Investigating Holocene lacustrine sedimentation in New England using ground-penetrating radar and sidescan sonar

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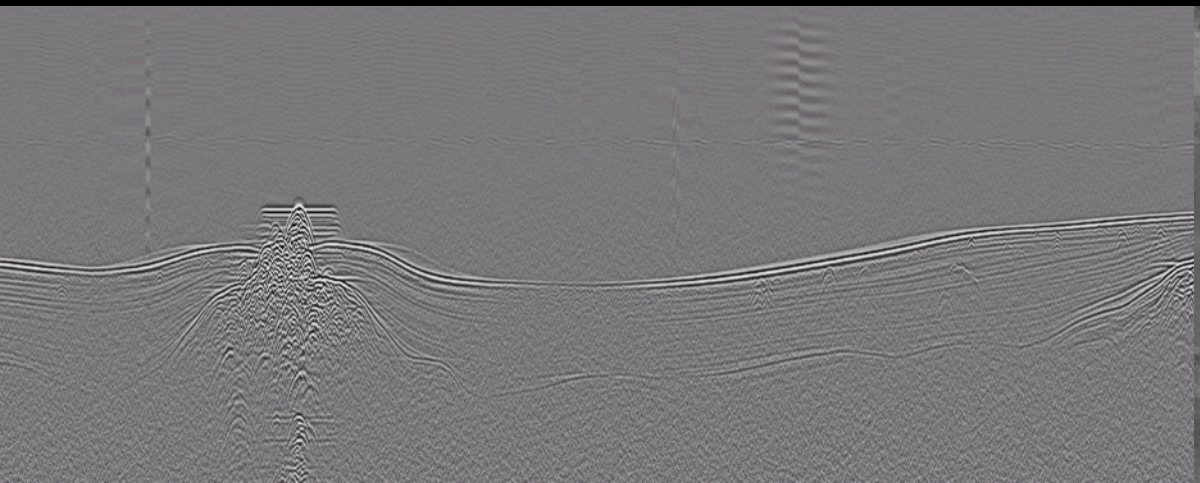

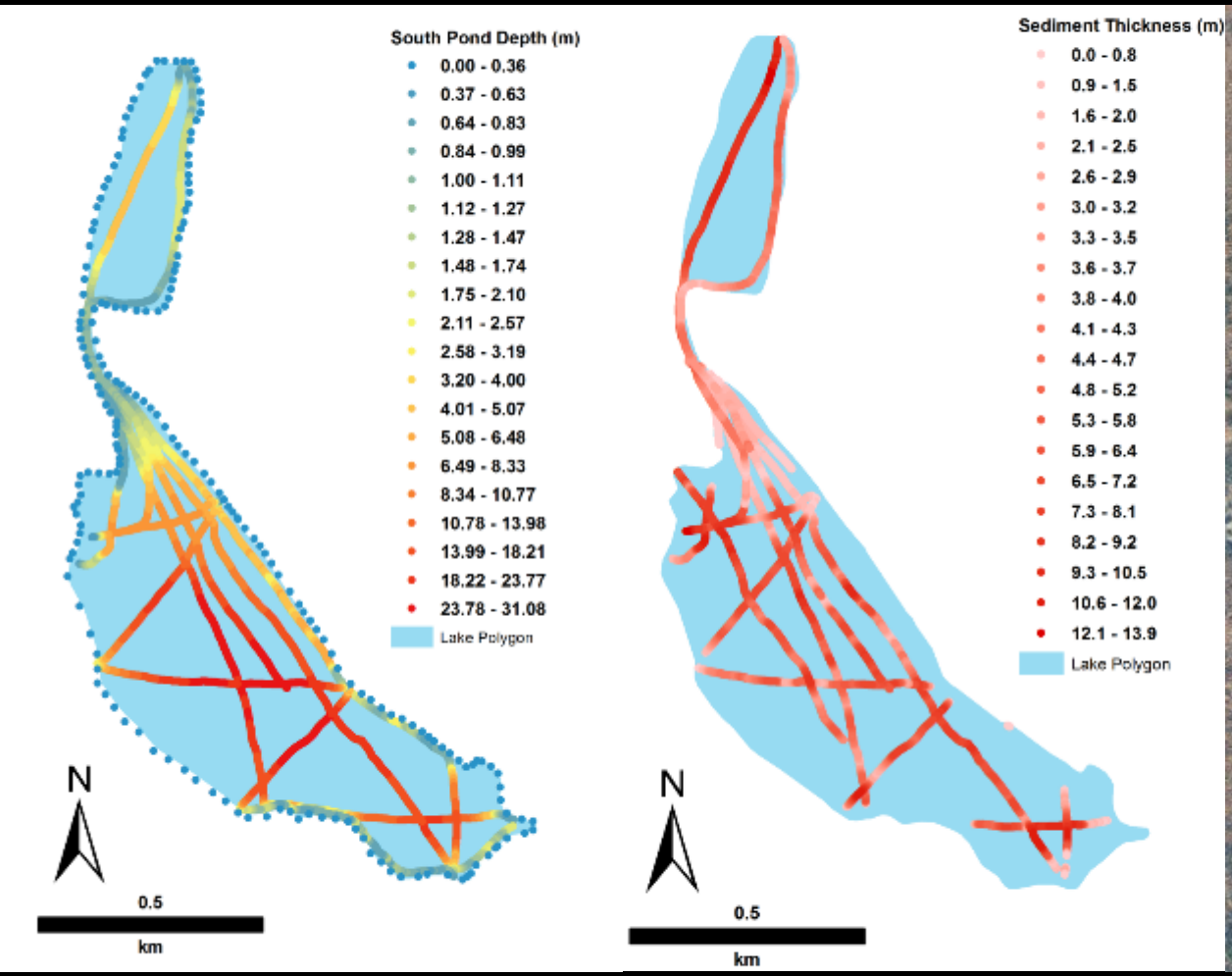

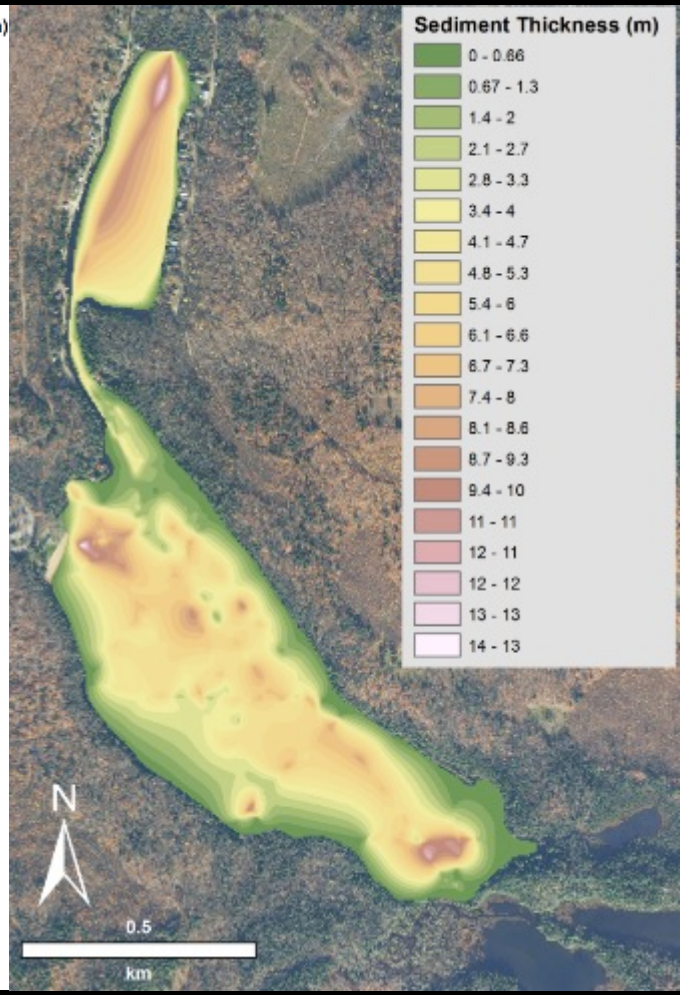

Key Point: Lake sediments are not always uniformly deposited

What are we looking for?

- Total sediment volume
  - Geophysics can help constrain error

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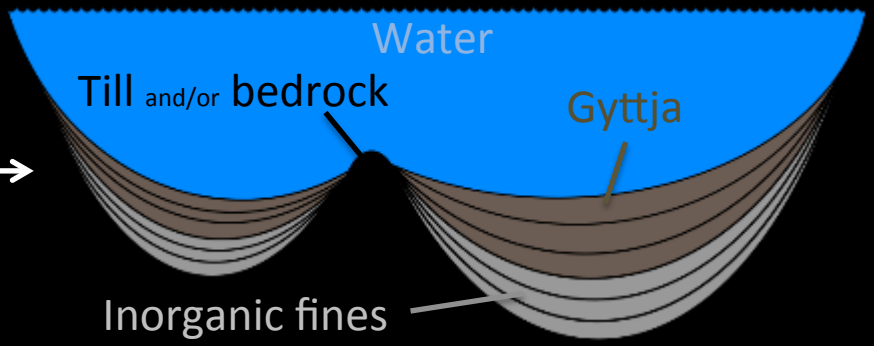

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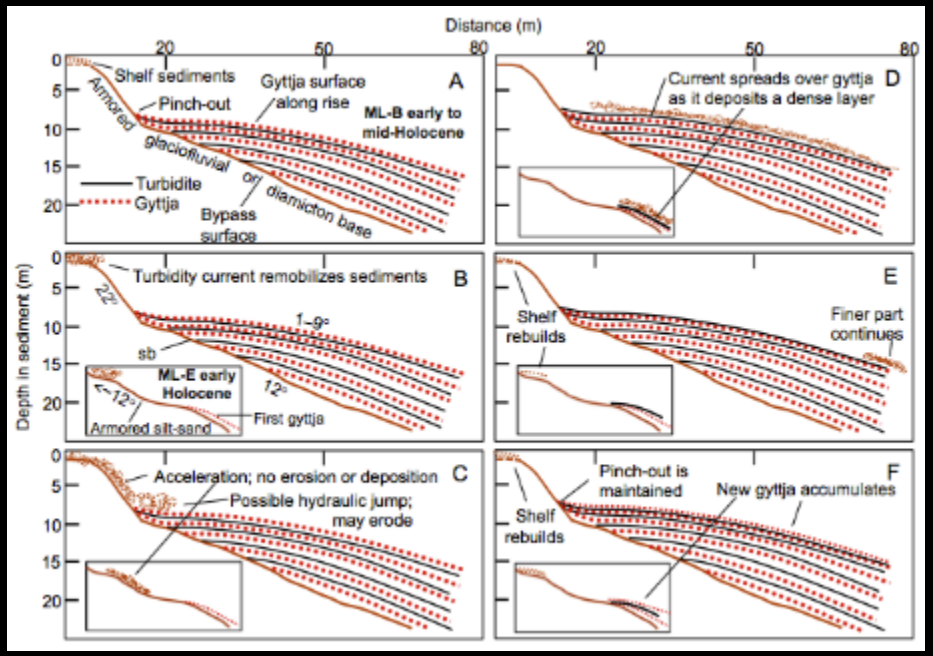
  - Resolve complex stratigraphy such as in Davis and Ford (1982) (Arcone, 2013)



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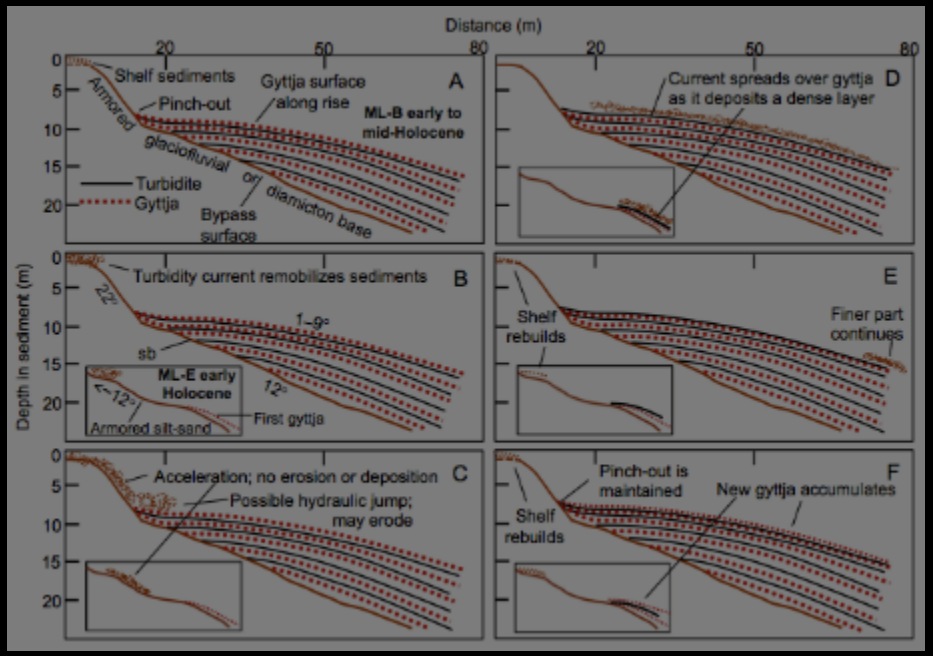
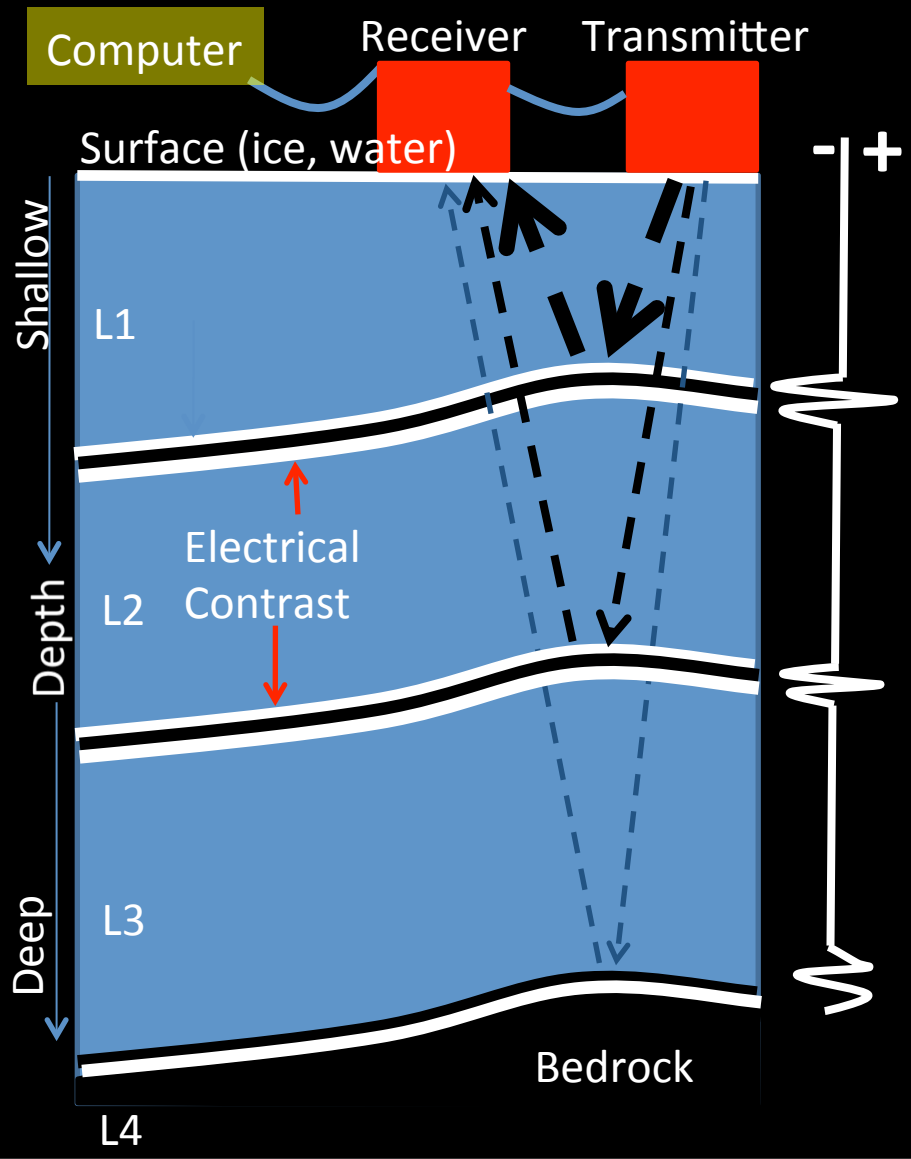


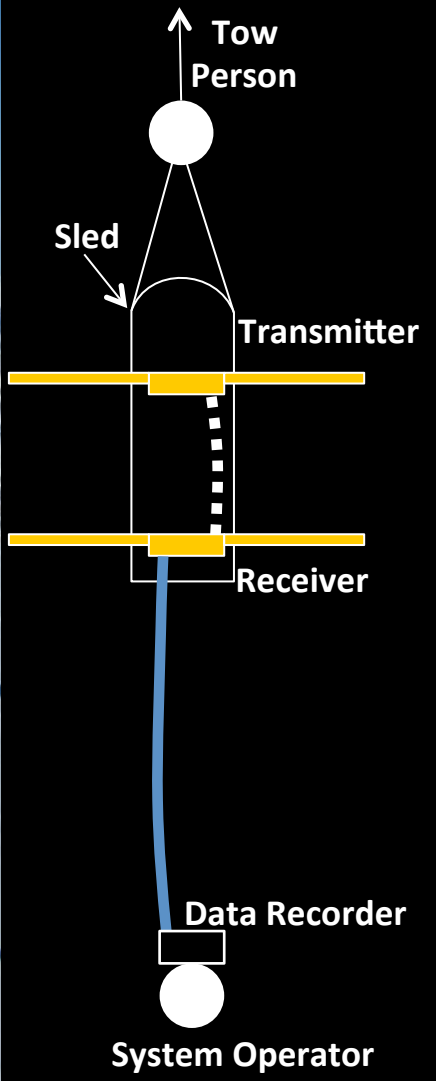
- Ultimately: Rates & Dates!
  - Periodic rate
    - Post-glacial
    - Anthropogenic
  - Bulk sediment yield rate

Questions

- What is the Holocene sedimentation rate in Penobscot Wshd / Maine / N. E.?
- Do Holocene and Anthropocene rates differ?
- Hypotheses:
  - Rates in Maine ≈ low
  - Humans have influence

Ground Penetrating Radar – The Basics



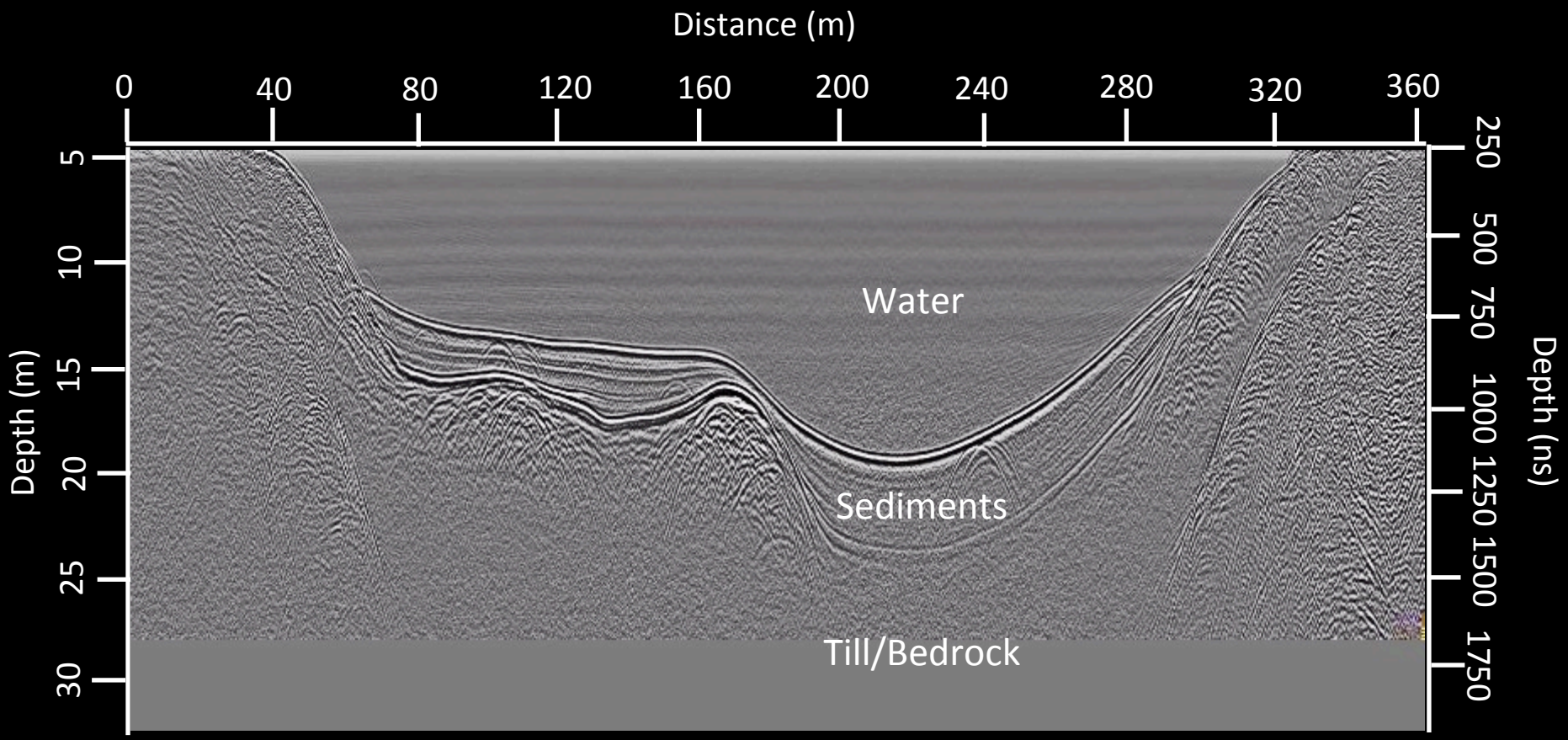


Lake GPR in Practice

Key points:

- Water conductivity
- Gas / organics

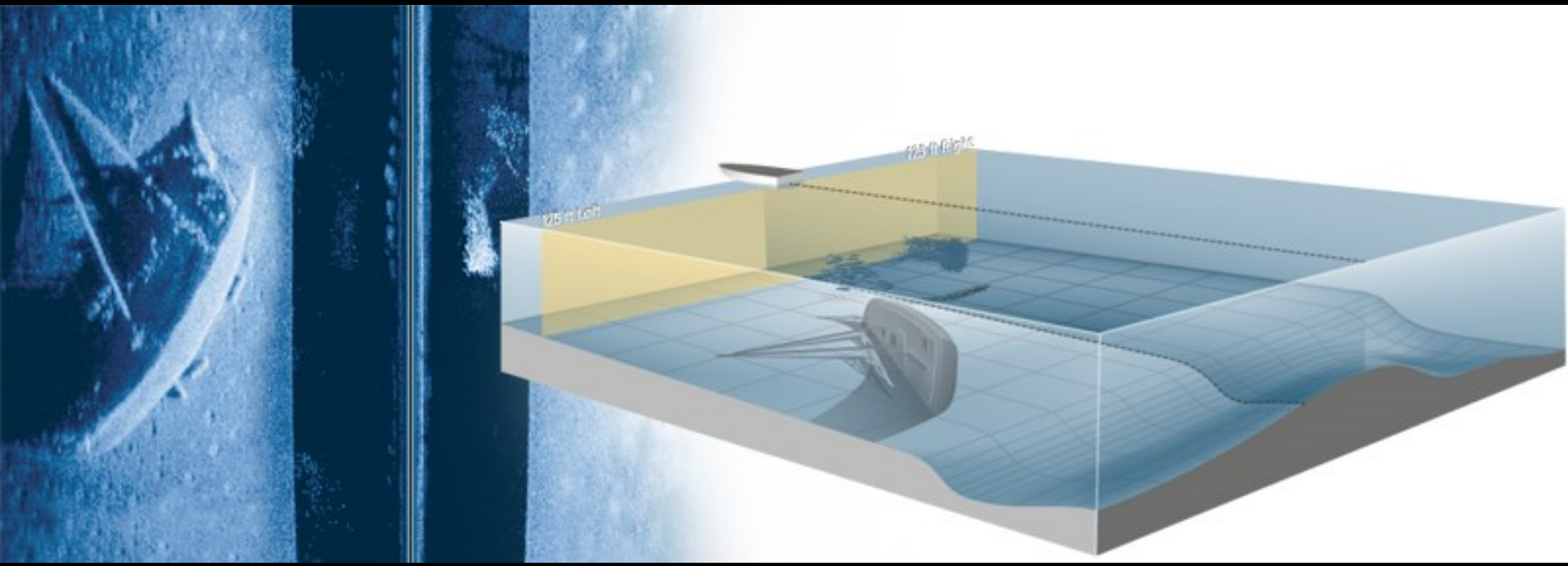
Ground Penetrating Radar – Data



Sidescan Sonar – The Basics

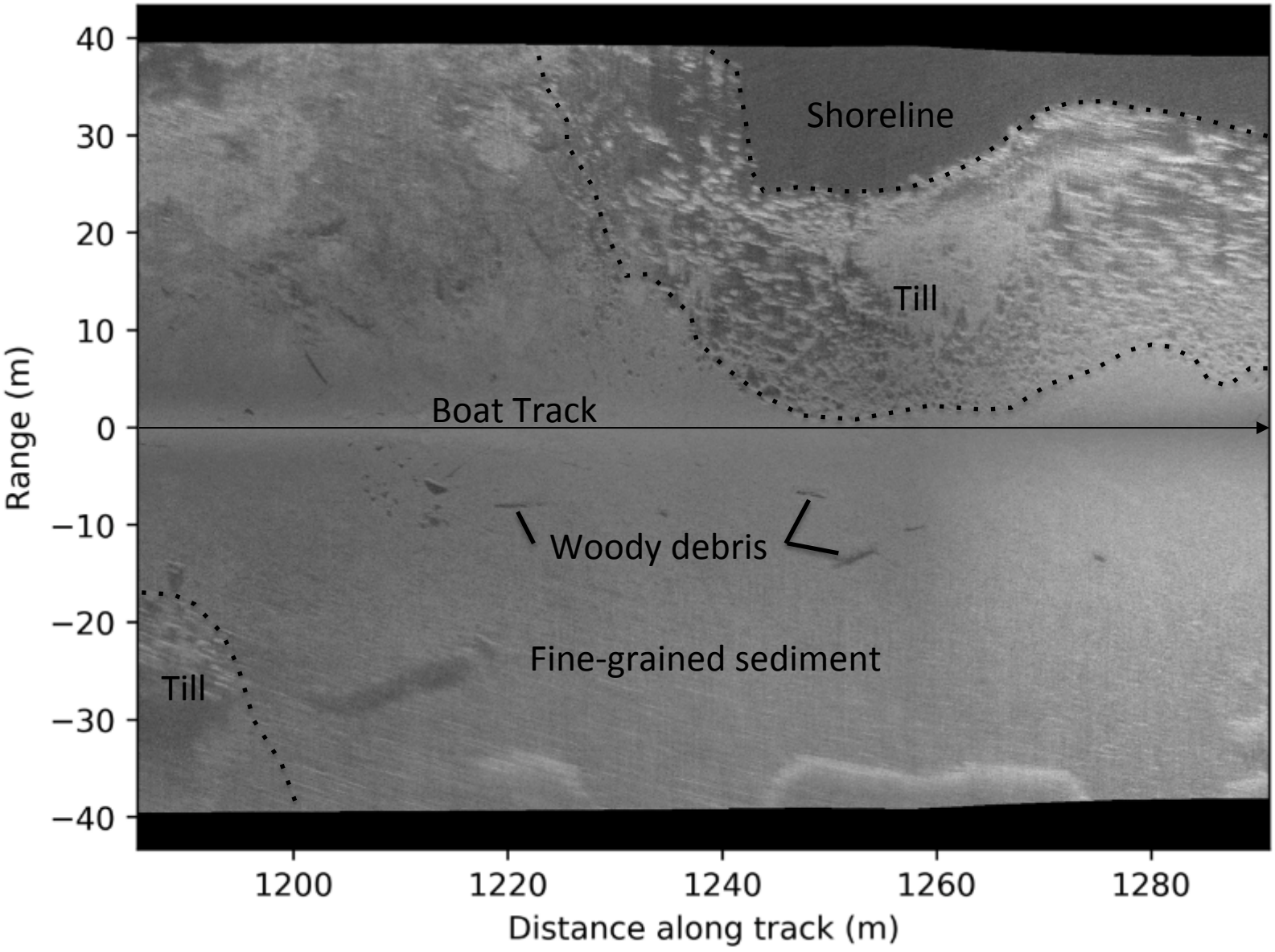
Key points:

- Brightness = reflectivity
- Texture changes

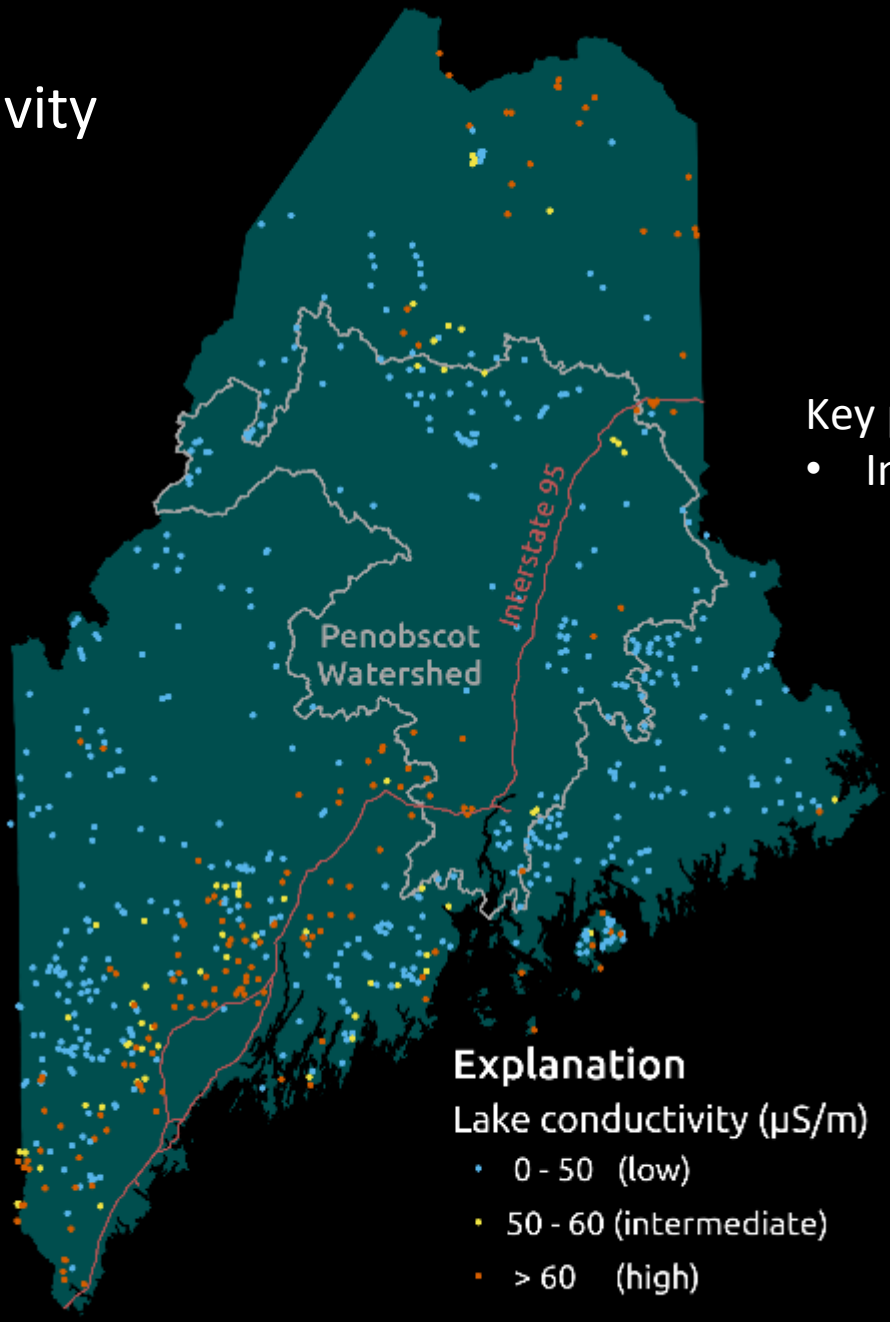


https://www.humminbird.com/Category/Technology/Side-Imaging/ (accessed 2017-10-04)

Sidescan Sonar – Data



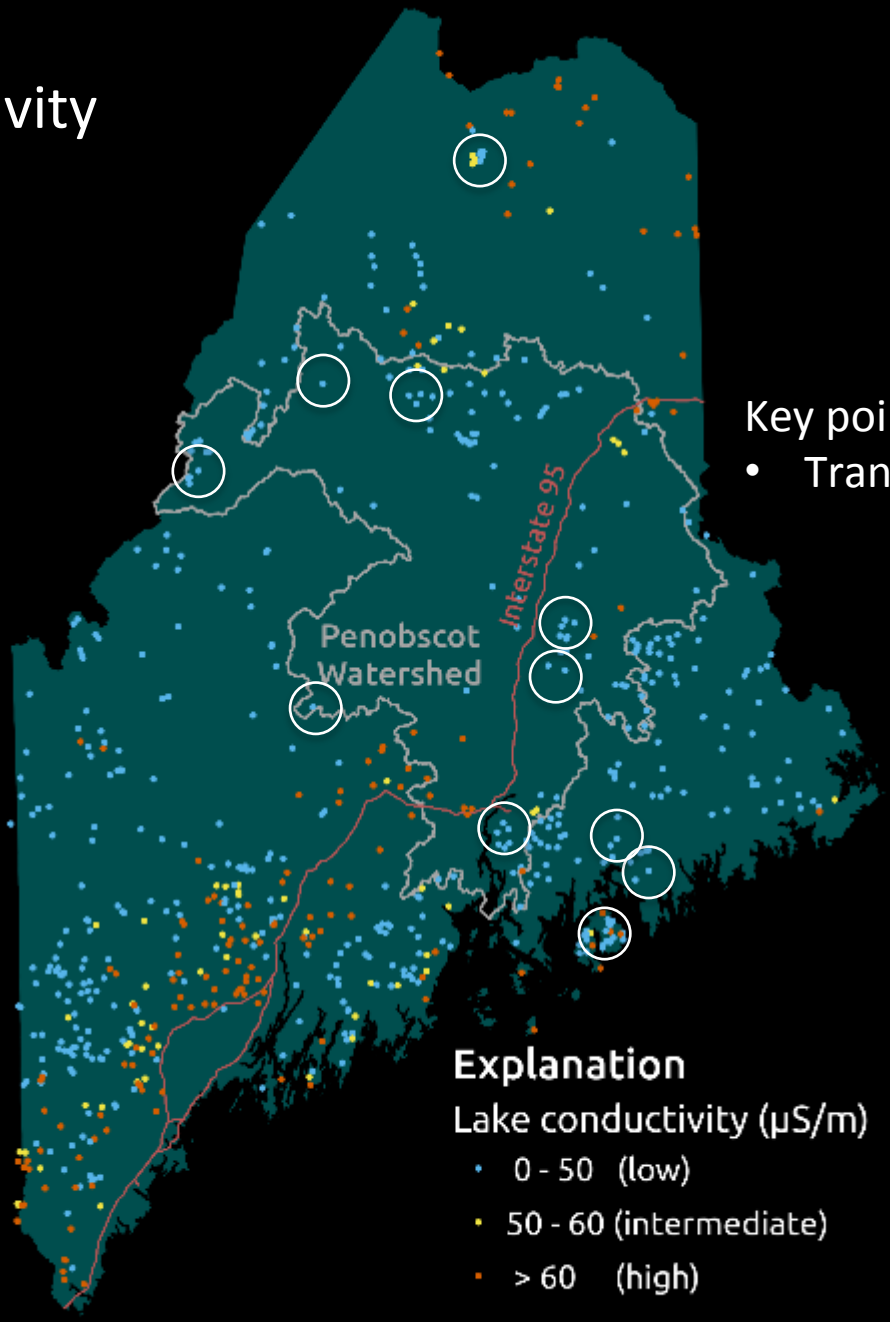
Setting - Conductivity



Key point:

- Influence of development

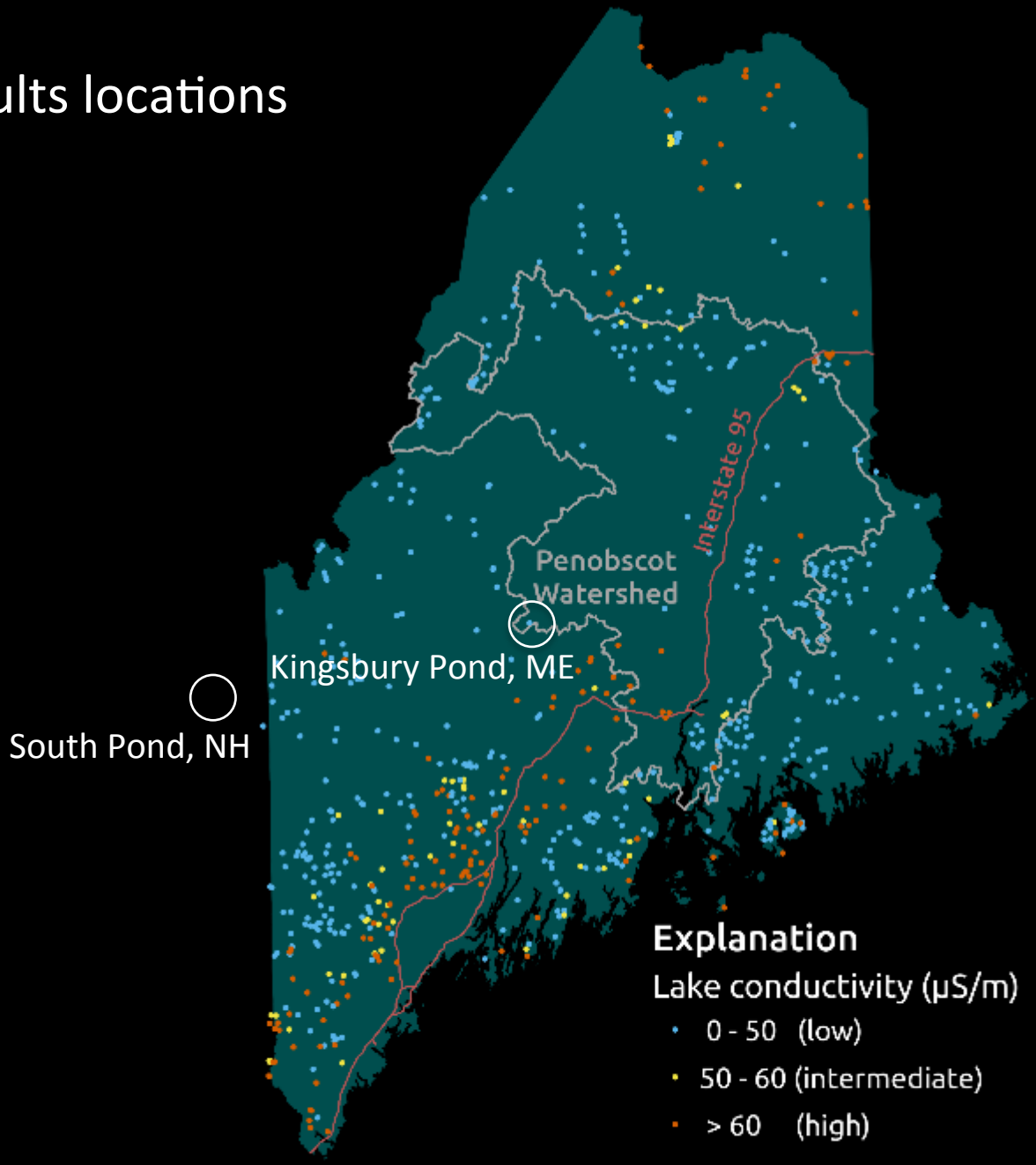
Setting - Conductivity



Key point:

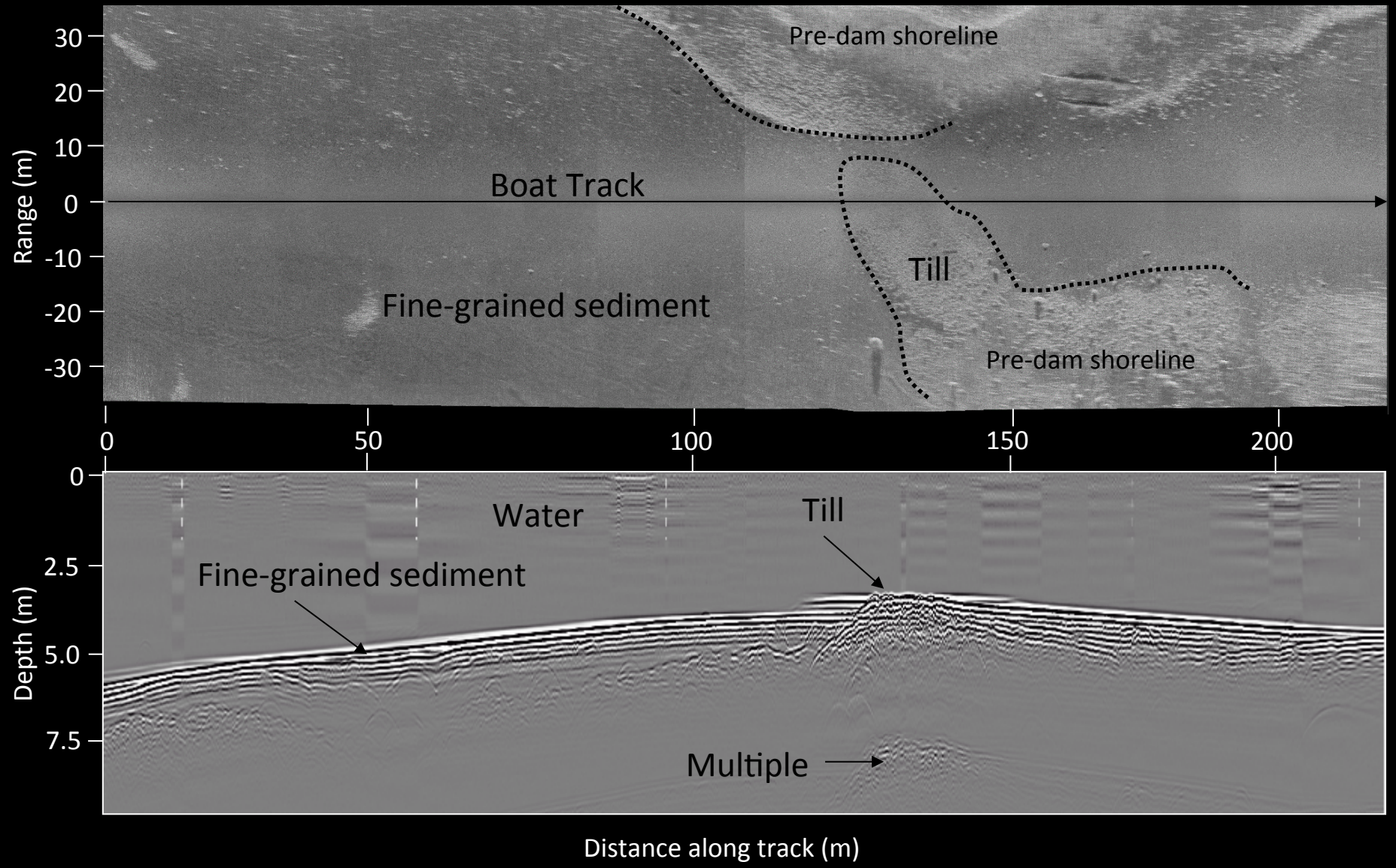
- Transect through deglaciation

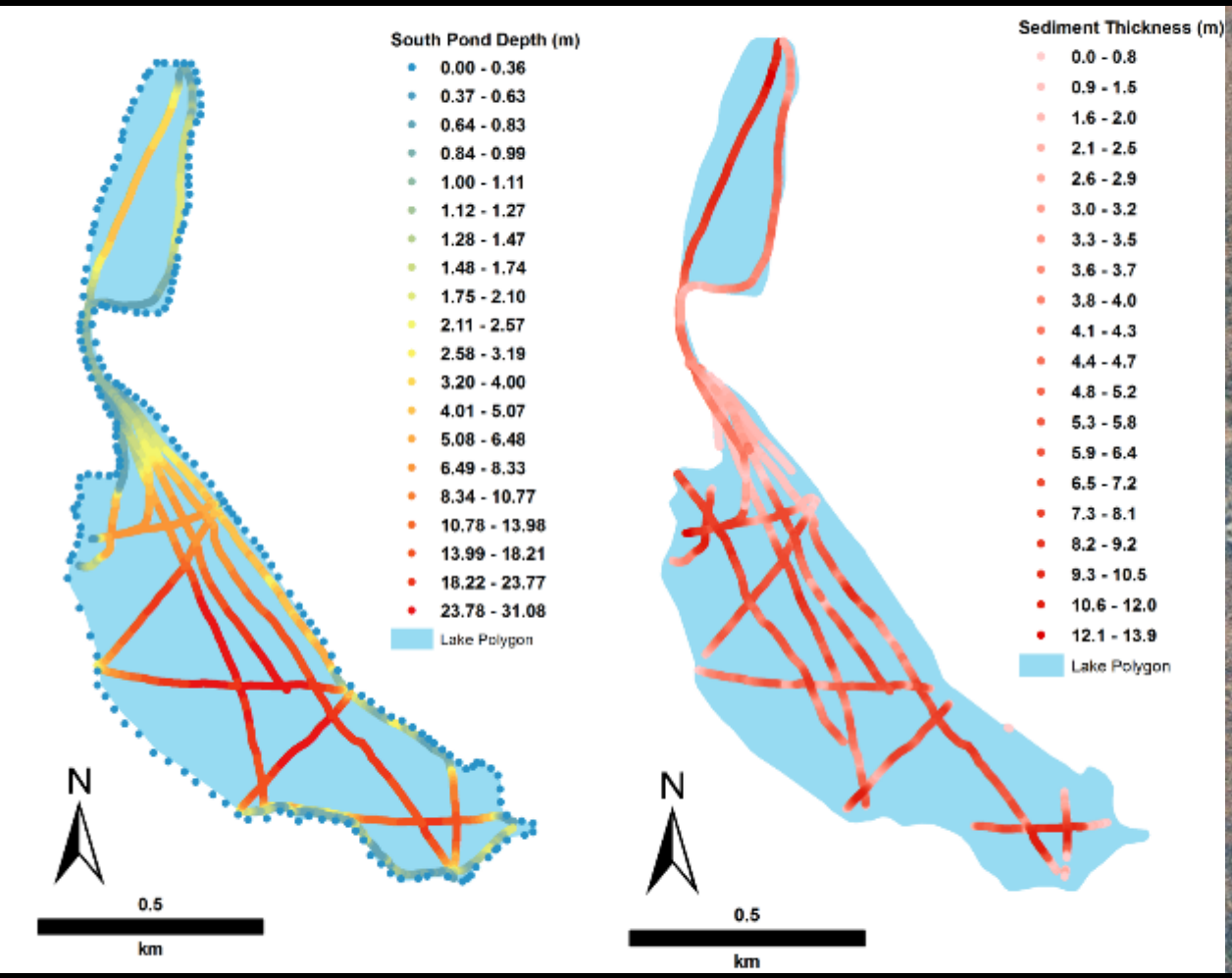
Results locations

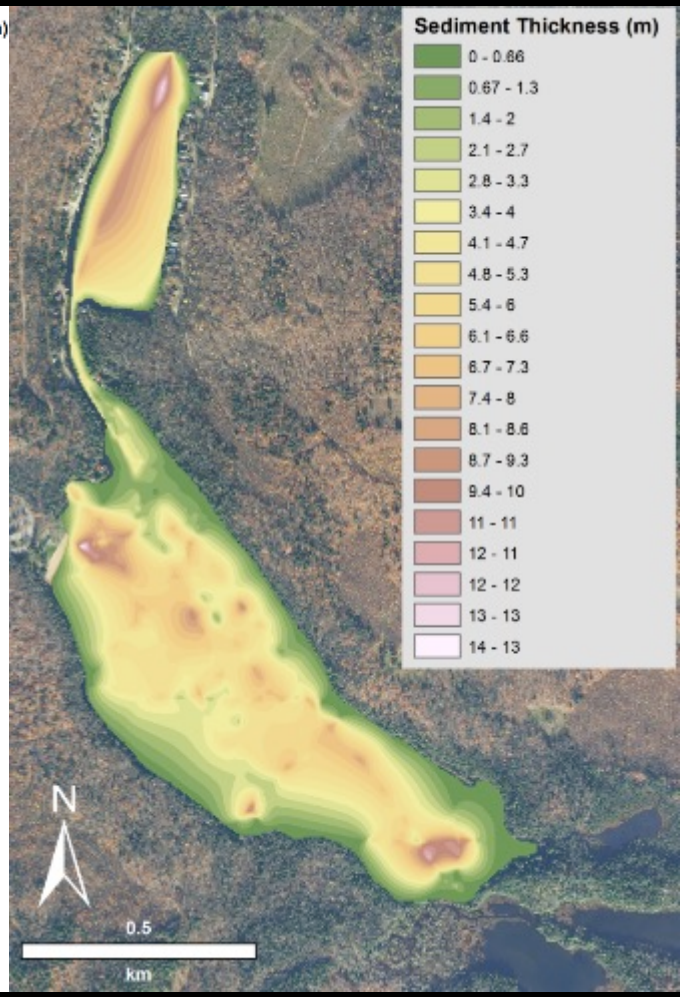


Key Points:

- Post-glacial E & D
- Anthropogenic/Post-industrial E & D







Key Points:

- Volume vs. point measurement for sedimentation rate
- Selecting core sites
- Source to Sink E&D Studies since LGM, industrial influence

Acknowledgements

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Stephen Norton

Katherine Allen

Cody Barnett


Questions?

References

Arcone, S.A., 2013, GPR Profiles of Mirror Lake, NH: Exceptional Signal Penetration in Low Conductivity Water and Subbottom Sedimentation, *in* American Geophysical Union, Fall Meeting 2013,.

Arcone, S.A. Sedimentary architecture beneath lakes subjected to storms: Control by turbidity current bypass and turbidite armouring, interpreted from GPR images: Sedimentology,.

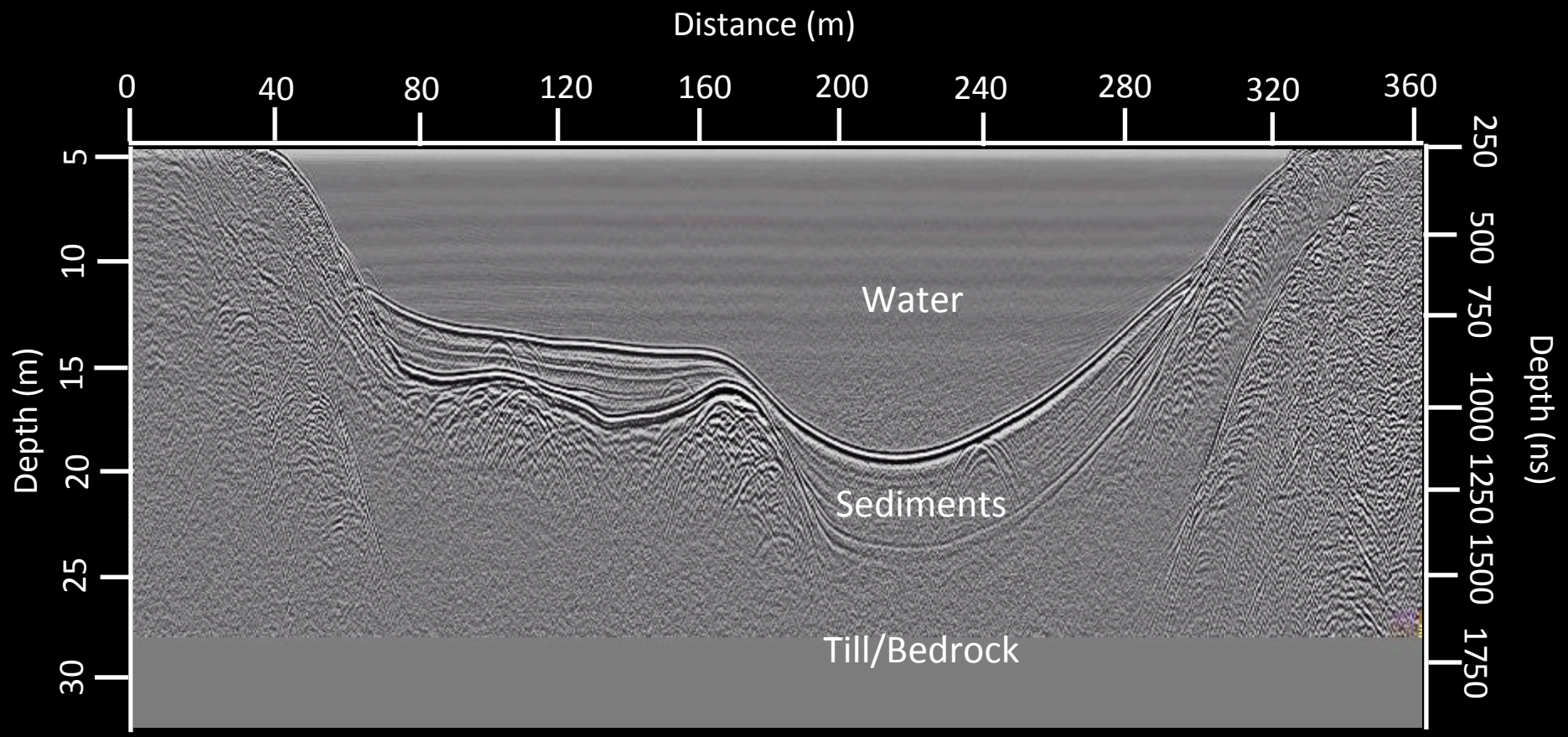
Borns, H.W., Doner, L.A., Dorion, C.C., Jacobson, G.L., Kaplan, M.R., Kreutz, K.J., Lowell, T. V., Thompson, W.B., and Weddle, T.K., 2004, The deglaciation of Maine, U.S.A., *in* Developments in Quaternary Science, v. 2, p. 89–109, doi: 10.1016/S1571-0866(04)80190-8.

Buscombe, D., Grams, P.E., and Smith, S.M., 2016, Automated Riverbed Sediment Classification Using Low-Cost Sidescan Sonar: Journal of Hydraulic Engineering, v. 142, p. 1–7, doi: 10.1061/(ASCE)HY.1943-7900.0001079.

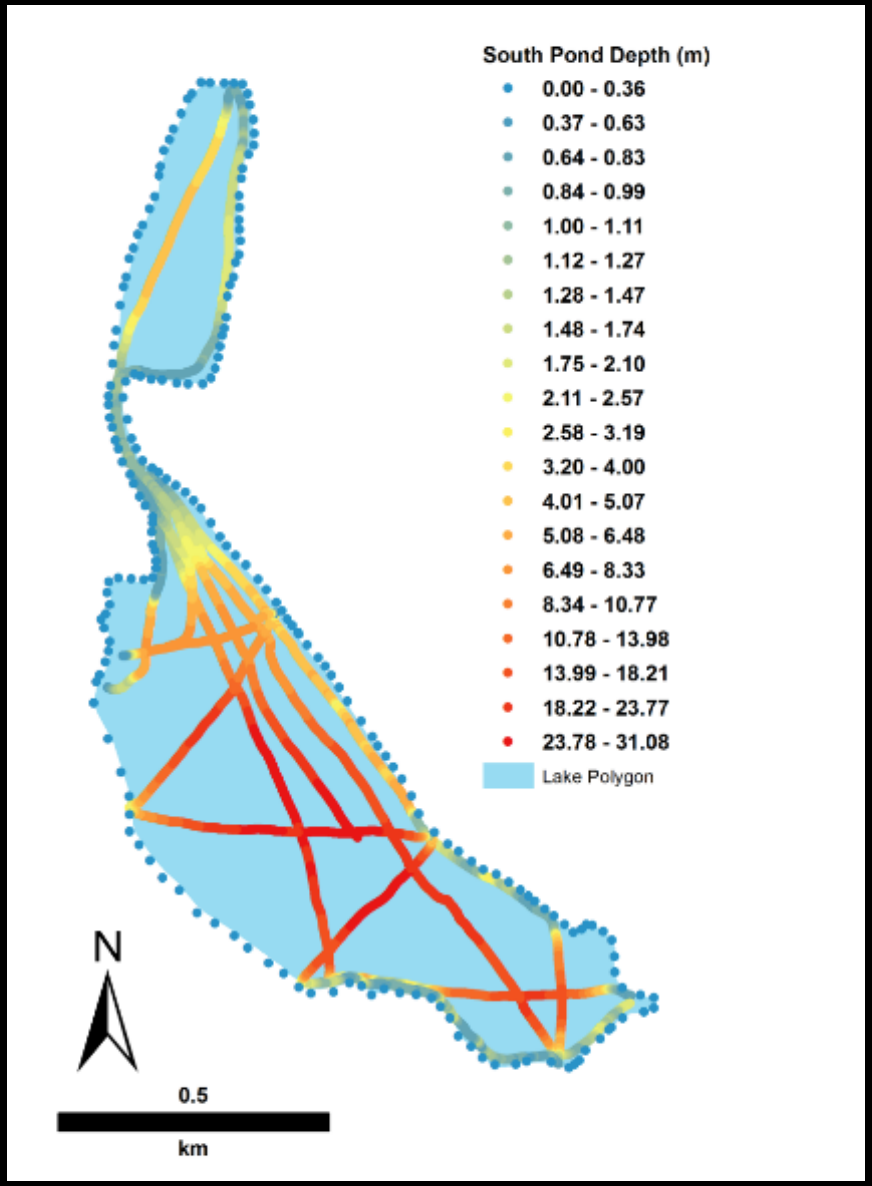
Davis, M.B., and Ford, M.S. (Jesse), 1982, Sediment focusing in Mirror Lake, New Hampshire: Limnology and Oceanography, v. 27, p. 137–150, doi: 10.4319/lo.1982.27.1.0137.

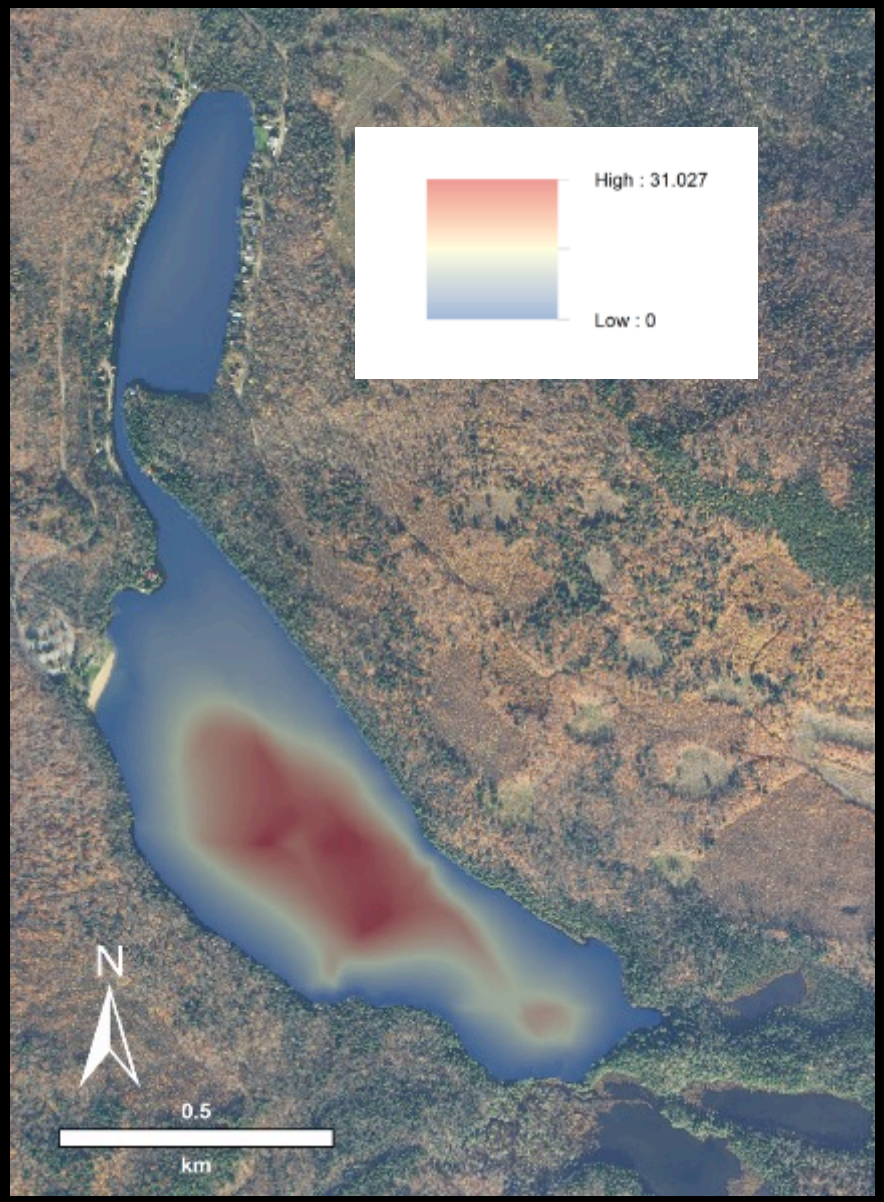
Johnson Outdoors Marine Electronics Inc, 2017, Humminbird Side Imaging:, https://www.humminbird.com/Category/Technology/Side-Imaging/ (accessed October 2017).

Smith, S.M., and Wilcock, P.R., 2015, Upland sediment supply and its relation to watershed sediment delivery in the contemporary mid-Atlantic Piedmont (U.S.A.): Geomorphology, v. 232, p. 33–46, doi: 10.1016/j.geomorph.2014.12.036.

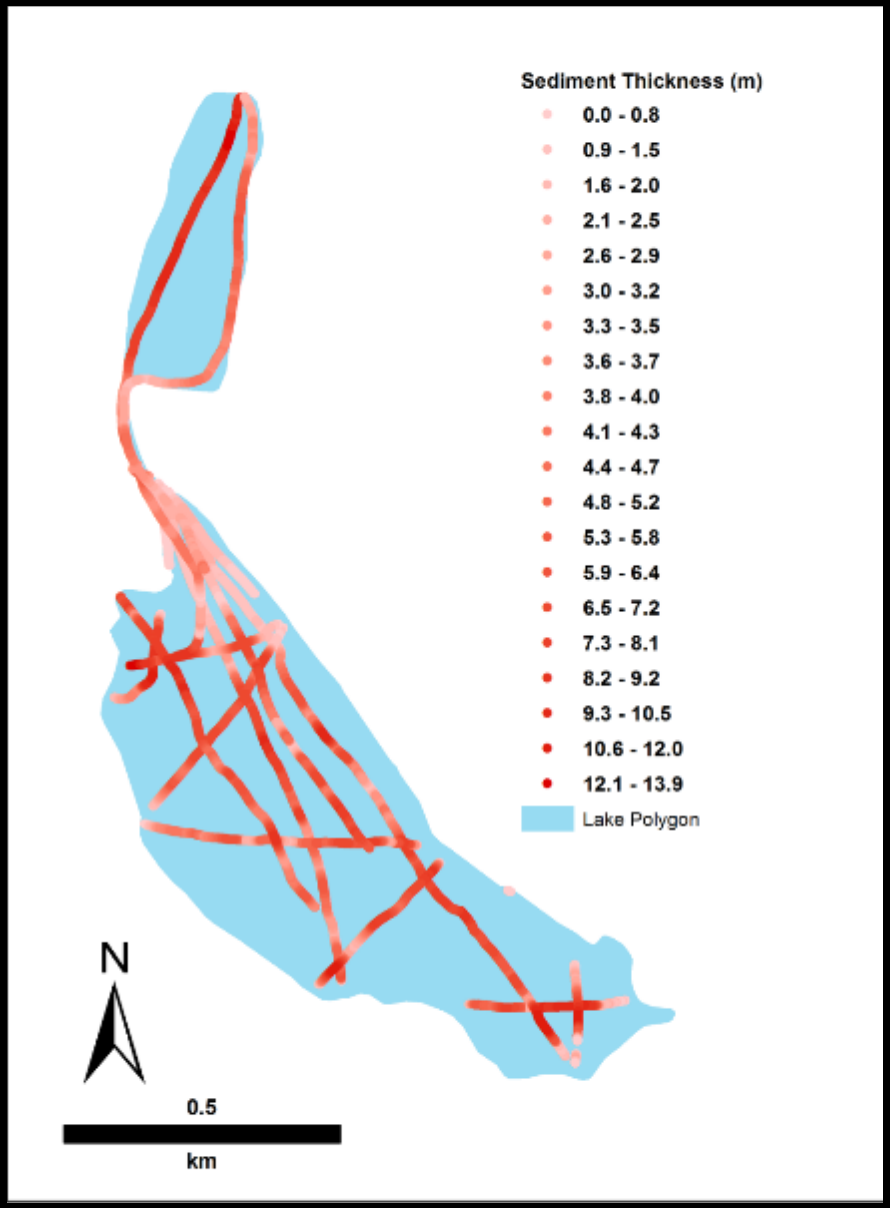

Distance (m)
0
40
80
120
160
200
240
280
320
360
Depth (m)
5
10
15
20
25
30
Depth (ns)
250
500
750
1000
1250
1500
1750
Water
Sediments
Till/Bedrock

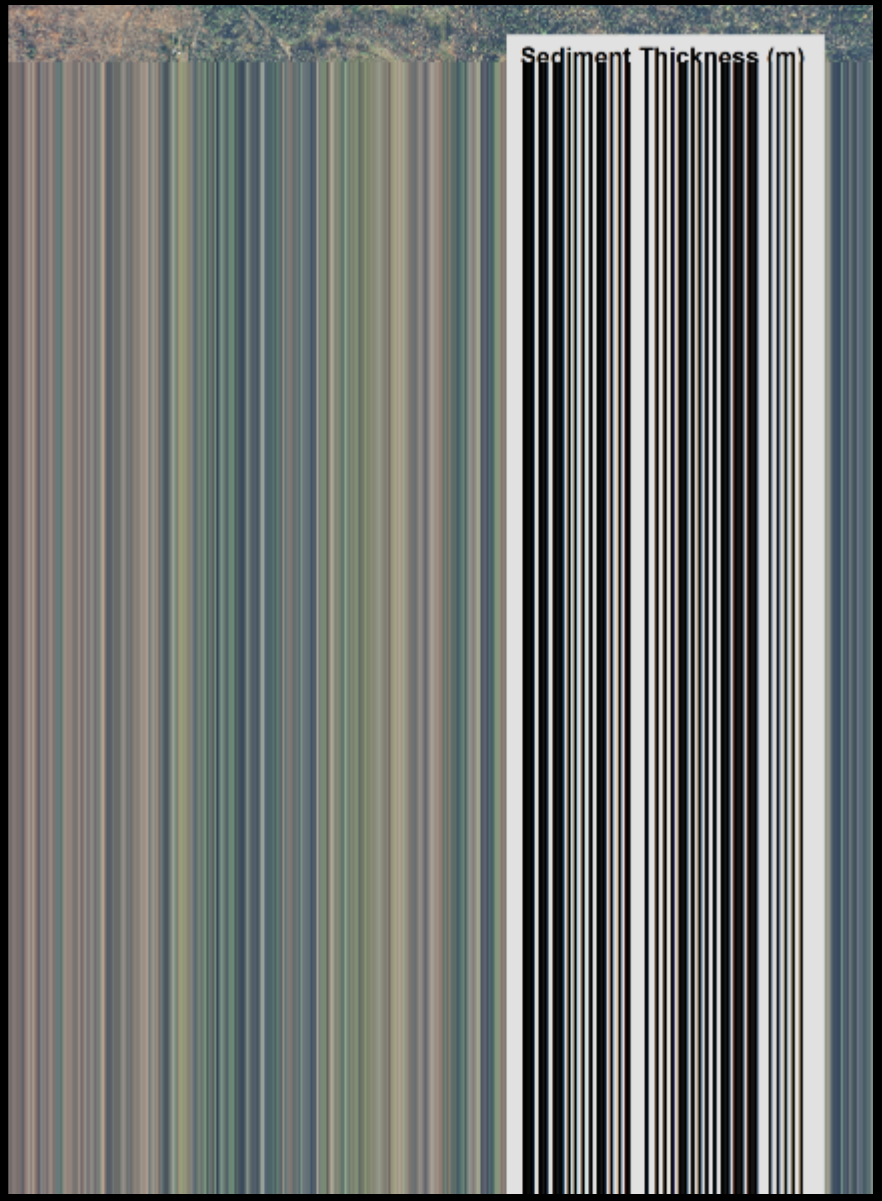
South Pond – NH
Depth





South Pond – NH
Thickness





South Pond – NH
Uncertainty