Santa Cruz Mid-County Basin
Use of Airborne Electromagnetic (AEM) Surveys in Groundwater Sustainability Planning

MONTGOMERY & ASSOCIATES
Water Resource Consultants

Santa Cruz Mid-County Groundwater Agency

December 11, 2025 Board Meeting Agenda Item 7.1

Presented by: Cameron Tana, P.E.

Seawater Intrusion

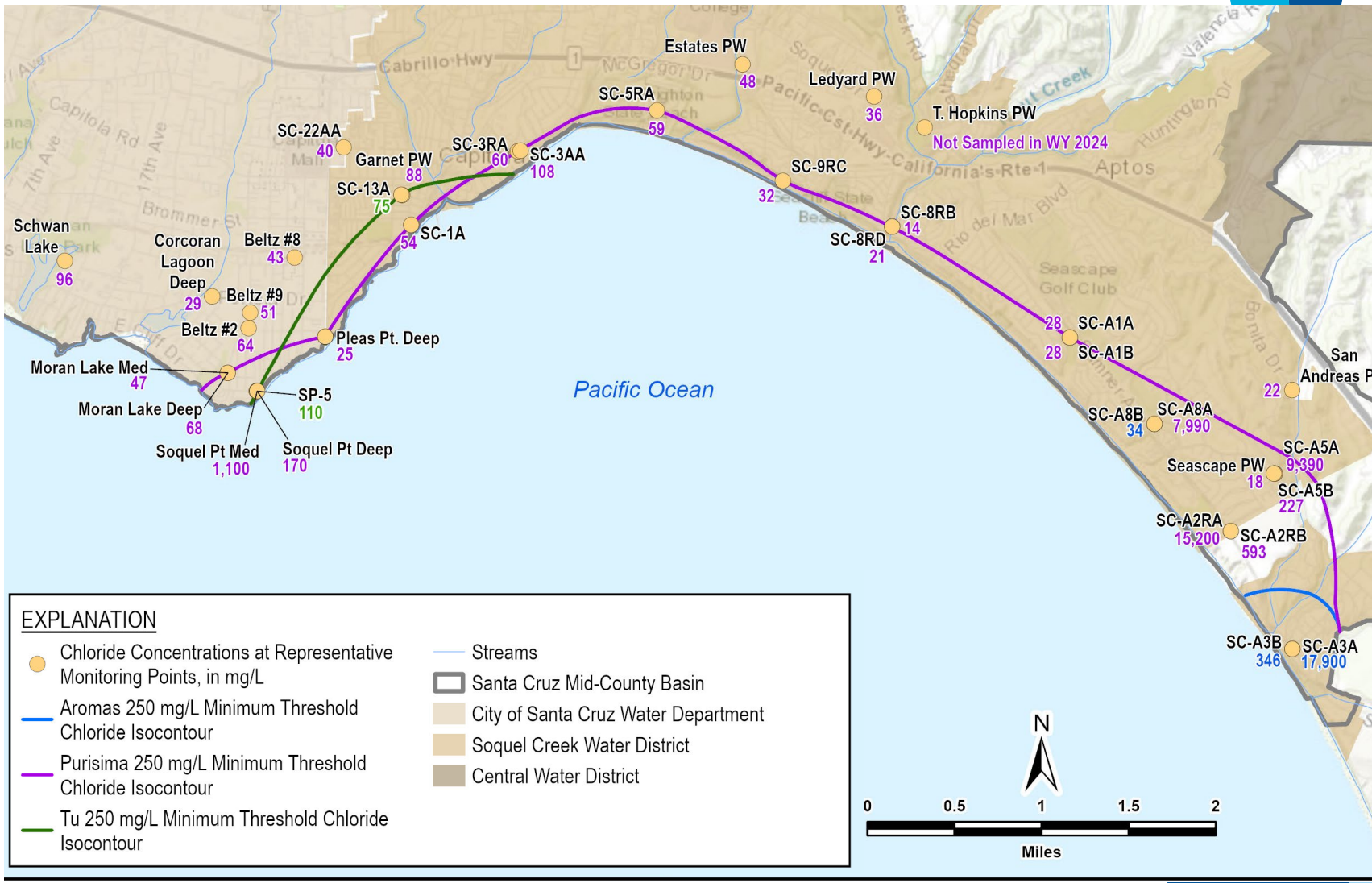
Outline

- GSP Sustainable Management Criteria for Seawater Intrusion
- GSP Sustainability Status for Seawater Intrusion
- Use of 2017 Offshore AEM Data
- Use of 2022 Offshore AEM Data
- Summary of Comparison of 2017 and 2022 AEM Data in Seascape Area
- Induction Logging as an Alternative Geophysical Method for Seawater Intrusion

GSP Sustainable Management Criteria for Seawater Intrusion are not Assessed with AEM Data

Seawater Intrusion

- Coastline forms Basin boundary
- **Onshore** minimum threshold isocontour required by GSP regulations
- **Onshore** representative monitoring points for chloride concentrations and groundwater elevation proxies



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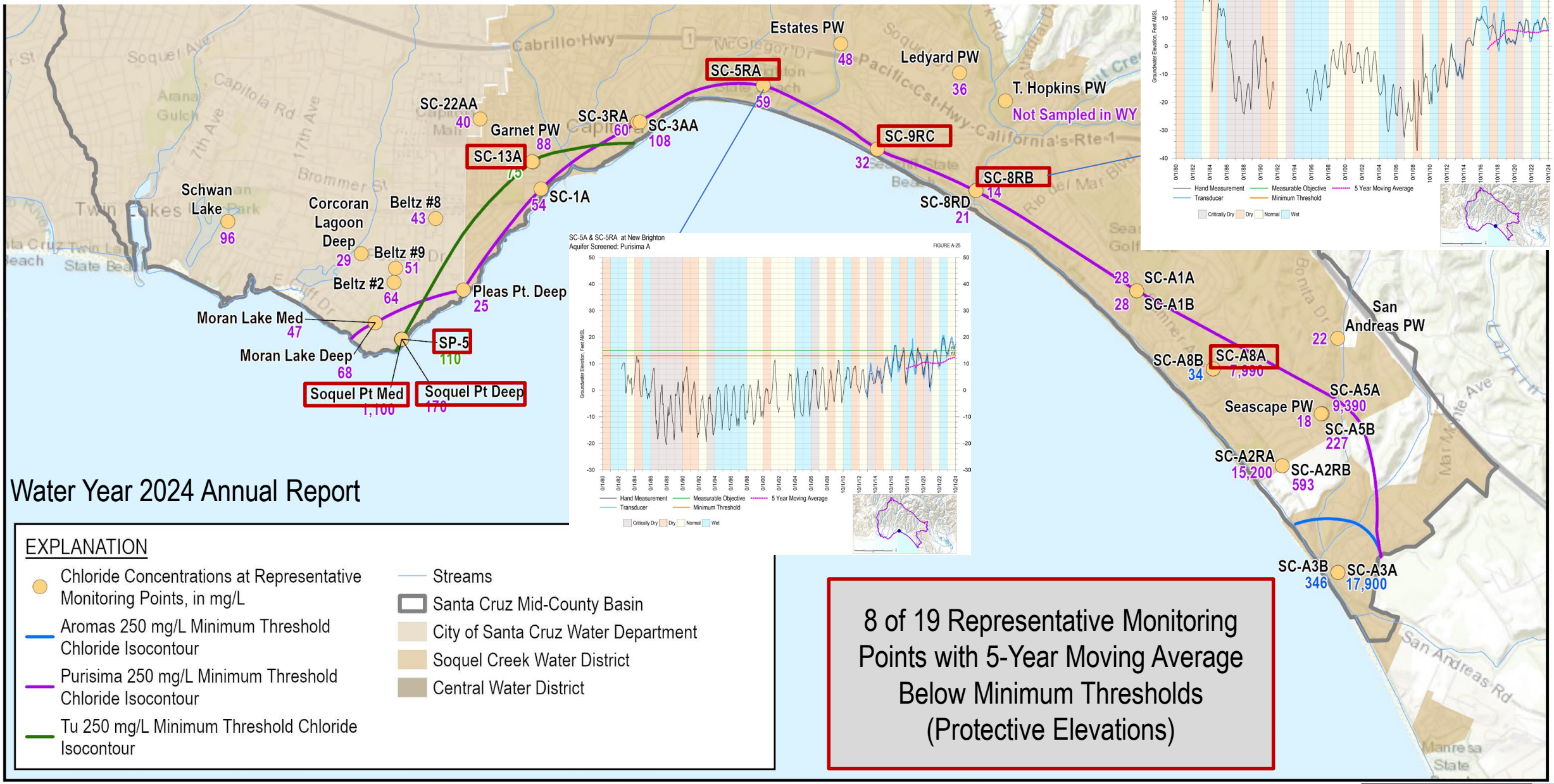
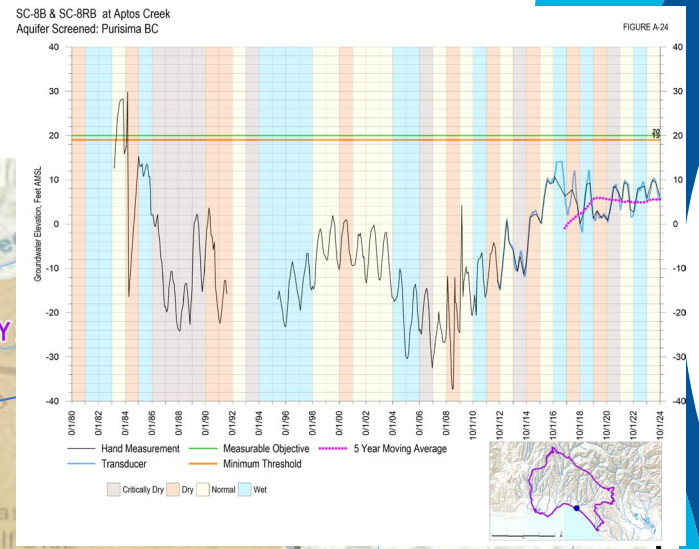
Undesirable Results Occurring Because Groundwater Levels at the Coast are Still Too Low





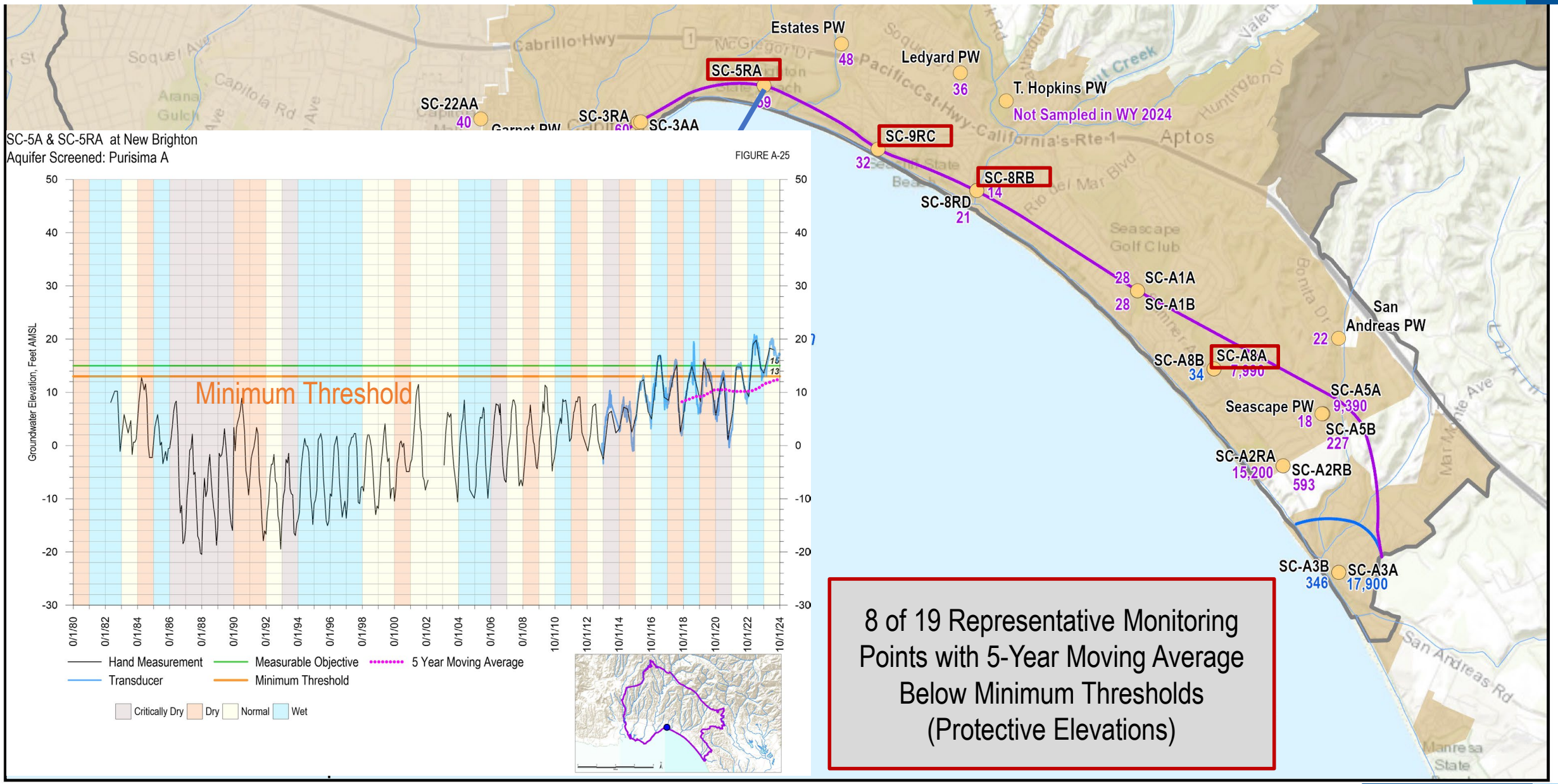
Water Year 2024 Annual Report

EXPLANATION

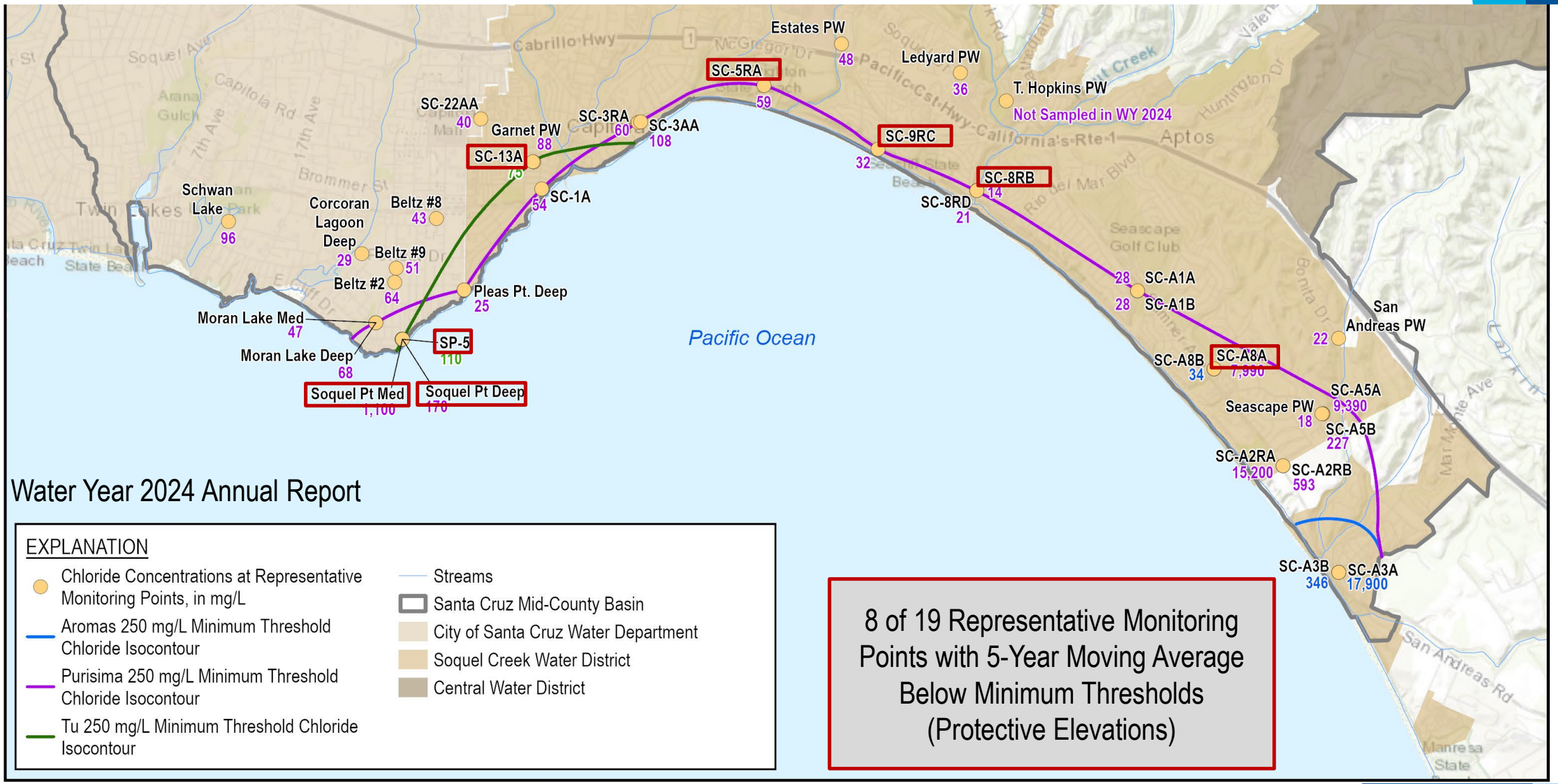
- Chloride Concentrations at Representative Monitoring Points, in mg/L
- Aromas 250 mg/L Minimum Threshold Chloride Isocontour
- Purisima 250 mg/L Minimum Threshold Chloride Isocontour
- Tu 250 mg/L Minimum Threshold Chloride Isocontour
- Streams
- Santa Cruz Mid-County Basin
- City of Santa Cruz Water Department
- Soquel Creek Water District
- Central Water District

8 of 19 Representative Monitoring Points with 5-Year Moving Average Below Minimum Thresholds (Protective Elevations)

Undesirable Results Occurring Because Groundwater Levels at the Coast are Still Too Low



Undesirable Results Occurring Because Groundwater Levels at the Coast are Still Too Low

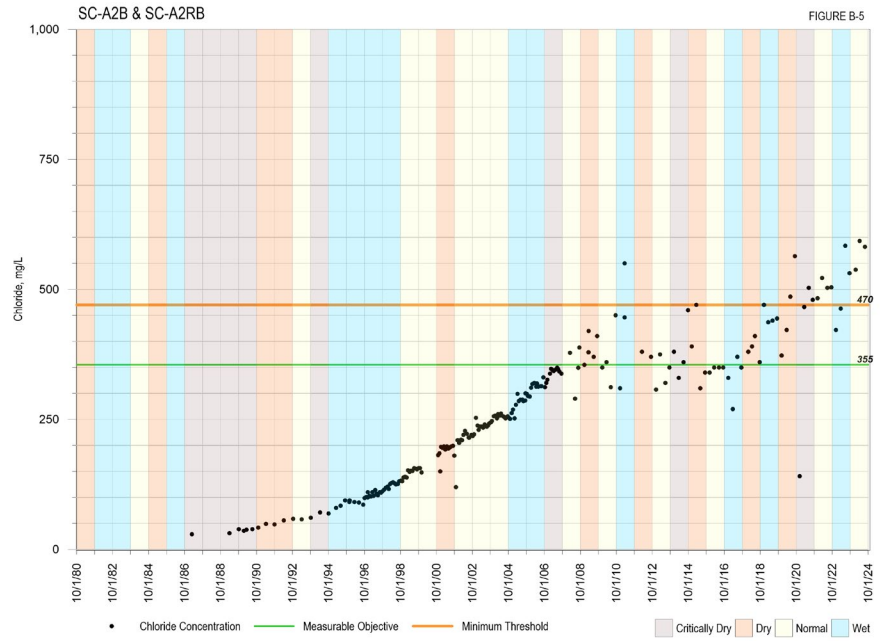


Seawater Intrusion – Chloride Concentrations

Measurable Objective
2013-2017 average chloride concentration for all intruded wells, 100 mg/L for unintruded coastal and inland wells

Minimum Threshold
Historical maximum concentration for intruded wells, 250 mg/L for unintruded coastal wells, 150 mg/L for unintruded inland wells

Undesirable Result
MT exceedances in 2 or more of the last 4 consecutive samples at any RMP well

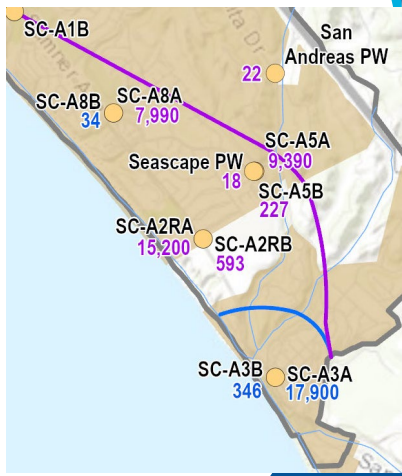


✓ Many wells have concentrations below MOs (25/36)

✗ 2 RMP exceed MT: SC-A2RB & SC-A5B in the Seascape area

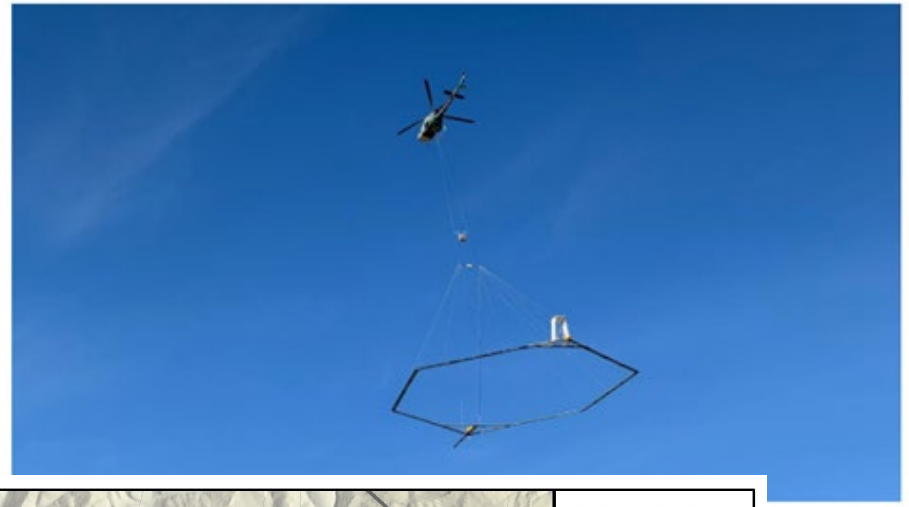
✗ There are Undesirable Results occurring at SC-A2RB & SC-A5B

KEY FINDING:
Undesirable results (UR) continue to occur: SC-A2RB & SC-A5B (4 or more consecutive years)

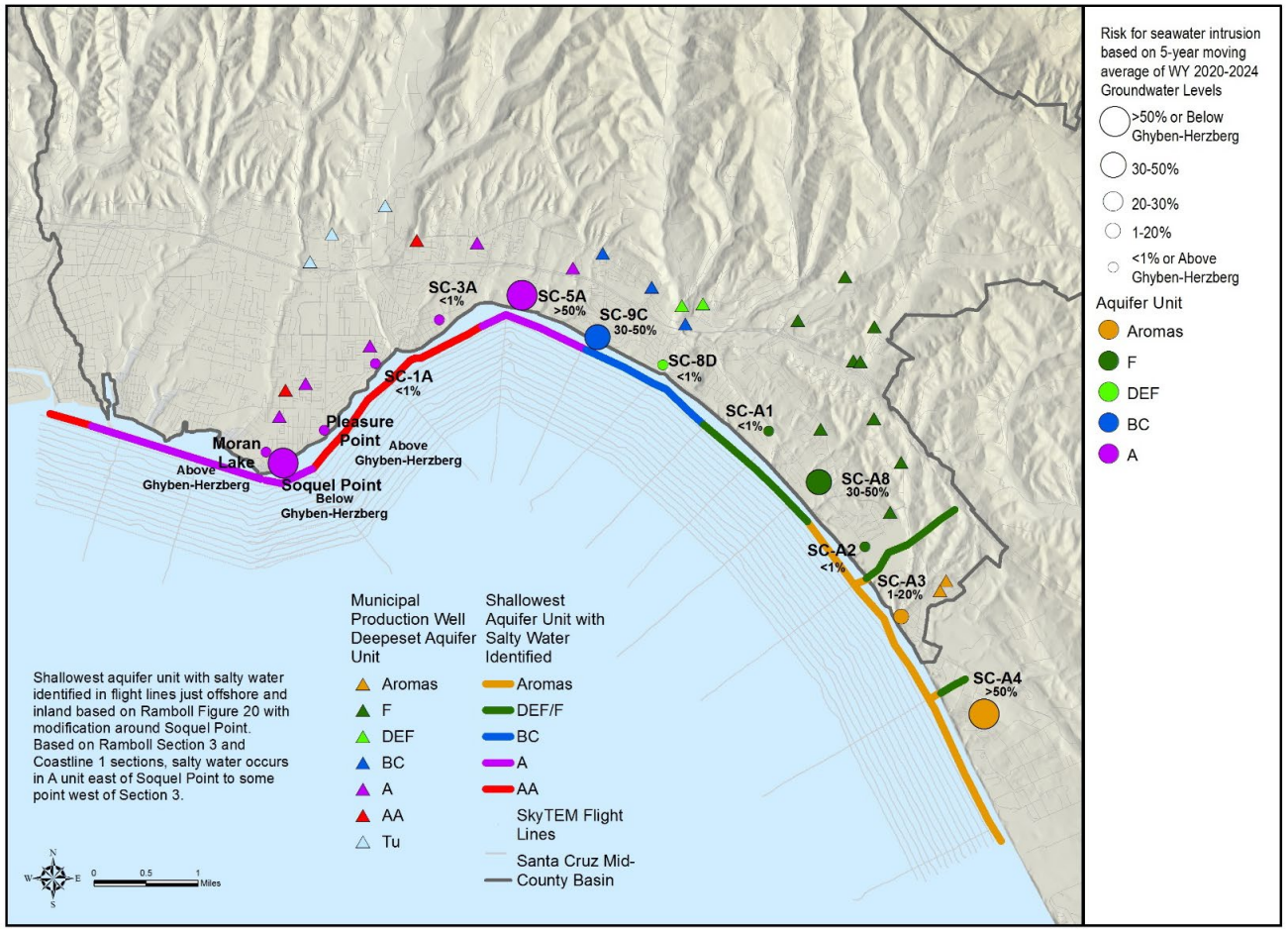


Measurable Objective (MO): goal for each sustainability indicator | **Minimum Threshold (MT):** indicator of potential concern | **Undesirable Result:** combination of MT exceedances that cause significant and unreasonable conditions

2017 Offshore AEM Data Emphasized Need to Prevent Seawater Intrusion



- Close proximity of offshore interface in pumped aquifer units
- Emphasizes importance of seawater intrusion as sustainability indicator for GSP
- Prompted accelerated efforts to recover groundwater levels to prevent further seawater intrusion sooner than 2040



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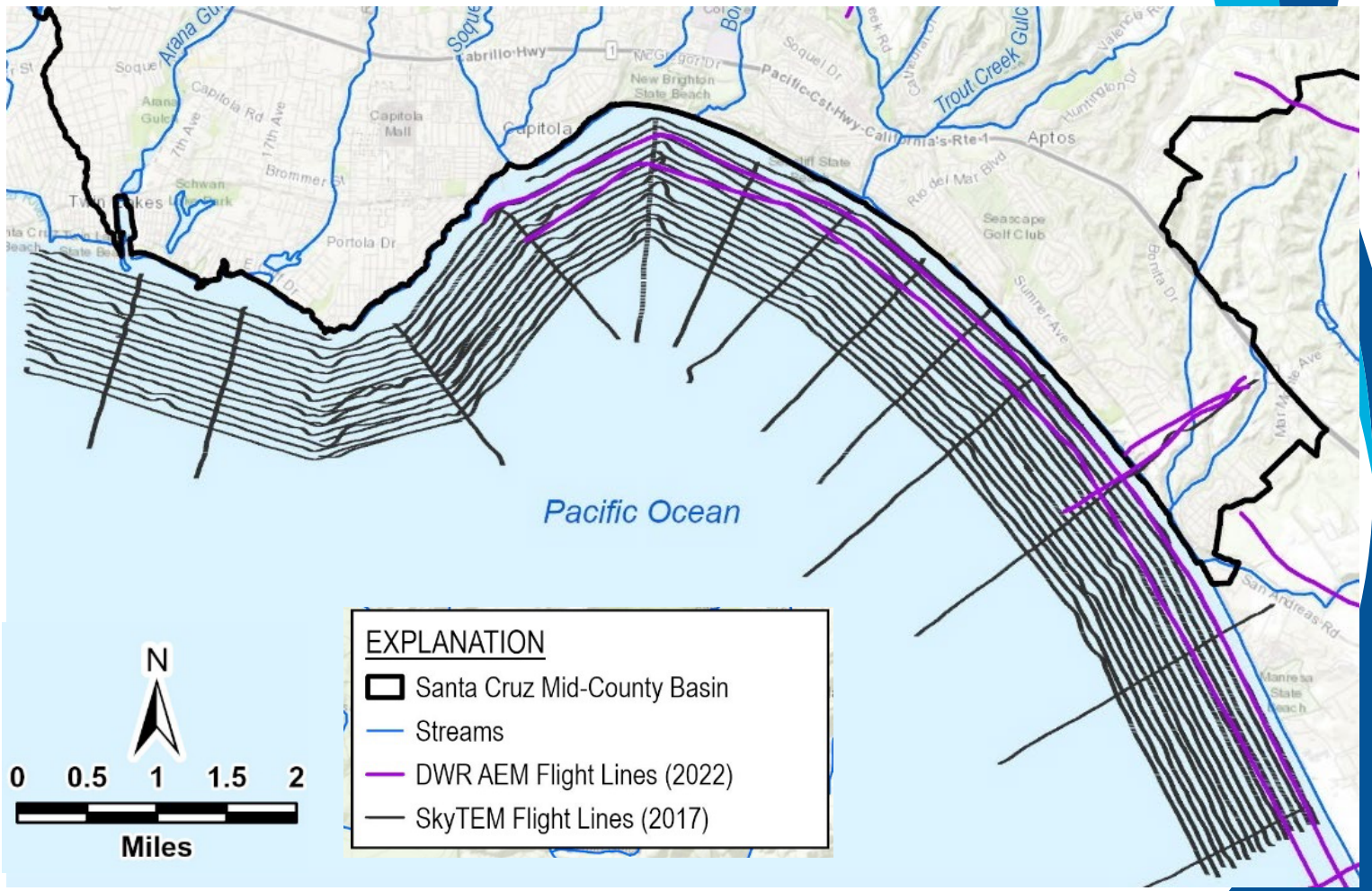
Use of 2022 Offshore AEM Data that is Sufficient to Confirm 2017 Survey Conclusion

2022 DWR vs. 2017 MGA

- Fewer offshore survey lines
- Shallower depth of investigations
- Did not extend to City of Santa Cruz
- Not as close to coast in some areas



Closest 2022 offshore line is close enough to coast with sufficient depth of investigation to evaluate using DWR results

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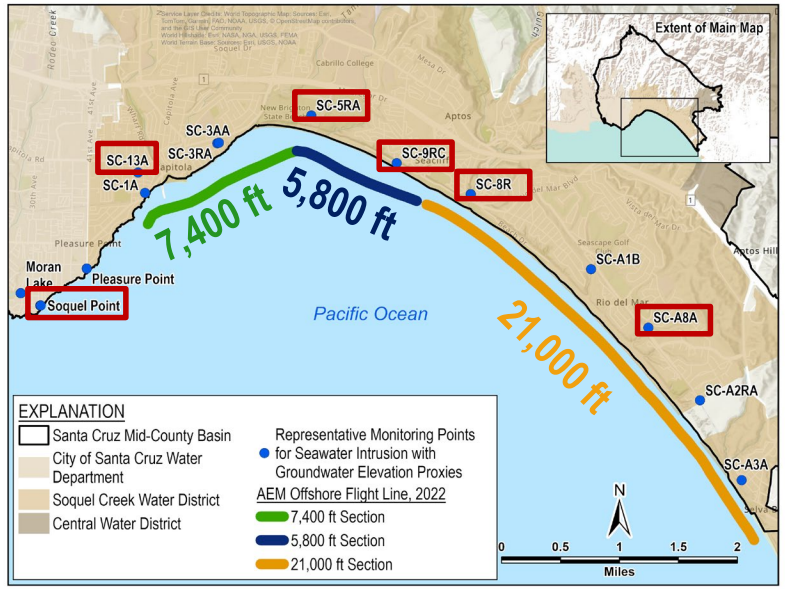
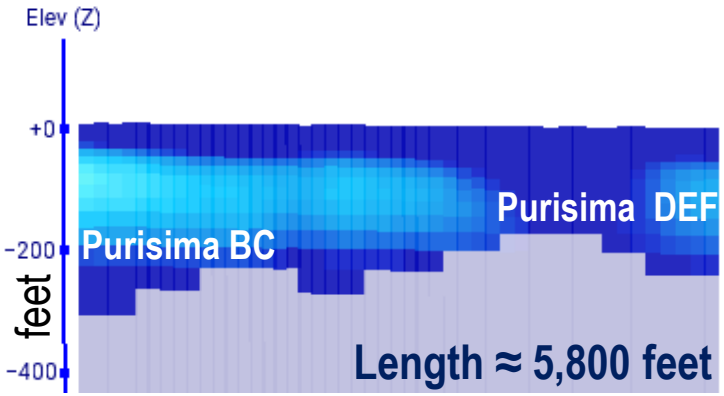
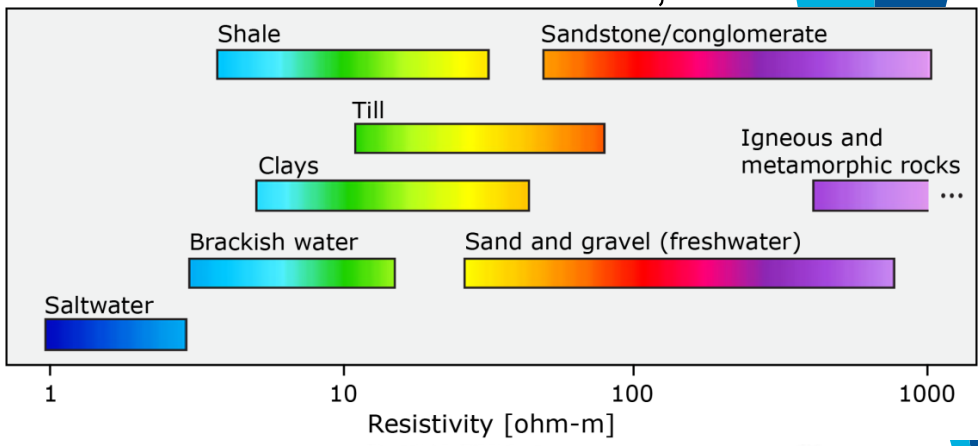
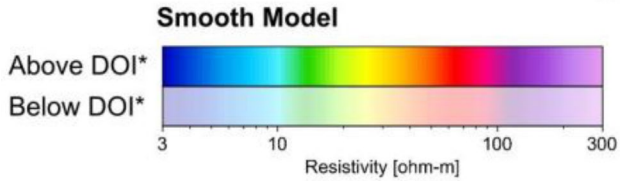
2022 Offshore AEM Data Confirmed 2017 Survey Conclusion



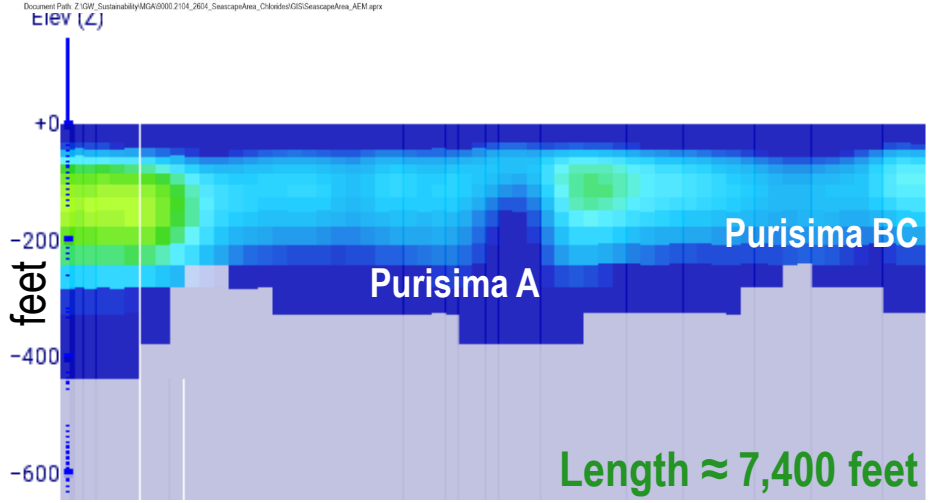


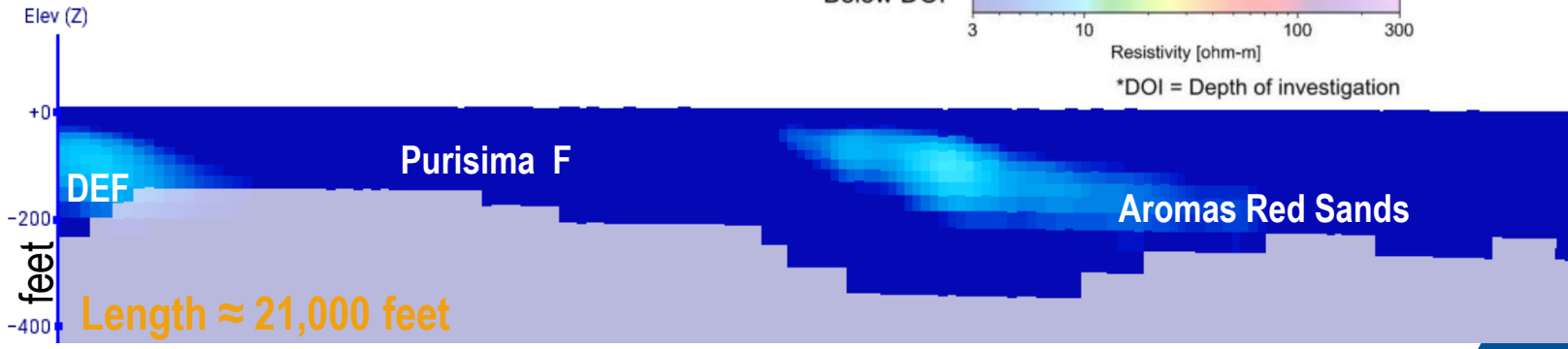
Results from DWR, 2023





*DOI = Depth of investigation





5x Vertical Exaggeration

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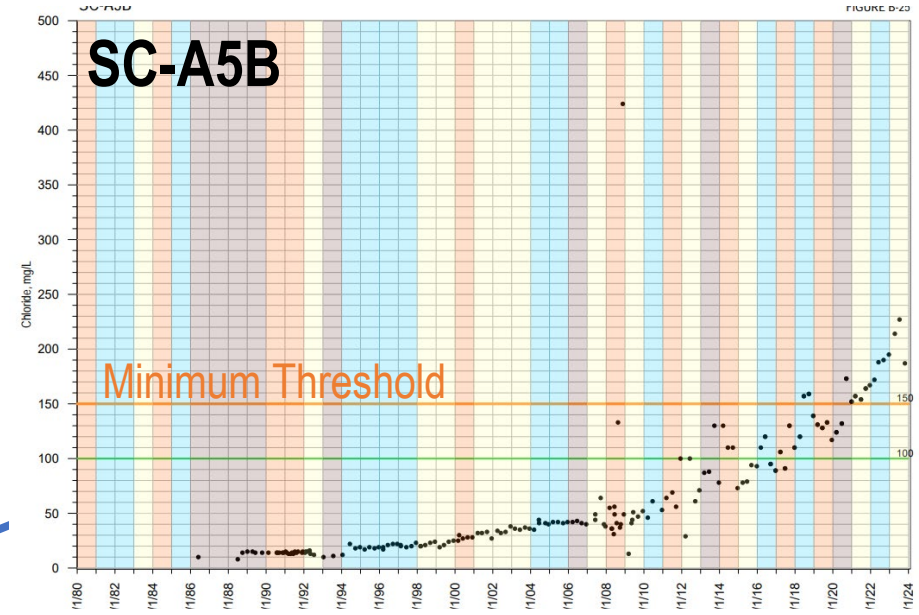
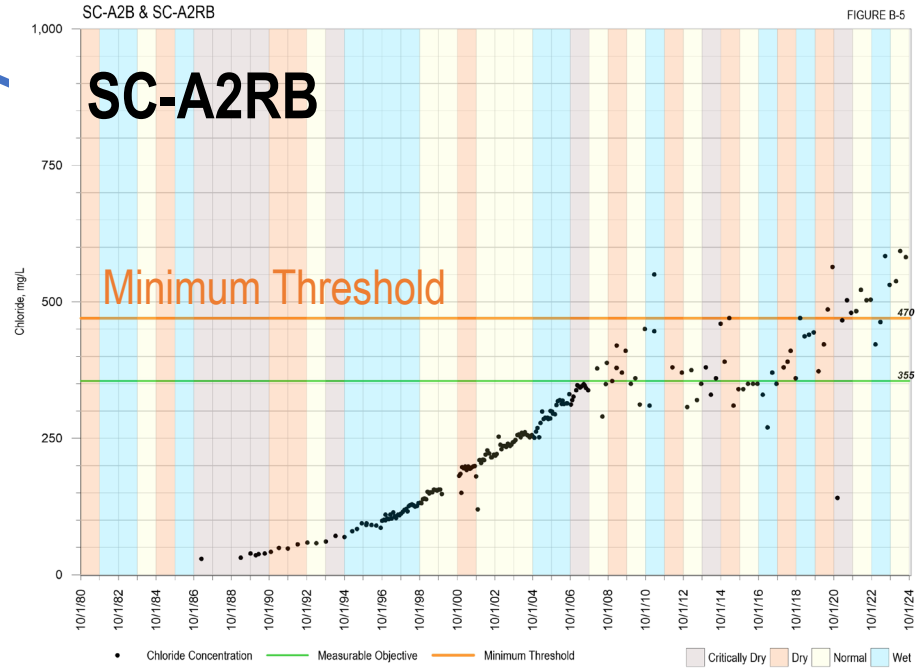
5-year periodic evaluation (2025): “seawater intrusion persists in offshore aquifers”

Undesirable Results in Onshore Seascape Area





Chloride concentrations increasing and exceed minimum thresholds

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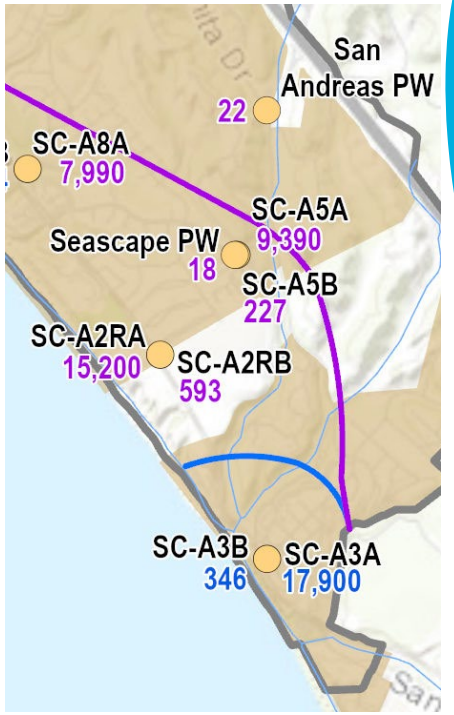
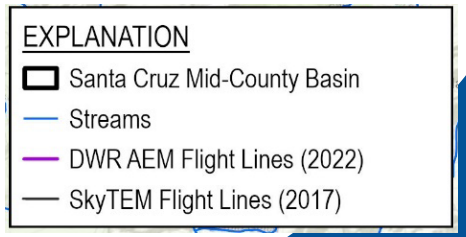
Onshore Seascape Area Subject of Comprehensive Evaluation

- Key questions about increasing concentration trend
  - What are causes?
  - Is it likely to continue?
  - What are consequences?
- Evaluation required more direct comparison of 2017 and 2022 AEM onshore data
  - MGA contracted with Geophysical Imaging Partners (GIP) to re-process for comparison
- Evaluation results anticipated in March 2026





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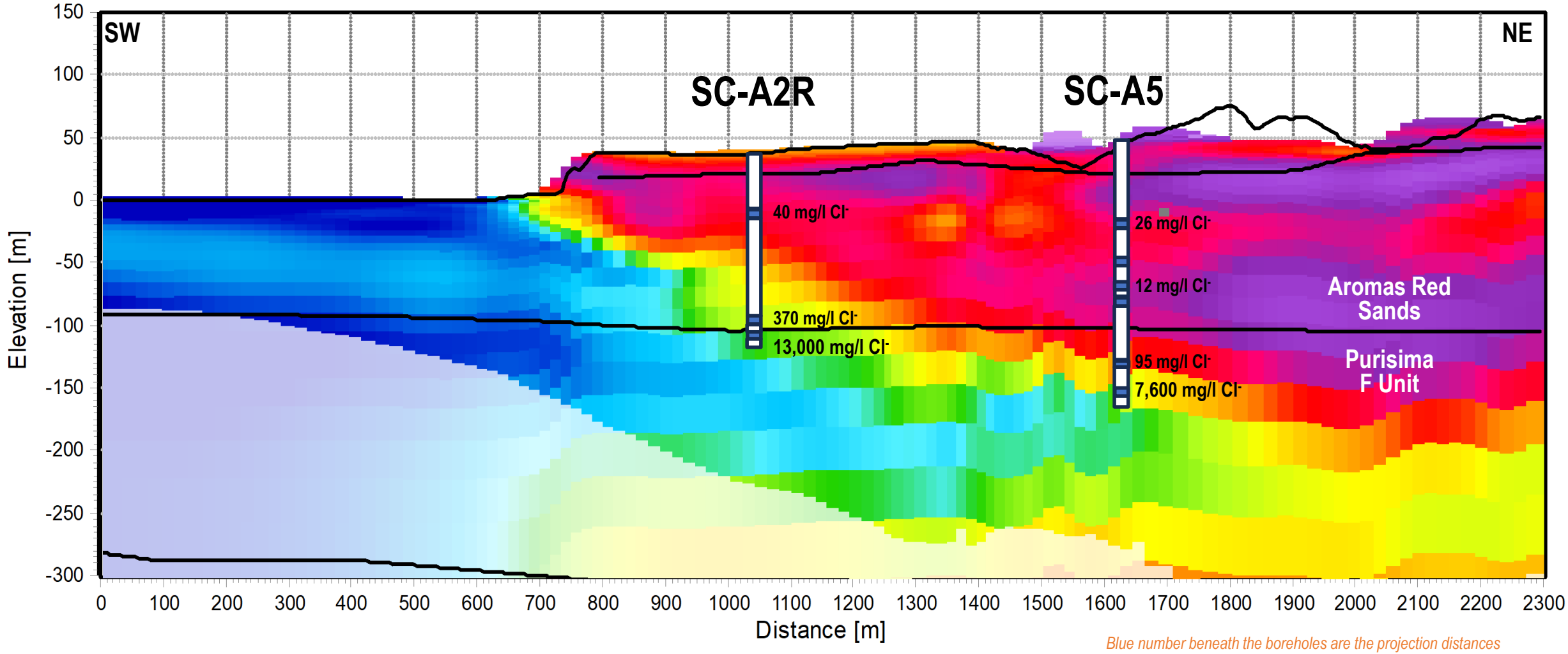
2017 Seascape Cross-section

Re-processed and inverted by GIP

The Chloride concentrations are from samples taken taken from the nearest time to when the two surveys were carried out

The solid lines: Montgomery & Associates HCM framework



Blue number beneath the boreholes are the projection distances

2022 Seascape Cross-section

Re-processed and inverted by GIP

The Chloride concentrations are from samples taken taken from the nearest time to when the two surveys were carried out

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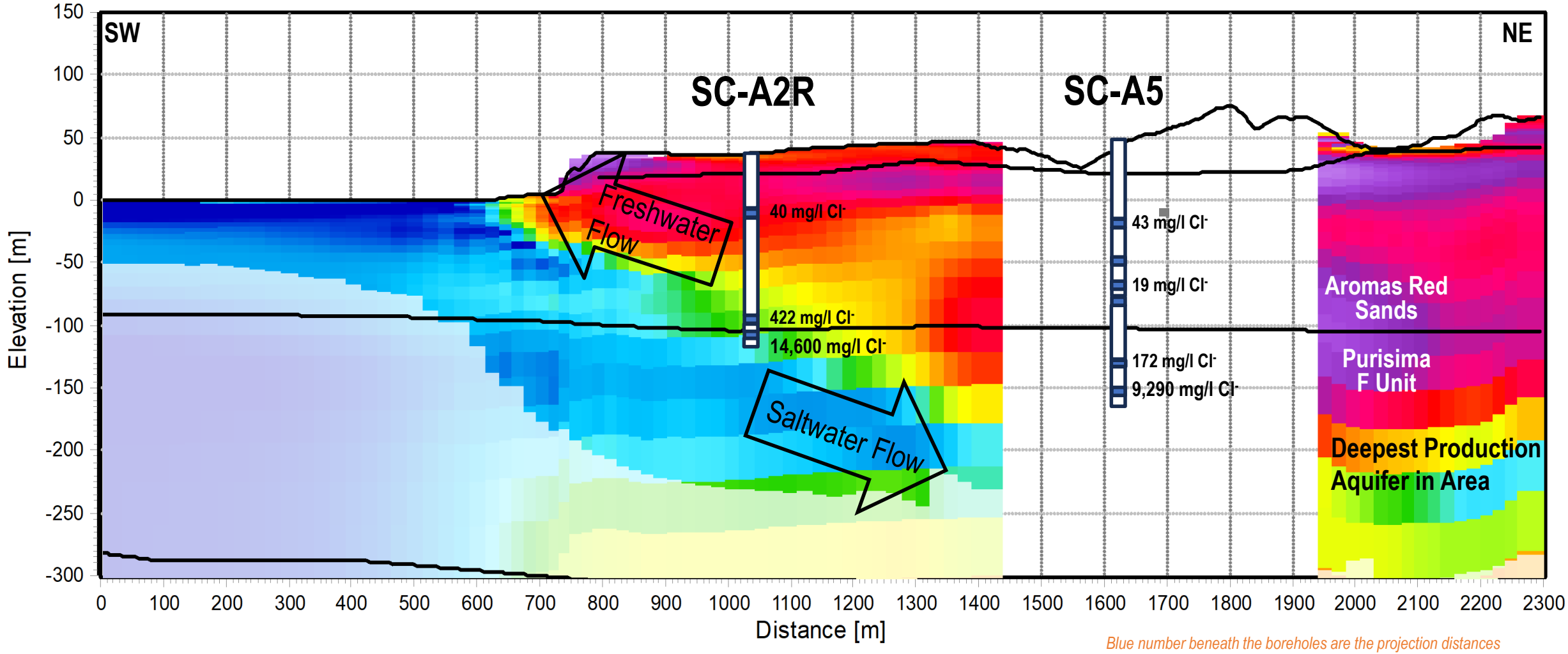
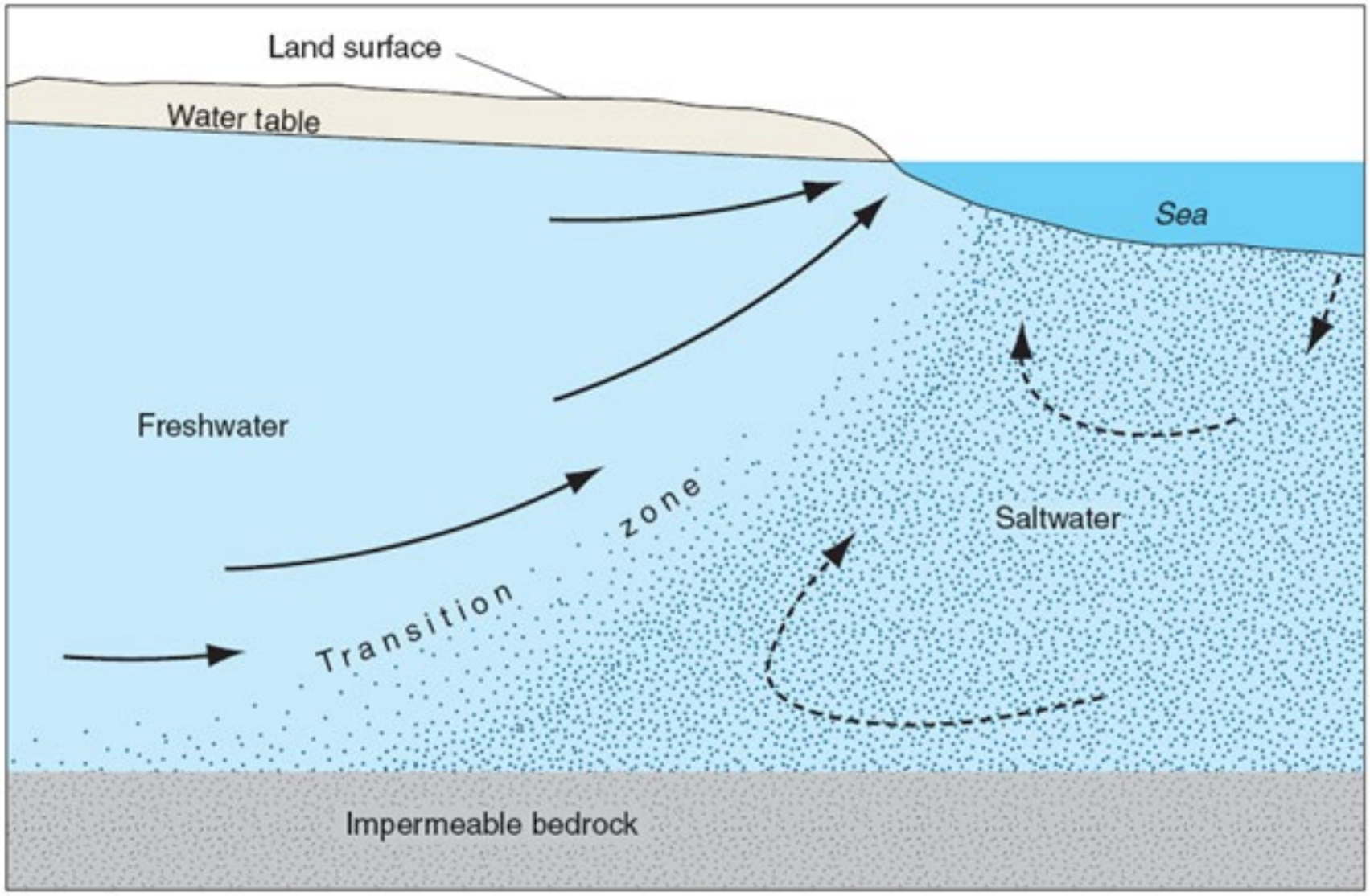


Blue number beneath the boreholes are the projection distances

Typical Flow Pattern at Freshwater-Saltwater Interface



Modified by Barlow, 2003, U.S. Geological Survey Circular 1262, from Cooper, 1964

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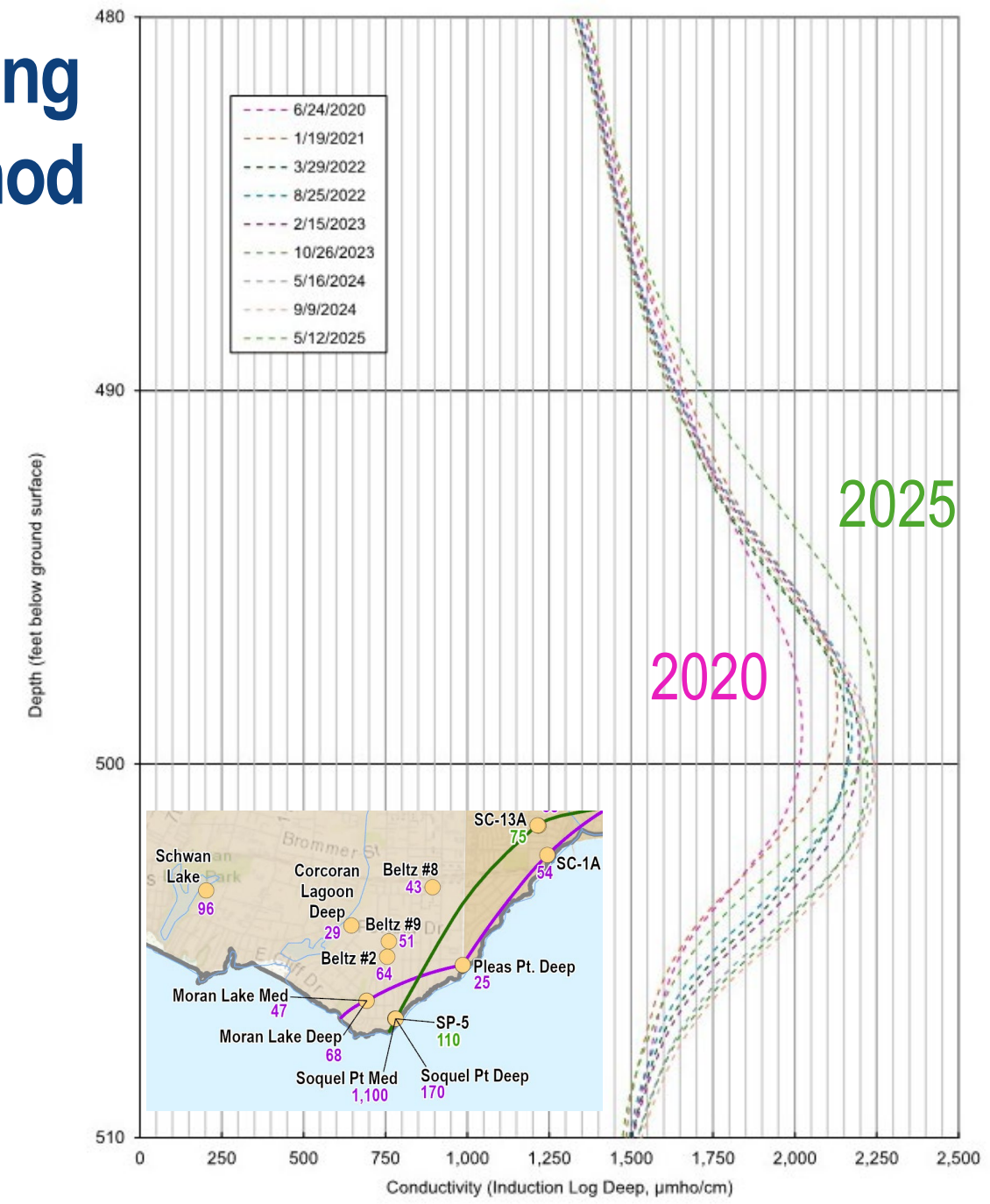
City of Santa Cruz Induction Logging is an Alternative Geophysical Method to Track Seawater Intrusion

- Since 2020, City has conducted 9 induction logs at SP-5, the deepest well at Soquel Point
- Tracks seawater intrusion over full depth of well at same location over time
- Identified potential increase in seawater intrusion in unscreened interval



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Summary

- Per regulations, the GSP defines sustainability onshore
- AEM data is not required by SGMA
- 2022 offshore AEM data confirmed conclusion from 2017 offshore AEM data
- Comparison of data from onshore AEM surveys consistent with measured chloride concentrations indicating advancement of seawater intrusion in deeper zones of Seascape area
- Induction logging is an alternative geophysical method to track seawater intrusion

Questions