Sediment Characterization of the Post-Dredge Surface: Comparison of In-Situ and Post-Dredge Grab Samples in Freshwater and Marine Sediments in the Lower Columbia River Basin and Puget Sound

Pacific Chapter WEDA

Seward, Alaska
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PORT OF PORTLAND
Possibility. In every direction.

DEPARTMENT OF ECOLOGY
State of Washington

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10

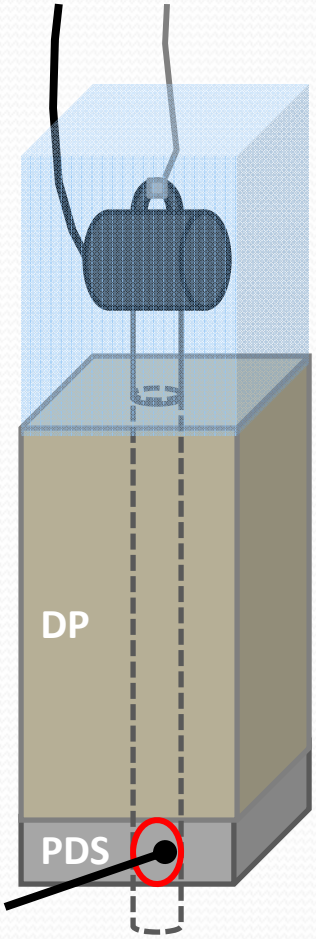
Purpose

- Determine if pre-dredge, in-situ core samples taken at the maximum anticipated depth of dredging are predictive of post-dredge surface (PDS) chemistry
- Compare results from pre-dredge core samples and post-dredge grab samples at 4 sites
- Use findings to better inform state and federal regulatory decision making for dredging projects

Sampling the post-dredge surface (PDS):

BEFORE DREDGING

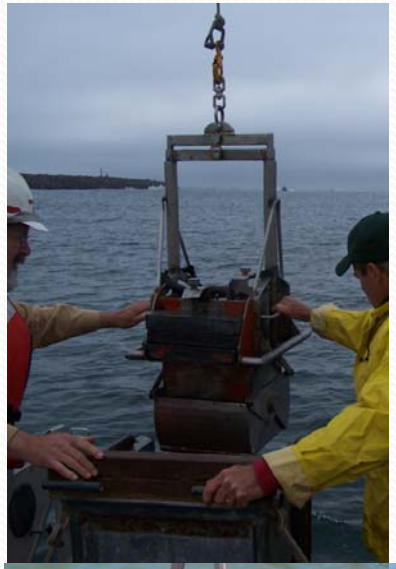
Vibracore sampler:

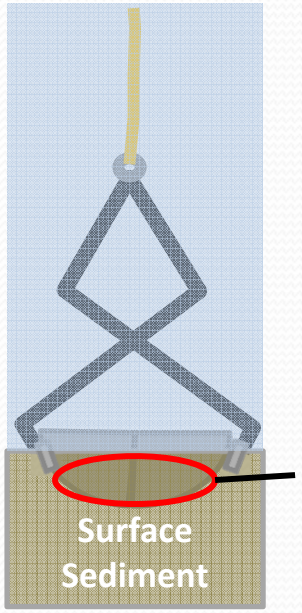


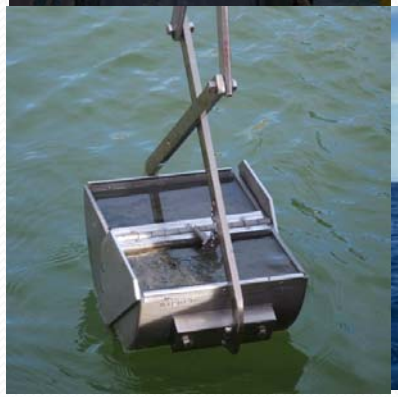
In-situ core sample
(pre-dredge predictor)

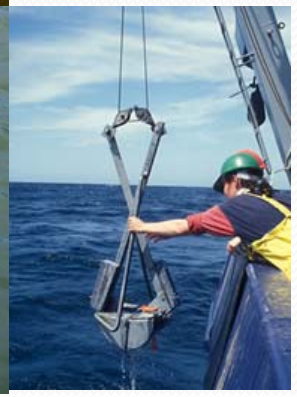
AFTER DREDGING

Grab samplers:





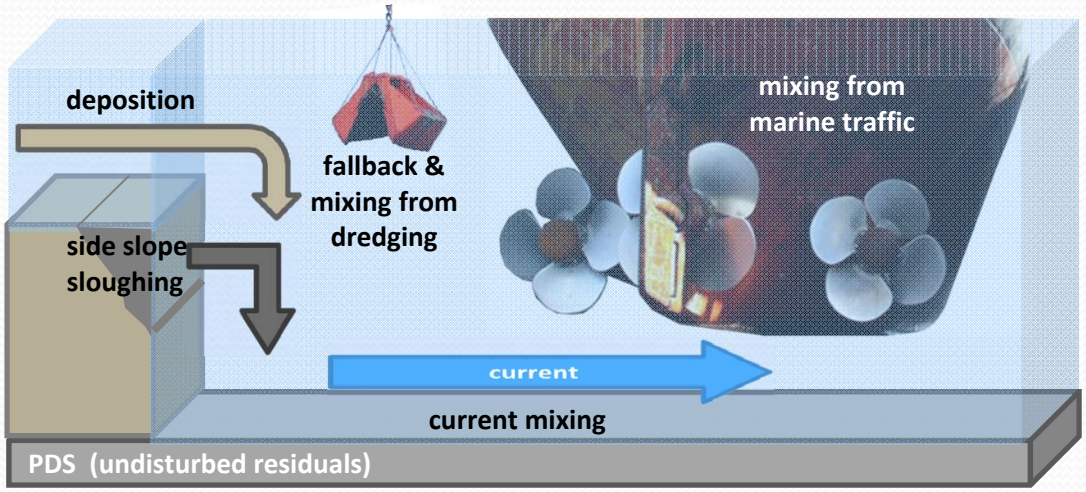




Post-dredge grab samples
(the actual PDS)

Problem

- In-situ, PDS core sample measures undisturbed residuals in the dredge area
- BUT, in-situ samples don't account for other processes during and after dredging:
  - Fallback & mixing during dredging
  - Deposition during/after dredging
  - Mixing during dredging
  - Side-slope sloughing
  - Mixing caused by natural processes and marine traffic



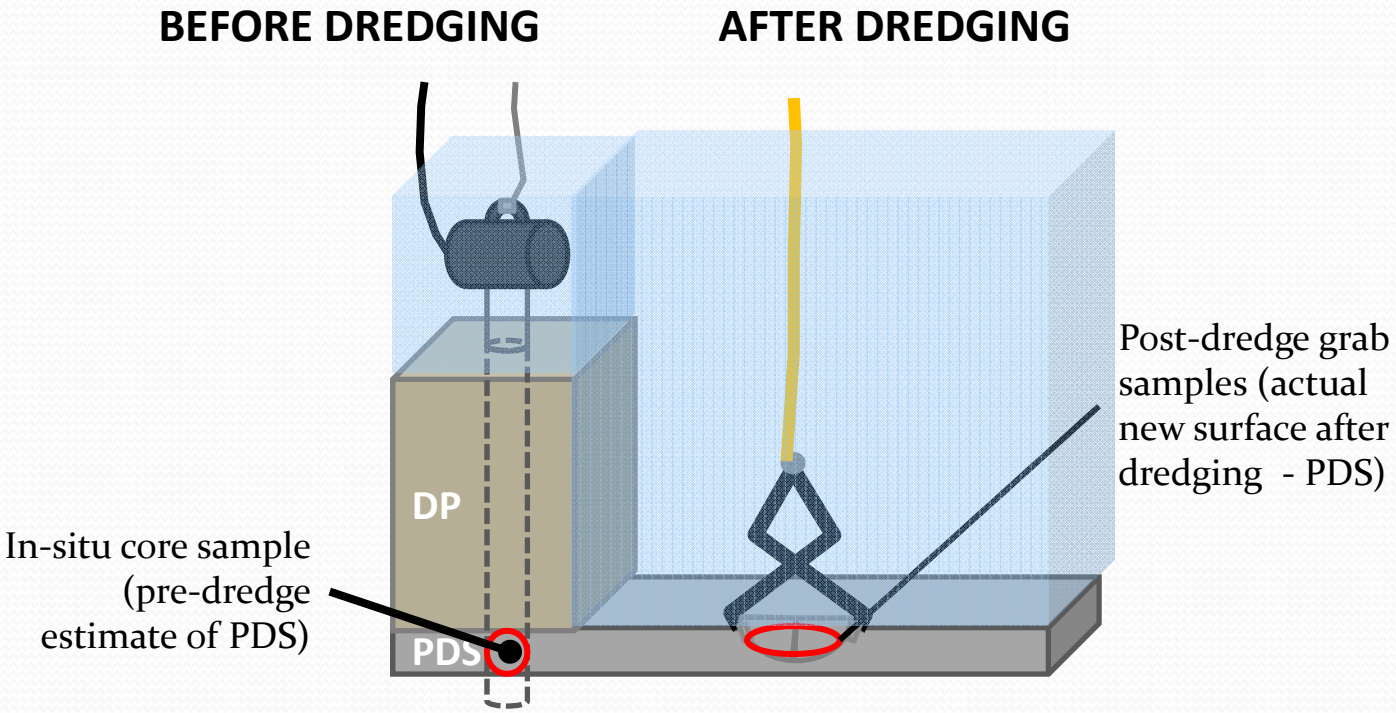
Regulatory Review of Post-Dredge Surface

- Regulatory agencies want to know what's being dredged AND what may be exposed after dredging
- Concern about contaminant concentrations that may affect:
  - Endangered species concerns
  - State water quality parameters (sediment-water column interface)
  - State anti-degradation policies

    (i.e., exposed surface >> dredge prism = **BAD**)
- State and federal permits may require:
  - Physical isolation of the PDS
    - Placement of a clean sand cover
    - Natural infill (of cleaner sediment)
  - Monitoring after dredging

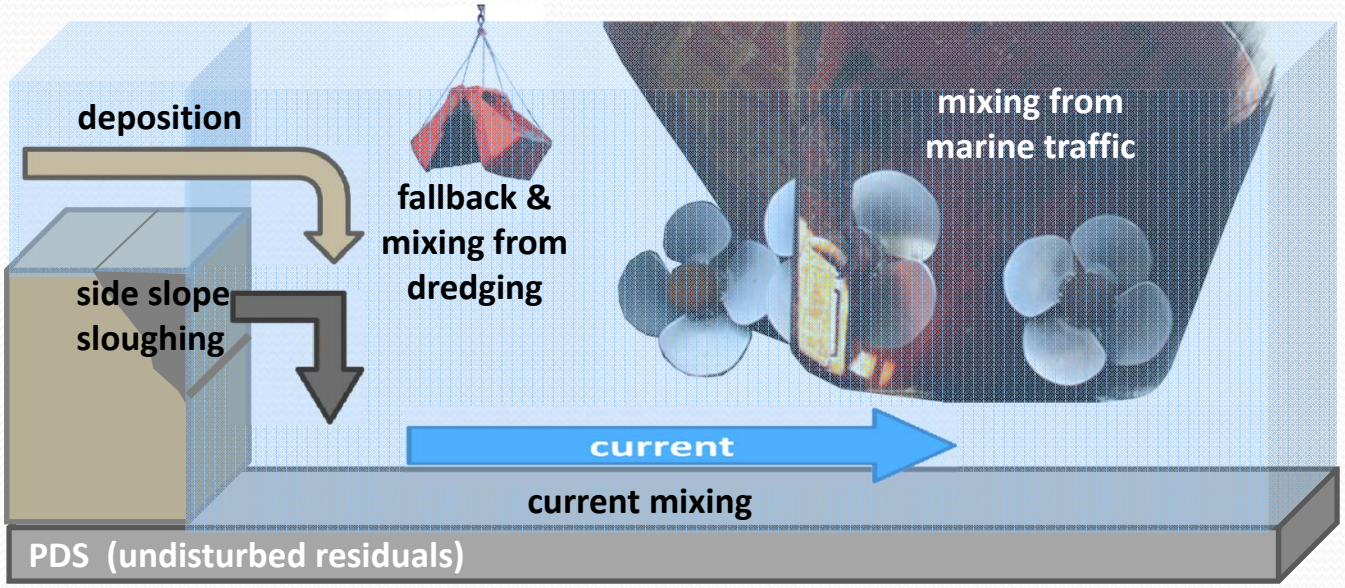
Methods

Compared **concentrations** of chemicals of concern:

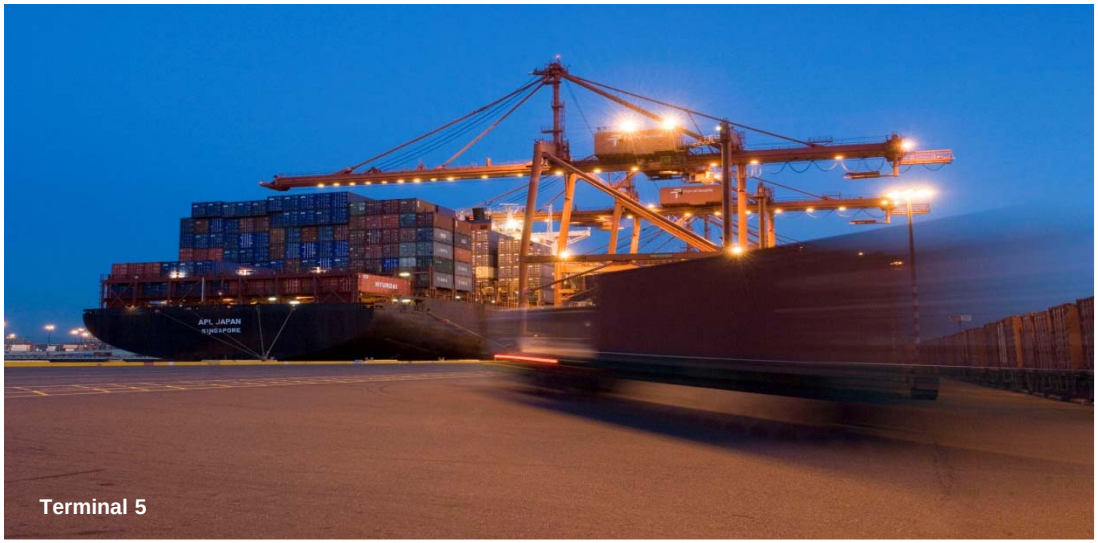


Methods *(cont.)*

To explain differences, identified potential factors contributing to PDS chemistry:



Marine Site

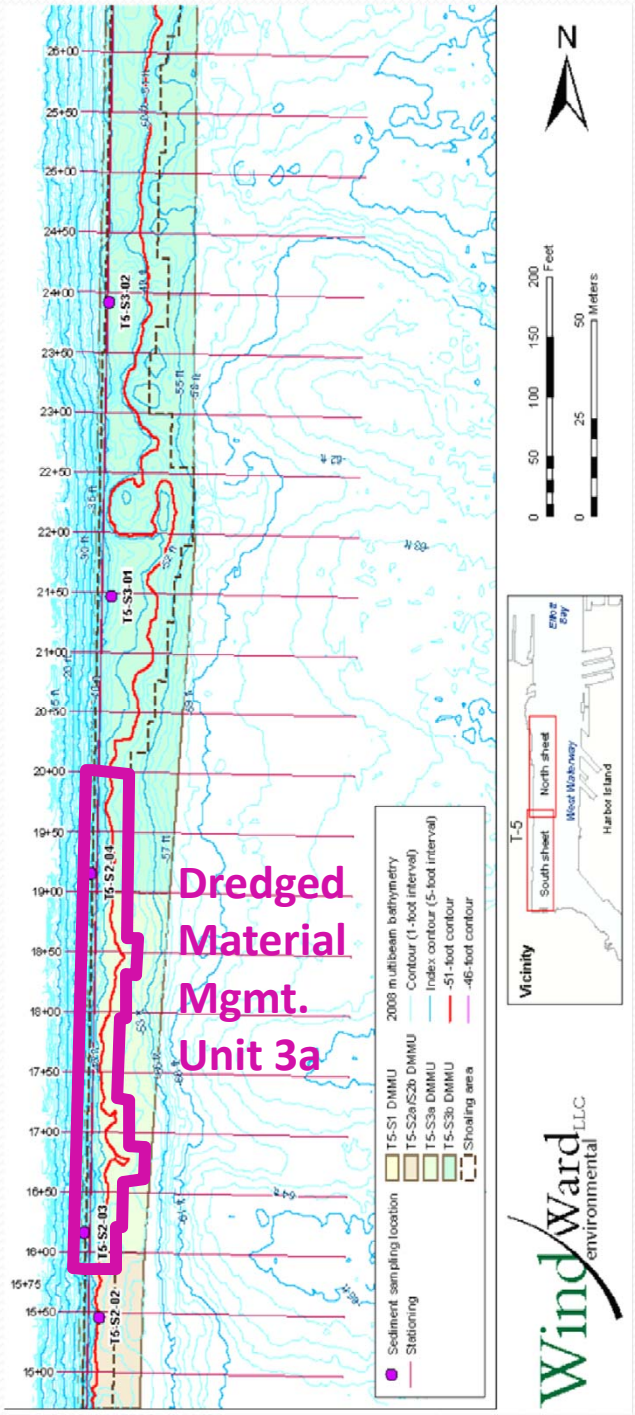

Terminal 5

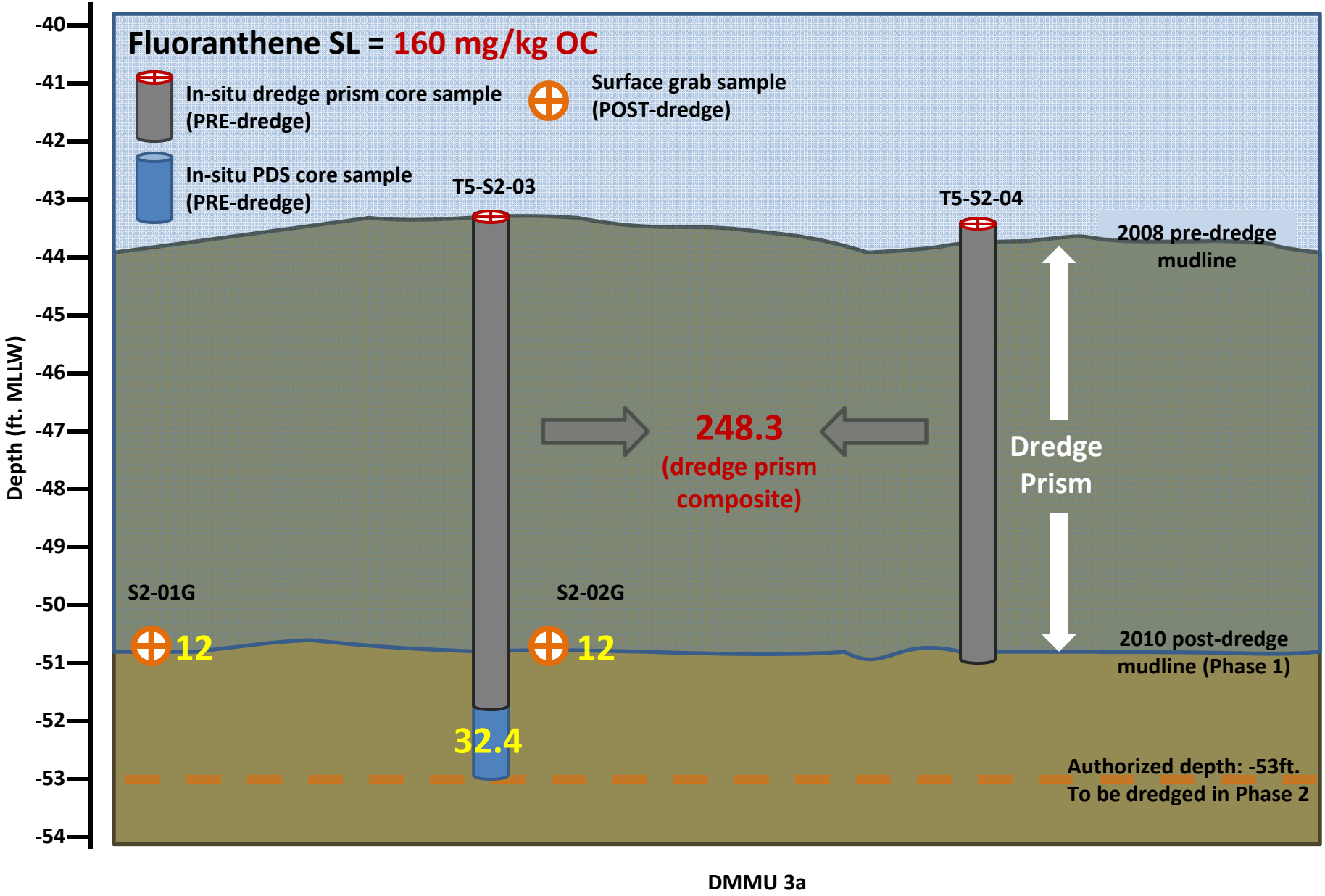

N
0
0.5
1
2
miles
Puget Sound
(Elliot Bay)
SEATTLE
Harbor
Island
PoS T5
Duwamish R.

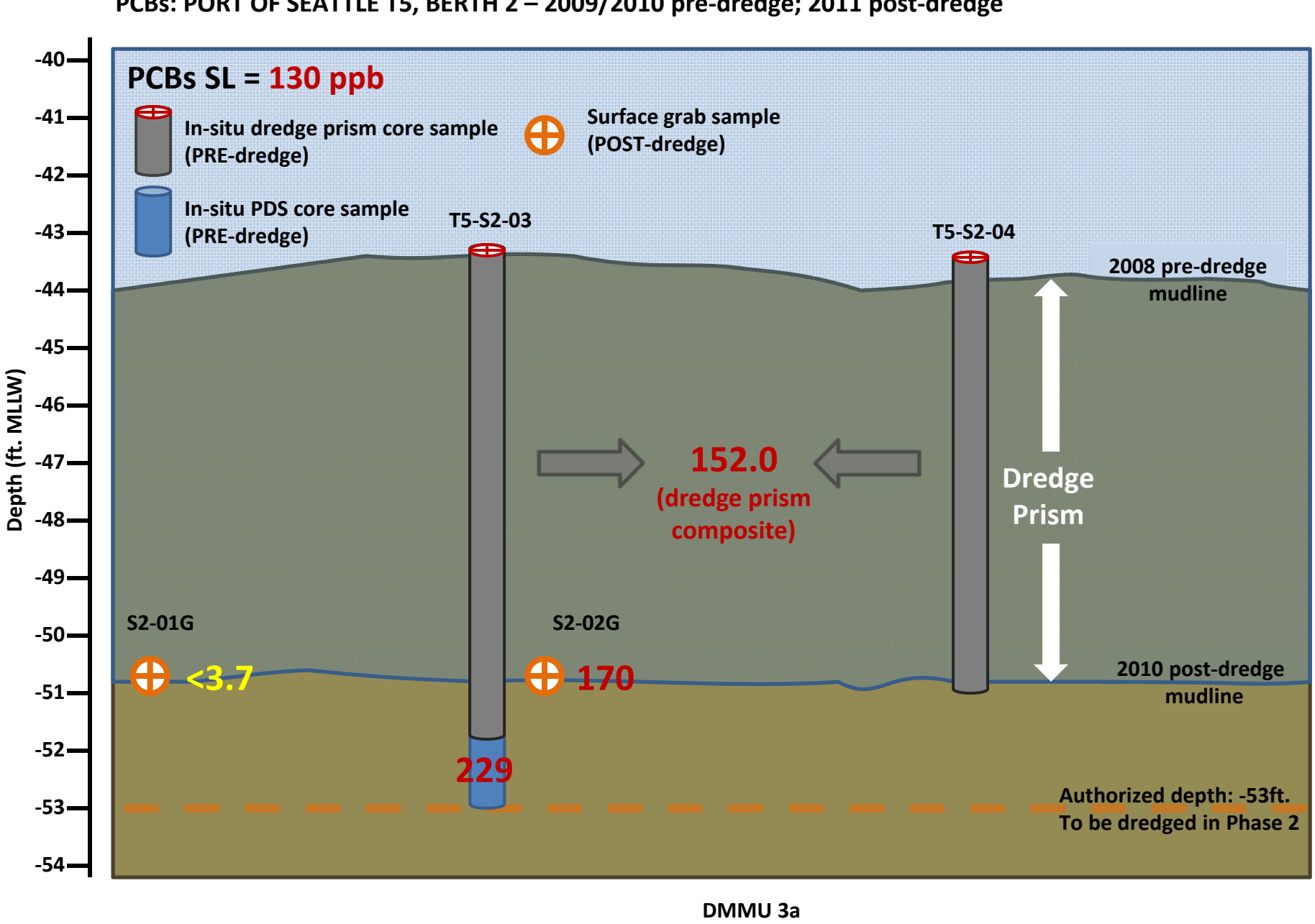
Port of Seattle
Terminal 5, Berth 2

DETAILS

- Location: Duwamish River, West Waterway
- Volume: DMMU 3a, 5,180 cy
  (project total: 10,400)
- Depth: Phase 1 - Dredged to -50 feet +1 MLLW
- Disposal: Upland (unknown)
- Project dredged in Dec. 2010/Jan. 2011
- Sand cover placed after post-dredge sampling
- Phase 2 (planned) – deepen to -53 feet +1 MLLW




FLUORANTHENE: PORT OF SEATTLE T5, BERTH 2 – 2009/2010 pre-dredge; 2011 post-dredge
Fluoranthene SL = 160 mg/kg OC
In-situ dredge prism core sample (PRE-dredge)
Surface grab sample (POST-dredge)
In-situ PDS core sample (PRE-dredge)
T5-S2-03
T5-S2-04
2008 pre-dredge mudline
248.3
(dredge prism composite)
Dredge Prism
S2-01G
12
S2-02G
12
2010 post-dredge mudline (Phase 1)
32.4
Authorized depth: -53ft.
To be dredged in Phase 2
Depth (ft. MLLW)
-40
-41
-42
-43
-44
-45
-46
-47
-48
-49
-50
-51
-52
-53
-54
DMMU 3a

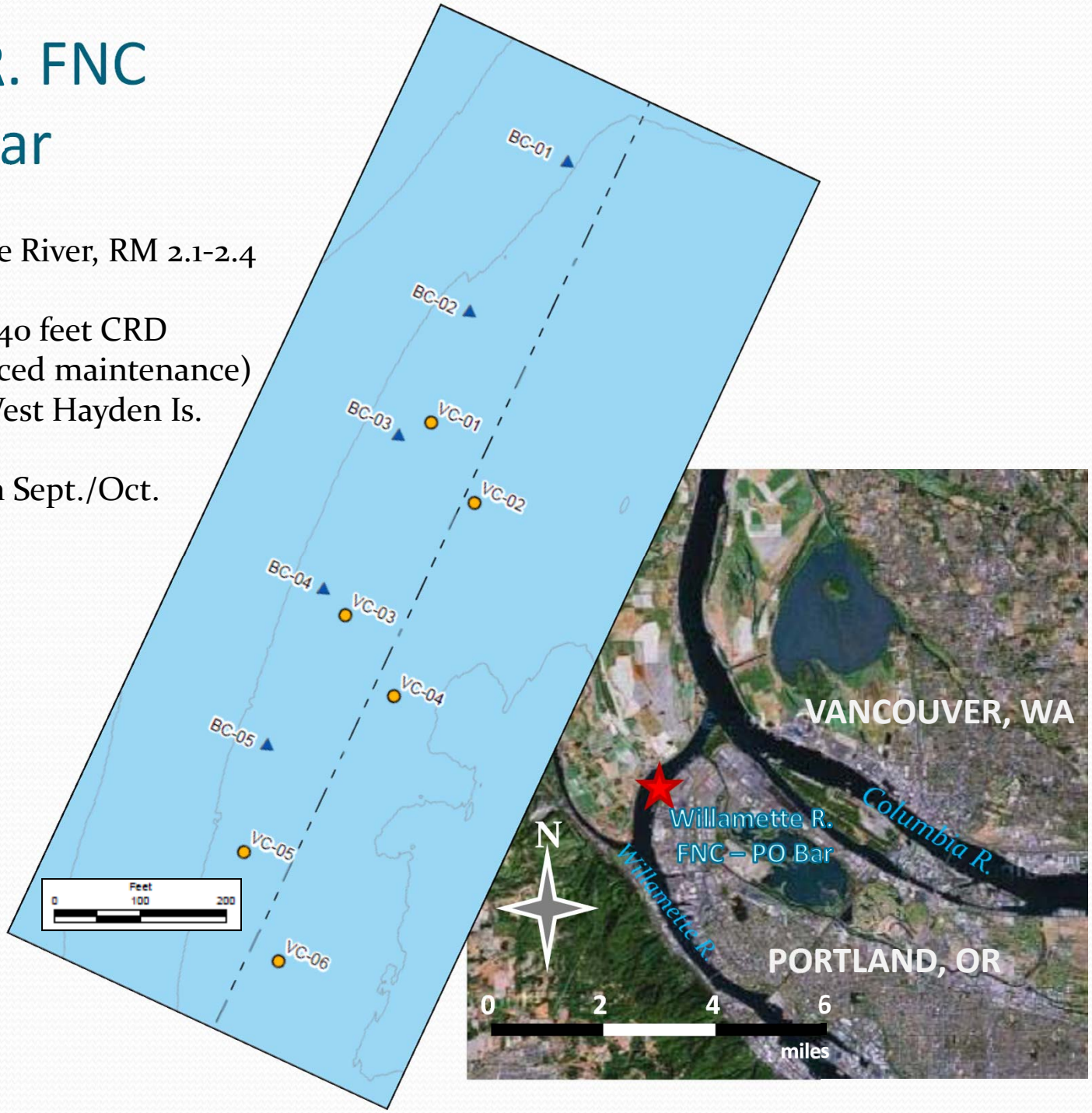

PCBs: PORT OF SEATTLE T5, BERTH 2 – 2009/2010 pre-dredge; 2011 post-dredge
PCBs SL = 130 ppb
In-situ dredge prism core sample (PRE-dredge)
Surface grab sample (POST-dredge)
In-situ PDS core sample (PRE-dredge)
T5-S2-03
T5-S2-04
2008 pre-dredge mudline
152.0
(dredge prism composite)
Dredge Prism
S2-01G
<3.7
S2-02G
170
229
2010 post-dredge mudline
Authorized depth: -53ft.
To be dredged in Phase 2
Depth (ft. MLLW)
-40
-41
-42
-43
-44
-45
-46
-47
-48
-49
-50
-51
-52
-53
-54
DMMU 3a

Freshwater Sites (3)

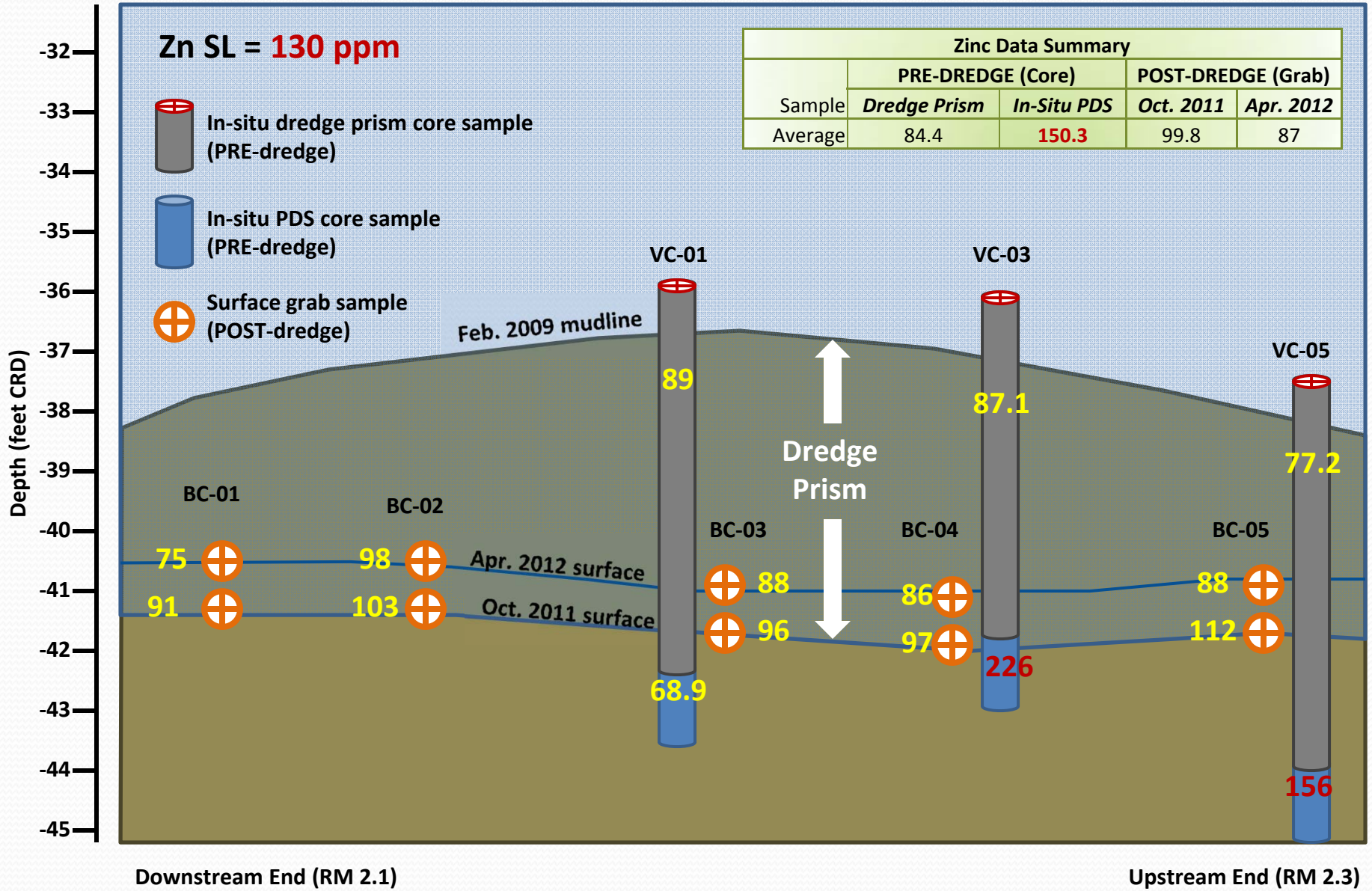
Willamette R. FNC
Post Office Bar

DETAILS

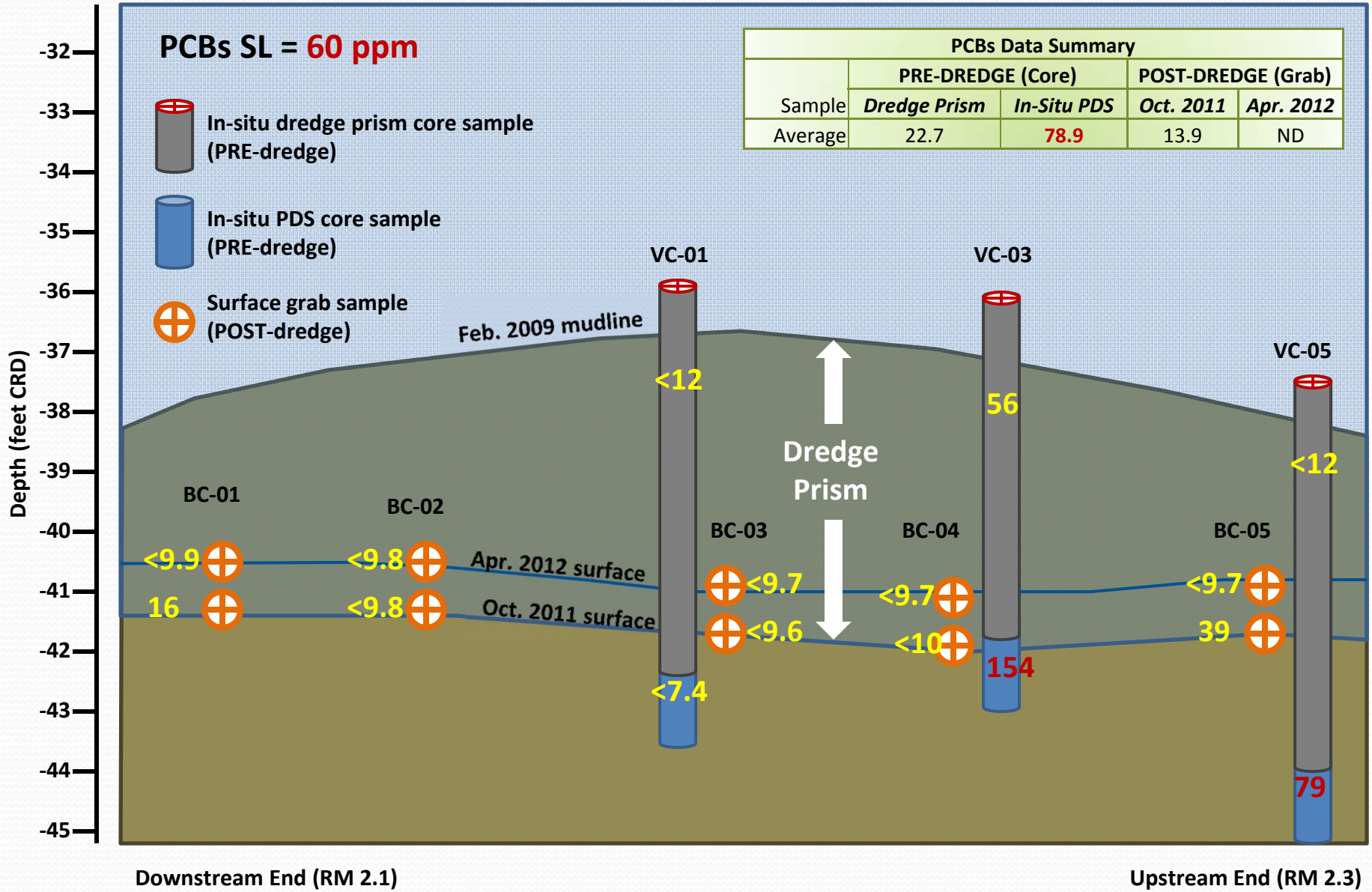
- Location: Willamette River, RM 2.1-2.4
- Volume: 52,300 cy
- Depth: Dredged to -40 feet CRD
  (plus 2 feet advanced maintenance)
- Disposal: Upland, West Hayden Is. Placement Site
- Project completed in Sept./Oct. 2011



ZINC: WILLAMETTE R., POST OFFICE BAR – 2009 pre-dredge; 2011/2012 post-dredge



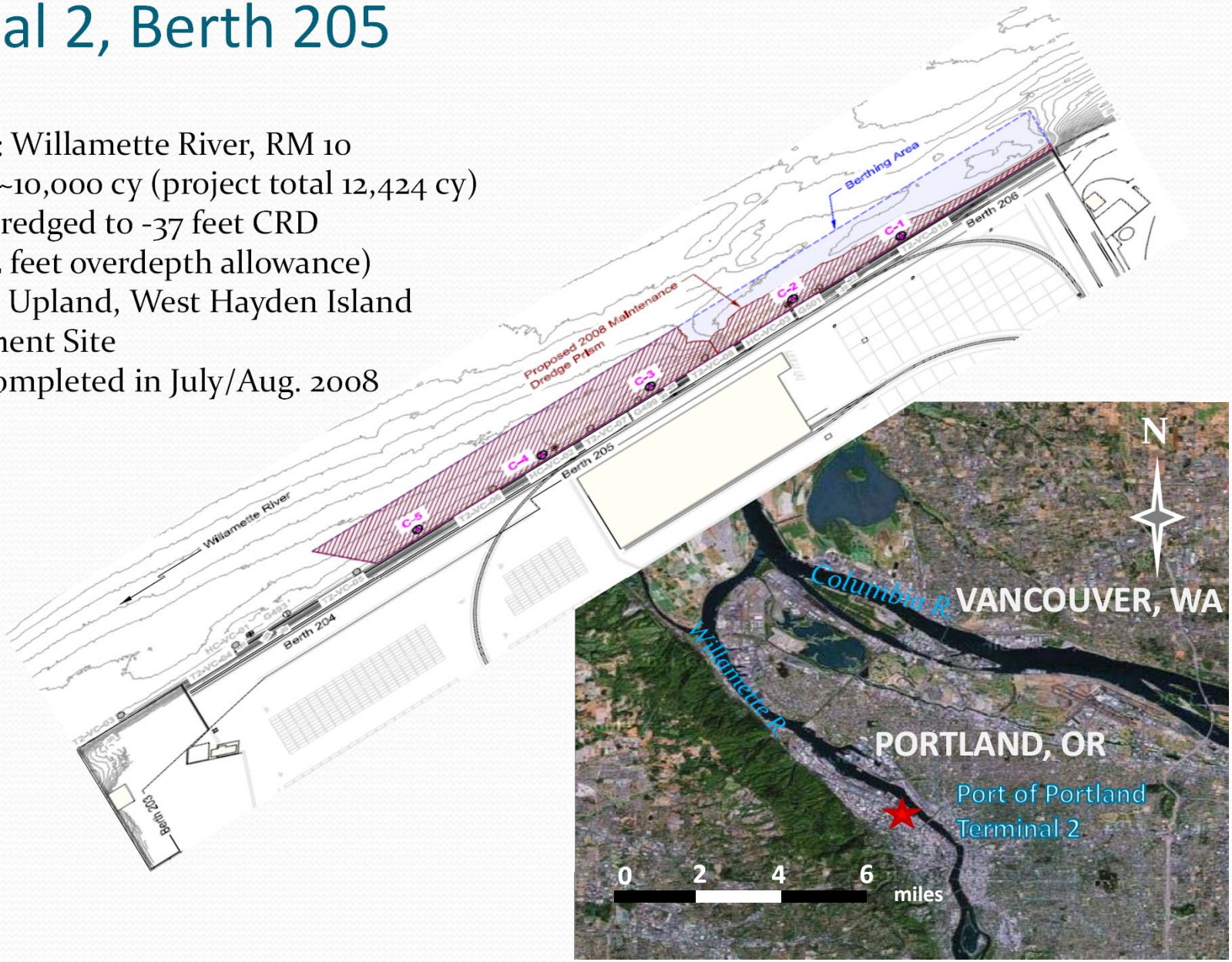
PCBs: WILLAMETTE R., POST OFFICE BAR – 2009 pre-dredge; 2011/2012 post-dredge



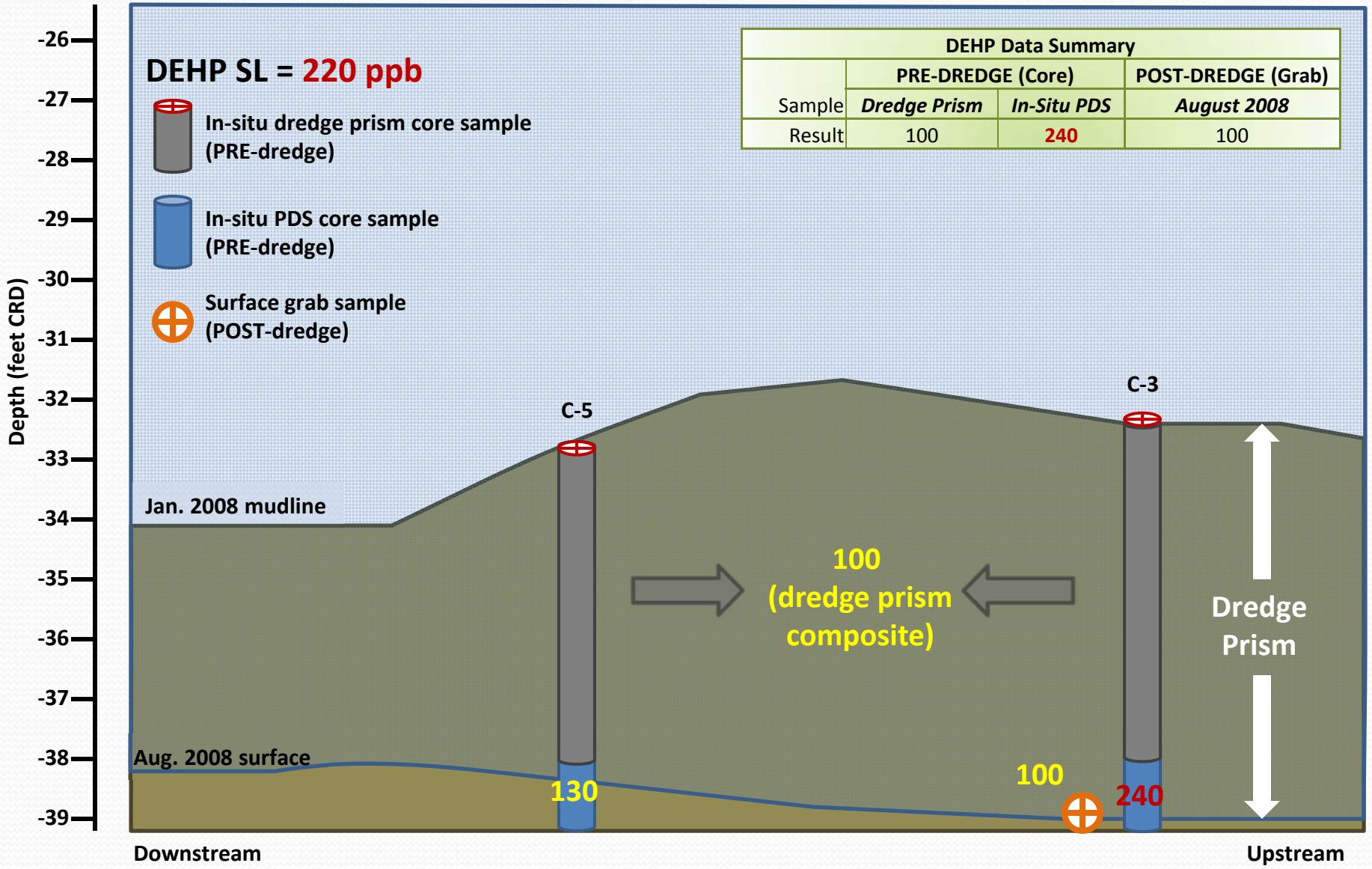
Port of Portland
Terminal 2, Berth 205

DETAILS

- Location: Willamette River, RM 10
- Volume: ~10,000 cy (project total 12,424 cy)
- Depth: Dredged to -37 feet CRD
  (plus 2 feet overdepth allowance)
- Disposal: Upland, West Hayden Island
  Placement Site
- Project completed in July/Aug. 2008



DEHP: PORT OF PORTLAND, TERMINAL 2 – January 2008 pre-dredge; August 2008 post-dredge

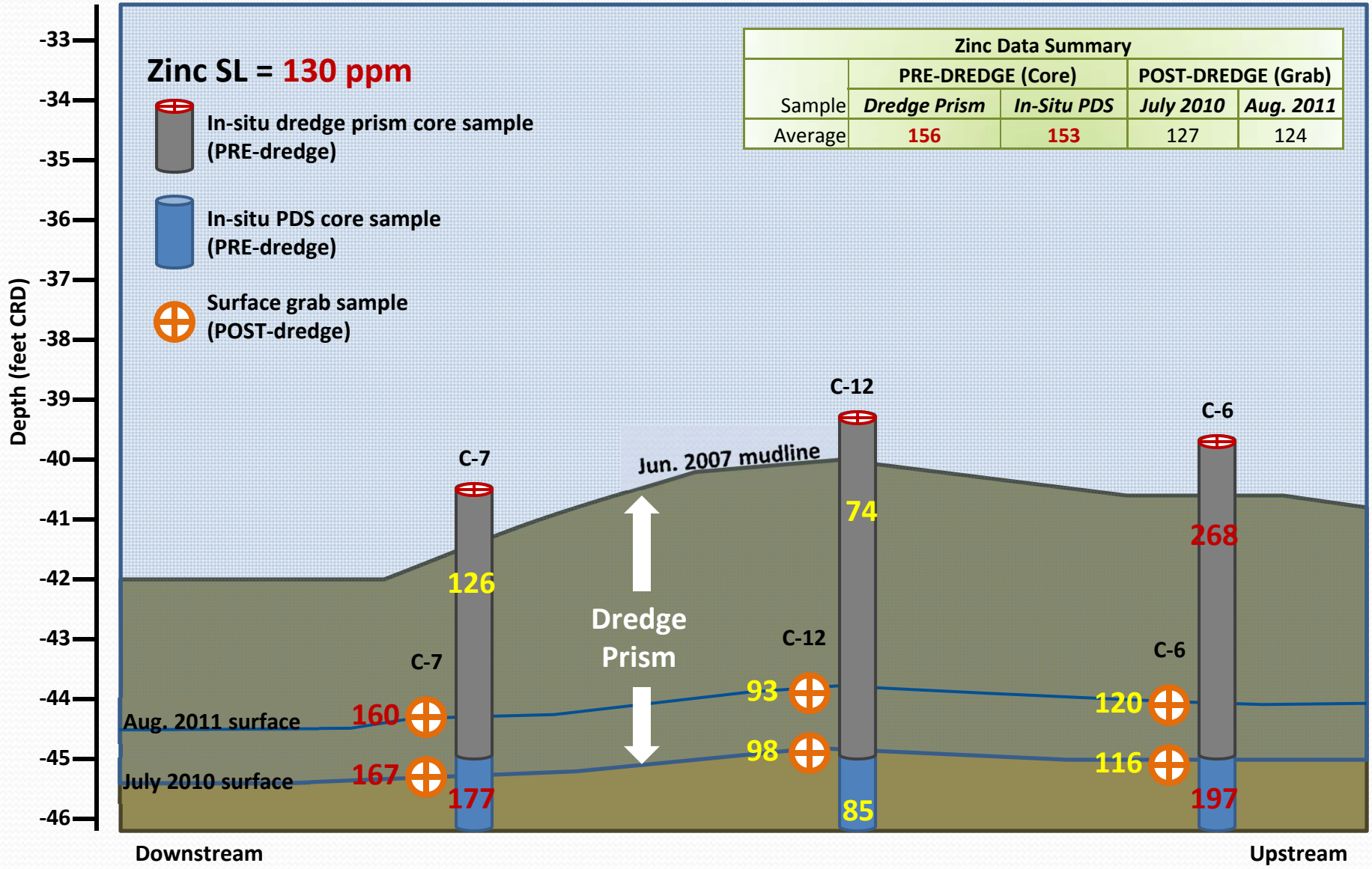


Port of Portland
Terminal 5, Berth 501

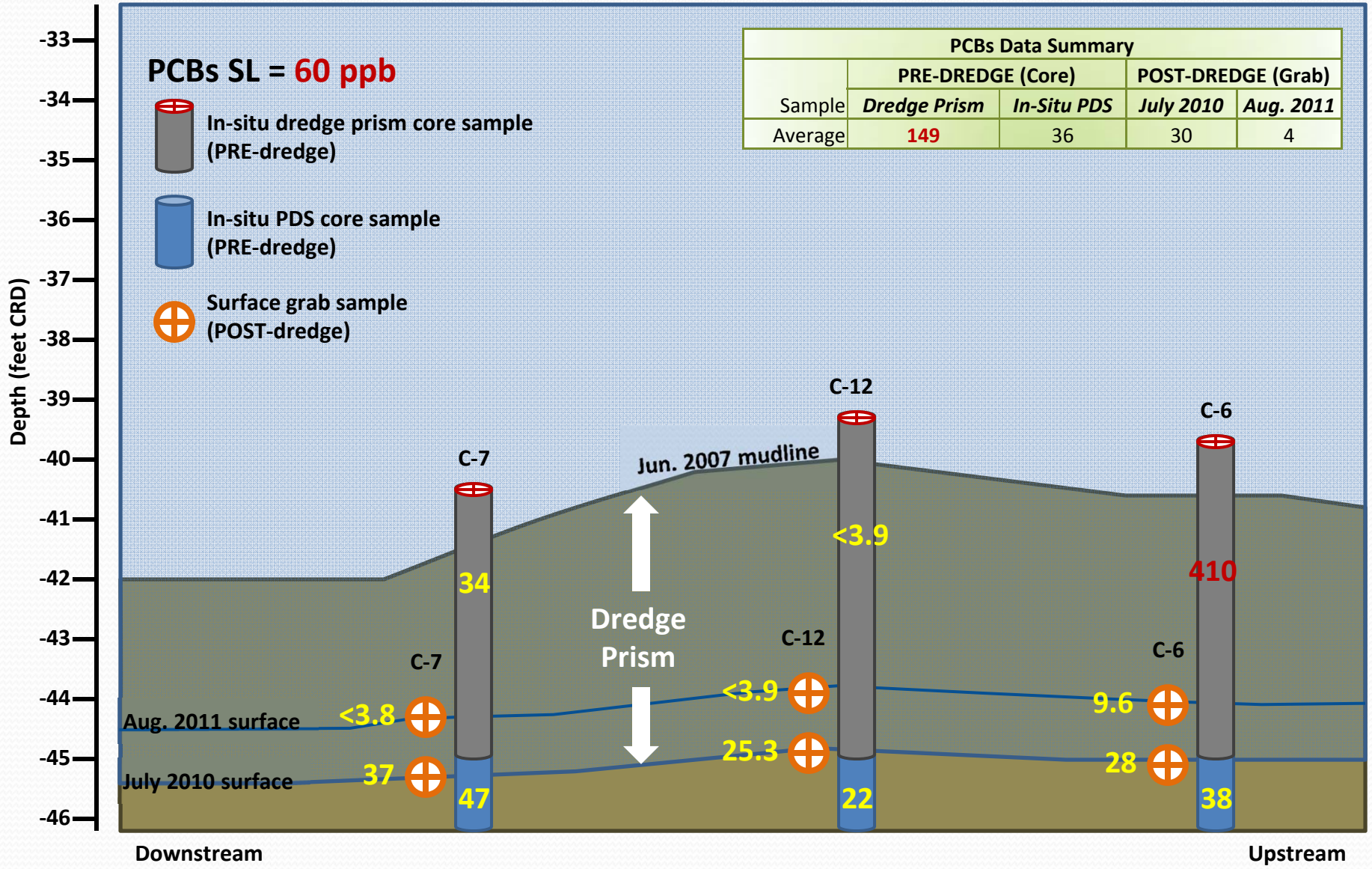
DETAILS

- Location: Willamette River, RM 1-2
- Volume: 12,246 cy (project total 25,000 cy)
- Depth: Dredged to -43 feet CRD
  (plus 3 feet overdepth allowance)
- Disposal: Upland, West Hayden Island
  Placement Site
- Project completed in July/Aug. 2010

ZINC: PORT OF PORTLAND, TERMINAL 5 – 2008 pre-dredge; 2010 & 2011 post-dredge

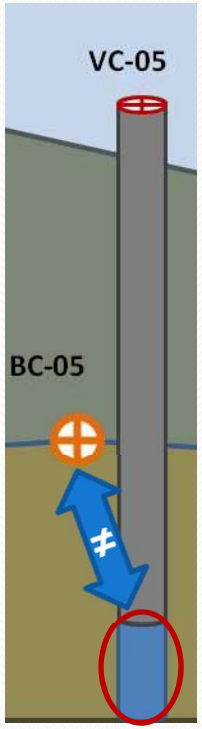


PCBs: PORT OF PORTLAND, TERMINAL 5 – 2008 pre-dredge; 2010 & 2011 post-dredge



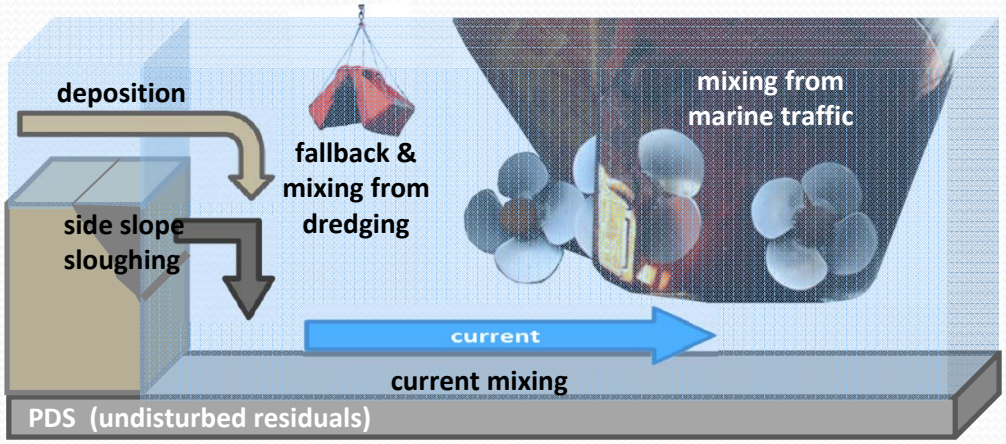
Why might there be differences between in-situ cores and PDS grabs?

- Patterns of contamination: site dependent and informed by historical data (contaminants increase or decrease with depth)
- Depth of actual dredging vs. depth of in-situ core sample

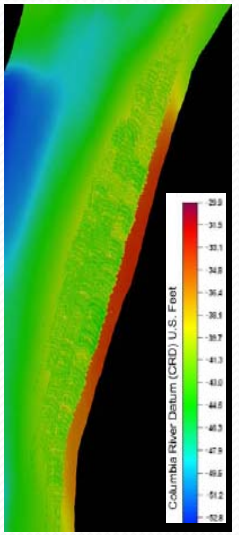


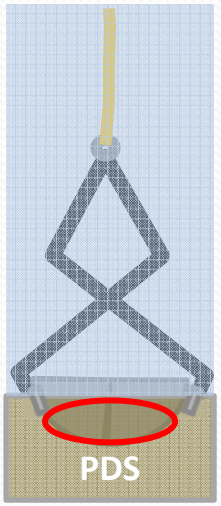
Why might there be differences between in-situ cores and PDS grabs?

- Factors Influencing PDS
  - Fallback is a reality
  - Mixing happens: natural river processes, marine traffic
  - Side slope sloughing
  - Known rates of deposition: 4 to 6" year at PO Bar and T5 (that's why we had to dredge!)



Regulatory requirements for the PDS (based on pre-dredge sampling)





- Port of Portland, T2
  - Bioassays
  - 1 ft. overdredge to accommodate sand cover
  - Bathymetric surveys
  - PDS sediment sampling + lab analysis (one-time)
- Port of Portland T5
  - Bioassays
  - Risk evaluation
  - Bathymetric surveys
  - PDS sediment sampling + lab analysis (x3)
- Willamette R., Post Office Bar - **$230K**, based on T&Cs in the Biological Opinion:
  - Sediment sampling + lab analysis (x4)
  - Benthic invertebrate sampling (x4)
  - Hydrographic survey (difference plots) (x4)
- Port of Seattle, T5 – post dredge surface grabs required due to phased dredging approach

BUT, what if we hadn't taken post-dredge grab samples?

- Overdredge and place sand cover

OR

- Monitored natural recovery
  - Demonstrate cleaner infill covering the PDS
  - Requires additional sampling & monitoring after dredging (sometimes up to 18 mos. after dredging)

Conclusions

- Post-dredge sampling provides the best measure of post-dredge surface chemistry
- The pre-dredge, in-situ core must be taken at the maximum anticipated depth of dredging
- When available, consider historic information and knowledge of site conditions to help predict PDS chemistry:

$$C_{PDS} = c_{\text{in-situ core}} + c_{DP(\text{mixed\&fallback})} + c_{\text{side slope}} + c_{\text{deposition}}$$

Conclusions

Agencies and the regulated community should continue to work as partners and use science to better predict the effects of the dredging operation and site conditions and on the PDS

Future Work

- Examine additional paired in-situ core and PDS grab samples at dredge sites to identify local trends
- Improve tools that predict PDS chemistry and reduce sampling when feasible

Questions?

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REGION 10