A robust, permanent upstream passage system for juvenile American eels Penobscot River, Maine

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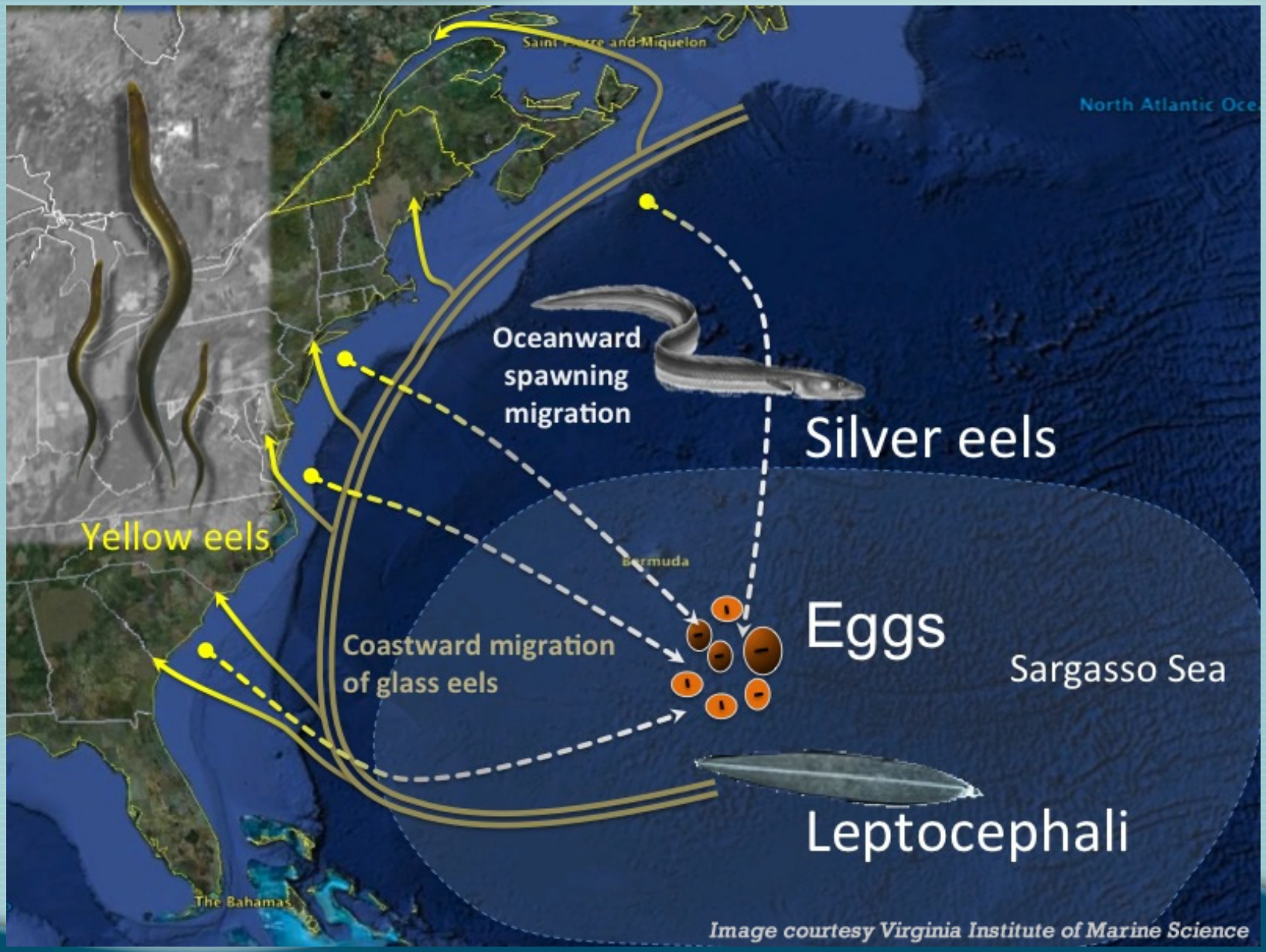
Kleinschmidt

Migration


Saint Pierre and Miquelon
North Atlantic Ocean
Oceanward spawning migration
Silver eels
Yellow eels
Bermuda
Eggs
Sargasso Sea
Coastward migration of glass eels
Leptocephali
The Bahamas
Image courtesy Virginia Institute of Marine Science

Management and Status

- Cultural significance (*Nga taonga tuku iho – te tuna; The eel – An ancient gift from the gods)*
- Important fishery - sustenance/commercial (depleted stock - ASMFC)
- Endangered in Ontario; species of concern in the U.S. (2 listing petitions)
- *"There's gold in them thar eels"*
  - Recent increase in demand (Asian aquaculture)
  - Value < $200 a pound (2010) to $2,600 (2012)
  - 9,700 pound quota in Maine (2016)
  - $12 M harvest in Maine (2017)

Regulatory Compliance

Federal Energy Regulatory Commission may require a dam/hydro owner to:

- perform an American eel passage location study;
- identify the location of eelway(s) and design specifications;
- outline a schedule for installing the facility;
- develop an operational and maintenance plan;
- develop a monitoring plan; and
- work with state, federal, and tribal organizations.

Monitoring at Dams

Visual, nighttime surveys

- Repeated “spotlight” surveys
  - below spillways,
  - face of dam,
  - bedrock outcrops,
  - rough concrete support walls,
  - tailrace areas,
  - every nook, every cranny
  - predictable and repeated patterns

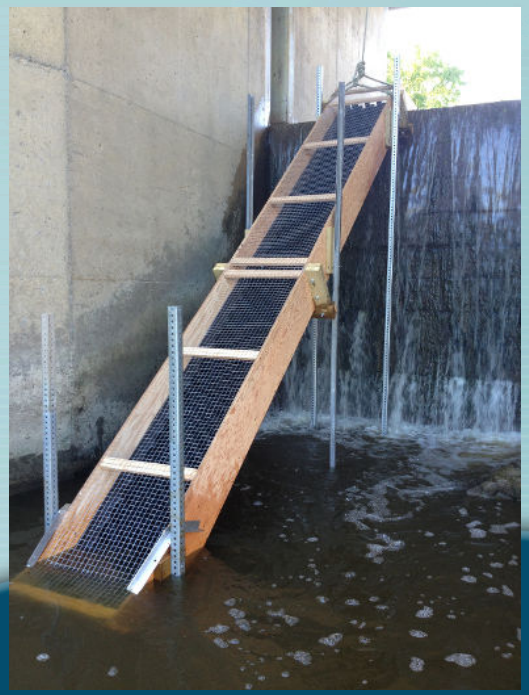
Monitoring at Dams

Designing Eelways at Dams

- Location, location, location
- Design, design, design
  - Slope and orientation
  - Substrate
  - Cover
  - Attraction flow
  - Conveyance flow
  - Predators
  - Spill and high flows
  - Access
  - Debris and Maintenance
  - Monitoring

Traditional Seasonal Ladders

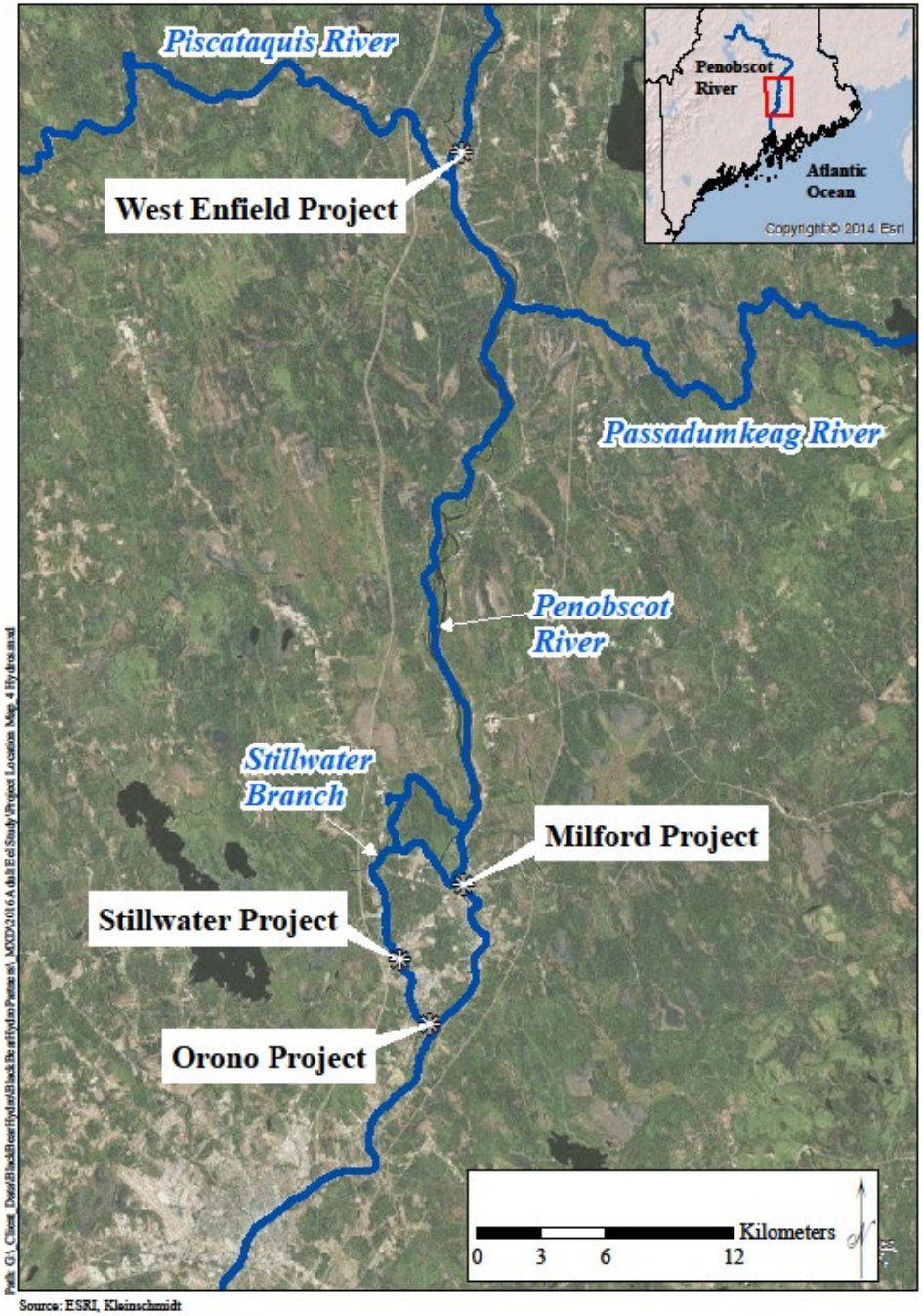
- Temporary (e.g., wooden, aluminum)
- Difficult to access; increased safety risk
- High-maintenance
- Delayed installation due to high river flows
- Subject to debris and damage
- Limited flow / passage conditions
- Inexpensive



Robust Permanent Eelway Design at Low Head Dam

- Permanent
- Flow-through
- Less safety risk
- Lower maintenance
- Longer operational period (permanently deployed)
- Higher range of flow conditions
- Expensive

Orono Dam, Penobscot River (ME)



Orono Dam, Penobscot River (ME)

Eel Fishway at Orono Dam

GENERAL NOTES:

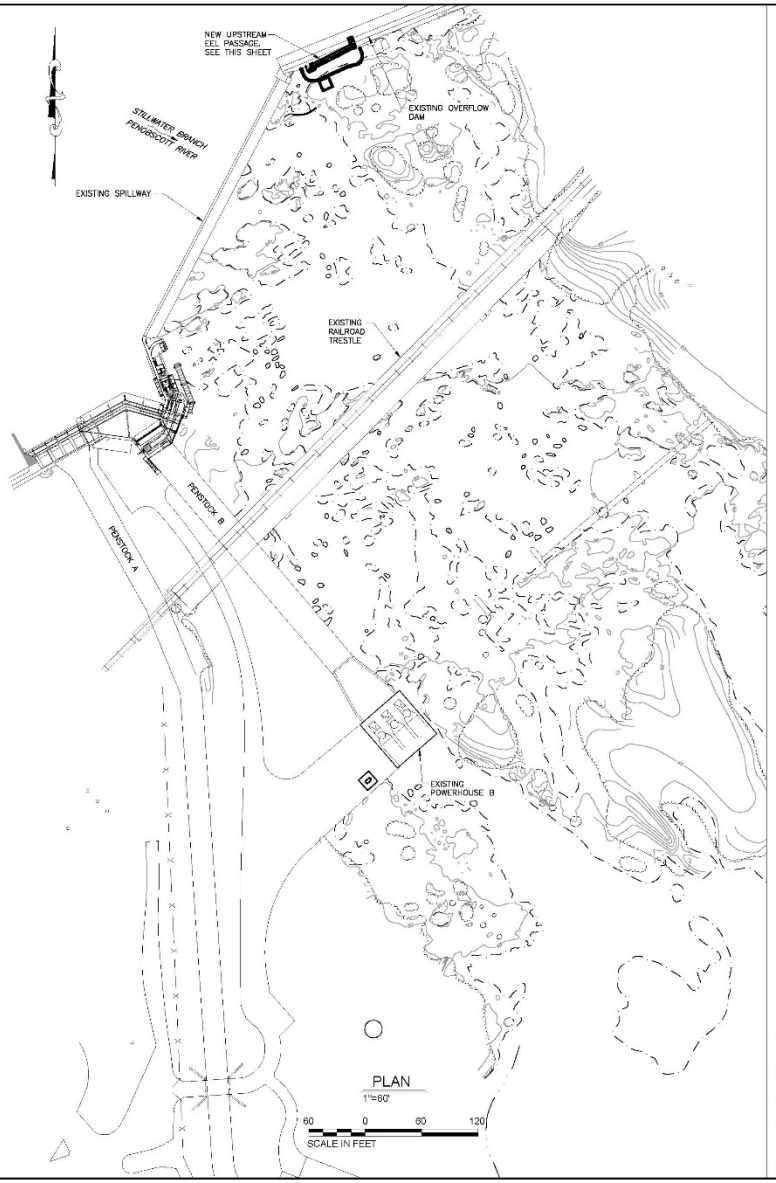
1. CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH THESE DRAWINGS.
2. CONTRACTOR SHALL SCHEDULE WORK IN COOPERATION WITH THE OWNER AND SHALL COORDINATE WITH DAM REPLACEMENT WORK.
3. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR FABRICATION AND ERECTION OF ALL STRUCTURAL STEEL, MISCELLANEOUS METAL FABRICATIONS, AND CONCRETE REINFORCEMENT.
4. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON THE ORIGINAL EXHIBIT F DRAWINGS. VERIFY DIMENSIONS PRIOR TO START OF WORK AND NOTIFY THE OWNER/ENGINEER OF ANY DISCREPANCIES.

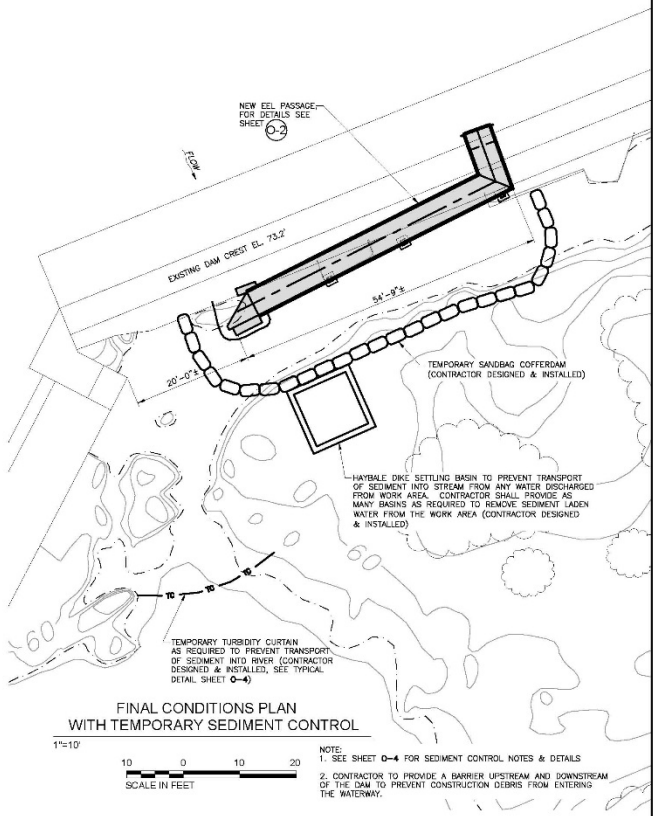
METAL NOTES:

1. ALL STRUCTURAL AND MISCELLANEOUS STEEL MEMBERS SHALL BE PAINTED AS SPECIFIED BELOW.
   A. SURFACE PREPARATION: SSPC– SP 10 NEAR WHITE BLAST CLEANING.
   B. COATING: TWO COATS OF DEVOE BAR-RUST 235 MULTI-PURPOSE EPOXY AT 6.0–8.0 MILS DFT/COAT.
   C. COATING SHALL BE APPLIED PER MANUFACTURERS INSTRUCTIONS.
   D. TOP COAT COLOR WILL BE SELECTED BY OWNER FROM MANUFACTURERS STANDARD COLORS.
2. ALL FASTENERS AND HARDWARE SHALL BE GALVANIZED PER ASTMA–153, UNLESS NOTED OTHERWISE.
3. STEEL BARS, PLATES, ANGLES AND CHANNELS AND OTHER SHAPES, UNLESS NOTED OTHERWISE – ASTM A36.
4. ALUMINUM – 6061–T6
5. BOLTS – 3/4" ASTM A325 OR 304 S.S.
6. WELD:
   A. STEEL PER AWS D1.1 MATCHING ELECTRODES TO STRENGTH OF BASE METALS.
   B. ALUMINUM PER AWS D1.2 USING 5356 FILLER ALLOY
7. ADHESIVE ANCHOR BOLTS – HILTI, INC. HAS E STANDARD ISO 898 CLASS 5.8 GALVANIZED RODS WITH HIT–HY 200 EPOXY GROUT ADHESIVE OR APPROVED EQUAL, UNLESS NOTED OTHERWISE. INSTALLED PER MANUFACTURERS INSTRUCTIONS, MINIMUM EMBEDMENT, 5" FOR 1/2" & 5/8" DIA. 7" FOR 3/4" DIA. AND 12" FOR 1" DIA. ANCHORS.

CONCRETE NOTES:

1. REMOVE EXISTING CONCRETE TO EXTENT SHOWN ON THE DRAWINGS. THE OWNER SHALL EXAMINE THESE AREAS BEFORE NEW CONCRETE IS PLACED.
2. ALL LOOSE ROCK, CONCRETE, AND SOIL SHALL BE REMOVED PRIOR TO CONSTRUCTION. REMOVE ANY GREASE, OIL OR OTHER COATINGS ON ANY EXISTING SURFACE.
3. WHEN CONCRETE IS PLACED DIRECTLY AGAINST ROCK SURFACES OR SURFACES, THE SURFACE SHALL BE CLEANED WITH HIGH–PRESSURE WATER TO REMOVE ALL DIRT OR LOOSE MATERIAL.
4. ALL WORK SHALL CONFORM TO ACI 318, ACI 301 AND ACI 347, LATEST EDITIONS.
5. SPECIFICATIONS:
   A. MINIMUM 28 DAY STRENGTH = 4000 PSI.
   B. MAXIMUM WATER/CEMENT RATIO = 0.45.
   C. SLUMP 3" TO 4".
   D. AIR CONTENT PROVIDED BY AIR ENTRAINMENT ADMIXTURE 5 % TO 7% AS MEASURES BY ASTM C231.
   E. ADMIXTURES CONTAINING CALCIUM CHLORIDE SHALL NOT BE USED.
6. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.
7. CURE CONCRETE FOR 7 DAYS MINIMUM. DO NOT APPLY LOADS TO NEW CONCRETE FOR AT LEAST 7 DAYS UNLESS APPROVED BY THE ENGINEER.
8. REINFORCEMENT:
   A. ASTM A615 GRADE 60, SUBMIT SHOP DRAWINGS.
   B. FIELD BEND REINFORCING BARS TO CLEAR BOXOUTS AND PIPES WHERE REQUIRED. NO CUTTING OF REINFORCEMENT BARS SHALL BE DONE WITHOUT PRIOR APPROVAL OF ENGINEER.
      I. SPLICES: SPLICES SHALL BE ACI CLASS B UNLESS NOTED OTHERWISE.
      II. HOOKS: SHALL BE DIMENSIONED AND BENT PER ACI STANDARDS.
      III. REBAR COVER: 3" UNLESS NOTED OTHERWISE.
9. CONSTRUCT FORMS TRUE TO LINE AND GRADE, ADEQUATELY BRACED TO MAINTAIN POSITION DURING PLACEMENT OF CONCRETE. WELDING OF FORM TIES TO STRUCTURAL DOWELS IS NOT PERMITTED, THOUGH ADDITIONAL DOWELS MAY BE INSTALLED FOR THAT PURPOSE.
10. PROVIDE 3/4" CHAMFER ON ALL EXPOSED EDGES UNLESS NOTED OTHERWISE.
11. REPAIR ALL AIR HOLES AND VOIDS LARGER THAN 1/4" AND FILL ALL TIE HOLES. REMOVE FINS AND PROJECTIONS.
12. VERTICAL CONCRETE SURFACES SHALL HAVE A SMOOTH FORMED FINISH. HORIZONTAL CONCRETE SURFACES SHALL HAVE A SMOOTH RUBBED FINISH (U.N.O.), EXCEPT WALKING SURFACE SHALL HAVE BROOM FINISH.
13. PROVIDE ADHESIVE WATERSTOPS OF WATER SWELLING ELASTIC SEALING MATERIAL BETWEEN EXISTING CONCRETE OR ROCK AND NEW CONCRETE AS NEEDED AND WHERE INDICATED. END ALL WATERSTOP 3"± FROM EXPOSED FINISHED CONCRETE SURFACE. IF DAMAGED BY EXPOSURE TO WATER PRIOR TO CONCRETE PLACEMENT REMOVE AND REPLACE. ACCEPTABLE PRODUCTS:
   A. ADEKA ULTRASEAL TEL: 518–756–6565.
   B. PARASTOP II TEL: 800–658–5500.
   C. WATERSTOP RX TEL: 312–966–5720.





FINAL CONDITIONS PLAN
WITH TEMPORARY SEDIMENT CONTROL

1"=10'

10 0 10 20
SCALE IN FEET

NOTE:
1. SEE SHEET **O–4** FOR SEDIMENT CONTROL NOTES & DETAILS
2. CONTRACTOR TO PROVIDE A BARRIER UPSTREAM AND DOWNSTREAM OF THE DAM TO PREVENT CONSTRUCTION DEBRIS FROM ENTERING THE WATERWAY.

NOTES:
1. TOPOGRAPHY SHOWN IS BASED ON AERIAL SURVEY PERFORMED BY AERIAL SURVEY & PHOTO ON 8/17/11. VERTICAL DATUM FOR SURVEY IS NAVD88.
2. ALL ELEVATIONS OTHER THAN TOPOGRAPHY ARE BASED ON NGVD29.
3. NAVD88 + 0.689' = NGVD29.

RECORD DRAWING
THIS DRAWING REPRESENTS THE BEST INFORMATION AVAILABLE TO THE ENGINEER UPON COMPLETION OF THE WORK.
Kleinschmidt
DATE: 7-29-16 BY:

STATE OF MAINE Lucas D. Stiles 13197 LICENSED PROFESSIONAL ENGINEER

No.	Revision	Date	Drawn	Checked
	RECORD DRAWING	7-29-16	TLT	LDS

Designed LDS | Drawn TLT | Checked JEW

BLACK BEAR HYDRO PARTNERS, LLC
MILFORD, ME

ORONO PROJECT
UPSTREAM EEL PASSAGE PROJECT

PLAN

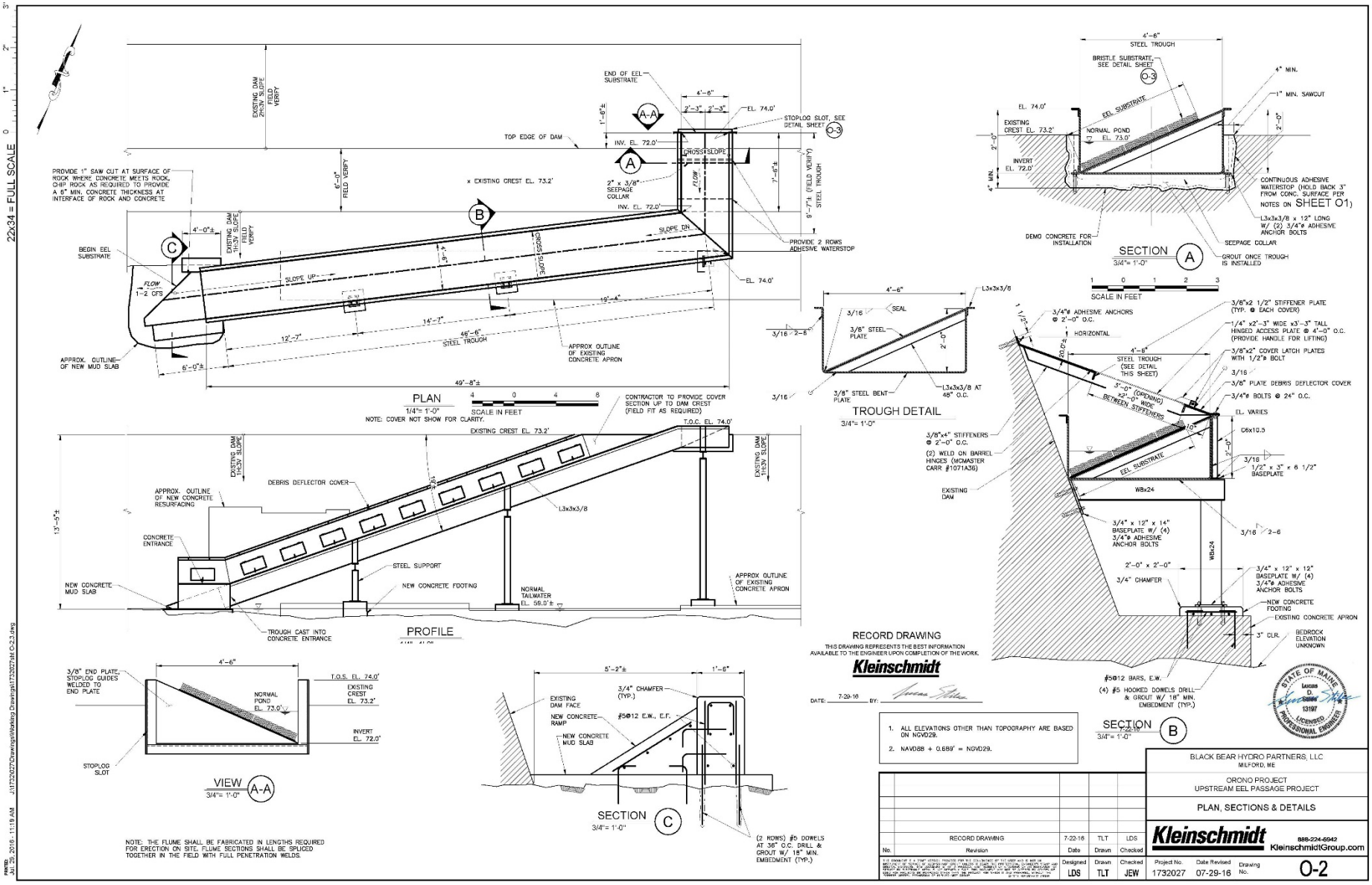
Kleinschmidt 888-224-6942 KleinschmidtGroup.com

Project No. 1732027 | Date Revised 07-29-16 | Drawing No. O-1

Eel Fishway at Orono Dam

- Design characteristics
  - 54.75-ft (16.7-m) long
  - 4.5-ft (1.4-m) wide
  - 14-ft (4.3-m) elevation (tailwater to normal headpond el.)
  - Lateral slope = 24 degrees
  - Vertical slope = 20 degrees
  - Conveyance flow = approximately 1 cubic feet a second (0.03 mps) at normal head pond el.
  - Grizzly rack at exit for debris mgmt.
  - Bristles:
    - 2.75 inches tall (70 mm)
    - 1 inch space between bristles; rows staggered every 0.5 inches

Eel Fishway at Orono Dam



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Video Monitoring (2016)

- Methods/Results

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Penobscot River, Maine

QUESTIONS?

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