



Service Life Design and Durability of Steel Bridges: North Commuter Parkway and Traffic Bridge Project

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TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Agenda



- Introduction
- Project Overview
- Project Requirements
- Service Life Assessment of Structural Steel
- Conclusions

Introduction

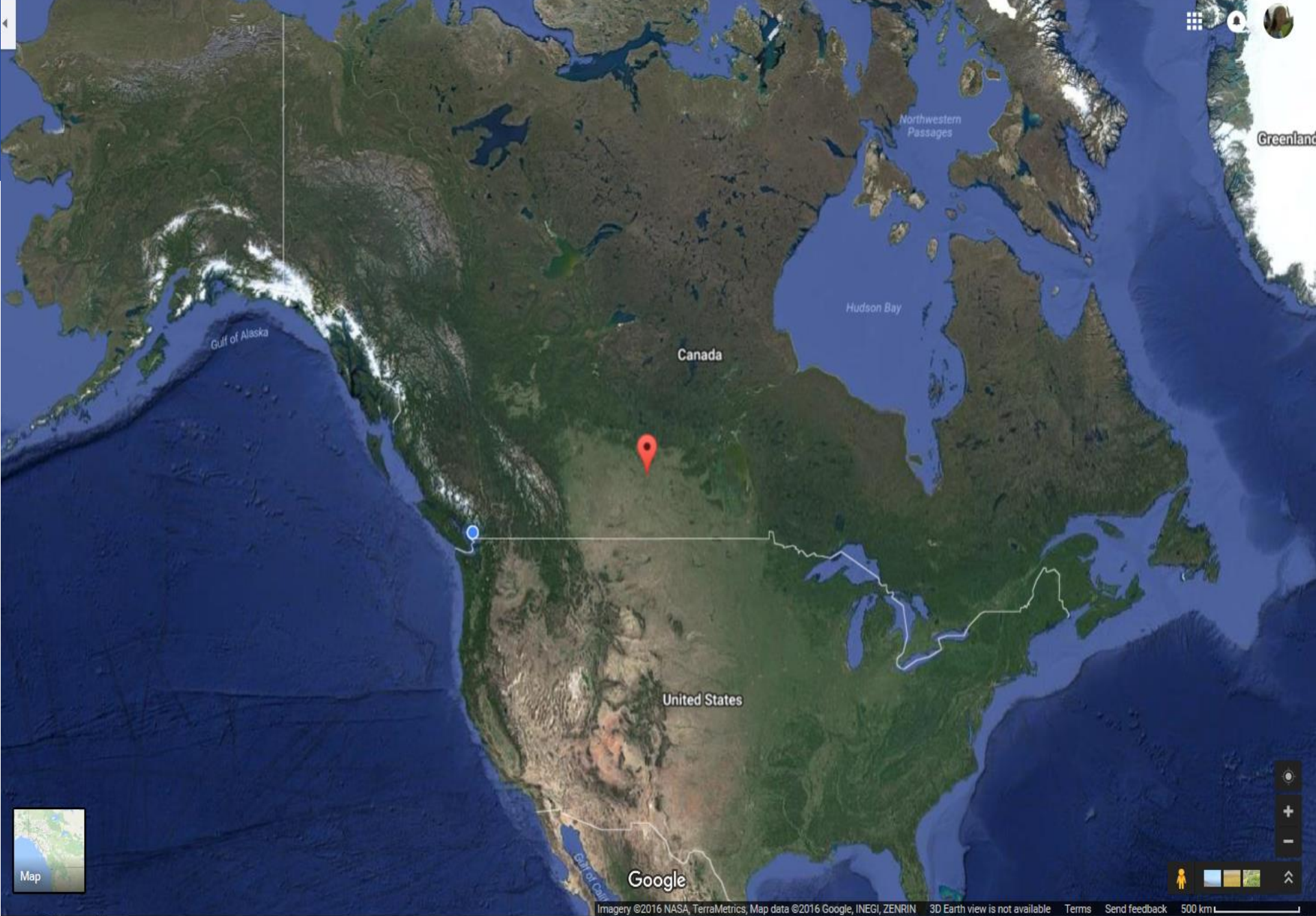


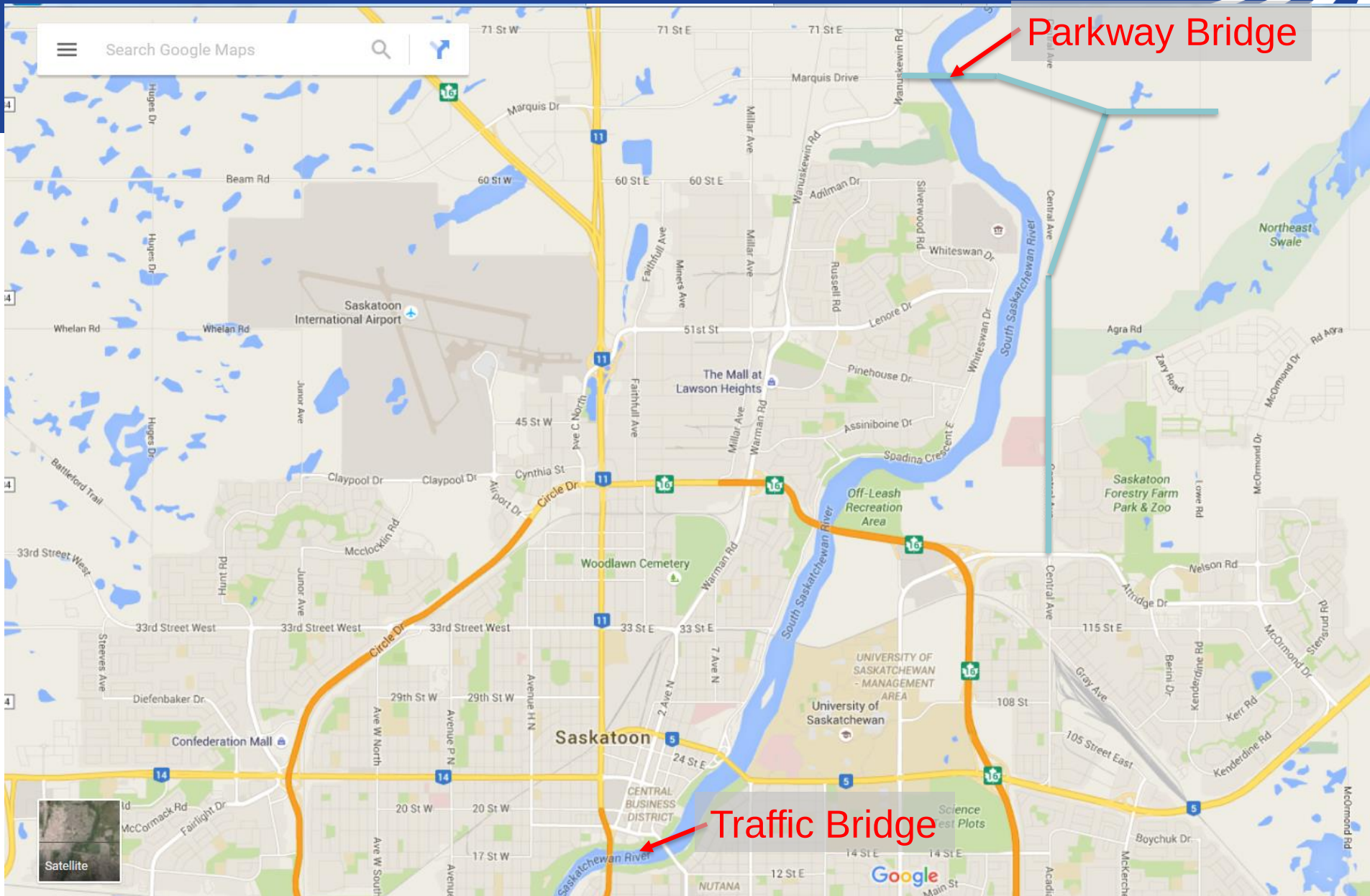
- Infrastructure deteriorates long before it is supposed to.
- The goal: design for service life.
- Use of a rational approach to design and quantify service life

North Commuter Parkway and Traffic Bridge Project



- Located in Saskatoon, Saskatchewan, Canada
- Owner: City of Saskatoon
- Design-Build Project (PPP) with 30 years concession period for O&M
 - Graham Commuter Partners
 - COWI North America
- Scheduled to be open to traffic: Oct 2018

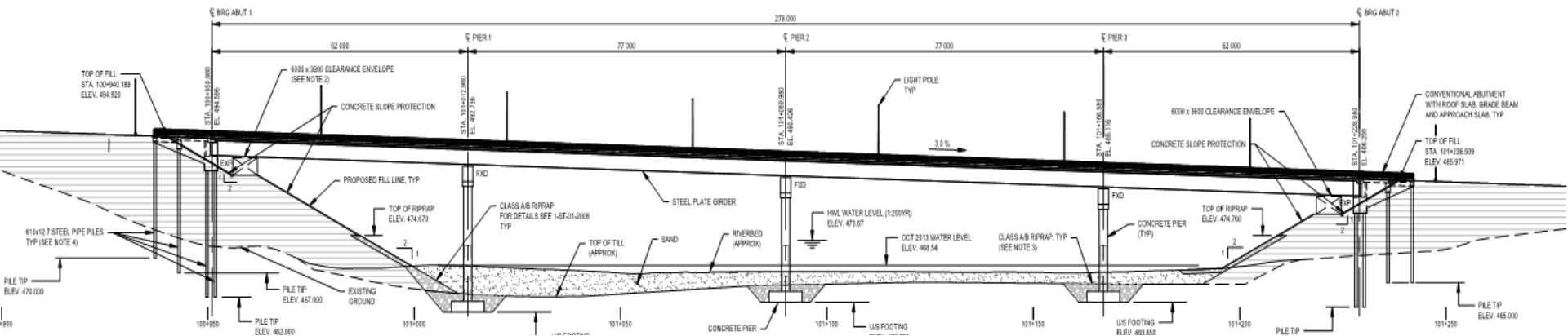
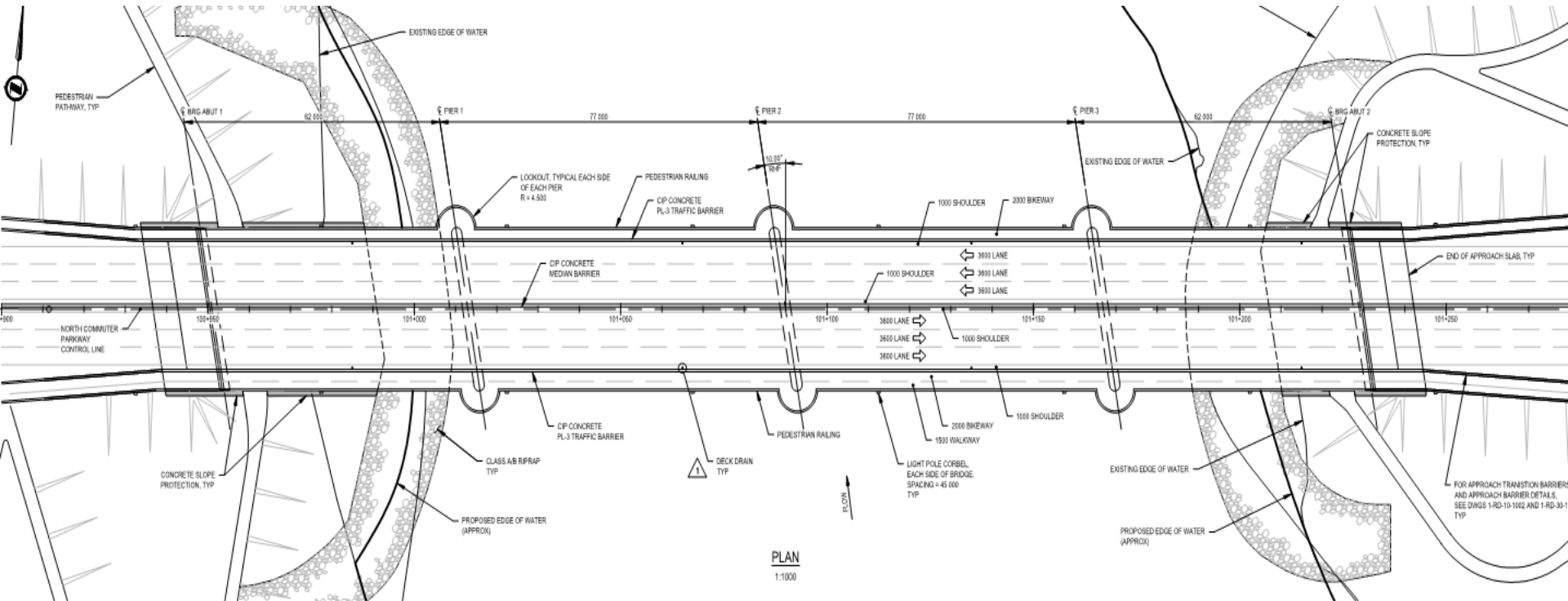




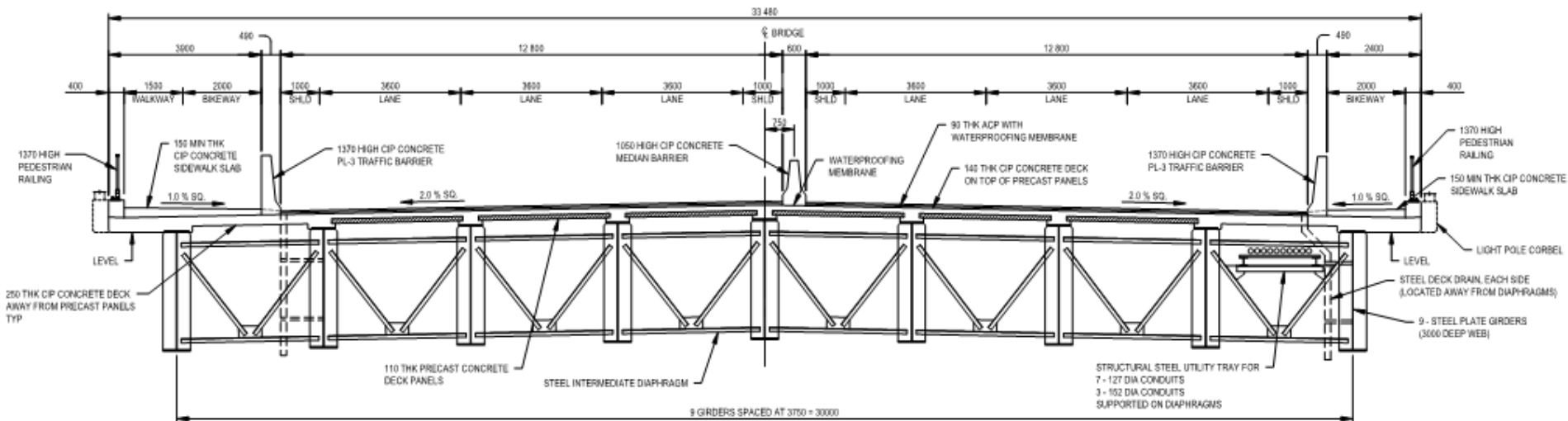
Future Site of Parkway Bridge



Parkway Bridge



Parkway Bridge



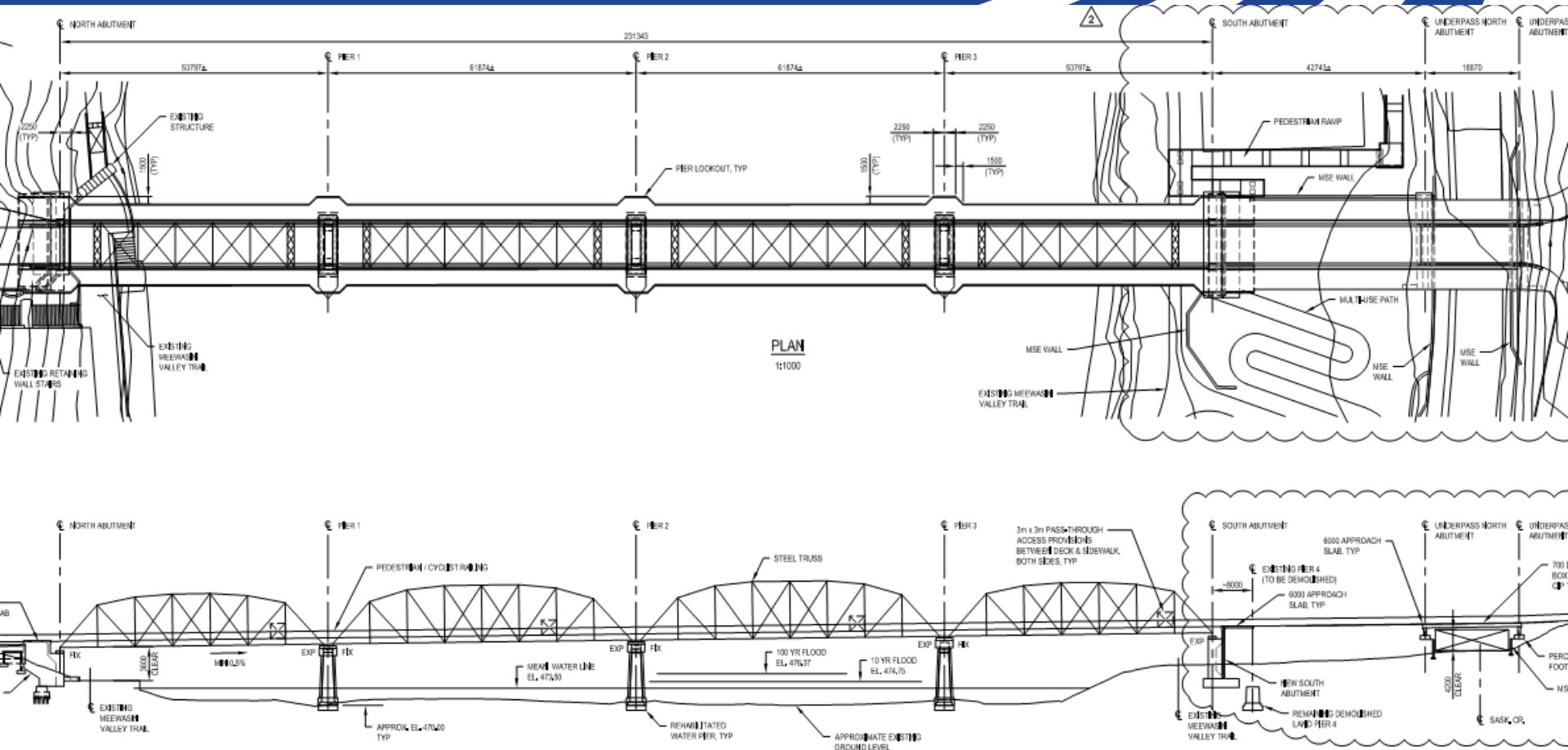
Replacement of Traffic Bridge



Replacement of Traffic Bridge



Traffic Bridge



Project Requirements



- Service life requirements well defined, for each component:
 - A minimum service life in years
 - Durability criteria
 - End of service life definition provided

Project Requirements

Element	MSL (Years)	Durability Criteria and End of Service Life Definition ⁽²⁾
Weathering Steel	100	Any Fair Condition State on any component or cracks.
Coatings	25	Any Fair Condition State defect.
Expansion Joints (Gland)	20	Any Poor Condition State defect.
Expansion Joint Armouring or Cover Plates	40	Leakage between armouring and concrete or Poor Condition State defects.

Structural Steel Components

- Weathering steel: 100 year service life
 - end of service life means any "fair" condition state on any components or cracks
 - structural design allows for corrosion loss up to 10% of cross section
- Coatings: 25 year service life
 - end of service life means any fair condition state defects
 - type of coating system specified
 - locations of coatings specified: deck level up to 3m, within 3m of expansion joints

Service Life Assessment of Steel Structures

- Define exposure zones for superstructure steel components
- Develop exposure zones that related to ISO 12944: international standard on corrosion protection of steel structures by protective paint

Service Life Assessment of Steel Structures

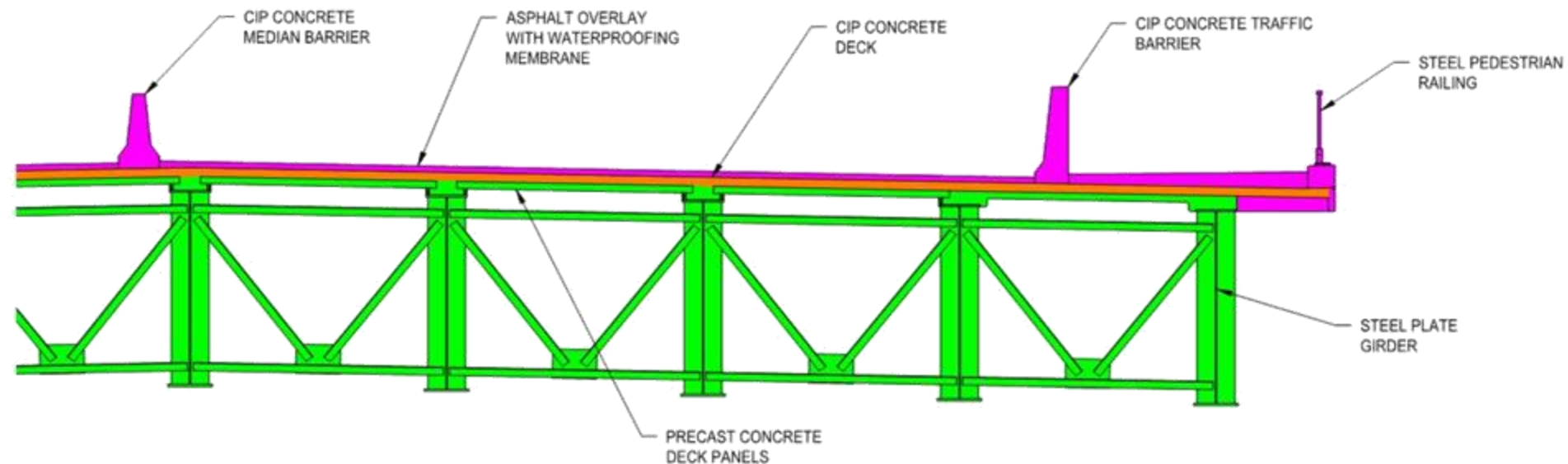
ISO 12944 – Corrosivity Categories		Bridge Exposure Zones
C1 very low		
C2 low	Rural	
C3 medium	Urban. Low salinity	Atmospheric
C4 high	Coastal moderate salinity	Indirect Deicing Salts
C5-M very high	Coastal high salinity	Direct Deicing Salts

Exposure Zones

- Parkway Bridge: exposure zones for a typical section at midspan

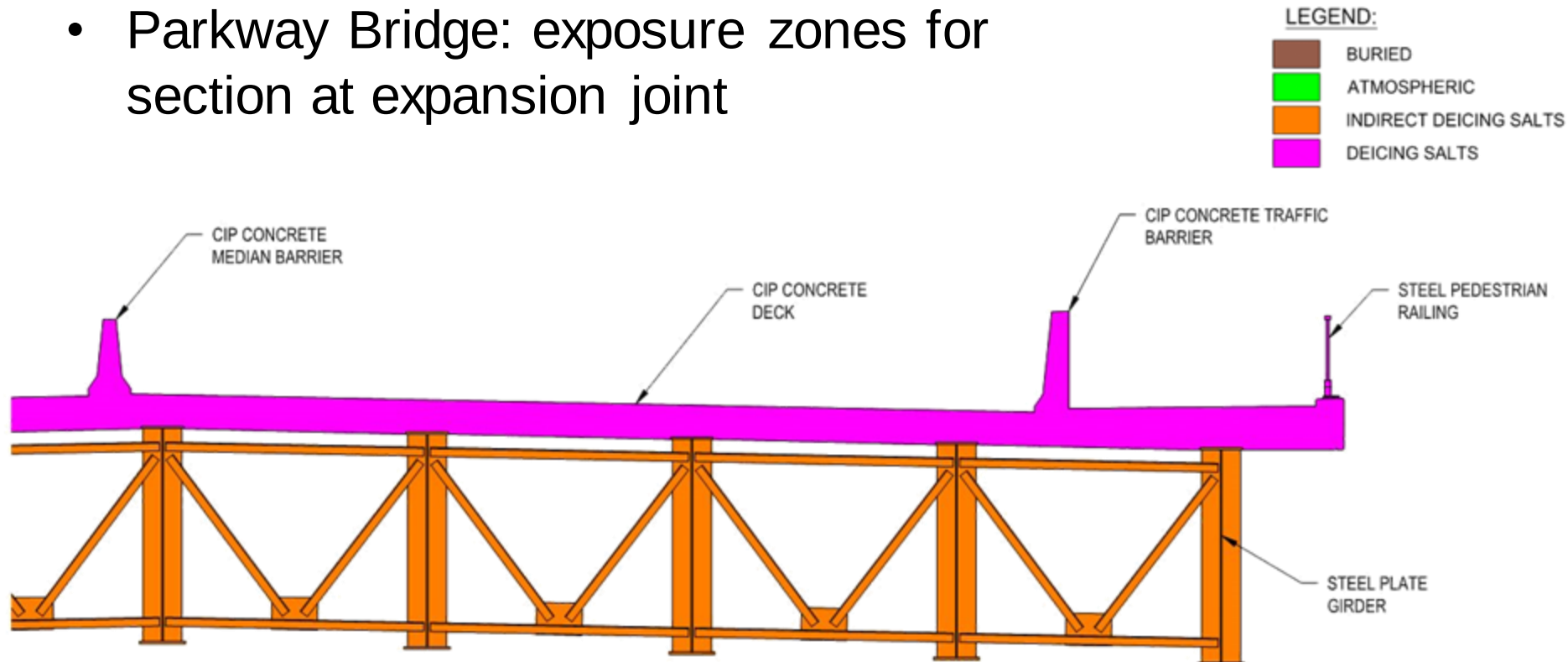
LEGEND:

BURIED	ATMOSPHERIC
INDIRECT DEICING SALTS	DEICING SALTS



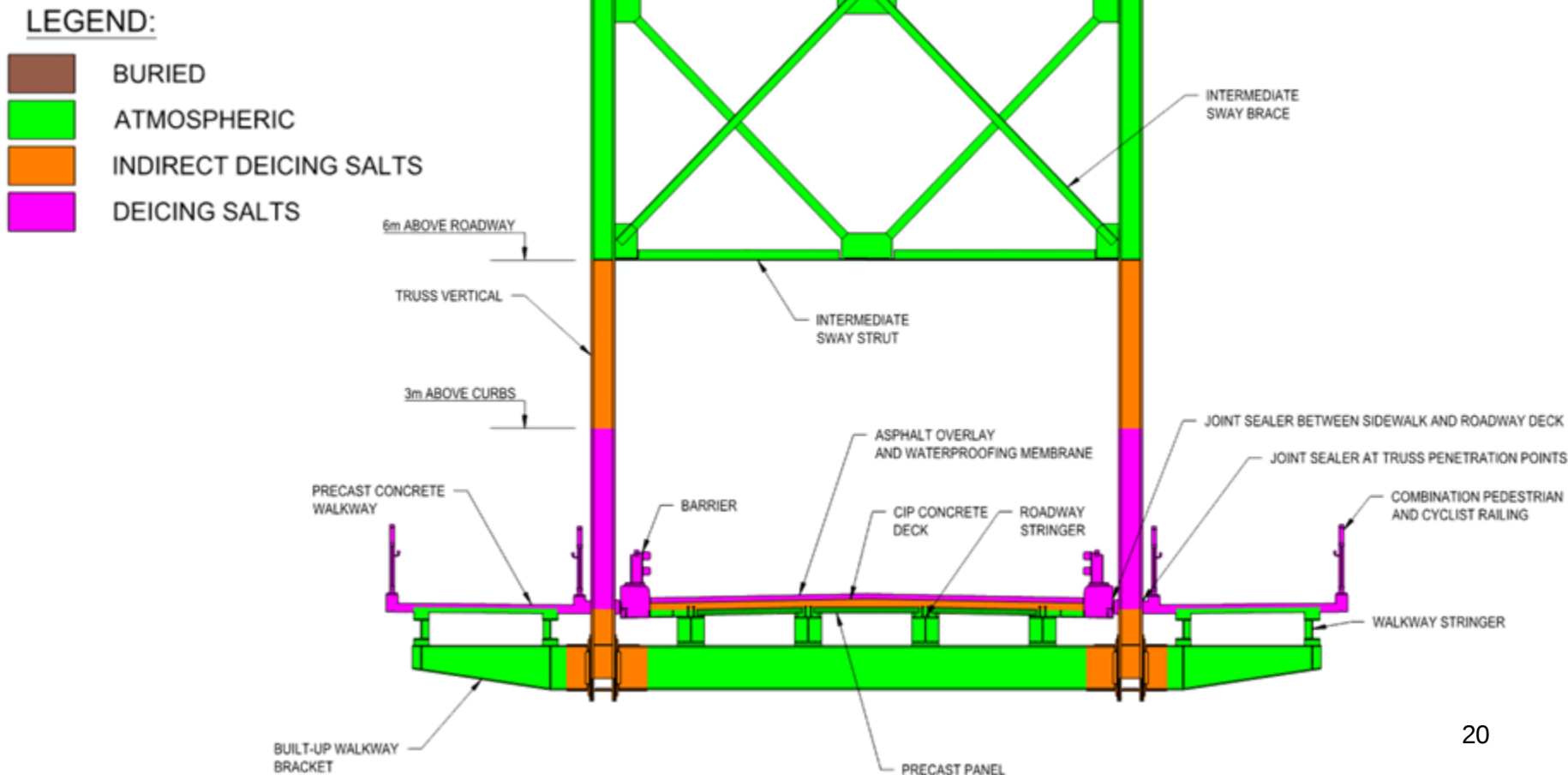
Exposure Zones

- Parkway Bridge: exposure zones for section at expansion joint



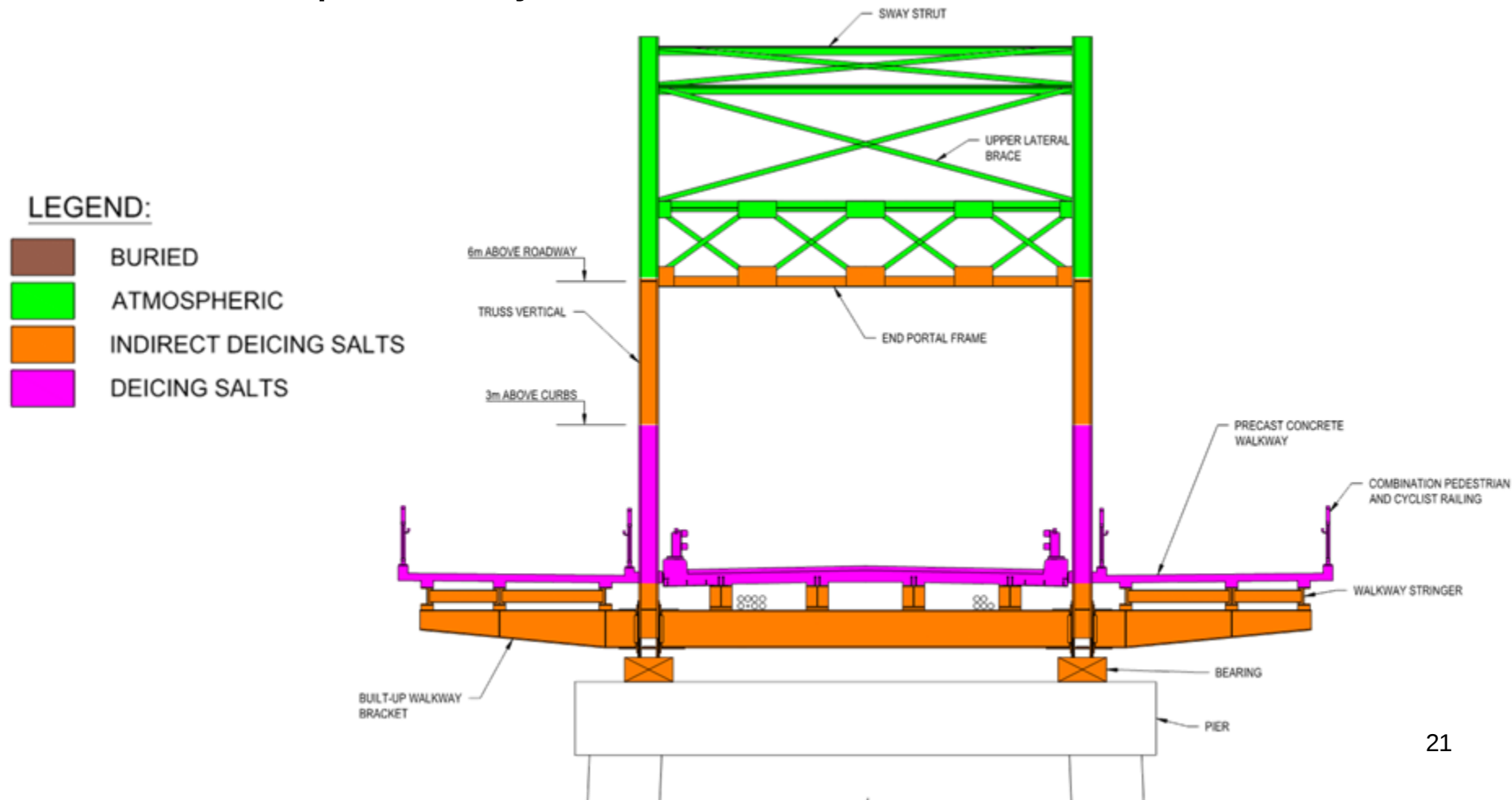
Exposure Zones

- Traffic Bridge: Exposure zones for a typical section at midspan at a truss penetration points



Exposure Zones

- Traffic Bridge: Exposure zones for a typical section within 3m of expansion joint

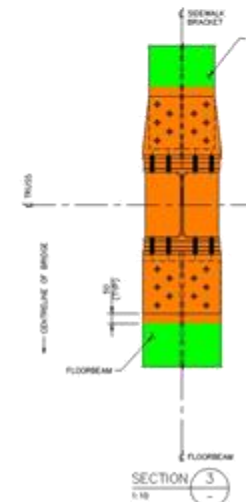
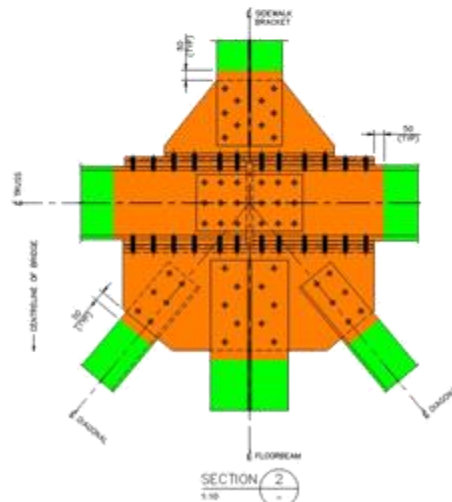
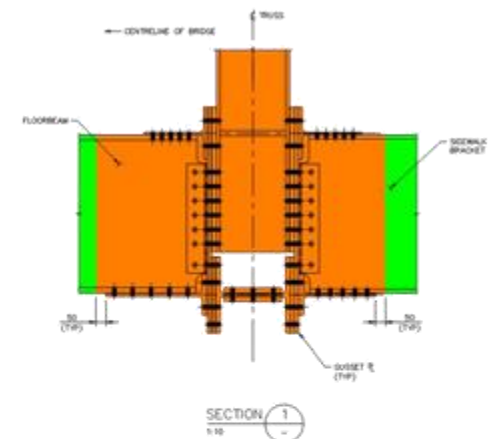
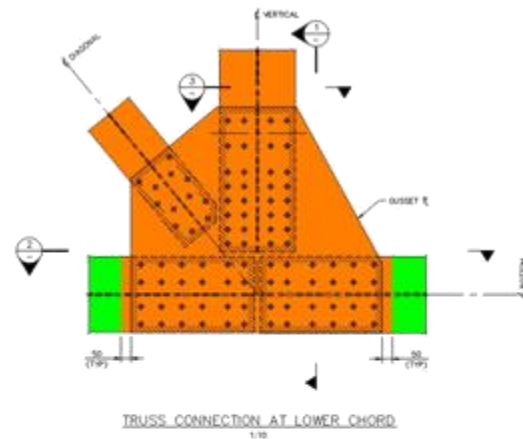


Exposure Zones

- Traffic Bridge: Exposure zones for lower chord node

LEGEND:

	BURIED
	ATMOSPHERIC
	INDIRECT DEICING SALTS
	DEICING SALTS



Design

- Estimation of corrosion section loss
 - ASTM G101-04 (2015) "Standard Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels".
- Estimate of coating service life
 - “Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work”, NACE (National Association of Corrosion Engineers) International paper 08279, 2008*

*New Paper is no.7422, 2016

Design

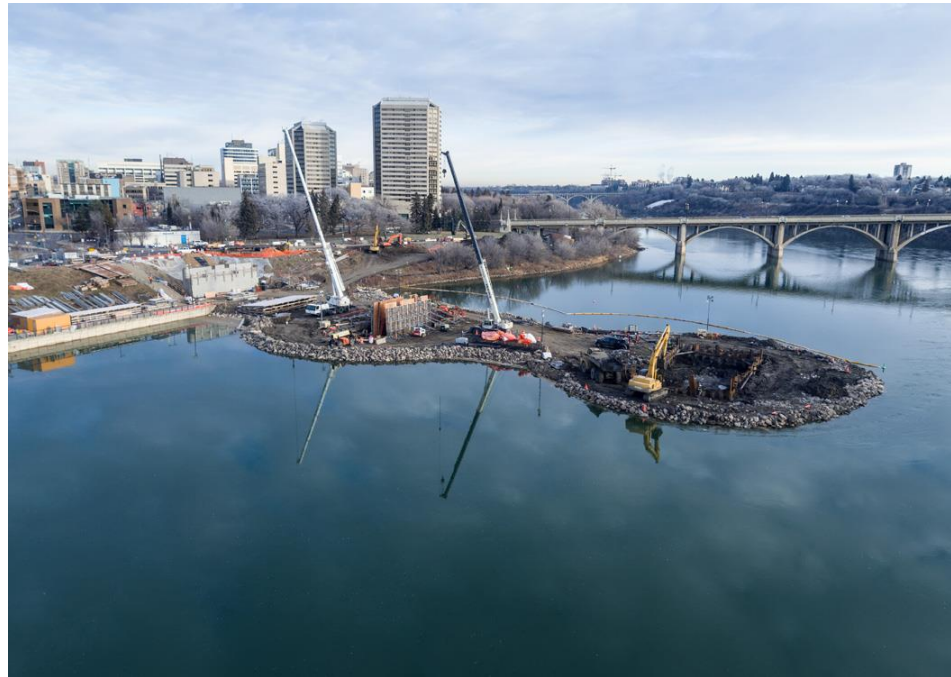
Exposure Zone	Design
Atmospheric (category C3)	Bare weathering steel: - corrosion allowance 0.5 mm/surface
Indirect Deicing Salts (category C4)	Bare weathering steel: - corrosion allowance 0.8mm/surface - corrosion allowance 1.5 mm/surface under breather joints Three coat paint system approved by Owner for steel below deck within 3m of expansion joints.
Direct Deicing Salts (category C5-M)	Three coat paint system approved by Owner.

Project Requirements: for truss lower chords - sections will be sized so that estimations of corrosion loss over service life do not exceed 10% of the cross section required for structural capacity.

Recent Construction Photos



Recent Construction Photos



Conclusions



- The superstructure steel components of Parkway Bridge and Traffic Bridge have been designed for a 100 year service life
- Definitions of exposure zones consistent with ISO 12944
- Choice of mitigation methods:
 - corrosion allowances based on ASTM G101
 - coating service life based on NACE paper 08279

Questions?

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AASHTO SHRP2 R19A Website:

<http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>

FHWA GoSHRP2 Website:

www.fhwa.dot.gov/GoSHRP2/