

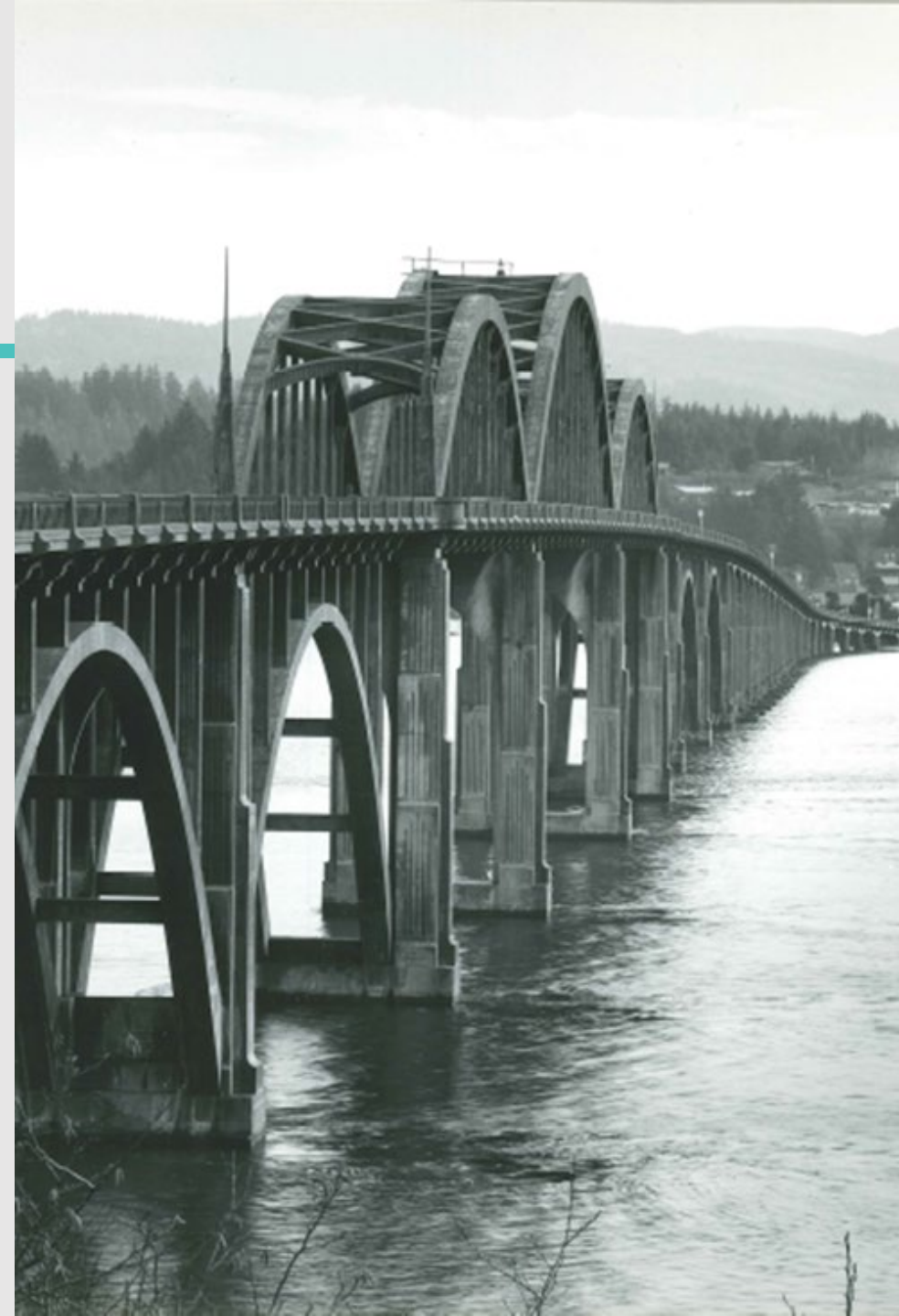
CATHODIC PROTECTION, GEN 2.1

Rebecca Burrow, PE

Western Bridge Engineers Seminar 2023

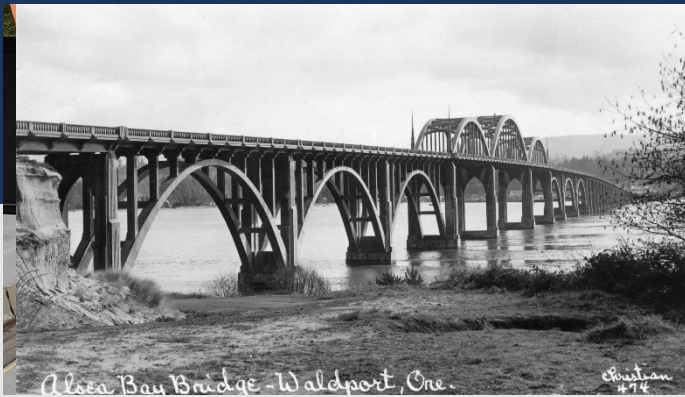
AGENDA

- History of CP at ODOT
- Basics of Impressed Current Cathodic Protection (ICCP)
- ICCP Bridges of Oregon
- What's Next?



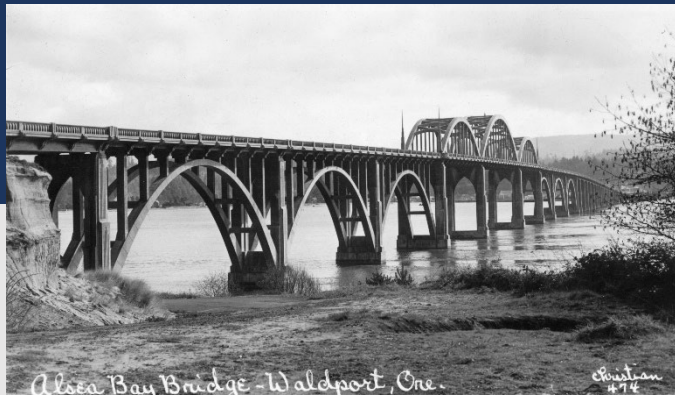
ODOT BRIDGE PRESERVATION

THE BEGINNING – ALSEA BAY BRIDGE



1936 – How it Started

ODOT BRIDGE PRESERVATION THE BEGINNING – ALSEA BAY BRIDGE

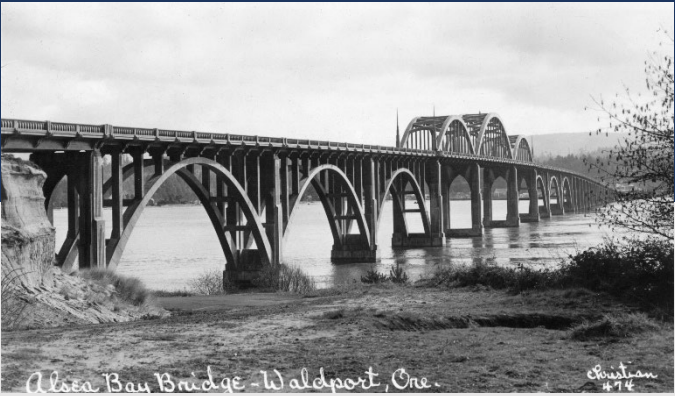


1936 – How it Started



1973 – Corrosion Hurts

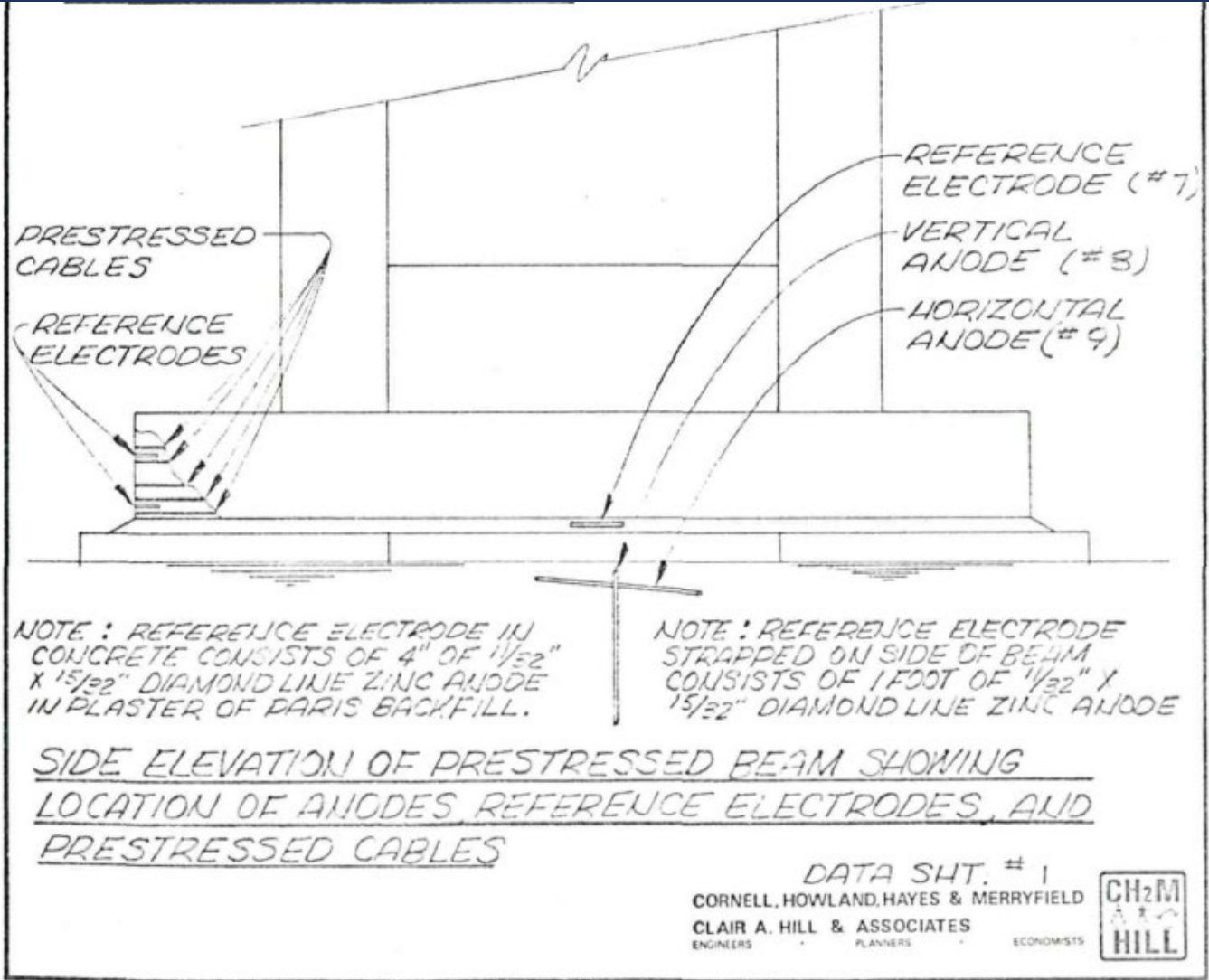
ODOT BRIDGE PRESERVATION THE BEGINNING – ALSEA BAY BRIDGE



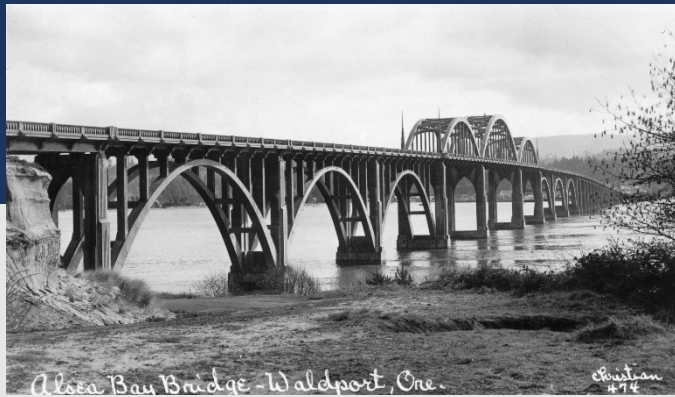
1936 – How it Started



19



ODOT BRIDGE PRESERVATION THE BEGINNING – ALSEA BAY BRIDGE



1936 – How it Started



1973 – Corrosion Hurts



1991 – How it Ended

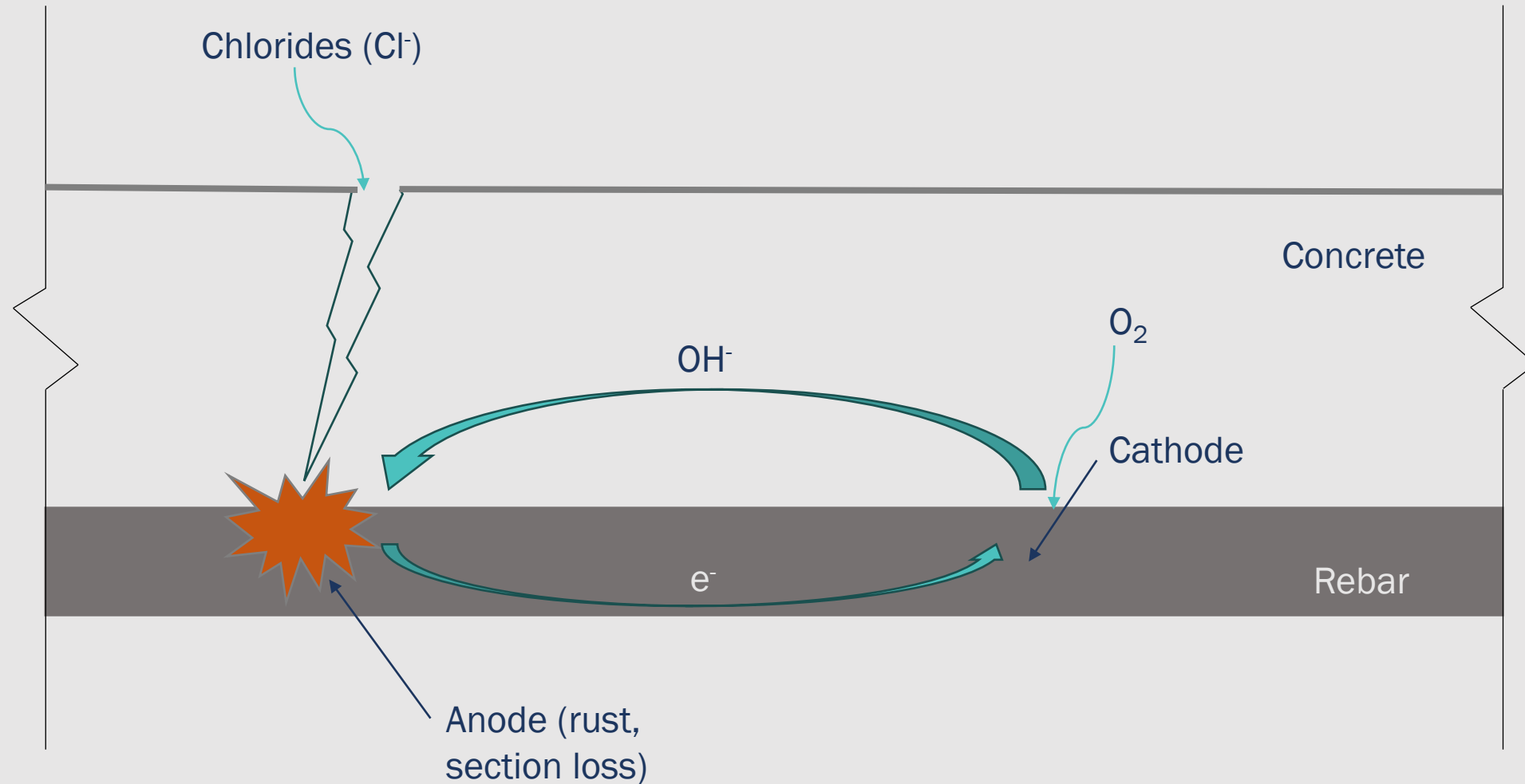


ODOT ICCP THE BEGINNING – CAPE CREEK BRIDGE

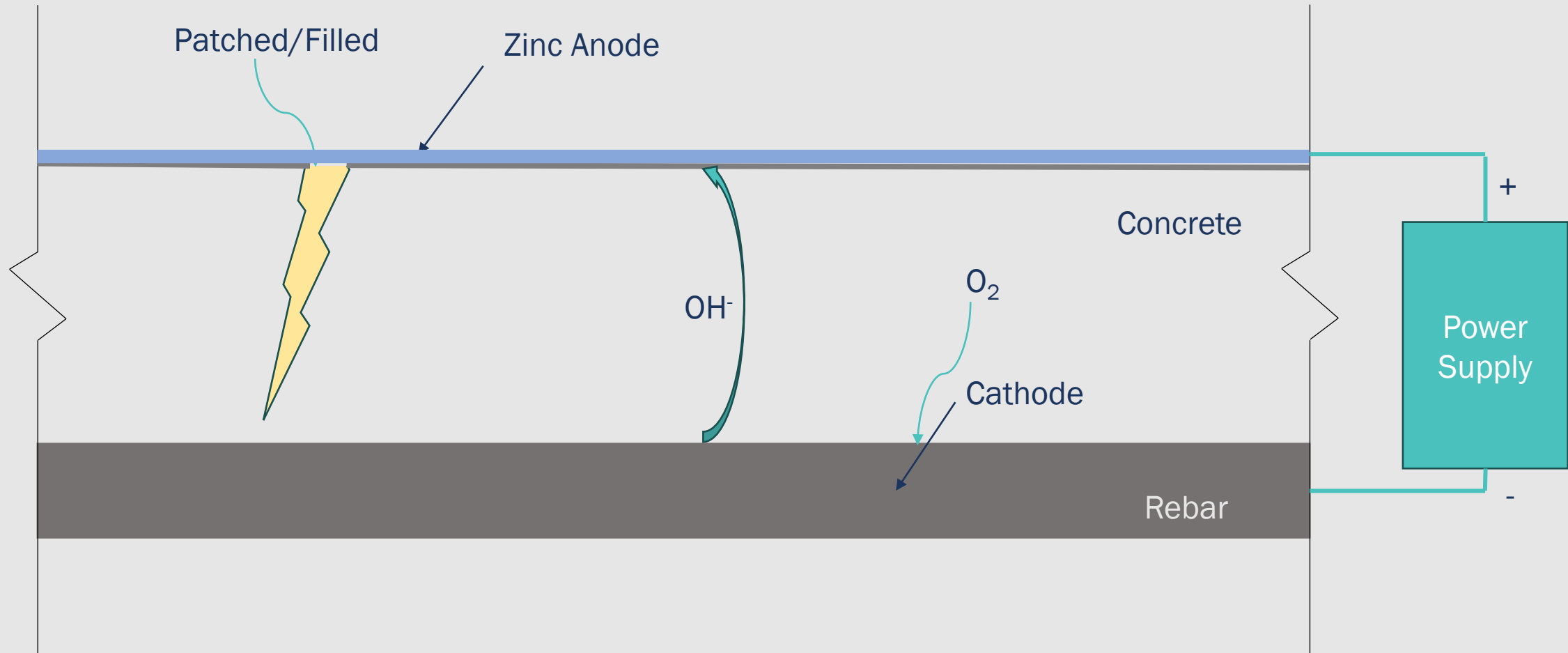
- Arc-sprayed zinc anode technology - Caltrans research
 - Excellent anode properties
 - Gray concrete-like appearance
- Cape Creek Bridge
 - US101 – 20 miles S of Alsea Bay
 - ICCP in 1991



IMPRESSED CURRENT CATHODIC PROTECTION THE BASICS



IMPRESSED CURRENT CATHODIC PROTECTION THE BASICS



IMPRESSED CURRENT CATHODIC PROTECTION IN THE FIELD



IMPRESSED CURRENT CATHODIC PROTECTION

Is it worth it?



- Yaquina Bay Bridge (01820)
- South Approach
 - ICCP – 1994, 2023
 - In 2021 - 2533 LF of Girder, 55 LF in CS2 (~2%)
- North Approach –
 - ICCP – 2023
 - In 2021 – 1269 LF of Girder, 91 LF CS3/4 (~7%), 896 LF in CS2 (~70%)



IMPRESSED CURRENT CATHODIC PROTECTION

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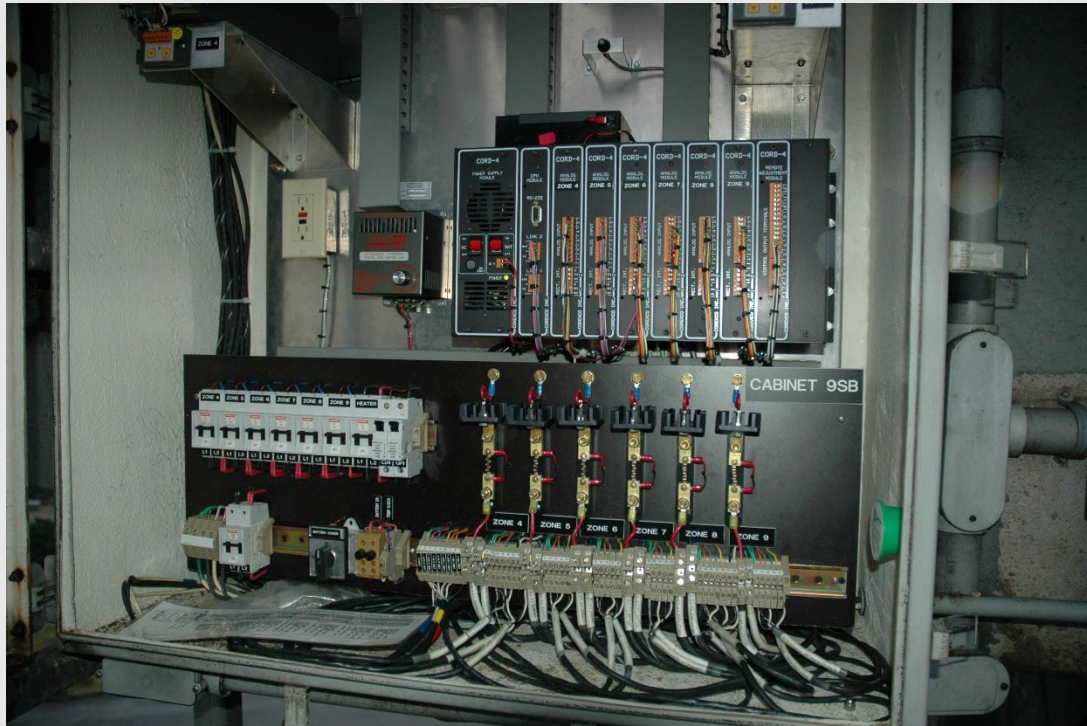


YAQUINA BAY (N. APPROACH) - BR# 01820A - HWY 9 - MP: 141.40

SPAN 4: EXPOSED REBAR

IMPRESSED CURRENT CATHODIC PROTECTION

Is it worth it?



- Yaquina Bay (total)
 - Monthly cost ~\$130
 - Project Cost ~ \$26M
 - ~\$500k in concrete repair
 - \$4M in Zinc Anode
 - \$7.5M in Access and Containment
 - Estimated Replacement ~\$800M-\$1.5B
 - Assume 4 lane signature structure

IMPRESSED CURRENT CATHODIC PROTECTION

Is it worth it?

04143A - Fogarty Creek - EA 01180 - Charge Unit: 2321

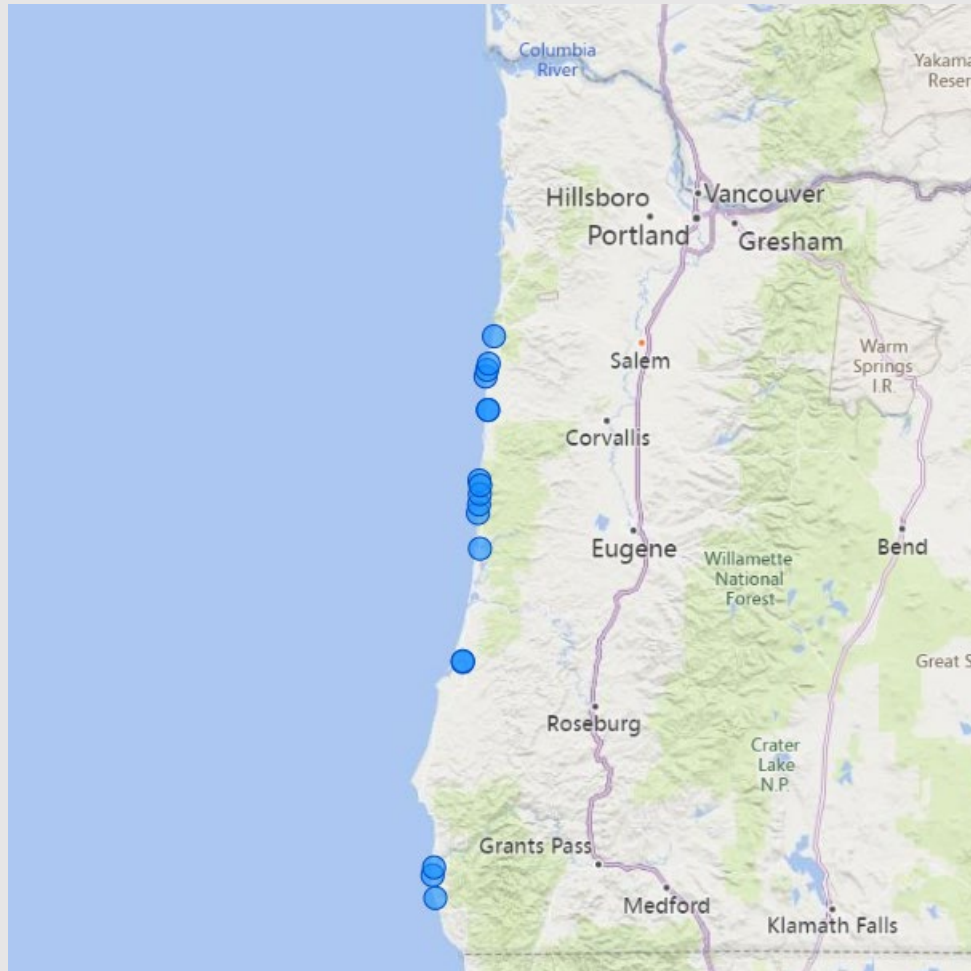
Sum of Quantity (kWh) by Year, Quarter, Month and Day



• Fogarty Creek (04143A) - 2016

- Monthly cost ~\$30
- Project Cost ~ \$1.8M
 - ~\$600k in concrete repair
 - \$100k in Access and Containment
- Estimated Replacement - \$4M
 - Sensitive Site

ICCP BRIDGES OF OREGON



- 15 Bridges with “active” ICCP Systems
 - One is County-owned
- 1.2M square feet of protected concrete
- Most are arc-sprayed zinc anode
 - One graphite, one titanium

ICCP BRIDGES OF OREGON

Bridge	Year Built	Surface Area	New CP Applied	First CP Applied
Cape Creek, Hwy 9	1931	102399	2020	1991
Cape Perpetua Half Viaduct, Hwy 9	1931	1838	2020	1998
Yaquina Bay, Hwy 9	1934	90673	2022	1997
Depoe Bay, Hwy 9	1927	63958	2024-2027	1996
US101 Frontage Road, Ben Jones (Rocky Creek)	1927	40149	2024	2001
Cummins Creek, Hwy 9	1931	19106	2024-2027	2001
Rogue River, Hwy 9 (Gold Beach, Isaac Patterson)	1930	180511	2024-2027	2005



ICCP BRIDGES OF OREGON



Bridge	Year Built	Surface Area	Current CP Applied	First CP Applied
Tenmile Creek, Hwy 9	1931	14769	2008	
Hunter Creek, Hwy 9	1959	16500	2013	
Pistol River, Hwys 9 & 255	1962	34350	2013	
Big Creek, Hwy 9 at MP 175.02	1931	20075	2014	
Fogarty Creek, Hwy 9	1955	12400	2015	
Siuslaw River, Hwy 9 (Florence)	1936	173000	2018	
Coos Bay, Hwy 9 (McCullough Main Spans)	1936	119392	2018	
Devils Lake Outlet, Hwy 9 (D River)	1949	17300	2021	

WHAT'S NEXT FOR THE ICCP BRIDGES?

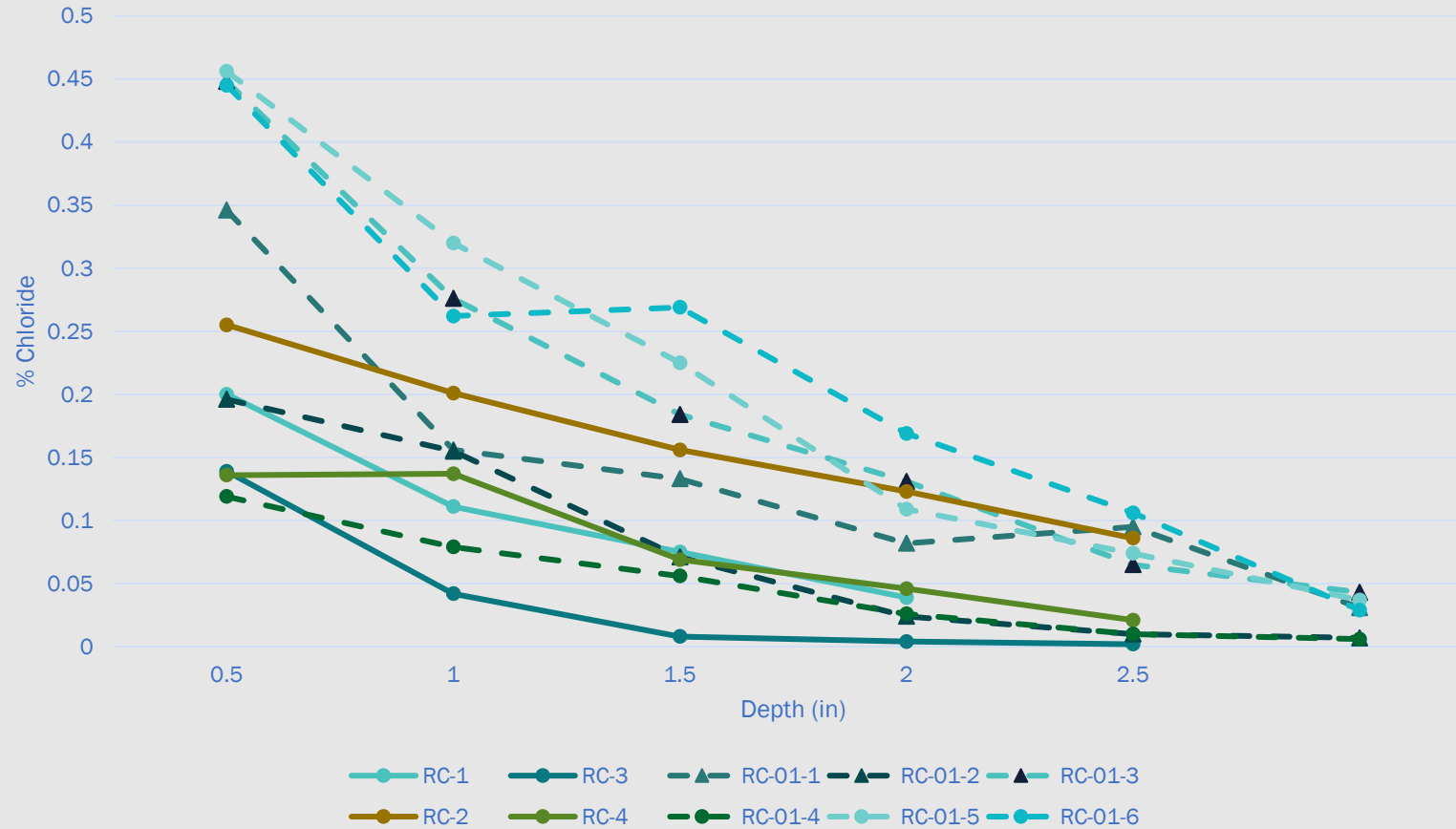


WHAT'S NEXT FOR THE ICCP BRIDGES?



WHAT'S NEXT FOR THE ICCP BRIDGES?

Rocky Creek New Cores compared to 2001 Powder Samples



WHAT'S NEXT FOR THE ICCP BRIDGES?



Damage from sand blasting



Shallow rebar

WHAT'S NEXT FOR THE ICCP BRIDGES?

- Research to be done
 - Methods to extend life of existing zinc
 - Seasonal operation?
 - Cleaning routine?
 - More detail on chloride distribution
 - Are the bars passivated?
 - Sealant options
 - Is there something that could be applied over the zinc after decommissioning the system?
 - Electrochemical Chloride Extraction?





Questions?

Rogue River Bridge—Gold Beach—Length 2,000 ft. Cost \$600,000. Oregon Coast Highway.

