Washington State Department of Transportation

SR 520 Bridge Replacement Program

Test Pile Project Results

Presented by
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HDR Engineering Inc.

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Agenda

- Introduction
- In-Water Work Activities
- Test Pile Project Objectives
- Noise Reduction Results
- In-water Work Windows
- Lateral Load Test Results

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Introduction

- $4.65B Project
- Enhance Safety and Reliability
- Replaces World's Longest Floating Bridge

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Project Location

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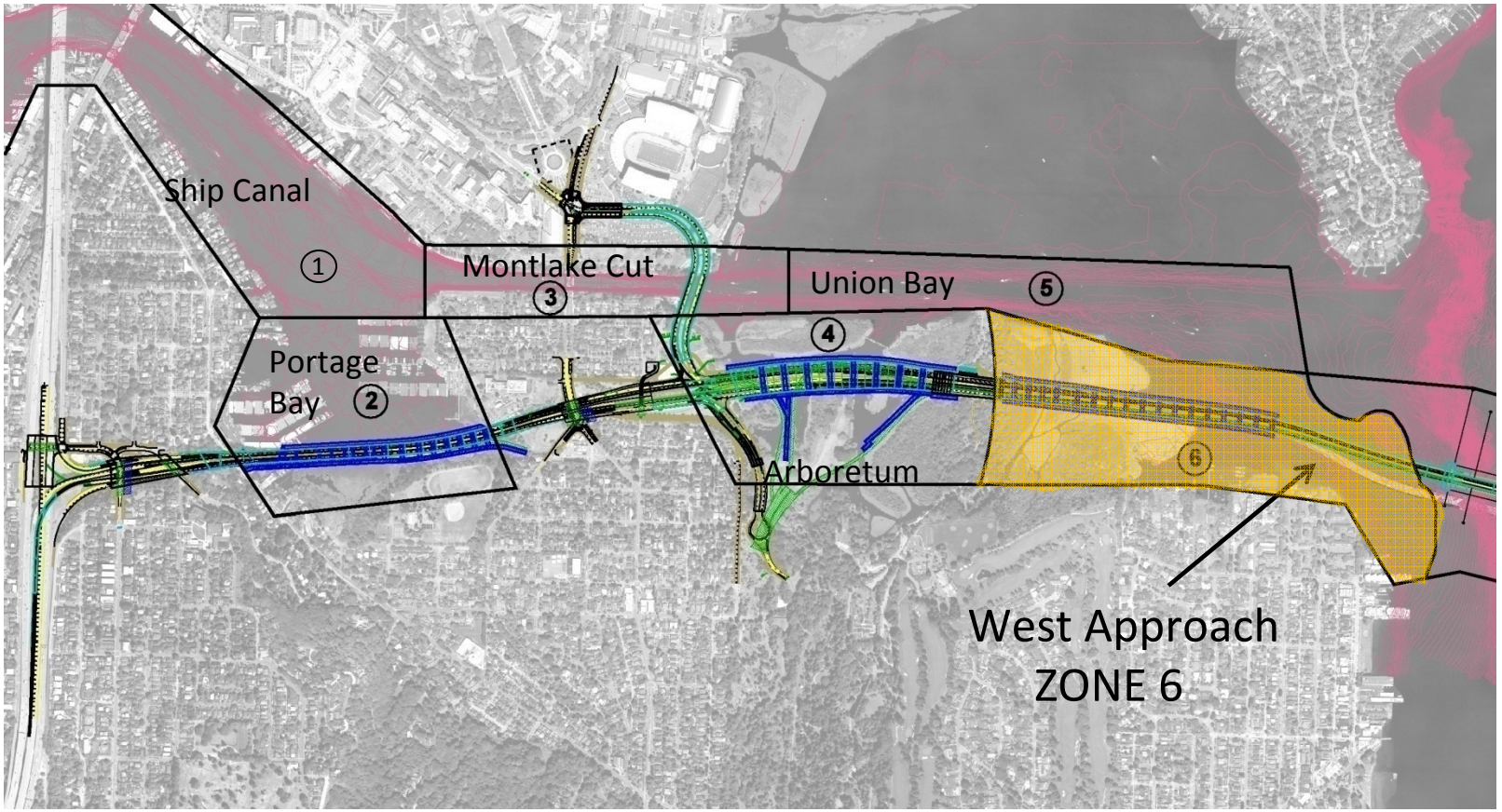
How Do You Construct a Project and Protect Endangered Species?



- Defined Fish Zones

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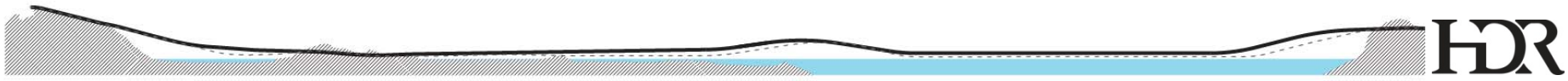
Fish Zone #6

Species	Life History Stage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Chinook	-Adult						Low	High	High	High	Low		
	-Residual	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal
	-Juvenile			Low	Low	High	High	High	Low				
Steelhead	-Adult	Low	Low	Low	Low	Low	Nominal						Nominal
	-Residual	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal
	-Juvenile		Nominal	Nominal	Nominal	Low	Low	Low	Nominal				
Sockeye	-Adult	Nominal				Low	High	High	High	Low			Nominal
	-Juvenile Rearing	High	High	High	High	High	High	High	High	High	High	High	High
	-Juvenile Out migrating			Low	High	High	High	High					
Coho	-Adult								Low	High	High	High	Low
	-Juvenile			Low	High	High	High	Low					
Bull Trout	-Sub Adult	Nominal	Nominal	Nominal	Low	Low	Low	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal

Nominal Presence
Low Presence
High Presence

High Presence



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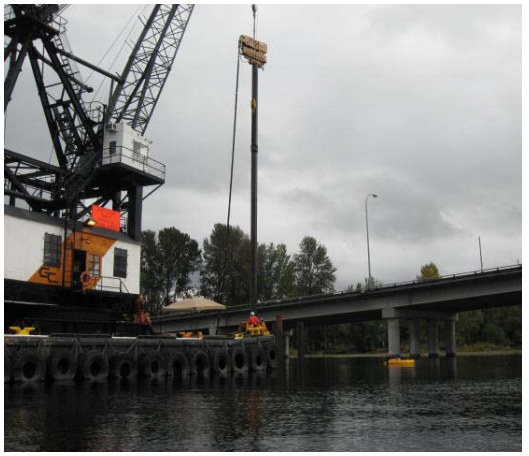
In-Water Work Activities

- **Impact Pile Driving**
- **Drilled Shaft – Template Pile Installation**
- **Drilled Shaft – Casing Vibration**
- Drilled Shaft – Concrete Pour Within Casing
- Drilled Shaft – Shaft Dewatering/Soil Excavation
- **Pile Removal**
- Above Water Work



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Fish Zone #6: In-Water Work Activities

Driven Piles	950
Shaft Casings	125
Pile Removal	1180

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Fish Zone #6: In-Water Work Windows

Construction Activity	Steps/Components	Proposed Work Window											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Work Bridges Installation	Shoreline access												
	Pile Driving												
	Above water work												
Drilled Shafts	**Template Piles/ Casing Vibration**												
	Shaft dewatering/excavation												
	Concrete pour w/in shaft												
Ex Br Removal	Above water work												
	Piling removal												
Work Bridges Removal	Above water work												
	Pile Removal												

Indicates No In-Water Work Permitted

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Test Pile Project Objectives

- Test Effectiveness of Noise Attenuation Methods
- Determine the Feasibility of Removing Piles
- Determine Lateral Load Characteristics of Soft Soils

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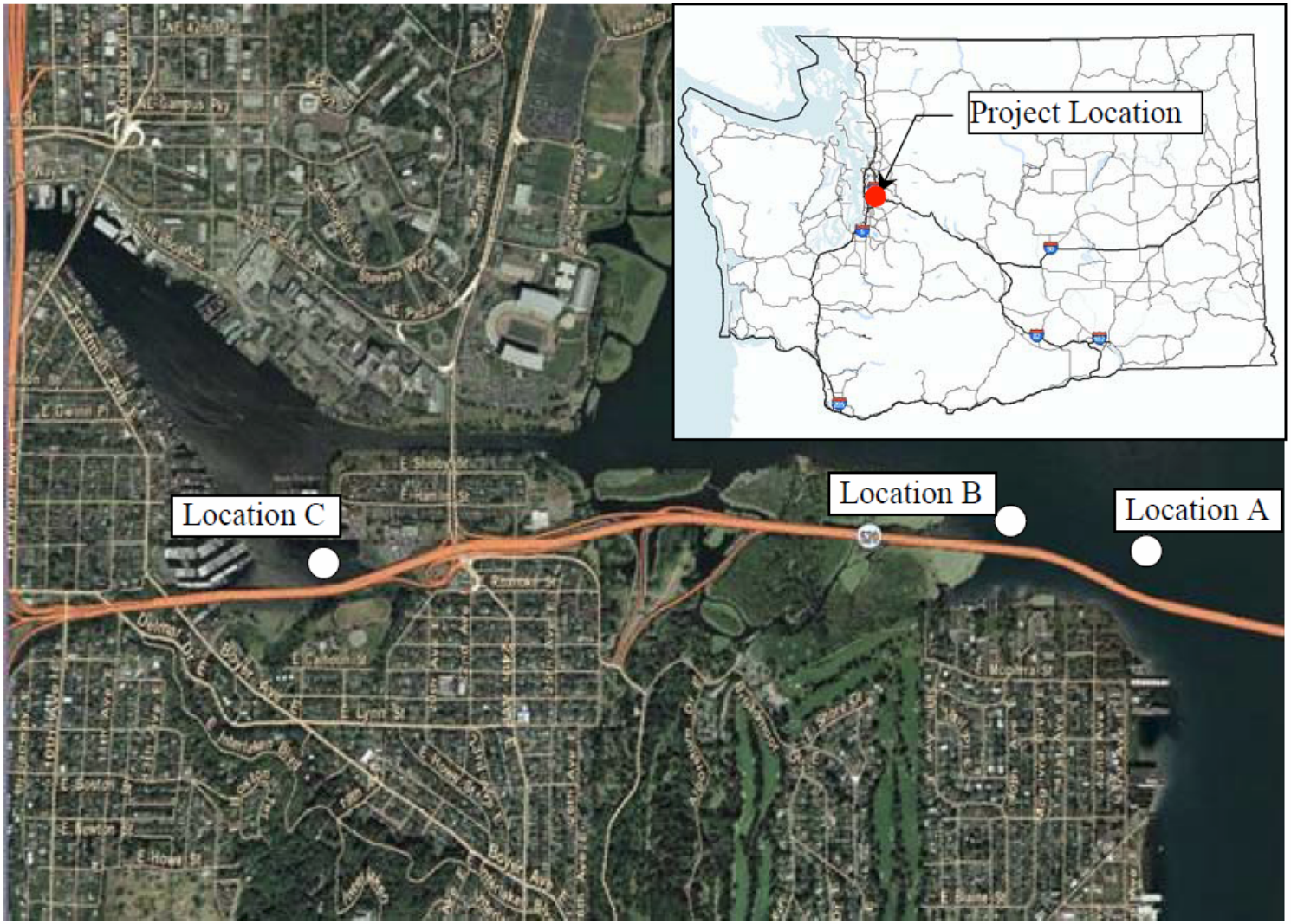
Test Locations



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Other Benefits

- Barge Access to Shallow Water Areas
- Length, Capacity and Drivability of Piles
- Ability to Extract Piles
- Effectiveness of Noise Attenuation Devices

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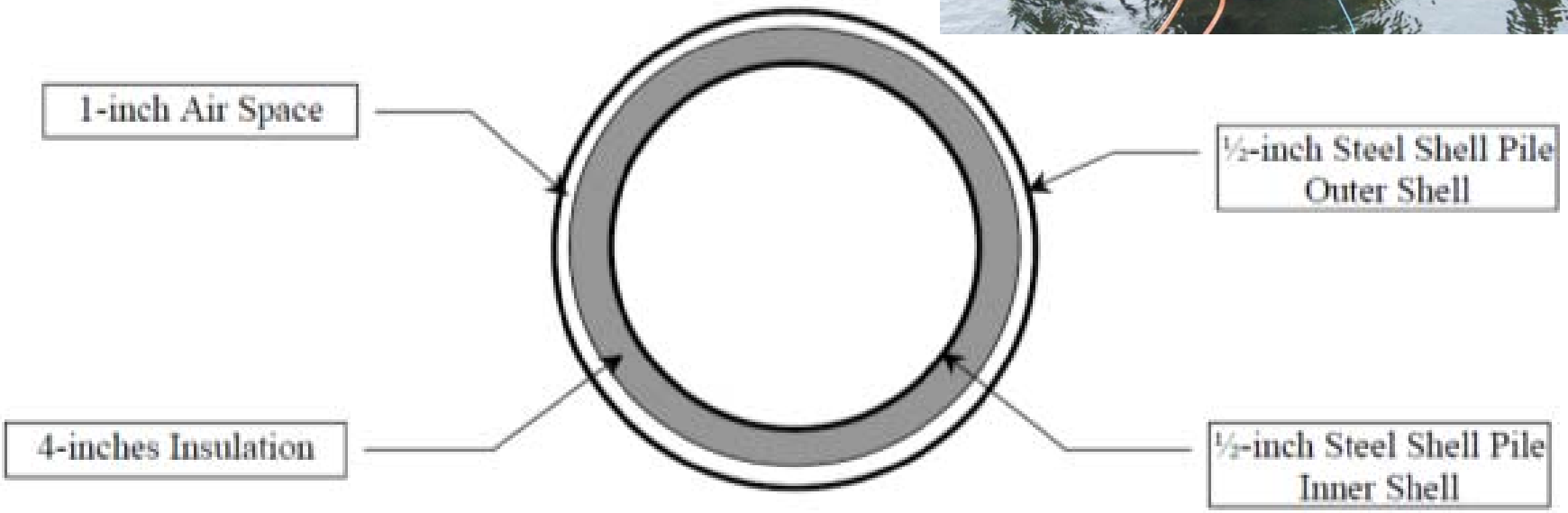
Summary of Noise Monitoring Results

- Double Walled Noise Attenuation Pile (DNAP)
  – Minimal Reduction (4dB)



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Summary of Noise Monitoring Results

- Confined and Unconfined Bubble Curtains – 20 to 30 dB Reductions

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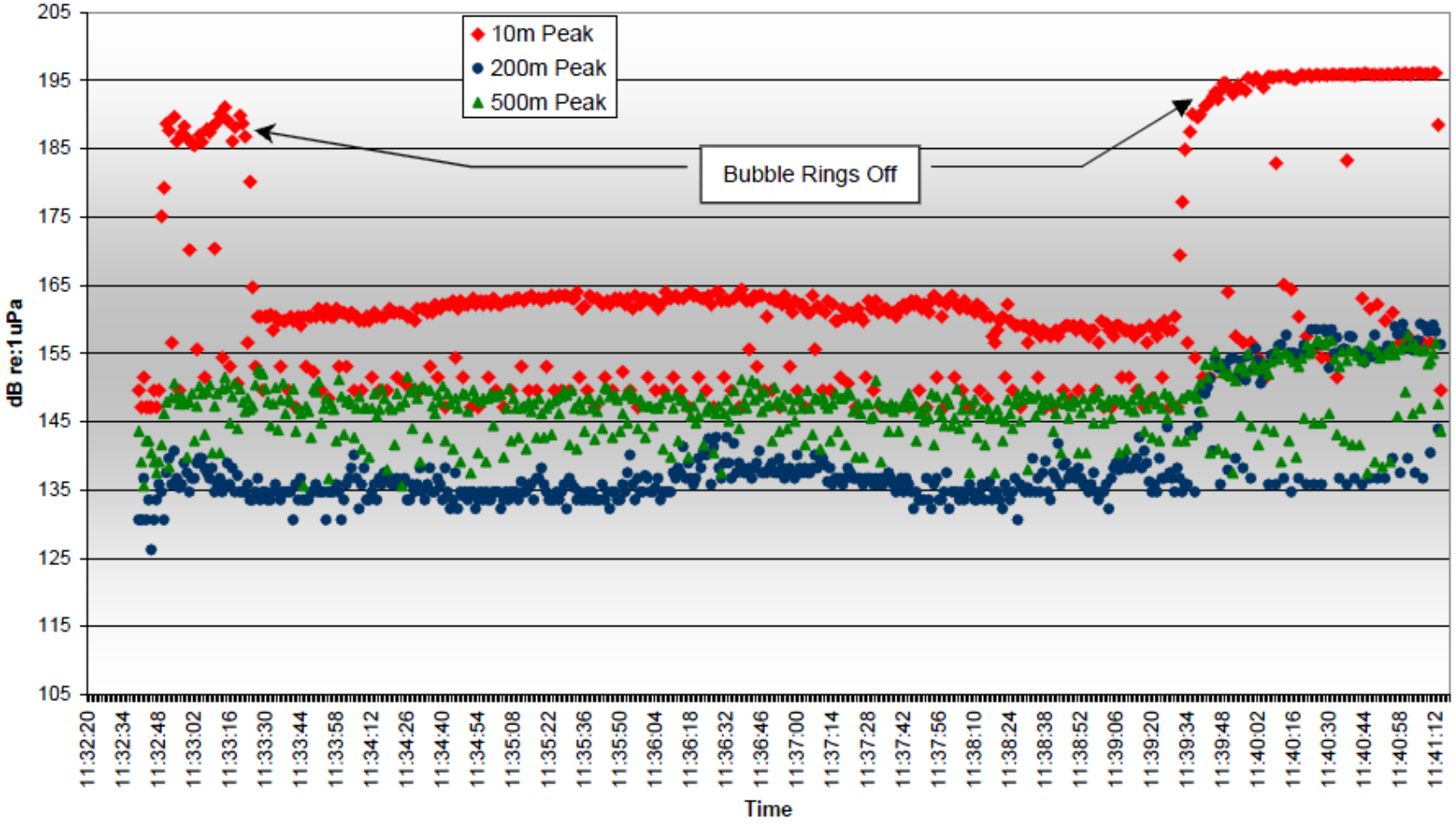
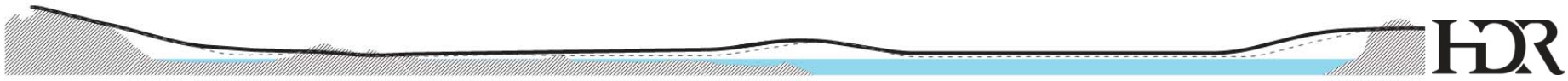
Effectiveness of Bubble Curtain





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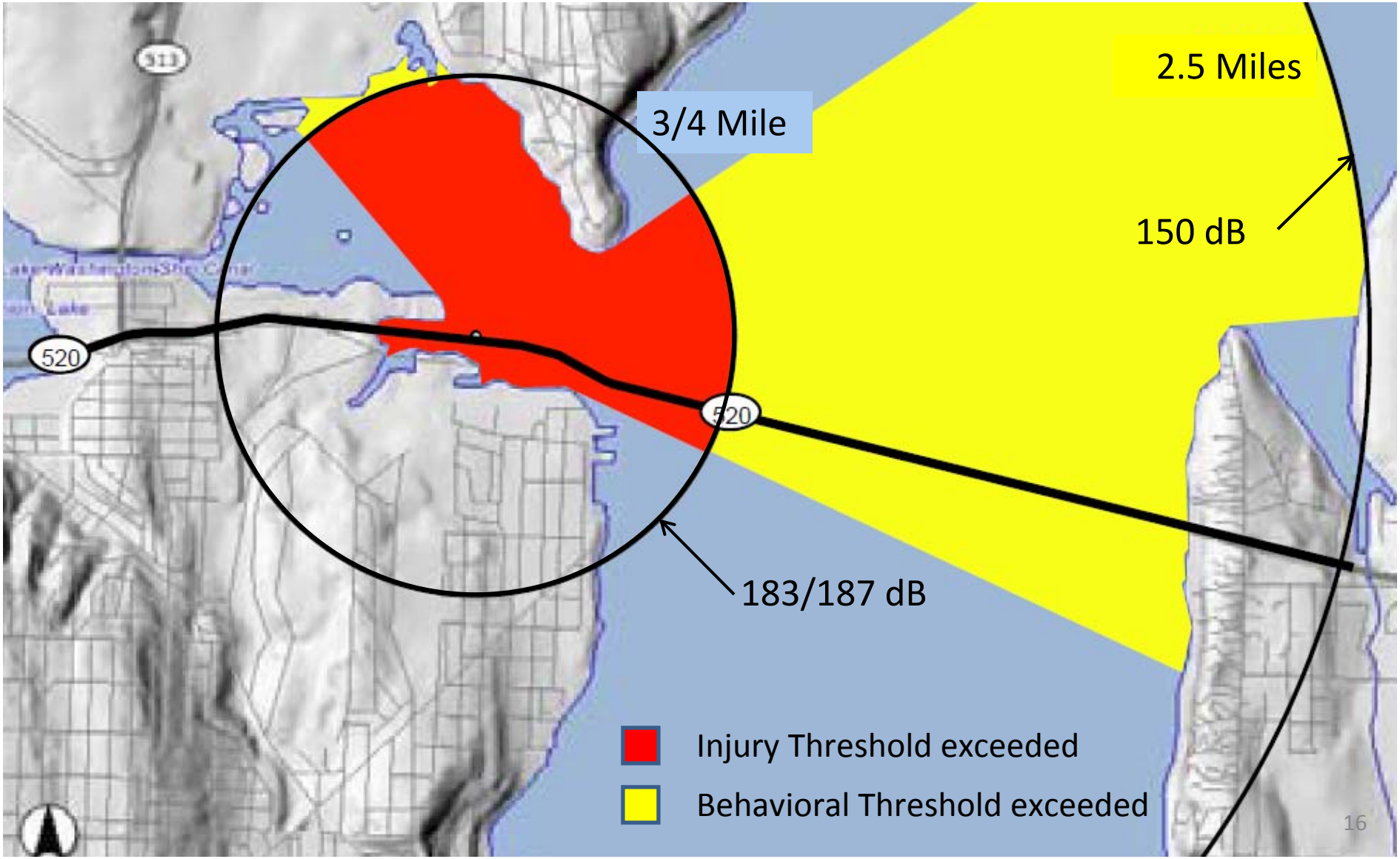

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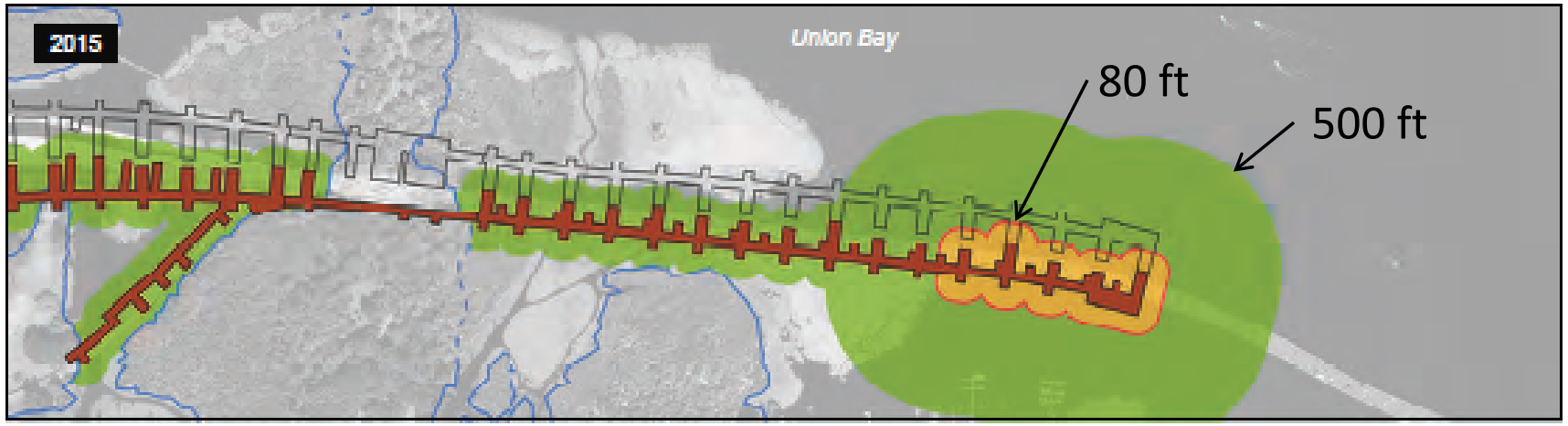
Bubble Curtain Noise Reduction



West Approach

Behavioral Threshold exceeded (150 dB), 96% Reduction

Injury Threshold exceeded (183/187 dB), 98% Reduction

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In-Water Work Windows- Before Test

Construction Activity	Steps/Components	Proposed Work Window											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
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	Above water work												
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Ex Br Removal	Above water work												
	Piling removal												
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In-Water Work Windows- After Test

Construction Activity	Steps/Components	Proposed Work Window											
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Indicates No In-Water Work Permitted

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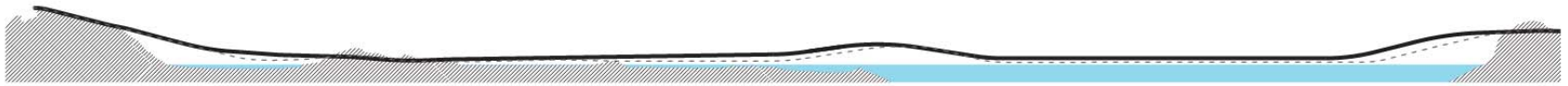
Noise Attenuation Summary

- The Fish Injury Threshold Reduces by 98%
- The Behavioral Fish Threshold Drops by 96%
- Significantly Reduced Mitigation for Affects on Fish
- Increased In-water Work Windows by 2 Months



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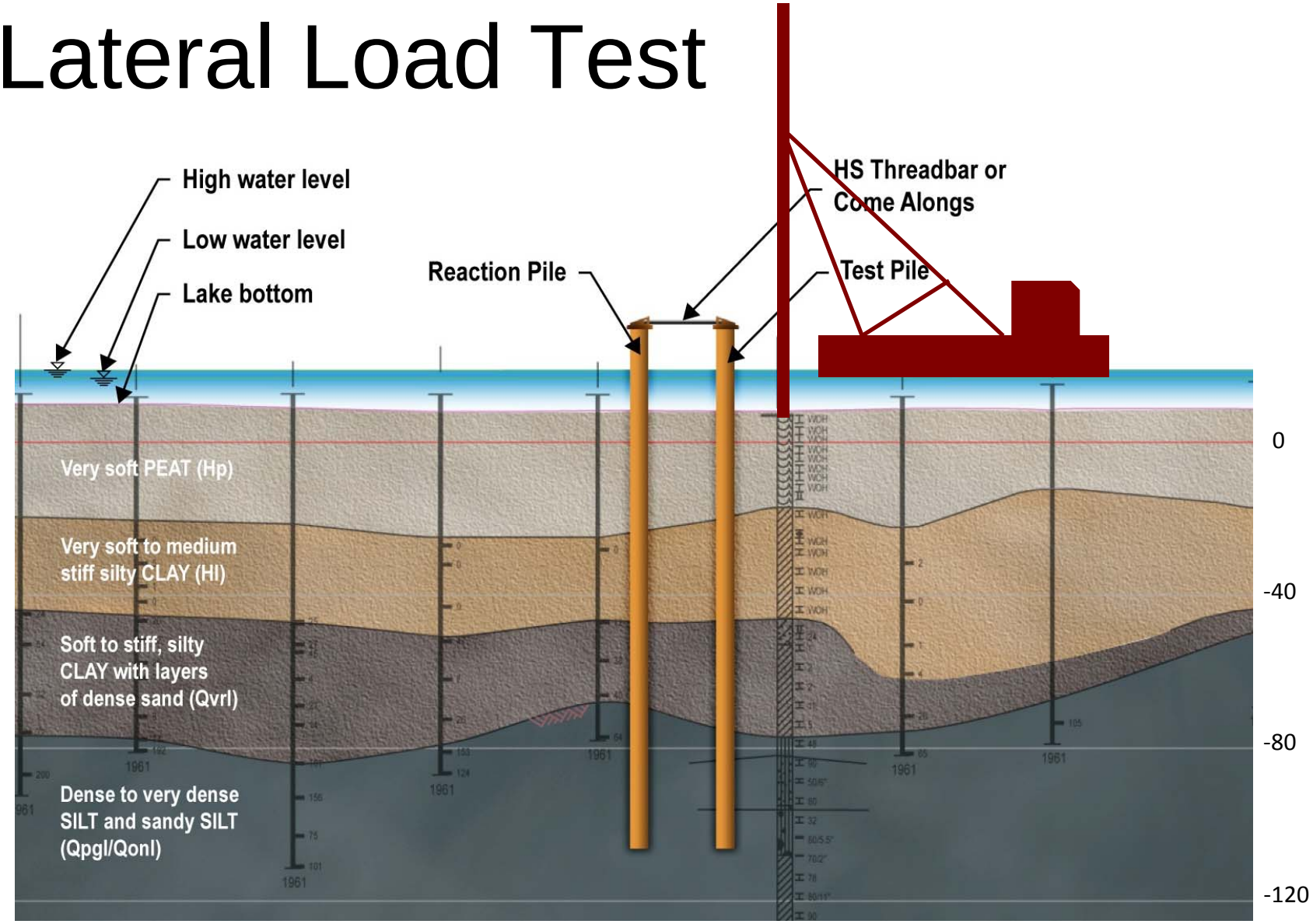
Lateral Load Test



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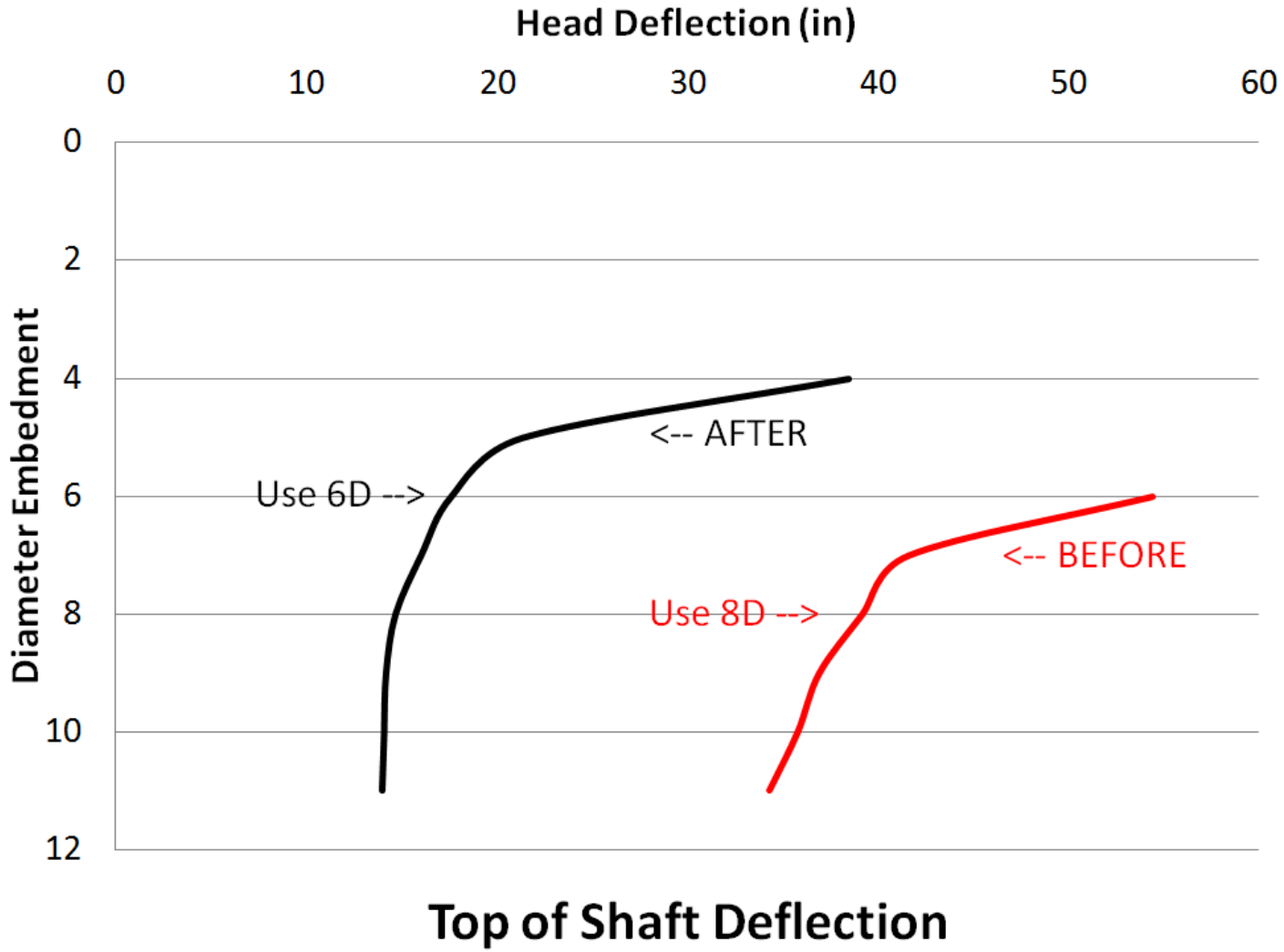
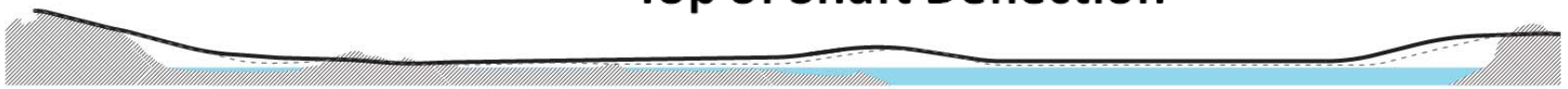
Depth of Embedment





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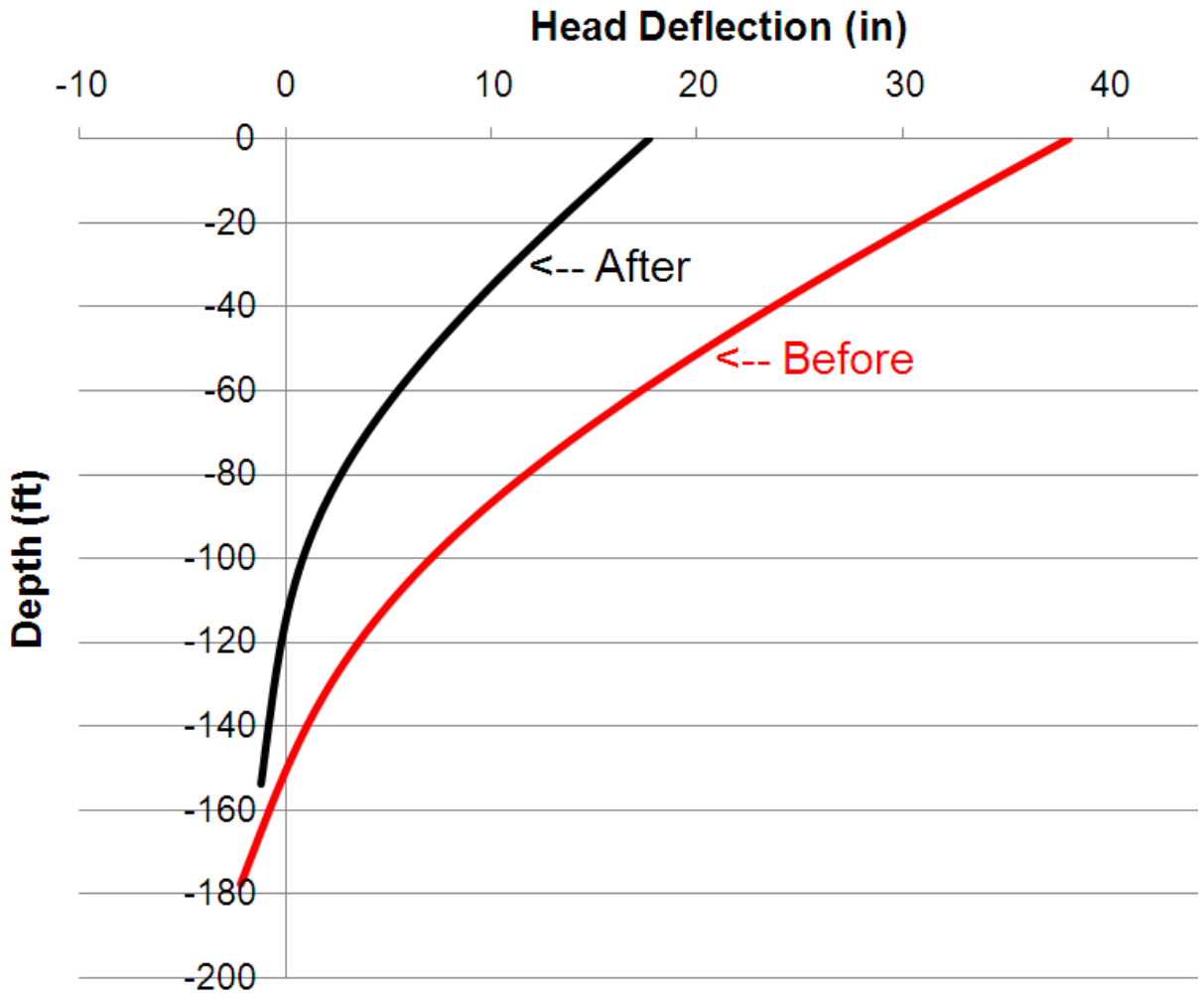
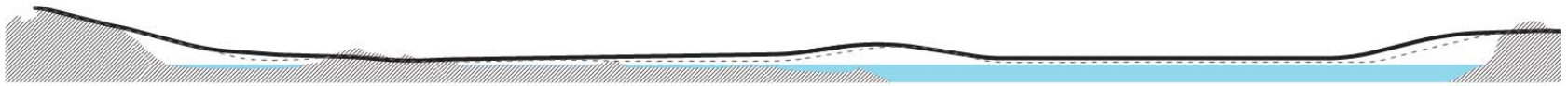
Shaft Deflection





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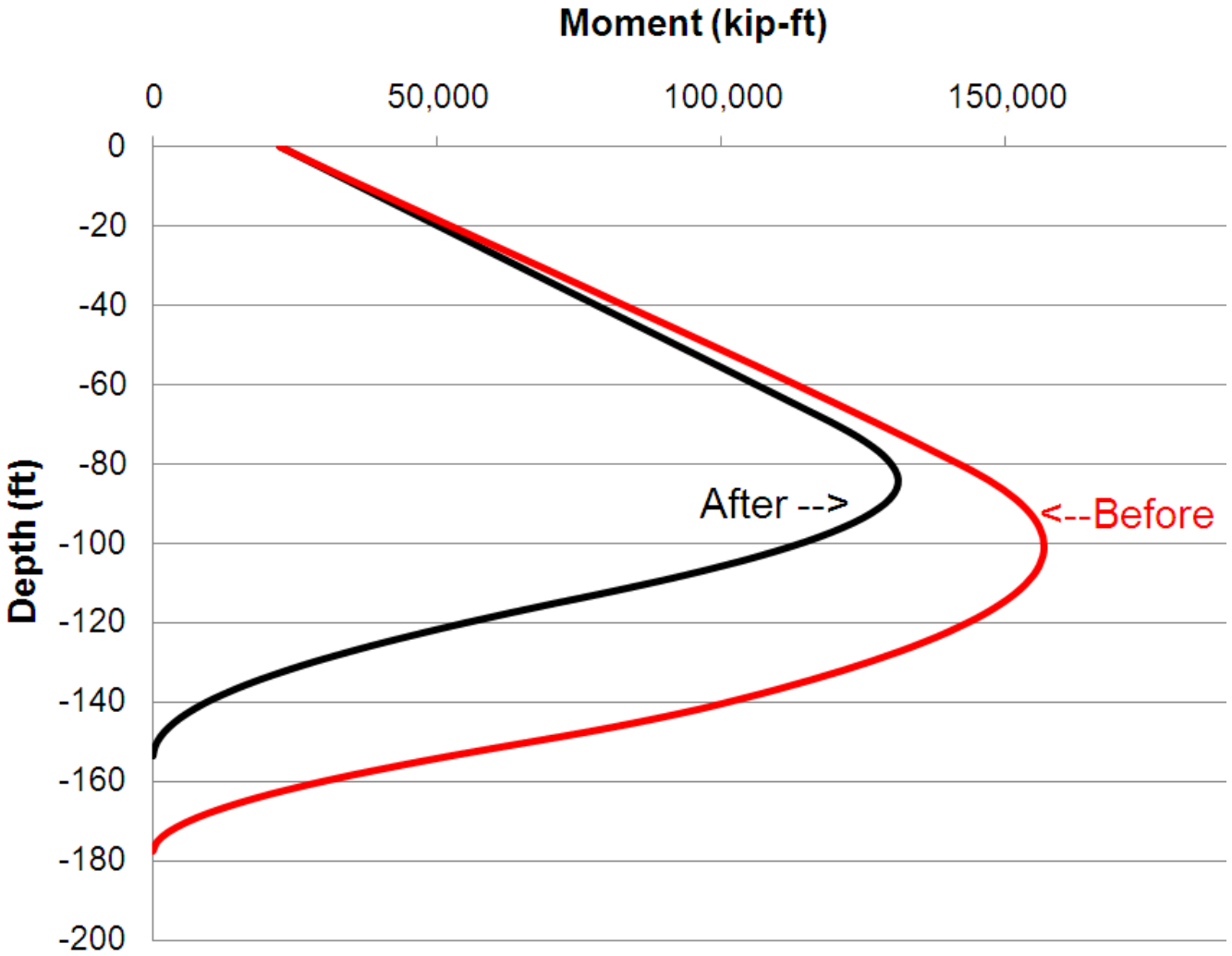
Moment Curve



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Lateral Load Test Summary

- Reduced deflections at top by 50%
- Reduced moments in shaft by 20%
- Reduced depth of embedment by 15%
- Reduced cost of shafts by 25%
- $10M Savings

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SR 520 Bridge Replacement Program

Test Pile Project Results

Questions

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