

# PILOT STUDY TO ASSESS EFFECTIVENESS FOR NEARSHORE PLACEMENT OF DREDGED MATERIAL

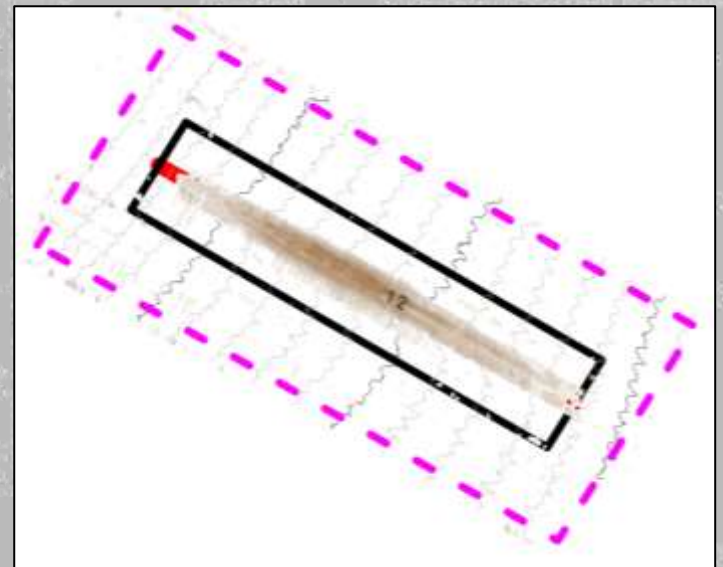
## *TO SUSTAIN PEACOCK SPIT AT THE MOUTH OF COLUMBIA RIVER, WA*

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WEDA Pacific Chapter – 2019 Annual Meeting  
31 OCT 2019



US Army Corps  
of Engineers®

# Presentation Overview

*Mouth of Columbia River & Peacock Spit Evolution*

*Thin-Layer Placement by Hopper Dredge – The Concept*

*Thin-Layer Placement at North Head Site – The Pilot Study*

*Dispersion of Dredged Sand Placed at North Head Site  
- Monitoring Results*



Canada

United States

WASHINGTON

OREGON

IDAHO

Pacific

Ocean

Mouth of  
Columbia River

Navigation Gateway  
\$25/yr Billion in commerce

# Mouth of Columbia River

3 Jetties Constructed 1885-1939

Nav Chan = 2,260 ft wide x 5 miles long  
48-55 ft deep

*Pacific*

Long Beach

Ilwaco

North Head

Baker Bay

Chinook

Peacock Spit

Sand Island

Washington

North Jetty

Jetty "A"

Sand Island Pile Dikes

MCR Channel Dredging  
1.5 - 3.5 MCY sand/yr

Channel

Clatsop Spit

Lower Columbia River Nav Channel

South Jetty

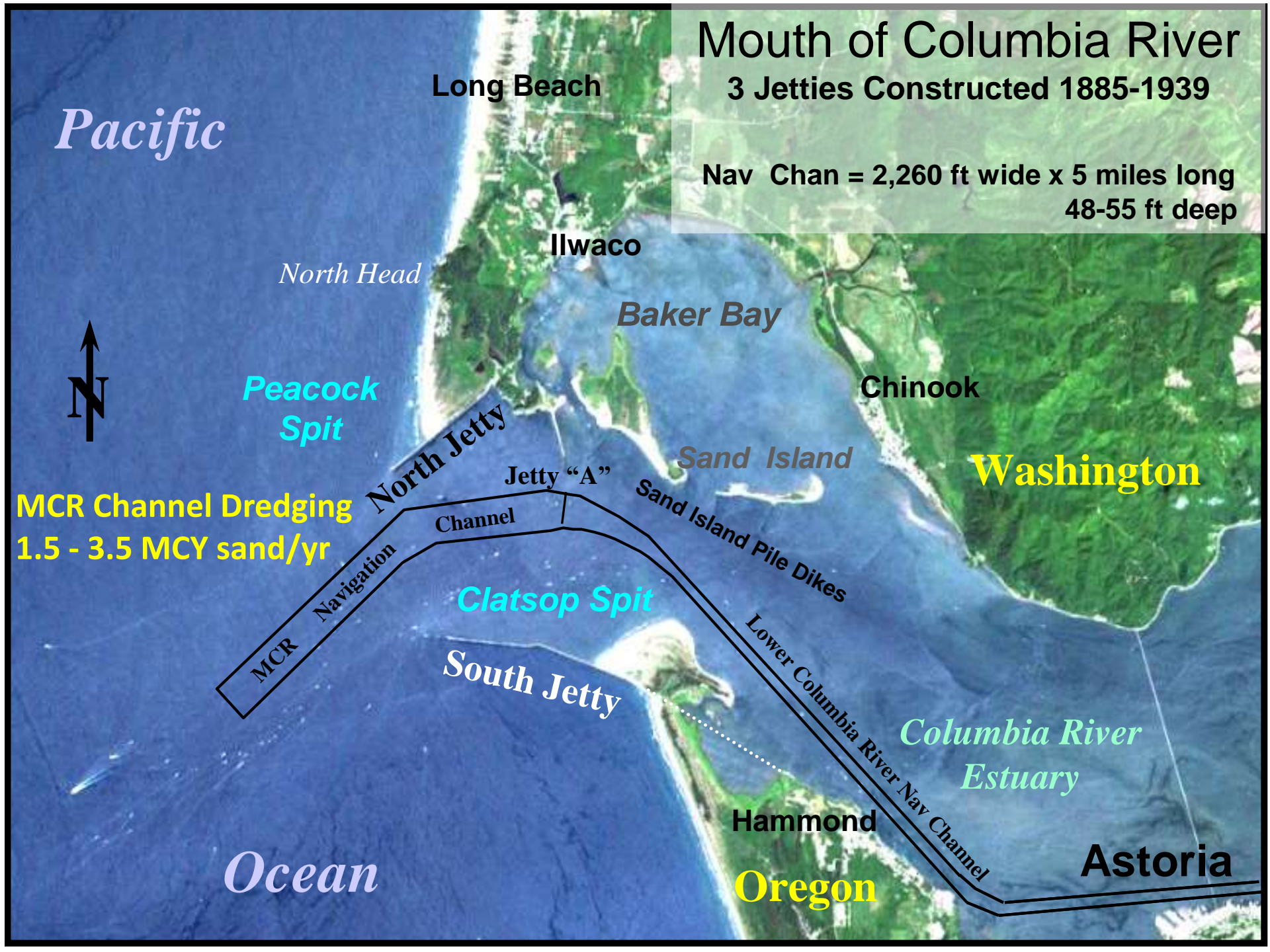
Columbia River Estuary

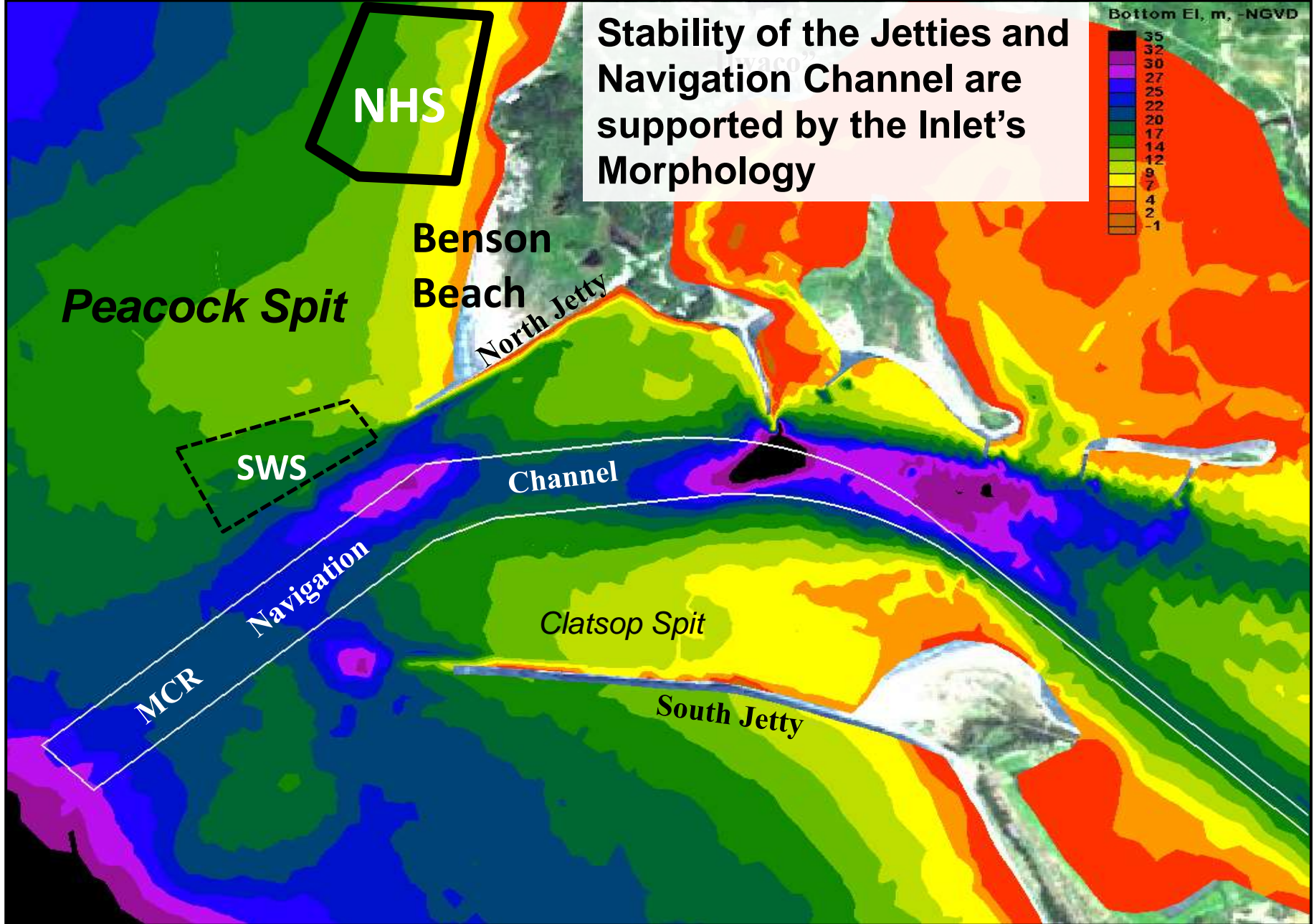
Hammond

Oregon

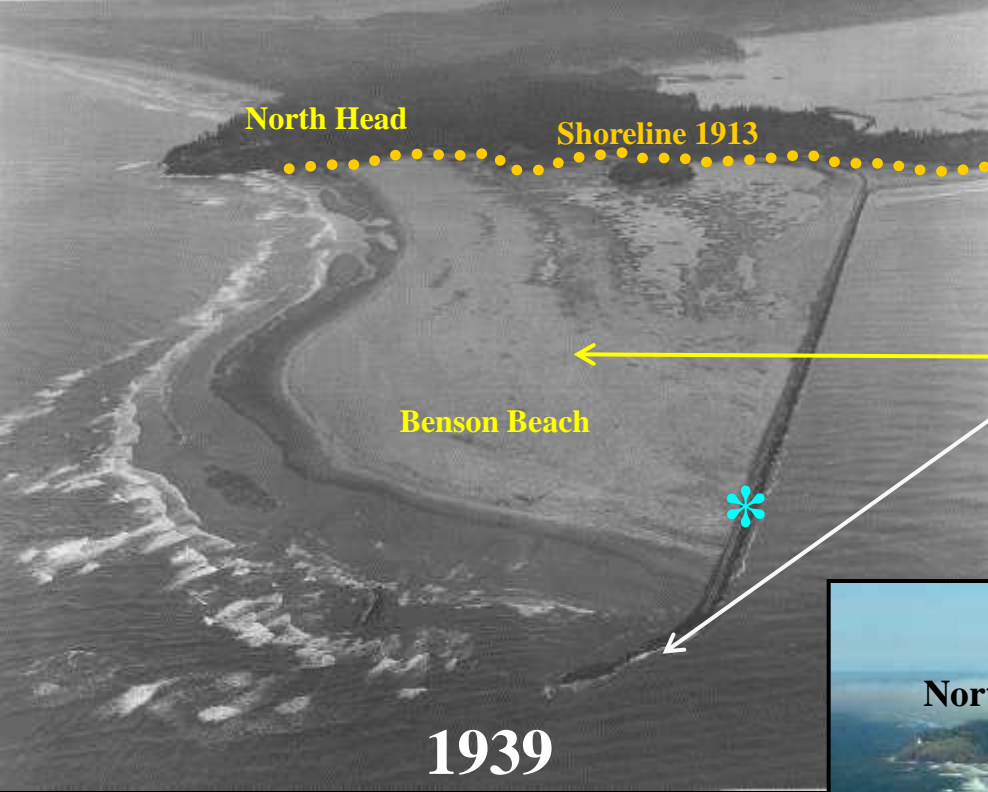
Astoria

*Ocean*





**MCR Bathymetry**



**Jetty construction motivated rapid morphology accretion and scour**

**ACCRETION** protects jetties from waves  
**SCOUR** destabilizes jetty toe

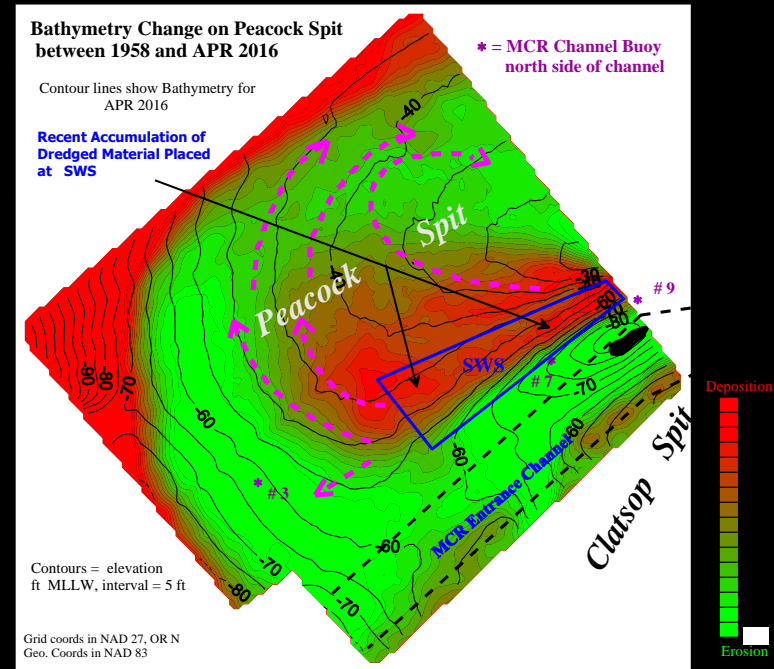
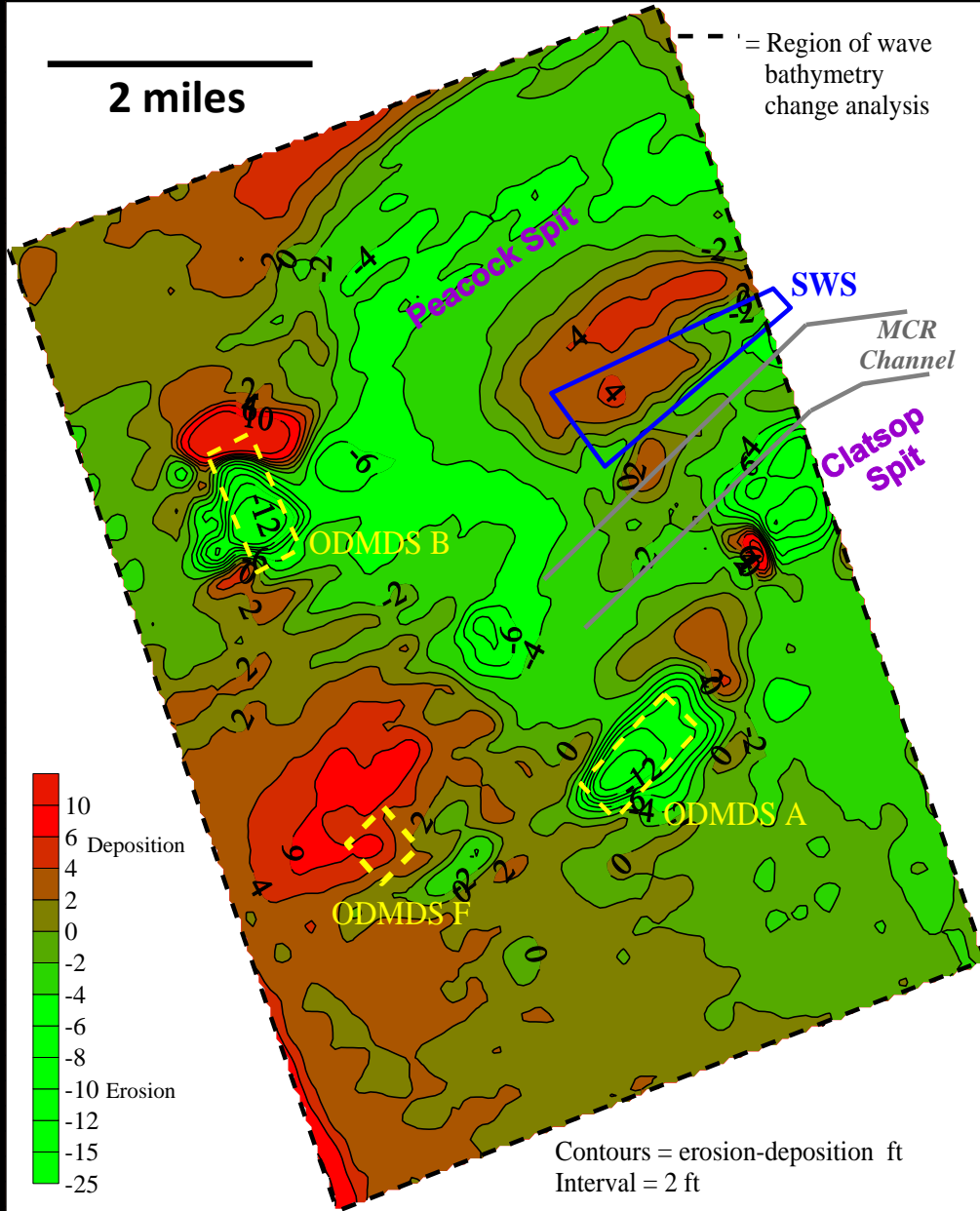
**As Peacock Spit recedes,  
North Jetty is subjected to  
added scour and increased  
wave attack**



**Benson Beach has receded  
700 meters since 1939**

**2002**

# MCR Bathymetry Difference: 1997 to 2016



**Peacock Spit is Eroding Despite USACE Placing 45 million cubic yards of sand within the SWS.**

**We Need to Feed Peacock Spit from its northern flank (NHS) & southern flank to sustain the Spit and the MCR inlet.**



MCR North Jetty

← - - - - -  
**Increased Rate of  
Shoreface Recession**

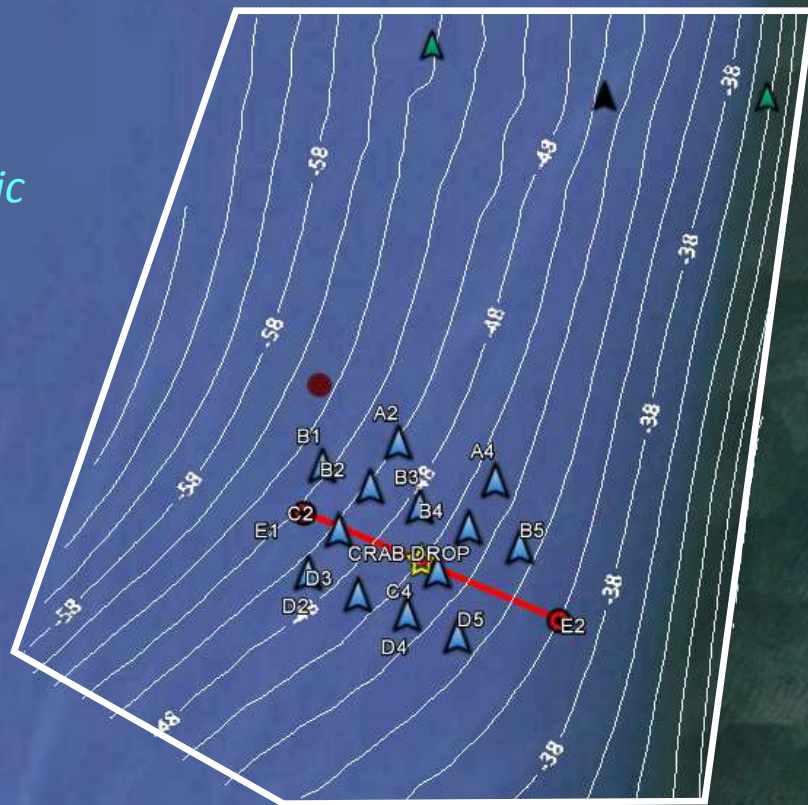
***Benson Beach***  
**Topographic Expression of Peacock Spit**

View to South



# NORTH HEAD SITE STUDY AREA

Pacific



North Head

Benson Beach

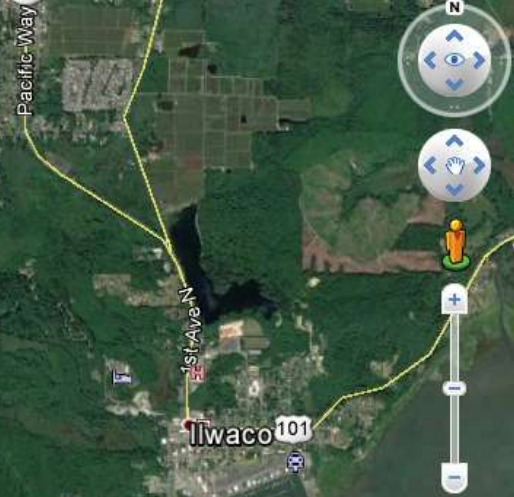
Peacock Spit

Ocean

Mouth of Columbia River

Ruby Island

Sand Island

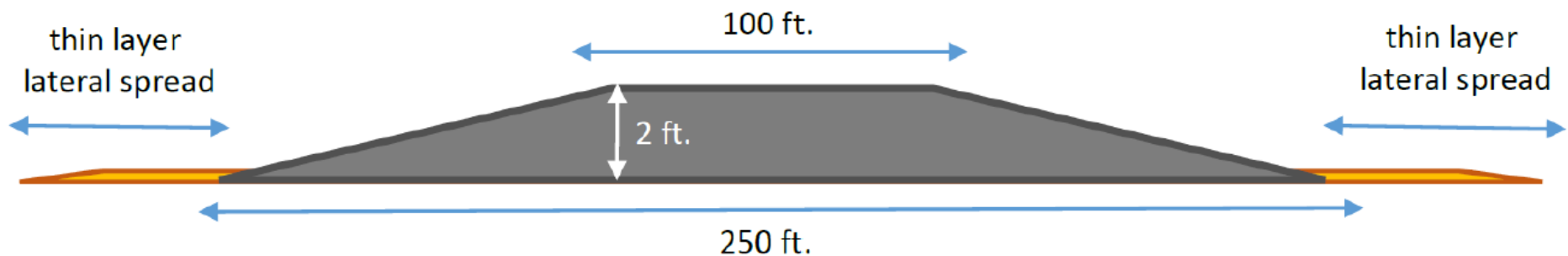


***Intended Concept for Nearshore Placement at NHS 1/2***  
***---Presented to Stakeholders and Agencies in MAY 2018---***

- A One-Time Experiment to measure dispersion
- Low-relief Accumulation on Seabed using thin-layer placement
- No effect on Waves: 2 ft. of mounding of dredged material in 35-50 ft. water depth will not affect wave action.
- Minimal-Impact on Benthos: Thin-layer placement along 1 transect (dump alignment) for 6-10 dumps. Each dump to be placed 2-3 hours apart. Successive placement will span about 24 hours.
- Observations: NOAA CamPods and successive bathymetry surveys to detect changes in mound geometry and volume over time.
- Calibration of Sediment Transport Model by USGS

***Intended Concept for Nearshore Placement at NHS 2/2  
----Presented to Stakeholders and Agencies in MAY 2018---***

**Proposal:** Build a detectable feature on the North Head Site seafloor in about 35-50 ft. water depth to observe sediment dispersion. A feature of 2-ft. high in about 35-40 ft. water depth.



# ***Thin-Layer Placement by Hopper Dredge***

## ***The Concept***

### ***Thin-Layer Placement***

= Controlled Release of dredged material to achieve minimum Deposition on seabed within safe & efficient operational constraints

# Dredged Material Placed in Open Water - *Plume Dynamics* -

Hopper Dredge or Barge Placement

**Convective  
Descent**

Neutrally buoyant material  
enters water column

water  
column

**Dynamic  
Collapse**

**Passive Transport  
and Diffusion**

Bottom Encounter & Lateral Spreading

**seabed**



# The *Essayons*



An ocean-going hopper dredge operated by the U.S. Army Corps of Engineers

5,500 cy hopper capacity – Ocean Placement

MIN operating depth, Fully Loaded: 35 ft

The hopper dredge *Essayons* utilizes a series of 12 doors located on the hull bottom to sequentially release each load of dredged material.....

Which can Result in a gradual release of dredged material from the vessel.

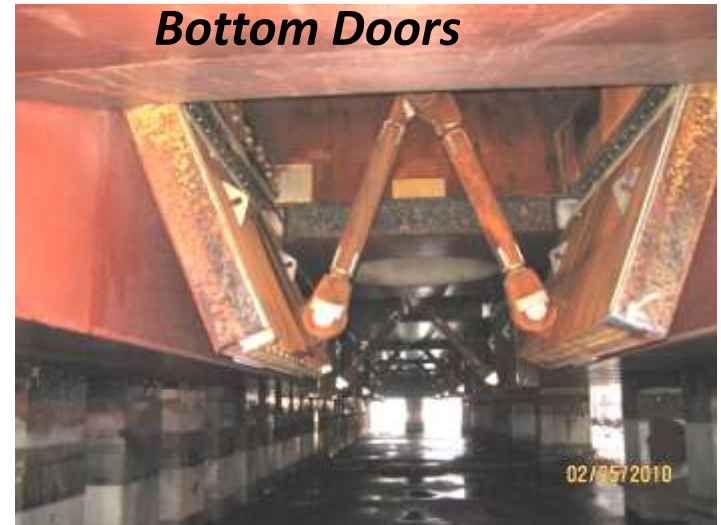
## Thin-Layer Placement

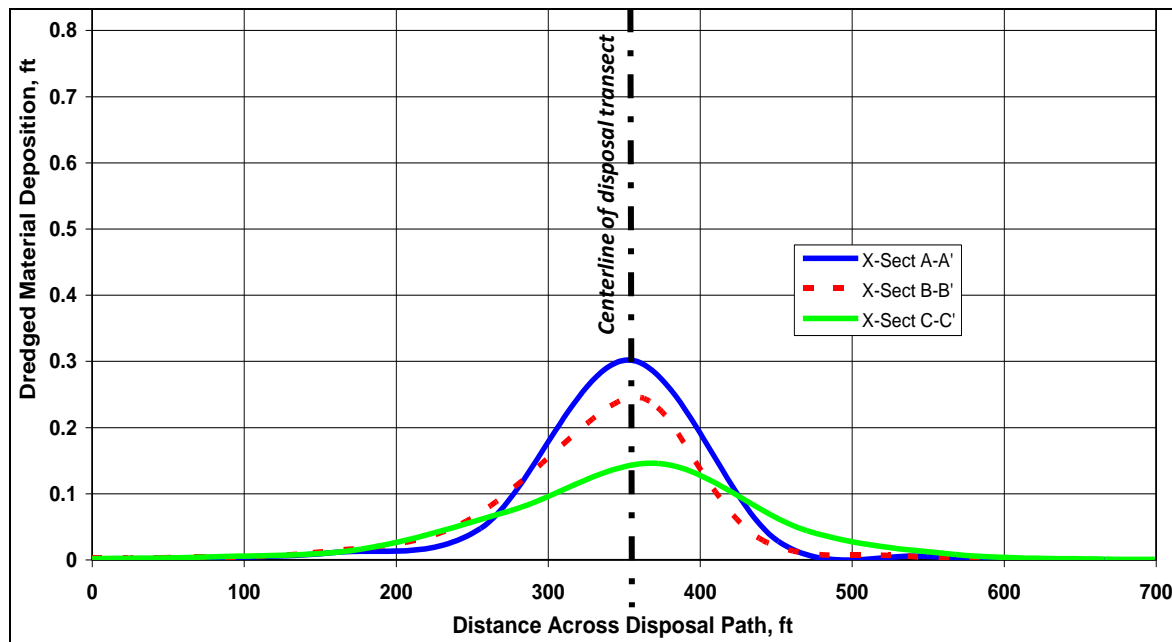
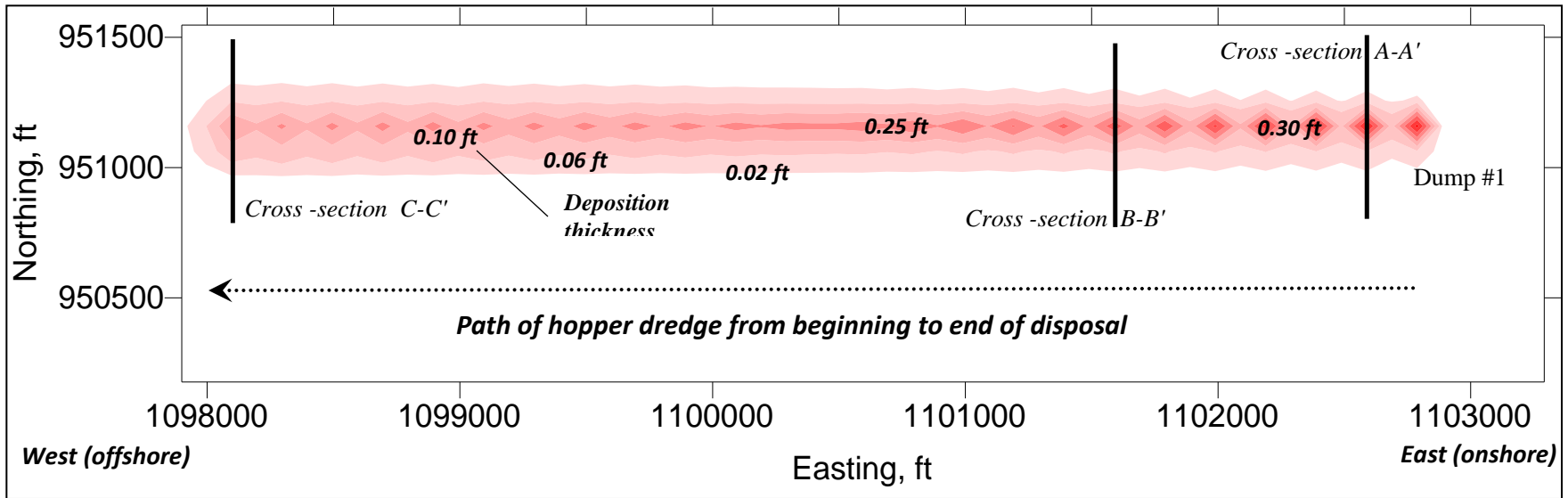
= Controlled Release of dredged material to achieve minimum Deposition on seabed within safe & efficient operational constraints

Bottom doors on bottom hull of *Essayons*.

Each opening is 8ft x 8ft.

## Bottom Doors



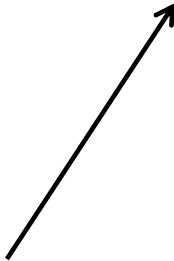
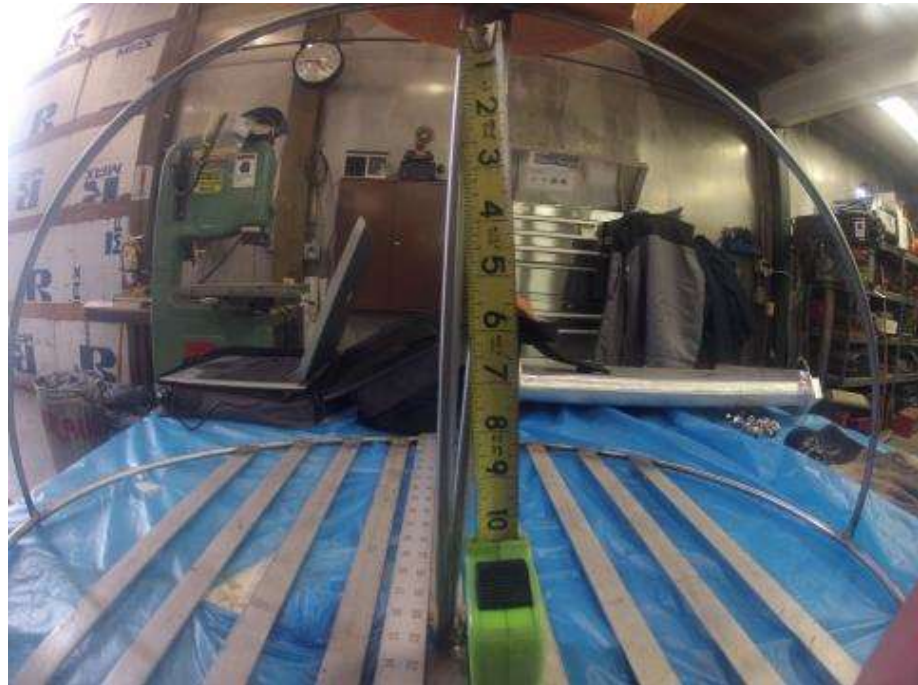


**Dump #1(1256):** 5,000 cy placed 14 Sept 2005:  
 11:16 - 11:25 am, Avg vessel speed = 9.0 ft/sec  
 tide elevation = 5.3 ft MLLW, depth averaged  
 current = 6 cm/sec at 223 deg

**Dump #2(1257):** 5,000 cy placed 14 Sept 2005:  
 14:04 - 14:12 am, Avg vessel speed = 9.2 ft/sec  
 tide elevation = 3.8 ft MLLW, depth averaged  
 current = 11 cm/sec at 290 deg

**Figure 44. Top Graphic:** Computer simulation of dredged material placement and result. The amount of dredged material placed along each 5,000 ft transect was 5,500 cy per load. Seabed elevation varied from -40 to -53 ft MLLW along the path of the hopper dredge during disposal runs (proceeding from east to west). Maximum thickness of deposited dredged material, via model simulation, varied from 0.1 to 0.30 ft along the disposal transect.

**Bottom Graphic:** Dredged material deposition, from Dump #1 simulation-above, shown in terms of three (3) cross-sections: A-A', B-B', and C-C'. Section A-A' is located near the beginning of the disposal run (simulated for the *Essayons*). C-C' is located near the end of the disposal run. The width of the deposition along the disposal transect varies from 350 ft to 500 ft. Deposition asymmetry is due to cross-current and *Essayons* draft reduction during dredged material placement.



## Prototype deployable deposition meter.

These are designed to go “over the side” and be retrieved like crab traps.

A Gopro camera, attached to the deposition meter mount, can record the deposition event.

COURTESY OF CURTIS ROEGNER-NOAA



**Frame 5 of 5**  
**After passage of**  
**Hopper dredge**

**Post Placement**  
**1.5 minutes after frame 1**

**Crab  
bait**

**2 inches (5 cm)**

**28 SEP 2012: load 1397**

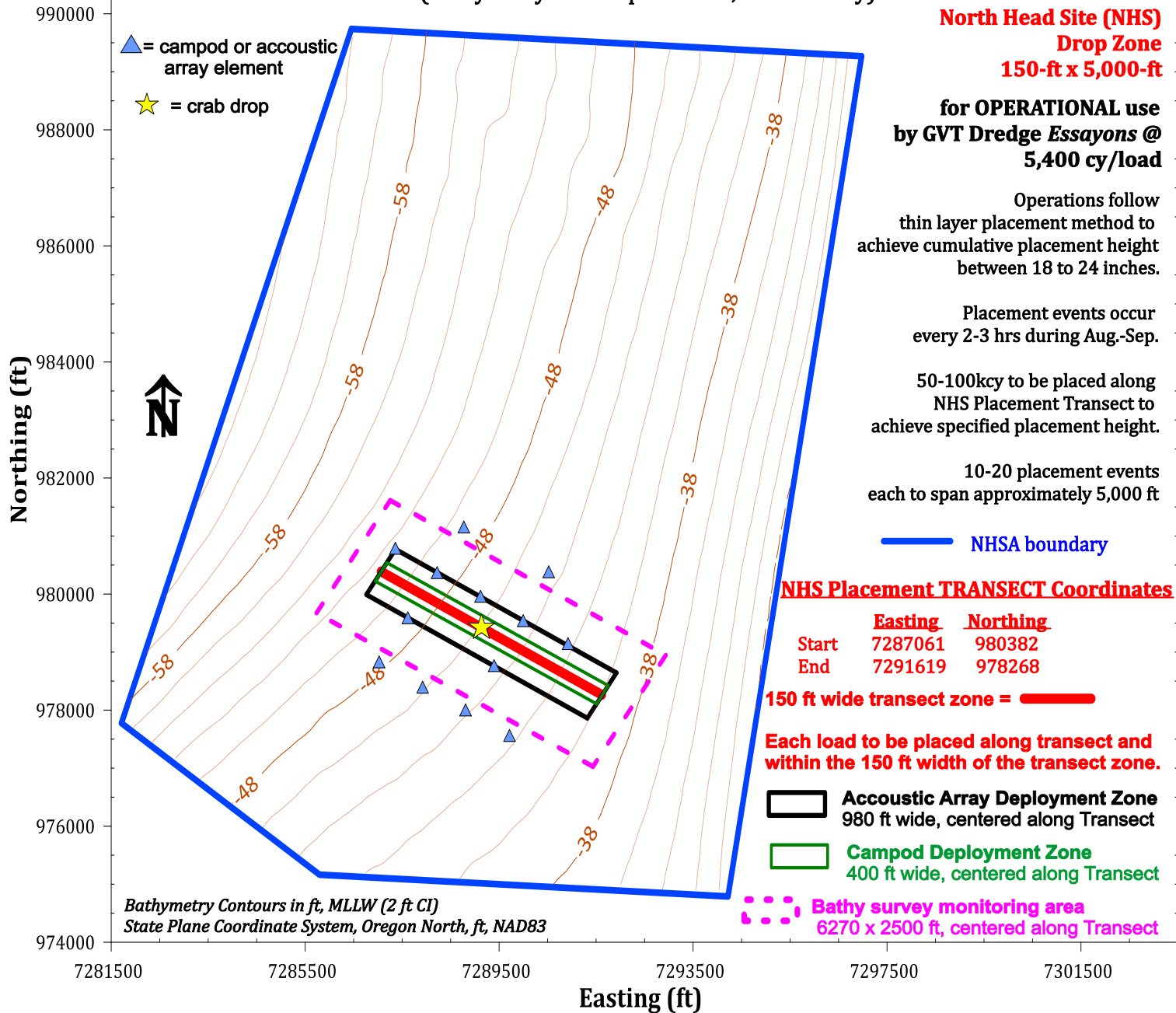
**Deposited dredged material (sand) = ~ 1 inch (2.54 cm)**


*Thin-Layer Placement at North Head Site*

*The Pilot Study – Phase I*


# MCR North Head Study Area (NNSA) - 2018 Initial Utilization Plan


(Bathymetry from September 5, 2017 Survey)




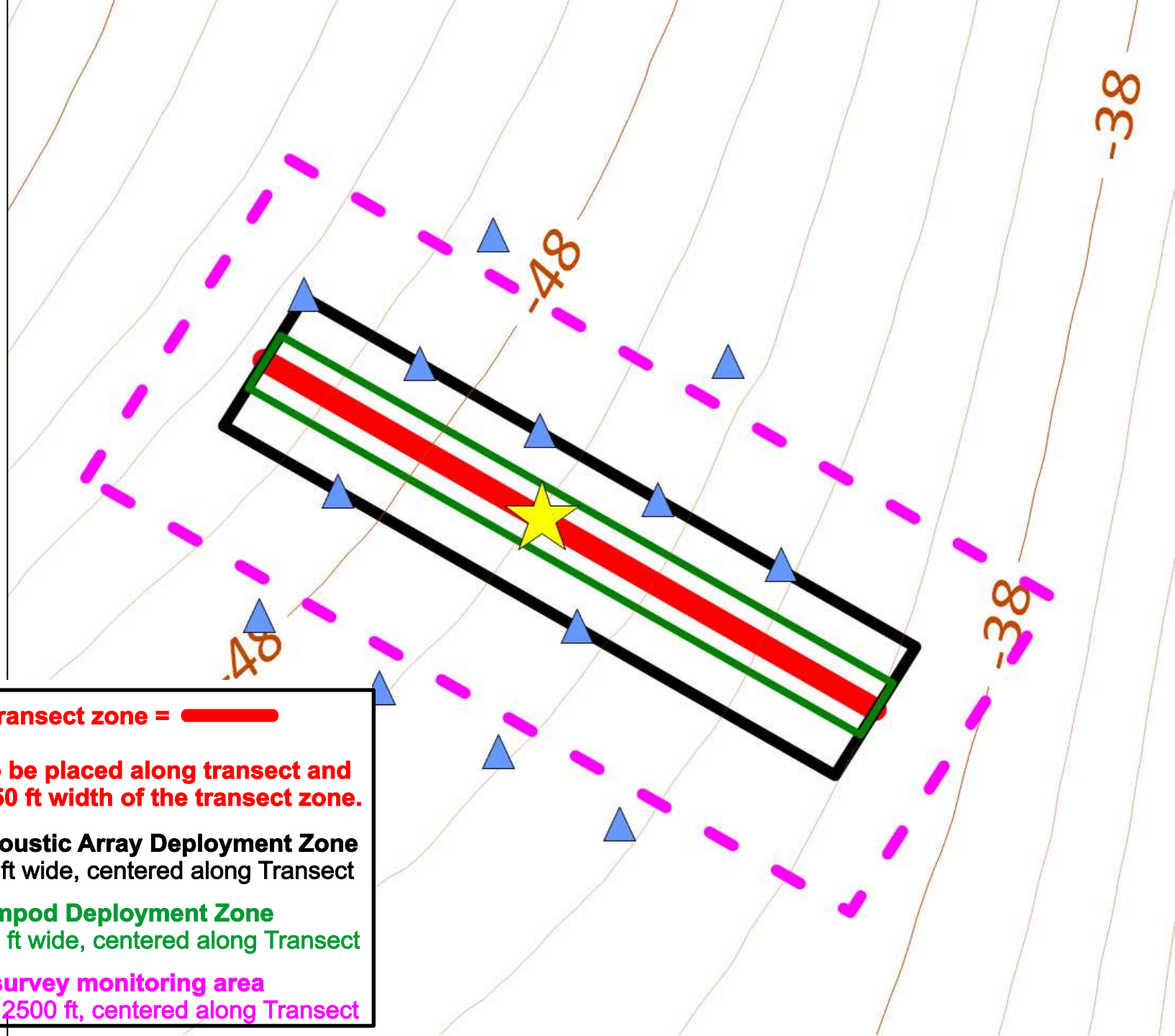
**150 ft wide transect zone =** 

**Each load to be placed along transect and within the 150 ft width of the transect zone.**

 **Accoustic Array Deployment Zone**  
980 ft wide, centered along Transect

 **Campod Deployment Zone**  
400 ft wide, centered along Transect

 **Bathy survey monitoring area**  
6270 x 2500 ft, centered along Transect



7288000

7290000

# MCR NORTH HEAD SITE

## 19-21 SEP 2018

Dredge: ESSAYONS

# Hopper Dredge Tracklines During Placement Operations

Date: 19-21 SEPTEMBER 2018

File: DTR09192018.trk, DTR09202018.trk, DTR09212018.trk

### 9 loads placed along prescribed 150-ft wide transect zone

### 51,000 CY Placed

980000

980000

150 ft wide  
transect zone



978000

978000

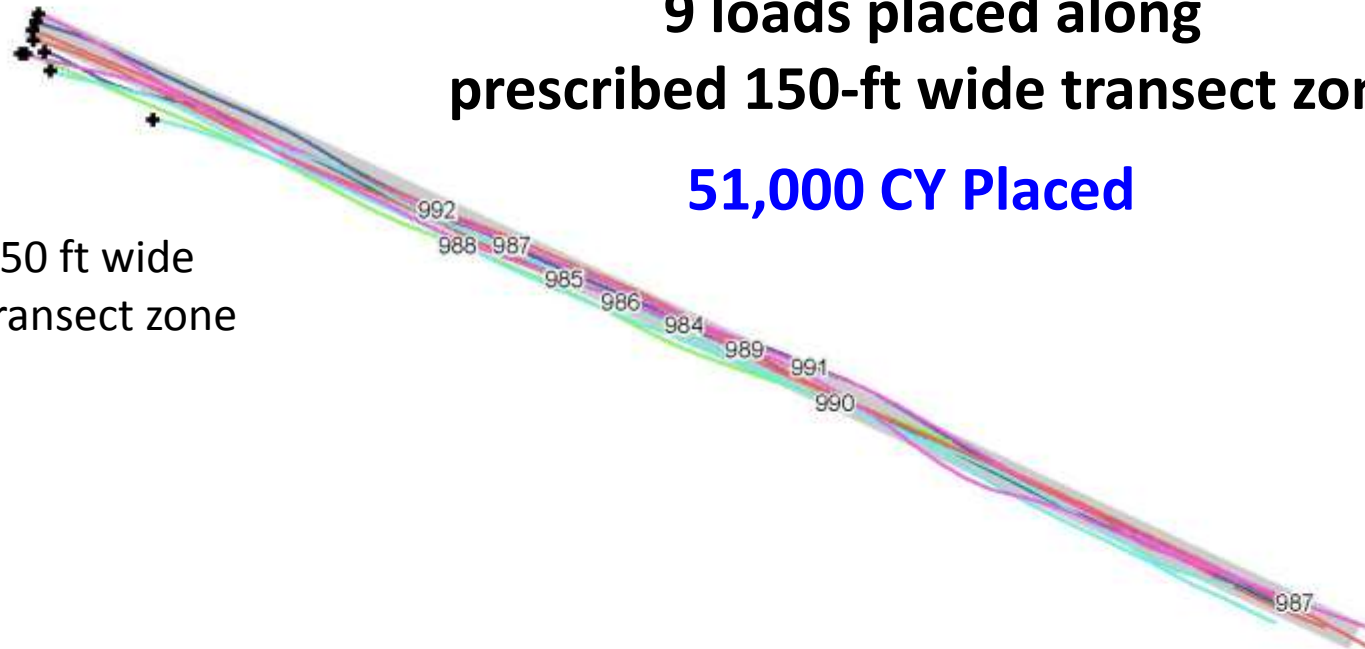
0 150 300 600 900 Feet



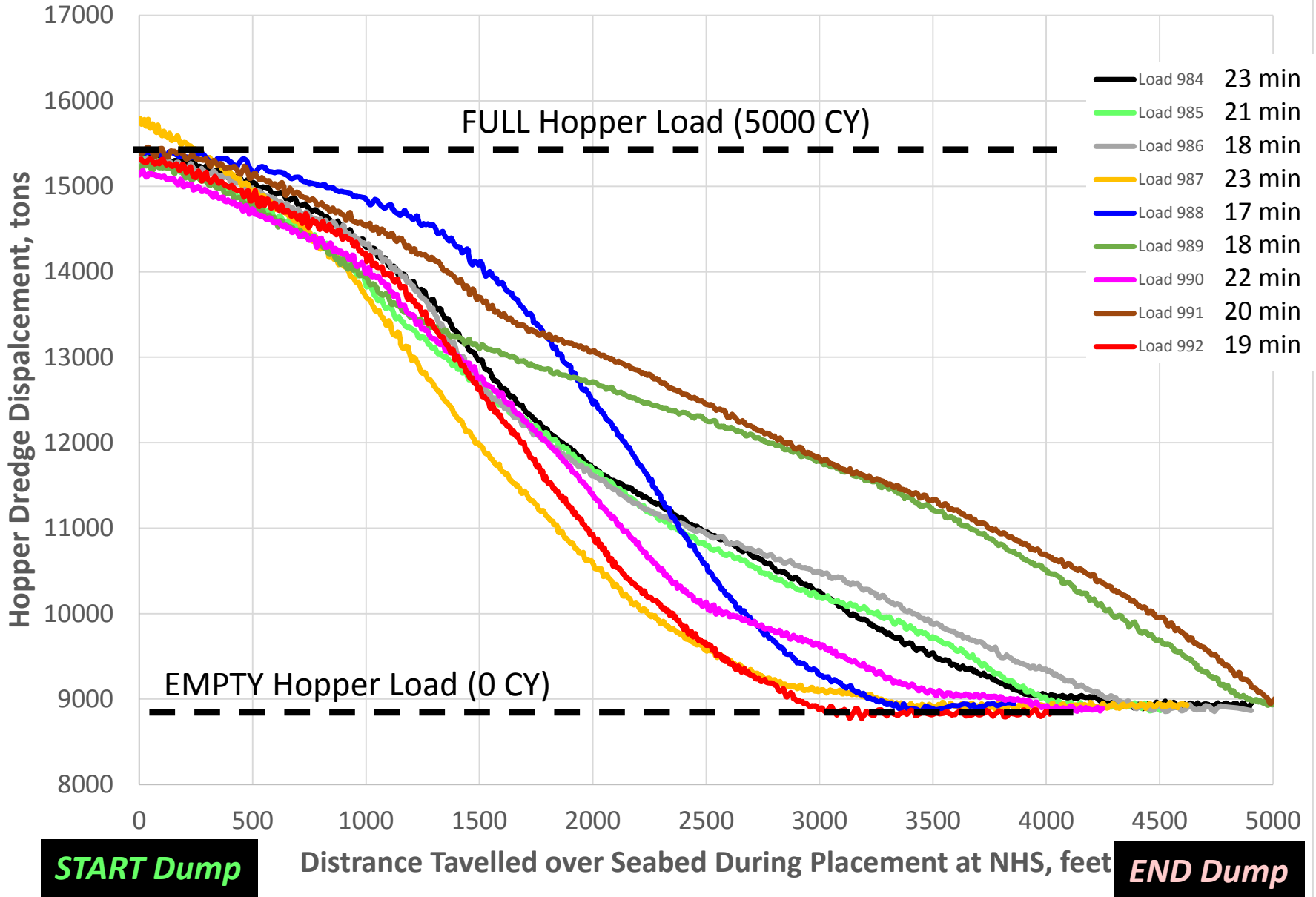
Horizontal Coordinate System: NAD83 Oregon North U.S. Survey Feet

7288000

7290000



# Hopper Dredge Placement Rate Along NHS Transect



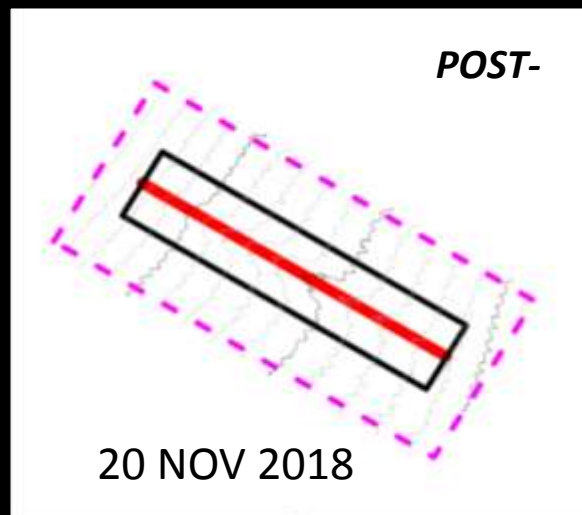
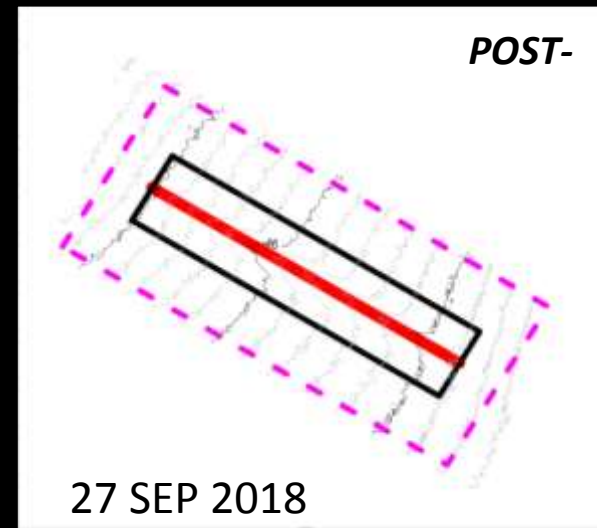
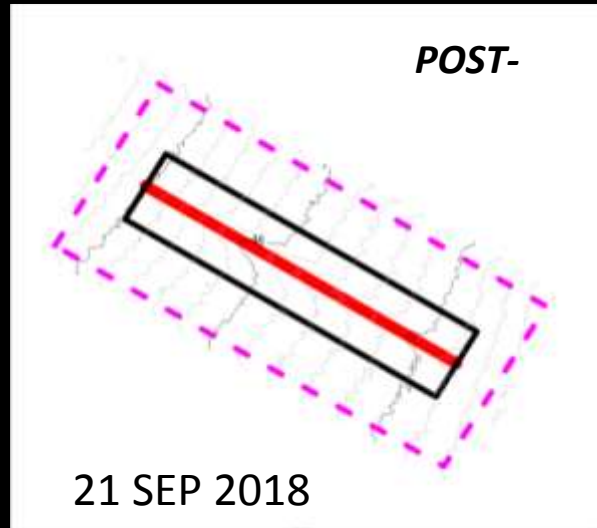
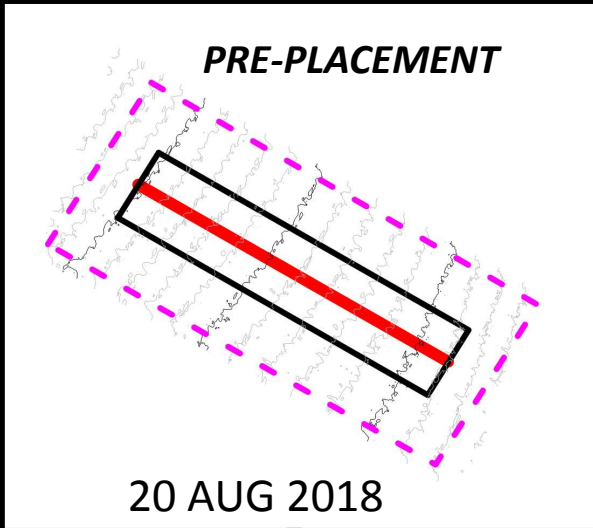
**START Dump**

**END Dump**

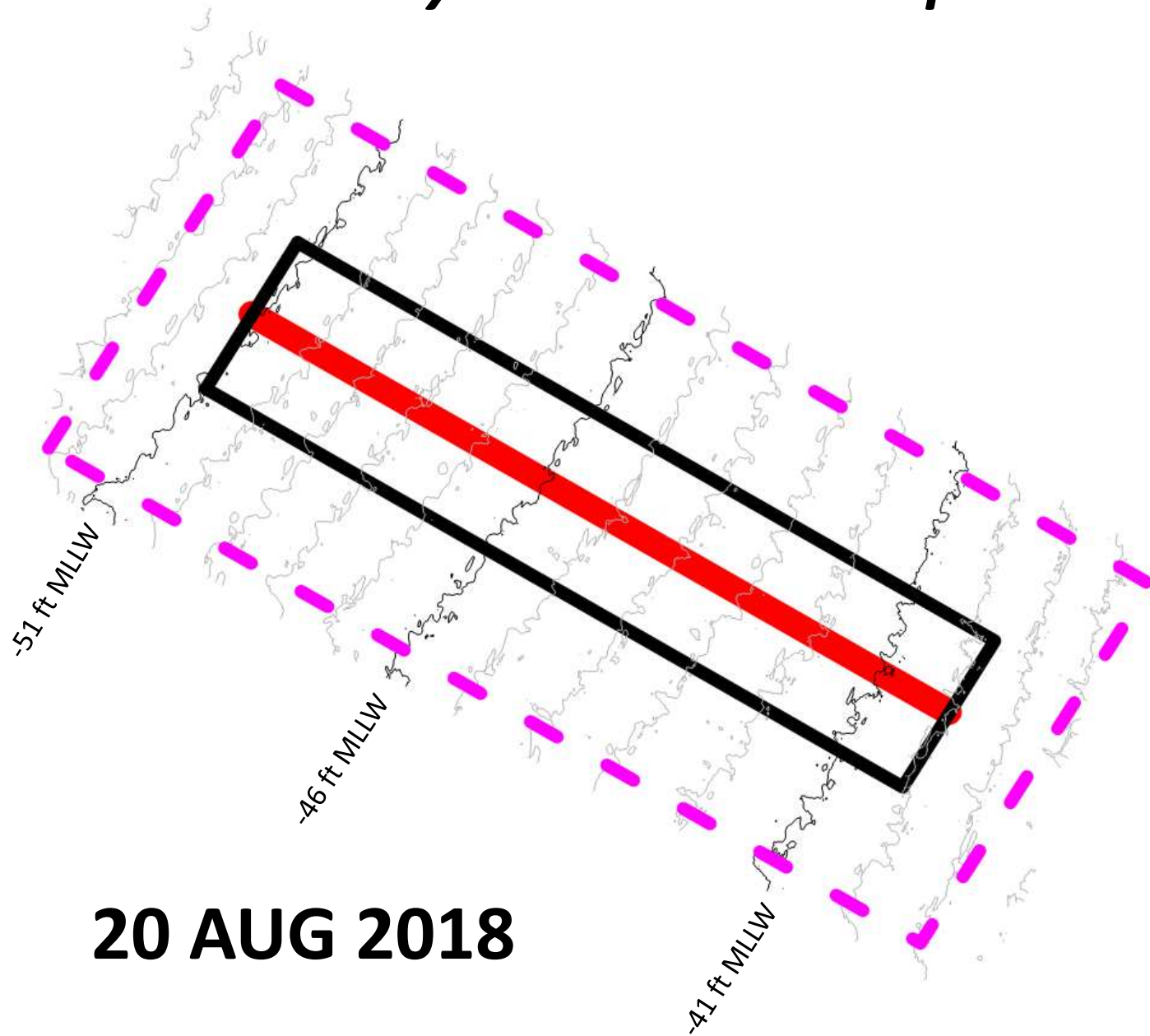
# Monitor the Dispersion of Dredged Material Placed on Seabed at North Head Site

(1-2 ft high sand mound on sand substrate)

*By evaluating bathymetry change measured by successive multi-beam surveys*



# 30 days *BEFORE* initial placement



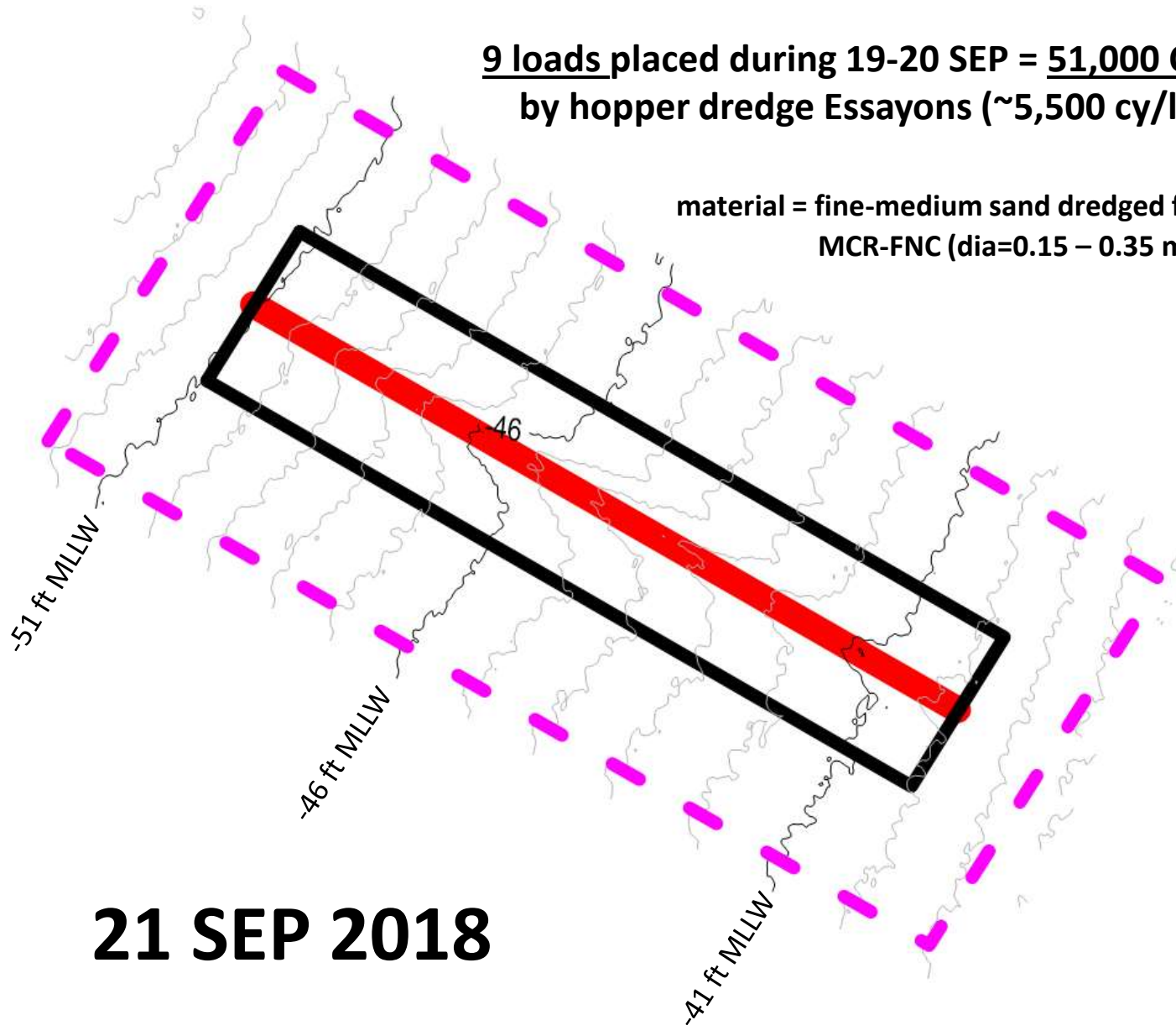
**20 AUG 2018**



# 0 day AFTER placement

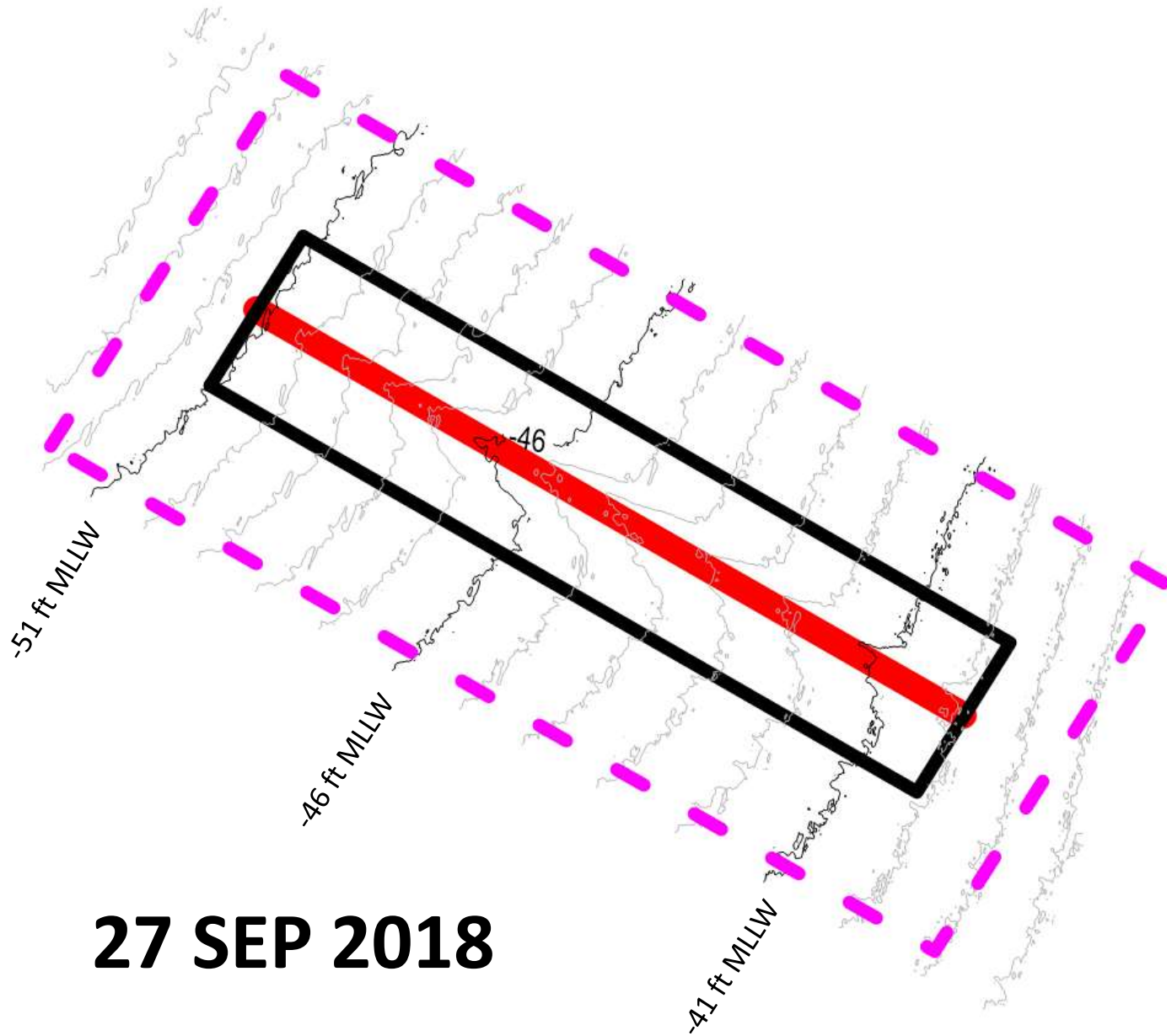
9 loads placed during 19-20 SEP = 51,000 CY  
by hopper dredge Essayons (~5,500 cy/load)

material = fine-medium sand dredged from  
MCR-FNC (dia=0.15 – 0.35 mm)



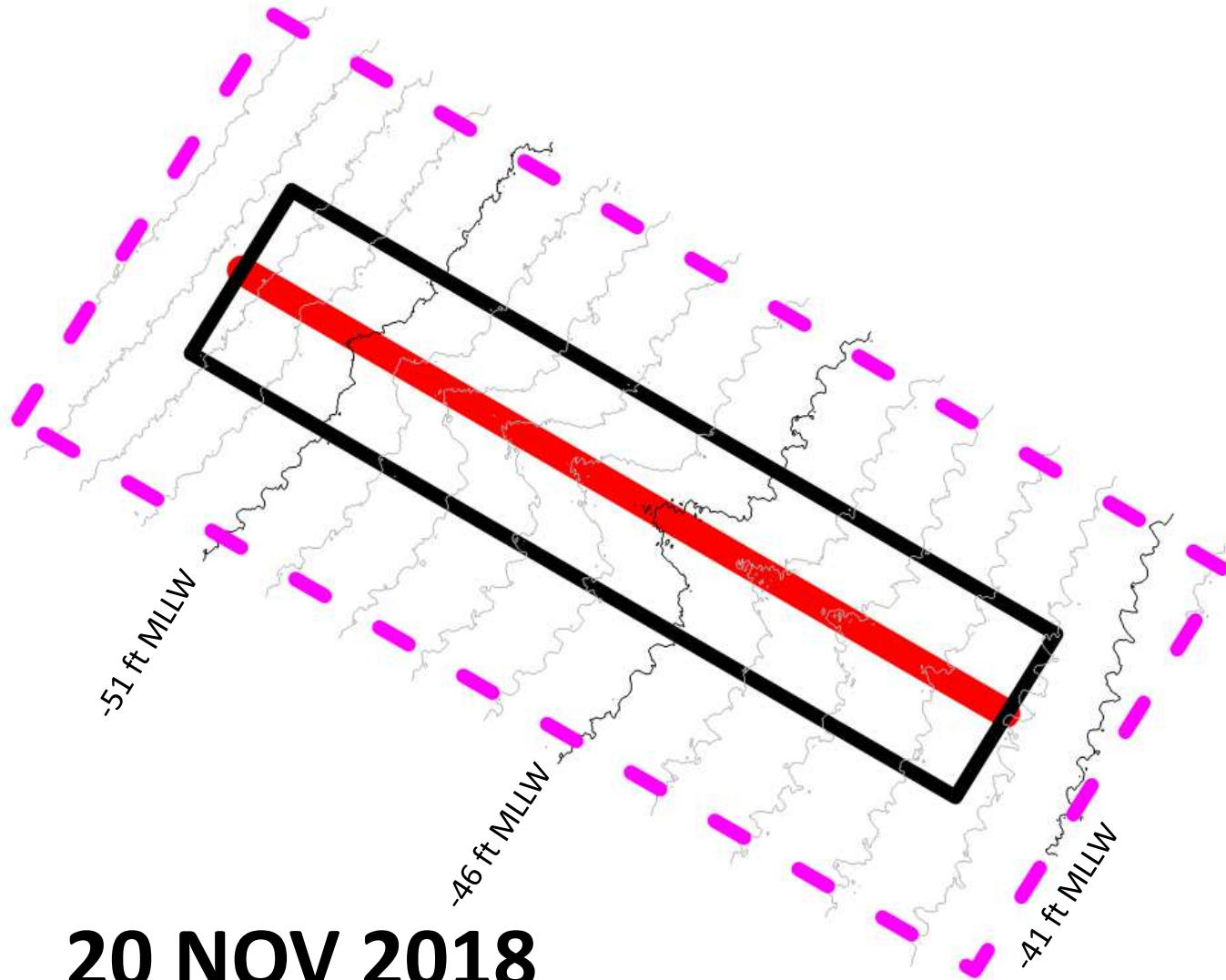
**21 SEP 2018**

# 7 days AFTER placement



**27 SEP 2018**

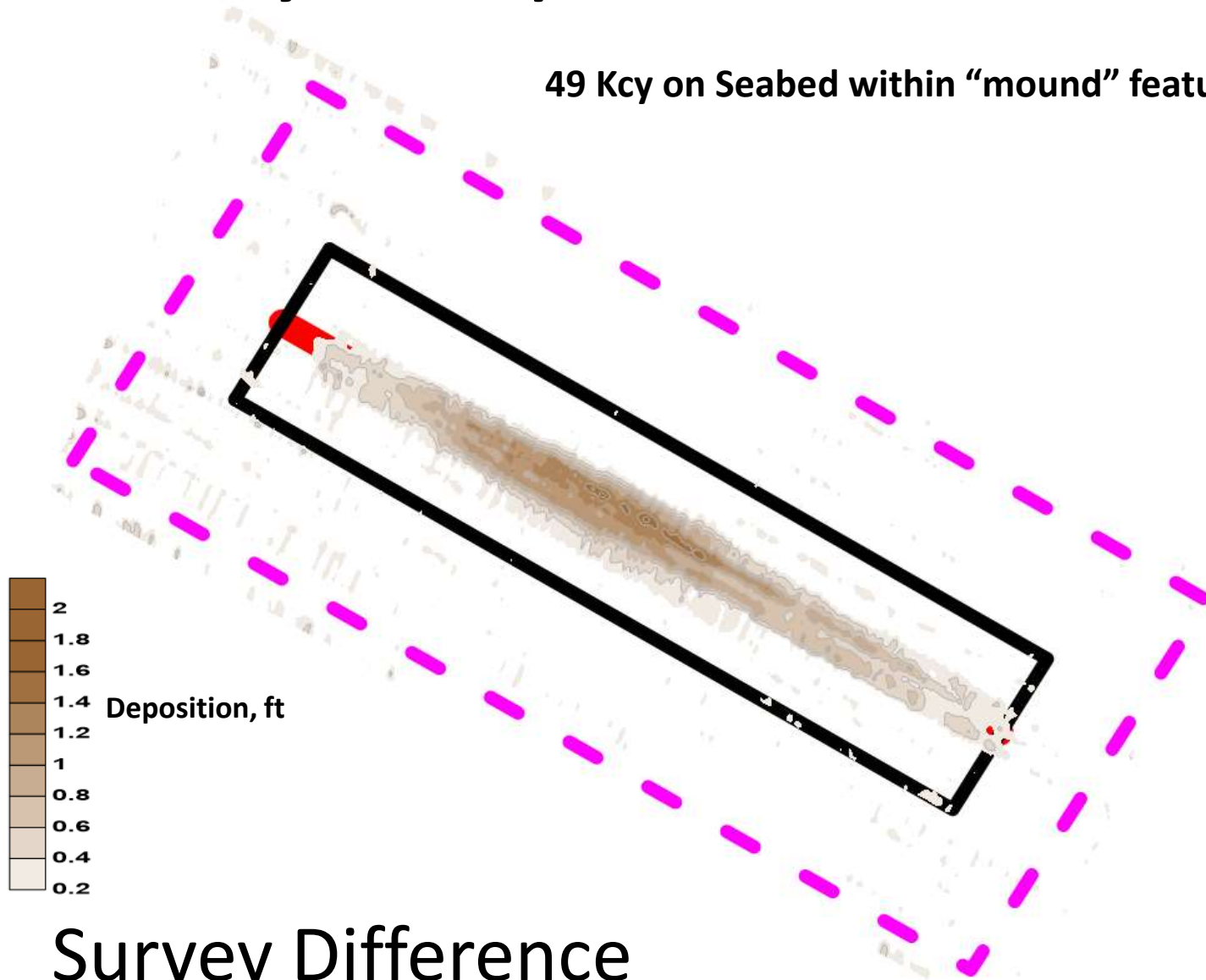
# 61 days AFTER placement



**20 NOV 2018**

# *0 day AFTER placement* - 51,000 CY placed

49 Kcy on Seabed within "mound" feature



Survey Difference

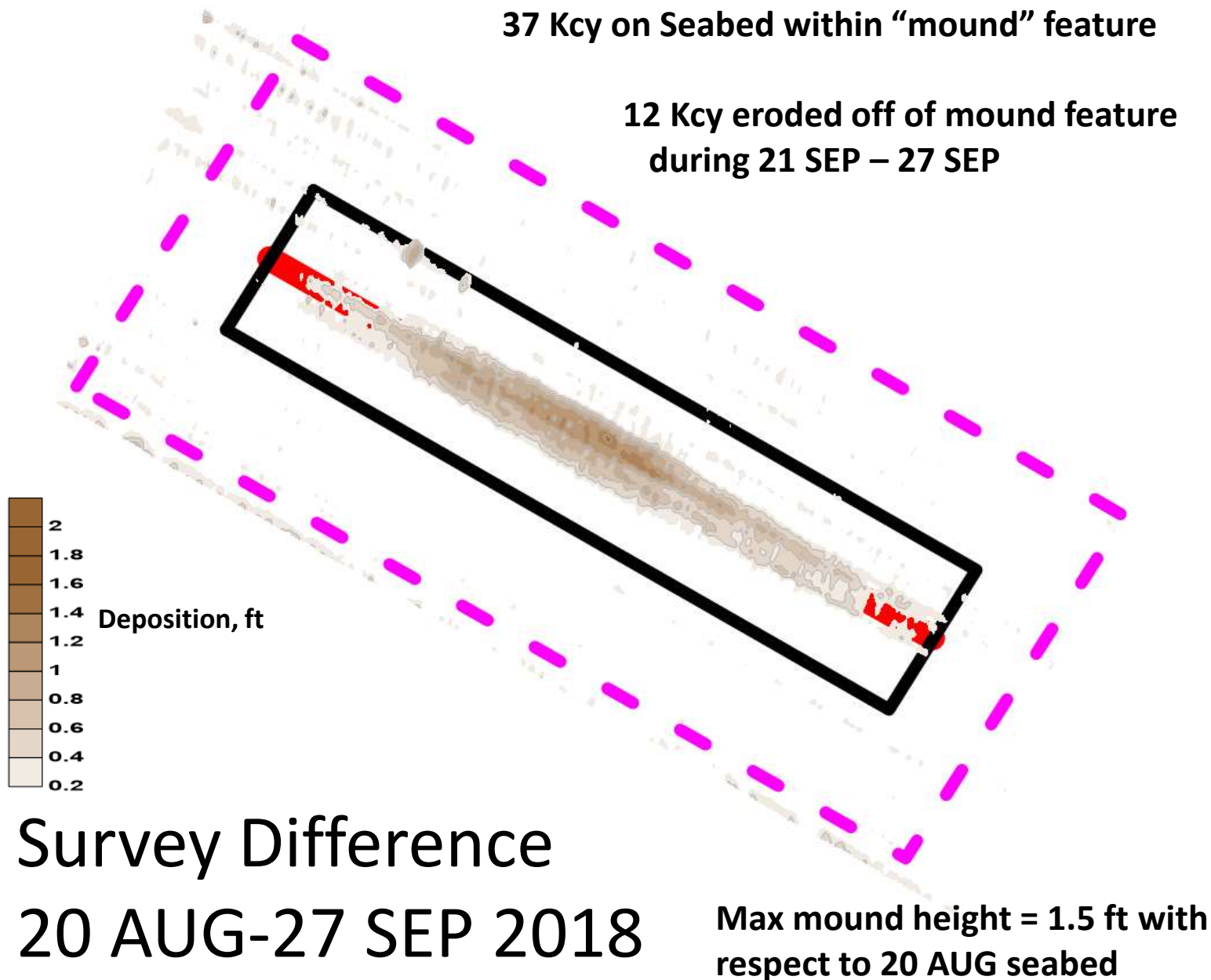
20 AUG-21 SEP 2018

Max mound height = 1.9 ft with respect to 20 AUG seabed

# 7 days AFTER placement - 51,000 CY initially placed

37 Kcy on Seabed within "mound" feature

12 Kcy eroded off of mound feature during 21 SEP – 27 SEP

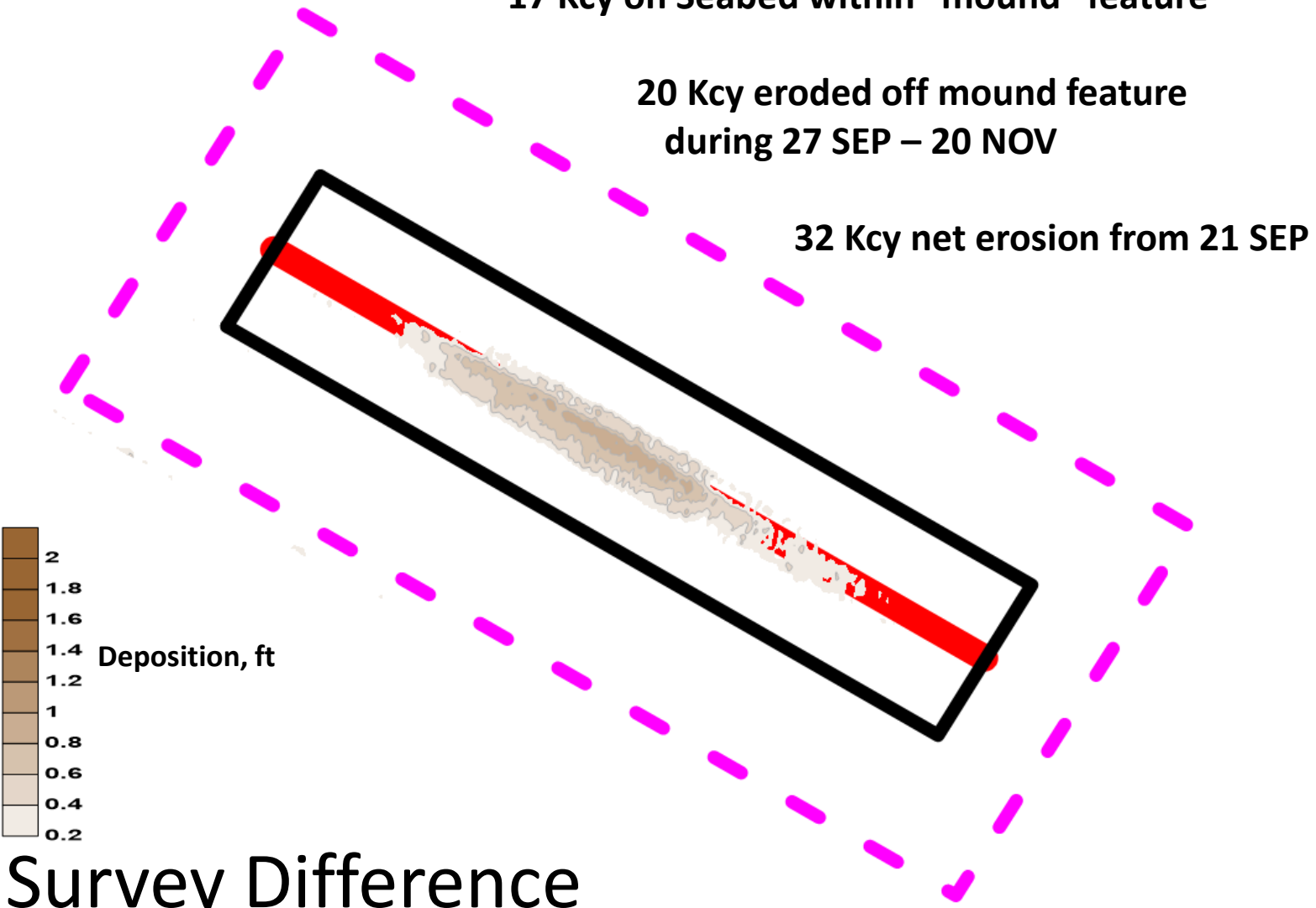


# 61 days AFTER placement - 51,000 CY initially placed

17 Kcy on Seabed within "mound" feature

20 Kcy eroded off mound feature during 27 SEP – 20 NOV

32 Kcy net erosion from 21 SEP



Survey Difference

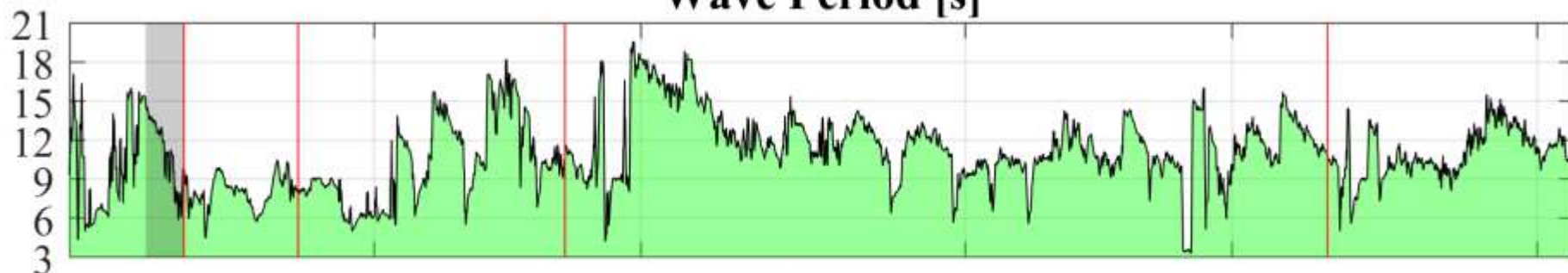
20 AUG-20 NOV 2018

Max mound height = 1.0 ft with respect to 20 AUG seabed

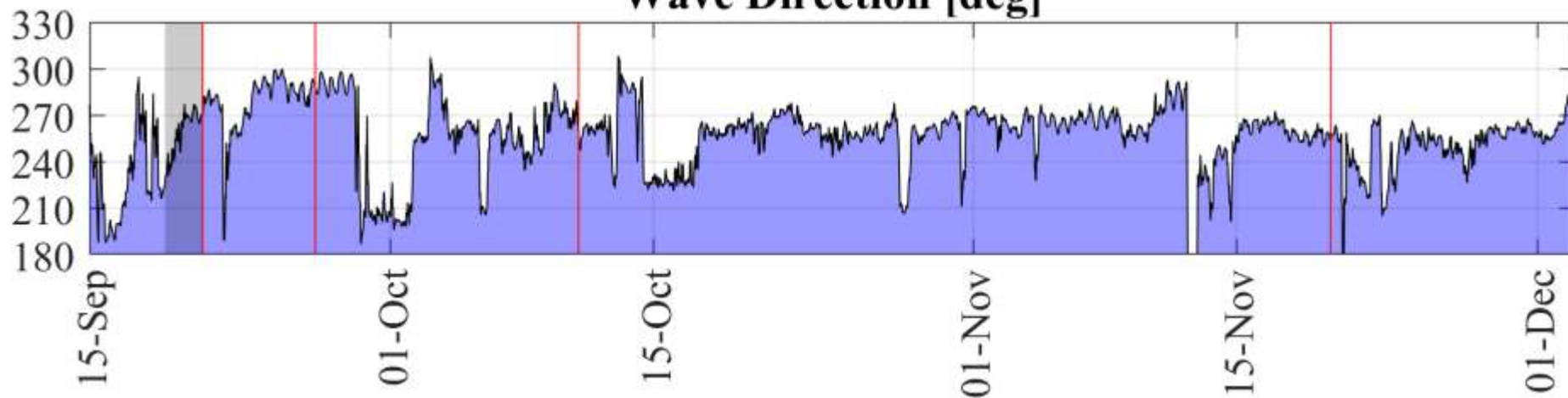
### Wave Height [m]



### Wave Period [s]

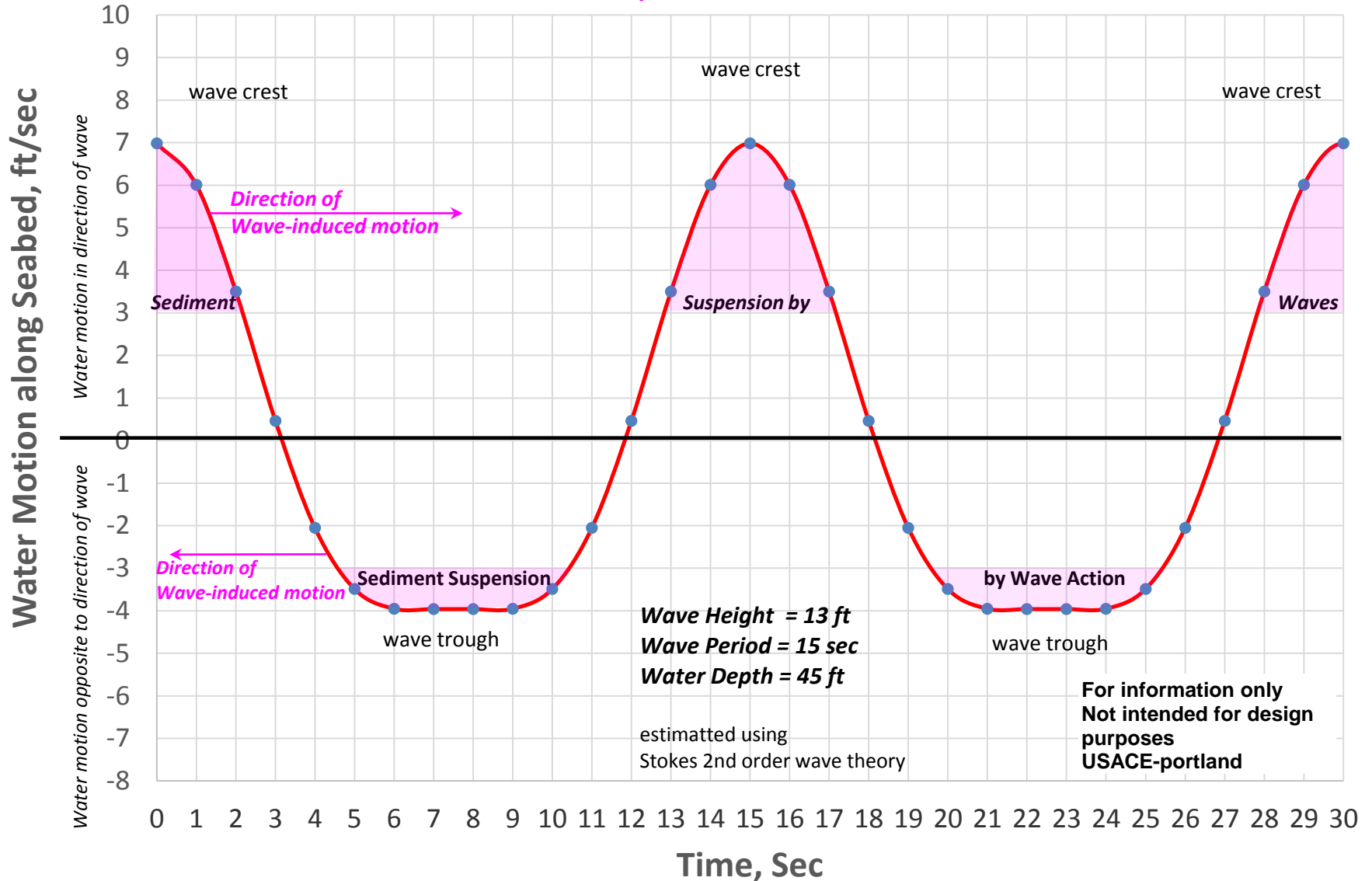


### Wave Direction [deg]



# Velocity Variation on the Seabed due to Wave Action

Currents > 3 ft/sec can mobilize fine-medium sand





# NHS-Phase I Findings

*9 loads (51,000 cy) of sand where placed by the gvt hopper dredge Essayons along a 5,000 ft-long transect, using thin-layer placement method, and produced a 2 ft high mound.*

*Placement occurred during 19-21 SEP 2018, in water depth of 40-50 ft depth along the northern flank of Peacock Spit.*

**Post-placement surveys were conducted at 0 days, 7 days, and 60 days after placement completion.**

**At day 0, The resultant mound formed on seabed was 5,000 ft long and 300 to 500 ft wide. All 9 loads were released within the 150 ft wide placement transect.**

**At day 0, the initial detectable volume of placed material along the mound feature was 49,000 CY, or 96% detected on seabed. (2,000 cy of dredged material was dispersed to the surrounding seabed during placement).**

**By day 7, the detectable mound volume had been reduced to 37,000 cy due to sediment dispersion; 37% (12,000 cy) dispersed from mound. Waves were 3-10 ft high, 6-10 sec, and S-NW.**

**By day 60, the mound volume had been reduced to 17,000 CY: 77% (32,000 cy) dispersed from mound. Max mound height was 1 ft. By Spring 2019, Mound was GONE.**

# **BONUS - PRESENTATION**

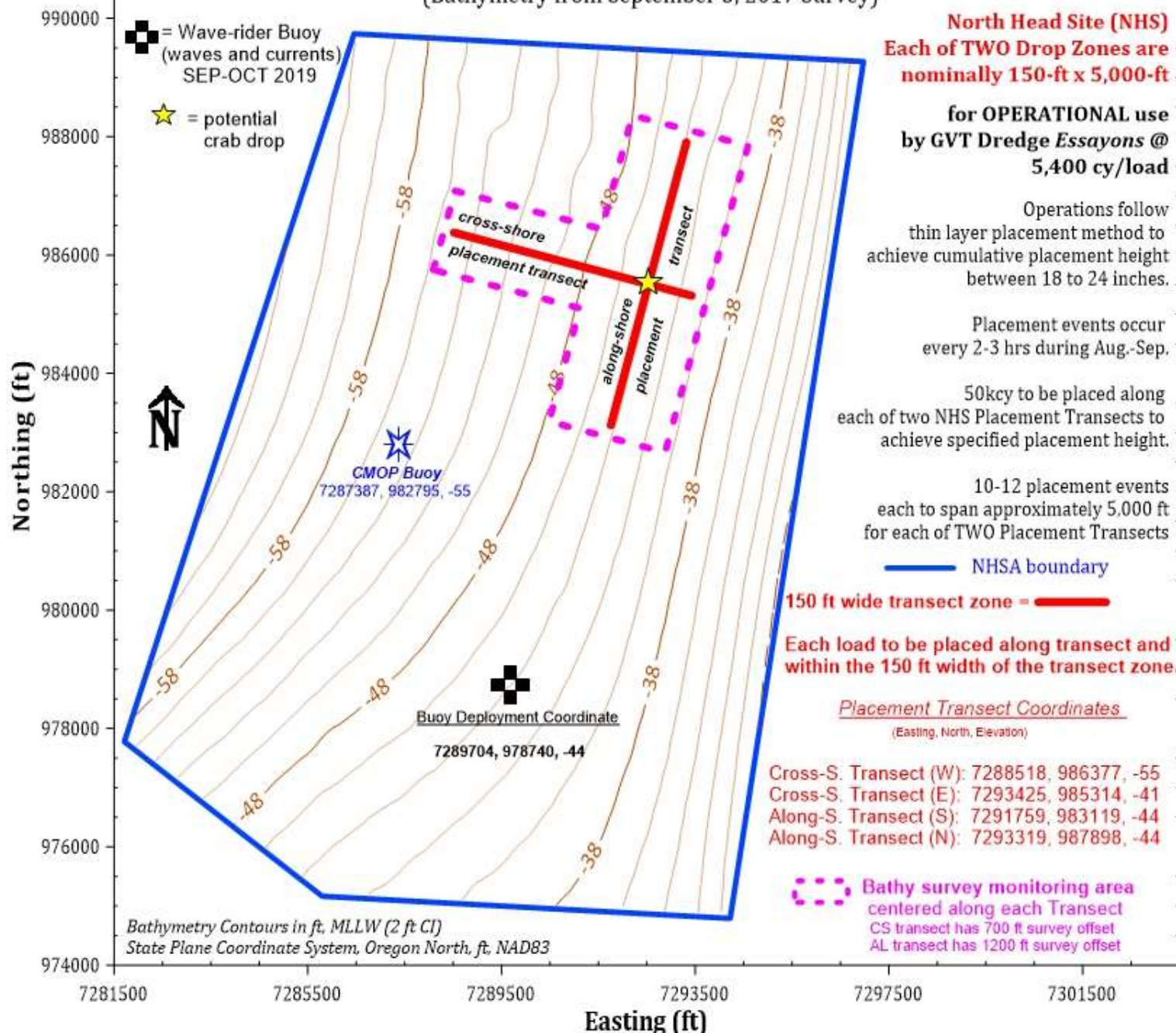
**NHS – PHASE II (2019 Placement)**

**100,000 CY placed  
Along TWO Transects**

**Determine if there is  
preferential transport direction**

# MCR North Head Study Area (NHSA) - 2019 Phase II Plan

(Bathymetry from September 5, 2017 Survey)



⊠ = Wave-rider Buoy  
(waves and currents)  
SEP-OCT 2019

★ = potential  
crab drop



★ CMOP Buoy  
7287387, 982795, -55

⊠ Buoy Deployment Coordinate  
7289704, 978740, -44

**North Head Site (NHS)**  
Each of TWO Drop Zones are  
nominally 150-ft x 5,000-ft  
for OPERATIONAL use  
by GVT Dredge *Essayons* @  
5,400 cy/load

Operations follow  
thin layer placement method to  
achieve cumulative placement height  
between 18 to 24 inches.

Placement events occur  
every 2-3 hrs during Aug.-Sep.

50kcy to be placed along  
each of two NHS Placement Transects to  
achieve specified placement height.

10-12 placement events  
each to span approximately 5,000 ft  
for each of TWO Placement Transects

— NHSA boundary

150 ft wide transect zone = —

Each load to be placed along transect and  
within the 150 ft width of the transect zone.

Placement Transect Coordinates  
(Easting, North, Elevation)

Cross-S. Transect (W): 7288518, 986377, -55  
Cross-S. Transect (E): 7293425, 985314, -41  
Along-S. Transect (S): 7291759, 983119, -44  
Along-S. Transect (N): 7293319, 987898, -44

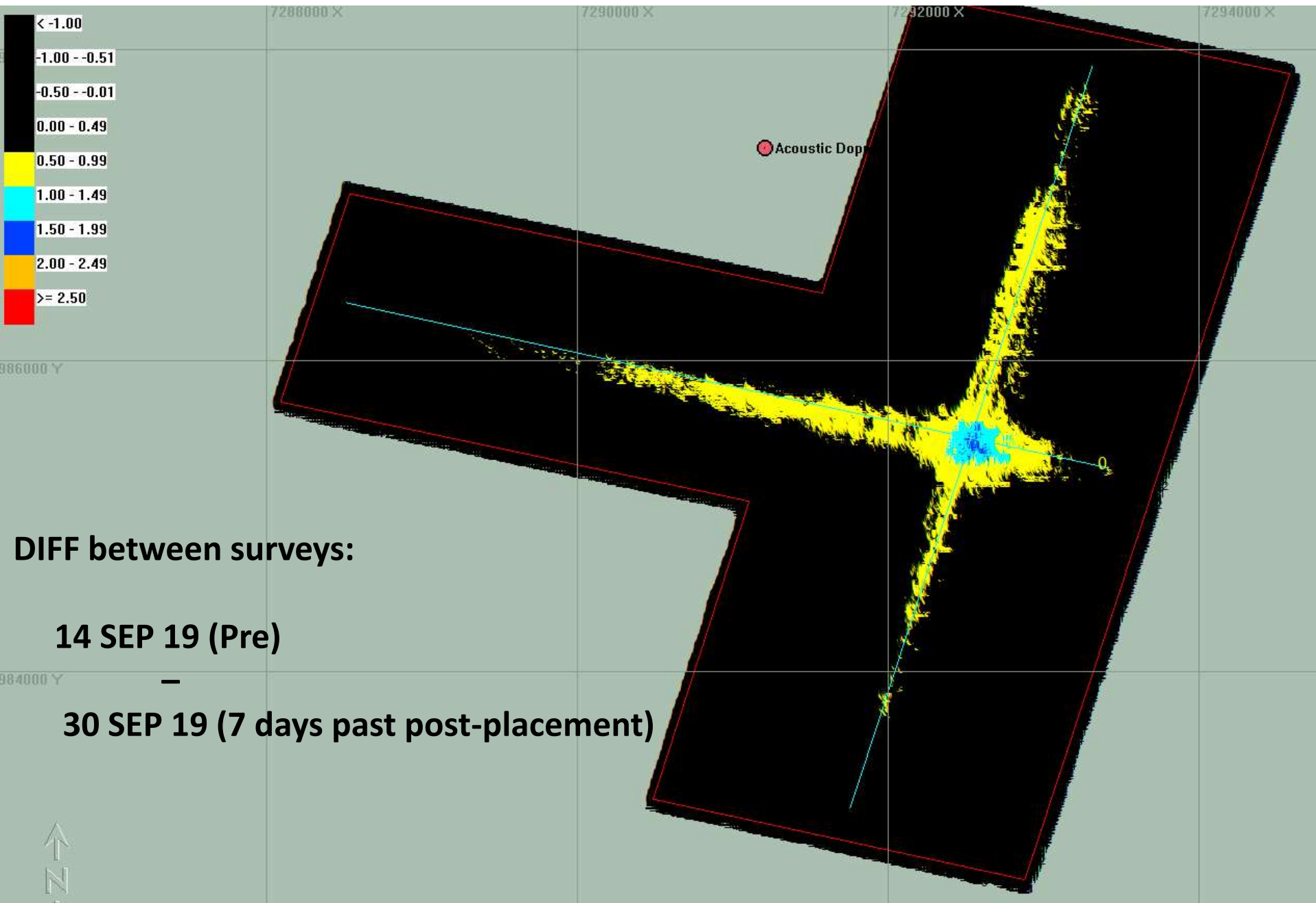
⋯ Bathy survey monitoring area  
centered along each Transect  
CS transect has 700 ft survey offset  
AL transect has 1200 ft survey offset

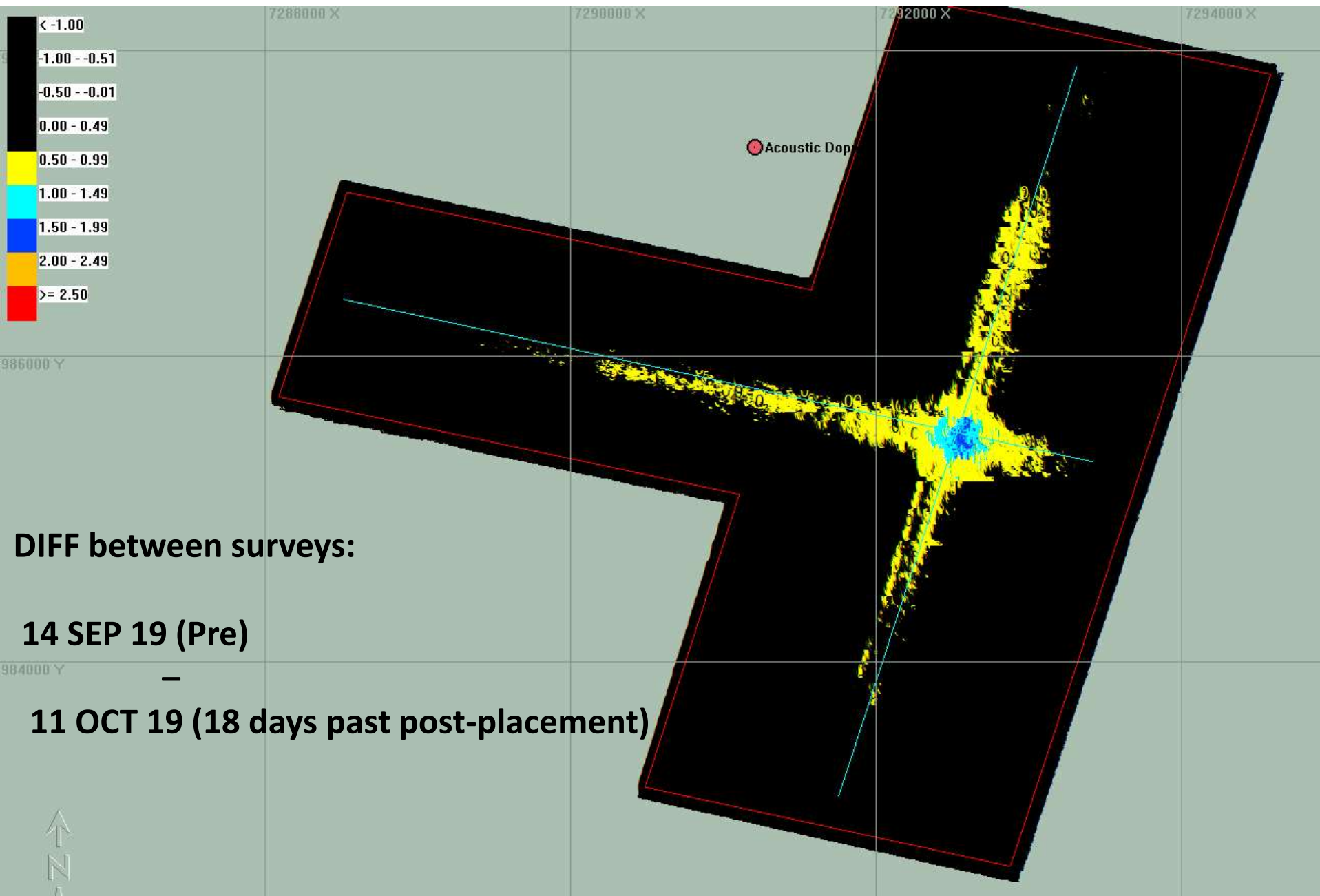
Bathymetry Contours in ft, MLLW (2 ft CI)  
State Plane Coordinate System, Oregon North, ft, NAD83

990000  
988000  
986000  
984000  
982000  
980000  
978000  
976000  
974000

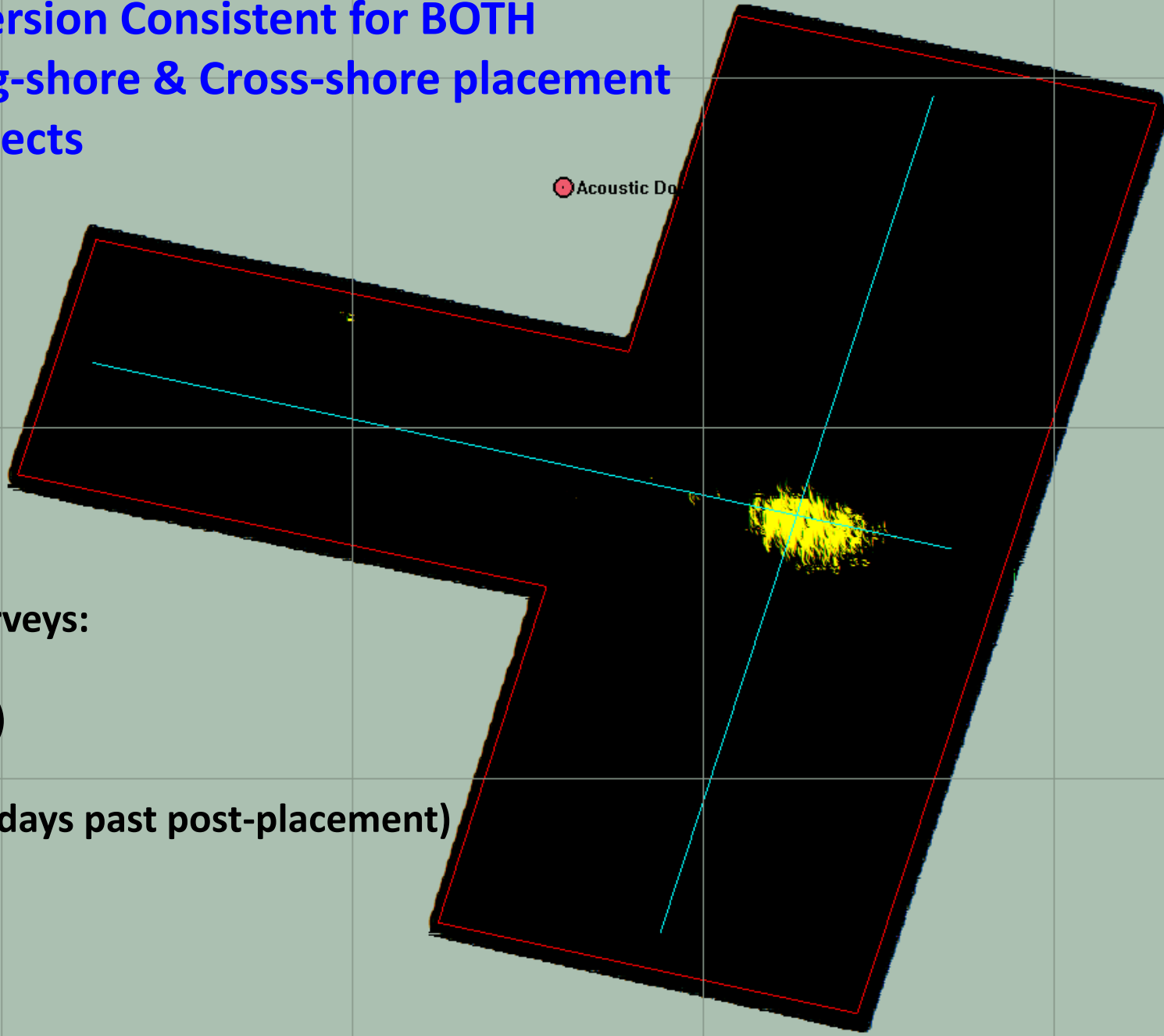
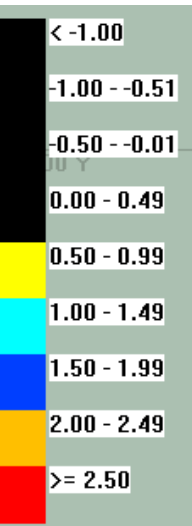
7281500 7285500 7289500 7293500 7297500 7301500

Easting (ft)





# Dispersion Consistent for BOTH Along-shore & Cross-shore placement Transects



Acoustic Do

DIFF between surveys:

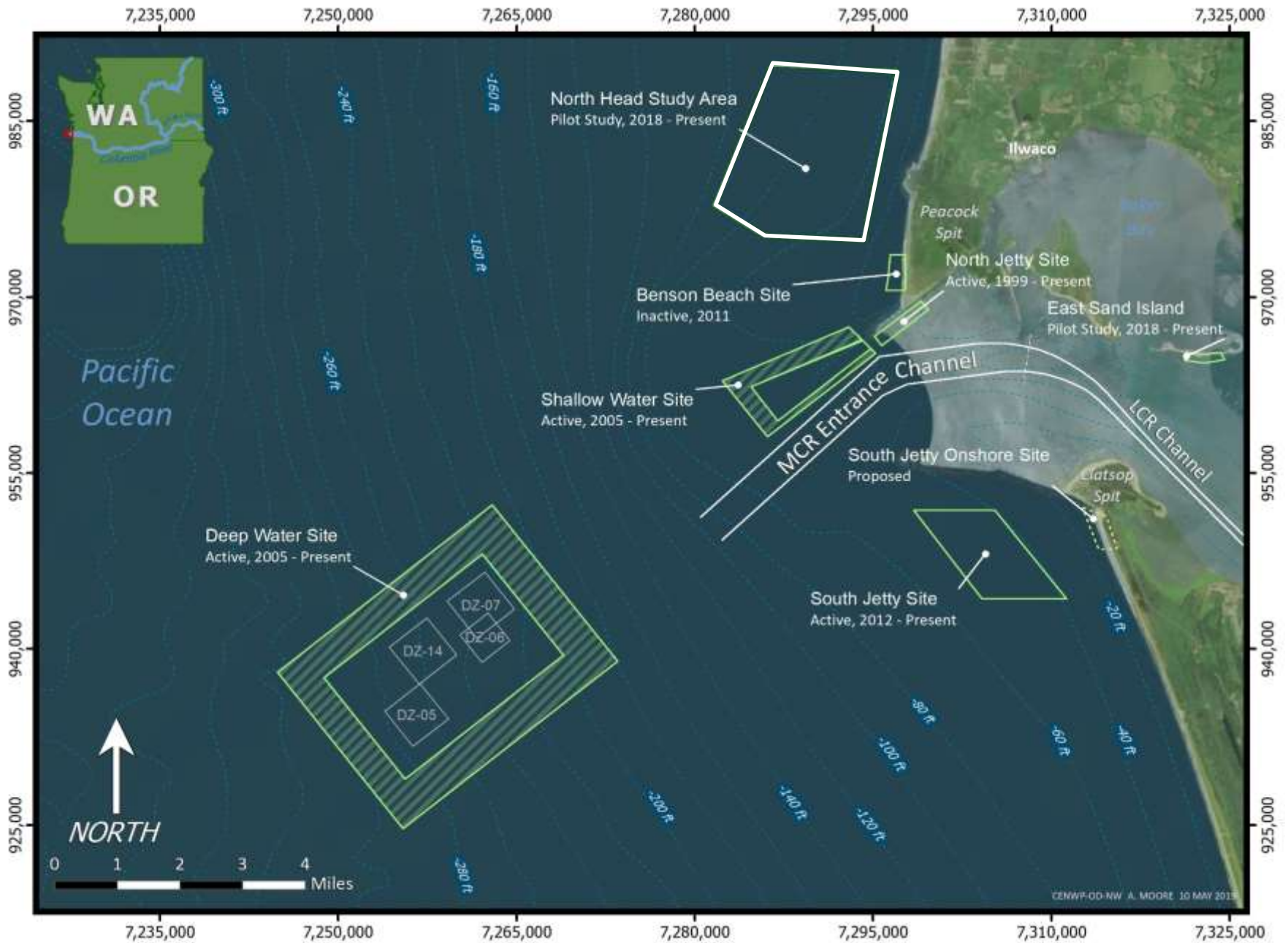
14 SEP 19 (Pre)

-

24 OCT 19 (31 days past post-placement)



# Mouth of the Columbia River



# CANBY

