

Wellhead Protection

John Lovie

Sun Vista/Sunlight Beach HOA

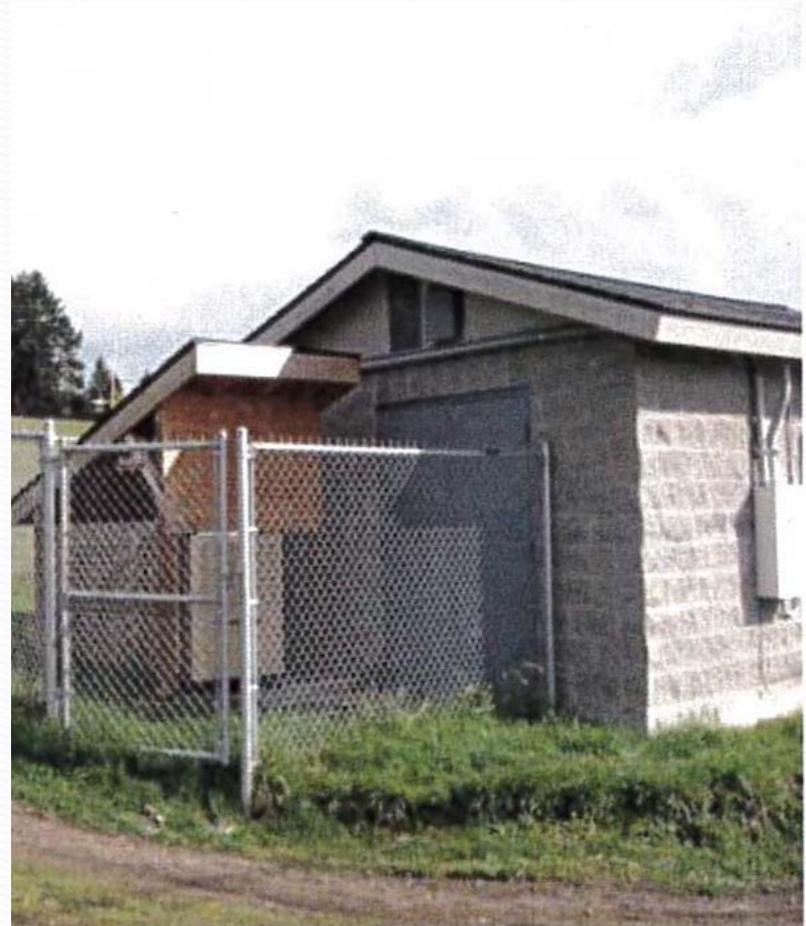
Presented to Island County WRAC

Topics

- Overview
- Wellhead Protection Program
 - Susceptibility Analysis
 - WHPA Delineation
 - Contaminant Sources
- Potential Concerns
 - Septic Tanks
 - Seawater Intrusion
- Summary

Sun Vista/Sunlight Beach HOA

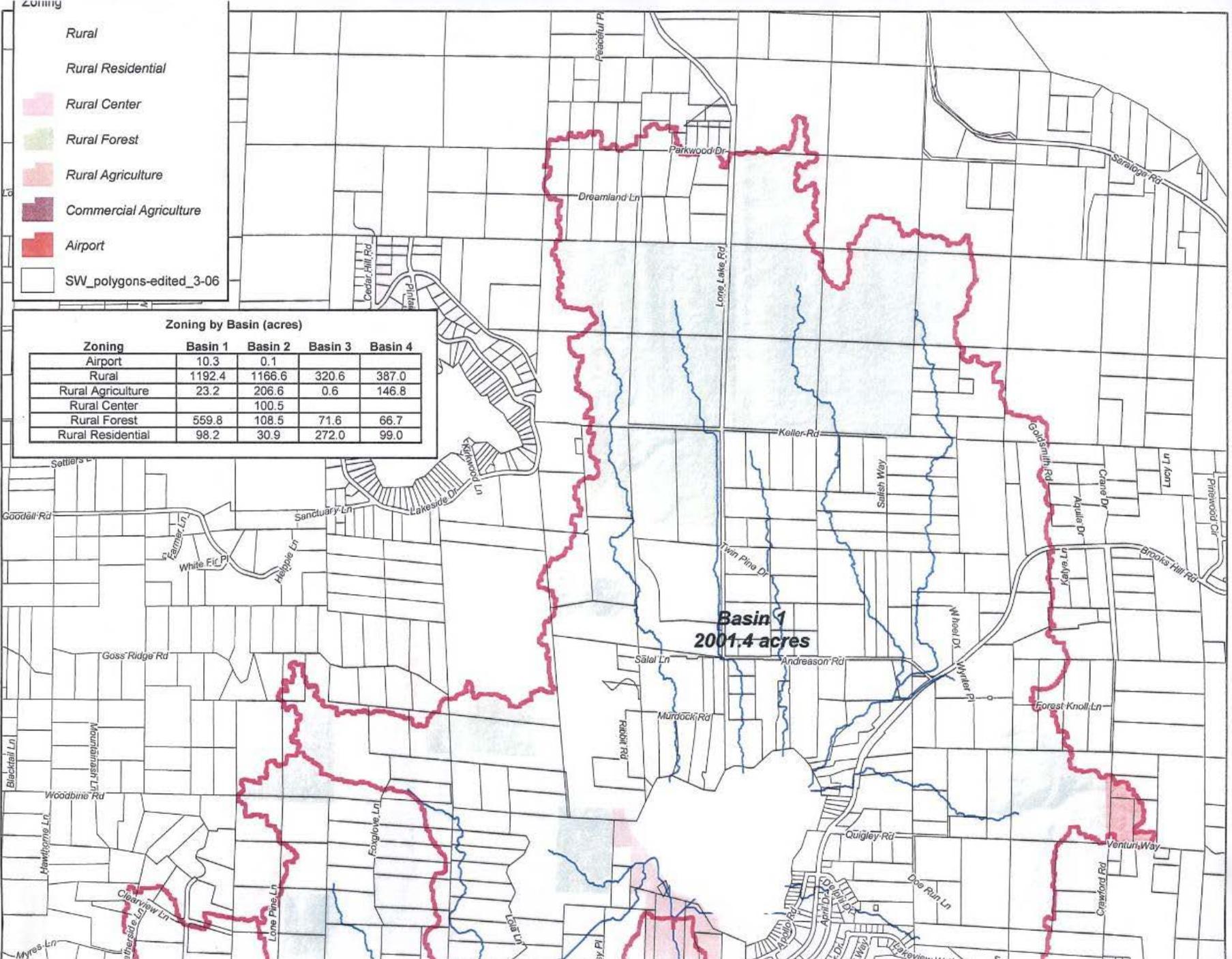
- Class A system
- 163 hookups
- Two shallow wells
- Coastal aquifer
- Useless Bay drainage basin #4
- Critical aquifer recharge area
- Common Pool Resource - owned by patrons
- All-volunteer board



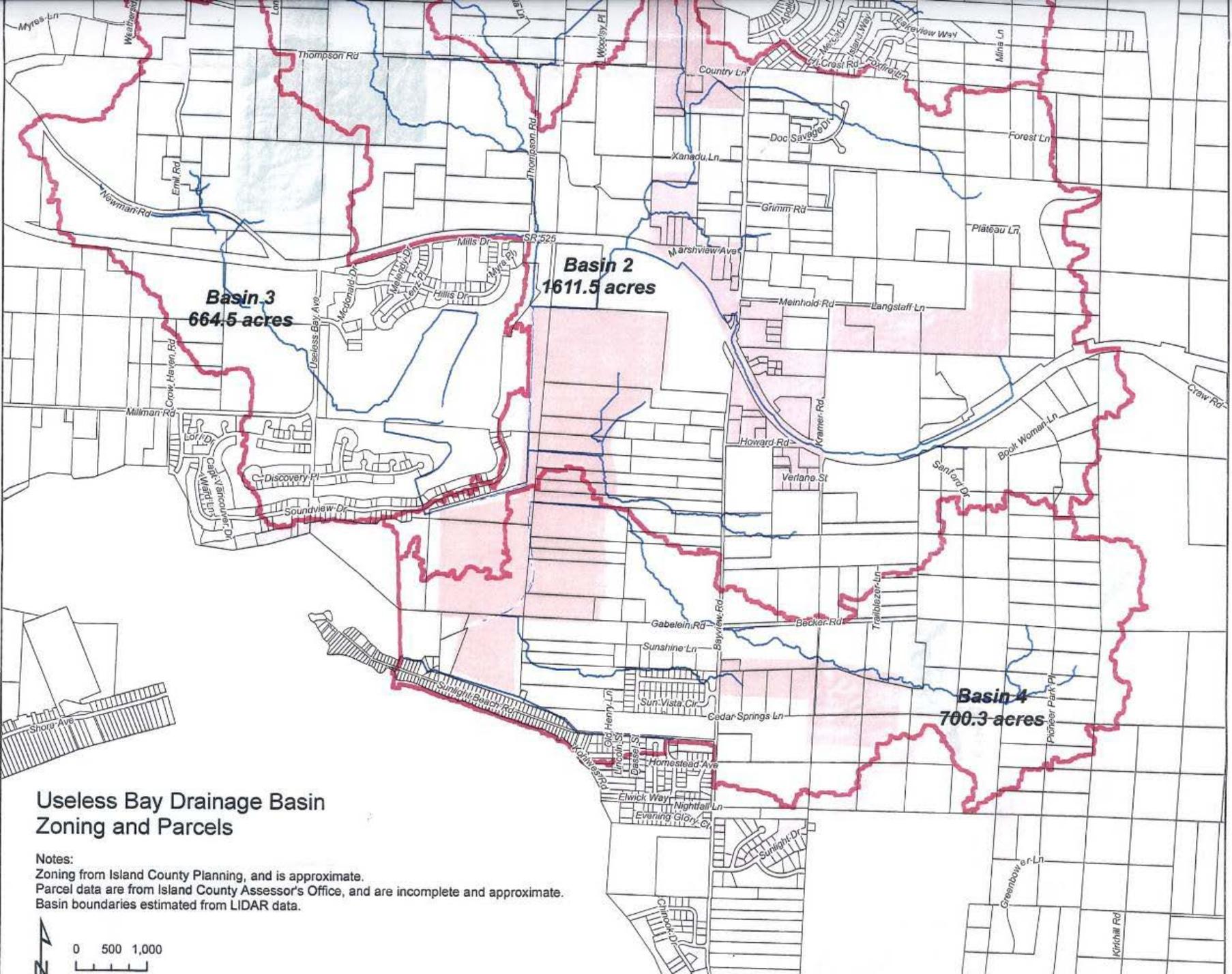
- Zoning**
- Rural
 - Rural Residential
 - Rural Center
 - Rural Forest
 - Rural Agriculture
 - Commercial Agriculture
 - Airport
 - SW_polygons-edited_3-06

Zoning by Basin (acres)

Zoning	Basin 1	Basin 2	Basin 3	Basin 4
Airport	10.3	0.1		
Rural	1192.4	1166.6	320.6	387.0
Rural Agriculture	23.2	206.6	0.6	146.8
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Rural Forest	559.8	108.5	71.6	66.7
Rural Residential	98.2	30.9	272.0	99.0

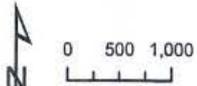


Basin 1
2001.4 acres

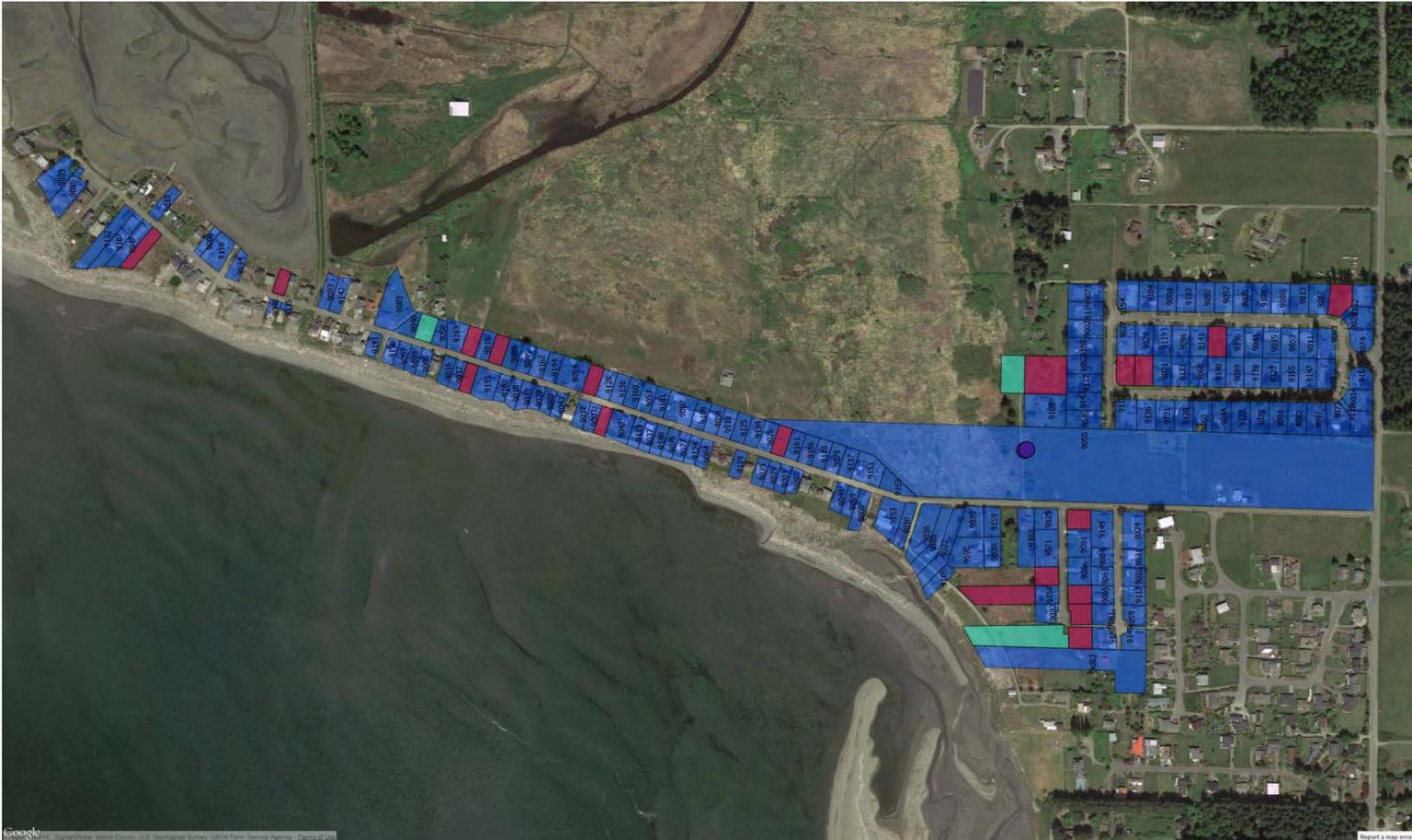


Useless Bay Drainage Basin Zoning and Parcels

Notes:
 Zoning from Island County Planning, and is approximate.
 Parcel data are from Island County Assessor's Office, and are incomplete and approximate.
 Basin boundaries estimated from LIDAR data.



Service Area and Well Site



Wellhead Protection Program

Roles and Responsibilities – Water System

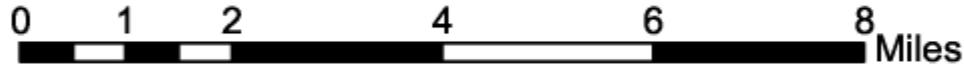
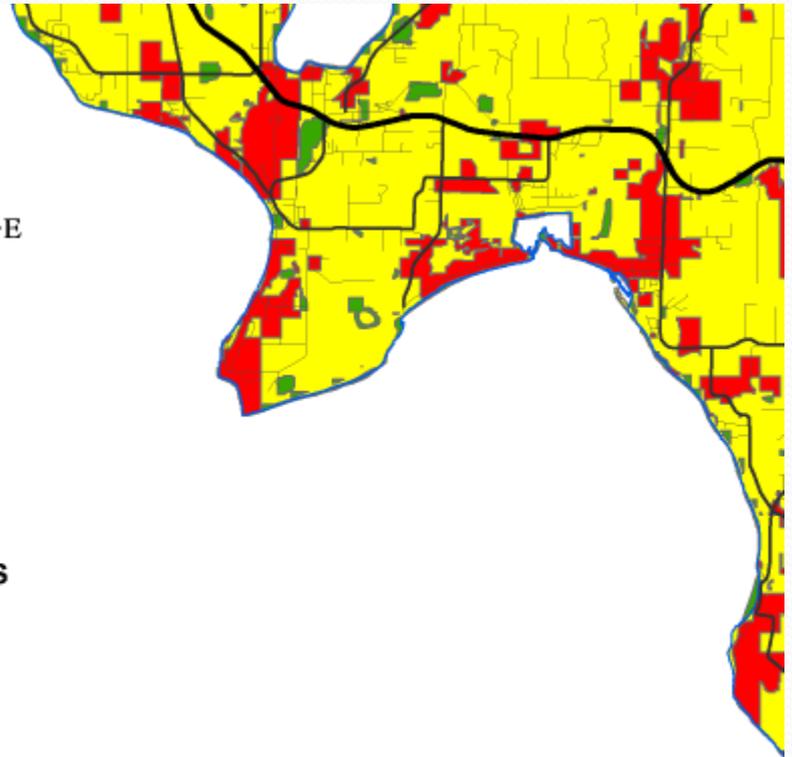
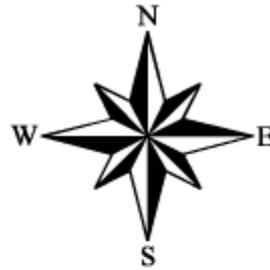
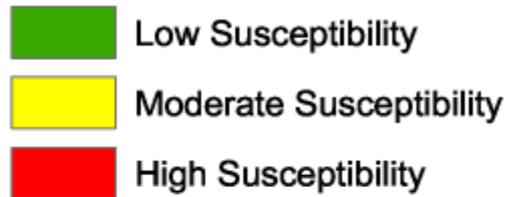
1. Susceptibility assessment
2. Wellhead Protection Area delineation
3. Inventory of contaminant sources
4. Notification to regulatory agencies
5. Notification to property owners
6. Contingency plan for potable water
7. Coordination with emergency responders

Susceptibility Assessment

- Shallow wells
- Septic systems
- Underground heating oil storage tanks
- Coastal aquifer

CARA Map

Aquifer Susceptibility



**Island County
Critical Aquifer Recharge Area Map**

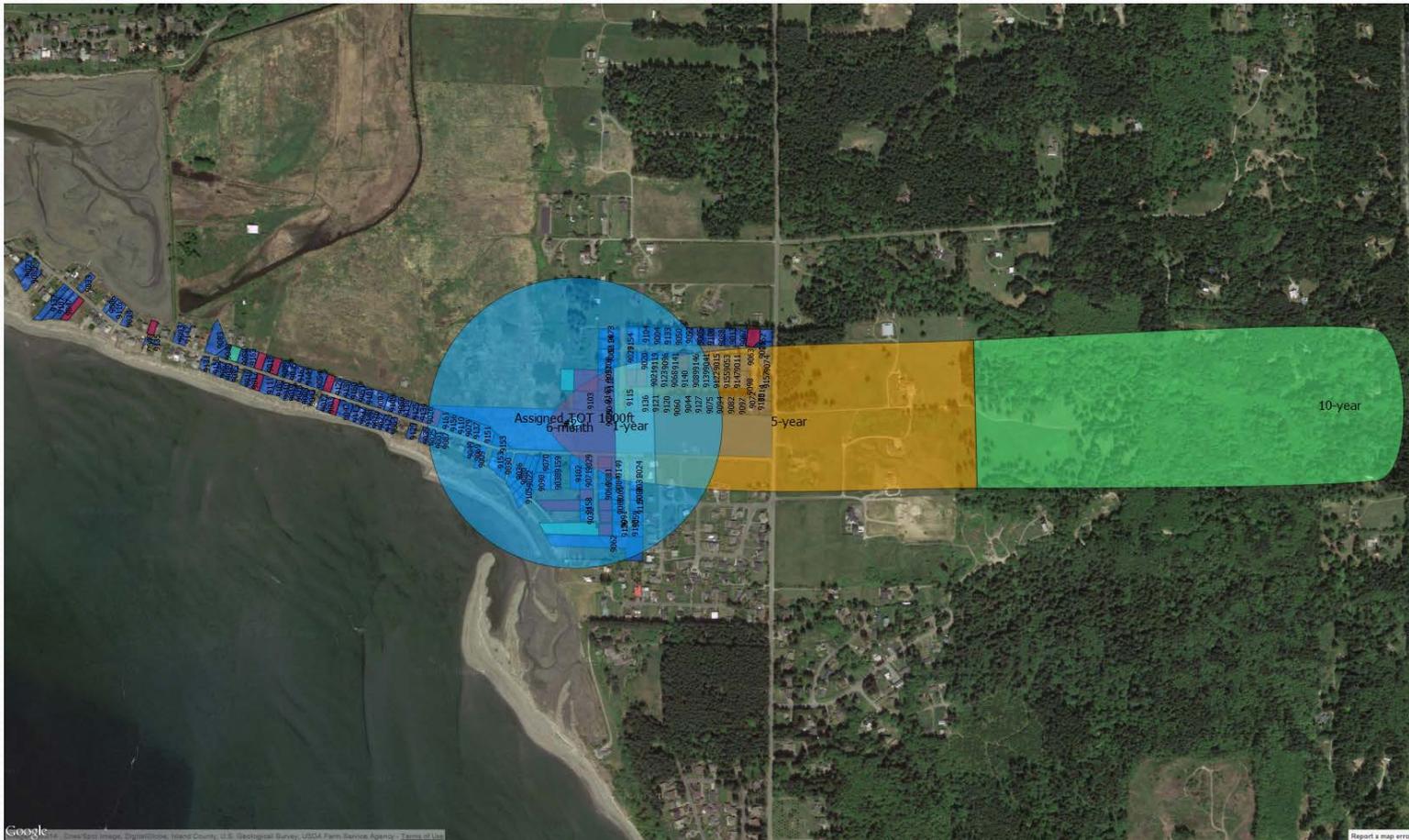
WHPA Delineation

- SWAP map shows simple radius
- Met criteria for non-circular zone of contribution
- Hired Golder Associates to carry out delineation
- Contributed data from level logging

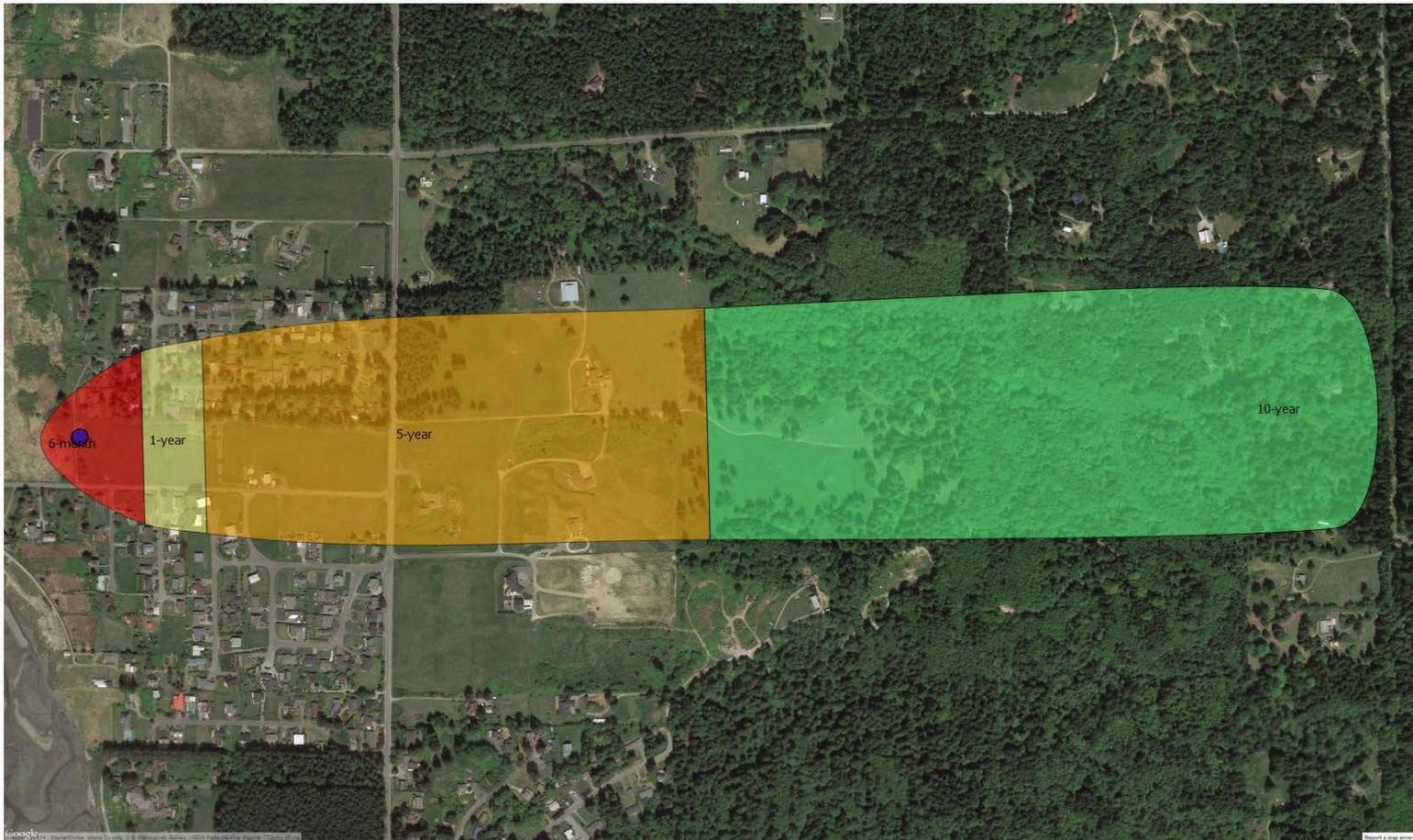
Service Area



Service Area + SWAP + WHPA



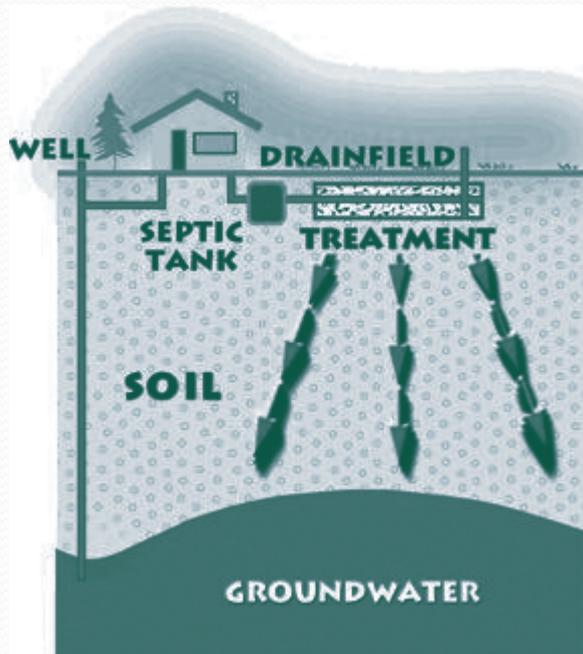
WHPA Delineation



Inventory of Contaminant Sources

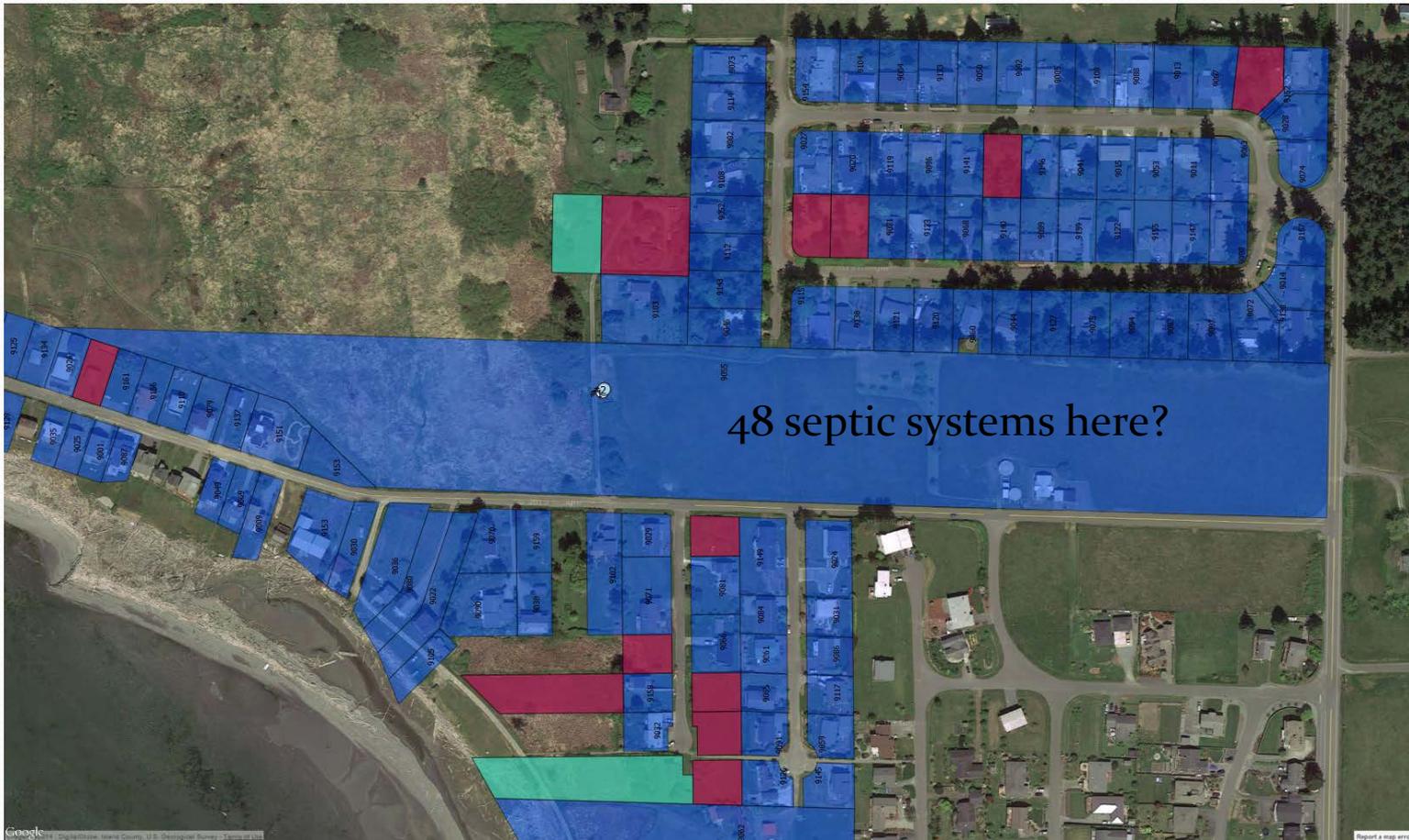
- EDR Summary Report
- None known within WHPA
- *Potential* sources
 - Septic tanks
 - Oil storage tanks
 - Seawater intrusion

Septic Tanks



- Potential development of hillside above well
- 48 additional septic systems?
- DOH tool for nitrate balance

Septic Tanks



Washington Department of Health

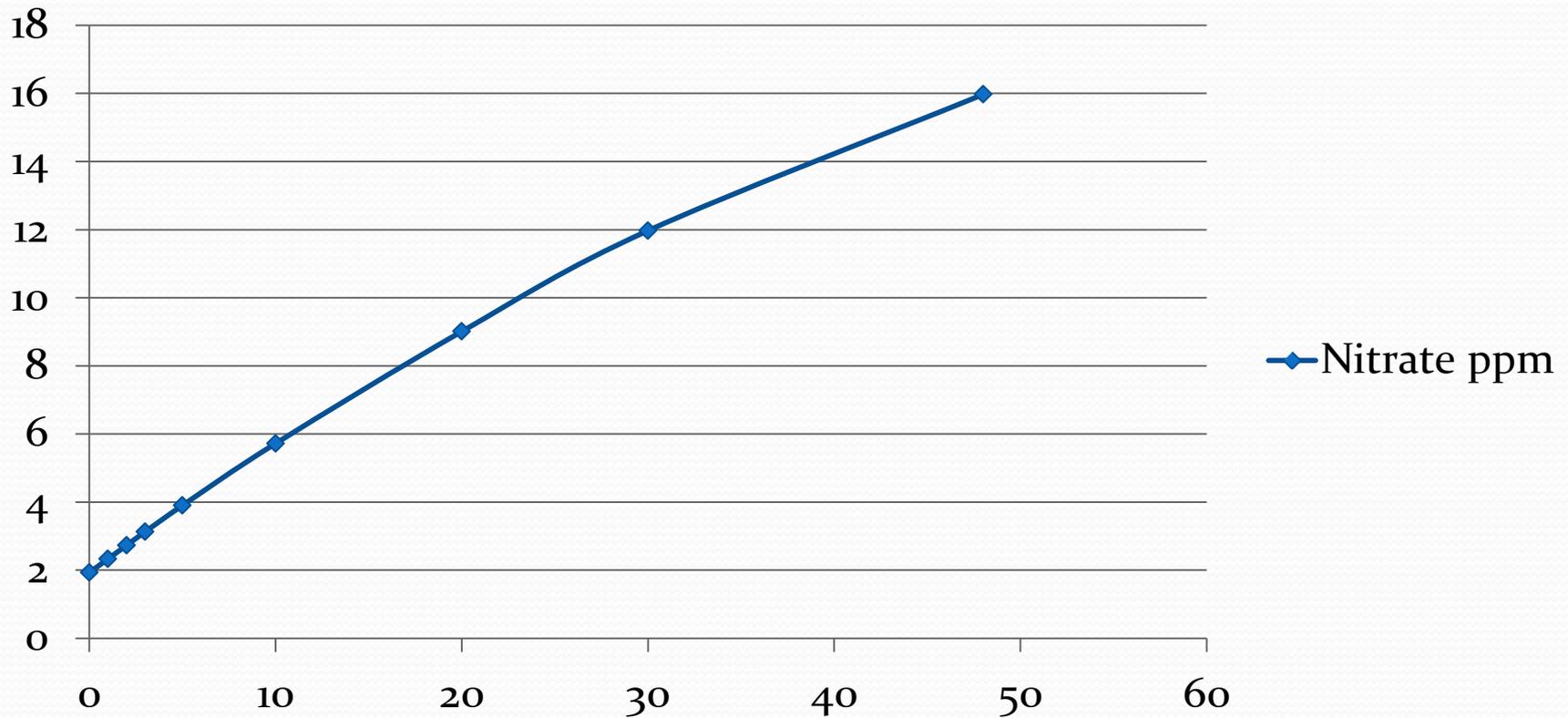
Level 1 Nitrate Balance for Large On-Site Sewage Systems

Effect of addition of 48 septic systems on hillside above wells

Input Values	Factor	Units	Values	Instructions	Information Source
Nitrate concentration in precipitation	N_R	mg/l as N	0.24	Default	Default
Total nitrogen concentration in wastewater	N_W	mg/l	60	Default - residential strength	Default
Soil denitrification	d	unitless	0.1	Default	Default
Aquifer thickness	b	ft	20	Default or aquifer thickness if known	WHP
Drainfield area	A_D	ft ²	385,000	Primary drainfield area	Lot width*length
Distance from drainfield to property boundary	D_{pb}	ft	100	Measure in direction of GW flow	Sanitary control area
Aquifer width	W_A	ft	275	Perpendicular to GW flow	Lot width
Aquifer hydraulic conductivity	K	ft/day	400	Measured or literature value	WHP (T/b)
Hydraulic gradient	i	ft/ft	0.002	If unknown, use 0.001	WHP
Recharge	R	in/yr	3.00	Recharge will be a % of ppt	USGS Recharge map
Nitrate concentration of upgradient ground water	N_B	mg/l	2	Prefer sampling data	Current background
Wastewater volume	V_W	gpd	12,960	Design flows or measured volume	lots*gpd/lot
Output Values					
Groundwater nitrate value	N_{GW}	mg/l as N	16.01	Point of Compliance (POC)	
Groundwater nitrate value	$N_{GW\ ALT}$	mg/l as N	15.97	Alternative POC	

Nitrate ppm vs Number of Septics

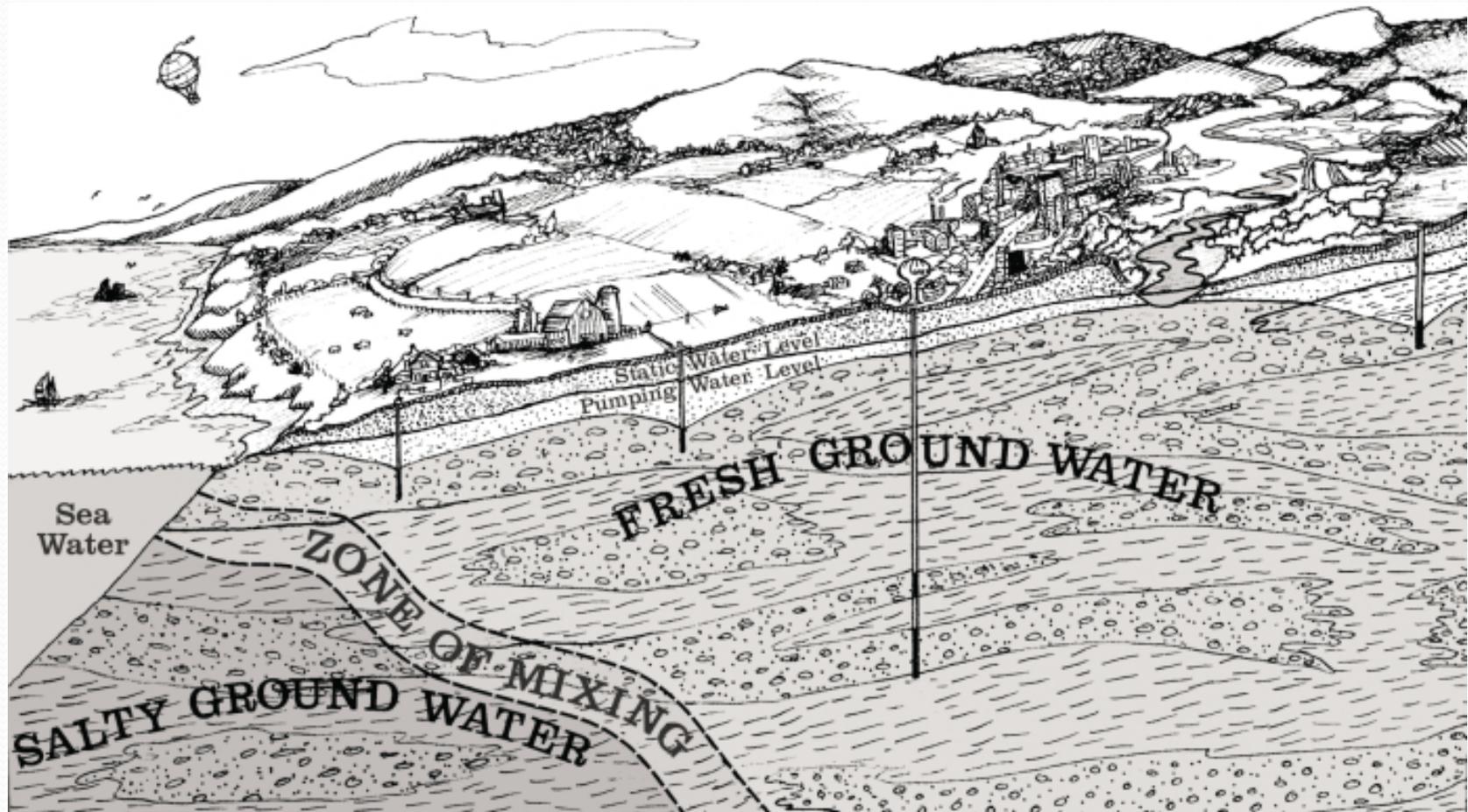
Nitrate ppm



Potential Development

- Installation of 48 septic tanks would raise nitrate to 16 ppm (currently 2 ppm)
- Limit is 10 ppm
- Increase of 2 ppm is a red flag
- Max number of new units to keep increase below 2 ppm is <5

Seawater Intrusion



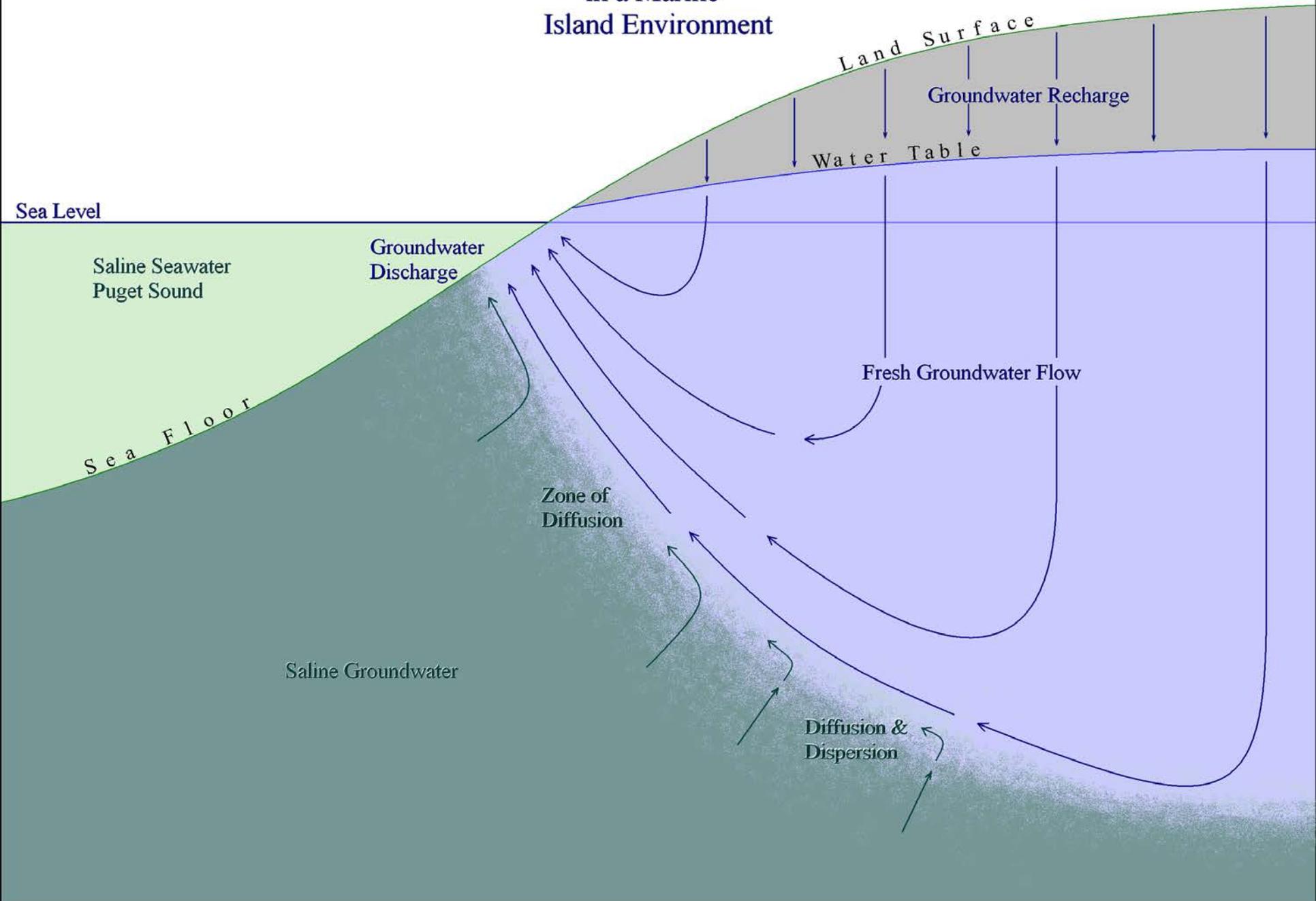
Seawater Intrusion



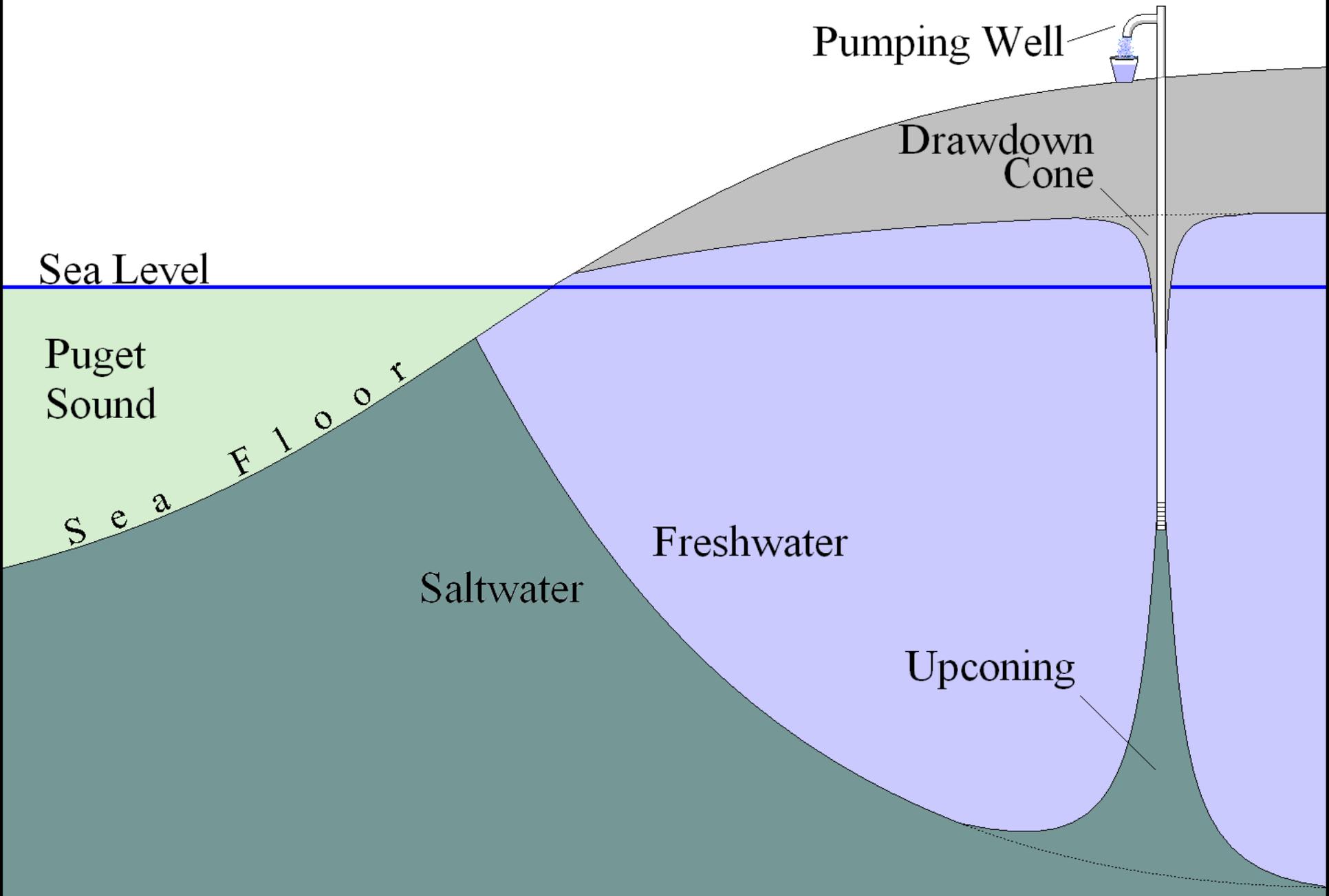
Seawater Intrusion Risk Factors

- Low elevation ~ 20 ft
- Screens are at or below sea level
- Drawdown cone goes below sea level
- 600 ft from salt water – separated by wet or low land
- Adjacent to wetland
- Chloride has increased from 5 to 10 ppm since 1990s
- DD #1 pumping project

Groundwater Flow in a Marine Island Environment



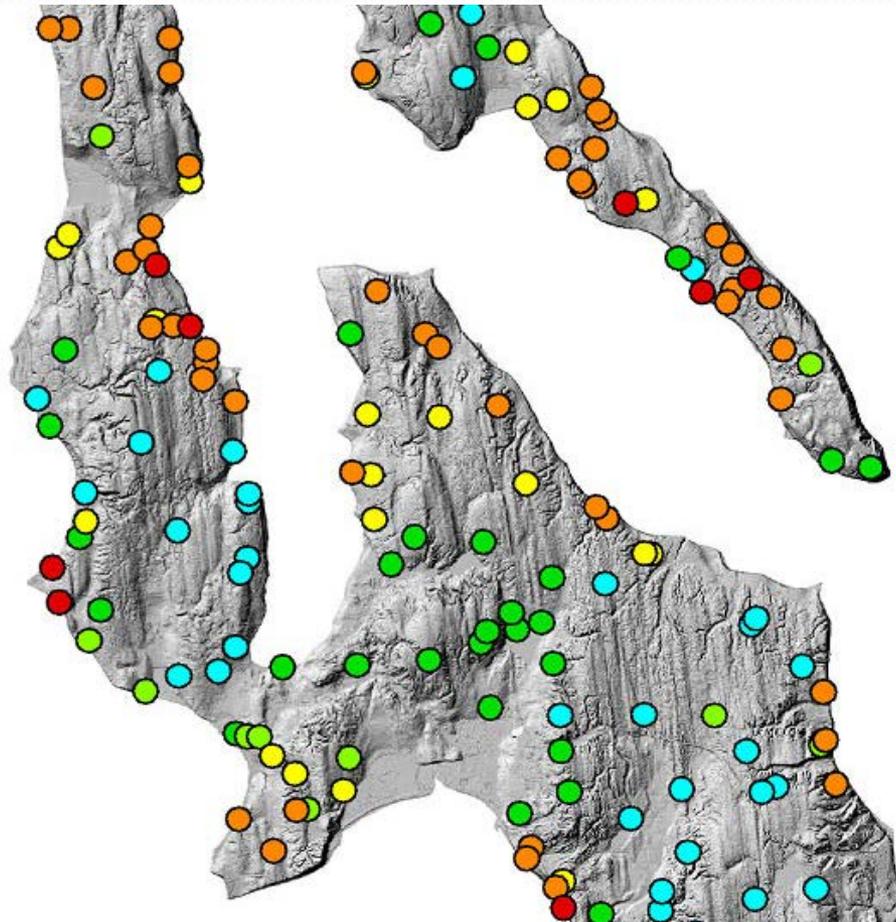
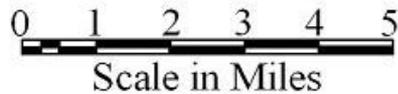
Drawdown and Upconing



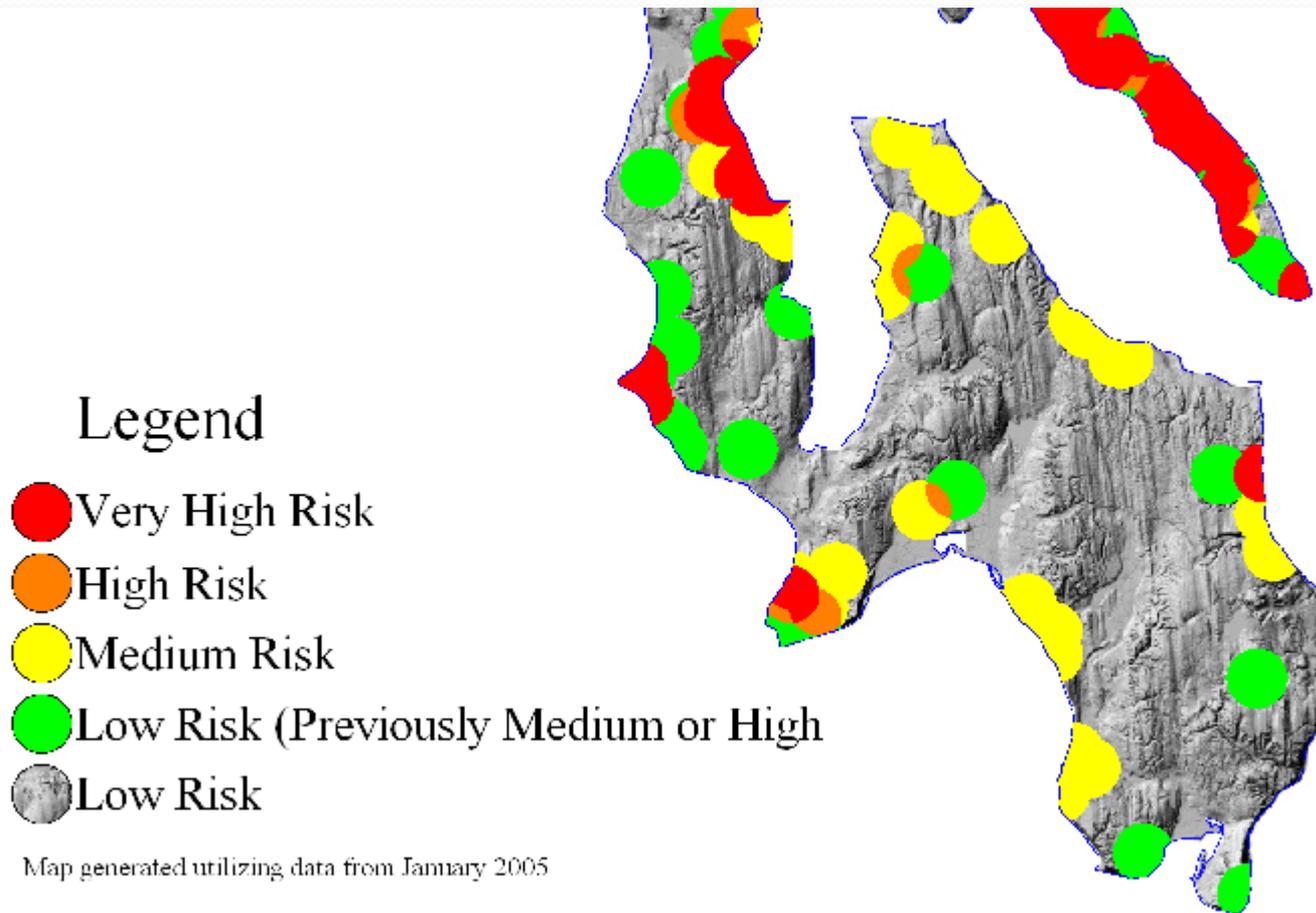
Water Level Elevation

Water Level Elevation

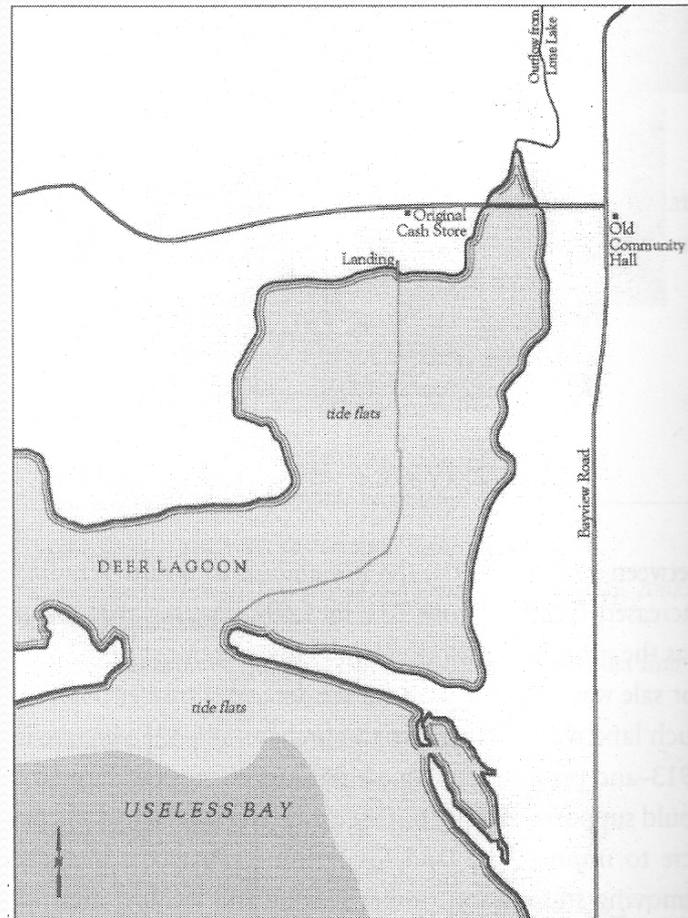
- Very High (> 20)
 - High (8 to 20)
 - Medium High (6 to 8)
 - Medium (4 to 6)
 - Low (1 to 4)
 - Very Low (< 1)
- Feet Above Mean Tide*



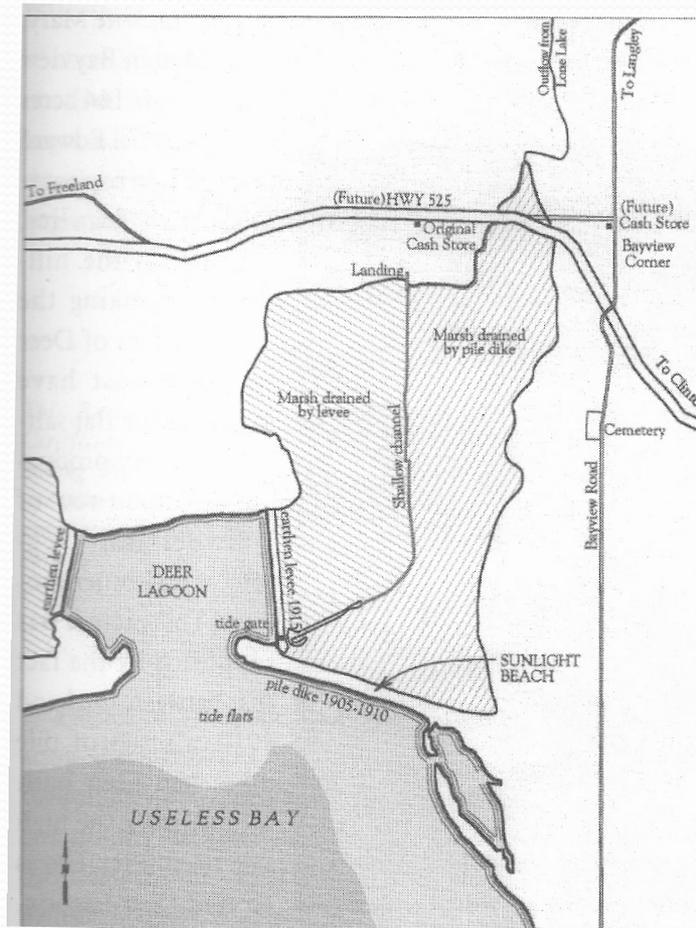
Revised Seawater Intrusion Policy 'Circle Map'



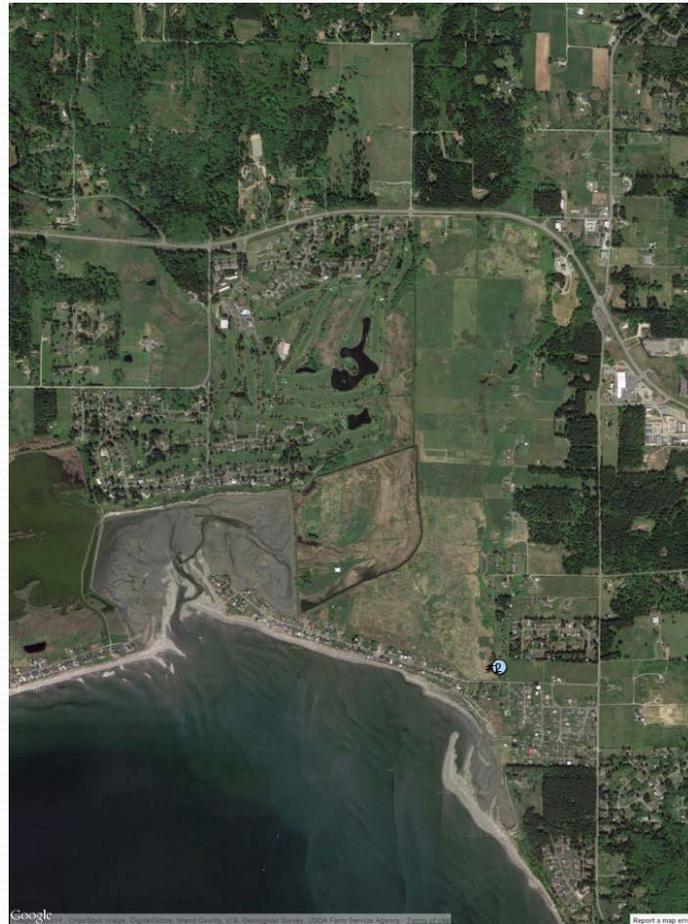
Diking District #1 1900



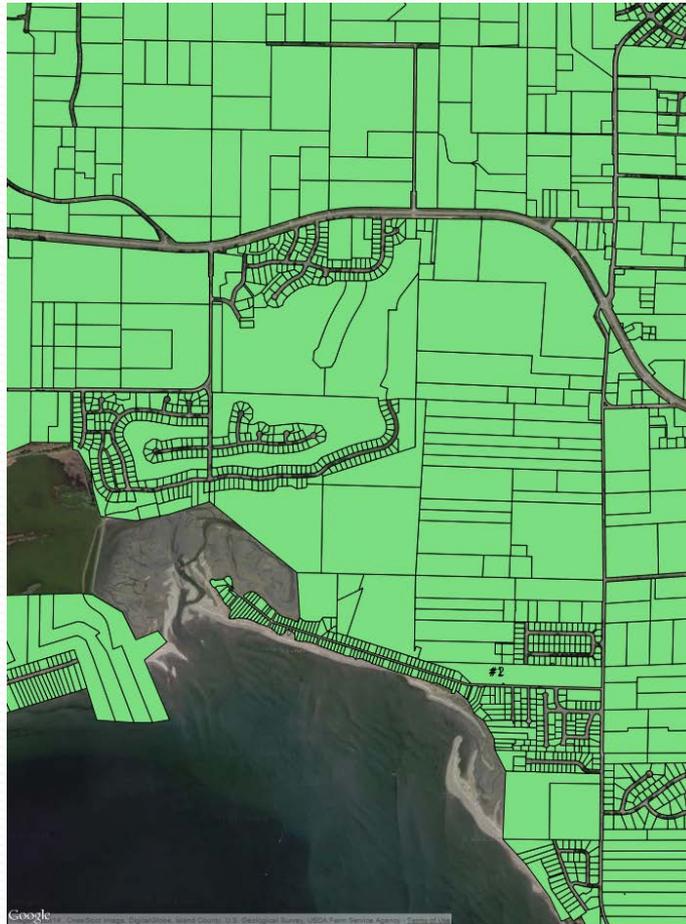
Diking District #1 1915



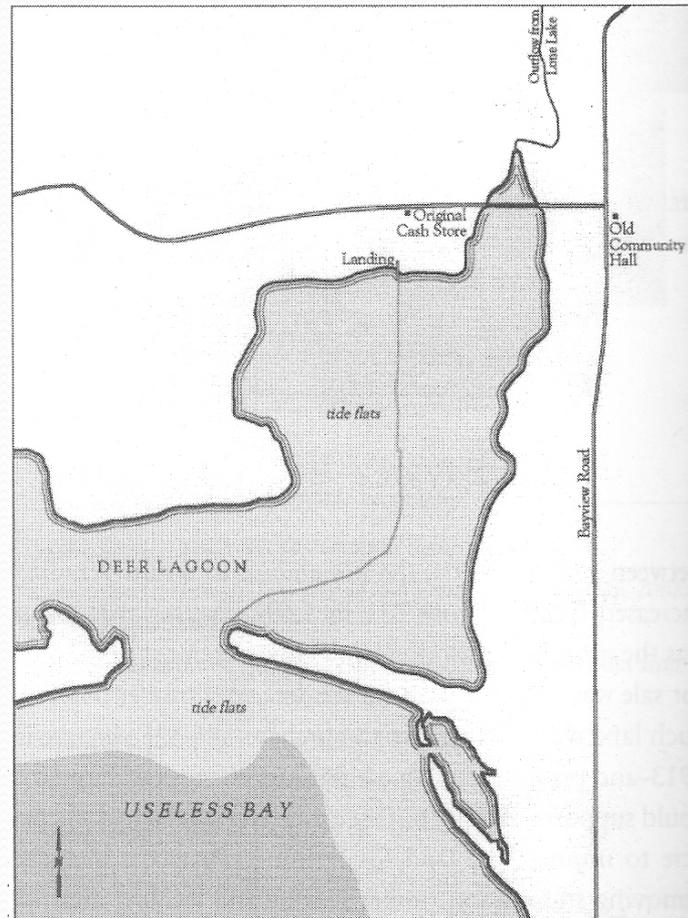
Diking District #1 2014



Diking District #1 20???



Diking District #1 1900



DD #1 Pumping Project

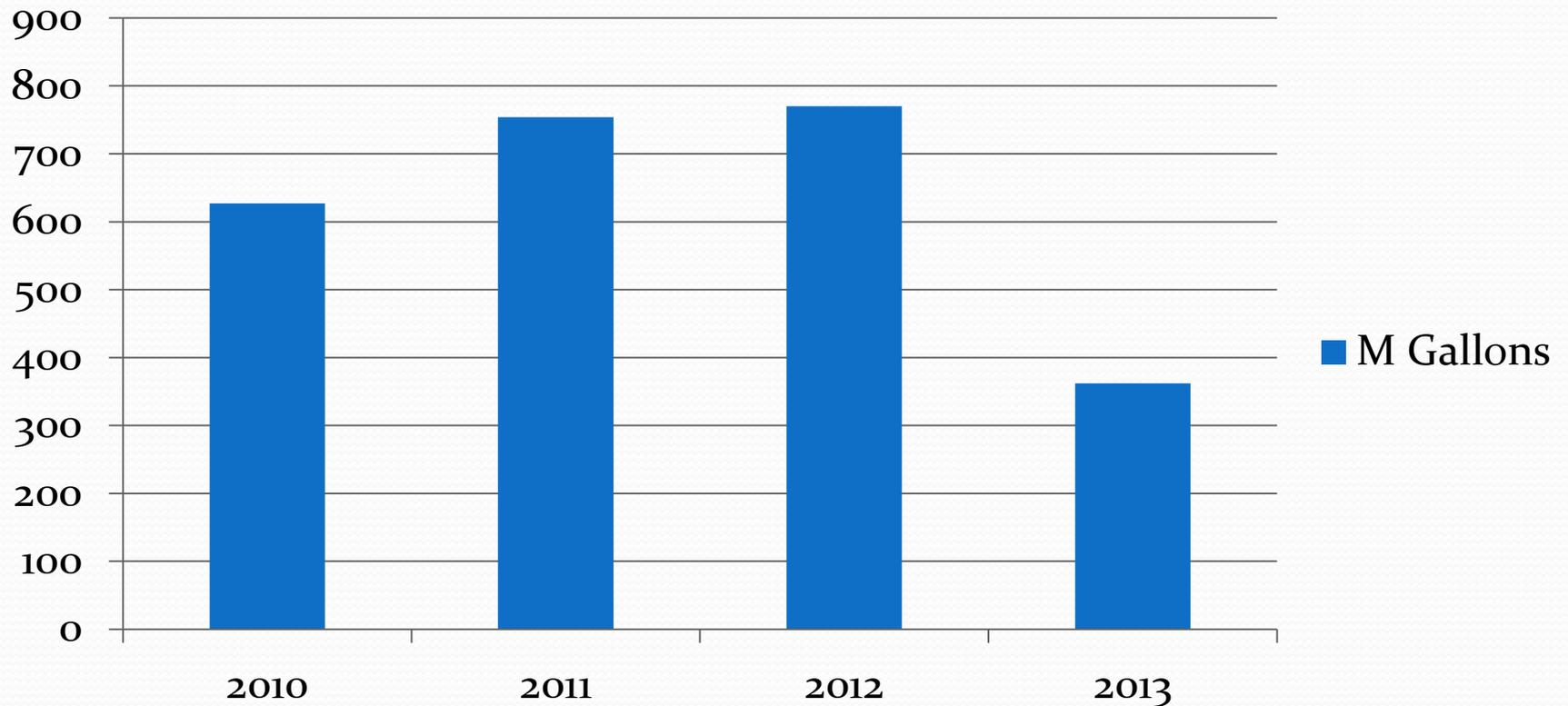


DD #1 Pumping Project

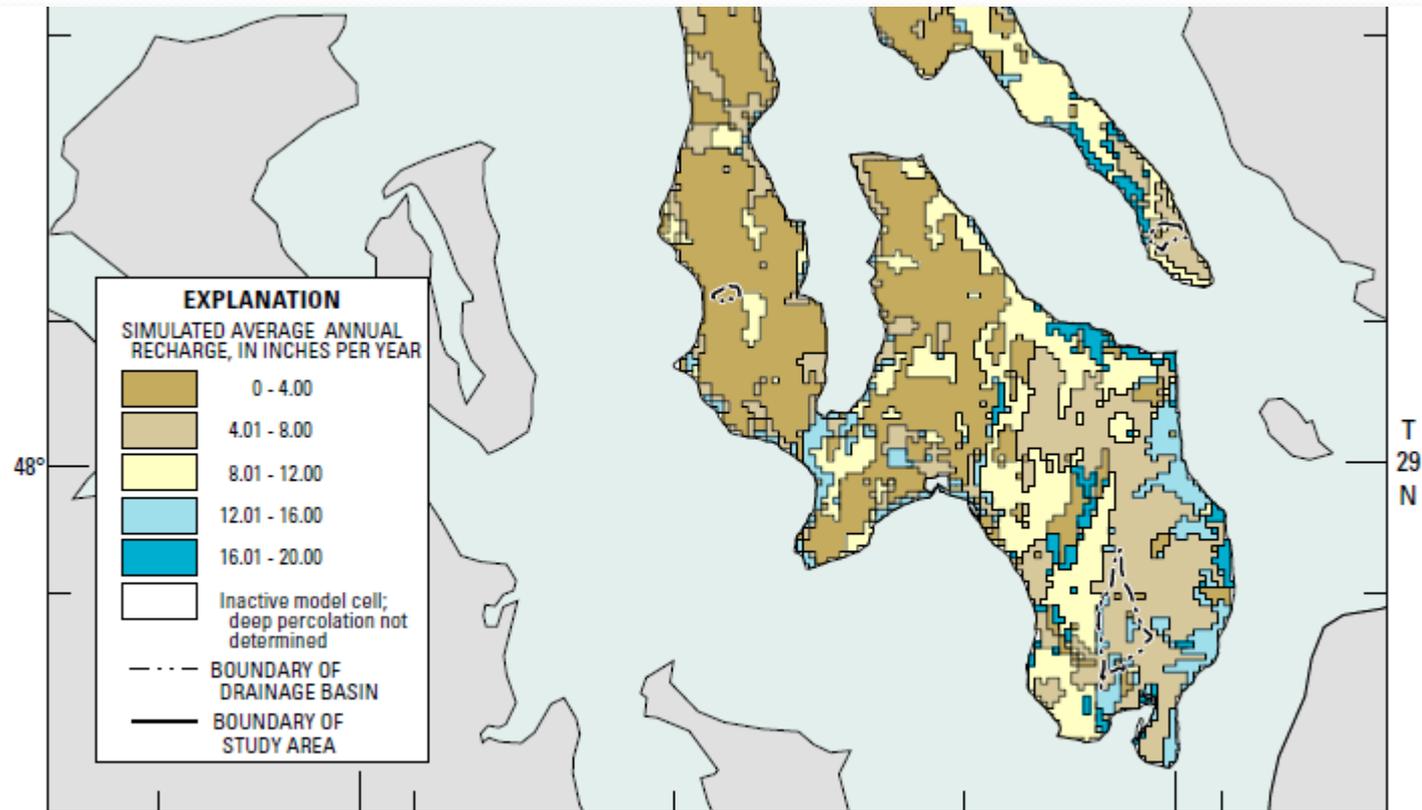


DD #1 Pumping Volumes

M Gallons



Groundwater Recharge

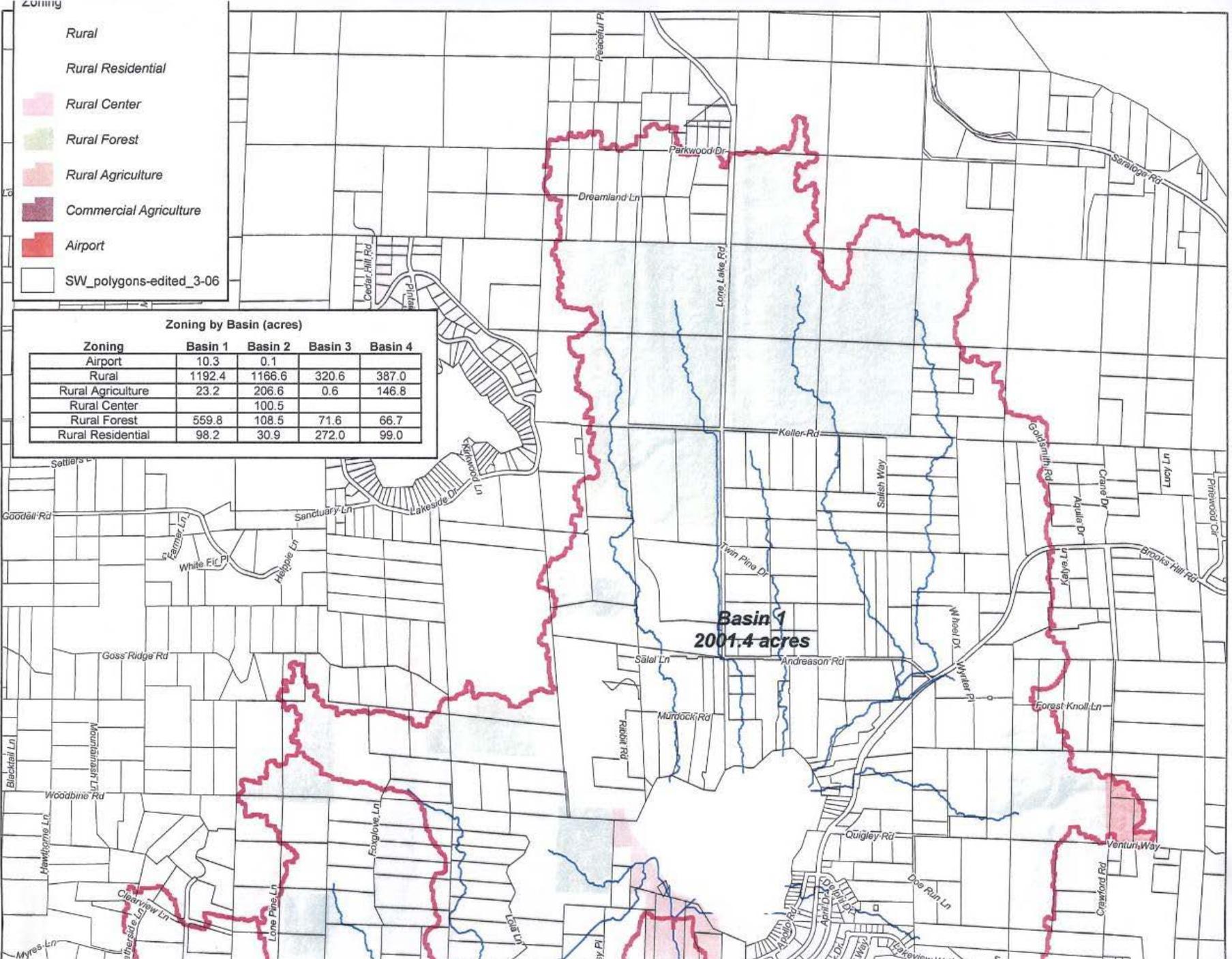


Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972
Universal Transverse Mercator projection, Zone 10

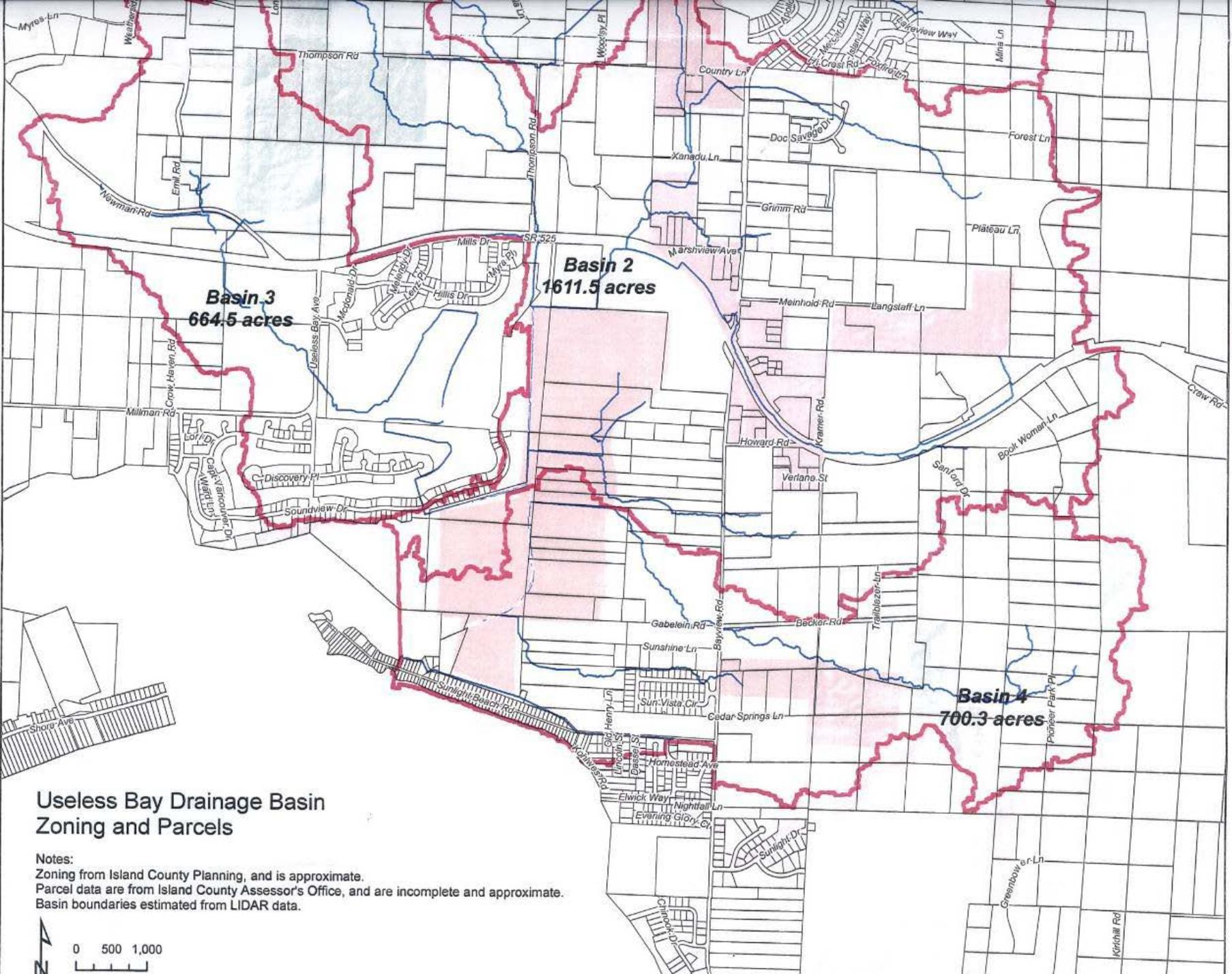
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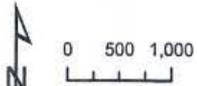
Basin 3
664.5 acres

Basin 2
1611.5 acres

Basin 4
700.3 acres

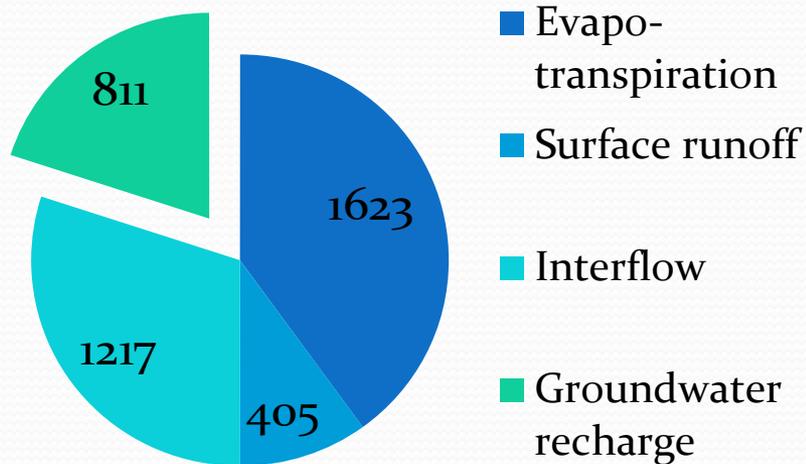
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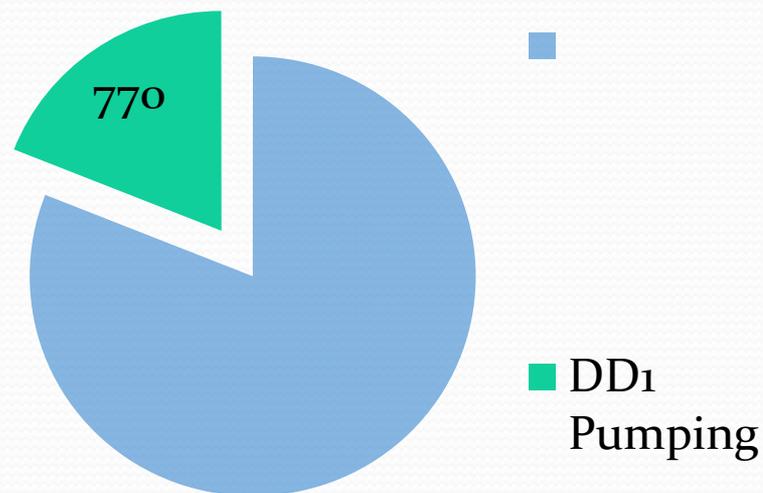


Rainwater Disposition

Disposition, M Gallons

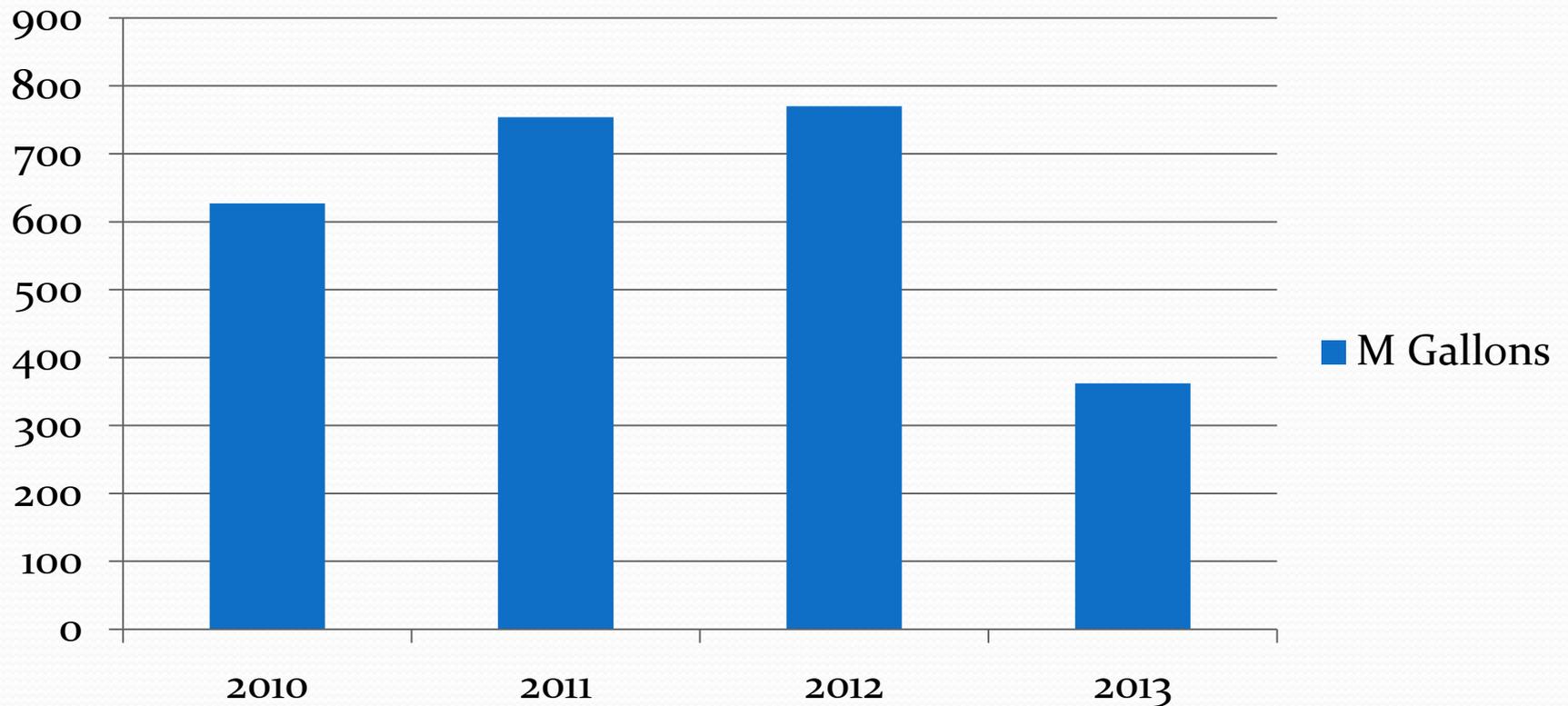


Pumping, M Gallons



DD #1 Pumping Volumes

M Gallons

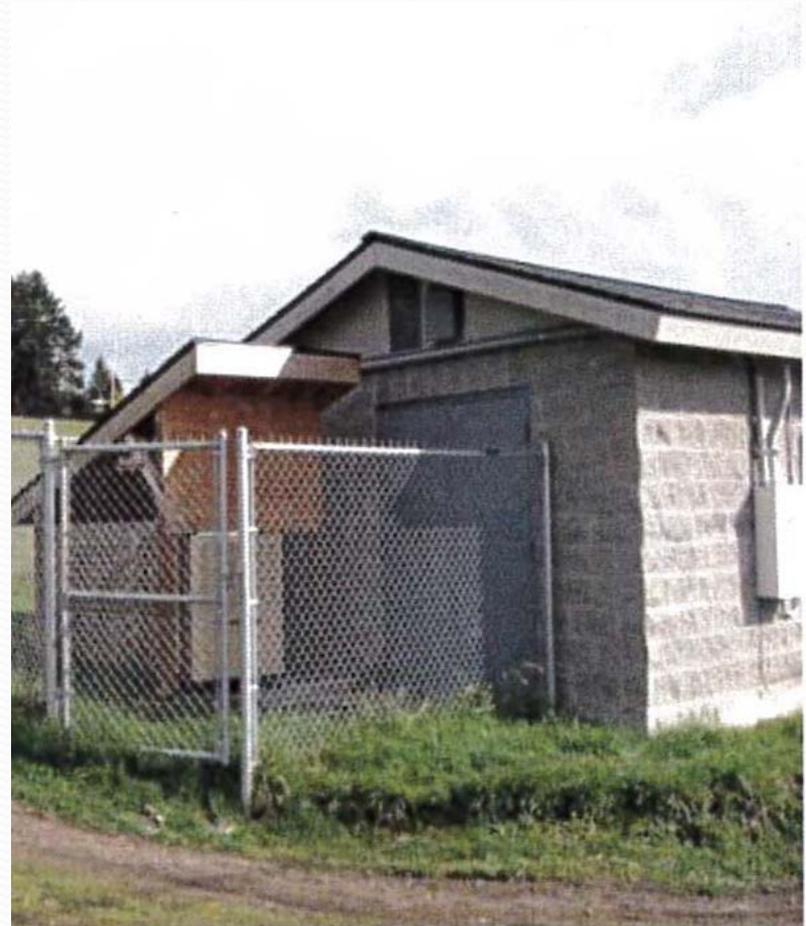


Seawater Intrusion

- Not a current threat, but we cannot afford to be complacent
- Wetland dewatering by DD#1 has the potential to reduce wetland water level below sea level, opening the risk of seawater intrusion
- New operating plan maintains wetland ecology and reduces threat to wells
- Need for ongoing vigilance
- DD #1 has been copied on WHP document

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Observations

- Preparation of a Wellhead Protection Program is a significant burden for a small water system
- The Wellhead Protection Program is an essential tool in identifying current and potential threats
- We are looking forward to continuing support from regulatory agencies at local, State and County levels

Wellhead Protection

John Lovie

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