

# 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.

# 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

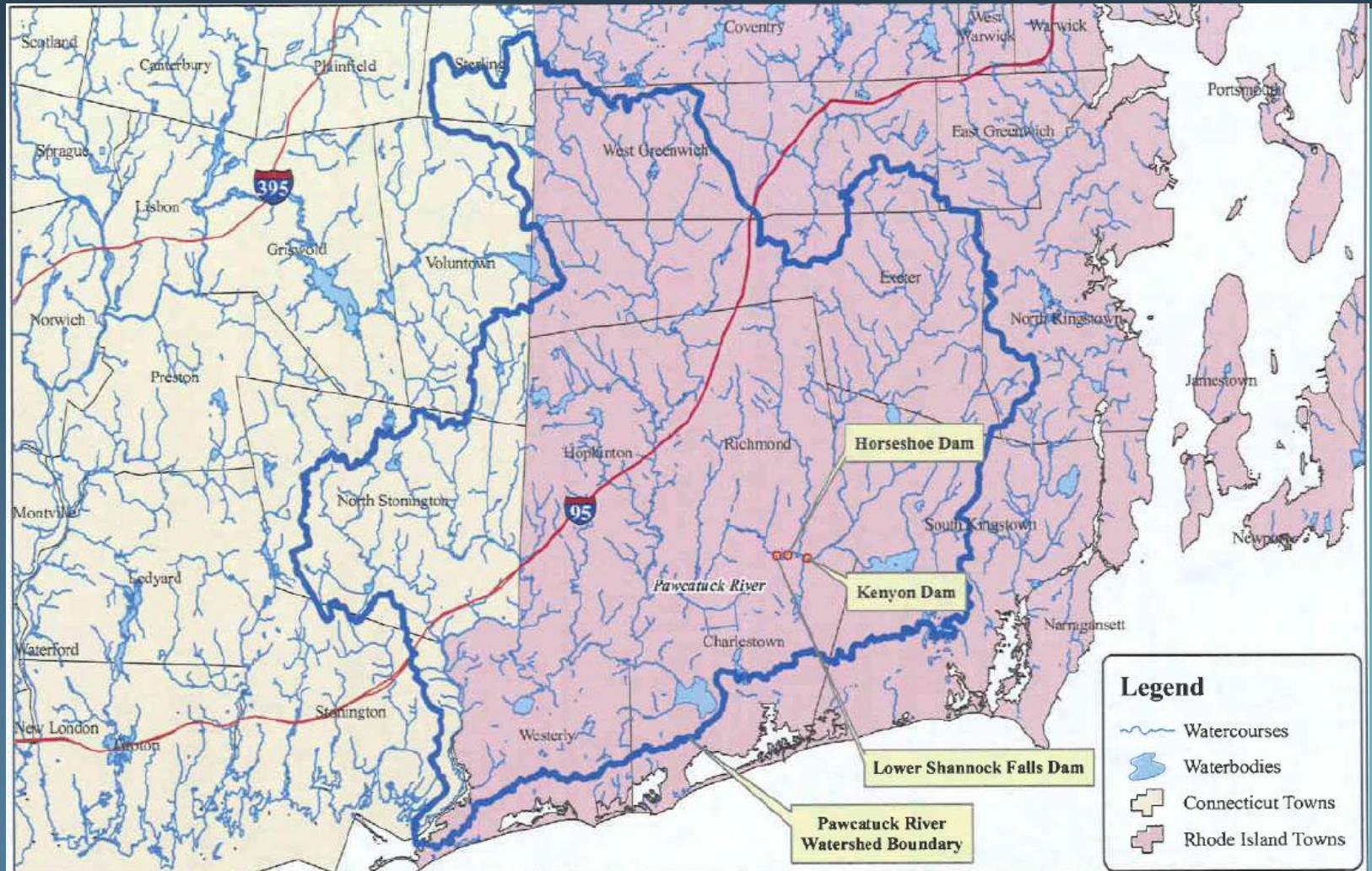
# Agenda

## 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

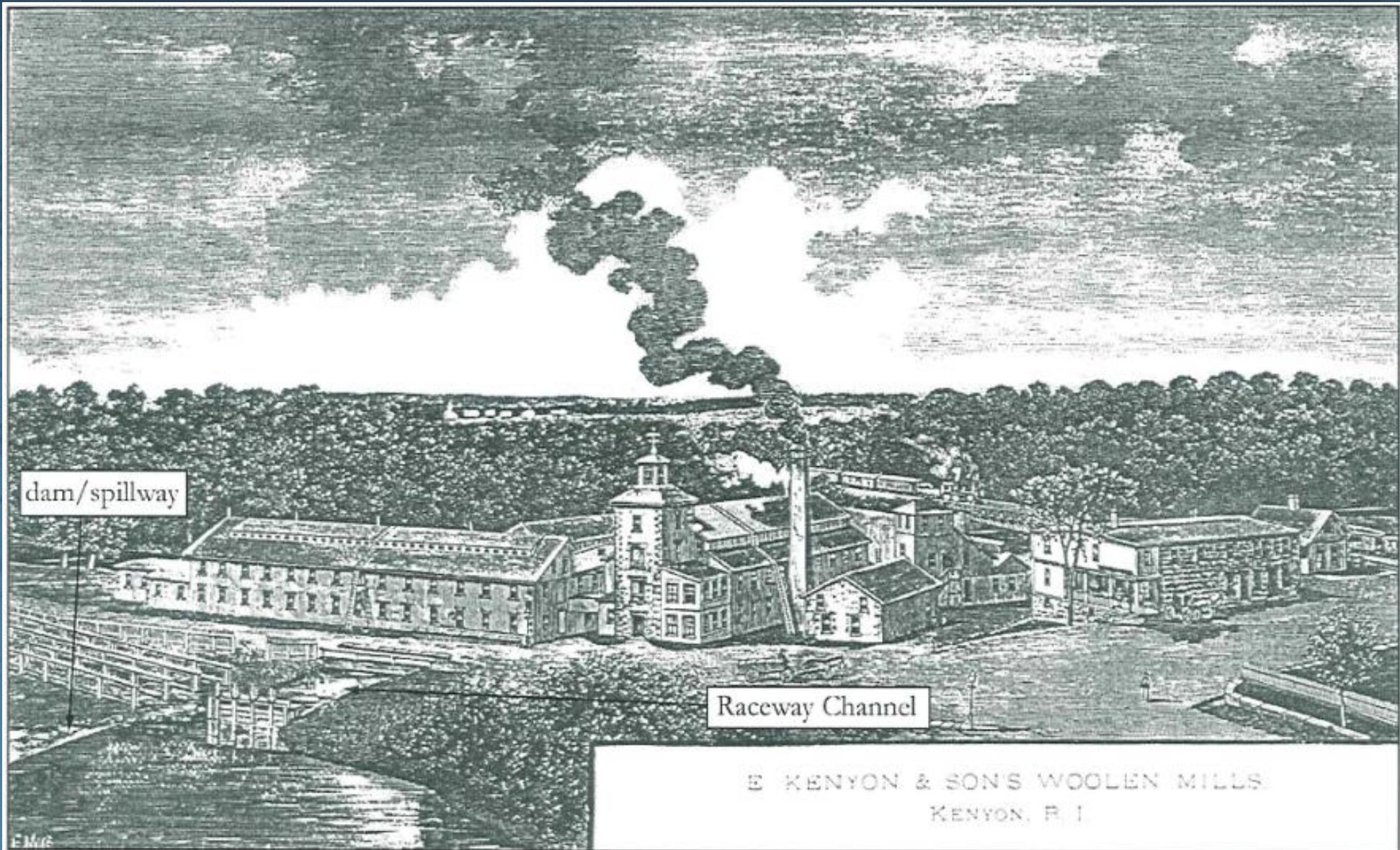


Figure 5-1. Ca. 1889 lithograph of the E. Kenyon & Son's Woolen Mills (source: Cole 1889).

# Site Description

## Kenyon Mill Dam Fish Passage Project

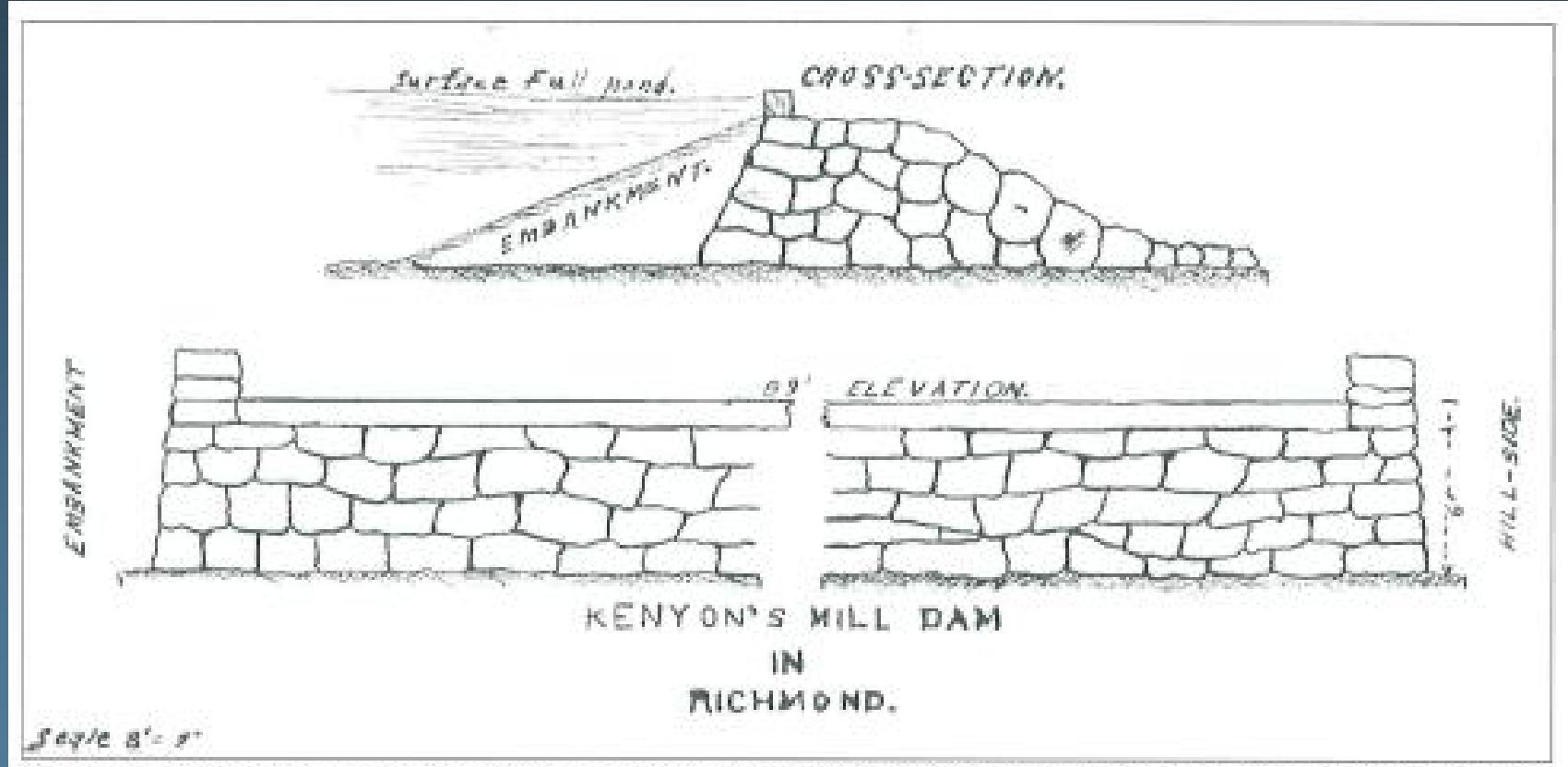


Figure 5-3. 1891 plan and cross section of Kenyon's Mill Dam in Richmond (source: RI Commissioner of Dams and Reservoirs Annual Report 1891).

# 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

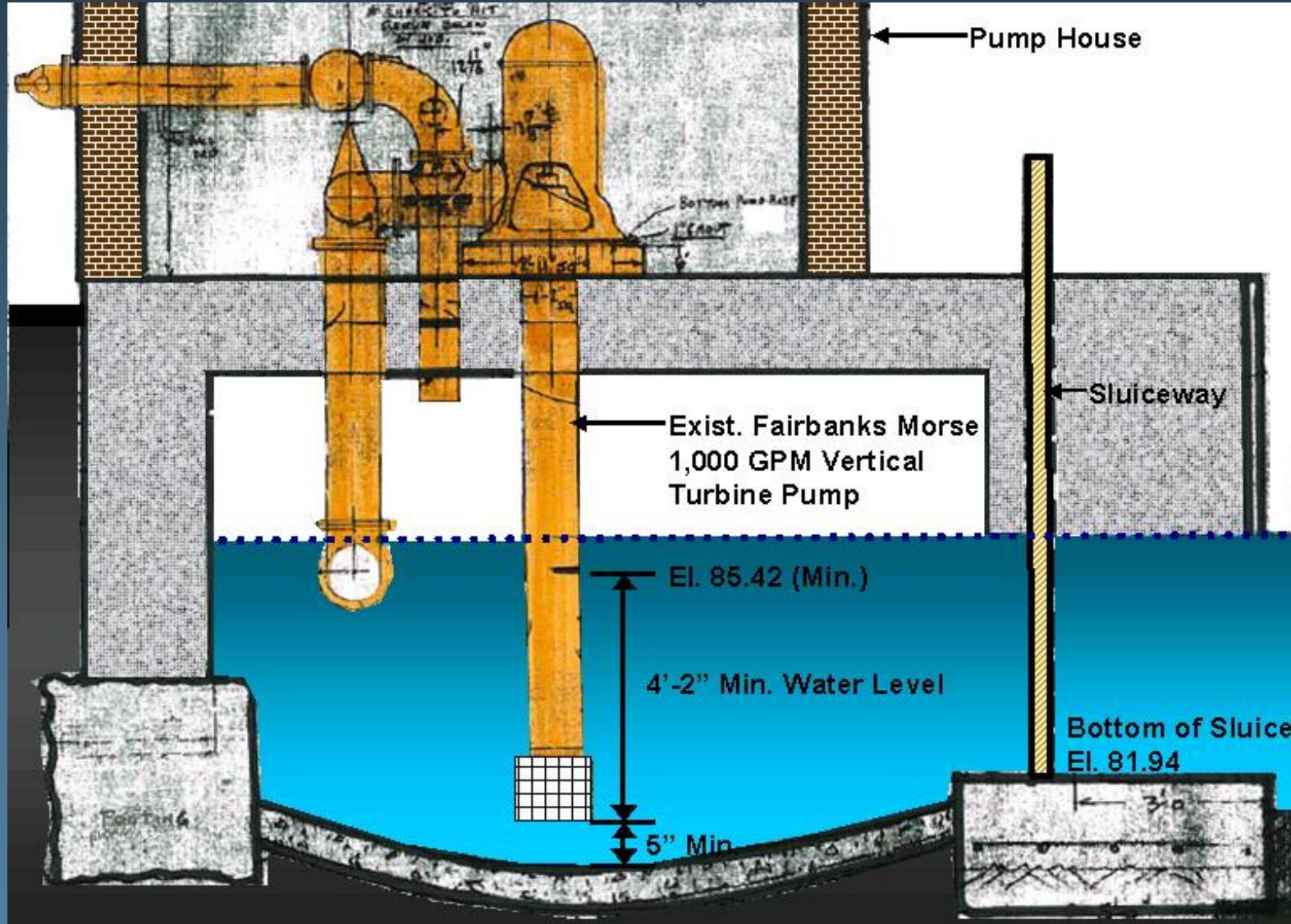
## Current Site Photographs



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



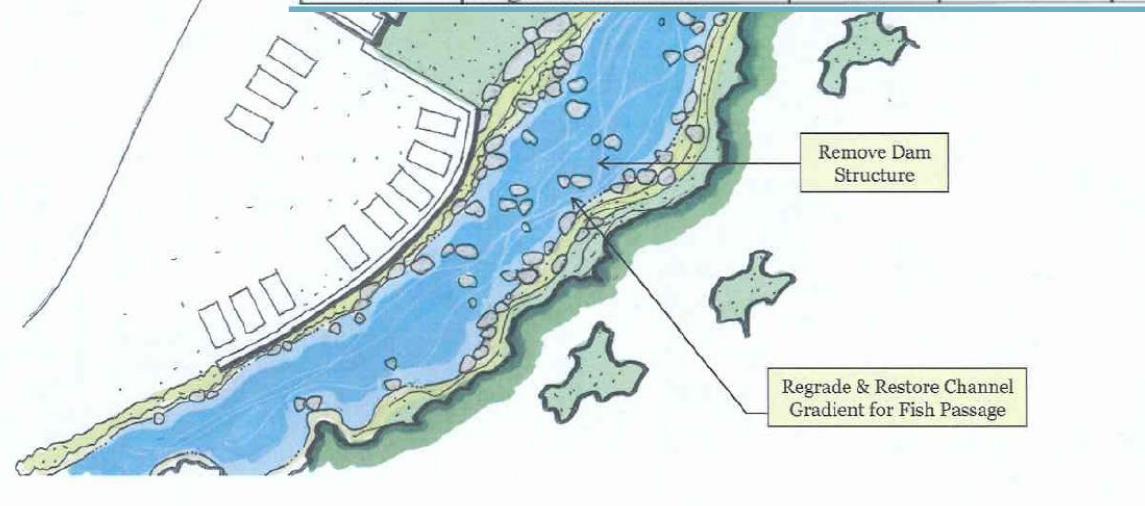
Source: August 2007  
Malone and MacBroom Feasibility Study

# 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

Alternative	Description	Achieves Fish Passage?	Improves Habitat Conditions?	Minimizes Long Term Dam Maintenance?	Potential for Impact to Historic Resources?	Prudent and Feasible Alternative?
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



Source: August 2007

Malone and MacBroom Feasibility Study

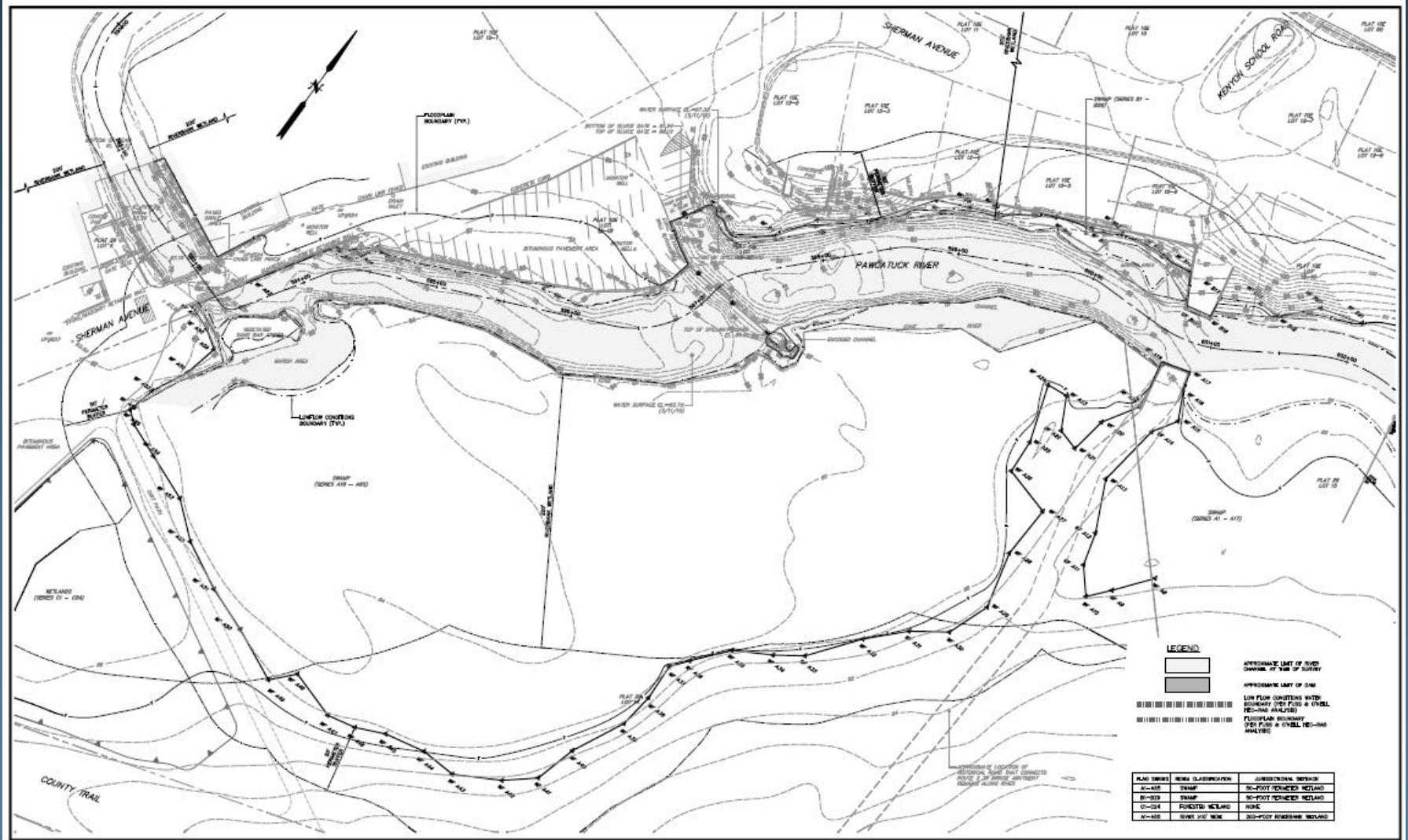
# Agenda

## 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

# Data Collection and Assessments

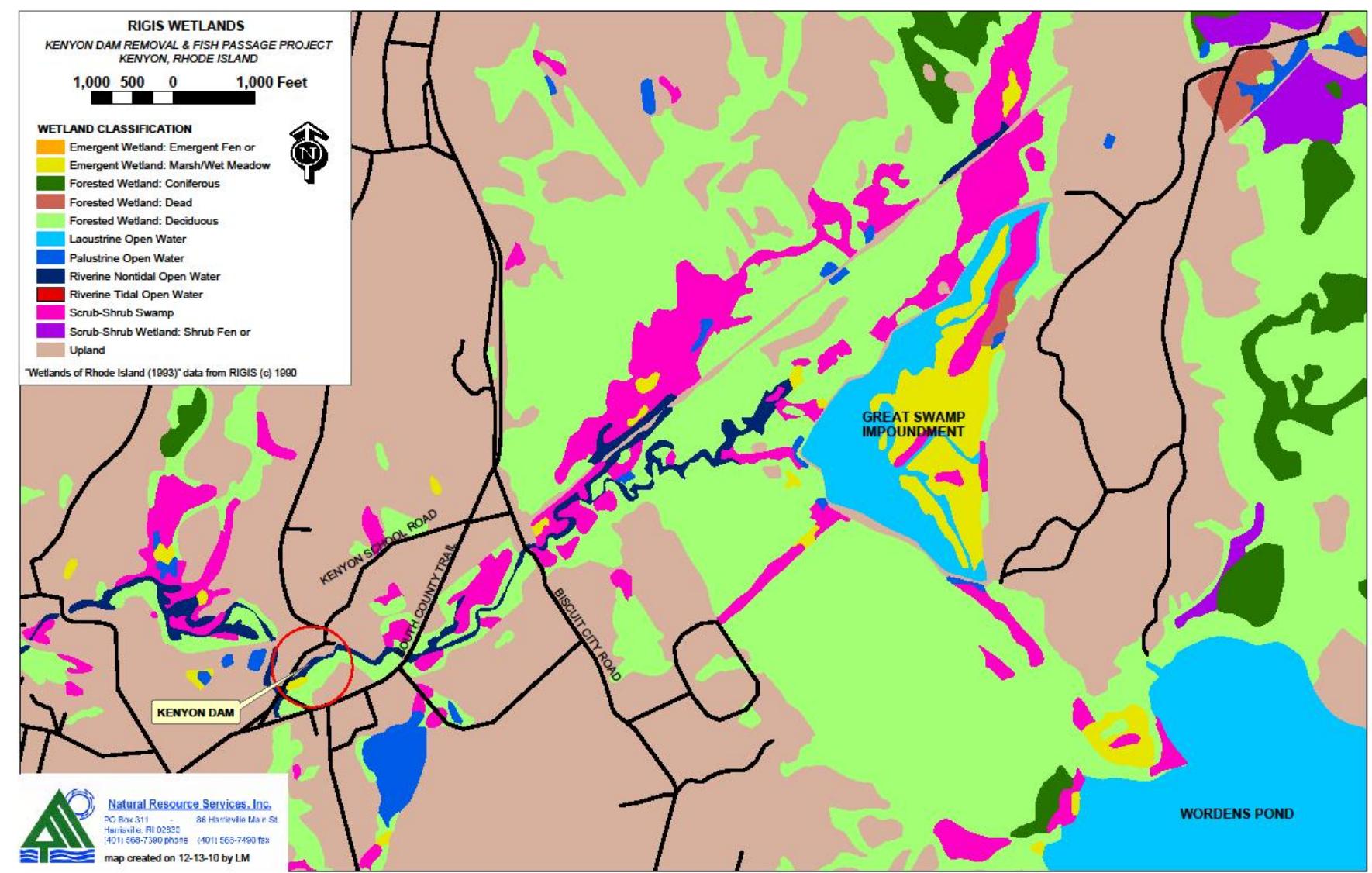
## Kenyon Mill Dam Fish Passage Project



Site Survey and Topographic Mapping

# Data Collection and Assessments

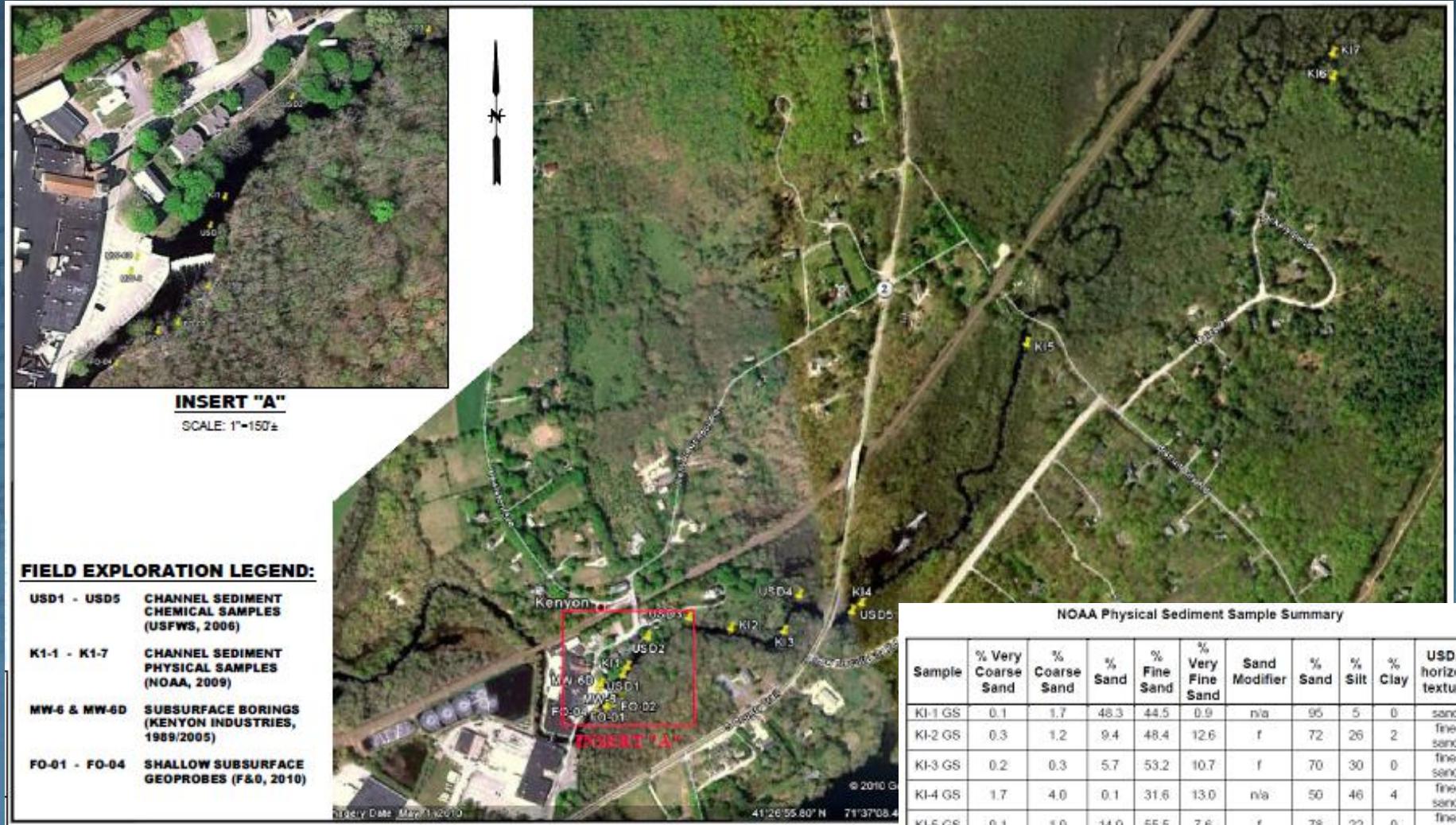
## Kenyon Mill Dam Fish Passage Project



Existing Wetland Resources

# Data Collection and Assessments

## Kenyon Mill Dam Fish Passage Project

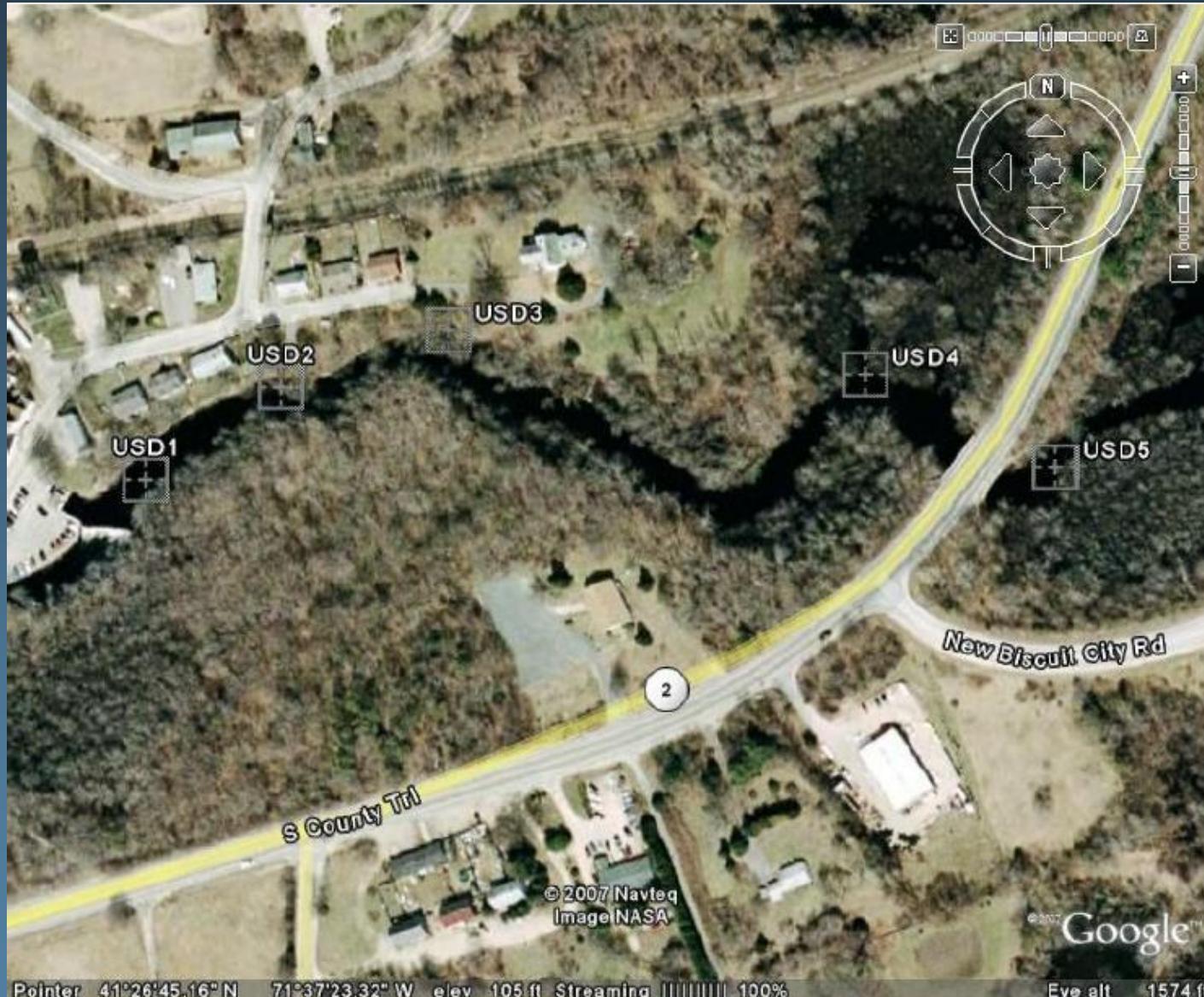


## Physical Sediment Sampling

Source: Assessment of Dams/Barriers Fish Passage Restoration on the Pinhook River, Washington County, Rhode Island (NOAA, August 2009)

# 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	USD1	USD2	USD3	USD4	USD5	Reference Criteria	Freshwater Criteria (1)						
							(2000)			1999 NOAA SQuRTs, 1999			
							TEC	R-DEC	I/C-DEC	TEC	PEC	TEL	TEL
Sample Date	17-Aug-06	17-Aug-06	17-Aug-06	17-Aug-06	17-Aug-06		Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs Hazecca	Threshold Effects Level	Probable Effects Level		Upper Effects Threshold
SVOCs (via Method 8260)													
Acetone	ug/kg						NE	7,800,000	10,000,000				
SVOCs/PAHs (via Method 8270)													
Aceanaphthalene	ug/kg	35	814	BDL	23.6	BDL	NE	23,000	10,000,000	57	845	12	160 M
Anthracene	ug/kg	27.8	128*	5.52	24.5*	BDL	57.2	35,000	10,000,000	33	108	16	260 M
Benz(a)anthracene	ug/kg	17	382*	11.4	52.4	BDL	108	900	7,800	1,058	32	385	500 I
Benz(a)pyrene	ug/kg	74.1*	311*	8.61	50.2*	BDL	150	400	800	1,495	32	782	700 I
Benz(b)fluoranthene	ug/kg	169	720	21.3	10.7	4.57	NE	900	7,800	NE			
Benz(c)phenanthrene	ug/kg						NE	800	10,000,000				
Benz(k)fluoranthene	ug/kg	413*	160*	8.76	36.6*	BDL	NE	900	75,000		27		13,400 S
Bis(2-ethylhexyl)phthalate	ug/kg						NE	46,000	410,000				
Chrysene	ug/kg	118*	481*	15.8	28.1*	502	165	495	780,000	1,066	1,280	37	57 862
Dibenzo(a,h)anthracene	ug/kg	15*	71.9*	BDL	14.6*	BDL	33	402	800	33	10	111	100 M
Fluoranthene	ug/kg	264*	1020*	45.7*	207*	11.1	423	26,050	10,000,000	433	2,230	31	2,355 1,505 M
Fluorene	ug/kg	23.1*	118*	6.98	37.3*	BDL	77.4	28000	10,000,000	77.4	336	16	300 M
Indeno(1,2,3-cd)pyrene	ug/kg	71.8*	308*	11.5	63.4*	BDL	NE	900	7,800		17		335 M
Naphthalene	ug/kg	33.1*	173*	9.73	71.5*	BDL	176	54000	10,000,000	176	561	15	600 I
Phenanthrene	ug/kg	143*	571*	24.8*	152*	6.67	204	40,000	10,000,000	204	1,170	19	42 515 800 I
Pyrene	ug/kg	166*	291*	323	782*	252	195	13,000	10,000,000	195	1,520	44	53 875 1,000 I
2-Methylnaphthalene	ug/kg	64.2	298	12.7	120	BDL	NE	123,000	10,000,000				
Acenaphthene	ug/kg	5.61	59.2	6.99	9.86	BDL	NE	43,000	10,000,000				290 M
Benz(e)pyrene	ug/kg	72.2	320	10.6	58	BDL	NE	NE	NE				
Total Selected PAHs	ug/kg	1345.7*	5642*	524.2*	1781.9*	731.4*	1,610	NE	NE	1,610	22,800	254	12,000 M
Total Metals (via Method 8010/7471)													
Arsenic	mg/kg	0.6	3	1	1	BDL	0.79	7	7	9.70	93	10.8	5.9 17 M
Barium	mg/kg						NE	5,600	10,000				
Beryllium	mg/kg						NE	0.4	1.3				
Cadmium	mg/kg	0.9*	1.3*	0.9*	1.3*	1.1*	0.99	30	1,000	0.99	4,96	0.58	0.6 3.83 3 I
Chromium	mg/kg	3	12	11	5.4	6.3	43.4	360**	10,000	45.4	111	38.3	37.3 90 95 H
Copper	mg/kg	4	22	5.4	4	2	31.8	3,100	10,000	31.8	145	28	35.7 167 85 H
Lead	mg/kg	10	79*	17	9	BDL	35.8	150	500	35.8	129	37	35 91.3 127 H
Manganese	mg/kg						NE	380	10,000				
Mercury	mg/kg	BDL	0.2	BDL	BDL	BDL	0.18	23	610	0.18	106	0.17	0.49 0.56 M
Nickel	mg/kg	BDL	5	BDL	BDL	BDL	227	1,000	10,000	227	46.6	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	466	98	123.1 316 620 M
PCBs (via Method 8082)	ug/kg	19.2	80.8*	10	18	0.08	50.8	10,000	10,000	50.8	875	31.8	34.1 277 26 M
Pesticides (via Method 8081)													
p,p-DDD	ug/kg	2.68	3.08	0.72	1	0.06						3.54	8.31 60 I
Sum-DDD	ug/kg	3.87	5.93	1.28	2.28	0.22							
p,p-DDE	ug/kg	3.32	3.13	0.81	1.11	0.22						1.42	6.75 50 I
Sum-DDE	ug/kg	3.45	3.45	0.93	1.26	0.48							
p,p-DDT	ug/kg	0.897	1.78	0.46	1.38	0.52							<50 I
Sum-DDT	ug/kg	0.83	2.09	0.52	1.54	0.52							
Aldrin	ug/kg	1.07	7.85	BDL	1.38	BDL							40 I
alpha-BHC	ug/kg	0.05	0.212	0.154	0.132	0.158							
beta-BHC	ug/kg				0.07	0.12							
gamma-BHC	ug/kg				BDL	BDL							
gamma-BHC (Lindane)	ug/kg				BDL	BDL							
gamma-Chlordane	ug/kg	0.08	0.15	0.15	0.17	0.13							
Chlordiphen	ug/kg	0.231	0.149	0.154	0.382	0.248							
Dieldrin	ug/kg	0.08	BDL	BDL	BDL	BDL	1.8*	40	400	1.9	61.8	2.86	6.67 300 I
Endosulfan II	ug/kg				BDL	BDL							
Endrin	ug/kg				BDL	0.127	0.145	0.13		242	207	2.67	62.4 500 I
PCB	ug/kg	0.08	BDL	BDL	BDL	BDL							100 I
Heptachlor	ug/kg	0.08	0.32	0.08	0.13	BDL							
Heptachlor epoxide	ug/kg				BDL	0.127	0.164			247	18	0.6	2.74 30 I
Mirex	ug/kg		0.201	0.488	BDL	BDL							
cis-Nonachlor	ug/kg	0.08	0.112	BDL	BDL	BDL							
trans-Nonachlor	ug/kg				BDL	BDL							
Oxychlorophane	ug/kg				BDL	BDL							
Toxaphene	ug/kg				BDL	BDL							

BOL = Below Laboratory Detection Limit  
 RED TEXT = Exceed R-DEC  
 ✓ = Exceeds TEC  
 \* = Exceeds PEC  
 = Exceeds TEL (h. azteca)  
 = Exceeds TEL  
 = Exceeds PEL  
 = Exceeds UET

UNDERLINED TEXT  
 BOLD UNDERLINED TEXT  
 ITALICIZED TEXT

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



# 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

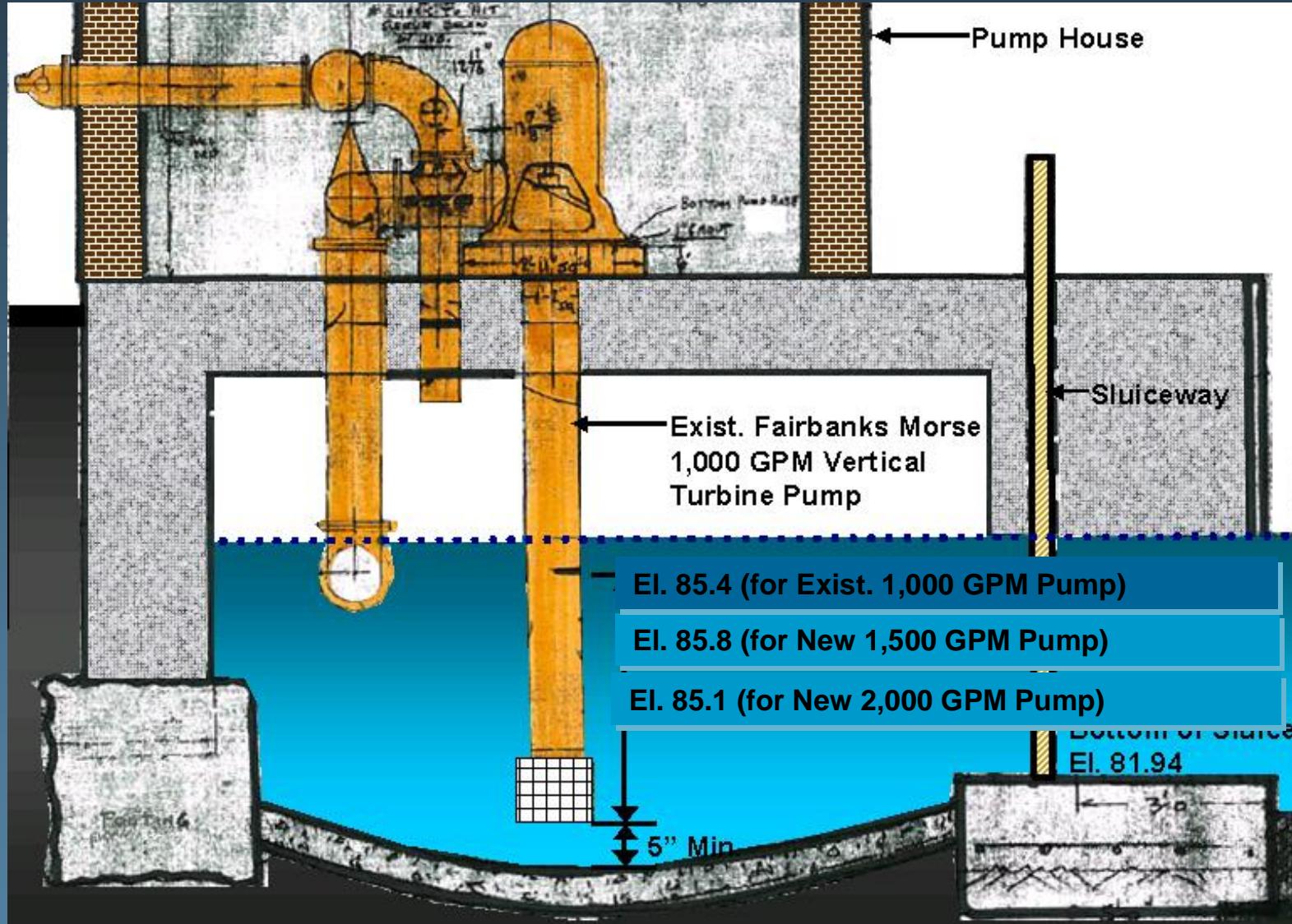
## Kenyon Mill Dam Fish Passage Project

### 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

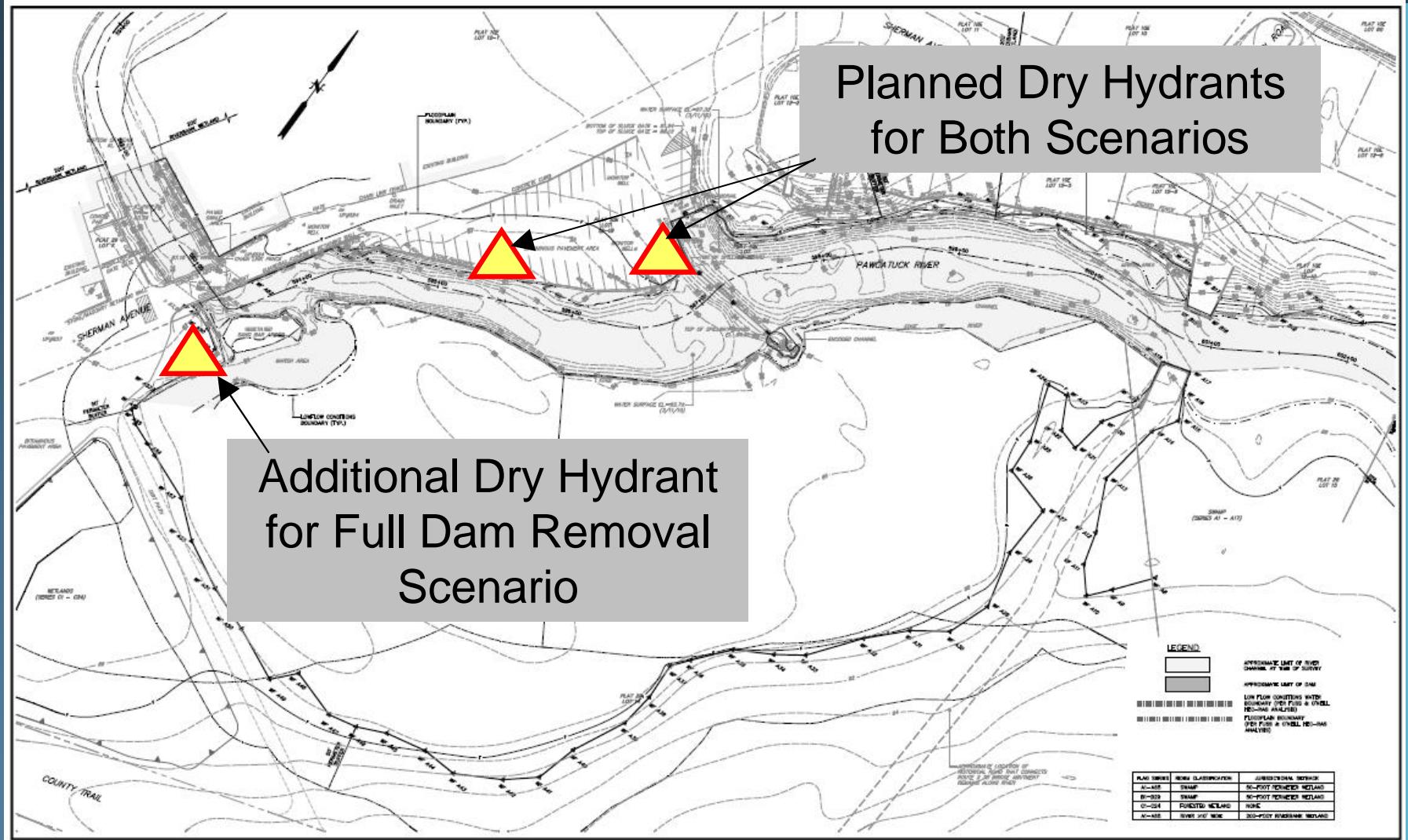
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Kenyon Fire Suppression System

# Fish Passage Alternatives Analyses

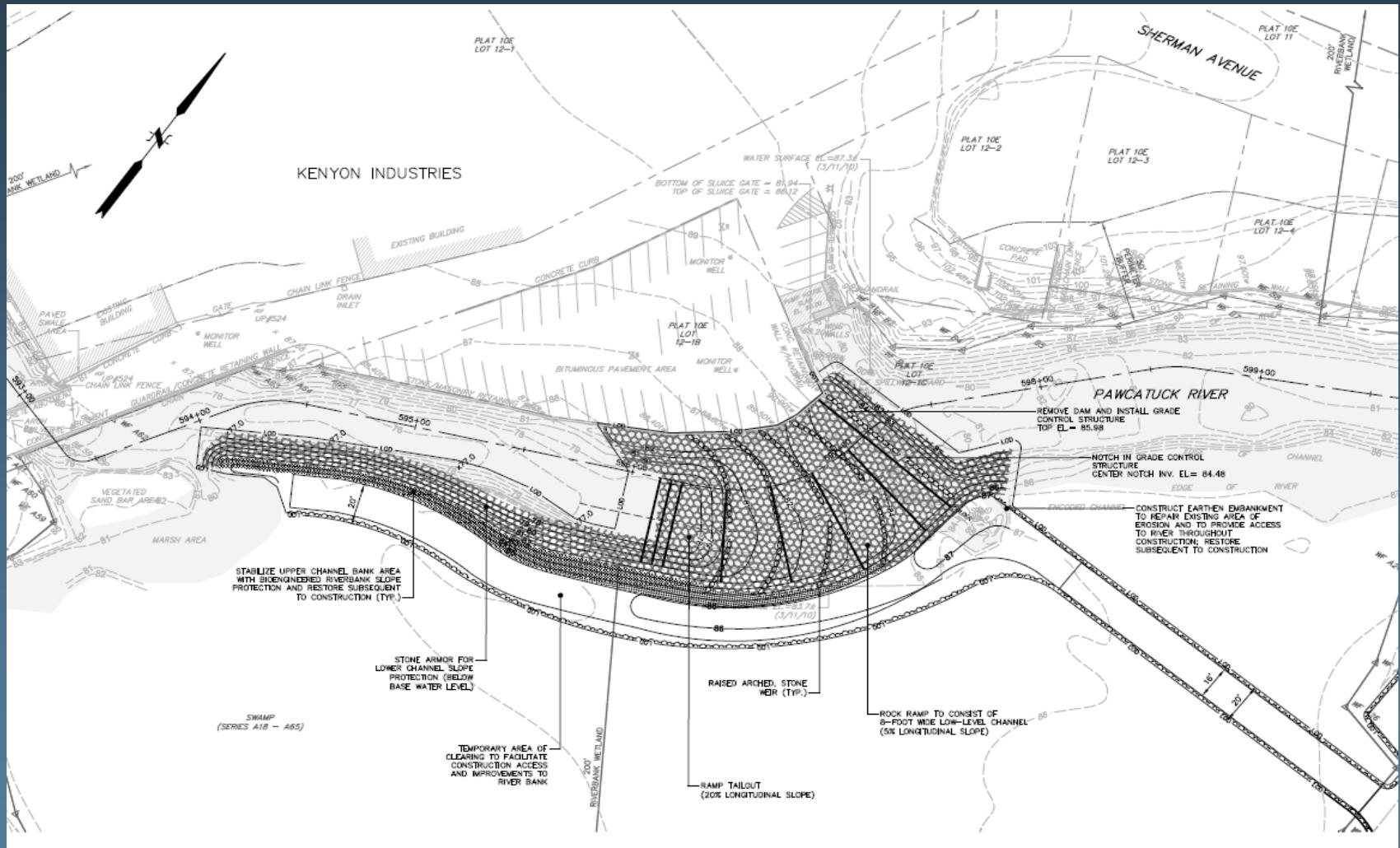
## Kenyon Mill Dam Fish Passage Project



Potential Local Fire Department Dry Hydrant Locations

# Fish Passage Alternatives Analyses

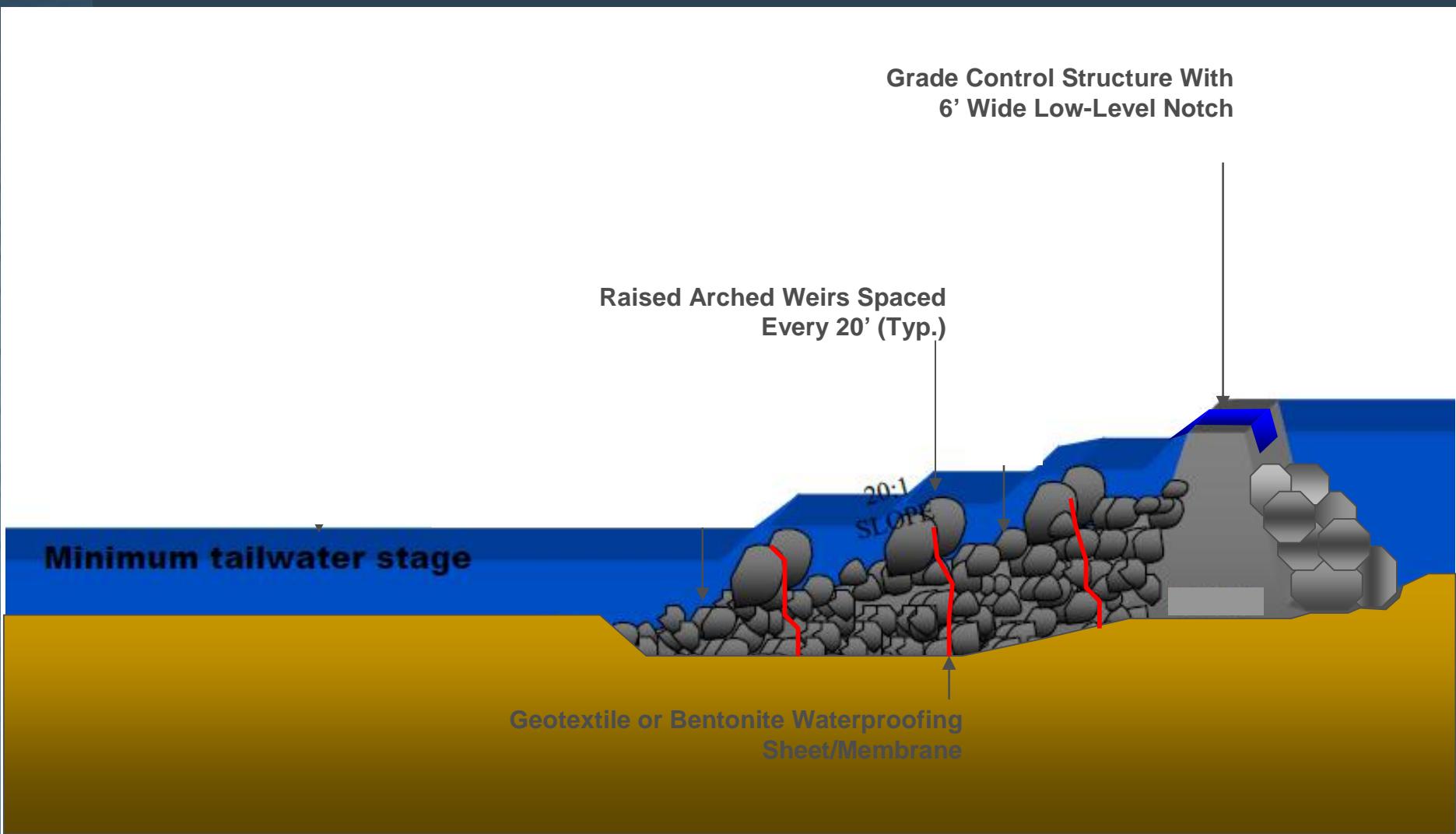
## Kenyon Mill Dam Fish Passage Project



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

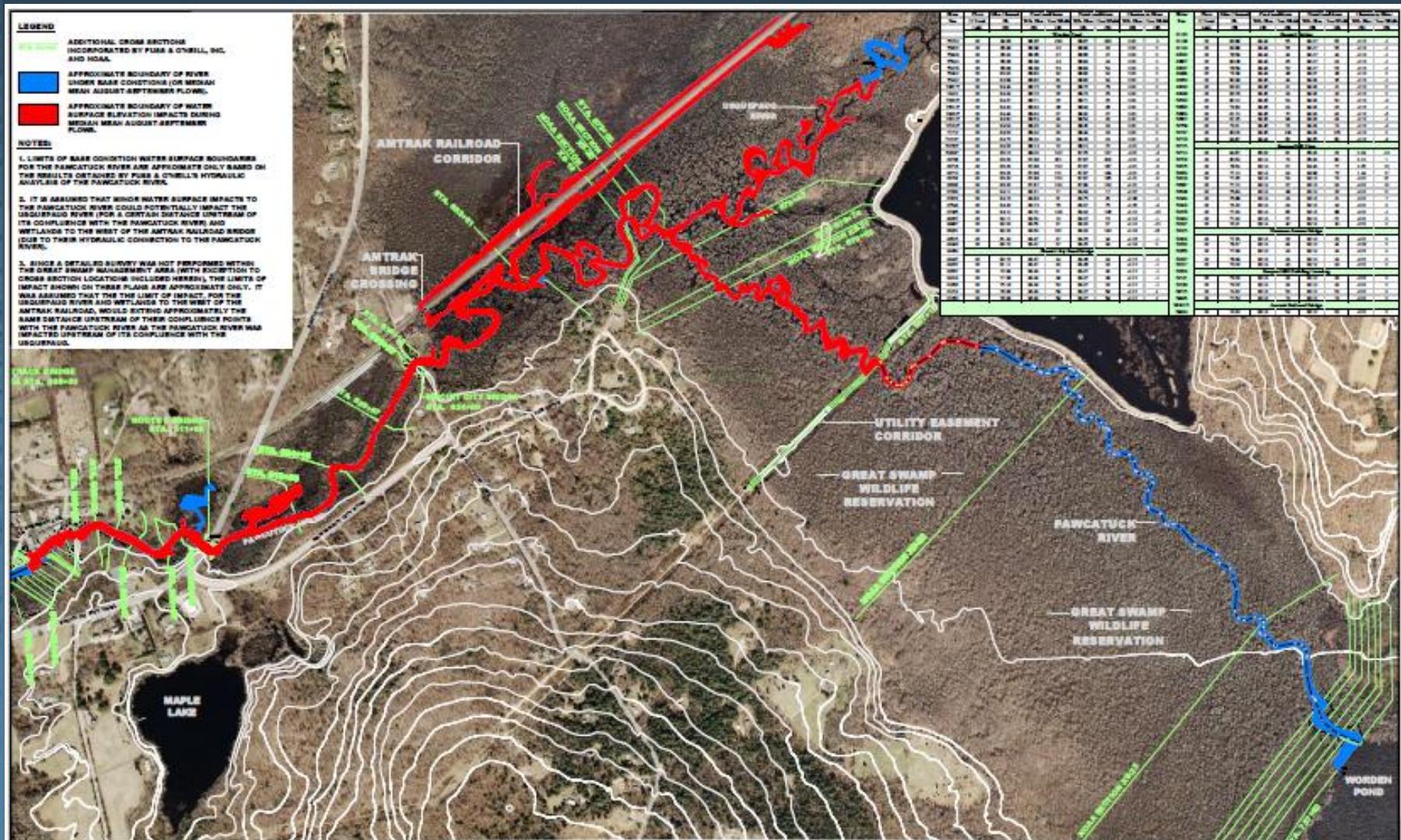
## Kenyon Mill Dam Fish Passage Project



Base Flow Water Surface Elevation Modeling

# Fish Passage Alternatives Analyses

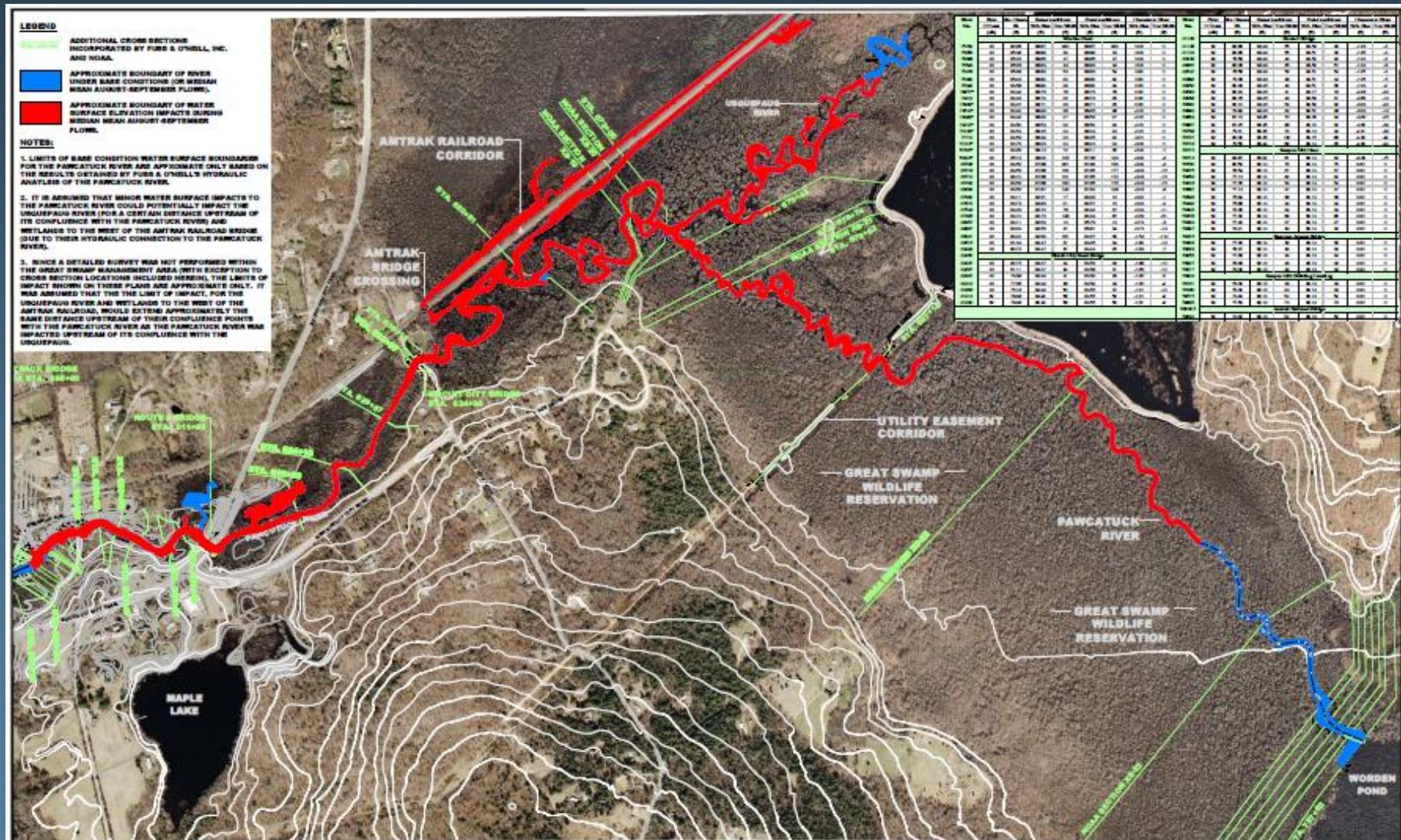
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Water Surface Change Plan

# Fish Passage Alternatives Analyses

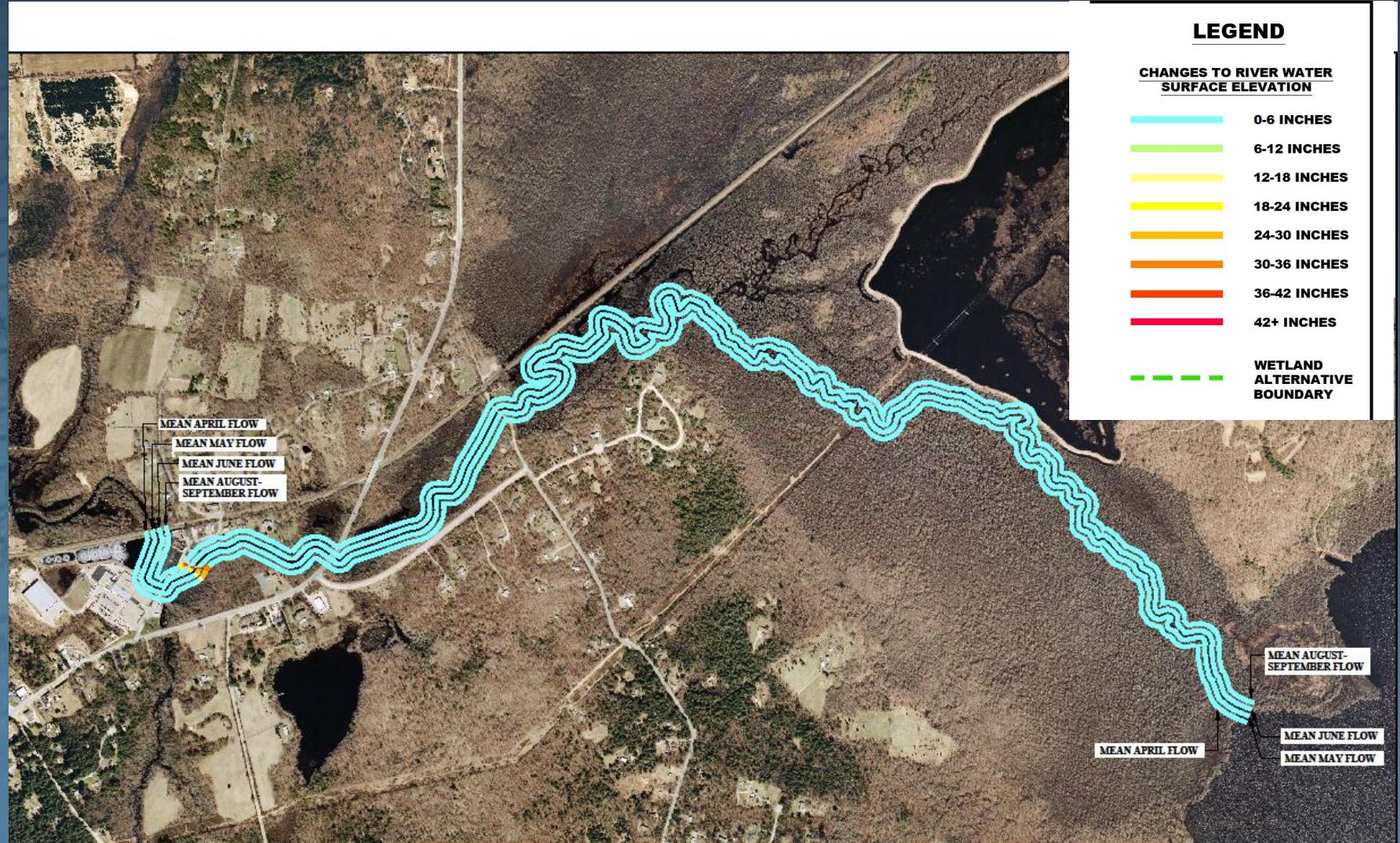
## Kenyon Mill Dam Fish Passage Project



Full Dam Removal – Water Surface Change Plan

# Fish Passage Alternatives Analyses

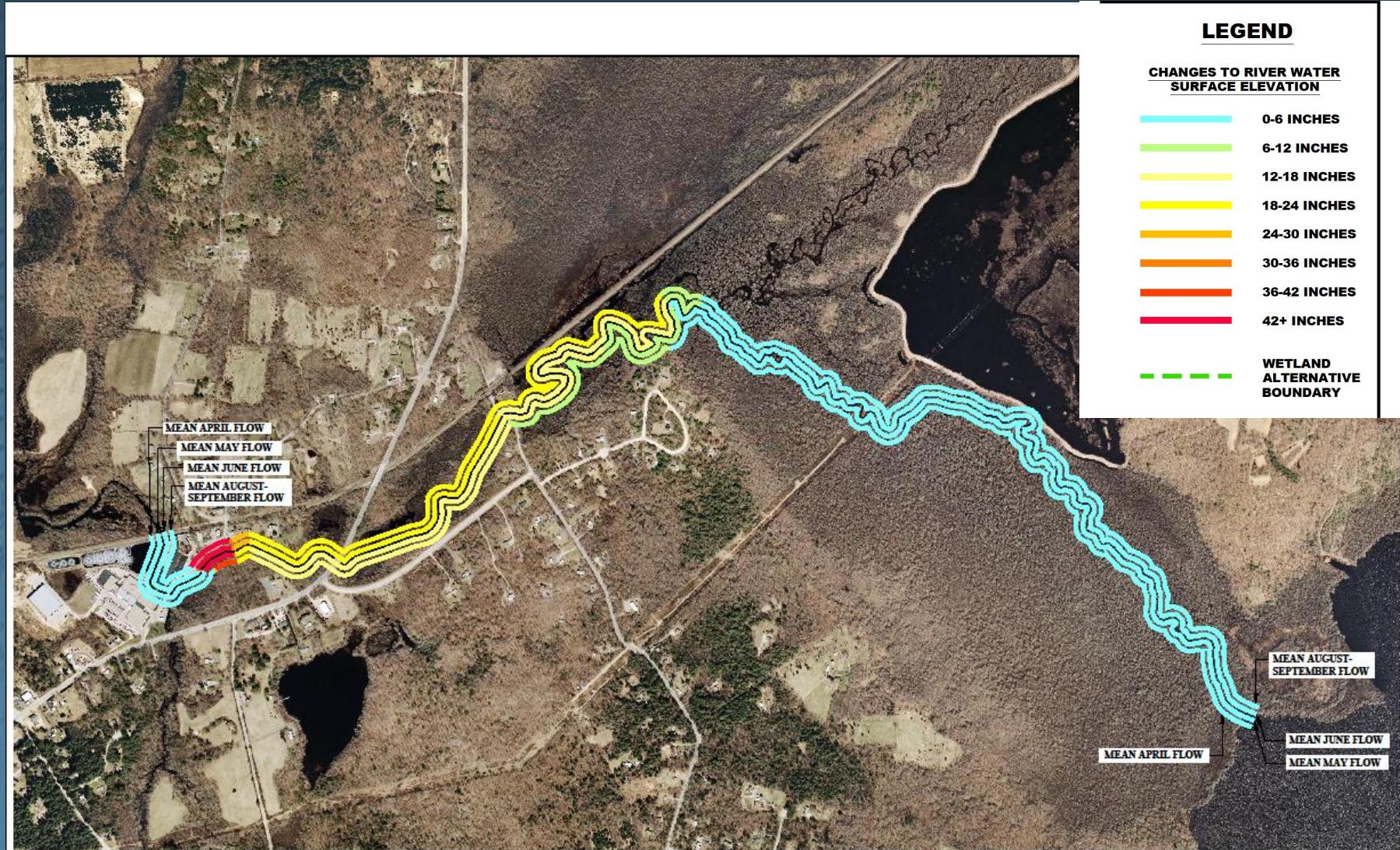
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Seasonal Water Surface Change Plan

# Fish Passage Alternatives Analyses

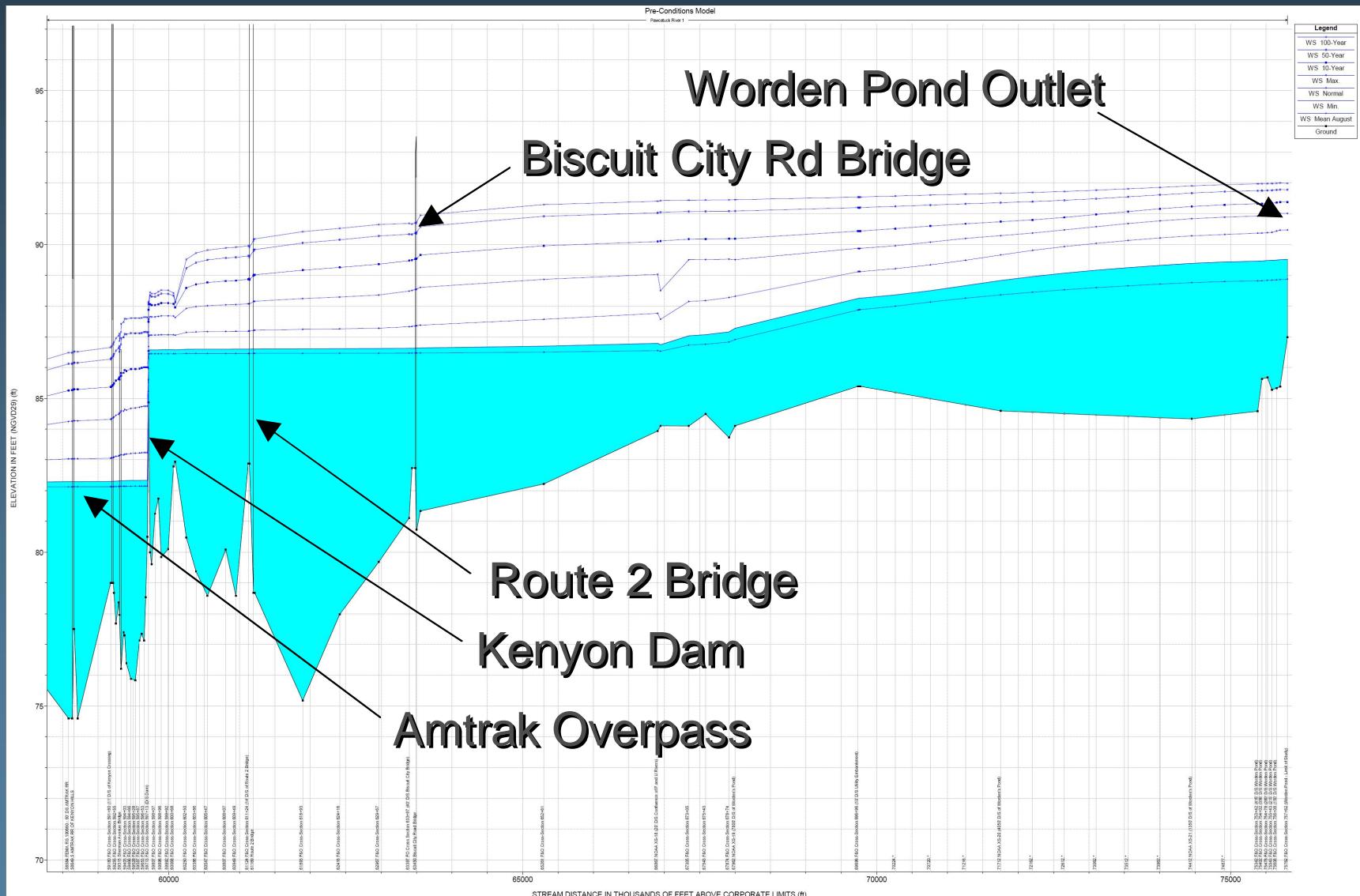
## Kenyon Mill Dam Fish Passage Project



Full Dam Removal – Seasonal Water Surface Change Plan

# Fish Passage Alternatives Analyses

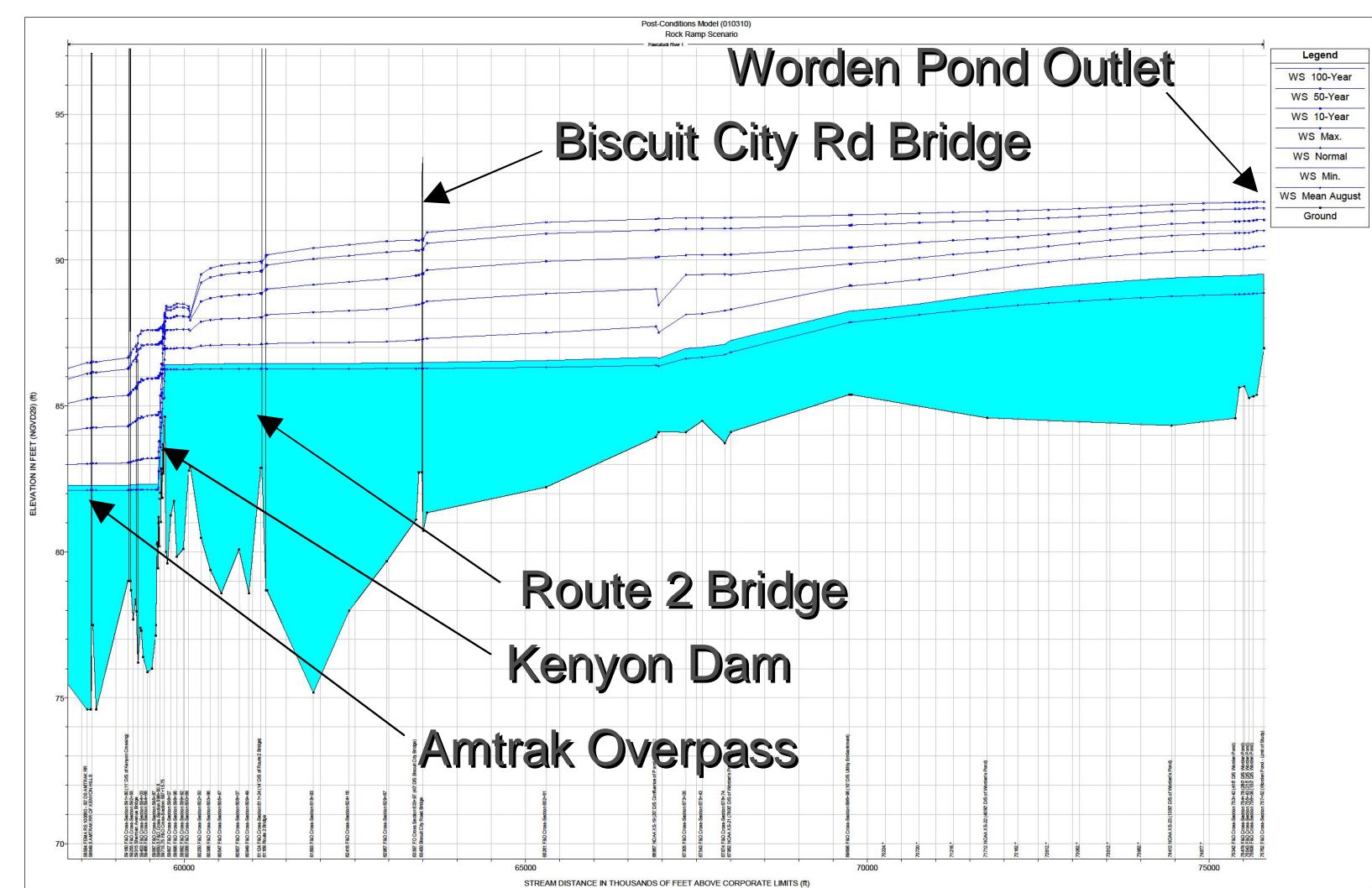
## Kenyon Mill Dam Fish Passage Project



Existing Conditions – Water Surface Profile

# Fish Passage Alternatives Analyses

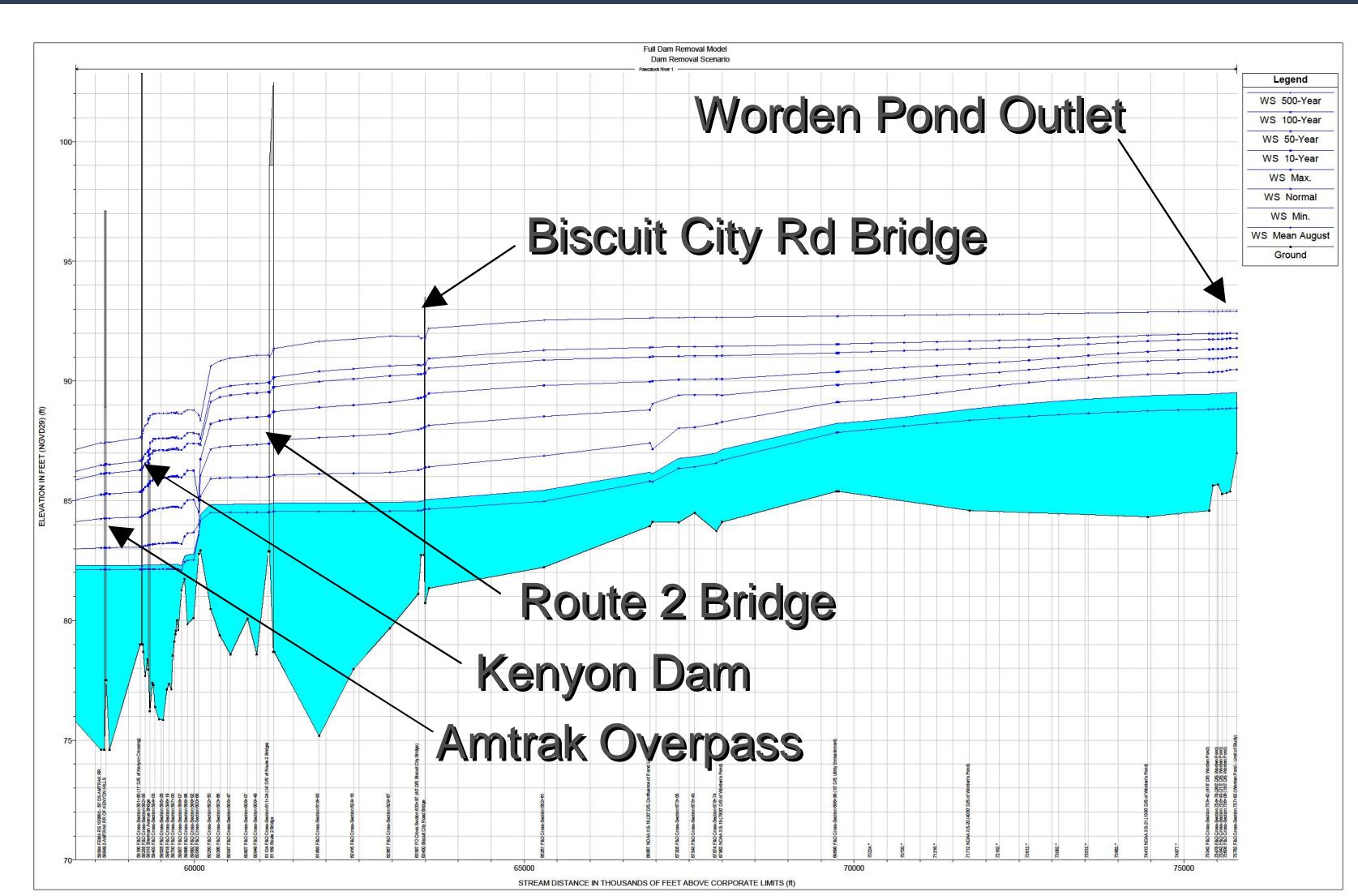
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Water Surface Profile

# Fish Passage Alternatives Analyses

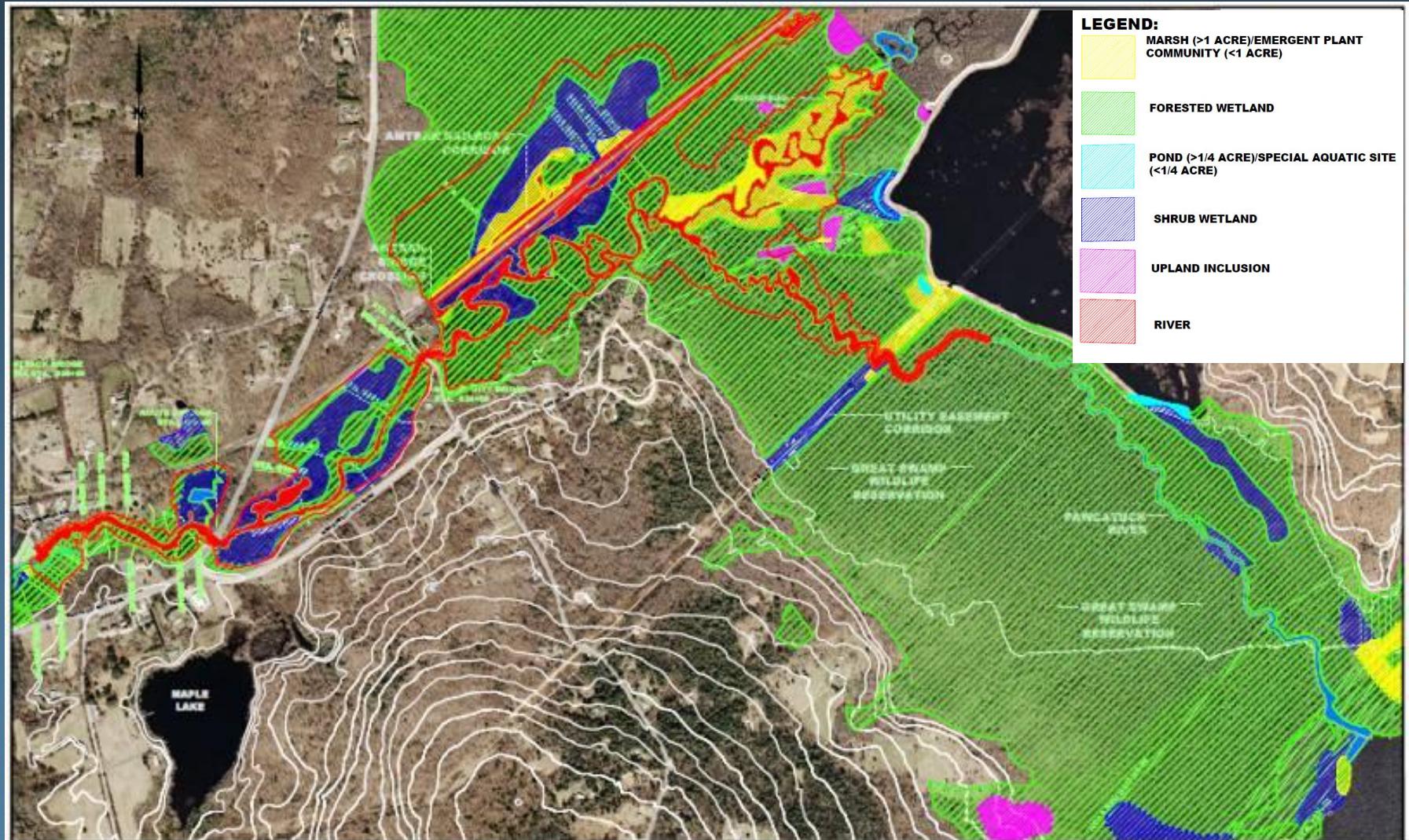
## Kenyon Mill Dam Fish Passage Project



Full Dam Removal – Water Surface Profile

# Fish Passage Alternatives Analyses

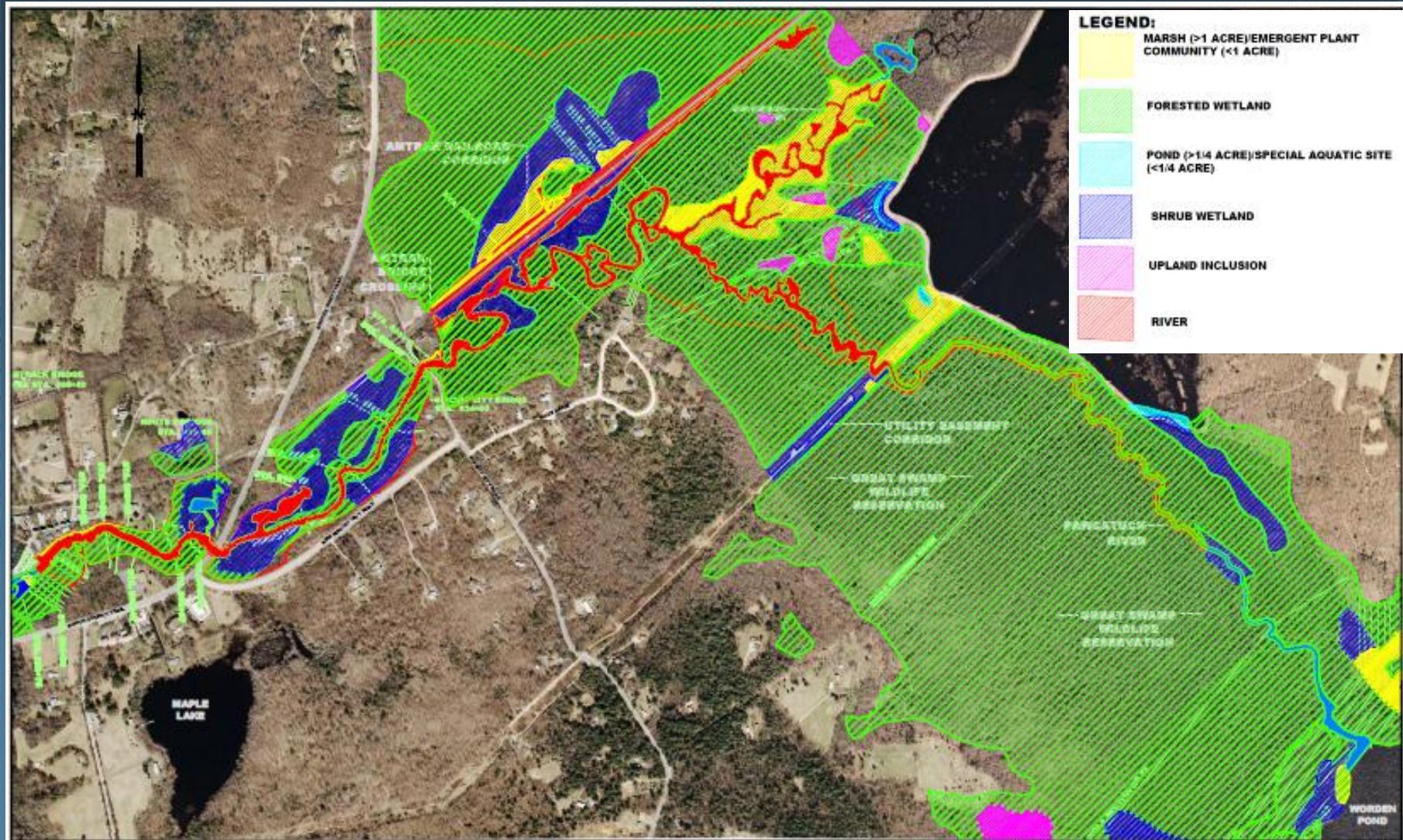
## Kenyon Mill Dam Fish Passage Project



Rock Ramp – Wetland Assessment Plan

# Fish Passage Alternatives Analyses

## 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



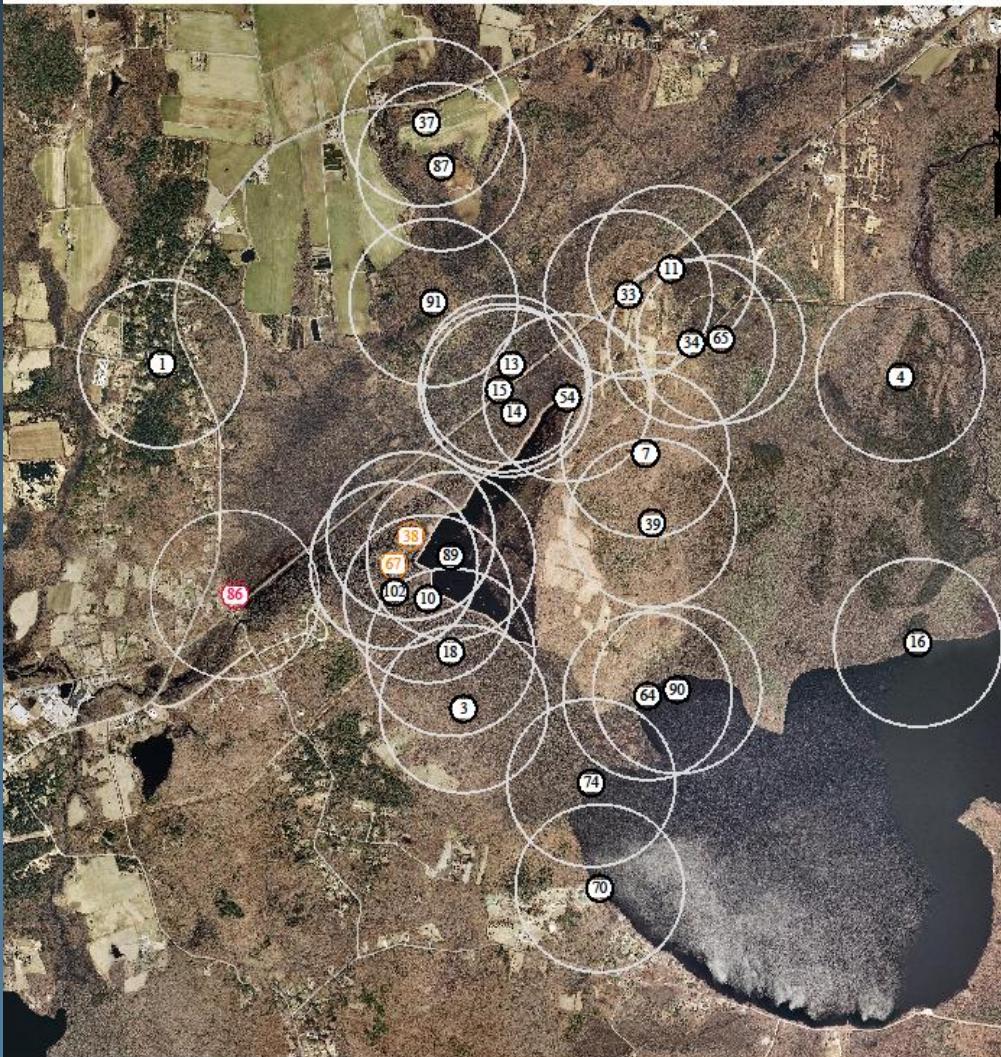
RARE SPECIES LOCATIONS WITH NO EXPECTED IMPACTS

RARE SPECIES LOCATIONS WITH POTENTIAL EXPECTED IMPACTS

Rock Ramp - Natural History Database

# Fish Passage Alternatives Analyses

## Kenyon Mill Dam Fish Passage Project



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