



Suncook River – Providing Resiliency Following a Channel-Changing Flood Event

New Hampshire Water & Watersheds Conference
March 18, 2016



Outline

- Study area and avulsion
- Project initiation and fundraising
- Designs, construction, costs

Study Area – Epsom, NH



Background

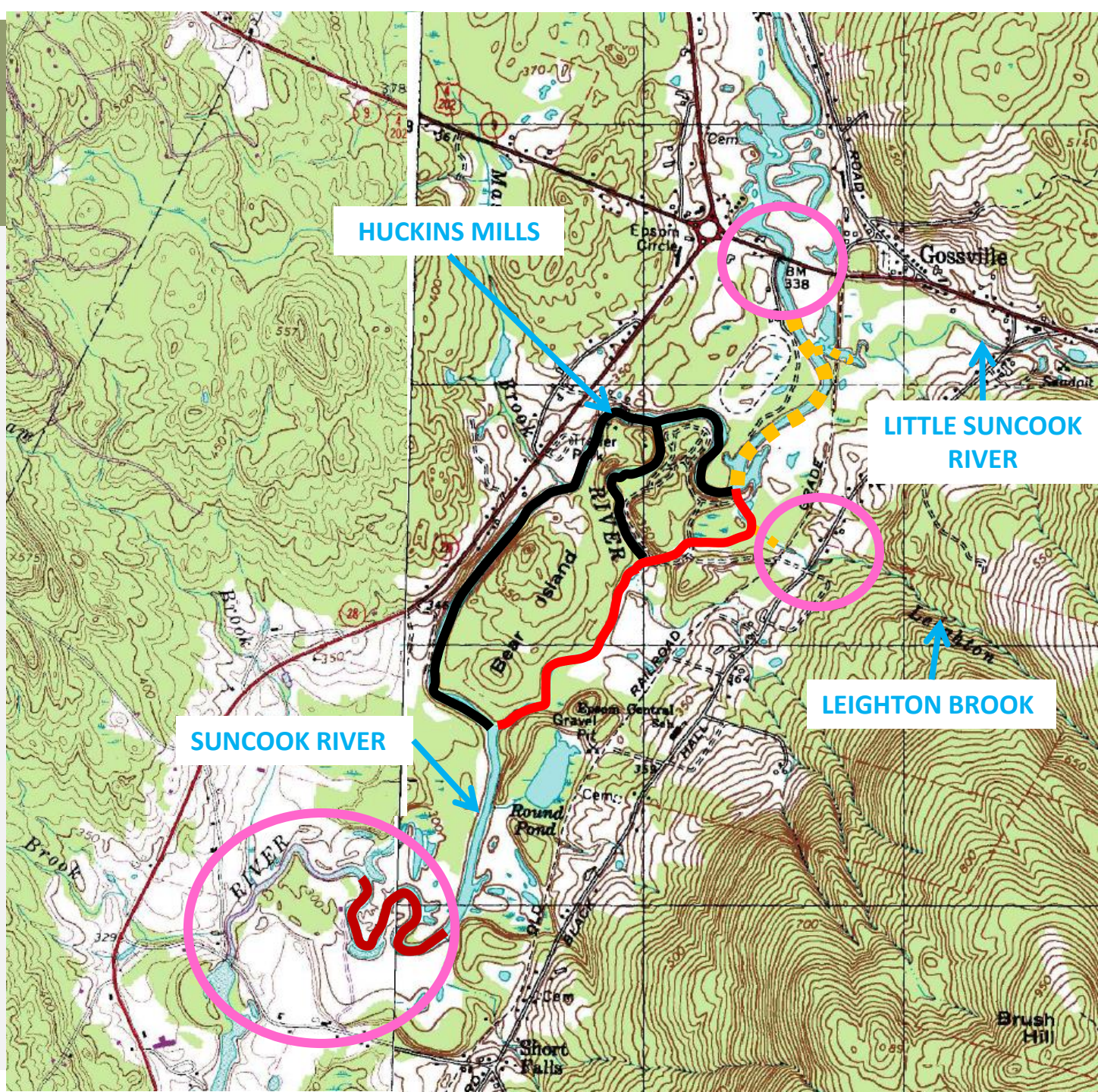
Channel Avulsion

Channel Abandonment

Migrating Knickpoints

Aggradation

Infrastructure



1992



2011



2006 – Day after Flood

Suncook River Flow



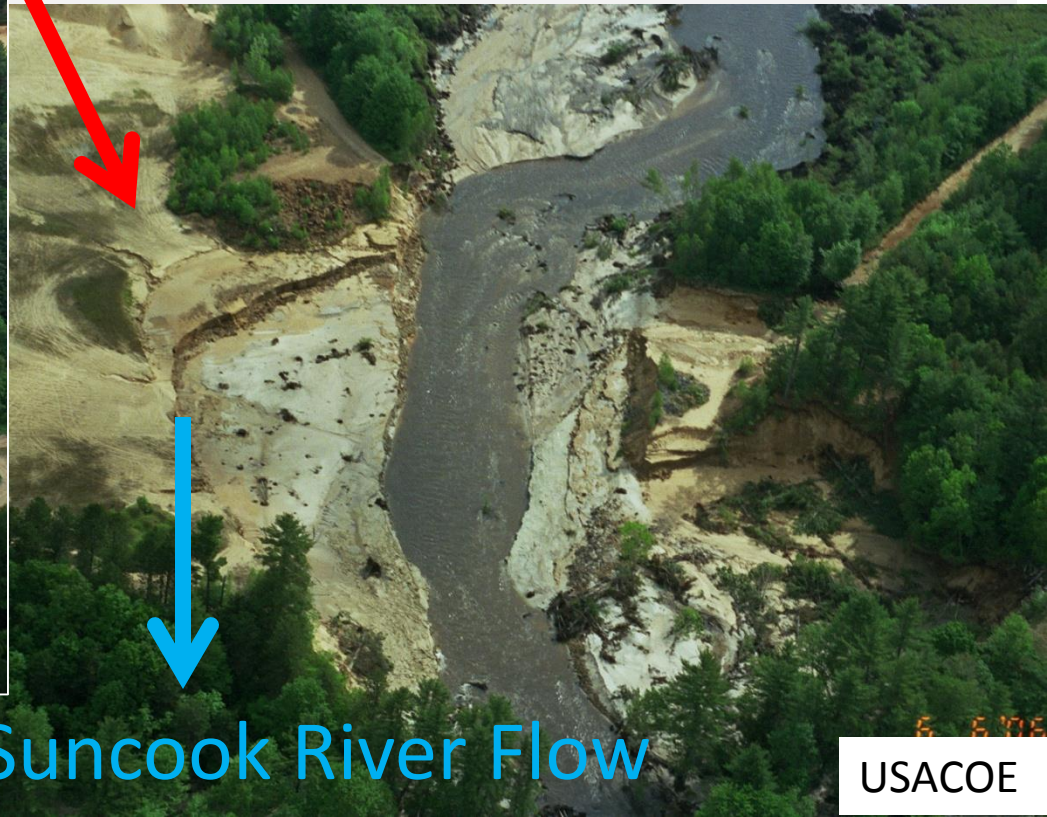
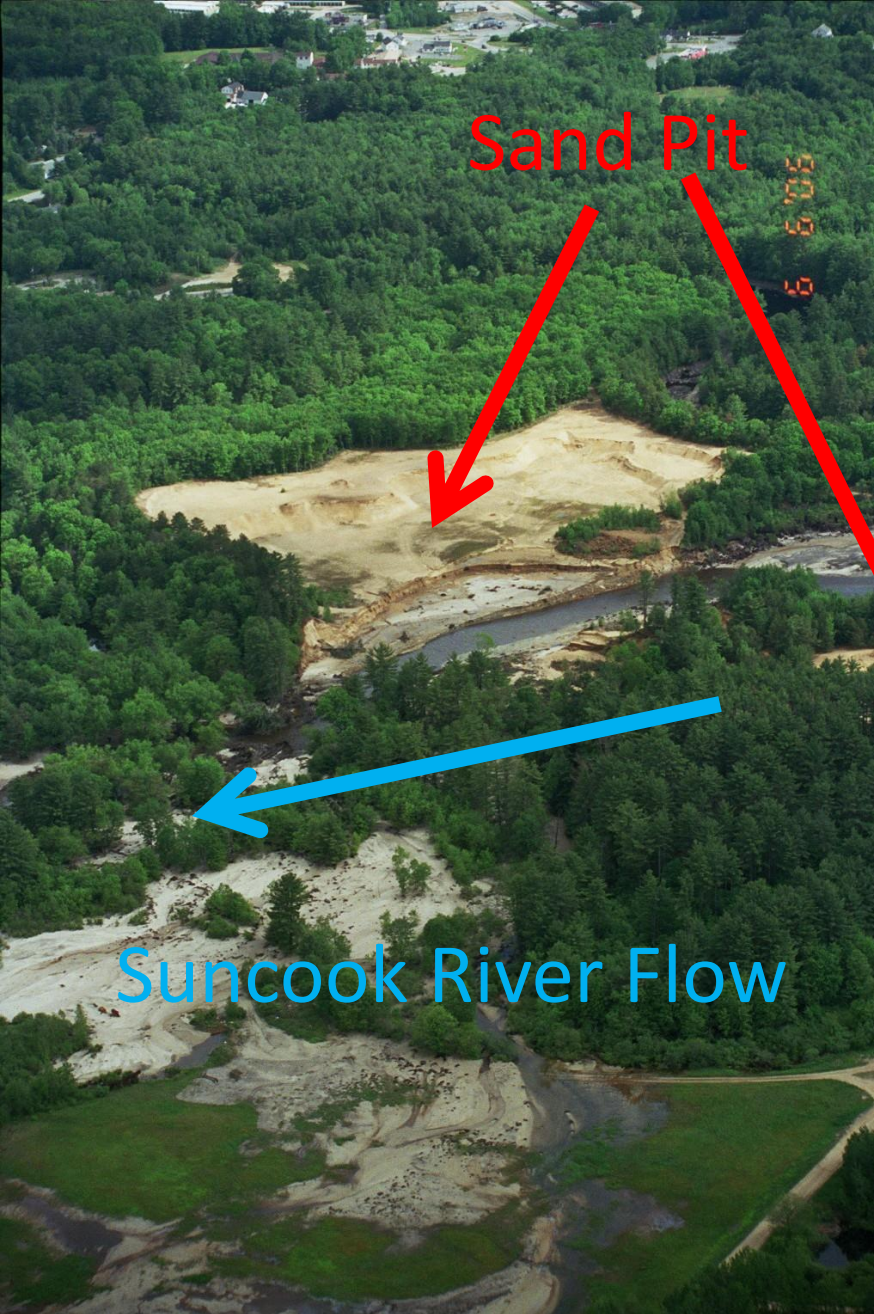
Avulsion Site



Former Channel



2006 – Day after Flood



2006 – Day after Flood

Suncook
River Flow



Leighton Brook



6 6 '06

2006 – Day
after Flood



Downstream
Deposition



Current Conditions

Glacial Lag Deposits Surrounded by Sand



Incision and Widening on Leighton Brook



Former Channel
Elevation

Infrastructure



Black Hall Rd - Leighton Brook



Rt 4 Bridge - Suncook River



Buildings - Leighton Brook

Project Goals

- Protect bridge infrastructure
 - Rt 4 bridge over Suncook River
 - Black Hall Rd bridge over Leighton Brook
- Control upstream migration of knickpoints on Suncook River and tributaries
- Control channel widening

Project Initiation and Fundraising



Project Initiation and Fundraising



Project Initiation and Fundraising



05/19/2006 10:20

Project Initiation and Fundraising



2006

- NHDES Geological Survey conducts post-avulsion baseline survey
- \$8,000

Landscape Response to Rapid Incision: The 2006 Suncook River Avulsion

Chad Wittkop, Chemistry and Geology, Minnesota State University, Mankato, MN, and Pat Dryer, Geography, University of Wisconsin, Eau Claire, WI



Background and Study Area

Map showing the Suncook River and its avulsion channel. The main channel is shown in blue, and the avulsion channel is shown in red. The map includes a north arrow and a scale bar.

Geology

Geological cross-section showing the Suncook River and its avulsion channel. The map shows the river channel and the avulsion channel. The legend includes: Over a 100 ft thickness, massive and argillaceous, with micaceous and shaly nodules; Mottled, micaceous, silty sandstone, brownish, low-angle bedding; Shaly, micaceous, silty sandstone, brownish, low-angle bedding; Shaly, micaceous, silty sandstone, brownish, low-angle bedding; Shaly, micaceous, silty sandstone, brownish, low-angle bedding; Shaly, micaceous, silty sandstone, brownish, low-angle bedding; Shaly, micaceous, silty sandstone, brownish, low-angle bedding.

Avulsion Cause and Effects

Diagrams and photos showing the avulsion cause and effects. The diagrams illustrate the avulsion process and the effects on the river channel. The photos show the river channel and the avulsion channel.

Discussion: Signatures of Rapid Incision

Map and photos showing the signatures of rapid incision. The map shows the river channel and the avulsion channel. The photos show the river channel and the avulsion channel.

A. (2005)

Aerial photo of the Suncook River in 2005. The river channel is shown in blue, and the avulsion channel is shown in red.

B. (2007)

Aerial photo of the Suncook River in 2007. The river channel is shown in blue, and the avulsion channel is shown in red.

Suncook River

Cross-section A and B of the Suncook River. The graphs show the elevation of the river channel and the avulsion channel. The x-axis is Horizontal Distance (Feet) and the y-axis is Elevation Above Sea Level (Feet).

Minnesota River Valley

Cross-section of the Minnesota River Valley. The graph shows the elevation of the river channel and the avulsion channel. The x-axis is Horizontal Distance (Feet) and the y-axis is Elevation Above Sea Level (Feet).

References

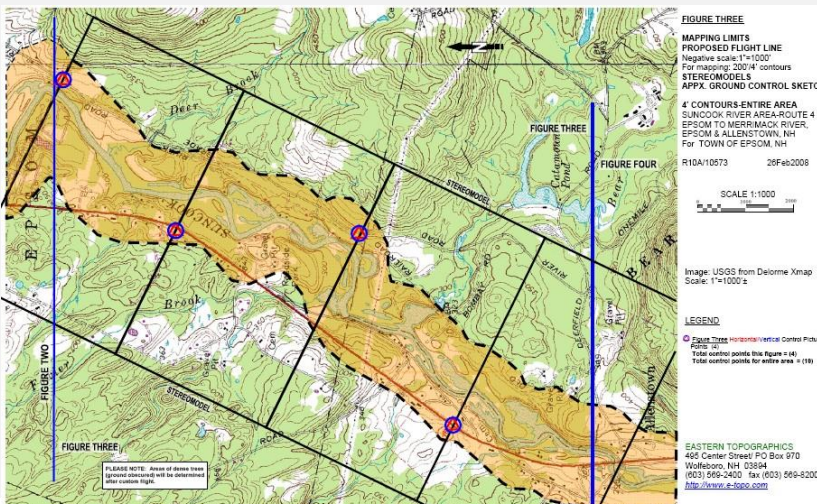
List of references for the study.

Acknowledgements

Acknowledgements for the study.

2007

- NHDES and U.S. EPA Section 319 Grant - \$24,000
- Non-federal match of \$16,000 from Town of Epsom
- FEMA awards \$275,000 to USGS for flood recovery mapping
- FEMA awards \$134,424 to DES for 2' contour aerial mapping
- USGS commits \$13,800 to install new stream gage



Sediment Transport Characterization and Flood Recovery Mapping of the Suncook River in Epsom, Pembroke and Allenstown, New Hampshire

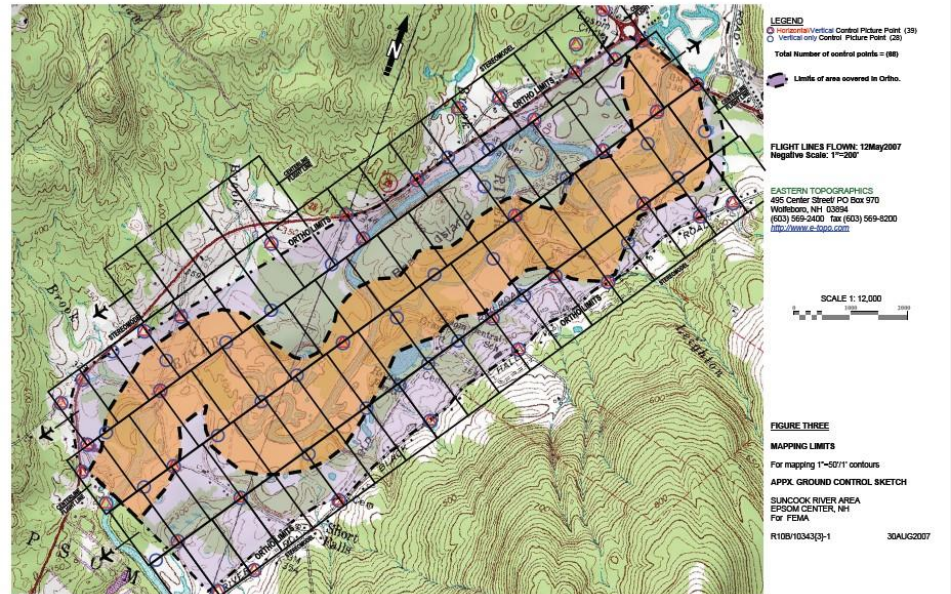


USGS
science for a changing world

Suncook River Public Informational Meeting
March 26, 2008
Robert Flynn PE, Hydrologist, rflynn@usgs.gov
NH-VT Water Science Center

2008

- FEMA commits \$37,360 for 4' aerial imagery from Epsom to the Merrimack River
- FEMA awards \$2,000,000 for home acquisition applications in Allenstown



2009

- DES works with Town of Epsom on grant application for NHSCC Moose Plate program- \$100,000 SECURED
- DES applies for \$3.8 million to FEMA for Pre-disaster Mitigation Grant – DENIED
- Moose Plate Grant withdrawn from Town due to PDM grant award denial.



New Hampshire State Conservation Committee
P.O. Box 3907
Concord, NH 03302



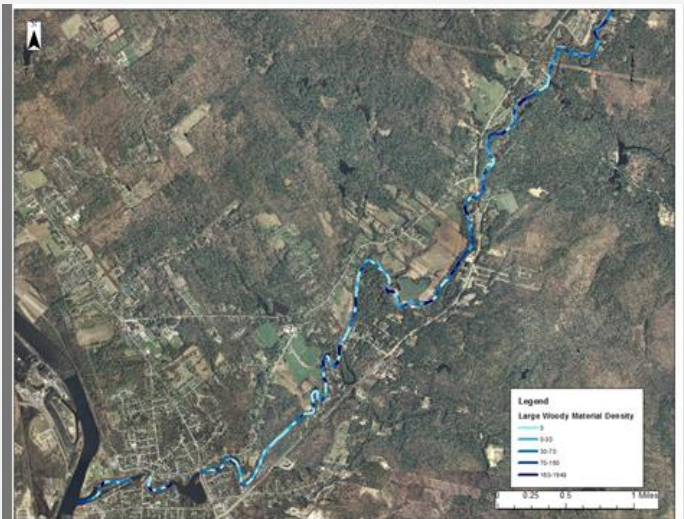
FEMA Mitigation eGrants

System Training

**Subgrant Applicant
Quick Reference Guide**

2010

- State of NH Capital Appropriation - \$850,000 Design/Engineering/Permitting/Construction
- State of NH Capital Appropriation - \$185,000 Fluvial Erosion Hazard Zone Delineation and mobile wood inventory by DESGS



2010

- Department of Safety award of \$55,000 to Central NH Regional Planning Commission.

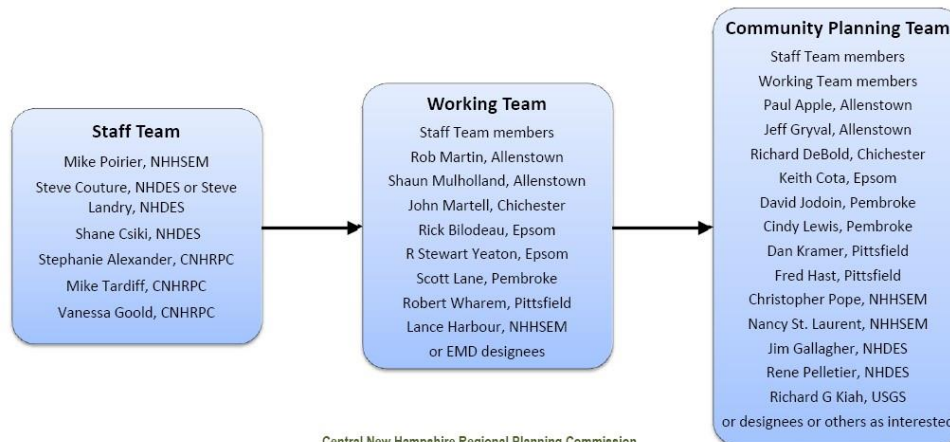
Suncook River Community Planning Team and its Support Teams

January 18, 2011

Narrative Description

1. **Staff Team**, comprised of NHHSEM, NHDES, and CNHRPC staff. This group will be working on the ground to facilitate the completion of these tasks.
2. **Working Team**, comprised of the Staff Team plus the Emergency Management Directors/emergency responders of the 4 communities. This group will provide direction and support to the Staff Team, helping to set priorities and working together to ensure that the communities' needs are met.
3. **Community Planning Team**, comprised of the Staff Team, Working Team, other NHHSEM and NHDES staff members, and the community representatives including Boards of Selectmen and Town Administrators, which is the full group. This group will provide the overall oversight and make the policy decisions which guide the efforts of the Working Team and the Staff Team.

Flow Chart



Central New Hampshire Regional Planning Commission

28 Commercial Street, Suite 3 Concord, NH 03301 ❖ www.cnhrpc.org ❖ 226-8020 ❖ salexander@cnhrpc.org

01-04-11

Suncook River Community Planning Team Tasks

Item	Task	Town(s)	Description/Key Steps
Mid-range Solutions – have steps that could begin within 12 months but completion of the entire project may take longer			
Q	Prevent avulsion of Round Pond	Epsom	See also G & Q.
R	Mitigate the potential for damage to the Epsom well house	Epsom	Damage to the Town well house could result from a Round Pond breach. The Town could add this project to the Hazard Mitigation Plan. A project could be to dry-flood proof the well with a floodwall around pumphouse and aluminum stoplogs inserted during flooding events. The well is located in the Epsom Village Water District. See also G.
S	Stop head-cutting of the Route 4 bridge	Chichester	DOT is involved in the installation of grate-control structures to help stop the head-cutting.
T	Remove hazardous debris (that could exacerbate damage during a flood) from the Suncook River channel and banks	Allenstown Chichester Epsom Pembroke	Debris is throughout the River and keeps flowing down stream. Agencies should meet to determine if easements are possible from private landowners to remove the debris. Identify the critical areas where debris will cause problems. Permits will be needed.
U	Develop plan/pass legislation that would allow state to pay non-federal share of mitigation grants with a condition that towns be able to pay the amount back through some type of tax process	Epsom	Develop plan/pass legislation that would allow state to pay non-federal share of mitigation grants with a condition that towns be able to pay the amount back through some type of tax process
Long Term Solutions – completion clearly long-term and/or may require critical steps/studies to be conducted to determine if such a solution is even feasible			
V*2	Update Floodplain delineation maps	Allenstown Chichester Epsom Pembroke	Incorporate the new USGS floodplain data layer into FEMA floodplain maps.
W*2	Stabilize the banks of the river in certain places to protect critical infrastructure		Stabilize the banks of the river in certain places to protect critical infrastructure
X	Dredge/remove sediment		Dredge/remove sediment
Y	Mitigate the potential for damage from ice jams against bridges		Cold River Research Lab (federal) will conduct field research and develop reports if needed.
Z	Establish a "Suncook River Advisory Commission"		The Suncook River Team wants to establish a group something similar to other river advisory commissions.

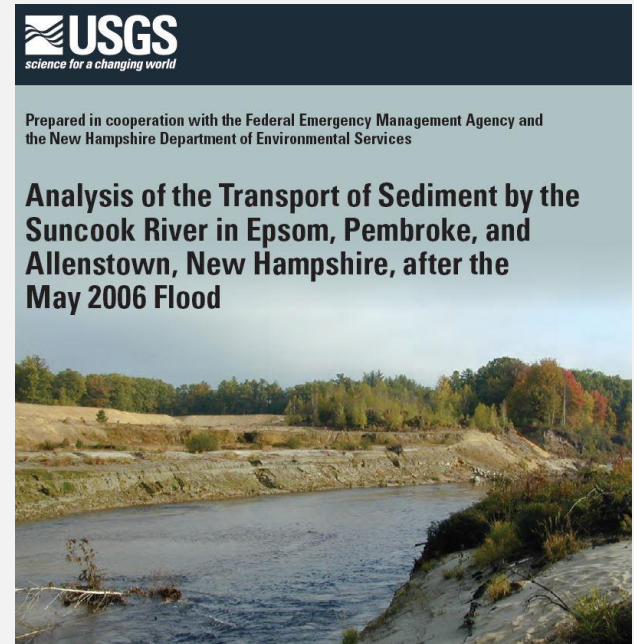
2010

- 2nd PDM grant request of \$2.4 million denied
- DES secures \$200,000 to remove Buck Street Dam
- \$336,000 SEPP penalty mitigation secured for Suncook



2011

- State of NH Capital Appropriation - \$2,000,000 for property acquisition and hazard mitigation secured
- Dept. of Safety awards \$450,000 for geotechnical survey, design, and permitting
- Inter-Fluve Inc. under contract!
- USGS publishes Sediment Transport Study



2012 - 2014

- \$1.7 million NFWF grant request from DES denied
- Capital appropriation of \$1.8 million secured by DES
- Designs from IFI lead to all permits being secured for proposed work on Suncook and Leighton Brook

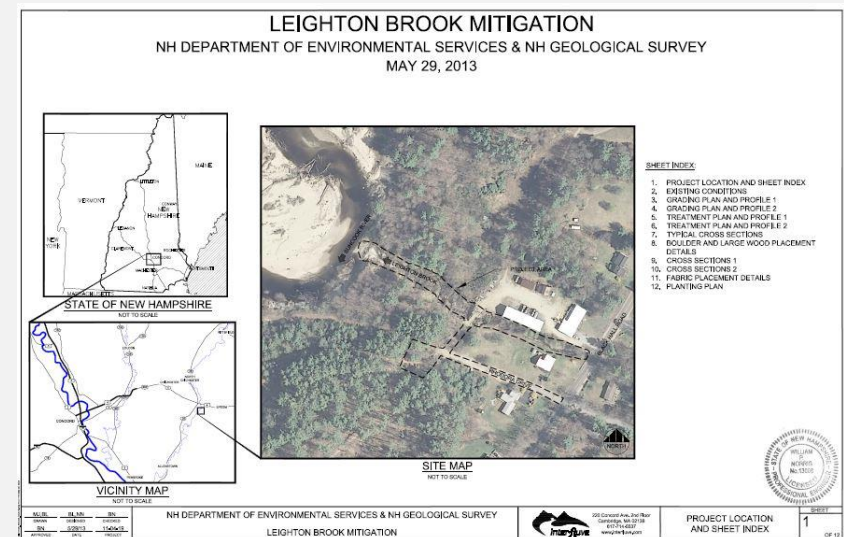


EasyGrantsID: 42085
 National Fish and Wildlife Foundation – Hurricane Sandy Coastal Resiliency Competitive Grants Program 2013, Full Proposal
 Title: Suncook River Infrastructure Protection Project - Epsom (NH)
 Organization: New Hampshire Department of Environmental Services

Grant Information

Title of Project
 Suncook River Infrastructure Protection Project - Epsom (NH)

Total Amount Requested \$ 1,750,156.85
Matching Contributions Proposed \$ 1,728,635.00
Proposed Grant Period 07/01/ 2014 - 07/31/ 2016



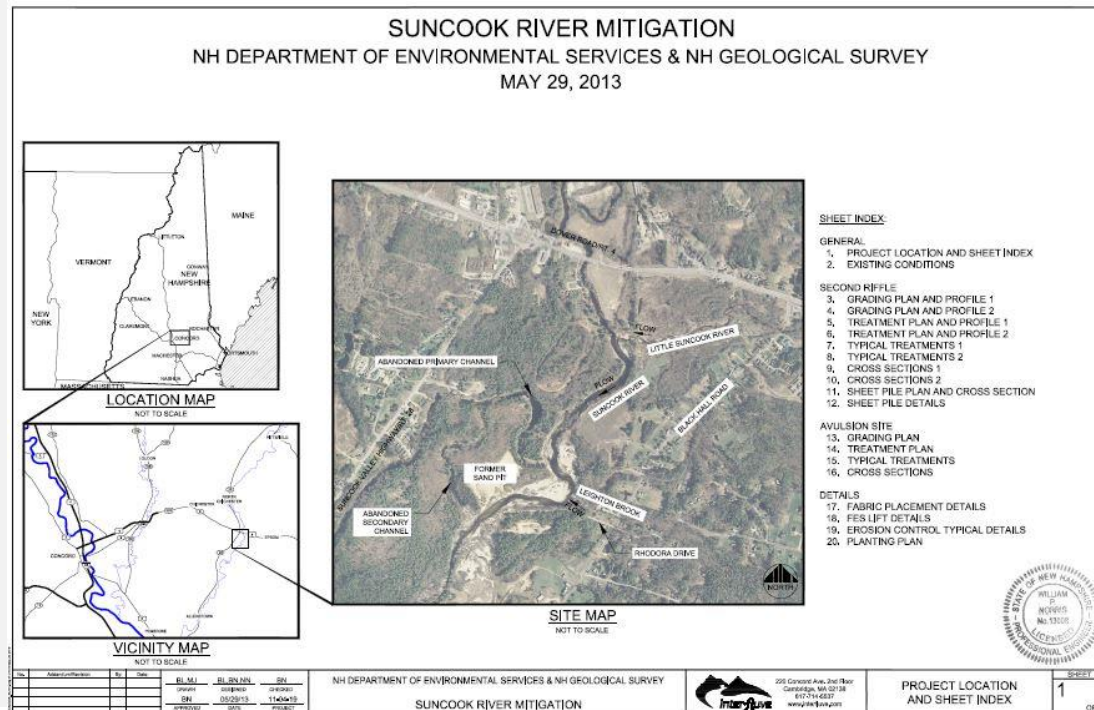
2015

- SumCo EcoContracting contract with DES for Leighton Brook stabilization - \$260,000
- Work completed December 2015
- NHDOT commits \$900,000 for Suncook construction



2016

- Finalize designs for Suncook River
- Issue bid packages and select construction contractor
- Secure \$500,000 contingency funds (if necessary)



Project Initiation and Fundraising – Suncook Saga Summary

On the Suncook River, a slow, rolling disaster response



Months after floods, residents struggle

Waters swamped many in Suncook Valley twice

"I wish Gov. Lynch's house was right here. Then the problem would be taken care of."

By MADDIE HANNA
Monitor staff

Four months after April floods surged through the Suncook Valley, recovery efforts along the river drag on, a process that has left residents frustrated with government agencies they say have provided little help.

"We're all living in shambles," said Patricia Audet, who lives with her 61-year-old mother, Claire, in a flood-devastated duplex on Riverside Park Drive in Allenstown. "Gov. John Lynch said right to her face, give my mother a hug (and) said, 'Claire,

slammed Riverside Park Drive and Brookside Terrace in Allenstown, King's Towne mobile home park in Egmont and Bachelors Road in Fum Brook.

The hardest-hit residents have been in a perpetual state of repairing and rebuilding. They've evacuated their homes, sometimes with nowhere to go. They've wrangled with insurance companies, many of whom still haven't paid their claims. They've had to replace what was just replaced a year before – if they had the money.

The Federal Emergency Management Agency has given the state \$26 million since the April nor'easter. The



See FLOODS – A9 An image of the flood along the Suncook in May 2006.

I have sponsored a bill to fix the Suncook River problem

To the Editor:

Rep. Brandon Guida, R-Pembroke, and myself have co-sponsored a bill regarding the remediation of the Suncook River.

We will be working closely with Representatives Dan and Carol McGuire (R-Epsom), Rep. Richardson (R-Allenstown), Rep. Seaworth (R-Pembroke) and Rep. Jack Barnes to fine tune the legislation before it is introduced into the House and muster as much support as we can for its passage and

implication.

The existing capital budget for 2012-13 incorporates the total sum of \$2,850,000 in state and federal money for this project, a small portion of which has already been approved. Money is tight and we must remain vigilant.

As most of you know, I detest junkets and receptions that are offered by lobbyists or people who have any business before the House. The previous legislature spent approximately \$100,000 per year to

pay national left-wing organization of legislators which could best be described as a money-laundering scheme. This organization would take the money from the state legislatures and recycle it by offering junkets to members to locations to study issues that have no relevance to New Hampshire and information which is readily accessible from a variety of think tanks and the federal government. This House will discontinue the membership and thereby

save the state approximately \$100,000.

I realize that it is just a drop in the bucket, and, in order to come close to retiring the existing deficit, each legislator must come up with at least \$2 million in cuts.

I wish you all a blessed Christmas and a happy holiday season.

Tony F. Soltani, Representative
Allenstown, Epsom, Pittsfield
12/22/2010
100 N 3079 Banker



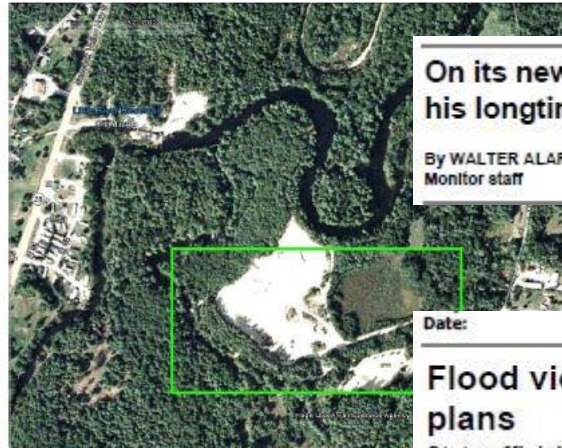
3:28 PM THU APRIL 25, 2013

erched into the sand pit. The water in the old riverbed is running backwards on the right. (Courtesy)

Environment

Stabilizing The Suncook: Pacifying A River Run Amok

By [SAM EVANS-BROWN](#) / [PEOPLE/EGM/AND-BROWN](#)



Credit Google Earth: 2003
During the 2006 Mother's Day flood the sand pit showed in the square filled with water from the Suncook smaller river that breaks off south of Old Mill Road. Water spilled into the river.

On its new course, the Suncook threatens his longtime home

By **WALTER ALARKON**
Monitor staff

Date: Wednesday, June 20, 2007 9:44:16 AM

Flood victims demand answers on plans

State officials draw residents' frustration

By **MADDIE HANNA**
Monitor staff

River's new path is likely to stay

Epsom residents eye transformed Suncook

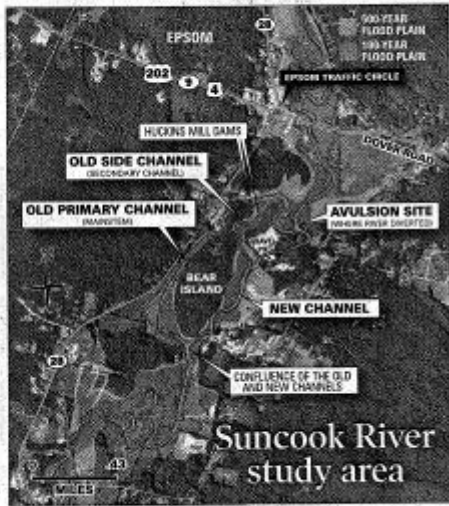
By **ETHAN WILENSKY-LANFORD**
Monitor staff

Engineers gave 109 Epsom residents little hope Wednesday that the Suncook River would return to its former course. They presented four options for how the region could respond to the river's changes.

None of the options would protect the river from potential flooding this spring. Construction proposals require millions of dollars. Federal funds might be available, according to state Department of Environmental Services officials, but only with matching local or state spending. Epsom, meanwhile, is on its fourth default budget.

Before the meeting, many residents said they wanted the river back where it was.

A quarter-mile-long diversion dam to steer the water into its former channel would cost \$5.5 million, said Peter Walker of the engineering firm Vanasse Hangen Brustlin Inc. Even with the money,

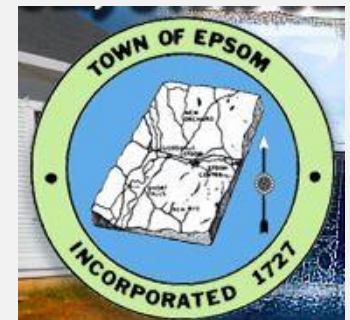
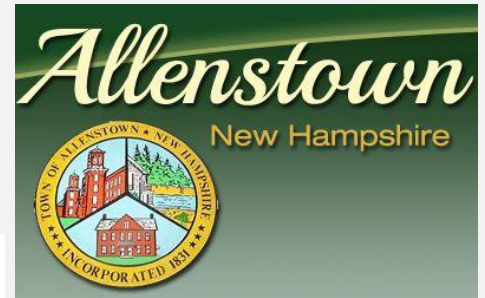


Source: N.H. Departments of Environmental Services and Transportation, NH Gov't
CHARLOTTE THIBALTY / Monitor staff

See RIVER – B2

Project Initiation and Fundraising – Suncook Saga Summary

Since 2006, \$23 million in grant/appropriation requests denied - \$9.4 million secured



Project Initiation and Fundraising – Suncook Saga Summary



WARNING

Suncook RIVER RESTORATION PROJECT AHEAD

**CREWS AND HEAVY EQUIPMENT
IN RIVER**

PLEASE PROCEED WITH CAUTION
A SHORT PORTAGE MAY BE NECESSARY

Design Goal

Use our geomorphic understanding of the Suncook River to provide protection for infrastructure (grade control and bank stabilization) while maintaining geomorphic form and function.

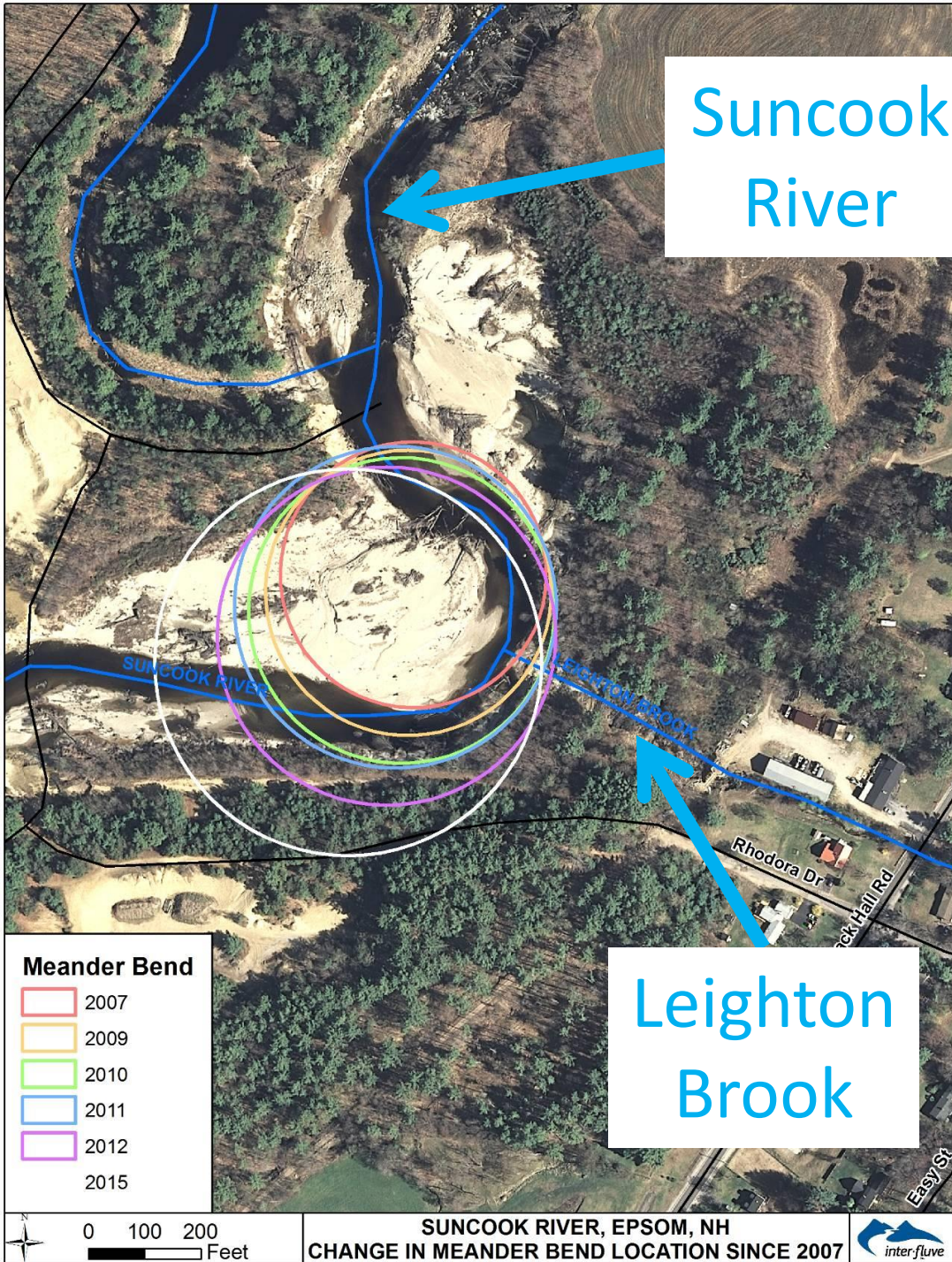
At the same time, attempt to improve fish and aquatic organism habitat

Studies/Analyses

- Topographic survey
- Geomorphic assessment
- Meander bend analysis
- HEC-RAS 1-D hydraulic model
- TUFLOW 2-D hydraulic model
- Geophysical surveys
- Scour analysis

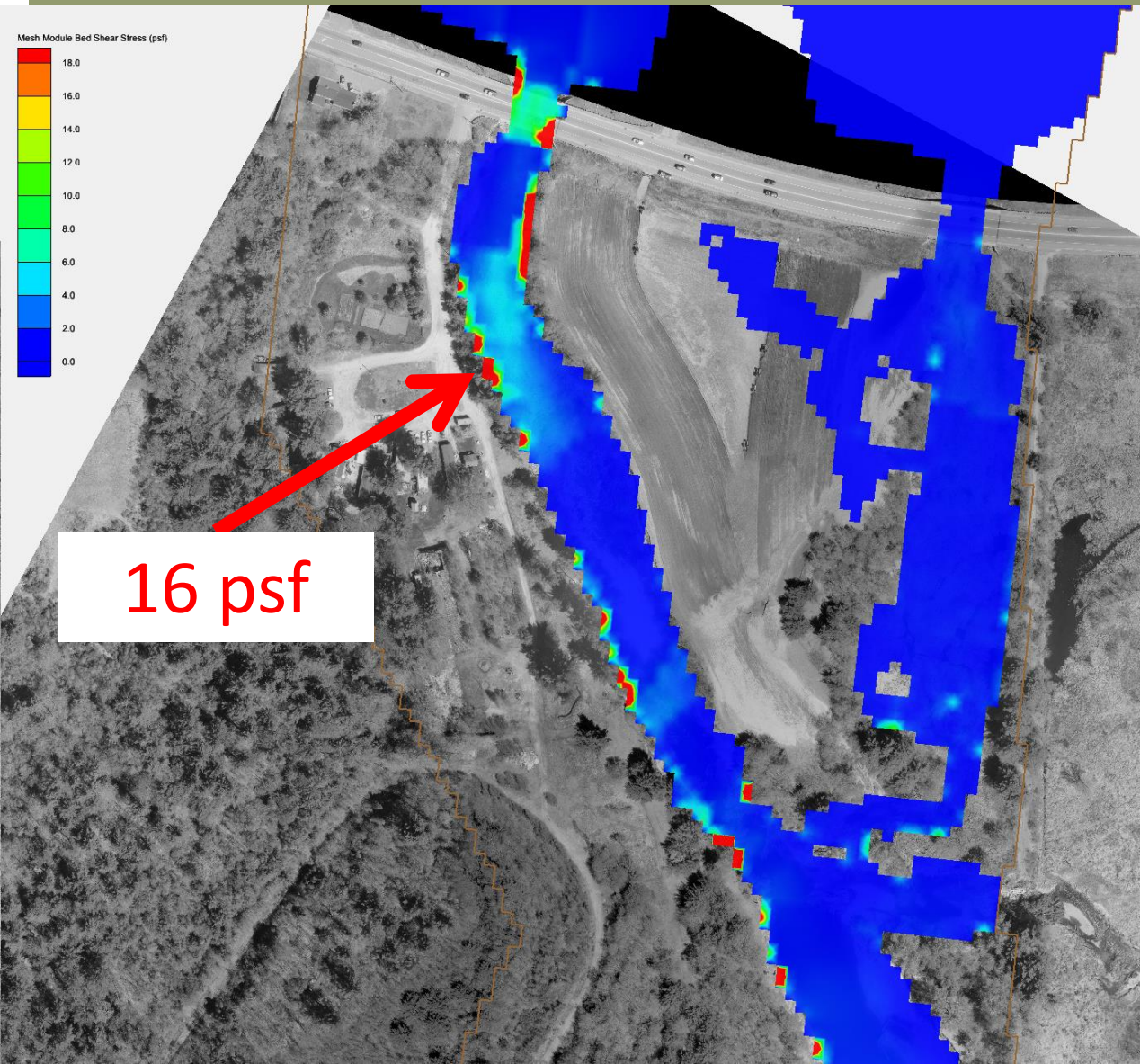


Meander Bend Analysis



- Potential is there for increased meandering
- May continue SW away from Leighton
- Other bends may cause changes at Leighton

2-D Hydraulic Model

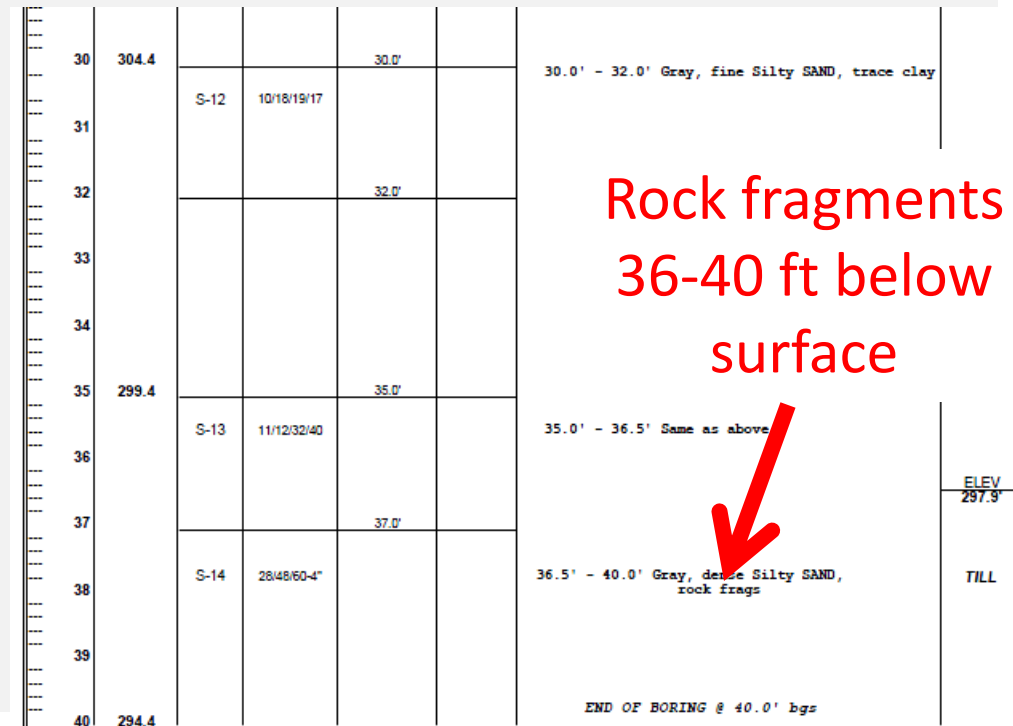


- High shear stresses and velocities
- Shears necessitate large rocks for stability

Geophysical survey – borings and seismic survey

- Lag deposits in channel – not necessarily under floodplains
- Mostly sands and silts
- Hard material lies ~30 ft below the ground surface in the floodplains

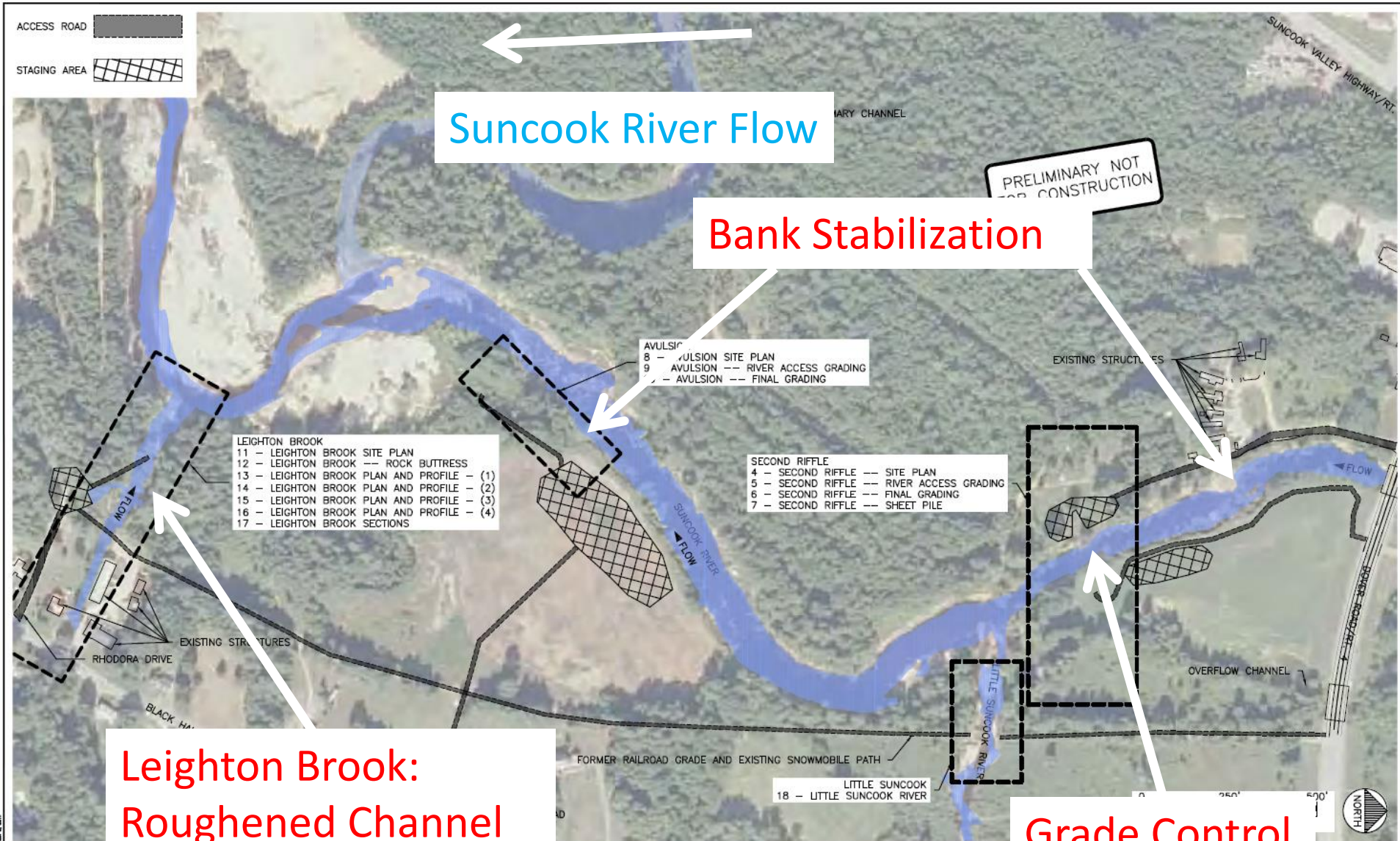
- **Geology is not helpful for this project**



Scour Analysis

- Deep scour potential downstream of the Rt 4 bridge
 - Existing pools >15ft deep
- Installation of large woody habitat structures could increase scour potential, risk and uncertainty along channel margins

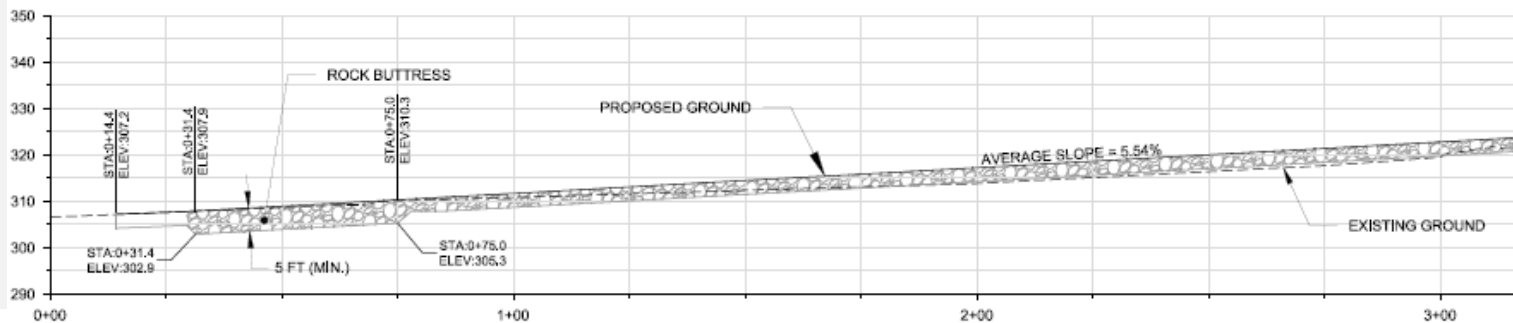
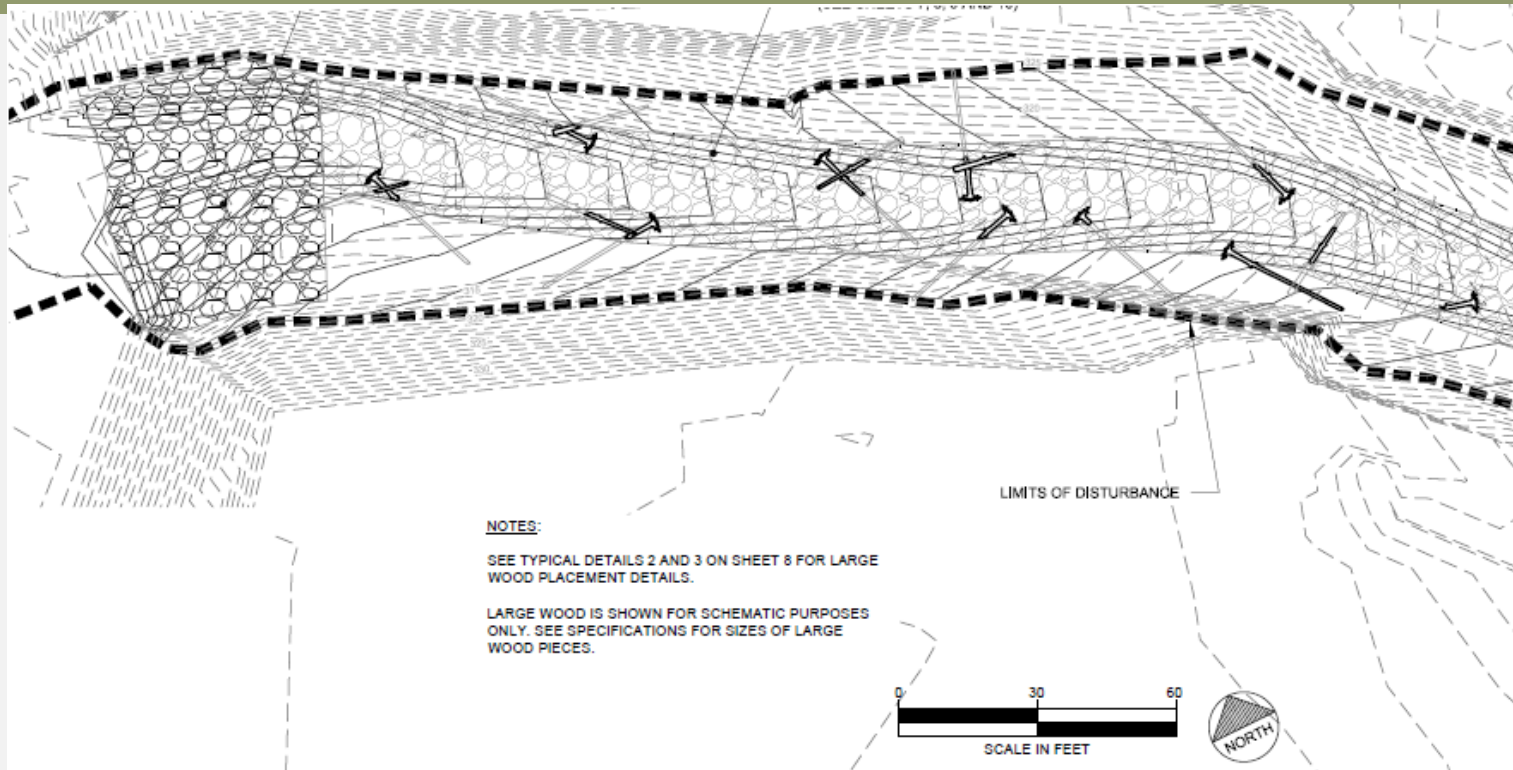
Suncook River and Leighton Brook Designs



Leighton Brook Designs



Designs – Leighton Brook



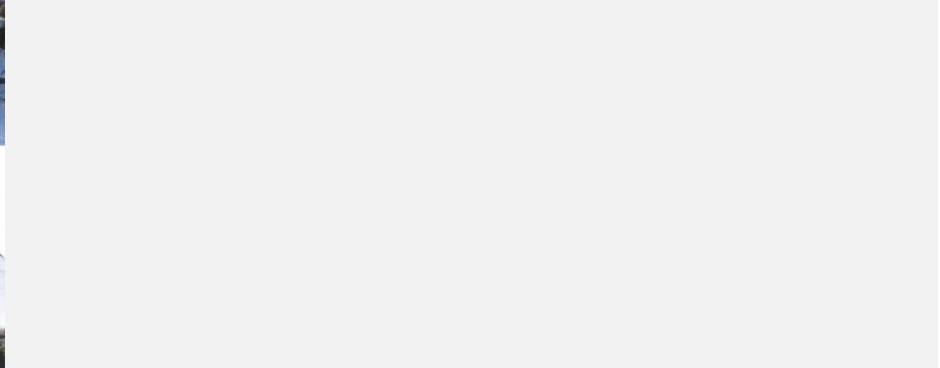




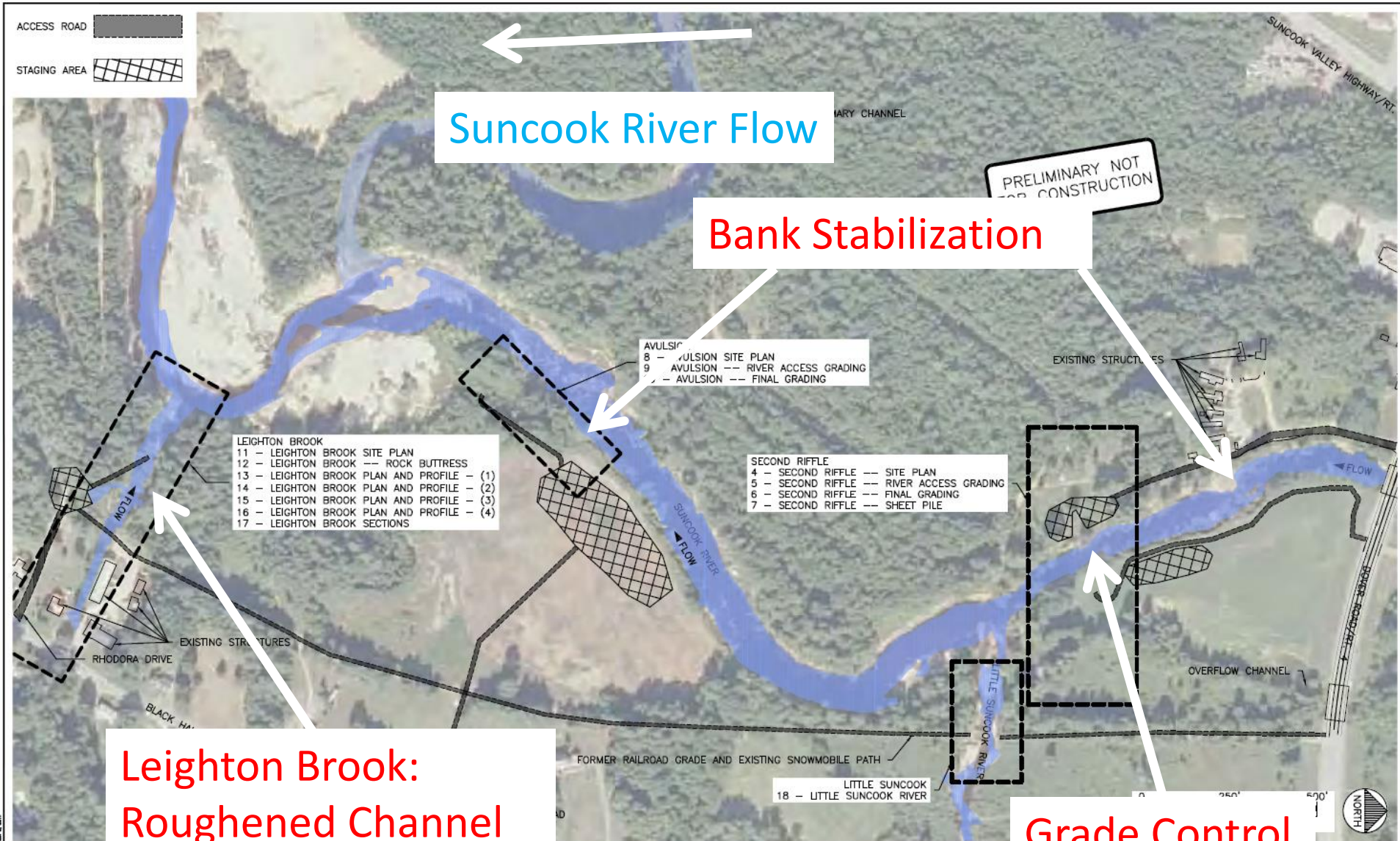


Construction Photos





Suncook River and Leighton Brook Designs



**Leighton Brook:
Roughened Channel
Construction**

Grade Control

STM	BN
DRAWN	DESIGN
BN	12-08
APPROVED	DATE

RVICES & NH GEOLOGICAL SURVEY
MITIGATION

220 Concord
Cambridge, MA 02138
617-714-5537
www.interfluve.com

SITE PLAN

Suncook River Designs: Below Rt 4 Bridge - Grade Control Riffle



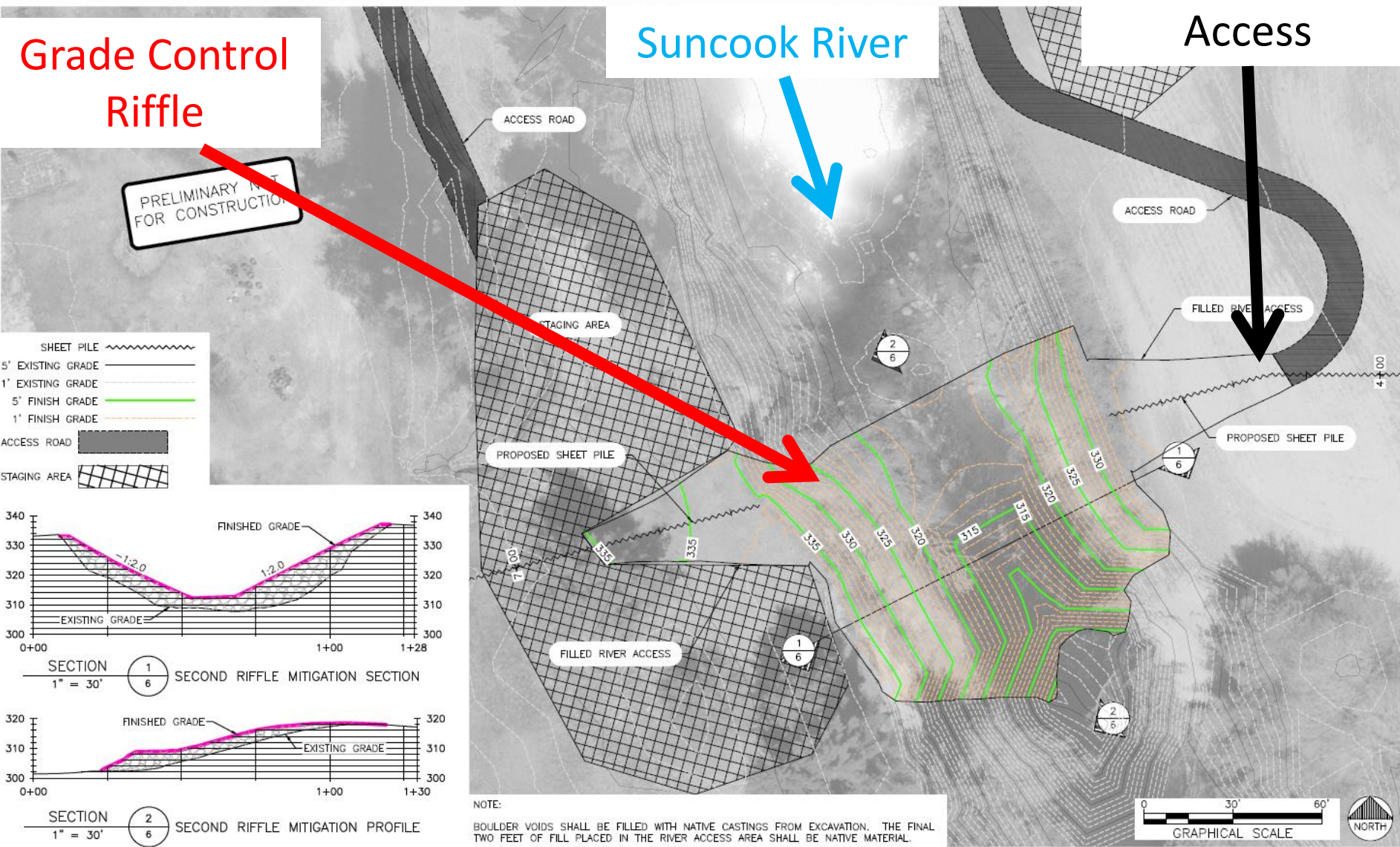
- Consolidated clays with embedded cobbles and boulders
- Pool below ~15-20 ft deep – large scour potential
- Sandy, silty banks

Designs: Grade Control

Grade Control Riffle

Suncook River

Access



STM	BN	BN
DRAWN	DESIGNED	CHECKED
BN	12-08-2011	
APPROVED	DATE	PROJECT

NH DEPARTMENT OF ENVIRONMENTAL SERVICES & NH GEOLOGICAL SURVEY
 SUNCOOK RIVER MITIGATION

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SECOND RIFFLE -- FINAL GRADING

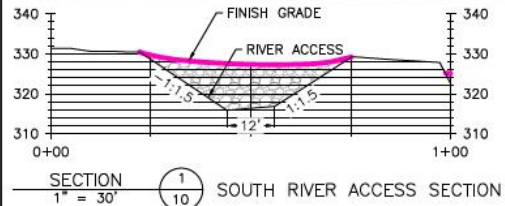
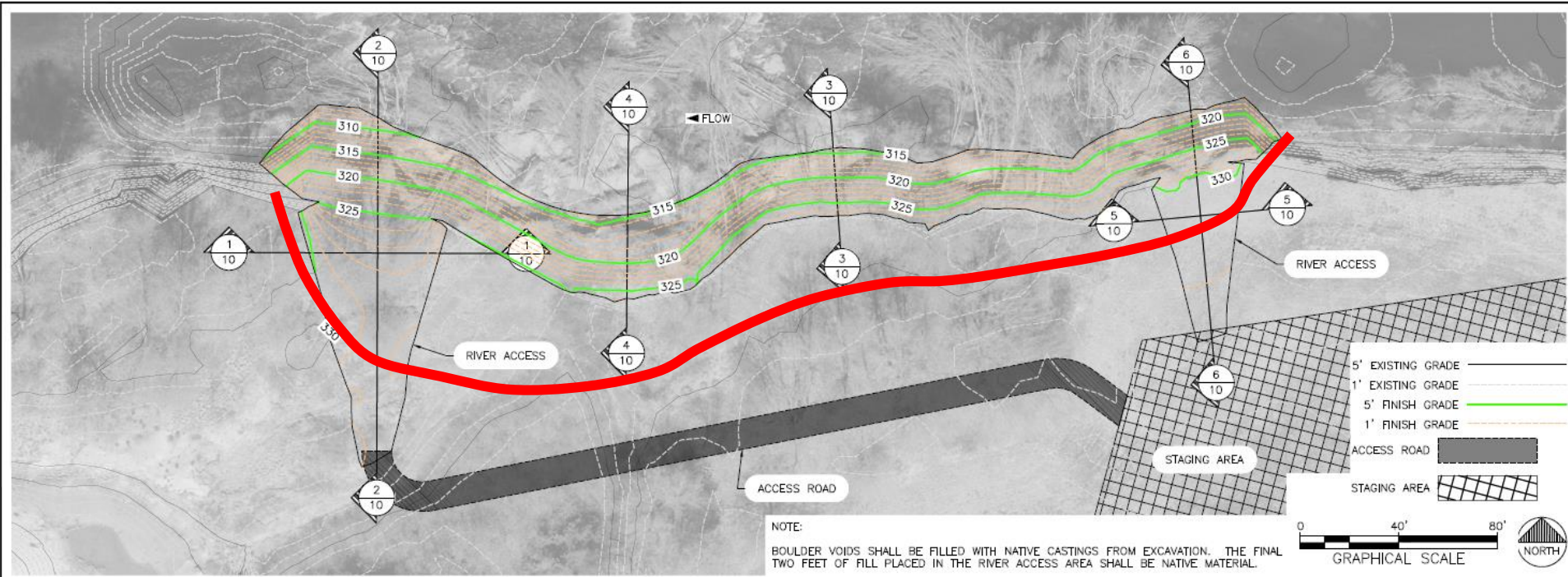
Avulsion Site Bank Stabilization

- ~10 vertical drop over 350 ft
- Boulders 1-3 ft diameter

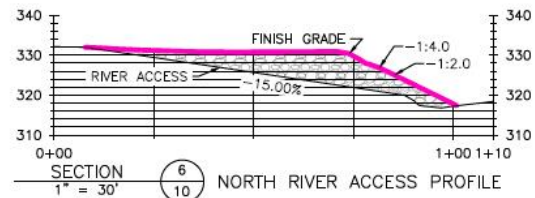
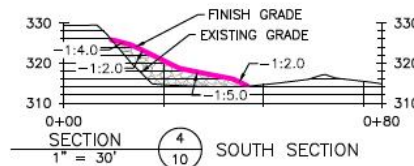
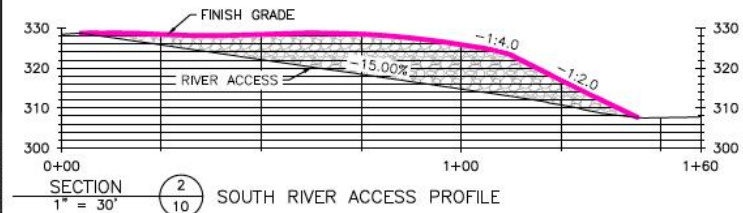
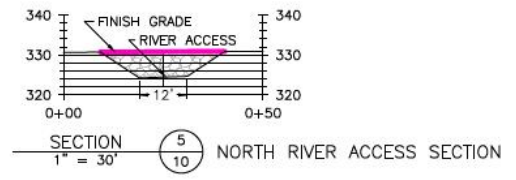
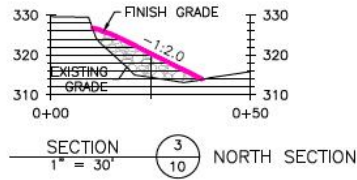


- Channel eroding around boulders through sand on left bank
- No stable geology
- Part of 10 ft knickpoint has begun to migrate upstream

Avulsion Site: Bank Stabilization



PRELIMINARY NOT FOR CONSTRUCTION



STM	BN	BN
DRAWN	DESIGNED	CHECKED
BN	12-08-2011	
APPROVED	DATE	PROJECT

NH DEPARTMENT OF ENVIRONMENTAL SERVICES & NH GEOLOGICAL SURVEY
SUNCOOK RIVER MITIGATION

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AVULSION -- FINAL GRADING

SHEET
10
OF 19

Costs

Item	Cost Estimate (\$)	Actual Cost (\$)
Leighton Brook	\$311,000	\$259,217
Suncook River	\$2.6million	
TOTAL	\$2,911,000	

Source	Funding Amount
FY16/17 Capital Funds	\$1.8million
NHDOT Federal Highway Bridge Funds	\$900,000
Mitigation Settlement	\$336,000
Remaining funds from Leighton construction	\$81,319
Total	\$3,117,319

- Replacing bridge: estimated at \$12-15 million

Summary

- Local geology is not very helpful
- Bridge replacement too costly
- Valley-spanning control too costly
- Scour potential too great for substantial use of logs, rootwads
- Fabric lifts and revegetation will help soften look above the high shear stress values
- Science and \$\$\$ guide the designs – no room for error in bridge infrastructure projects



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