BUILDING A WORLD OF DIFFERENCE

1 May 2015

MEETING THE CHALLENGES OF IN-WATER DESIGN AND CONSTRUCTION

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WATER DIVISION

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BLACK & VEATCH
Building a world of difference.®

AGENDA

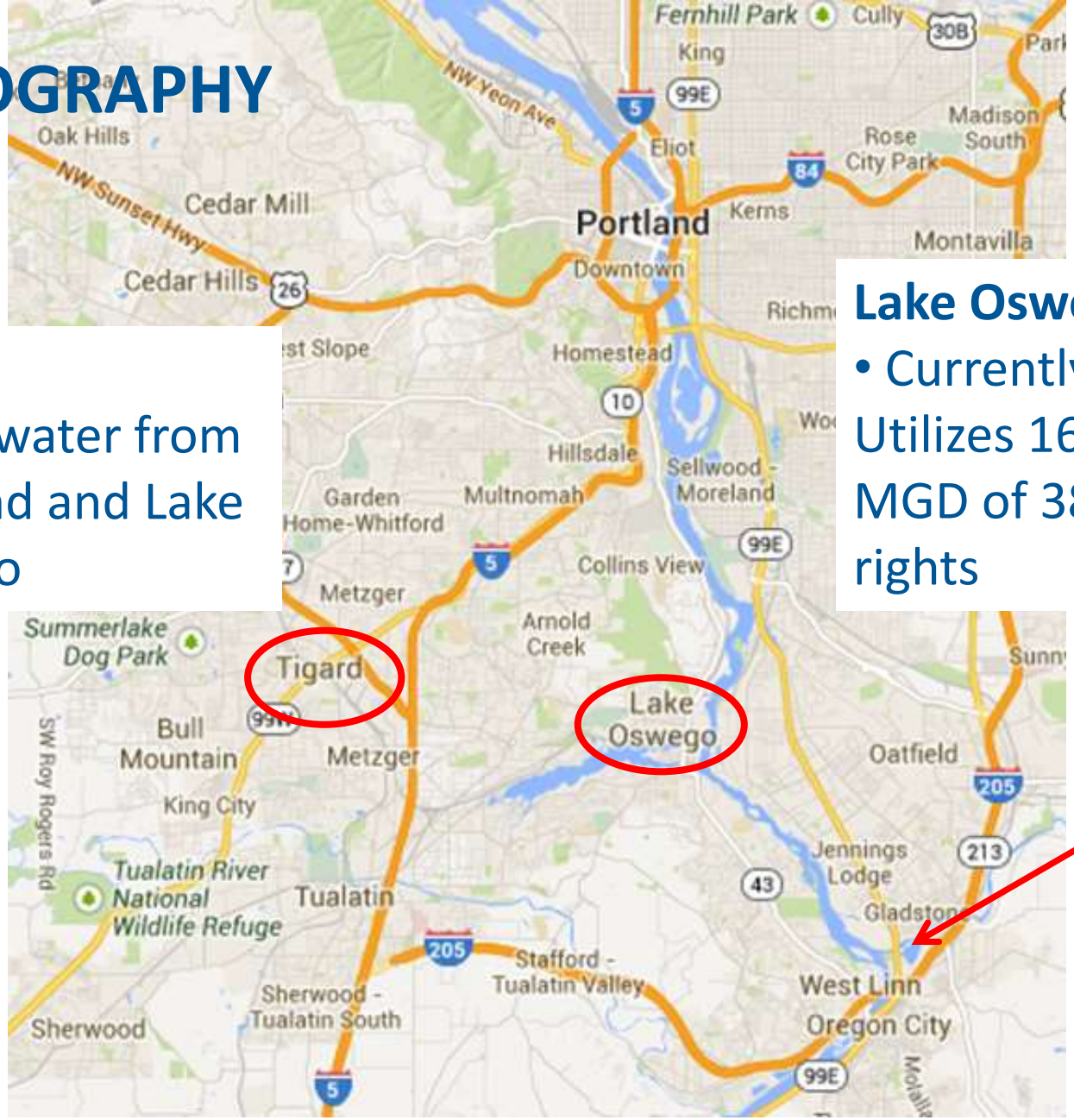
1. Program and Project Background
2. River Hydrology and Intake Siting
3. Construction

PROGRAM AND PROJECT BACKGROUND

DEVELOPMENT OF THE PARTNERSHIP

- August 2008 – Cities of Lake Oswego and Tigard enter partnership agreement to share drinking water resources and costs.
- Develop full use of Lake Oswego's existing Clackamas River water rights to supply 38 MGD.
- Tigard customers gain a long-term, affordable drinking water source.
- Lake Oswego spreads the cost for needed upgrades among a larger base of rate payers.

GEOGRAPHY



Tigard

- Buys water from Portland and Lake Oswego

Lake Oswego

- Currently Utilizes 16.5 MGD of 38 MGD rights

Project Site

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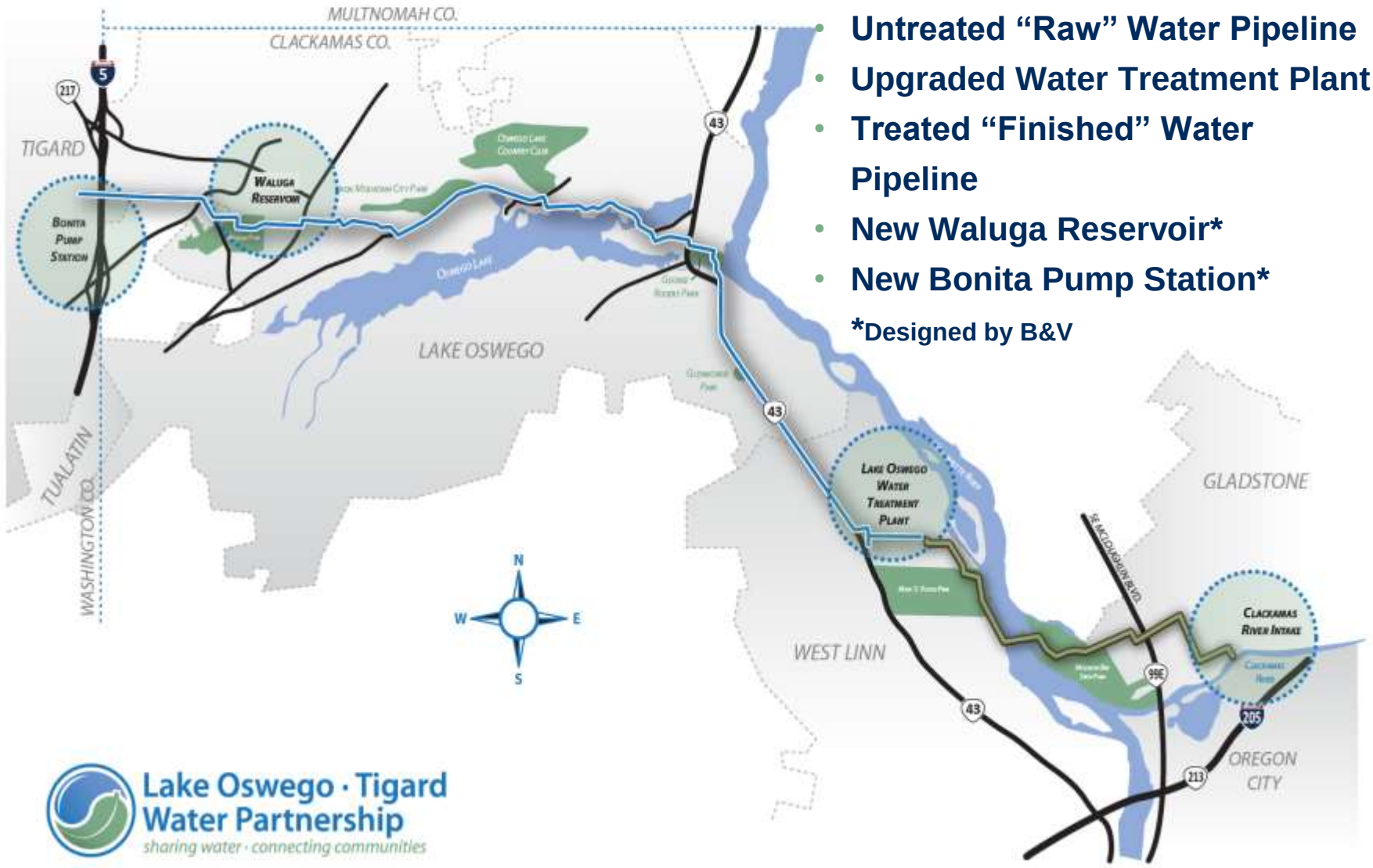
Water System Improvements

- New River Intake Pump Station*
- Untreated “Raw” Water Pipeline
- Upgraded Water Treatment Plant
- Treated “Finished” Water Pipeline
- New Waluga Reservoir*
- New Bonita Pump Station*

*Designed by B&V



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EXISTING INTAKE PUMP STATION ISSUES

- Vulnerability to withstand seismic events.
- Maximum pumping capacity of 16.5 MGD
- Firm capacity of 11.7 MGD.
- Insufficient pump intake and impeller submergence during low river/peak demand season.
- Poor sweeping velocity to carry algae mats and debris downstream.

Existing Intake built in 1969.

RIVER HYDROLOGY AND INTAKE SITING

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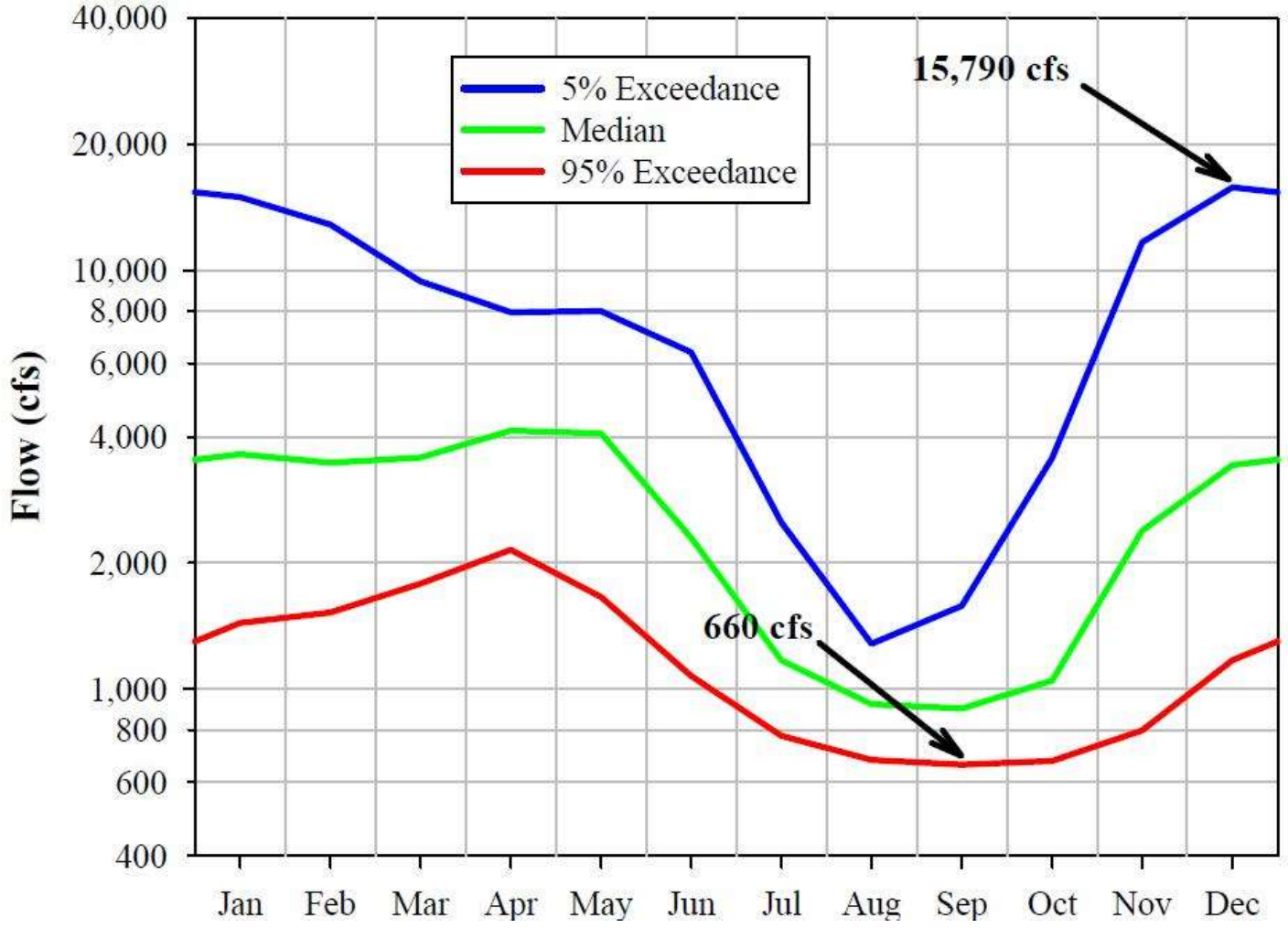
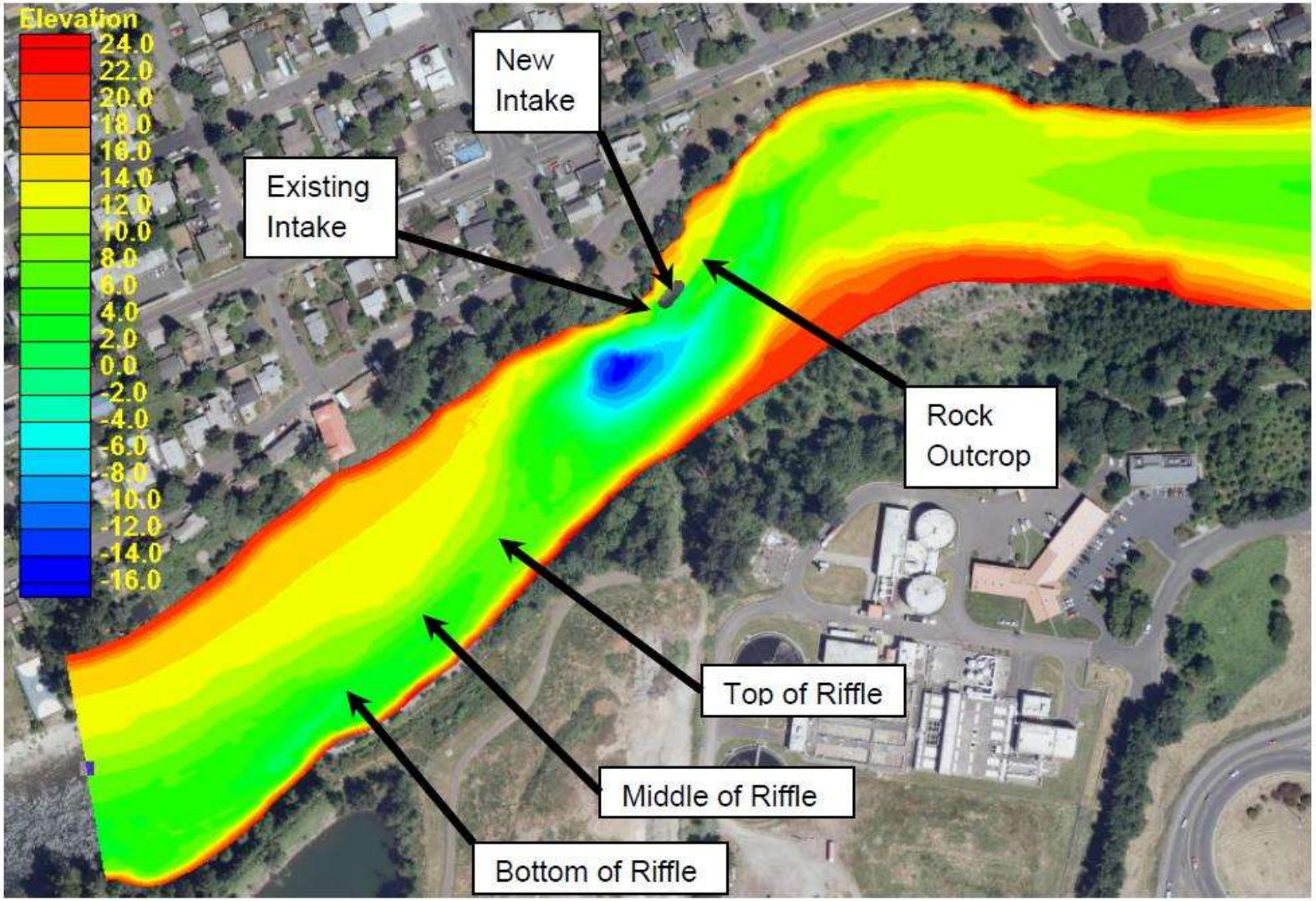
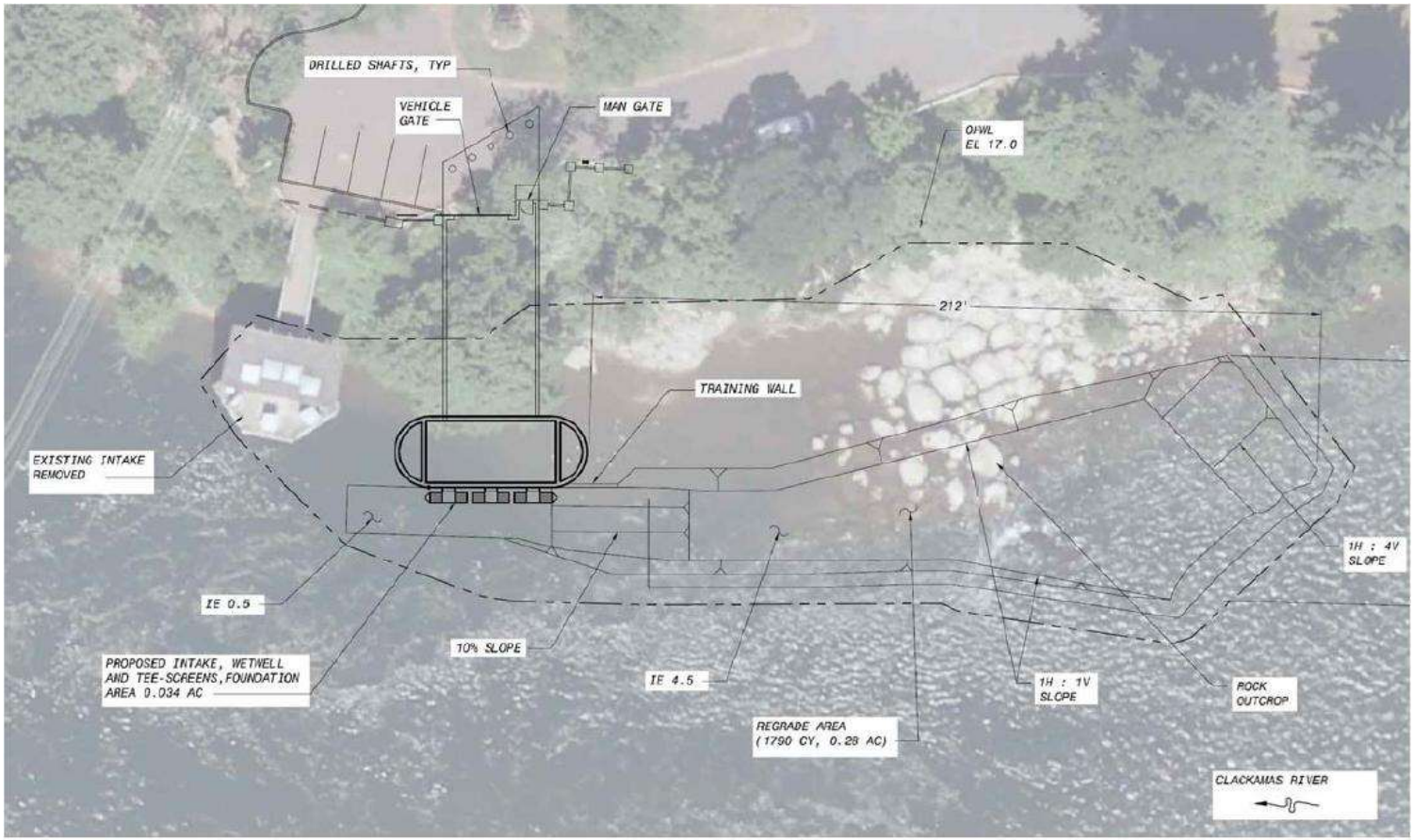


Monthly 5%, 50% (Median), and 95% exceedance flows for the Clackamas River near Oregon City

- Intake located at upper end of pool with riffles leading into and out of the pool.
- Bank at intake is soft rock that tends to be scoured clean
- Rocky outcrop of hard rock and boulders 100 ft upstream



Extent and bathymetry of model developed to estimate 2D flow conditions

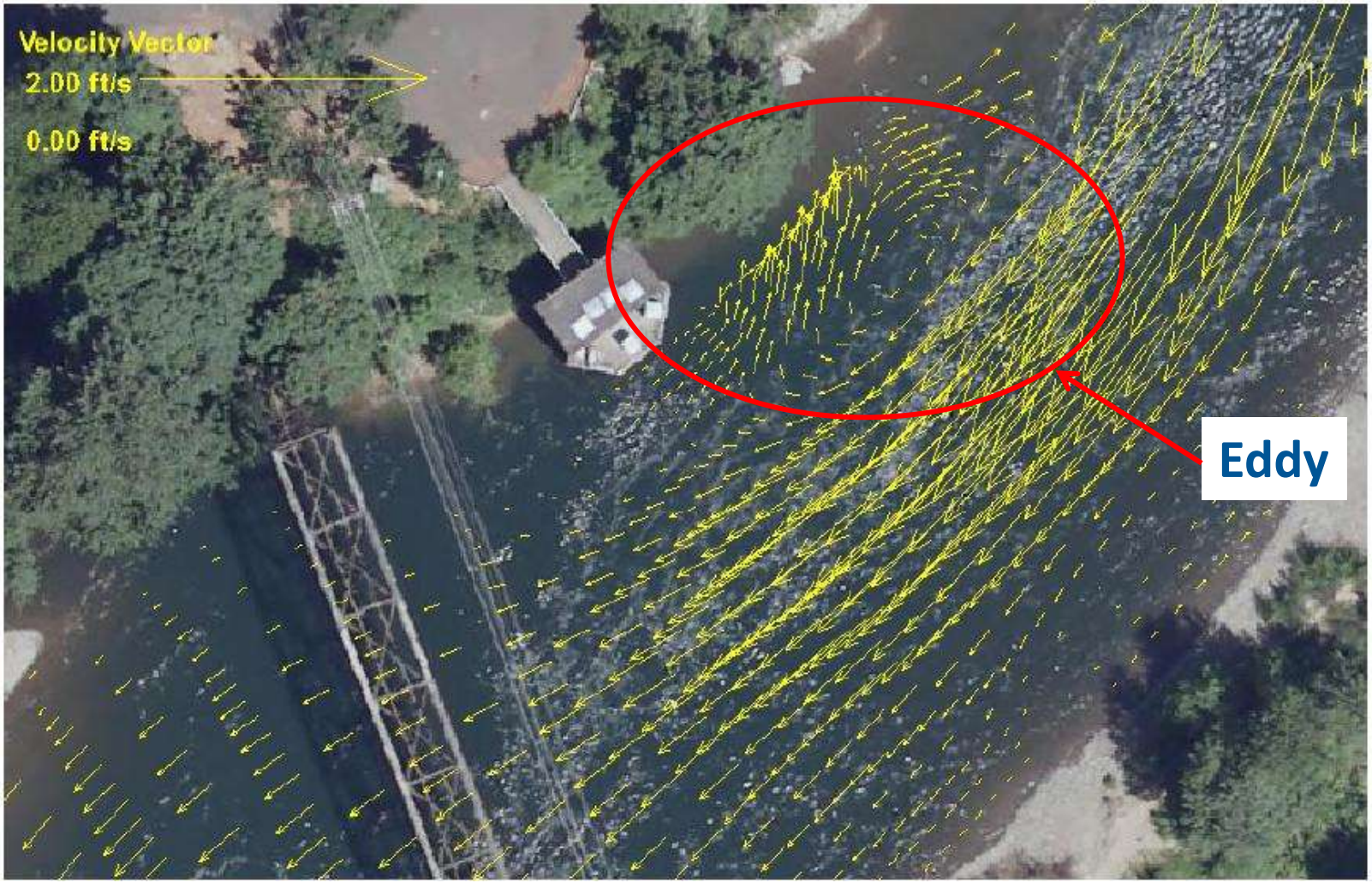


- Currently an eddy occurs during various low flow conditions resulting in poor sweeping velocity across the intake fish screens.
- Channel excavated upstream of the intake to funnel flow toward screens.
- Channel required excavation of 1,600 cubic yards of rock.

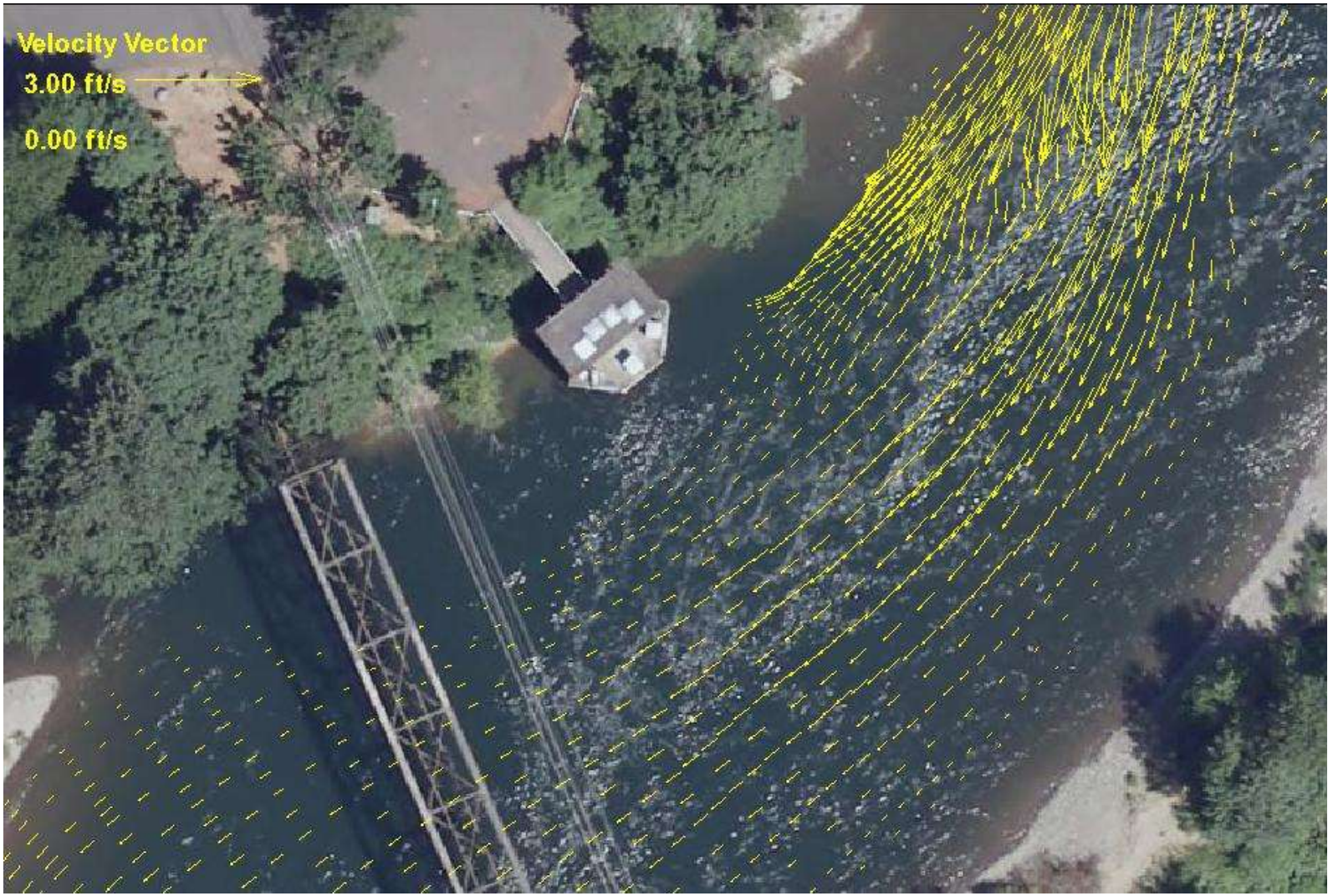
RIVER MODELING

Summary of flow and velocity conditions modeled at the intake:

Model Run	Bathymetry	Flow (cfs)	% Excd	Intake Conditions				Withdraw Rate (cfs)
				WSE (ft)		Depth (ft)	Sweeping Vel (ft/s)	
1	Existing	660	95%	9.5	Low	6.8	-0.20	59
2	Existing	660	95%	11.3	High	8.6	0.04	59
3	Proposed	660	95%	8.1	Low	7.6	0.51	53
4	Proposed	660	95%	12.0	High	11.5	0.49	53
5	Existing	1,050	25% (1)	10.0	Obs(1)	6.9	-0.20	10
6	Proposed	1,050	25% (1)	10.8	Typ(2)	10.3	1.29	59
7	Existing	15,790	5%	21.7	Typ(2)	16.7	6.01	59
8	Proposed	15,790	5%	21.7	Typ(2)	21.2	7.15	59



Run 1: Existing bathymetry, low flow, maximum withdrawal (Sweeping Velocity = -0.2 ft/sec)



Run 3: New bathymetry, low flow, maximum withdrawal (Sweeping Velocity = 0.51 ft/sec)

CONSTRUCTION

IN WATER WORK PERIOD FOR CLACKAMAS RIVER

- **In-Water Work Period (IWWP): July 15th – August 31st**
- **Avoid vulnerable life stages (including migration, spawning, and rearing) of important fish species.**
- **Anadromous – fish that live part or the majority of their lives in in saltwater, but return to fresh water to spawn.**
- **IWWP dictated by following fish species:**
  - Chinook (King) Salmon – fall and spring runs
  - Coho (Silver) Salmon
  - Steelhead – summer and winter runs
  - Cutthroat Trout

CONSTRUCTION CHALLENGES

- **Site access is extremely limited**
- **In-Water Work Period (IWWP): July 15th – August 31st**
- **General Construction Schedule:**
  - 1st IWWP (2013) – construct work bridge and cofferdam.
  - Excavate within cofferdam and construct RIPS structure.
  - 2nd IWWP (2014) – remove cofferdam, construct channelization.
  - Startup and testing.
  - 3rd IWWP (2015) – demolish existing RIPS.

Site prior to construction

Site prior to construction

Lower waler ring of cofferdam

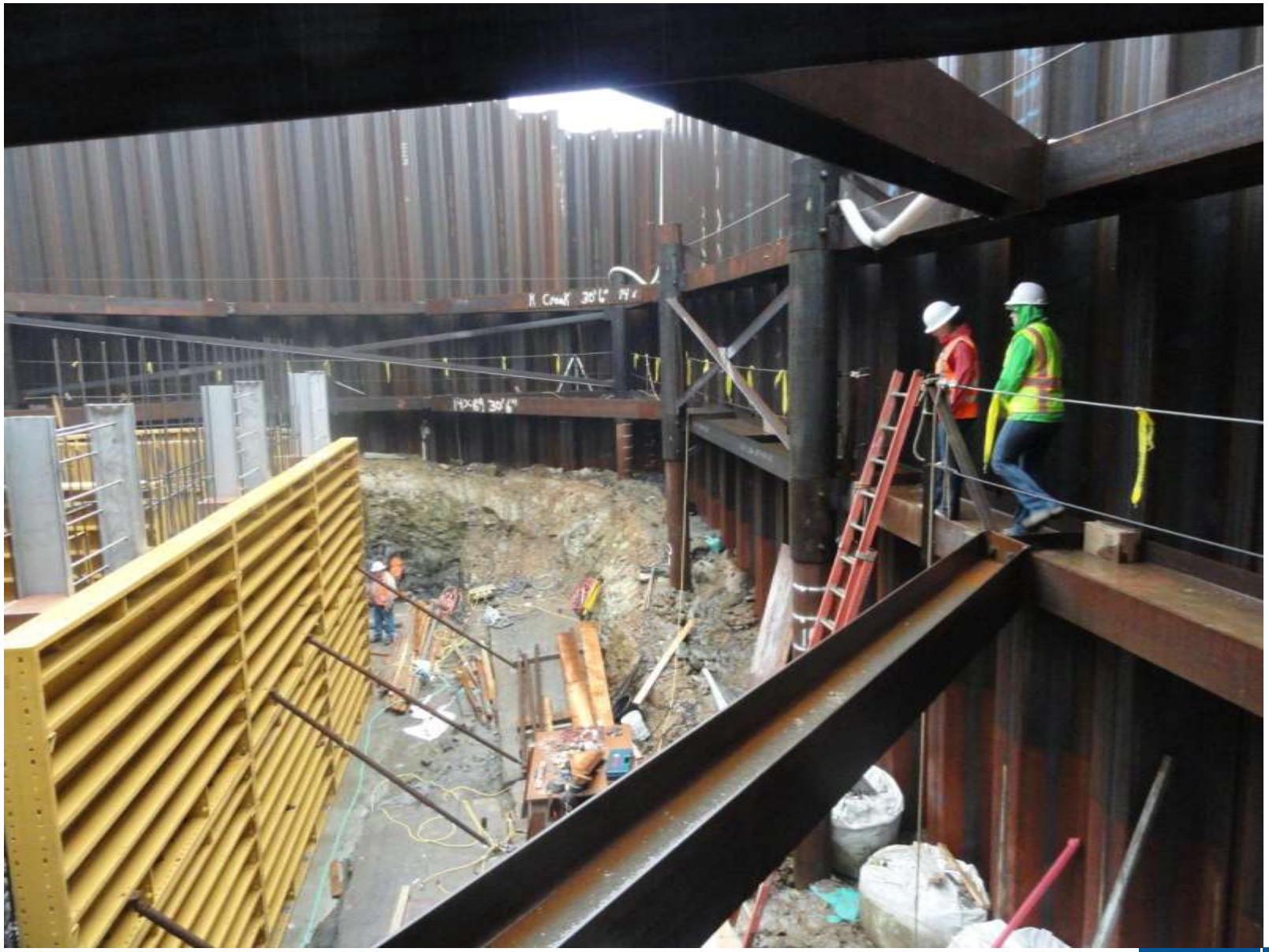
Spud pile installation

Driving sheet piles

Completed cofferdam before dewatering

Preparing foundation rebar

CONSTRUCTION



COFFERDAM BREACH

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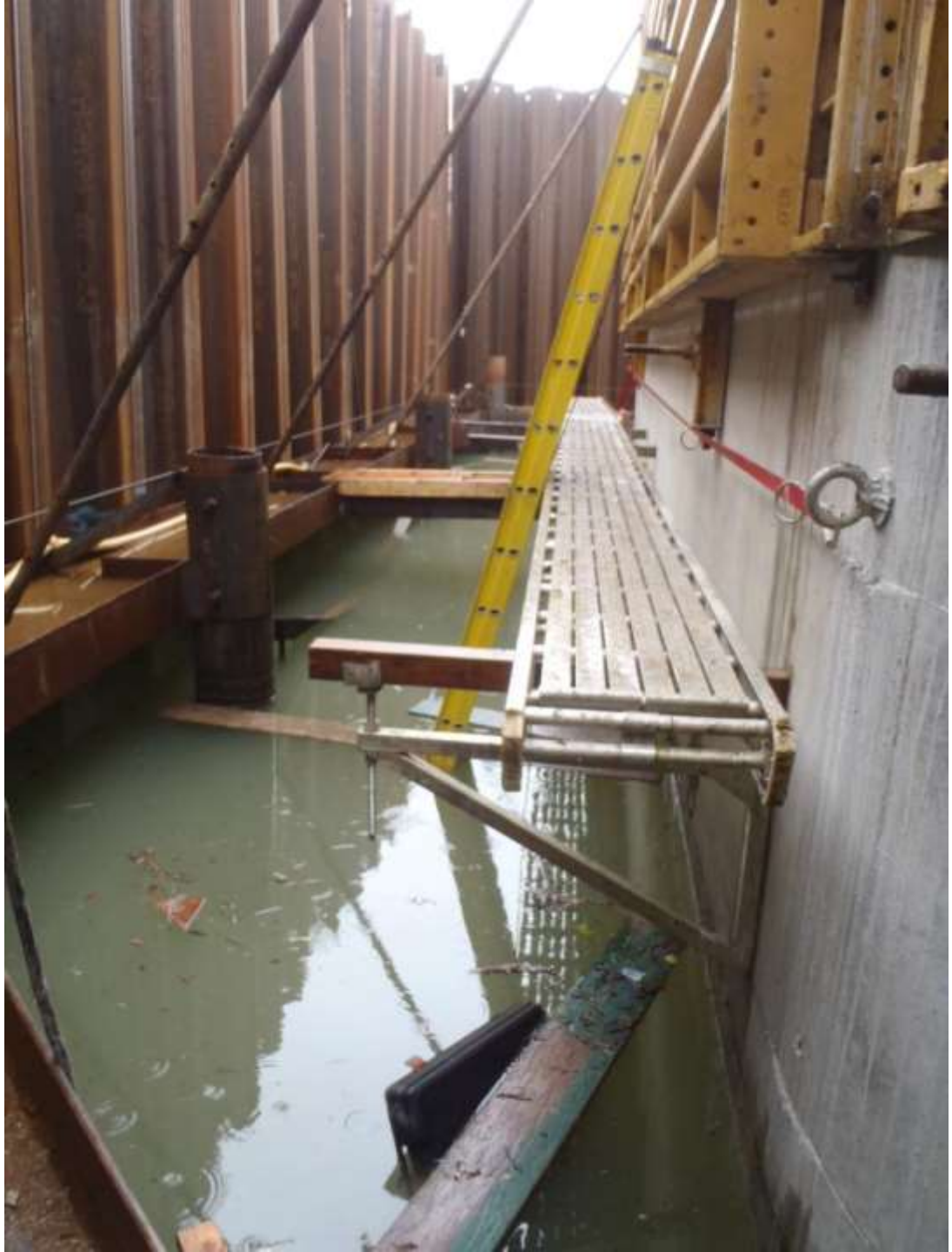

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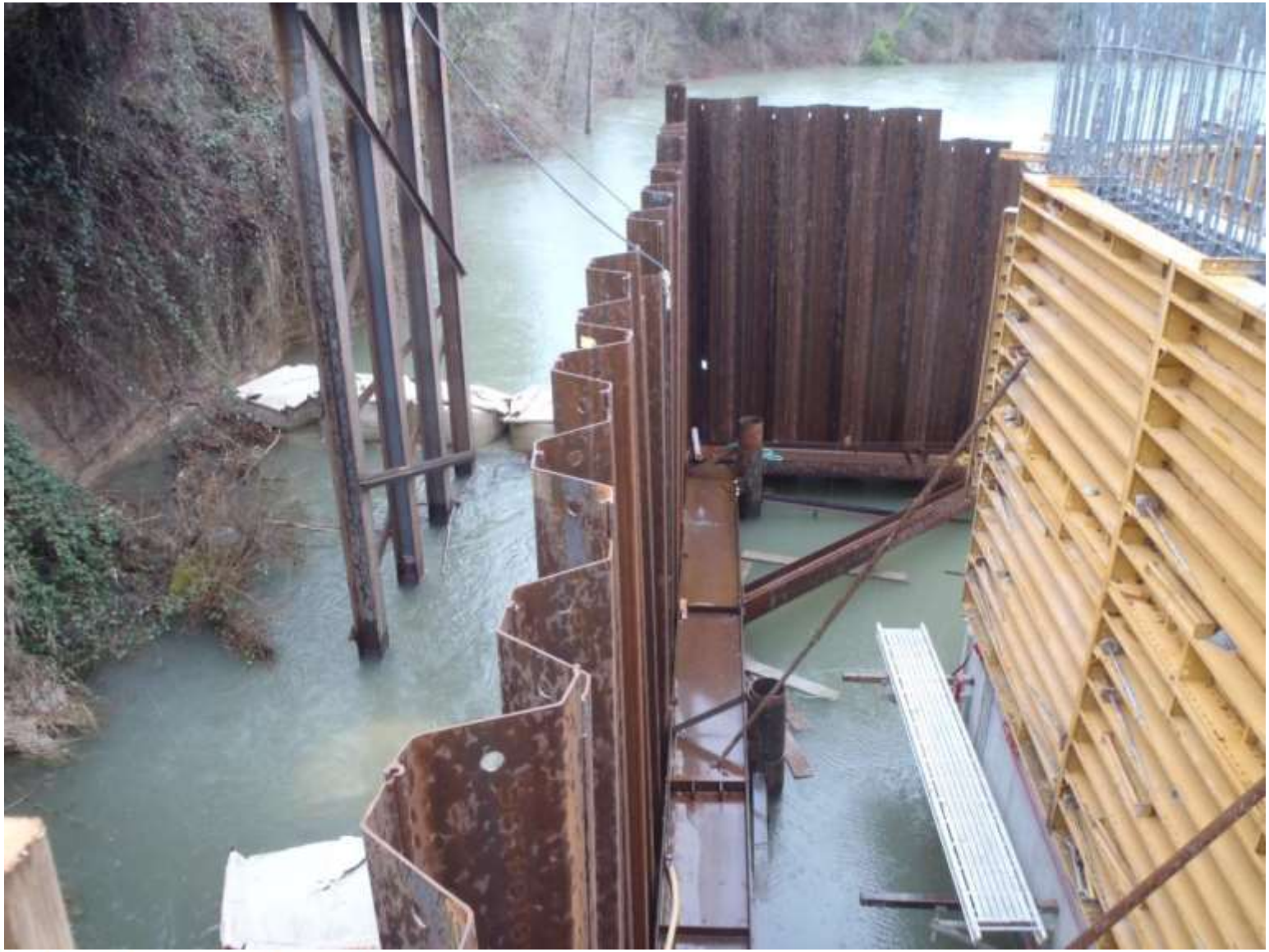

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COFFERDAM FAILURE

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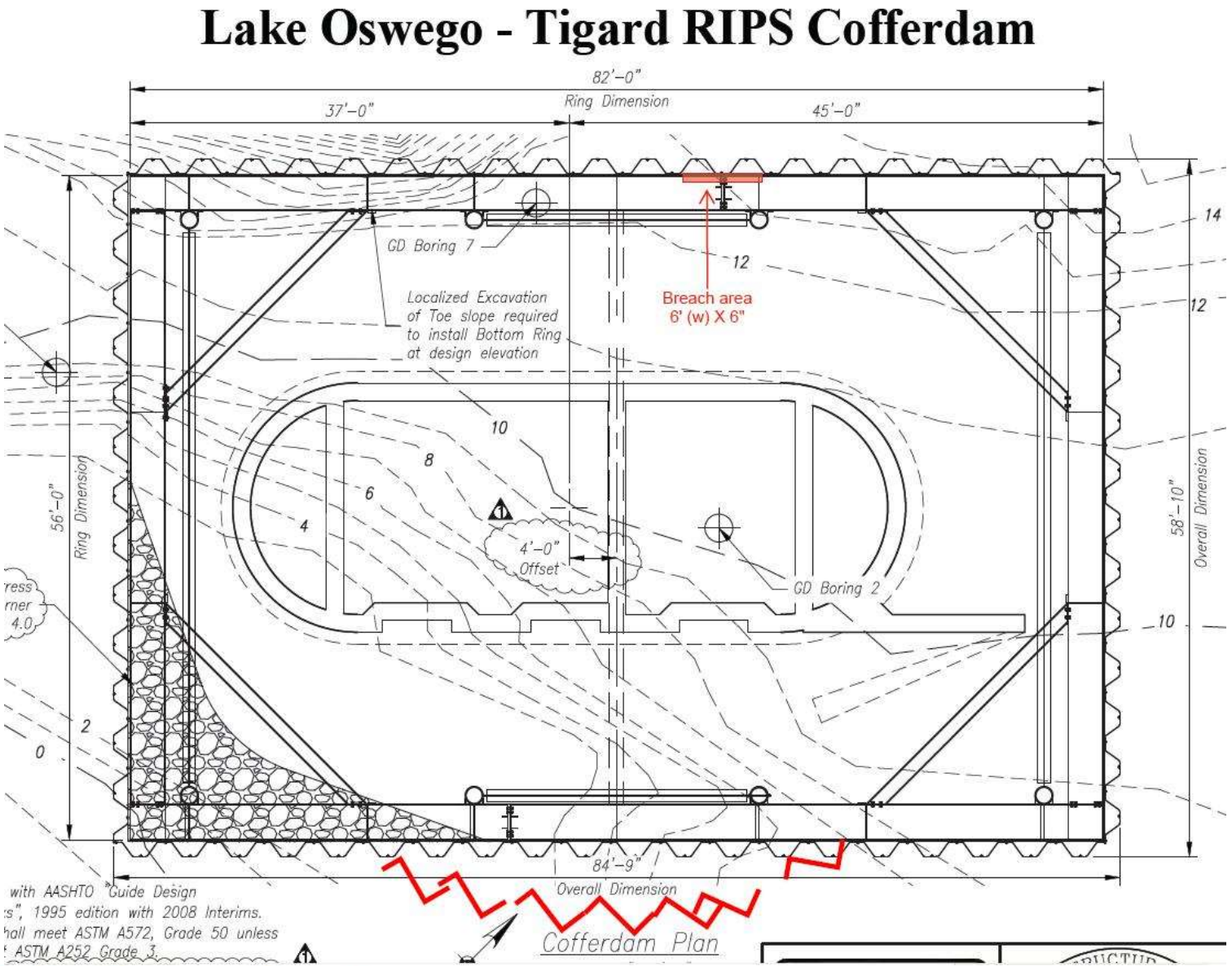

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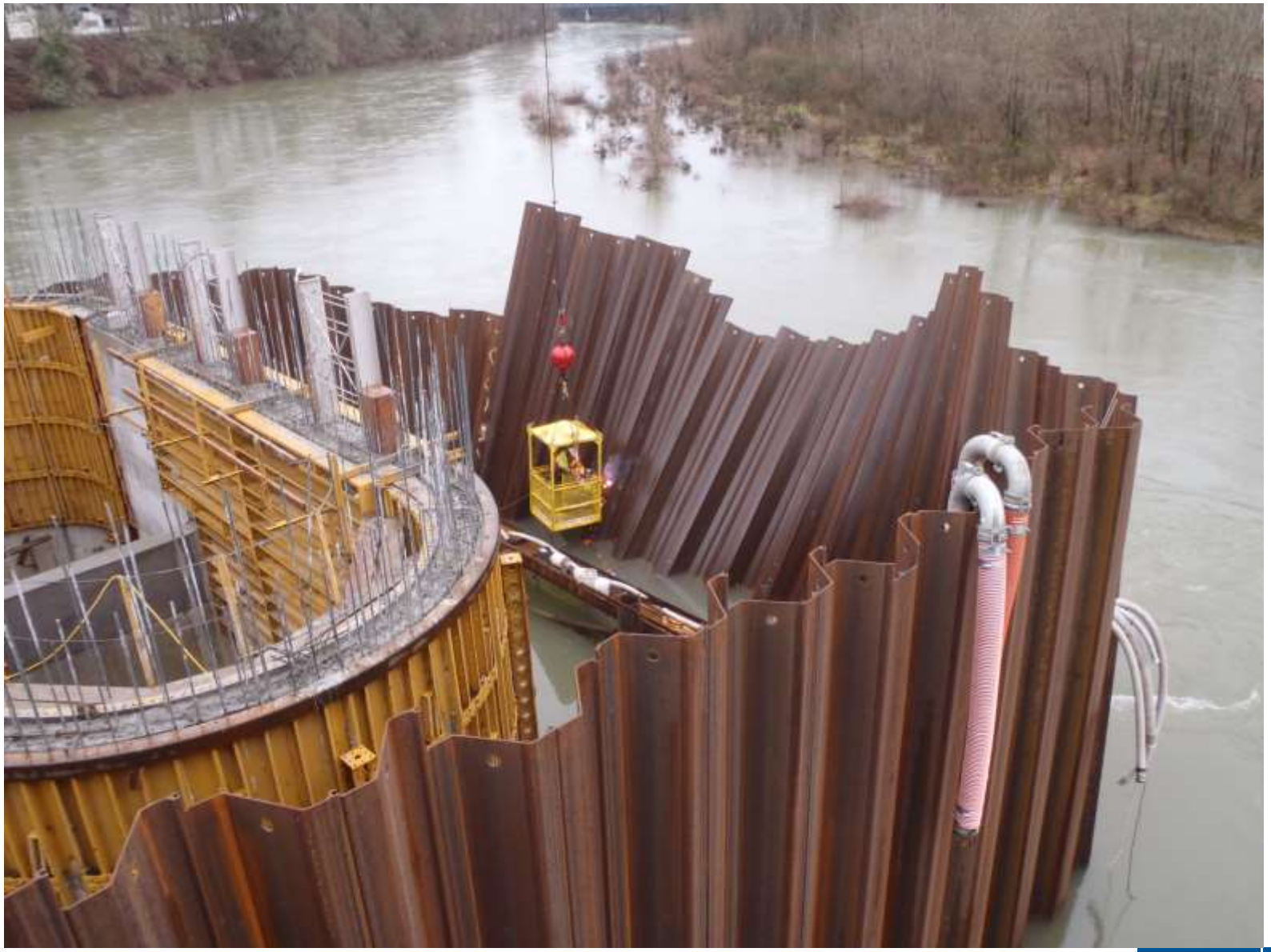
COFFERDAM STABILIZATION



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QUESTIONS?

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