

# Kenyon Mill Dam Fish Passage Project

Public Informational Meeting  
Richmond/Charlestown, RI



Wood-Pawcatuck Watershed Association

April 12, 2011

7:00 P.M. – 9:00 P.M.



**FUSS & O'NEILL**  
*Disciplines to Deliver*

# Agenda

## Kenyon Mill Dam Fish Passage Project

- Introduction (5 min.)
- Project Background (5 min.)
- Project Description (50 min.)
  - *Site Description*
  - *Previous Dam Assessments and Current Condition*
  - *Feasibility Study Alternatives Evaluations*
  - *Data Collection and Assessments*
  - *Fish Passage Alternatives Analyses*
  - *Next Steps*
- Questions and Discussion

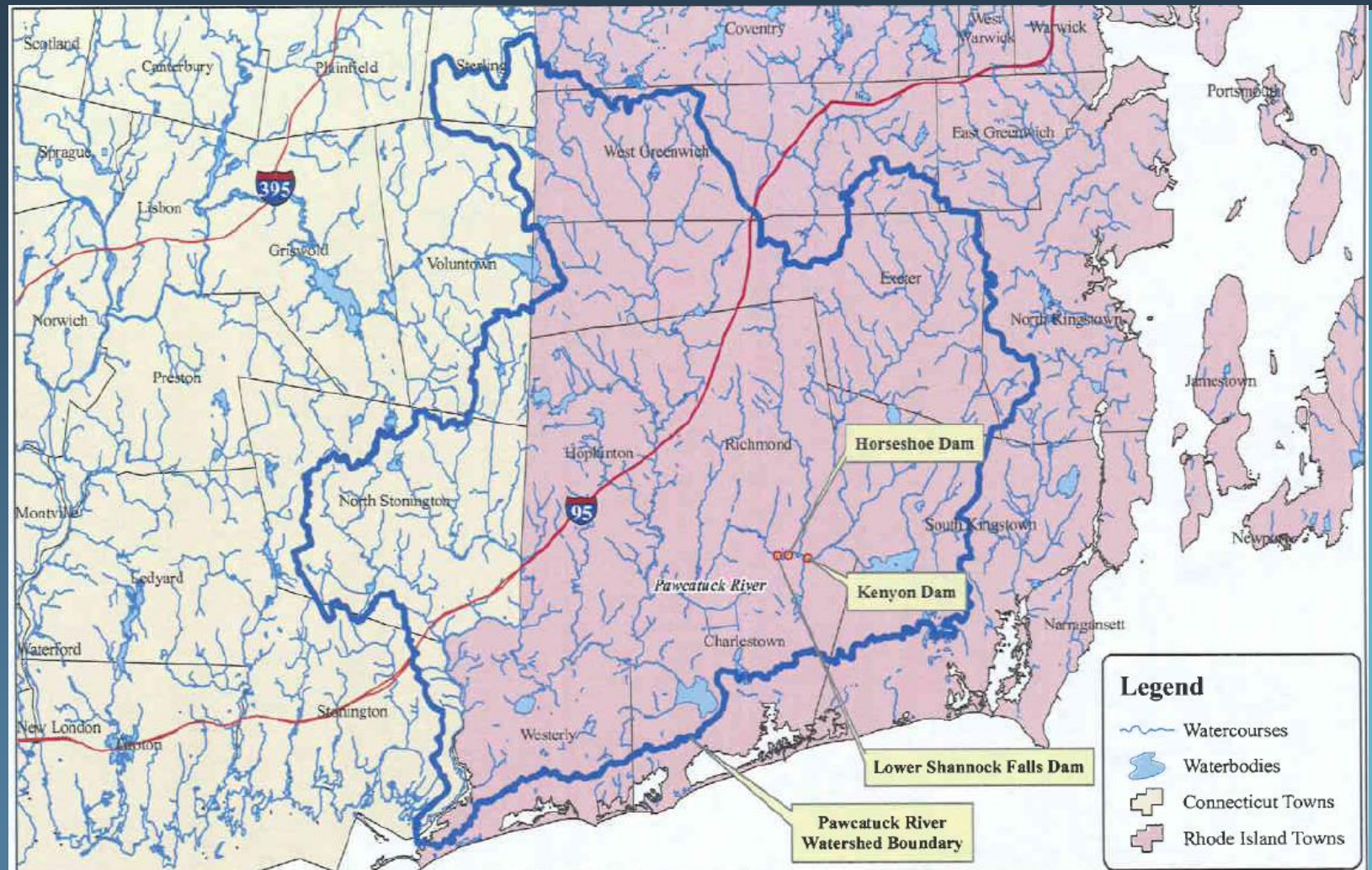
# Agenda

## Kenyon Mill Dam Fish Passage Project

### Site Description

# Site Description

## Kenyon Mill Dam Fish Passage Project



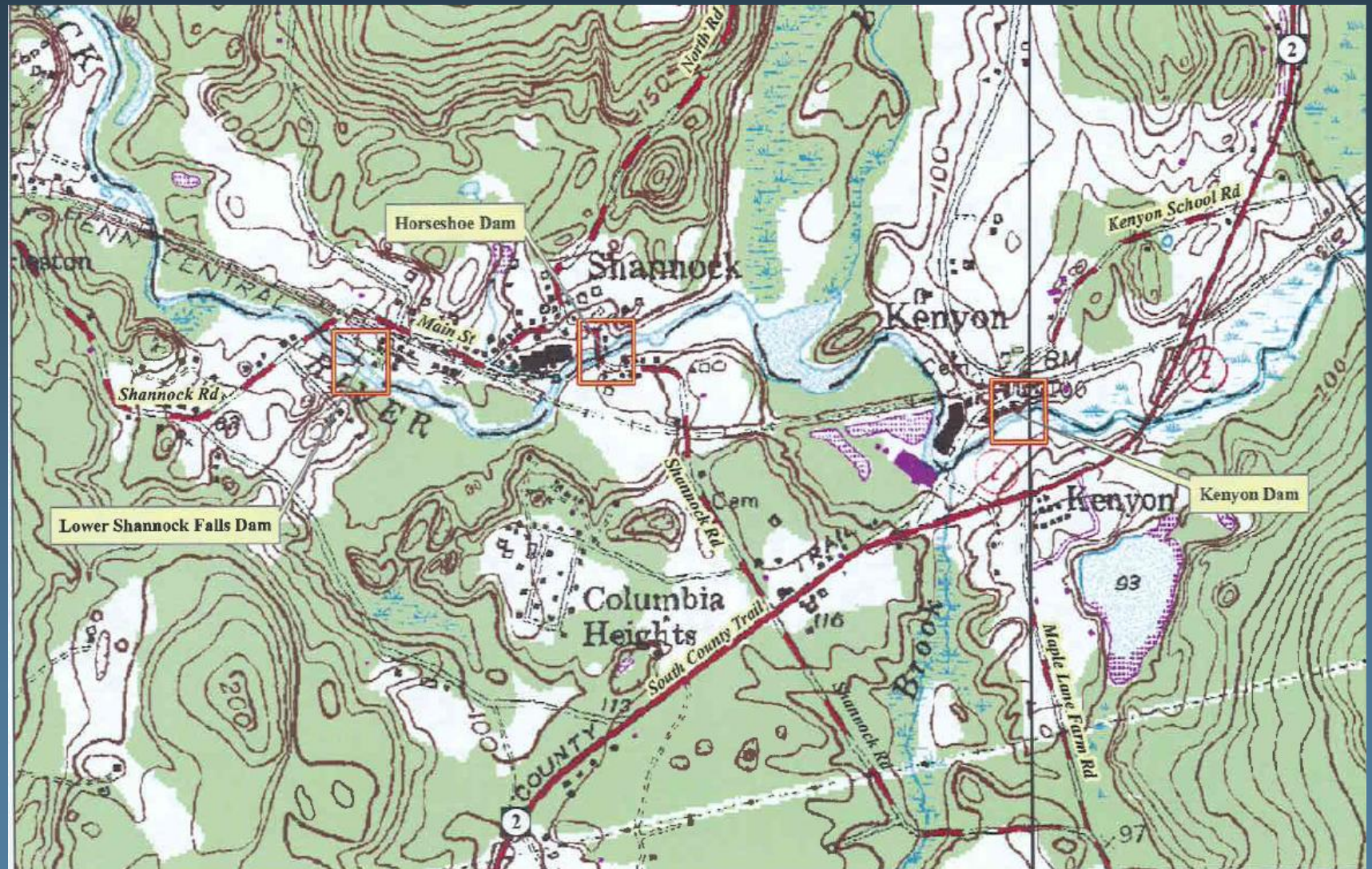
Source: August 2007 Malone and MacBroom Feasibility Study

## Watershed and River Continuity Map



# Site Description

## Kenyon Mill Dam Fish Passage Project



Upper Pawcatuck River Project Site Locations

# Site Description

## Kenyon Mill Dam Fish Passage Project

### Target Fish Species

- Alewife
- Blueback Herring
- American Shad
- Atlantic Salmon
- American Eel
- Resident Fish Species
  - *Brown Trout*
  - *Brook Trout*



# Site Description

## Kenyon Mill Dam Fish Passage Project

- 1772 – Iron Works Mill
- 1820 – Sold by T. Holburton to Lewis Kenyon, Became Cotton/Woolen Mill
- 1844 – Lewis Kenyon's Sons Expanded Mill
- 1857 – Elijah Kenyon, Sole Owner of Mill (Woolen Mill)
- 1881 - Expanded Mill Complex (E. Kenyon & Son)
- 1894 – Expanded Mill Complex Including Rerouting River Through Mill (First Date When Dam is Referenced)
- 1911 – Mill and Equipment Sold to F.P. Smith of Boston
- 1936 – Mill Bought by Kenyon Piece Dye Works, Large Scale Improvements
- 1996 – Mill Operating as Kenyon Industries

# Site Description

## Kenyon Mill Dam Fish Passage Project

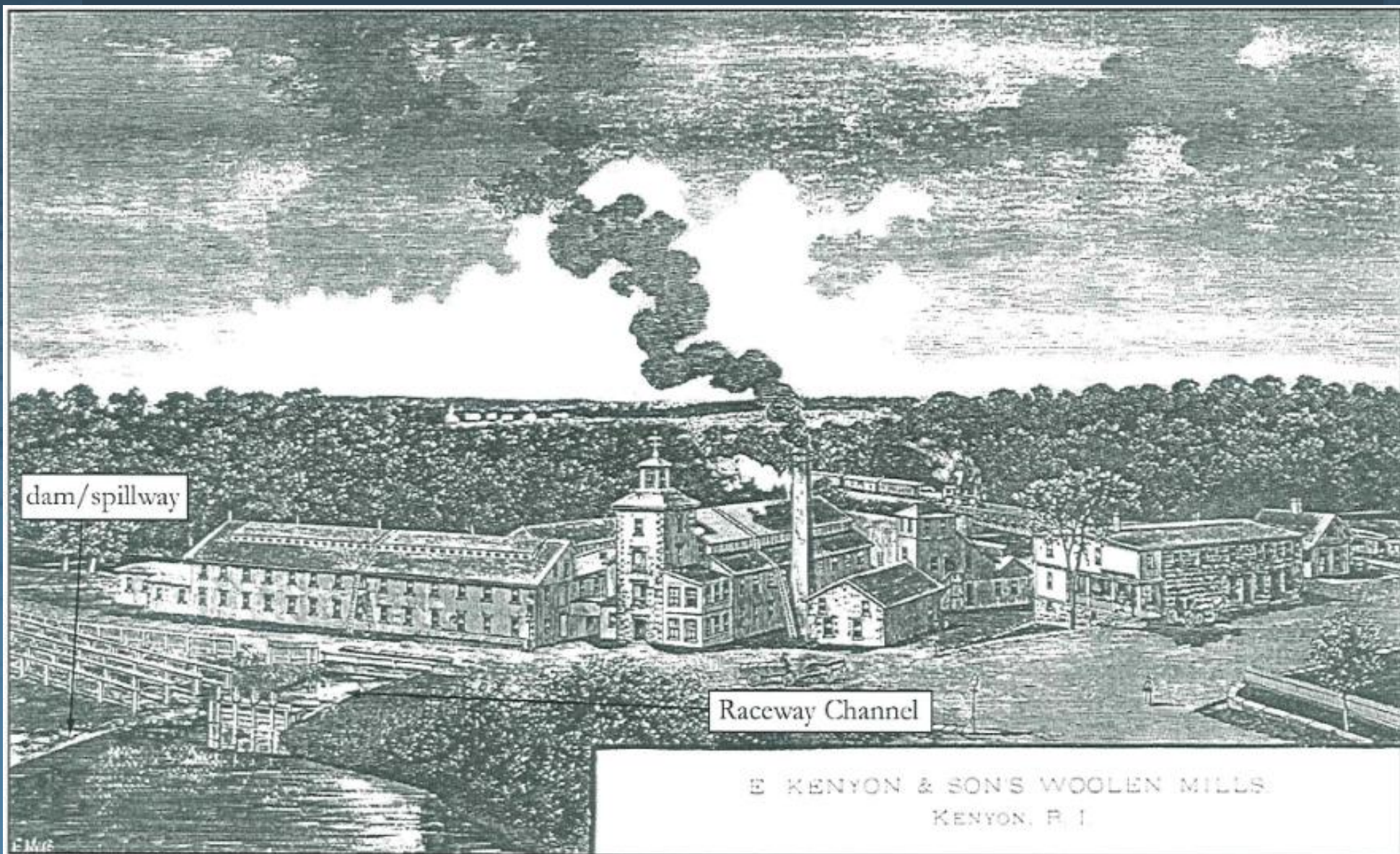
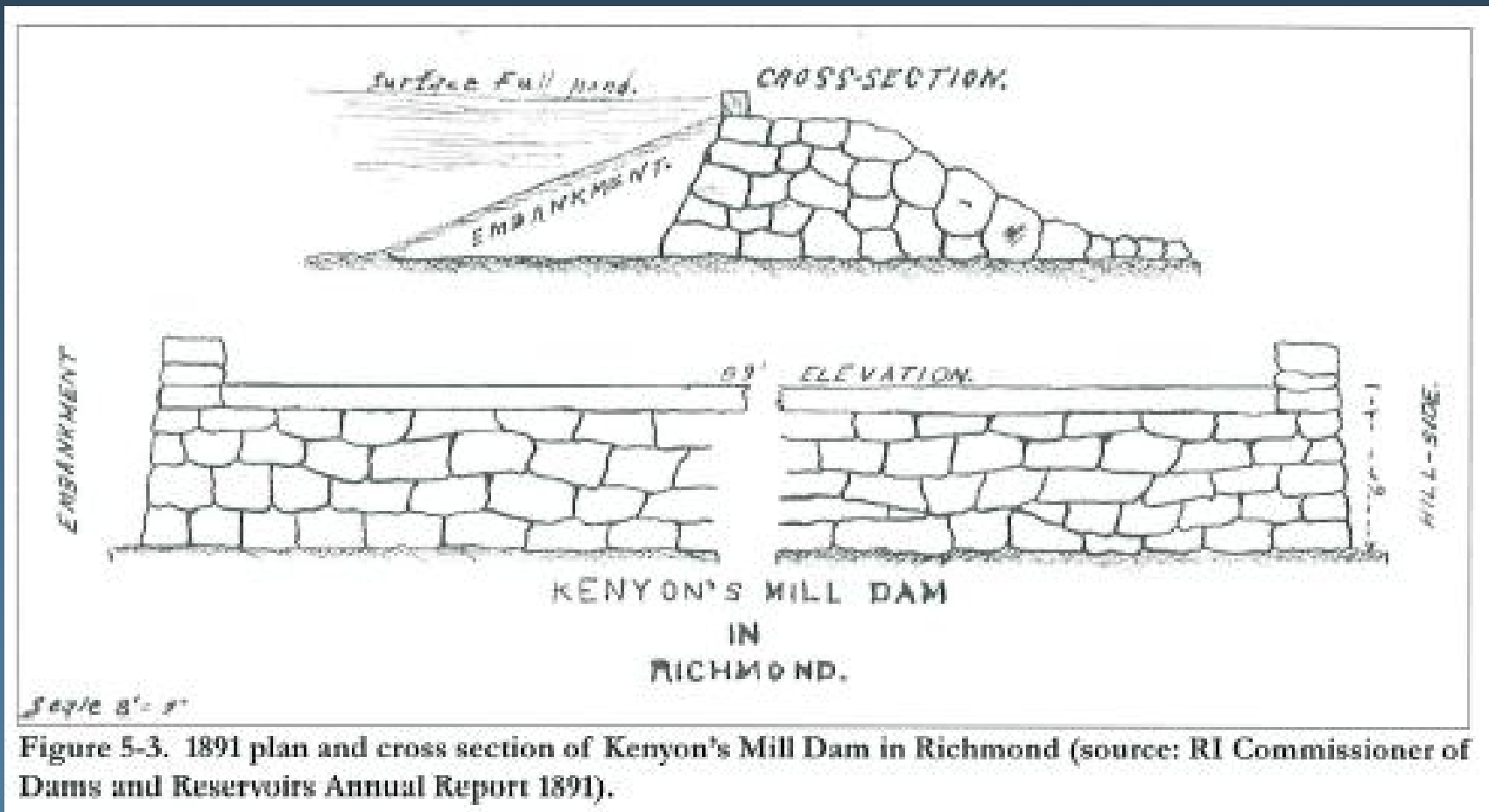


Figure 5-1. Ca. 1889 lithograph of the E. Kenyon & Son's Woolen Mills (source: Cole 1889).



# Site Description

## Kenyon Mill Dam Fish Passage Project



# Site Description

## Kenyon Mill Dam Fish Passage Project



Source: RIGIS/URI

1939 Site Aerial



# Site Description

## Kenyon Mill Dam Fish Passage Project



Existing Dam at Kenyon Industries

# Agenda

## Kenyon Mill Dam Fish Passage Project

### Previous Dam Assessments and Current Condition



# Current Dam Condition

## Kenyon Mill Dam Fish Passage Project

### Current Site Photographs



Existing Spillway – August 2009

# Current Dam Condition

## Kenyon Mill Dam Fish Passage Project

### Current Site Photographs



Existing Spillway – October 2010



# Current Dam Condition

## Kenyon Mill Dam Fish Passage Project

### Current Site Photographs



Mill Fire Suppression System Intake - March 2009

# Current Dam Condition

## Kenyon Mill Dam Fish Passage Project

### Current Site Photographs

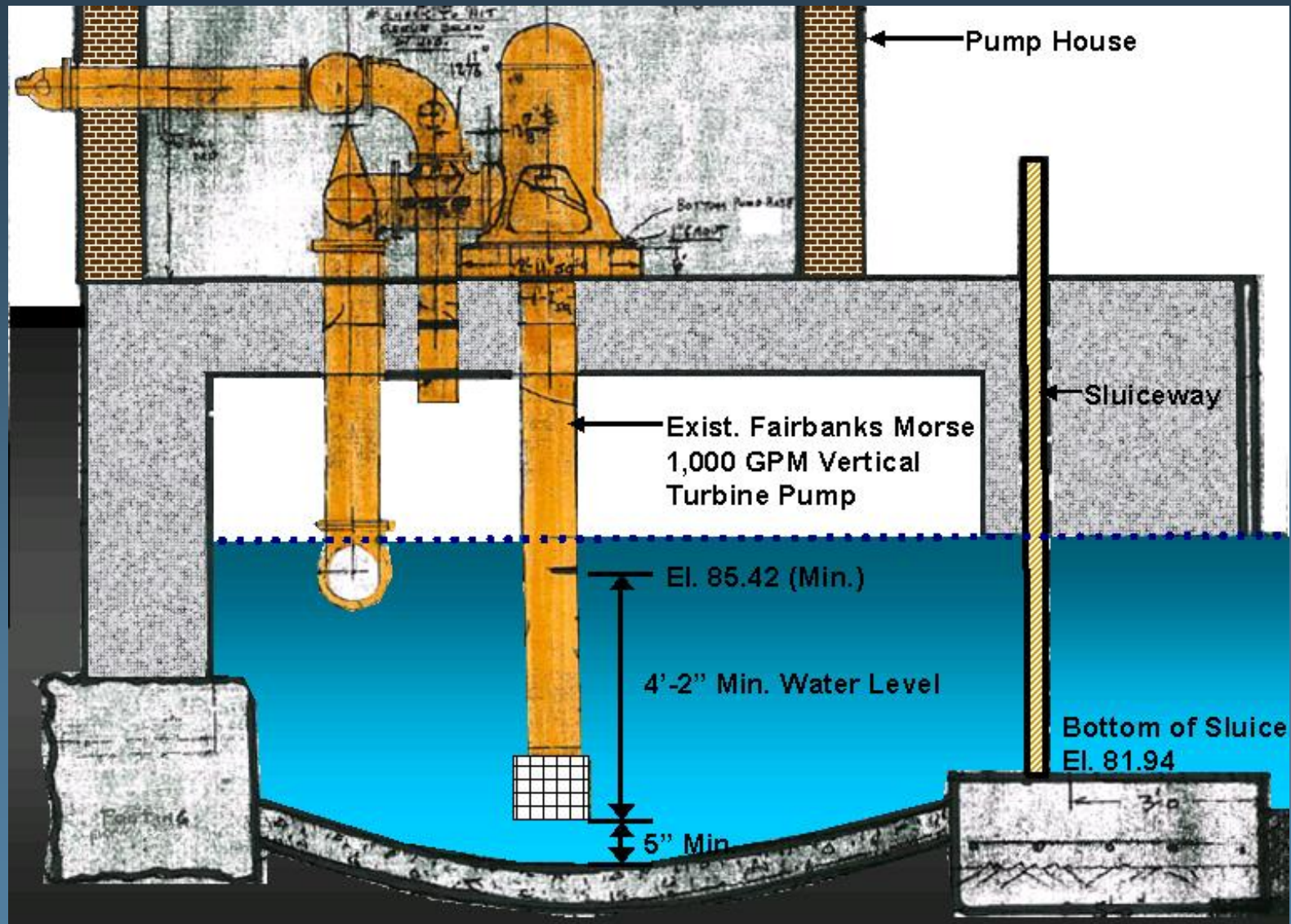


Mill Fire Suppression System Intake - August 2009



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project



Kenyon Industries Fire Suppression Pump Intake System



# Current Dam Condition

## Kenyon Mill Dam Fish Passage Project

### Current Condition of Dam

- *Partial Breach at End of Spillway on River-Left (Charlestown side)*
- *Spillway Section in Need of Repair*
- *No Low-level Discharge Outlet*
- *Current Visual Assessment of Spillway Reflects POOR Condition*

# Agenda

## Kenyon Mill Dam Fish Passage Project

### 2007 Feasibility Study Alternatives Evaluation

# 2007 Feasibility Study Alternatives Evaluation

## Kenyon Mill Dam Fish Passage Project

### Feasibility Study Alternatives

**TABLE 5-1**  
**Summary of Alternatives Considered**

<i>Alternative</i>	<i>Description</i>
<i>Kenyon Mill Dam</i>	
K-1	No Action
K-2	Fish Ladder on Right Bank
K-3	Bypass Channel Through Existing Breach
K-4	Full Dam Removal
K-5	High Gradient Riffle

BRANCK, FISH PASSAGE FEASIBILITY STUDY  
PAWCATUCK RIVER  
BIDDEFORD AND CHARLESTOWN, RHODE ISLAND

August 10, 2007  
MDE #2049-01



*Prepared for:*

Wood-Pawcatuck Watershed Association  
205 Arville Road  
Hope Valley, Rhode Island 02832

*Prepared by:*

MILONE & MACBROOM, INC.  
99 Ruddy Drive  
Charlton, Connecticut 06119  
(203) 270-4371  
www.miloneandmacbroom.com



Source: August 2007

Malone and MacBroom Feasibility Study



# 2007 Feasibility Study Alternatives Evaluation

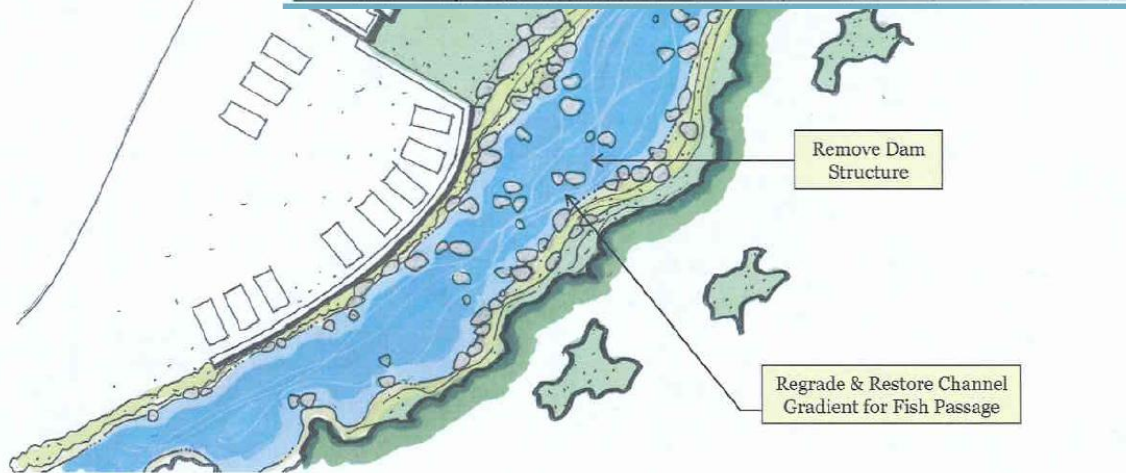
## Kenyon Mill Dam Fish Passage Project

### Alternatives Evaluation Summary Table

**TABLE 8-10**  
**Summary of Alternatives at Kenyon Mill Dam**

<i>Alternative</i>	<i>Description</i>	<i>Achieves Fish Passage?</i>	<i>Improves Habitat Conditions?</i>	<i>Minimizes Long Term Dam Maintenance?</i>	<i>Potential for Impact to Historic Resources?</i>	<i>Prudent and Feasible Alternative?</i>
K-1	No Action	No	No	No	No	No
K-2	Fish Ladder	Yes	No	No	Yes	Yes
K-3	Bypass Channel	Yes	No	No	Yes	Yes
K-4	Full Dam Removal	Yes	Yes	Yes	Yes	Yes
K-5	High Gradient Riffle	Yes	No	Yes	Yes	No

Restructure Fire  
Suppression System at  
Kenyon Industries



Source: August 2007

Malone and MacBroom Feasibility Study

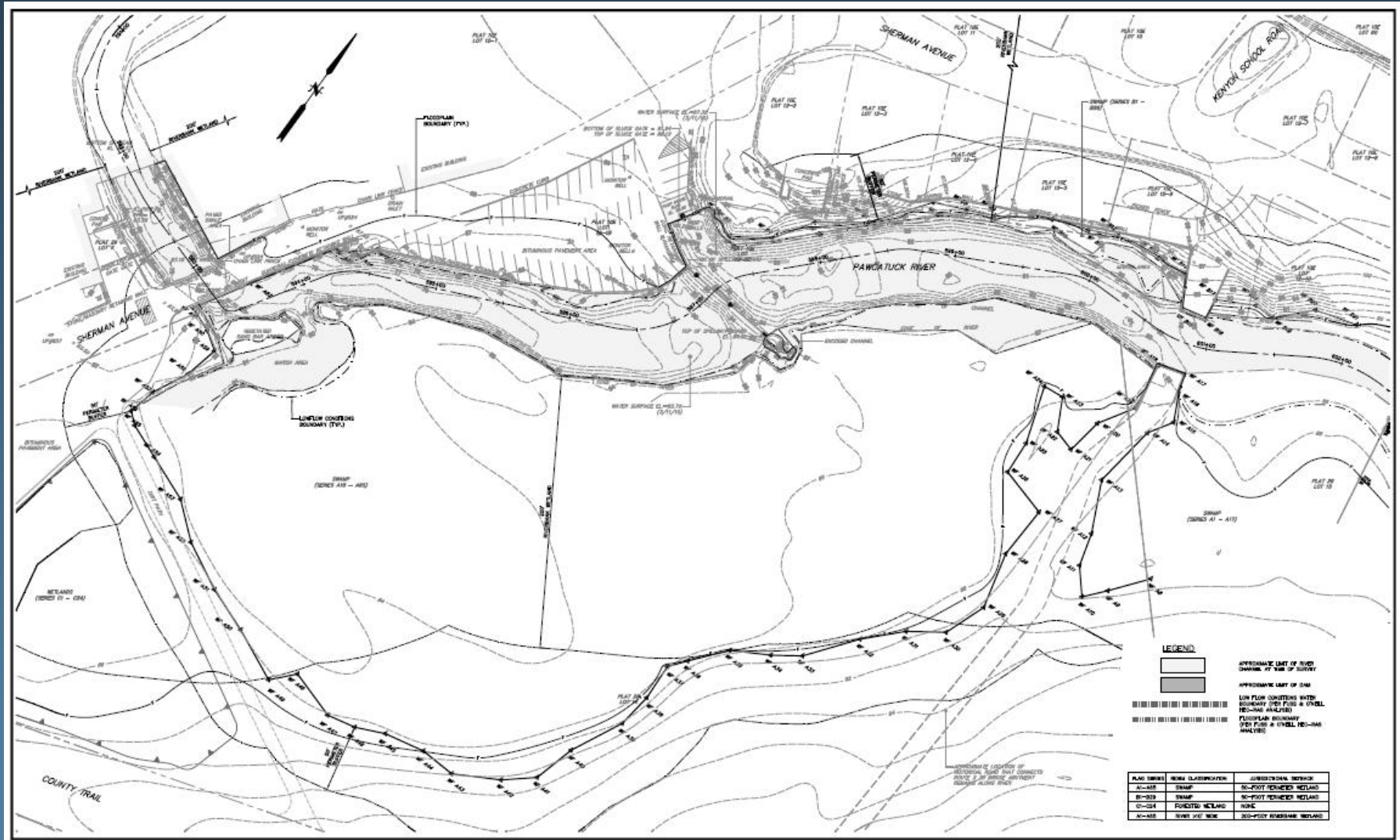
# Agenda

## Kenyon Mill Dam Fish Passage Project

# Data Collection and Assessments

# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project



Site Survey and Topographic Mapping

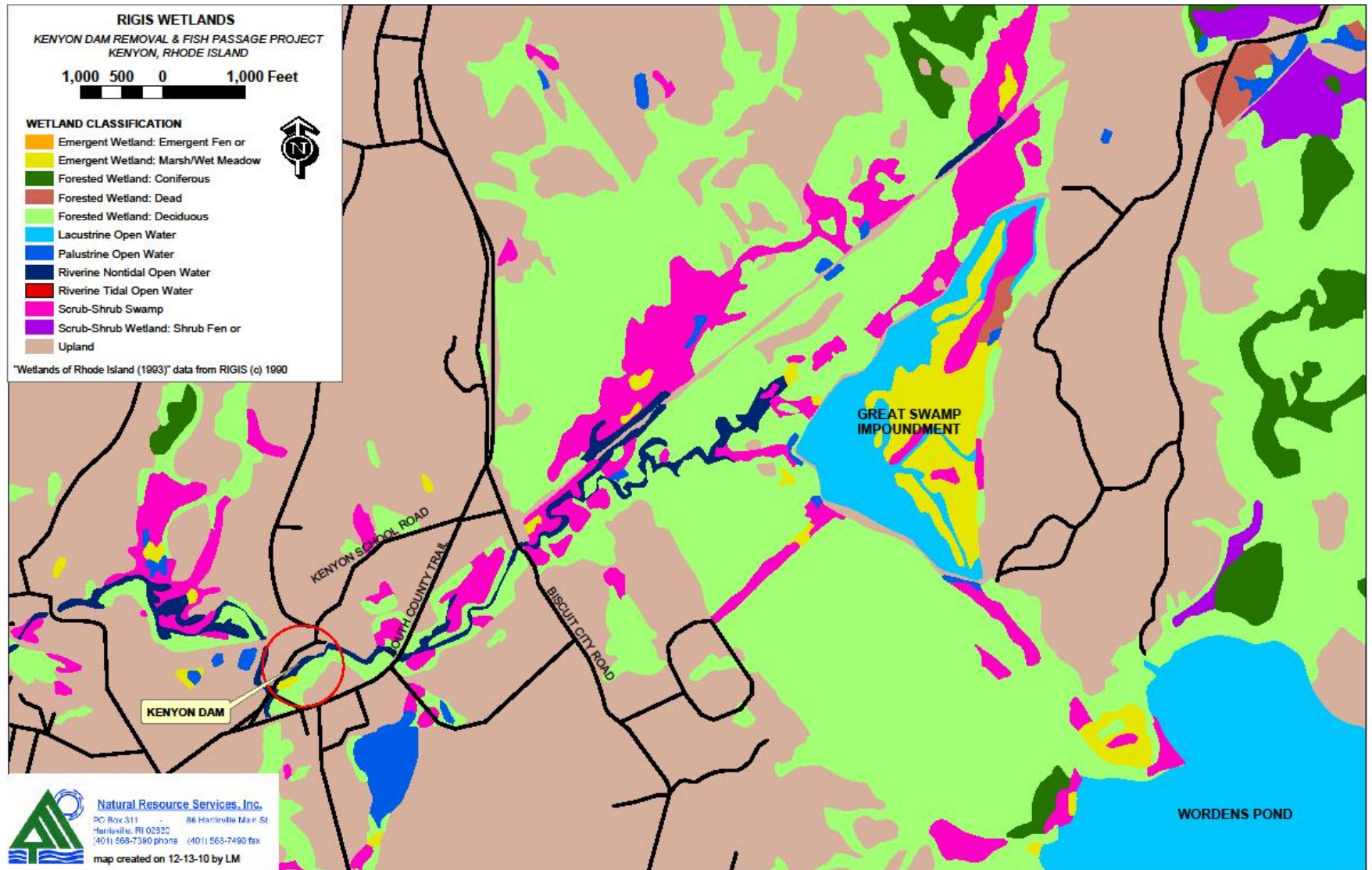


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# Site Survey and Topographic Mapping

# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project

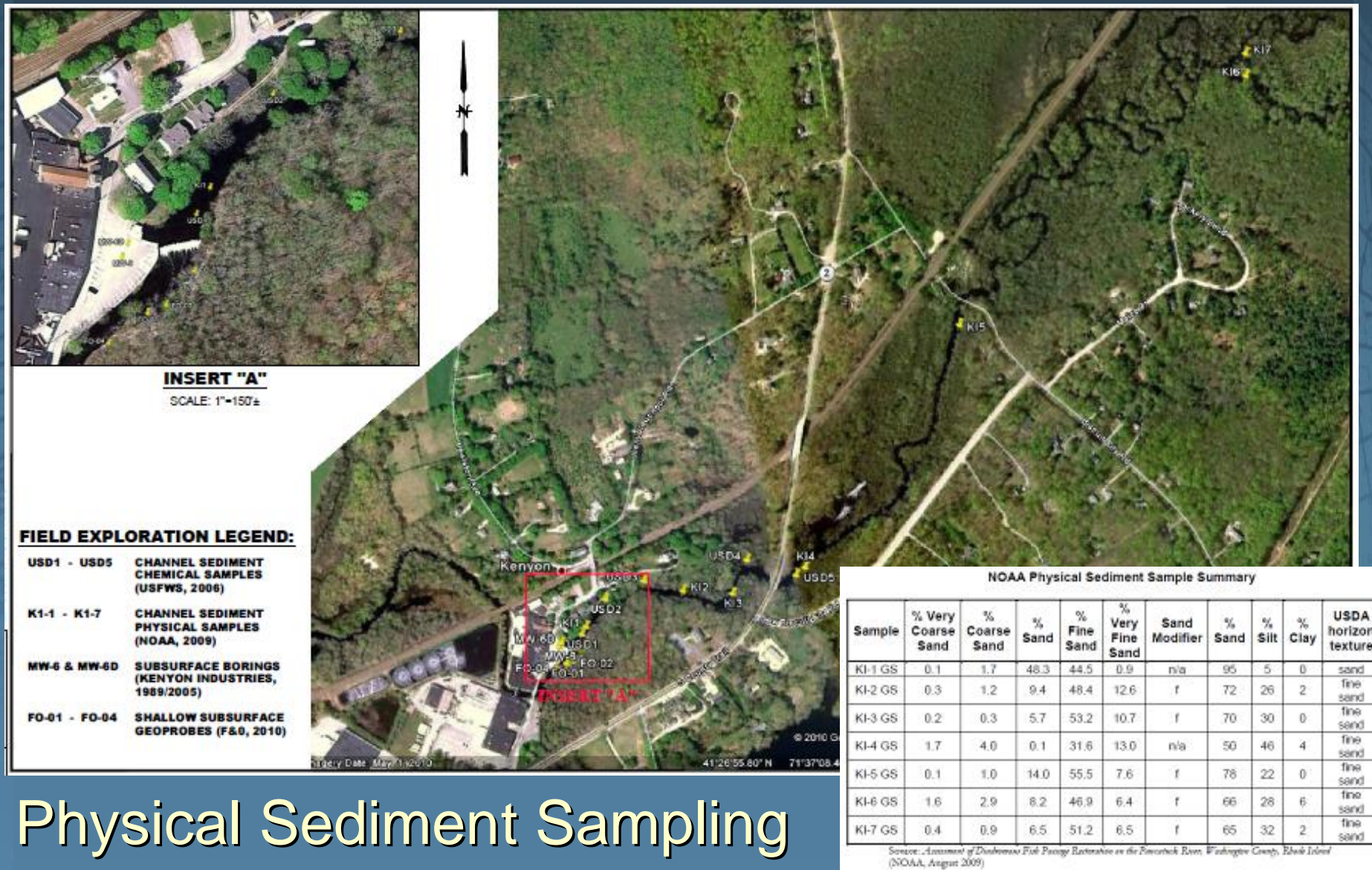


## Existing Wetland Resources



# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project

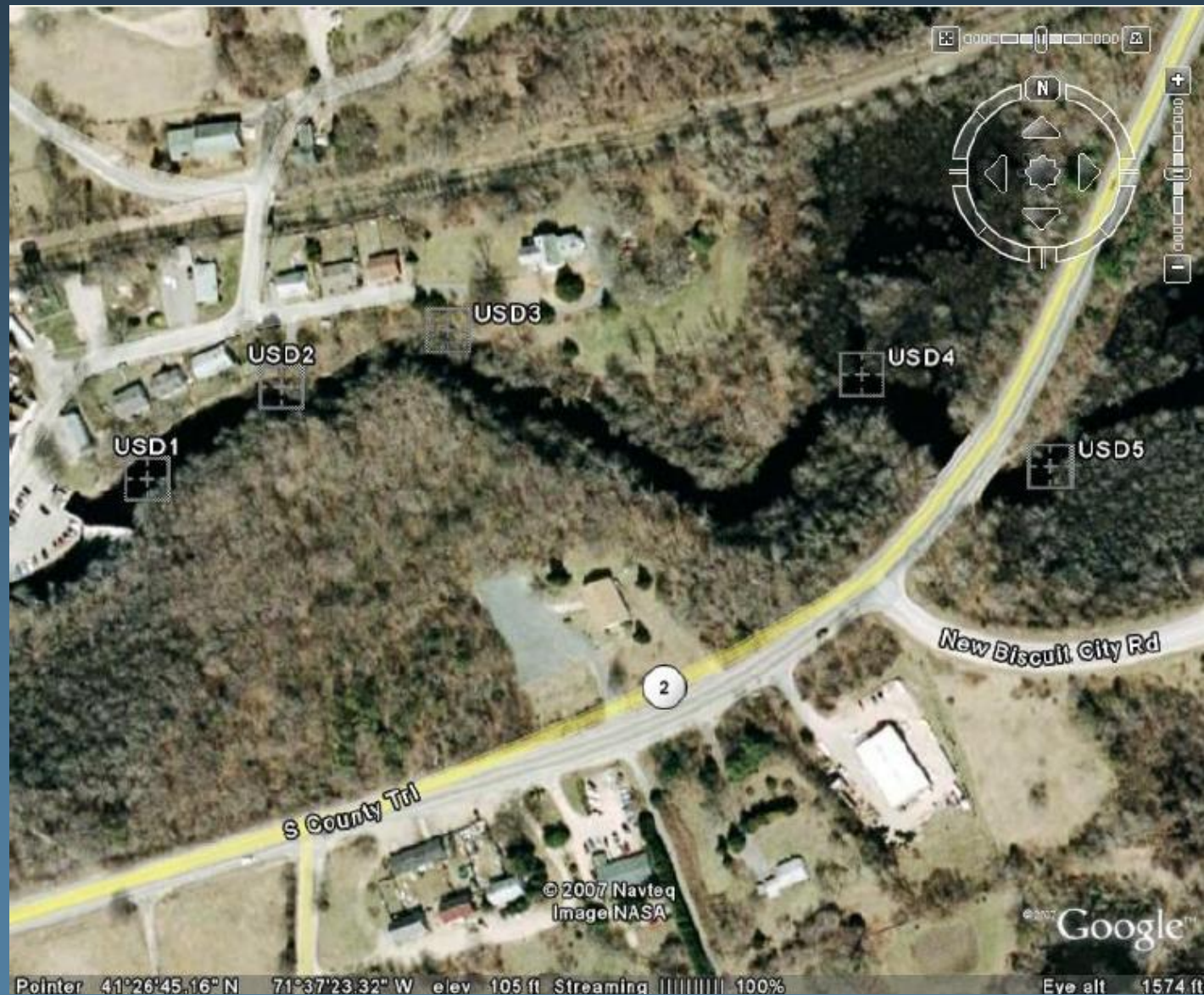


## Physical Sediment Sampling



# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project



## Chemical Sediment Sampling



# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project

Summary Table of Sediment Test Results  
Kenyon Mill Dam  
Samples Collected by USFWS on Aug. 17, 2006

	Location	US01	US02	US03	US04	US05	Reference Criteria			Freshwater Criteria (1)						
										(2000)			1999 NOAA SQUIRTs, 1999			
							Sample Date	17-Aug-06	17-Aug-06	17-Aug-06	17-Aug-06	17-Aug-06	TEC	R-DEC	I/C-DEC	TEC
											Threshold Effect Concentrations	Probable Effect Concentrations	Lowest ARCs Hazards	Threshold Effect Level	Probable Effect Level	Upper Effects Threshold
VOCs (via Method 8280)																
Acetone	µg/kg						NE	7,800,000	10,000,000							
SVOCs/PAHs (via Method 8270)																
Acenaphthylene	µg/kg	35	81.9	BDL	23.6	BDL	NE	23,300	10,000,000							160 M
Anthracene	µg/kg	27.8*	128*	5.52	24.5*	BDL	57.2	35,000	10,000,000	57	845	10				260 M
Benzo(a)anthracene	µg/kg	77*	382*	11.4	53.4*	BDL	108	900	7,300	108	1,050	18	32	385	500	I
Benzo(a)pyrene	µg/kg	74.1*	311*	8.61	50.2*	BDL	150	400	800	150	1,450	32	32	782	700	I
Benzo(b)fluoranthene	µg/kg	189	7.20	21.3	10.7	4.57	NE	900	7,300	NE	NE					
Benzo(ghi)perylene	µg/kg						NE	800	10,000,000							
Benzo(k)fluoranthene	µg/kg	43.5*	180*	6.6	36.0*	BDL	NE	900	78,000							
Bis(2-ethylhexyl)phthalate	µg/kg						NE	46,000	410,000				27			13,400 S
Chrysene	µg/kg	115*	491*	15.8	89.1*	5.02	NE	165	420	780,000	166	1,390	27	57	862	800 I
Dibenz(a,h)anthracene	µg/kg	16*	71.0*	BDL	14.8*	BDL	33	400	930	33			10			300 M
Fluoranthene	µg/kg	254*	1000*	45.7*	207*	11.1	423	20,000	10,000,000	423	2,230	31	111	2,355	1,500	M
Fluorene	µg/kg	26.1*	115*	6.96	37.8*	BDL	77.4	28000	10,000,000	77.4	536	10				300 M
Indeno(1,2,3-cd)pyrene	µg/kg	71.5*	306*	11.5	63.4*	BDL	NE	900	7,300				17			330 M
Naphthalene	µg/kg	33.1*	173*	9.73	71.5*	BDL	176	54000	10,000,000	176	561	15				600 I
Phenanthrene	µg/kg	143*	671*	24.8*	152*	6.67	264	40,000	10,000,000	264	1,170	19	42	515	800	I
Pyrene	µg/kg	108*	341*	33.0*	75.2*	7.26*	195	13,000	10,000,000	195	1,520	44	53	675	1,000	I
2-Methylnaphthalene	µg/kg	64.2	258	12.7	1.26	BDL	NE	123,000	10,000,000							
Acenaphthene	µg/kg	5.01	59.2	6.99	9.30	BDL	NE	43,000	10,000,000							290 M
Benzo(g)pyrene	µg/kg	72.2	300	10.0	95	BDL	NE	NE	NE							
Total Selected PAHs	µg/kg	1345.7*	5542*	624.2*	1781.9*	751.4*	1,610	NE	NE	1,610	22,800	264				12,000 M
Total Metals (via Method 8010/7471)																
Arsenic	mg/kg	0.6	3		1	BDL	0.70	7	7		0.79	33	10.8	5.9	17	17 M
Barium	mg/kg						NE	5,500	10,000							
Beryllium	mg/kg						NE	0.4	1.3							
Cadmium	mg/kg	0.3*	1.3*	0.9*	1.3*	1.1*	0.99	30	1,000	0.99	4.98	0.58	0.6	5.53	3	I
Chromium	mg/kg	3	12	11	5.4	6.1	43.4	380**	10,000	43.4	111	36.3	37.3	90	95	H
Copper	mg/kg	4	22	5.4	4	2	31.6	3,100	10,000	31.6	146	25	35.7	197	88	I
Lead	mg/kg	10	79*	17	9	BDL	35.8	150	500	35.8	128	37	35	61.3	127	H
Manganese	mg/kg						NE	390	10,000							
Mercury	mg/kg	BDL	0.2	BDL	BDL	BDL	0.18	23	610	0.18	1.08		0.17	0.49	0.56	M
Nickel	mg/kg	BDL	5	BDL	BDL	BDL	22.7	1,000	10,000	22.7	48.8	19.5	18	35.9	43	H
Vanadium	mg/kg						NE	550	10,000							
Zinc	mg/kg	17	81	27	29	29	121	6,000	10,000	121	450	98	123.1	315	520	M
PCBs (via Method 8082)	µg/kg	19.2	80.8*	10	18	0.08	59.8	10,000	10,000	59.8	678	31.6		277	26	M
Pesticides (via Method 8081)																
p,p-DDD	µg/kg	2.88	3.08	0.72		0.08								3.54	8.51	80 I
Sum-DDD	µg/kg	3.87	5.93	1.28	2.28	0.22				4.88	28					I
p,p-DDD	µg/kg	2.88	2.12	0.81		0.11								1.42	6.75	50 I
Sum-DDD	µg/kg	3.49	3.45	0.93	1.28	0.48				3.16	31.3					I
p,p-DDT	µg/kg	0.89*	1.76	0.46	1.38	0.32										<50 I
Sum-DDT	µg/kg	0.83	2.09	0.52	1.54	0.52				4.16	62.9		6.98	4450	50	I
Aldrin	µg/kg	1.07	7.85	BDL	1.38	BDL										40 I
alpha-BHC	µg/kg	0.05	0.212	0.154	0.132	0.158										
beta-BHC	µg/kg	BDL	0.07	0.12	0.13	BDL										
delta-BHC	µg/kg	BDL	BDL	BDL	BDL	BDL										
gamma-BHC (Lindane)	µg/kg	BDL	BDL	BDL	BDL	BDL				2.37	4.90		0.14	1.38	9	I
gamma-Chlordane	µg/kg	0.08	0.15	0.15	0.17	0.13				3.24	17.8		4.5	8.9	30	I
Chlorpyrifos	µg/kg	0.2231	0.149	0.149	0.149	0.149										
Dieldrin	µg/kg	0.08	BDL	BDL	BDL	BDL	1.9*	40	400	1.9	61.8		2.85	6.67	300	I
Endosulfan II	µg/kg	BDL	BDL	BDL	BDL	BDL										
Endrin	µg/kg	BDL	BDL	0.127	0.149	0.13				2.22	207		2.87	82.4	500	I
HCB	µg/kg	BDL	0.08	BDL	BDL	BDL										100
Heptachlor	µg/kg	0.08	0.32	0.08	0.13	BDL										10
Heptachlor epoxide	µg/kg	BDL	BDL	0.127	BDL	0.164				2.47	18		0.6	2.74	30	I
Mirex	µg/kg	0.201	0.499	BDL	BDL	BDL										
o,p'-Nonachlor	µg/kg	0.06	0.112	BDL	BDL	BDL										
trans-Nonachlor	µg/kg	BDL	BDL	BDL	BDL	BDL										
Oxydemeton	µg/kg	BDL	0.308	BDL	BDL	BDL										
Cyfluthrin	µg/kg	BDL	BDL	BDL	BDL	BDL										

BDL	= Below Laboratory Detection Limit
RED TEXT	= Exceed R-DEC
✓	= Exceed I/C-DEC
	= Exceeds TEC
	= Exceeds PEC
	= Exceeds TEL (h. azteca)
*	= Exceeds TEL
UNDERLINED TEXT	= Exceeds PEL
BOLD UNDERLINED TEXT	= Exceeds PEL
ITALICIZED TEXT	= Exceeds UET

Inorganics (%)	USD1	USD2	USD3	USD4	USD5
TOC	2.5	7.3	4.3	8.9	5.1
Grain Size Analysis (%)					
% Sand	89.4	60.4	65.2	63.6	64.4
% Silt	5.7	25.8	26.1	26	25.7
% Clay	4.8	13.7	9	25.7	10
% Moisture	44.2	61.7	66.1	70.5	53.8

# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project

# Summary of Chemical Sediment Sampling

- Only one parameter in one sample exceeded RI Direct Exposure Criteria
- All results consistent with prior/historical use at the site and along the river
- Sediment Management Plan to be developed and implemented for the project

[illegible]



# Agenda

## Kenyon Mill Dam Fish Passage Project

# Fish Passage Alternatives Analyses

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

### Fish Passage Design Alternatives

- Rock Ramp Construction
  - *Replaces Dam Spillway with a Rock Ramp (approx. 160-feet long)*
  - *Minimal Water Level Change or Effect on Upstream Wetland Resources*
  - *Continued Use of River by Kenyon Industries' Fire Suppression System*
  - *Portage Path Planned for Recreational Boaters*
- Full Dam Removal
  - *Spillway Removed, Potential Modifications to River Channel to Optimize Fish Passage*
  - *Water Level Lowered to Pre-Dam Levels, Some Effect on Upstream Wetland Resources*
  - *River Likely No Longer Used for Kenyon Industries' Fire Suppression System*
- Neither Alternative Will Have an Effect on Worden Pond Water Levels

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

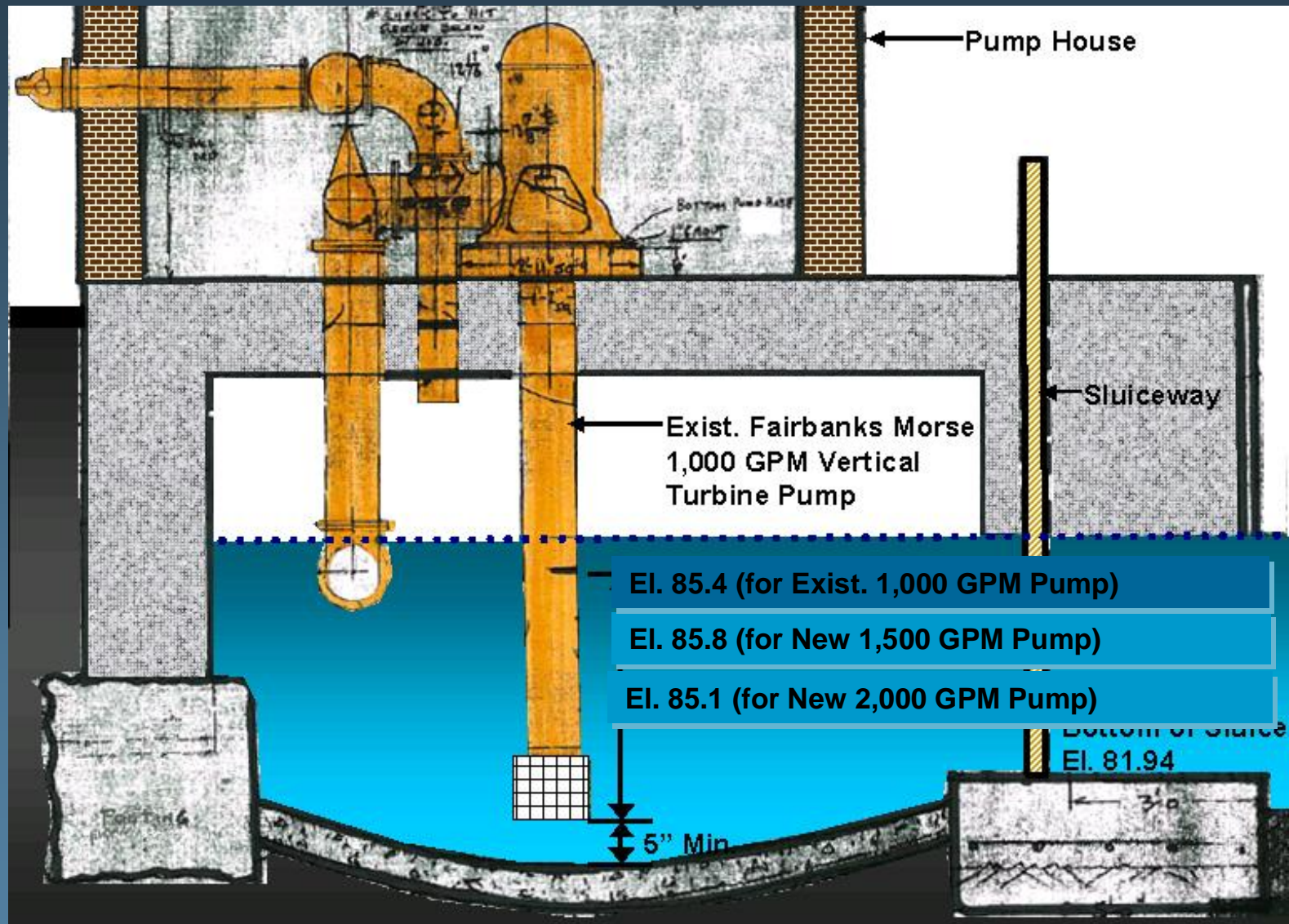
### Rock Ramp Alternative

- *Replaces Dam Spillway with a Rock Ramp (approx. 160-feet long, length determined in final design)*
- *Minimal Water Level Change and Sediment Migration*
- *Minimal Effect on Upstream Wetland Resources*
- *No Effect on Upstream Shallow Groundwater Supply Wells*
- *No Potential for Scour at Upstream Bridges*
- *Continued Use of River by Kenyon Industries' Fire Suppression System, Two Dry Hydrants Installed*
- *Requires Continued Maintenance*
- *Less than Optimal Fish Passage Efficiency*



# Fish Passage Alternatives Analyses

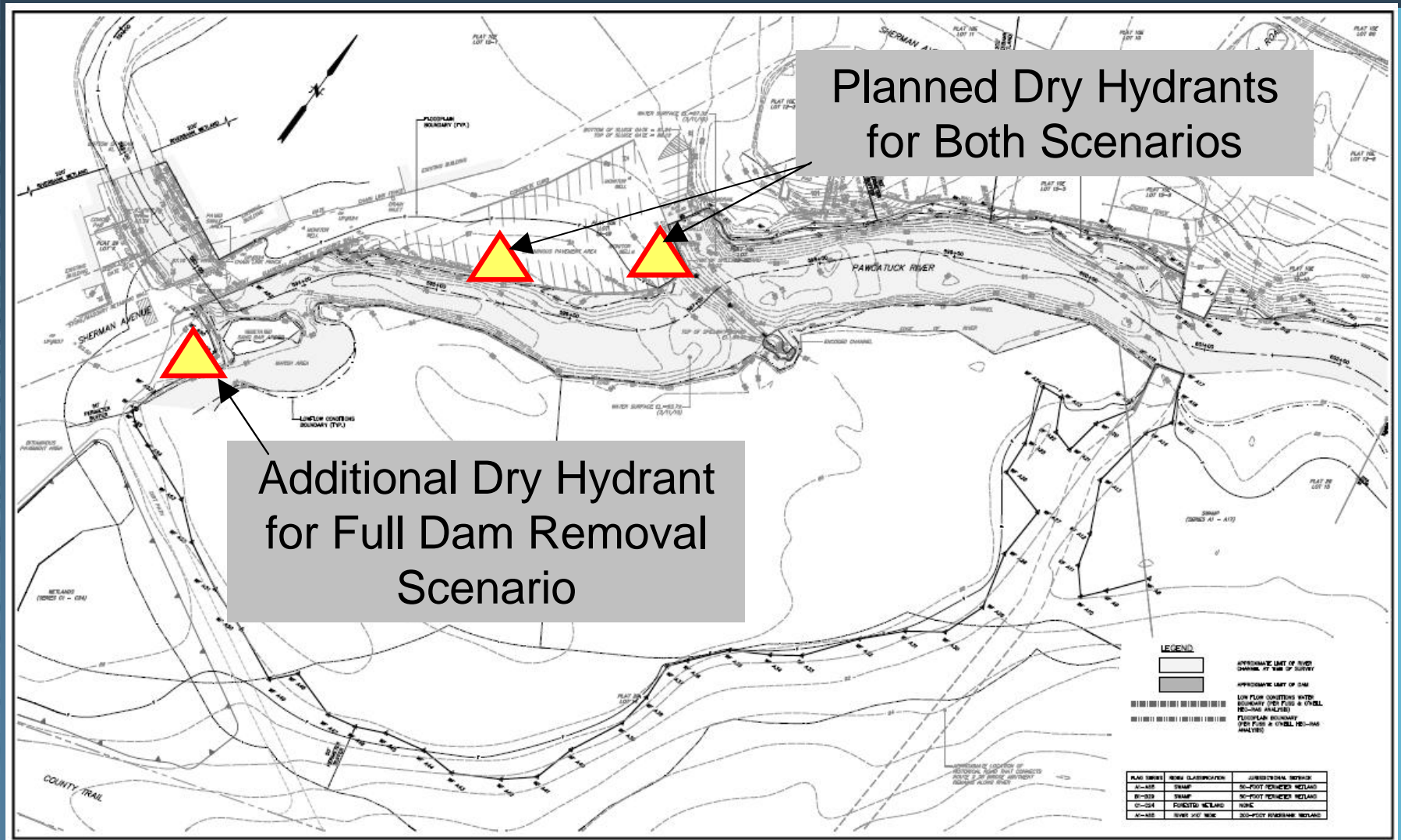
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Kenyon Fire Suppression System

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

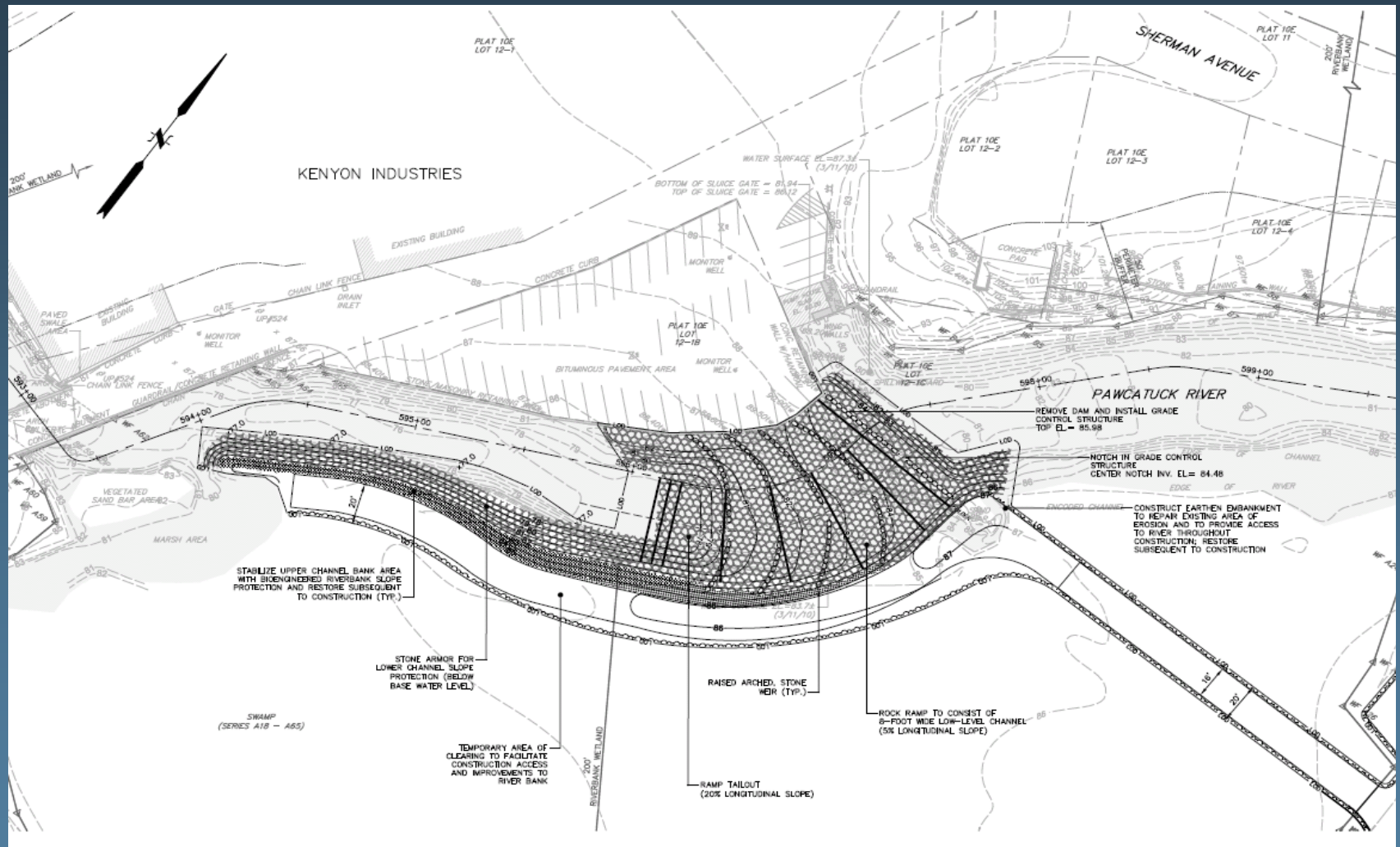


Potential Local Fire Department Dry Hydrant Locations



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

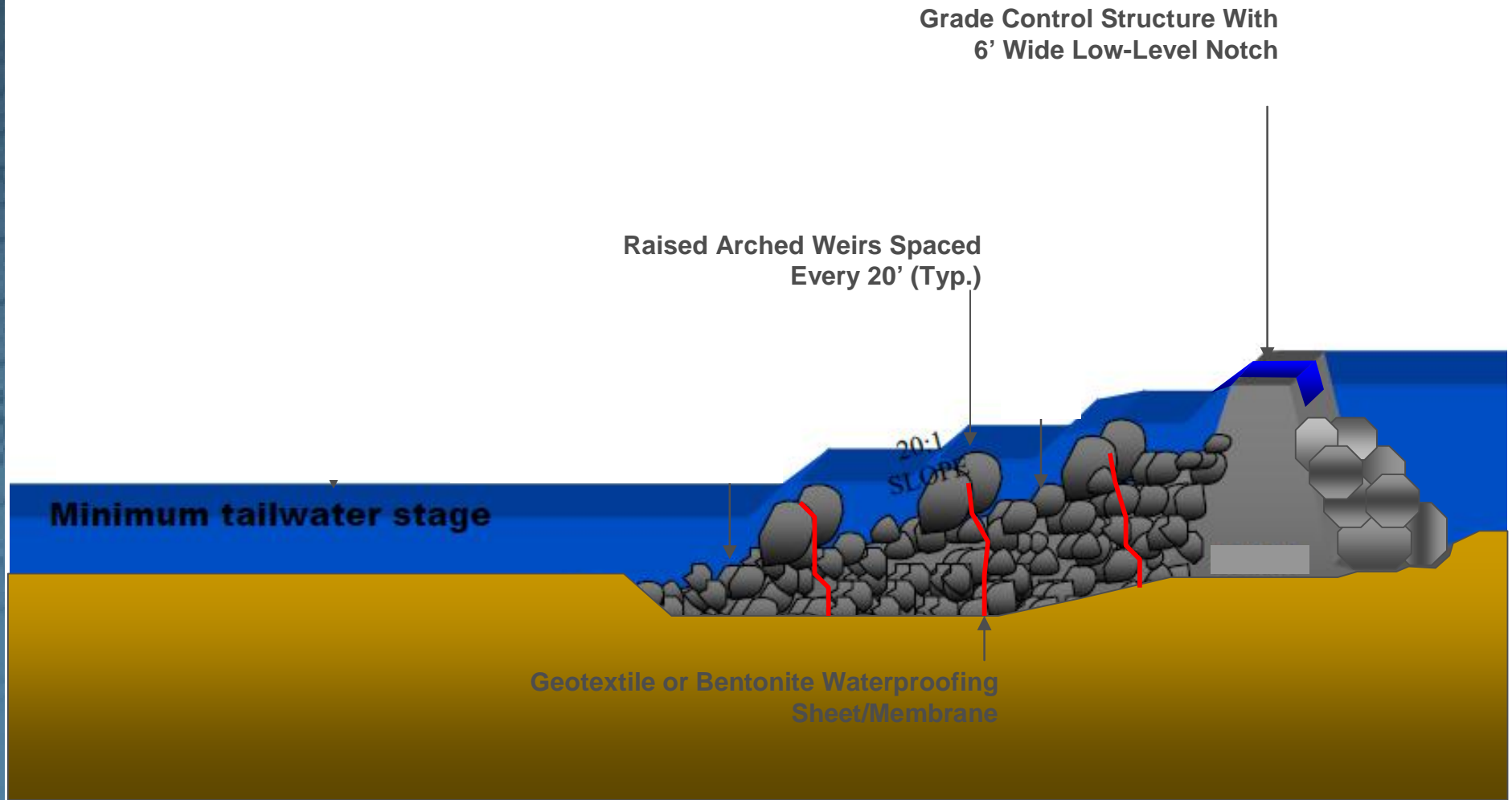


# Preliminary Rock Ramp Layout - Plan View



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project



Rock Ramp - Profile View

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

### Full Dam Removal Alternative

- *Removes Dam Spillway – No Replacement Structure*
- *Potential Water Level Change and Sediment Migration*
- *Potential Effect on Upstream Wetland Resources*
- *Potential Effect on Upstream Shallow Groundwater Supply Wells*
- *Potential Scour Protection Needed at Upstream Bridges*
- *River Likely No Longer Used for Kenyon Industries' Fire Suppression System*
- *Three Dry Hydrants Installed Along River Channel for Local Fire Department Use*
- *No Future Maintenance*
- *Optimal Fish Passage Efficiency*



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

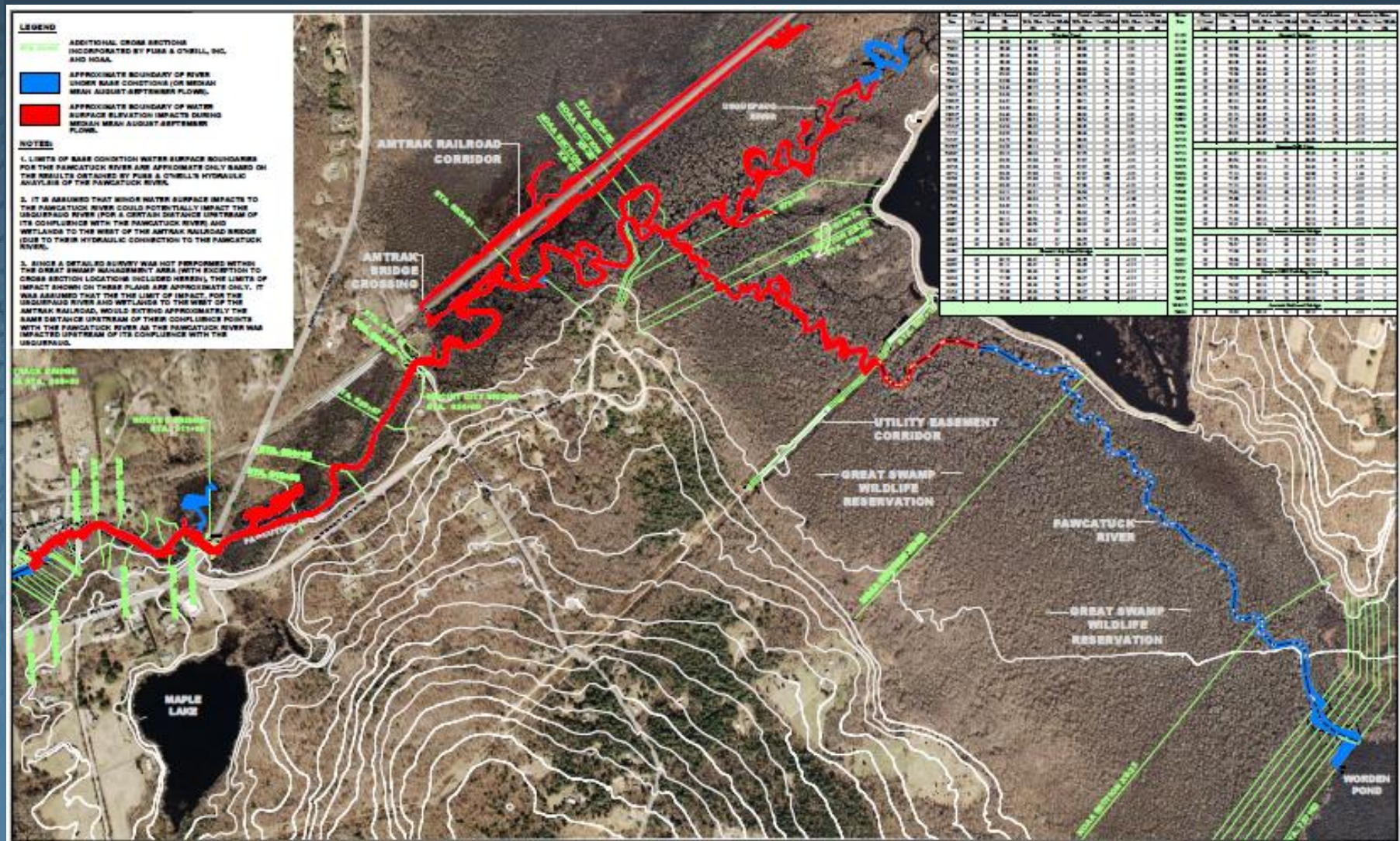


Base Flow Water Surface Elevation Modeling



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

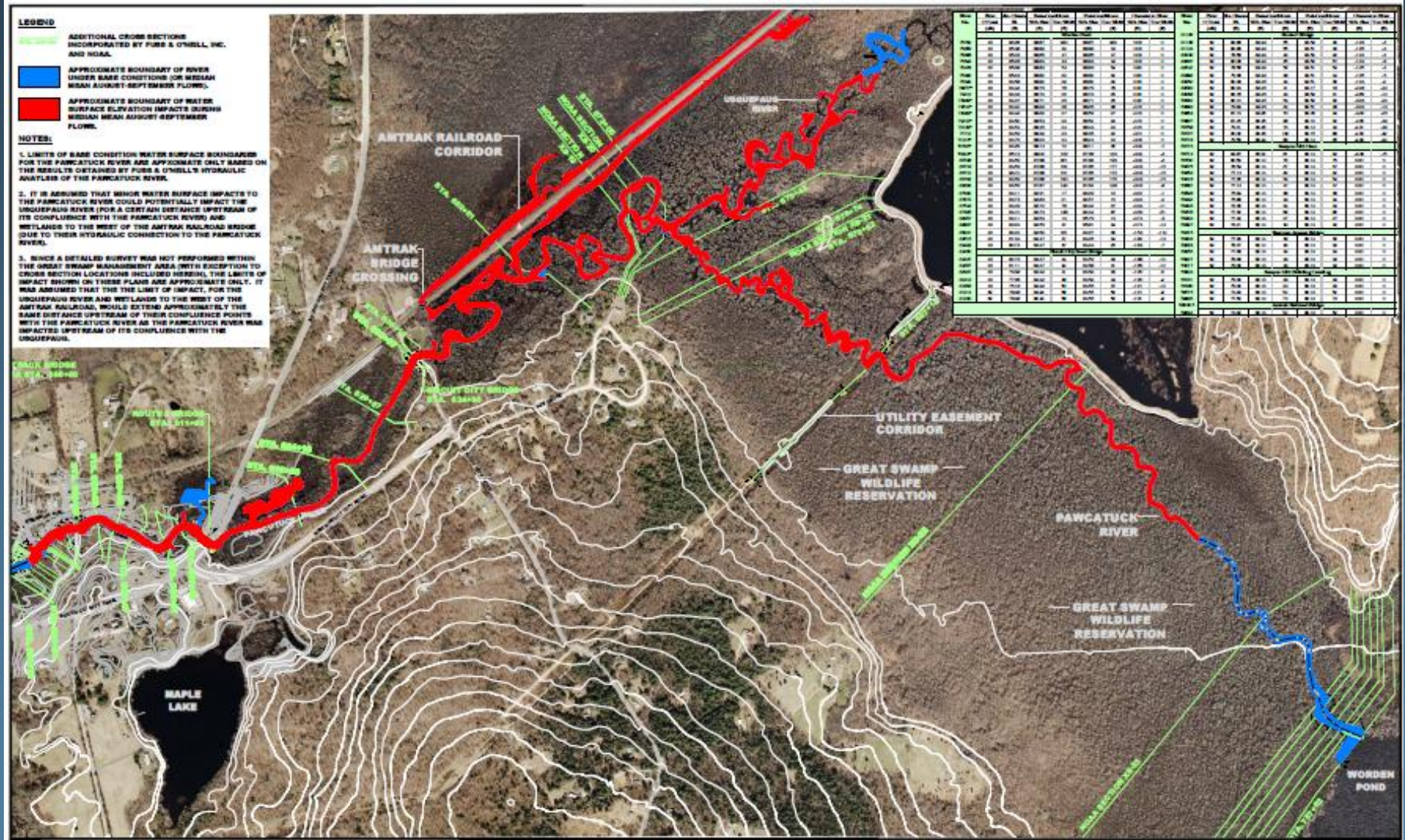


Rock Ramp – Water Surface Change Plan



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

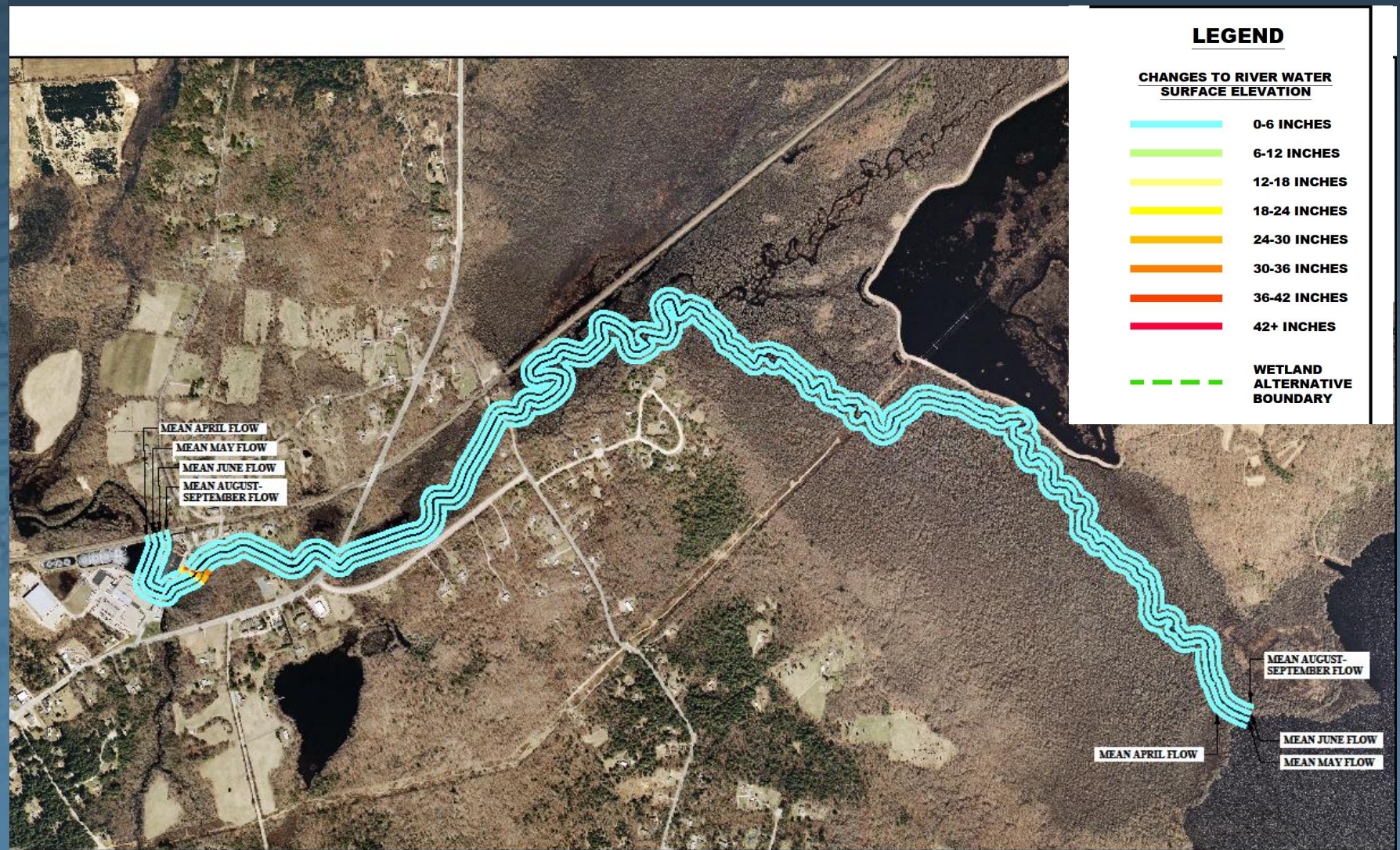


# Full Dam Removal – Water Surface Change Plan



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

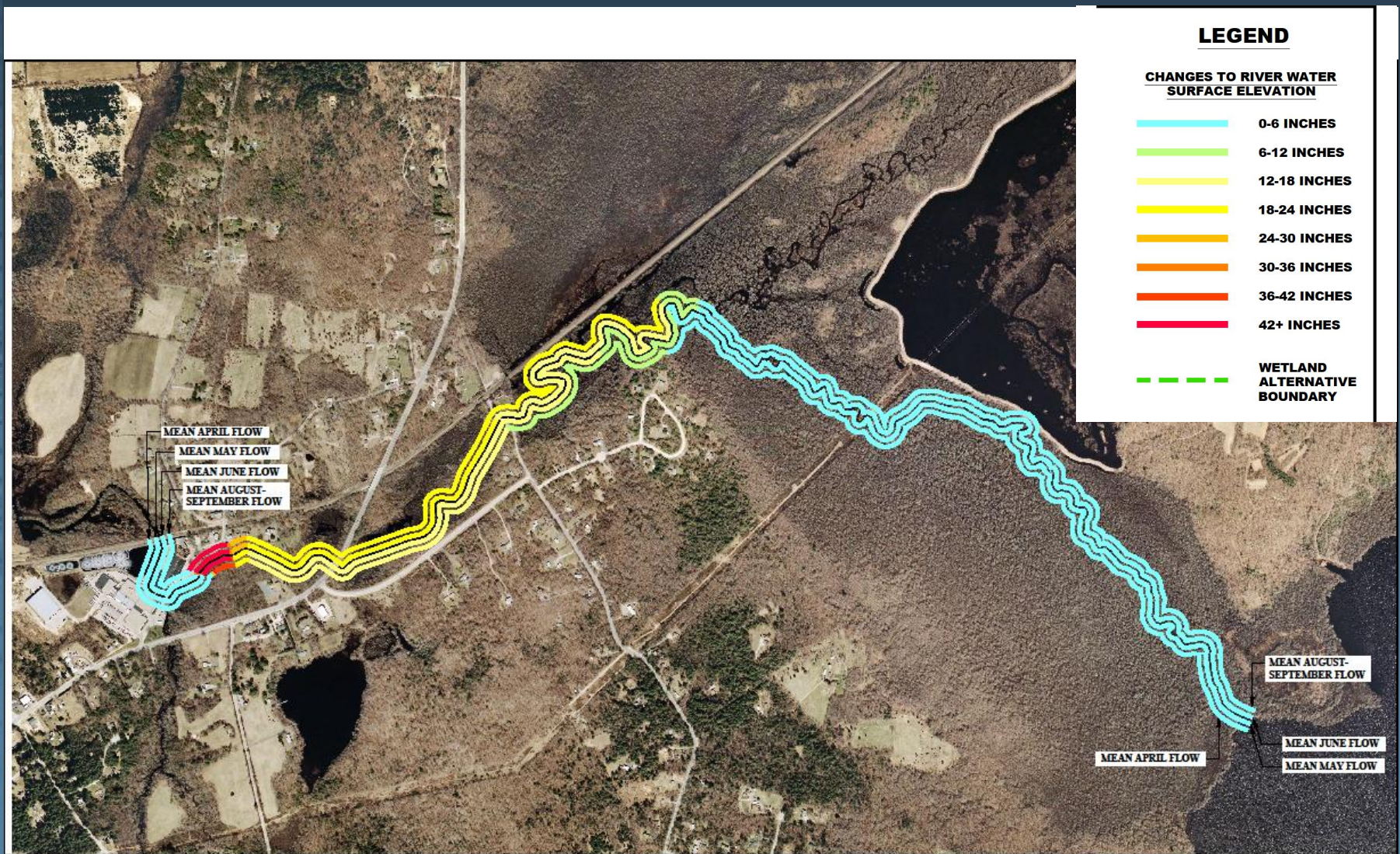


Rock Ramp – Seasonal Water Surface Change Plan



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

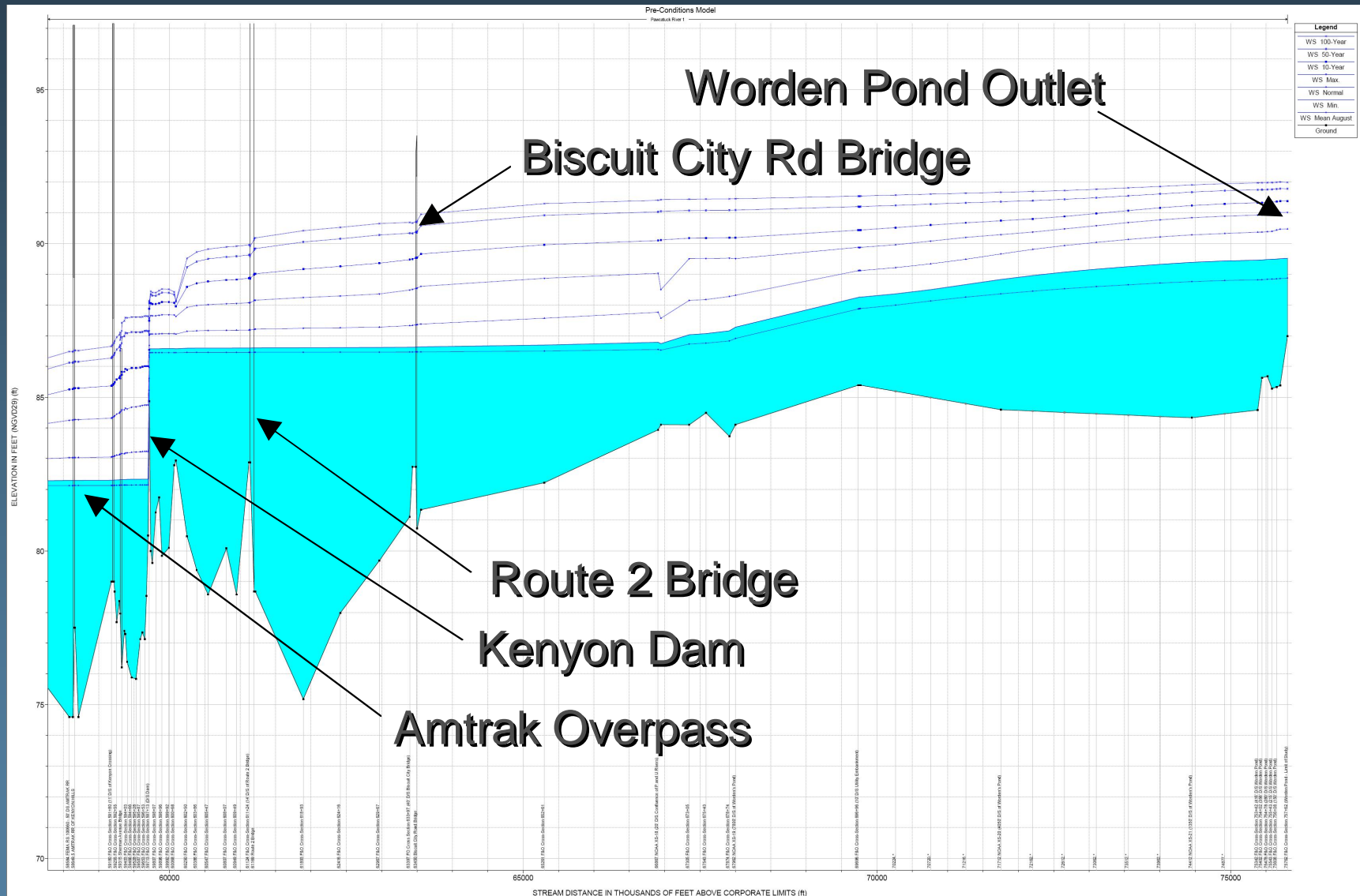


Full Dam Removal – Seasonal Water Surface Change Plan



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

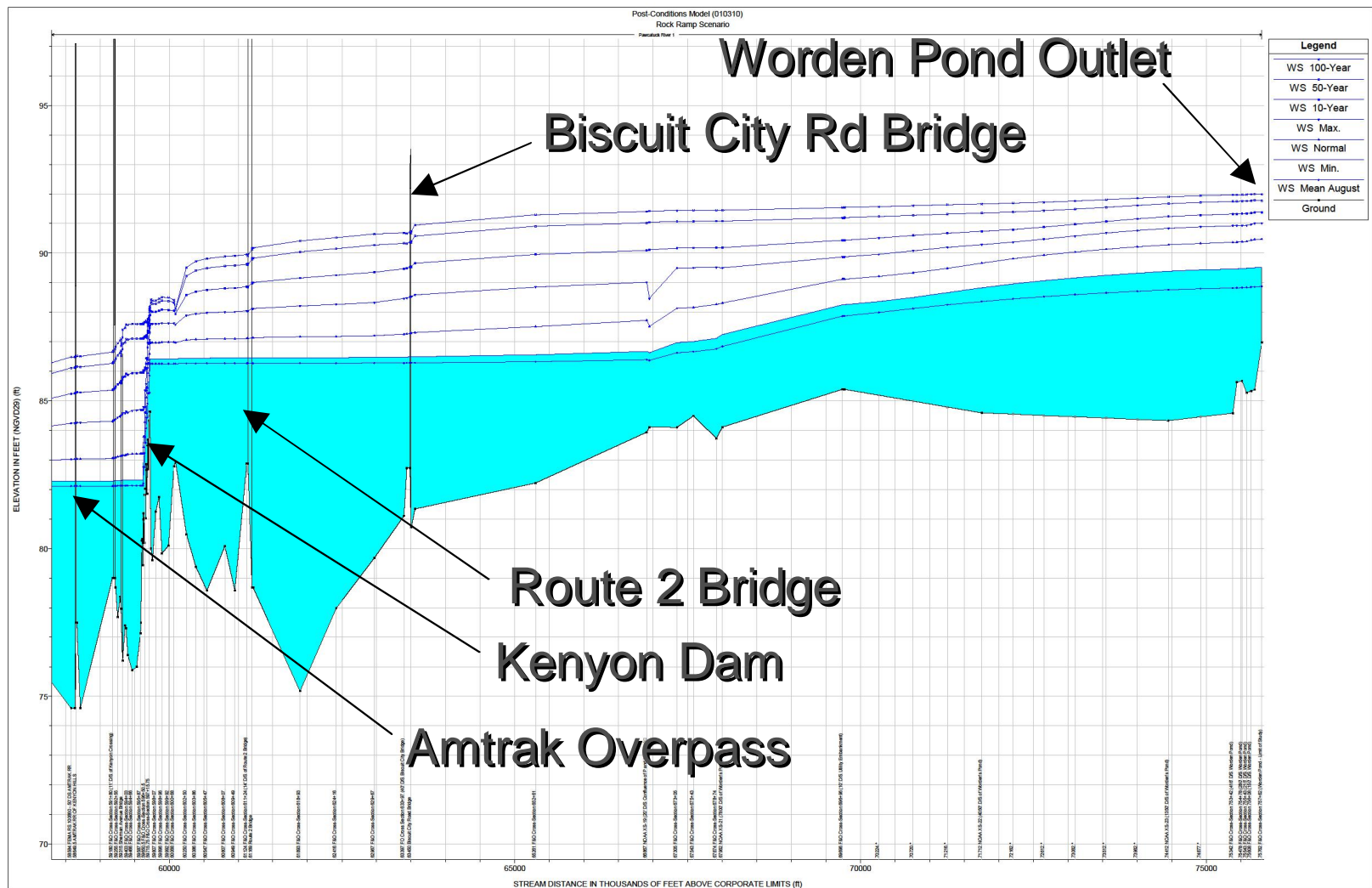


Existing Conditions – Water Surface Profile



# Fish Passage Alternatives Analyses

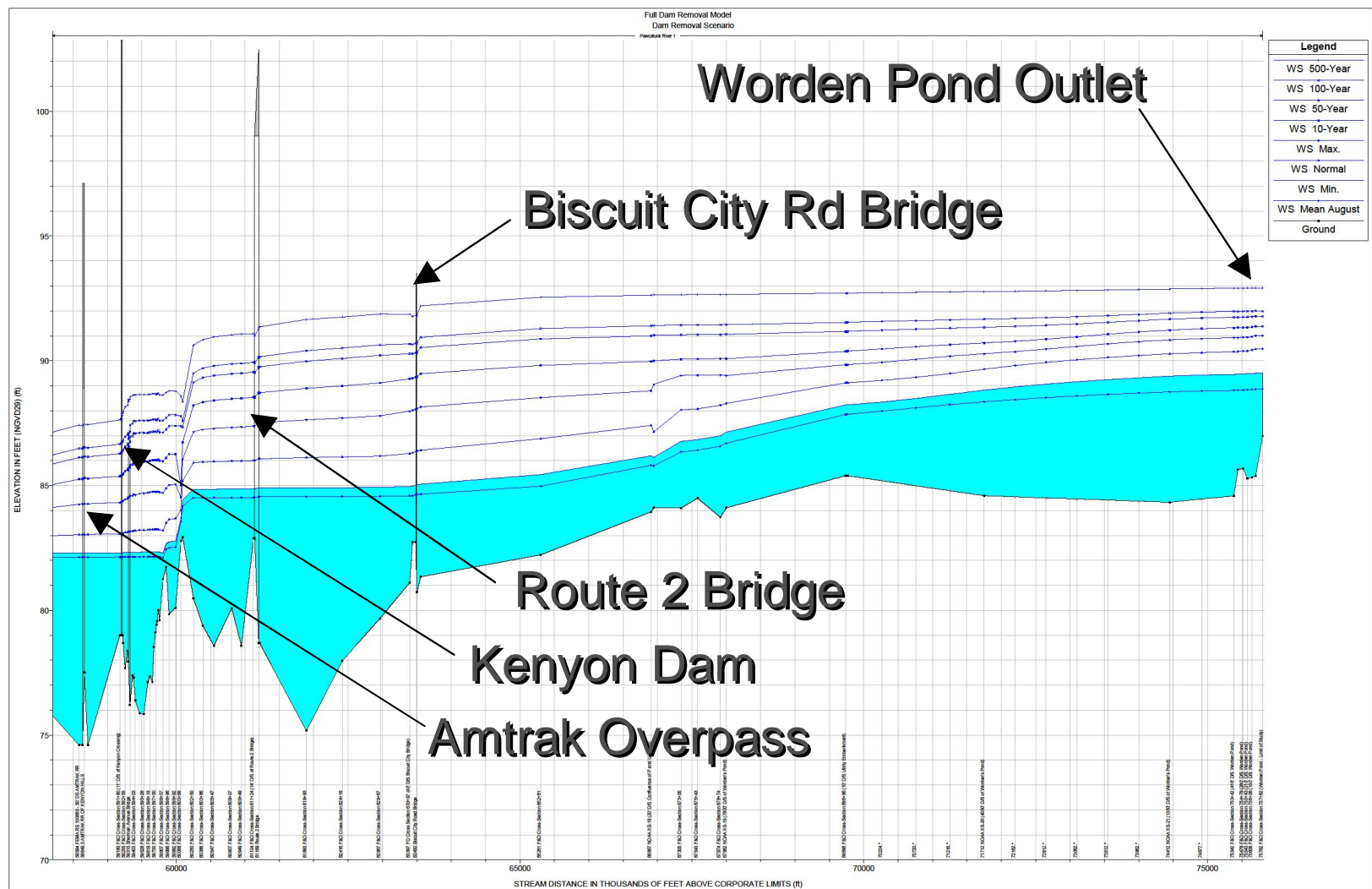
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Water Surface Profile

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

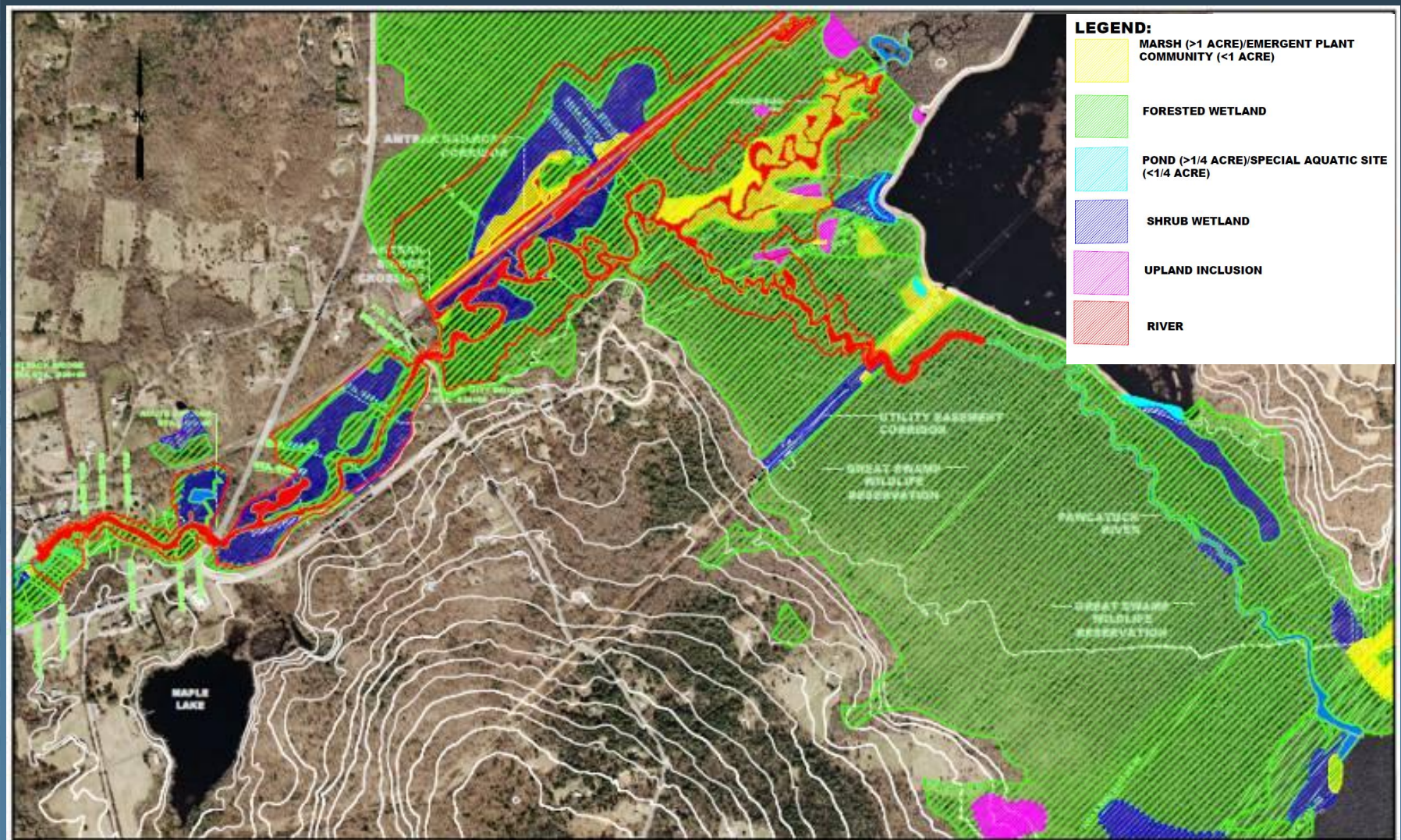


Full Dam Removal – Water Surface Profile



# Fish Passage Alternatives Analyses

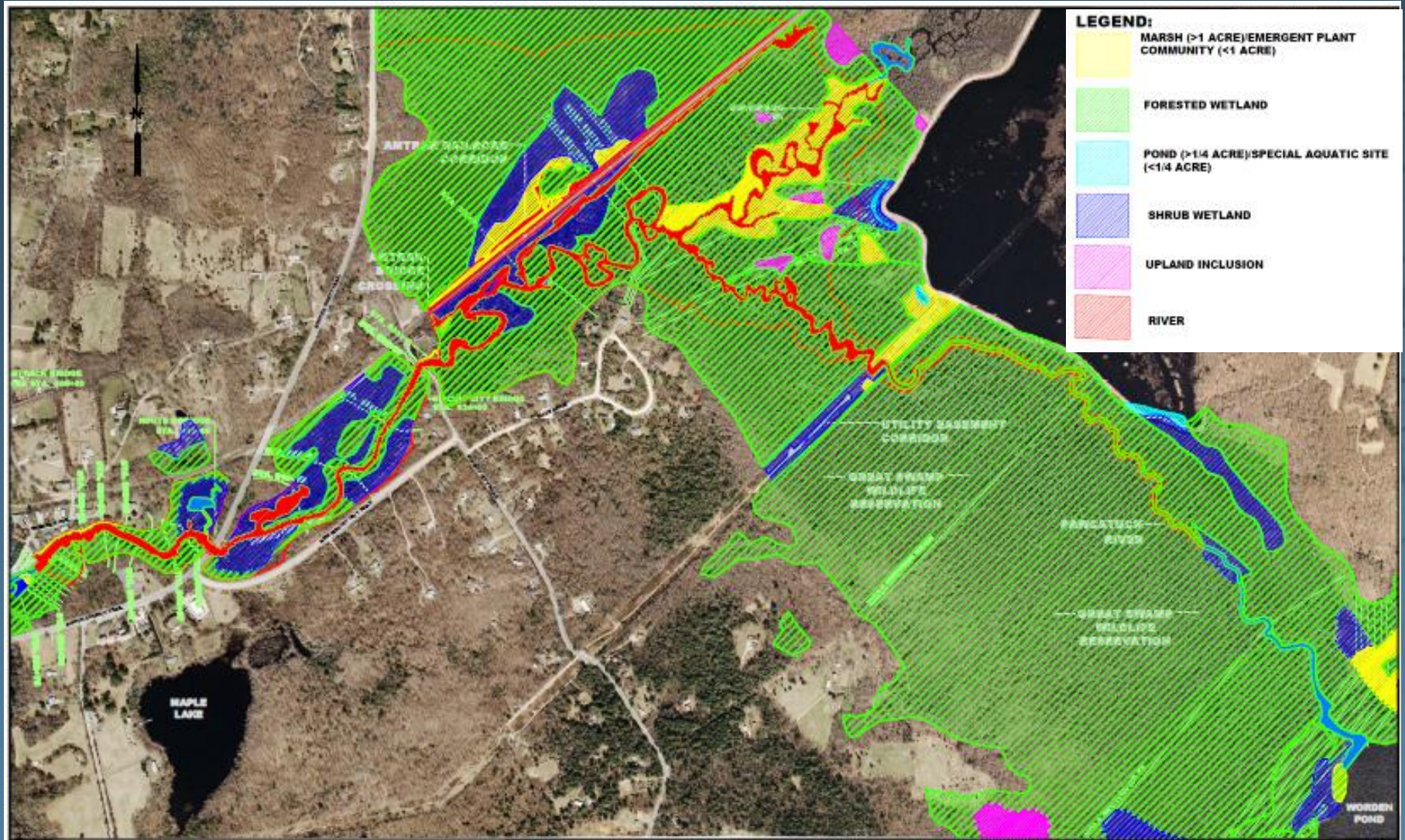
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Wetland Assessment Plan



# Kenyon Mill Dam Fish Passage Project



# Full Dam Removal – Wetland Assessment Plan



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project





### **NOTES:**

RARE SPECIES LOCATIONS IDENTIFIED  
WITHIN 1-MILE OF EFFECTED  
WETLAND BOUNDARY.

### **SOURCE:**

RINHS - NATURAL RESOURCE  
SERVICES, INC.; GREAT  
SWAMP/KENYON DAM. RARE,  
THREATENED, AND ENDANGERED  
SPECIES REQUEST.

### **LEGEND**

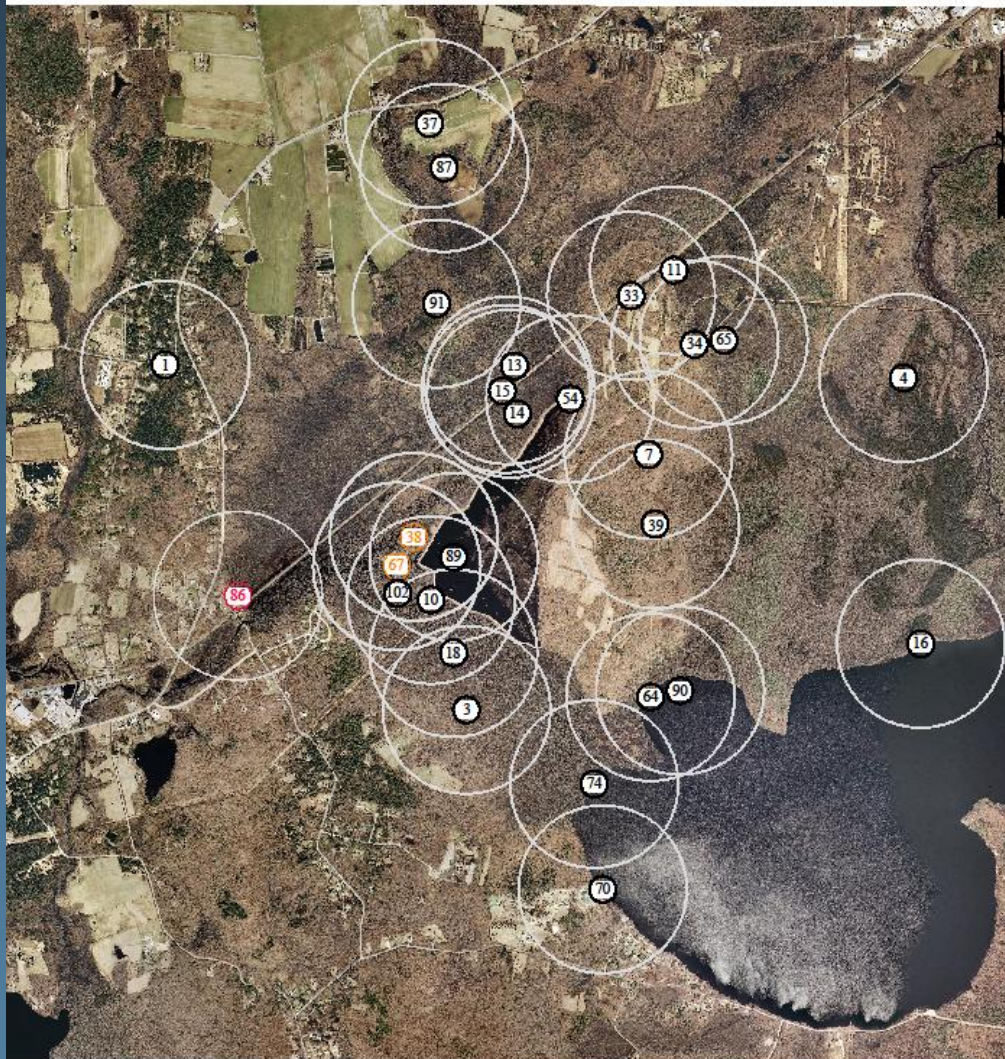
-  RARE SPECIES LOCATIONS  
WITH NO EXPECTED IMPACTS
-  RARE SPECIES LOCATIONS  
WITH POTENTIAL EXPECTED  
IMPACTS

Rock Ramp - Natural History Database



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project



### NOTES:

RARE SPECIES LOCATIONS IDENTIFIED WITHIN 1-MILE OF EFFECTED WETLAND BOUNDARY.

### SOURCE:

RIMS - NATURAL RESOURCE SERVICES, INC.; GREAT SWAMP/KENYON DAM, RARE, THREATENED, AND ENDANGERED SPECIES REQUEST.

### LEGEND

-  RARE SPECIES LOCATIONS WITH NO EXPECTED IMPACTS.
-  RARE SPECIES LOCATIONS WITH POTENTIAL EXPECTED IMPACTS
-  RARE SPECIES LOCATIONS WITH EXPECTED IMPACTS
-  APPROXIMATE WETLAND ALTERATION BOUNDARY

Full Dam Removal –Natural History Database



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project



Evaluation of Potential Shallow Groundwater Well Impacts



# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project

### Alternatives Evaluation Criteria

- Kenyon Industries Fire Suppression System and Local Fire Water Supply
- Potential Effects on Wetland Resource Alterations, Rare/Endangered Species and Habitat, Historic Resources
- Potential Effects on Shallow Groundwater Wells
- Potential Sediment Migration (transitional)
- Potential Bridge and River Channel Scour/Instability
- Potential Effects on Recreational Users (boaters, hunters)
- Potential Flood Impacts/Benefits
- Construction Costs / Post-Construction Maintenance Costs



# Agenda

## Kenyon Mill Dam Fish Passage Project

Next Steps

# Next Steps

## Kenyon Mill Dam Fish Passage Project

- State Historic Commission / Narragansett Tribe Coordination (ongoing)
- Potential Wetland Studies/Evaluations
- Continued Negotiations with Kenyon Industries
- Prepare/Transmit Permit Applications
- Public Review Period and Public Workshop
- Final Design
- Bidding and Construction



# Agenda

## Kenyon Mill Dam Fish Passage Project

# Questions and Discussion