TROUT UNLIMITED

IPSWICH RIVER ASSOCIATION

RESTORATION AND RESILIENCY PROJECT

IPSWICH RD CULVERT REPLACEMENT

BOXFORD, MA

JUNE 2020

*Quantities provided are estimates. Contractors are responsible for verifying quantities as appropriate for completing the job.

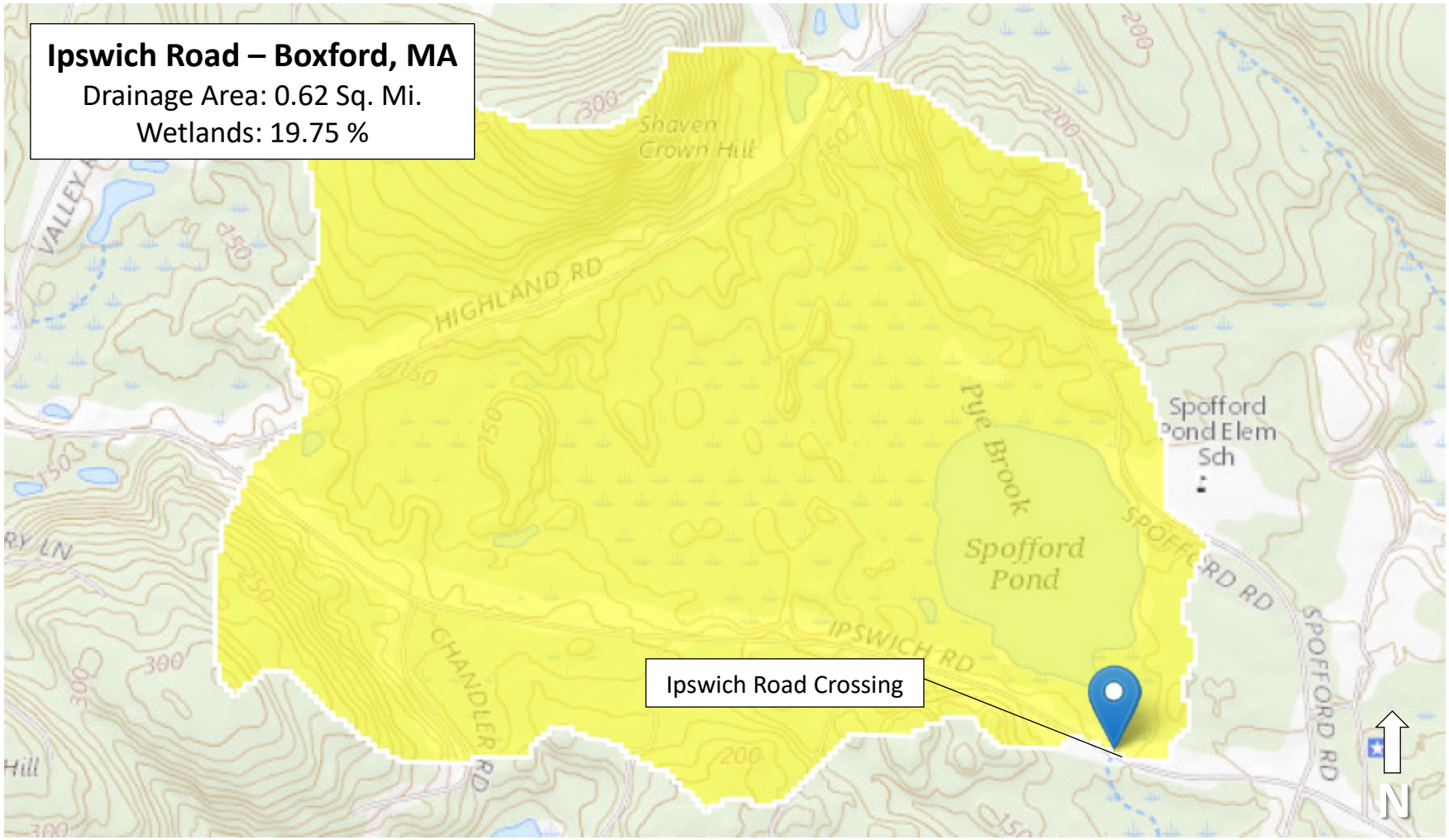
ESTIMATED QUANTITIES	
Excavation	1628 CY
Earthfill	1492 CY
Hot-Mix, Bituminous, 6" thickness	304 sy
Hauling	185 cy
Concrete Culvert Removal, 5' DIA X 66''	1 ea
Asphalt Removal	2500 SQ FT
Tree Removal	4 ea
Step Rock, 24" x 30" x 18"	60 ea
Footer Rock, 18" x 24" x 12"	70 ea
Excavation, Grade Control Strutures	49 cy
Contech Concrete Box Culvert, 12' wide x 7' rise x 66' long	1 ea
Contech Concrete headers, 12' long	2 ea
Contech Concrete wingwalls, 45 deg	4 ea
Seeding/Mulching	0.10 ac
Silt Fence	200 lf
Non-Woven Geotextile	898 sy
Gravel for footers	69 cy
Gravel for Road	79 cy
Substrate gravel	119 cy
Rock for Pad and wingwall protection	32 cy
Dewatering	LS
Traffic Control	LS

LOCATION PLAN
no scale

Construction Specifications		
TU	3	Structure Removal
TU	5	Pollution Control
TU	6	Seeding, Sprigging, and Mulching
TU	8	Mobilization/Demobilization
TU	11	Removal of Water
TU	21	Excavation
TU	23	Earthfill
TU	61	Loose Rock Riprap
TU	95	Geotextile
TU	600	Erosion and Sediment Control

Material Specifications		
TU	523	Rock
TU	592	Geotextile

Site Map – Drainage Area:



Map and data produced using U.S. Geological Survey (USGS) StreamStats. Blue marker indicates the location of the Ipswich Road crossing. Yellow-shaded area indicates the crossing's drainage area.

Site Photographs – Existing Conditions

Structure Inlet

View of existing structure inlet.

Structure Outlet

View of existing structure outlet.

Upstream of Structure

View looking upstream of structure.

Downstream of Structure

View looking downstream of structure.

Existing Conditions – Site Topography

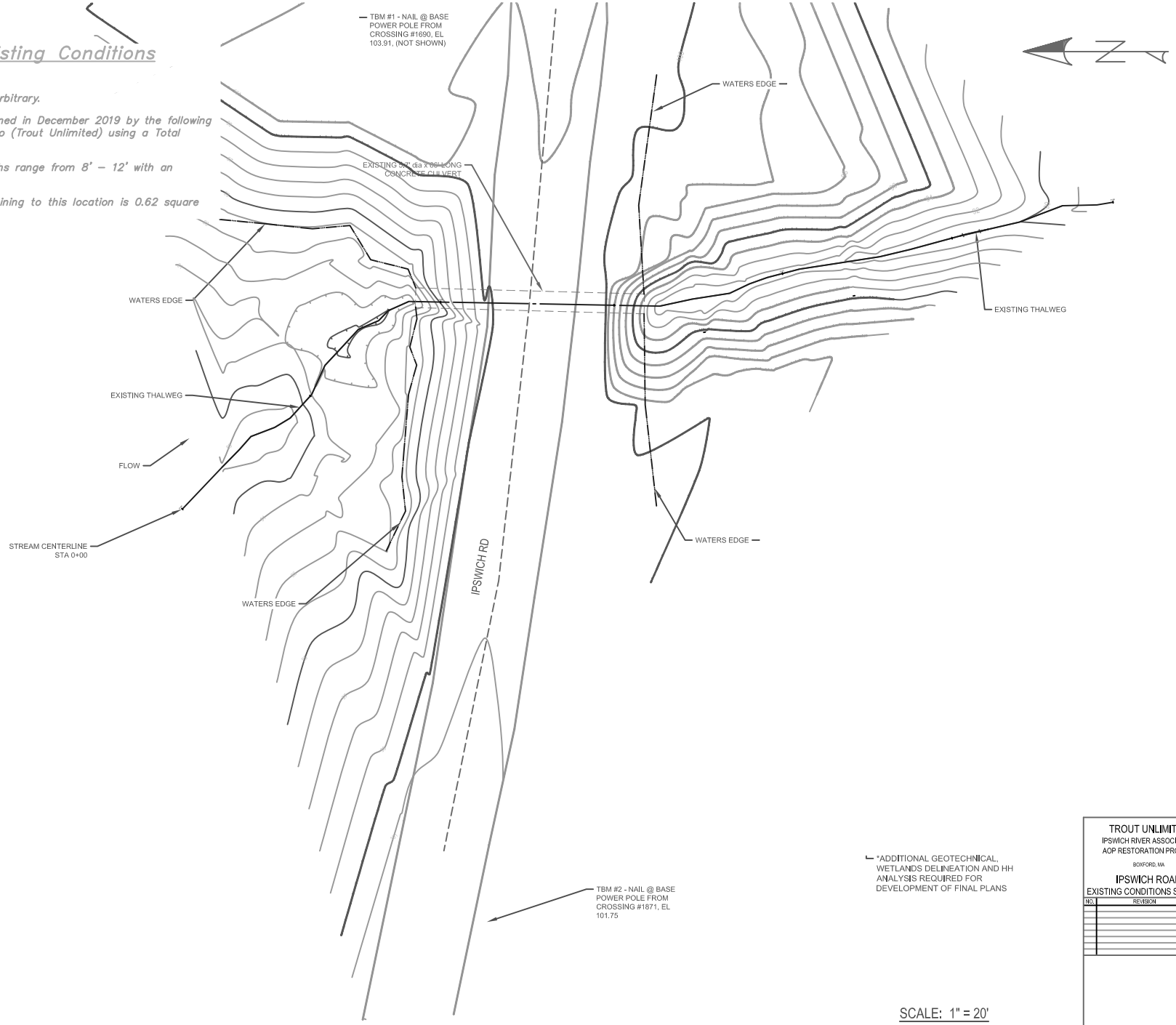
Map and data produced using OLIVER – MassGIS Online Data Viewer. Red dot indicates the location of the Ipswich Road crossing.

Existing Conditions – Aerial Imagery

Map and data produced using OLIVER – MassGIS Online Data Viewer. Red dot indicates the location of the Ipswich Road crossing.

Survey and Existing Conditions Notes:

1. *The vertical datum is arbitrary.*
2. *Site survey was performed in December 2019 by the following personnel: Joel DeStasio (Trout Unlimited) using a Total Station.*
3. *Reference bankfull widths range from 8' – 12' with an average of 10'.*
4. *The watershed area draining to this location is 0.62 square miles.*



*ADDITIONAL GEOTECHNICAL, WETLANDS DELINEATION AND HH ANALYSIS REQUIRED FOR DEVELOPMENT OF FINAL PLANS

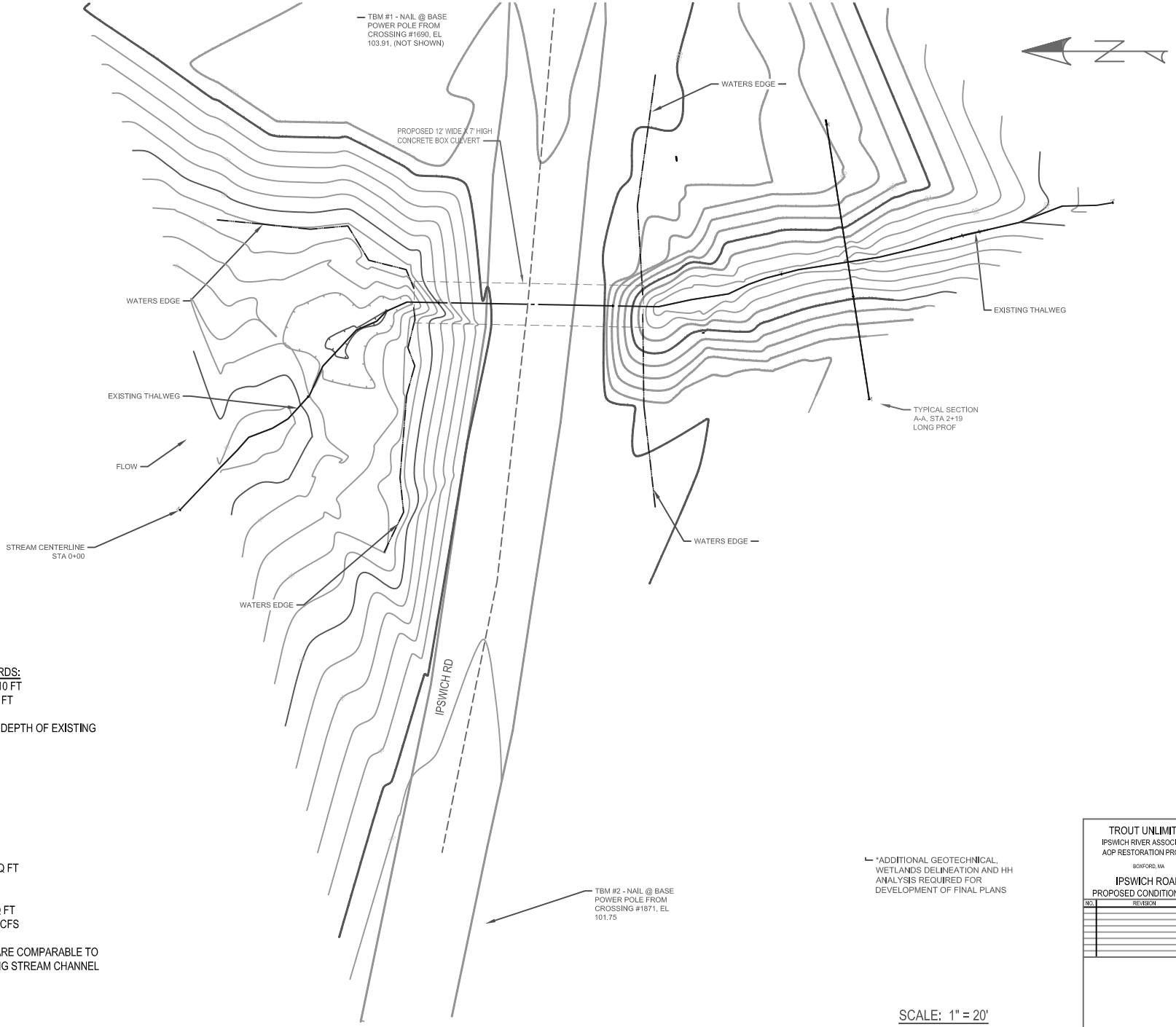
SCALE: 1" = 20'

TROUT UNLIMITED
IPSWICH RIVER ASSOCIATION
AOP RESTORATION PROJECT
BOXFORD, MA

IPSWICH ROAD
EXISTING CONDITIONS SITE PLAN

NO.	REVISION	DATE

DATE: JUNE 2020
PROJECT #:
DESIGNED BY: JDT
DRAWN BY: JDT



MASS STREAM CROSSING STANDARDS:
EXISTING BANKFULL AVG WIDTH = 10 FT
PROPOSED STRUCTURE SPAN = 12 FT

BOX CULVERT W/2 FT EMBEDMENT DEPTH OF EXISTING CHANNEL SUBSTRATE

OPENNESS RATIO = 0.91 FT

HYDROLOGY: (EFH2)
DA = 0.62 SQ MILES
Q2 = 51CFS
Q100 = 683 CFS

EXISTING CULVERT AREA = 25.5 SQ FT
Q (CMP) = 255 CFS

PROPOSED CULVERT AREA = 60 SQ FT
Q (CONCRETE BOX CULVERT) = 865CFS

WATER DEPTHS AND VELOCITIES ARE COMPARABLE TO THOSE FOUND WITHIN THE EXISTING STREAM CHANNEL

*ADDITIONAL GEOTECHNICAL, WETLANDS DELINEATION AND HH ANALYSIS REQUIRED FOR DEVELOPMENT OF FINAL PLANS

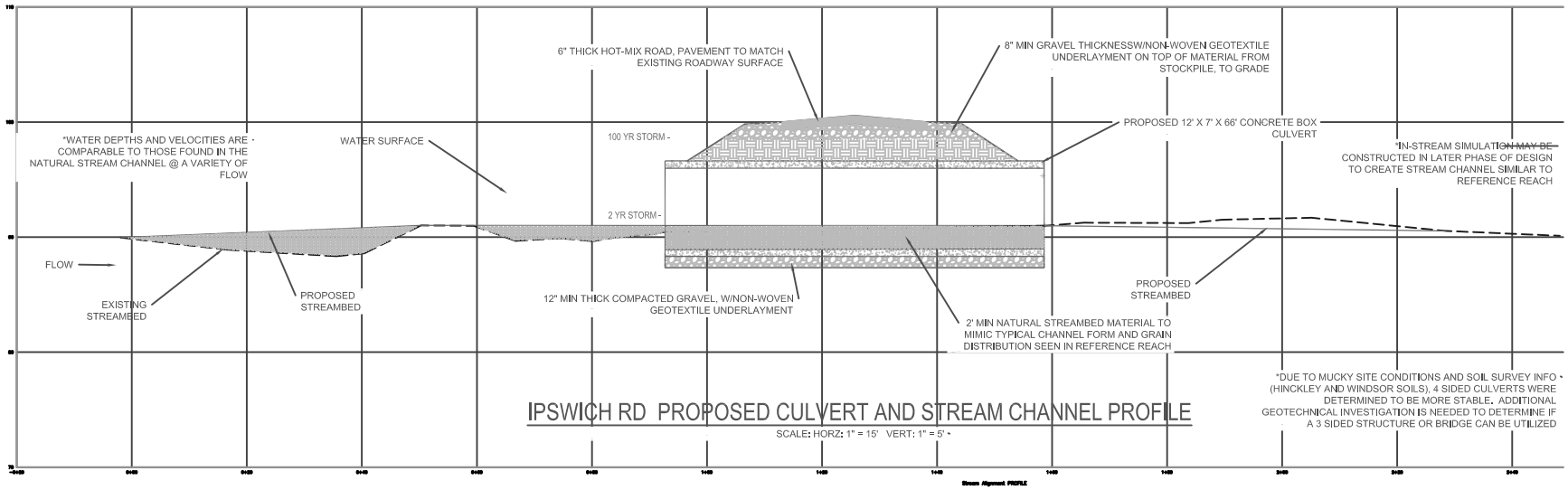
SCALE: 1" = 20'

TROUT UNLIMITED
IPSWICH RIVER ASSOCIATION
AOP RESTORATION PROJECT
BOXFORD, MA

IPSWICH ROAD
PROPOSED CONDITIONS PLAN

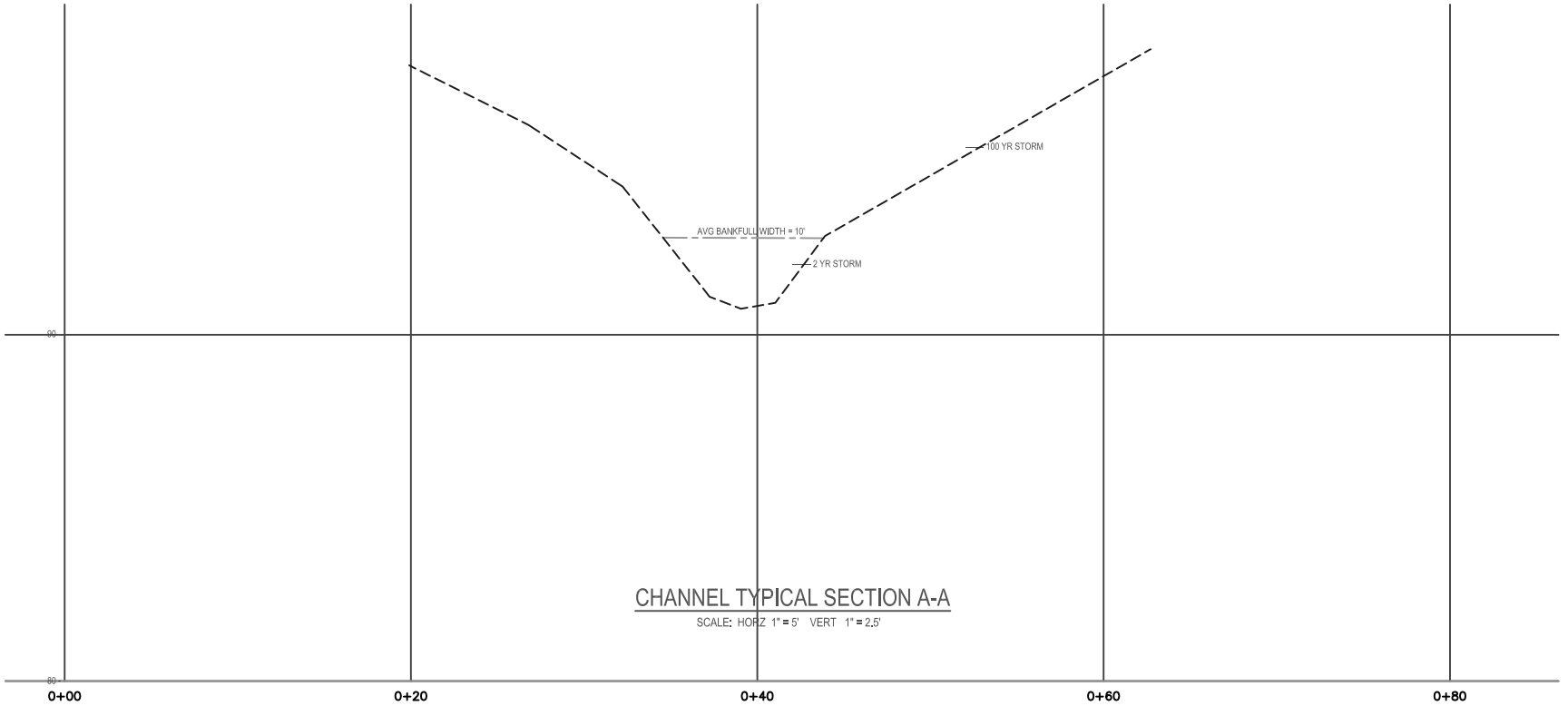
NO.	REVISION	DATE

DATE: JUNE 2020
PROJECT #:
DESIGNED BY: JDT
DRAWN BY: JDT



IPSWICH RD PROPOSED CULVERT AND STREAM CHANNEL PROFILE

SCALE: HORZ: 1" = 15' VERT: 1" = 5'



CHANNEL TYPICAL SECTION A-A

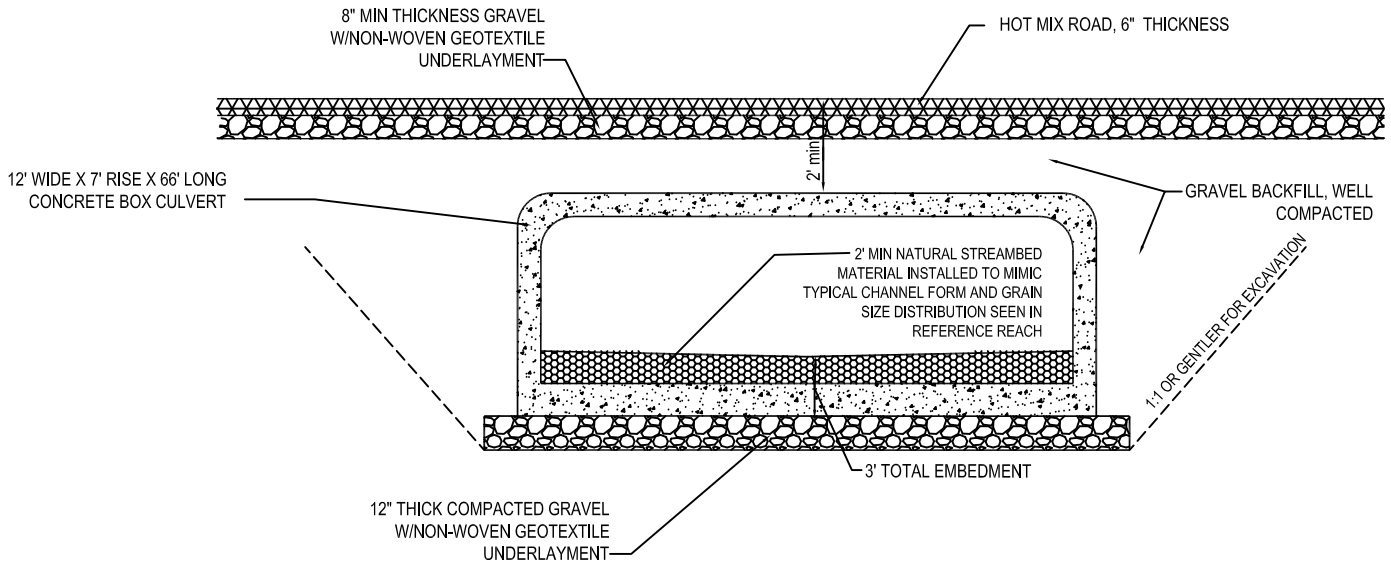
SCALE: HORZ 1" = 5' VERT 1" = 2.5'

TROUT UNLIMITED
IPSWICH RIVER ASSOCIATION
AOP RESTORATION PROJECT
BOXFORD, MA

IPSWICH ROAD
LONGITUDINAL PROFILE

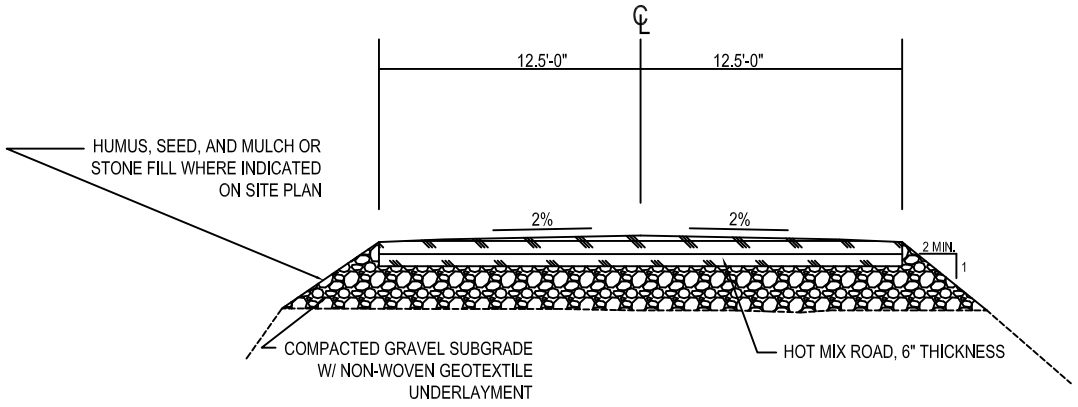
NO.	REVISION	DATE

DATE: JUNE 2020
PROJECT #:
DESIGNED BY: JDT
DRAWN BY: JDT



TYPICAL CULVERT SECTION

NO SCALE



TYPICAL ROAD SECTION

NOT TO SCALE

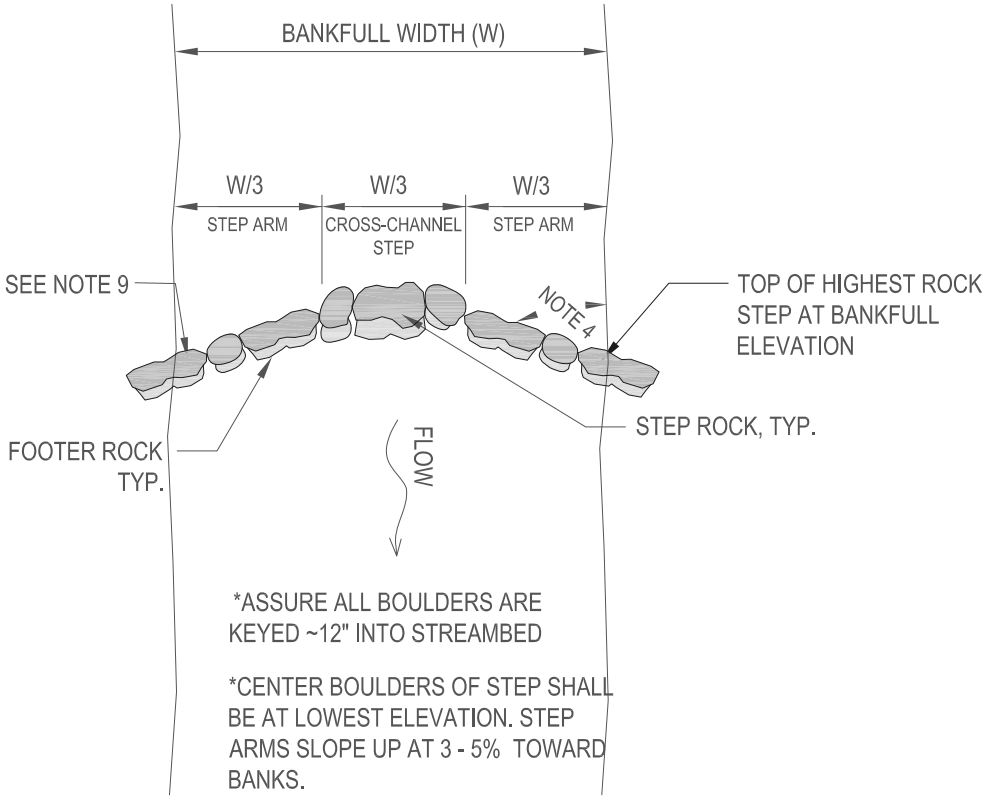
*PROPOSED ROAD TO MATCH
EXISTING ROAD ELEVATIONS

ROADSIDE BARRIERS TO BE
CONSIDERED IN FUTURE PHASE OF
DESIGN, IF NEEDED

TROUT UNLIMITED
IPSWICH RIVER ASSOCIATION
AOP RESTORATION PROJECT
BOXFORD, MA
IPSWICH RD
CULVERT CROSS SECTION

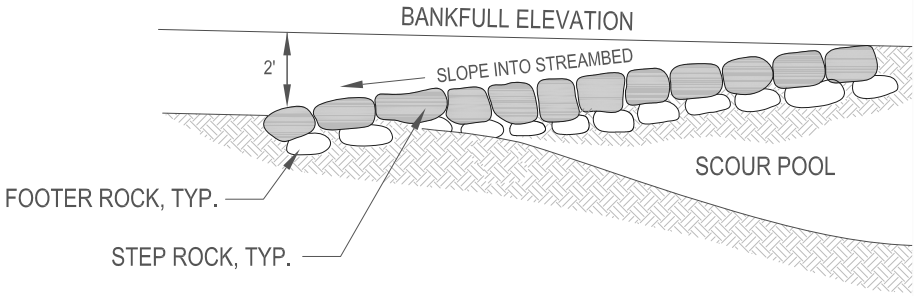
NO.	REVISION	DATE

DATE: JUNE 2020
PROJECT #:
DESIGNED BY: JDT
DRAWN BY: JDT



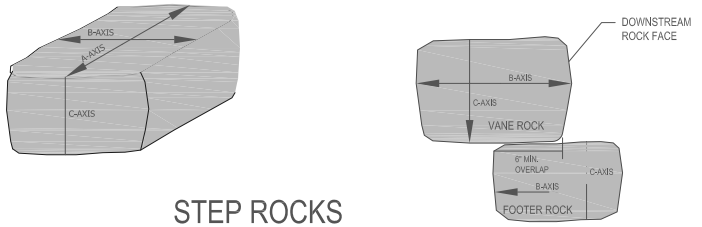
ROCK STEP PLAN VIEW

NOT TO SCALE



PROFILE VIEW

NOT TO SCALE



STEP ROCKS

	A-AXIS	B-AXIS	C-AXIS
MINIMUM	TO BE DETERMINED IN LATER DESIGN PHASE		

FOOTER ROCKS

	A-AXIS	B-AXIS	C-AXIS
MINIMUM	TO BE DETERMINED IN LATER DESIGN PHASE		

TROUT UNLIMITED
IPSWICH RIVER WATERSHED
AOP RESTORATION PROJECT
BOXFORD, MA

IPSWICH RD
ROCK STEP DETAILS

NO.	REVISION	DATE

DATE: JUNE 2020
PROJECT #:
DESIGNED BY: JDT
DRAWN BY: JDT

Hydrology & Hydraulic Analysis

Attribute	Value	Units	Definition
Drainage Area	0.62	sq. miles	Area that drains to crossing
Wetlands	19.75	percent	Percentage of NWI storage
Elevation	155	feet	Mean basin elevation
Precipitation	47	inches	Mean annual precipitation
Aquifer	64.17	percent	Percentage of land underlain by sand & gravel aquifers
X-Coordinate	239405	meters	Basin centroid E/W location
Y-Coordinate	938145	meters	Basin centroid N/S location

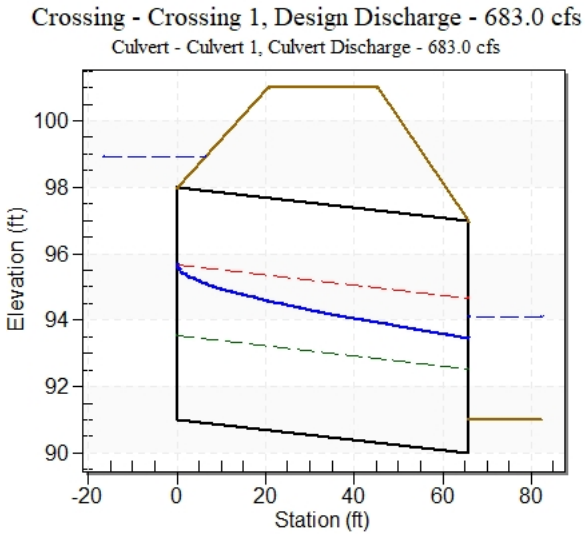
Return T (yr)	Peak Q_T (ft^3/s)[1]
2	24
5	89.9
10	155.8
25	353.5
50	485.3
100	683

References:

[1] USDA NRCS EFH2 – EFH2 uses procedures defined in the Natural Resources Conservation Service National Engineering Handbook, Part 650, (NEH 650), *Engineering Field Handbook* (EFH); Chapter 2, *Estimating Runoff and Peak Discharge* (NEH 650.02) and the National Engineering Handbook, Part 630, *Hydrology* (NEH 630).

USGS StreamStats was used to delineate drainage area, obtain basin characteristics. NOAA Atlas 14 was used for precipitation frequency estimates.

HY-8 Hydraulic Analysis Program of the U.S. Federal Highway Administration provides results for the above peak flow estimates for the proposed crossing design and indicates that the crossing as proposed will successfully pass the expected 100-year storm event.



Discharge Name	Total Discharge (cfs)	Headwater Elevation (ft)	Flow Type	Outlet Control Depth (ft)	Outlet Depth (ft)	Outlet Velocity (ft/s)
2	24	91.84	1-JS1t	0.56	0.82	5.1
5	89.9	93.03	1-JS1t	1.17	1.3	6.7
10	155.8	93.94	1-S2n	1.60	1.8	7.8
25	353.5	96.03	1-S2n	2.71	3.1	9.9
50	485.3	97.21	1-S2n	3.53	3.7	10.9
100	683	98.93	5-S2n	5.29	4.4	11.8

Note that prediction errors are quite large when using regression equations to estimate flows and bankfull widths based on drainage area. It is best to account for potentially larger flows at these return intervals.

Computed Project Costs

Ipswich Rd	AOP - Concrete Box Culvert	Prog:		Date:	6/9/2020
By: JDT	Checked By:			Check Date:	
Practice Name	**Component Name**	**Unit**	**Price**	**Qty**	**Cost**
Obstruction Removal	Concrete pipe, >36" dia	LF	$70.15	66	$4,629.90
	Tree Removal, disposal	EA	$250.00	4	$1,000.00
	Guardrail Removal	LF	$19.96	120	$2,395.20
	Asphalt Removal	SY	$11.28	278	$3,135.84
	Concrete Headwalls, removal, disposal	Tons	$97.20	19	$1,846.80
					$13,007.74
Seed/Mulch	Hydroseeding (Small application, ≤2,000 SF)	SF	$0.20	4356	$871.20
	Straw mulch, by power mulcher	SY	$0.21	484	$101.64
					$972.84
Asphalt Road	Hot Bituminous Pavement (Asphalt) 6" thick	SF	$10.04	2500	$25,100.00
	Crushed Gravel, compacted in place yardage	CY	$30.29	79	$2,392.91
	Nonwoven Geotextile- NRCS Class I - Level installation	SY	$2.00	355	$710.00
					$28,202.91
Stream Simulation	Wet earth/muck, excavated, loaded	CY	$12.50	75	$937.50
	Haul common earth, 12 CY Truck, 0.5 mile cycle	CY	$11.00	75	$825.00
	Rock step/footer placement imported material	CY	$68.00	27	$1,836.00
	Nonwoven Geotextile- NRCS Class I - Level installation	SY	$2.00	159	$318.00
	Cluster boulders, 12" to 18" dia	ton	$90.00	20	$1,800.00
					$5,716.50
AOP - Concrete Box Culvert	Common earth, excavated, loaded	CY	$10.00	1677	$16,770.00
	On-site material, walk-behind plate, lifts, compacted in place yardage	CY	$12.02	1492	$17,933.84
	Haul common earth, 12 CY Truck, 0.5 mile cycle	CY	$11.00	185	$2,035.00
	Channel substrate placement from on site	CY	$30.02	119	$3,572.38
	Concrete Box Culvert, 12' x 7' x 66', delivered, wingwalls, headers	LF	$2,383.33	66	$157,299.78
	Concrete box install	LS	$62,919.60	1	$62,919.60
	Crushed Gravel, compacted in place yardage	CY	$30.29	69	$2,090.01
	Common gradations ≥ 9"	CY	$45.00	68	$3,060.00
	MSG longspan, guardrail, 120' total	LF	$43.55	120	$5,226.00
	Beam Guardrail, terminal type EAGRT, TL2	EA	$2,700.00	4	$10,800.00
	Nonwoven Geotextile- NRCS Class I - Sloped installation (4:1 or steeper)	SY	$2.75	384	$1,056.00
	Traffic Control	Ea.	$5,000.00	1	$5,000.00
	Per piece of equipment, mob. and demob. total	Ea.	$840.00	4	$3,360.00
	Silt Fence, installation and removal	LF	$3.44	200	$688.00
	Turbidity Curtain	LF	$34.50	65	$2,242.50
	Dewatering Sediment Bag 10'x15', leveled, w disposal, no subgrade	Ea.	$369.00	1	$369.00
	Cofferdam, sand bags, 20' wide, 3' high, installation and removal	Ea.	$2,172.00	2	$4,344.00
	Sump pump, 4" diaphragm pump 8 hrs. a day, includes suction and discharge hoses	Day	$268.80	14	$3,763.20
	Temp Access, gravel, geo,exc, and removal	LS	$2,121.00	1	$2,121.00
					$304,650.31
			Project Subtotal		**$352,550.30**
			Total Project Cost with Contingency (20%)		**$423,060.36**

*Cost estimate references: RS Means, Mass DOT, NH DOT, NRCS, Local Sources