

A BACI study of river restoration with large-wood additions using PIT-tagged tracer particles to access bed-sediment mobility on the Narraguagus River, Maine



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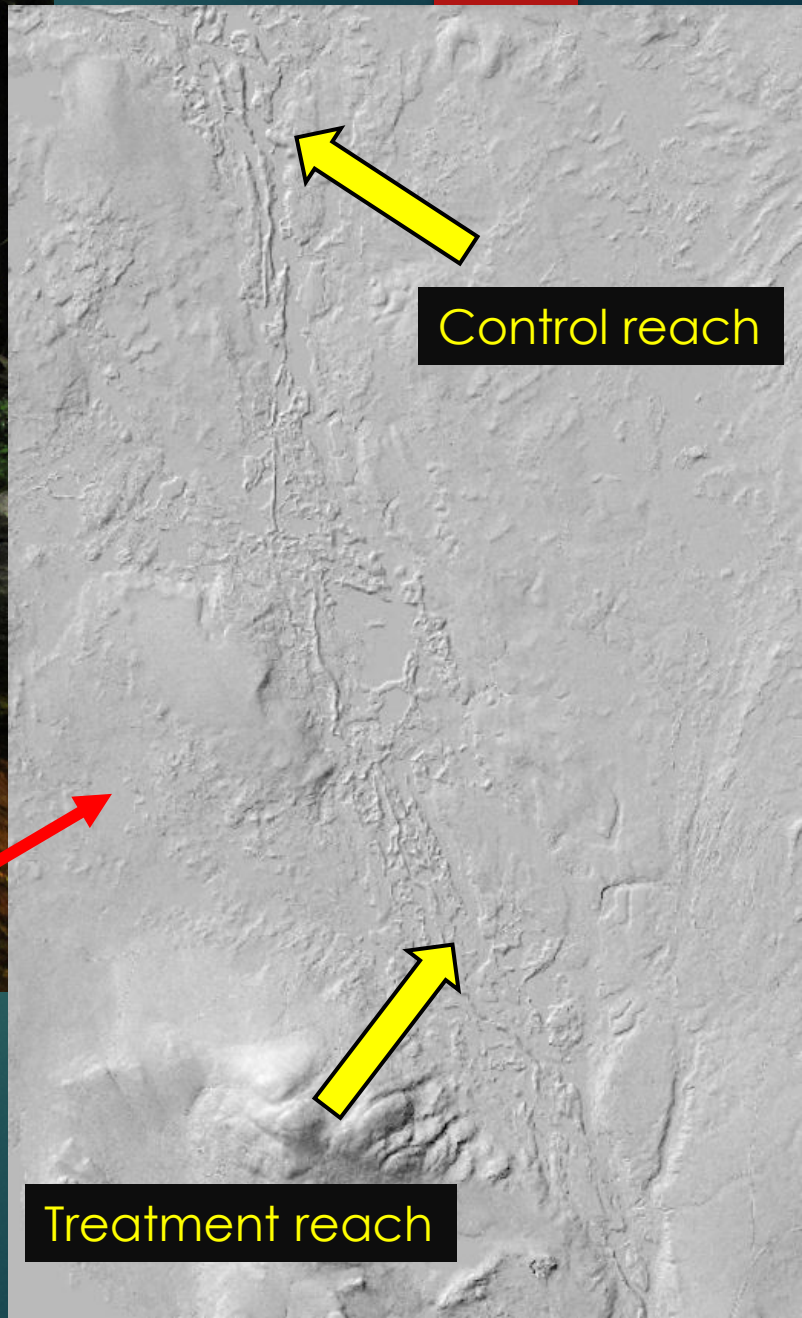
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³ Connecticut Fund for the Environment, Save the Sound, New Haven, CT

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Narraguagus River, Maine USA: Atlantic salmon restoration





Courtesy of Forest History Society



Courtesy of Forest History Society



Courtesy of Forest History Society



Courtesy of Town of Clifton Museum

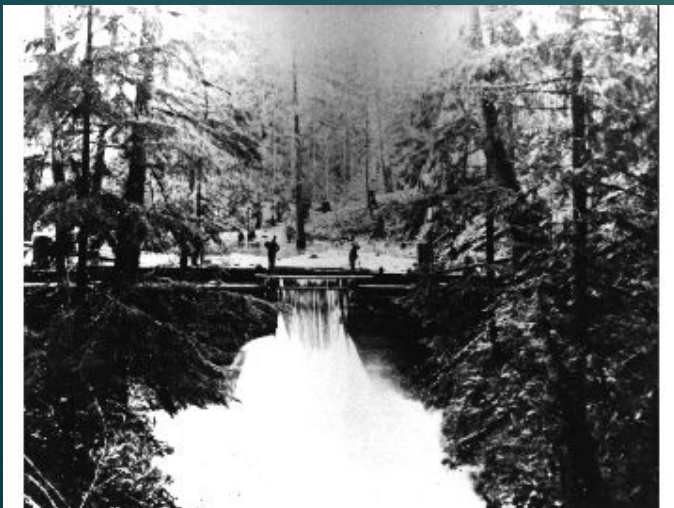


Courtesy Boston Public Library



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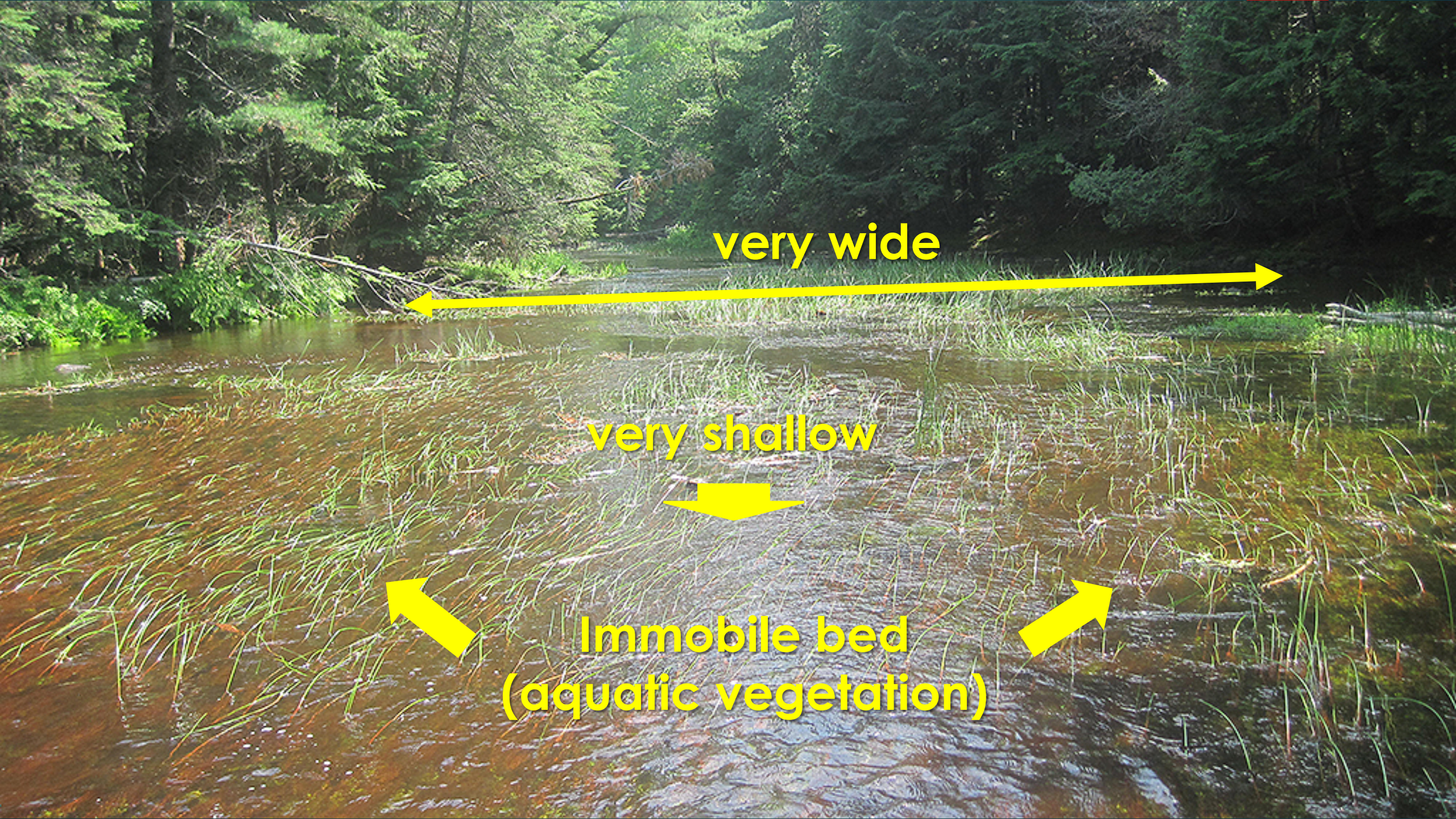
U.S. Forest Service



Photo courtesy Boston Archives



Photo courtesy Minnesota Historical Society
collection, locator number HD5.44 r9.

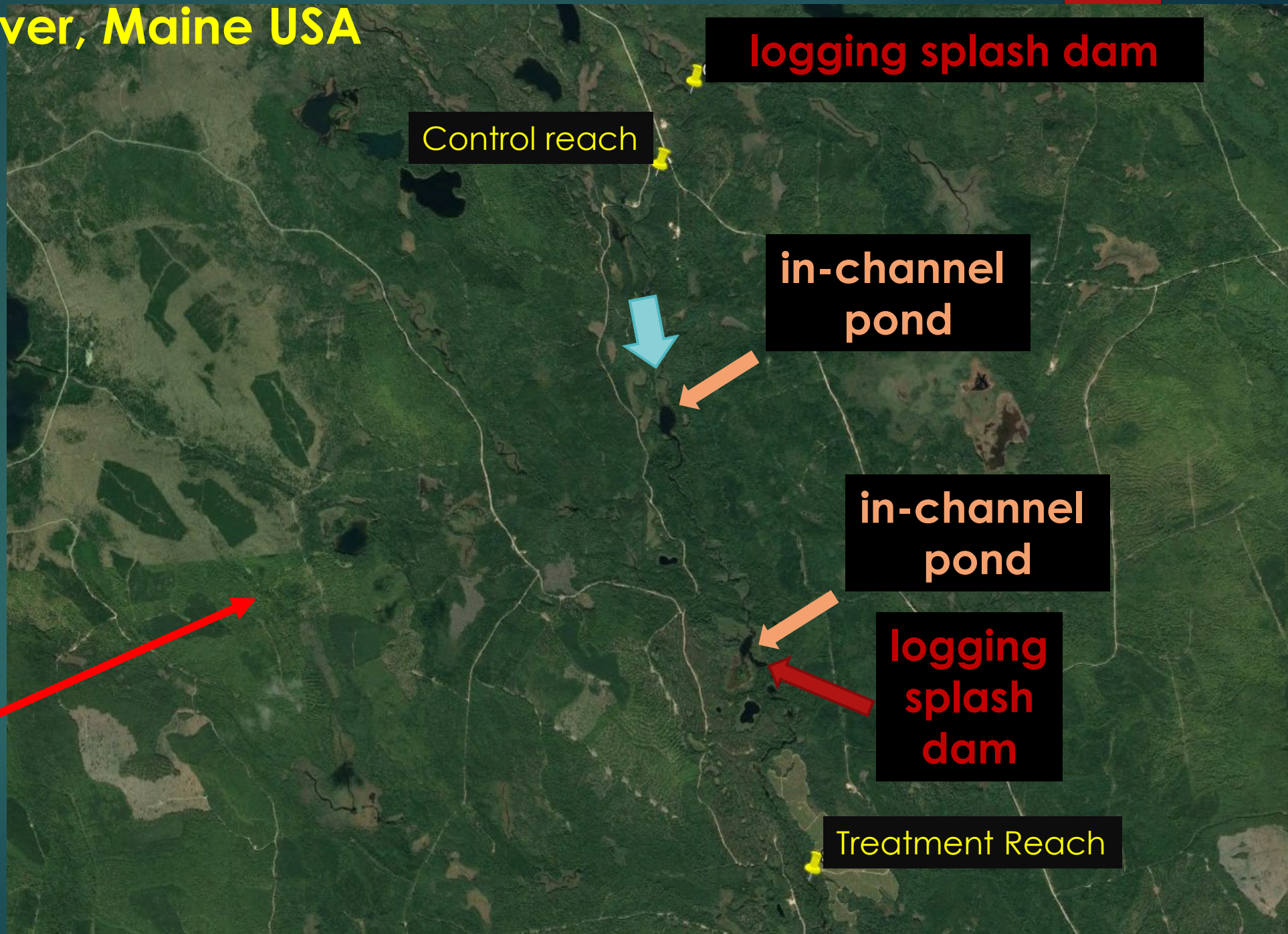
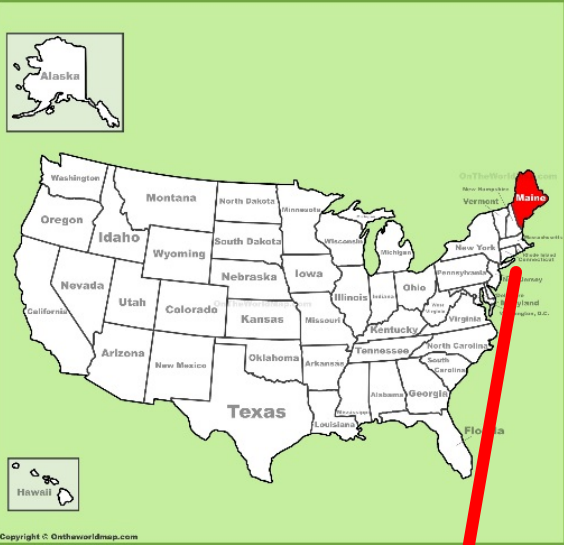


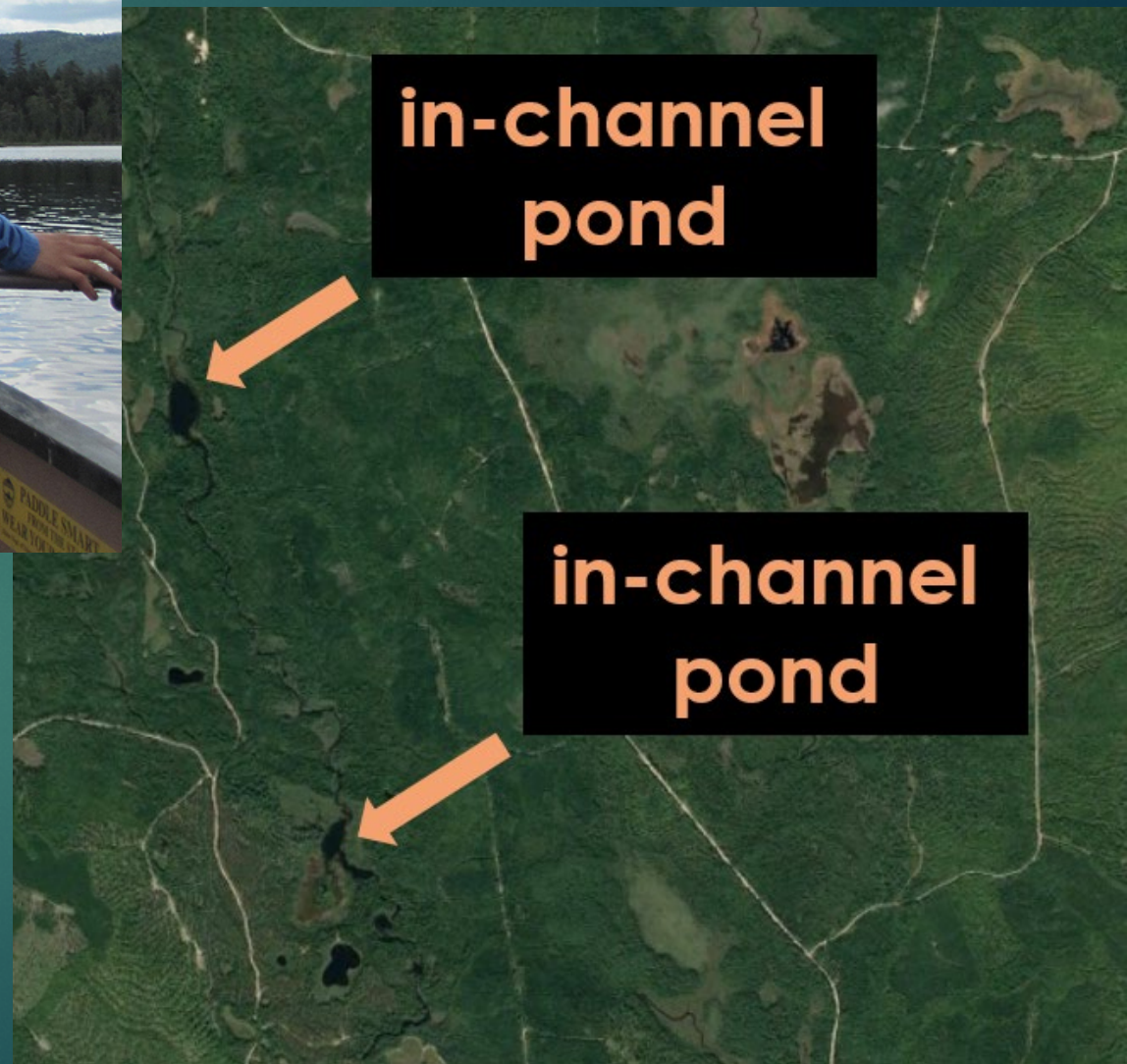
very wide

very shallow

Immobile bed
(aquatic vegetation)

Narraguagus River, Maine USA

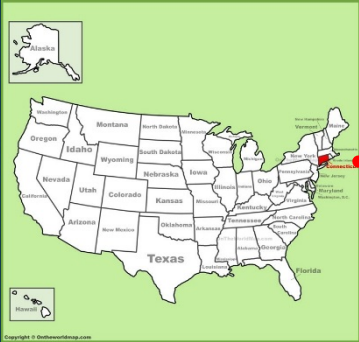




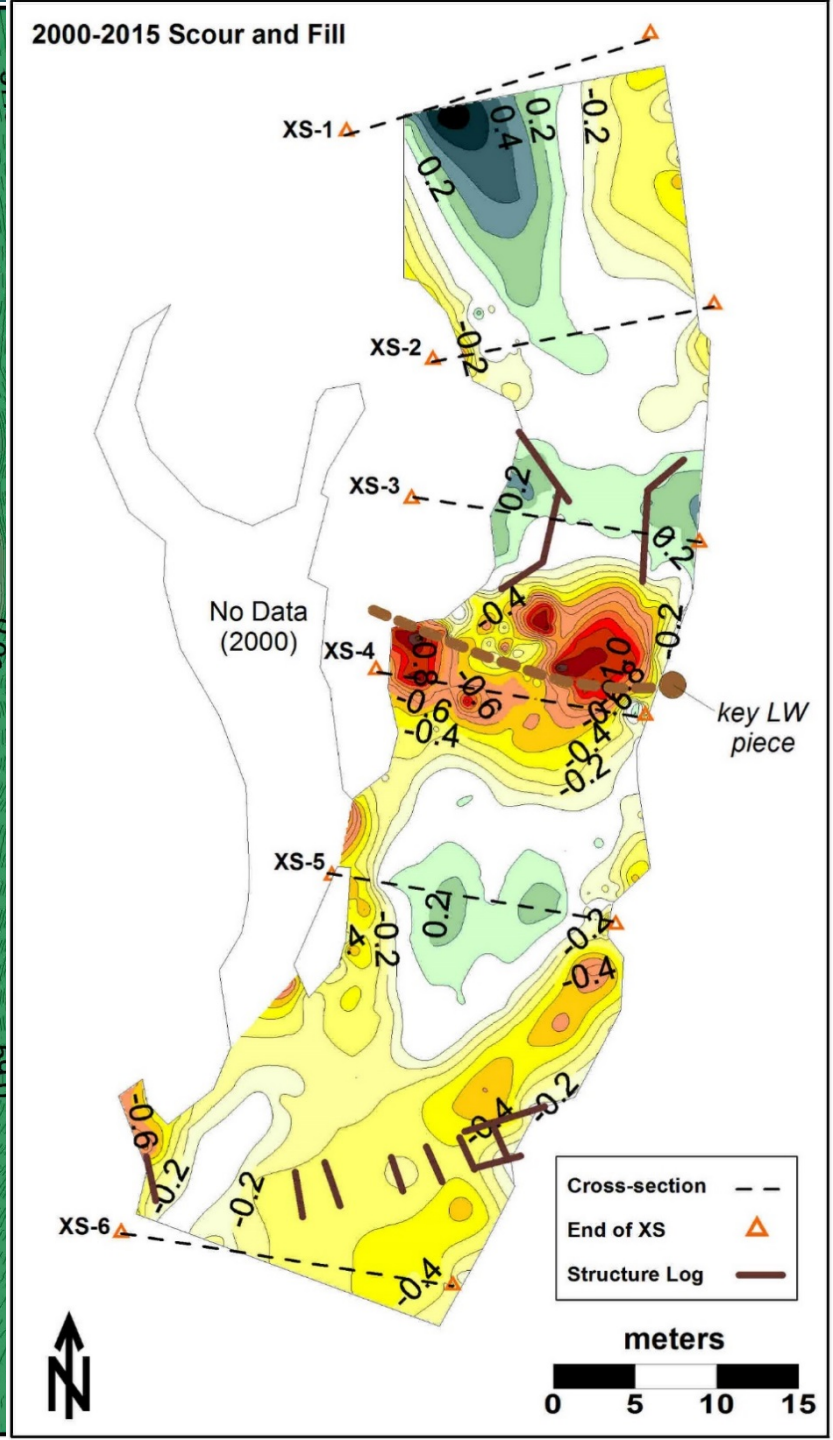
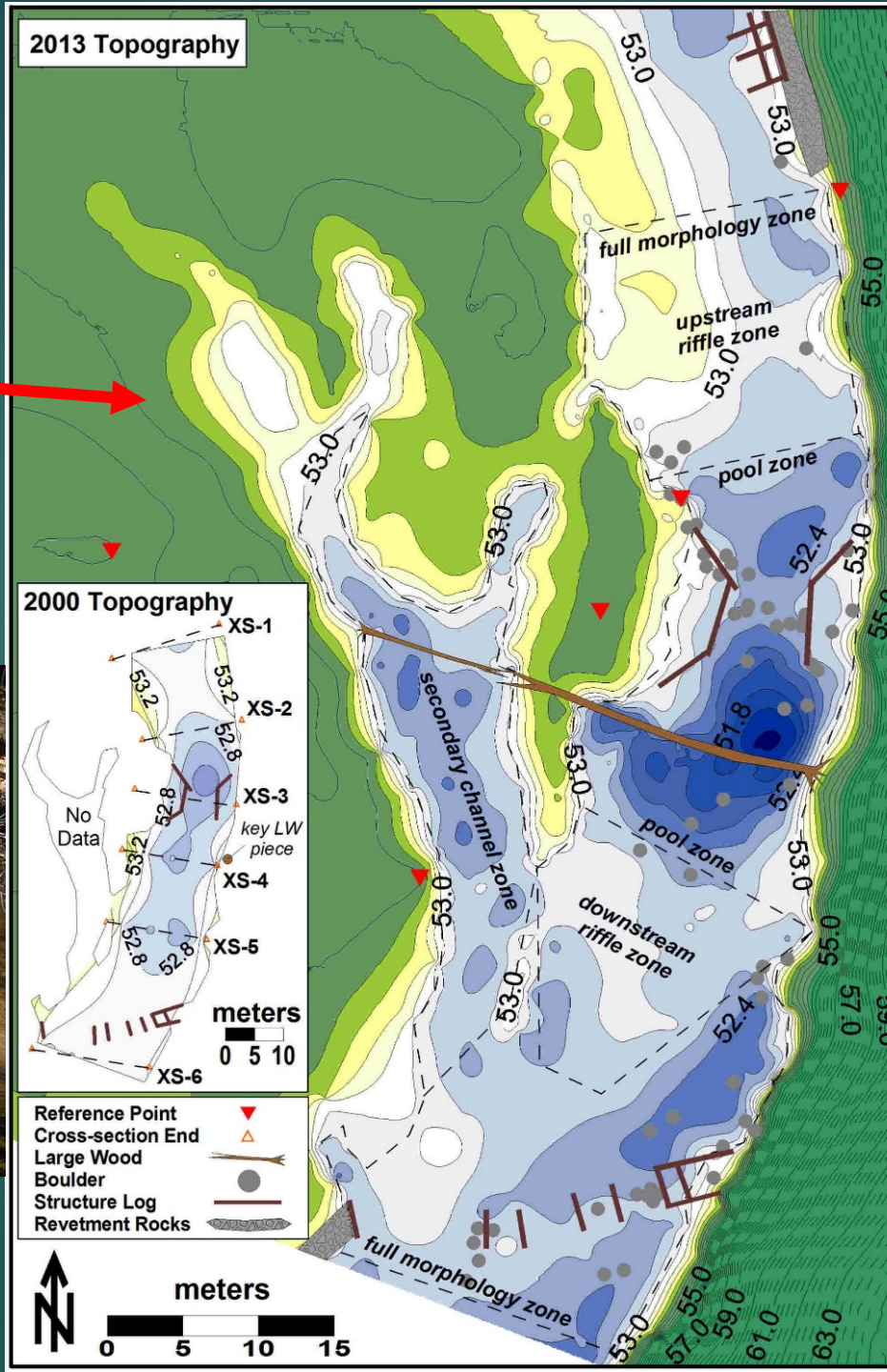


**How can wood
additions help?**

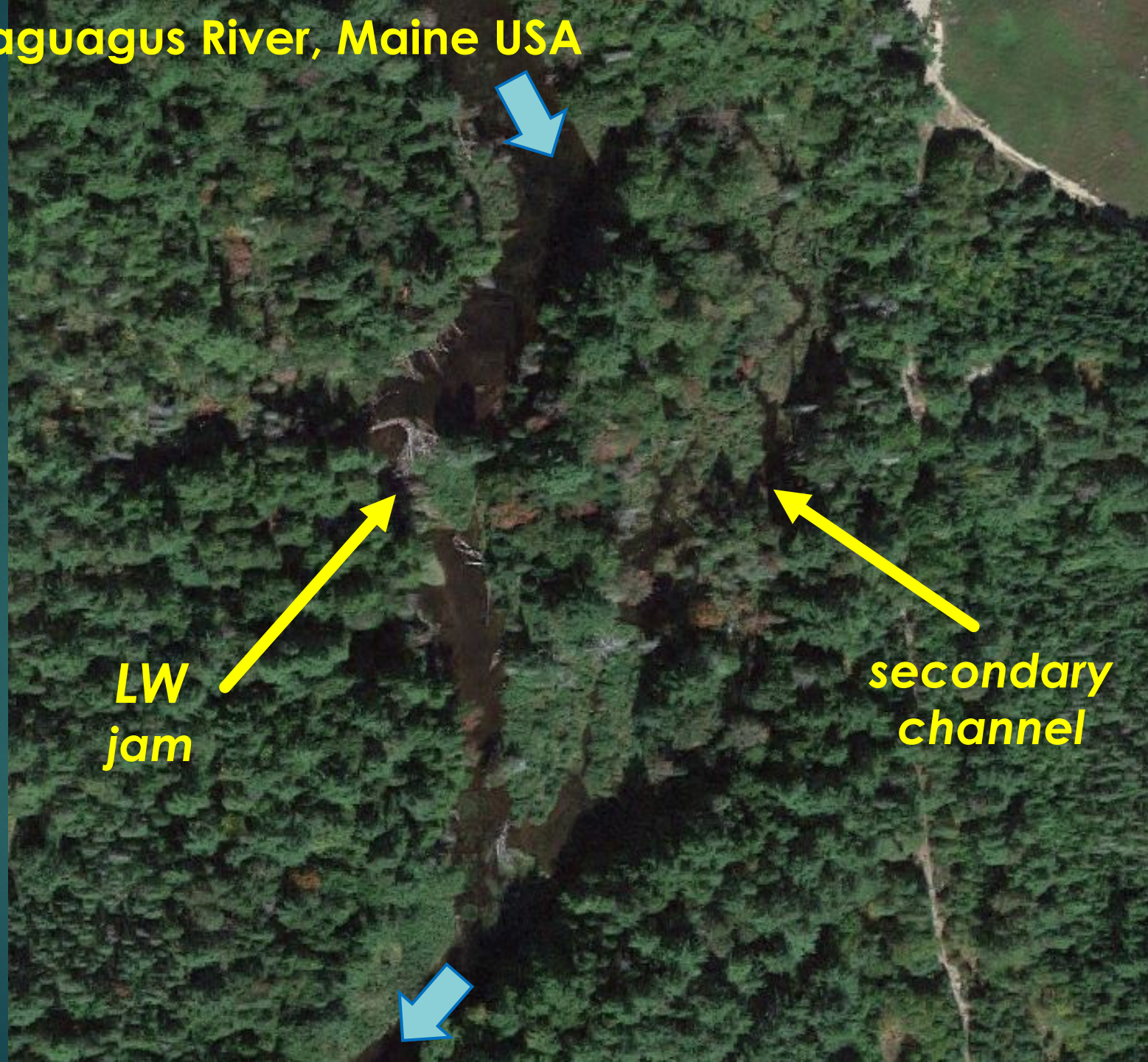
Blackledge River, CT



2011



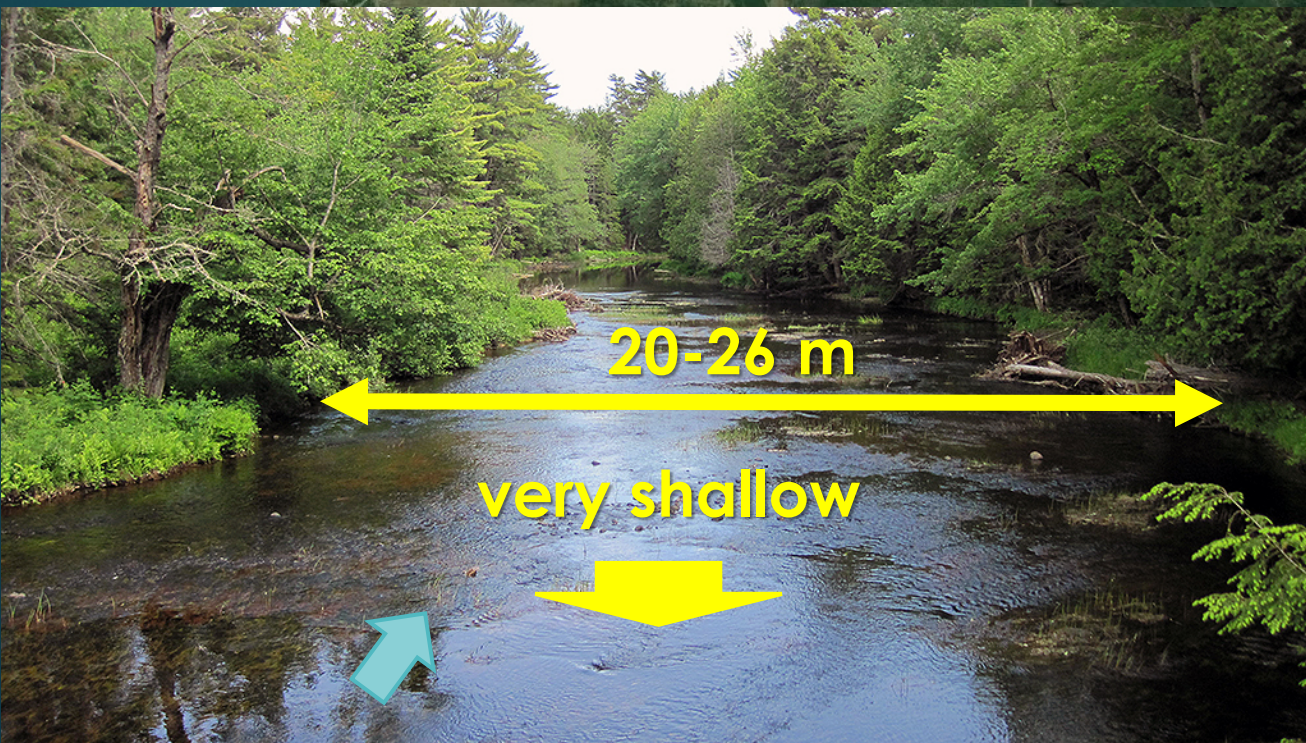
Narraguagus River, Maine USA



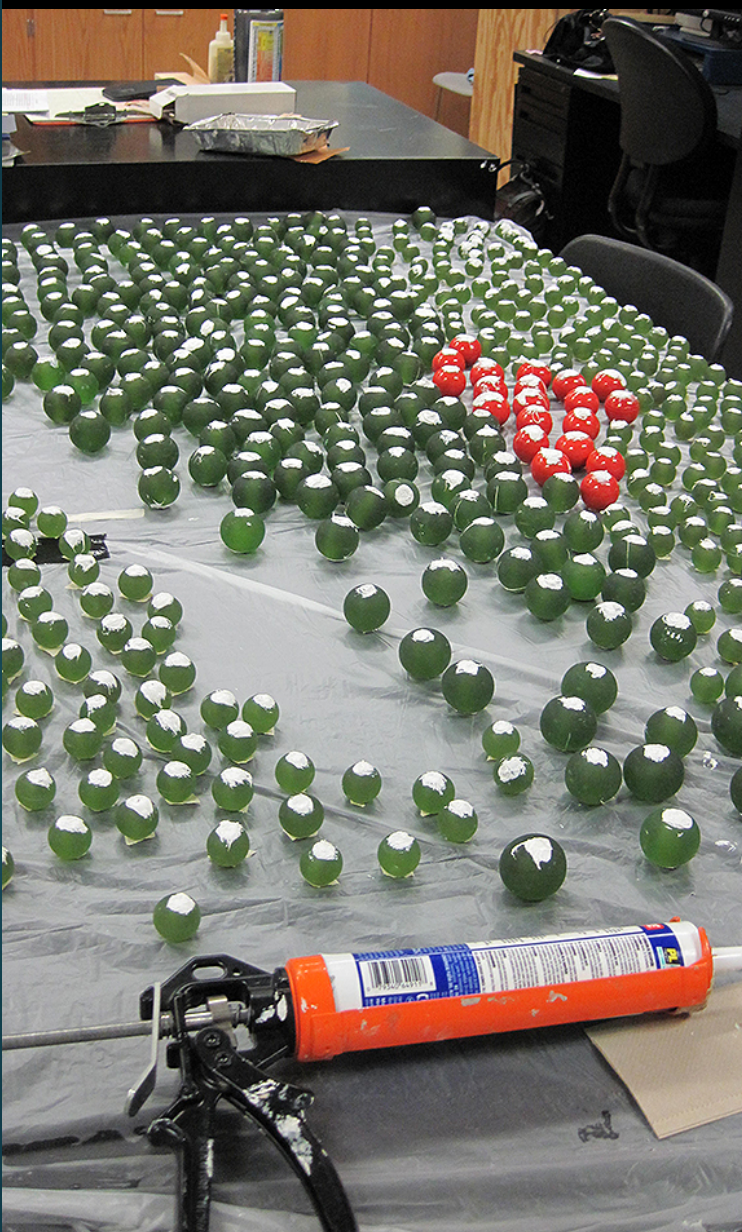
*LW
jam*

*secondary
channel*

BACI: Before, After Control, Impact



PIT Tag Tracer Particles



June-July 2016

- 10 cross-sections with 20 particles/cross-section
- Alternate 28-mm and 40-mm PIT-tagged particles
- Cross-section elevation surveys
- Embeddedness estimates along cross-sections



PIT Tag Tracer Particles

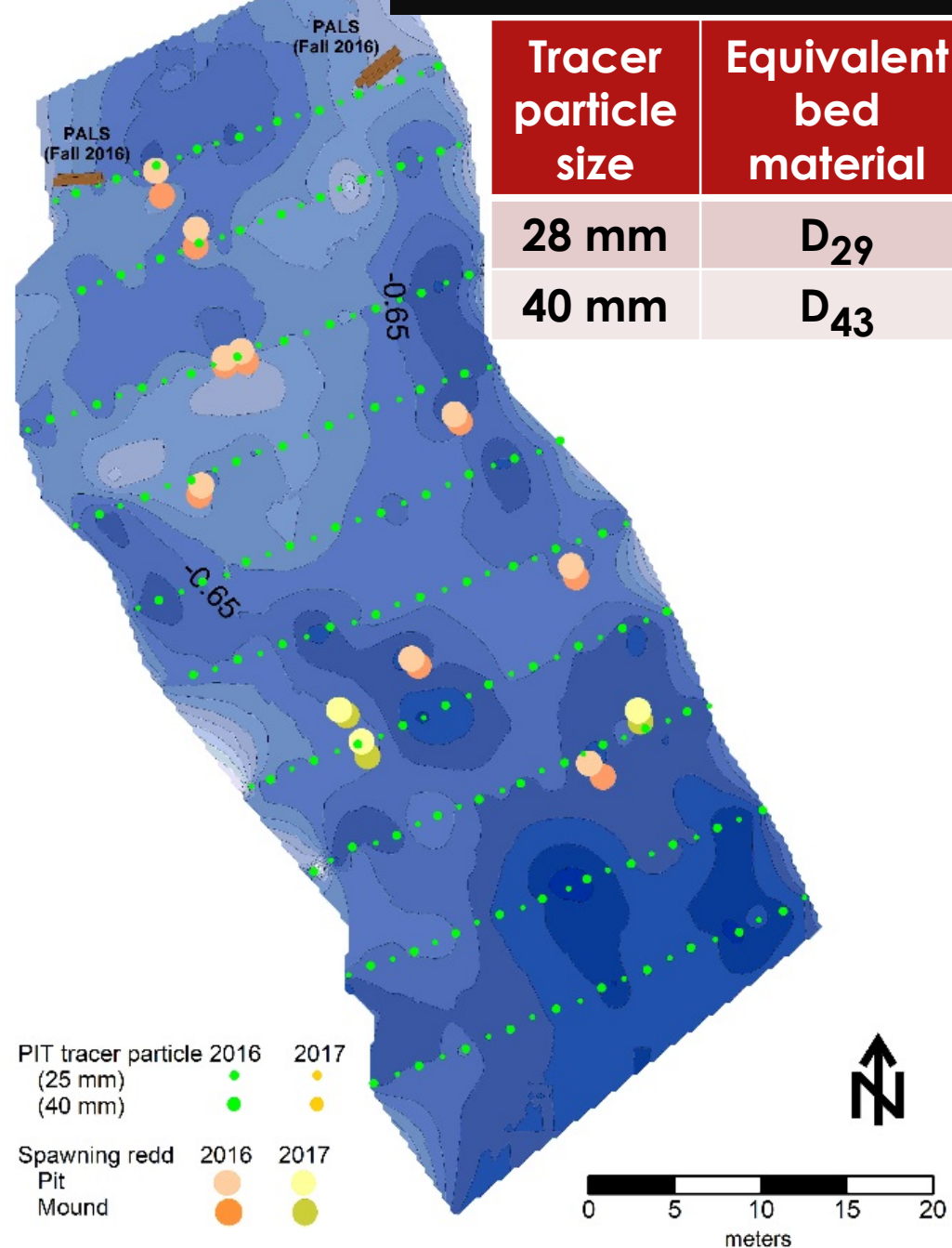


28 mm

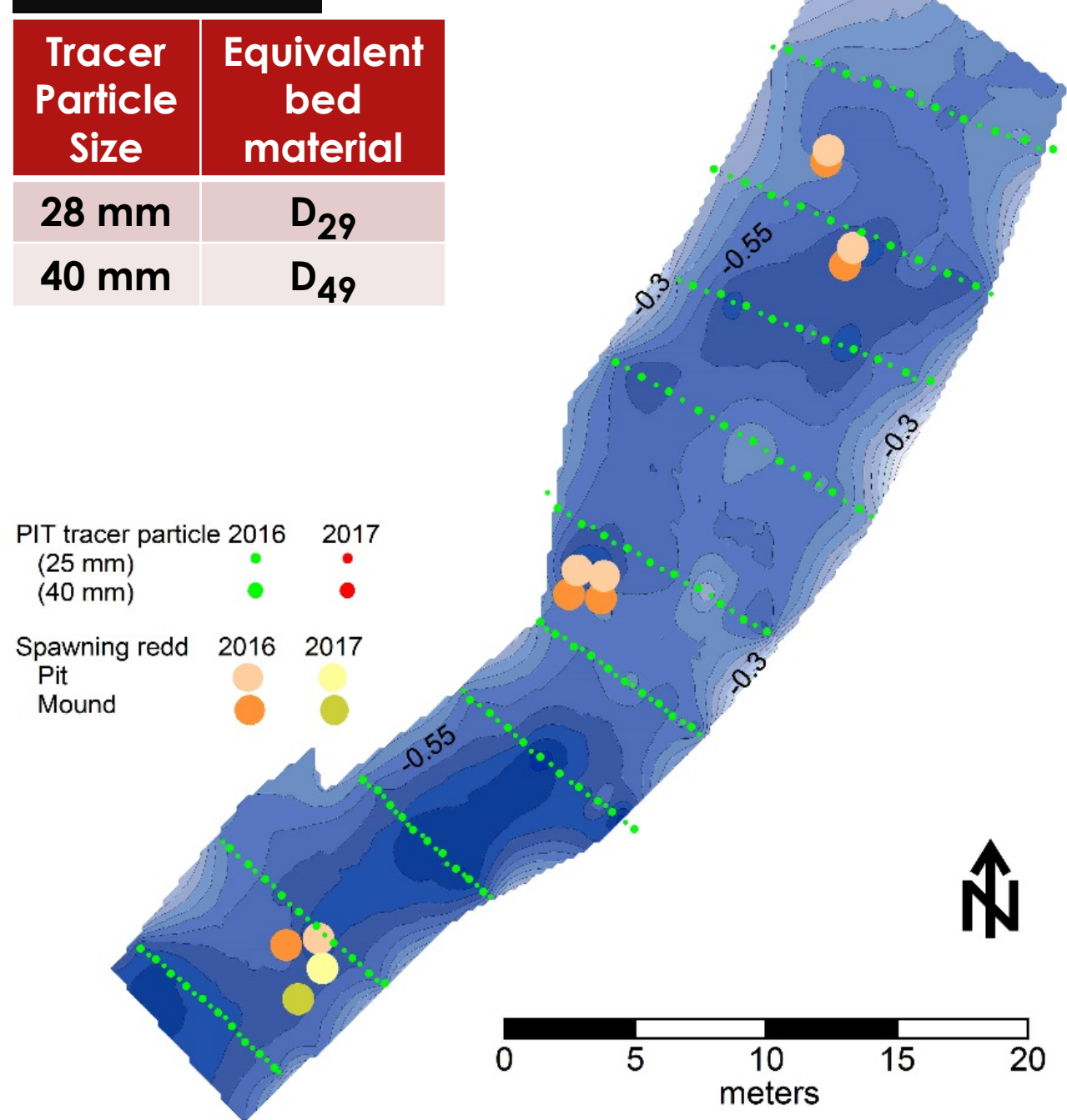
40 mm

28 mm

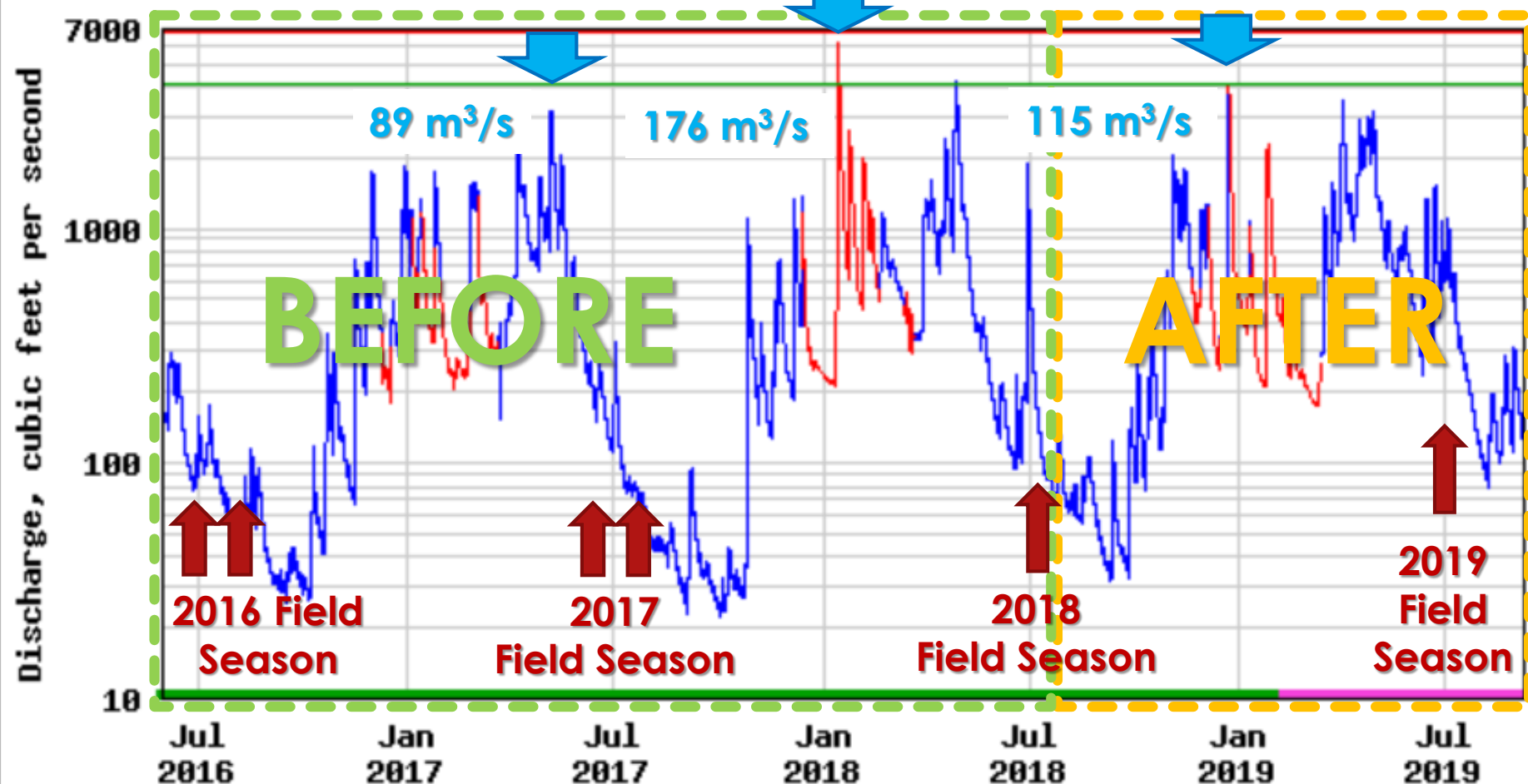
SXS – Treatment Reach



TXS – Control



USGS 01022500 Narraguagus River at Cherryfield, Maine



- Discharge
- Estimated discharge
- Period of approved data
- Period of provisional data
- 10 Year Peak Flow *
- 2 Year Peak Flow *

Cross-section resurveys

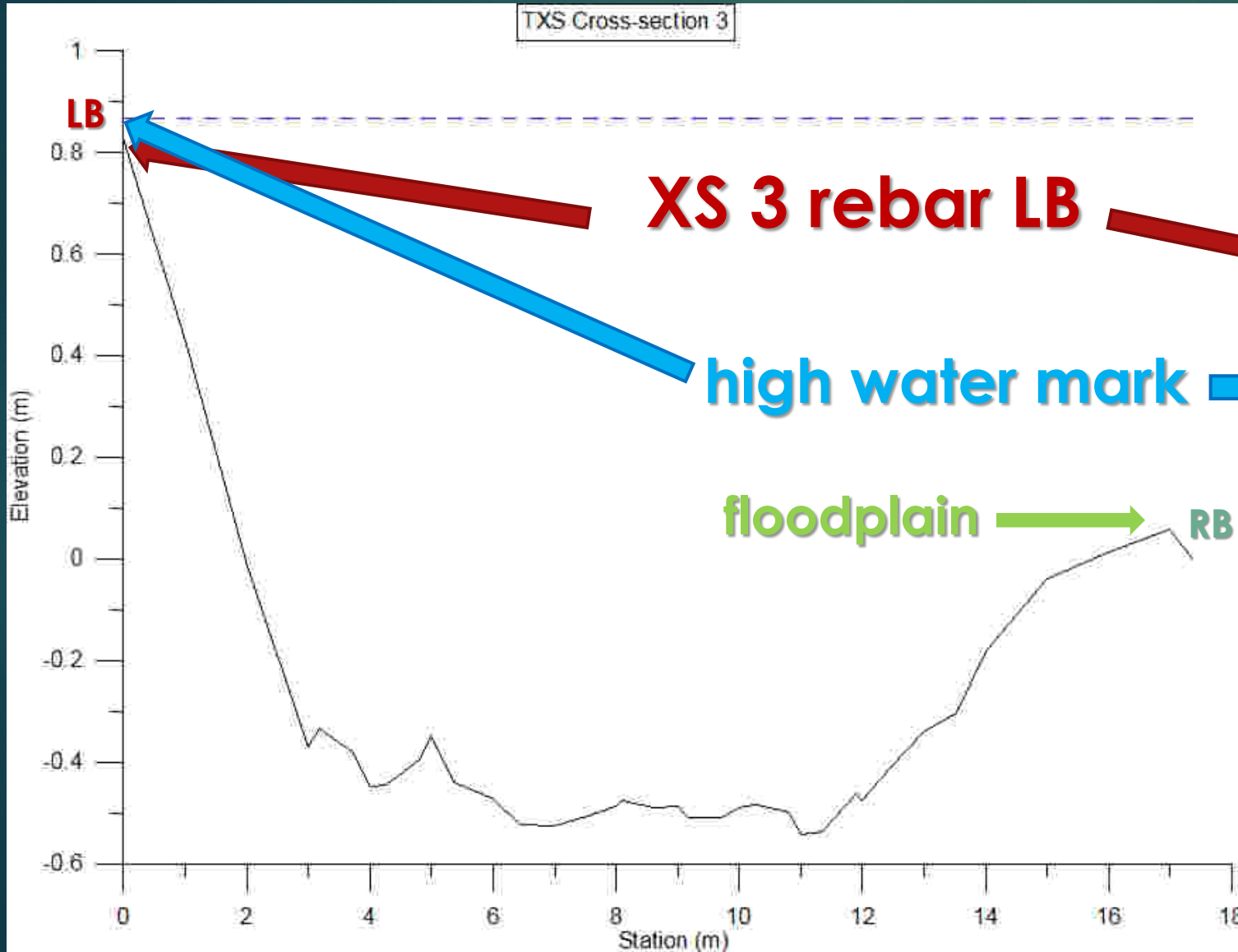


PIT tag particle search and resurvey



Control

2018 high water marks



Treatment (IMPACT): July 2018



Post-Assisted Log Structures (PALS)

Treatment (IMPACT): July 2018

2016



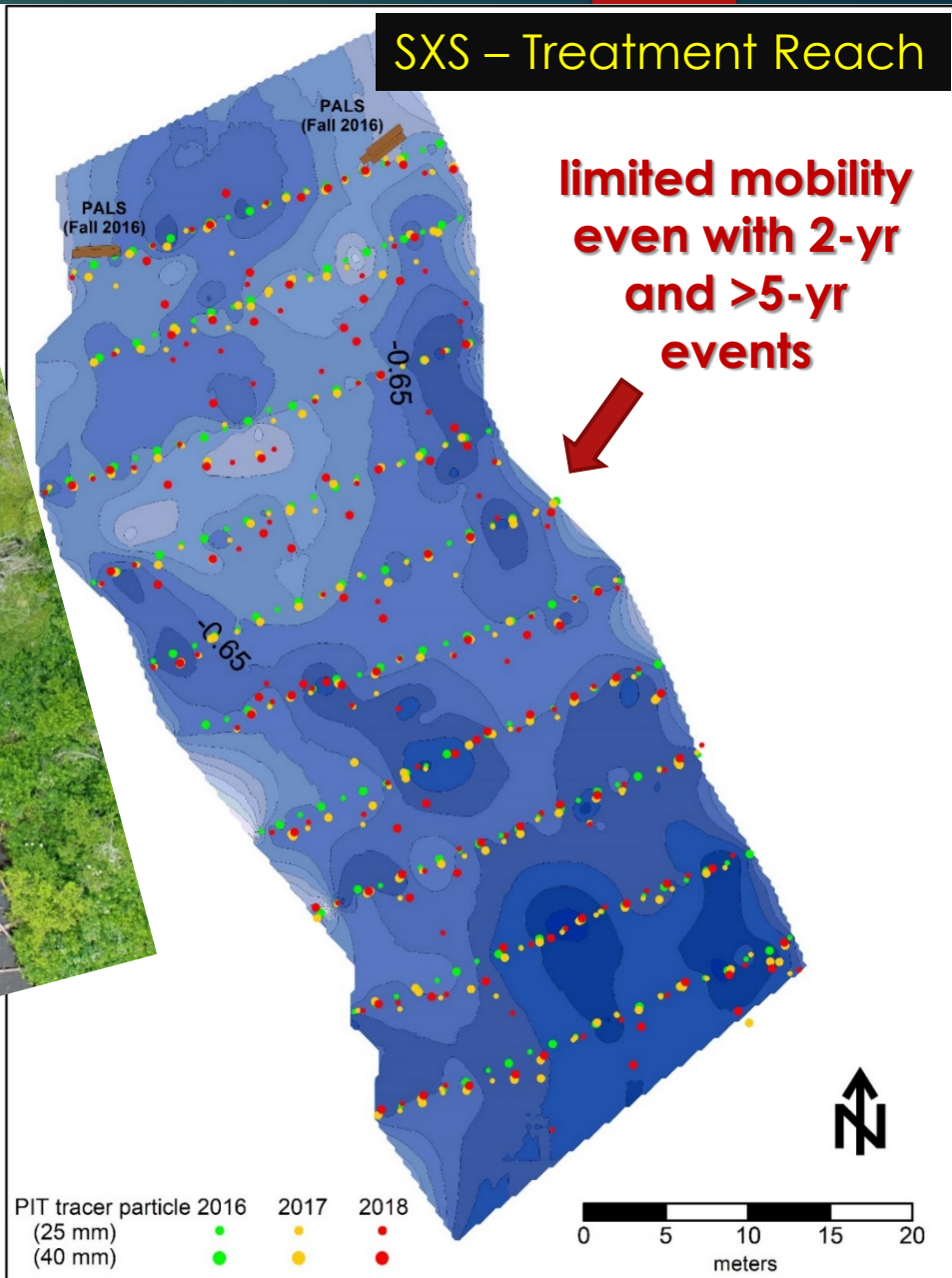
2018

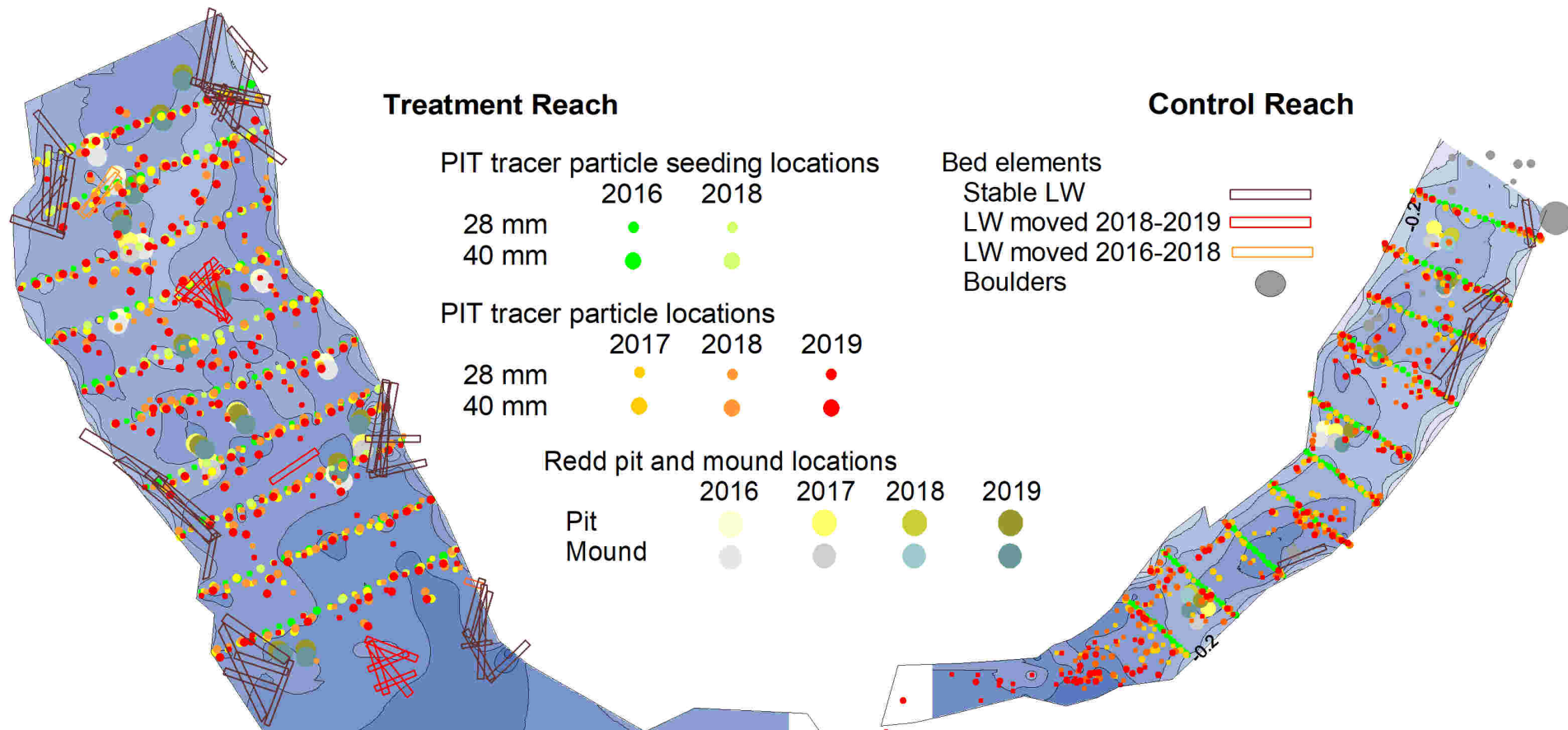


2018



SXS – Treatment Reach



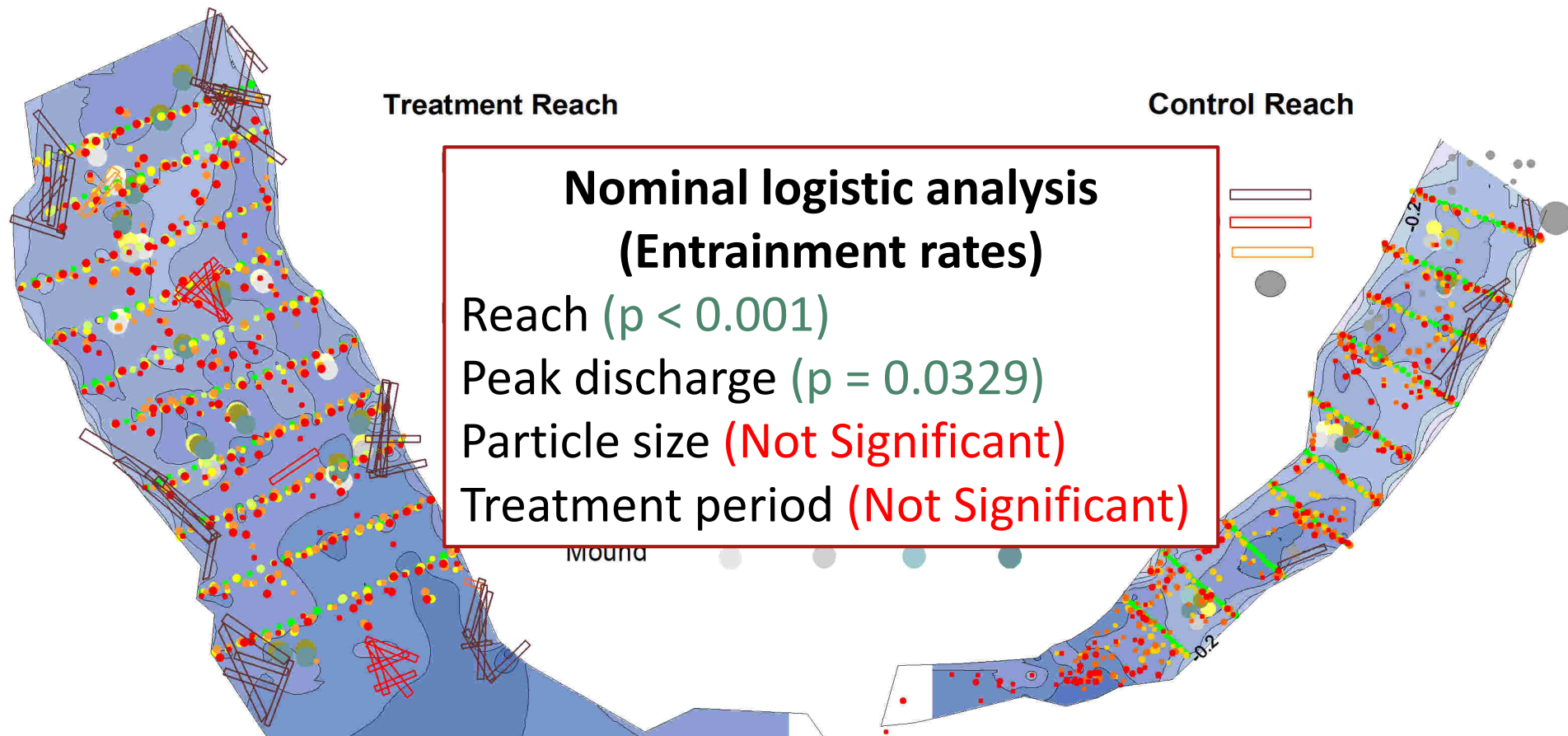


Recovery Rate (vs previous year)

Year	28-mm	40-mm
2017	99 (NA)	99 (NA)
2018	92 (93)	97 (98)
2019	96 (102)	89 (92)

Recovery Rate (vs previous year)

Year	28-mm	40-mm
2017	93 (NA)	96 (NA)
2018	89 (96)	87 (91)
2019	91 (102)	86 (102)



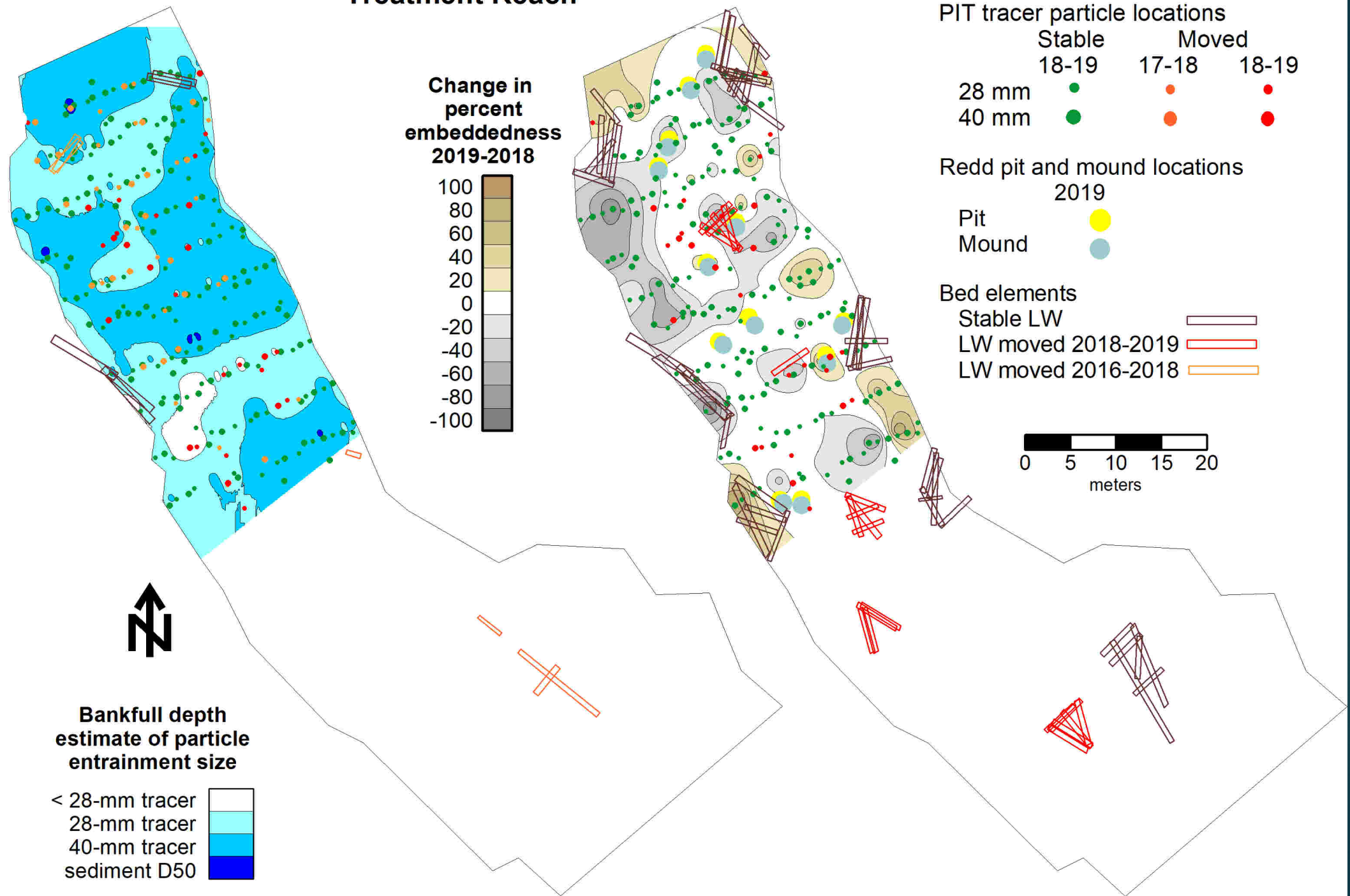
Entrapment rate (re-entrained)

Year	28-mm	40-mm
2017	13.1 (NA)	8.2 (NA)
2018	17.4 (4.3)	22.9 (0.0)
2019	13.2 (2.5)	10.2 (0.8)

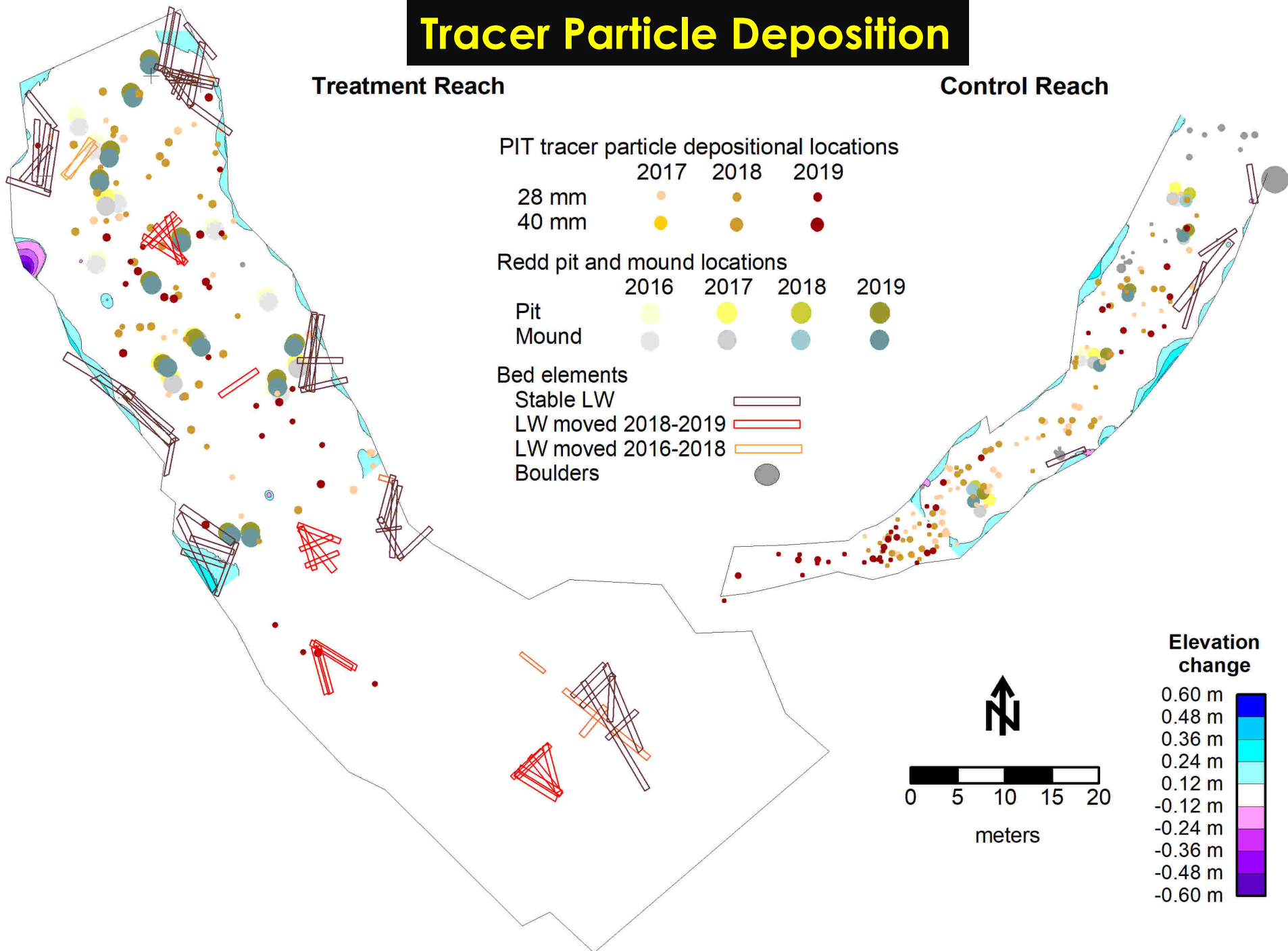
Entrapment rate (re-entrained)

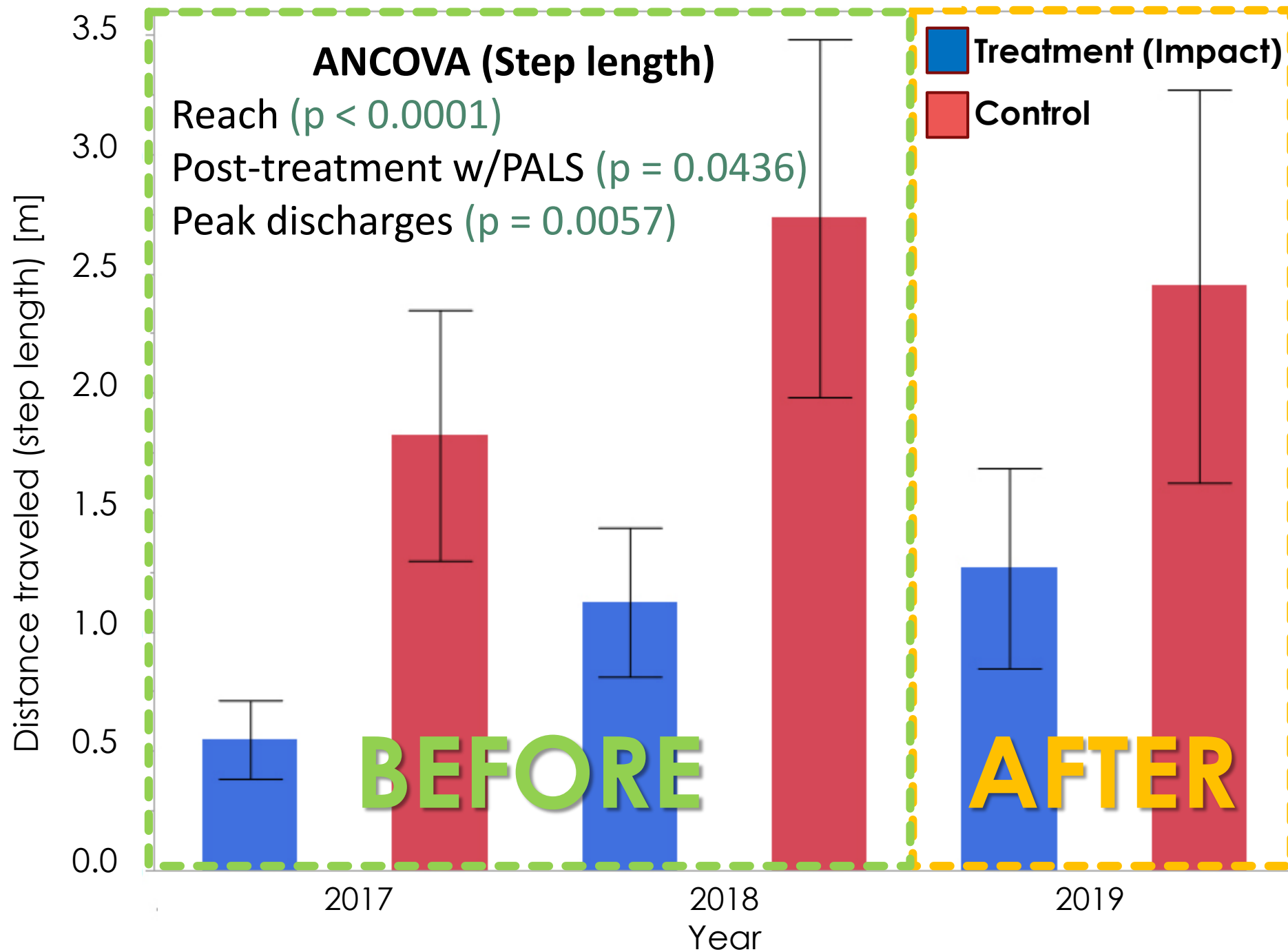
Year	28-mm	40-mm
2017	24.6 (NA)	29.4 (NA)
2018	22.1 (7.1)	48.4 (14.5)
2019	20.9 (13.0)	28.6 (15.9)

Treatment Reach

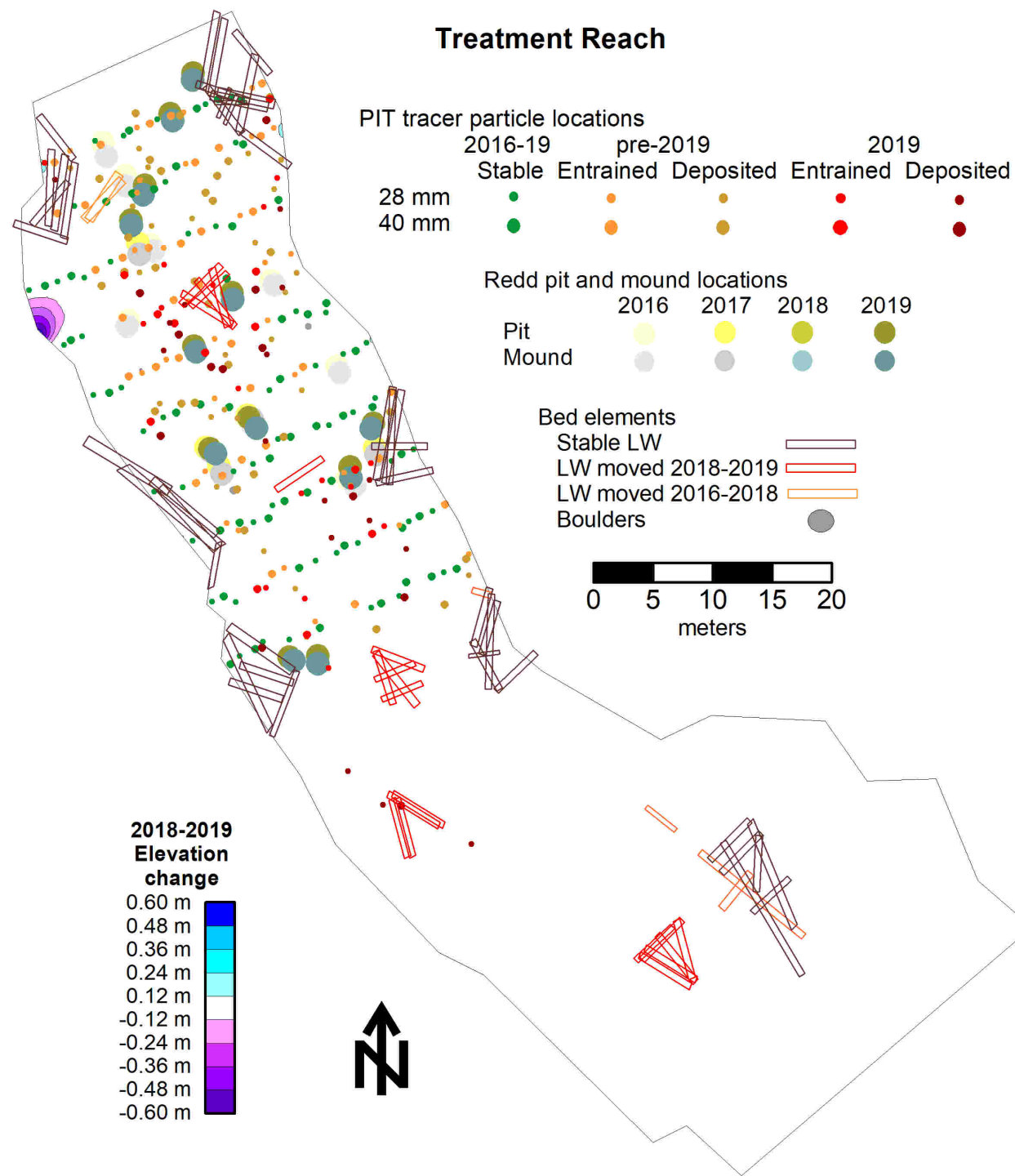


Tracer Particle Deposition





Treatment Reach



Conclusions

- The Narraguagus River is overly wide and shallow due to past logging activities
- Particle mobility is limited even during a large flood
- Particle entrainment rates between 28 mm and 40 mm particles are similar (equal mobility?)
- PALS additions did NOT impact entrainment rates, but DID increase particle step lengths in the treatment reach

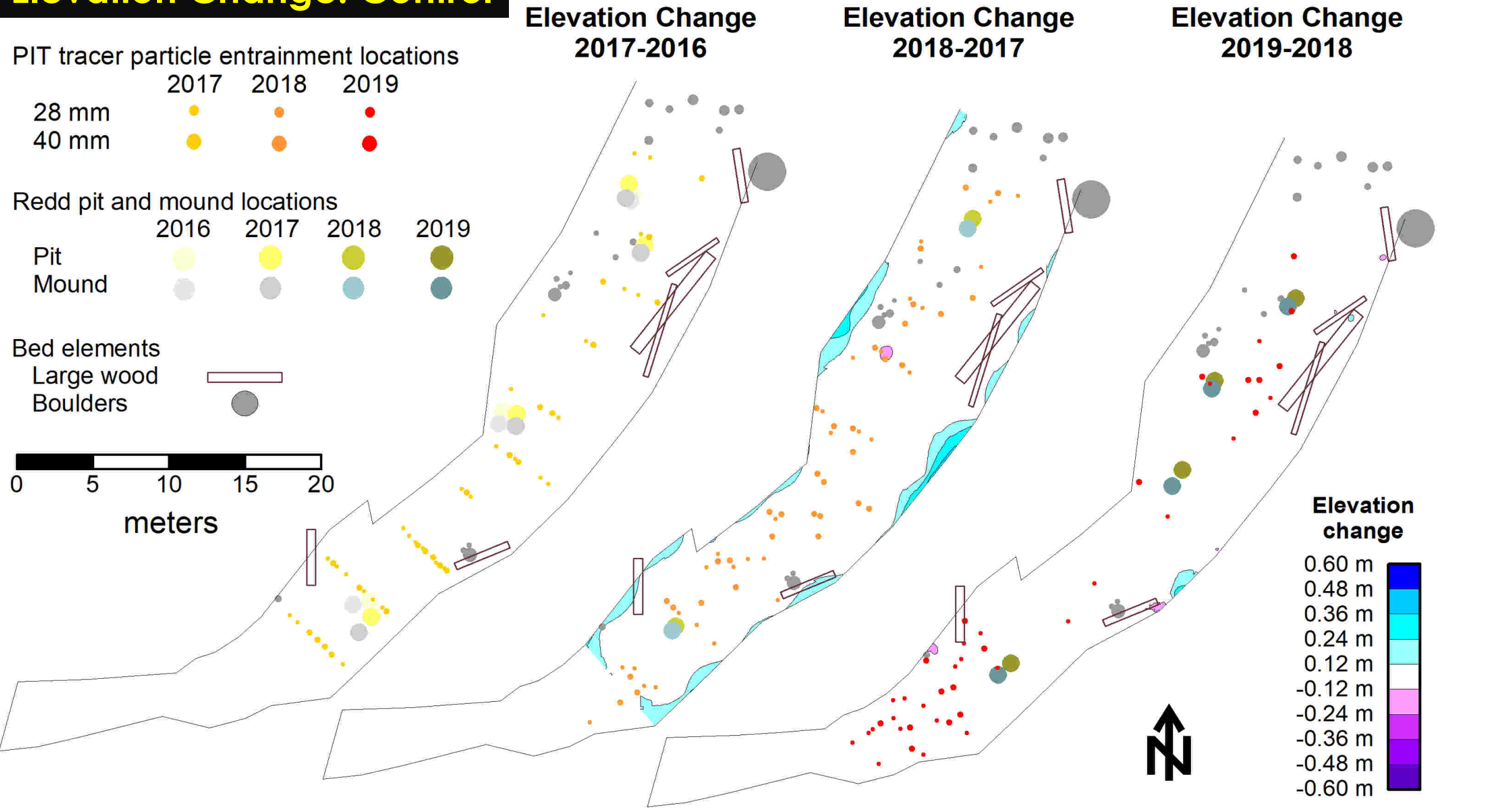


Thank you!





Elevation Change: Control



Elevation Change: Treatment

