

Elizabeth Webbing Mills Dam

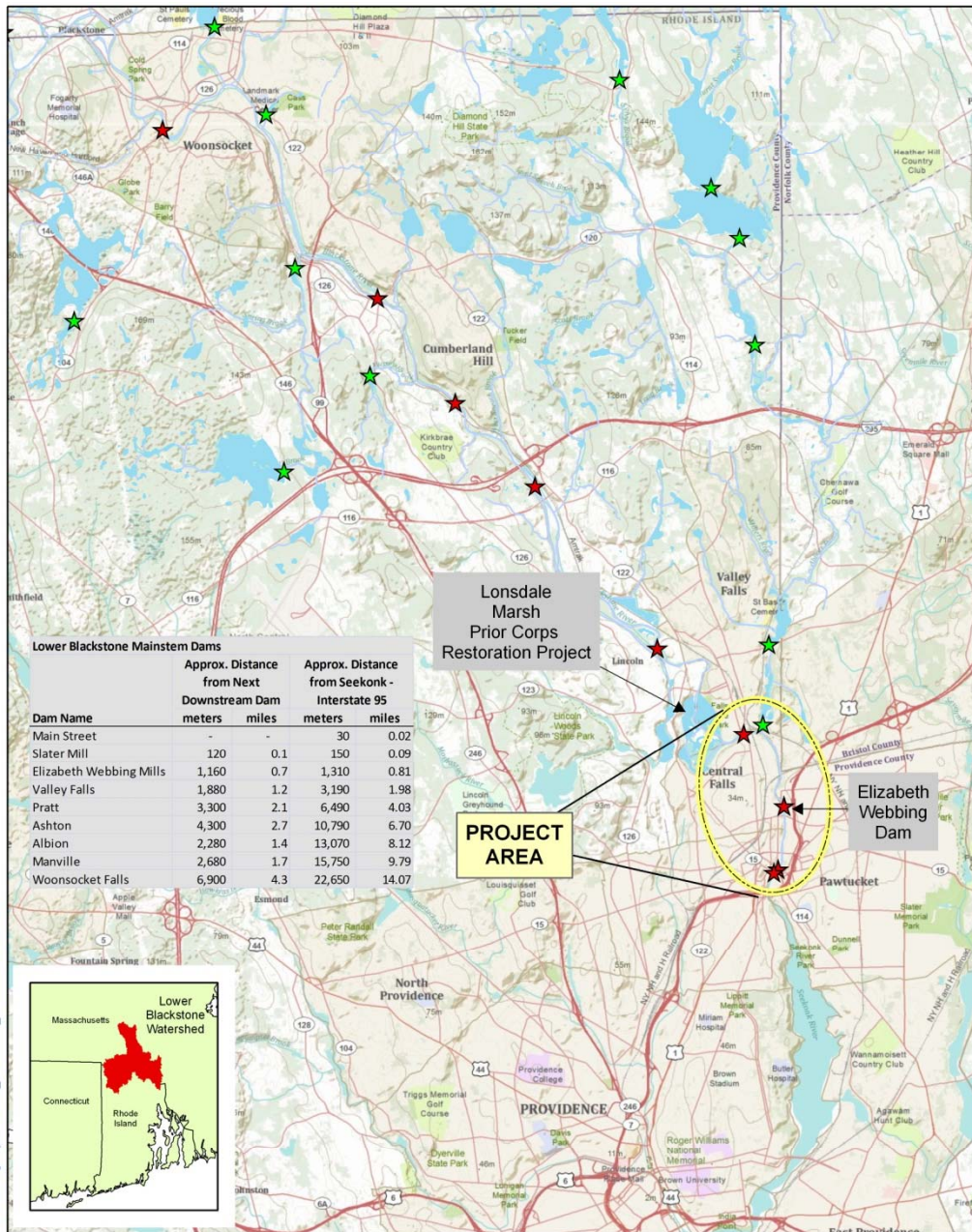
Fish Passage Study



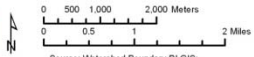
US Army Corps
of Engineers



Rhode Island
Department of
Environmental
Management



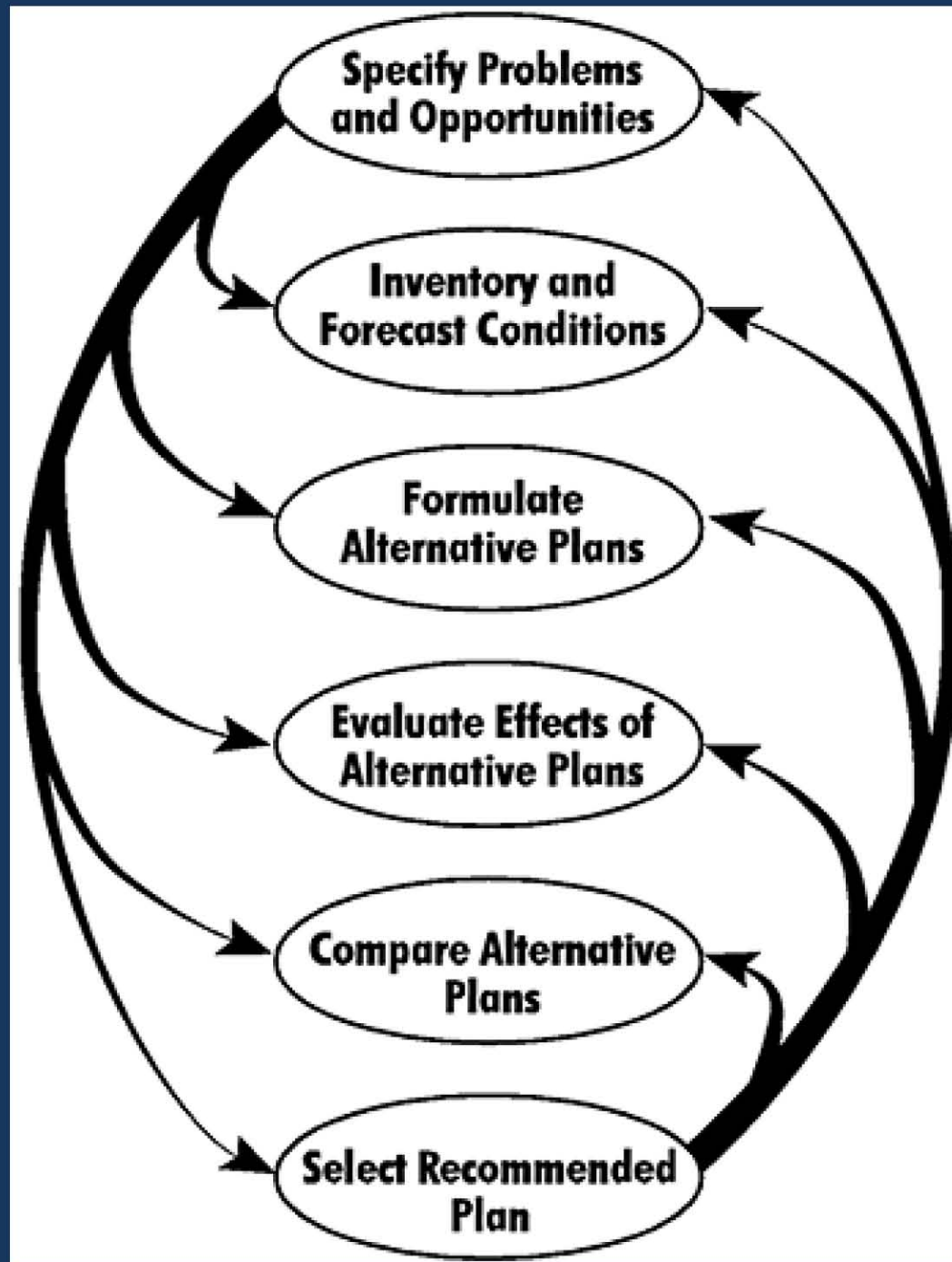
- 1997 Reconnaissance Investigation
- Problem Identified - degradation of riverine habitat and impediments to diadromous fish migration.
- 2004 Preliminary Restoration Plan to provide fish passage at four dams.
- No further Corps involvement due to FERC
- RIDEM & NRCS partnered to provide passage at three dams
- 2010 RIDEM purchased EWD
- Later 2010 requested Corps to evaluate restoration alternatives at EWD



- ★ Mainstem Dam
- ★ Other Blackstone Watershed Dams

Lower Blackstone River
Rhode Island

Source: Watershed Boundary RI GIS; National Inventory of Dams 2009



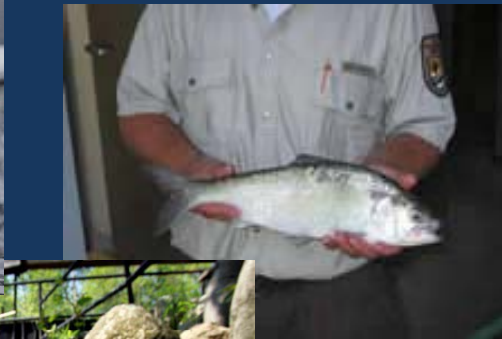
Problems & Opportunities

- loss and degradation of wetlands
- loss and degradation of riparian habitat
- loss and degradation of riverine habitat
- loss and degradation of pond habitat
- loss of diadromous fish
- degraded water and sediment quality

28-37% of the wetland habitat in MA and RI was lost due to development; 30% loss in BRW since 1700's



Robert F. Bukaty | AP



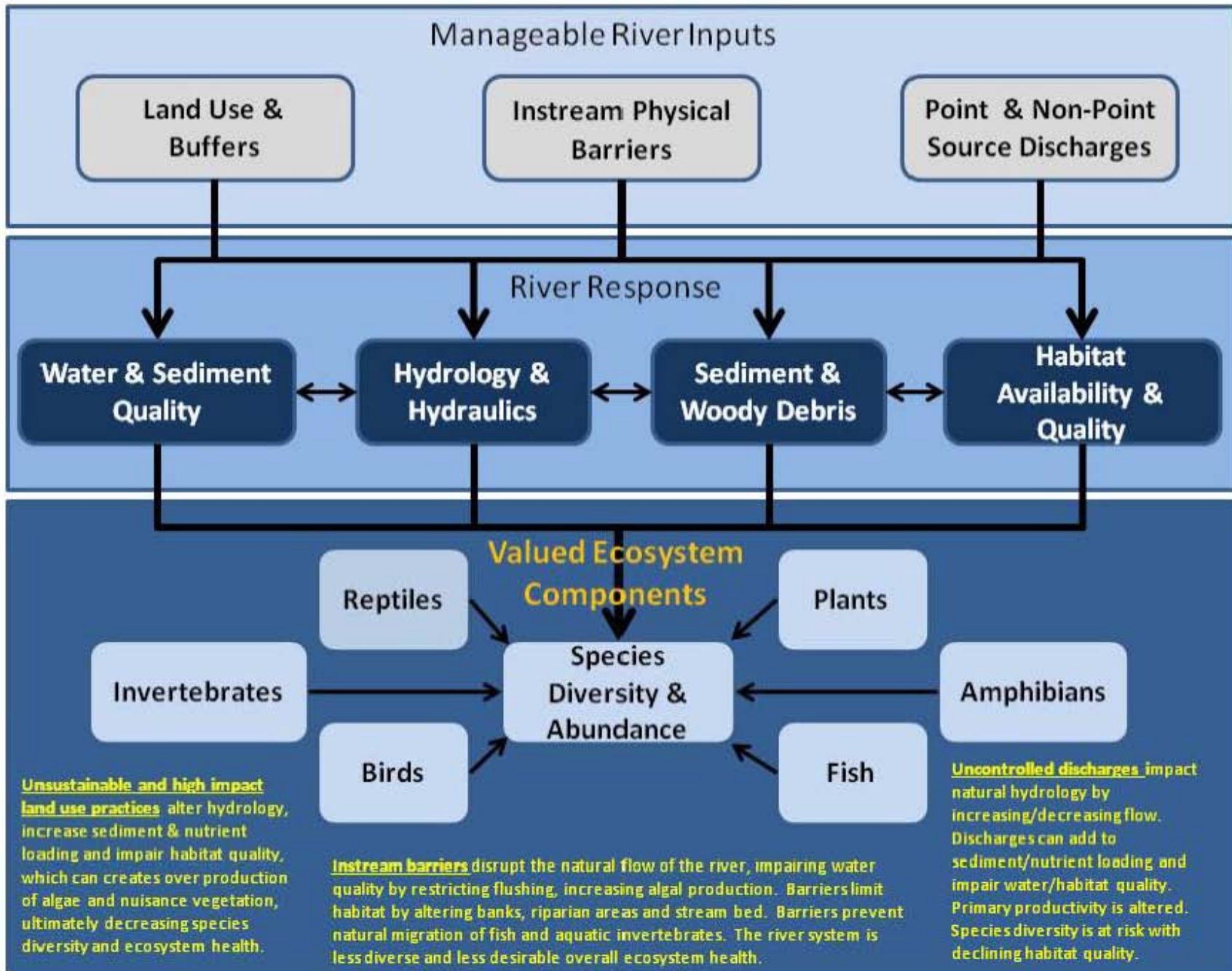
As of 1997 there were 17 dams along the BR



1/2 of the lakes and ponds in BRW are eutrophic or hypereutrophic

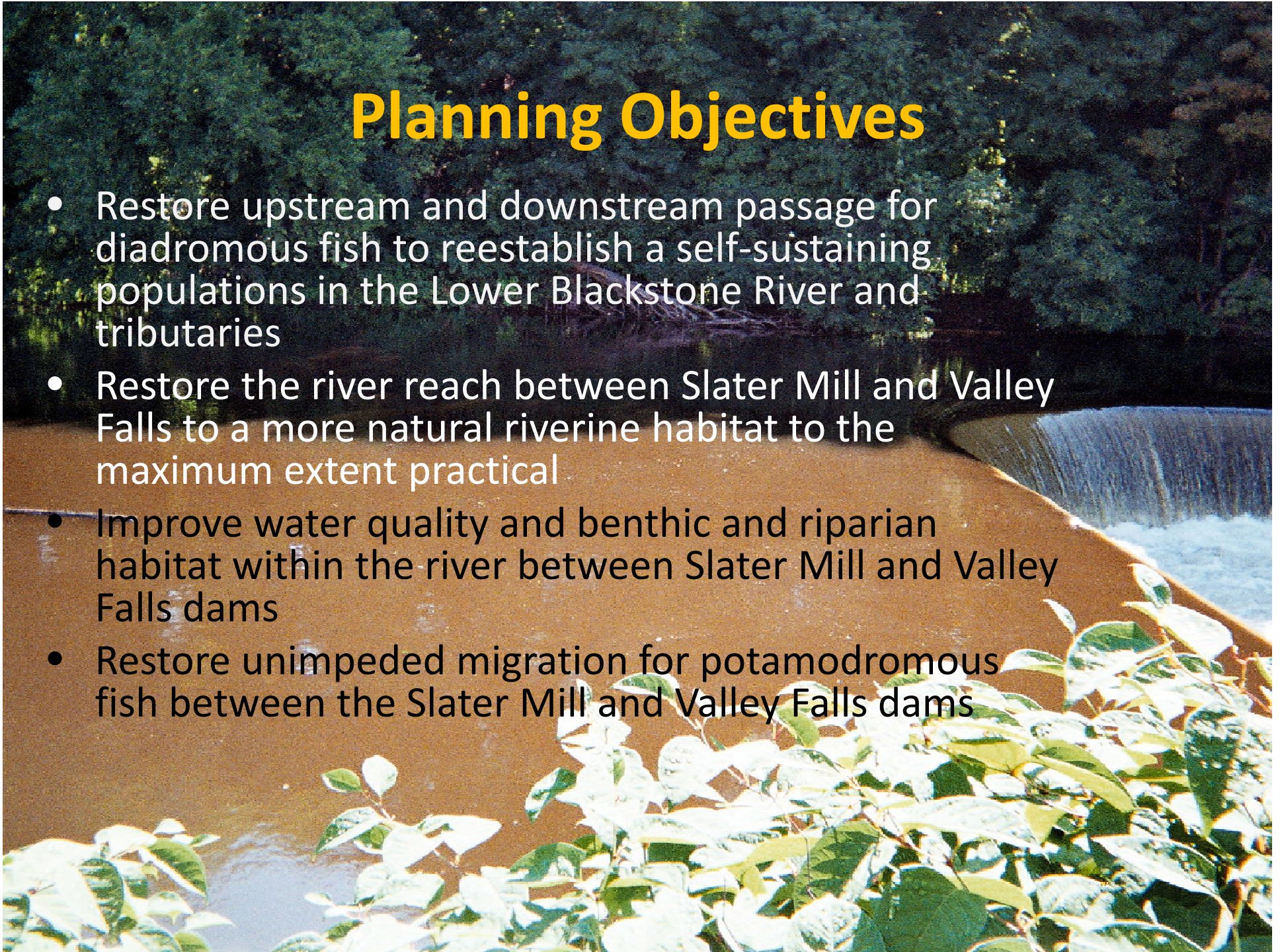
Lots of available information
(URI, NBEP, EA Engineering, NRCS, UMASS, CDM,
BRWA, BRWC/FOBRW...)





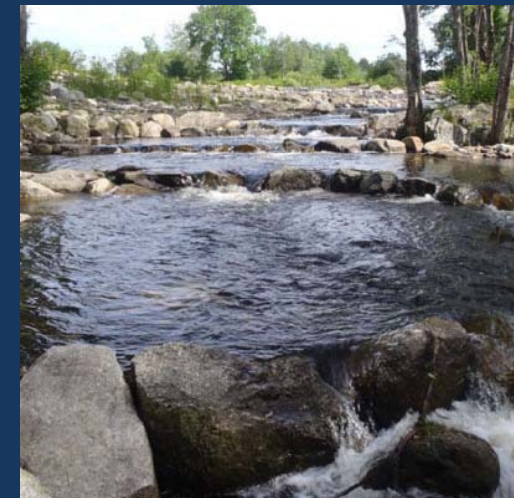
Planning Objectives

- Restore upstream and downstream passage for diadromous fish to reestablish a self-sustaining populations in the Lower Blackstone River and tributaries
- Restore the river reach between Slater Mill and Valley Falls to a more natural riverine habitat to the maximum extent practical
- Improve water quality and benthic and riparian habitat within the river between Slater Mill and Valley Falls dams
- Restore unimpeded migration for potamodromous fish between the Slater Mill and Valley Falls dams



Identify Restoration Measures

- Dam removal
- Partial dam removal
- Lowering the dam height by 2'
- Fish lift (elevator)
- Pool type fishway
- Denil-style fish passage
- Steeppass fishway
- Nature-like bypass
- Rock ramp
- Hydropower facility removal
- Hydropower facility partial removal



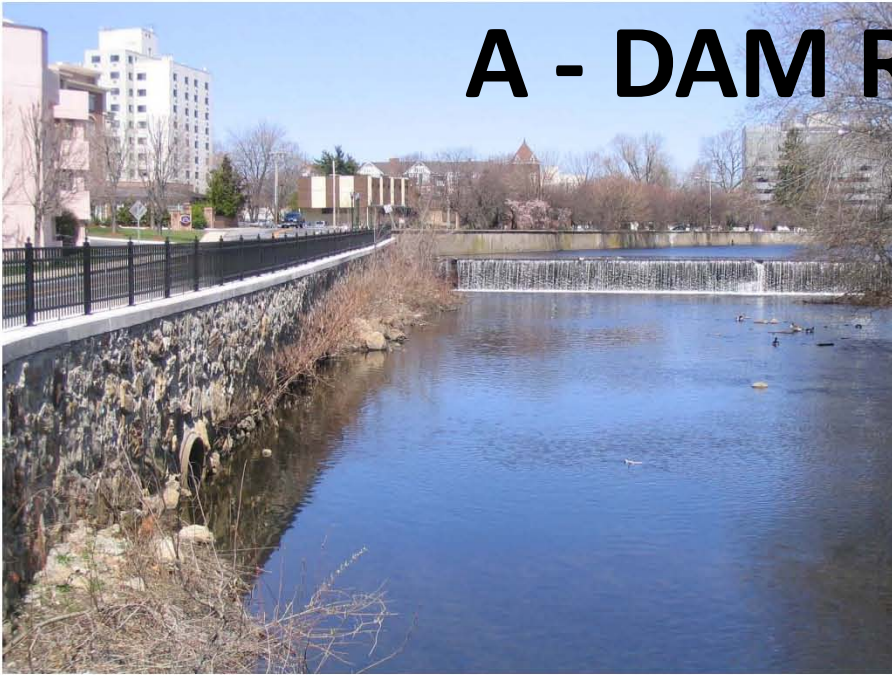
Alternative Plans

0 – No Action “Without Project Condition”

Federal Government or local interests do not implement a project to achieve the planning objectives

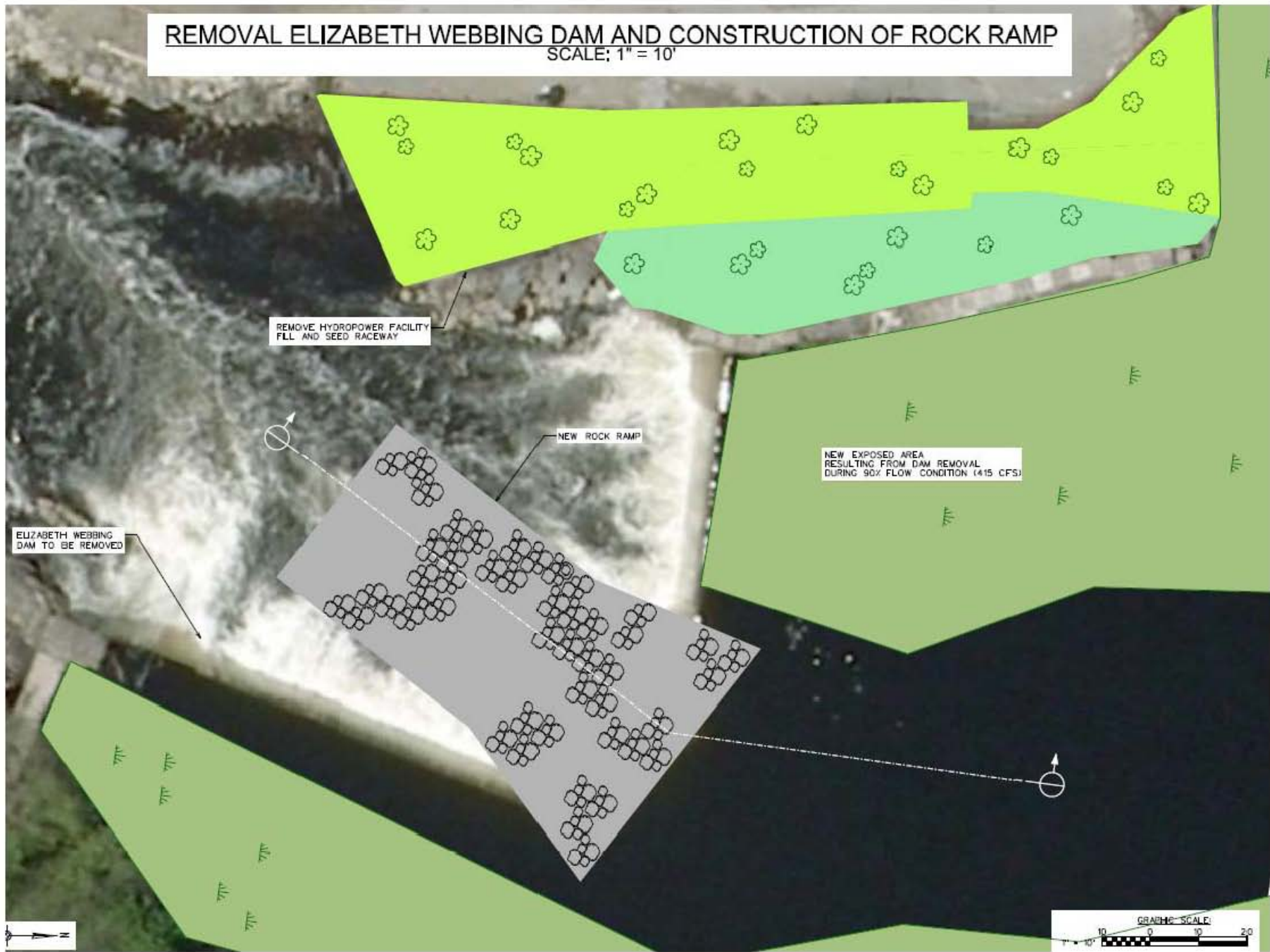
- Render projects underway useless
- No improvement in habitat, water quality, connectivity etc.

A - DAM REMOVAL



REMOVAL ELIZABETH WEBBING DAM AND CONSTRUCTION OF ROCK RAMP

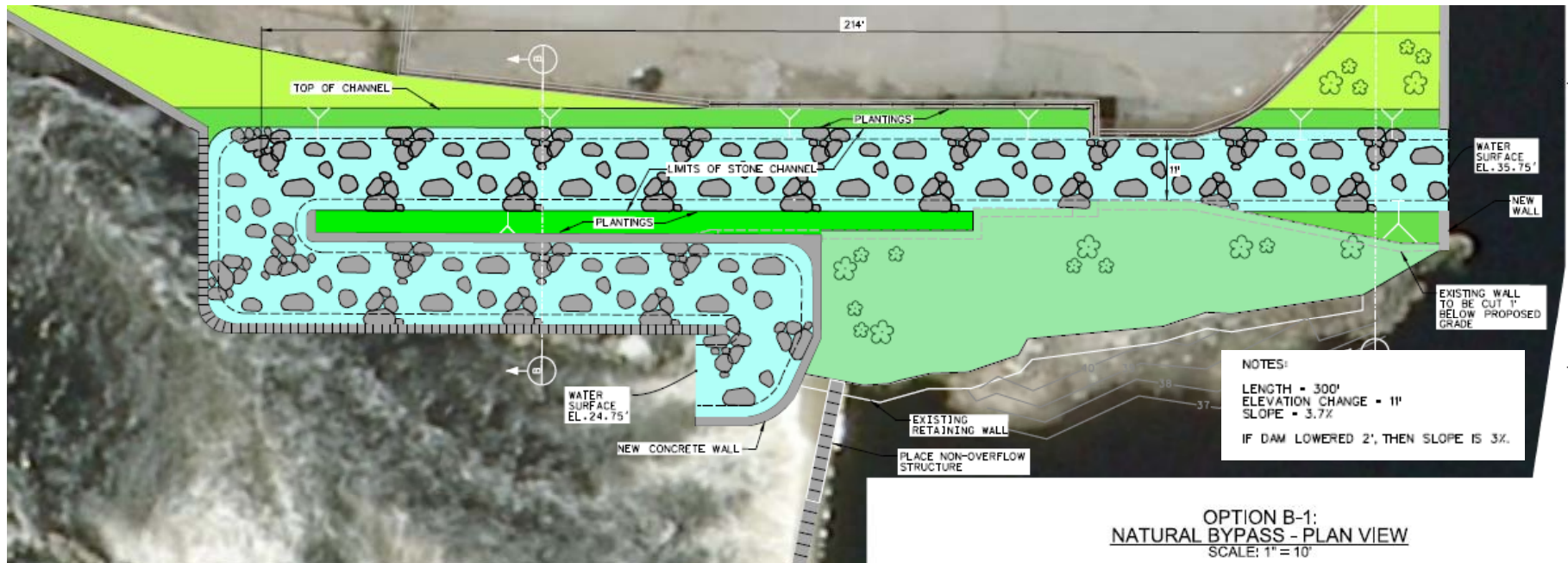
SCALE: 1" = 10'



B – Nature-like bypass through hydropower raceway

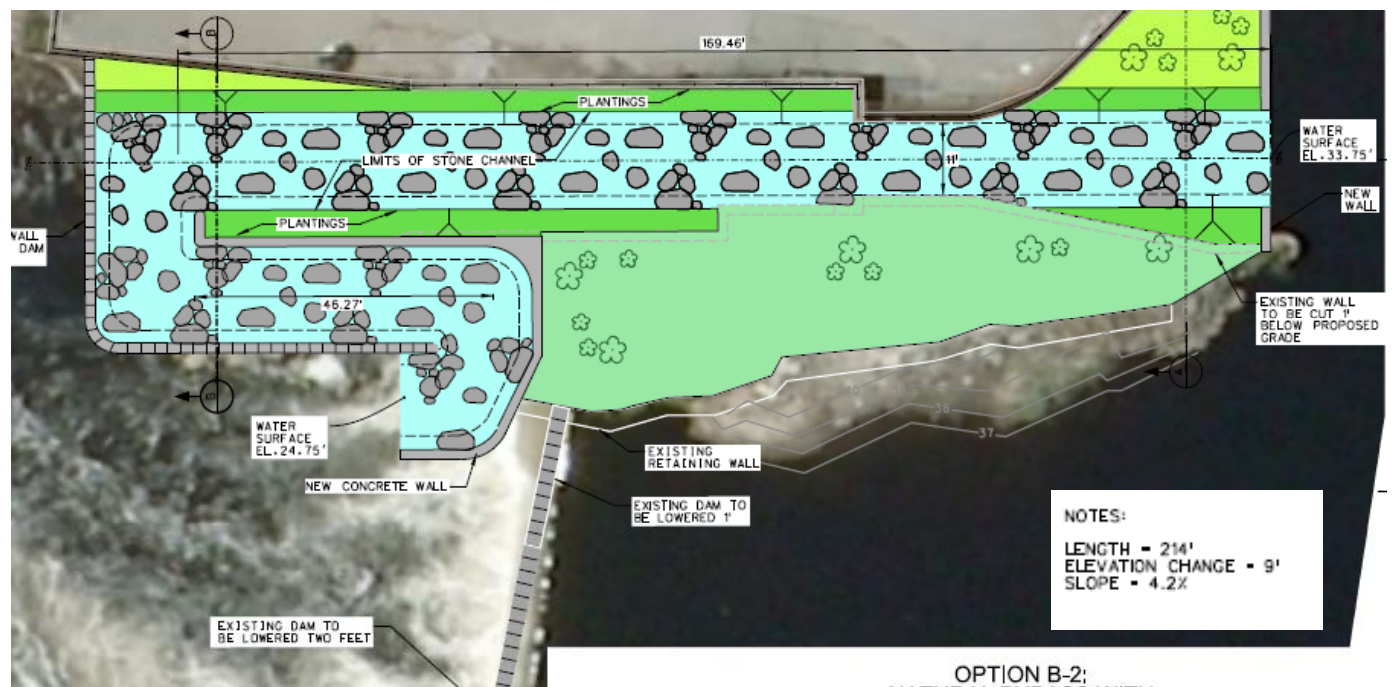
1. Long bypass (300') no dam alteration
2. Short bypass (214') and lowering dam 2'





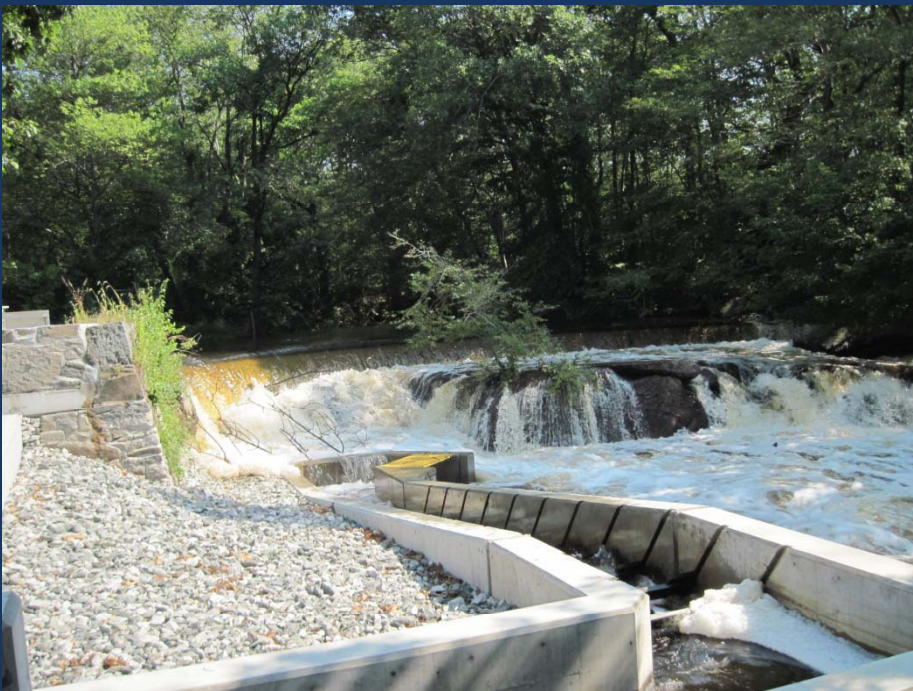
Why two options?

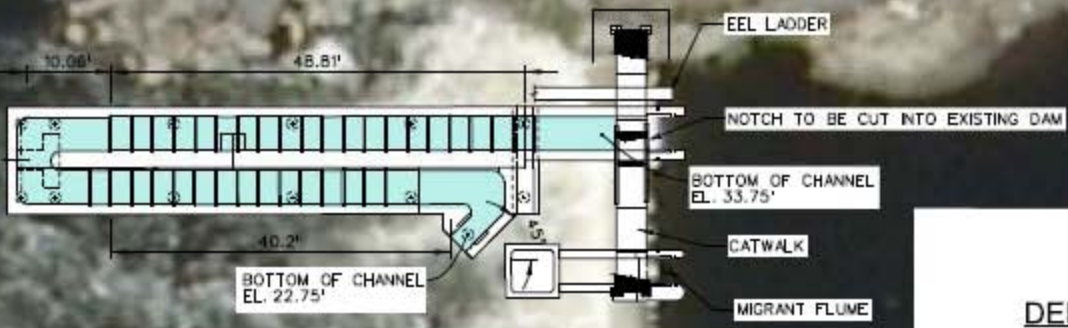
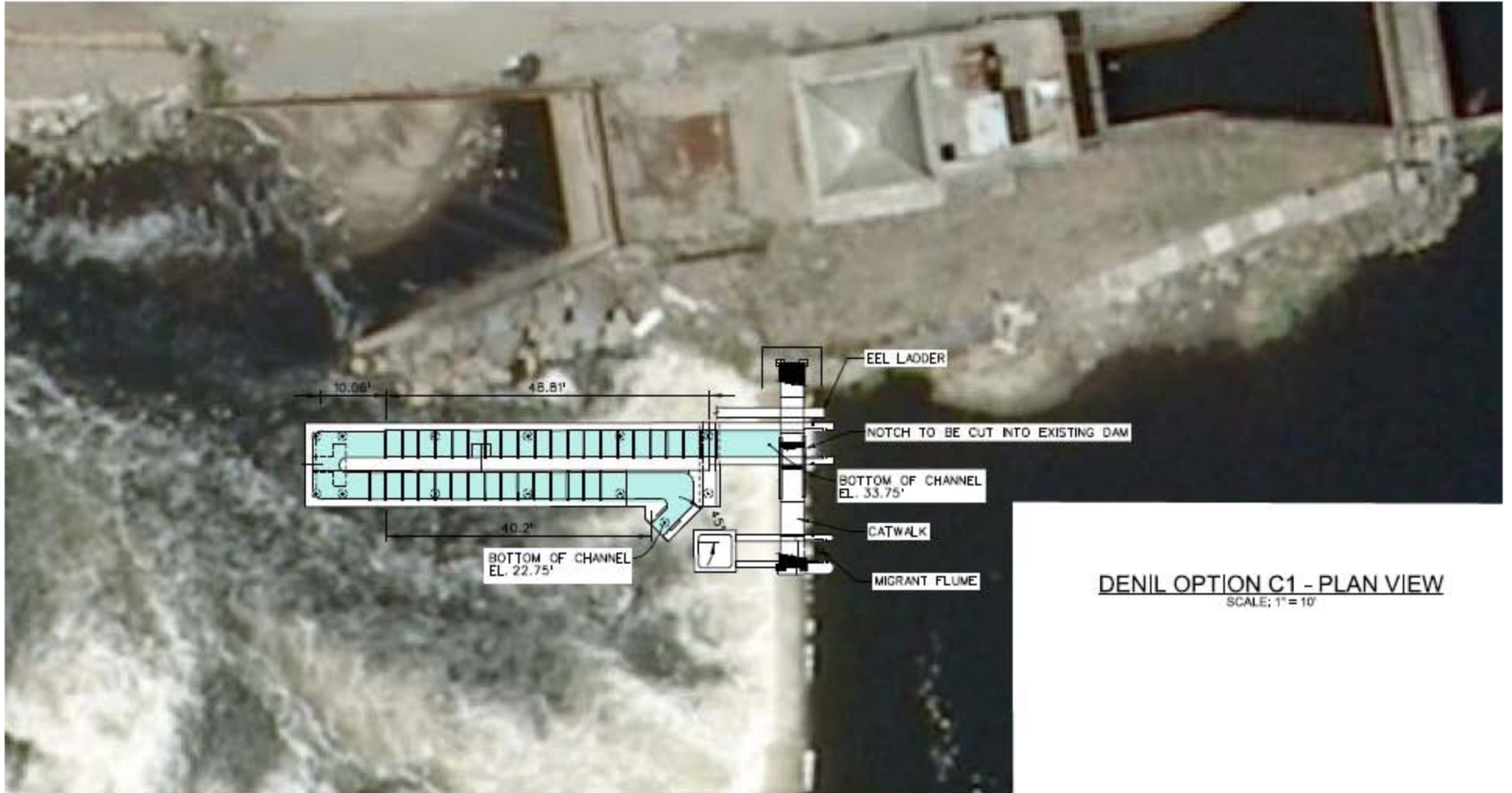
- Length and Slope; improve passage efficiency
- Lower pool; more natural condition; improve WQ



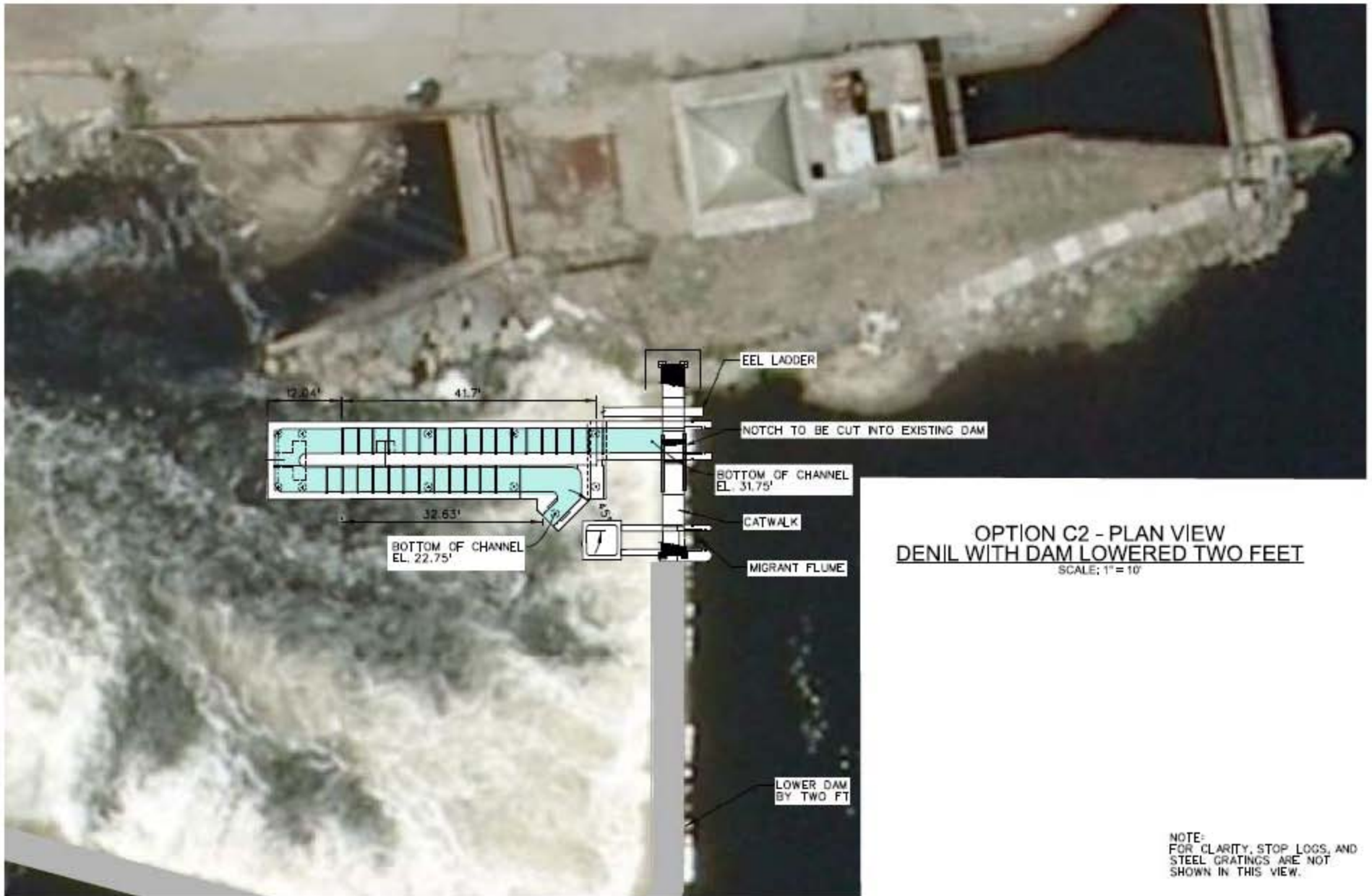
C – Denil fish passage on right/west side of river

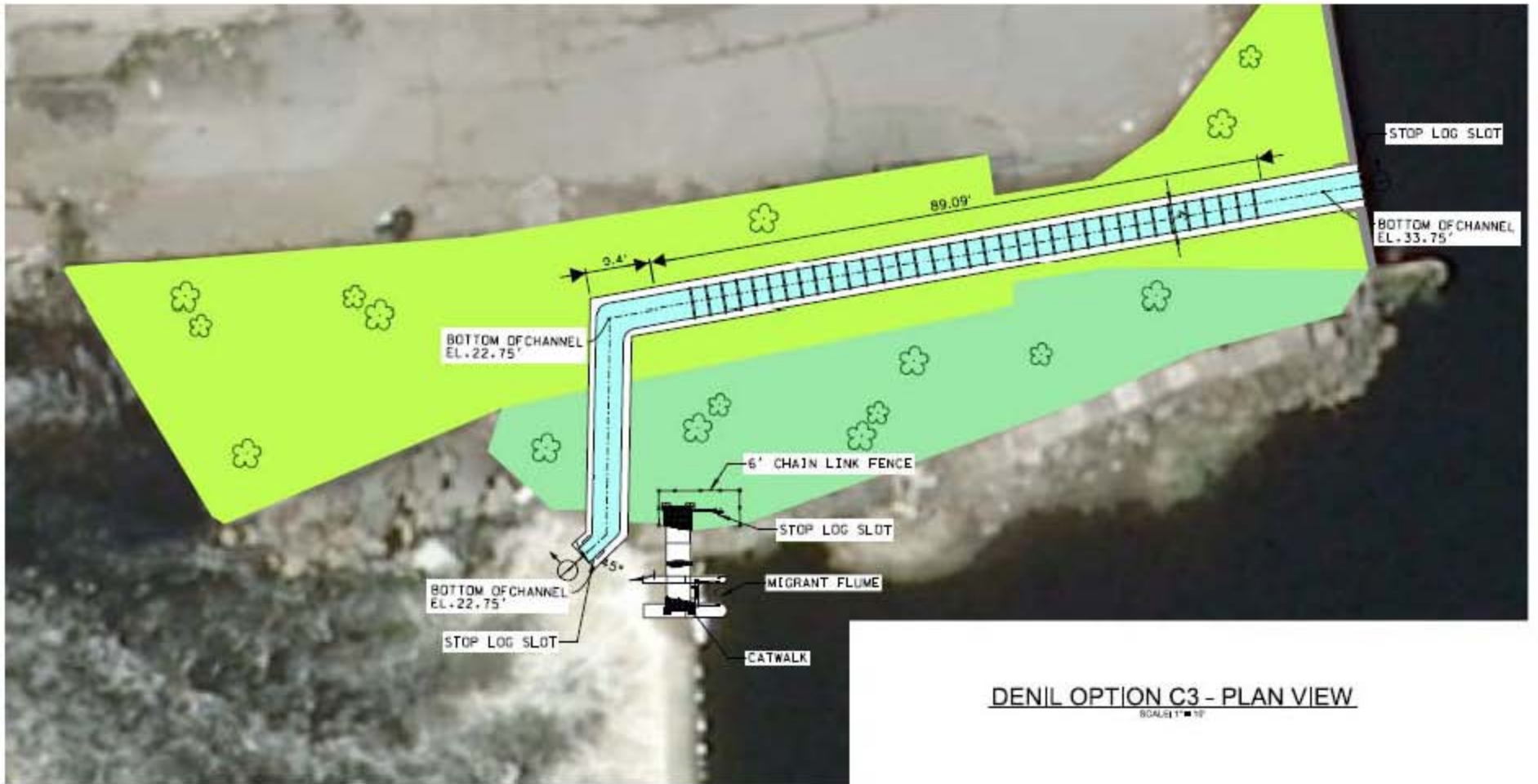
1. Denil adjacent to hydropower facility
2. Denil and lowering dam 2'
3. Denil through the hydropower raceway





DENIL OPTION C1 - PLAN VIEW
SCALE: 1" = 10'





Evaluate Alternatives

Compare to No Action and each other

- Quantity & quality of habitat
- Cost
- Other beneficial & adverse effects (e.g., envir, social, economic etc.)
- P&G Criteria for Evaluating Federal Water Projects (*Completeness, Effectiveness, Efficiency & Acceptability*)

How do we quantify benefits (outputs)?

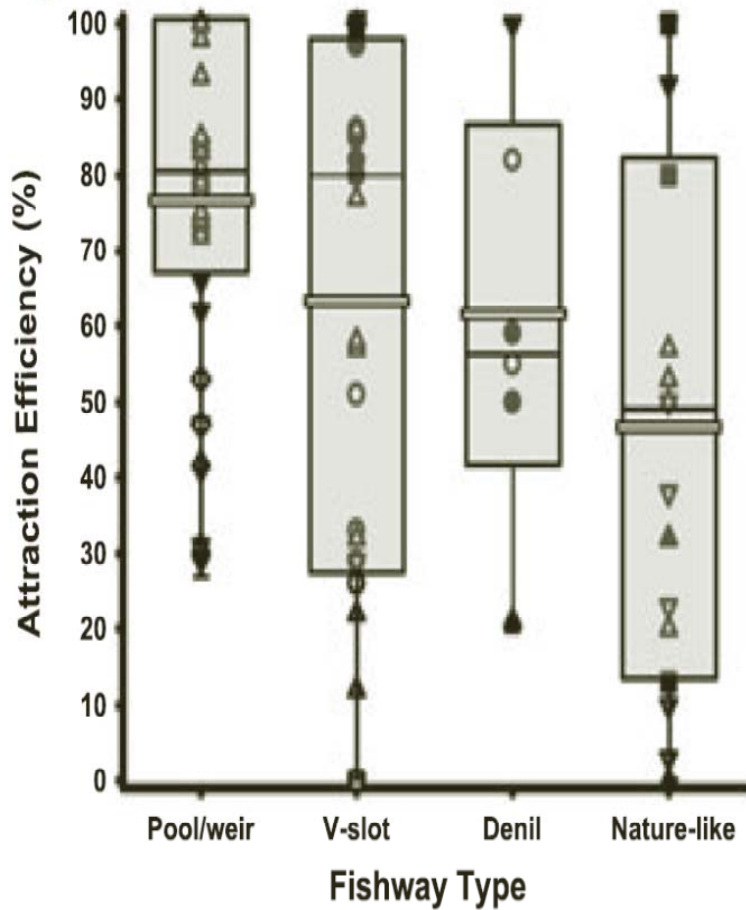
Passing ability (up & down)

Habitat improvements – WQ, hydrology, benthic habitat etc.

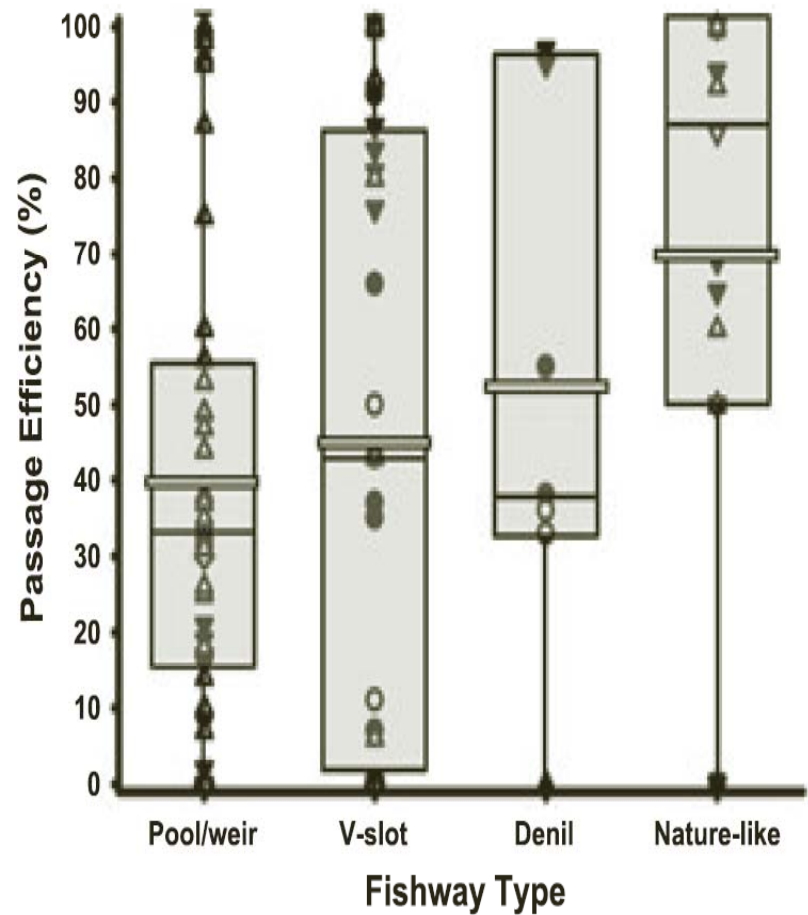
USFWS HEP (1980) – assumption that qty & quality habitat is numerically describable;

Species specific index is used to rate the quality of habitat (0-1). This HSI is then multiplied by habitat available to produce Habitat Units (HU).

a)



b)



19 Studies
26 Species
101 Records

C.M. Bunt, T. Castro-Santos & A. Haro 2011. River Research and Applications

DOES NOT ACCOUNT FOR REDUCED PASSAGE EFFICIENCY WITH CONSECUTIVE STRUCTURES

$$\text{Passing/Improvement Index} \times \text{Objective Relative Importance} \times \text{Available Habitat} = \text{Habitat Unit}$$

Passing/improvement Index
0 = Not effective/No change
0.25 = Low pass/Min improvement
0.50 = Mod-High up pass, limited down pass/Mod improvement
0.75 = High pass/High improvement
1.0 = Optimal pass/Optimal improvement

X

Planning Objective Relative Importance
0.25 = Riparian habitat
0.25 = Hydrology, sediment transport, water quality, benthic habitat
0.25 = Potamodromous fish migration
1.0 = Diadromous fish migration

X

Potential Habitat (acres)
6 = Riparian habitat
21 = Hydrology, sediment transport, water quality, benthic habitat
206 = Potamodromous fish migration
206 = Diadromous fish migration

=

Habitat Unit

Alternative	Fish Passing Index		Other Objectives Hydro, Sed Trnspt, WQ,	
	Diadromous Fish	Potamodromous Fish	Benthic Habitat	Riparian Habitat
0 No Action	0	0	0	0
A Full dam removal	1	1	1	1
B-1 Long nature-like bypass, no alteration to dam	0.75	0.75	0.25	0
B-2* Short nature-like bypass, lowering dam two feet	0.85	0.85	0.50	0.25
C-1 Denil, no alteration to facility or dam	0.50	0.25	0	0
C-2* Denil, lowering dam two feet	0.60	0.35	0.25	0.25
C-3 Denil through the hydropower raceway	0.50	0.25	0	0

0 = Not effective/No change
 0.25 = Low pass/Min improvement
 0.50 = Mod-High up pass, limited down pass/Mod improvement
 0.75 = High pass/High improvement
 1.0 = Optimal pass/Optimal improvement

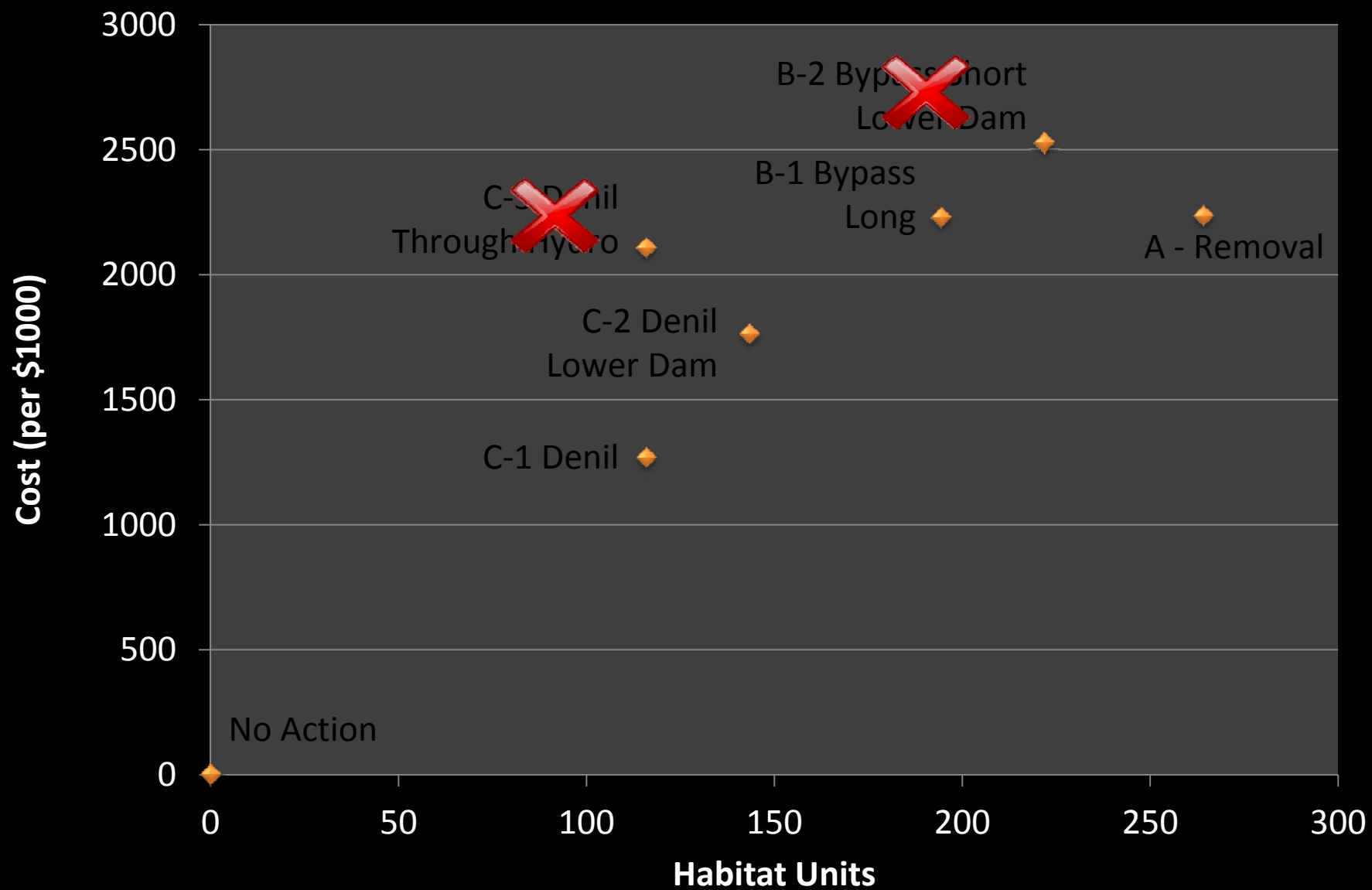
$$\text{Passing/Improvement Index} \times \text{Objective Relative Importance} \times \text{Available Habitat} = \text{Habitat Unit}$$

Alternative	Habitat Units				Total Units
	Diadromous Fish	Potamodromous Fish	Hydro, Sed Trnspt, WQ, Benthic	Riparian Habitat	
0 No Action	0	0	0	0.0	0
A Full dam removal	206	52	5	1.5	264
B-1 Long nature-like bypass	155	39	1	0.0	194
B-2 Short nature-like bypass & lower dam	175	44	3	0.4	222
C-1 Denil adjacent to hydropower	103	13	0	0.0	116
C-2 Denil adjacent to hydropower & lower dam	124	18	1	0.4	143
C-3 Denil through the hydropower raceway	103	13	0	0.0	116

Total Project Costs

Alternative	Total Units	Total Costs
0 No Action	0	\$0
A Full dam removal	264	\$2,233,000
B-1 Long nature-like bypass	194	\$2,229,000
B-2 Short nature-like bypass & lower dam	222	\$2,525,000
C-1 Denil adjacent to hydropower	116	\$1,268,000
C-2 Denil adjacent to hydropower & lower dam	143	\$1,763,000
C-3 Denil through the hydropower raceway	116	\$2,108,000

Cost Effectiveness




Incremental Cost Analysis

How many \$ more does next plan cost for each additional benefit?

Alternative	Cost (\$/1000)	HU	IC (\$/1000)	IHU	IC/IHU (\$1000/HU)
0 No Action	\$0	0	\$0	0	\$0
C-1 Denil adjacent to hydropower	\$1,268	116	\$1,268	116	\$11
C-2 Denil adjacent to hydropower & lower dam	\$1,763	143	\$495	27	\$18
B-1 Long nature-like bypass	\$2,229	194	\$466	51	\$9
A Full dam removal	\$2,233	264	\$4	70	\$0

Best Buy Plan
Greatest increase in output for the least increment in cost

If Dam Removal is not an option

Alternative	Cost (\$/1000)	HU	IC (\$/1000)	IHU	IC/IHU (\$1000/HU)
0 – No Action	\$0	0	\$0	0	\$0
C-1 – Denil adjacent to hydropower	\$1,268	116	\$1,268	116	\$11
C-3 – Denil through  hydropower raceway	\$2,108	116			
C-2 – Denil adjacent to hydropower & lower dam	\$1,763	143	\$495	27	\$18
B-1 – Long nature-like bypass	\$2,229	194	\$961	79	\$12
B-2 – Short nature-like bypass & lower dam	\$2,525	222	\$1,257	106	\$12

Best Buy

B-2 next Best Buy advancing from 1st selected plan

Other Beneficial & Adverse Effects

Category	Existing Condition	Dam Removal
Diadromous Fish	Poor	++
Potamodromous Fish	Poor	++
RTE Species	Poor	++
Vegetation	Poor	+
Water Quality	Poor	++
Benthic Aquatic Habitat	Poor	++
Riparian Habitat	Poor	++
River Hydrology	Poor	++
Sediment and Woody Debris Transport	Poor	+
Waterfowl	Poor	0
Recreation	Moderate	+
Aesthetics	Poor/Moderate	+
Cultural and Historic Properties	Good	-
Air Quality	Moderate/Good	-
Noise	Moderate	-

Score = 15

Change index	Description	Points
0	No change expected or offset by other factor	0
-	Some negative effects	-1
--	Substantial negative effects	-2
+	Some positive effects	1
++	Substantial positive effects	2

Relative Degree of Change

Alternative		Score
A	Full dam removal	15
B-1	Long nature-like bypass	9
B-2	Short nature-like bypass & lower dam	10
C-1	Denil adjacent to hydropower	0
C-2	Denil adjacent to hydropower & lower dam	3
C-3	Denil through the hydropower raceway	5

Supported Plans

A – Full Dam Removal

B-2 – Short Nature-like Bypass & Lowering the Dam

C-1 – Denil adjacent to hydropower



