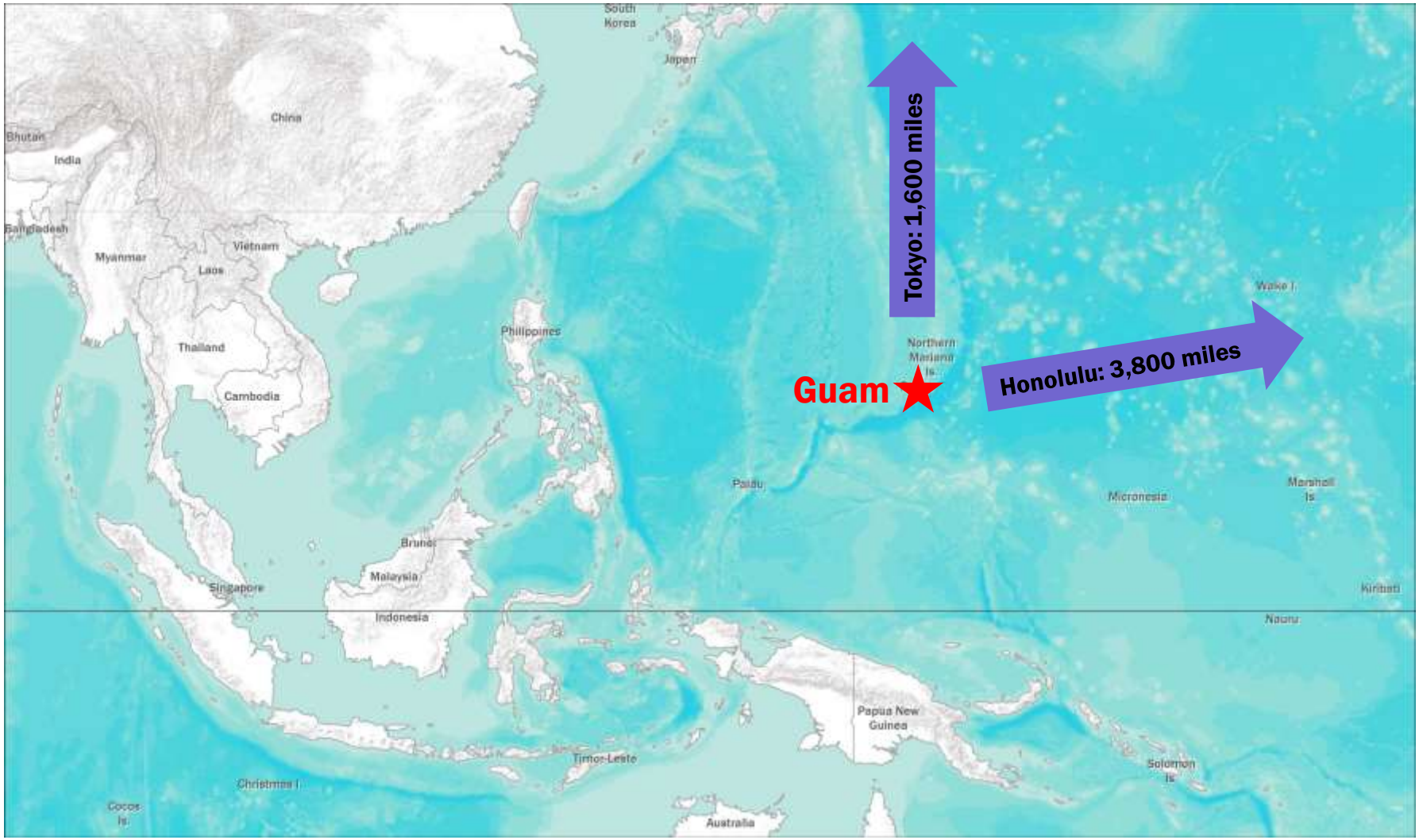
Colin Ricks

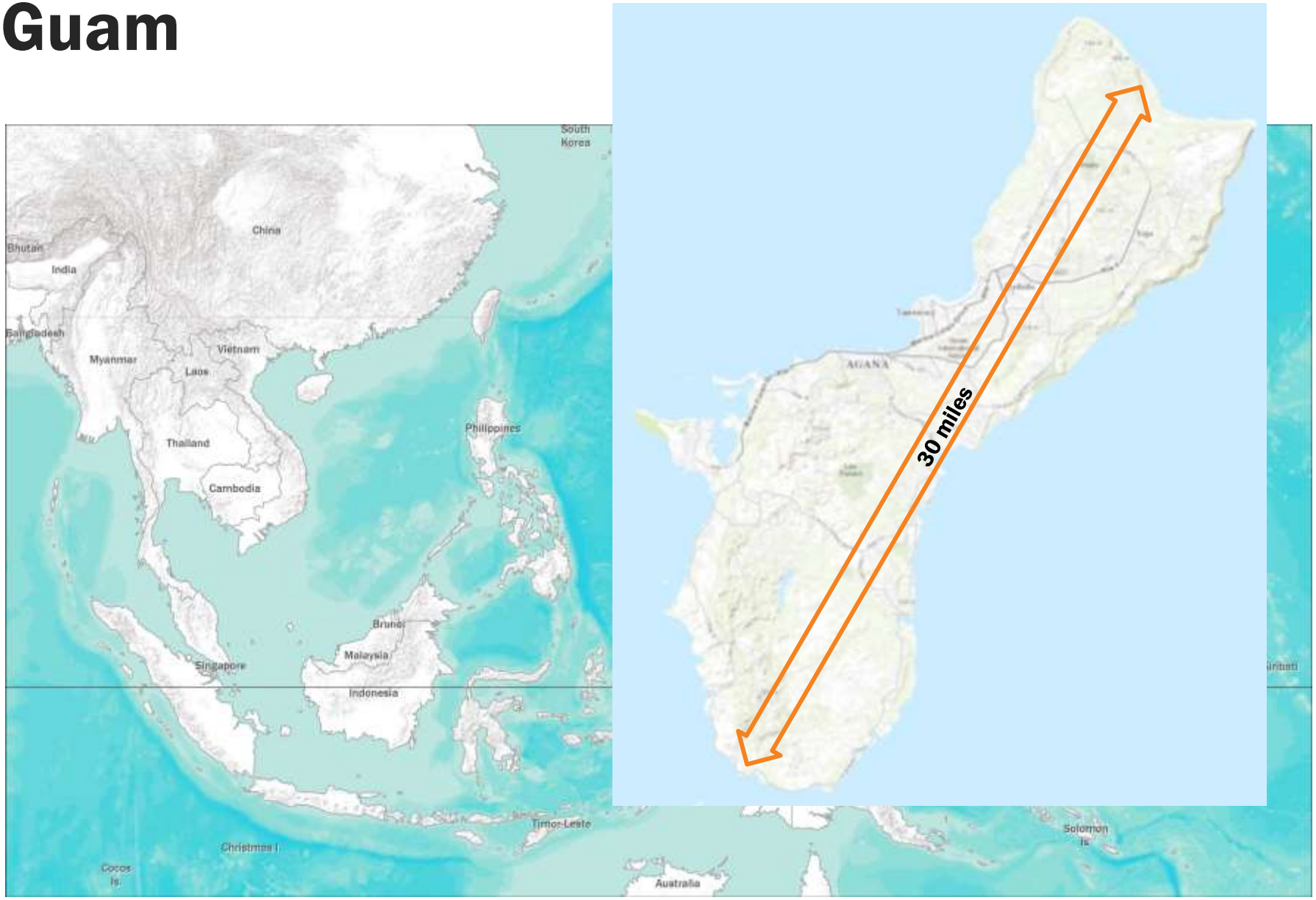
Hydraulic Modeling of the Guam Water System

May 1, 2015

Guam


South Korea
Japan
China
Bhutan
India
Bangladesh
Myanmar
Vietnam
Laos
Thailand
Cambodia
Philippines
Tokyo: 1,600 miles
Wake I.
Northern Mariana Is.
Guam
Honolulu: 3,800 miles
Palau
Micronesia
Marshall Is.
Brunei
Malaysia
Singapore
Indonesia
Kiribati
Nauru
Papua New Guinea
Timor-Leste
Solomon Is.
Christmas I.
Cocos Is.
Australia

Guam


South Korea
China
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Laos
Thailand
Cambodia
Philippines
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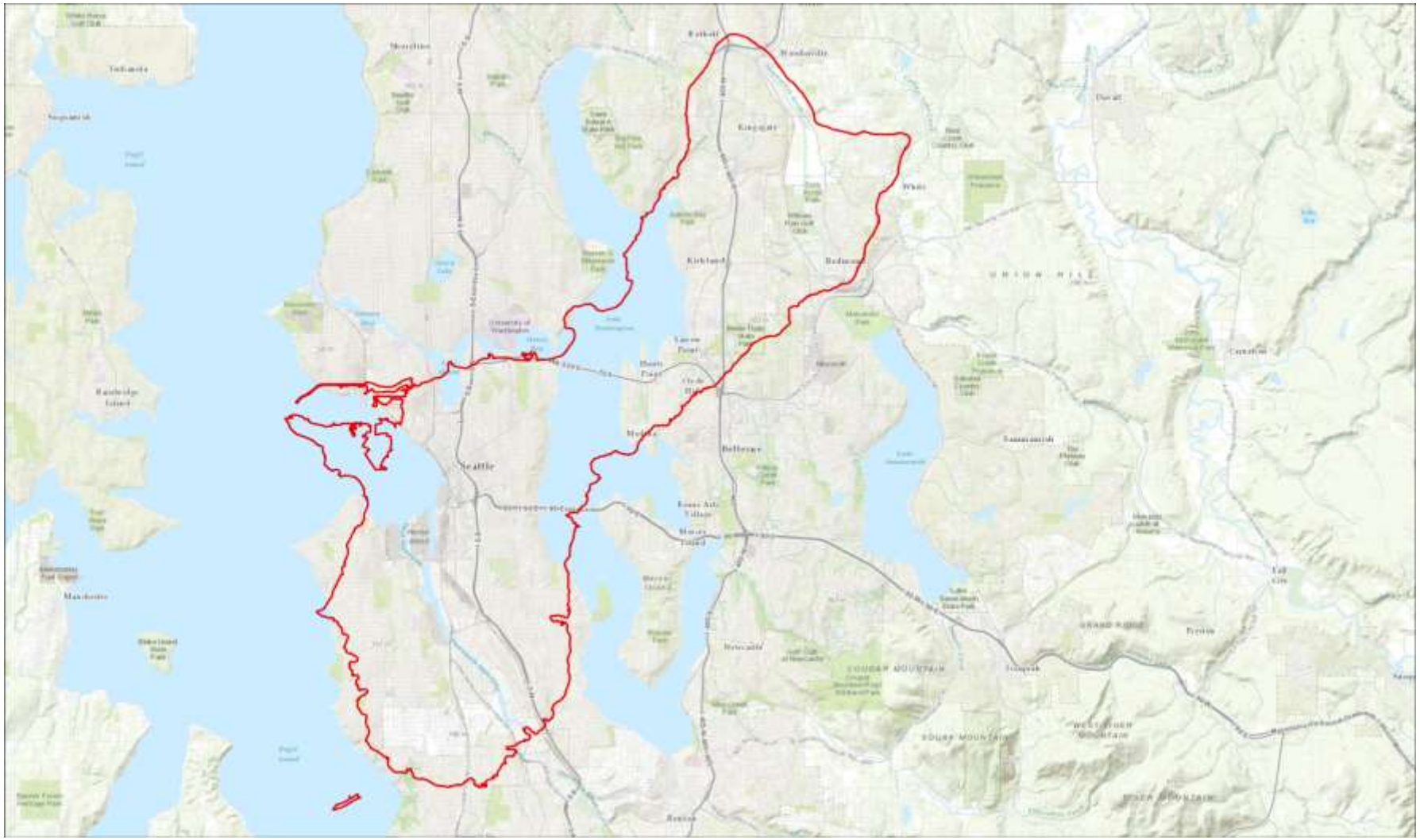
Indonesia
Timor-Leste
Christmas I.
Cocos Is.
Australia
Solomon Is.
AGANA
30 miles

Guam



Guam

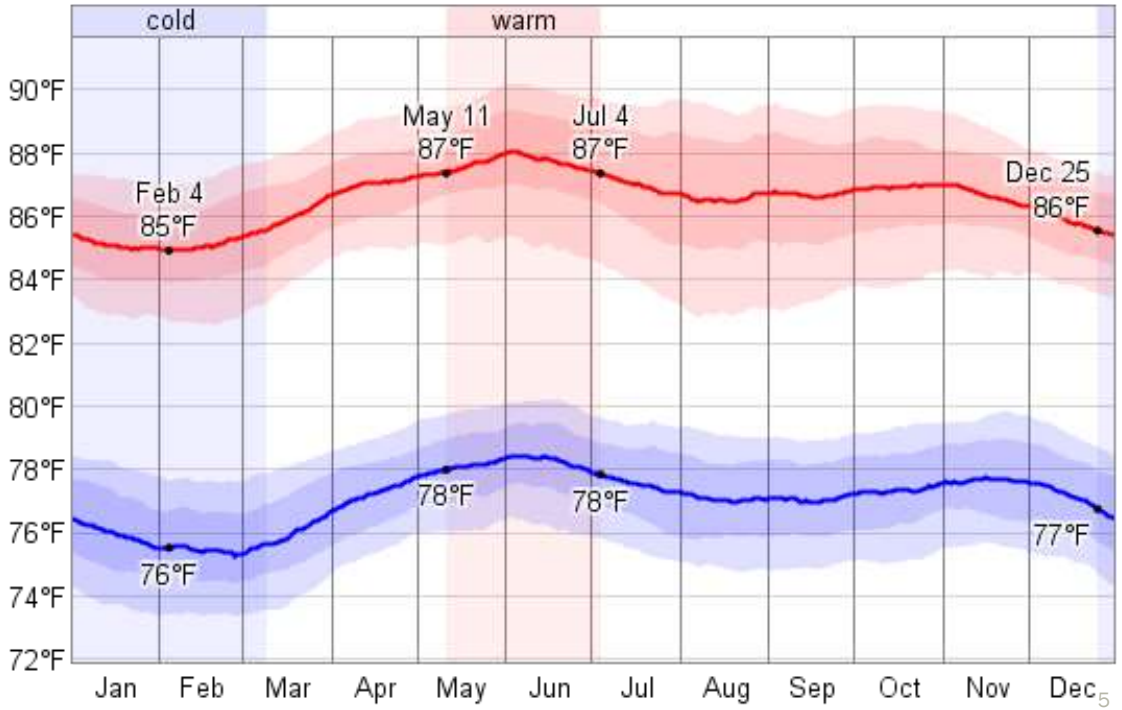
2010 Population: 160,000

Tropical Climate

- Average rainfall: 92 inches/year
- Average temp: 82°F

Principal Industries:

- Tourism
- US Military



Guam History

~2000 BC – Chamarros arrived

1521 – Ferdinand Magellan

1668 – Spanish colonization

1898 – Surrendered to US

1941 – Captured by the Japanese

1950 – US Territory

Guam Waterworks Authority (GWA)

Serves civilian population

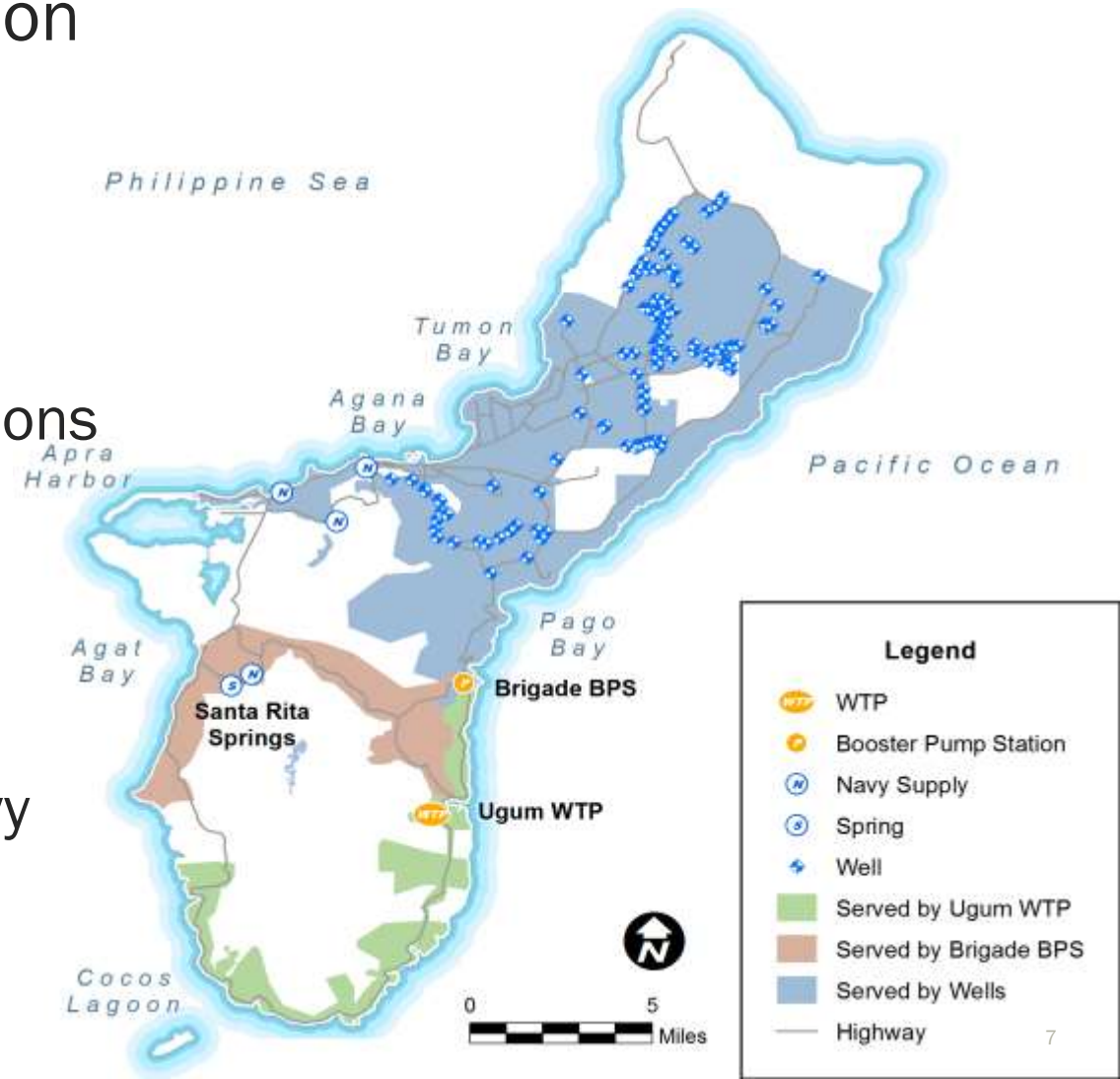
- ~55,000 customers

Water System

- 600 miles of pipe
- 29 Tanks, ~29 MG
- 26 Booster Pump Stations

Supply

- 38 MGD (avg 2014)
- 120 wells in North
- Surface water in South
- Connections to US Navy water system



GWA Challenges

Leaks

GWA Challenges

Leaks

Partially-Closed Valves

GWA Challenges

Leaks

Partially-Closed Valves

Maintenance

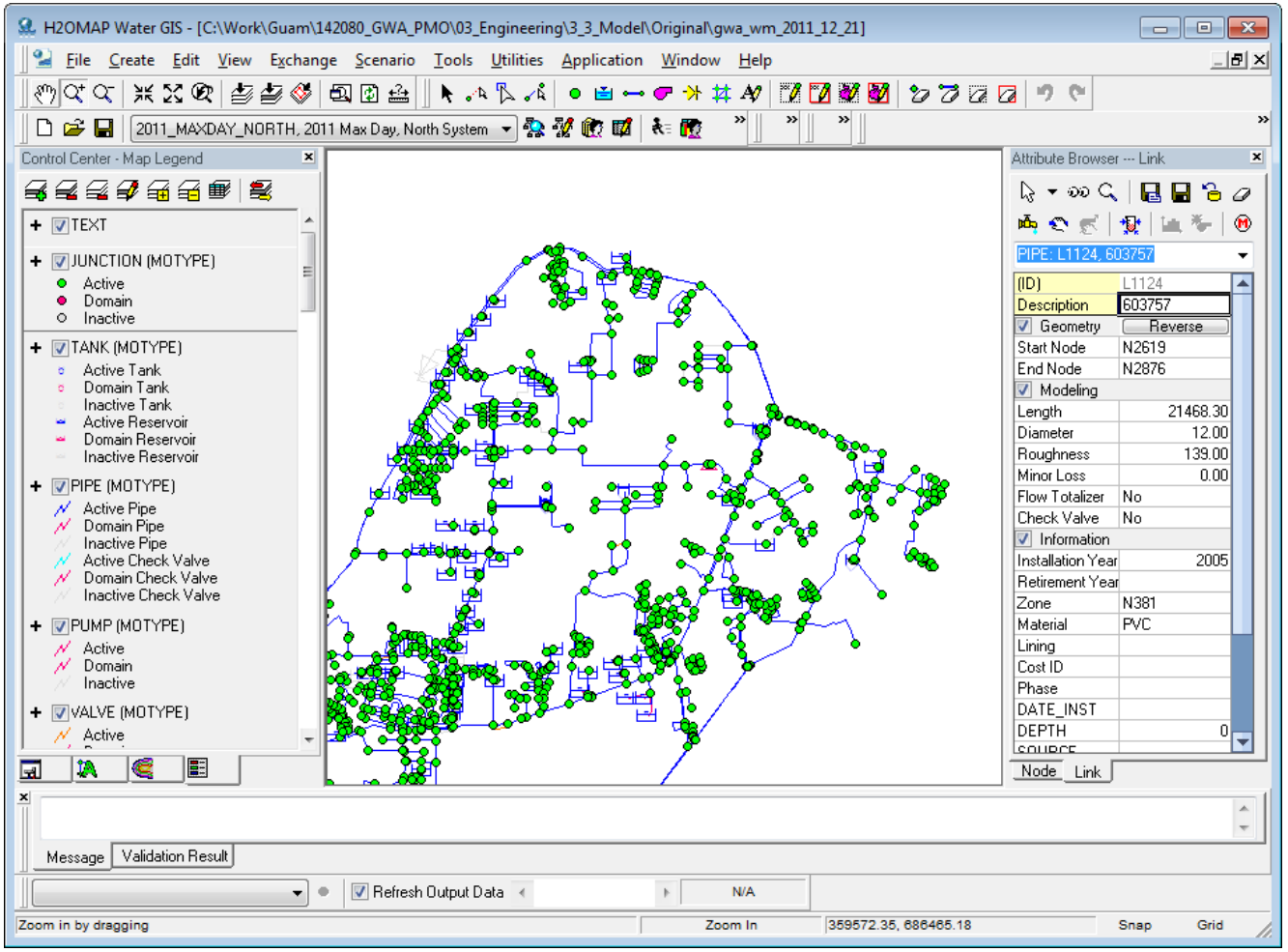
GWA Challenges

- Leaks
- Partially-Closed Valves
- Maintenance
- Record Keeping

Water Distribution Model

First model built in 2006

Innovyze's H2OMAP Water



GIS

Started GIS from Model Piping

GIS

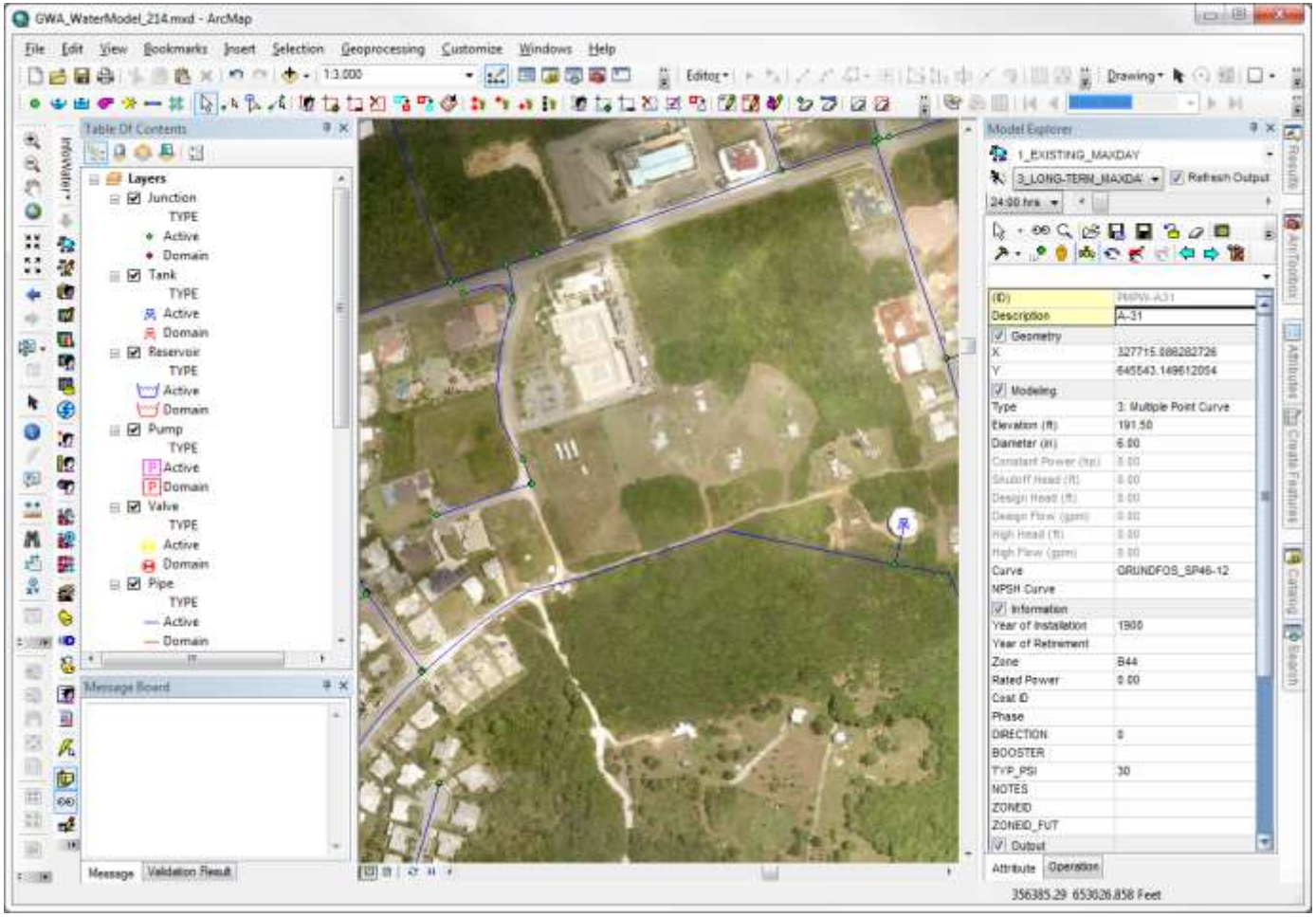
Started GIS from Model Piping

GIS Updates

- As-Builts
- Field Work
- Leak Detection

Updated Model

- 2012 - Model converted to InfoWater
- Runs in ArcGIS
- Piping from latest GIS
- Ongoing updates to GIS



Model / GIS Linking

Add New Piping

Fix Piping Alignments

- Only maintain one database

Model / GIS Linking

Model Development

- Standardize and document how model will be built and updated

Appendix A

Model Development

This appendix documents the methodologies and information used in updating the GWA InfoWater computer model and how the model should be updated in the future.

Model Attributes

This section describes how model attribute fields were populated for each type of model facility. Fields in the model software that are not listed in this appendix were not used or the software default values were used. Model facilities are in the 1993 Guam Geodetic Network, North American Datum of 1983 (NAD 83) coordinate system.

General Attributes

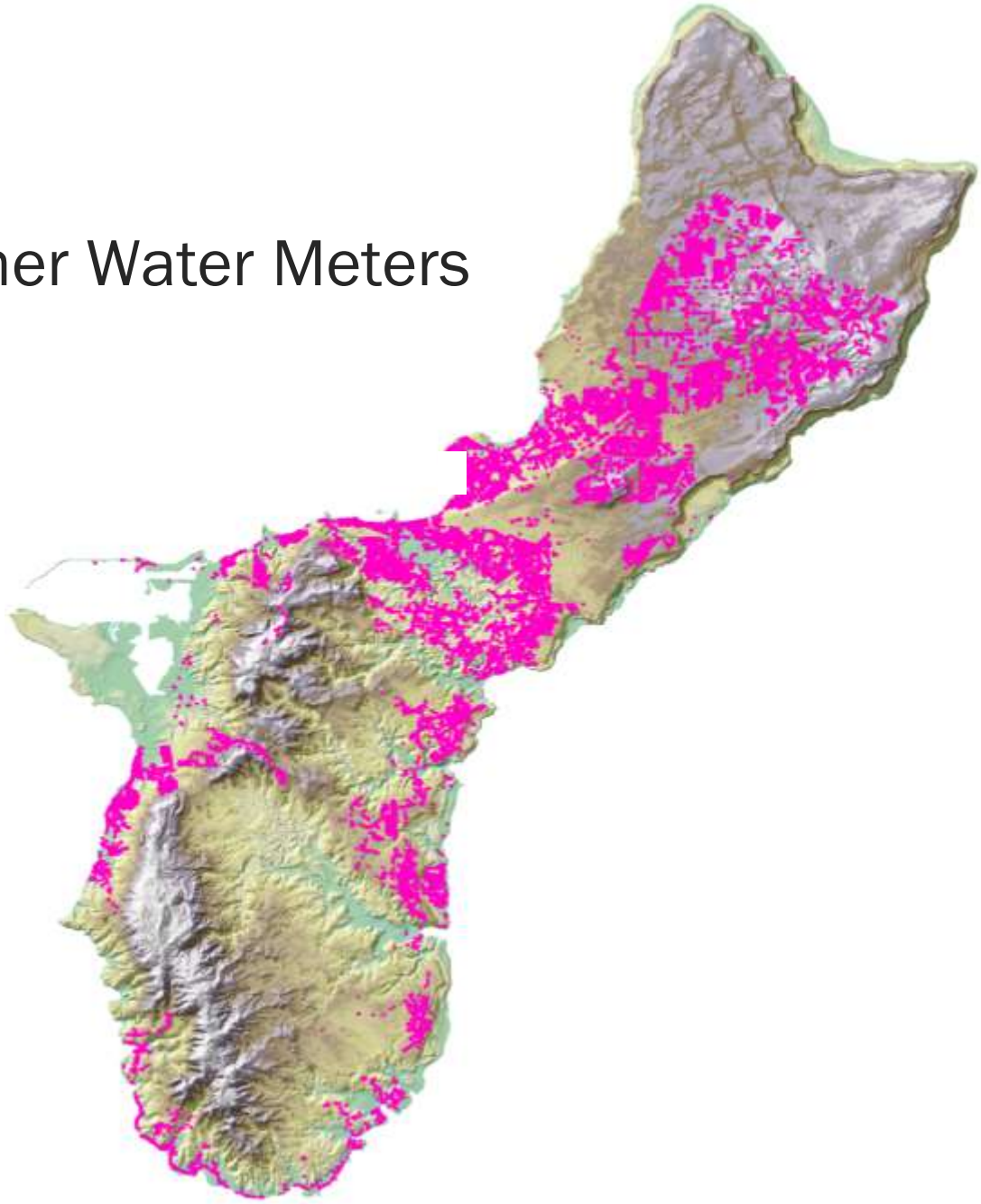
Table A-1 lists the attributes that are common between all facilities.

Table A-1. Common Attributes

Attribute	Value			
	Facility Type	*Abbreviation*	*Unique Suffix*	*Sample ID*
ID	Junction	J	A unique number or description of the facility	J-2
	Pipe	P L (modeled pipes from GIS lateral layer)		P-2 L-2
	Valve	PRV (pressure reducing valve) PSV (pressure sustaining valve) PRV_PSV (PRV/PSV valve) FCV (flow control valve) TCV (throttle control valve)		PRV-10 PSV-101 PRV_PSV-1 FCV-MANGILAD TCV-101
	Tank	T	Description of the facility	T-INARAJAN
	Well	W		W-A01
	Water treatment plant wet well	WTP		WTP-UGUM
	Spring wet well	SPRG		SPRG-SANTA_RITA
	Well Pump	PMPW		PMPW-A01
	Booster Pump	PMPB		PMPB-ACCESS1
Year of Installation	Year installed. This value is used to specify that a facility will be active in a scenario. For example, a facility with an installation year of 2020 or before will be active in a 2020 scenario. Facilities with a blank value will not be active. The following values were used as default values for specific cases.			
	Year	*Description*		
	1900	Default value if installation year is unknown, otherwise, use the actual year of construction		
	>2013	Value used in model for piping in GIS labeled as "Proposed." The piping is in the model to match the GIS but it is not active.		

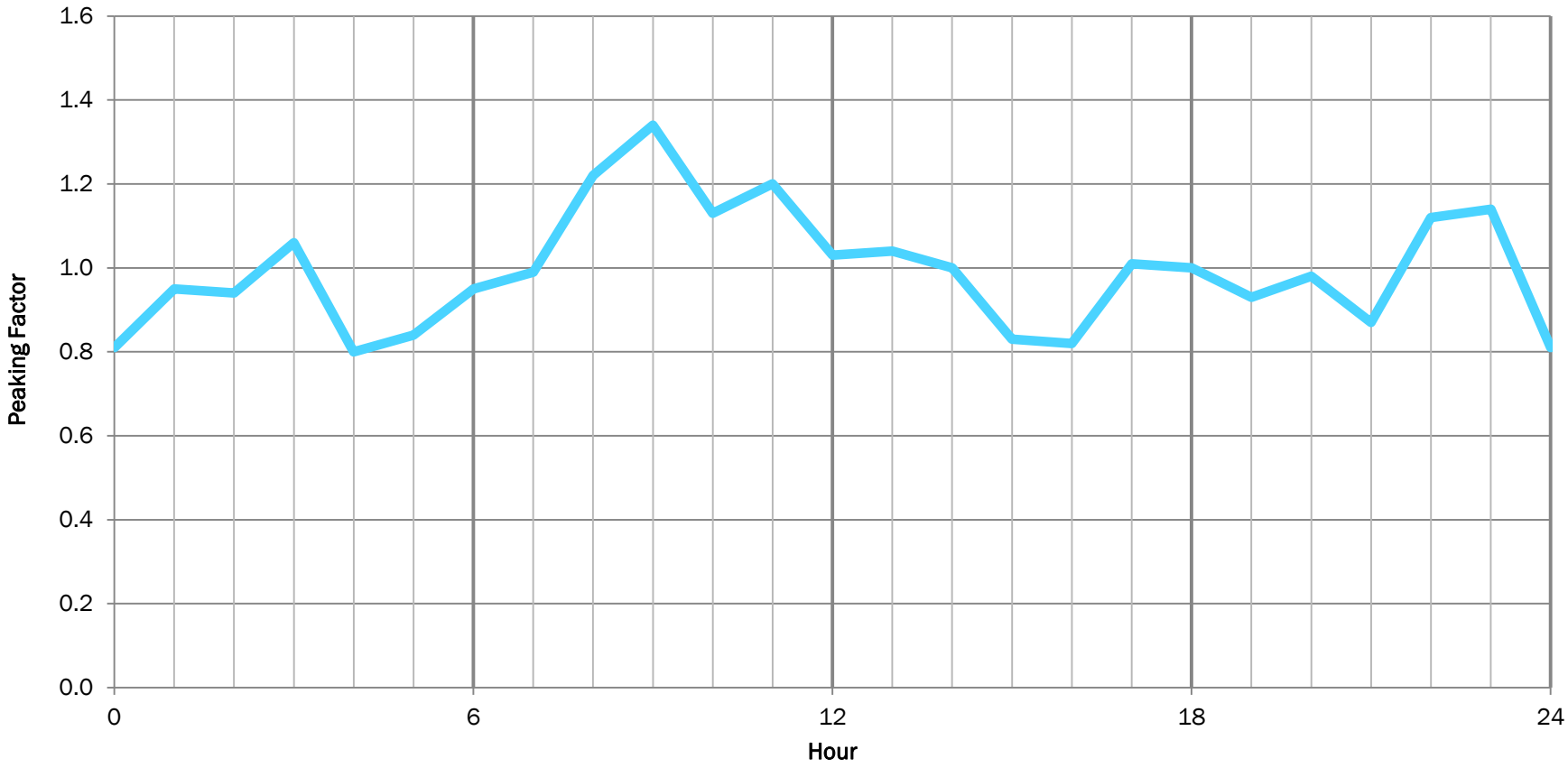
Demands

- GPS Customer Water Meters



Demands

Diurnal Pattern



Demands

Calibration / Field Work

Fire Flow Tests

Hydraulic Calibration

- Check Hydraulics, C Factors, Closed Valves

Calibration / Field Work

Pressure Loggers

Calibration / Field Work

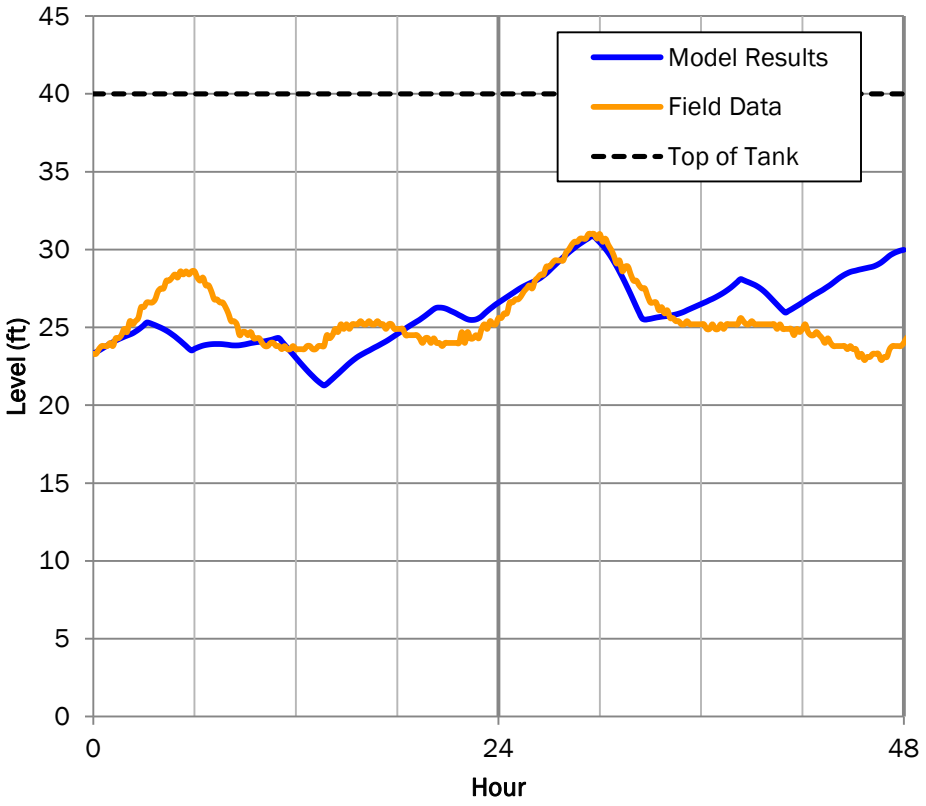
PRV Location and Setting

Calibration / Field Work

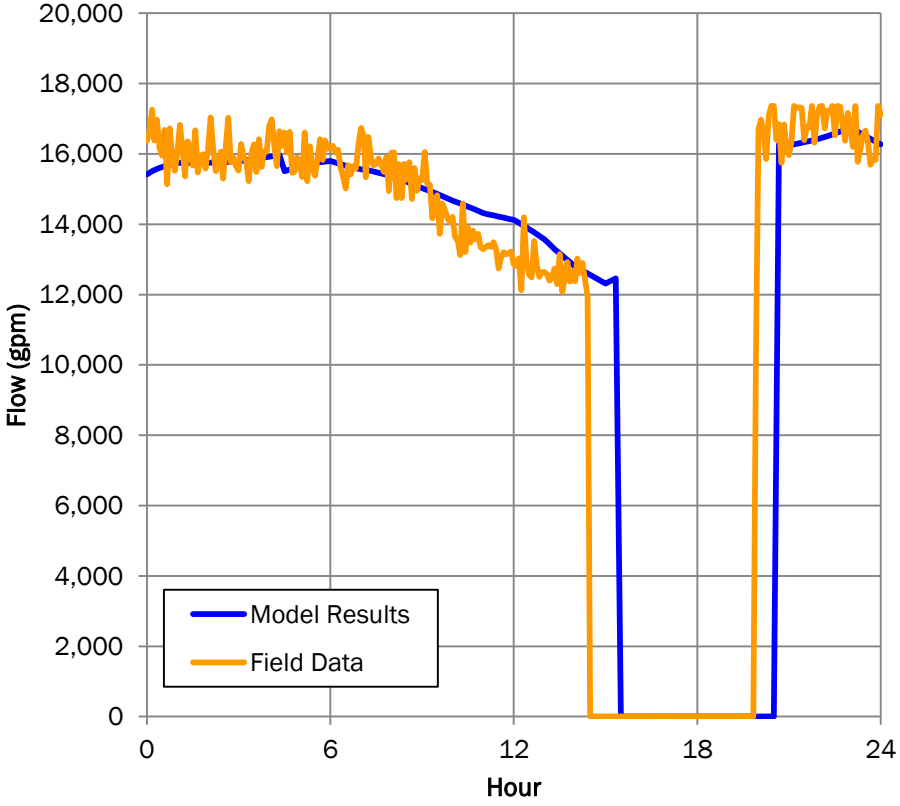
- Verified pump curves
- Pump Tests

Operational Calibration

Tanks



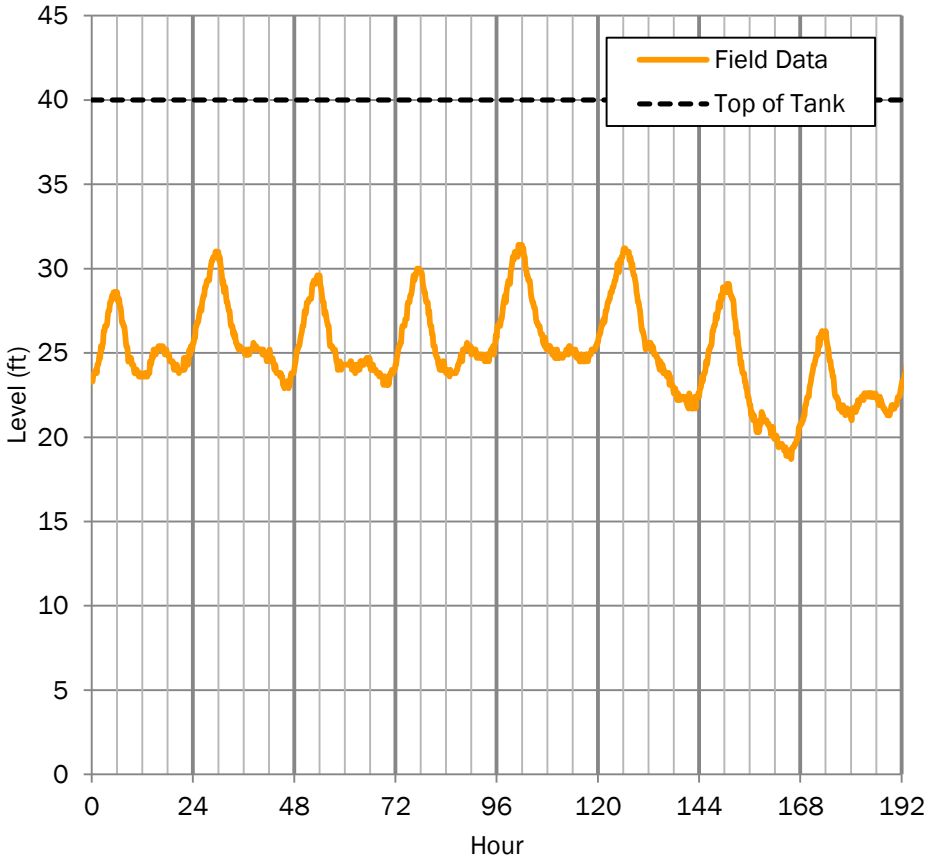
Pumps



Operational Calibration – No SCADA

Tank Levels

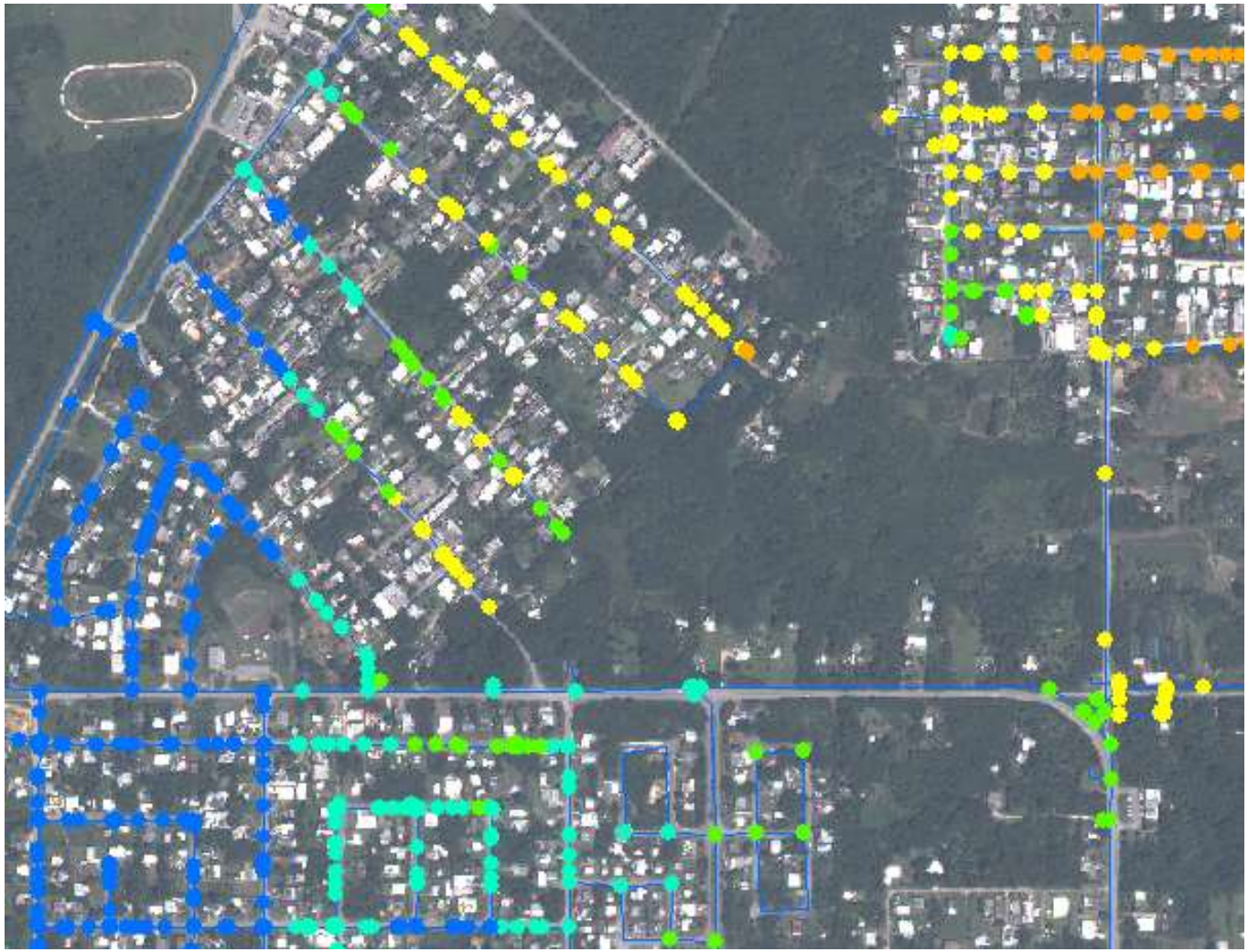
Flow Meters



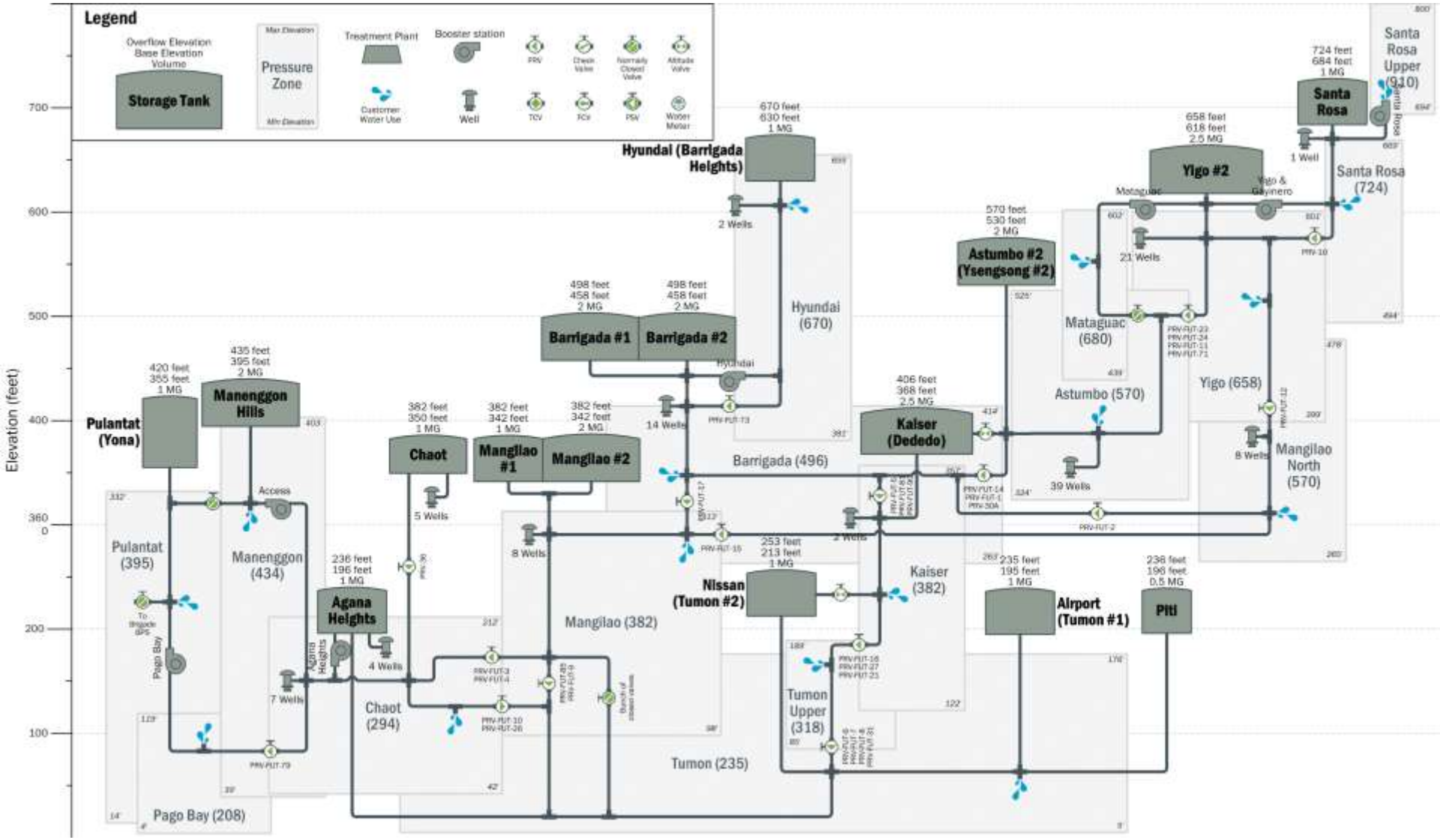
Model Analysis / Uses

Evaluation

- Storage
- Pressure
- Velocity
- Fire Flow
- Supply

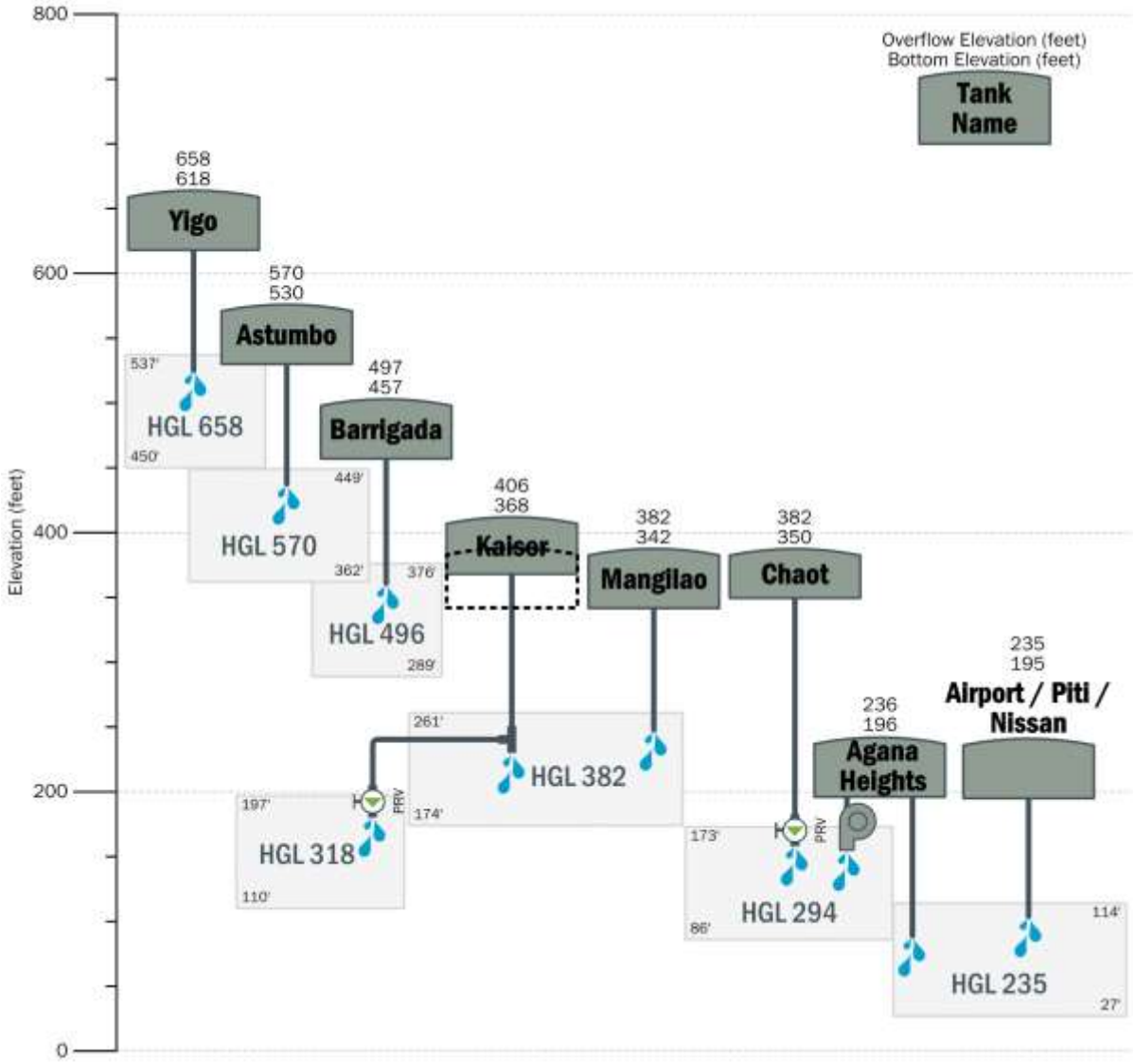


Hydraulic Schematic

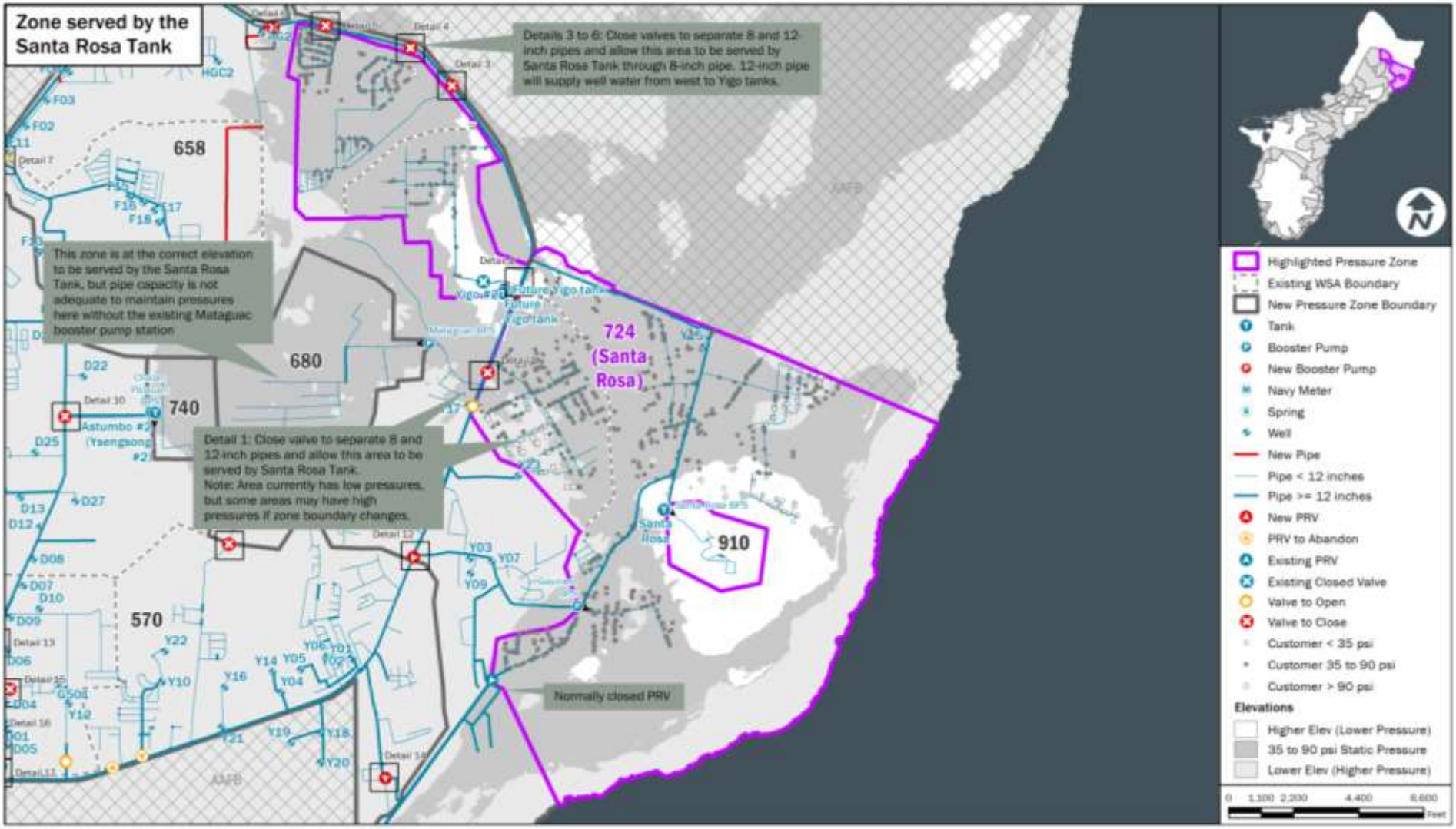


Model Analysis

- Storage - Long Term Plan
- Fire Flow
- Supply
- Realignment of Pressure Zones



Pressure Zone Realignment



Next Steps

- Refine zone realignment plan
- Update model with new GIS
- Identify areas for further field investigation and testing
- Continue improving calibration

Lessons Learned

- Have a good plan for updating model
- Document processes and sources
- Every system is unique

Questions?