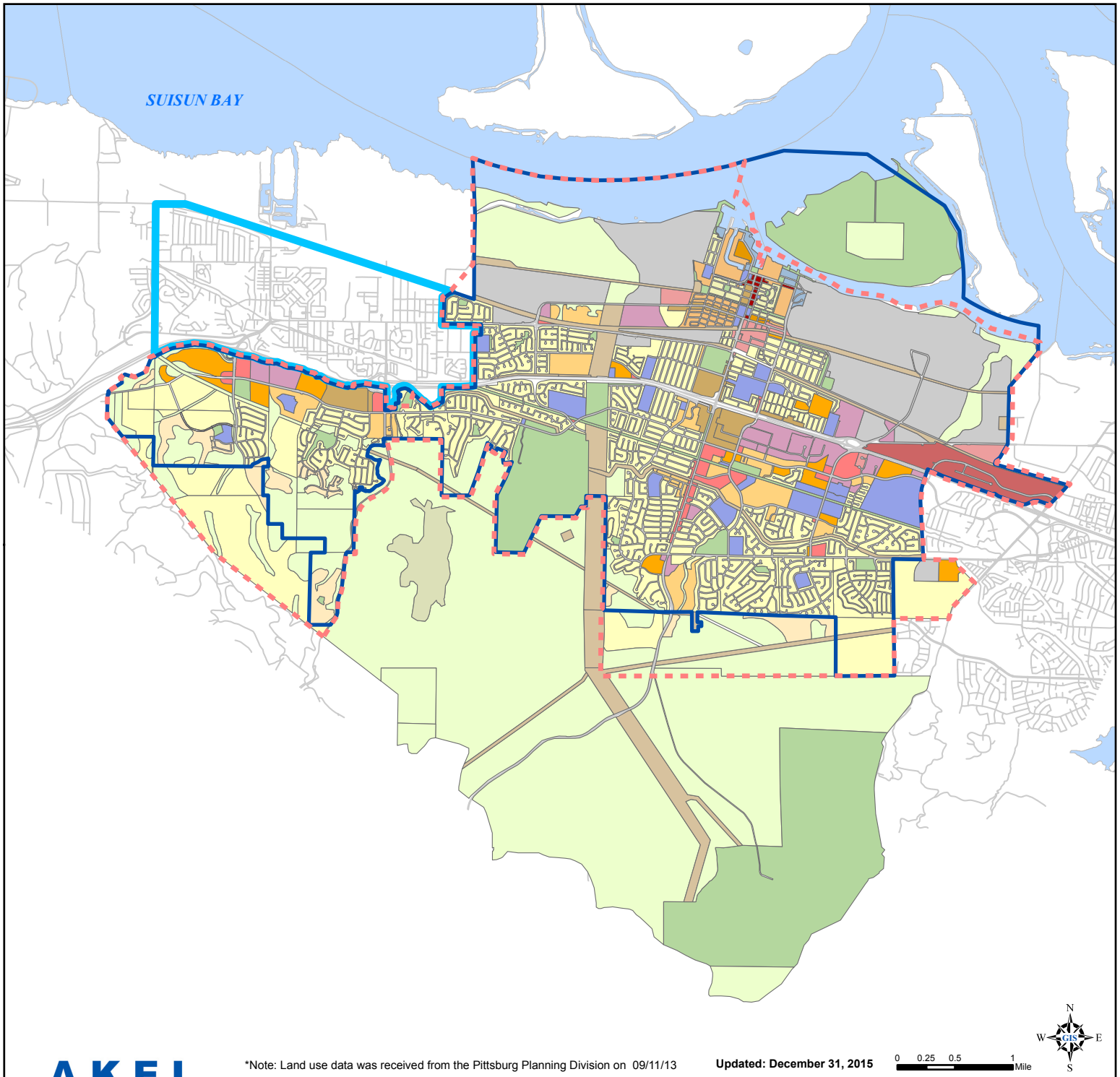


Figure 3.1
General Plan Land Use
Water System Master Plan
City of Pittsburg

*Note: Land use data was received from the Pittsburg Planning Division on 09/11/13

Updated: December 31, 2015

AKEL ENGINEERING GROUP, INC.

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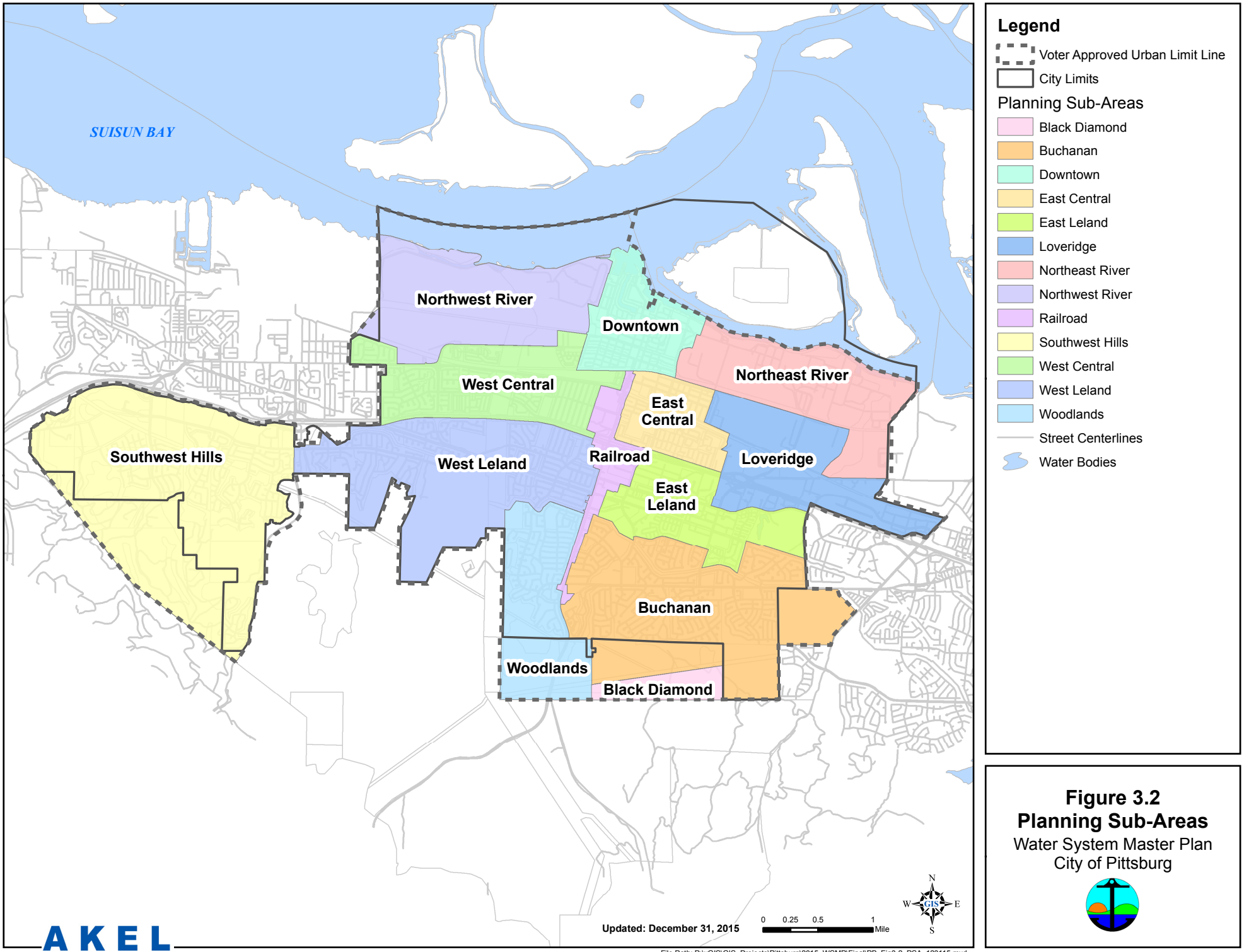

Figure 3.2
Planning Sub-Areas
Water System Master Plan
City of Pittsburg

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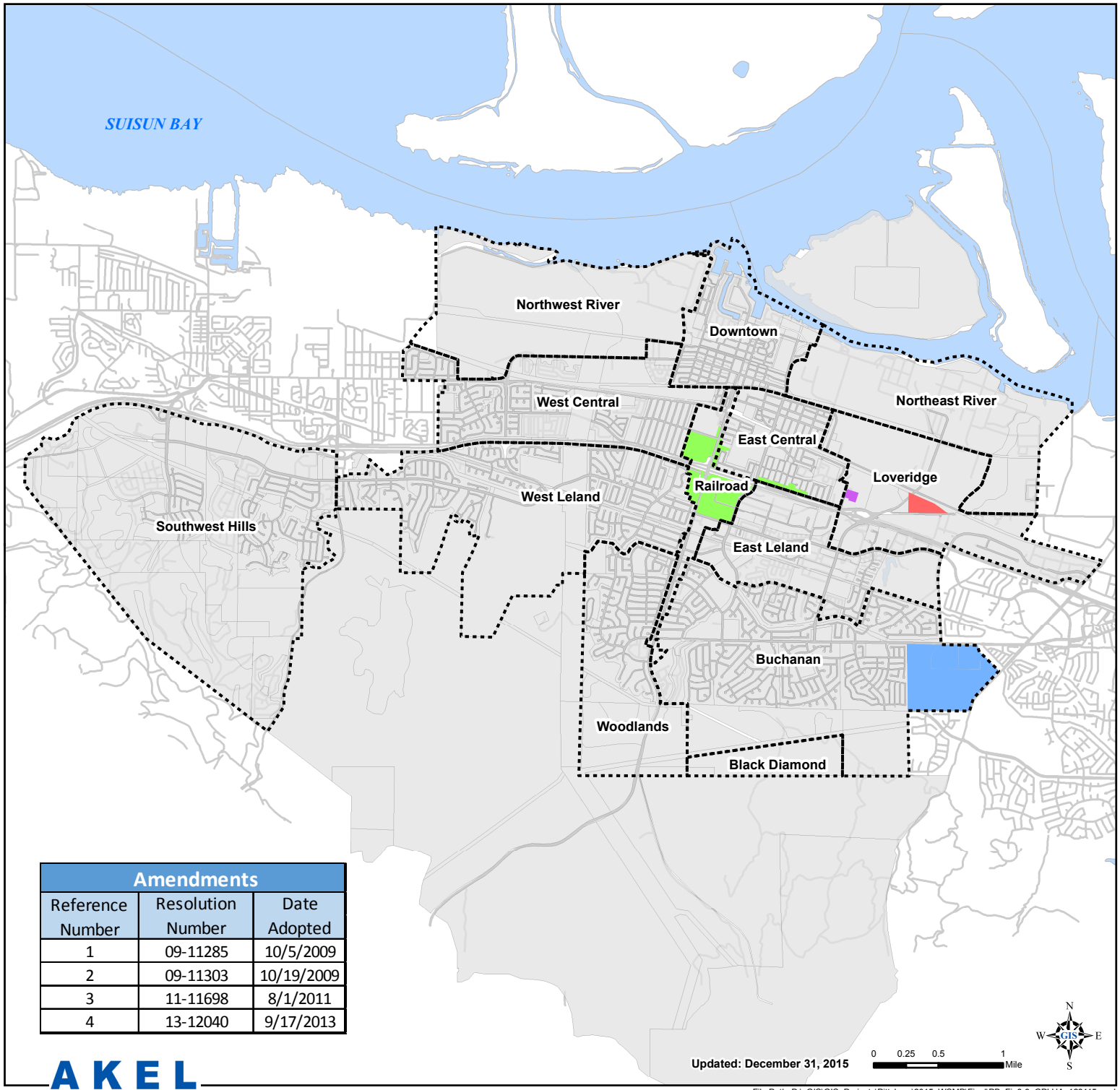

Legend

- Planning Sub-Areas
- Land Use Amendments
- Reference Number
  - 1
  - 2
  - 3
  - 4
- Street Centerlines
- General Plan Area
- Water Bodies

Amendments		
Reference Number	Resolution Number	Date Adopted
1	09-11285	10/5/2009
2	09-11303	10/19/2009
3	11-11698	8/1/2011
4	13-12040	9/17/2013

Figure 3.3
General Plan Land Use Amendments 2009 - 2014
Water System Master Plan
City of Pittsburg

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3.2.1 Downtown

The Downtown sub-area is characterized by a variety of land uses including residential, commercial, and parks. Retail and commercial office uses line Railroad Ave, a major north south transportation route, where newer medium and high density residential developments line the New York Slough waterfront.

3.2.2 Northeast River

This sub-area is located on the banks of New York Slough, adjacent to the Downtown sub-area. Large-scale heavy industrial operations are the primary uses while open space exists on the majority of the remaining area. USS-Posco, Dow Chemical, and the Delta Diablo Wastewater Treatment Plant are some of the facilities located in this sub-area.

3.2.3 Loveridge

Located north of State Highway 4 on the east edge of the City, the Loveridge sub-area is comprised mostly of commercial and industrial areas. A variety of other land uses line East Leland Road, including a community commercial center, business commercial complex, service commercial center, and several multi-family housing developments. Industrial development is anticipated within this sub-area in the near future, as described in the City's Loveridge Sub-Area Master Plan.

3.2.4 East Central

The East Central sub-area is adjacent to the south side of the Downtown sub-area and is comprised of more than 50 percent residential use. Some of the City's older neighborhoods and Pittsburg High School are located in this sub-area. Neighborhood commercial establishments and commercial offices can be found along the major streets within the East Central sub-area.

3.2.5 Railroad Avenue

Railroad Avenue lines a major commercial corridor near the center of the City. More than two thirds of the net area has commercial uses while the remainder of the sub-area is comprised of residential, parks, and public uses. The City's Civic Center and City Park are located within this sub-area.

3.2.6 East Leland

The East Leland sub-area contains a variety of different uses. The area north of East Leland Road is used primarily for business commercial establishments, while the land on the south side of East Leland Road contains a mix of residential and public uses including three educational institutions.

3.2.7 Buchanan

Located in the southeast area of the City, the Buchanan sub-area is characterized, primarily, by single-family residential uses; however, two parks and three schools are also located in this sub-area. Undeveloped low density residential lands comprise the remaining area within the Buchanan sub-area.

3.2.8 Woodlands

Woodlands also lies on the southeast edge of the City and is similar to the Buchanan sub-area in its land uses. Low density residential developments, a park, and a public school are contained in the northern portion of the sub-area. The southern portion of the sub-area is outside the City's ULL, which is predominantly open space with a small pocket of undeveloped low density residential land.

3.2.9 West Central

The majority of the West Central sub-area contains low and medium density residential developments. Public facilities and parks are intermixed within the residential areas. The northeast corner of the sub-area is used for business commercial and industrial operations.

3.2.10 West Leland

The West Leland sub-area is comprised of low density residential uses, public facilities, and the City's joint Golf Course/Stoneman Park recreational area. The City's general plan land use element indicates that the area contains approximately 46 percent residential, 38 percent parks, and 16 percent of combined open space, public, and utility uses.

3.2.11 Southwest Hills

Annexed by the City in 1990, this sub-area is the site of many new planned and undeveloped residential areas, as well as open space areas, which are located on rolling hill land. Large scale development of this area is expected in this sub-area.

3.2.12 Northwest River

The portion of Northwest River that is contained within the ULL consists of open space, industrial, and utility Right of Way (ROW) uses. The NRG Power Plant utilizes the industrial area for its operations and the ROW for its transmission lines. The Northwest River sub-area land use classifications were amended in 2006 to replace open space and utility/ROW areas with industrial space.

3.3 PROPOSED MAJOR DEVELOPMENTS

Since the 2010 Water System Master Plan (WSMP) was completed and adopted, there have been several adjustments to the number of dwelling units in the Southeast and Southwest Hills or

infill developments. As more detailed site plans become available, the master plan assumptions can be updated accordingly.

3.3.1 Southeast Hills Developments and Infill Developments

The Southeast Hills comprises several proposed developments including: Montreux, Thomas Ranch, Highlands Ranch, Sky Ranch, and Tuscany Meadows (**Figure 3.4**). The infill developments consist of several projects scattered throughout the City, within Pressure Zones 1 and 2. These infill developments include the land use amendments, as shown on **Figure 3.3** and summarized on **Table 3.1**. The table lists the developments and their respective number of proposed dwelling units.

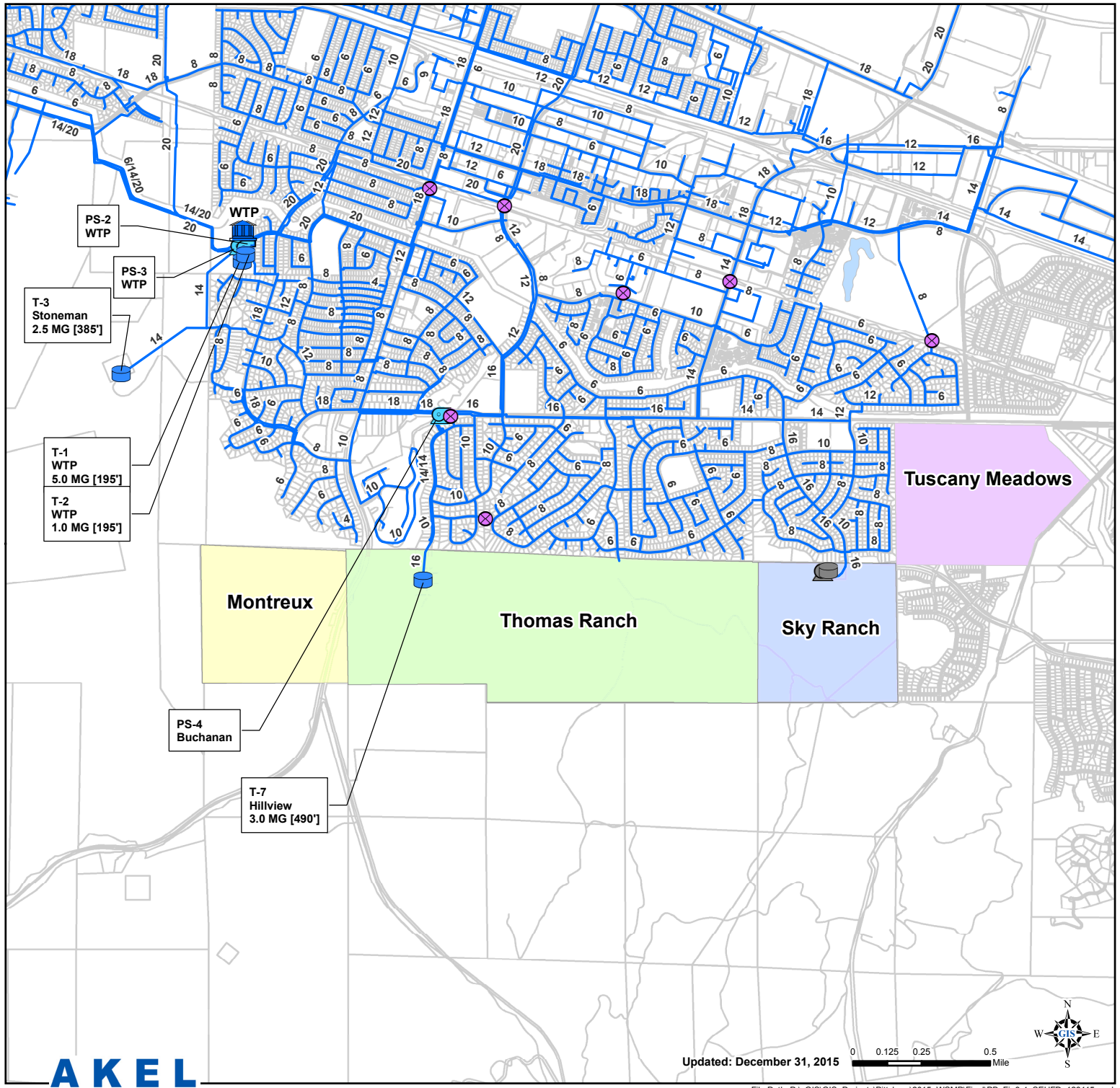
In order to provide service to the Southeast Hills area, domestic water is first pumped from the water treatment plant, located at 300 Olympia Drive, and conveyed south via an existing 18-inch transmission main along Crestview Drive, then east along Buchanan Road to Pressure Zone 2 (**Figure 3.4**). Servicing higher elevations in the Southeast Hills requires additional pumping and storage facilities. Pressure Zone 1 is supplied from the water treatment plant by gravity transmission mains.

3.3.2 Southwest Hills Developments

The Southwest Hills comprises a large portion of the City's planned growth and has experienced several changes since the adoption of the 2010 WSMP.

Approved developments in the Southwest Hills include: Vista del Mar (under construction), Alves Ranch, Bailey Estates, and the San Marco Development (including San Marco Villas apartments and the Veranda, Valencia and Serrano single-family neighborhoods, which are currently built or under construction). The General Plan land use diagram identifies other potential areas for development on other properties in the Southwest Hills, including Spilker, DeBonneville, West Coast Transit Village, and the Pittsburg/Bay Point BART Station and BART Annex.

- Montecito and Faria Developments. The Montecito development, which was listed separately in the 2010 WSMP, was merged on Table 3.1 into the Faria development, as requested by City staff.
- Ridge Farms 1 and 2 and San Marco Developments. The Ridge Farms 1 and 2 developments, which were listed separately in the 2010 WSMP, were merged on **Table 3.1** into the Faria development for both Ridge Farms 1 and Ridge Farms 2, per comments by City staff.
- Smith Development. Though this property located south of the Oak Hills Development (Smith property) is currently designated *Open Space* in the General Plan, the planning department identified potential residential units that were included in this master plan (**Table 3.1**).



Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Southeast Hills Developments

- Montreux
- Sky Ranch
- Thomas Ranch
- Tuscany Meadows
- Street Centerlines
- Parcels
- Water Bodies

Figure 3.4
Southeast Hills
Future Developments
Water System Master Plan
City of Pittsburg

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Table 3.1 Future Land Use Inventory

Water System Master Plan

City of Pittsburg

Development Name	Residential Dwelling Units		Commercial	Industrial	Loveridge Industrial	School		Park
	Single Family (DU)	Multi-Family (DU)	(AC)	(AC)	(AC)	(AC / students)[7,8]		(AC)
Southwest Hills[1]								
Alves Ranch	167	393	5.1					
Bailey Estates	249							2.0
Bay Point/ BART Expansion and Annex		1,000	1.1					
De Bonneville	120							
Faria[11,12]	1,500							
Golf Course[14]	482[10]							
San Marco[11,13,15]	1,587					6.3[9]	Acres	17
The Villas at San Marco[14,15]		471	0.6					
Toscana at San Marco[15]	252							
San Marco Village C[15]		516						
Esperanza at San Marco[15]		300						
San Marco Village O[15]		58						
Smith[10]	150							
Spilker	89							
Vista del Mar[16]	469					11.3	Acres	
West Coast Transit Village		525						
Southeast Hills[2]								
Montreux	356							3.0
Thomas Ranch	255							
Tuscany Meadows	917	365						5.4
Sky Ranch	415							1.5
Zones 1 and 2 Infills[3,4,5]								
Zone 1	595	2,330	-5.8	14		650	Students[8]	
Zone 2	60	142	4.0			838	Students[8]	
Loveridge Sub-Area[6]					233			
Ambrose Park								12.3
NRG Power Plant				170				
Total	**7,663**	**6,100**	**6**	**184**	**233**			**41**

Notes: 1/6/2016

1. Source: Information received from City staff, 1/22/09, and Stetson Engineers
2. Source: 2000 Water System Master Plan, Amendment No. 3, June 2007, and
3. Zone 1 Infill Sources:
   a. List of developments under construction and General Plan allowances from Sewer Master Plan Update Table from City Planning 2/14/09
   b. Appendix C of the 2007 WWCSMP
4. General Plan allowances replaced WWCSMP Land Use changes for basins listed in Sewer Master Plan Update Table from City Planning 2/14/09
5. Zone 2 Source:
   a. Information received from City staff, email dated 4/3/09
6. Source: Loveridge Sub-Area Master Plan, RBF Consulting, October 2008
7. Acreage for planned school
8. Planned increase in student population for respective zone infills
9. The San Marco school site is no longer planned and is currently in use.
10. These proposed residential units are currently located on designated "Open Space" the proposed intensity.
11. Park acreages may be designated to the Faria development to total 17 acres. This is based on the City parkland dedication requirements.
12. Rdige Farms 1 and 2 have been merged into Faria.
13. Montecito and Faria have been combined per City staff email 5/14/2014.
14. The Golf Course Project listed in this table was not included in the development of capital improvements and capacity allocations. However, this master plan identifies the water system facilities (transmission mains, booster stations, and storage reservoirs) that may require resizing or need to be added to service this project.
15. San Marco and San Marco Villages B, C, M, and O unit counts as provided by the City 2/14/2014.
16 Per City staff email dated 2/14/14, the following building permits were issued (mostly towards the end of 2013):

It should be noted that, per City's planning division staff, the owner of this property must request an amendment to the General Plan, and the City Council must make the appropriate findings to approve such an amendment, before the owner would be allowed to construct the intensity of development envisioned occurring there.

- Southwest Hills Study. In 2008/2009 Seeno Homes (Seeno Construction Company) retained the services of Stetson Engineers Inc. and completed a memorandum that documented revised dwelling units, revised pressure zones, and revised transmission mains layout for the Southwest Hills (**Appendix A**).

  Table 3.1 lists the revised the projects and dwelling unit counts from that study (**Figure 3.5**), as approved by City planning staff.

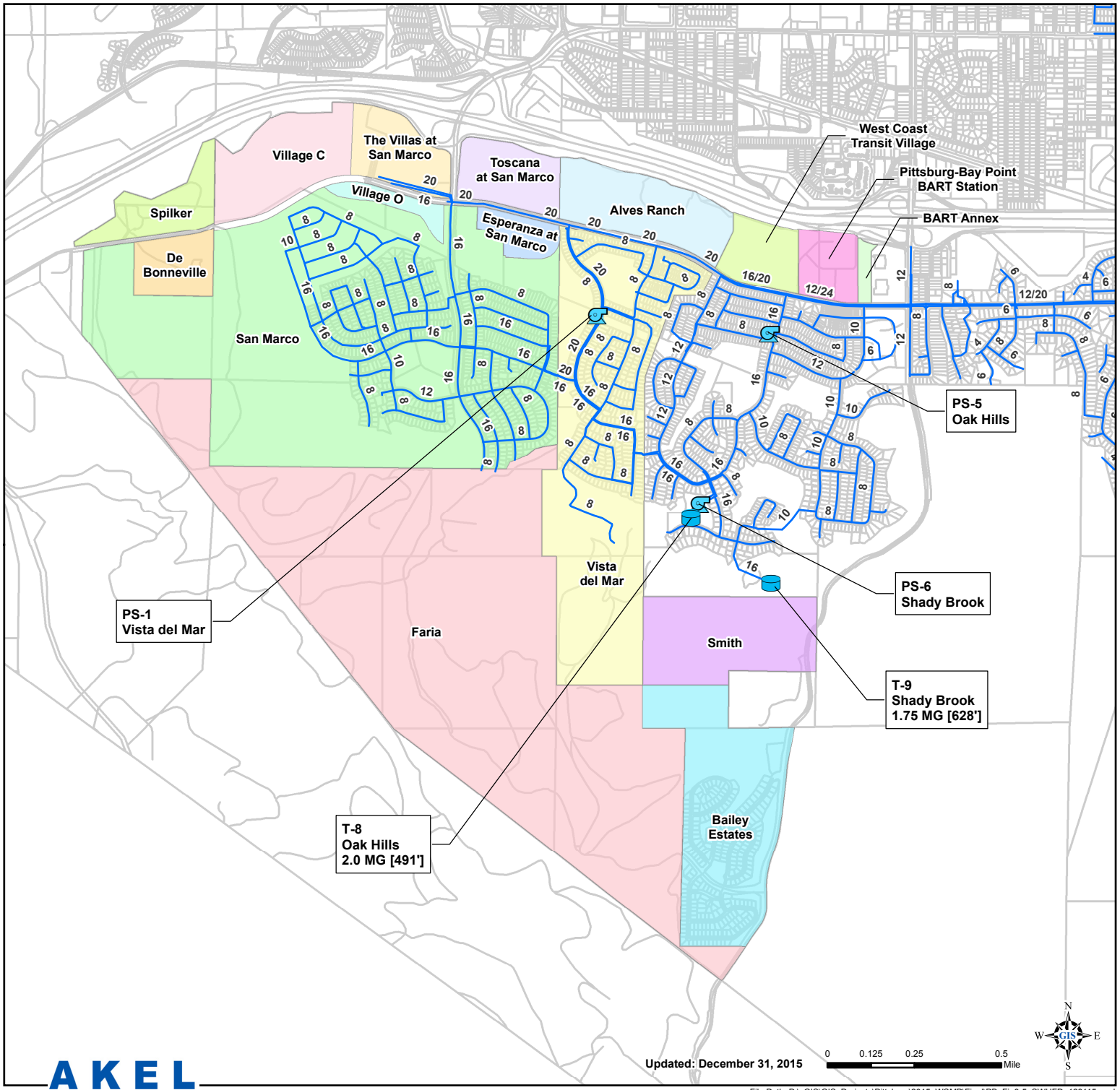
3.3.3 Recent Annexations

Recent annexations were identified, and which included Ambrose Park and the NRG Plant. Both of these areas will be serviced by the City's water distribution system. The annexations are also listed in **Table 3.1**.

3.4 HISTORICAL AND FUTURE GROWTH

The City's historical and projected population data are presented in **Table 3.2**. The information was extracted from the previous master plan, and from information maintained by city staff. Though historical populations were used in understanding the domestic water consumption behaviors and trends, population forecasts are presented for informational purposes only.

Estimates of future domestic water demands were not based on population, but rather on dwelling units for residential land uses and on gross acres for non-residential land uses.



Legend

Existing

- Storage Tanks
- Booster Stations
- Pipes

Southwest Hills Developments

- Alves Ranch
- BART Annex
- Bailey Estates
- De Bonneville
- Esperanza at San Marco
- Faria
- Pittsburg-Bay Point BART Station
- San Marco
- Smith
- Spilker
- The Villas at San Marco
- Toscana at San Marco
- Village C
- Village O
- Vista del Mar
- West Coast Transit Village
- Street Centerlines
- Parcels

Figure 3.5
Southwest Hills Future Developments

Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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Table 3.2 Historical and Projected Population

Water System Master Plan

City of Pittsburg

Year	Population [1,2]	Annual Growth (%)
Historical Population		
1990	47,600	5.6%
1991	48,500	1.9%
1992	49,300	1.7%
1993	50,300	1.9%
1994	50,800	1.1%
1995	51,300	1.0%
1996	51,500	0.4%
1997	52,500	1.8%
1998	53,700	2.4%
1999	54,800	2.0%
2000	56,800	3.5%
2001	57,700	1.7%
2002	59,400	2.9%
2003	60,300	1.5%
2004	60,700	0.7%
2005	61,100	0.7%
2006	60,900	-0.3%
2007	61,300	0.7%
2008	61,900	0.9%
2009	62,200	0.5%
2010	63,300	1.7%
2011	63,700	0.7%
2012	64,800	1.6%
2013	65,300	0.9%
Projected Population		
2014	66,400	1.7%
2015	67,600	1.7%
2016	68,700	1.7%
2017	69,900	1.7%
2018	71,100	1.7%
2019	72,300	1.7%
2020	73,500	1.7%
2021	74,800	1.7%
2022	76,000	1.7%
2023	77,300	1.7%
2024	78,700	1.7%
2025	80,000	1.7%
2026	81,300	1.7%
2027	82,700	1.7%
2028	84,100	1.7%
2029	85,600	1.7%
2030	87,000	1.7%

Note: 4/9/2014

1. Population has been rounded to the nearest 100 capita, % increase was calculated based on non-rounded number
2. Population Estimate Sources:
   a. 1990-2010: California Department of Finance Sheet E-4
   b. 2011-2013: California Department of Finance Sheet E-1.

CHAPTER 4 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the City's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed transmission mains, storage reservoirs, and booster stations.

4.1 HISTORICAL WATER USE TRENDS

The historical domestic water consumption per capita was calculated to determine the average amount of water used per day, per capita. This was accomplished by dividing the City's historical water production, obtained from water treatment plant records, by the historical population for the respective years. **Table 4.1** lists the City's historical per capita consumption factors, for the period 2001-2013, which were used for the purpose of evaluating water use trends.

The per capita consumption has generally decreased from 163 gpdc in 2001 to 138 gpdc in 2013, a reduction of approximately 15%. Over the past 3 years, the City's per capita consumption has averaged at 133 gallons per day per capita (gpdc). This trend justified updating the water system performance criteria, as discussed later in this chapter.

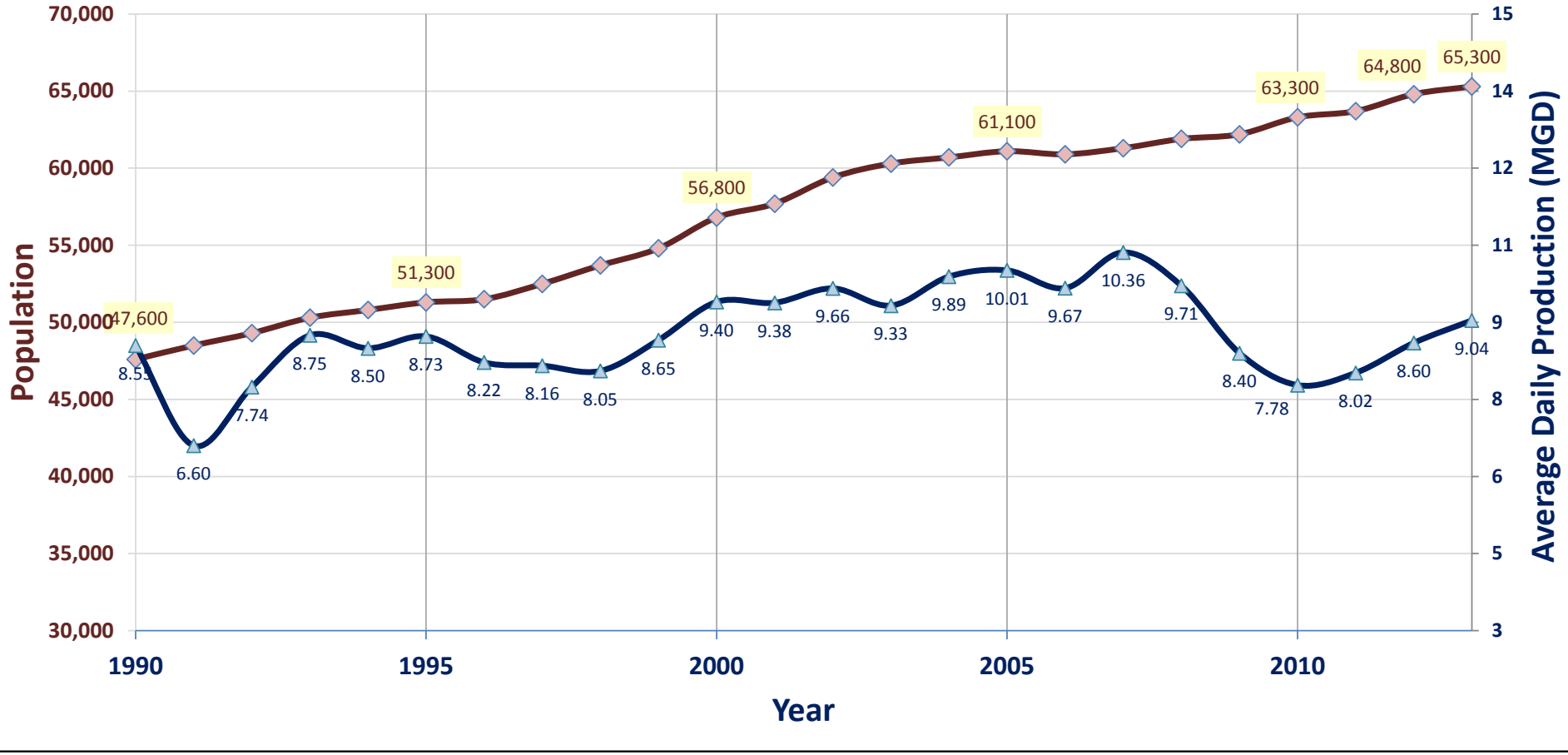
These trends are further documented on **Figures 4.1** and **4.2**. **Figure 4.1** compares the City's annual population versus annual production, while **Figure 4.2** compares the annual production versus the average per capita consumption factor.

It should be noted that this master plan did not rely on the per capita consumption to estimate water demand from future area, but rather on the available detailed land use inventory developed by City staff (**Table 3.1**).

4.2 SUPPLY CRITERIA

In determining the adequacy of the domestic water supply facilities, the source must be large enough to meet the varying water demand conditions, as well as provide sufficient water during potential emergencies such as power outages and natural or created disasters.

Ideally, a water distribution system should be operated at a constant water supply rate with consistent supply from the water source at the water treatment plant. On the day of maximum demand, it is desirable to maintain a water supply rate equal to the maximum day demand rate. Water required for peak hour demands or for fire flows would come from storage. The water supply criteria is summarized on **Table 4.2**. It should be noted that **Appendix B** provides a comparison between the criteria used in the 2010 WSMP and the criteria presented in this chapter, and used in this master plan.



LEGEND

- Population
- Average Daily Production (MGD)

April 9, 2014

Figure 4.1
Historical Population vs. Average Daily Production
Water System Master Plan
City of Pittsburg

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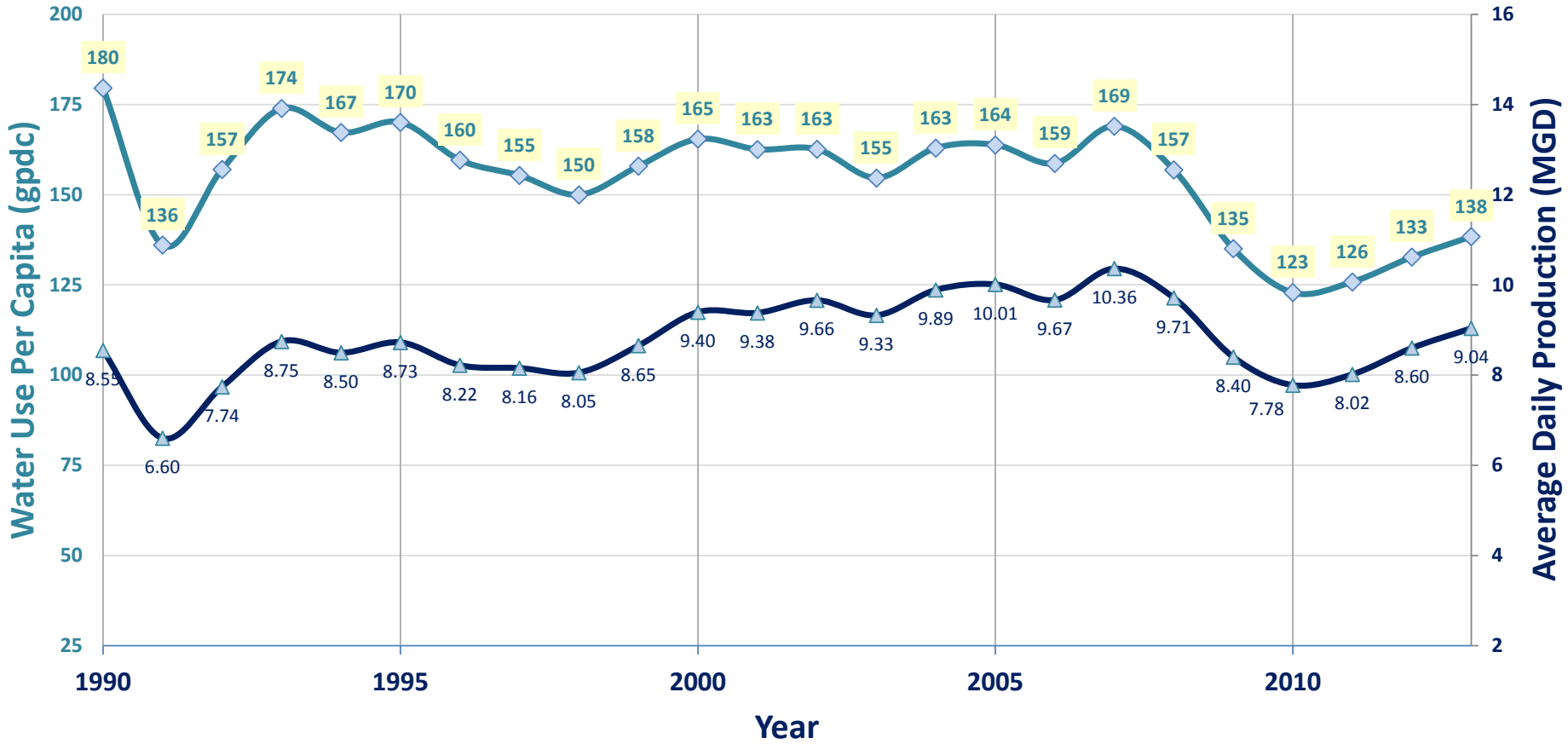

LEGEND

- Water Use Per Capita (gpdc)
- Average Daily Production (MGD)

NOTES:

1. The 2010 Urban Water Management Plan recommends an interim water use target of 153 gallons per day per capita (gpdc) and a 2020 urban water use target of 136 gpdc, consistent with requirements of the Water Conservation Act of 2009.

April 9, 2014

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Figure 4.2

Water Use Per Capita vs. Average Daily Production

Water System Master Plan
City of Pittsburg

Table 4.1 Maximum Day Peaking Factors Analysis
Water System Master Plan
City of Pittsburg

Year	Population [1]	Annual Production [2]			Maximum Day Production [2]			Maximum Month Production [2,3]				Average Per Capita Water Use [5]
		(MG/year)	(MGD)	(gpm)	Total (MGD)	Date	Max to Avg Ratio	Total (MG/month)	Month	(MGD)	Max to Avg Ratio [4]	(gpdc)
Historical Production (2001-2012)												
2001	57,700	3,424	9.38	6,514	16.73	6/6/2001	1.78	409.65	August	13.65	1.46	163
2002	59,400	3,526	9.66	6,709	20.88	7/13/2002	2.16	455.12	July	15.17	1.57	163
2003	60,300	3,404	9.33	6,476	18.79	6/28/2003	2.01	455.33	July	15.18	1.63	155
2004	60,700	3,610	9.89	6,868	15.35	6/15/2004	1.55	431.69	July	14.39	1.45	163
2005	61,100	3,654	10.01	6,952	17.67	8/11/2005	1.77	455.78	August	15.19	1.52	164
2006	60,900	3,528	9.67	6,712	17.75	7/21/2006	1.84	465.65	July	15.52	1.61	159
2007	61,300	3,782	10.36	7,196	17.67	7/4/2007	1.71	453.75	July	15.13	1.46	169
2008	61,900	3,545	9.71	6,745	15.35	6/25/2008	1.58	395.46	July	13.18	1.36	157
2009	62,200	3,066	8.40	5,833	13.73	6/29/2009	1.63	361.38	July	12.05	1.43	135
2010	63,300	2,839	7.78	5,401	13.94	9/4/2010	1.79	344.20	July	11.47	1.48	123
2011	63,700	2,926	8.02	5,567	13.77	8/9/2011	1.72	348.15	July	11.61	1.45	126
2012	64,800	3,139	8.60	5,972	14.98	8/10/2012	1.74	366.28	August	12.21	1.42	133
2013	65,300	3,299	9.04	6,277	14.19	7/2/2013	1.57	370.05	July	12.33	1.36	138
Historical Maximum Ratios												
7-Year Maximum							1.79				1.48	169
5-Year Maximum							1.79				1.48	157
3-Year Maximum							1.74				1.45	133
Last Year's Maximum							1.57				1.36	133
Recommended Criteria												
		2010 Master Plan Criteria					1.90				1.60	180
		2014 Master Plan Criteria					**1.80**				1.50	**153**

Note:

4/9/2014

1. Population data extracted from US Census and population estimates provided by City staff, June 2008
2. Historical Water Production Records extracted from the City's Water Treatment Plant reports
3. Some production records in this table include irrigation of the Golf Course, Stoneman Park, City Park, and Civic Center. These demands have since been converted to the recycled water system.
4. Monthly use statistics are included for information purposes. They were not used in the master planning of water transmission and distribution facilities.
5. The recommended per capita water use factor is consistent with the 2015 Interim Water Use Target outlined in the 2010 Urban Water Management Plan.

Table 4.2 Planning and Design Criteria Summary
Water System Master Plan
City of Pittsburg

Design Parameter	Criteria
Supply	Supply = Maximum Day Demand + Standby
Storage	Zones 1 and 2: Total Required Storage = Operational + Fire + Emergency
	Zones 3 and above: Total Required Storage = Operational + Fire + Emergency + Time-of-Use
	Operational Storage: 25% of Maximum Day Demand
	Emergency Storage: 50% of Maximum Day Demand
	Fire Storage: New Residential, SF = 0.12 MG; Residential, SF = 0.18 MG; Residential, MF = 0.24 MG; Commercial/School = 0.54 MG; Industrial = 0.63 MG; Special Zone 1 Industrial = 0.65 MG; Loveridge Sub-Area = 0.48 MG
	Time-of-Use Storage (Zones 3 and above): 6-hours of Maximum Day Demand
Distribution Mains	Distribution mains should be designed to meet the greater of:
	1) Peak Hour Demand, or 2) Maximum Day Demand + Fire Flow
	Criteria for existing and future pipelines include [1]:
	If pipe diameter ≤ 12", maximum pipeline velocity is 5 feet per second
	If pipe diameter ≥ 14", maximum headloss is 2 feet/1,000 feet
Pump Stations	Zones 1 and 2: Meet Maximum Day Demand with largest unit out of service
	Zones 3 and above: Meet Partial-Peak Time-of-Use Pumping (18-hour pumping) with largest unit out of service
	Hydropneumatic systems to meet Maximum Day Demand plus fire flow
PRVs	PRVs should be designed to meet the greater of:
	Peak Hour Demand, or Maximum Day Demand + Fire Flow
Service Pressures	Maximum Pressure: 100 psi
	Existing System Minimum Pressure (during Maximum Day): 40 psi
	Future System Minimum Pressure (during Peak Hour)[2]: 40 psi
	Existing System Minimum Pressure (during Peak Hour): 35 psi
	Minimum Residual Pressure (during Fires): 20 psi
Demand Peaking Factors	Maximum Month Demand: 1.5 x Average Day Demand
	Maximum Day Demand: 1.8 x Average Day Demand
	Peak Hour Demand: 2.8 x Average Day Demand
Fire Flows	Residential, New Single Family[3]: 1,000 gpm for 2 hours
	Residential, Single Family: 1,500 gpm for 2 hours
	Residential, Multi Family: 2,000 gpm for 2 hours
	East Contra Costa Court House[4]: 2,186 gpm
	Commercial: 3,000 gpm for 3 hours
	Schools[5]: 3,000 gpm for 3 hours
	Industrial: 3,500 gpm for 3 hours
	Zone 1 Special Industrial User[6]: 3,625 gpm for 3 hours
	Loveridge Sub-Area[6]: 4,000 gpm for 2 hours
Demand Coefficients	Residential, SF: 340 gpd/DU
	Residential, MF: 270 gpd/DU
	Commercial: 1,700 gpd/AC
	Schools: 1,000 gpd/AC; 20 gpd/student
	Park: 3,825 gpd/AC
	Heavy Industrial and High Intensity Commercial: 1,000 + gpd/AC
	Loveridge Sub-Area[6]: 1,200 gpd/AC

Note: 6/18/2014

1. Pipeline headloss criteria and fire flow requirements during maximum day demands might be relaxed on a case by case basis, at the discretion of City staff, and depending on the redundancy and reliability of the considered design. In no case shall the criteria listed in this table be relaxed without the review and approval of the City Engineer.
2. Minimum pressure criteria for future system is extracted from Section 64602 of the Title 22 California Code of Regulations.
3. New single-family homes are required to have fire sprinklers installed for suppression purposes. Homes over 3,600 sq ft require an increased fire flow.
4. The East Contra County Courthouse fire flow duration was not provided in the final fire protection plan received 5/13/2014.
5. Fire Flows for Delta View Elementary School, located in Pressure Zone 4 West, was reduced to 1,500 gpm for 2 hours due to fire sprinklers provisions, per letter from Fire Marshal dated February 2, 2010.
6. Source: CCCFPD Fire Inspector emails received 2/25/2014 and 3/4/2014.

The City's water treatment plant has a hydraulic design capacity of 32 million gallons per day (MGD), and is currently limited by the CDPH to 12 MGD when the water temperature is less than 10 degrees Celsius (50 degrees Fahrenheit) and 24 MGD when the water temperature is less than 20 degrees Celsius (68 degrees Fahrenheit). The City's water treatment plant currently operates at 6 to 18 MGD.

4.3 STORAGE CRITERIA

The intent of domestic water storage is to provide supply for operational equalization, fire protection, and other emergencies, such as power outages or supply outages. Operational or equalization storage provides the difference in quantity between the customer's peak hour demands and the system's available reliable supply. The storage criterion is summarized on **Table 4.2**.

4.3.1 Operational Storage

Operational or equalization storage capacity is necessary to reduce the variations imposed on the supply system by daily demand fluctuations. Peak hour demands may require up to 2 times the amount of maximum day supply capacity. With storage in place, this increase in demand can be met by the operational storage rather than by increasing production from the supply sources.

Equalization storage also stabilizes system pressures for enhancing the service in each pressure zone. Equalization storage requirements typically range from 25 percent to 50 percent of maximum day demand. The City criterion requires that 25 percent of the maximum day demand be reserved for operational storage.

4.3.2 Fire Storage

Fire storage is also needed to maintain acceptable service pressures within a pressure zone, in the event of a fire flow, which may occur during the maximum day demand. The recommended fire storage capacity varies by pressure zone and land use type, and is usually higher for commercial and industrial areas. Fire flow provisions for each pressure zone were calculated based on the governing (highest) land use type within a reservoir service area as follows:

- **Category 1.** Pressure zone fire storage for new single family residential areas equipped with fire sprinklers were calculated at 1,000 gpm for two hours, or 0.12 MG.
- **Category 2.** Pressure zone fire storage for single family residential areas was calculated at 1,500 gpm for two hours, or 0.18 MG.
- **Category 3.** Pressure zone fire storage for multi-family residential areas was calculated at 2,000 gpm for two hours, or 0.24 MG.
- **Category 4.** Pressure zone fire storage for the Loveridge Sub-area was calculated at 4,000 gpm for two hours, or 0.48 MG.

- **Category 5.** Pressure zone fire storage for commercial areas was calculated at 3,000 gpm for three hours, or 0.54 MG.
- **Category 6.** Pressure zone fire storage for school areas was calculated at 3,000 gpm for three hours, or 0.54 MG.
- **Category 7.** Pressure zone fire storage for industrial areas was calculated at 3,500 gpm for three hours, or 0.63 MG.
- **Category 8.** Pressure zone fire storage for the special Zone 1 industrial user was calculated at 3,625 gpm for three hours, or 0.65 MG.

4.3.3 Emergency Storage

Emergency storage is the volume of water stored to meet demand during emergency situations such as pipe failures, distribution main failures, pump failures, power outages, natural disasters, or other cases in which the supply sources are not able to meet the demand condition.

The amount of water reserved for emergencies is determined by policies adopted by the City and is based on an assessment of the costs and benefits including the desired degree of system reliability, risk during an emergency situation, economic considerations, and water quality concerns.

In California, the amount of emergency storage reserve in municipal water systems is usually between 50 percent and 100 percent of the maximum day demand. The City of Pittsburg criterion for emergency storage is 50 percent of the maximum day demand.

4.3.4 Total Storage

The total storage is the summation of operational (equalization), fire, and emergency storage requirements as follows:

Qs = 25% MDD (equalization) + fire flow (varies) + 50% MDD (emergency)

where:

Qs is the Total Required Storage, in gallons

MDD is the Maximum Day Demand, in gallons

This criterion is used for evaluating the capacity adequacy of the existing storage facilities for each zone, and for recommending capacity improvements in existing and future zones.

4.4 PRESSURES CRITERIA

Acceptable service pressures within distribution systems vary depending on City criteria and pressure zone topography. It is essential that the water pressure in a consumer's residence or

place of business be maintained within an acceptable range. Low pressures below 30 psi can cause undesirable flow reductions when multiple faucets or water using appliances are used at once.

Excessively high pressures can cause faucets to leak and valve seats to wear out prematurely. Additionally, high service pressures can cause unnecessarily high flow rates, which can result in wasted water and high utility bills. The criteria for pressures in the domestic water system include the following:

- Maximum pressure, usually experienced during low demands and winter months
- Minimum pressure, usually experienced during peak hour demands and summer months
- Minimum pressure during fire flows and during the maximum day demand

The American Water Works Association Manual on Computer Modeling and Water Distribution System (AWWA M-32) indicates that maximum pressures in transmission and distribution pipes are usually in the range of 90-110 pounds per square inch (psi). It is also important to comply with plumbing codes which may impose a maximum pressure of 80 psi to mitigate the impact on internal plumbing. The City's existing system was evaluated based on a maximum allowable pressure in the distribution system of 100 psi, and individual pressure-reducing valves are required on services where the 80 psi pressure is exceeded.

The minimum acceptable pressure is usually in the range of 40-50 psi, which generally provides for sufficient pressures for second story fixtures. When backflow preventers are required, they may reduce the pressures by approximately 12-15 psi. The recommended minimum pressure during fire flows is 20 psi, as established by the National Fire Protection Association (NFPA).

The City's existing pressure criteria is summarized on **Table 4.2** and includes:

- Maximum pressure: 100 psi
- Minimum pressure: 40 psi during maximum day and 35 psi during peak hour demands
- Minimum pressure during fire flows: 20 psi

The CDPH approved revised waterworks standards, which changed Title 22 of the California Code of Regulations. The new standards require that any distribution system that may adversely affect the existing distribution system must maintain pressures greater than or equal to 40 psi excluding fire flows. Therefore, to meet the updated waterworks standards, the pressure criteria was updated accordingly.

4.5 UNIT FACTORS

Domestic water demand unit factors are coefficients commonly used in planning level analysis to estimate future average daily demands for areas with predetermined land uses. The unit factors are multiplied by the number of dwelling units for residential categories, and by the gross acreages for non-residential categories, to yield the average daily demand projections.

4.5.1 Unit Factors for Residential and Non-Residential Land Uses

Domestic water demand unit factors are coefficients commonly used in planning level analysis to estimate future average daily demands for areas with predetermined land uses. The unit factors are multiplied by the number of dwelling units or gross acreages for residential categories, and by the gross acreages for non-residential categories, to yield the average daily demand projections.

Each customer account was geocoded and spatially joined within its pressure zone based on the City's current planning area boundaries using Geographic Information Systems (GIS). Geocoding is the process of finding associated geographic coordinates (often expressed as latitude and longitude) from street addresses. The customer accounts were grouped by land use type including single and multi-family residential, commercial, industrial, and others to determine the average amount of water use per account or per area.

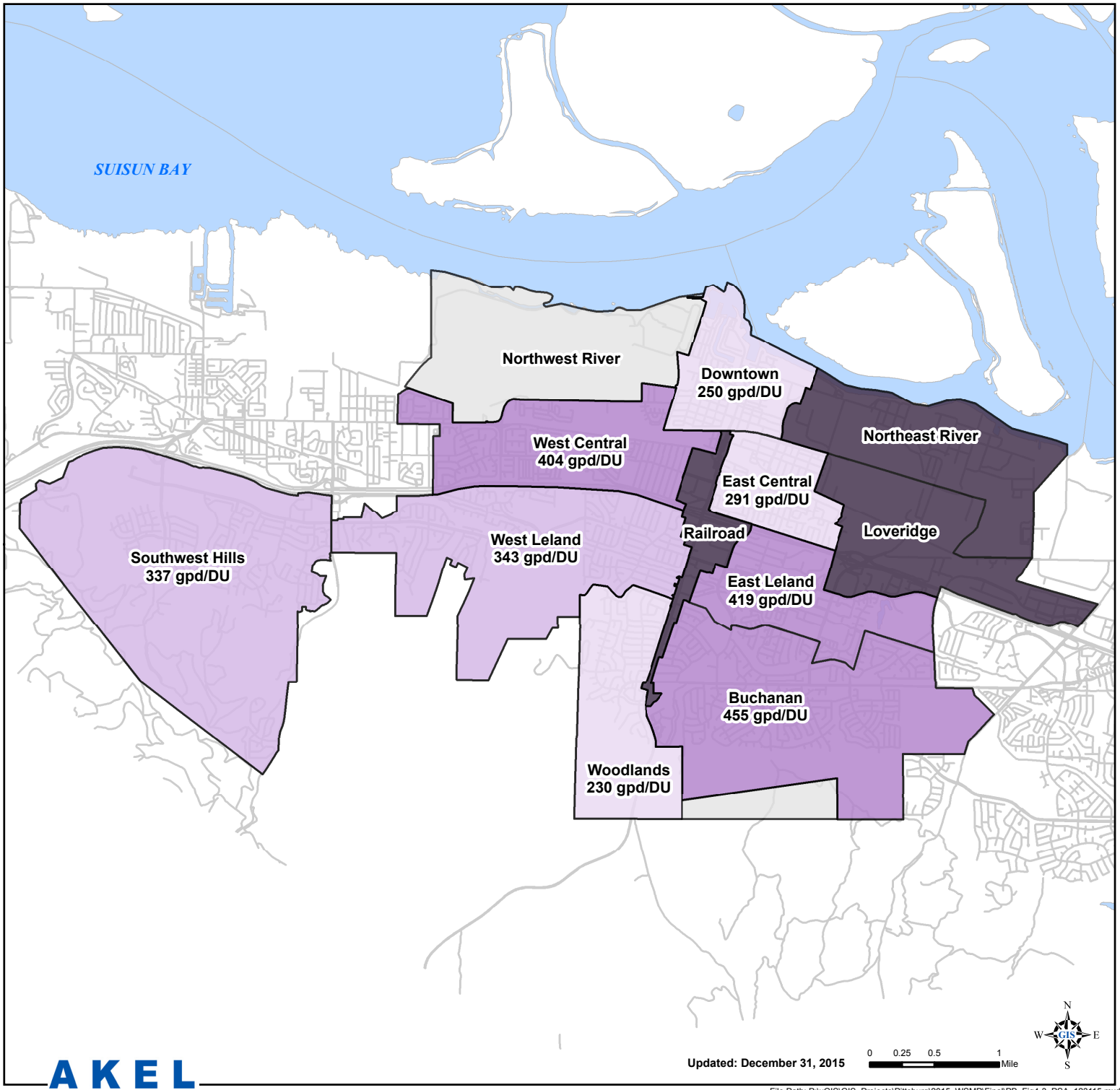
This analysis relied on the City's 2012 water billing records, which lists the monthly water demand for each serviced account in the City, to estimate the unit factors by planning areas as well as by pressure zone. The demand was adjusted to balance with 2013 production records, and to account for transmission main losses and vacancies in existing land uses. The demand unit factor was then calculated using the total water production and total number of residential and non-residential land use acreages.

These domestic demand unit factors were considered to be the more specific and more sensitive to changes in land use categories. These unit factors, summarized on **Table 4.2**, were used for projecting the City's future domestic water demands.

4.5.2 Average Water Consumption by Sub-Area and Pressure Zone

The demand unit factor for each planning area and pressure zone was then calculated using the total water production and total number of residential accounts. The demand unit factors for each planning sub-area and for each pressure zone are graphically summarized on **Figures 4.3** and **4.4**, respectively.

The analysis generally indicates that planning sub-areas with higher commercial and industrial land uses have higher unit factors than areas with higher percentage of residential land uses. The unit factor for the Downtown planning sub-area was estimated at 250 gallons per day per dwelling unit (gpd/DU), as compared 419 gpd/DU for the East Leland planning sub-area. The analysis



Legend

gpd/DU by Planning Sub-Areas

- 200 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- > 600
- Street Centerlines
- Water Bodies

Scale		
gpd/DU	gpm/DU	gpdc
200-300	0.14 - 0.21	67-100
300 - 400	0.21 - 0.28	100 - 133
401 - 500	0.29 - 0.35	134 - 167
501 - 600	0.36 - 0.42	168 - 200
> 600	> 0.42	> 200

Figure 4.3
Planning Sub-Area gpd/DU
Water System Master Plan
City of Pittsburg

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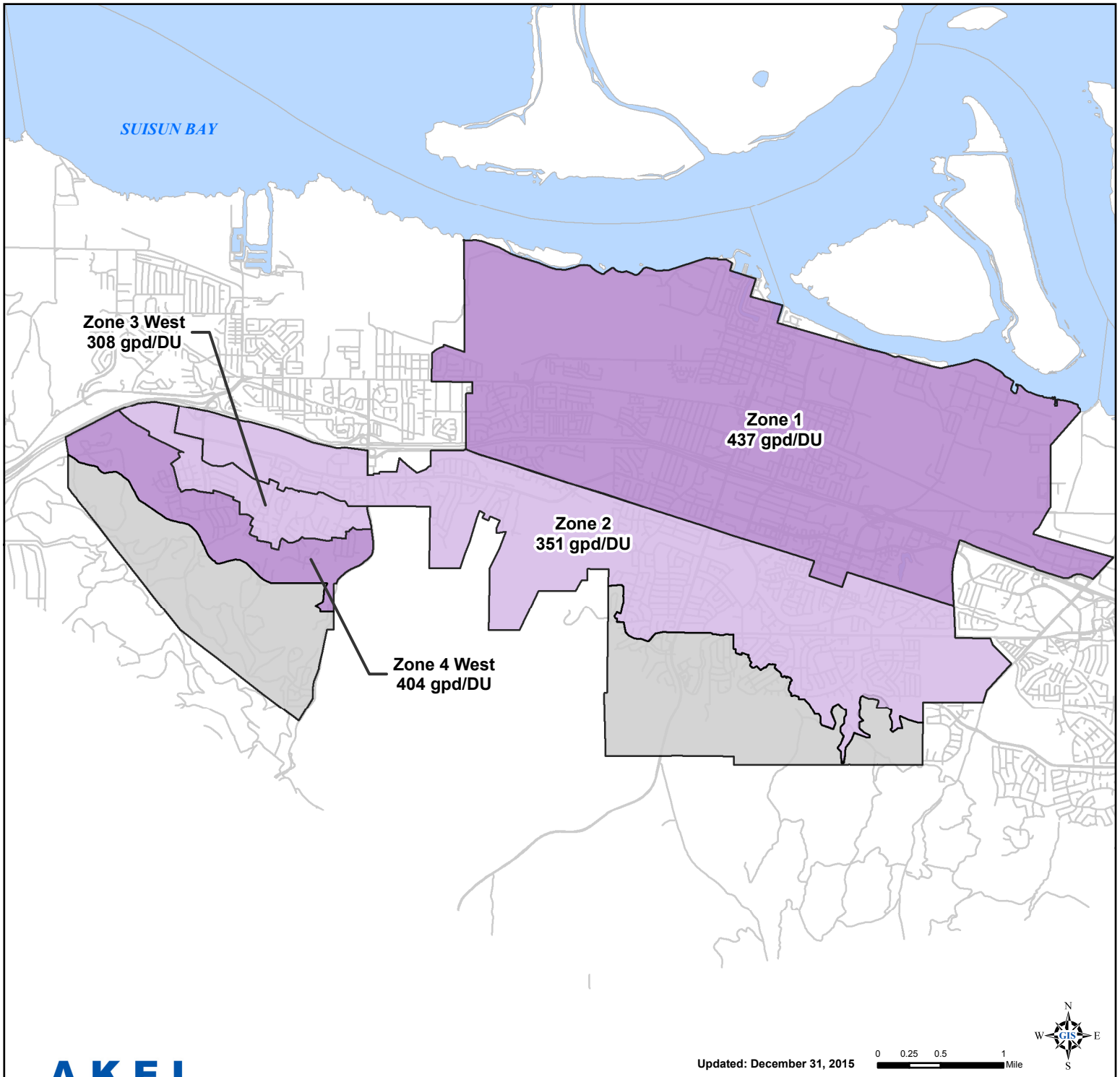

Legend

gdp/DU by Pressure Zone

- 300 - 400
- 401 - 500
- Street Centerlines
- Water Bodies

Scale		
gpd/DU	gpm/DU	gpdc
300 - 400	0.21 - 0.28	100 - 133
401 - 500	0.29 - 0.35	134 - 167

Figure 4.4
Pressure Zones
gpd/DU
Water System Master Plan
City of Pittsburg

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indicates that the Southwest Hills, which includes some of the newer subdivisions, had a unit factor of 337 gpd/DU (**Figure 4.3**).

This analysis confirmed that land use categories influence the domestic water demands. The unit factors discussed in this methodology are consolidated to include the low density residential, multi-family residential and non-residential domestic water demands. A more detailed analysis was subsequently performed to develop unit factors for the residential and non-residential land uses.

4.6 SEASONAL DEMANDS AND PEAKING FACTORS

Domestic water demands within municipal water systems vary with the time of day and month of the year. It is necessary to quantify this variability in demand so that the water distribution system can be evaluated and designed to provide reliable water service under these conditions.

Water use conditions that are of particular importance to water distribution systems include the average day demand (ADD), the maximum month demand (MMD), the maximum day demand (MDD), the peak hour demand (PHD), and the winter demand.

The average day demand represents the annual water demand, divided by 365 days, since it is expressed in daily units. The winter demand typically represents the low month water demands and is used for simulating water quality analysis.

4.6.1 Maximum Month Demand

The maximum month demand (MMD) is the highest demand that occurs within a calendar month during a year. The City's MMD usually occurs in the summer months in either July or August. The MMD is used primarily in the evaluation of supply capabilities.

Historical monthly water production records, obtained for the period between 2001 and 2013 (**Table 4.1**), indicate the maximum month to average month ratio ranging between 1.36 and 1.63. Over the reviewed period, this ratio neither showed significant increasing or decreasing trends. Though this value was not used in this master plan, an MMD of 1.5 seems to be representing the trends in the City of Pittsburg. The following equation is recommended for estimating the maximum month demand, given the average day demand:

Maximum Month Demand = **1.5** x Average Day Demand

4.6.2 Maximum Day Demand

The MDD is the highest demand that occurs within a 24 hour day during a year. The City's MDD, which usually occurs during the summer months, is typically used for the evaluation and design of storage facilities, distribution mains, pump stations, and pressure reducing valves. The MDD, when combined with fire flows, is one of the highest demands that these facilities should be able to service while maintaining acceptable pressures within the system.

The maximum day demands were also obtained from the City's water production records. Water treatment plant staff records indicate the date of occurrence and magnitude of the maximum day demand for each calendar year, as listed in **Table 4.1**. The maximum day to average day demand ratios for the period between 2001 and 2013 ranged from 1.55 to 2.16 and occurred in June, July, or August.

Through an analysis of these maximum day demands it was determined that a ratio of 1.8 would be used in this master plan. The following equation is then used to estimate the MDD, given the ADD:

Maximum Day Demand = **1.8** x Average Day Demand

4.6.3 Peak Hour Demand

The PHD is another high demand condition that is used in the evaluation and design of water distribution systems. The peak hour demand is the highest demand that occurs within a one hour period during a year. The peak hour demand is considered to be the largest single measure of the maximum demand placed on the distribution system. The PHD is often compared to the MDD plus fire flow to determine the largest demand imposed on the system for the purpose of evaluating distribution mains.

Consistent with the maximum day peaking factor, the peak hour demand factor was reduced proportionately in conjunction with recent water use trends. The PHD can then be calculated using the ADD and the following equation:

Peak Hour Demand = **2.8** x Average Day Demand

4.7 TRANSMISSION AND DISTRIBUTION MAIN CRITERIA

Transmission and distribution mains are usually designed to convey the maximum expected flow condition. In municipal water systems this condition is usually the greater of either the PHDor the MDD plus fire flow. The hydrodynamics of pipe flow create two additional parameters that are taken into consideration when evaluating or sizing water mains: head loss and velocity.

Head loss is a loss of energy within pipes that is caused by the frictional effects of the inside surface of the pipe and friction within the moving fluid itself. Head loss creates a loss in pressure which is undesirable in water distribution systems. Head loss, by itself, is not an important factor as long as the pressure criteria is not violated. However, high head loss may be an indicator that the pipe is nearing the limit of its carrying capacity and may not have sufficient capacity to perform under stringent conditions. The maximum head loss in pipes 14 inches in diameter and larger is 2 feet per 1,000 feet of pipe.

Since high flow velocities can cause damage to pipes and lead to high head loss, it is desirable to keep the velocity below a predetermined limit. The City criterion for maximum pipeline velocity is 5 feet per second for pipes 12 inches in diameter and smaller. This criterion also ensures that the

head loss is kept below an acceptable limit, as the head loss in a pipe is a function of the flow velocity. Flow velocities in transmission mains 14 inches and larger are governed by the head loss criteria.

A summary of the criteria pertaining to transmission and distribution mains is included in **Table 4.2**. The pipe roughness coefficients used for calculating head loss were based on industry standards for various pipe materials, based on the age of the pipe, and are listed in **Table 4.3**.

It should be noted that the headloss criteria in transmission mains may be relaxed, where feasible, to account for transmission main redundancy and reliability. Relaxing of the criteria requires the review and approval of the City Engineer. At specific locations in town, approval has been given by the City engineer to relax criteria due to redundancy in the distribution system.

4.8 TIME OF USE

Pacific Gas and Electric (PG&E) has defined peak use times of the year where a tiered system of energy rates are implemented to encourage decreased energy consumption. Time of use is implemented from May 1 through October 31, which coincides with the maximum day and peak hour demands in the water system. There are three stages of energy rates during summer time of use:

- **Off Peak:** This category is typically associated with the lowest energy costs and occurs from 9:30 PM to 8:30 AM.
- **Partial Peak:** This category has medium energy costs and is intended to minimize energy use when possible. It occurs from 8:30 AM to 12:00 PM, and again from 6:00 PM to 9:30 PM.
- **On Peak:** This is the highest cost category, and is intended to encourage users to avoid energy consumption whenever possible. It occurs from 12:00 PM to 6:00 PM.

City staff have been implementing time of use pumping, when possible, and in several pressure zones. In an effort to continue this practice, and reduce peak energy costs, the planning and design criteria has been updated to include time of use considerations for pressure zones above Zone 2. This criteria, documented in **Table 4.2**, applies to storage tanks and pump stations:

- **Storage Tanks:** Zones 3 and above will include the same criteria as discussed in Section 4.3, and will also include 6 hours of MDD volume to account for time of use.
- **Pump Stations:** Zones 3 and above will be sized to meet partial peak pumping (18 hour pumping) during MDD, with the largest unit out of service.

Table 4.3 Pipe Roughness Coefficients

Water System Master Plan

City of Pittsburg

Pipe Material	Age (years)					
	0	10	20	30	40	50
Asbestos Cement	125	125	125	125	125	125
Cast Iron	120	110	100	90	85	80
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	145	145	140	140	135	135
Steel	130	120	110	100	90	80

Note: 4/9/2014

1. At age=0, the roughness coefficients are commonly used values for new pipes. Roughness coefficients decrease with age at a rate that depends on pipe material. For planning purposes, the hydraulic analysis assumed an average pipe age of 15-20 years for both existing and future scenarios.
2. Pipes with an unknown material or age were assigned a roughness coefficient of 111 or 121.

CHAPTER 5 – DOMESTIC WATER DEMANDS

This chapter summarizes existing domestic water demands, identifies the recycled water demands, and projects the future domestic water demands.

5.1 EXISTING DOMESTIC WATER DEMANDS

The existing water demands used for this master plan were based on the City's 2012 water billing consumption records and water treatment plant production records. The water billing consumption records included the individual monthly demands for each customer account and the land use category for each account. The water treatment plant production records listed the total monthly historical production.

The existing demand distribution, by pressure zone, was obtained from the water billing records. Using GIS, each customer account was geocoded and spatially joined within its existing pressure zone. The accounts were then sorted by pressure zone and the total demand in each zone was calculated.

The demands extracted from the water billing records are lower than the total demands listed in the water treatment plant records due to system losses that occurred between the treatment plant and customer service connections. The total domestic water demands were increased proportionally to reflect the total 2013 production and account for transmission main losses.

The domestic water demands, for each pressure zone, are summarized on **Table 5.1**. The City's existing average day domestic water demand is calculated at 9.04 MGD.

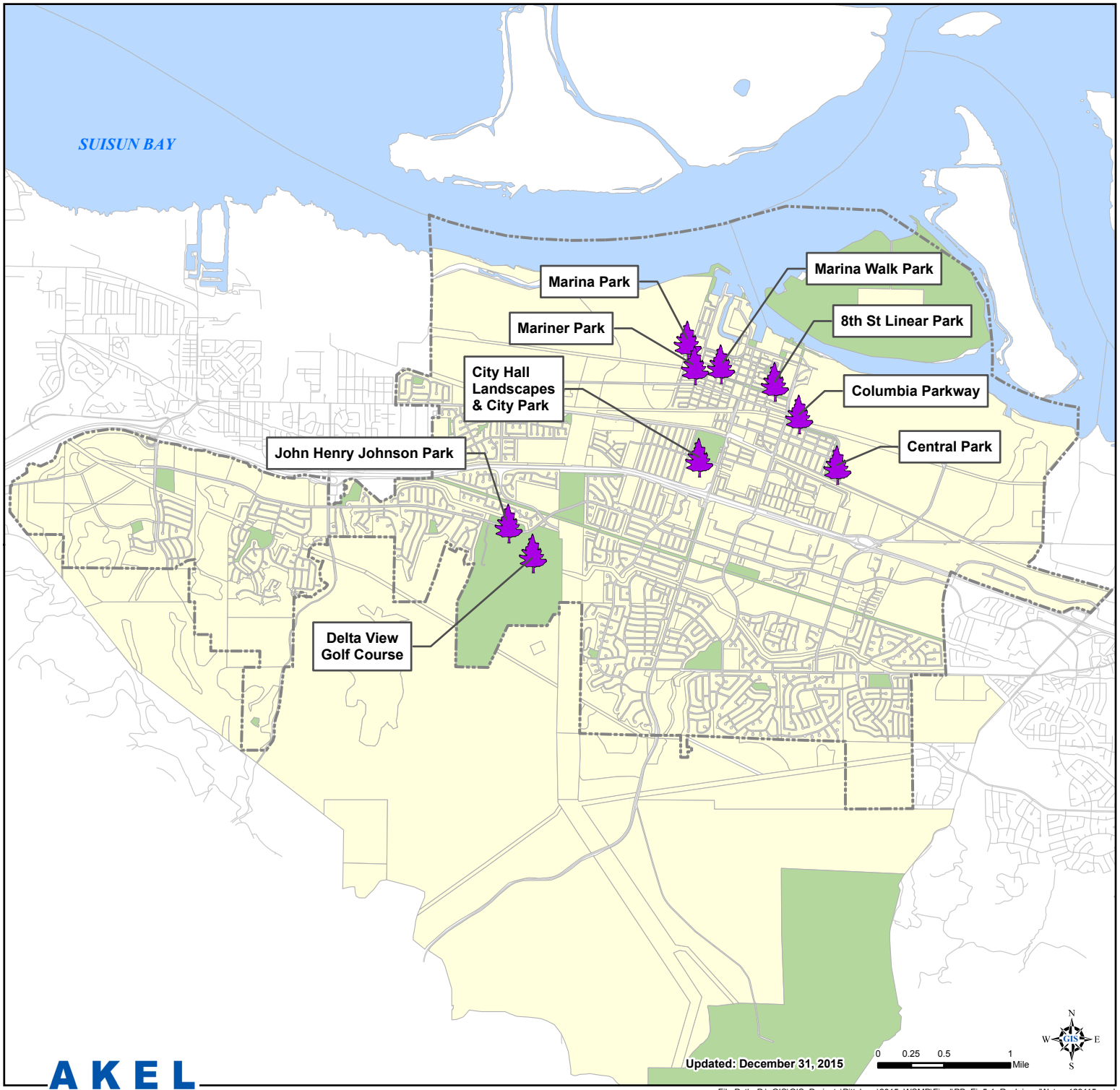
5.2 RECYCLED WATER DEMANDS

Several irrigated areas within the City are now serviced by an expanded recycled water system. The City currently serves the landscape irrigation requirements of four park areas with recycled water and was recently expanded to serve the landscape of the City Park, City Hall, Mariner Park, Stoneman North Park, and Delta View Golf Course (**Figure 5.1**). The recycled water system includes the irrigation demands.

5.3 FUTURE DOMESTIC WATER DEMANDS

Future demands were projected using the unit factors for residential and non-residential land uses and for each planned development. **Table 5.2** organizes the future developments, and their corresponding domestic water demands, into the following categories:

- Southwest Hills



Legend

- Reclaimed Water Deliveries
- General Plan Area
- Parks
- Street Centerlines
- City Limits
- Water Bodies

Figure 5.1
Reclaimed Water Users
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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Table 5.1 Existing Water Demands

Water System Master Plan
City of Pittsburg

Pressure Zone	Existing Water Demands		
	Average Day Demand[1] (MGD)	Maximum Day Demand[2] (MGD)	Peak Hour Demand[3] (MGD)
Zone 1	**4.79**	8.61	13.40
Zone 2 E & W	**3.14**	5.65	8.79
Zone 3 E	**0.46**	0.82	1.28
Zone 3 W	**0.38**	0.68	1.05
Zone 4 E			0.00
Zone 4 W	**0.28**	0.51	0.79
Total	**9.04**	**16.27**	**25.31**

4/9/2014

Note:

1. Total demand was adjusted to reflect the total production for 2013, from WTP records. The distribution is based on 2012 water billing records.

2. Maximum Day Demand = 1.8 x Average Day Demand

3. Peak Hour Demand = 2.8 x Average Day Demand

Table 5.2 Future Water Demands by Development

Water System Master Plan
City of Pittsburg

Development Name	Residential Dwelling Units		Commercial	Industrial	Loveridge Industrial	School	Park	Residential, Commercial, and Industrial Demands					
								ADD		MDD		PHD	
	Single Family (DU)	Multi-Family (DU)	(AC)	(AC)	(AC)	(AC) [7] (students) [8]	(AC)	(gpm)	(MGD)	(gpm)	(MGD)	(gpm)	(MGD)
Southwest Hills [1]													
Alves Ranch	167	393	5.1					119.1	0.17	214.5	0.31	333.6	0.48
Bailey Estates	249						2.0	64.1	0.09	115.4	0.17	179.5	0.26
Bay Point/ BART Expansion and Annex		1,000	1.1					188.8	0.27	339.8	0.49	528.6	0.76
De Bonneville	120							28.3	0.04	51.0	0.07	79.3	0.11
Faria	1,500							354.2	0.51	637.5	0.92	991.7	1.43
San Marco[10]	1,587					6.3	12.9	413.3	0.60	744.0	1.07	1157.4	1.67
The Villas at San Marco[10]		471	0.6					89.0	0.13	160.2	0.23	249.3	0.36
Toscana at San Marco	252							59.5	0.09	107.1	0.15	166.6	0.24
San Marco Village C		516						96.8	0.14	174.2	0.25	270.9	0.39
Esperanza at San Marco		300						56.3	0.08	101.3	0.15	157.5	0.23
San Marco Village O		58						10.9	0.02	19.6	0.03	30.5	0.04
Smith	150							35.4	0.05	63.8	0.09	99.2	0.14
Spilker	89							21.0	0.03	37.8	0.05	58.8	0.08
Vista del Mar[10]	469					11.3 [7]		118.6	0.17	213.5	0.31	332.0	0.48
West Coast Transit Village		525						98.4	0.14	177.2	0.26	275.6	0.40
Southeast Hills [2]													
Montreux	356						3.0	92.0	0.13	165.6	0.24	257.7	0.37
Thomas Ranch	255							60.2	0.09	108.4	0.16	168.6	0.24
Sky Ranch	415						1.5	102.0	0.15	183.5	0.26	285.5	0.41
Tuscany Meadows	917	365					5.4	299.3	0.43	538.7	0.78	838.0	1.21
Zones 1 and 2 Infills [3, 4, 5]													
Zone 1	595	2,330	-5.8	14		650 [8]		589.3	0.85	1060.7	1.53	1649.9	2.38
Zone 2	60	142	4.0			838 [8]		57.2	0.08	102.9	0.15	160.0	0.23
Loveridge Sub-Area [6]					233			194.2	0.28	349.5	0.50	543.7	0.78
Ambrose Park							12.3	32.7	0.05	58.8	0.08	91.5	0.13
NRG Power Plant				170				118.1	0.17	212.5	0.31	330.6	0.48
Total	**7,181**	**6,100**	**5**	**184**	**233**		**37**	**3,299**	**4.75**	**5,937**	**8.55**	**9,236**	**13.30**

Notes: 2/6/2015

1. Source: Information received from City staff, 1/22/09
2. Source: 2000 Water System Master Plan, Amendment No. 3, June 2007
3. Zone 1 Infill Sources:
   a. List of developments under construction and General Plan allowances from Sewer Master Plan Update Table from City Planning 2/14/09
   b. Appendix C of the 2007 WWCSMP
4. General Plan allowances replaced WWCSMP Land Use changes for basins listed in Sewer Master Plan Update Table from City Planning 2/14/09
5. Zone 2 Source:
   a. Information received from City staff, email dated 4/3/09
6. Source: Loveridge Sub-Area Master Plan, RBF Consulting, October 2008
7. Acreage for planned school
8. Planned increase in student population for respective zone infills
9. Park acreages may be designated to the Montecito, Faria, and Ridge Farms 1 development respectively at 6, 8, and 3 acres. This is based on the City parkland dedication requirements.
10. While building permits have been issued for San Marco, San Marco Village B, and Vista del Mar, recent aerial photography and water billing records indicate that water demands may yet to be fully realized in the distribution system. Buildout demands are used

- Southeast Hills
- Zones 1 and 2 Infills

The average day domestic water demands from these future developments is calculated at 4.38 MGD. These demands were used in sizing the future infrastructure facilities, including transmission mains, storage reservoirs, and booster stations. Demands were also used for allocating and reserving capacities in the existing or proposed facilities.

5.4 MAXIMUM DAY AND PEAK HOUR DEMANDS

The maximum day and peak hour demands for the existing and future demands were calculated using the average day demands and City peaking factor criteria. The maximum day to average day ratio of 1.8, and peak hour to average day ratio of 2.8, were applied to the average day demands to obtain estimates of the higher demand conditions.

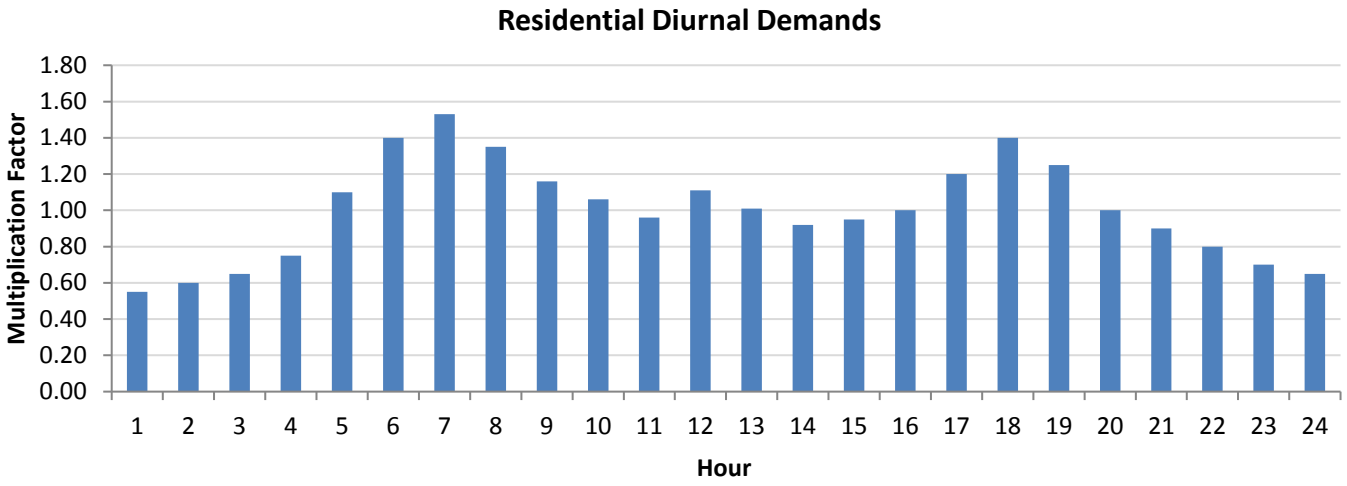
The maximum day and peak hour demands for the existing and future scenarios are listed in **Tables 5.1** and **5.2**, respectively. The existing maximum day and peak hour demands are calculated at 16.27 MGD and 25.31 MGD, respectively. The projected additional maximum day and peak hour demands anticipated from future developments are calculated at 7.89 MGD and 12.27 MGD, respectively. The projected total maximum day demand and peak hour demand are 24.16 MGD and 37.58 MGD respectively.

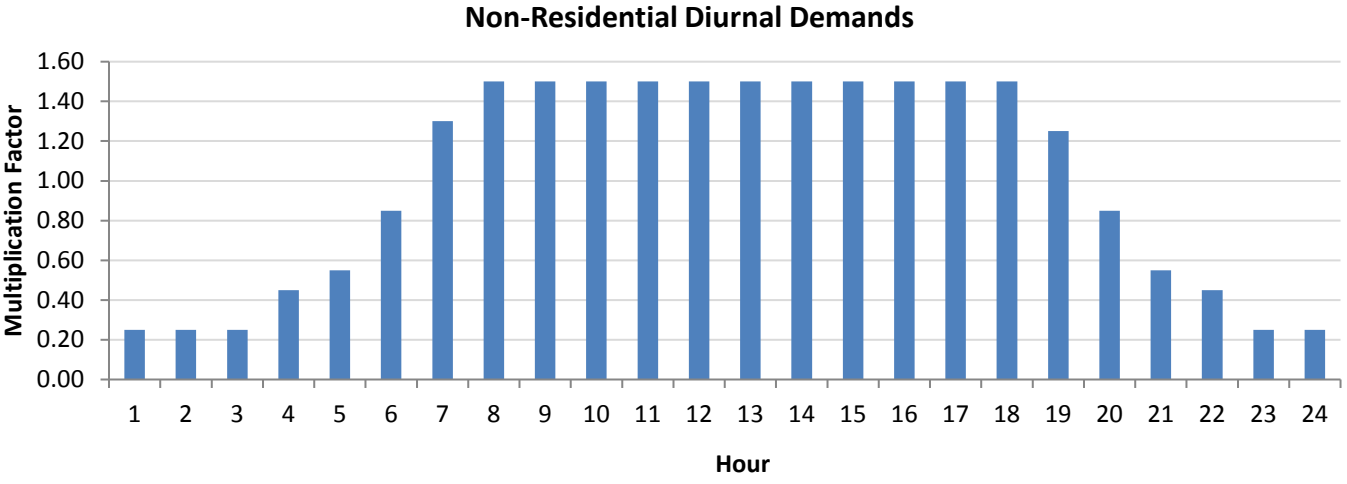
5.5 DIURNAL DEMAND PATTERNS

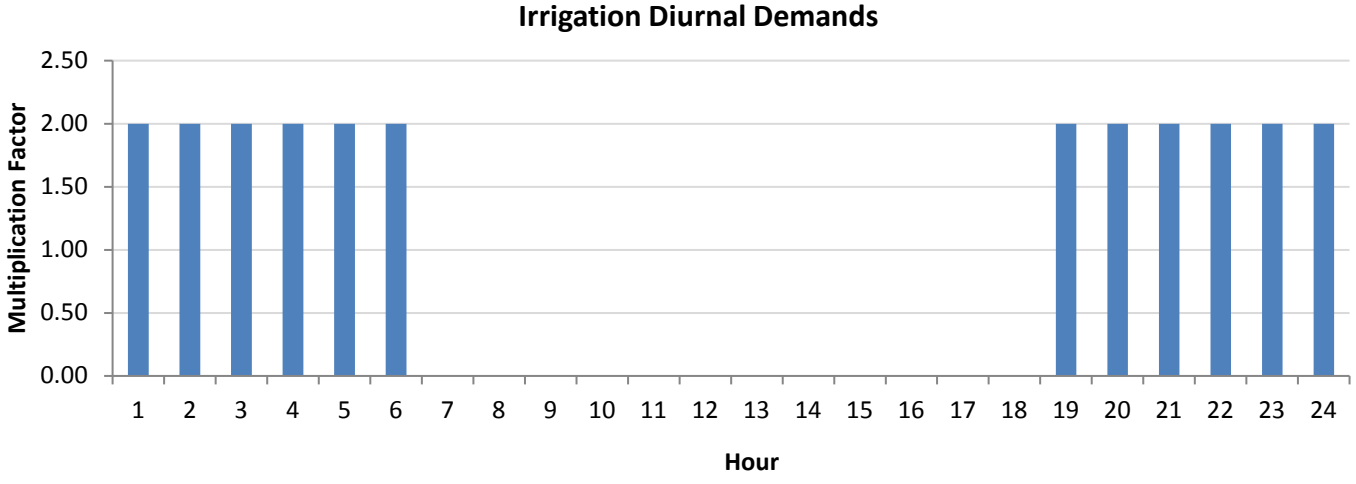
Water demands vary with the time of day and by account type according to the land use designation. These fluctuations were accounted for in the modeling effort and evaluation of the water distribution system. The diurnal demand patterns affect the water levels in storage reservoirs and amount of flow through distribution mains.

Three different diurnal curves (**Figure 5.2**) were used to model the demand patterns of 1) residential, 2) commercial, industrial, and non-residential, and 3) irrigation use accounts. In the absence of data that can be used to develop these curves, they were based on industry acceptable demand patterns for these corresponding land use types. The diurnal patterns were confirmed during the calibration effort of the City's hydraulic model and corresponding Supervisory Control and Data Acquisition (SCADA) information.

Each diurnal curve has a unique pattern that creates maximum and minimum flow conditions at different times of the day. Residential demands peak in the morning and evening and are at a minimum during the night hours. Commercial and industrial demands are also at a minimum during the night; however, they remain at a constant maximum from the hours of 8 AM to 6 PM. The irrigation demands are highest at night and lowest during the day.







LEGEND

4/9/2014

Figure 5.2
Diurnal Demand Curves
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC

CHAPTER 6 - HYDRAULIC MODEL

This chapter describes the development and calibration of the City's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.1 OVERVIEW

Hydraulic network analysis has become an effectively powerful tool in all aspects of water distribution planning, design, operation, management, emergency response planning, system reliability analysis, fire flow analysis, and water quality evaluations. The City's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.2 MODEL SELECTION

The City's hydraulic model combines information on the physical characteristics of the water system (pipelines, storage reservoirs) and operational characteristics (how they operate). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes and calculate pressures at nodes or junctions.

There are several network analysis software products that are released by different manufacturers, which can equally perform the hydraulic analysis satisfactorily. The selection of a particular software depends on user preferences, the distribution system's unique requirements, and the costs for purchasing and maintaining the software.

The City's previous model was developed using Innovyze's (formerly known as MWH Soft) H_2ONET, which only works inside another software: Autodesk's AutoCAD. Innovyze released the same software engine and functionality as a standalone product, H_2OMAP, which was used to develop the City's new hydraulic model. The model has an intuitive graphical interface and offers robust integration with ESRI's ArcGIS.

6.3 HYDRAULIC MODEL DEVELOPMENT

Developing the hydraulic model included skeletonization, digitizing and quality control, developing pipes and nodes databases, and water demand allocation.

6.3.1 Skeletonization

Skeletonizing the model refers to the process where pipes not essential to the hydraulic analysis of the system are stripped from the model. Skeletonizing the model is useful in creating a system that accurately reflects the hydraulics of the pipes within the system, while reducing complexities

of large systems, which will reduce the time of analysis while maintaining accuracy, but will also comply with limitations imposed by the computer program.

In the City of Pittsburg's case, skeletonizing was kept to a minimum due to the availability of information in the City's CAD sheets and GIS.

6.3.2 Pipes and Nodes

Computer modeling requires the compilation of large numerical databases that enable data input into the model. Detailed physical aspects, such as pipe size, pipe elevation, and pipe lengths contribute to the accuracy of the model.

Pipes and nodes represent the physical aspect of the system within the model. A node is a computer representation of a place where demand may be allocated into the hydraulic system, while a pipe represents the distribution and transmission aspect of the water demand. In addition, reservoir dimensions and capacities, pump station capacity and design head, and PRV settings were also included into the hydraulic model.

6.3.3 Digitizing and Quality Control

The City's existing domestic water distribution system was digitized in ArcGIS using several sources of data and various levels of quality control. The data sources included: 1) the City's existing system as maintained by staff in AutoCAD, and 2) a recently developed version of the water system in GIS.

After reviewing the available data sources, it was determined that it was best to develop a new GIS-based version of the system that can be verified by City staff. Thus, using the existing AutoCAD and GIS versions of the system, this project reconstructed the domestic water system in GIS. Resolving discrepancy in data sources was accomplished by graphically identifying each discrepancy and submitting it to engineering staff for review and comments. City comments were incorporated in the verified model.

6.3.4 Demand Allocation

Demand allocation consists of assigning water demand values to the appropriate nodes in the model. The goal is to distribute the demands throughout the model to best represent actual system response.

Allocating demands to nodes within the hydraulic model required multiple steps, incorporating the efficiency and capabilities of GIS and hydraulic modeling software. The water billing records, which contain usage and location, were geocoded to reflect actual and current water demands.

Domestic water demands from each anticipated future development, as presented in a previous chapter, were also allocated to the model for the purpose of sizing the required future facilities.

The demands from the southwest hills developments were divided by pressure zones. Infill areas and annexations were also included in the future demand allocation.

6.4 MODEL CALIBRATION

Calibration is intended to instill a level of confidence in the pressures and flows that are simulated, and it generally consists of comparing model predictions to field measured results, and making necessary adjustments. The calibrated hydraulic model was updated with system operational controls, and system operations at tanks and pump stations was verified for SCADA data obtained for 2013. The hydraulic model was thus validated for consistency with 2013 SCADA operations.

6.4.1 Calibration Methodology

The following sections describe the methodology that was used in the calibration of the hydraulic model.

Calibration Plan

A calibration plan was prepared for the newly developed hydraulic model and it consisted of identifying locations for installing temporary pressure loggers in the field. Each pressure logger was installed to monitor pressures for a period of one week. A total of 13 monitoring sites, installed throughout the distribution system, provided representative pressure readings for existing Pressure Zone1, Pressure Zone 2 East, Pressure Zone 2 West, Pressure Zone 3 East, and Pressure Zone 3 West. The calibration plan is shown on **Figure 6.1**.

Field Pressure Monitoring and SCADA

City staff conducted the field flow monitoring using in-house pressure loggers maintained and used by City staff. The pressure loggers were installed and measured at least seven days of pressure readings at each site. It should be noted that some sites were monitored for 14 days, as shown on **Table 6.1**. The table also identifies the size of the transmission main closest to the monitored site. The pressure loggers recorded a reading every 5-minutes and at the conclusion of the monitoring program, the data was downloaded and prepared for comparison with the model simulations.

In addition to field monitoring, actual operational data recorded by the SCADA system, and coinciding with the monitoring period, was extracted and used for calibration purposes. The SCADA information included tank levels for each existing tank.

EPS Calibration

Calibration can be performed for steady state conditions or for extended period simulations (EPS). In steady state calibration, the model is compared to field monitoring results consisting of a single value, such as a single hydrant test. EPS calibration consists of compared model predictions to diurnal operational changes in the water system. Operational settings for reservoirs, booster

SUISUN BAY

P1-1
Range Rd
& Polaris Dr 10"

P1-2
Bay Side Dr
& Marina Blvd 10"

P1-3
Railroad Ave
& Civic Ave 18"

P1-4
Loveridge Rd
& Leland Rd 16"

P1-5
Century Blvd 0.5 miles West
of Auto Center Dr 16"

P1-6
Betty Ln
& Leland Rd 12"

P1-7
Pittsburg Antioch Hwy
& 14th St 18"

P2-1
Crestview Dr
& Chatworth Ave 18"

P2-2
Ventura Dr
& Norine Dr 6"

P2-3
Oak Hills Dr
& Leland Rd 16"

P2-4
Ventura Dr
& Canyon Oaks Cir 16"

P3-1
Railroad Ave
& Castlewood Dr 10"

P3-2
Southwood Dr
& Fieldgate Dr 16"

Zone 1
195'

Zone 2
385'

Zone 3E
490'

Zone 3W
491'

Zone 4E
613'

Zone 4E
Sky Ranch
570'

Zone 3E
Sky Ranch
459'

Zone 4W
628'

Zone 5
763'

Zone 6
867'

Zone 7

Zone 8
1011'

Zone 7
900'

Zone 5

Zone 6

Legend

- Pressure Loggers

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations

Pipes

- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 4 West
- Pressure Zones
- Street Centerlines
- Water Bodies

Figure 6.1
Calibration Locations

Water System Master Plan
City of Pittsburg

Updated: December 31, 2015

0 0.25 0.5 1 Mile

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Table 6.1 Pressure Logger Monitoring Plan

Water System Master Plan
City of Pittsburg

Location Number	Description	Pipe Size (in)	Monitoring Date	Data Interval (minutes)	Duration (Days)
P1-1	Range Road & Polaris Drive	10	8/06/08 to 8/20/08	5	14
P1-2	Bay Side Drive & Marina Boulevard	10	8/06/08 to 8/20/08	5	14
P1-3	Railroad Avenue & Civic Avenue	18	8/06/08 to 8/20/08	5	14
P1-4	Loveridge Road & Leland Road	16	7/30/08 to 8/06/08	5	7
P1-5	Century Boulevard & 0.5 miles west of Auto Center Drive	16	7/30/08 to 8/06/08	5	7
P1-6	Betty Lane & Leland Road	12	7/30/08 to 8/06/08	5	7
P1-7	Pittsburg Antioch Highway & Colombia	18	7/30/08 to 8/06/08	5	7
P2-1	Crestview Drive & Chatworth Ave	18	7/30/08 to 8/06/08	5	7
P2-2	Ventura Drive & Norine Dr.	6	8/20/08 to 8/27/08	5	7
P2-3	Oak Hills Drive & Leland Road	16	8/20/08 to 8/27/08	5	7
P2-4	Ventura Drive & Canyon Oaks Circle	16	8/20/08 to 8/27/08	5	7
P3-1	Railroad Avenue & Castlewood Drive	10	8/06/08 to 8/20/08	5	14
P3-2	Southwood Drive & Fieldgate	16	8/20/08 to 8/27/08	5	7

Note: 4/9/2014

1. Calibration plan and pressure logger locations were developed as part of the 2010 WSMP, and the results are considered valid for this update.

stations, and PRVs are listed in a previous chapter and were used to establish the operational parameters of the hydraulic model.

The calibration process was iterative and resulted with satisfactory comparisons between the field measurements and the hydraulic model predictions at the 13 sites and at the storage reservoirs. The calibration results were graphically summarized for each site and included in **Appendix C**. Representative extracts from **Appendix C** are shown on **Figure 6.2** for two flow monitored sites, and **Figure 6.3** for two storage reservoirs.

Calibration Verification

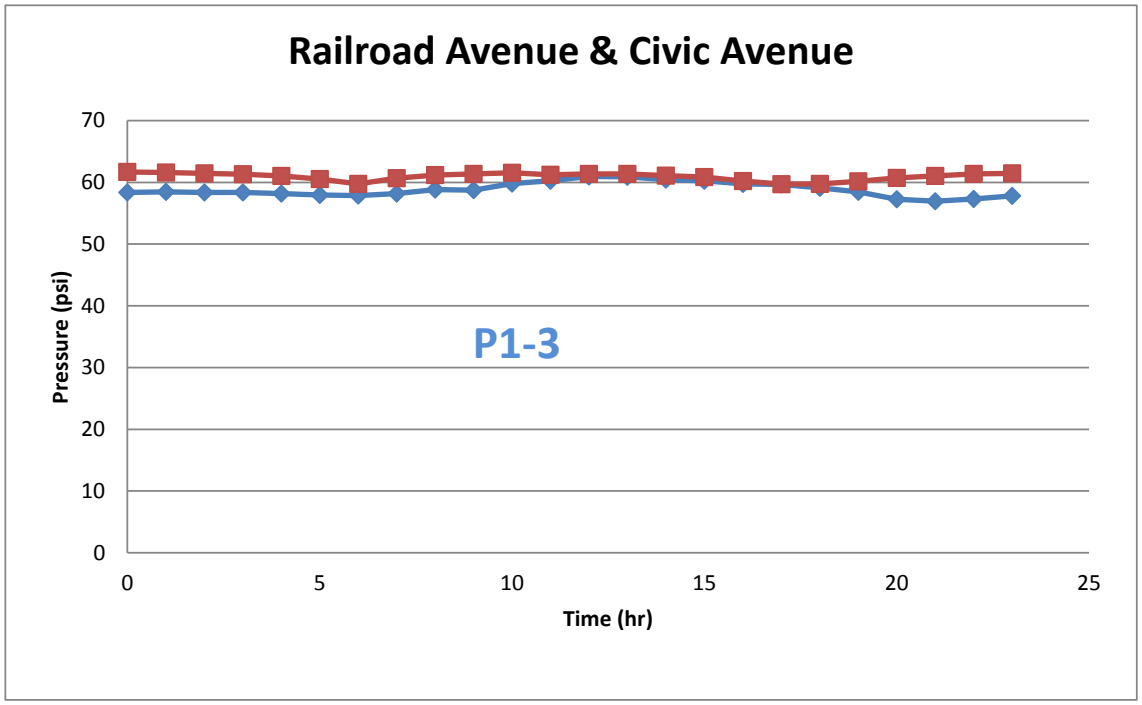
The hydraulic model was calibrated during the preparation of the 2010 WSMP, and has been continuously updated since the adoption of the 2010 WSMP. Several special studies included localized calibration, including comparisons of field pressures with the hydraulic model at selected locations.

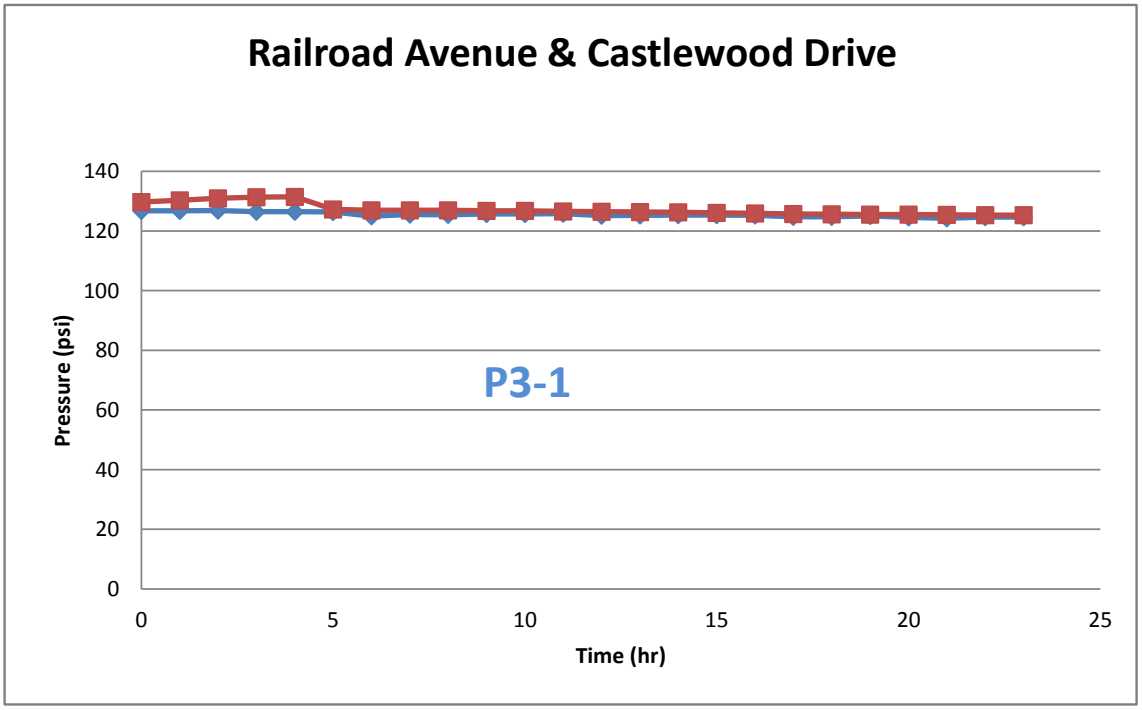
Additionally, this master plan included a new and thorough comparison between the 2013 operations, as recorded by SCADA for tanks and booster stations, and the hydraulic model. The comparison reconfirmed the consistency of the model in predicting the system's behavior under various operational conditions.

6.4.2 Use of the Calibrated Model

The updated hydraulic model was used as an established benchmark in the capacity evaluation of the existing water distribution system. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth.

This valuable investment will continue to prove its value to the City as future planning issues or other operational conditions surface. It is recommended that the model be maintained updated with recent construction to preserve its integrity.





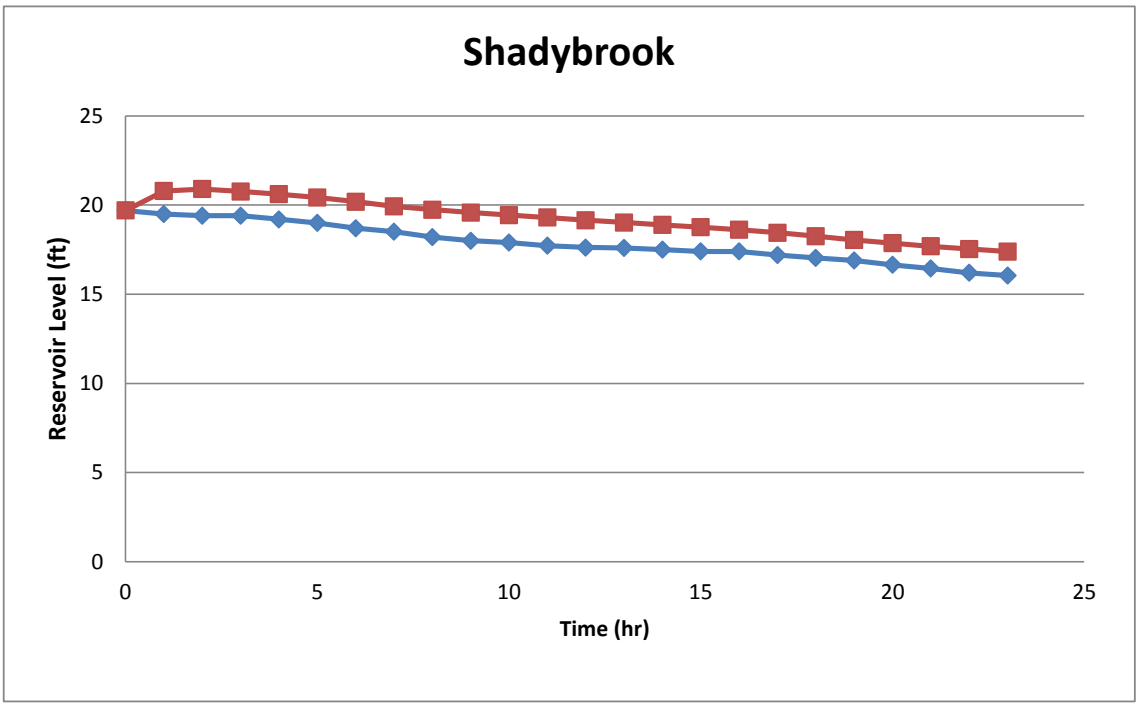
LEGEND

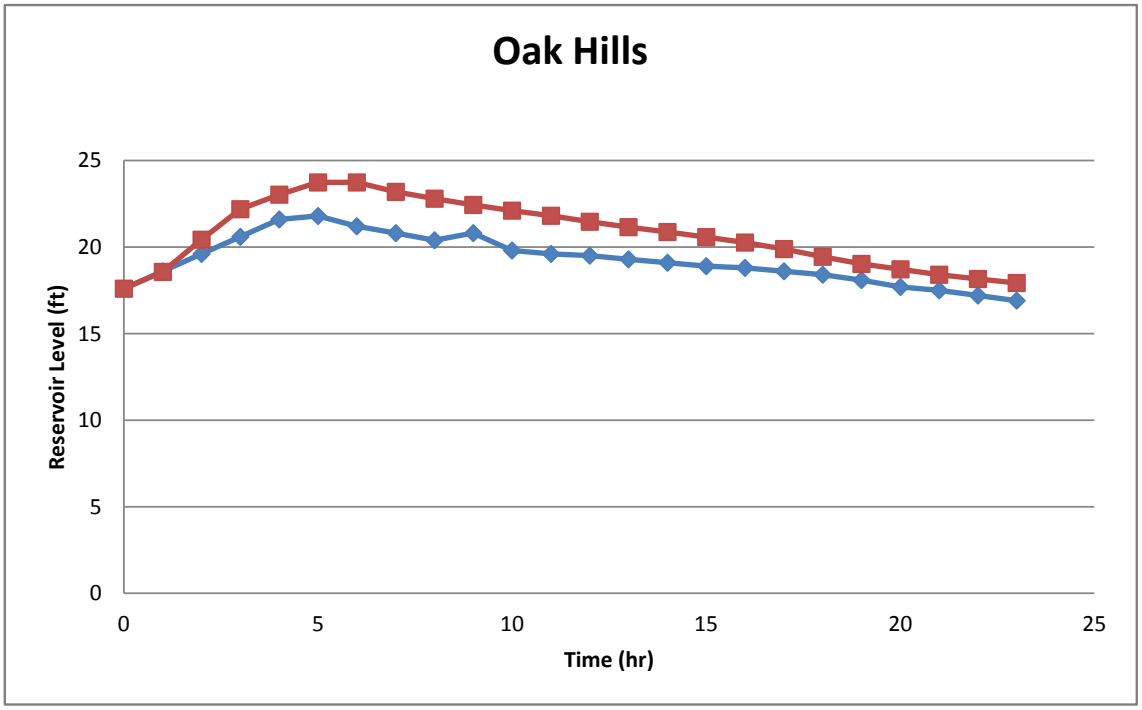
8/7/2008 Model

December 31, 2015

Figure 6.2
Pressure Loggers 1-3 and 3-1
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.





LEGEND

City Data Model

December 31, 2015

Figure 6.3
Shady Brook and Oak Hills
Reservoir Levels
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

This section presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies, as well as improvements needed to expand the system and service growth.

7.1 OVERVIEW

The calibrated hydraulic model was used for evaluating the distribution system for capacity deficiencies during PHD and during MDD in conjunction with fire flows. Since the hydraulic model was calibrated for extended period simulations, the analysis duration was established at 24 hours for most analyses, and 48-hours for some.

The criteria used for evaluating the capacity adequacy of the domestic water distribution system facilities (transmission mains, storage reservoirs, and booster stations) was discussed and summarized in the System Performance and Design Criteria chapter.

7.2 FIRE FLOW ANALYSIS

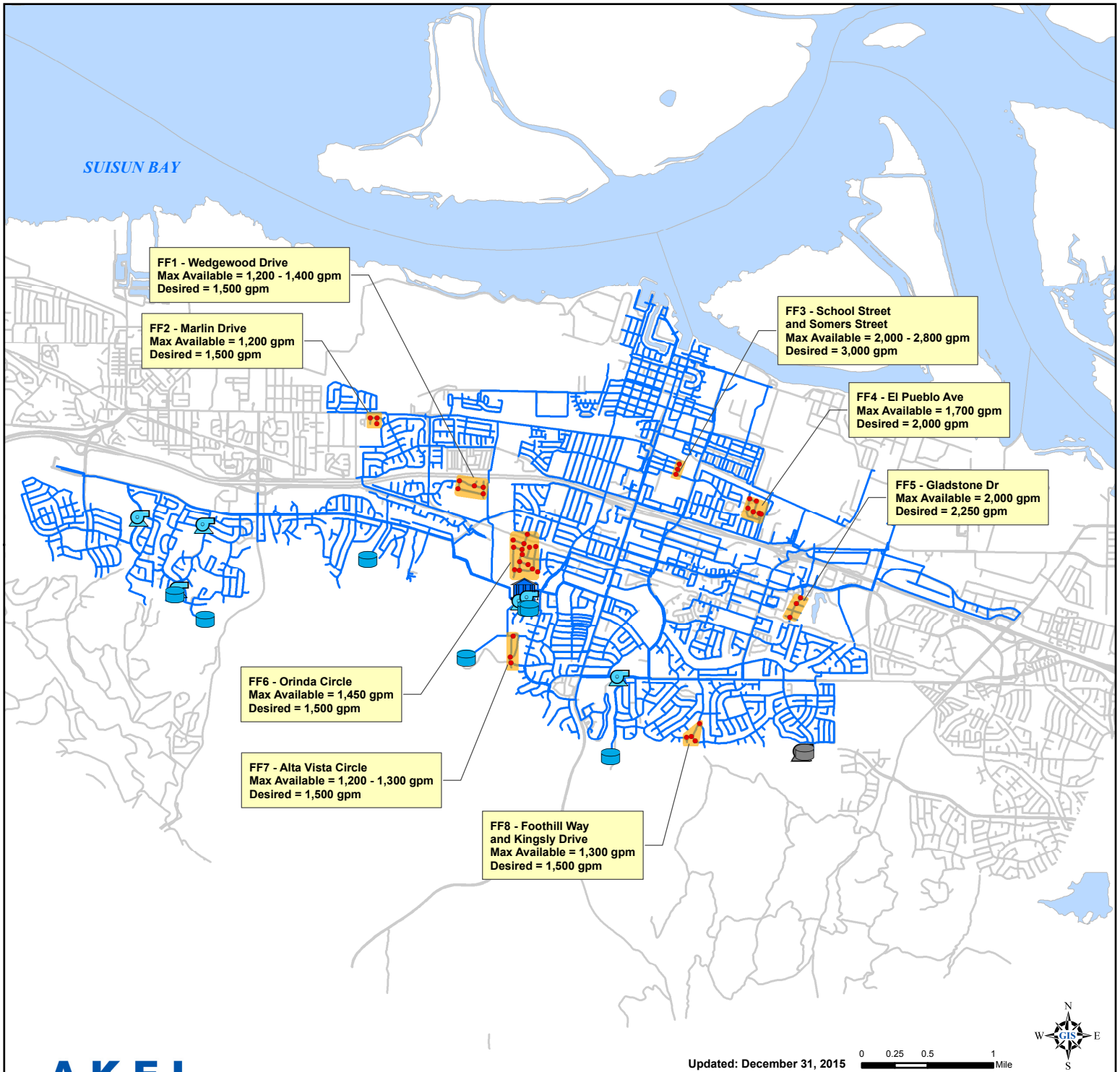
The fire flow analysis consisted of using the MDD in the hydraulic model and applying hypothetical fire flows. The magnitude and duration of each fire flow was based on the governing land use type within proximity to the fire location. The criteria for fire flows was also summarized in the System Performance and Design Criteria chapter.

The hydraulic model indicates that the City's existing distribution system performed reasonably well during the fire flow analysis with the few exceptions noted on **Figure 7.1**, and described in the following sections.

7.2.1 Existing System - Pressure Zone 1

The hydraulic model indicates that the following areas did not meet fire flow requirements in this pressure zone:

- **FF1.** Wedgewood Drive: The desired fire flow at 20 psi is 1,500 gpm while the maximum available flow ranges between 1,200 and 1,400 gpm.
- **FF2**. Marlin Drive: The desired fire flow at 20 psi is 1,500 gpm while the maximum available flow is 1,200 gpm
- **FF3.** School Street and Somers Street Intersection: The desired fire flow at 20 psi is 3,000 gpm while the maximum available flow ranges between 2,000 gpm and 2,800 gpm.



Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- Pipes
- Junctions Below Fire Flow Criteria
- Street Centerlines
- Water Bodies

Figure 7.1
Existing Fire Flow Analysis
(Max Day + Fire)
Water System Master Plan
City of Pittsburg

Updated: December 31, 2015

AKEL ENGINEERING GROUP, INC.

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- **FF4**. El Pueblo Avenue: The desired fire flow at 20 psi is 2,000 gpm while the maximum available flow is 1,700 gpm.
- **FF5.** Gladstone Drive: The desired fire flow at 20 psi is 2,250 gpm, while the maximum available flow is 2,000 gpm.

7.2.2 Existing System - Pressure Zone 2

The hydraulic model indicates that the following area did not meet fire flow requirements in this pressure zone:

- **FF6.** Orinda Circle: The desired fire flow at 20 psi is 1,500 gpm while the maximum available flow is 1,450 gpm.

7.2.3 Existing System - Pressure Zone 3

The hydraulic model indicates that the following areas did not meet fire flow requirements in this pressure zone:

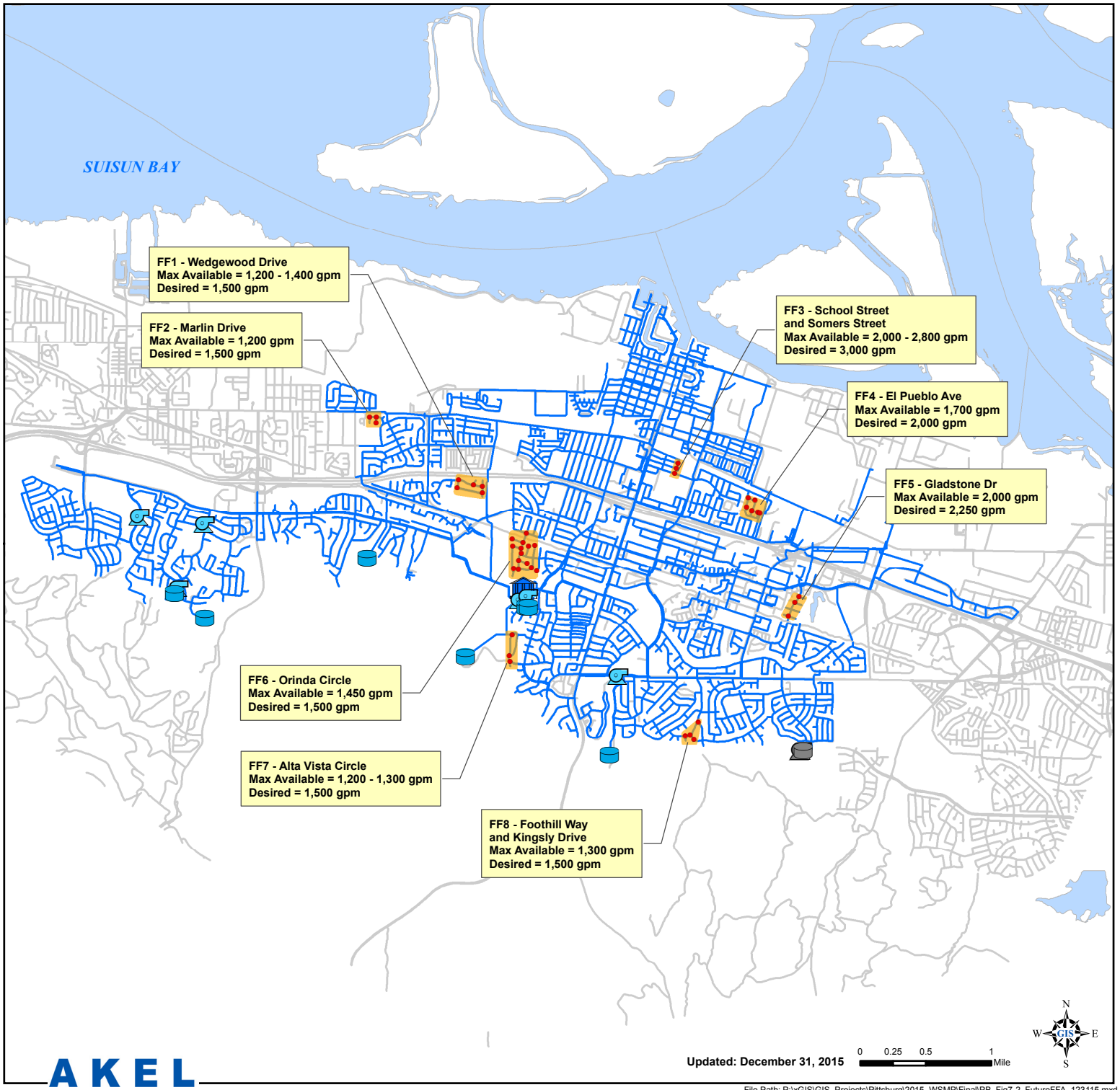
- **FF7.** Alta Vista Circle: The desired fire flow at 20 psi is 1,500 gpm while the maximum available flow ranges between 1,200 gpm and 1,300 gpm. In lieu of paralleling the existing 6-inch main, this deficiency can be mitigated by constructing a PRV from the lower pressure Zone 2 to pressure Zone 3. The PRV may be located near the intersection of Crestview Drive and Alta Vista Circle, or along the existing transmission main from the Stoneman Reservoir.
- **FF8.** Foothill Way and Kingsley Drive Intersection: The desired fire flow at 20 psi is 1,500 gpm while the maximum available flow is 1,300 gpm.

Additionally, the existing 8-inch main on Zion Avenue, between Laguna Circle and Oakdale Place, experiences high velocities during simulations of residential fire flows in this eastern most portion of Zone 3 East. Though pressures are acceptable, the pipe velocity reaches 10 feet per second during fire flows. It should be noted that this main lies within an easement.

7.2.4 Future System

Future transmission main, storage, and booster station improvements, required for servicing future growth, were added to the fire flow analysis to determine if they will mitigate the fire flow analysis deficiencies. The future improvements do not help to mitigate the fire flow deficiencies, and the deficiencies (**Figure 7.2**) will require specific improvements.

This study identified specific improvements needed to mitigate the existing fire flow deficiencies. These improvements are not significant and consist of upsizing several segments of distribution mains or looping connectivity to enhance the pressures and meet the fire flow requirements.



Legend

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- Pipes
- Junctions Below Fire Flow Criteria
- Street Centerlines
- Water Bodies

Figure 7.2
Future Fire Flow Analysis (Max Day + Fire)
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Pittsburg\2015_WSMP\Final\PB_Fig7-2_FutureFFA_123115.mxd

The improvements are graphically shown on **Figure 7.3** and listed in the capital improvement program chapter of this report.

7.3 LOW PRESSURES ANALYSIS

The hydraulic model was also used to determine if the existing domestic water distribution system meets the City's System Performance and Design Criteria, as discussed in a previous chapter. During MDD the minimum pressure requirement is 40 psi, while during the peak hour demand, the minimum pressure requirement is 35 psi.

Two main areas within Pressure Zone 1, were identified to experience low pressure conditions, below the City's design criteria, during either MDD or PHD, as shown on **Figure 7.4**. The existing PRVs from Pressure Zone 2 are intended to respond to these low pressure conditions.

It should be noted that while not mitigating these low pressure areas, enhanced operations of the Zone 1 reservoir levels may reduce the need for the PRVs during these peak demand periods. The hydraulic model indicates that operations of the PRVs can be reduced with the following tank water levels:

- Maximum Day Demand: Maintain water levels in Pressure Zone 1 Tanks above 15 feet
- Average Day Demand: Maintain water levels in Pressure Zone 1 Tanks above 10 feet.

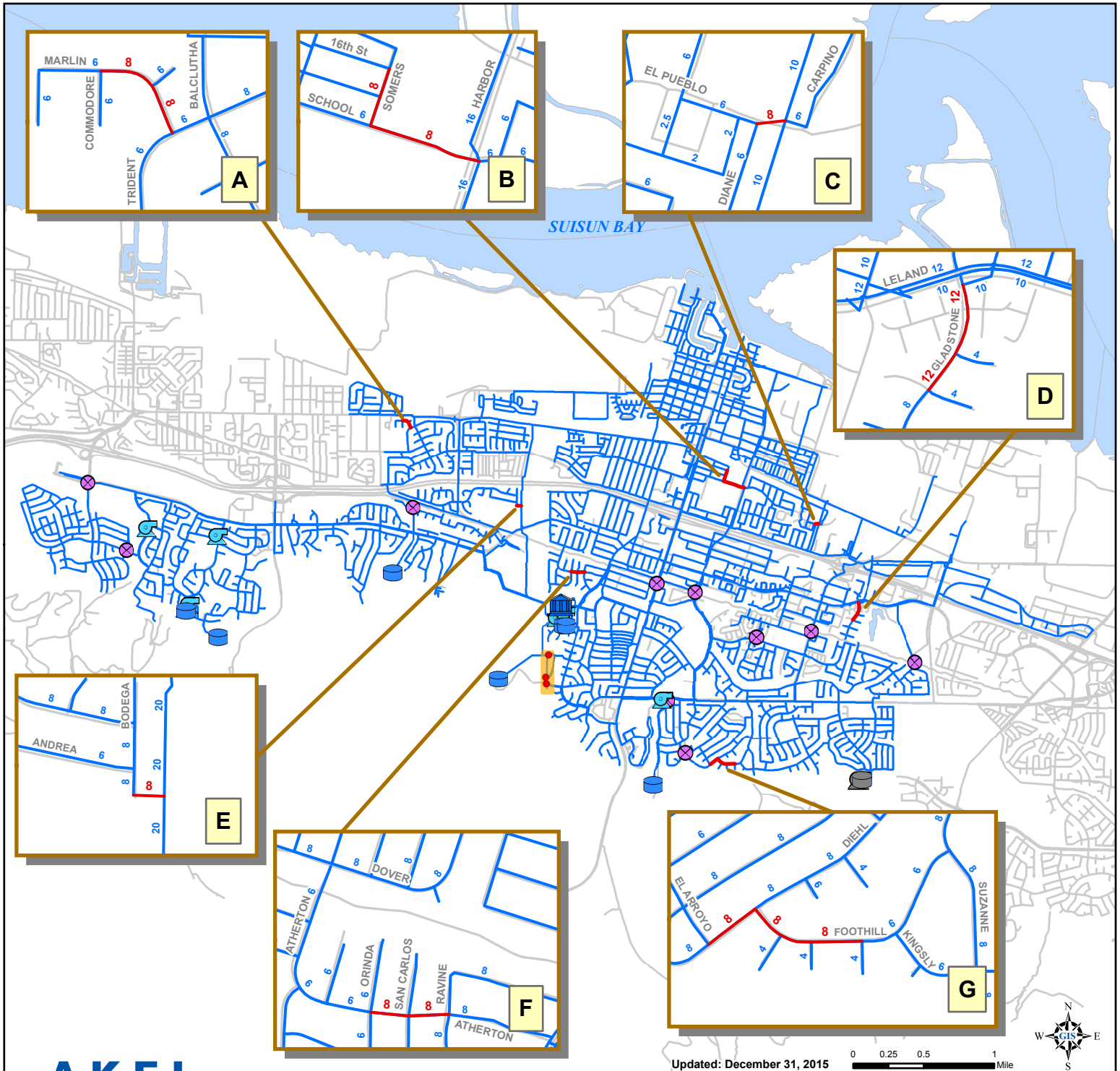
7.3.1 Area 1 – Pressure Zone 1 (Stoneman West and Small World Park)

This area is generally bound by Crestview Drive on the west, Highway 4 on the north, Piedmont Way on the east, and the Delta De Anza Trail on the south. The area, which includes Stoneman West Park and Small World Park, is located along the upper elevations of Pressure Zone 1, and thus experiences some of Pressure Zone 1's lowest pressures.

Transmission main reinforcements or upgrades do not mitigate the low pressure conditions in this area. Instead, a new pressure zone (Pressure Zone 1.5), as discussed in the 2010 Water System Master Plan, may be necessary.

Establishing a new "Pressure Zone 1.5 East" to service this area can be accomplished by either of the following options: Supply from Pressure Zone I, or supply from Pressure Zone II. Development of a Pressure Zone 1.5 East does not necessitate an increase in the proposed new 16 inch transmission main on Buchanan Road.

Option 1 – Pressure Zone 1.5 East with Supply from Pressure Zone 1 via New Booster Station. In this alternative, a Pressure Zone 1.5 East booster station is constructed with a firm capacity of approximately 400 gpm, with an additional 3,500 gpm fire flow pump to account for an industrial fire flow. It should be noted that the 20-inch Zone 1 transmission main that transverses this area should remain dedicated to servicing Zone 1, and necessary pipe appurtenances should be installed to bypass this main, and service Pressure Zone 1.5 East.



Legend

Proposed

- Pipes

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Junctions Below Fire Flow Criteria
- Street Centerlines
- Water Bodies

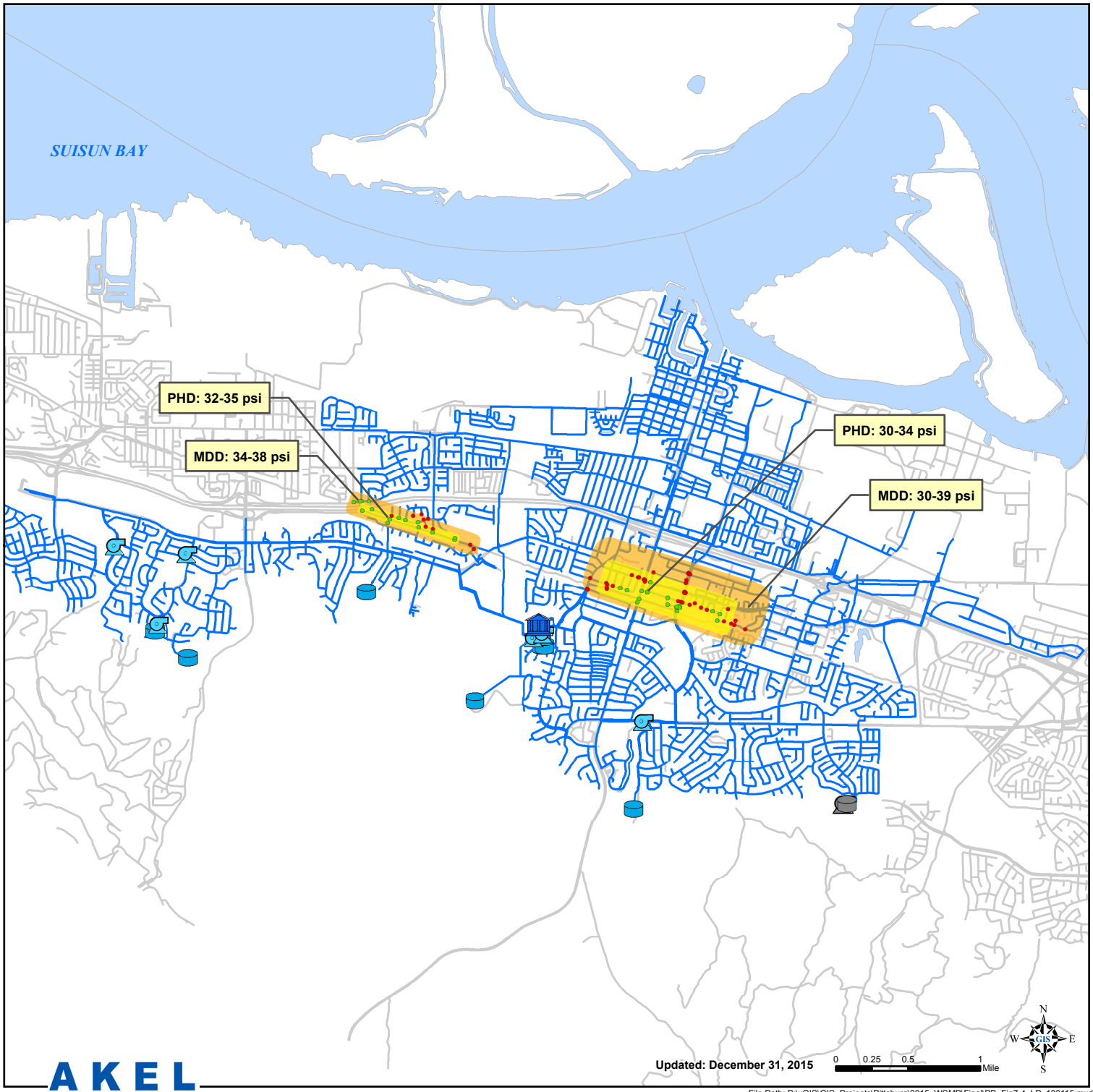
Figure 7.3
Fire Flow Improvements

Water System Master Plan
City of Pittsburg

Updated: December 31, 2015

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Pittsburg\2015_WSMP\Final\PB_Fig7-3_FutureFFwImp_123115.mxd



Legend

Low Pressures

- Peak Hour Demand Junctions
- Max Day Demand Junctions
- Peak Hour Demand Pressures (psi)
- Max Day Demand Pressures (psi)

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- Pipes
- Street Centerlines
- Water Bodies

Figure 7.4
Low Pressures
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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In previous studies, this option relied on the continued use of the Highlands 1.0 MG tank in Zone 2. This tank, however, is planned to be decommissioned with new development in the northeast. As a result, a booster-fed Pressure Zone 1.5 East would require the use of a hydro-pneumatic system. It is also recommended that the pumps installed utilize a variable frequency drive to maintain constant pressure to the new zone.

Option 2 – Pressure Zone 1.5 East with Supply from Pressure Zone 2 via new Pressure Reducing Station(s). In this alternative, supply is conveyed via the proposed new transmission main on Crestview Drive and Buchanan Road. In lieu of a separate booster station identified in the previous alternative, this alternative can rely on the Water Treatment Plant Pump Stations. The proposed new transmission main along Crestview Drive and Buchanan Road can be used for conveying the additional 400 gpm to service this new zone.

7.3.2 Area 2 – Pressure Zone 1 (Birchwood Drive)

This area is generally bound by the Delta de Anza Trail on the south, the Rancho Way extension on the west, Highway 4 on the North, and Leland Road on the East. Like the Stoneman Park and Small World Park area, this area is also located along the upper elevation of Pressure Zone 1 and does not noticeably benefit from upsizing or reinforcing transmission mains. Like Area 1, this area will also benefit most from creating another Pressure Zone 1.5 West. This area's estimated MDD is 150 gpm.

Pressure Zone 1.5 West with Supply from Pressure Zone 2 via New PRV. In this alternative, a new main is needed to extract water from Pressure Zone 2. A new PRV can be constructed near the location of the existing Birchwood PRV, located west of Resling Court. The PRV will tap the Pressure Zone 2 distribution system, and extend service to the new Pressure Zone 1.5 West. An 8-inch main needs to be constructed from the new PRV to Wedgewood Drive. The existing mains in Pressure Zone 1.5 will be isolated with valve closures, from Pressure Zone 1. If Pressure Zone 1.5 is constructed, the need for CIP fire flow improvement FF1-6 will be mitigated.

7.4 STORAGE ANALYSIS

The City's existing domestic water system storage capacity, required to meet the storage criteria, as identified in the System Performance and Design Criteria chapter is identified in this section. This section identifies the existing and future storage requirements to meet the storage capacity, then compares it with the existing storage facilities in each zone and makes recommendations for new storage facilities.

7.4.1 Existing Storage Requirements

Existing storage requirements were identified for each existing pressure zone and are summarized in **Table 7.1**. The table lists the existing domestic water demands, excludes the recycled water demands, and identifies the operation, fire and emergency storage for each pressure zone.

Table 7.1 Existing Storage Requirements

Water System Master Plan
City of Pittsburg

Pressure Zone	Existing Water Demands		Existing Water Storage Requirements					
	Average Day Demand	Maximum Day Demand[1]	Operational at 25%	Emergency at 50%	Fire Protection [2]	Time of Use	Operational + Emergency + Time of Use	Total, By Pressure Zone
	(MGD)		(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
Zone 1	4.79	8.61	2.15	4.31	0.65	-	6.46	7.11
Zone 2 E & W	3.14	5.65	1.41	2.83	0.54	-	4.24	4.78
Zone 3 E	0.46	0.82	0.21	0.41	0.54	0.21	0.82	1.36
Zone 3 W	0.38	0.68	0.17	0.34	0.18	0.17	0.68	0.86
Zone 4 E								
Zone 4 W	0.28	0.51	0.13	0.25	0.24	0.13	0.51	0.75
Total	**9.04**	**16.27**	**4.07**	**8.14**	**2.15**		**12.71**	**14.86**

Note:

6/18/2014

1. Maximum Day Demand = 1.8 x Average Day Demand
2. Fire Protection requirement represents largest fire requirement for each zone, based on account types listed in water billing records
3. Total demands reflect the average day production and escalated using the peaking factor. The distribution is based on 2012 water billing records.

The table also lists the total required storage for existing domestic water demands at 15.36 MG.

7.4.2 Future Storage Requirements

Future storage requirements were identified based on the known future developments, in each existing and future pressure zone, as shown on **Table 7.2**. The table lists the future domestic water demands and identifies the operation, fire and emergency storage for each pressure zone. For water quality reasons in the Hillview tank, the water demand for the Montreux development is accounted for in the Zone 2 East new Highlands tank.

The table also lists the total required storage for future domestic water demands at 9.84 MG.

7.4.3 Recommended New Storage Facilities

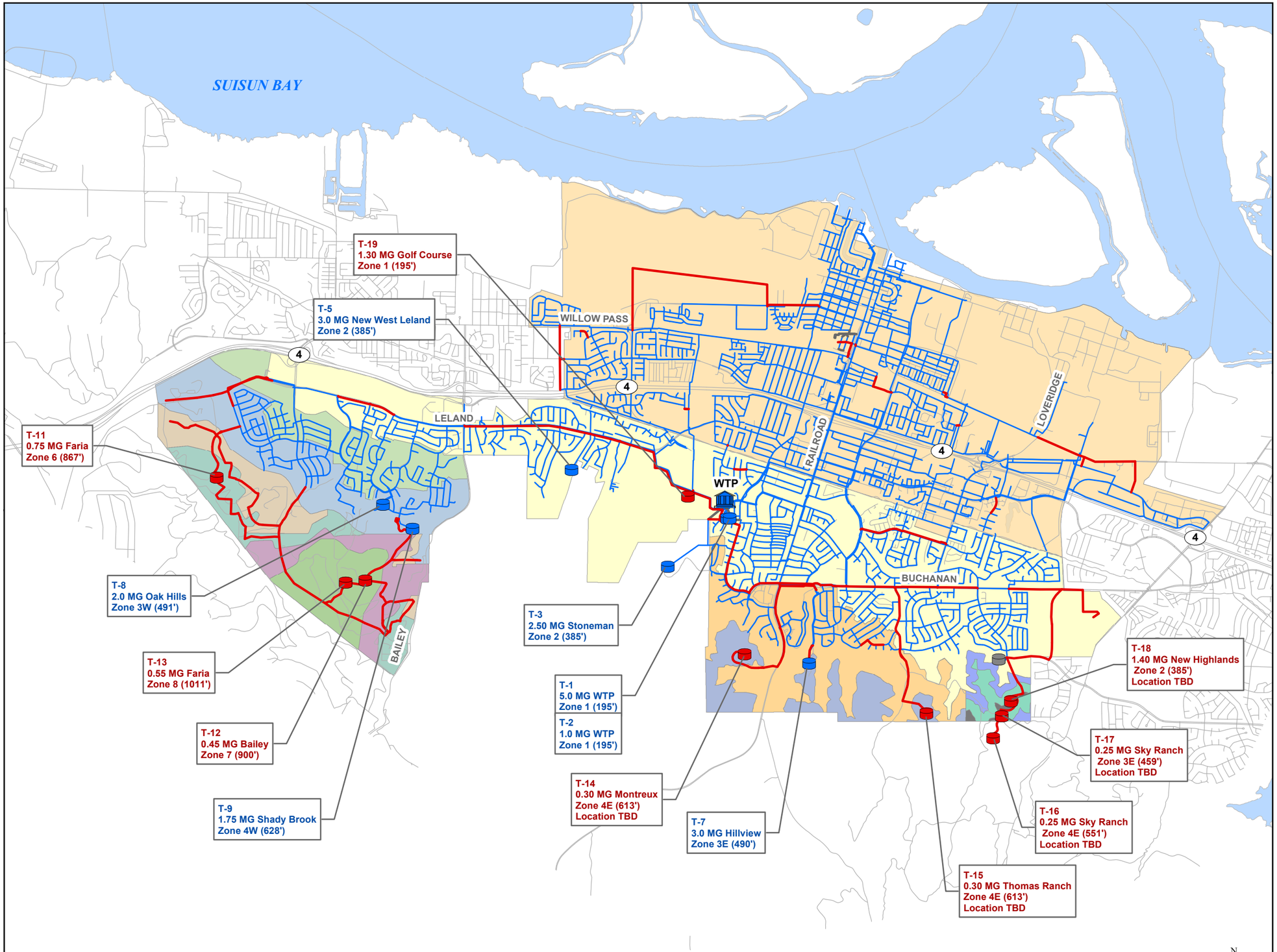
The existing and future storage requirements, shown on **Tables 7.1** and **7.2**, were compared with existing City storage facilities in each zone and the required storage facility improvements were identified and listed on **Table 7.3**. The table lists existing storage facilities for each zone, and identifies existing storage capacity deficiencies, and identifies future storage capacity requirements to meet the needs from future developments identified in this master plan.

It should be noted that the existing Zone 3 East Hillview tank was constructed in 1975 and was initially sized for Zone 1 and Zone 2 developments. For water quality reasons, when the Hillview tank is planned for replacement, it should be replaced with an appropriately sized 1.4 MG storage tank at the end of it's useful life. The 1.5 MG storage deficiency should be replaced in Zone 1 and 2. Staff's recommendation is to build the proposed Zone 2 reservoir at 2.0 MG instead of 1.4 MG, and add the difference to the proposed 1.3 MG Zone 1 reservoir when it is constructed, if funding is available.

The proposed storage reservoirs are summarized on **Table 7.4** and graphically shown on **Figure 7.5**:

- Proposed 1.30 MG Pressure Zone 1 (Golf Course) reservoir
- Proposed 1.40 MG Pressure Zone 2 (New Highlands) reservoir
- Proposed 0.25 MG Pressure Zone 3 East (Sky Ranch) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Montreux) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Thomas Ranch) reservoir
- Proposed 0.25 MG Pressure Zone 4 East (Sky Ranch) reservoir
- Proposed 0.75 MG Pressure Zone 6 West (Faria) reservoir
- Proposed 0.45 MG Pressure Zone 7 West (Bailey) reservoir
- Proposed 0.55 MG Pressure Zone 8 West (Faria) reservoir

The City-wide total required new domestic water system storage capacity is 7.05 MG.



*Note: Future Sky Ranch pressure zones are based on contour elevations.

Updated: December 31, 2015

Legend

Proposed
- Storage Tanks
- Pipes

To Be Abandoned
- Tank

Existing
- WTP
- Storage Tanks
- Pipes

Pressure Zones
- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'
- Street Centerlines
- Water Bodies

T-3 2.50 MG Stoneman Zone 2 (385') — Existing Storage Reservoirs

T-12 0.60 MG Bailey Zone 7 (900') — Proposed Storage Reservoirs

*Note: Elevations shown are zone high water line.

Figure 7.5
Existing and Proposed Storage Reservoirs
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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Table 7.2 Future Storage Requirements

Water System Master Plan
City of Pittsburg

Pressure Zone	Future Water Demands																					Future Water Storage Requirements					
	Southwest Hills [1]															Southeast Hills				Zones 1 and 2 Infills		Annexations		Totals						
	Alves Ranch	Bailey Estates	De Bonneville	Faria	Bay Point/ BART Expansion	San Marco	The Villas at San Marco	Toscana at San Marco	San Marco Village C	Esperanza at San Marco	San Marco Village O	Smith	Spilker	Vista Del Mar	West Coast Transit Village	Montreux [2]	Thomas Ranch	Sky Ranch	Tuscany Meadows	Zones 1 and 2 Infills	Loveridge Sub-Area	NRG Power Plant	Ambrose Park	Total Average Day Demand	Total Maximum Day Demand [3]	Operational at 25%	Emergency at 50%	Fire Protection [4, 5, 6, 7]	Time-of-Use	Operational + Emergency	Total
	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)		(MG)	(MG)	(MG)	(MG)	(MGD)	(MGD)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
Zone 1																				0.85	0.28	0.17		1.30	2.34	0.58	1.17	0.48	-	1.75	2.23
Zone 2 E & W	0.17				0.27	0.04		0.09		0.08				0.09	0.14	0.05		0.01	0.43	0.08			0.05	1.50	2.70	0.68	1.35	0.54	-	2.03	2.57
Zone 3 E																		0.06						0.06	0.11	0.03	0.06	0.12	0.03	0.09	0.23
Zone 3 W						0.14	0.13		0.09		0.02			0.08										0.46	0.82	0.21	0.41	0.42	0.21	0.62	1.24
Zone 4 E																0.08	0.09	0.07						0.24	0.43	0.11	0.22	0.36	0.11	0.32	0.79
Zone 4 W			0.04	0.02		0.32			0.05				0.03											0.47	0.84	0.21	0.42	0.24	0.21	0.63	1.08
Zone 6				0.23		0.10																		0.33	0.60	0.15	0.30	0.12	0.15	0.45	0.72
Zone 7		0.09		0.04								0.05												0.18	0.33	0.08	0.16	0.12	0.08	0.25	0.45
Zone 8				0.22																				0.22	0.40	0.10	0.20	0.12	0.10	0.30	0.52
Total	0.17	0.09	0.04	0.51	0.27	0.61	0.13	0.09	0.14	0.08	0.02	0.05	0.03	0.17	0.14	0.13	0.09	0.15	0.43	0.93	0.28	0.17	0.05	**4.77**	**8.58**	**2.14**	**4.29**	**2.52**	**0.89**	**6.43**	**9.84**

Note:

2/6/2015

1. Demands were calculated and allocated to storage tanks using the information provided in Tables 3-1, 3-2, 3-3, and 3-4, Southwest Area Water Master Plan Draft, Stetson Engineers, 1/14/09, and adjusted based on City staff comments received in 2013 and 2014.
2. Due to water quality concerns in the Zone 3 East storage tank, Zone 3 East storage for the Montreux development is allocated to Zone 2.
3. MDD = 1.8 x ADD
4. Fire Protection requirement represents largest fire requirement for each zone, based on Future Land Use Inventory
5. Fire Protection for for Thomas Ranch (0.12 MG), Sky Ranch (0.12MG), and Montreux (0.12MG) are intended to be in separate tanks, though they were combine in this table under Zone 4E for calculation purpposes
6. Fire Protection for Zone 7 is intended to include 2 fire flows for servicing 5 tributary pressure zones.
7. Fire Protection for Zone 8 is intended to include 2 fire flows for servicing 2 tributary pressure zones.

Table 7.3 Storage Analysis

Water System Master Plan
City of Pittsburg

Pressure Zone	Existing Water Storage Requirements				Future Water Storage Requirements				Total Existing and Future Storage Requirement[5]	Existing Storage Reservoirs [1]							Storage Balance for Existing Demands[4]	Proposed New Storage Reservoirs										Total Storage	Existing and Future Storage Balance
	Operational + Emergency	Time of Use	Fire Protection	Total	Operational + Emergency	Time of Use	Fire Protection	Total		WTP	Stoneman	New West Leland	Hillview	Oak Hills	Shady Brook	Total		Zone 6W (Faria)	Zone 7W (Bailey)	Zone 8W (Faria)	Montreux	Thomas Ranch	Sky Ranch 3E	Sky Ranch 4E	New Highlands[7]	Zone 1 (Golf Course)	Total		
										T-1 / T-2	T-3	T-5 (T-5)[2]	T-7	T-8	T-9			T-11 (T-3)[2]	T-12 (T-4)[2]	T-13	T-14 (T-6)[2]	T-15 (T-7)[2]	T-16 (T-8)[2]	T-17	T-18 (T-9)[2]	T-19 (T-10)[2]			
	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
Zone 1	6.46	-	0.65	7.11	1.75	-	0.48	2.23	8.87	6.0						6.0	-1.1									1.3	1.3	7.3	-1.57
Zone 2 E & W	4.24	-	0.54	4.78	2.03	-	0.54	2.57	6.81		2.5	3.0				5.5	0.7								1.4		1.4	6.9	0.09
Zone 3 E	0.62	0.21	0.54	1.36	0.09	0.03	0.12	0.23	1.60				3.0			3.0	1.6						0.25				0.3	3.25	1.65
Zone 4 E	0.00	0.00	0.00	0.00	0.32	0.11	0.36	0.79	0.79							0.0	0.0				0.30	0.30		0.25			0.9	0.85	0.06
Subtotal									18.06							14.5	1.2										3.8	18.30	0.24
Zone 3 W	0.51	0.17	0.18	0.86	0.62	0.21	0.42	1.24	1.92					2.0		2.0	1.1										0.0	2.00	0.08
Zone 4 W	0.38	0.13	0.24	0.75	0.63	0.21	0.24	1.08	1.58						1.75	1.75	1.0										0.0	1.75	0.17
Zone 6[6]	0.00	0.00	0.00	0.00	0.45	0.15	0.12	0.72	0.72							0.0	0.0	0.75									0.8	0.75	0.03
Zone 7	0.00	0.00	0.00	0.00	0.25	0.08	0.12	0.45	0.45							0.0	0.0		0.45								0.5	0.45	0.00
Zone 8	0.00	0.00	0.00	0.00	0.30	0.10	0.12	0.52	0.52							0.0	0.0			0.55							0.6	0.55	0.03
Subtotal									5.20							3.8	2.1										1.8	5.50	0.30
Total	**12.71**		**2.15**	**14.86**	**6.43**		**2.52**	**9.84**	**23.26**	**6.00**	**2.50**	**3.00**	**3.00**	**2.00**	**1.75**	**18.25**	**3.39**	**0.75**	**0.45**	**0.55**	**0.30**	**0.30**	**0.25**	**0.25**	**1.40**	**1.30**	**5.55**	**23.80**	**0.54**

Note:

2/6/2015

1. West Leland tank (T-6) has been taken out of service and was not included in this analysis
2. The tank number listed in parentheses is the tank number used in Amendment No. 3.
3. The Highlands Tank is proposed to be abandoned upon construction of the New Highlands Tank, and, therefore, is not included in the existing system storage analysis.
4. This total includes only the operational and emergency storage requirements for future and existing scenarios, plus the largest fireflow of the two.
5. Zone 3 East excess storage is assumed to aid in the Zone 1 deficiency.
6. Zone 5 West and Zone 6 West Storage are planned to be consolidated in Zone 6 West, with PRV service to Zone 5 West in the future.
7. Montreux Zone 3 East storage to be served from the Hillview Reservoir, and storage is to be allocated to the Zone 2 New Highlands tank.

Table 7.4 Proposed Storage Reservoirs

Water System Master Plan
City of Pittsburg

Pressure Zone	Tank Number	Volume (MG)	HWL Zone[1]	HGL[2]	Reservoir	Height (ft)	Diameter (ft)	Bottom Elevation (ft)
Zone 1[3]	T-19	1.30	1 (195')	193	Golf Course	24	96.0	170
Zone 2	T-18	1.40	2 (385')	378	New Highlands	24	99.7	355
Zone 3E	T-17	0.25	3E (459')	459	Sky Ranch	20	46.1	440
Zone 4E	T-14	0.30	4E (613')	613	Montreux	24	46.1	590
Zone 4E	T-15	0.30	4E (613')	613	Thomas Ranch	24	46.1	590
Zone 4E	T-16	0.25	4E (570')	570	Sky Ranch	20	46.1	551
Zone 6	T-11	0.75	6 (867')	867	Faria	24	72.9	844
Zone 7	T-12	0.45	7 (900')	900	Bailey	24	56.5	877
Zone 8	T-13	0.55	8 (1011')	1011	Faria	24	62.5	988

Note: 2/6/2015

1. HWL is the high water line for the pressure zone, and does not account for transmission losses that occur as the water is conveyed across the pressure zone.
2. The HGL is the hydraulic grade line, which corresponds to the HWL less the estimated transmission losses to convey water to the tank.
3. Elevation is preliminary, and further siting analysis should be performed prior to construction.

7.5 TRANSMISSION MAINS

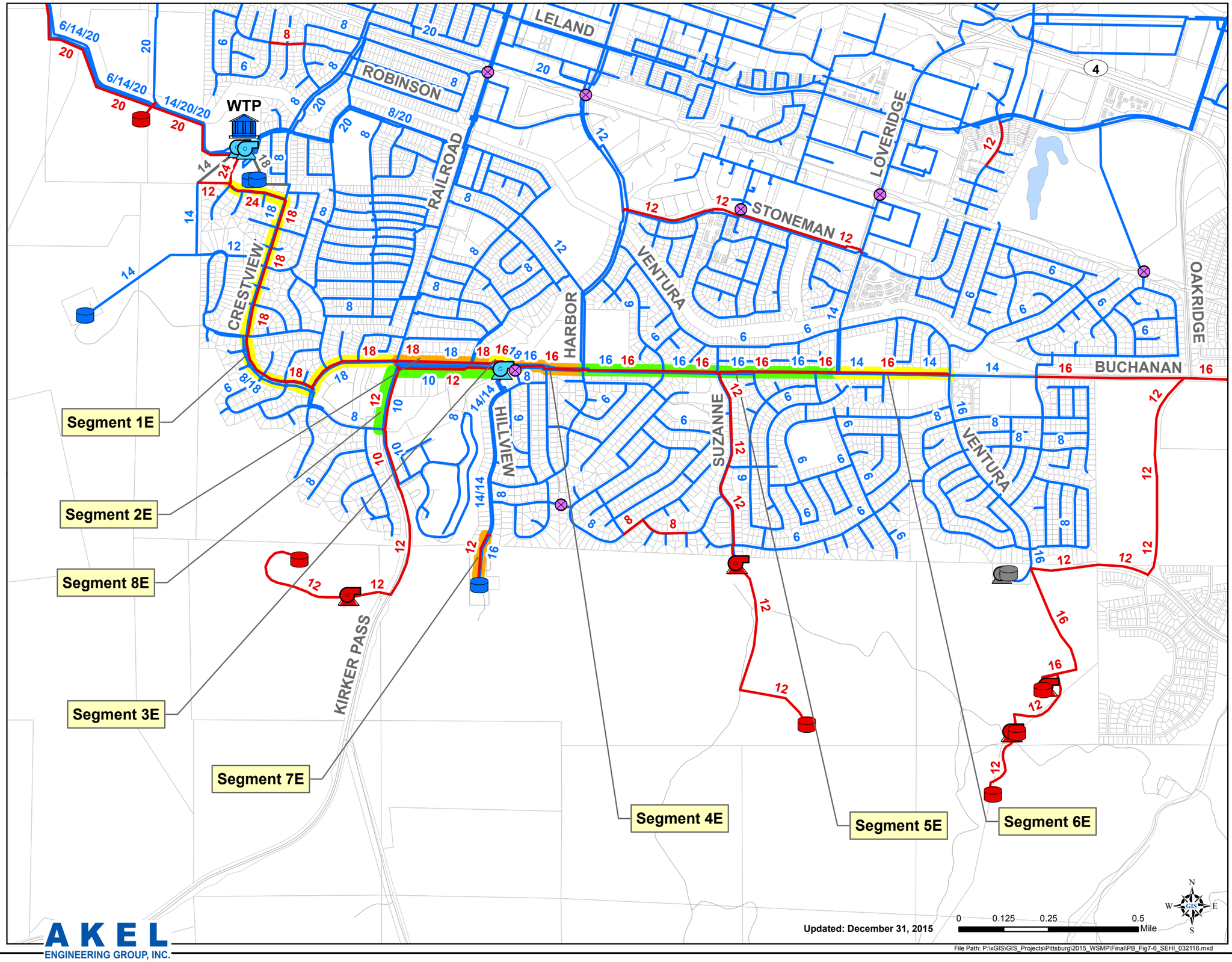
In general, transmission mains were sized to carry the MDD plus fire flows. The primary transmission main segments between the Water Treatment Plant booster pump station and Pressure Zone 2 East and West storage facilities were based on MDD, unless the segment was conveying fire flows from an existing or proposed storage facility. Fire flow allocation to the transmission mains was based on pipeline redundancy to the location of the simulated fire flow. Where transmission main redundancy was available, fire flow requirements were reduced appropriately. Transmission main and fire flow criteria are listed in the System Performance and Design Criteria chapter.

7.5.1 Southeast Hills

The existing 18-inch Buchanan transmission main, starting at the water treatment plant and servicing the Buchanan Pump Station, continues as a 16-inch main to service the Buchanan and portions of the Woodlands developments. The design of this existing 18-inch and 16-inch main did not account for servicing future developments in the Southeast Hills. Therefore, this section identifies the additional transmission main requirements for servicing the future developments at General Plan buildout conditions. These developments include “infill development” in Pressure Zone 2, Montreux, Sky Ranch, and Thomas Ranch.

A new transmission main, starting at the water treatment plant, is needed to extend service to these proposed developments (**Table 7.5**). The transmission main was divided into segments (**Figure 7.6**) for analyzing its capacity and determining additional capacity allocation by development.

- **Segment 1E.** This 18-inch segment starts at the treatment plant, and continues south on Crestview Drive, then eastward on Buchanan Road to Kirker Pass Road. This pipe parallels an existing 18-inch main and is 6,000 feet in length.
- **Segment 2E.** This 18-inch segment continues along Buchanan Road, between Kirker Pass Road and the Buchanan Road Booster Station. The segment parallels an existing 18-inch main, and is 1,400 feet in length.
- **Segment 3E.** This 16-inch segment continues along Buchanan Road, between the Buchanan Road Booster Station and the Buchanan Road PRV. This segment parallels an existing 18-inch main and is 300 feet in length.
- **Segment 4E.** This 16-inch segment continues along Buchanan Road, between the Buchanan Road PRV and Harbor Street. This segment parallels an existing 16-inch main and is 1,100 feet in length.



Legend

Proposed
- Storage Tanks
- Booster Stations
- Pipes

To Be Abandoned
- Tank
- Booster Station

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels
- Water Bodies

Figure 7.6
Transmission Main Analysis for the Southeast Hills
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

Table 7.5 Transmission Main Capacity Analysis for the Southeast Hills and Infills including Tuscany Meadows

Water System Master Plan

City of Pittsburg

Developments	Demands			Existing and Future Transmission Main Segments													
				Segment 1E (Segment 1) [1] 6,000 LF		Segment 2E (Segment 2) [1] 1,400 LF		Segment 3E (Segment 3) [1] 300 LF		Segment 4E (Segment 4) [1] 1,100 LF		Segment 5E (Segment 5) [1] 3,700 LF		Segment 6E (Segment 6) [1] 1,700 LF		Segment 7E 770 LF		Segment 8E 3,500 LF	
	ADD (MGD)	MDD (MGD)	MDD+TOU (MGD)	EXIST. 18"	FUT. 18"	EXIST. 18"	FUT. 18"	EXIST. 18"	FUT. 16"	EXIST. 16"	FUT. 16"	EXIST. 16"	FUT. 16"	EXIST. 14"	FUT. 16"	EXIST. 16"	FUT. 12"	EXIST. 10"	FUT. 12"
Existing Developments																			
Existing Zone 2 E/O WTP	2.47	4.45	-	1.90	2.55	1.90	1.47	2.81		2.10	0.84	2.10	0.84	1.21					
Existing Zone 3E	0.46	0.82	1.10	1.10		1.10										0.82		0.23	
Zone 1 PRV Loveridge		0.27	-		0.27		0.27		0.27		0.27		0.27						
Future Developments																			
Infills Zone 2	0.08	0.15	-		0.15		0.15		0.15		0.15		0.15						
Montreux	0.13	0.24	0.32		0.32		0.32										0.32		0.32
Thomas Ranch	0.09	0.16	0.21		0.21		0.21		0.21		0.21		0.21						
Sky Ranch	0.15	0.26	0.35		0.35		0.35		0.35		0.35		0.35		0.35				
Tuscany Meadows	0.43	0.78	-		0.78		0.78		0.78		0.78		0.78		0.78				
	Fire Flow			0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	1.44	1.44	1.44	1.44
	Total Demand			3.72	5.35	3.72	4.27	3.53	2.48	2.82	3.32	2.82	3.32	1.93	1.85	2.26	1.76	1.67	1.76
	Design Capacity			3.39	3.39	3.39	3.39	3.39	2.49	2.49	2.49	2.49	2.49	1.75	2.49	2.49	1.17	0.72	1.17
	Total Demand				**9.07**		**7.99**		**6.01**		**6.14**		**6.14**		**3.78**		**4.02**		**3.43**
	Total Capacity				**6.78**		**6.78**		**5.88**		**4.98**		**4.98**		**4.24**		**3.66**		**1.89**

Note:

2/6/2015

1. The segment number listed in parentheses is the segment number used in Amendment No. 3.
2. A roughness coefficient of 120 was used to analyze the capacity of the individual pipe segments.
3. Assume 0.5 MG taken through looped connection and not allocated to the transmission mains.
4. Segment 8E capacity was analyzed using the headloss criteria; however, the 12-inch segment analyzed using the velocity criteria will minimize the shown discrepancy.
5. Pipe segment size includes a fire flow allocation relevant to Gerneral Plan zoning designations.
6. Pipe headloss criteria and fire flows were laxed, where feasible, to account for transmission main redundnacy and reliability In each case, the laxing was approved by City Engineer.

- **Segment 5E.** This 16-inch segment continues along Buchanan Road, between Harbor Street and Loveridge Road. This segment parallels an existing 16-inch main and is 3,700 feet in length.

- **Segment 6E.** This 16-inch segment continues along Buchanan Road, between Loveridge Road and Ventura Road. This segment parallels an existing 14-inch main and is 1,700 feet in length.

- **Segment 7E.** This 12-inch segment continues south along Hillview Drive, from the end of Hillview Drive, south to the Hillview Tank. This segment parallels an existing 16-inch main and is 770 feet in length. In lieu of constructing this segment, fire flow deficiencies can be mitigated by constructing a pressure regulating valve at the proposed Montreux Zone 4 East pump station.

- **Segment 8E.** This 12-inch segment proceeds west along Buchanan Road, then south along Kirker Pass Road, between the Buchanan Road and the Castlewood Drive. This segment parallels an existing 10-inch main and is 3,500 feet in length.

7.5.2 Southwest Hills

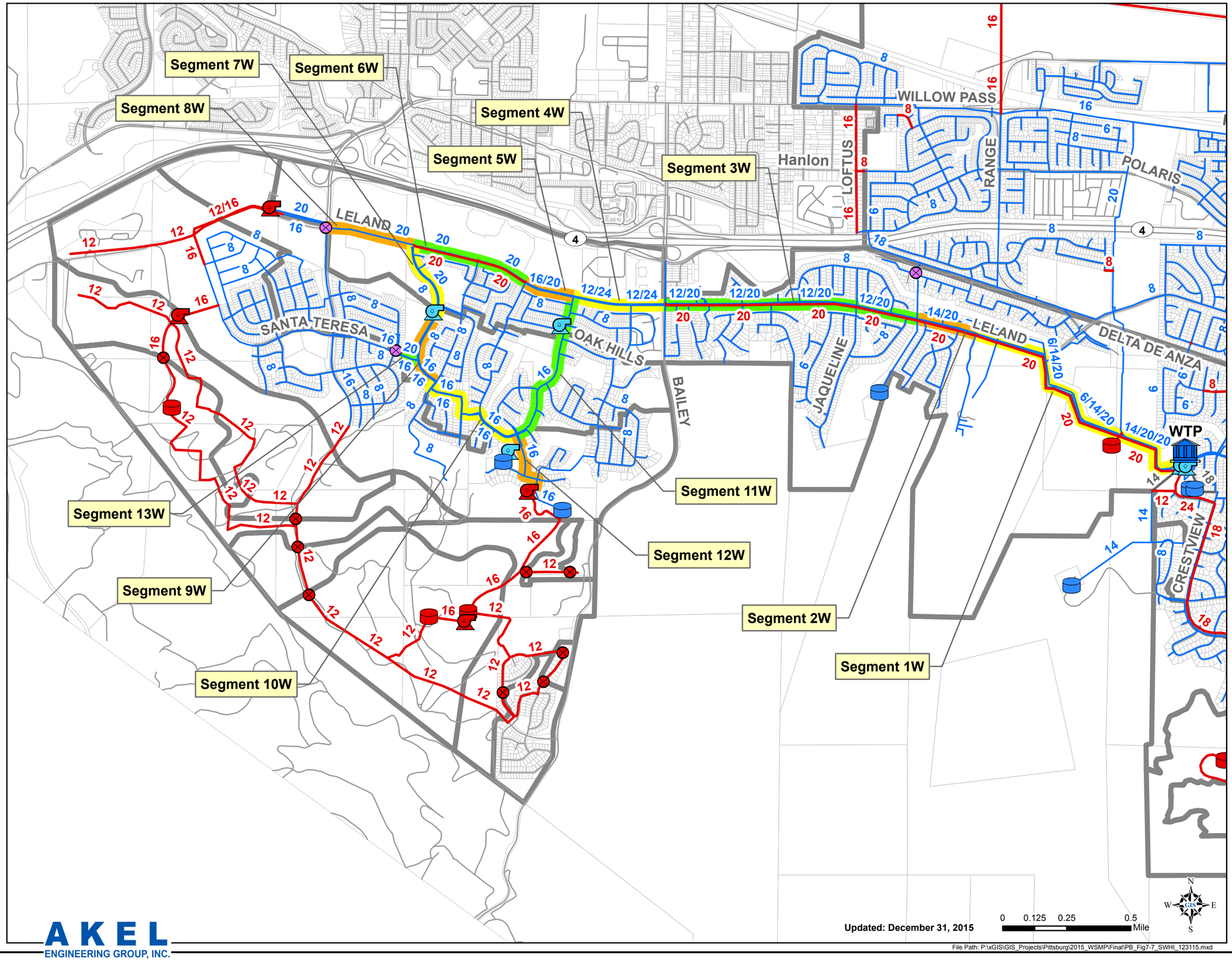
An existing 20-inch transmission main along West Leland, from the water treatment plant to Bailey Road, services the existing Southwest Hills developments, including Oak Hills and portions of the San Marco developments. Amendment No. 2 concluded that the design of the existing 20-inch main did not account for servicing other developments in the Southwest Hills, and that a new parallel main is needed.

The transmission main was divided into several segments (**Figure 7.7**) for analyzing its capacity and determining the capacity allocation by proposed development. The analysis, which is summarized in **Table 7.6**, indicates that Segments 1, 2, and 3 will require a new 20-inch transmission main. The new main will parallel the existing main to service the proposed Southwest Hills development area.

- **Segment 1W.** This segment consists of an existing 20-inch transmission main and a parallel 14-inch transmission main, with an additional recommended 20-inch transmission main. This segment starts at the water treatment plant and continues 5,850 feet to John Henry Johnson Parkway along West Leland Road.

- **Segment 2W.** This segment consists of an existing 20-inch transmission main and a parallel 14-inch transmission main, with an additional recommended 20-inch transmission main. This segment starts at John Henry Johnson Parkway and continues 1,250 feet to where the 20-inch main from the West Leland tank connects along West Leland Road.

- **Segment 3W.** This segment consists of an existing 20-inch transmission main and a parallel 12-inch transmission main, with an additional recommended 20-inch transmission



Legend

Proposed

- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels

Updated: December 31, 2015

0 0.125 0.25 0.5 Mile

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Figure 7.7
Transmission Main Analysis for the Southwest Hills
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

Table 7.6 Transmission Main Capacity Analysis for the Southwest Hills

Water System Master Plan
City of Pittsburg

Developments	Demands			Existing and Future Transmission Main Segments																				
				Segment 1W (Segment 1) [1] Zone 2 5,850 LF			Segment 2W (Segment 1) [1] Zone 2 1,250 LF			Segment 3W (Segment 1) [1] Zone 2 5,000 LF			Segment 4W (Segment 2/3) [1] Zone 2 1,900 LF		Segment 5W (Segment 4) [1] Zone 2 1,050 LF		Segment 6W (Segment 5) [1] Zone 2 2,450 LF		Segment 7W Zone 2 1,500 LF	Segment 8W Zone 2 3,050 LF	Segment 9W Zone 3W 1,000 LF	Segment 10W Zone 3W 3,700 LF	Segment 11W Zone 3W 3,200 LF	Segment 12W Zone 4W 1,450 LF	Segment 13W Zone 3W 350 LF
	ADD (MGD)	MDD (MGD)	MDD+TOU (MGD)	EXIST. 20"	EXIST. 14"	FUT. 20"	EXIST. 20"	EXIST. 14"	FUT. 20"	EXIST. 20"	EXIST. 12"	FUT. 20"	EXIST. 12"	NEW 24"	EXIST. 16"	NEW 20"	NEW 20"	FUT. 20"	NEW 20"	NEW 20"	NEW 20"	NEW 16"	EXIST. 16"	EXIST. 16"	NEW 20"
Existing Developments																								
Oak Hills (Z2/3/4)	0.55	1.00	1.21	1.21			1.21			1.21			1.21										0.86	0.27	0.27
Zone 2 E/O Bailey Rd	0.47	0.85	-		0.85			0.85			0.85														
Zone 1 PRV Birchwood		1.11	-	0.86	0.25		0.86	0.25																	
Subtotal - Existing				2.07	1.10	0.00	2.07	1.10	0.00	1.21	0.85	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.27	0.27
Future Developments																								
Ambrose Park	0.05	0.08	-			0.08			0.08			0.08													
Alves Ranch	0.17	0.31	-			0.31			0.31			0.31		0.31		0.31	0.31								
Bailey Estates	0.09	0.17	0.22			0.22			0.22			0.22		0.22		0.22	0.22		0.22			0.22	0.22		
Bay Point/BART	0.27	0.49	-			0.49			0.49			0.49		0.49											
De Bonneville	0.04	0.07	0.10			0.10			0.10			0.10		0.10		0.10		0.10			0.10				
Faria	0.51	0.92	1.22			1.22			1.22			1.22		1.22		1.22	1.22		0.68	0.54	0.68	0.68		0.68	
San Marco	0.61	1.10	1.21	1.21			1.21			1.21				1.21	1.21		1.21		0.27	0.94	0.27				0.27
The Villas at San Marco	0.13	0.23	0.31			0.31			0.31	0.31				0.31	0.31		0.31		0.31	0.004	0.31				0.31
Toscana at San Marco	0.09	0.15	-			0.15			0.15	0.15				0.15	0.15			0.15		0.15					
San Marco Village C	0.14	0.25	0.33			0.33			0.33	0.33				0.33		0.33	0.33		0.12	0.10	0.12				0.12
Esperanza at San Marco	0.08	0.15	0.22			0.22			0.22	0.22				0.22	0.22		0.22		0.08	0.15	0.08				0.08
San Marco Village O	0.02	0.03	0.07			0.07			0.07			0.07		0.07		0.07		0.07	0.04		0.04				0.04
Smith	0.05	0.09	0.12			0.12			0.12			0.12		0.12		0.12	0.12		0.12		0.12	0.12		0.12	
Spilker	0.03	0.05	0.07			0.07			0.07			0.07		0.07		0.07		0.07		0.07					
Vista del Mar	0.17	0.31	0.41			0.41			0.41			0.41		0.41		0.41	0.41		0.41		0.20	0.20			
West Coast Transit Village	0.14	0.26	-			0.26			0.26			0.26		0.26											
Fire Flow				n/a	n/a	n/a	n/a	n/a	n/a	1.08	n/a	1.08	1.08	1.08	1.08	1.08	2.16	2.16	2.88	2.16	1.80	1.08	1.44	1.08	2.88
Subtotal - Existing				2.07	1.10	0.00	2.07	1.10	0.00	1.21	0.85	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.27	0.27
Subtotal - Future				1.21	0.00	4.29	1.21	0.00	4.29	2.23	0.00	3.27	0.00	5.50	1.89	2.86	4.36	0.39	2.25	2.06	2.04	1.23	0.00	1.03	0.81
Total Demand				3.28	1.10	4.29	3.28	1.10	4.29	4.52	0.85	4.35	2.29	6.58	2.97	3.94	6.52	2.55	5.13	4.22	3.84	2.31	2.30	2.37	3.95
Design Capacity				4.47	1.75	4.47	4.47	1.75	4.47	4.47	1.17	4.47	1.17	7.23	2.49	4.47	4.47	4.47	4.47	4.47	4.47	2.49	2.49	2.49	4.47
Total Demand						**8.67**			**8.67**			**9.72**		**8.87**		**6.91**		**9.07**	**5.13**	**4.22**	**3.84**	**2.31**	**2.30**	**2.37**	**3.95**
Total Capacity						**10.70**			**10.70**			**10.12**		**8.39**		**6.96**		**8.95**	**4.47**	**4.47**	**4.47**	**2.49**	**2.49**	**2.49**	**4.47**

5/13/2014

Note:

1. The segment number listed in parentheses is the segment number used in Amendment No. 3.
2. Segment 1W and 2W contain demand that PRV's from Zone 2 to Zone 1 at Bancroft Court.
3. Segment 9W, 10W and 11W have a split fireflow from Zone 3, with each portion containing half the fire. Segment 9W and 10W are in series and therefore share an equal portion of the fire.
4. Please note that there is a parallel 16-inch Zone 4 pipe that is not included in this analysis.
5. A roughness coefficient of 120 was used to analyze the capacity of the individual pipe segments.
6. Pipe segment size includes a fire flow allocation relevant to Gerneral Plan zoning designations.
7. Pipe headloss criteria and fire flows were laxed, where feasible, to account for transmission main redundnacy and reliability In each case, the laxing was approved by City Engineer.

main. This segment starts where the 20-inch main from the West Leland tank connects and continues 5,000 feet to Bailey Road along West Leland Road.

- **Segment 4W.** This segment consists of an existing 12-inch transmission main, with a newly installed parallel 24-inch transmission main. This segment starts at Bailey Road and continues 1,900 feet to Southwood Drive along West Leland Road.
- **Segment 5W.** This segment consists of an existing 16-inch transmission main, with a newly installed parallel 20-inch transmission main. This segment starts at Southwood Drive and continues 1,050 feet to Woodhill Drive along West Leland Road.
- **Segment 6W.** This segment consists of an existing 20-inch transmission main, with an additional recommended 20-inch transmission main. This segment starts at Woodhill Drive and continues 2,450 feet to Tomales Bay Drive along West Leland Road.
- **Segment 7W.** This segment consists of a new 20-inch transmission main. This segment starts at West Leland Road and continues 1,500 feet to the existing Vista del Mar Pump Station, along Tomales Bay Drive.
- **Segment 8W.** This segment consists of a new 20-inch transmission main. This segment starts at Tomales Bay Drive and continues 3,050 feet to San Marco Boulevard, along West Leland Road.
- **Segment 9W.** This segment consists of a new 20-inch transmission main. This segment starts at the existing Vista del Mar Pump Station and continues 1,000 feet to Alves Ranch Road, along Tomales Bay Drive.
- **Segment 10W.** This segment consists of a partially new 16-inch transmission main. This segment starts at Alves Ranch Road and continues 3,700 feet, first on Ramora Drive, and then on Woodhill Drive, to Sunpeak Drive.
- **Segment 11W.** This segment consists of an existing 16-inch transmission main. This segment starts at West Leland Road, and continues 3,200 feet to Sunpeak Drive, along Southwood Drive, and part of Woodhill Drive.
- **Segment 12W.** This segment consists of an existing 16-inch transmission main. This segment starts at the Oak Hills Pump Station and continues 1,450 feet to the proposed Bailey Pump Station site, along Sunpeak Drive.
- **Segment 13W.** This segment consists of a new 20-inch transmission main. This segment starts approximately 900 feet northwest of the intersection Tomales Bay Drive and Alves Ranch Road, and continues west 350 feet to the San Marco development.

Table 7.7 Pump Station Capacity Analysis

Water System Master Plan
City of Pittsburg

Name	Water MP ID	Amend No. 3 ID	Elevation (ft)	Source Pressure Zone	Destination Pressure Zone	Total Booster Station Capacity (gpm)	Total Booster Station Capacity (MGD)	Firm Booster Station Capacity (gpm)	Firm Booster Station Capacity (MGD)	Total Demand (gpm)	Total Demand (MGD)
Existing Pump Stations											
Vista del Mar	PS-1	PS-1	252	2W (385')	3W (491')	4,500	6.48	3,000	4.32	1,442	2.08
Buchanan Road	PS-4		175	2E (385')	3E (490')	6,600	9.50	4,600	6.62	896	1.29
Oak Hills	PS-5		205	2W (385')	3W (491')	2,800	4.03	1,400	2.02	1,095	1.58
Shady Brook	PS-6		421	3W (491')	4W (628')	3,000	4.32	1,500	2.16	1,500	2.16
Highlands Ranch	PS-7		221	2W (385')	2W (385')	4,500	6.48	3,000	4.32	n/a	n/a
Proposed Southwest Hills Booster Stations											
San Marco Villas	PS-8		280	2W (385')	4W (628')	2,000	2.88	1,000	1.44	978	1.41
Faria	PS-10	PS-4	521	4W (628')	6 (867')	1,120	1.61	560	0.81	556	0.80
Bailey	PS-11	PS-5	535	4W (628')	7 (912')	1,360	1.96	680	0.98	679	0.98
Faria	PS-12		870	7 (912')	8 (1023')	760	1.09	380	0.55	374	0.54
Proposed Southeast Hills Booster Stations											
Montreux	PS-13		246	3E (490')	4E (613')	280	0.40	140	0.20	134	0.19
Thomas Ranch	PS-14		195	2E (385')	4E (613')	300	0.43	150	0.22	145	0.21
Sky Ranch Z3	PS-15		285	2E (385')	3E (459')	460	0.66	230	0.33	227	0.33
Sky Ranch Z4	PS-16		340	3E (459')	4E (551')	260	0.37	130	0.19	121	0.17

11/20/2015

Table 7.8 Proposed Pump Stations

Water System Master Plan
City of Pittsburg

Name	Booster Station ID	Amend No. 3 ID	Elevation (ft)	Source Pressure Zone	Destination Pressure Zone	Total Pump Capacity (gpm)	Firm Capacity (gpm)	Number of Pumps	Pump Number	Pump Status	Design Capacity (gpm)
Proposed Southwest Hills Booster Stations											
San Marco Villas	PS-8		280	2W (385')	4W (628')	2,000	1,000	2	1	Duty	1,000
									2	Standby	1,000
Faria	PS-10	PS-4	521	4W (628')	6 (867')	1,120	560	2	1	Duty	560
									2	Standby	560
Bailey	PS-11	PS-5	535	4W (628')	7 (912')	1,360	680	2	1	Duty	680
									2	Standby	680
Faria	PS-12		870	7 (912')	8 (1023')	760	380	2	1	Duty	380
									2	Standby	380
Proposed Southeast Hills Booster Stations											
Montreux	PS-13		246	3E (490')	4E (613')	280	140	2	1	Duty	140
									2	Standby	140
Thomas Ranch	PS-14		195	2E (385')	4E (613')	300	150	2	1	Duty	150
									2	Standby	150
Sky Ranch	PS-15		285	2E (385')	3E (459')	460	230	2	1	Duty	230
									2	Standby	230
Sky Ranch	PS-16		340	3E (459')	4E (551')	260	130	2	1	Duty	130
									2	Standby	130

11/20/2015

7.6 PUMP STATIONS ANALYSIS

Pump stations were sized to convey the maximum day demand of the zones they are servicing, including the tributary higher zones. In addition, the pump stations were sized to include provisions for designating one of largest pumps as a standby for emergency and other conditions.

7.6.1 Proposed Pump Stations

The pump station analysis is summarized on **Table 7.7**, listing existing and proposed pump station capacities, and identifying the MDD each station is intended to service. The proposed new pump stations are listed on **Table 7.8**. The table lists the proposed pump stations, with their firm capacity necessary to service the destination pressure zone and higher zones.

It should be noted that the pump station firm capacity excludes the capacity of the standby pump. A total number of pumps are suggested in this table, although City staff may choose otherwise during the design phase, as long as the firm capacity and standby criteria is met.

Figure 7.8 graphically shows the pumps stations along with required proposed PRVs required for servicing new pressure zones or for providing system redundancy. **Figure 7.9** is a schematic of the water system hydraulic profile that illustrates the relative elevation and general connectivity of the proposed storage reservoirs, booster stations, and PRVs.

7.6.2 Water Treatment Plant Pump Station

The existing high level booster pump station at the water treatment plant provides service to Pressure Zone 2 and higher zones which are tributary to this zone. The initial pump station included five 2,000-gpm pumps with a total pumping capacity of 10,000 gpm. Four of the pumps are considered full duty while the fifth pump is assigned a standby status.

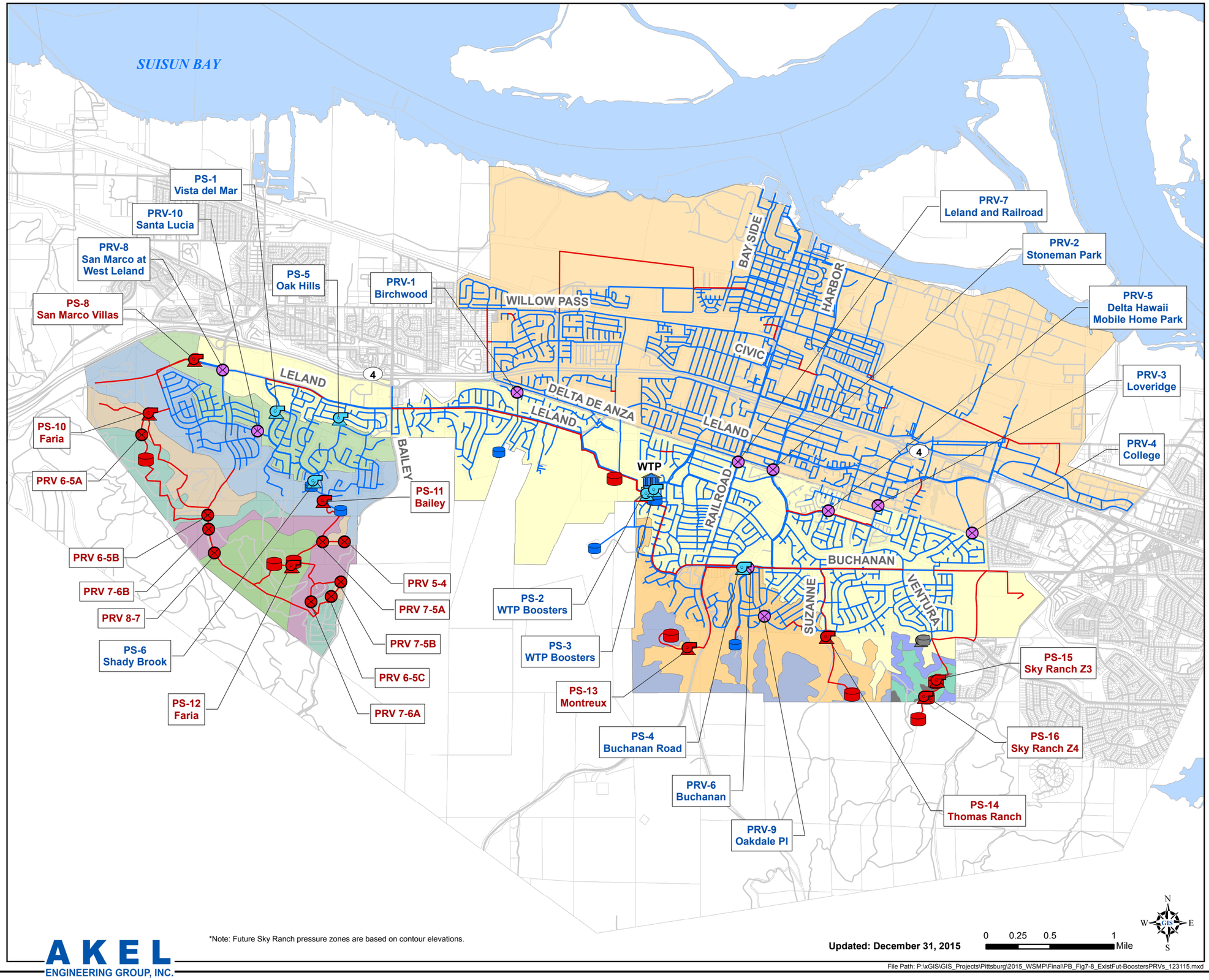
An upgrade to this initial pump station was completed and consists of a new pump station structure housing four pumps with individual capacities of 2,500 gpm. One of the new pumps is reserved for standby purposes.

The combined Water Treatment Plant Pump Stations total capacity is 20,000 gpm, and their firm capacity is 15,500 gpm. A pumping capacity analysis indicates that the Water Treatment Plant Pump Stations are capable of meeting existing and projected future MDD.

An analysis of the Water Treatment Plant Pump Stations is summarized on **Table 7.9**. The analysis included accommodating existing and future flows through the Birchwood, Stoneman, and Loveridge PRVs to Pressure Zone 1.

7.6.3 Sky Ranch Pump Stations

There are two pump stations recommended to service the future Sky Ranch development. The pump stations were sized based on the demand of the development and time of use criteria.



Legend

Proposed
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned
- Tank
- Booster Station

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Pressure Zones
- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'
- Street Centerlines
- Water Bodies

PS-6 Shady Brook — Existing Booster Stations

PS-10 Faria — Proposed Booster Stations

*Note: Future Sky Ranch pressure zones are based on contour elevations.

Updated: December 31, 2015

Figure 7.8
Existing and Proposed Booster Stations and PRVs
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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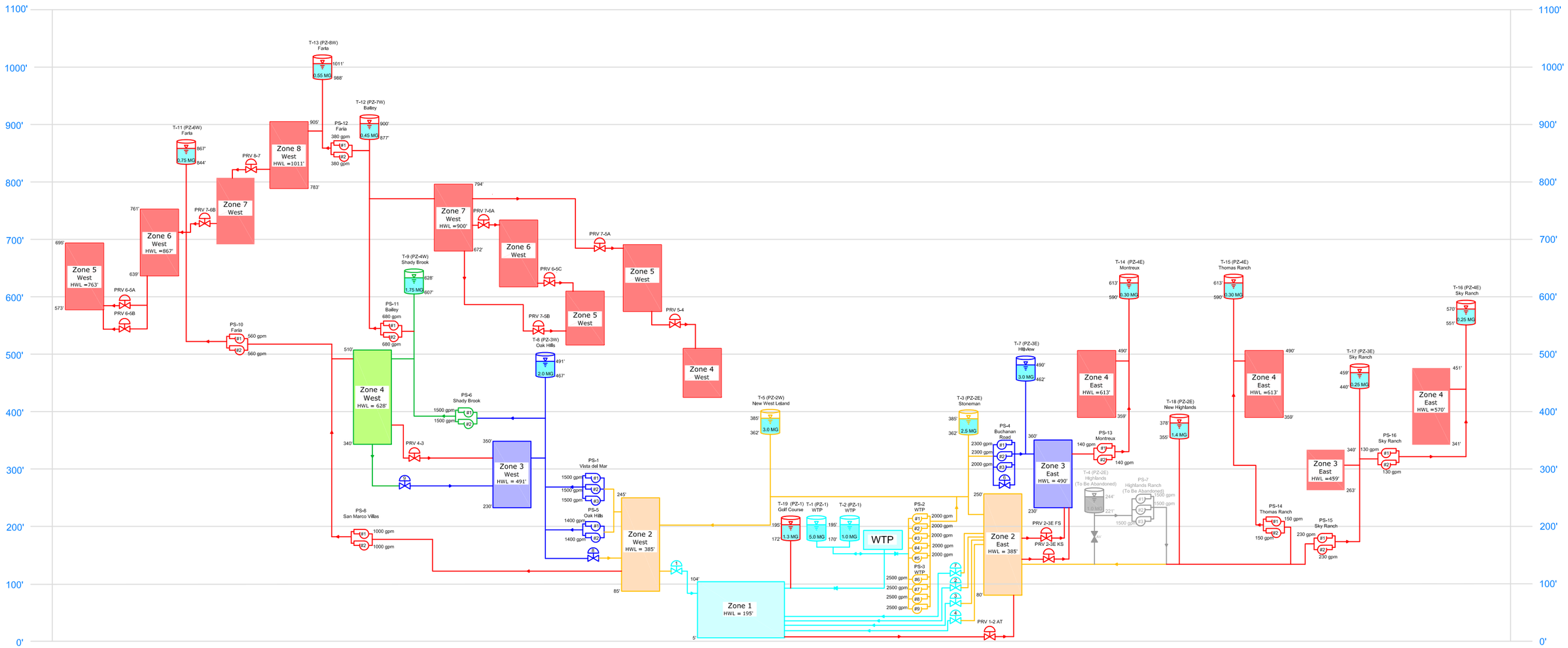


Legend

- Reservoir (HWL / # MG / LOW)
  - HWL: HIGH WATER LEVEL (ft)
  - # MG: RESERVOIR CAPACITY (MG)
  - LOW: BOTTOM ELEVATION (ft)
- Booster Pumping Station
- Pressure Regulating Valve
- Proposed Reservoir (HWL / # MG / Low)
  - HWL: High Water Level (ft)
  - # MG: Reservoir Capacity (MG)
  - Low: Bottom Elevation (ft)
- Proposed Transmission Main
- Proposed Booster Pumping Station
- Check Valve
- Altitude Valve (AV)
- Transmission Main
- Pressure Zone (High / Zone # HWL / Low)
  - HWL: Zone High Water Level
  - High: Highest Service Elevation, ft.
  - Low: Lowest Service Elevation, ft.
- Proposed Pressure Zone (High / Zone # HWL / Low)
  - HWL: Zone High Water Level
  - High: Highest Service Elevation, ft.
  - Low: Lowest Service Elevation, ft.
- Proposed Pressure Regulating Valve

Figure 7.9
Existing System and Proposed Improvements Hydraulic Profile Schematic
Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

Updated: December 31, 2015

Table 7.9 Water Treatment Plant - Booster Station Capacity Analysis

Water System Master Plan
City of Pittsburg

Water Treatment Plant Upgrade		Capacity (gpm)
Water Demands		
Existing Maximum Day Demand		
Existing Maximum Day Demands (Zones 2 and Higher)		5,318
Existing Maximum Day Demand (Zone 1 PRVs)		1,310
Total Existing Demand		**6,628**
Projected Buildout Future Demand		
Projected Buildout Maximum Day Demands (Zones 2 and Higher)		9,653
Projected Buildout Maximum Day Demand (Zone 1 PRVs)		960
Total Projected Buildout Demand		**10,613**
WTP Pump Stations Capacity		
Pump Station A (PS-2)		
Pump 1	(Duty)	2,000
Pump 2	(Duty)	2,000
Pump 3	(Duty)	2,000
Pump 4	(Duty)	2,000
Pump 5	(Standby)	2,000
WTP Pump Station 1 Firm Capacity		8,000
Pump Station B (PS-3)		
Pump 6	(Duty)	2,500
Pump 7	(Duty)	2,500
Pump 8	(Duty)	2,500
Pump 9	(Standby)	2,500
WTP Pump Station 2 Firm Capacity		7,500
Total Pump Station Capacity		**20,000**
Total WTP Pump Station Firm Capacity		**15,500**

Note:

2/6/2015

1. Existing pump capacities at the Water Treatment Plant were obtained from City operation staff.
2. Each pump station has allocations for standby capacity.
3. Flows through the existing Stoneman, Loveridge and Birchwood PRV's depends on pressure settings. Peak hour flows are assumed in this analysis.

The Sky Ranch Z3 pump station boosts water from Pressure Zone 2 to Pressure Zone 3 East Sky Ranch, and is intended to service future demands associated with the Sky Ranch development. It should be noted that this new pressure zone will be at a different hydraulic grade line than existing Pressure Zone 3 East. Should potential for future connections between Pressure Zone 3 East Sky Ranch and Zone 3 East be realized, pressure regulation at the zone boundaries would be necessary.

Pump Station Sky Ranch 4 boosts water from Pressure Zone 3 East Sky Ranch to Pressure Zone 4 East Sky Ranch. As with Pressure Zone 3 East Sky Ranch, Pressure Zone 4 East Sky Ranch will have a different hydraulic grade than Pressure Zone 4 East, and would require pressure regulation at potential future zone boundary connections.

7.6.4 Thomas Ranch Pump Station

The Thomas Ranch Pump Station boosts water from Pressure Zone 2 to Pressure Zone 4 East and services the Thomas Ranch Development. The required firm capacity of the proposed Thomas Ranch Pump Station for servicing this development is designed based on demand of the development and time of use criteria. Thomas Ranch is within the Zone 4 East boundaries, and is located in the Southeast Hills area of the City.

7.6.5 Montreux Pump Station

The Montreux Pump Station boosts water from Pressure Zone 3 East to Pressure Zone 4 East and services the Montreux Development. The required firm capacity of the proposed Montreux Pump Station for servicing this development is designed based on demand of the development. Montreux that is within the Zone 4 East boundaries, including time of use, and is located in the Southeast Hills area of the City.

7.6.6 San Marco Villas Pump Station

The San Marco Villas Pump Station boosts water from Pressure Zone 2 to Pressure Zone 4 West. This pump station will service multiple developments in the Southwest Hills. The required firm capacity of the proposed San Marco Villas Pump Station is designed to carry proposed Zone 4 West demands, including time of use, and to supply water for servicing higher zones. The San Marco Villas Pump Station is proposed on West Leland Road in the Southwest Hills area of the City.

7.6.7 Faria Pump Station

The Faria Pump Station boosts water from Pressure Zone 4 West to Pressure Zone 6. This pump station will service multiple developments in the Southwest Hills. The required firm capacity of the proposed Faria Pump Station is designed to service Zone 5 West and Zone 6, including time of use, and maintain adequate storage at the Faria Reservoir. The proposed location of the pump station is on a future road in the Southwest Hills area of the City.

7.6.8 Bailey Pump Station

The Bailey Pump Station boosts water from Pressure Zone 4 West to Pressure Zone 7. This pump station will service the Bailey Reservoir, as well as convey the demand of the Faria Reservoir. The required firm capacity of the proposed Bailey Pump Station is designed to carry the demand of Zones 7 and 8, including time of use, and maintain adequate storage at the Bailey Reservoir in the Southwest Hills. The proposed location of this pump station is on a flow split from the 16 inch that leads to the Shady Brook Reservoir.

7.6.9 Faria Pump Station

The Faria Pump Station boosts water from Pressure Zone 7 to Pressure Zone 8. This pump station will service the Faria Reservoir. The required firm capacity of the proposed Faria Pump Station is designed to carry the demands of Zone 8 and the Zone 7 portion of the Montecito development, including time of use, and maintain adequate storage at the Faria Reservoir. The proposed location of the Faria Pump Station is on a future road in the Southwest Hills.

7.7 PROPOSED PRESSURE REDUCING STATIONS

Pressure reducing valves will be required to create new pressure zones in the southwest hills, as proposed by the Stetson Engineers Inc. plan for the southwest hills (Jan 2009). Additionally, some PRVs are required for redundancy and reliability purposes, by providing domestic water from higher pressure zones to lower pressure zones, which might be experiencing emergencies.

The proposed pressure reducing valves are listed on **Table 7.10**, with a recommended downstream set point. It should be noted that the set point is highly dependent on the final elevation of the constructed PRV and should be confirmed at that time of design.

7.8 SPECIAL PLANNING AREAS AND PROJECTS

Several projects were analyzed in this study, and include the annexation of the NRG Plant and the Loveridge Industrial Park sub-area. The domestic water demands from these two areas were included in the city-wide analysis for storage and in the hydraulic model evaluation.

In addition, projects that have a significant impact on City infrastructure, but are either planned or have unit counts that vary significantly and were therefore not included in the analysis tables of the master plan, are included as discussion items in this section of the master plan.

7.8.1 NRG Power Plant Annexation

The NRG Power Plant Annexation site includes 170 acres of undeveloped power plant land, the Power Plant structure, and the McCampbell Analytical Company. The 170 acres lies within the Pressure Zone 1 Boundary and will be served by a future 16-inch pipe. With the annexation, the previously undeveloped power plant land is planned for industrial use. This area was accounted for in this master plan.

Table 7.10 Proposed Pressure Reducing Valves

Water System Master Plan
City of Pittsburg

Location	PRV ID	Size[1,2] (in)	Preliminary Elevation (ft)	Pressure Zone		Preliminary Downstream Setpoint (psi)	Preliminary Hydraulic Grade (ft)
				Upstream	Downstream		
Smith	PRV 5-4	3 / 6	540	5	4W	40	632
Smith	PRV 7-5A	4 / 6	680	7	5	55	807
Faria	PRV 6-5A	8	535	6	5	94	752
Faria	PRV 6-5B	8	520	6	5	100	751
Faria	PRV 7-6B	6	730	7	6	40	822
Bailey	PRV 6-5C	3 / 6	614	6	5	40	706
Bailey	PRV 7-5B	3 / 6	530	7	5	60	669
Bailey	PRV 7-6A	6	730	7	6	55	857
Faria	PRV 8-7	6	820	8	7	40	912

Notes:
1. PRV sizing based on flow capacity of CLA-VAL 90-01 PRV.
2. A "/" indicates a need for a bypass for fire flow requirements.

12/7/2015

7.8.2 Loveridge Industrial Park Sub-Area

The Loveridge sub-area is a master planned portion of the City's northern industrial center, and is comprised of commercial and industrial zones. Loveridge contains 233 acres of industrial zoning that was accounted for in this master plan, and is within the Pressure Zone 1 boundaries. Loveridge sub-area is planned to be served by an 18-inch pipe that will follow the Loveridge Specific Plan alignments.

7.8.3 West Coast Transit Village Development Area

The Water System Master Plan is modeled for 550 multi-family dwellings units as requested by Discovery Builders on October 30, 2009. However, the City of Pittsburg and Seecon signed a Memorandum of Understanding (MOU) in March 2009 that commits the City to an original site plan of 1,040 multi-family dwelling units with 2.5 acres of commercial use. If the project site is developed to this higher level, the water infrastructure requirements will change as follows:

- **Transmission Pipes –** Servicing the proposed project to the buildout referenced in the MOU will not result in a necessary upsizing of the transmission mains; however, the cost allocation for the transmission main segment will need to be updated to include the additional units and office space.
- **Pump Stations –** Servicing the project to the MOU buildout will require an additional 170 gpm reserved capacity at the water treatment plant high level booster station.
- **Storage –** Servicing the increased buildout of the West Coast Transit Village development would also require an increase in Zone 2 storage of approximately 0.18 MG.

7.8.4 Golf Course Development

The Golf Course development is planned to be constructed within the City Limits, just south of the Delta View Golf Course. This proposed site includes a project that will be serviced by the existing Pressure Zone 2, as well as a proposed new Pressure Zone 3, which services only the Golf Course development. For the purpose of this master plan, the Golf Course development is not included in the capital improvement program and corresponding cost allocation analysis, however the infrastructure requirements for this project are quantified in this section.

The project proponent is proposing a total of 482 dwelling units (110 single family dwelling units in Zone 2 and 372 single family dwelling units in a new Zone 3). The infrastructure requirements for this Golf Course development to the master plan are as follows:

- **Transmission Pipes –** The increase in MDD in the proposed 20-inch Segment 1W is calculated at 0.30 MGD, in addition to a fire flow requirement of 1.44 MGD for serving the residential dwelling units of this development located in Zone 2. Though Segment 1W does not need to be upsized, its cost allocation will need to be updated to include this development.

Additionally, the proposed 20-inch Segment 2W will also require a 1.44 MGD capacity for meeting fire flow requirements, since fire storage for this development is located in the New 3.0 MG West Leland Tank. Though Segment 2W does not need to be upsized, its cost allocation will need to be updated to include this development.

It should be noted that the construction of this development will accelerate the construction triggers for Segment 1W and 2W.

- **Pump Stations –** Servicing the project will require approximately 205 gpm of additional reserved capacity at the water treatment plant high level booster station. In addition, the project has an isolated Zone 3 pressure zone, which will require a new booster station with a firm capacity of 160 gpm.
- **Storage –** Servicing the potential Golf Course development will require a total storage capacity of 0.40 MG. The Pressure Zone 2 portion of the storage capacity is estimated at 0.05 MG, while the Zone 3 portion the storage capacity is estimated at 0.17 MG, in addition to 0.12 MG fire storage requirement. A new Zone 3 storage reservoir specific to this development will be required.

CHAPTER 8 – CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and to accommodate anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the Capital Improvement Program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

8.1 COST ESTIMATE ACCURACY

Cost estimates presented in the Capital Improvement Program (CIP) were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

The Association for the Advancement of Cost Engineering (AACE International), formerly known as the American Association of Cost Engineers has defined three classifications of assessing project costs. These classifications are presented in order of increasing accuracy: Order of Magnitude, Budget, and Definitive.

- **Order of Magnitude Estimate.** This classification is also known as an "original estimate", "study estimate", or "preliminary estimate", and is generally intended for master plans and studies.

  This estimate is not supported with detailed engineering data about the specific project, and its accuracy is dependent on historical data and cost indexes. It is generally expected that this estimate would be accurate within -30 percent to +50 percent.

- **Budget Estimate.** This classification is also known as an "official estimate" and generally intended for predesign studies. This estimate is prepared to include flow sheets and equipment layouts and details. It is generally expected that this estimate would be accurate within -15 percent to +30 percent.

- **Definitive Estimate.** This classification is also known as a "final estimate" and prepared during the time of contract bidding. The data includes complete plot plans and elevations, equipment data sheets, and complete specifications. It is generally expected that this estimate would be accurate within -5 percent to + 15 percent.

Costs developed in this study should be considered "Order of Magnitude" and have an expected accuracy range of **-30 percent** and **+50 percent**.

8.2 COST ESTIMATE METHODOLOGY

Cost estimates presented in this chapter are opinions of probable construction and other relevant costs developed from several sources including the previous 2010 Water System Master Plan, cost curves, and Akel experience on other master planning projects. Where appropriate, costs were escalated to reflect the more current Engineering News Records (ENR) Construction Cost Index (CCI).

The costs estimated for each recommended improvement were included in the CIP, which is used by City staff to update the City's Capital Improvement Budget and to support the determination of the Facility Reserve Charge (FRC).

8.2.1 Unit Costs

The unit cost estimates used in developing the CIP are summarized on **Table 8.1**. Domestic water pipeline unit costs are based on length of pipes, in feet. Storage reservoir unit costs are based on capacity, per million gallon (MG). Pump Station costs are based on an equation that replaces the pump curve listed in the previous master plan. Pressure reducing stations are based on the size of proposed valves, in inches.

The unit costs are intended for developing the Order of Magnitude estimate, and do not account for site specific conditions, labor of material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys for reservoir sites, investigation of alternative routings for pipes, and other various factors.

8.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the Engineering News Record (ENR) Construction Cost Index (CCI), which is widely used in the engineering and construction industries.

The costs in this Water System Master Plan were calculated using a 20-City national average ENR CCI of 9,800, reflecting a date of June of 2014.

8.2.3 Land Acquisition

Construction of pipelines is generally assumed to be within existing or future street right-of-ways. A land acquisition fee for the construction of storage reservoirs and pump station was assumed based on recent land acquisitions. For planning purposes, it was assumed that a pump station will require 0.5 acre. For estimating storage reservoir land acquisition, costs were assumed at 12 United States dollars per square foot of the site.

8.2.4 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore construction contingencies were used. In the absence of bid

Table 8.1 Unit Costs

Water System Master Plan
City of Pittsburg

Pipe Size (in)	($/Lineal Foot)
8	$118
10	$136
12	$150
16	$181
18	$195
20	$223
24	$244
30	$270
36	$318
Pump Stations	**($)**
Estimated Pumping Station Project Cost = $1.9 * 10^{(0.7583*\log(Q)+3.1951)}$; where Q is in gpm	
Pressure Reducing Stations (in)	**($)**
3" valve	$44,000
4" valve	$58,000
6" valve	$72,000
8" valve	$86,000
10" valve	$100,000
12" valve	$114,000
16" valve	$228,000
18" valve	$257,000
20" valve	$286,000
Storage Reservoirs	
Construction Cost (MG)	**($/gallon)**
≤ 1.0 MG	$2.00
1.1 MG - 3.0 MG	$1.60
3.1 MG - 5.0 MG	$1.15
> 5.0 MG	$0.86
Land Acquisition	**($/site sq ft)**
Land Acquisition	$12.00

6/18/2014

tabulations, the estimated construction cost includes a **30 percent** contingency allowance to account for unforeseen events and unknown field conditions.

8.2.5 Project Related Costs

The capital improvement costs also account for project-related costs, comprising of engineering design, project administration (developer and City staff), construction management and inspection, and legal costs. In the absence of bid tabulations, the project related costs were estimated by applying an additional **30 percent** to the estimated construction costs.

8.3 CAPITAL IMPROVEMENT PROGRAM

The CIP costs for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated future growth throughout the City are summarized on **Table 8.2**.

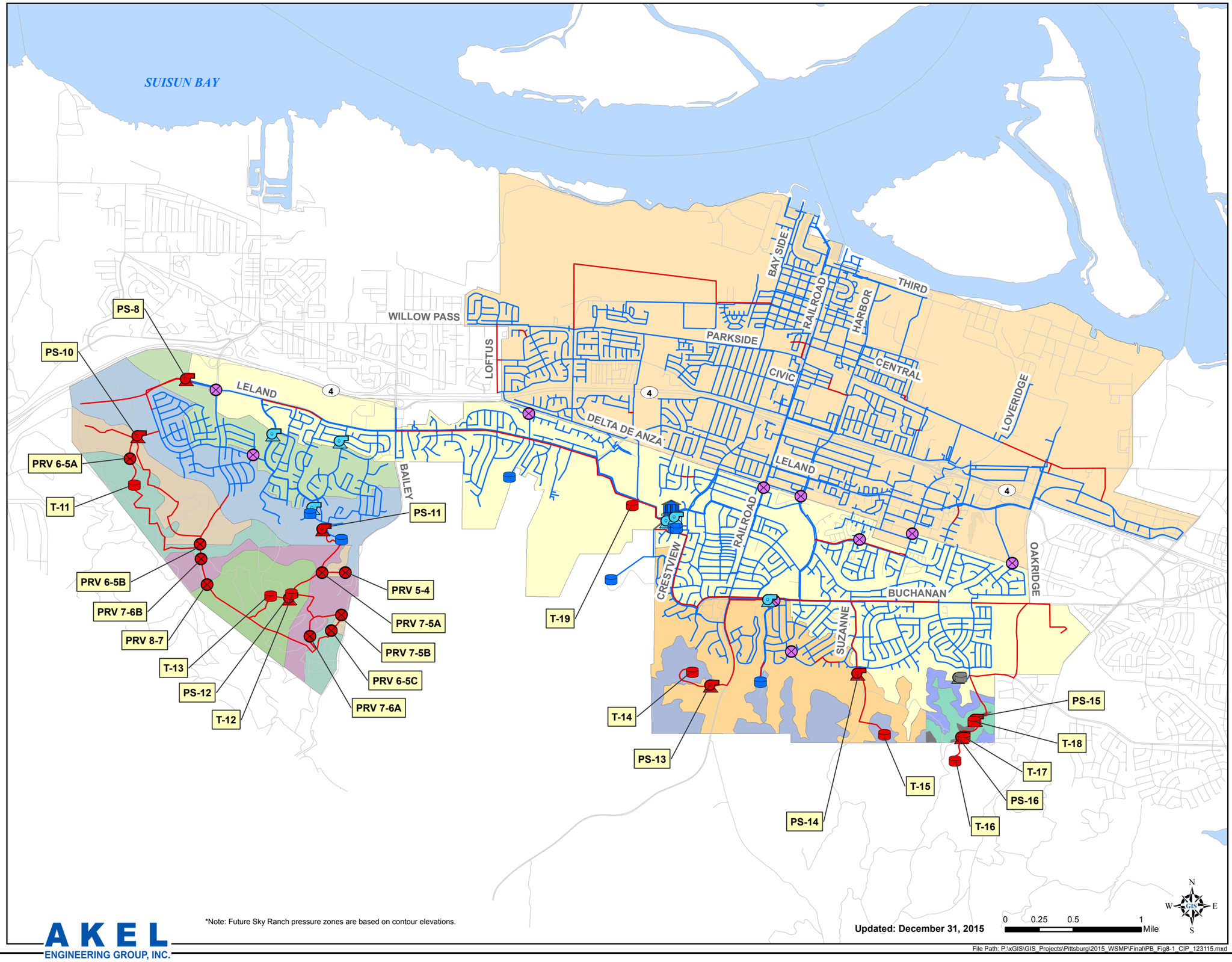
The capital costs are generally distributed according to the City's historical capability for budgeting construction of new domestic water infrastructure. The City is capable of allocating larger resources based on the necessity of the projects, and will perform updated reassessments as necessary.

The CIP has been divided into the following phases:

- **Imminent:** This immediate term phase includes improvements that are in the bid process and are planned for fiscal years 2014 and 2015.
- **Phase 1:** This short-term phase includes improvements that are allocated based on annual fiscal budgets between 2016 and 2020.
- **Phase 2:** This intermediate phase includes improvements that are allocated based on a 5-year period between 2021 and 2025.
- **Phase 3:** This long term phasing plan includes improvements that are allocated beyond 2025.

It should be noted that this phasing plan is subject to revisions by City staff. **Table 8.2** includes a numbering system for ease of reference and for locating the improvements on corresponding figures. **Figure 8.1** graphically shows the locations, and reference numbers, for each proposed storage reservoir and booster station. **Figure 8.2** shows the locations, and reference numbers for the transmission mains.

For graphical clarity, additional figures were created as follows: **Figure 8.3** details the Southeast Hills, **Figure 8.4** details the Southwest Hills, **Figure 8.5** details the Northwest, and **Figure 8.6** details the Northeast, with each figure labeling improvements for transmission mains. **Figure 7.3** shows the improvements required for meeting the City's fire flow criteria.



Legend

Proposed
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned
- Tank
- Booster Station

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Pressure Zones
- Zone 1
- Zone 2
- Zone 3 East
- Zone 3 West
- Zone 3 East Sky Ranch
- Zone 4 East
- Zone 4 West
- Zone 4 East Sky Ranch
- Zone 5
- Zone 6
- Zone 7
- Zone 8
- Sky Ranch Above 450'
- Street Centerlines
- Water Bodies

*Note: Future Sky Ranch pressure zones are based on contour elevations.

Updated: December 31, 2015

Figure 8.1
CIP Facility Locations
Tanks and Booster Stations

Water System Master Plan
City of Pittsburg

AKEL ENGINEERING GROUP, INC.

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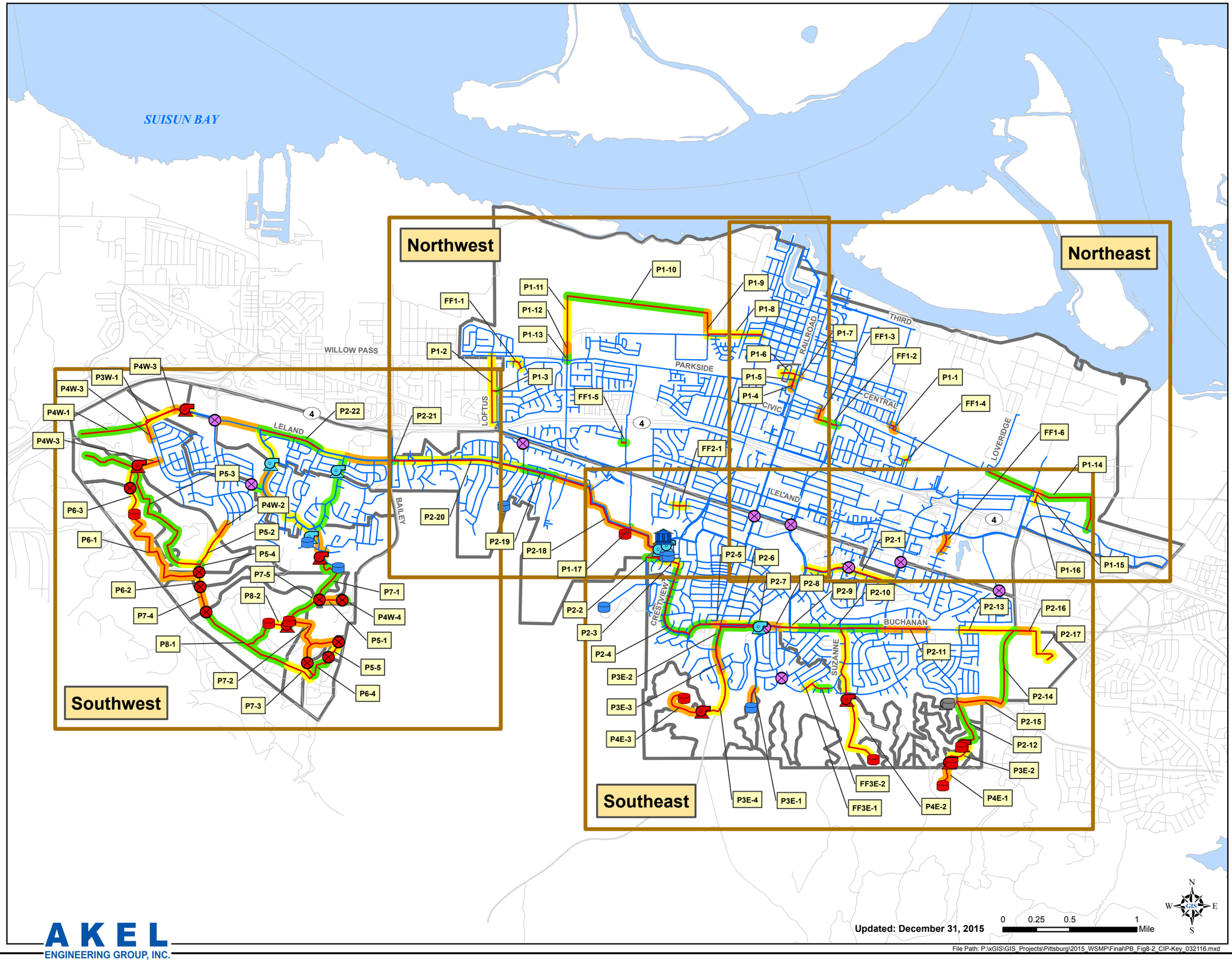

Legend

Proposed

- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned

- Tank
- Booster Station

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Water Bodies

Figure 8.2
CIP Facility Locations
Transmission Mains
Water System Master Plan
City of Pittsburg

Updated: December 31, 2015

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ZONE 1
ZONE 2
ZONE 3 EAST
ZONE 4 EAST
ZONE 4 EAST SKY RANCH
ZONE 3 EAST SKY RANCH
LELAND
RAILROAD
CRESTVIEW
SUZANNE
OAKRIDGE
BUCHANAN
FF2-1
FF1-6
FF3E-1
FF3E-2
P1-14
P1-15
P1-16
P1-17
P2-18 (Seg. 1W)
P2-1
P2-2
P2-3 (Seg. 1E)
P2-4 (Seg. 1E)
P2-5 (Seg. 1E)
P2-6 (Seg. 2E)
P2-7 (Seg. 3E)
P2-8 (Seg. 4E)
P2-9 (Seg. 4E)
P2-10 (Seg. 5E)
P2-11 (Seg. 6E)
P2-12
P2-13
P2-14
P2-15
P2-16
P2-17
P3E-1 Seg. 7E
P3E-2 (Seg. 8E)
P3E-3
P3E-4
P4E-1
P4E-2
P4E-3
P4E-4
8/14/14
14/20
14/20/20
12/14
8/16

Legend

Proposed
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned
- Tank
- Booster Station
- Pipes

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels
- Water Bodies

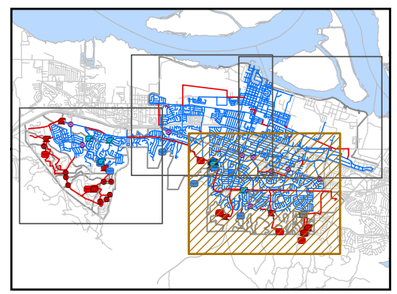

Figure 8.3
CIP Facility Locations
Southeast Hills
Water System Master Plan
City of Pittsburg

Updated: December 31, 2015

0 0.125 0.25 0.5 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

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ZONE 3 WEST
ZONE 4 WEST
ZONE 2
ZONE 6
ZONE 5
ZONE 4 WEST
ZONE 7
ZONE 5
ZONE 8
ZONE 7
ZONE 5
ZONE 7
ZONE 6
LELAND
(Seg. 8W)
Hanlon
LOFTUS
BAILEY
P1-3
P1-2
P2-22 (Seg. 6W)
(Seg. 7W)
(Seg. 5W)
(Seg. 4W)
P2-21 (Seg. 3W)
P2-20 (Seg. 3W)
(Seg. 9W)
(Seg. 13W)
(Seg. 11W)
(Seg. 10W)
(Seg. 12W)
P3W-1
P4W-1
P4W-2
P4W-3
P5-1
P5-2
P5-3
P5-4
P5-5
P6-1
P6-2
P6-4
P7-1
P7-2
P7-3
P7-4
P7-5
P8-1
P8-2
P4W-4

Legend

Proposed

- Storage Tanks
- Booster Stations
- PRVs
- Pipes

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels
- Water Bodies

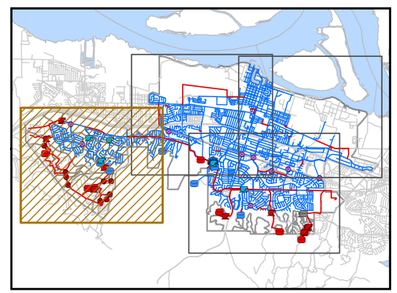

Figure 8.4
CIP Facility Locations
Southwest Hills
Water System Master Plan
City of Pittsburg

Updated: March 18, 2016

0 0.125 0.25 0.5 Mile

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Pittsburg\2015_WSMP\Final\PB_Fig8-4_SWH_031816.mxd

AKEL
ENGINEERING GROUP, INC.

ZONE 1

ZONE 2

WILLOW PASS

LOFTUS

Hanlon

PARKSIDE

BAY SIDE

RAILROAD

CIVIC

HARBOR

LELAND

DELTA DE ANZA

P1-1 P1-2 P1-3 P1-4 P1-5 P1-6 P1-7 P1-8 P1-9 P1-10 P1-11 P1-12 P1-13 P1-17

P2-1 P2-2 P2-3 (Seg. 1E) P2-4 (Seg. 1E) P2-18 (Seg. 1W) P2-19 (Seg. 2W) P2-20 (Seg. 3W) P2-21 (Seg. 3W)

FF1-1 FF1-2 FF1-3 FF1-5 FF2-1

4

0 0.125 0.25 0.5 Mile

Updated: December 31, 2015

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Legend

Proposed

- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned

- Pipes

Existing

- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels
- Water Bodies

Figure 8.5
CIP Facility Locations
Northwest
Water System Master Plan
City of Pittsburg

AKEL
ENGINEERING GROUP, INC.

ZONE 1

ZONE 2

BAY SIDE
RAILROAD
THIRD
COLUMBIA
PARKSIDE
CIVIC
HARBOR
CENTRAL
LOVERIDGE
LELAND
RAILROAD
4

P1-8
P1-6
P1-5
P1-4
P1-7
FF1-3
FF1-2
P1-1
FF1-4
P1-14
P1-15
P1-16
FF1-6
P2-1

Legend

Proposed
- Storage Tanks
- Booster Stations
- PRVs
- Pipes

To Be Abandoned
- Pipes

Existing
- WTP
- Storage Tanks
- Booster Stations
- PRVs
- Pipes
- Pressure Zones
- Street Centerlines
- Parcels
- Water Bodies

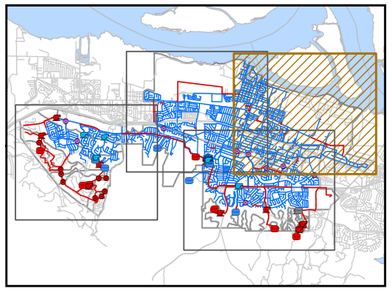

Figure 8.6
CIP Facility Locations
Northeast
Water System Master Plan
City of Pittsburg

AKEL
ENGINEERING GROUP, INC.

Updated: December 31, 2015

0 0.125 0.25 0.5 Mile

N W GIS E S

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Table 8.2 Capital Improvement Program

Water System Master Plan

City of Pittsburg

Improvement Number	Pressure Zone	Type of Improv.	Street	Limits	Pipeline and Appurtenances Costs: Diam. (in)	Length (ft)	Unit Cost[5] ($)	Pipe Cost ($)	Other Infrastr. Costs[2] ($)	Baseline Constr. Cost ($)	Estimated Constr. Cost[3, 6] ($)	Land Acquisition Cost[6] ($)	Capital Improv. Cost[4, 6] ($)	Phasing: Imminent 2014-2015 ($)	Phase 1 2016-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-Buildout ($)	% Benefit: Existing Users	Future Users	Cost Sharing: Existing Users ($)	Future Users ($)
Improvements to Correct Existing Deficiencies																					
East Leland Subarea - Pipe Looping to Enhance Pressures																					
P2-1	Zone 2	Pipe	Stoneman Avenue	Harbor St. to Loveridge Rd.	12	3,300	150	495,000		495,000	643,500		836,550		836,550			100%		836,550	
East Central Subarea - Connections to Transmission Main																					
P1-1	Zone 1	Pipe	Columbia Street	Pittsburg Antioch Hwy. to Columbia St.	8	375	118	44,250		44,250	57,525		74,783		74,783			100%		74,783	
West Central Subarea - Western Loop																					
P1-2	Zone 1	Pipe	Loftus Road	Schooner Wy. To Willow Pass Rd.	16	2,800	181	506,800		506,800	658,840		856,492	856,492				100%		856,492	
P1-3	Zone 1	Pipe	Hanlon Way	e/o Loftus Rd.	8	300	118	35,400		35,400	46,020		59,826	59,826				100%		59,826	
P2-2	Zone 2	Pipe	WTP site	Hillsdale Dr. to existing 14"	12	460	150	69,000		69,000	89,700		116,610	116,610				100%		116,610	
Downtown Subarea - Cornwall Street Improvements																					
P1-4	Zone 1	Pipe	Cornwall Street	Dual Crossing under the railroad	8 / 10	140	754	105,560		105,560	137,228		178,396		178,396			100%		178,396	
P1-5	Zone 1	Pipe	Cornwall Street	Leslie Dr. to Central Ave.	16	300	181	54,300		54,300	70,590		91,767		91,767			100%		91,767	
P1-6	Zone 1	Pipe	Central Avenue	Cornwall St. to Industrial Complex	16	570	181	103,170		103,170	134,121		174,357		174,357			100%		174,357	
P1-7	Zone 1	Pipe	Central Avenue	Connection across Railroad Ave between 14" and 16"	16	60	181	10,860		10,860	14,118		18,353		18,353			100%		18,353	
										Subtotal - Existing Deficiencies			**2,407,135**	**1,032,928**	**1,374,207**					**2,407,135**	
Improvements to Meet Fire Flow Criteria																					
FF1-1	Zone 1	Pipe	Marlin Drive	Commodore Ct. to Trident Dr.	8	460	118	54,280		54,280	70,564		91,733		91,733			100%		91,733	
FF1-2	Zone 1	Pipe	School Street	Somers St. to Harbor St.	8	800	118	94,400		94,400	122,720		159,536		159,536			100%		159,536	
FF1-3	Zone 1	Pipe	Somers Street	From School St. to 16th St.	8	420	118	49,560		49,560	64,428		83,756		83,756			100%		83,756	
FF1-4	Zone 1	Pipe	El Pueblo Avenue	Diane Ave. to 120 ft e/o Diane Ave.	8	125	118	14,750		14,750	19,175		24,928		24,928			100%		24,928	
FF1-5	Zone 1	Pipe	Vacant Field	Zone 1 20-inch to Bodega Dr.	8	170	118	20,060		20,060	26,078		33,901		33,901			100%		33,901	
FF1-6	Zone 1	Pipe	Gladstone Drive	E Leland Rd. to Diokno Ct.	12	700	150	105,000		105,000	136,500		177,450		177,450			100%		177,450	
FF2-2	Zone 2	Pipe	Atherton Avenue	Orinda Ln. to Ravine Dr.	8	525	118	61,950		61,950	80,535		104,696		104,696			100%		104,696	
FF3E-1	Zone 3E	Pipe	Diehl Way	El Arroyo Pl. to Foothill Wy.	8	350	118	41,300		41,300	53,690		69,797		69,797			100%		69,797	
FF3E-2	Zone 3E	Pipe	Foothill Way	Diehl Wy. to Skyline Pl.	8	715	118	84,370		84,370	109,681		142,585		142,585			100%		142,585	
										Subtotal - Existing Deficiencies			**888,382**		**888,382**					**888,382**	
Mirant Power Plant and Loveridge Specific Plan																					
Mirant Power Plant Annexation - Transmission Main Loop																					
P1-8	Zone 1	Pipe	10th Street	Montezuma St. to Willow Pass Rd.	16	2,185	181	395,485		395,485	514,131		668,370		668,370				100%		668,370
P1-9	Zone 1	Pipe	Utility Rd	890 ft n/o Willow Pass Rd and Tenth St.	16	890	181	161,090		161,090	209,417		272,242		272,242				100%		272,242
P1-10	Zone 1	Pipe	Eastern Alignment	5570 ft e/o Utility Rd. intersection	16	5,570	181	1,008,170		1,008,170	1,310,621		1,703,807		1,703,807				100%		1,703,807
P1-11	Zone 1	Pipe	Southern Alignment	2045 ft s/o of Eastern Alignment to Railroad Crossing	16	2,050	181	371,050		371,050	482,365		627,075		627,075				100%		627,075
P1-12	Zone 1	Pipe	Easement	Cross under Santa Fe RR	16/36	300	468	140,400		140,400	182,520		237,276		237,276				100%		237,276
P1-13	Zone 1	Pipe	Southern Alignment	200 ft s/o of Railroad Crossing to Parkside Dr.	16	120	181	21,720		21,720	28,236		36,707		36,707				100%		36,707
Loveridge Specific Plan - Transmission Main Loop																					
P1-14	Zone 1	Pipe	Loveridge Development	Loveridge Specific Plan alignments	18	5,500	195	1,072,500		1,072,500	1,394,250		1,812,525		1,812,525				100%		1,812,525
P1-15	Zone 1	Pipe	Loveridge Development	Loveridge Specific Plan alignments	18	280	195	54,600		54,600	70,980		92,274		92,274				100%		92,274
P1-16	Zone 1	Casing[1]	Loveridge Development	Loveridge Specific Plan alignments	18/38	120	494	59,280		59,280	77,064		100,183		100,183				100%		100,183
										Subtotal - Mirant and Loveridge			**5,550,459**		**5,550,459**					**5,550,459**	
Expansion Improvements - Southeast Hills and Infills																					
Transmission Main from WTP to Highlands Ranch and Southeast Developments																					
P2-3	Zone 2	Pipe	Hillsdale Drive	WTP site to Crestview Dr.	24	1,325	520	689,000		689,000	895,700		1,164,410	1,164,410				63%	37%	729,654	434,756
P2-4	Zone 2	Pipe	Crestview/W. Buchanan	Hillsdale to Railroad Ave. (Seg. 1E)	16	4,975	181	900,475		900,475	1,170,618		1,521,803		1,521,803			63%	37%	953,607	568,196
P2-5	Zone 2	Casing[1]	W. Buchanan Road	Cross under Railroad Rd.	16/36	200	468	93,600		93,600	121,680		158,184	158,184				63%	37%	99,123	59,061
P2-6	Zone 2	Pipe	W. Buchanan Road	Railroad Ave. to PS-4 (Seg. 2E)	16	1,400	181	253,400		253,400	329,420		428,246	428,246				51%	49%	219,246	209,000
P2-7	Zone 2	Pipe	W. Buchanan Road	PS-4 to Buchanan Rd. PRV (Seg. 3E)	12	300	150	45,000		45,000	58,500		76,050	76,050				11%	89%	8,397	67,653
P2-8	Zone 2	Pipe	W. Buchanan Road	Buchanan Rd. PRV to Harbor St. (Seg. 4E)	12	1,100	150	165,000		165,000	214,500		278,850	278,850				44%	56%	122,021	156,829
P2-9	Zone 2	Casing[1]	W. Buchanan Road	Cross under Harbor St.	12/32	300	416	124,800		124,800	162,240		210,912	210,912				44%	56%	92,292	118,620
P2-10	Zone 2	Pipe	W. Buchanan Road	Harbor St. to Loveridge Rd. (Seg. 5E)	12	3,700	150	555,000		555,000	721,500		937,950	937,950				44%	56%	410,435	527,515
P2-11	Zone 2	Pipe	W. Buchanan Road	Loveridge Rd. to Ventura Rd. (Seg. 6E)	12	1,700	150	255,000		255,000	331,500		430,950	430,950					100%	0	430,950
P3E-1	Zone 3E	Pipe	Hillview Dr.	From end of Hillview Dr.to T-7 (Seg. 7E)	12	770	150	115,500		115,500	150,150		195,195			195,195			100%	0	195,195
P3E-2	Zone 3E	Pipe	Kirker Pass Road	From PS-4 to Castlewood Dr. (Seg. 8E)	12	3,500	150	525,000		525,000	682,500		887,250			887,250			100%	0	887,250
Proposed New Zone I Tank																					
T-19	Zone 1	Tank	New Zone 1 Tank	Servicing Zone 1	1.3 MG				2,080,000	2,080,000	2,704,000	1,045,440	4,874,272		4,874,272				100%		4,874,272
P1-17	Zone 1	Pipe	Future Road	From existing 20" to T-19	20	1,100	223	245,300		245,300	318,890		414,557		414,557				100%		414,557
Highlands Storage Tank																					
P2-12	Zone 2	Pipe	Highlands Ranch	Connection to Highlands Ranch Tank	16	1,030	181	186,430		186,430	242,359		315,067		315,067			47%	53%	147,661	167,406
T-18	Zone 2	Tank	Highlands Ranch	Servicing Zone 2	1.4 MG				2,240,000	2,240,000	2,912,000	784,080	4,804,904		4,804,904			47%	53%	2,251,887	2,553,017
Tuscany Meadows Subdivision																					
P2-13	Zone 2	Pipe	W. Buchanan Road	From Meadows Ave. to the Standard Oil ROW	16	2,175	181	393,675		393,675	511,778		665,311		665,311				100%		665,311
P2-14	Zone 2	Pipe	Standard Oil ROW	From W. Buchanan Rd. to James Donlon Blvd.	12	3,050	150	457,500		457,500	594,750		773,175		773,175				100%		773,175
P2-15	Zone 2	Pipe	James Donlon Boulevard	From the Standard Oil ROW to Ventura Dr.	12	1,725	150	258,750		258,750	336,375		437,288		437,288				100%		437,288
P2-16	Zone 2	Pipe	W. Buchanan Road	From the Standard Oil ROW to approx. 860 ft e/o ROW	16	860	181	155,660		155,660	202,358		263,065		263,065				100%		263,065
P2-17	Zone 2	Pipe	Tuscany Meadows Property	Jogging along future road to service High Density Res.	12	1,850	150	277,500		277,500	360,750		468,975		468,975				100%		468,975
Sky Ranch Subdivision																					
PS-15	Zone 4E	Pump Sta.	Sky Ranch Pump Sta.	230 gpm Duty + 230 gpm Standby	2 x 230 gpm				367,944	367,944	478,327	50,000	686,825			686,825			100%		686,825
P3E-2	Zone 4E	Pipe	Extension of Ventura Drive	PS-15 to PS-16 and to T-17	12	1,750	150	262,500		262,500	341,250		443,625			443,625			100%		443,625
T-17	Zone 4E	Tank	Sky Ranch	Servicing Zone 3 (Sky Ranch)	0.25 MG				500,000	500,000	650,000	784,080	1,864,304			1,864,304			100%		1,864,304
PS-16	Zone 4E	Pump Sta.	Sky Ranch Pump Sta.	130 gpm Duty + 130 gpm Standby	2 x 130 gpm				238,719	238,719	310,335	50,000	468,435			468,435			100%		468,435
P4E-1	Zone 4E	Pipe	Extension of Ventura Drive	PS-16 to T-16	12	1,100	150	165,000		165,000	214,500	72,424	373,001			373,001			100%		373,001
T-16	Zone 4E	Tank	Sky Ranch	Servicing Zone 4 (Sky Ranch)	0.25 MG				500,000	500,000	650,000	784,080	1,864,304			1,864,304			100%		1,864,304
Thomas Ranch Subdivision																					
PS-14	Zone 4E	Pump Sta.	Thomas Ranch Pump Sta.	150 gpm Duty + 150 gpm Standby	2 x 150 gpm				266,081	266,081	345,905	50,000	514,677			514,677			100%		514,677
P4E-2	Zone 4E	Pipe	Suzanne Dr. extension	Buchanan Rd. to Thomas Ranch Tank	12	6,000	150	900,000		900,000	1,170,000		1,521,000			1,521,000			100%		1,521,000

Table 8.2 Capital Improvement Program

Water System Master Plan

City of Pittsburg

Improvement Number	Pressure Zone	Type of Improv.	Street	Limits	Pipeline and Appurtenances Costs: Diam. (in)	Length (ft)	Unit Cost[5] ($)	Pipe Cost ($)	Other Infrastr. Costs[2] ($)	Baseline Constr. Cost ($)	Estimated Constr. Cost[3, 6] ($)	Land Acquisition Cost[6] ($)	Capital Improv. Cost[4, 6] ($)	Phasing: Imminent 2014-2015 ($)	Phase 1 2016-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-Buildout ($)	% Benefit: Existing Users	% Benefit: Future Users	Cost Sharing: Existing Users ($)	Cost Sharing: Future Users ($)
T-15	Zone 4E	Tank	Thomas Ranch	Servicing Zone 4 (Thomas Ranch)	0.30 MG				600,000	600,000	780,000	784,080	2,033,304				2,033,304		100%		2,033,304
Montreux Subdivision																					
PS-13	Zone 4E	Pump Sta.	Montreux Pump Sta.	140 gpm Duty + 140 gpm Standby	2 x 140 gpm				252,518	252,518	328,274	50,000	491,756				491,756		100%		491,756
P3E-3	Zone 3E	Pipe	Kirker Pass Road	Castlewood Dr. to Pheasant Dr.	10	875	136	119,000		119,000	154,700		201,110				201,110		100%		201,110
P3E-4	Zone 3E	Pipe	Kirker Pass Road	Pheasant Dr. to PS-13	12	2,275	150	341,250		341,250	443,625		576,713				576,713		100%		576,713
P4E-3	Zone 4E	Pipe	Kirker Pass Road	PS-13 to T-14	12	2,025	150	303,750		303,750	394,875		513,338				513,338		100%		513,338
T-14	Zone 4E	Tank	Montreux	Servicing Zone 4 (Montreux)	0.30 MG				600,000	600,000	780,000	784,080	2,033,304				2,033,304		100%		2,033,304
										Subtotal Expansions Improvements (Excluding Southwest Hills)			**32,892,107**	**3,685,552**	**9,249,587**	**5,288,829**	**14,668,139**			**5,034,322**	**27,857,785**
Expansion Improvements - Southwest Hills																					
Transmission Main from WTP Southwest Hills Pump Station PS-2																					
P2-18	Zone 2	Pipe	W. Leland Road (Seg. 1W)	WTP to John Henry Johnson Pkwy	20	5,850	223	1,304,550		1,304,550	1,695,915		2,204,690		2,204,690				100%		2,204,690
P2-19	Zone 2	Pipe	W. Leland Road (Seg. 2W)	John Henry Johnson Pkwy to West Leland Tank 20"	20	1,250	223	278,750		278,750	362,375		471,088		471,088				100%		471,088
P2-20	Zone 2	Pipe	W. Leland Road (Seg. 3W)	W. Leland Tank 20" to Bailey Rd.	20	5,000	223	1,115,000		1,115,000	1,449,500		1,884,350		1,884,350				100%		1,884,350
P2-21	Zone 2	Casing[1]	W. Leland Road (Seg. 3W)	Cross under Bailey Rd.	20/40	200	520	104,000		104,000	135,200		175,760		175,760				100%		175,760
P2-22	Zone 2	Pipe	W. Leland Road (Seg. 6W)	Woodhill Dr. to Tomales Bay Dr.	20	2,450	223	546,350		546,350	710,255		923,332		923,332				100%		923,332
Transmission Mains - Future Southwest Hills Subdivisions																					
P3W-1	Zone 3W	Pipe	Future Road	New Zone 3 Developments	12	2,100	150	315,000		315,000	409,500		532,350			532,350			100%		532,350
P4W-1	Zone 4W	Pipe	W. Leland Road	1,925 feet west of flow split to flow split	12	1,925	150	288,750		288,750	375,375		487,988			487,988			100%		487,988
P4W-2	Zone 4W	Pipe	San Marco Boulevard	Extension to PS-9	16	500	181	90,500		90,500	117,650		152,945			152,945			100%		152,945
P4W-3	Zone 4W	Pipe	Future Road	PS-8 to Aragon Dr. and Santa Teresa Dr. to PS-10	16	3,150	181	570,150		570,150	741,195		963,554			963,554			100%		963,554
P4W-4	Zone 4W	Pipe	Future Road	Zone 4 Smith Pipe	12	150	150	22,500		22,500	29,250		38,025			38,025			100%		38,025
P5-1	Zone 5	Pipe	Future Road	Zone 5 Smith Pipe	12	900	150	135,000		135,000	175,500		228,150			228,150			100%		228,150
P5-2	Zone 5	Pipe	Future Road	From Zone 4 Boundary to future road west	12	1,350	150	202,500		202,500	263,250		342,225			342,225			100%		342,225
P5-3	Zone 5	Pipe	Future Road	Future road to the west from San Marco Blvd to end of pipe	12	8,100	150	1,215,000		1,215,000	1,579,500		2,053,350			2,053,350			100%		2,053,350
P5-4	Zone 5	Pipe	Future Road	PRV6-5a to future road to the west from San Marco Blvd	12	275	150	41,250		41,250	53,625		69,713			69,713			100%		69,713
P5-5	Zone 5	Pipe	Future Road	Bailey Estate Zone 5 Pipe	12	700	150	105,000		105,000	136,500		177,450				177,450		100%		177,450
P6-1	Zone 6	Pipe	Future Road	T-11 connection to end of Zone 6 pipe	12	5,200	150	780,000		780,000	1,014,000		1,318,200				1,318,200		100%		1,318,200
P6-2	Zone 6	Pipe	Future Road	Zone 7 boundary to PRV 6-5a	12	570	150	85,500		85,500	111,150		144,495				144,495		100%		144,495
P6-3	Zone 6	Pipe	Future Road	PS-10 to PRV 6-5A	16	200	181	36,200		36,200	47,060		61,178				61,178		100%		61,178
P6-3	Zone 6	Pipe	Future Road	PRV 6-5A to T-11	16	1,950	181	352,950		352,950	458,835		596,486				596,486		100%		596,486
P6-4	Zone 6	Pipe	Future Road	Bailey Estates Zone 6 Pipe	12	1,650	150	247,500		247,500	321,750		418,275				418,275		100%		418,275
P7-1	Zone 7	Pipe	Future Road	PS-11 to T-12 and to PS-12	16	3,850	181	696,850		696,850	905,905		1,177,677			1,177,677			100%		1,177,677
P7-2	Zone 7	Pipe	Future Road	From 16" to flow split and to Zone 5 and Zone 6	12	3,750	150	562,500		562,500	731,250		950,625				950,625		100%		950,625
P7-3	Zone 7	Pipe	Future Road	PRV 7-6 to Zone 8-7 emergency connection	12	1,775	150	266,250		266,250	346,125		449,963				449,963		100%		449,963
P7-4	Zone 7	Pipe	Future Road	PRV 8-7 to end of Zone 7 pipe	12	925	150	138,750		138,750	180,375		234,488				234,488		100%		234,488
P7-5	Zone 7	Pipe	Future Road	Connection to Smith development	12	120	150	18,000		18,000	23,400		30,420				30,420		100%		30,420
P8-1	Zone 8	Pipe	Future Road	T-13 to flow split and PRV 8-7 to Zone 7 Bailey boundary	12	5,125	150	768,750		768,750	999,375		1,299,188				1,299,188		100%		1,299,188
P8-2	Zone 8	Pipe	Future Road	PS-12 to T-13	16	700	181	126,700		126,700	164,710		214,123				214,123		100%		214,123
Pressure Reducing Valves - Future Southwest Hills[7]																					
PRV 5-4	Zone 4W	PRV	Smith Development	Zone 5 to Zone 4W	3 / 6				94,000	94,000	122,200		158,860			158,860			100%		158,860
PRV 7-5A	Zone 5	PRV	Smith Development	Zone 7 to Zone 5	4 / 6				101,000	101,000	131,300		170,690			170,690			100%		170,690
PRV 6-5A	Zone 5	PRV	Faria	Zone 6 to Zone 5	8				86,000	86,000	111,800		145,340				145,340		100%		145,340
PRV 6-5B	Zone 5	PRV	Faria	Zone 6 to Zone 5	8				86,000	86,000	111,800		145,340				145,340		100%		145,340
PRV 6-5C	Zone 5	PRV	Bailey	Zone 6 to Zone 5	3 / 6				94,000	94,000	122,200		158,860				158,860		100%		158,860
PRV 7-5B	Zone 5	PRV	Bailey	Zone 7 to Zone 5	3 / 6				94,000	94,000	122,200		158,860				158,860		100%		158,860
PRV 7-6A	Zone 6	PRV	Bailey	Zone 7 to Zone 6	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
PRV 7-6B	Zone 6	PRV	Faria	Zone 7 to Zone 6	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
PRV 8-7	Zone 7	PRV	Faria	Zone 8 to Zone 7	6				72,000	72,000	93,600		121,680				121,680		100%		121,680
Storage Reservoirs - Southwest Hills																					
T-11	Zone 6	Tank	Faria	Servicing Zone 5 and 6 West	0.75 MG				1,500,000	1,500,000	1,950,000	784,080	3,554,304				3,554,304		100%		3,554,304
T-12	Zone 7	Tank	Bailey	Servicing Zone 7 West and subsequent lower zones	0.50 MG				1,000,000	1,000,000	1,300,000	784,080	2,709,304			2,709,304			100%		2,709,304
T-13	Zone 8	Tank	Faria	Servicing Zone 8 West	0.60 MG				1,200,000	1,200,000	1,560,000	784,080	3,047,304				3,047,304		100%		3,047,304
Pump Stations - Southwest Hills																					
PS-8	Zone 4W	Pump Sta.	San Marco Villas Pump Sta.	1,000 gpm Duty + 1,000 gpm Standby	2 x 1,000 gpm				1,121,460	1,121,460	1,457,897	50,000	1,960,267	1,960,267					100%		1,960,267
PS-10	Zone 6	Pump Sta.	Faria Pump Sta.	560 gpm Duty + 560 gpm Standby	2 x 560 gpm				722,495	722,495	939,243	50,000	1,286,016				1,286,016		100%		1,286,016
PS-11	Zone 7	Pump Sta.	Bailey Pump Sta.	680 gpm Duty + 680 gpm Standby	2 x 680 gpm				837,096	837,096	1,088,224	50,000	1,479,692			1,479,692			100%		1,479,692
PS-12	Zone 8	Pump Sta.	Faria Pump Sta.	380 gpm Duty + 380 gpm Standby	2 x 380 gpm				538,435	538,435	699,966	50,000	974,956				974,956		100%		974,956
										Subtotal - Expansion Improvements-Southwest Hills			**33,914,914**		**7,619,485**	**10,564,521**	**15,730,908**			**0**	**33,914,914**
Capital Improvement Summary																					
													City-Wide Total								**75,652,997**
														4,718,480	**24,682,120**	**15,853,350**	**30,399,048**			**8,329,839**	**67,323,158**

Note:
1. Proposed casings size and carrier pipe size.
2. Tank and pump station pricing can vary widely with site conditions.
3. Baseline construction costs plus 30% to account for unforeseen events and unknown conditions.
4. Estimated construction cost plus 30% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs.
5. Cost estimates are based on the Engineering News Record (ENR) construction cost index (CCI) of 9800 for the 20 cities for June 2014.
6. A land acquisition fee for the construction of storage reservoirs and pump station was assumed based on City provided data for tanks, and the previous master plan for pump stations.
7. Costs for PRVs with bypass assume full unit cost of larger PRV and half unit cost of smaller PRV.

8.4 CAPACITY ALLOCATION ANALYSIS

This master plan includes a capacity allocation analysis which was based on the domestic water requirements for the proposed developments. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments.

8.4.1 Storage Reservoirs

The capacity allocation for storage reservoirs was performed by pressure zone, as shown on Table 8.3. The table lists the proposed tanks, with their assigned numbers, locations, and the percent allocation to either existing users or proposed developments.

8.4.2 Transmission Mains

The capacity allocation for transmission mains was performed for critical segments in the Southeast Hills and infill areas (Table 8.4) and for the Southwest Hills (Table 8.5). The tables list each proposed development, and identifies its percent allocation for each relevant pipe segment from the water treatment plant to either the Southeast or Southwest Hills.

The analysis also allocated capacity, in the transmission mains, for routing fire flows within the pressure zones and during MDD.

8.4.3 Pump Stations

The capacity allocation for pump stations was also performed by pressure zone, as shown on Table 8.6. The table lists the proposed pump stations, with their assigned numbers, locations, and the percent allocation to either existing users or proposed developments.

8.5 CONSTRUCTION TRIGGERS

Phasing of improvements, where feasible, will delay premature construction of water conveyance facilities and optimize the use of existing facilities. The suggested triggers for the construction of the domestic water facilities listed in this master plan are preliminary and will be dictated by the timing of the anticipated developments. Construction triggers are typically expressed in equivalent single family dwelling units (EDUs). For the purposes of this master plan, one EDU is approximately 340 gpd. Converting non-single family residential land use to EDUs can be calculated as follows:

- Multi-Family Residential: 1 Multi-Family Unit = 0.8 EDUs
- Commercial: 1 Commercial Acre = 5.0 EDUs
- Schools: 1 School Acre = 2.9 EDUs
- Park: 1 Park Acre = 11.3 EDUs

Table 8.3 Storage Reservoirs Capacity Allocations

Water System Master Plan
City of Pittsburg

Pressure Zone	No.	Name / Location	Size	Capacity Allocations																										Total
				Existing				Southwest Hills																	Southeast Hills				Zones 1 and 2 Infills		
				Existing - Oak Hills	Existing	Existing - E/O Bailey to WTP	Existing - E/O WTP	Alves Ranch	Bailey Estates	De Bonneville	Faria	Bay Point/ BART Expansion	San Marco	The Villas at San Marco	Toscana at San Marco	San Marco Village C	Esperanza at San Marco	San Marco Village O	Smith	Spilker	Vista Del Mar	West Coast Transit Village	Montreux	Thomas Ranch	Sky Ranch	Tuscany Meadows	Zones 1 Infills	Zones 2 Infills	
			(MG)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Zone 1	**T-19**	WTP-Golf Course	**1.30**																								100%		100%
Zone 2	**T-18**	New Highlands	**1.40**				47%																5%		1%	40%		8%	100%
Zone 2	**T-5**	New West Leland	**3.00**	9%		21%	30%	8%				12%	2%		4%		4%				4%	6%							100%
Zone 3 E	**T-17**	Sky Ranch 3	**0.25**																						100%				100%
Zone 4 E	**T-14**	Montreux	**0.30**																				100%						100%
Zone 4 E	**T-15**	Thomas Ranch	**0.30**																					100%					100%
Zone 4 E	**T-16**	Sky Ranch 4	**0.25**																						100%				100%
Zone 6 W	**T-11**	Faria	**0.75**								69%		31%																100%
Zone 7 W	**T-12**	Bailey	**0.45**						50%		22%								28%										100%
Zone 8 W	**T-13**	Faria	**0.55**								100%																		100%

12/1/2015

Table 8.4 Transmission Mains Capacity Allocations for the Southeast Hills and Infills

Water System Master Plan

City of Pittsburg

Developments	Demands			Existing and Future Transmission Main Segments															
				Segment 1E 6,000 LF		Segment 2E 1,400 LF		Segment 3E 300 LF		Segment 4E 1,100 LF		Segment 5E 3,700 LF		Segment 6E 1,700 LF		Segment 7E 770 LF		Segment 8E 3,500 LF	
	ADD (MGD)	MDD (MGD)	TOU (MGD)	EXIST. 18"	FUT. 18"	EXIST. 18"	FUT. 18"	EXIST. 18"	FUT. 16"	EXIST. 16"	FUT. 16"	EXIST. 16"	FUT. 16"	EXIST. 14"	FUT. 16"	EXIST. 16"	FUT. 12"	EXIST. 10"	FUT. 12"
Existing Developments																			
Existing Zone 2 E/O WTP	2.47	4.45	-	70%	58%	70%	45%	100%		100%	36%	100%	36%	100%					
Existing Zone 3E	0.46	0.82	1.10	30%		30%										100%		100%	
Zone 1 PRV Loveridge	-	0.27	-		5%		6%		11%		8%		8%						
Future Developments																			
Infills Zone 2	0.08	0.15	-		3%		5%		11%		6%		6%						
Montreux	0.13	0.24	0.32		6%		7%										100%		100%
Thomas Ranch	0.09	0.16	0.21		4%		5%		8%		6%		6%						
Sky Ranch	0.15	0.26	0.35		7%		8%		15%		11%		11%		20%				
Tuscany Meadows	0.43	0.78	-		17%		24%		55%		33%		33%		80%				
	Fireflow			0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	1.44	1.44	1.44	1.44
	Total Demand			3.72	5.35	3.72	4.27	3.53	2.48	2.82	3.32	2.82	3.32	1.93	1.85	2.26	1.76	1.67	1.76
	Total Percent			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

2/6/2015

Table 8.5 Transmission Mains Capacity Allocations for the Southwest Hills

Water System Master Plan
City of Pittsburg

Developments	Demands			Existing and Future Transmission Main Segments																								
				Segment 1W (Segment 1) [1] Zone 2 5,850 LF			Segment 2W (Segment 1) [1] Zone 2 1,250 LF			Segment 3W (Segment 1) [1] Zone 2 5,000 LF			Segment 4W (Segment 2/3) [1] Zone 2 1,900 LF		Segment 5W (Segment 4) [1] Zone 2 1,050 LF		Segment 6W (Segment 5) [1] Zone 2 2,450 LF		Segment 7W Zone 2 1,500 LF	Segment 8W Zone 2 3,050 LF	Segment 9W Zone 3W 1,000 LF	Segment 10W Zone 3W 3,700 LF	Segment 11W Zone 3W 3,200 LF	Segment 12W Zone 3W 1,450 LF	Segment 13W Zone 3W 350 LF
	ADD (MGD)	MDD (MGD)	MDD+TOU (MGD)	EXIST. 20"	EXIST. 14"	FUT. 24"	EXIST. 20"	EXIST. 14"	FUT. 24"	EXIST. 20"	EXIST. 12"	FUT. 24"	EXIST. 12"	NEW 24"	EXIST. 16"	NEW 20"	NEW 20"	FUT. 20"	NEW 20"	NEW 20"	NEW 20"	PART NEW 16"	EXIST. 16"	EXIST. 16"	EXIST. 20"
Existing Developments																												
Oak Hills (Z2)	0.20	0.35	-	10.7%			10.7%			19.5%			62.4%															
Oak Hills (Z3)	0.25	0.45	0.60	18.1%			18.1%			13.2%			26.0%											88.4%		24.8%
Oak Hills (Z4)	0.11	0.20	0.27	8.1%			8.1%			5.9%			11.6%											11.6%	56.7%	
Zone 2 E/O Bailey Rd	0.47	0.85	-		77.2%			77.2%			100.0%																	
Zone 1 PRV Birchwood	0.00	1.11	-	26.2%	22.8%		26.2%	22.8%																				
Future Developments																												
Ambrose Park	0.05	0.08	-																									
Alves Ranch	0.17	0.31	-			7.2%			7.2%			13.4%		7.9%		10.8%	7.1%											
Bailey Estates	0.09	0.17	0.22			5.2%			5.2%			5.1%		3.4%		7.7%	5.1%		9.9%		10.9%	18.0%			9.3%		
Bay Point/BART	0.27	0.49	-			11.4%			11.4%			21.3%		12.5%														
De Bonneville	0.04	0.07	0.10			2.3%			2.3%			2.3%		1.5%		3.4%		25.1%		4.8%								
Faria	0.51	0.92	1.22			28.5%			28.5%			28.1%		18.6%		42.8%	28.0%		30.4%	26.3%	33.6%	55.7%			28.8%		
San Marco	0.61	1.10	1.21	36.9%			36.9%			29.0%				19.1%	63.9%		27.7%		11.9%	45.8%	13.1%						24.9%
The Villas at San Marco	0.13	0.23	0.31			7.1%			7.1%	6.8%				4.7%	16.2%		7.0%		13.6%	0.2%	15.0%						28.4%
Toscana at San Marco	0.09	0.15	-			3.6%			3.6%	8.5%				3.9%	8.1%			39.6%		7.5%							
San Marco Village C	0.14	0.25	0.33			7.8%			7.8%	7.4%				5.1%		11.7%	7.7%		5.3%	4.9%	5.9%						11.2%
Esperanza at San Marco	0.08	0.15	0.22			5.2%			5.2%	9.8%				4.9%	11.8%		5.1%		3.5%	7.1%	3.8%						7.2%
San Marco Village O	0.02	0.03	0.07			1.5%			1.5%			1.5%		1.0%		2.3%		16.7%	1.6%		1.8%						3.4%
Smith	0.05	0.09	0.12			2.9%			2.9%			2.8%		1.9%		4.3%	2.8%		5.4%		6.0%	10.0%			5.2%		
Spilker	0.03	0.05	0.07			1.7%			1.7%			1.7%		1.1%		2.5%		18.6%		3.5%							
Vista del Mar	0.17	0.31	0.41			9.6%			9.6%			12.7%		7.9%		14.4%	9.5%		18.4%		9.9%	16.3%					
West Coast Transit Village	0.14	0.26	-			5.9%			5.9%			11.1%		6.5%														
	Fire Flow			n/a	n/a	n/a	n/a	n/a	n/a	1.08	n/a	1.08	1.08	1.08	1.08	1.08	2.16	2.16	2.88	2.16	1.80	1.08	1.44	1.08	2.88		
	Total Demand			3.28	1.10	4.29	3.28	1.10	4.29	4.52	0.85	4.35	2.29	6.58	2.97	3.94	6.52	2.55	5.13	4.22	3.84	2.31	2.30	2.37	3.95		
	Total Percent			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		

6/20/2014

Note:

1. The segment number listed in parentheses is the segment number used in Amendment No. 3.

Table 8.6 Pump Stations Capacity Allocations

Water System Master Plan
City of Pittsburg

Developments	Demands			Existing and Future Booster Stations												
				WTP Boosters		Buchanan Rd.	Oak Hills	Shady Brook	Vista del Mar	Faria	Bailey Estates	Faria	Montreux	Thomas Ranch	Sky Ranch	Sky Ranch
				PS-2	PS-3	PS-4	PS-5	PS-6	PS-1	PS-10	PS-11	PS-12	PS-13	PS-14	PS-15	PS-16
	ADD	MDD	MDD+ TOU						(PS-1) [1]	(PS-4) [1]	(PS-5) [1]					
	(MGD)	(MGD)	(MGD)	EXIST.	NEW	EXIST.	EXIST.	EXIST.	EXIST.	FUT.	FUT.	FUT.	FUT.	FUT.	FUT.	FUT.
Existing Developed Zones																
Zone 1	4.79	8.61	-	14.2%												
Zone 2	3.14	5.65	-	58.2%												
Zone 3 East	0.46	0.82	1.10	11.3%		82.1%										
Zone 3 West	0.38	0.68	0.90	9.3%			57.3%									
Zone 4 West	0.28	0.51	0.67	6.9%			42.7%	39.6%								
Future Developments																
Zone 1 Infills	0.85	1.53	-		17.1%											
Zone 2 Infills	0.08	0.15	-		1.7%											
Tuscany Meadows	0.43	0.78	-		8.7%											
Sky Ranch	0.15	0.26	0.35		4.0%										100%	100%
Thomas Ranch	0.09	0.16	0.21		2.3%									100%		
Montreux	0.13	0.24	0.32		3.6%	17.9%							100%			
Ambrose Park	0.05	0.08	-		1.0%											
Alves Ranch	0.17	0.31	-		3.5%			13.0%								
Bailey Estates	0.09	0.17	0.22		2.5%				7.9%		21.6%					
Bay Point/BART	0.27	0.49	-		5.5%											
De Bonneville	0.04	0.07	0.10		1.1%											
Faria	0.51	0.92	1.22		13.7%			40.2%	32.3%	74.4%	66.5%	100%				
San Marco	0.61	1.10	1.21		13.6%				12.7%	25.6%						
The Villas at San Marco	0.13	0.23	0.31		3.4%				14.4%							
Toscana at San Marco	0.09	0.15	-		1.7%											
San Marco Village C	0.14	0.25	0.33		3.8%				5.7%							
Esperanza at San Marco	0.08	0.15	0.22		2.5%											
San Marco Village O	0.02	0.03	0.07		0.7%				1.7%							
Smith	0.05	0.09	0.12		1.4%			7.2%	5.8%		11.9%					
Spilker	0.03	0.05	0.07		0.8%											
Vista del Mar	0.17	0.31	0.41		4.6%				19.5%							
West Coast Transit Village	0.14	0.26	-		2.9%											
Total Percent				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Maximum Booster Capacity				**11.52**	**10.80**	**6.62**	**2.02**	**2.16**	**4.32**	**0.81**	**0.98**	**0.55**	**0.20**	**0.22**	**0.33**	**0.19**

6/23/2014

Note:

1. The pump station number listed in parentheses is the station number used in Amendment No. 3.

- Loveridge Sub-Area: 1 Loveridge Sub-Area Acre = 3.5 EDUs

8.5.1 Transmission Mains

In the Southeast Hills, the capacity analysis for the water transmission mains, indicates that Segments 1E, 2E, 3E, 4E, 5E, and 6E are currently exceeding the design criteria. The City is in the bidding process for design of segments 2E-6E. These segments were phased as "imminent improvements" and were deemed a higher priority than Segment 1E in a separate analysis. Segment 1E may reach the same criticality as Segments 2E-6E with the construction of approximately 870 new EDUs in the southeast hills.

Construction of Segments 7E and 8E must be completed before the Montreux Development is constructed.

In the Southwest Hills, construction of Segments 1W and 2W, which parallel the existing 20-inch main from the water treatment plant and continues to the West Leland Tank tie in, can be deferred. Approximately 4,900 single family dwelling units may be routed through the existing 20-inch transmission main. Units in excess of that number will trigger the construction of Segments 1W and 2W.

Segment 3W runs along West Leland Road from the West Leland Tank tie in to Bailey Road. Fire flow requirements from newly constructed commercial developments along West Leland Road accelerate the need for the future segment. With the construction of the new commercial developments or construction of approximately 2,300 single family homes in Pressure Zone 2 or higher, the future 20-inch Segment 3W is recommended as soon as possible.

Segment 6W runs along West Leland Road, between Woodhill Drive and Tomales Bay Drive. It is recommended that Segment 6W be triggered with the construction of 2,600 new EDUs. It should also be noted that the development of the commercial land use near the intersection of San Marco Boulevard and West Leland Road will also trigger this segment even without the 2,600 EDUs.

In summary, the following transmission main segments are recommended for construction with:

- Construction Trigger for Segment 1E: 870 EDUs
- Construction Trigger for Segment 1W: 4,900 EDUs
- Construction Trigger for Segment 2W: 4,900 EDUs
- Construction Trigger for Segment 3W: 2,300 EDUs
- Construction Trigger for Segment 6W: 2,600 EDUs or Commercial Development

8.5.2 Pump Stations

In general, the construction of new booster stations throughout the City is triggered by the specific development in it's respective Pressure Zone, with the exception of the San Marco Hills pump

station. This pump station serves Pressure Zones 4 and higher, and is recommended with the construction of approximately 1,800 single family homes.

The City was proactive in planning and constructing improvements to the high level booster station at the water treatment plant, and **Table 7.9** indicates that no further improvements are needed to meet maximum day demands.

In summary, the following pump station is recommended for construction with:

- Construction Trigger for San Marco Hills Pump Station: 1,800 EDUs

8.5.3 Storage Reservoirs

Storage reservoirs are needed for operational, emergency, and fire storage. In general, construction of most storage reservoirs is triggered by the specific developments in its respective zone.

Currently, portions of Zone 2 East rely on storage from the West Leland Reservoir. The construction trigger for the new Zone 2 East 1.4 MG Highlands tank is 1,303 EDUs. The following conditions apply to the trigger of the new tank:

- Additional Southeast Hills development in Zone 2 East or higher must be conveyed through the Southeast Hills transmission mains. Because this will ultimately impact pressures for existing users in Zone 2 East, units in Zone 2 East and higher are included in the development trigger count.
- Southwest Hills Zone 2 West development has priority in the West Leland storage tank. Because Zone 2 East is currently utilizing excess storage in the West Leland tank, new development in Zone 2 West should be counted against the development trigger.
- Demands for existing users are based on 2012 water demands. As such, recent development was evaluated for Pressure Zone 2 to evaluate new development. Approximately 297 homes have been constructed since 2012 and were included in the trigger analysis.

The following reservoirs are recommended with new development:

- Proposed 1.30 MG Pressure Zone 1 (Golf Course) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Montreux) reservoir
- Proposed 0.30 MG Pressure Zone 4 East (Thomas Ranch) reservoir
- Proposed 0.25 MG Pressure Zone 3 East (Sky Ranch) reservoir
- Proposed 0.25 MG Pressure Zone 4 East (Sky Ranch) reservoir
- Proposed 0.75 MG Pressure Zone 6 West (Faria) reservoir
- Proposed 0.45 MG Pressure Zone 7 West (Bailey) reservoir
- Proposed 0.55 MG Pressure Zone 8 West (Faria) reservoir

CHAPTER 9 – SITE PLACEMENT CRITERIA

This chapter presents City criteria for the siting of storage reservoirs and booster stations. The criteria include the visual aspect and biological resource for reservoirs and booster pump stations. A noise element is also included for booster pump stations.

9.1 STORAGE RESERVOIRS

Recently constructed reservoirs in the City of Pittsburg typically have minimal visual impacts compared to the older above-ground steel reservoir tanks which are painted beige and are easily visible in the southern hillsides and ridgelines from various vantage points within the City, including views from State Highway 4. Only small portions (approximately 3 feet) of the recently built new reservoir structures are visible above the final ground surface due to the use of soil to effectively bury the reservoirs beneath the hillside surface topography.

In accordance with standard engineering practice, site specific geotechnical investigations will be conducted prior to reservoir construction and findings from the investigations will be incorporated in the design of each reservoir.

9.1.1 Visual

New reservoirs located in the viewsheds identified in the City of Pittsburg General Plan would be visible from various vantage points within the City. Site selection and design for the new reservoirs shall be given additional attention in the design process to minimize visual impacts to hillside and ridgeline views within the City.

The design criteria for new reservoirs in the City of Pittsburg shall include grading and the use of soil and vegetation surrounding the reservoirs to visually screen the new structures. Approximately three (3) feet of the reservoir structure may be visible above the final ground surface created by the soil. Low-glare earth toned paints shall be used on portions of the reservoirs visible above the soil and, depending on the specific views of the site; landscape shrubs may be included to screen views of the above-ground portions of the reservoirs in prominently visible areas. Lights used for reservoir security lighting shall be designed to ensure that light is directed downward and does not create an additional source of light or glare for adjacent properties.

The City will acquire in title or through easements, as it deems appropriate, only that amount of land it deems necessary to provide adequate space for reservoir construction, maintenance, access, and safety.

9.1.2 Biological Resources

The East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP) provides a framework for biological and natural resource protection within the City and adjacent areas planned for future growth in the City's General Plan.

In accordance with the HCP/NCCP, new reservoir site selection, design and construction shall be required to include biological planning surveys, preconstruction surveys and any required construction monitoring. Planning surveys are required to identify the natural resources potentially affected by the proposed project and determine what additional preconstruction species surveys, if any, are needed. Construction monitoring shall be conducted to ensure any necessary avoidance and minimization measures are implemented properly.

Applicable HCP/NCCP development fees shall be paid to the HCP/NCCP account prior to reservoir construction based on the Development Fee Zones map (HCP/NCCP Figure 9-1) and fee requirements in Chapter 9 of the HCP/NCCP.

9.2 PUMP STATIONS

Recently constructed pump stations in residential areas have been concealed within structures that appear similar to adjacent residential structures. These buildings include architectural elements, materials and colors designed to blend in with surrounding residential development. Recently constructed pump stations that are not visible from public vantage points typically are constructed within simple concrete block structures, and surrounding open land associated with the pump stations are landscaped with shrubs.

9.2.1 Visual

Pump stations shall be enclosed within structures which will conceal the pumps. Pump stations in residential areas that are visible from public vantage points shall be designed to blend in architecturally with the context of adjacent residential development. Pump stations that are not visible from public vantage points, and would not change the context or visual character of surrounding neighborhoods, may be constructed with simple concrete block construction and shall include landscaping on open land adjacent to the pump stations. Any lighting associated with the pump stations shall be directed downward to ensure excess light and glare does not adversely affect adjacent properties.

The City will acquire in title or through easements, as it deems appropriate, only that amount of land it deems necessary to provide adequate space for pump station construction, maintenance, access, and safety.

9.2.2 Biological Resources

New pump station locations will be subject to the East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP) framework for biological and natural

resource protection within the City and within adjacent areas planned for future growth in the City's General Plan.

In accordance with the HCP/NCCP, the site selection, design and construction of the new pump stations will be required to include biological planning surveys, preconstruction surveys and any required construction monitoring. Planning surveys are required to identify the natural resources potentially affected by the proposed project and determine what additional preconstruction species surveys, if any, are needed. Construction monitoring shall be conducted to ensure any necessary avoidance and minimization measures are implemented properly.

Applicable HCP/NCCP development fees will be paid to the HCP/NCCP account prior to reservoir construction based on the Development Fee Zones map (HCP/NCCP Figure 9-1) and fee requirements in Chapter 9 of the HCP/NCCP.

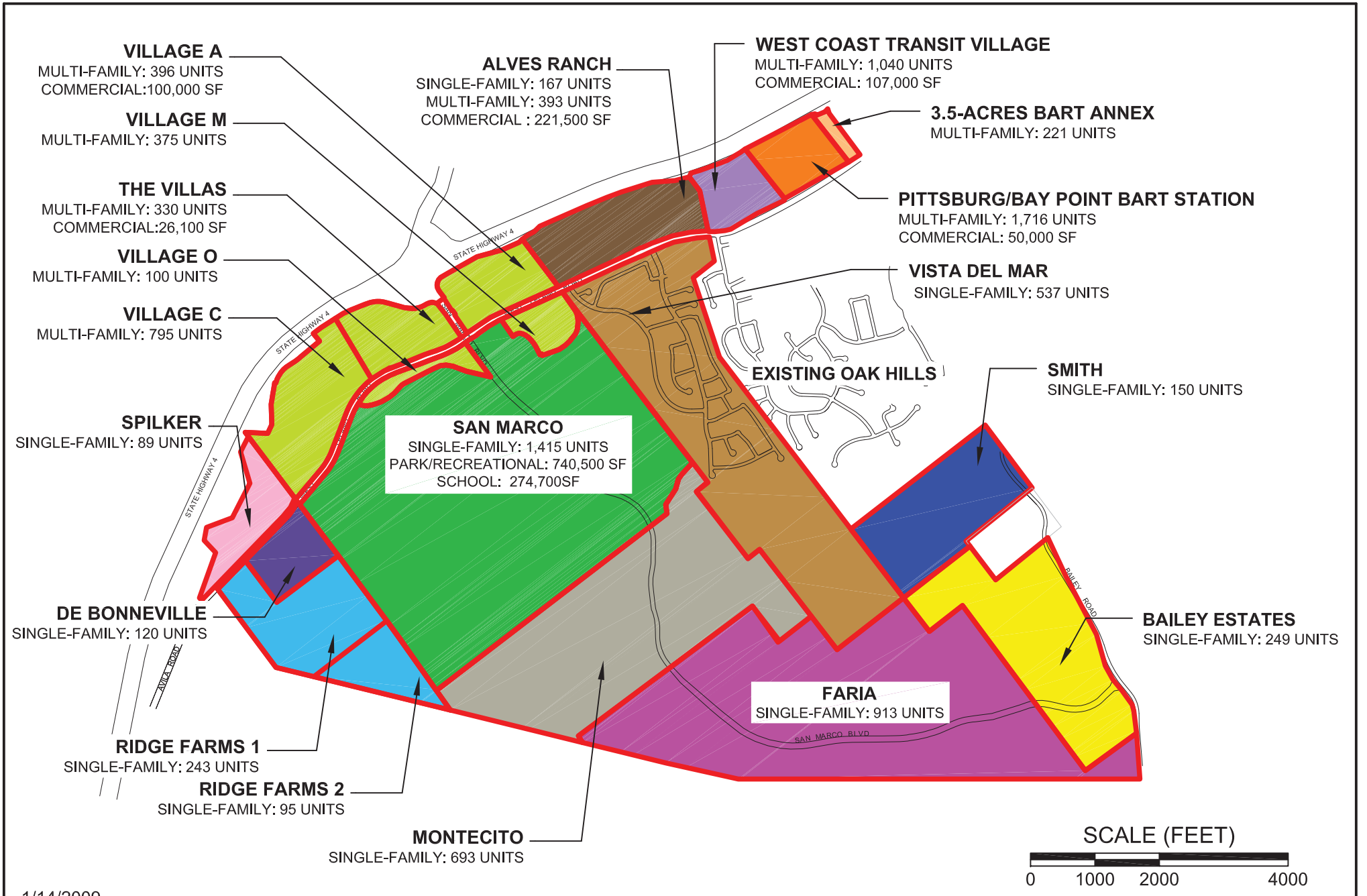
9.2.3 Noise

Pumps used in pump stations are designed to minimize exterior noise and existing pumps operate at noise levels that do not exceed the 60 dB exterior noise levels considered normally acceptable for residential uses. The pump station structures shall be constructed with materials that provide noise attenuation, ensuring the pumps do not exceed established exterior noise levels for residential or other sensitive land uses.

APPENDICES

APPENDIX A

Stetson Study for the Southwest Hills



1/14/2009

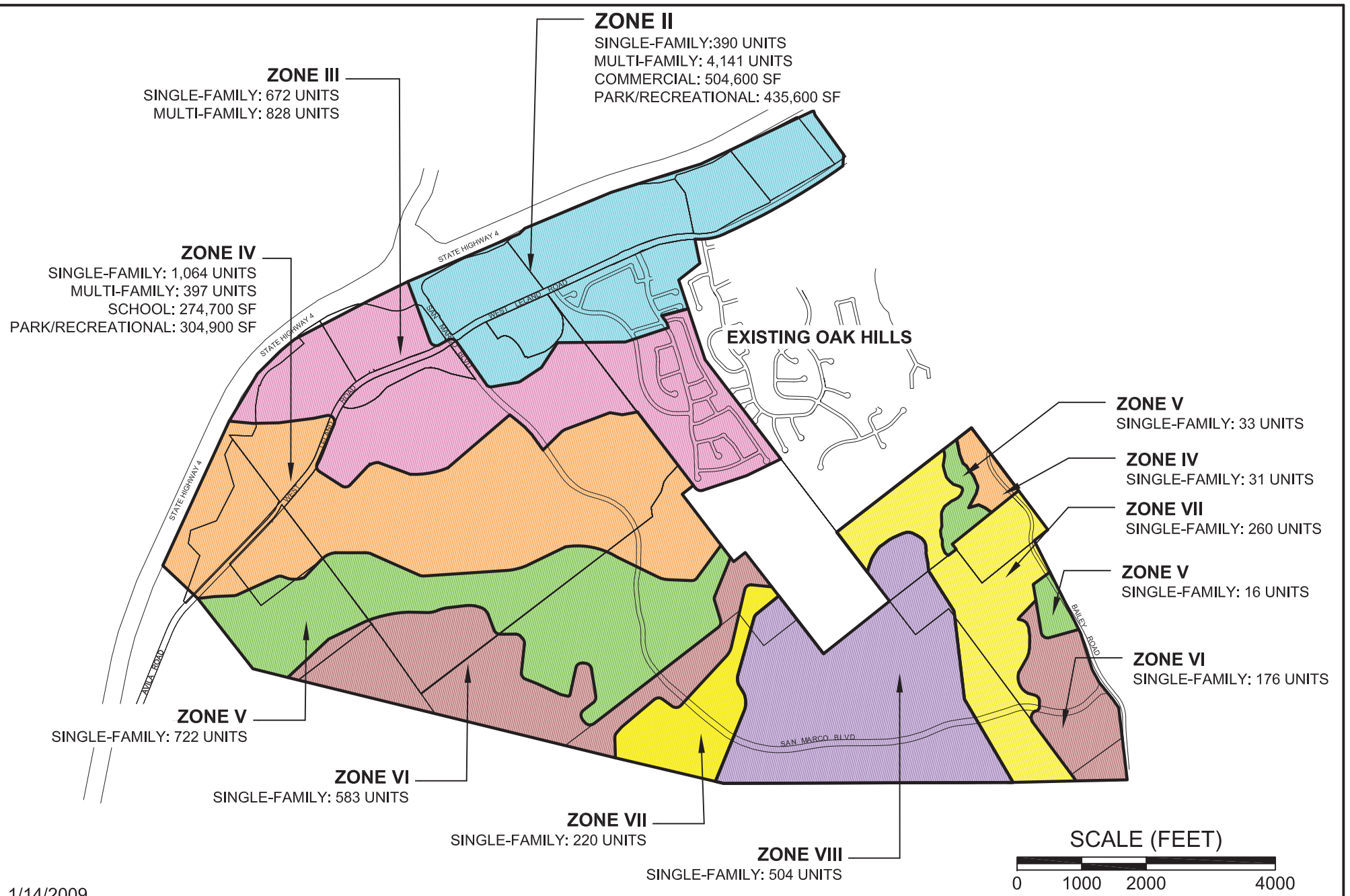
STETSON ENGINEERS INC.

Stetson Engineers Inc.
2171 E. Francisco Blvd., Suite K
San Rafael, CA. 94901
(415) 457-0701

SOUTHWEST AREA, PITTSBURG,CA
PROPERTY MAP

N E S W

FIGURE 1



1/14/2009

STETSON ENGINEERS INC.

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SOUTHWEST AREA, PITTSBURG,CA

WATER MASTER PLAN PRESSURE ZONES

FIGURE 2

Table 1

TOTAL NUMBER OF RESIDENTIAL UNITS AND NON-RESIDENTIAL AREA ON PROPERTIES IN THE SOUTHWEST AREA, CITY OF PITTSBURG

	Residential			Commercial Use		School Use		Park/Recreational Use	
	Single-Family	Multi-Family	Total						
Property	**Units**	**Units**	**Units**	**Square Feet**	**Acres**	**Square Feet**	**Acres**	**Square Feet**	**Acres**
Alves Ranch	167	393	560	221,500	5.1	0	0.0	0	0.0
Bailey Estates	249	0	249	0	0.0	0	0.0	0	0.0
De Bonneville	120	0	120	0	0.0	0	0.0	0	0.0
Faria	913	0	913	0	0.0	0	0.0	0	0.0
Montecito	693	0	693	0	0.0	0	0.0	0	0.0
Pittsburg / Bay Point Bart Station	0	1,716	1,716	50,000	1.1	0	0.0	0	0.0
3.5-Acres Bart Annex	0	221	221	0	0.0	0	0.0	0	0.0
Ridge Farms 1	243	0	243	0	0.0	0	0.0	0	0.0
Ridge Farms 2	95	0	95	0	0.0	0	0.0	0	0.0
San Marco Single-Family	1,415	0	1,415	0	0.0	274,700	6.3 [b]	740,500	17.0 [c]
San Marco The Villas	0	330	330	26,100	0.6 [a]	0	0.0	0	0.0
San Marco Village A	0	396	396	100,000	2.3	0	0.0	0	0.0
San Marco Village C	0	795	795	0	0.0	0	0.0	0	0.0
San Marco Village M	0	375	375	0	0.0	0	0.0	0	0.0
San Marco Village O	0	100	100	0	0.0	0	0.0	0	0.0
Smith	150	0	150	0	0.0	0	0.0	0	0.0
Spilker	89	0	89	0	0.0	0	0.0	0	0.0
Vista Del Mar	537	0	537	0	0.0	0	0.0	0	0.0
West Coast Transit Village	0	1,040	1,040	107,000	2.5	0	0.0	0	0.0
Totals	**4,671**	**5,366**	**10,037**	**504,600**	**11.6**	**274,700**	**6.3**	**740,500**	**17.0**

Note:
[a] A gas station
[b] An elementary school
[c] Two parks (3 acres & 4 acres) and one community park (10 acres)

Table 2

TOTAL NUMBER OF RESIDENTIAL UNITS AND NON-RESIDENTIAL AREA IN EACH WATER PRESSURE ZONE SOUTHWEST AREA, CITY OF PITTSBURG

Water Pressure Zone	Residential			Commercial Use		School Use		Park/Recreational Use	
	Single-Family	Multi-Family	Total						
	Units	Units	Units	Square Feet	Acres	Square Feet	Acres	Square Feet	Acres
II	390	4,141	4,531	504,600	11.6 [a]	0	0.0	435,600	10.0 [c]
III	672	828	1,500	0	0.0	0	0.0	0	0.0
IV	1,095	397	1,492	0	0.0	274,700	6.3 [b]	304,900	7.0 [d]
V	771	0	771	0	0.0	0	0.0	0	0.0
VI	759	0	759	0	0.0	0	0.0	0	0.0
VII	480	0	480	0	0.0	0	0.0	0	0.0
VIII	504	0	504	0	0.0	0	0.0	0	0.0
Totals	**4,671**	**5,366**	**10,037**	**504,600**	**11.6**	**274,700**	**6.3**	**740,500**	**17.0**

Note:
[a] Includes a gas station (0.6 acres)
[b] An elementary school
[c] A community park (10 acres)
[d] Two parks (3 acres & 4 acres)

TABLE 2-1
TOTAL NUMBER OF RESIDENTIAL UNITS IN EACH WATER PRESSURE ZONE, SOUTHWEST AREA, CITY OF PITTSBURG

	Residential															
	Single-Family Units								Multi-Family Units							
Property	**Zone II**	**Zone III**	**Zone IV**	**Zone V**	**Zone VI**	**Zone VII**	**Zone VIII**	**Totals**	**Zone II**	**Zone III**	**Zone IV**	**Zone V**	**Zone VI**	**Zone VII**	**Zone VIII**	**Totals**
Alves Ranch	167	0	0	0	0	0	0	**167**	393	0	0	0	0	0	0	**393**
Bailey Estates	0	0	0	16	176	57	0	**249**	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	102	18	0	0	0	**120**	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	107	323	483	**913**	0	0	0	0	0	0	0	**0**
Montecito	0	0	104	346	208	14	21	**693**	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**	1716	0	0	0	0	0	0	**1716**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**	221	0	0	0	0	0	0	**221**
Ridge Farms 1	0	0	17	198	28	0	0	**243**	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	95	0	0	**95**	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	358	752	160	145	0	0	**1,415**	0	0	0	0	0	0	0	**0**
San Marco Village A	0	0	0	0	0	0	0	**0**	396	0	0	0	0	0	0	**396**
San Marco Village C	0	0	0	0	0	0	0	**0**	0	398	397	0	0	0	0	**795**
San Marco Village M	0	0	0	0	0	0	0	**0**	375	0	0	0	0	0	0	**375**
San Marco Village O	0	0	0	0	0	0	0	**0**	0	100	0	0	0	0	0	**100**
Smith	0	0	31	33	0	86	0	**150**	0	0	0	0	0	0	0	**0**
Spilker	0	0	89	0	0	0	0	**89**	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**	0	330	0	0	0	0	0	**330**
Vista Del Mar	223	314	0	0	0	0	0	**537**	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**	1,040	0	0	0	0	0	0	**1040**
Totals	390	672	1,095	771	759	480	504	**4,671**	4,141	828	397	0	0	0	0	**5,366**

TABLE 2-2
TOTAL AREA FOR COMMERCIAL USE IN EACH WATER PRESSURE ZONE
SOUTHWEST AREA, CITY OF PITTSBURG

	Commercial Use (Square Feet)							
Property	**Zone II**	**Zone III**	**Zone IV**	**Zone V**	**Zone VI**	**Zone VII**	**Zone VIII**	**Totals**
Alves Ranch	221,500	0	0	0	0	0	0	**221,500**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	50,000	0	0	0	0	0	0	**50,000**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	0	0	0	0	0	0	**0**
San Marco Village A	100,000	0	0	0	0	0	0	**100,000**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	26,100	0	0	0	0	0	0	**26,100**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	107,000	0	0	0	0	0	0	**107,000**
Totals	504,600	0	0	0	0	0	0	**504,600**

TABLE 2-3
TOTAL AREA FOR SCHOOL USE IN EACH WATER PRESSURE ZONE
SOUTHWEST AREA, CITY OF PITTSBURG

	School Use (Square feet)							
Property	**Zone II**	**Zone III**	**Zone IV**	**Zone V**	**Zone VI**	**Zone VII**	**Zone VIII**	**Totals**
Alves Ranch	0	0	0	0	0	0	0	**0**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	0	274,700	0	0	0	0	**274,700**
San Marco Village A	0	0	0	0	0	0	0	**0**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**
Totals	0	0	274,700	0	0	0	0	**274,700**

TABLE 2-4
TOTAL AREA FOR PARK/RECREATIONAL USE IN EACH WATER PRESSURE ZONE
SOUTHWEST AREA, CITY OF PITTSBURG

	Park/Recreational Use (Square Feet)							
Property	**Zone II**	**Zone III**	**Zone IV**	**Zone V**	**Zone VI**	**Zone VII**	**Zone VIII**	**Totals**
Alves Ranch	0	0	0	0	0	0	0	**0**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	435,600	0	304,900	0	0	0	0	**740,500**
San Marco Village A	0	0	0	0	0	0	0	**0**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**
Totals	435,600	0	304,900	0	0	0	0	**740,500**

Table 3

TOTAL NUMBER OF RESIDENTIAL UNITS AND NON-RESIDENTIAL AREAS SERVED BY WATER STORAGE TANKS
SOUTHWEST AREA, CITY OF PITTSBURG

Tank No.	Water Storage Tanks	Existing / Proposed	Water Pressure Zone	Residential			Commercial Use		School Use		Park/Recreational Use	
				Single-Family	Multi-Family	Total						
				Units*	Units*	Units*	Square Feet	Acres	Square Feet	Acres	Square Feet	Acres
T-2	Zone II 0.6 MG West Leland Tank Zone II 2 MG West Leland Tank Zone II 3 MG West Leland Tank	Existing Proposed Existing	II	390	4,141	4,531	504,600	11.6 [a]	0	0	435,600	10.0 [c]
	Zone III 2 MG Oak Hills Tank	Existing	III	672	828	1,500	0	0.0	0	0.0	0	0.0
	Zone IV 1.75 MG Shady Brook Tank	Existing	IV	1,047	397	1,444	0	0.0	274,700	6.3 [b]	304,900	7.0 [d]
T-1	Zone V Tank	Proposed	V	722	0	722	0	0.0	0	0.0	0	0.0
T-3	Zone VI Tank	Proposed	VI	600	0	600	0	0.0	1	0.0	1	0.0
T-4	Zone VII Tank (Bailey Estates)	Proposed	VII	260	0	516	0	0.0	2	0.0	2	0.0
			VI	176	0		0	0.0	3	0.0	3	0.0
			V	49	0		0	0.0	4	0.0	4	0.0
			IV	31	0		0	0.0	5	0.0	5	0.0
T-6	Zone VIII Tank	Proposed	VIII	504	0	724	0	0.0	6	0.0	6	0.0
			VII	220	0		0	0.0	7	0.0	7	0.0
Totals				**4,671**	**5,366**	**10,037**	**504,600**	**11.6**	**274,700**	**6.3**	**740,500**	**17.0**

Note:
[a] Includes a gas station (0.6 acres)
[b] An elementary school
[c] A community park (10 acres)
[d] Two parks (3 acres & 4 acres)

*** Does not include the following existing units currently being served in the Southwest Area:**

Water Pressure Zone	Oak Hills		East of Bailey Road		Totals	
	Single-Family Units	Multi-Family Units	Single-Family Units	Multi-Family Units	Single-Family Units	Multi-Family Units
II	467	264	1,169	0	1,636	264
III	307	0	0	0	307	0
IV	371	0	0	0	371	0
Totals	**1,145**	**264**	**1,169**	**0**	**2,314**	**264**

TABLE 3-1
TOTAL NUMBER OF RESIDENTIAL UNITS SERVED BY WATER STORAGE TANKS , SOUTHWEST AREA, CITY OF PITTSBURG

	Residential Use															
	Single-Family Units								Multi-Family Units							
	T-2,T-5 & Existing	Existing	Existing	T-1	T-3	T-4	T-6		T-2,T-5 & Existing	Existing	Existing	T-1	T-3	T-4	T-6	
Property	Zone II West Leland Tanks	Zone III Oak Hills Tank	Zone IV Shady Brook Tank	Zone V Tank	Zone VI Tank	Zone VII Tank (Bailey Estates)	Zone VIII Tank	Totals	Zone II West Leland Tanks	Zone III Oak Hills Tank	Zone IV Shady Brook Tank	Zone V Tank	Zone VI Tank	Zone VII Tank (Bailey Estates)	Zone VIII Tank	Totals
Alves Ranch	167	0	0	0	0	0	0	**167**	393	0	0	0	0	0	0	**393**
Bailey Estates	0	0	0	0	0	249	0	**249**	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	102	18	0	0	0	**120**	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	107	117	689	**913**	0	0	0	0	0	0	0	**0**
Montecito	0	0	104	346	208	0	35	**693**	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**	1,716	0	0	0	0	0	0	**1,716**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**	221	0	0	0	0	0	0	**221**
Ridge Farms 1	0	0	17	198	28	0	0	**243**	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	95	0	0	**95**	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	358	752	160	145	0	0	**1,415**	0	0	0	0	0	0	0	**0**
San Marco Village A	0	0	0	0	0	0	0	**0**	396	0	0	0	0	0	0	**396**
San Marco Village C	0	0	0	0	0	0	0	**0**	0	398	397	0	0	0	0	**795**
San Marco Village M	0	0	0	0	0	0	0	**0**	375	0	0	0	0	0	0	**375**
San Marco Village O	0	0	0	0	0	0	0	**0**	0	100	0	0	0	0	0	**100**
Smith	0	0	0	0	0	150	0	**150**	0	0	0	0	0	0	0	**0**
Spilker	0	0	89	0	0	0	0	**89**	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**	0	330	0	0	0	0	0	**330**
Vista Del Mar	223	314	0	0	0	0	0	**537**	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**	1,040	0	0	0	0	0	0	**1,040**
Totals	**390**	**672**	**1,064**	**722**	**583**	**516**	**724**	**4,671**	**4,141**	**828**	**397**	**0**	**0**	**0**	**0**	**5,366**

TABLE 3-2
TOTAL COMMERCIAL USE AREA SERVED BY STORAGE TANKS
SOUTHWEST AREA, CITY OF PITTSBURG

	Commercial Use (Square Feet)							
	T-2,T-5 & Existing	Existing	Existing	T-1	T-3	T-4	T-6	
Property	Zone II West Leland Tanks	Zone III Oak Hills Tank	Zone IV Shady Brook Tank	Zone V Tank	Zone VI Tank	Zone VII Tank (Bailey Estates)	Zone VIII Tank	Totals
Alves Ranch	221,500	0	0	0	0	0	0	**221,500**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	50,000	0	0	0	0	0	0	**50,000**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	0	0	0	0	0	0	**0**
San Marco Village A	100,000	0	0	0	0	0	0	**100,000**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	26,100	0	0	0	0	0	0	**26,100**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	107,000	0	0	0	0	0	0	**107,000**
Totals	**504,600**	**0**	**0**	**0**	**0**	**0**	**0**	**504,600**

TABLE 3-3
TOTAL SCHOOL USE AREA SERVED BY STORAGE TANKS
SOUTHWEST AREA, CITY OF PITTSBURG

	School Use (Square feet)							
	T-2,T-5 & Existing	Existing	Existing	T-1	T-3	T-4	T-6	
Property	Zone II West Leland Tanks	Zone III Oak Hills Tank	Zone IV Shady Brook Tank	Zone V Tank	Zone VI Tank	Zone VII Tank (Bailey Estates)	Zone VIII Tank	Totals
Alves Ranch	0	0	0	0	0	0	0	**0**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	0	0	274,700	0	0	0	0	**274,700**
San Marco Village A	0	0	0	0	0	0	0	**0**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**
Totals	**0**	**0**	**274,700**	**0**	**0**	**0**	**0**	**274,700**

TABLE 3-4
TOTAL PARK/RECREATIONAL USE AREA SERVED BY STORAGE TANKS
SOUTHWEST AREA, CITY OF PITTSBURG

	Park/Recreational Use (Square Feet)							
	T-2,T-5 & Existing	Existing	Existing	T-1	T-3	T-4	T-6	
Property	Zone II West Leland Tanks	Zone III Oak Hills Tank	Zone IV Shady Brook Tank	Zone V Tank	Zone VI Tank	Zone VII Tank (Bailey Estates)	Zone VIII Tank	Totals
Alves Ranch	0	0	0	0	0	0	0	**0**
Bailey Estates	0	0	0	0	0	0	0	**0**
De Bonneville	0	0	0	0	0	0	0	**0**
Faria	0	0	0	0	0	0	0	**0**
Montecito	0	0	0	0	0	0	0	**0**
Pittsburg / Bay Point Bart Station	0	0	0	0	0	0	0	**0**
3.5-Acres Bart Annex	0	0	0	0	0	0	0	**0**
Ridge Farms 1	0	0	0	0	0	0	0	**0**
Ridge Farms 2	0	0	0	0	0	0	0	**0**
San Marco Single-Family	435,600	0	304,900	0	0	0	0	**740,500**
San Marco Village A	0	0	0	0	0	0	0	**0**
San Marco Village C	0	0	0	0	0	0	0	**0**
San Marco Village M	0	0	0	0	0	0	0	**0**
San Marco Village O	0	0	0	0	0	0	0	**0**
Smith	0	0	0	0	0	0	0	**0**
Spilker	0	0	0	0	0	0	0	**0**
San Marco The Villas	0	0	0	0	0	0	0	**0**
Vista Del Mar	0	0	0	0	0	0	0	**0**
West Coast Transit Village	0	0	0	0	0	0	0	**0**
Totals	**435,600**	**0**	**304,900**	**0**	**0**	**0**	**0**	**740,500**

APPENDIX B

Planning and Design Criteria Comparison

Appendix B Planning and Design Criteria Comparison

Water System Master Plan

City of Pittsburg

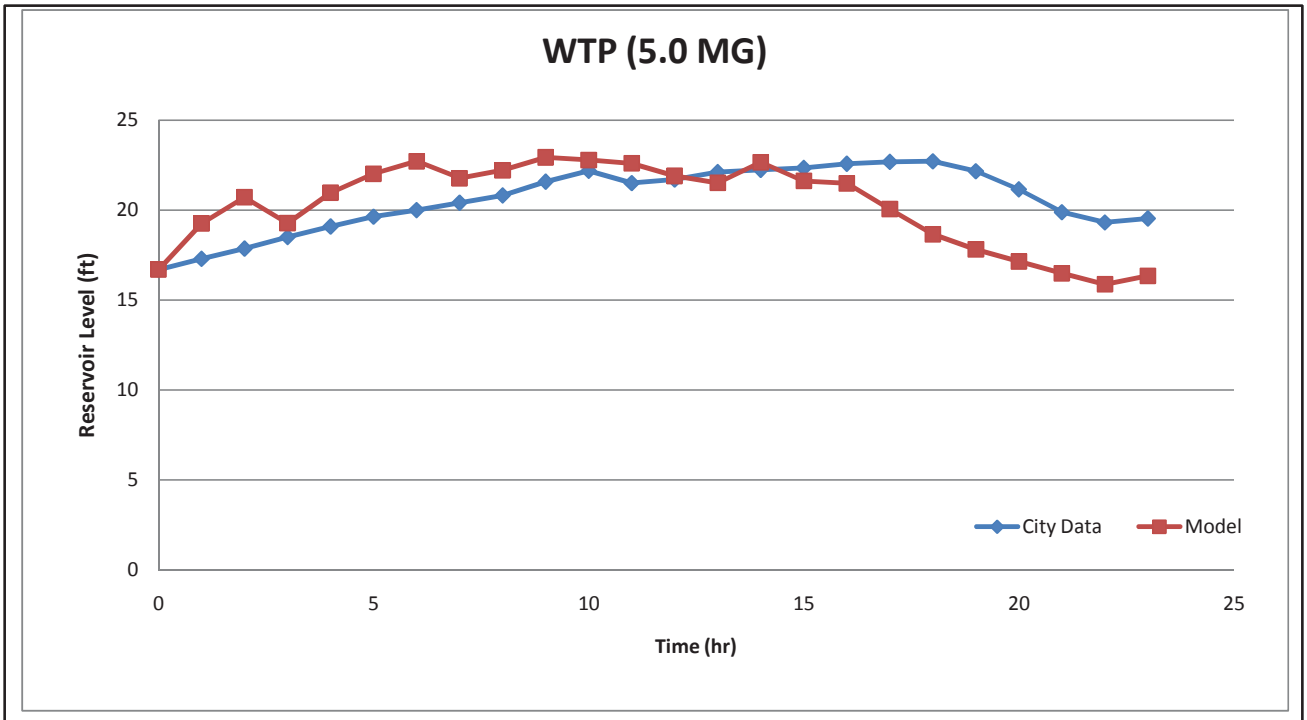
Design Parameter	2010 WSMP Criteria	2014 WSMP Criteria
Supply	Supply = Maximum Day Demand + Standby	Supply = Maximum Day Demand + Standby
Storage	Total Required Storage = Operational + Fire + Emergency Operational Storage: 25% of Maximum Day Demand Emergency Storage: 50% of Maximum Day Demand Fire Storage: Residential, SF = 0.18 MG; Residential, MF = 0.24 MG; Commercial/School = 0.54 MG; Industrial = 0.63 MG; Loveridge Sub-Area = 0.96 MG; Civic Center = 1.2 MG	Zones 1 and 2: Total Required Storage = Operational + Fire + Emergency Zones 3 and above: Total Required Storage = Operational + Fire + Emergency + Time-of-Use Operational Storage: 25% of Maximum Day Demand Emergency Storage: 50% of Maximum Day Demand Fire Storage: New Residential, SF = 0.12 MG; Residential, SF = 0.18 MG; Residential, MF = 0.24 MG; Loveridge Sub-Area = 0.48 MG; Commercial/School = 0.54 MG; Industrial = 0.63 MG; Special Zone 1 Industrial = 0.65 MG Time-of-Use Storage (Zones 3 and above): 6-hours of Maximum Day Demand
Distribution Mains	Distribution mains should be designed to meet the greater of: Peak Hour Demand, or Maximum Day Demand + Fire Flow Criteria for existing pipelines: Maximum pipeline velocity: 5 feet per second for diameter <= 12" Maximum headloss: 2 feet/1,000 feet for diameter > 16"	Distribution mains should be designed to meet the greater of: 1) Peak Hour Demand, or 2) Maximum Day Demand + Fire Flow Criteria for existing and future pipelines include [1]: If pipe diameter ≤ 12", maximum pipeline velocity is 5 feet per second If pipe diameter ≥ 14", maximum headloss is 2 feet/1,000 feet
Pump Stations	Meet Maximum Day Demand with largest unit out of service Hydropneumatic systems to meet Maximum Day Demand plus fire flow	Zones 1 and 2: Meet Maximum Day Demand with largest unit out of service Zones 3 and above: Meet Partial-Peak Time-of-Use Pumping (18-hour pumping) with largest unit out of service Hydropneumatic systems to meet Maximum Day Demand plus fire flow
PRVs	PRVs should be designed to meet the greater of: Peak Hour Demand, or Maximum Day Demand + Fire Flow	PRVs should be designed to meet the greater of: Peak Hour Demand, or Maximum Day Demand + Fire Flow
Service Pressures	Maximum Pressure: 100 psi Minimum Pressure (during Maximum Day): 40 psi Minimum Pressure (during Peak Hour): 35 psi Minimum Residual Pressure (during Fires): 20 psi	Maximum Pressure: 100 psi Existing System Minimum Pressure (during Maximum Day): 40 psi Future System Minimum Pressure (during Peak Hour)[2]: 40 psi Existing System Minimum Pressure (during Peak Hour): 35 psi Minimum Residual Pressure (during Fires): 20 psi
Demand Peaking Factors	Maximum Month Demand: 1.6 x Average Day Demand Maximum Day Demand: 1.9 x Average Day Demand Peak Hour Demand: 2.9 x Average Day Demand	Maximum Month Demand: 1.5 x Average Day Demand Maximum Day Demand: 1.8 x Average Day Demand Peak Hour Demand: 2.8 x Average Day Demand
Fire Flows	Residential, Single Family: 1,500 gpm for 2 hours Residential, Multi Family: 2,000 gpm for 2 hours Commercial: 3,000 gpm for 3 hours Schools: 3,000 gpm for 3 hours Industrial: 3,500 gpm for 3 hours Loveridge Sub-Area: 4,000 gpm for 4 hours Civic Center: 5,000 gpm for 4 hours	Residential, New Single Family[3]: 1,000 gpm for 2 hours Residential, Single Family: 1,500 gpm for 2 hours Residential, Multi Family: 2,000 gpm for 2 hours East Contra Costa Court House[4]: 2,186 gpm Commercial: 3,000 gpm for 3 hours Schools[5]: 3,000 gpm for 3 hours Industrial: 3,500 gpm for 3 hours Zone 1 Special Industrial User[6]: 3,625 gpm for 3 hours Loveridge Sub-Area[6]: 4,000 gpm for 2 hours
Demand Coefficients	Residential, SF: 440 gpd/DU Residential, MF: 340 gpd/DU Commercial: 2,000 gpd/AC Schools: 2,000 gpd/AC 20 gpd/student Park: 2,500 gpd/AC Heavy Industrial and High Intensity Commercial: 2000 + gpd/AC Loveridge Sub-Area: 1,200 gpd/AC	Residential, SF: 340 gpd/DU Residential, MF: 270 gpd/DU Commercial: 1,700 gpd/AC Schools: 1,000 gpd/AC 20 gpd/student Park: 3,825 gpd/AC Heavy Industrial and High Intensity Commercial: 1,000 + gpd/AC Loveridge Sub-Area[6]: 1,200 gpd/AC

Notes:

1. Pipeline headloss criteria and fire flow requirements during maximum day demands might be relaxed on a case by case basis, at the discretion of City staff, and depending on the redundancy and reliability of the considered design. In no case shall the criteria listed in this table be relaxed without the review and approval of the City Engineer.
2. Minimum pressure criteria for future system is extracted from Section 64602 of the Title 22 California Code of Regulations.
3. New single-family homes are required to have fire sprinklers installed for suppression purposes. Homes over 3,600 sq ft require an increased fire flow.
4. The East Contra County Courthouse fire flow duration was not provided in the final fire protection plan received 5/13/2014.
5. Fire Flows for Delta View Elementary School, located in Pressure Zone 4 West, was reduced to 1,500 gpm for 2 hours due to fire sprinklers provisions, per letter from Fire Marshal dated February 2, 2010.
6. Source: CCCFPD Fire Inspector emails received 2/25/2014 and 3/4/2014.

APPENDIX C

Calibration Results



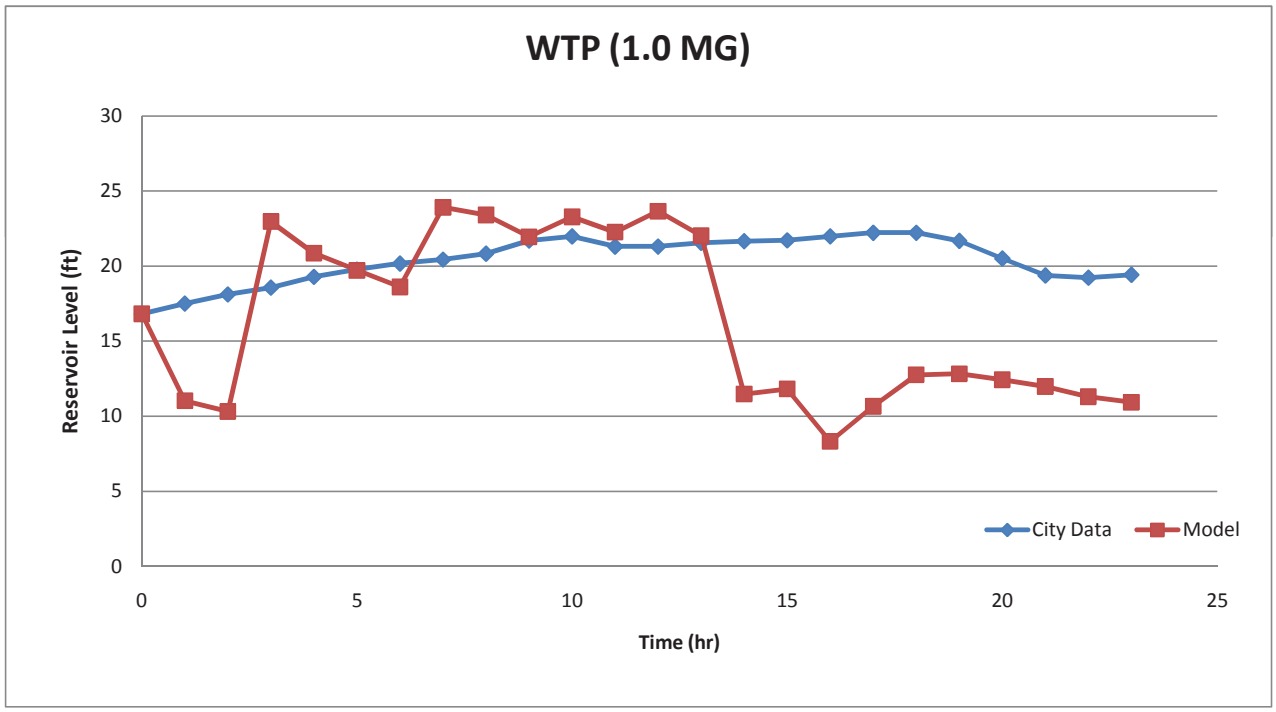


Figure 1

Water Treatment Plant

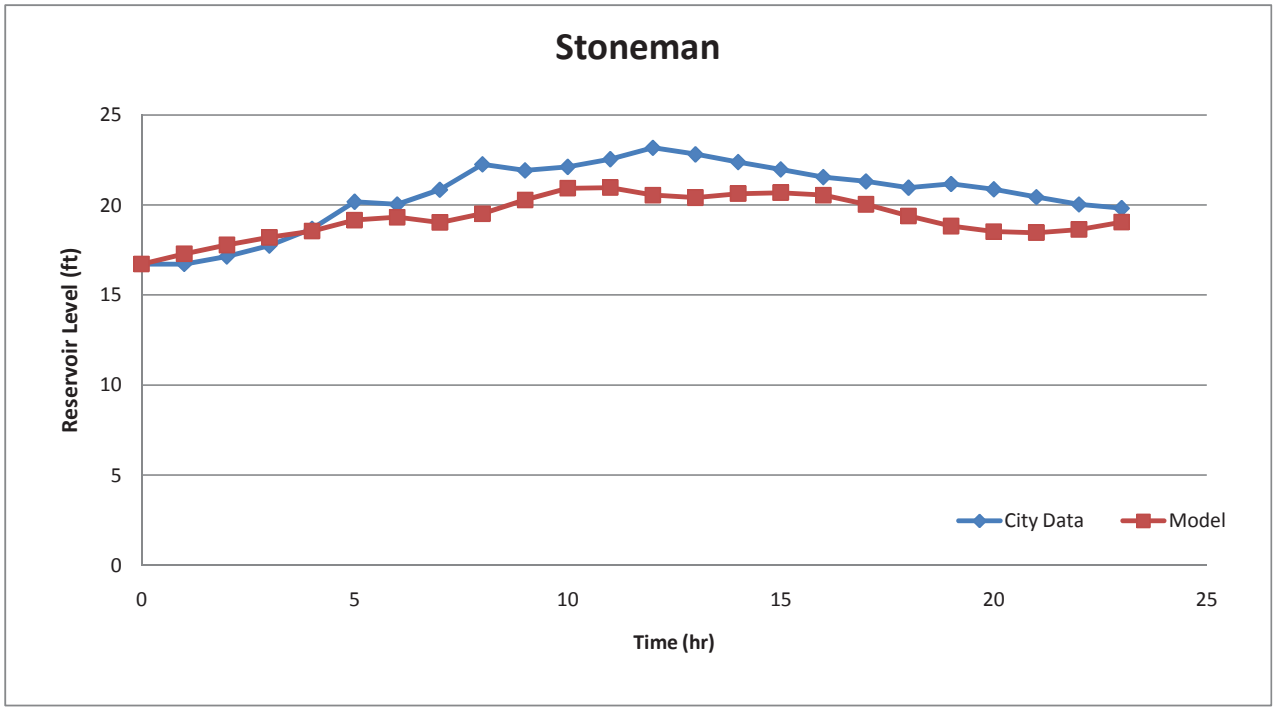
Reservoir Levels

Water System Master Plan

City of Pittsburg

8/6/2009

AKEL



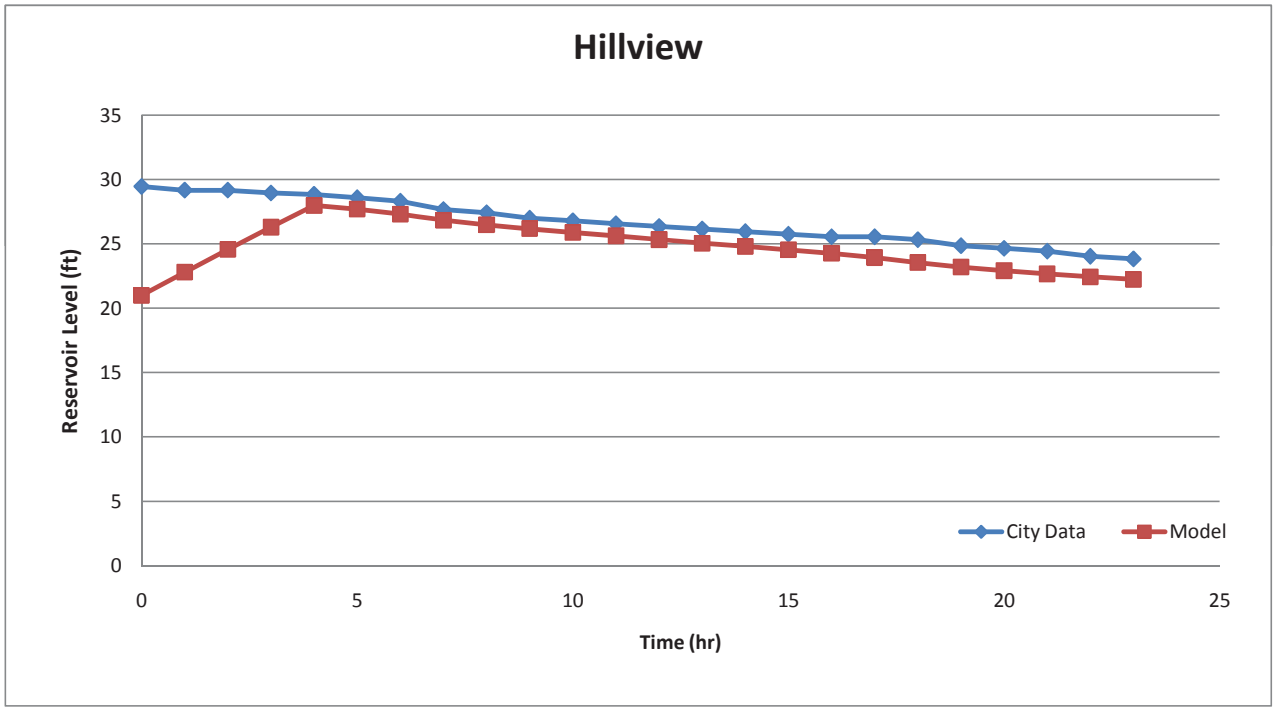
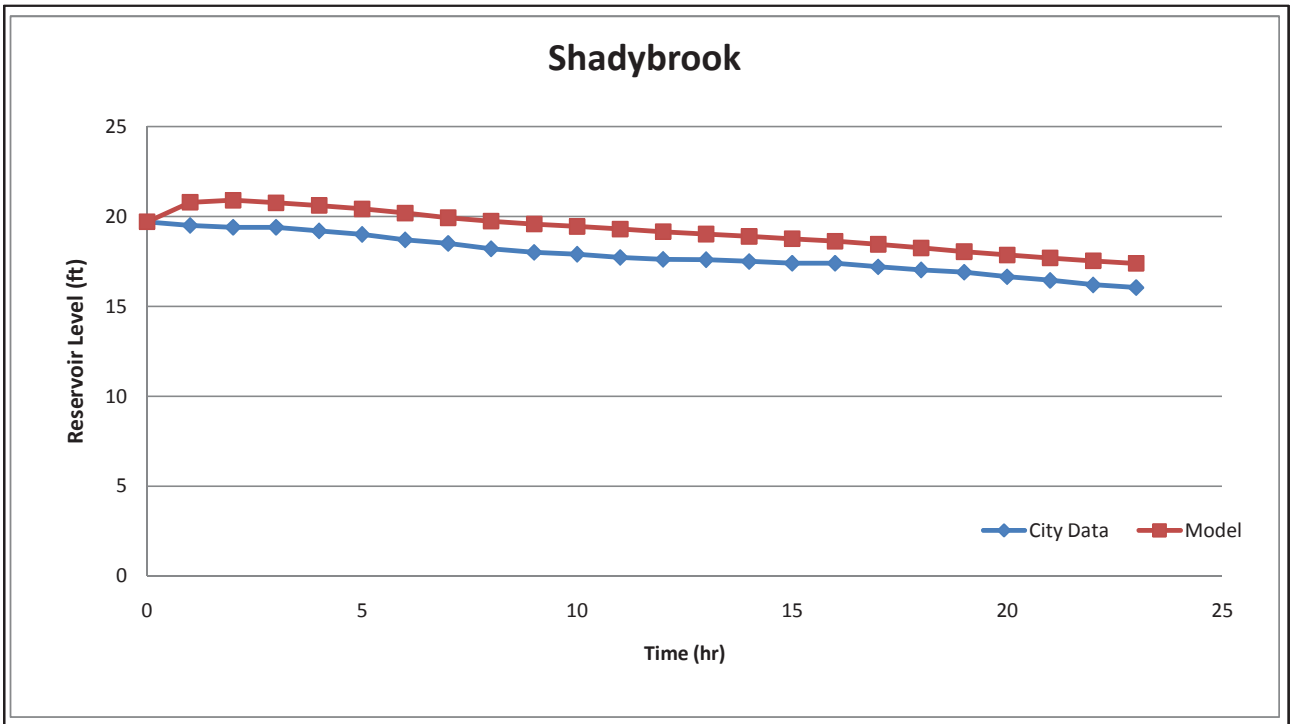


Figure 2

Stoneman and Hillview
Reservoir Levels
Water System Master Plan
City of Pittsburg

8/6/2009

AKEL
ENGINEERING GROUP, INC.



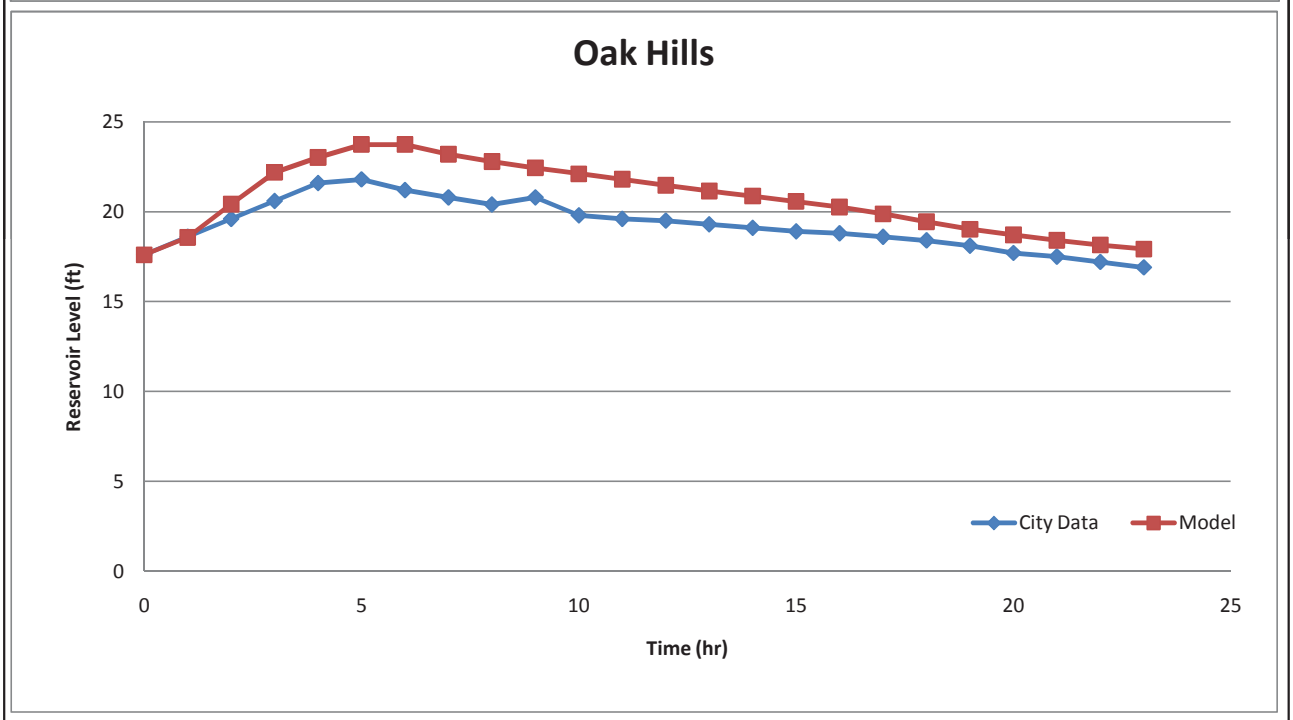


Figure 3

Shady Brook and Oak Hills Reservoir Levels

Water System Master Plan

City of Pittsburg

8/6/2009

AKEL

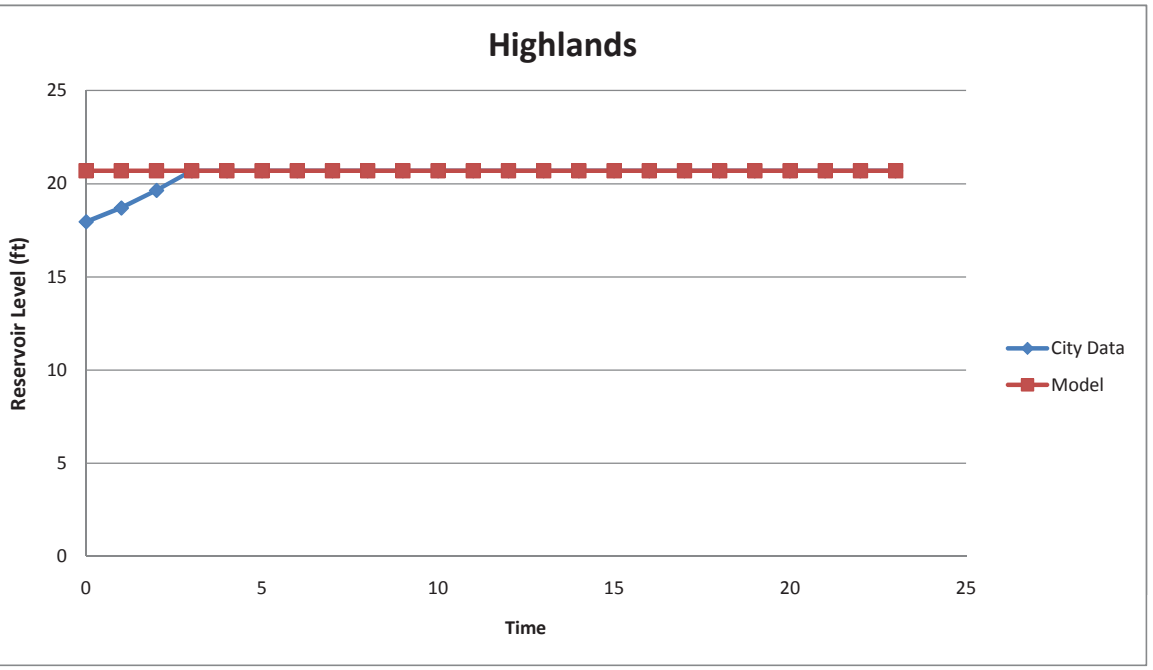


Figure 4

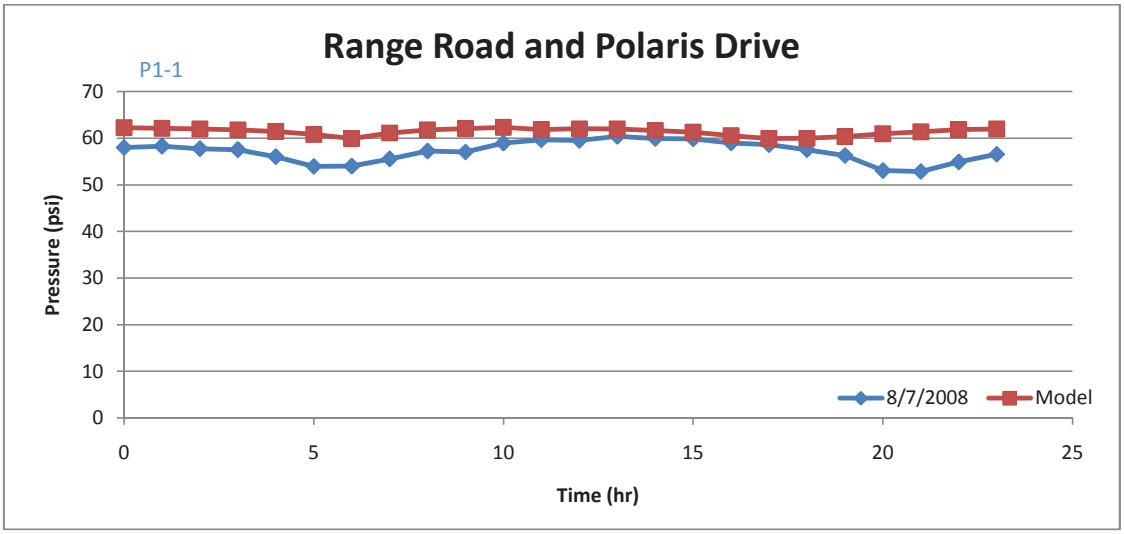
Highlands Reservoir Levels

Water System Master Plan

City of Pittsburg

8/6/2009

AKEL ENGINEERING GROUP, INC.



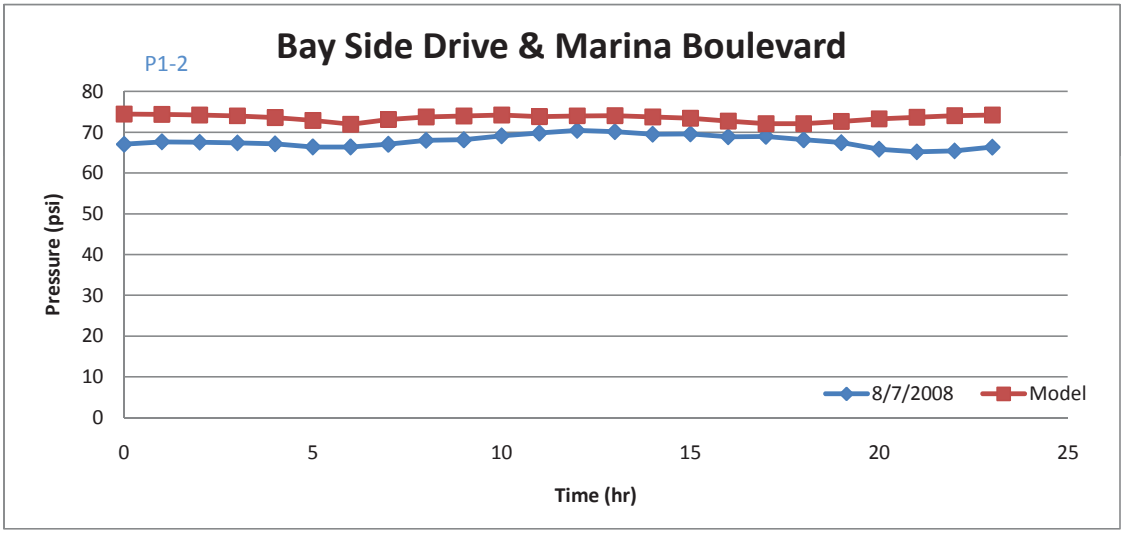


Figure 1
Pressure Teleloggers
Water System Master Plan
City of Pittsburg

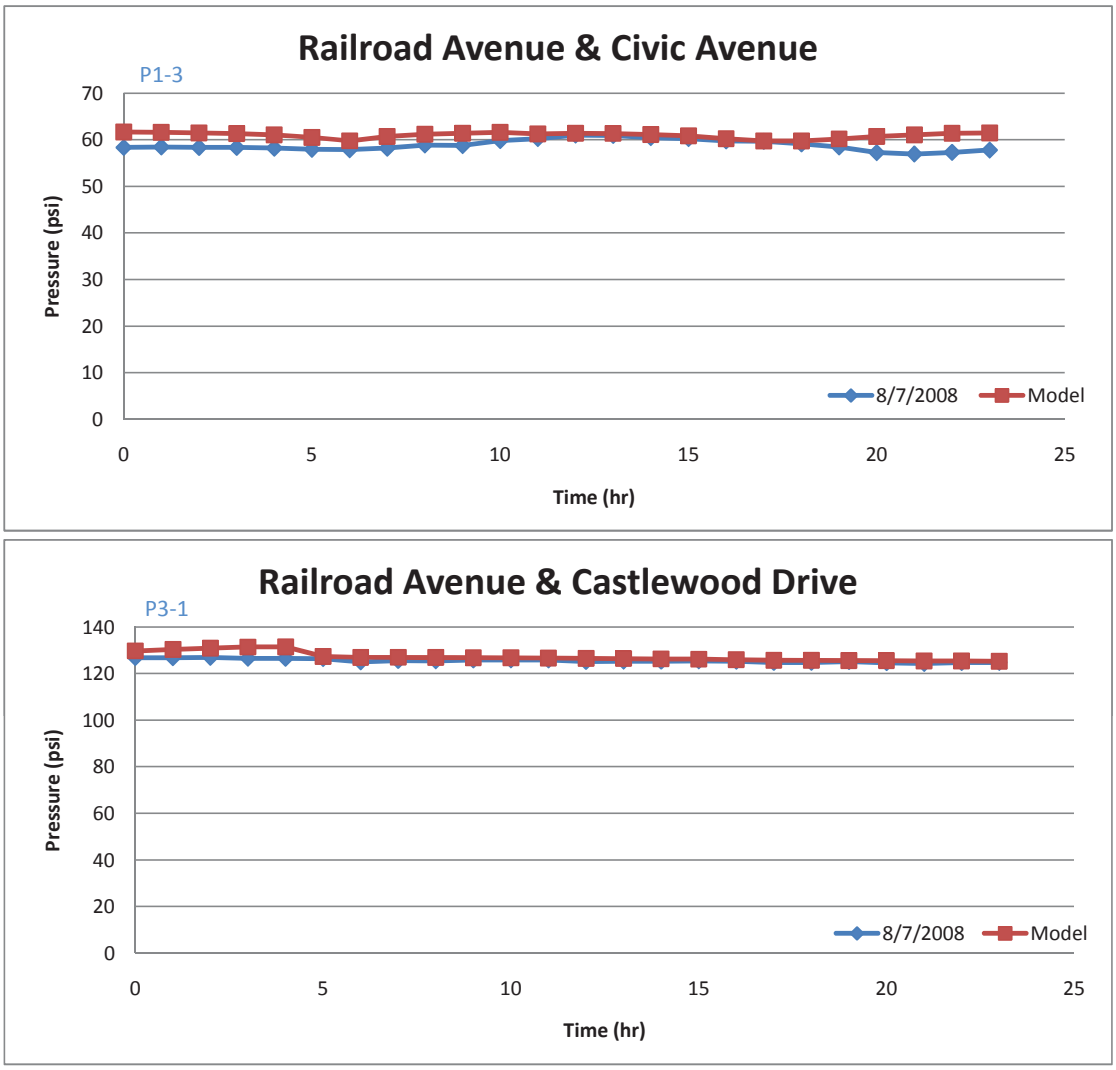


Figure 2

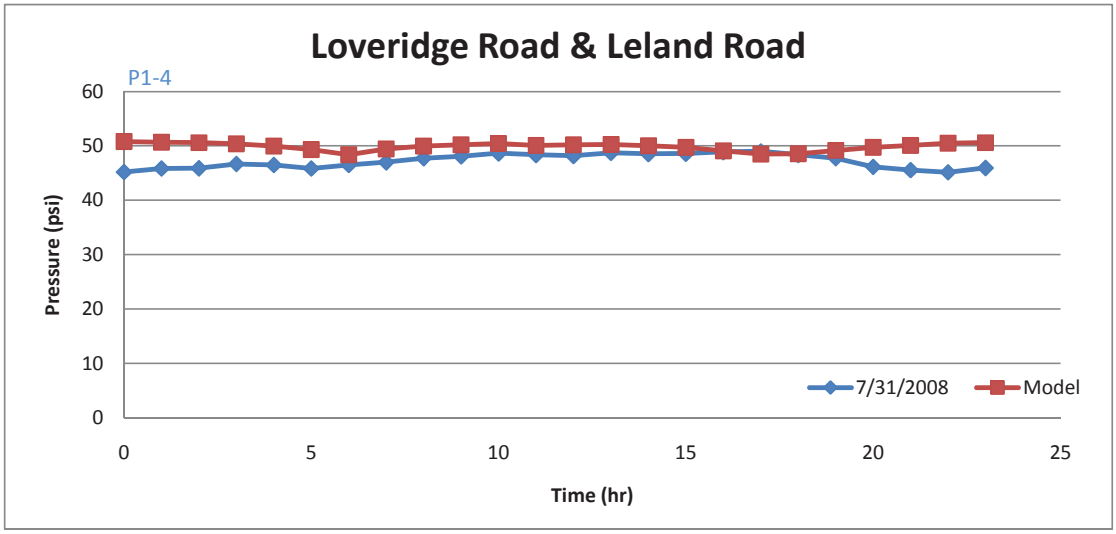
Pressure Teleloggers

Water System Master Plan

City of Pittsburg

AKEL ENGINEERING GROUP, INC.

12/30/2008



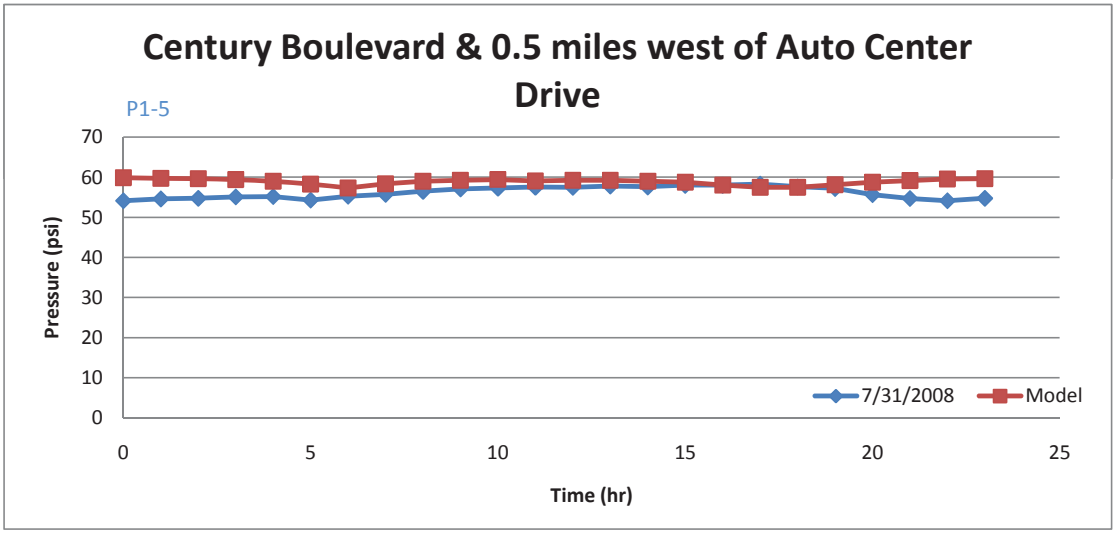
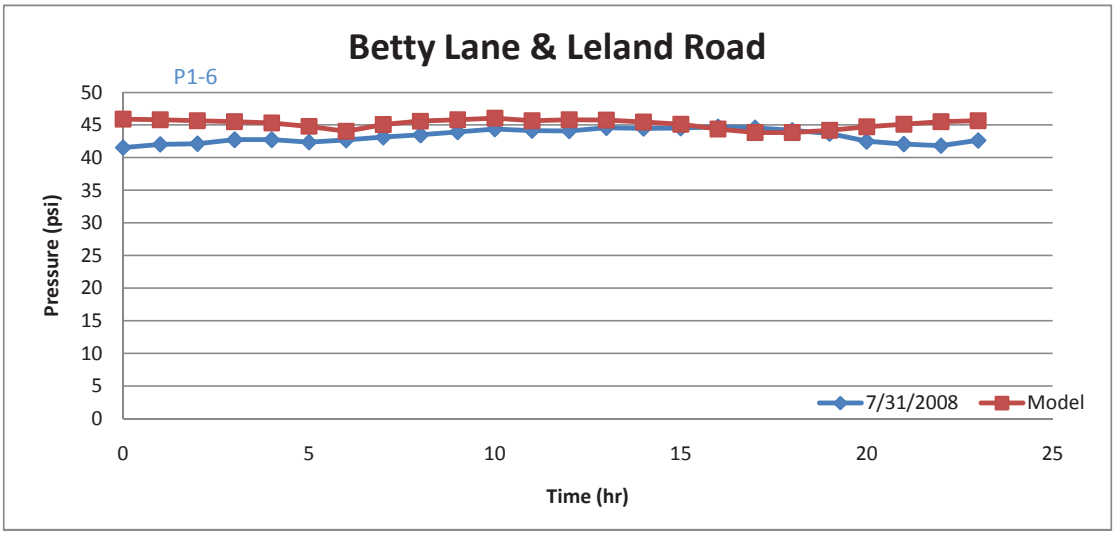


Figure 3

Pressure Teleloggers

Water System Master Plan

City of Pittsburg



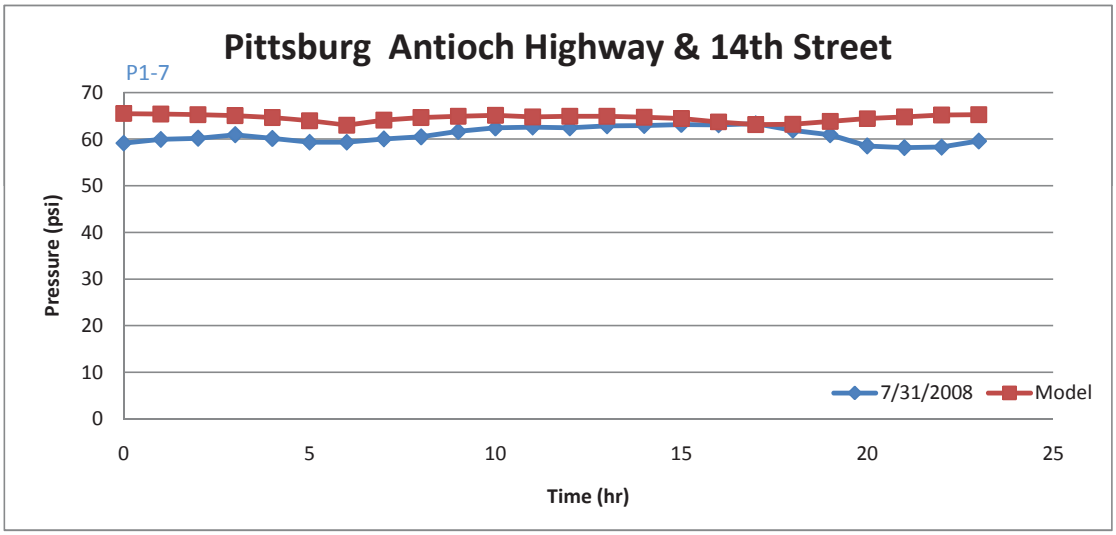


Figure 4

Pressure Teleloggers

Water System Master Plan

City of Pittsburg

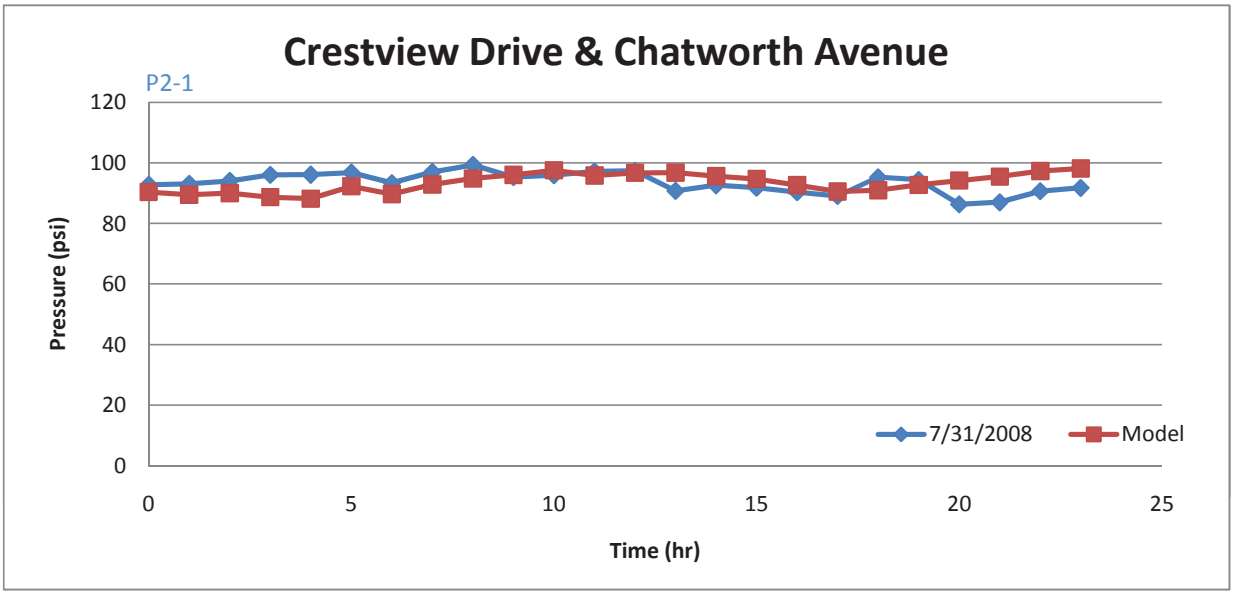
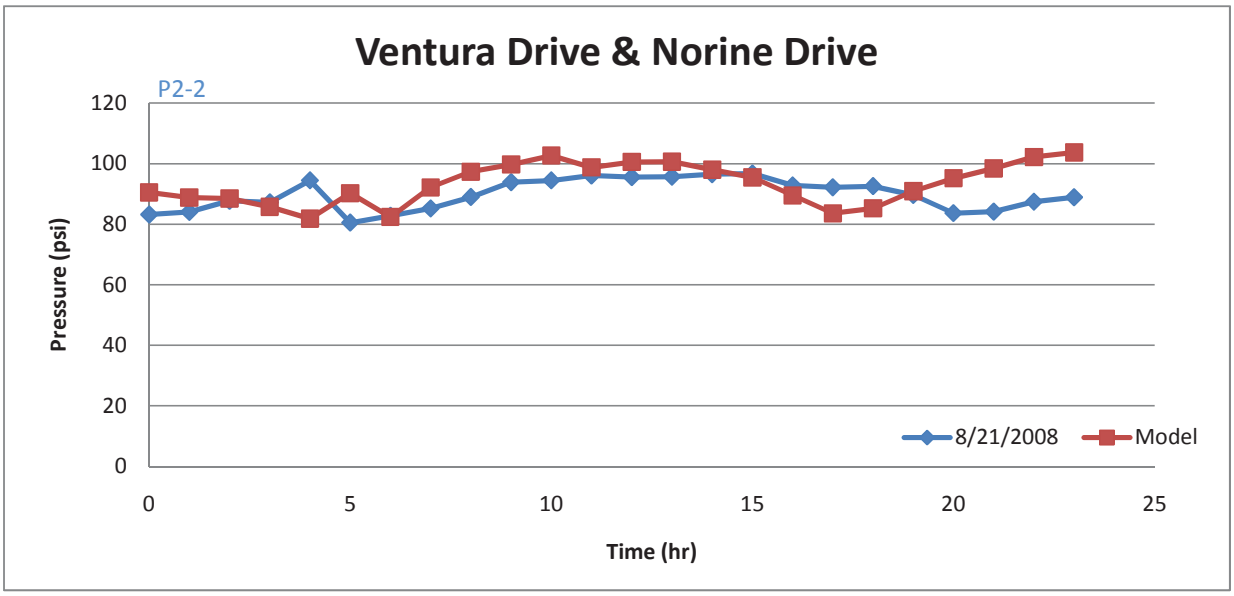


Figure 5

Pressure Teleloggers

Water System Master Plan

City of Pittsburg



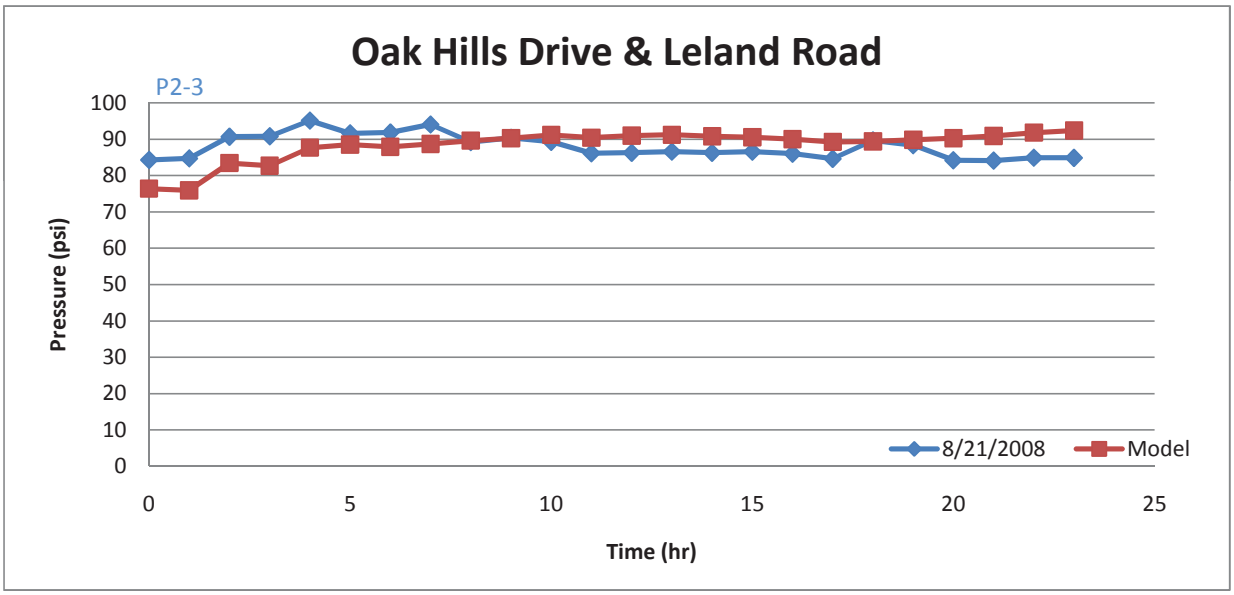
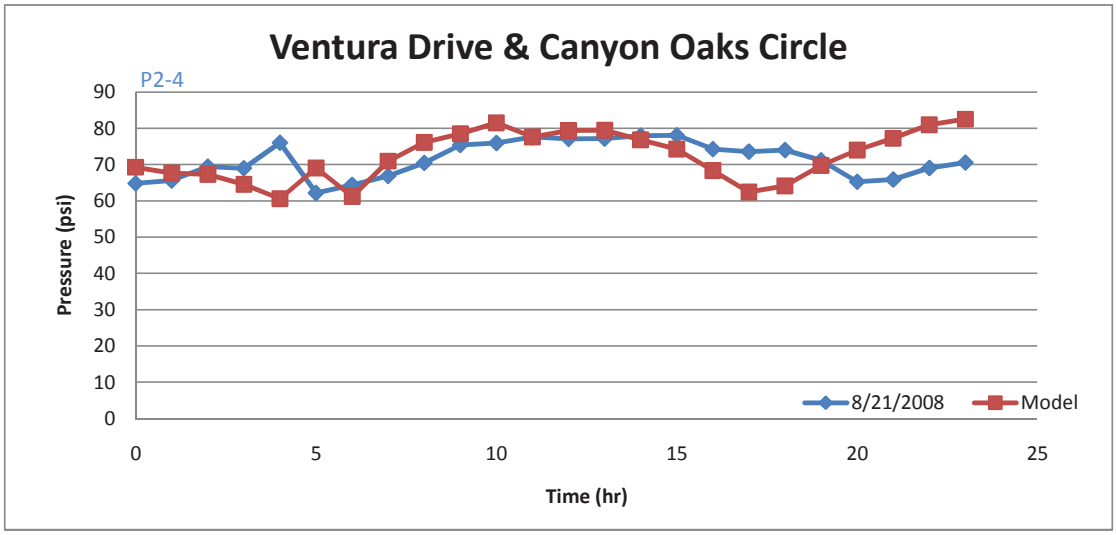


Figure 6

Pressure Teleloggers
Water System Master Plan
City of Pittsburg



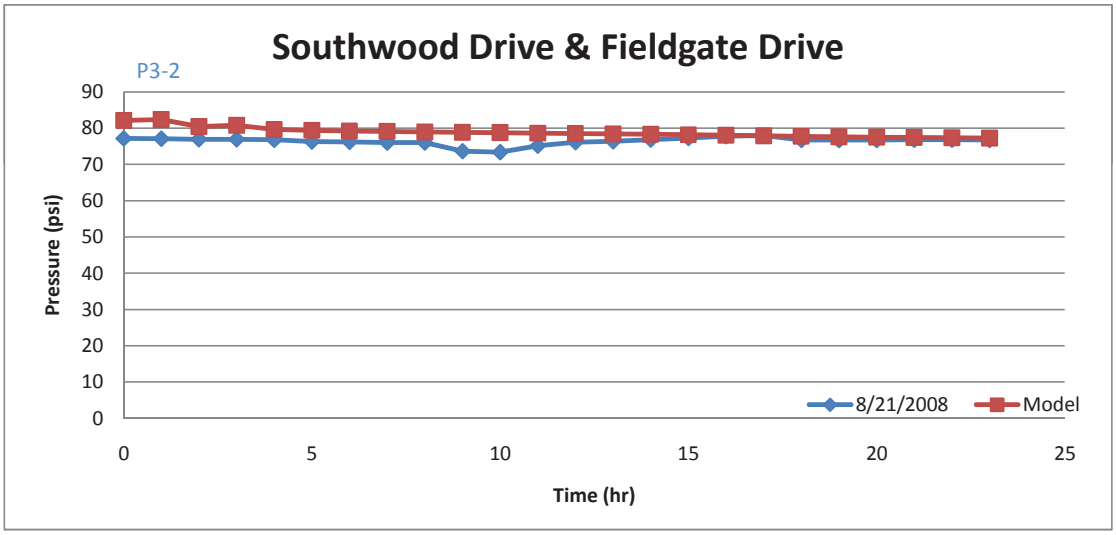


Figure 7

Pressure Teleloggers
Water System Master Plan
City of Pittsburg