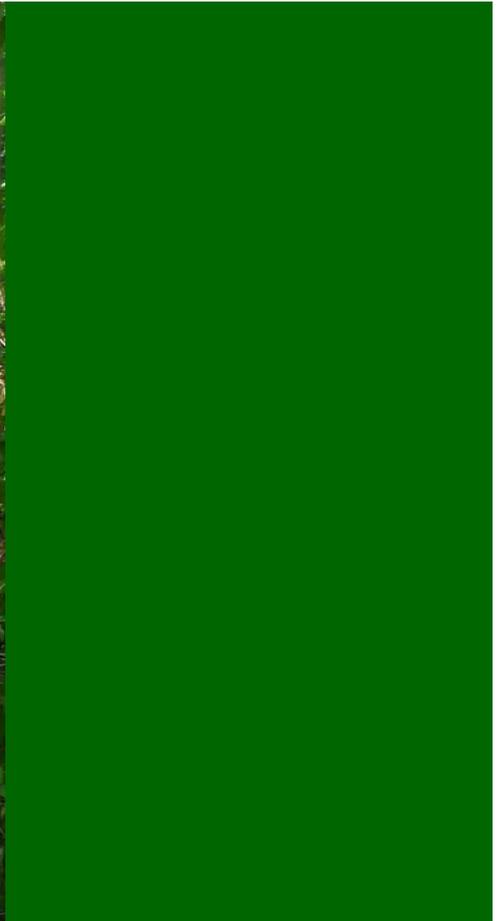


Warren Brook/Cold River, Alstead
October 2005







Slayton Hill Road culvert, Lebanon
July 2013

New Hampshire House Bill 648

Chapter 179 Laws of 2007

Comprehensive Flood Management Study Commission

Final Report

September 2008



HB 648 Comprehensive Flood Management Study Commission: Key Finding

Need: Ensure that bridges and culverts are adequately sized.

“DOT, DES and Fish & Game with input by the Nature Conservancy, should be tasked to develop the procedure and database for a standard culvert assessment data collection.”

[HTTP://GENCOURT.STATE.NH.US/STATSTUDCOMM/REPORTS/1853.PDF](http://GENCOURT.STATE.NH.US/STATSTUDCOMM/REPORTS/1853.PDF)

New Hampshire Stream Crossing Assessment Initiative

State Stream Crossing Steering Team

NHDES

New Hampshire Geological Survey

Wetlands Bureau

Coastal Program

NHDOT

NH Fish & Game

NH HSEM



New Hampshire Stream Crossing Assessment Initiative

Statewide Asset Data Exchange System
(SADES)

New Hampshire Stream Crossing Initiative



Field Manual

In Partnership With:

NH Department of Environmental Services
NH Department of Transportation
NH Fish and Game Department
NH Division of Homeland Security and Emergency Management
NH Regional Planning Commissions
UNH Technology Transfer Center

Version: 6.0

Guide to Parameters Collected at Each Crossing Type

Once CROSSING TYPE has been determined (based on upstream waterbody type), use the table below, along with the icons next to each parameter, to guide field data collection.

Parameter	Crossing Type		
	Stream	Wetland or Pond	Drainage
1.) Assessment Date	X	X	X
4.) User ID	X	X	X
5.) Observers	X	X	X
6.) Organization	X	X	X
7.) Project Name	X	X	X
10.) Road Name - Field	X	X	X
12.) Structure Skewed to Roadway	X	X	X
13.) If Channel Avulses, Stream Will	X	X	
14.) Estimated Distance Avulsion Would Follow Road (ft)	X	X	
15.) Waterbody - Upstream	X	X	X
16.) Crossing Type	X	X	X
17.) Angle of Stream Flow Approaching Structure	X		
18.) Floodplain Filled by Roadway Approaches	X		
19.) Number of Structures at Crossing	X	X	
20.) Overflow Structures Present	X	X	
21.) Structure Type	X	X	X
22.) Structure Material	X	X	X
23.) Inlet Type	X		
24.) Inlet Wingwall Angle - Stream Left	X		
25.) Inlet Wingwall Angle - Stream Right	X		
26.) Upstream - Width (A) (ft)	X	X	X
27.) Upstream - Open Height (B) (ft)	X	X	X
28.) Upstream - Wetted Width-Wall Rise (C) (ft)	X	X	X
29.) Upstream - Total Height (D) (ft)	X	X	X
30.) Structure Opening Partially Obstructed By	X	X	

Training Program

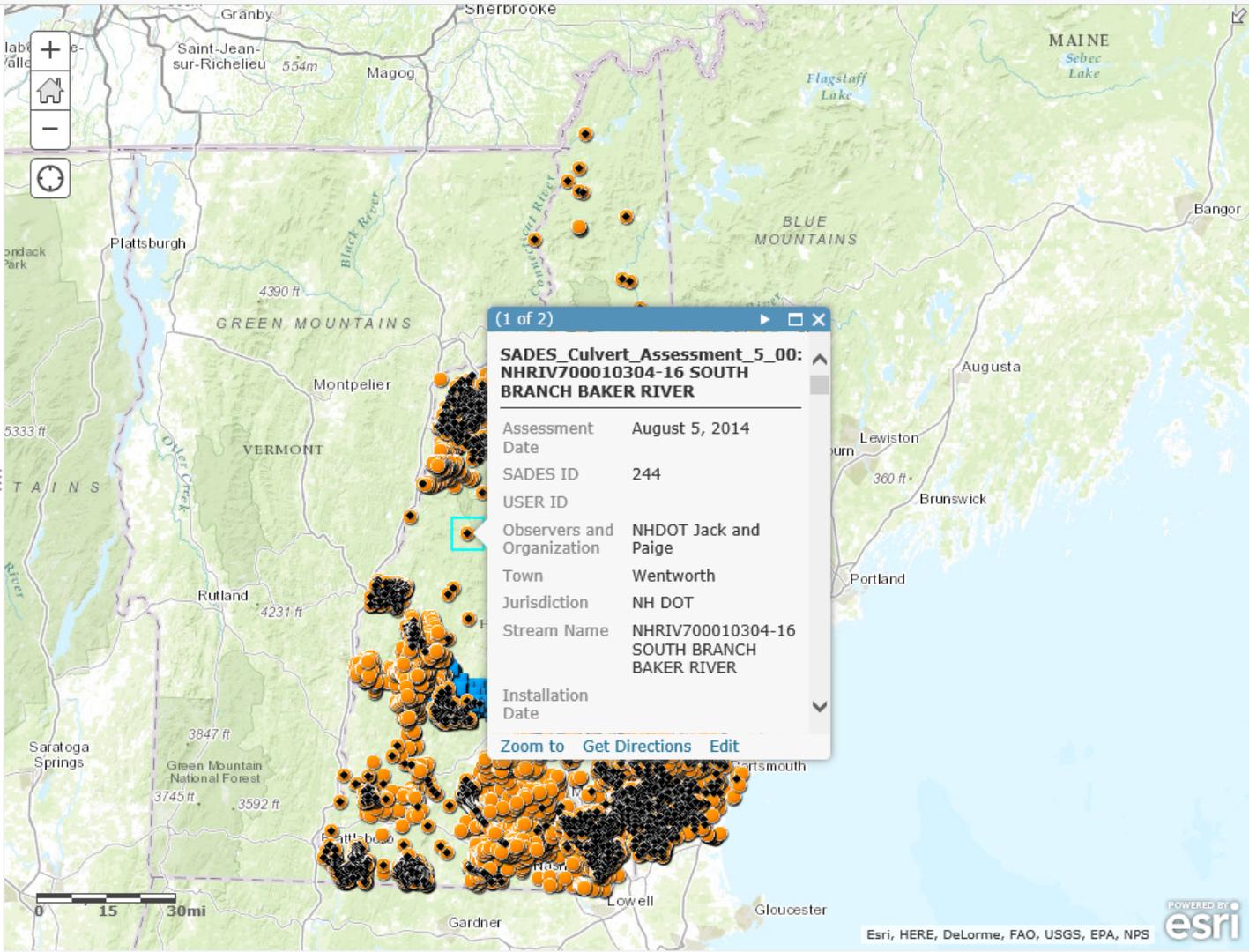
- 2 standard field sites
- Conduct training each spring for that season's collectors – have done this for 6 years
- Go through every field on form
- Also have a classroom PowerPoint version to supplement the field training as needed
- Perform field visits with collectors to provide guidance and feedback



Legend

- SADES_Culvert_Pictures_4_0
- Culvert_Assessment_5_1
- Warner Watershed Crossings

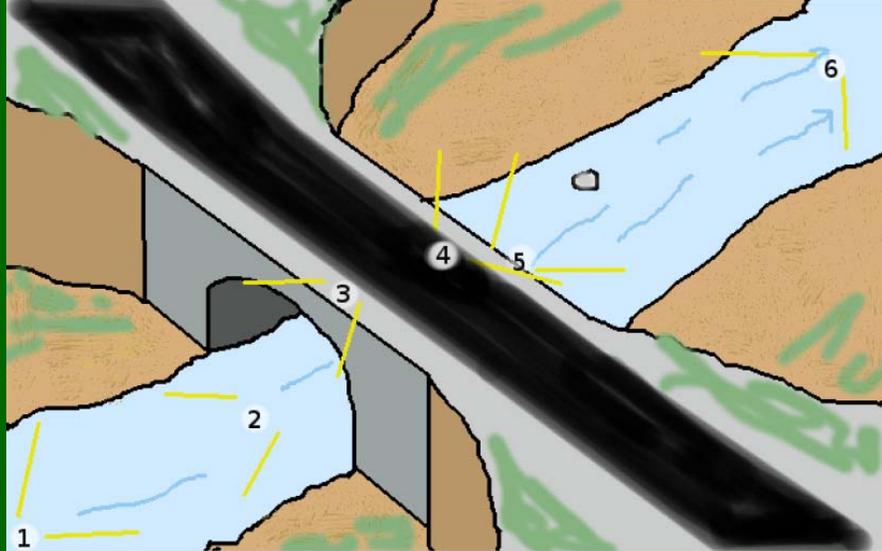
SADES
(Statewide Asset
Data Exchange
System)



Quality Control Review Process

```
NIHOT - Notepad
File Edit Format View Help
This report was created on 2011-09-06 16:19:41.284000 By Jeremy,D.Nicolletti
from the file S:\CO-Geology\Geoworks\Floods\Databases - Stream Crossings\SADES QA\Stream_Crossing_QA\Downloads_By_Data\SADES_CV_Exports\20110831_Never_Reviewed.csv

SADES "2,208" was flagged for rejection
The review level for this structure was "New"
For SADES ID "2,208", which was collected by "NK DOT Survey", the following was determined:
Comments:
-Crossing slope was listed as being 0.0. How was this value determined?
-The culvert slope as compared with the channel slope is "... but water velocity matches that of stream field says "...
Typically this results in a speed difference. Please double-check the crossing speed matches the channel speed.
-The depth of the water in the culvert at its outlet was "0.0000000000000000". Can you please provide a value for this field?
-The upstream deposit type listed as "... but evidence for Erosion/Aggradation value of "... is not Aggradation, what was the rationale for this not being aggradation given the pr
-The slope to the hydraulic control was listed as "0.0". How was this value determined?
-What is your rationale for not collecting at least 3 upstream bankfull width measurements for this crossing?
-Downstream bankfull widths are problematic: 0.0000000000000000, 0.0000000000000000, 0.0000000000000000
-What is your rationale for not collecting at least 3 downstream bankfull width measurements for this crossing?
-Reference bankfull widths are problematic: 0.0000000000000000, 0.0000000000000000, 0.0000000000000000
-What is your rationale for not collecting at least 3 reference bankfull width measurements for this crossing?
-The following fields required a yes or no value but did not have either:
culvertOverFlowPipe ("COLUMN_DNR") steppedFooters (" ") downstreamPool (" ") dbedrockPresent (" ") ubedrockPresent (" ") udepositsElevation (" ") ddepositsElevation (" ") indec
-The following fields were found to be blank:
Fields were blank. Is it possible to provide values for these fields (where applicable)?
SADES ID: 2,208 -collected by: NK DOT Survey on 1/7/2007 00:00:00
SADES ID: [Access=848r-848r-848r-848r] (SADES Incomplete; AOP Parameters Present)
A: Structure Details:
A: "steel-corrugated", "... "round culvert"
with a "... inlet (headwall).
Inlet is obstructed by:
No stepped footers were observed at the crossing.
Crossing inlet is "... and the outlet is "... with a drop of "0.0000000000000000" with no overflow pipe.
This crossing has "1" cell(s) and is not skewed.
Flood plain is "... filled by road approaches.
Avulsions will "... feet from crossing.
Crossing water speed matches stream?
Crossing depth matches stream?
The depth of water in the culvert was "0.0000000000000000".
Structure dimensions are: "3.0", "0.0", "0.0", "0.0"
Structure slope is "0.0" and is "... compared to the channel
Blank or missing record for sediment throughout culvert.
In structure and material is "... but is not through structure
There is a "... sediment deposit type in the crossing that is not compared to 1/2 bankfull height.
U: Upstream:
The upstream waterbody is described as a(n) "...
Stream approach angle is "...
Slope is undermining the upstream "...
There is no upstream slope break.
There is no steep riffle upstream.
No beaver dams were observed upstream.
There is a "... bed upstream with "... bank erosion.
Upstream bed erosion/aggradation is "...
Upstream bed deposition is "...
No bedrock sighted upstream.
Upstream bank armor is "...
Upstream vegetation is "... on the left and "... on the right
Upstream gutter is "... on left, and "... on right.
D: Downstream:
The downstream waterbody is described as a(n) "...
There is a "... bed downstream with "... bank erosion.
No beaver dams were observed downstream.
Slope is undermining the downstream "...
There is no pool downstream.
There is a "... hydraulic control "0.0000000000000000" feet downstream, with a slope percent of "0" between the control and outlet.
Downstream bed erosion/aggradation is "...
Downstream bed deposition is "...
No bedrock sighted downstream.
Downstream bank armor is "...
Downstream vegetation is "... on the left and "... on the right.
```

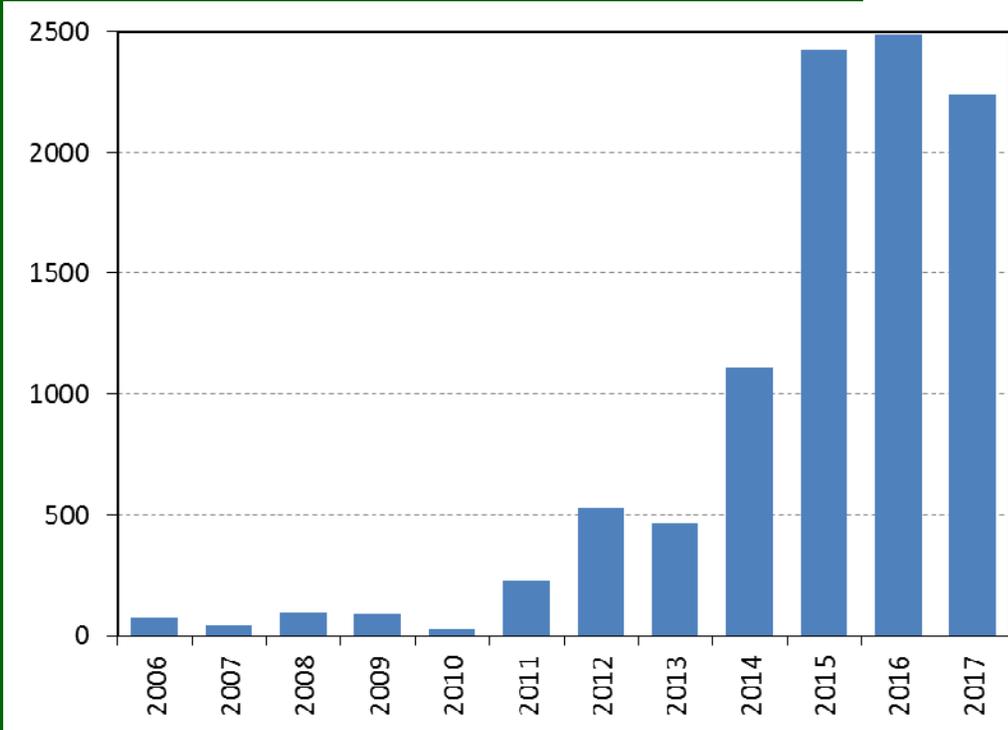
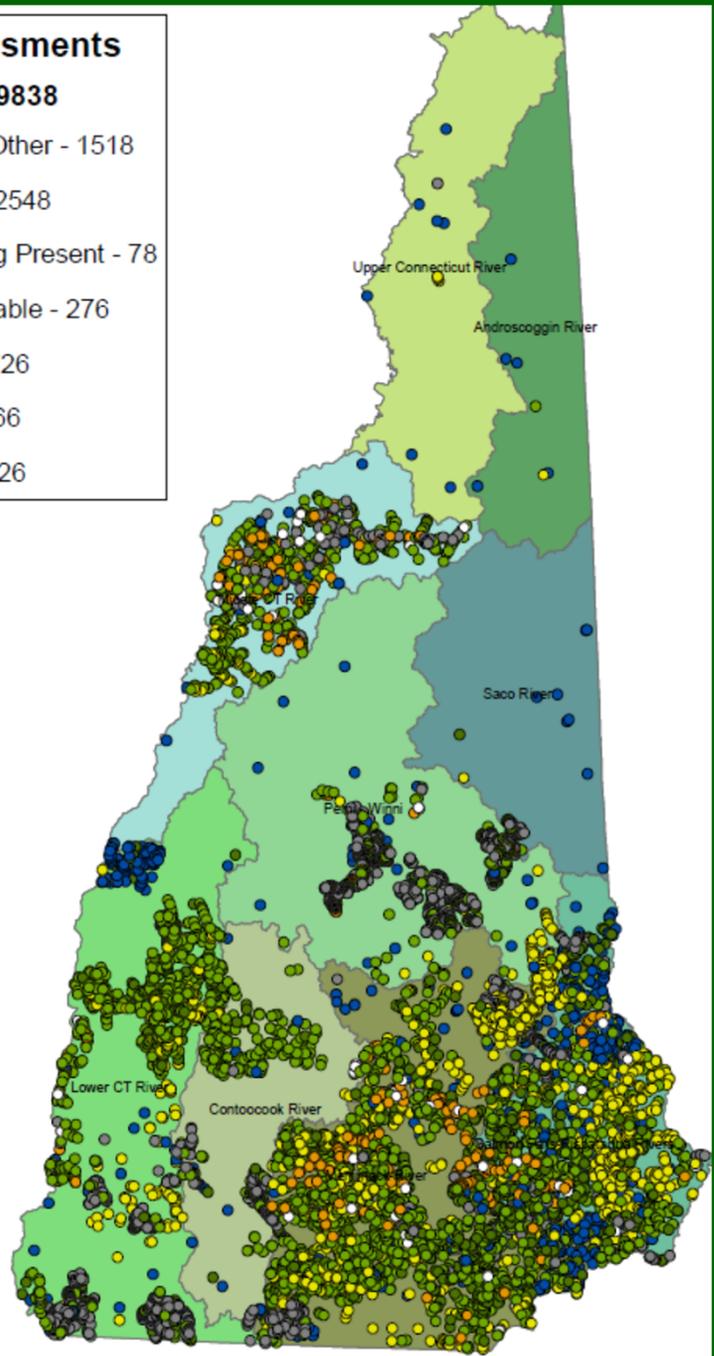
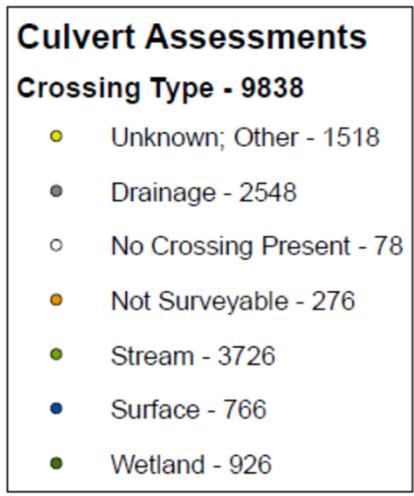


- 6 photos per crossing
- Cross-reference of photos with data
- Issues/comments to collectors
- Work in turn to address comments and complete process to enable running of geomorphic and AOP passage tools
- Streamworks-TU hydraulic model

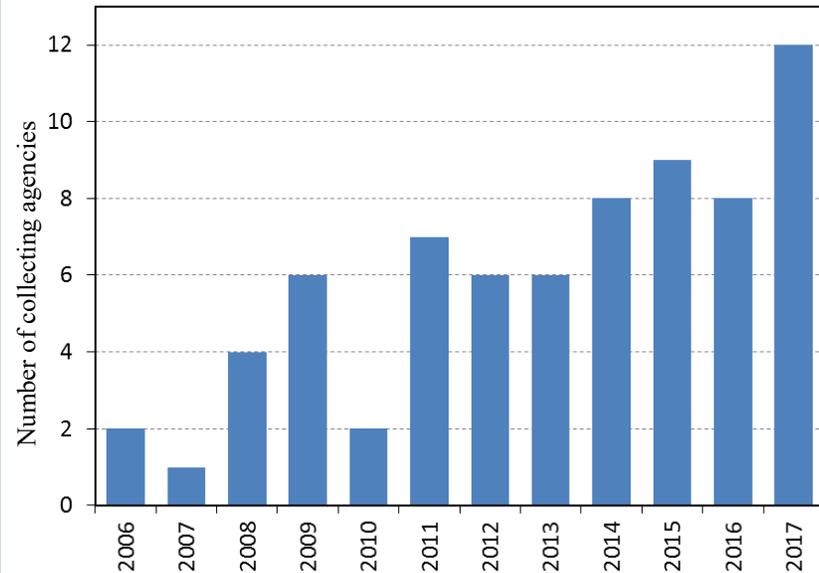
New Hampshire Stream Crossing Assessment Initiative

- Assessment totals:
 - 2017 – 1842 Assessments performed
 - Crossing Types
 - 559 Streams
 - 142 Wetlands
 - 33 Surface Waters (lakes, ponds, etc.)
 - 884 Drainages (catch basins, road side drainages, etc.)
 - 164 Not surveyable (private roads, safety concerns, trail crossings, etc.)
 - 39 No Crossing Present (NHD flowline, roads intersect was incorrect)

New Hampshire Stream Crossing Assessment Initiative

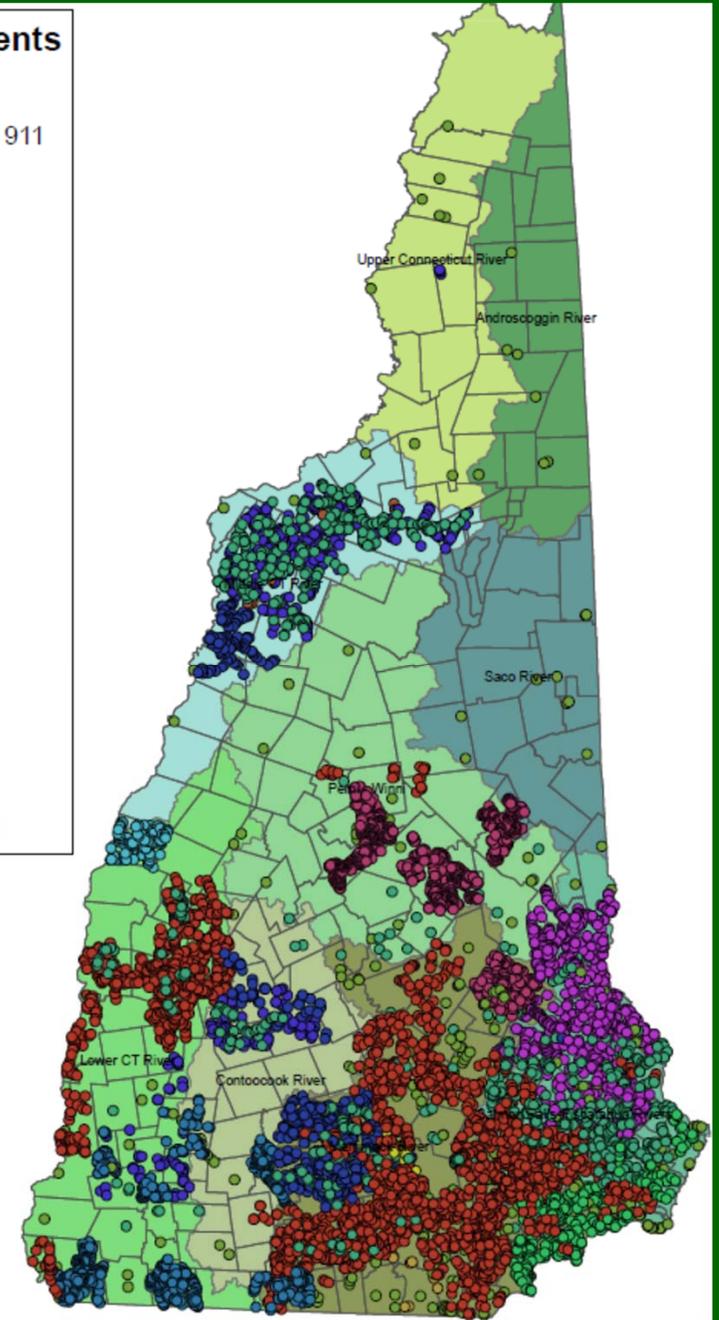


New Hampshire Stream Crossing Assessment Initiative



Culvert Assessments Organization

- Other - Not Set - 911
- LRPC - 1879
- NCC - 29
- NHDES - 14
- NHDOT - 415
- NHFG - 623
- NHGS - 2631
- NRPC - 12
- RPC - 418
- SNHPC - 24
- SRPC - 899
- SWRPC - 1119
- TU - 576
- UVLSRPC - 288



Rollins Brook at French Road
Epping



<50% bankfull (channel) width

Sediment continuity

Erosion and armoring



AOP and GC

- Aquatic Organism Passage
 - A ranking that predicts a crossing's overall ability to pass aquatic organisms (particularly fish).
- Geomorphic Compatibility
 - A rank that predicts the long-term compatibility of a culvert with river form and sediment transport processes.

AOP and GC

Geomorphic	AOP	Other
Number of culverts		Crossing type
Upstream dimensions	Culvert outlet invert type	Material
Upstream bankfull width	Outlet drop (ft)	Condition
Angle of stream flow approaching	Downstream pool present	Water depth
Culvert slope compared with channel slope	Downstream pool entrance depth	Upstream waterbody
Upstream bed deposition	Water depth in culvert at outlet (ft)	Downstream waterbody
Upstream deposits taller than 0.5 bankfull height	Number of culverts at crossing	Outlet height
Steeper Segment within 1/3 mile upstream	Structure opening partially obstructed	Beaver dam upstream
Downstream bed scour undermining the structure	Screening at inlet	Beaver dam downstream
Downstream bank heights are significantly taller than upstream banks	Sediment throughout the structure	
Upstream bank erosion		
Downstream bank erosion		
Upstream bank armoring		
Downstream bank armoring		

Geomorphic Compatibility

Category Name	Screen Score	Threshold Conditions	Description of structure-channel geomorphic compatibility
Fully compatible	$20 < GC \leq 25$	n/a	Structure fully compatible with natural channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. A similar structure is recommended when replacement is needed.
Mostly compatible	$15 < GC \leq 20$	n/a	Structure mostly compatible with current channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. Minor design adjustments recommended when replacement is needed to make fully compatible.
Partially compatible	$10 < GC \leq 15$	n/a	Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility.
Mostly incompatible	$5 < GC \leq 10$	% Bankfull Width + Approach Angle scores ≤ 2	Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.
Fully incompatible	$0 \leq GC \leq 5$	% Bankfull Width + Approach Angle scores ≤ 2 AND Sediment Continuity + Erosion and Armoring scores ≤ 2	Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.

Aquatic Organism Passage (AOP) Compatibility

VT Aquatic Organism Passage Coarse Screen	Full AOP	Reduced AOP	No AOP	
Updated 2/25/2008	for all aquatic organisms	for all aquatic organisms	for all aquatic organisms except adult salmonids	for all aquatic organisms including adult salmonids
AOP Function Variables / Values	Green (if all are true)	Gray (if any are true)	Orange	Red
Culvert outlet invert type	at grade OR backwatered	cascade	free fall AND	free fall AND
Outlet drop (ft)	= 0		> 0 , < 1 ft OR	≥ 1 ft OR
Downstream pool present			= yes (= yes AND	= no OR (= yes AND
Downstream pool entrance depth / outlet drop			n/m ≥ 1)	n/a < 1) OR
Water depth in culvert at outlet (ft)				< 0.3 ft
Number of culverts at crossing	1	> 1		
Structure opening partially obstructed	= none	≠ none		
Sediment throughout structure	yes	no		

OBJECTID	Town	Source	Flooding_D	Frequency	Date	FloodType	FloodPeriod	Impact	CrossType	CrossIssue	Location	Shape_Length	Shape_Area
2075	Exeter	Exeter HMP 2012	None - Need to verify	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Beech Hill Rd at Beech Hill Brook	4641.301341	1589536.861
2076	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	Pine Rd at the Exeter Town Line	7079.293721	3787768.164
2077	Exeter	Exeter HMP 2012	None - Need to verify	Unknown	None	Road flood	Past/potential flood	Unknown	Unknown type	Unknown	Epping Rd (Route 101) near Old Route 101	4137.431147	1282105.579
2078	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	Franklin and River St Neighborhoods	3358.338072	308703.1739
2079	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	Court Street (NH Route 108) at the intersection o*	16858.75181	13187370.71
2080	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	Court Street (NH Route 108) at the Exeter/Kersing*	6863.560901	3414863.853
2081	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	Kingston Road (NH Route 111) at Brickyard Pond to*	7491.888912	2934312.532
2082	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Portsmouth Avenue (NH Route 108) abutting the Tow*	4666.474027	1672279.822
2083	Exeter	Exeter HMP 2012	Vulnerable to tidal storm surge, identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Swasey Parkways	6333.173301	1941412.632
2084	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Powder Mill Road at the railroad crossing the Exe*	20744.022272	14372125.46
2085	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	No	None	Lary Ln neighborhood	4259.695558	982827.3784
2086	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	No	None	Brentwood Rd (NH Route 111A) west of the intersec*	4557.401044	1457164.843
2087	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	No	None	Brentwood Rd (NH Route 111A) east of the intersec*	6070.323918	2475772.724
2088	Exeter	Exeter HMP 2012	Identified by town as area of chronic reoccurring flooding or high potential for future flooding.	Unknown	None	Road flood	Past/potential flood	Unknown	No	None	Brentwood Rd (NH Route 111A) at the intersection *	3391.926162	764337.8499
2089	Exeter	Exeter HMP 2012	None - Need to verify	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Michael Bennet Rd	2877.365709	624359.3293
2090	Exeter	Exeter HMP 2012	Vulnerability to flooding in low-lying areas adjacent to the Exeter River	Unknown	None	Road flood	Past/potential flood	Unknown	Bridge	Unknown	King Arthur Ct and Linden St	4389.586359	1463592.631
2091	Exeter	Exeter HMP 2012	None - Need to verify	Unknown	None	Road flood	Past/potential flood	Unknown	Culvert	Unknown	Gilman Ln and Drinkwater Rd	5255.913772	1843227.508
2092	Exeter	Exeter HMP 2012	None - Need to verify	Unknown	None	Road flood	Past/potential flood	Unknown	Unknown type	Unknown	Oak St East	3179.05847	594806.2475
2093	Exeter	Exeter HMP 2012	Vulnerable to flooding from Squamscott River	Unknown	None	Road flood	Past/potential flood	Unknown	Unknown type	Unknown	Newfields Rd (Route 85)	12623.99964	6295376.674
2094	Exeter	Exeter HMP 2012	Vulnerable to flooding in low-lying areas adjacent to the Little River	Unknown	None	Road flood	Past/potential flood	Unknown	No	None	Colcord Pond Rd, Allard St	2480.414945	297520.4492