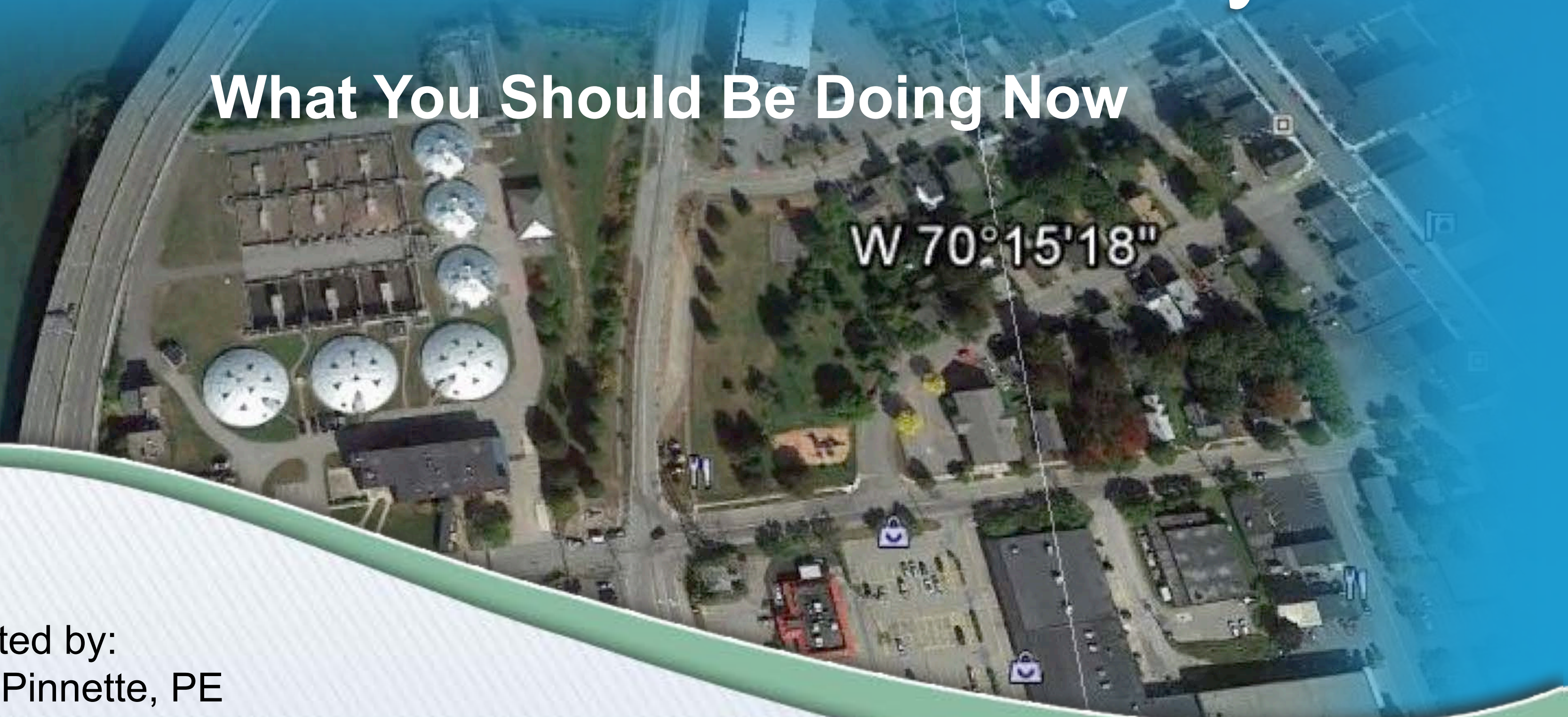
Planning for Climate Change at Your Wastewater Treatment Facility

What You Should Be Doing Now



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WRIGHT-PIERCE
Engineering a Better Environment

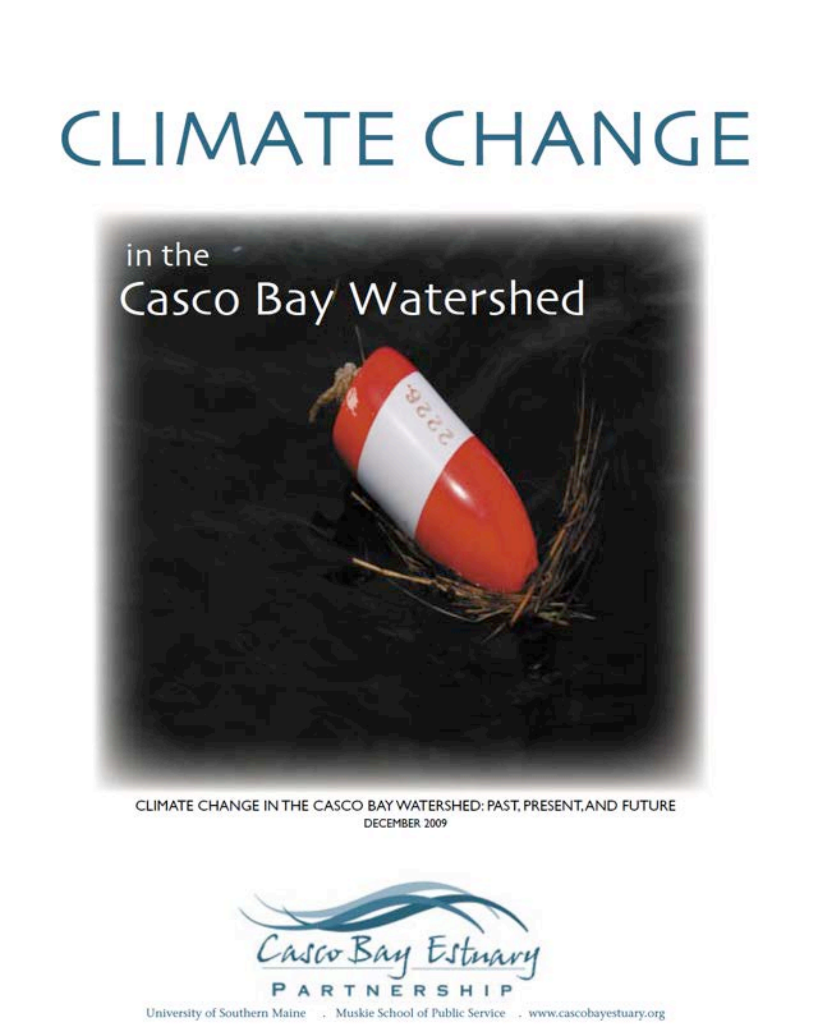
Facility Plan Update – South Portland WWTF

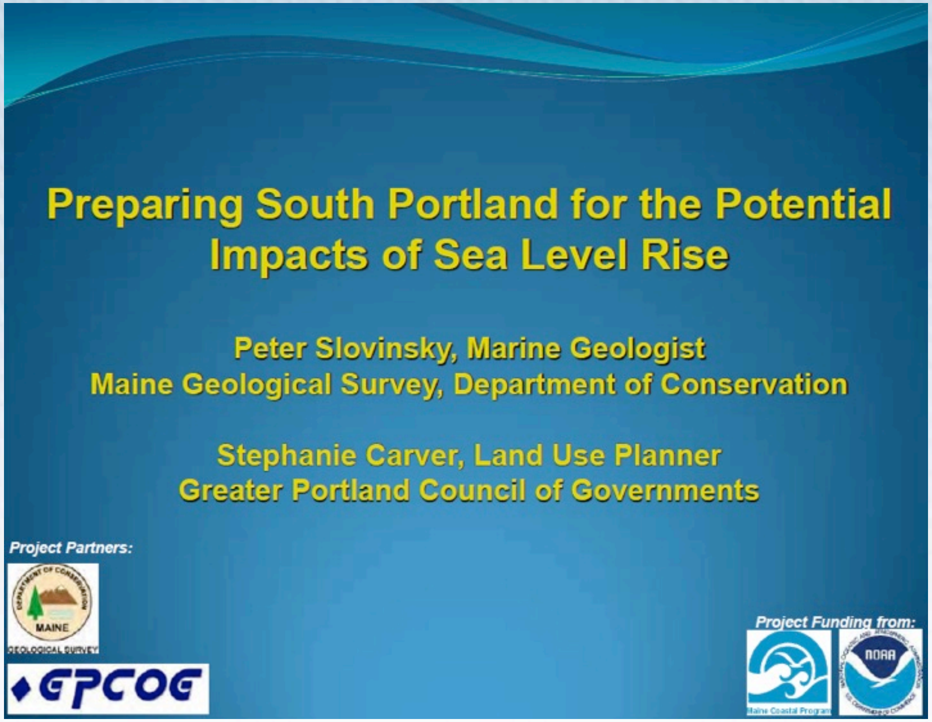
- Assess equipment replacement needs over 20-year planning period – asset management
- Evaluate strategic process improvements to enhance overall facility performance
  - Grit removal
  - Screening
  - Dewatering
- Analyze longer term concerns
  - Potential future discharge parameters/limits - nitrogen
  - Climate change

Potential Climate Change Impacts

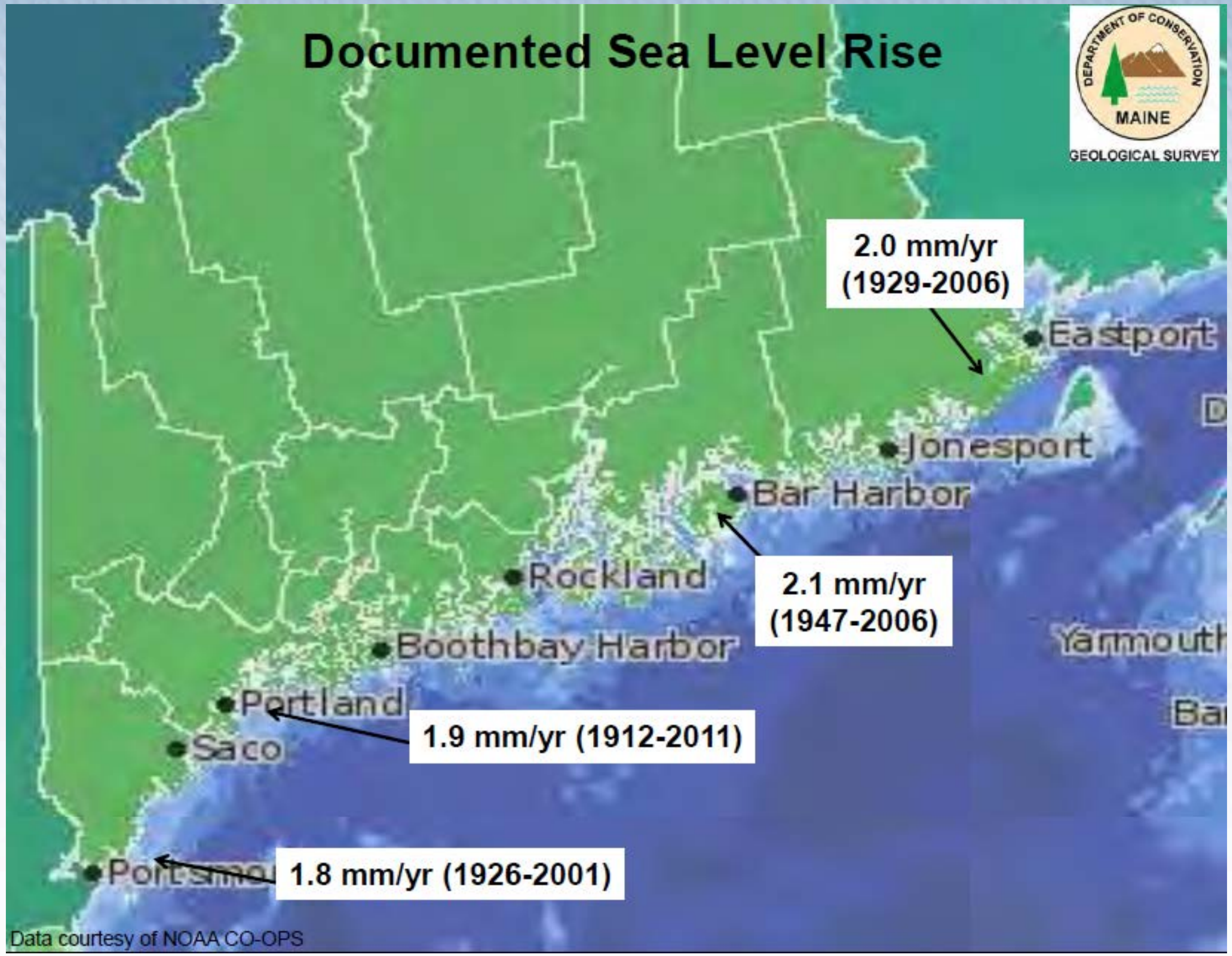
- Sea level rise
- Increasing storm intensities
- Increasing air temperatures
- Increasing wastewater temperatures

Key References for Climate Change Impacts

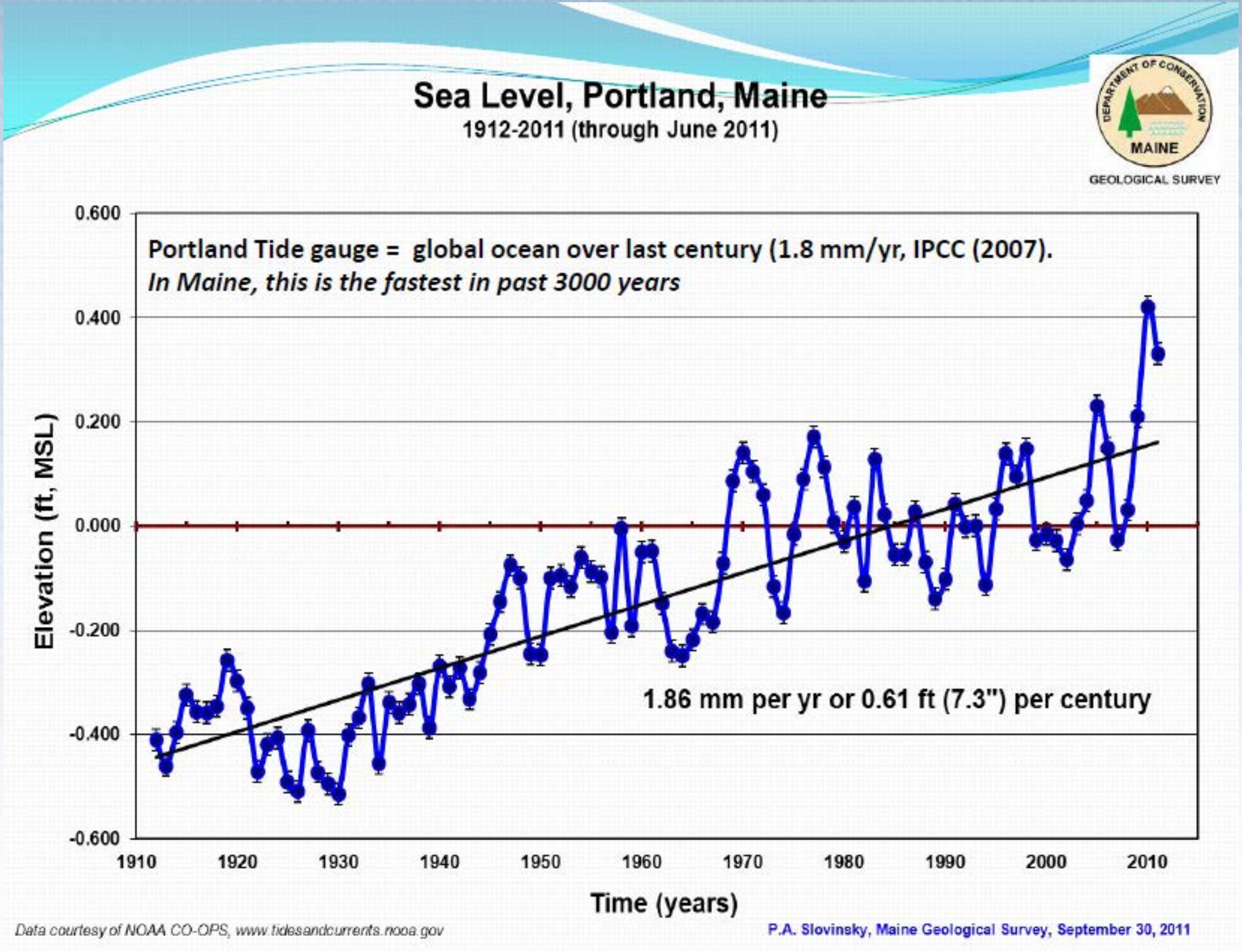




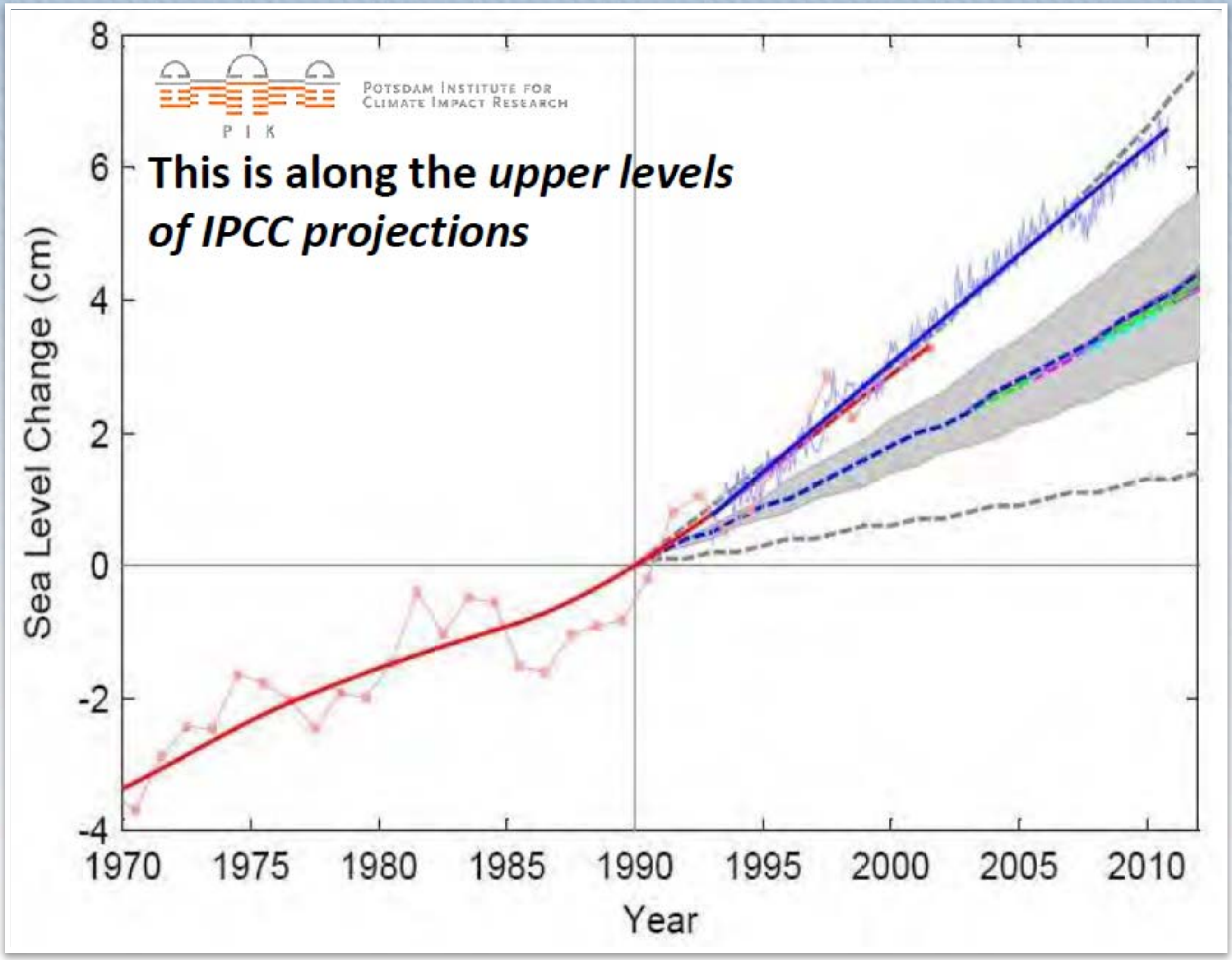
Sea Level
Rose 0.7’ in Past Century



Portland Tide Gauge

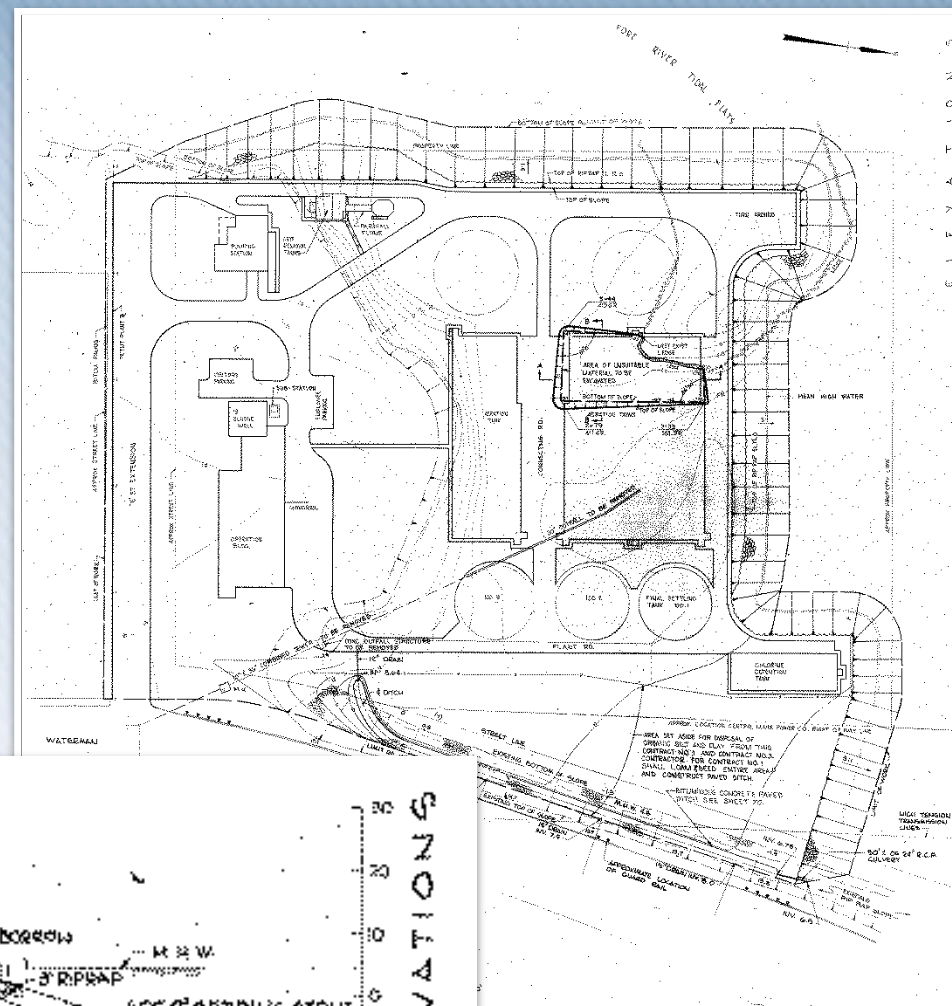


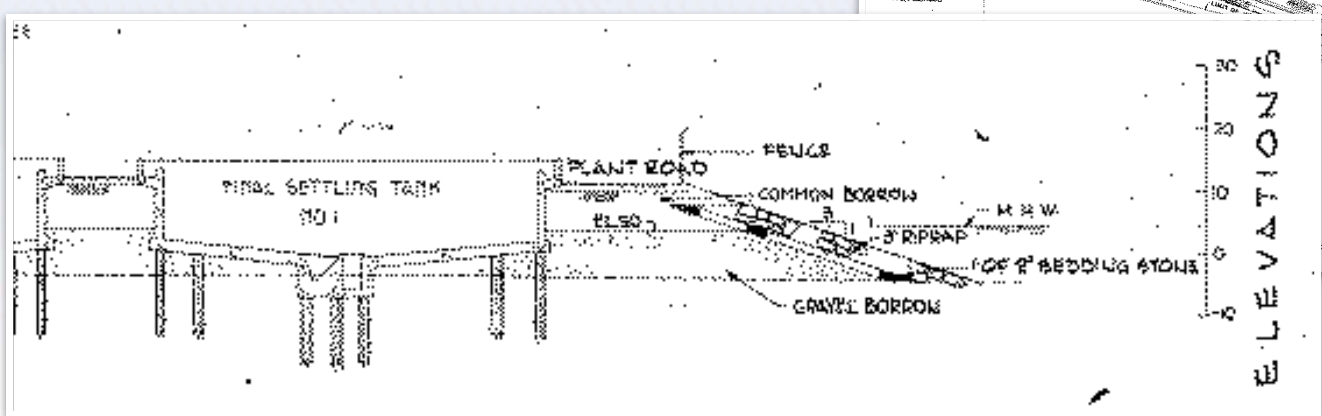
Actual Data
Consistent with Worse Case Scenario



Background

- Original WWTF operational in 1979
- Constructed partially in mud flats





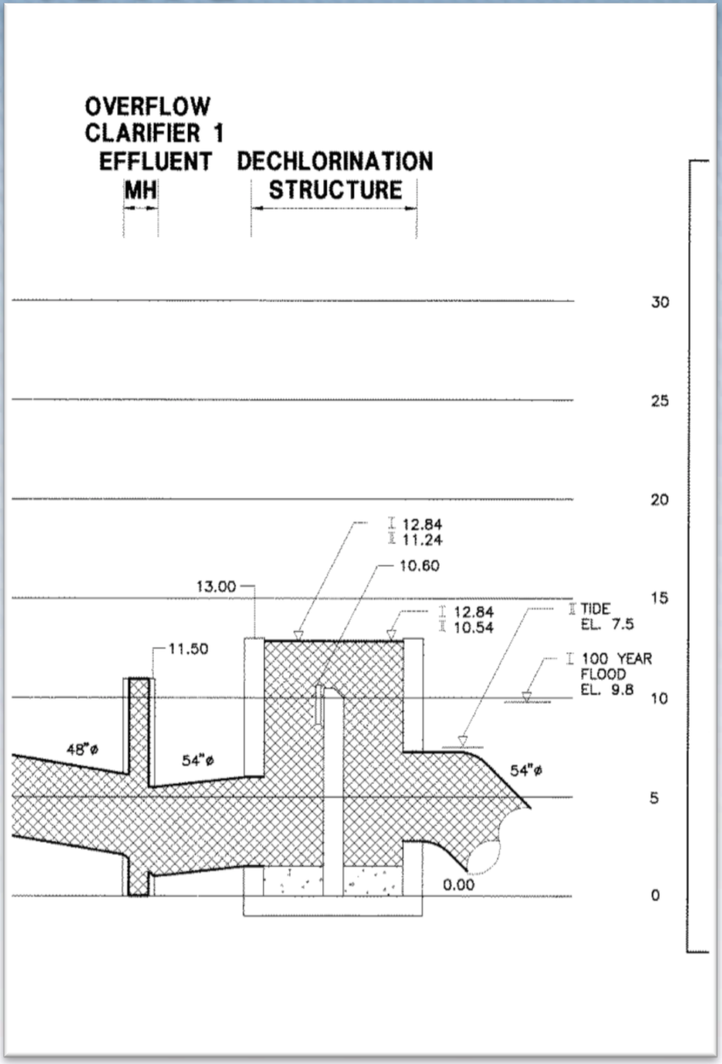
Background

- Wet weather flows
  - 1990 Consent Decree to increase peak secondary capacity
  - CSO long-term control plan
    - first, maximize flows to WWTF
    - second, separate combined sewers
  - 1995 upgrade to WWTF
    - converted existing secondary clarifiers to wet weather treatment
    - constructed new larger secondary clarifier for main WWTF

Current
South Portland WWTF

Current Design Peak Flows

- Main WWTF – 22.9 MGD
- Wet Weather – 33.1 MGD
- Total – 56.0 MGD



Current Flows

Condition	Main WWTF	Wet Weather Treatment	Total Flow
Average	**6.6**	**0.13**	**6.7**
Max Monthly	**13.5**	**1.7**	**14.6**
Peak Daily	**24.4**	**18.4**	**40.6**
Peak Hourly	**31.2**	**33.1**	**~56.0[a]**

a. peak flows typically not concurrent

- Wet weather flows are decreasing due to combined sewer separation
- May increase in future due to:
  - higher groundwater levels due to sea level rise
  - more intense storms due to climate change

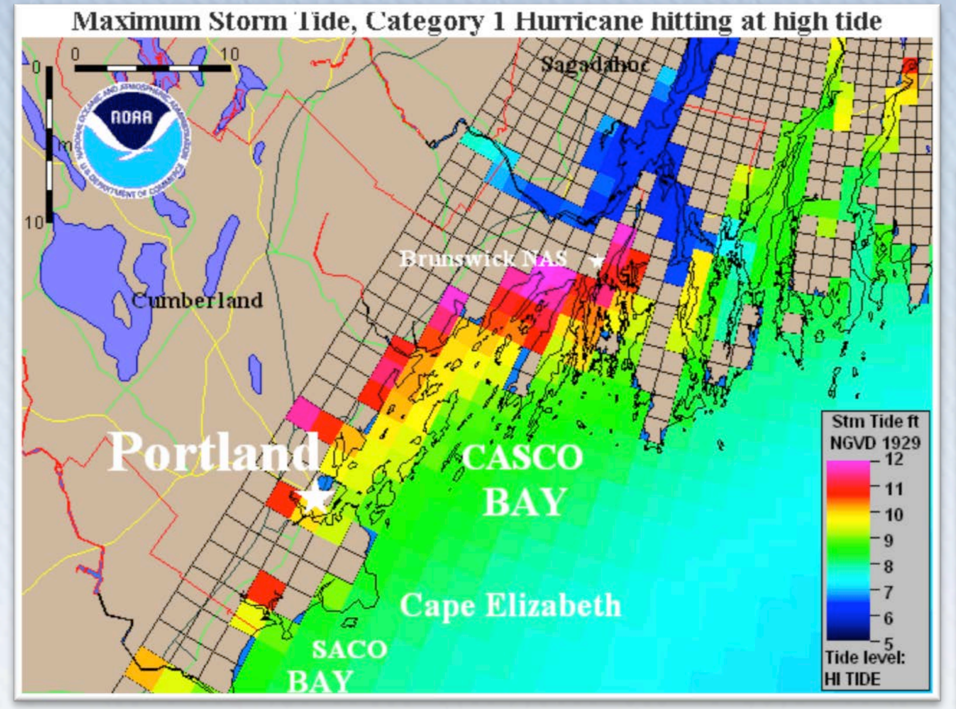
Projected 100-Year Flood Elevation – NAVD 1988

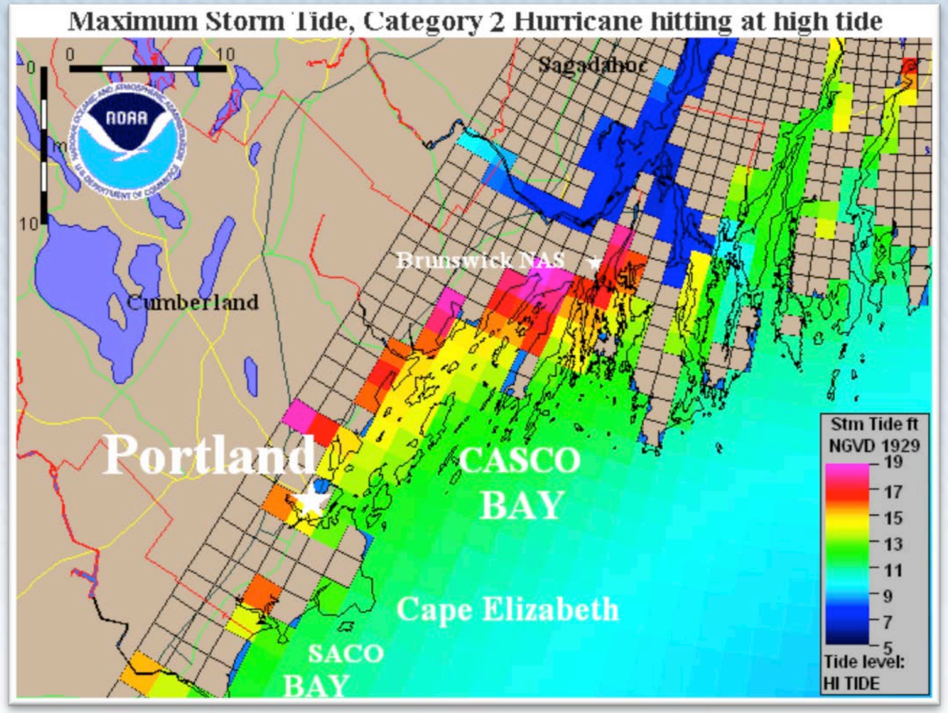
Scenario	Lower		Higher	
Year	2050	2100	2050	2100
Crust subsidence	0.024	0.043	0.024	0.043
Regional dynamic	NE	0.52	NE	0.79
Global eustatic	0.66	1.6	1.4	4.6
Total estimated sea level rise	0.68	2.17	1.42	5.43
Current (1998) FEMA 100-year flood w/storm surge	8.9	8.9	8.9	8.9
Future 100-year flood w/storm surge	9.5	11.1	10.3	14.3

Storm Surge vs. Typical Tidal Range

Item	Acronym	NAVD 1988
Highest observed water level w/storm surge (measured)	HOWL	8.87
Highest astronomical tide (predicted)	HAT	6.69
Mean higher-high water (measured)	MHHW	4.65
Mean high water (measured)	MHW	4.21
North American Vertical Datum of 1988	NAVD88	0.00
Mean diurnal tide level = (MHHW +MLLW)/2	DTL	-0.30
Mean sea level (DTL+MTL)/2	MSL	-0.32
Mean tide level = (MHW+MLW)/2	MTL	-0.35

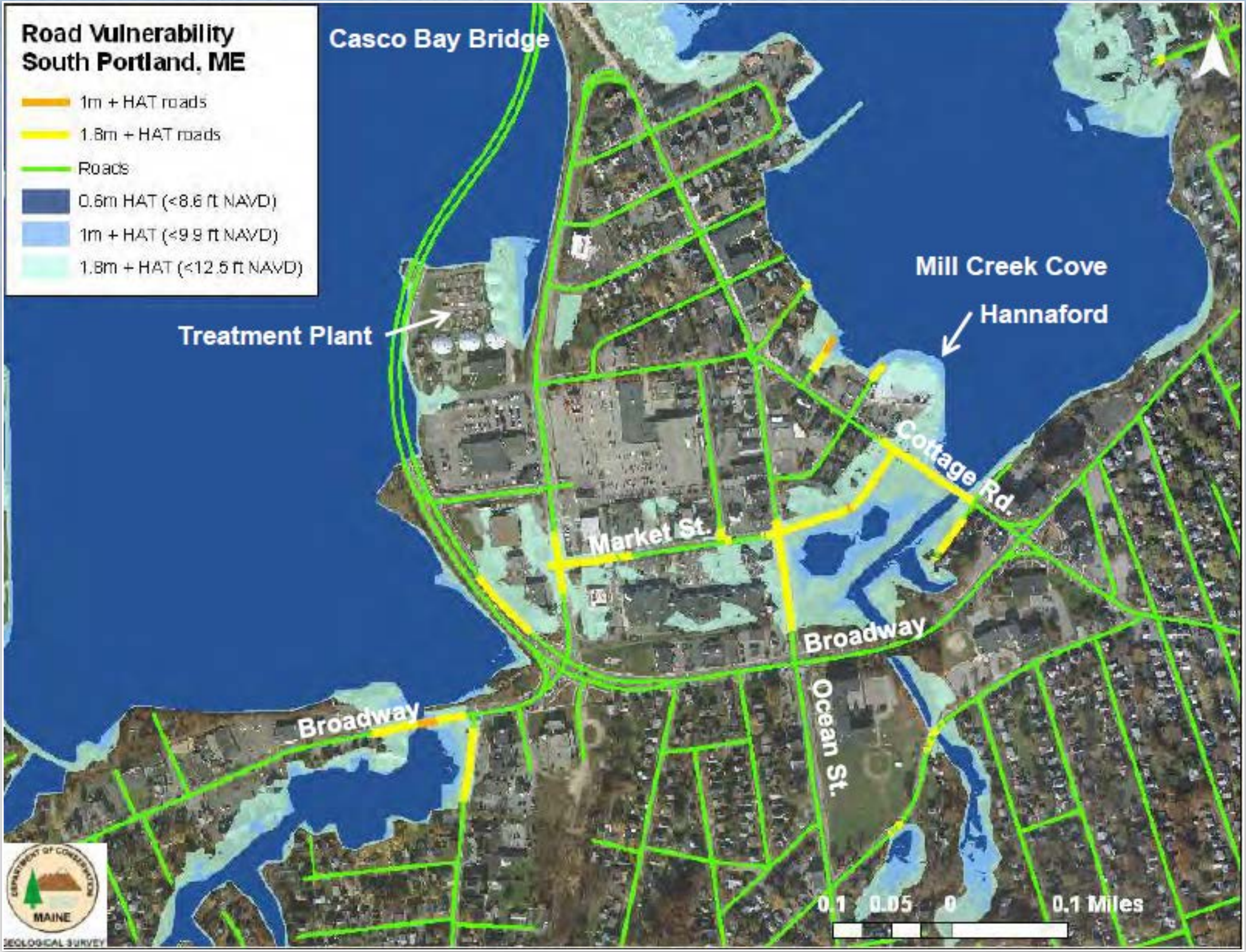
Predicted Storm Surge – Level 1 vs. 2





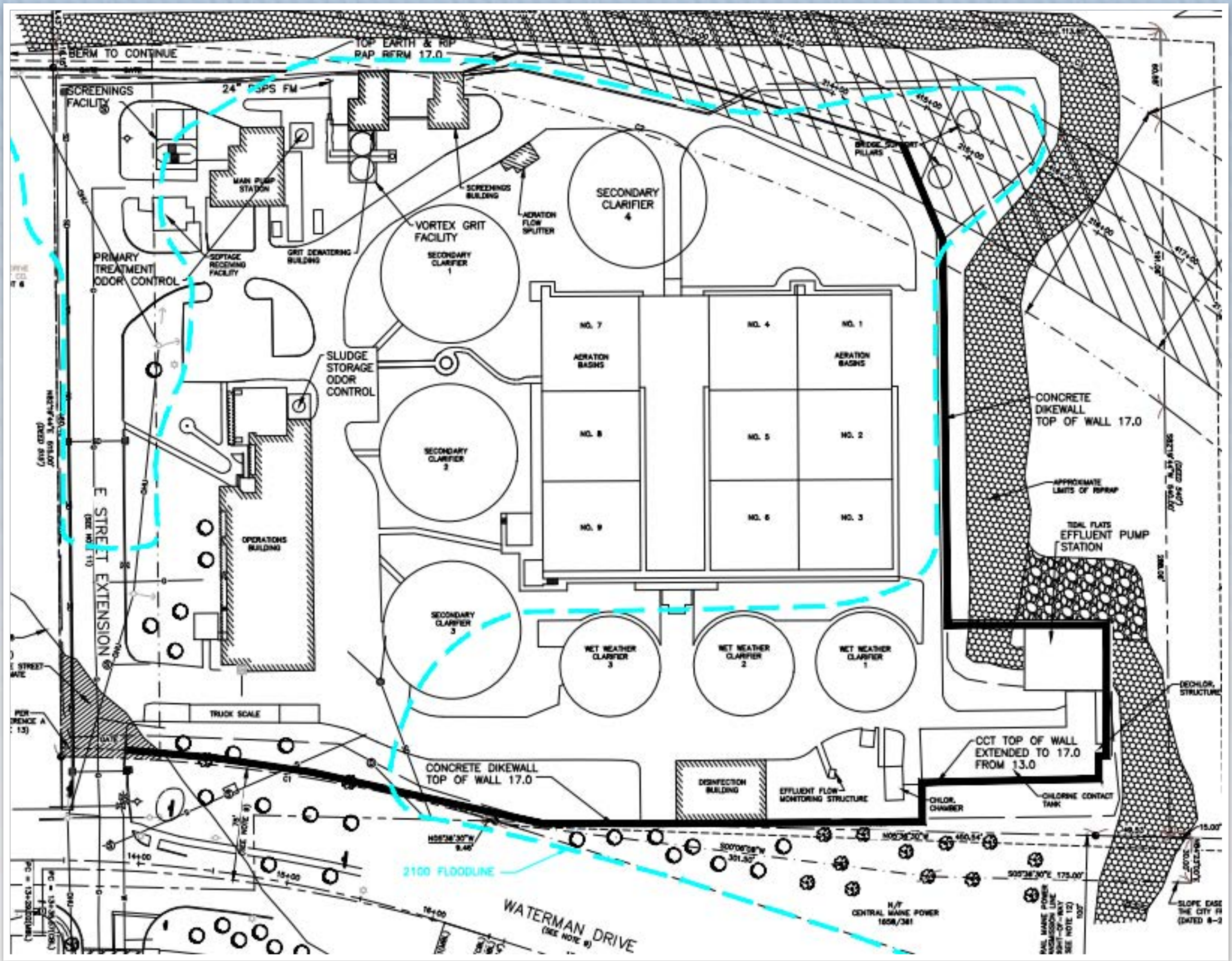
Current Conditions

Future
Sea Level Rise – Year 2100



Future
Sea Level Rise w/100-Year Storm Surge

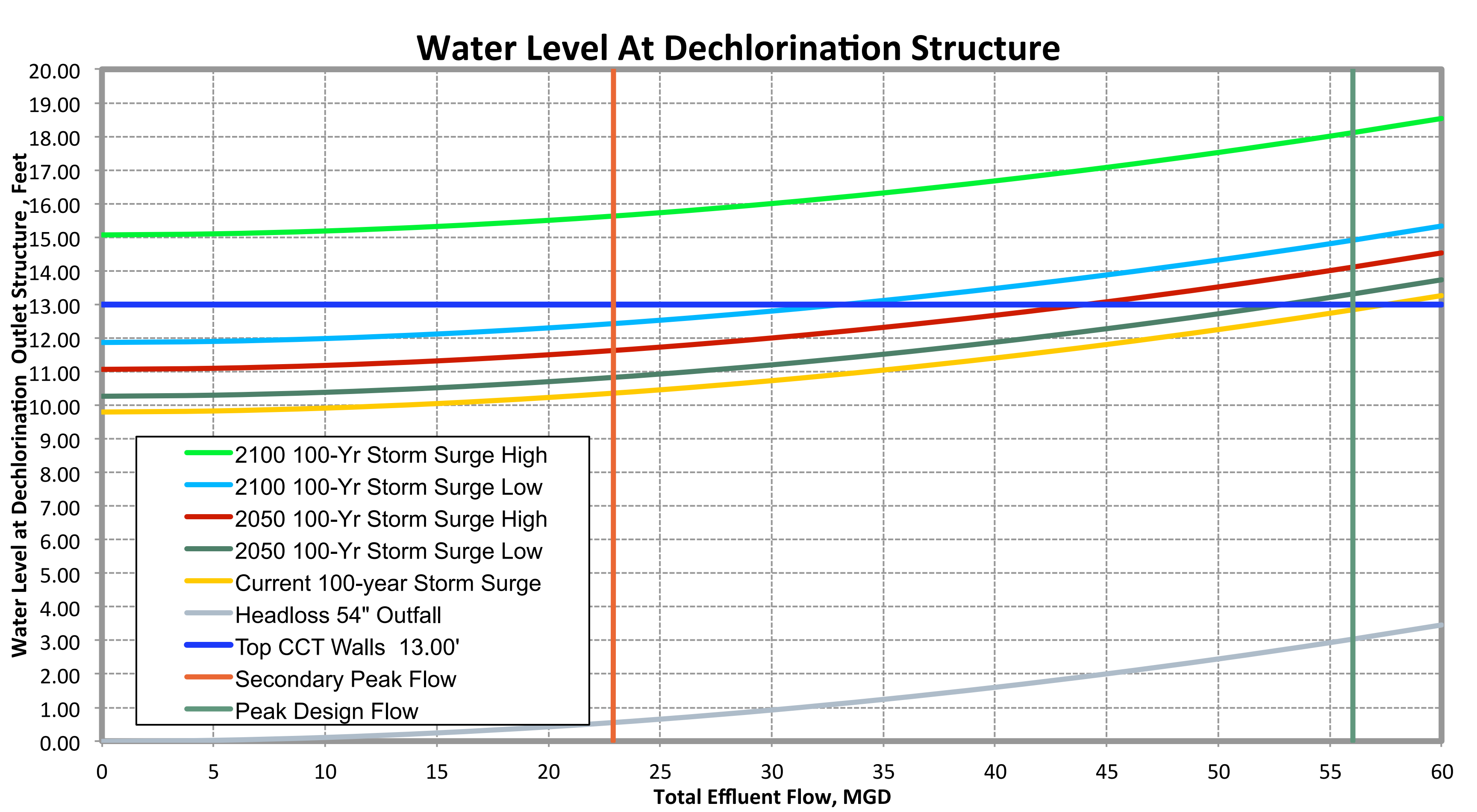
2100 Higher Scenario w/100 Year Storm Surge



Impacts of Sea Level Rise at WWTF

- Building Impacts
  - 2050 – limited flooding of grounds
  - 2100 – overtop ground floor of chlorination building and top of chlorine contact tank
- Hydraulic Impacts
  - Peak capacity with gravity flow decreases over time

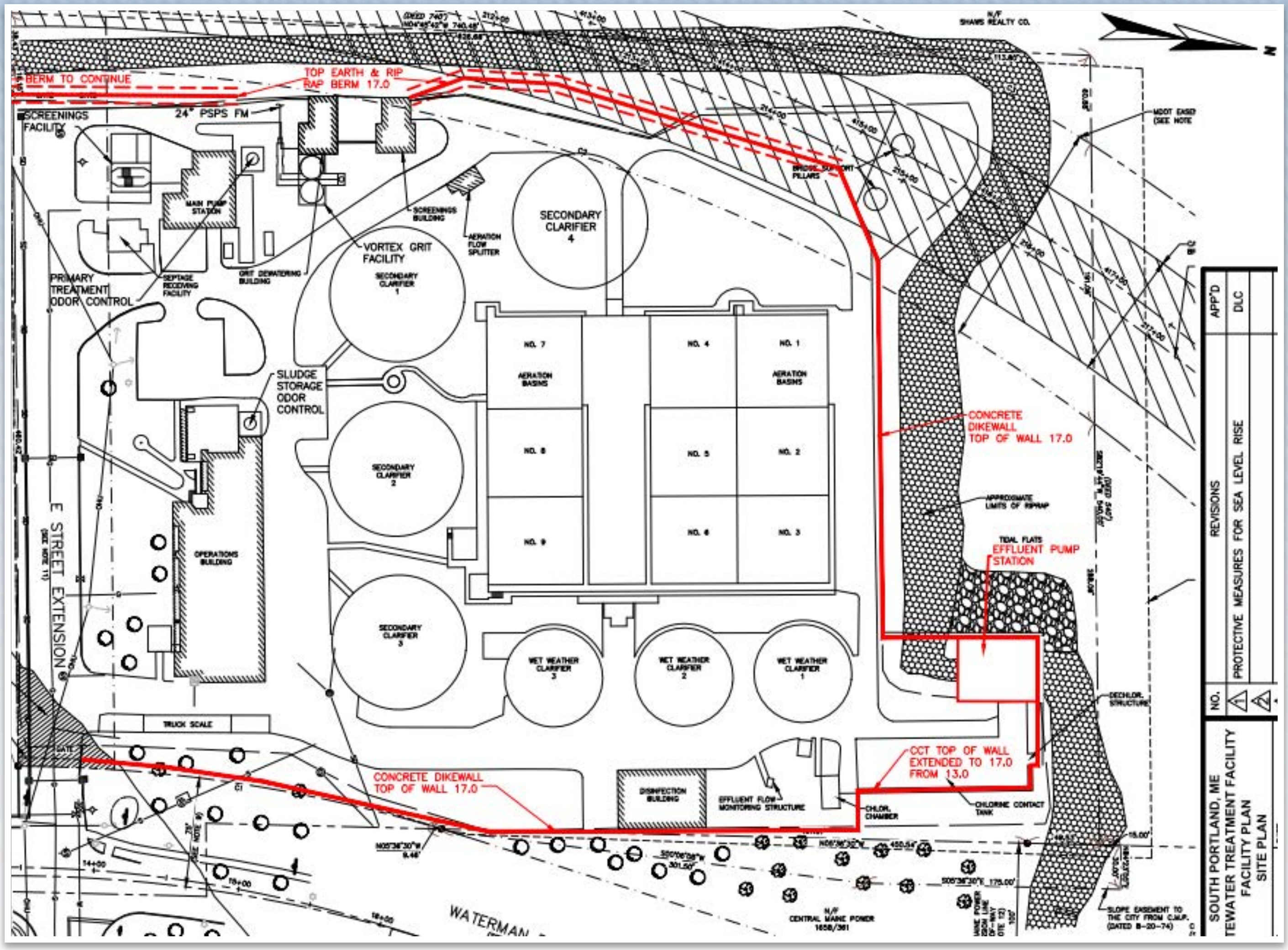
Gravity Flow Limitations with Sea Level Rise



Measures to Address Sea Level Rise at South Portland WTF

- Effluent pumping – 56 MGD capacity
  - potentially raise CCT walls to delay effluent pumping
- Protective berm
  - site is suitable for berm/dike at elevation 16.0 – NAVD88
  - provide ~ 1.7 feet of freeboard at 2100 high scenario with 100-year storm surge
  - also revisions to on-site storm drainage – prevent flooding from within – and direct to effluent pumping

Proposed Dike and Effluent Pump Station



Implementation

- Capital cost
  - Protective berm ~$1,000,000
  - Effluent pump station ~$15,000,000
- Timing
  - Depends on actual rate of sea level rise
  - Likely 20 to 35 year time horizon

Rising
Air and Water Temperatures

Rising Air Temperature

- Requires greater aeration capacity for fine bubble diffused aeration system
- Not an immediate concern at South Portland WWTF due to excess aeration capacity

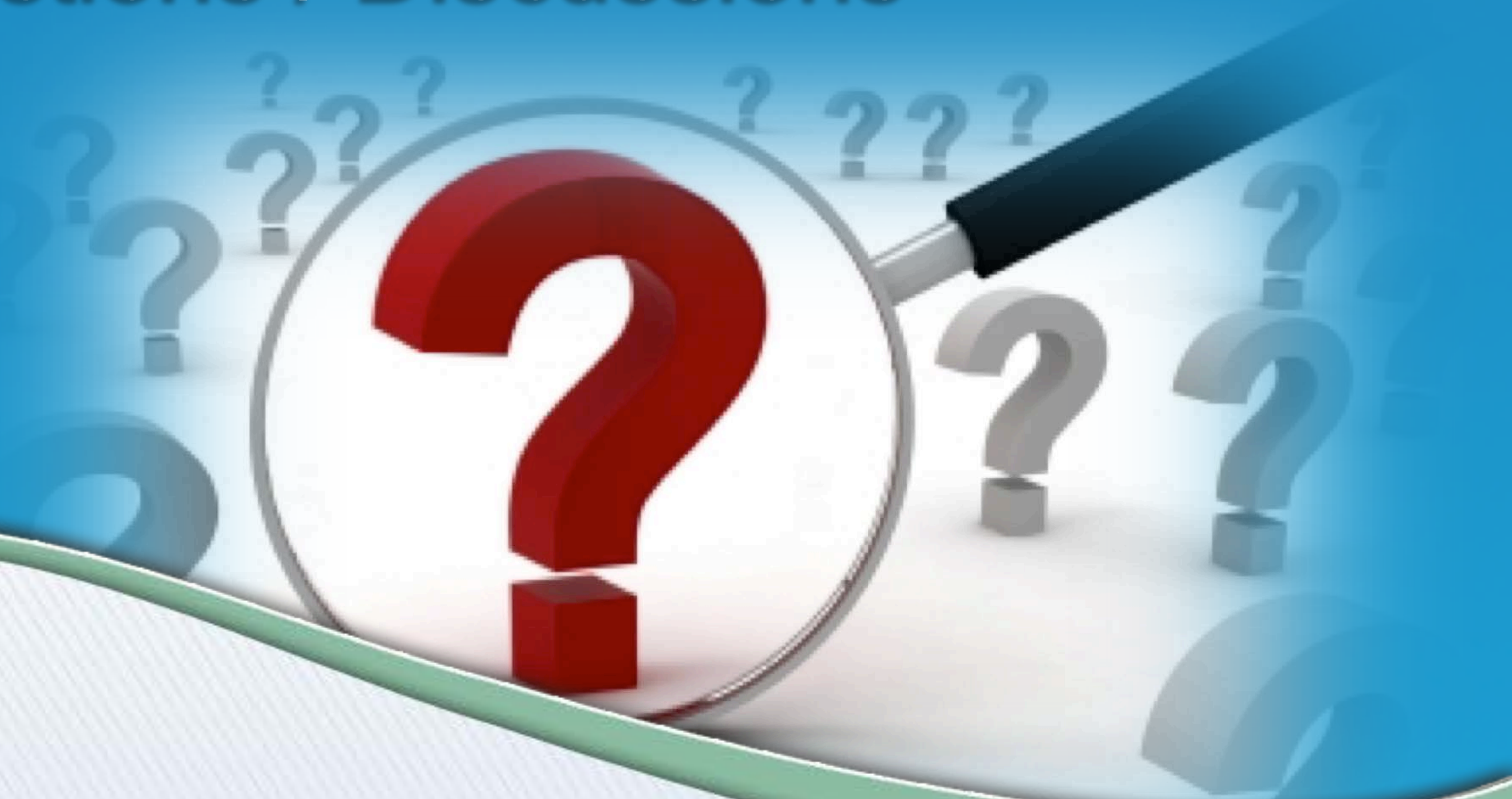
Rising Wastewater Temperature

- Contributes to higher aeration requirements
- Benefit for future nitrification

Summary

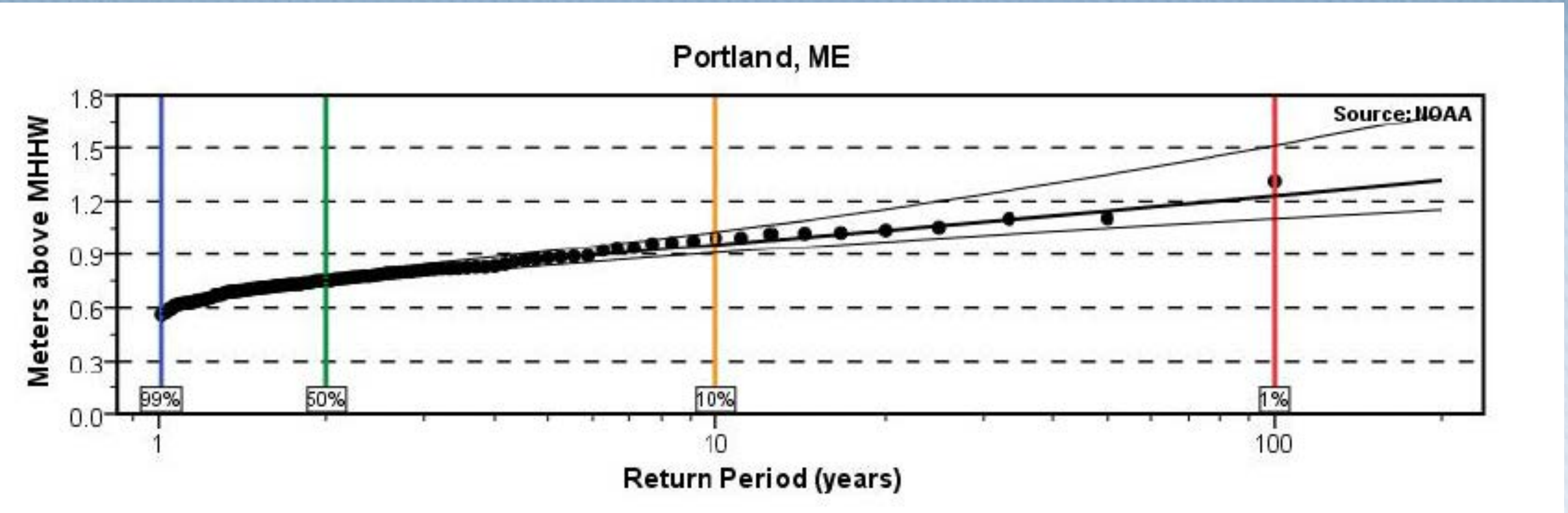
- Key impacts due to sea level rise
  - will need to be addressed within 20 to 35 year planning period
  - protective berm around WWTF
  - effluent pumping
  - possibly selective raising of tank walls to delay effluent pumping

Questions / Discussions



2100 Higher Scenario w/100-Year Storm Surge

Storm Surge above MHHW



- 100-year event corresponds to 1978 storm of record
- Higher intensity storms predicted in future due to climate change
- Projections do not included increase in storm surge
- Comparable to Level 1 hurricane