Evaluation of Bridge Cleaning Methods on Steel Structures

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PennDOT Project PITT002

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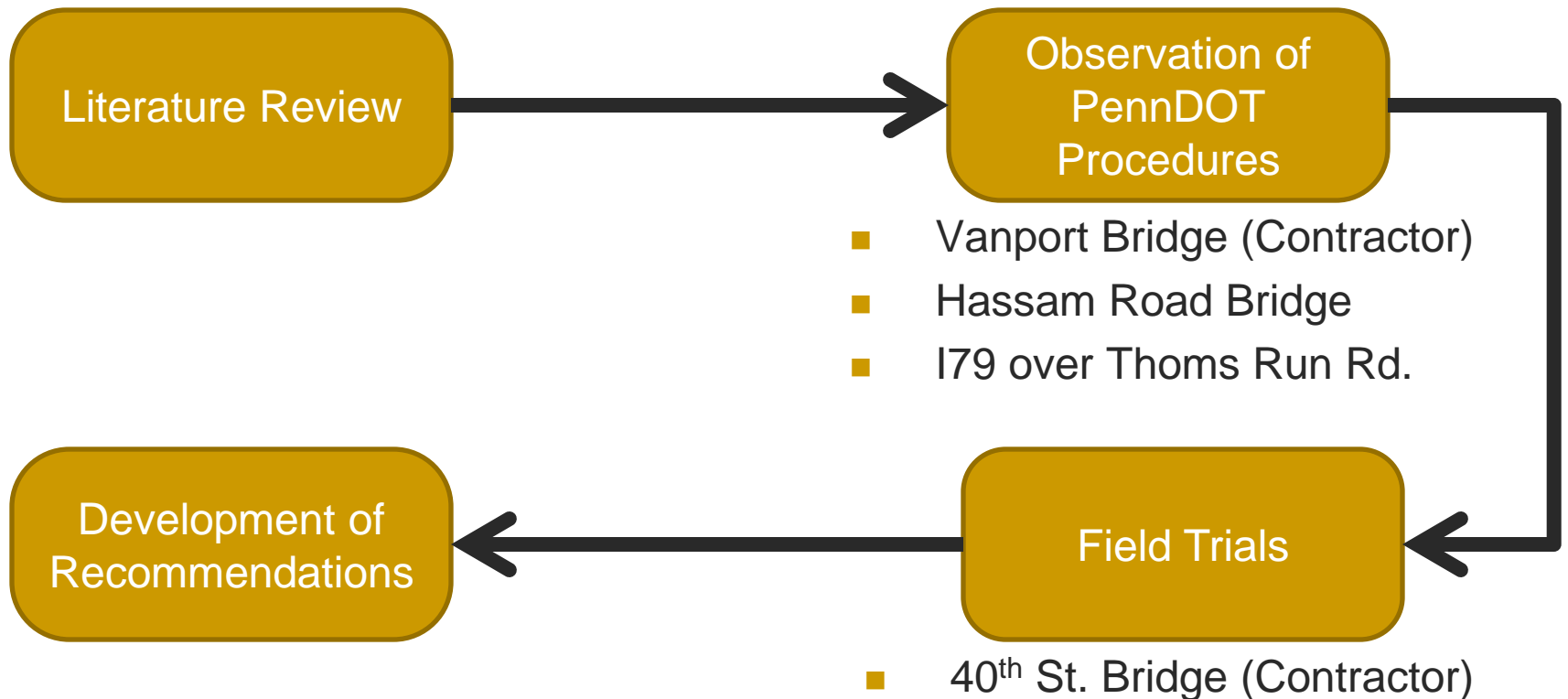
Purpose

Project Scope

- Determine the effectiveness and environmental impact of PennDOT bridge washing procedures.
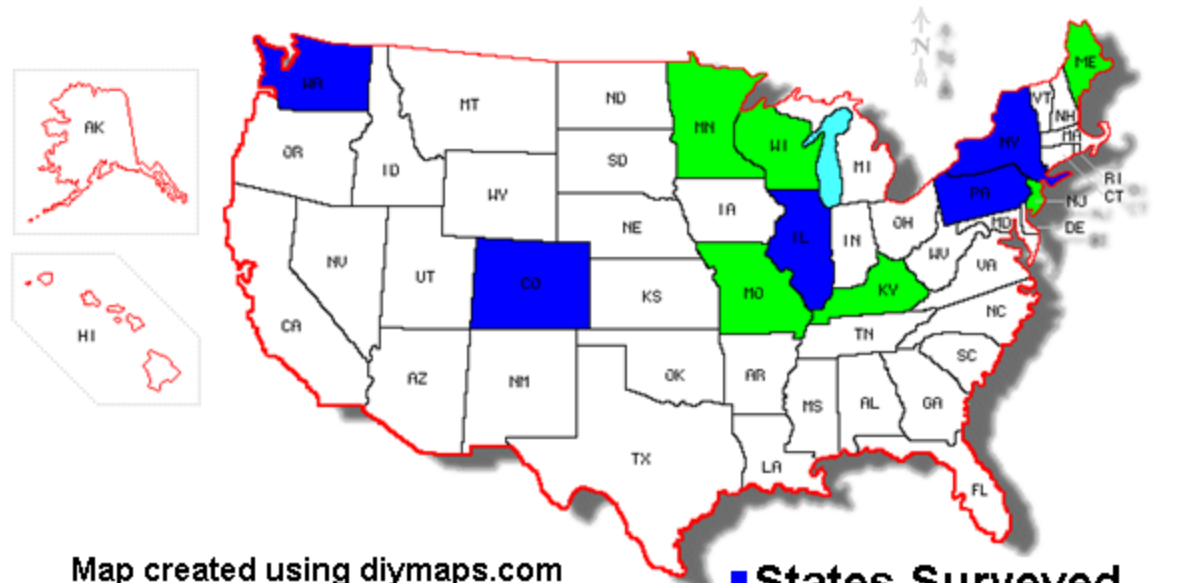
- Make recommendations on possible improvements.

Osmotic Blistering

Project Structure

Literature Review → **Observation of PennDOT Procedures**

- Vanport Bridge (Contractor)
- Hassam Road Bridge
- I79 over Thoms Run Rd.

Field Trials

- 40th St. Bridge (Contractor)

Development of Recommendations
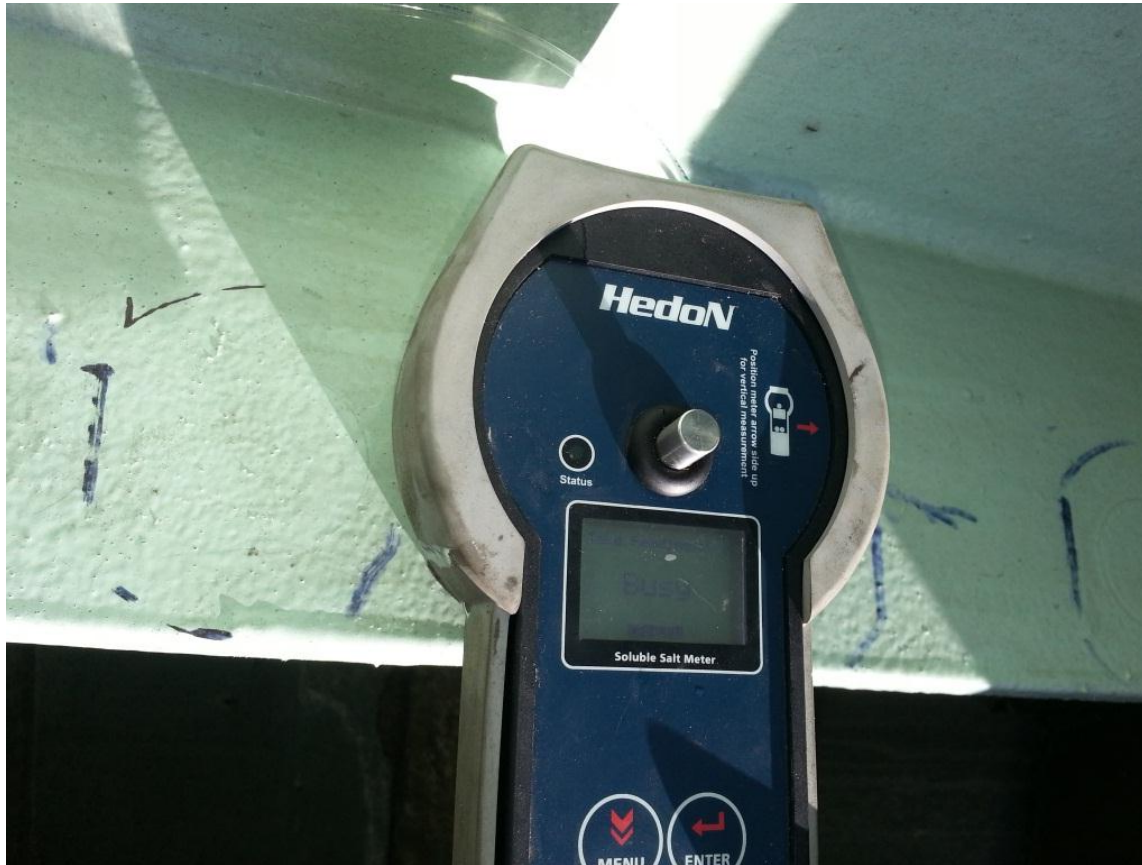
Review of Current Procedures

Map created using diymaps.com

■ States Surveyed

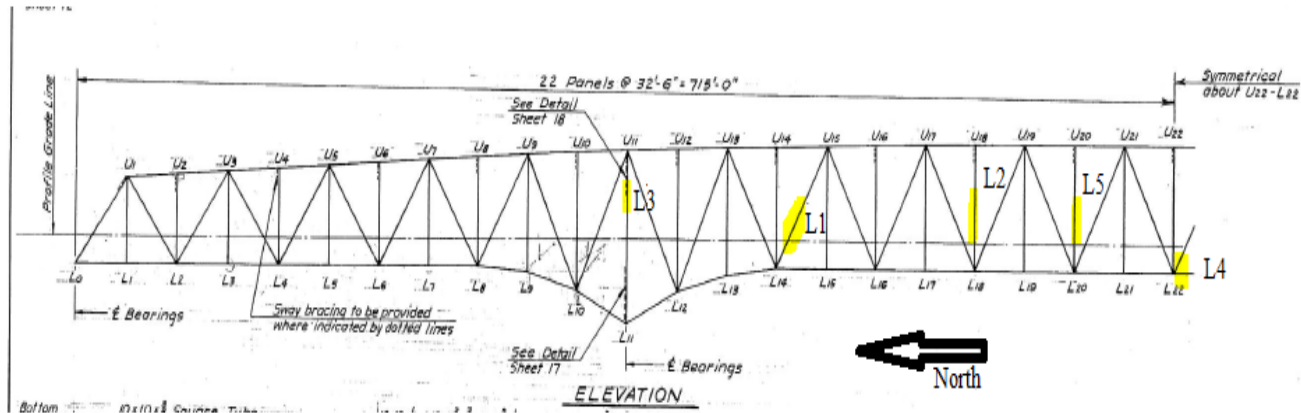■ States Reviewed Through Literature or Specifications

Soluble Salt Meter

Vanport Bridge

Image From Google Maps Streetview

Testing Locations

Location 1

Location 2

Location 3

Location 4

Location 5

Note: Image for Location 3 taken from Google Maps Streetview

Measured Salt Concentrations

Vanport Bridge Pre-Wash Surface Salt Concentrations		
Location	Mean SSC (mg/m^2)	Statistically Similar Location
3	31	5
5	27	2,3
2	21	5,4
4	14	2,1
1	13	4

Post-wash surface salt concentrations were significantly lower everywhere besides locations 4 and 5.

Location 5

Before
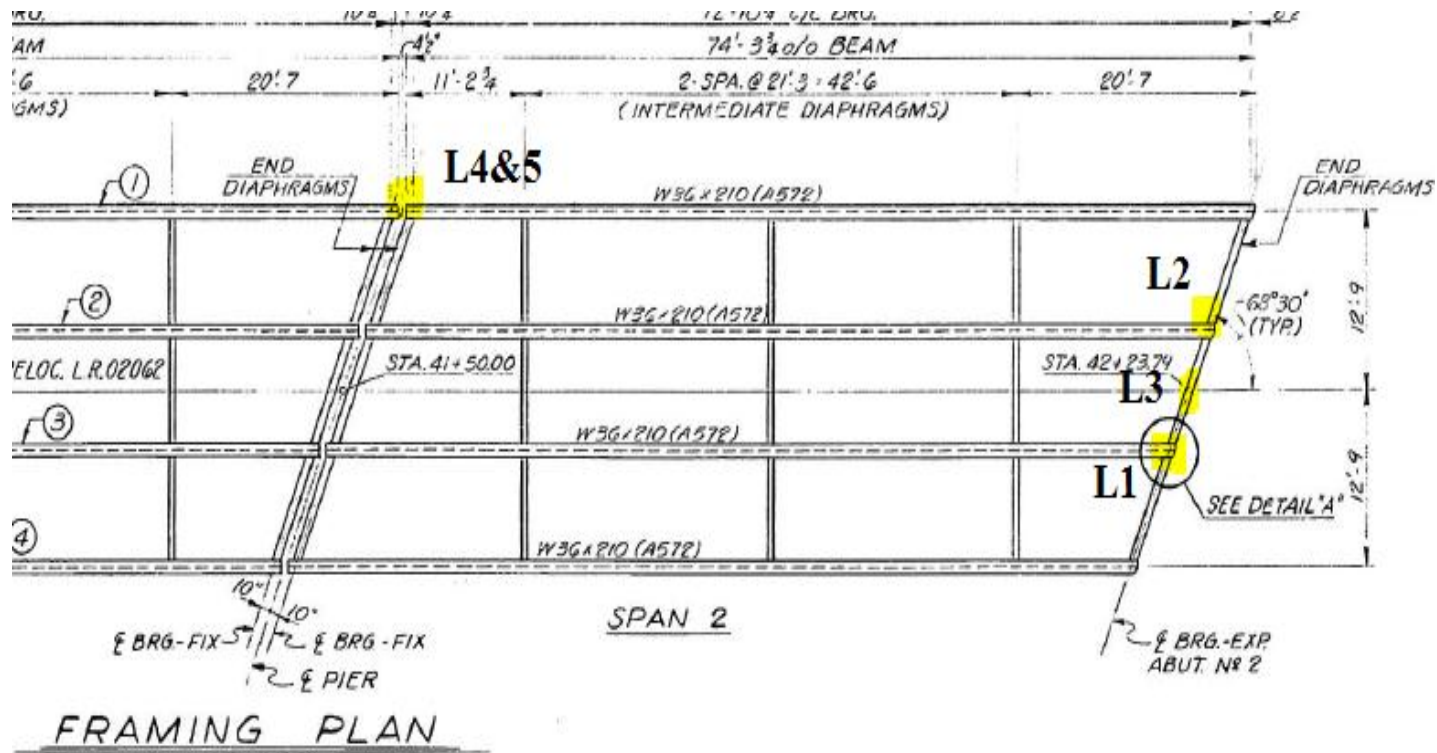

After

Location 5 Readings (mg/m^2)	
Before	After
30	37
24	278
28	44
	328

Hassam Road Bridge

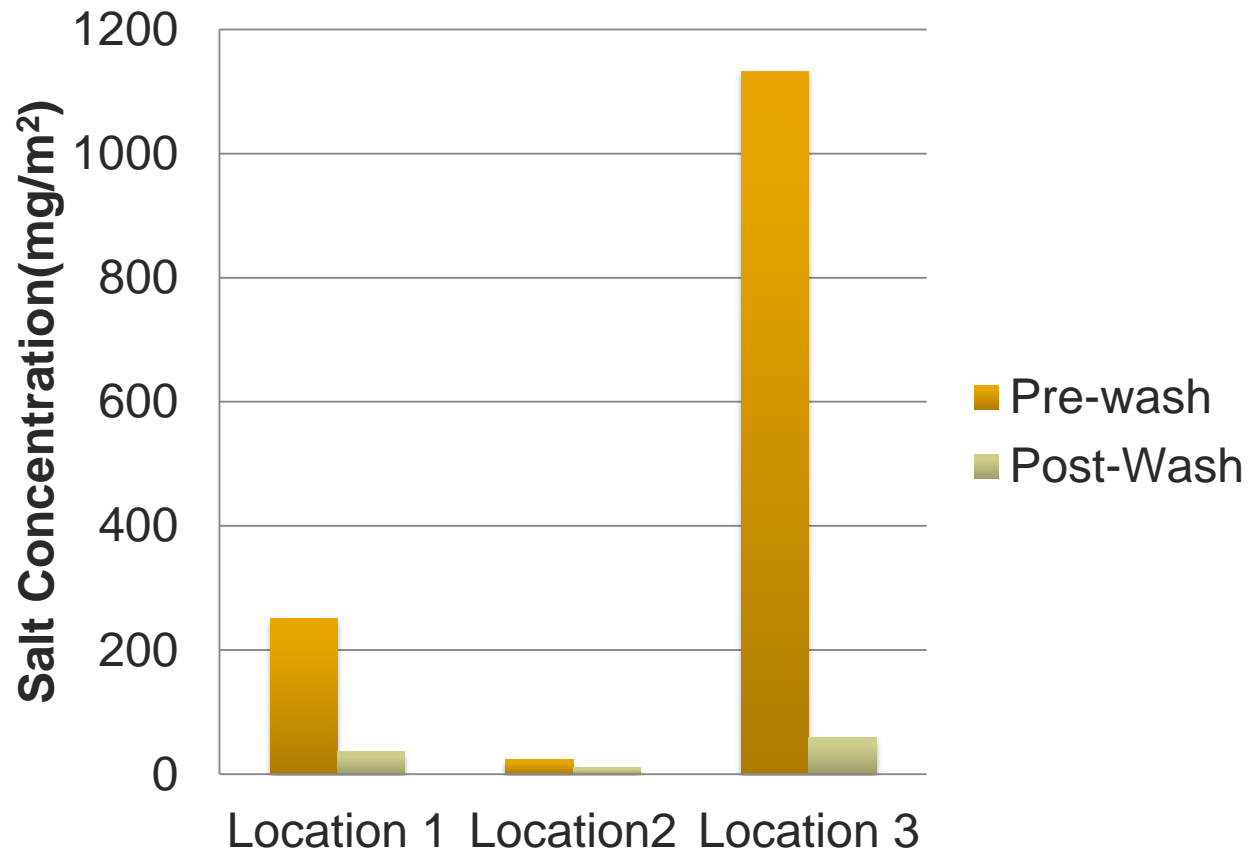# Testing Locations

Location 1

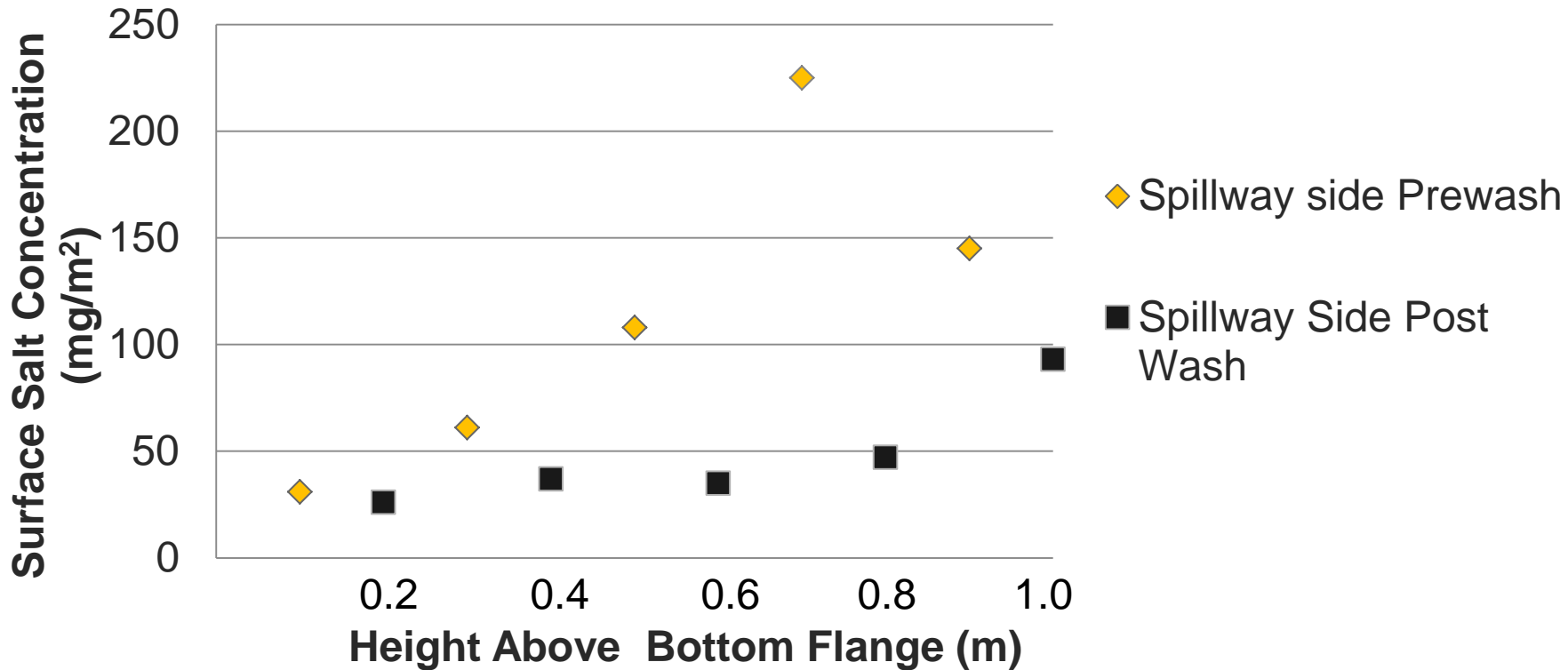Location 2

Location 3

Locations 4&5

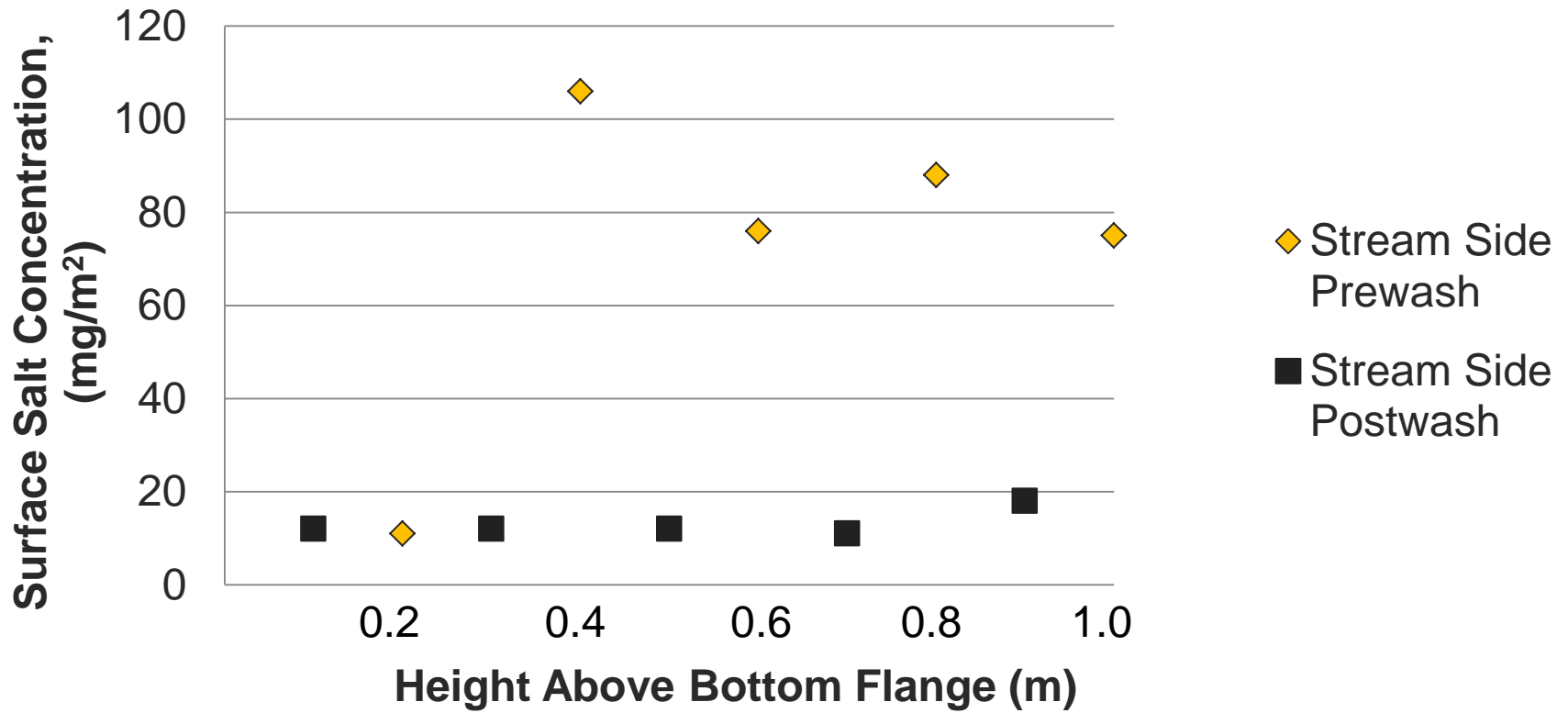# Results Locations 1, 2 & 3

Hassam Road Salt Concentrations

Locations 4 & 5 (Cont.)

Surface Salt Concentration On Spillway Side
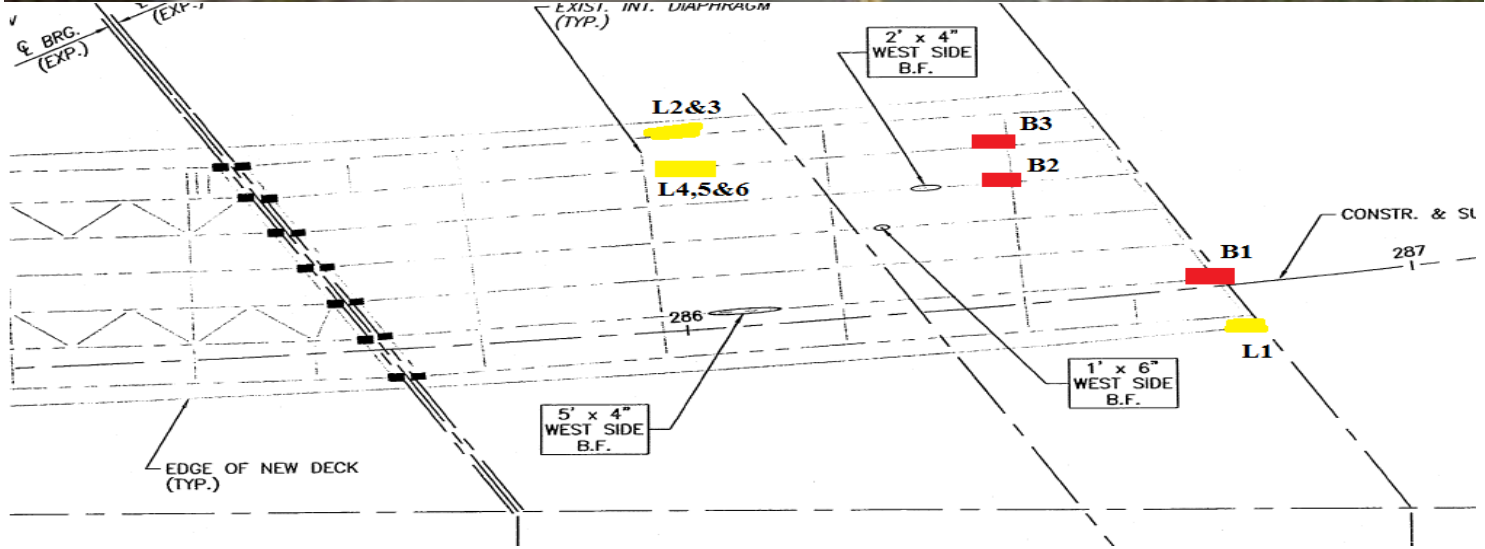
Locations 4 & 5 (Cont.)

Surface Salt Concentration Stream Side

I79 Bridge

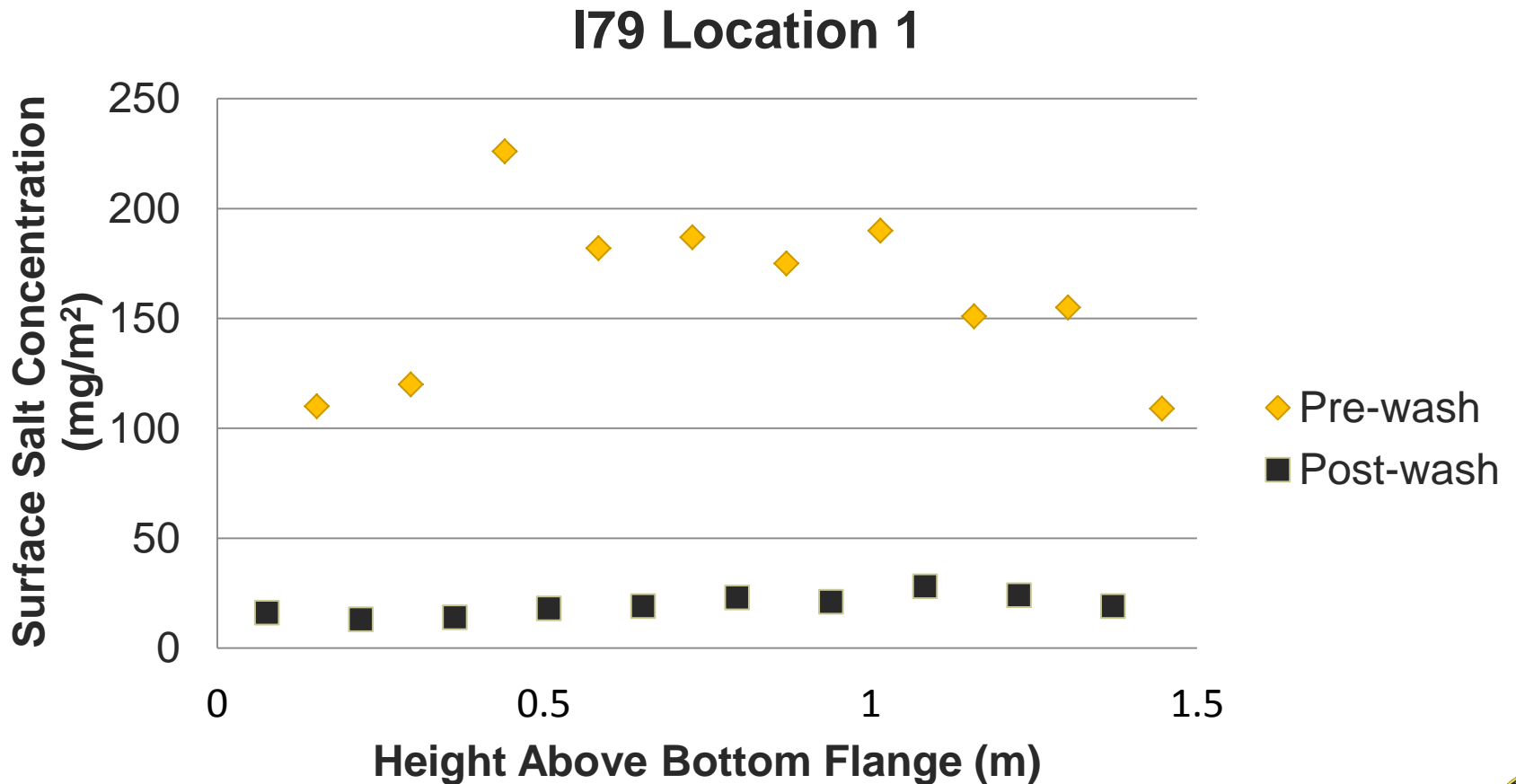# Testing Locations (Cont.)

Location 1

Location 2

Location 3
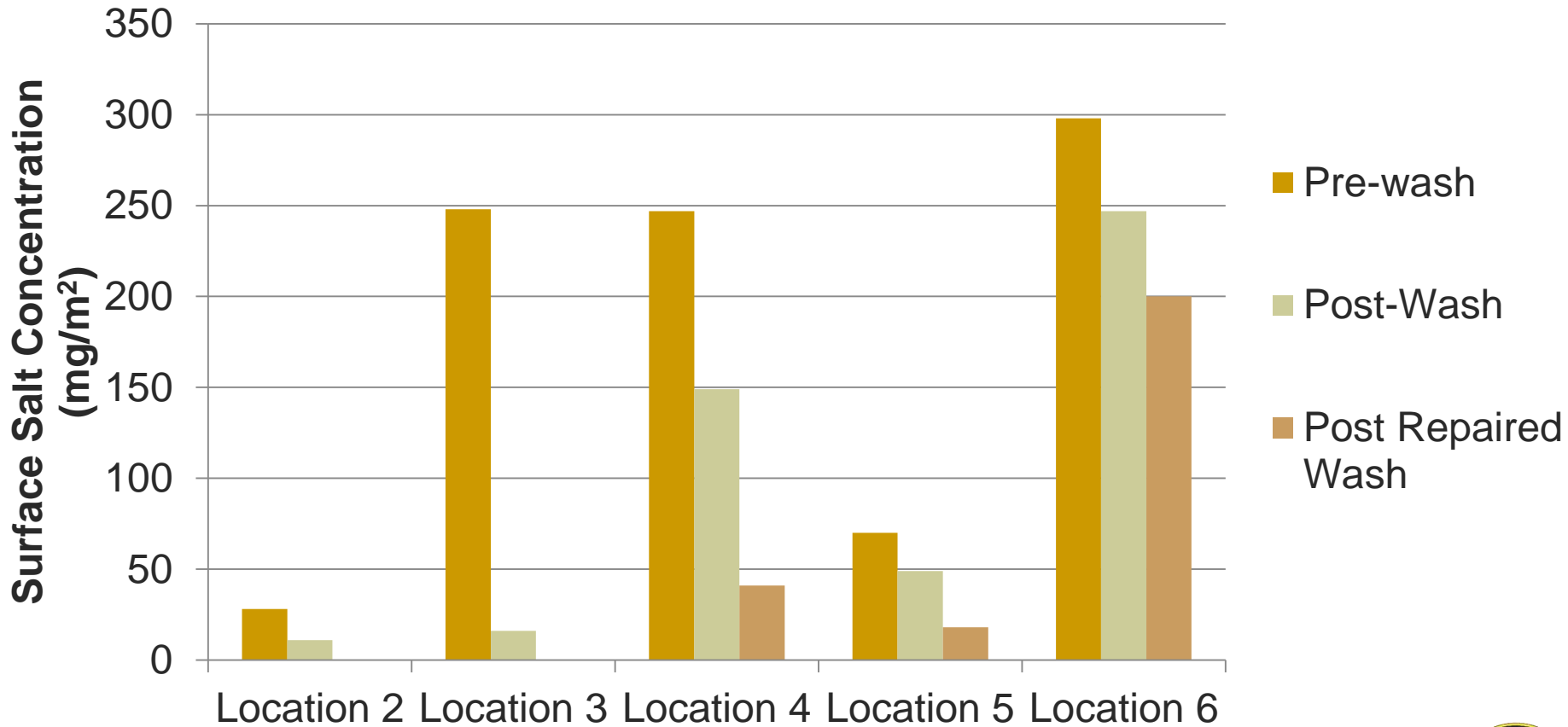

Location 4

Location 5 and 6

Location 1

I79 Location 1

Location 2-6

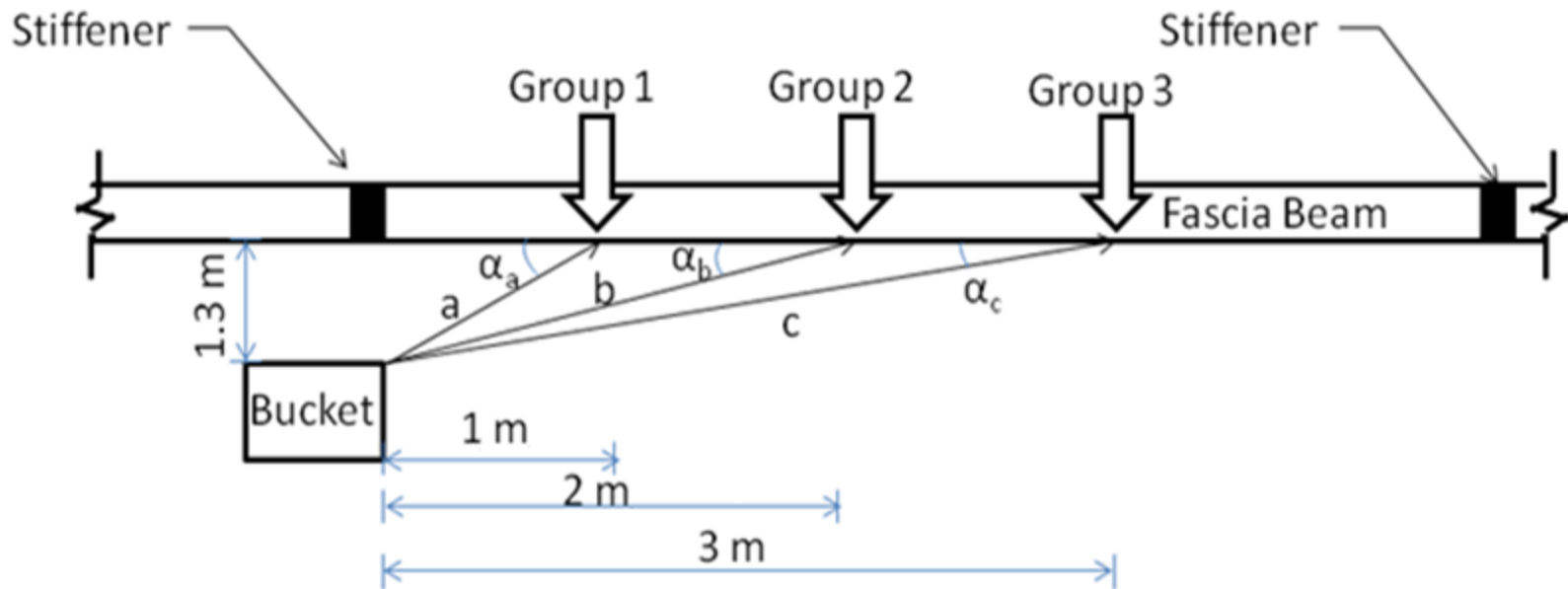I79 Salt Concentrations

40th St Bridge-Field Trials

Image taken from Google Maps

- Evaluate the effect of horizontal washing distance and stream angle on washing efficiency.

- Evaluate the effect of vertical distance below the target area on wash efficiency.

Experiment A

Stiffener

Stiffener

Group 1 Group 2 Group 3

Fascia Beam

1.3 m

α_a α_b α_c

a b c

Bucket

1 m

2 m

3 m

a: 1.7 Meters α_a=53.5 Degrees
b: 2.4 Meters α_b=34 Degrees
c: 3.3 Meters α_c=24 Degrees

Experiment A (Cont.)

Salt Removal vs. Distance

$R^2 = 0.68$

X-axis: **Distance (Meters)**
Y-axis: **Proportion of Salt Removal**
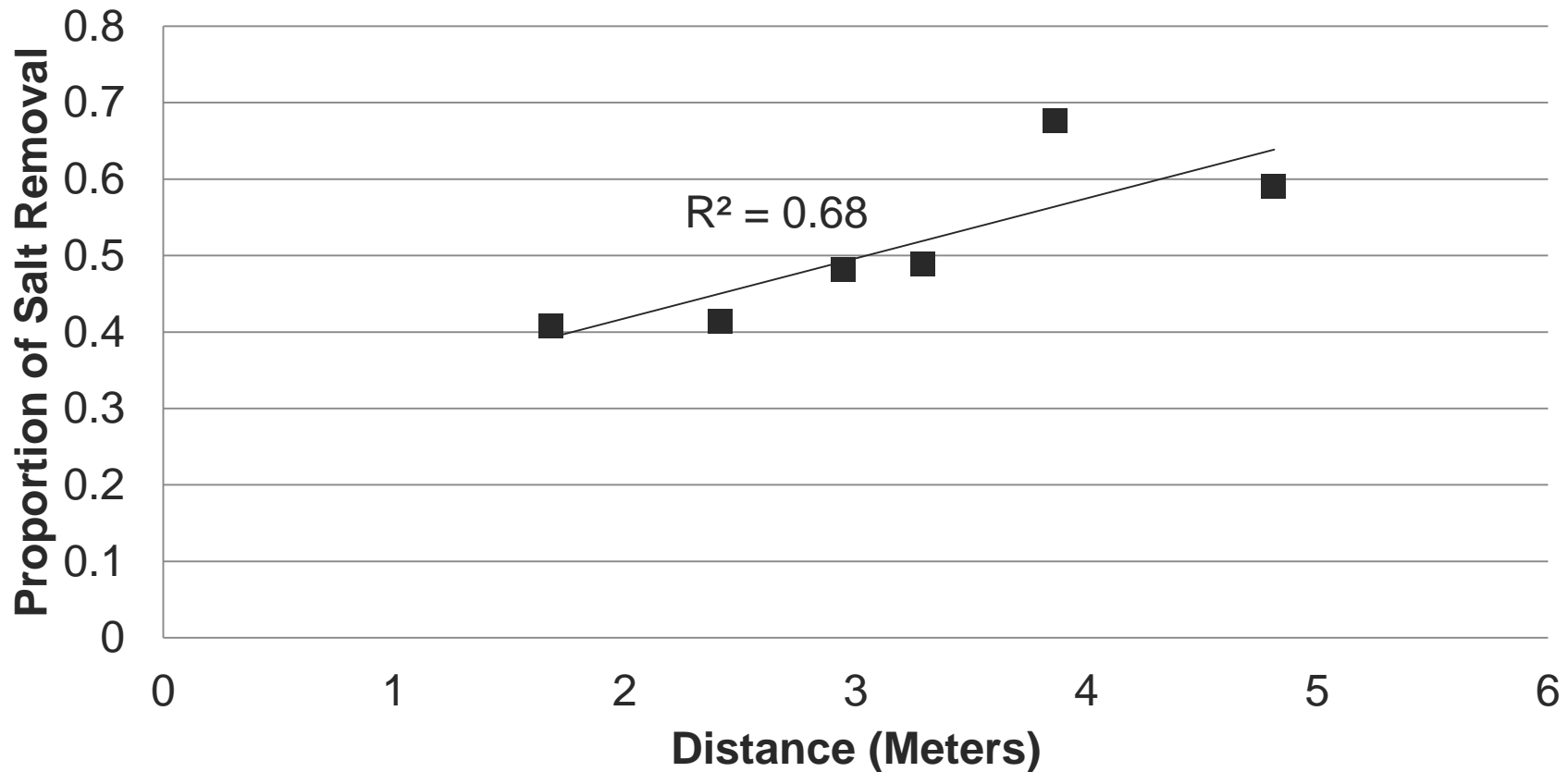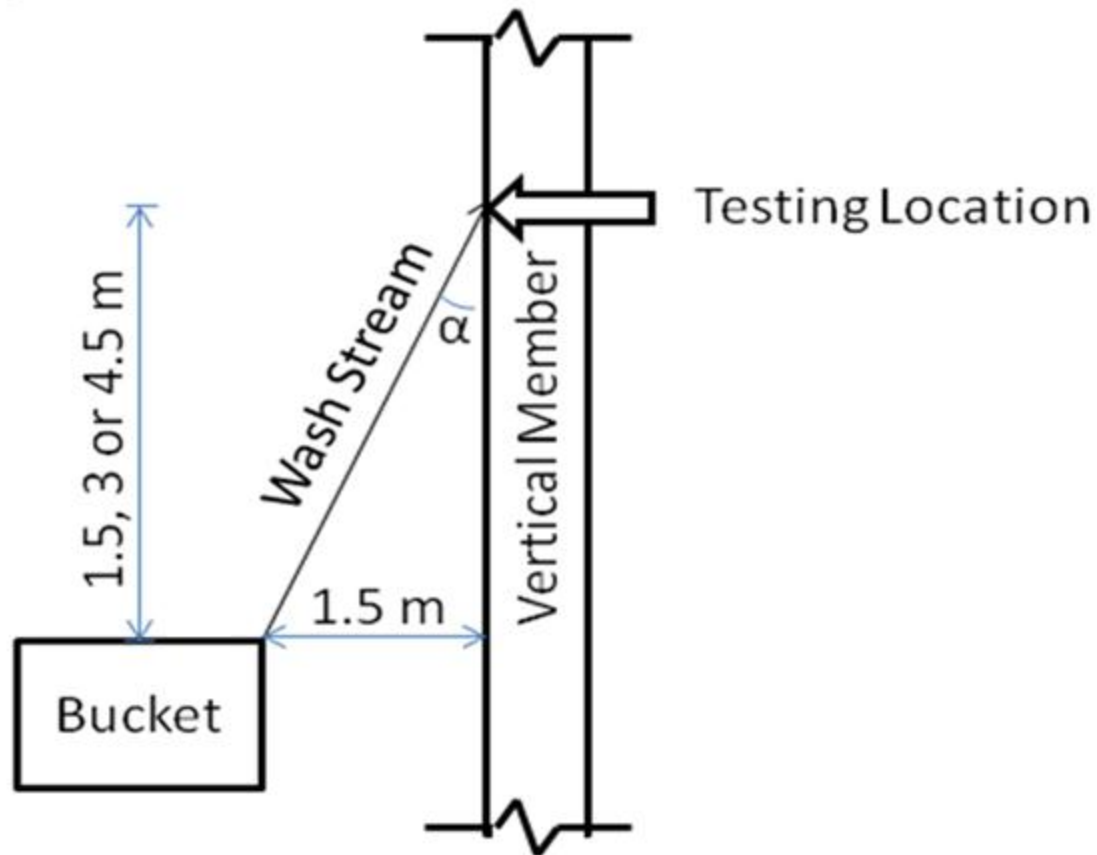
Experiment B

Experiment B (Cont.)

Test B Salt Removal					
Elevation Difference, m	Wash Angle (degrees)	Wash Distance, m	Pre-wash SSC, mg/m^2	Post-wash SSC, mg/m^2	Wash Efficiency (%)
1.5	45	2.1	14	17	-20
3	27	3.4	10	15	-45
4.5	18	4.7	13	13	0

Water Quality Testing

- Insignificant amount of hazardous materials was measured in the runoff water

Recommendations

Programming

- Cleaning horizontal members within 7 meters of a roadway would be beneficial

- Members beneath a leaking expansion joint should be cleaned frequently

- Current procedures are not effective at removing salt from members with large amounts of visible corrosion

- Bolts typical exhibited corrosion

Recommendations

Procedural

- Supplementing current procedure with chemicals is not necessary for most locations.

- A pressure gage should be installed to ensure wash stream is within specifications.

- Washing appears to be most effective when the upward vertical distance is limited.

Future Research

- Relationship between salt concentration and corrosion rates/coating longevity
- Evaluate the effect of washing angle, distance, and pressure on salt removal
- How frequently should the bridges be washed.
- How can salts effectively be removed from corroded areas

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