Willamette Falls Locks Commission Meeting
October 17, 2018

Dan Hartford, PE
Bob Riley, PE, SE

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Scope of Work Overview

- KPFF is contracted to Summit Strategies in support of the Willamette Falls Locks Commission & Project Partners
- Performed an independent condition assessment of the facility
- Focus: Infrastructure needs to reopen the Locks & allow them to operate safely
- We were not focused on costs for larger project needs, such as enhancements or operations for use by the public as a park, tourist or museum attraction

Scope of Work Overview

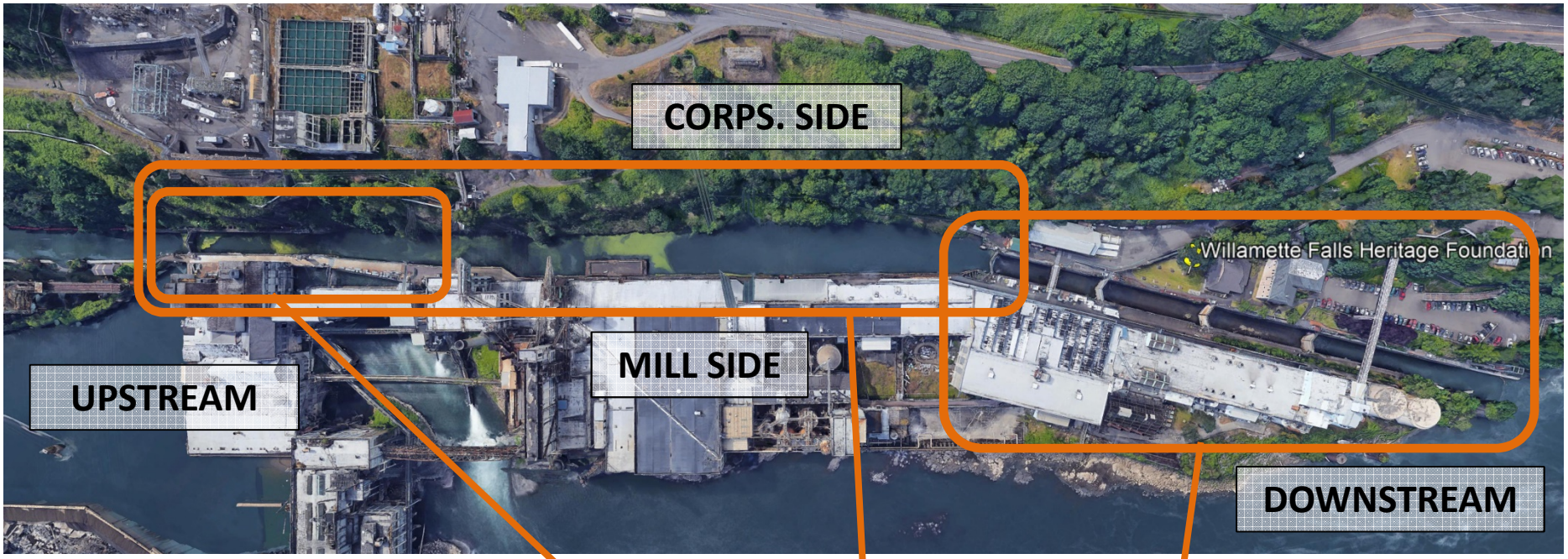
October 10, 2018 Conditions Assessment Report is based on the following information:

- 3-hour site assessment on May 30, 2018
- 2007 Engineering Study for Clackamas Heritage Partners
- 2011 Evaluation Report for USACE
- 2013 Interim Design Report for USACE
- 2017 Draft Disposition Study by USACE
- Historic Drawings

Summary of Conclusions

- Lock facility is in remarkably good condition
- Design and Construction details are outdated but have been well maintained
- All critical systems appear operable - facility can be reopened with minimal refurbishment to operating equipment
- Structural upgrades are needed (Wall and Monolith stability + gudgeon anchorages)
- Corps. side seepage needs to be addressed.
- Operational elements should be upgraded prior to

Facility Overview and Nomenclature



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Facility Overview and Nomenclature

OVERVIEW - GUARD LOCK AND PGE/CANAL WALL

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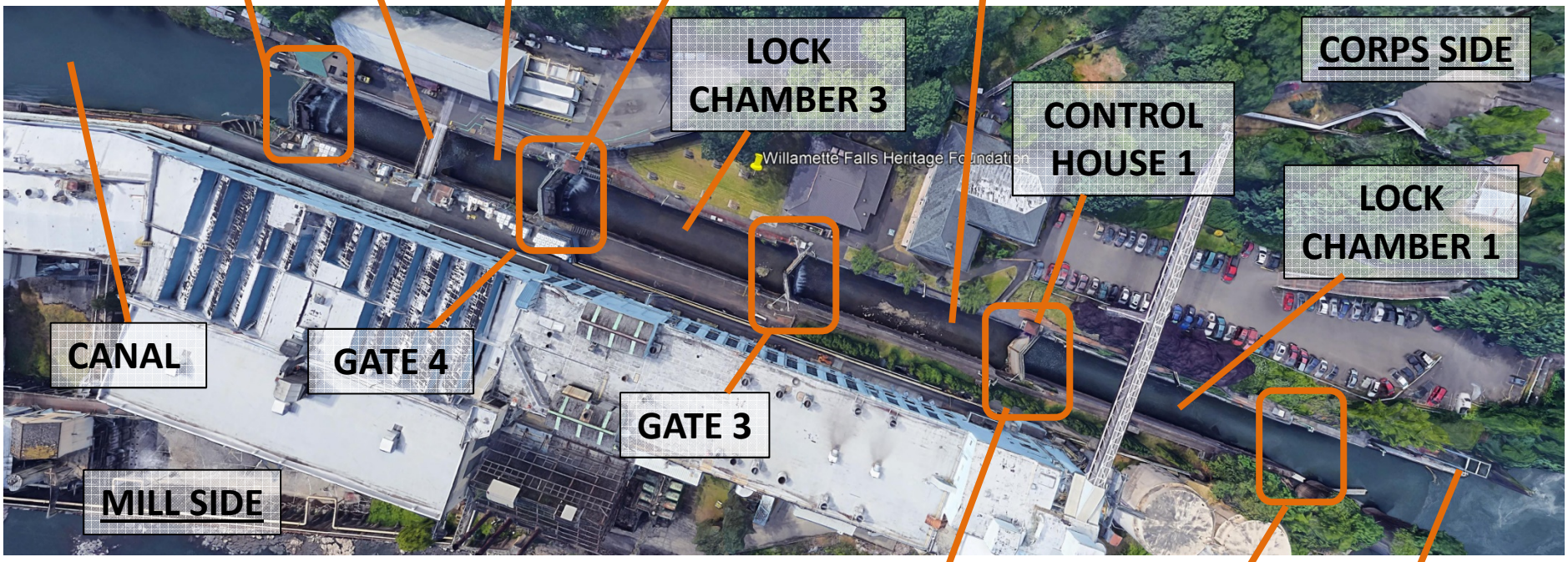
Facility Overview and Nomenclature



OVERVIEW – LOCK CHAMBERS 1-4

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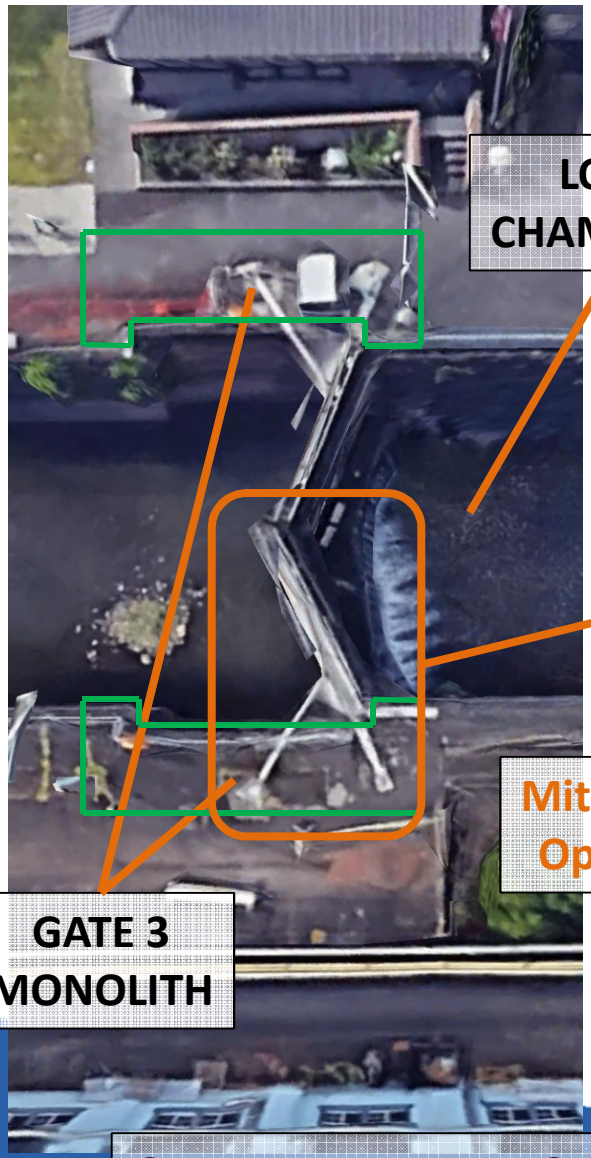
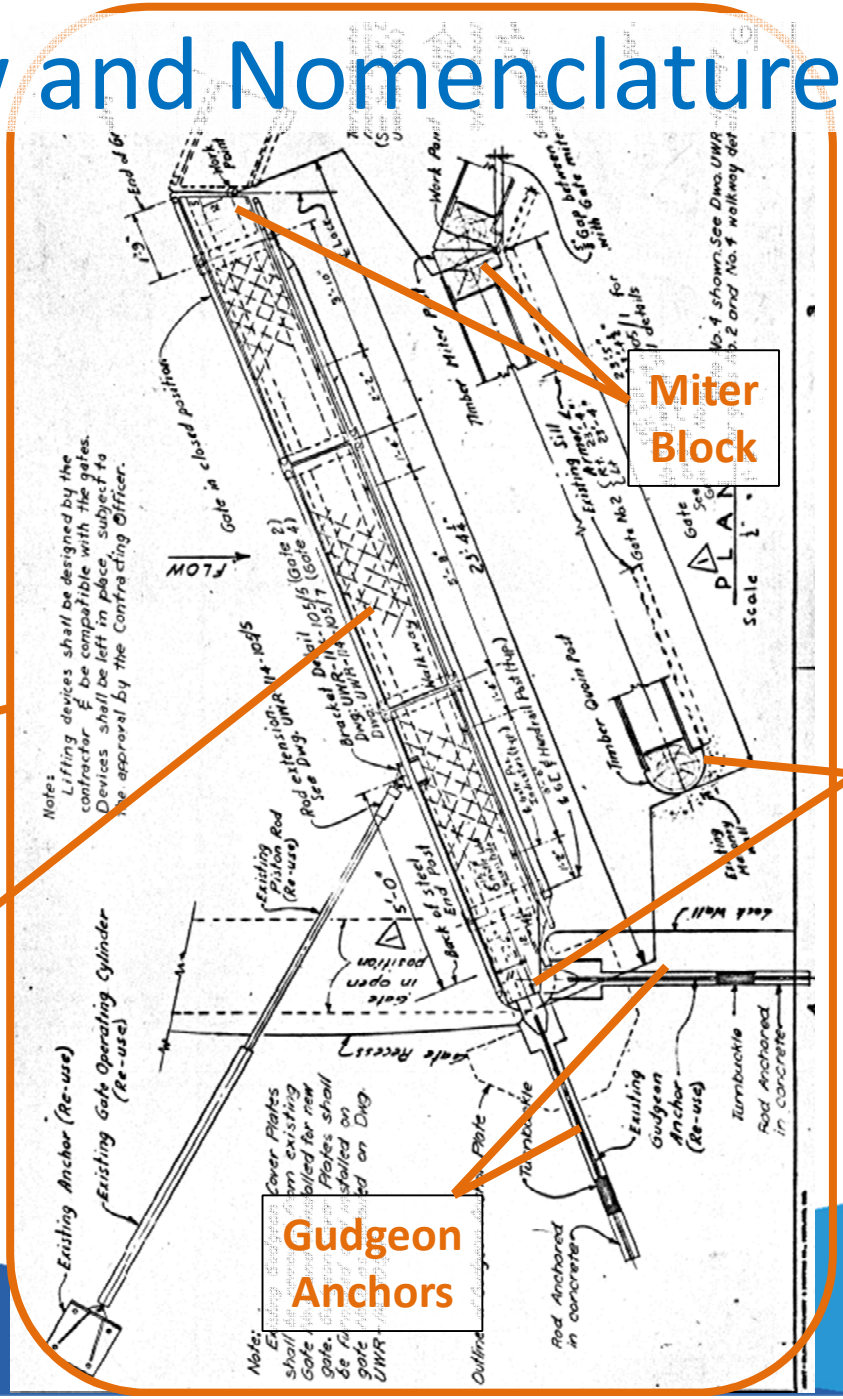
Facility Overview and Nomenclature



OVERVIEW – MITER GATES



Facility Overview and Nomenclature

INFRASTRUCTURE IMPROVEMENT NEEDS DEFINED

- CRITICAL NEED – COMPLETE PRIOR TO LOCK START UP
- MODERATE NEED – COMPLETE WITHIN 5 YEARS
- LONG TERM NEED – COMPLETE WITHIN 10 YEARS
- FUTURE CAPITAL COST – GATE INSPECTION AND REFURBISHMENT (AFTER 2030)
- MAINTENANCE NEEDS – OCCUR EITHER ANNUALLY OR EVERY 5 YEARS

Cost Needs Summary

Need Type	Amount ($2018)
Critical Need (Prior to Locks Re-Opening)	$8,610,000
Moderate Need (Within 5 years)	$2,940,000
Long Term Need (Within 10 years)	$240,000
Estimated Annualized Maintenance + Future Capital Improvement Set-Asides	$450,000

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Critical Infrastructure Needs ($2018)

	Item	Critical Need (Prior to Re-opening of Locks)
1	Erosion Repair and Ground Improvements at Lock Chamber 3	$ 249,000
2	Erosion Repair and Ground Improvements at Gate 4 Monolith (Corps Side)	$ 793,000
3	Control Running Water Via Drainage Trench at Gate 4 (Corps Side)	$ 24,000
4	Hydrographic Survey	$ 94,000
5	Reinstall Timber Brace for Wall Lagging, Lock 1 Mill Side	$ 4,000
6	Replace Walkway and Walkway Framing Supports	$ 283,000
7	Stabilize Chamber Walls in Select Locations	$ 1,915,000
8	Stabilize Gate Monoliths in Select Locations	$ 1,163,000
9	Replace Corroded Gudgeon Anchorages	$ 539,000
10	Operator Anchorage Repair	$ 523,000
11	Replace Pedestrian Draw Bridge over Lock 4	$ 528,000
12	Replace Gangway Float at Downstream Approach	$ 195,000
13	Install new Piles in Concrete Foundation at Downstream Approach	$ 78,000
14	Replace Timber Lining in Chamber #3	$ 202,000
15	Replace all Hydraulic Hoses	$ 57,000
16	Sample Hydraulic Fluid	$ 11,000
17	Detailed Inspection/Documentation of all Fill/Empty Valves	$ 50,000
18	Repairs to Valves (Projected)	$ 553,000
19	Lubricate all Systems	$ 29,000
20	Install New Gate & Valve Operating Cylinders at Gate #1	$ 59,000
21	Salvage, Rebuild and Store Cylinders from Gate #1	$ 32,000
22	Remove Debris	$ 36,000
23	Install Fire Protection Equipment	$ 760,000
24	Inspect / Repair Generator, Install Packaged Load Bank	$ 64,000
25	Repair Broken Luminaires	$ 15,000
26	Inspect / Document of Electrical Distribution System	$ 117,000
27	Repair of Electrical Distribution System	$ 78,000
28	Maintenance Activities	$ 145,000
	Total Cost Summary	***$ 8,610,000***

1

2

3

4

$5.4M of $8.6M in Repairs (approx 2/3 of total cost)

CRITICAL NEEDS SUMMARY

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Moderate Infrastructure Needs (Estimated Costs in $2018)

	Item	Moderate Need (Within Next 5 Years)
29	Replace Chamber Ladders	$ 43,000
30	Replace Damaged Guardrails (Railing on Mill Side from Gate 1 to Gate 5, and Guard Lock)	$ 96,000
31	Install New Hydraulic Power Units	$ 616,000
32	Replace Bottom Seals	$ 185,000
33	Replace Lighting System	$ 782,000
34	Replace/Refurbish Control System	$ 1,209,000
	Total Cost Summary	***$ 2,940,000***

MODERATE NEEDS SUMMARY

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Long Term Infrastructure Needs (Estimated Costs in $2018)		
	Item	**Long-Term Need (Within Next 10 Years)**
35	Repair Loss of Masonry at Lowest Course at the Downstream Approach, Mill Side	$ 234,000
	Total Cost Summary	***$ 240,000****

***Note – we are recommending most of the repairs be conducted either prior to Lock reopening or within the first 5 years of operations**

LONG TERM NEEDS SUMMARY

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Future Capital Costs (Estimated Costs in $2018)				
36	Inspect/Refurbish Gate Leaves (assume 25 year cycle)	$	1,215,000	$48,600 per year ($2018)
37	Flood Repair Contingency (assume 30 year cycle)	$	710,000	$23,700 per year ($2018)
		$	***1,930,000***	

FUTURE CAPITAL COSTS SUMMARY

Routine Maintenance (Estimated Costs in $2018)

	Item	Annual Maint Costs	Five Year Maint Costs
1	Inspect Timber Lining and Replace Rotting Pieces as Needed	$ 75,000	
2	Inspect Lock Walls and Region behind Lock Walls for Movement	$ 4,000	
3	Inspect Masonry for Structural Integrity	$ 4,000	
4	Remove Debris as Needed	$ 17,000	
5	Hydraulic Fluid Sampling	$ 16,000	
6	Replace One (1) Set of Gate and Valve Hydraulic Cylinder Operators	$ 60,000	
7	Lubricate Systems	$ 29,000	
8	Run Generator on Load Bank Monthly	$ 5,000	
9	Limit Switch Inspection / Repair / Replacement	$ 57,000	
10	Hydrographic Survey and Dredging		$ 188,000
11	Adjust Retention Diagonals on Miter Gate Leaf		$ 30,000
12	Testing and Correction of Grounding System		$ 32,000
13	Replace all Hydraulic Hoses		$ 48,000
14	Slide Gate Inspection / J seal & J clamp PM		$ 246,000
	Total Cost Summary	***$ 270,000***	***$ 550,000***

$110,000 per year ($2018)

ROUTINE MAINTENANCE COSTS SUMMARY

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Key Critical Needs Repairs

Critical Need	Amount ($2018)
1. Erosion Repair at Chamber 3 & Gate 4 (Corps Side)	$249K + $793K = $1.04M
2. Stabilize Chamber Walls	$1.92M
2. Stabilize Monolith Walls	$1.16M
3. Replace Corroded Gudgeon Anchors	$540K
4. Install Fire Protection Equipment	$760K

$5.42M
(63% OF $8.61M)

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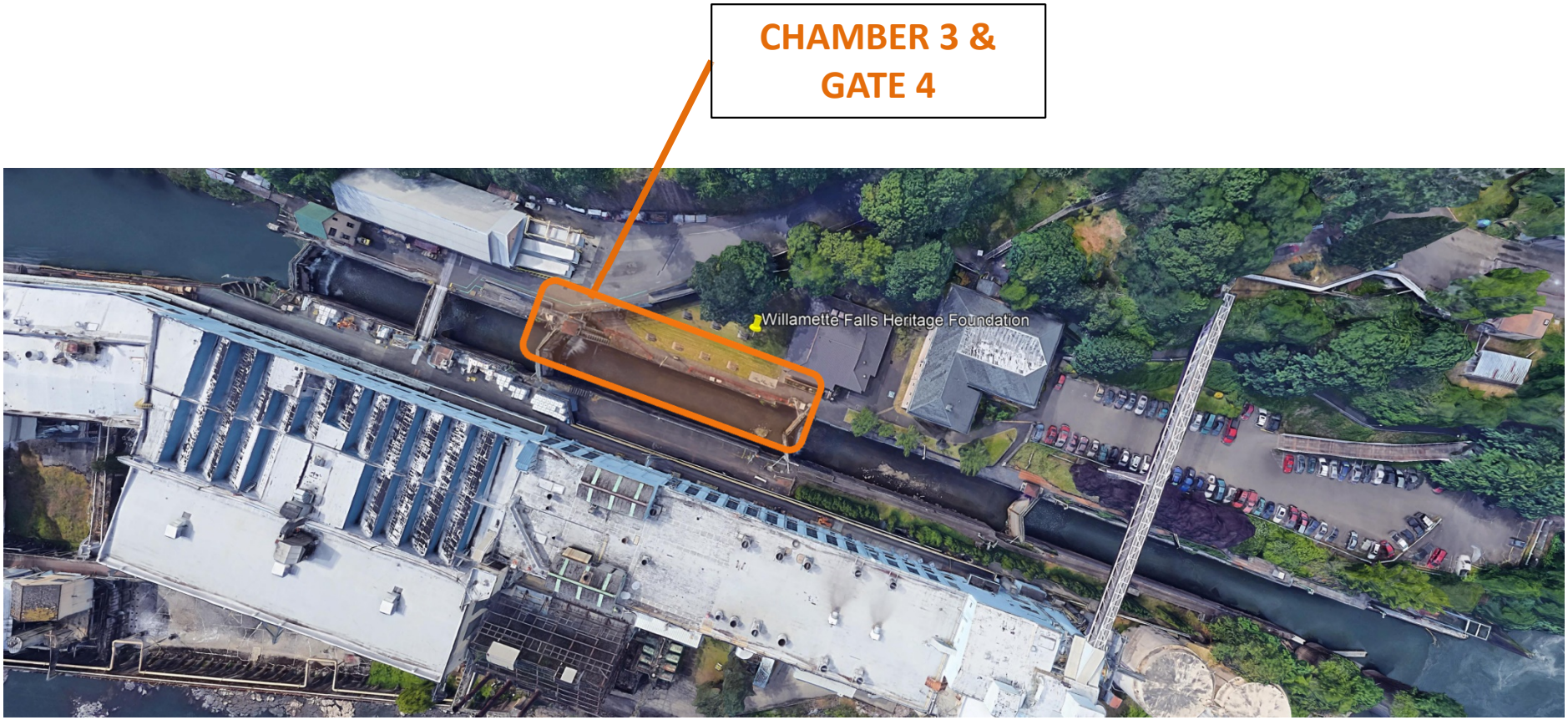
1. Erosion Repair at Chamber 3 & Gate 4



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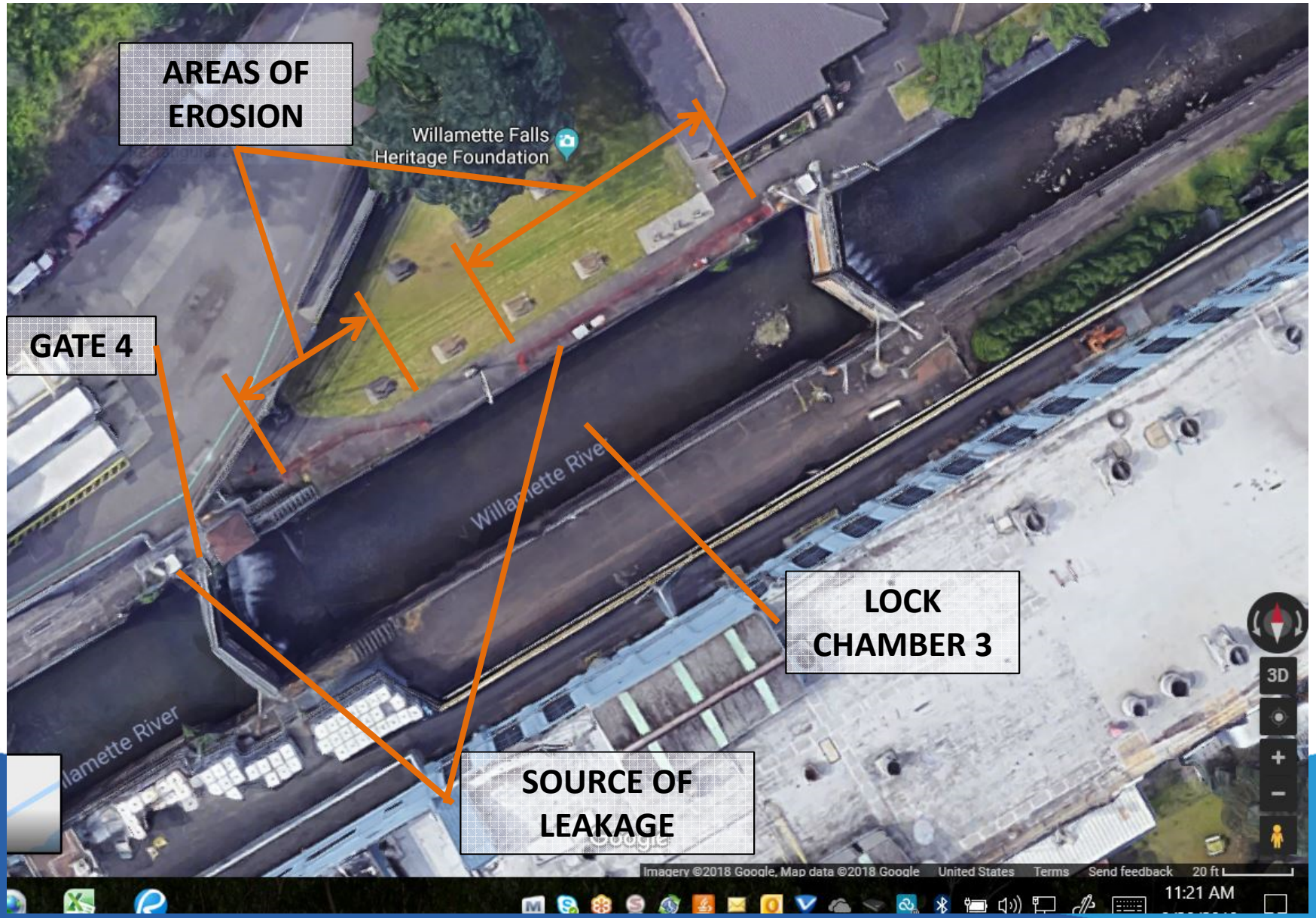
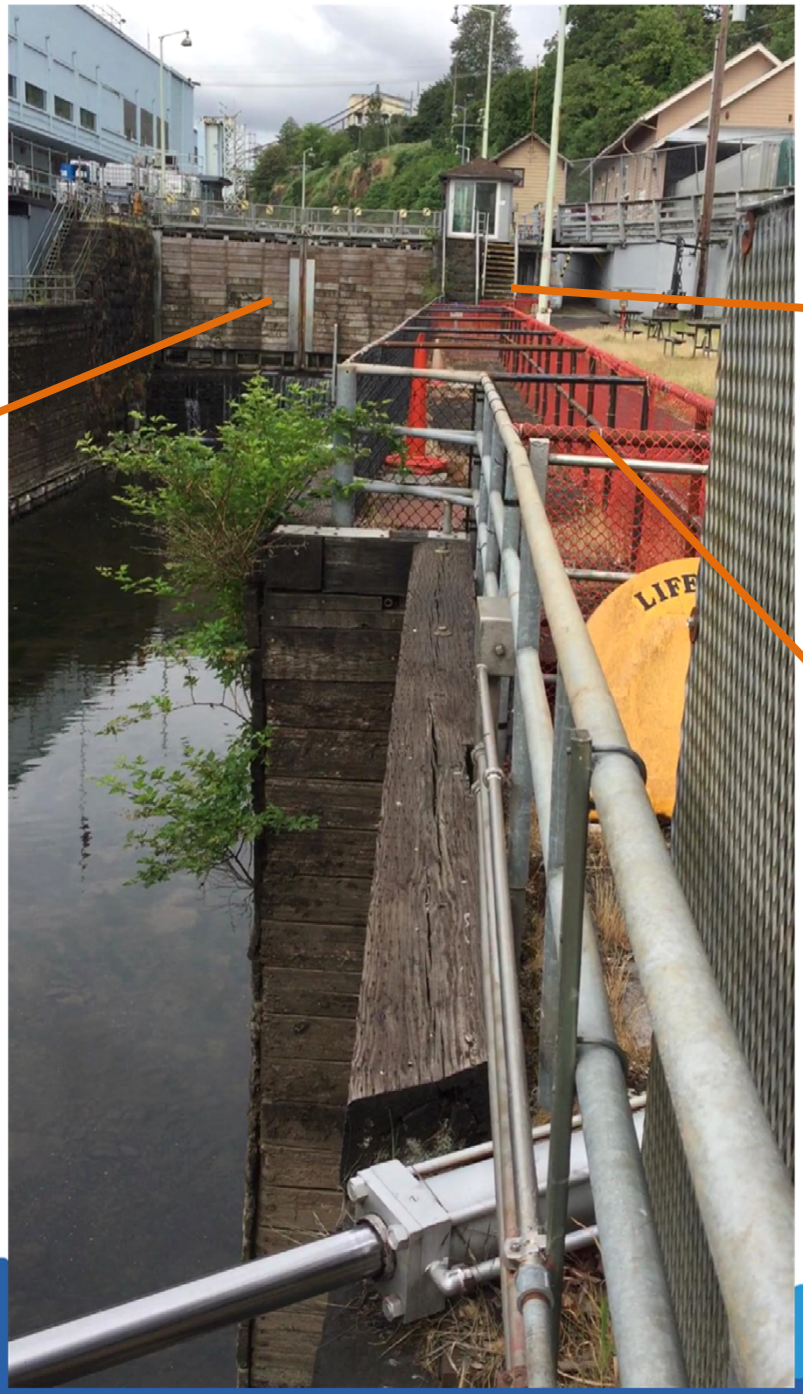


GATE 4



NOTE STAIRWAY

NOTE ORANGE BARRICADES DUE TO CURRENT STATE OF EROSION

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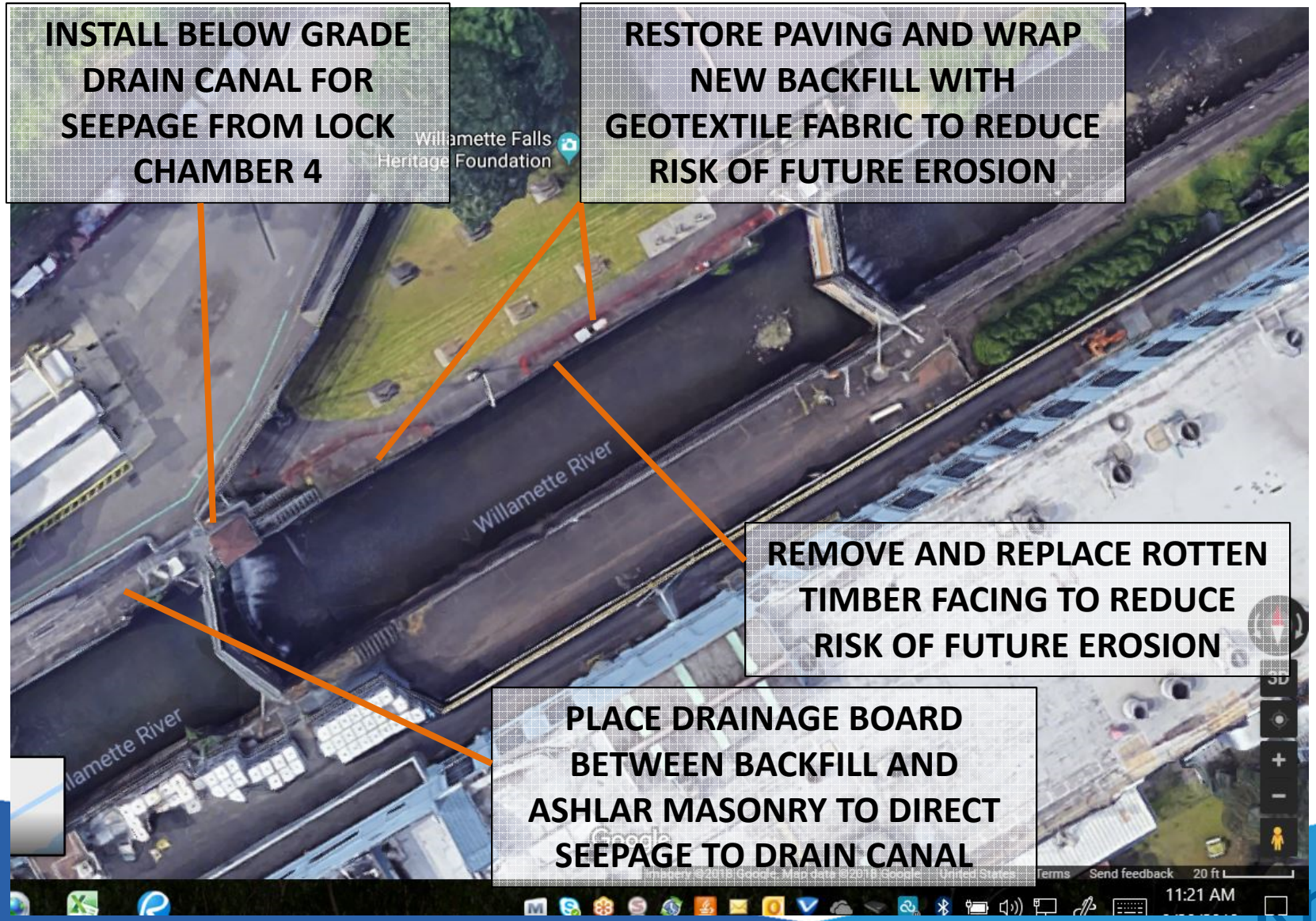
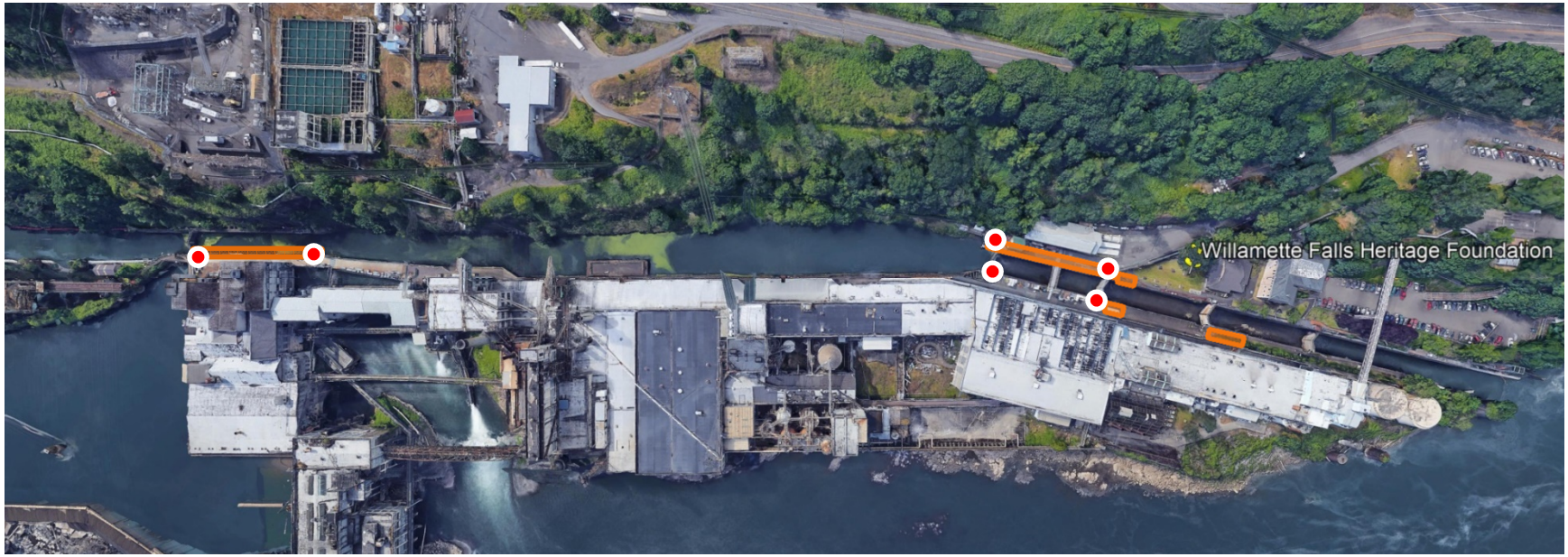
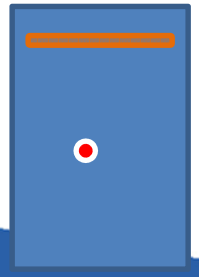
1. Erosion Repair at Chamber 3 & Gate 4



2. Stabilize Gate Monoliths and Chamber Walls

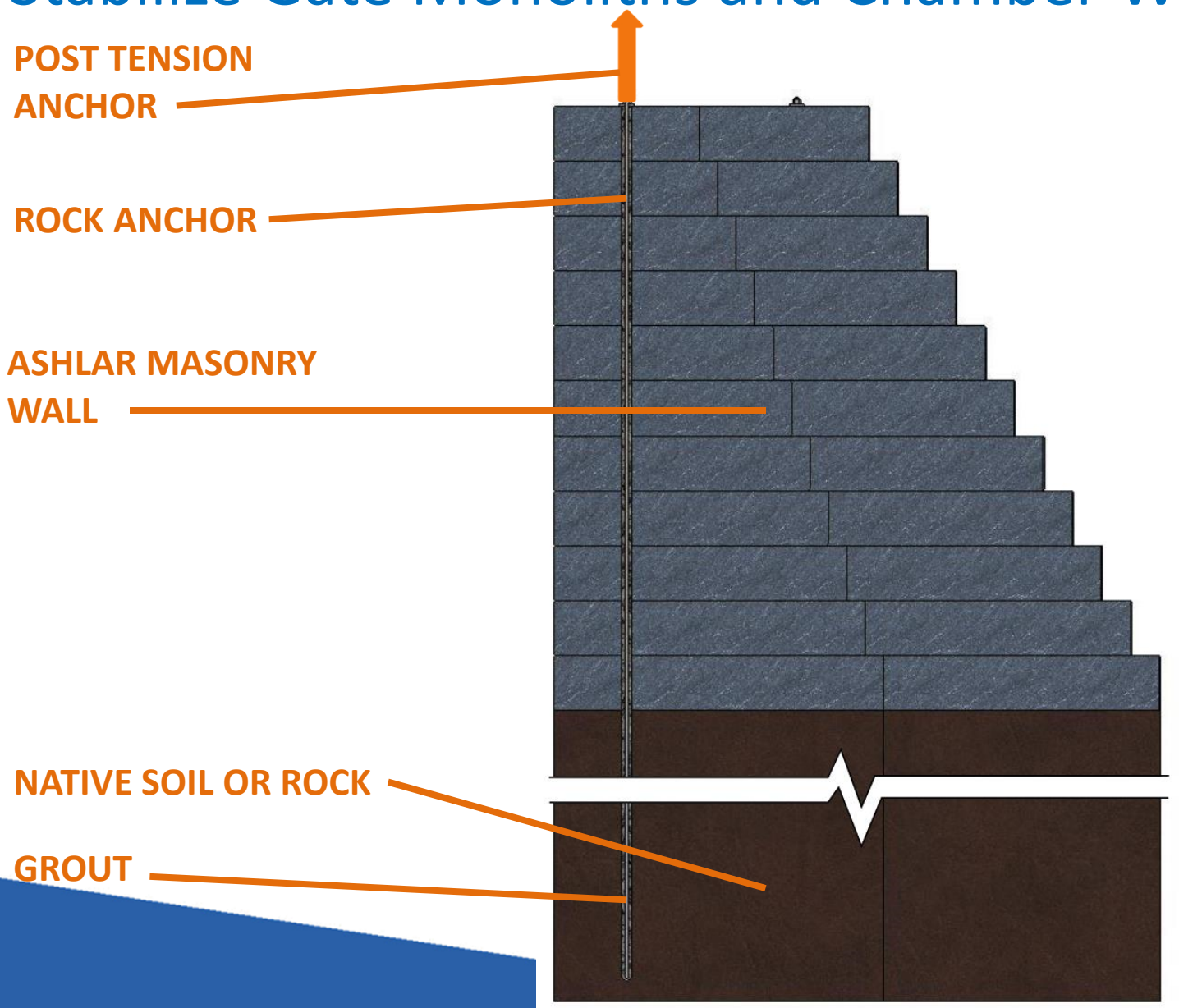




Chamber Wall Rock Anchors (67 assumed)

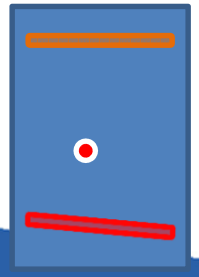
Monolith Rock Anchors (36 assumed)

2. Stabilize Gate Monoliths and Chamber Walls



Comparison with 2017 Corps Disposition Study

Alternative 3 estimated at $1.96M ($2017), with $1.84M in rock anchor work per USACE Study



Chamber Wall Rock Anchors (KPFF est = $930K ($2018))

Monolith Rock Anchors (KPFF est = $380K ($2018))

PGE/Canal Concrete Wall Rock Anchors (not included in KPFF report)

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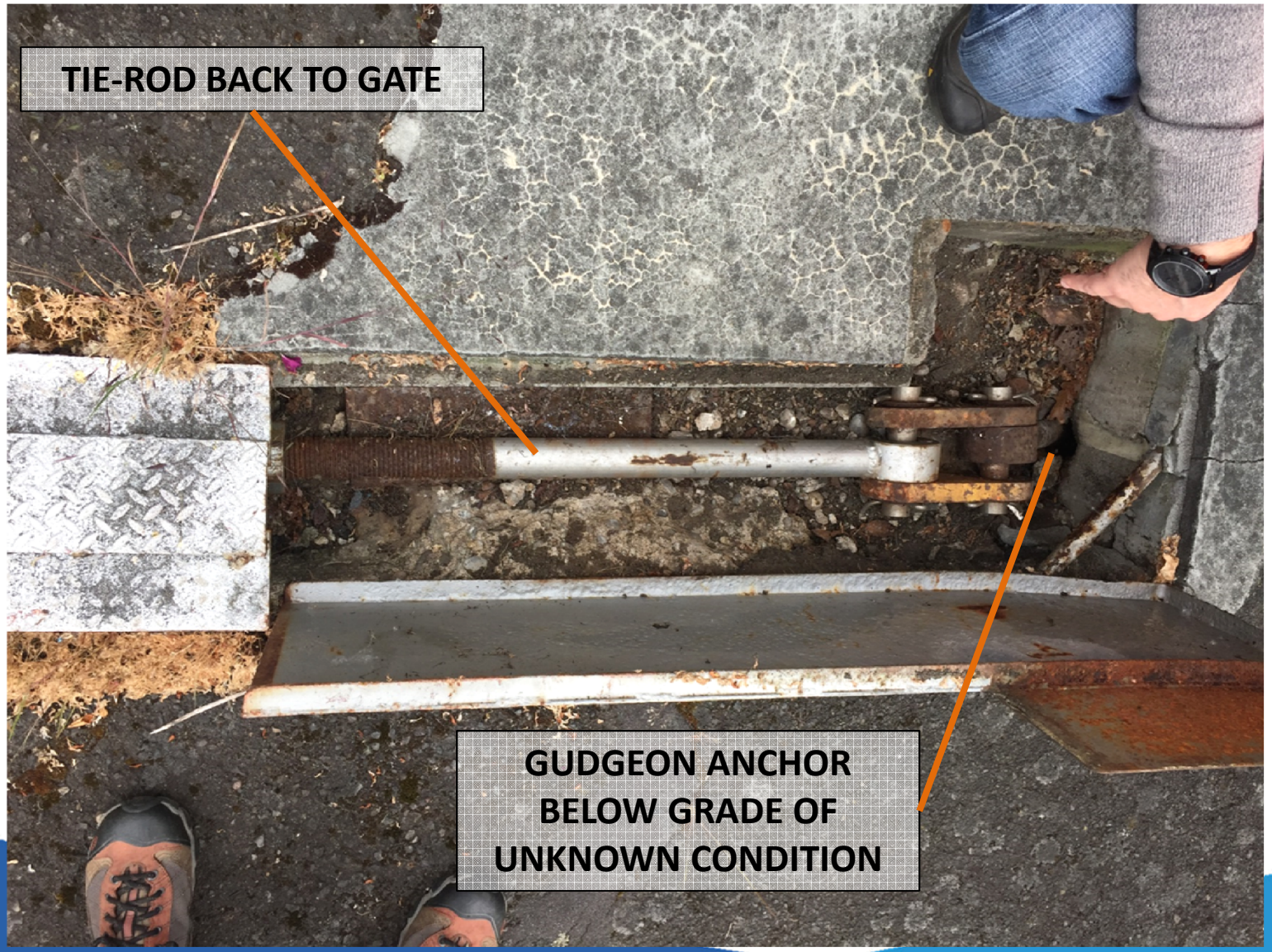
3. Replace Corroded Gudgeon Anchor



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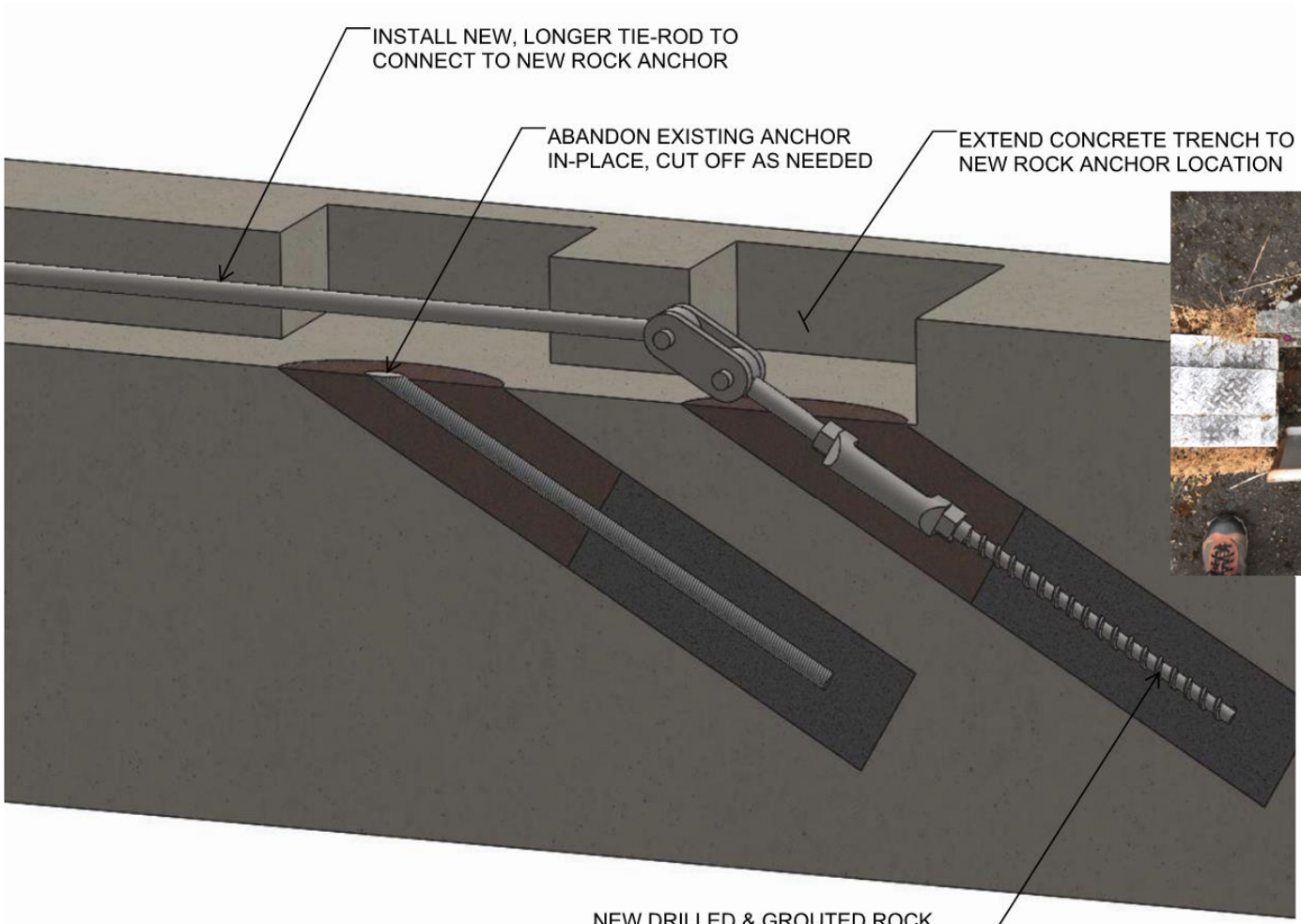

GUDGEON ANCHOR REPLACEMENT CONCEPT

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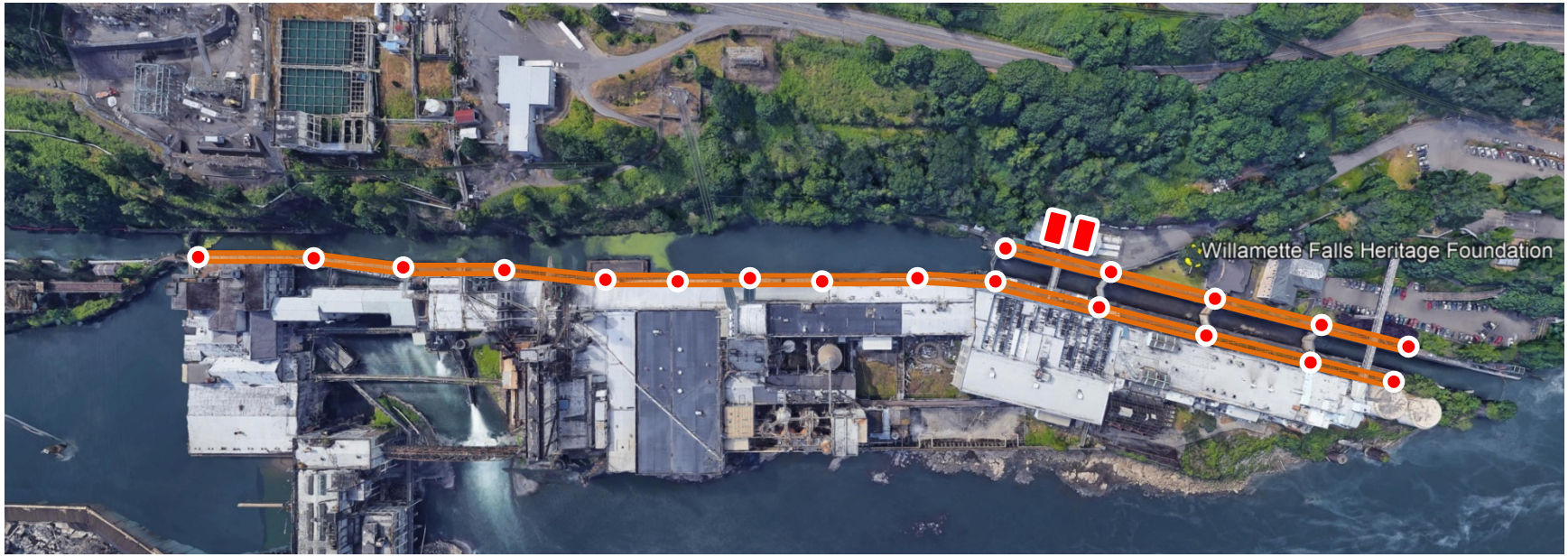
4. Install Fire Protection Equipment



New Dedicated 6” Fire Water Pipe (~3100 ft)

Branch Valve and Hose Reel (~20 places)

Pump Contingency (Assumed 2 Pumps)

Operational Needs – Key Elements

Any mechanical, electrical or control element that supports operation of the lock system

- **Water Management** - Miter Gates and Gate Operators Fill/Empty Valves (And their operators) – All Refurbished in 2009and Valve Operators
- **Operator Interface** – Local and Remote Selector Switch's and Push Buttons Traffic Control (Signals, Lighting, Manual Ball Valves Intercom)
- **System Monitoring** – How does the operator understand system conditions? (Limit Switches, Water Level Gauges)

Overall the Lock Operating Systems are in fair condition and can be restored to operation with minimal repairs.

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Operational Needs – System Limitations

- Existing Systems are Aging and Out of Date
- No independent control of miter gates and fill/empty valves
- Limited locations for operator interface
- Hydraulic piping under the lock – potential spill issue
- No built in Control Logic – Operators can inadvertently operate in unsafe manner.
- **Requires Skilled Operator – Limits Operational options**

Operational Needs – System Limitations

Key mechanical, electrical and controls elements should be upgraded prior to implementing an operating scheme using less skilled personnel

Moderate Need	Amount ($2018)
Replace/Refurbish Control System	$1,109k
Install New Hydraulic Power Units	$616K
Replace Lighting System	$782k

COSTS TO ALLOW OPERATIONS BY LESS SKILLED PERSONNEL

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Recommended Future

- **Hydraulic Piping Under Lock Eliminated**
- **Operator Control Available at each Gate**
- **Enhanced System Control Logic – Ease of Use**

New Networked Control Wiring

New HPU (14 places)

New Human Machine Interface (HMI)

New Human Machine Interface (HMI) + Programmable Logic Controller (PLC) In Control House

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