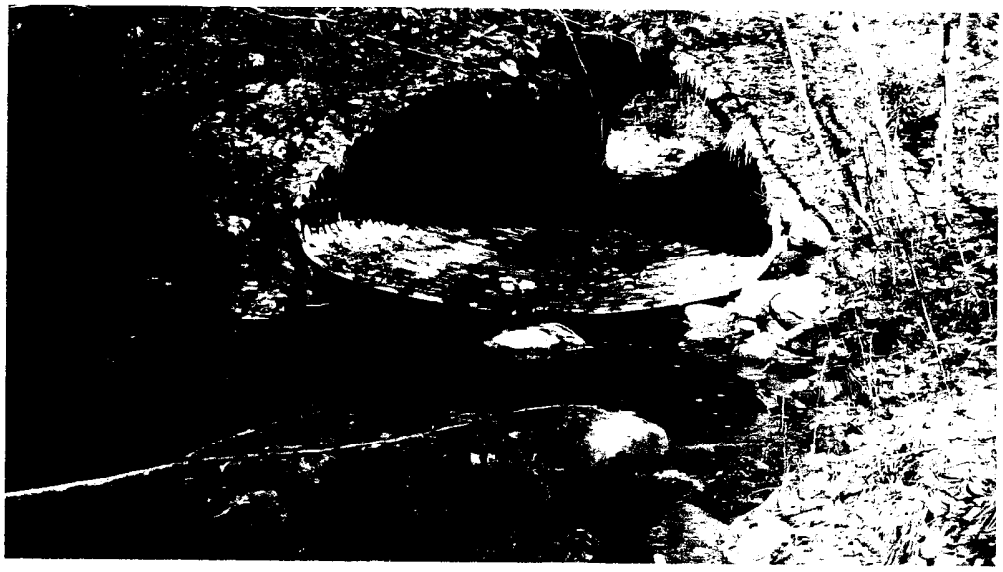
Preliminary Design Report

Pine Brook Bridge #2666
over
Pine Brook

Wilton, Maine

WIN 019295.00



Maine Department of Transportation

Bridge Program

Flow data from two sources are available for Pine Brook in Wilton. The FEMA Flood Insurance Study for the town of Wilton used TR 20 procedures to compute flows on Pine Brook. The FEMA flows are as follows:

FEMA Flood Study

Q_{10} = 320 cfs
Q_{50} = 555 cfs
Q_{100} = 665 cfs
Q_{500} = 910 cfs

Flows were also computed using the 1999 USGS full regression equation based on drainage basin characteristics provided by the Maine Department of Transportation Office of the Environment-Hydrology Section.

1999 USGS Full Regression Equation

Q_{10} = 231.9 cfs
Q_{50} = 384.0 cfs
Q_{100} = 459.1 cfs
Q_{500} = 655.1 cfs

Flows computed by the TR20 method are highly sensitive to the user's input and typically generate higher flows than other methods including regression equations. Due to the sensitivity issue with the TR 20 method, it is recommended that flows be based on the 1999 USGS full regression equation.

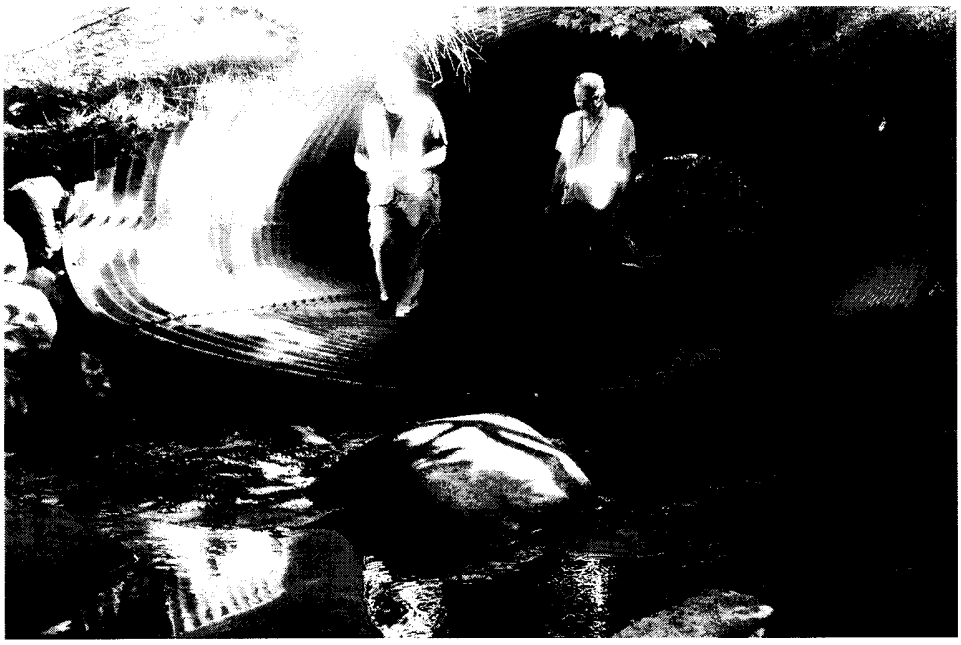
Summary

Drainage Area = 1.46 square miles
Fish passage flow (low) = 0.23 cfs
Fish passage flow (high) = 6.28 cfs
Ordinary High Water ($Q_{1.1}$) = 42.1 cfs
10 Year Flood (Q_{10}) = 231.9 cfs
25 Year Flood (Q_{25}) = 315.3 cfs
Design Discharge (Q_{50}) = 384.0 cfs
Check Discharge (Q_{100}) = 459.1cfs

Reported By: Michael Wight
Date: November 26, 2012

Existing Bridge

Pine Brook Bridge #2666 is located in Wilton on Route 156 over Pine Brook. The existing bridge consists of a 12'-6" span by 7'-11" rise by 70' long steel structural plate pipe arch built in 1971. The USGS topographic quad map indicates that Pine Brook is an intermittent stream. Inspection photos taken in the summer show little if any water in the culvert. See picture below:



Outlet of culvert on 7/31/2011

The downstream end of culvert is undermined many feet. An inspection in October 2012 penetrated the full 25' length of the staff road under the culvert at the downstream end. Water flows underneath the culvert. The culvert is hanging at the downstream end about 6" +/-.

The stream is not well aligned with the culvert at the upstream end. Overall Pine Brook has a steep slope 3% and greater. Based on the USGS topo map the stream slope at the culvert is about 3% +/-. Immediately upstream of the bridge is a 3'+/- rise in the streambed elevation. The stream appears to the degrading based on the eroded stream banks with exposed tree roots. The confluence with Wilson Stream is located about 700' downstream.

Existing Culvert Summary

Culvert invert elevation @ inlet = 582.96'
Culvert invert elevation @ outlet = 582.29'
Total drop along culvert = 0.67'
Culvert length along invert = 70'
Culvert slope = 1.4'/116' = 0.96%

The existing bridge was analyzed using the HY-8 program version 7.3. The tailwater conditions in HY8 are modeled as an irregular channel that is located downstream from the outlet. Tailwater effects from Wilson Brook from do not reach up to Pine Brook Bridge.

At Q50 the headwater to depth ratio is 0.76, which is less than 0.9 used for design. At Q100 the freeboard based on the edge of shoulder is about 5.1'. The slope protection at both ends of the culvert appears to be relatively stable. Fish passage is an issue at low flows, because the water depth is very shallow and the 6 inch drop at the culvert outlet.

SUMMARY
(Existing Bridge)

	Existing Structure
Total Area of Waterway Opening	78 ft^2
Headwater Elevation @ high fish passage flow	583.54 ft
Headwater Elevation @ $Q_{1.1}$	584.61 ft
Headwater Elevation @ Q_{25}	588.23 ft
Headwater Elevation @ Q_{50}	588.94 ft
Headwater Elevation @ Q_{100}	589.68 ft
HW/D @ Q_{50}	0.76
Outlet Velocity @ high fish passage flow	1.77 ft/s
Outlet Velocity @ $Q_{1.1}$	4.8 ft/s
Outlet Velocity @ Q_{25}	7.96 ft/s
Outlet Velocity @ Q_{50}	8.86 ft/s
Outlet Velocity @ Q_{100}	9.8 ft/s
Outlet Depth @ high fish passage flow	0.34 ft

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

Reported By: Michael Wight
Date: December 13, 2012

Proposed Bridge

The bridge was analyzed using the HY- 8 program version 7.3. The tailwater conditions in HY8 are modeled as an irregular channel that is located downstream from the outlet

Alternative #1 (Invert Lining) -The first option considered was an invert lining. The invert lining can be 5" thick concrete (shotcrete or cast in place) or 2" thick FRP. The concrete would extend up the side of the pipe arch about 6" above the limits of the rust. The hydraulic analysis was performed assuming a 5" thick concrete invert is used. Weirs are needed inside the pipe to maintain fish passage. The weirs inside the pipe will have a maximum spacing of 19', based on a drop of 3" between weirs. A minimum of 4 weirs are needed inside the culvert. The increase in headwater elevation at Q100 compared to existing culvert is 0.63'. At Q50 the headwater to depth ratio is 0.82, which is slightly less than 0.90 used for design.

A concrete pool and weir system with 4 pools and 5 weirs is needed at the downstream end for fish passage. The pool and weir system will be located within the limits of the existing culvert. Each pool will be 5.25' x 5.25' by 3' deep so that the energy dissipation factor at the high fish passage flow is less than 5.0. The drops between the pools are based on 0.5' or 6". Plain riprap aprons will be built as both ends of the culvert.

Invert elevations

Culvert invert elevation @ inlet =583.38'=582.96' + 0.42'
Culvert invert elevation @ outlet =582.71'=582.29'+ 0.42'

Alternative #2 (Sliplining) - The second option considered was a slip lining using a 10'-8" span by 6'-11" rise aluminum pipe arch. The bridge culvert was built in 1977 therefore the current age is only 35 years old. Because the existing steel pipe arch did not last 50 years, the MaineDOT Bridge Design Guide recommends that any metal pipe be made of aluminum and this would include any culverts used for sliplining. The annular space will be about 6 inches around the new pipe and will cause the invert to rise up about 6 inches. Weirs are needed inside the pipe to maintain fish passage. The weirs inside the pipe will have a maximum spacing of 19', therefore a minimum of 4 weirs are need inside the pipe. A concrete pool and weir system with 4 pools is also needed at the downstream end for fish passage. Each pool will have a minimum size of 5.25 ' x 5.25' by 3' deep so that the energy dissipation factor at the high fish passage flow is less than 5.0. Plain riprap aprons will be built as both ends of the culvert. At Q50 the headwater to depth ratio is 0.97 which is greater than 0.9 used for design. The headwater depth at Q100 increases 1.36', which is greater than the 1' increase allowed by FEMA. Due to the increase in headwater, slip lining is not a feasible option.

Sliplining-invert elevations

Culvert invert elevation @ inlet =583.46'= 582.96' + 0.5'

Culvert invert elevation @ outlet =582.79'= 582.29'+ 0.5'

Culvert Lining -Several relatively new proprietary lining products are now available to rehabilitate small and medium sized culverts.

Sekisui SPR

Sekisui SPR produces a product called SPR that could be used at this site. SPR utilizes steel reinforced interlocking PVC strips that are wound in place than grouted in place with high strength grout. The PVC strips have a mechanical lock. SPR can be used for circular and non -circular shapes up to 16.4' in diameter The Company's website is as follows:

http://www.sekisuispr.com/public/spr/en/technology/wickelrohr.html

An 8" thick lining was used based on a similar design provided by Sekisui. The lined pipe was modeled as a 10.92' span by 7.09' rise pipe arch with a manning's n of 0.01. At Q100 with the SPR lining, the headwater is 0.91" higher than the existing pipe however the outlet velocities have increased by 50%. The outlet velocity at Q100 is 14.7ft/s. The increased velocity will drastically increase the erosion of the stream downstream from the culvert. The use of an SPR liner is not recommended due to the very large increase in the outlet velocity.

PolySpray

The other new technology is a spray on polyurea coating by Hydratech. The specific product would be Poly Spray FS-250. PolySpray 250 is a polyurea- based, spray applied, rapid curing rigid liner. The maximum thickness of the coating is 30 mm or 1.18". Polyspray provides a smoother surface. The manning's n value is 0.011 for Polyspray vs. 0.033 for corrugated metal. Polyspray needs to be applied to a solid surface. Due to the holes in the bottom plates, a concrete invert would need to be installed first before the Polyspray is installed. A formal hydraulic analysis was not done for this option. The hydraulics performance will be very similar to the concrete invert lining option with a slight reduction in headwater elevations and higher outlet velocities. The Company's website is as follows:

http://www.hydratechllc.com/.

Centri-pipe

The Centri-pipe system is designed for corrosion protection and complete structural renewal of storm and sanitary sewer pipe between 2.5' (30') and 10' (120") in diameter. The process begins with inspection and an engineer determines the thickness of concrete that needs to be applied. The pipe is first cleaned by Centri-pipe's high pressure spin washer. Areas with missing invert plate are repaired using AP/M's self consolidating PL-12,000 mortar that is pumped into place. The Centri-pipe high speed spin caster is placed at the center of the culvert at its fair end. As the AP/M's PL-

800 concrete is centrifugally cast evenly around the inside of the culvert, the application head is retracted by a computer controlled motor at the correct speed to insure an even thickness. Unfortunately the existing culvert is larger than the recommended size for using Centri-pipe, therefore the use of Centri-pipe is not recommended. The Company's website is as follows:

http://www.centripipe.com/site/Home/tabid/36/Default.aspx

Alternative #3(Bankfull width) – The third option is a single 15' span by 8' rise by 70' long rectangular precast concrete box culvert with headwalls and precast toe walls. The ends of the box culvert shall be slope tapered with a single bottom step. The box culvert will be embedded 2' below the streambed. 1.5' tall sediment traps will be located inside the box culvert at regular intervals to help retain the streambed material. Plain riprap aprons will be built as both ends of the culvert.

According to John Perry, MaineDOT Biologist, the bankfull width is 15'. The 1.2 bankfull width is 18'.

Alternative #4 (1.2 Bankfull width) – The fourth option is a single 18' span by 8' rise by 70' long rectangular precast concrete box culvert with headwalls and precast toe walls. The ends of the box culvert shall be slope tapered with a single bottom step. The box culvert will be embedded 2' below the streambed. 1.5' tall sediment traps will be located inside the box culvert at regular intervals to help retain the streambed material. Plain riprap aprons will be built as both ends of the culvert.

Summary

From a pure hydraulics standpoint, the preferred alternative is a large single opening such as alternative #3 or #4. The final decision on what alternative to use will be based on other factors besides hydraulics such as available funding, constructability, traffic impacts, initial cost and life cycle cost. See the summary of preliminary design for the recommended option.

SUMMARY
(Culvert Rehabilitation Options)

	Concrete Invert Lining	Slipline With 10'-8"' span x 6'-11" rise Aluminum Pipe Arch	Culvert Lining with SPR
Total Area of Waterway Opening	69.9 ft^2	58 ft^2	60.7 ft^2
Headwater Elevation @ high fish passage flow	583.98 ft	584.16 ft	584.23 ft
Headwater Elevation @ $Q_{1.1}$	585.06 ft	585.34 ft	584.84 ft
Headwater Elevation @ Q_{25}	588.80 ft	589.37 ft	588.96 ft
Headwater Elevation @ Q_{50}	589.53 ft	590.17 ft	589.69 ft
Headwater Elevation @ Q_{100}	590.31 ft	591.04 ft	590.59 ft
HW/D @ Q_{50}	0.82	0.97	0.86
Outlet Velocity @ high fish passage flow	1.80 ft/s	3.18 ft/s	2.32 ft/s
Outlet Velocity @ $Q_{1.1}$	4.85 ft/s	5.31 ft/s	7.99 ft/s
Outlet Velocity @ Q_{25}	9.48 ft/s	9.86 ft/s	13.29 ft/s
Outlet Velocity @ Q_{50}	10.20 ft/s	10.60 ft/s	14.02 ft/s
Outlet Velocity @ Q_{100}	10.94 ft/s	11.37 ft/s	14.73 ft/s
Outlet Depth @ high fish passage flow	0.38 ft	0.46 ft	0.30 ft

SUMMARY

(Culvert Replacement Options)

	Precast Concrete Box Culvert 15' Span x 8'Rise	Precast Concrete Box Culvert 18' Span x 8'Rise
Total Area of Culvert	120 ft^2	144 ft^2
Total Area of Waterway Opening	90 ft^2	108 ft^2
Headwater Elevation @ high fish passage flow	584.01 ft	582.98 ft
Headwater Elevation @ $Q_{1.1}$	584.45 ft	584.24 ft
Headwater Elevation @ Q_{25}	587.77 ft	586.69 ft
Headwater Elevation @ Q_{50}	588.35 ft	587.19 ft
Headwater Elevation @ Q_{100}	588.96 ft	587.7 ft
HW/D @ Q_{50}	0.82	0.74
Outlet Velocity @ high fish passage flow	2.59 ft/s	1.86 ft/s
Outlet Velocity @ $Q_{1.1}$	5.15 ft/s	4.30 ft/s
Outlet Velocity @ Q_{25}	10.9 ft/s	4.24 ft/s
Outlet Velocity @ Q_{50}	11.65 ft/s	4.79 ft/s
Outlet Velocity @ Q_{100}	12.4 ft/s	5.37 ft/s
Outlet Depth @ high fish passage flow	0.09 ft	0.10 ft

Reported By: Michael Wight
Date: December 31, 2012

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

SPECIFICATIONS

Design: Load and Resistance Factor Design per AASHTO LRFD Bridge Design Specifications, Fifth Edition 2010.

DESIGN LOADING

Live Load ..... HL - 93 Modified

TRAFFIC DATA

Current (2011) AADT 1000

HYDROLOGIC DATA

Drainage Area ..... 1.46 sq mi
Design Discharge (Q50) ..... 384.0 cfs
Check Discharge (Q100) ..... 459.1 cfs
Headwater Elevation (Q50) ..... 589.53 ft
Headwater Elevation (Q100) ..... 590.31 ft
Discharge Velocity (Q50) ..... 10.20 fps
Discharge Velocity (Q100) ..... 10.94 fps
Headwater Elevation (Q1.1) ..... 585.06 ft
Discharge Velocity (Q1.1) ..... 4.85 fps
Headwater Elevation (Q25) ..... 588.80 ft

MATERIALS

Concrete: (unless noted otherwise) ..... Class "A"
Structural Wearing Surface ..... Class "LP"
Reinforcing Steel ..... ASTM A 615/A 615M, Grade 60

BASIC DESIGN STRESSES

Concrete ..... f'c = 4,350 psi

Reinforcing Steel ..... fy = 60,000 psi

WILTON
FRANKLIN COUNTY
PINE BROOK BRIDGE
OVER
PINE BROOK
ROUTE 156
STATE PROJECT NO. 19295.00
PROJECT LENGTH 0.000 mi.
BRIDGE NO. 2666

LIST OF DRAWINGS

Preliminary Title Sheet 1
Preliminary Plan 2
Preliminary Pipe Details 3

UTILITIES

Central Maine Power Company
Fairpoint Communications
Bee Line Tv, Inc.

MAINTENANCE OF TRAFFIC

Maintain two - way traffic during construction. When needed, single lane closures will be maintained by flaggers.

PROJECT LOCATION:	Located on State Route 156; 4.4 miles Northerly of the Jay town line. Lat.: 44°37'5.03", Long.: 70°15'58.42".
PROGRAM AREA:	Bridge Program
OUTLINE OF WORK:	Bridge Culvert Rehabilitaion And Install Concrete Fish Weirs

WIN 19295.00

019295.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
APPROVED
DATE
COMMISSIONER:
CHIEF ENGINEER:

PROJECT INFORMATION
PROGRAM
PROJECT MANAGER
DESIGNER
CONSULTANT
PROJECT RESIDENT
CONTRACTOR
PROJECT COMPLETION DATE
SIGNATURE
P.E. NUMBER
DATE

WILTON
PINE BROOK BRIDGE
PRELIMINARY TITLE SHEET

SHEET NUMBER
1
OF 3

(19)

Filename:\msta\001_Preliminary_Title.dgn Division: BRIDGE User: daniel.p.boissonneau Date:1/8/2013

GERARD C. CASTONGUAY
TOTAL AREA = 134.5± AC. (PER TAX MAP)

EXISTING SLOPE EASEMENT
ACQUIRED AS PART OF D.O.T. FILE NO. 4-131, OCTOBER 1976

Wilson Brook

℄ Existing Steel Plate Pipe Arch

EXISTING HIGHWAY DITCH DRAINAGE EASEMENT
ACQUIRED AS PART OF D.O.T. FILE NO. 4-131, OCTOBER 1976

D.O.T. FILE NO. 4-131

Internal Fish Weir

END B.L.

TO WASHINGTON TWP

STATE AID HIGHWAY NO. 1

14+00 13+00 400.00 12+00 11+00 ROUTE 156 10+00

BEGIN B.L.

TO WELD

External Fish Weir

TO WILTON VILLAGE

Plain Riprap Apron (Typ.)

Flow

EXISTING SLOPE EASEMENT
ACQUIRED AS PART OF D.O.T. FILE NO. 4-131, OCTOBER 1976

EXISTING SLOPE EASEMENT
ACQUIRED AS PART OF D.O.T. FILE NO. 4-131, OCTOBER 1976

PT = STA. 14+00.00

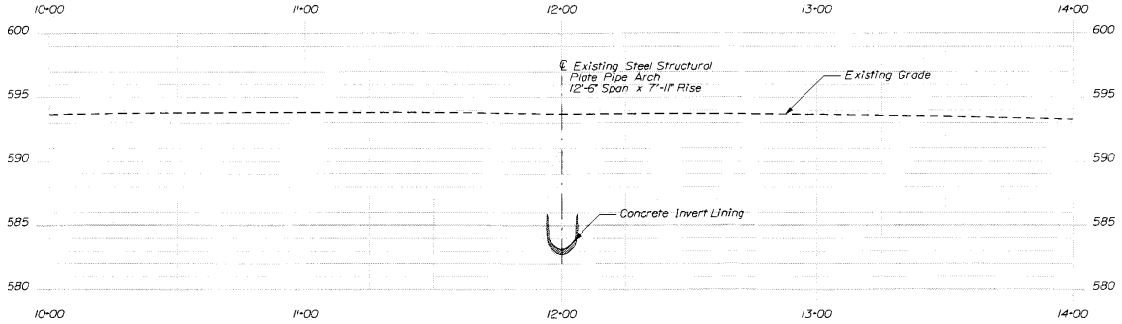
PC = STA. 10+00.00

CURVE DATA #1
PI = 12+00.48
D = 2°25'04.6"
Δ = 9°40'18.2" Lt.
R = 2369.62'
L = 400.00'
T = 200.48'
E = 8.47'

PLAN

25 0 25 50
Scale in Feet

FOOTHILLS LAND CONSERVANCY, INC.
TOTAL AREA = 59.6± AC. (PER TAX MAP)



PROFILE

Horiz. 25 0 25 50
Vert. 5 0 5 10
Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

019295.00

WIN 19295.00

BRIDGE NO. 2986

BRIDGE PLANS

PROJ. MANAGER STEPHEN BUDGE
DESIGN DETAILED
CHECKED/REVIEWED
DESIGN DETAILED
DESIGN DETAILED
REVISIONS 1
REVISIONS 2
REVISIONS 3
REVISIONS 4
FIELD CHANGES

BY: DATE

SIGNATURE

P.E. NUMBER

DATE

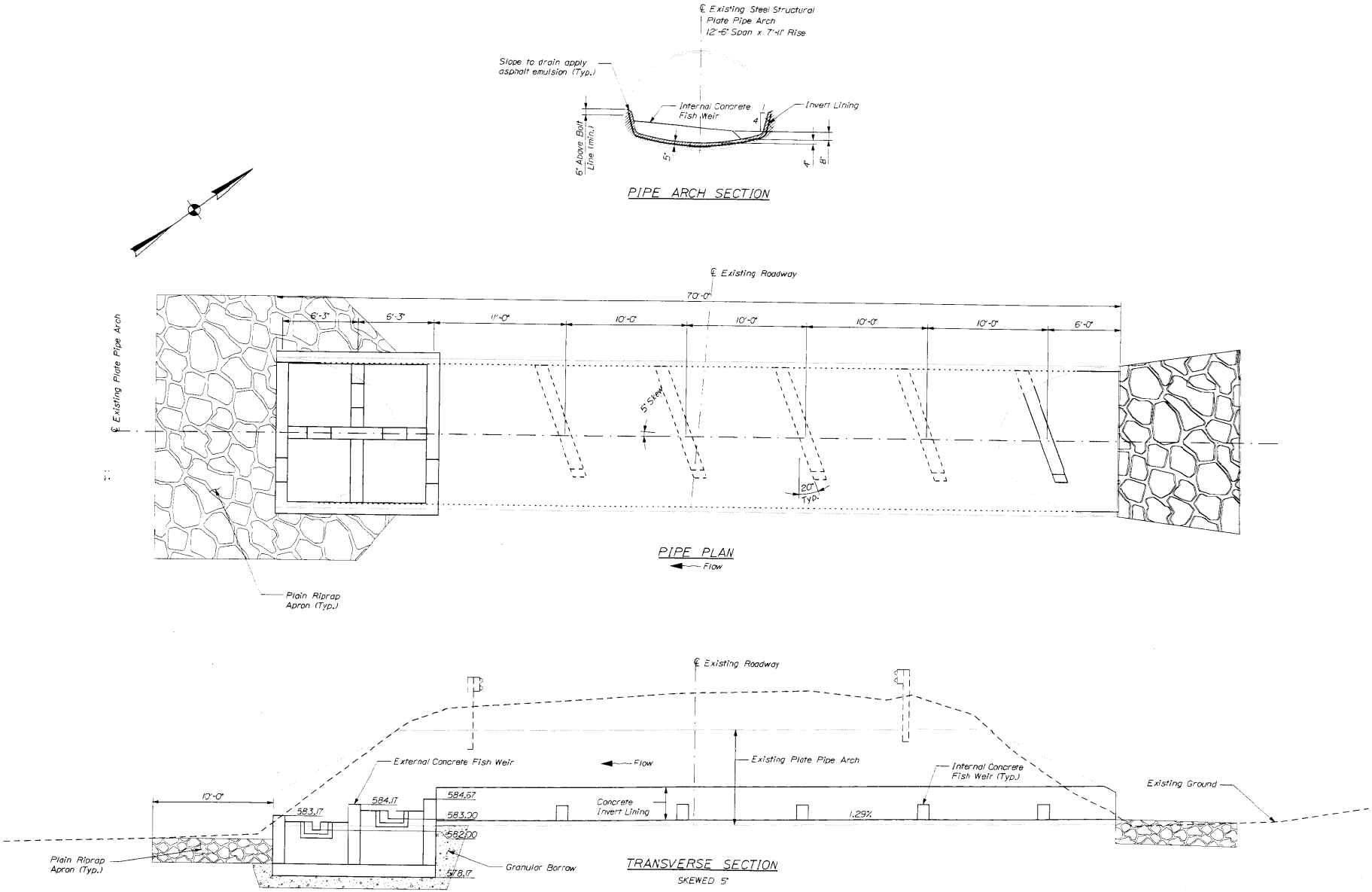
PINE BROOK BRIDGE
PINE BROOK
FRANKLIN COUNTY
WILTON

PLANS

SHEET NUMBER
2
OF 3

20

Filename: ...\msta\002_Preliminary_Plan.dgn Division: BRIDGE name: daniel.p.boissonneau Date: 1/8/2013



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

019295.00

WIN 19295.00

BRIDGE NO 2966

BRIDGE PLANS

PROJ. MANAGER: TIFFANY BRYCE	BY	DATE
DESIGN-DETAILED		
CHECKED-DETAILED		
DESIGN-2-DETAILED		
CHECKED-DETAILED		
DESIGN-3-DETAILED		
CHECKED-DETAILED		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

PINE BROOK BRIDGE
PINE BROOK
WILTON FRANKLIN COUNTY

PRELIMINARY INVERT LINING PLANS

SHEET NUMBER

3

OF 3

21

Filename: ...\msta\003_Preliminary_Pipe.dgn Division: BRIDGE ...name: daniel.p.boissonneau Date:1/8/2013

APPENDIX A

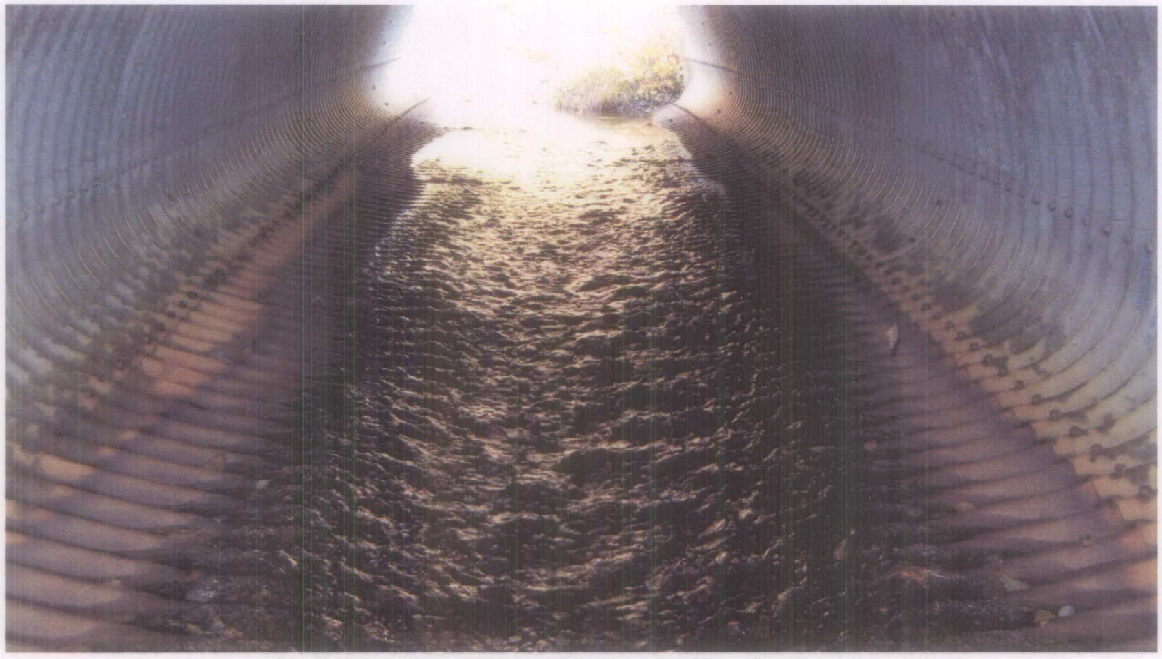
(Photographs)

Wilton
Pine Brook Bridge #2666
October 5, 2012

Looking upstream at outlet

Looking downstream from outlet

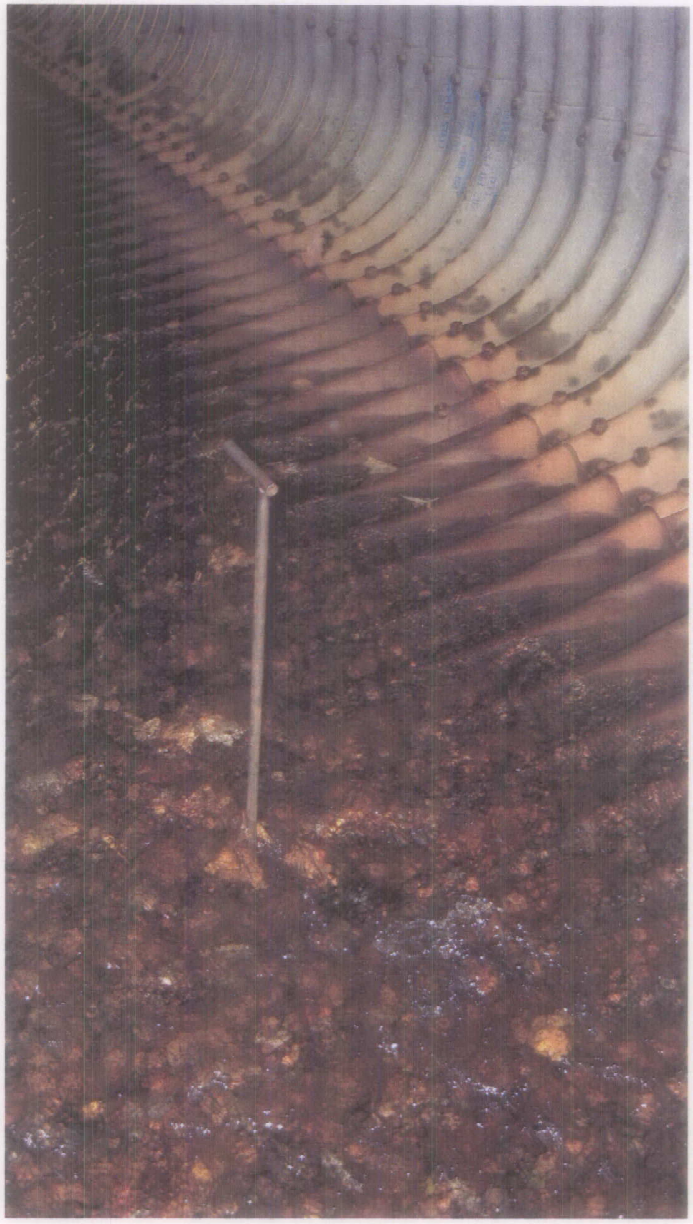
Wilton
Pine Brook Bridge #2666
October 5, 2012



Looking downstream from middle of culvert

Top plates near the middle of culvert

Wilton
Pine Brook Bridge #2666
October 5, 2012



Probe penetrated about 1' below the bottom plate near the middle of the culvert

Wilton
Pine Brook Bridge #2666
October 5, 2012

Looking downstream at inlet

APPENDIX B

Site Inspection Reports

Structure Inventory and Appraisal Sheet (English Units)

Bridge Key: 2666 Agency ID: 2666 SR: 71.8 SD/FO: N

IDENTIFICATION

State 1: 23 Maine
Struc Num 8: 2666
Facility Carried 7: #156
Location 9: 3 MI E TOWNLINE
Rte (On/Under)5A: Route On Structure
Rte. Signing Prefix 5B: 4 County Hwy
Level of Service 5C: 1 Mainline
Rte. Number 5D: 00156
Directional Suffix 5E: 0 N/A (NBI)
% Responsibility : 0
SHD District 2: 03 Western
County Code 3: 007 Franklin
Place Code 4: 07210 Wilton
Mile Post 11: 12.250 mi
Feature Intersected 6: PINE BROOK
Latitude 16: 44d 37' 05"
Longitude 17: 070d 15' 58"
Border Bridge Code 98: Not Applicable (P)
Border Bridge Number 99: n/a

INSPECTION

Frequency 91: 24 months
Inspection Date 90: 7/27/2010
Next Inspection: 07/27/2012
FC Frequency 92A: NA
FC Inspection Date 93A: NA
Next FC Inspection: NA
UW Frequency 92B: NA
UW Inspection Date 93B: NA
Next UW Inspection: NA
SI Frequency 92C: NA
SI Date 93C: NA
Next SI: NA
Element Frequency: 24 months
Element Inspection Date: 07/27/2010
Next Elem. Insp. Due: 07/27/2012

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy
Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic
Temporary Structure 103: Not Applicable (P)
Highway System 104: 0 Not on NHS
NBIS Length 112: Too Short
Toll Facility 20: 3 On free road
Functional Class 26: 07 Rural Mjr Collector
Defense Hwy 110: 0 Not a STRAHNET
Historical Significance 37: 4 Hist sign not determin
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0
Number of Spans Main Unit 45: 1
Main Span Material/Design 43A/B:
3 Steel
19 Culvert
Deck Type 107: N N/A (NBI)
Wearing Surface 108A: N N/A (no deck (NBI))
Membrane 108B: N N/A (no deck (NBI))
Deck Protection 108C: N N/A (no deck (NBI))

CONDITION

Deck 58: N N/A (NBI)
Super 59: N N/A (NBI)
Sub 60: N N/A (NBI)
Culvert 62: 4 Considerable Damage
Channel/Channel Protection 61: 5 Bank Prot Eroded

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress
Operating Rating Method 63: 2 AS Allowable Stress
Inventory Rating 66: HS20.0
Operating Rating 64: HS30.0
Design Load 31: 6 MS18(HS20)+mod
Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1977
Year Reconstructed 106: 0
Type of Service on 42A: 1 Highway
Type of Service under 42B: 5 Waterway
Lanes on 28A: 2
Lanes Under 28B: 0
Detour Length 19: 2.0 mi
ADT 29: 1,000
Truck ADT 109: 8 %
Year of ADT 30: 2011

APPRAISAL

Bridge Rail 36A: 0 Substandard
Approach Rail 36C: 1 Meets Standards
Transition 36B: 0 Substandard
Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 4
Deck Geometry 68: N Not applicable (NBI)
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 8 Equal Desirable
Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 8 Stable Above Footing

GEOMETRIC DATA

Length Max Span 48: 12.0 ft
Structure Length 49: 12.0 ft
Curb/Sdwlk Width L 50A: 0.0 ft
Curb/Sidewalk Width R 50B: 0.0 ft
Width Curb to Curb 51: 0.0 ft
Width Out to Out 52: 0.0 ft
Approach Roadway Width 32: 25.0 ft (w/ shoulders)
Median 33: 0 No median
Deck Area: 240. sq. ft
Skew 34: 5.00 °
Structure Flared 35: 0 No flare
Vertical Clearance 10: 99.99 ft
Horiz. Clearance 47: 20.00 ft
Minimum Vertical Clearance Over Bridge 53: 327.8 ft
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 0.0 ft
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Underclearance R 55: 327.8 ft
Minimum Lateral Underclearance L 56: 327.8 ft

PROPOSED IMPROVEMENTS

Bridge Cost 94: NA
Type of Work 75: Unknown (P)
Roadway Cost 95: Unknown
Length of Improvement 76:
Total Cost 96: Unknown
Future ADT 114: 1,500
Year of Cost Estimate 97: Unknown
Year of Future ADT 115: 2031

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.0 ft
Horizontal Clearance 40: 0.0 ft
Pier Protection 111: Not Applicable (P)
Lift Bridge Vertical Clearance 116: 0.0 ft

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
1	240/2	Steel Culvert	(LF)	62	0 %	0	0 %	0	55 %	34	45 %	28	0 %	0

Bridge Inspectio | de: Edit Type: Regular NBI Key: XKLW

Bridge: 2666 | Find... | Inspections (4): 07/27/2010 | Metric | English | Reports... | Save

1 CONDITION | 2 NOTES | 3 WORK | 4 APPRAISAL | 5 INVENTORY | 6 MAINE DOT | 7 SCHEDULE | 8 MEDIA

Show: All Notes | Structure Notes Only | Inspection Notes Only

Structure Notes:

1977 12' Steel bolted arch culvert.
MONITOR CRACKED PLATES - JEB 07-23-09

Inspection Notes:

Culvert in Poor condition. Stream flow exits culvert through holes in culvert floor. Holes in floor and/or very soft for downstream 1/3 of pipe length. Still may be time for invert.

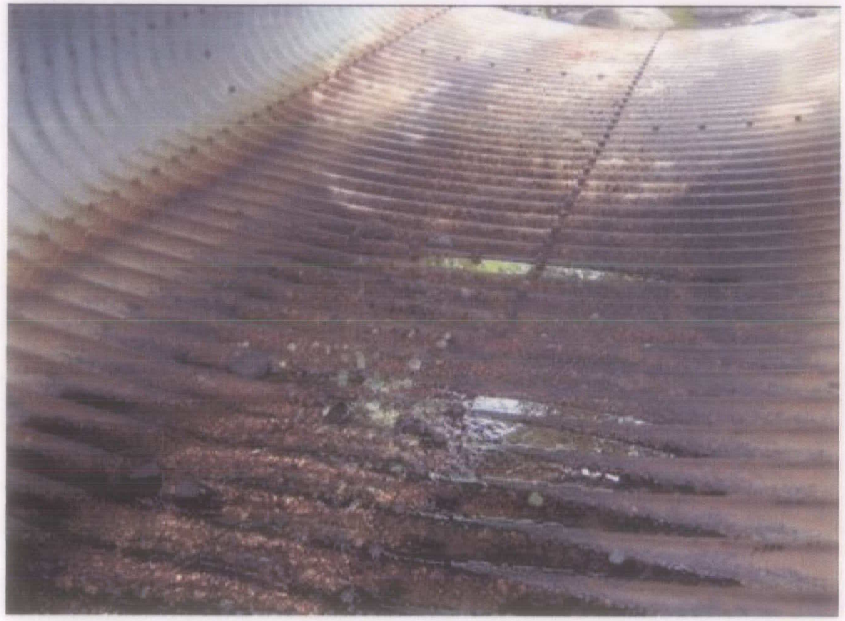
Hanging culvert at outlet 6" high by 6'+ deep.

2'-3' High bankings have bare roots exposed from high flow conditions.
Minor erosion above down stream end from roadway shoulder.

Channel:
Alignment - Poor
Gradient - Severe
Opening - Satisfactory
Composition - !-2 CF stones

Looking SE'ly

Looking down stream SW'ly

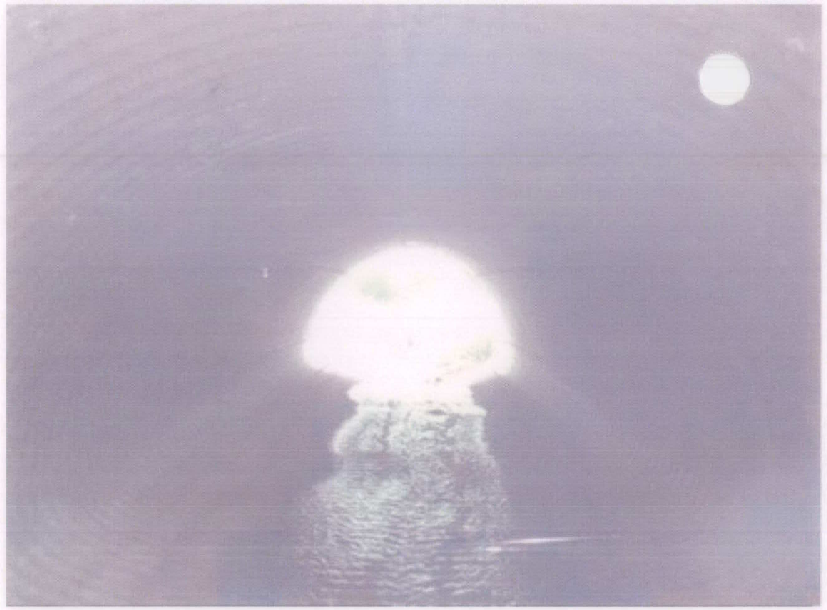


Looking down stream S'ly

Looking up stream NE'ly

Br.#2666	WILTON	Pine Brook	7-27-2010

Roadway looking E'ly



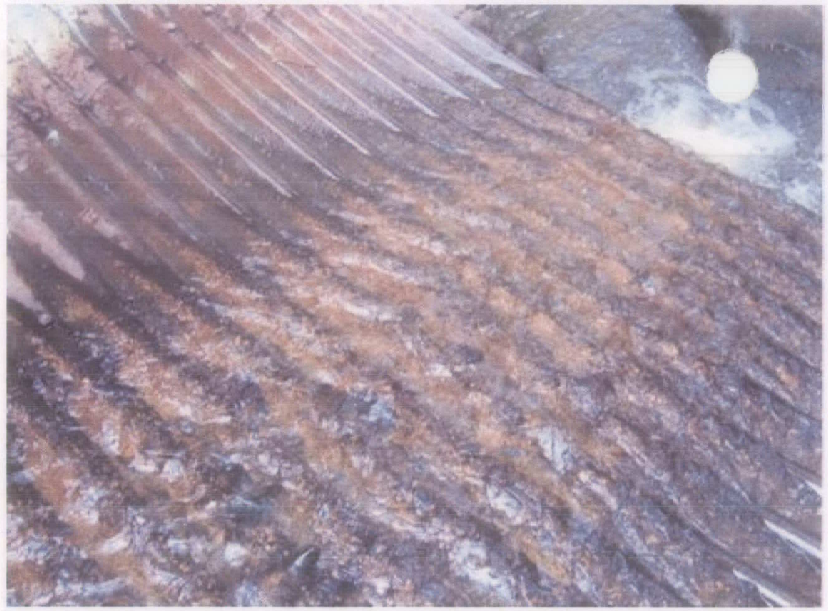
Looking up stream

Looking up stream

Looking down stream

2666	Wilton	Pine Brook	6-26-08

Hanging outlet end, 6" high, 6'+ deep



General view of rust nodules on invert

Minor erosion above down stream end

2666	Wilton	Pine Brook	6-26-08

Wilton
Pine Brook
Bridge
2666
10/5/2012
in pm (1-3)
60° sunny
Michael Wight

Notes

- bottom of culvert clean very few cobbles & leaves

- Rust Line ends @ middle of corner plates

- Some holes in bottom @ middle of pipe (6 locations +/-)

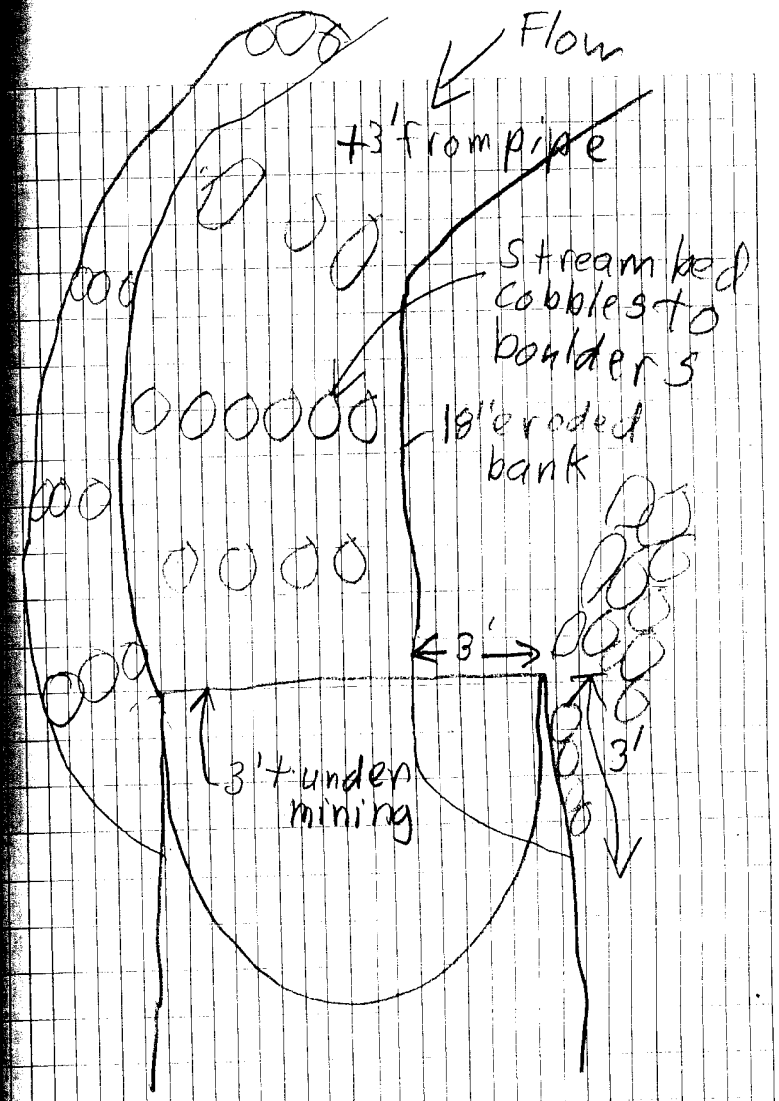
- @ middle of culvert penetrated 12" below plate

- bottom plates, heavy rust with rust nodules

- top plate in good cond. no distortion

- minor efflorescence on side & top plates

- water flowing under culvert



Plan - Upstream end

Water Depth

@ inlet @ ℄ 9"

10' in 4 seconds

10' in 4.5 seconds

10' in 5 seconds

15' from inlet @ ℄
WD 3 1/2"

@ middle 2 3/4"

@ 23' from outlet
WD = 0 flowing water stops

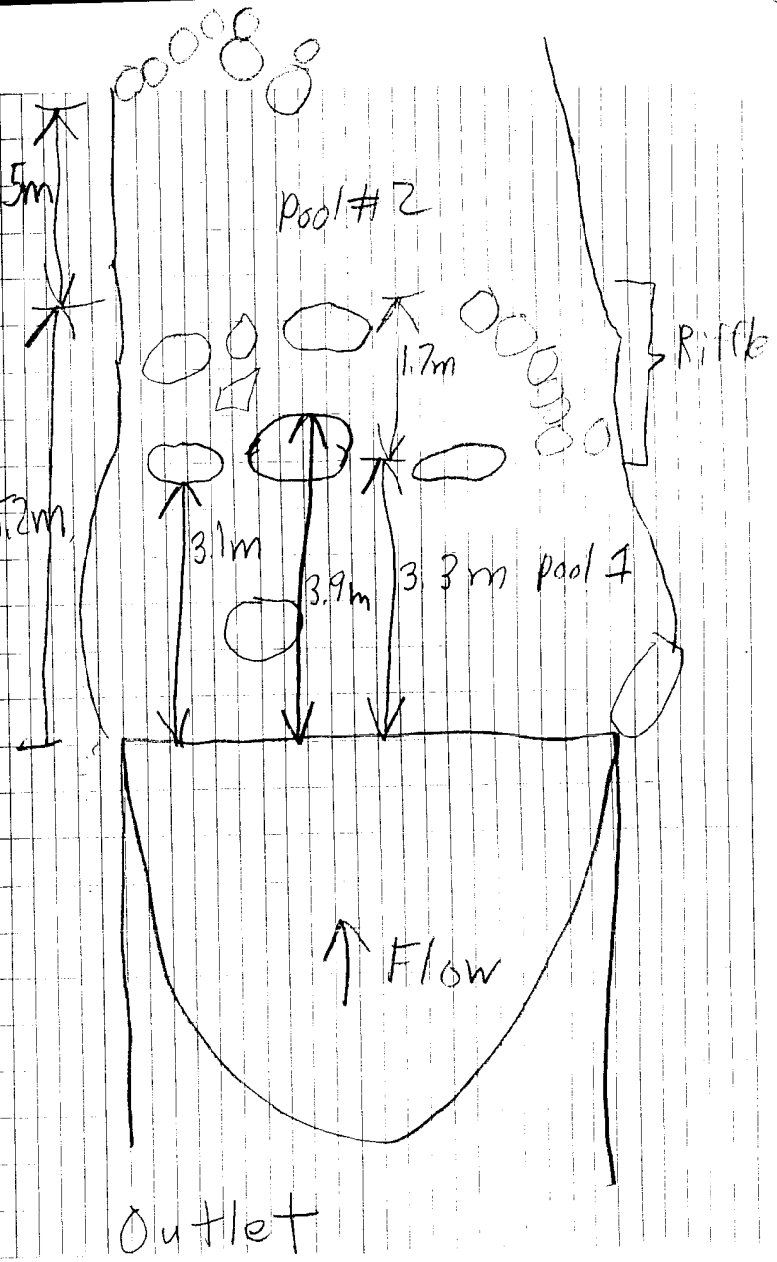
@ outlet no flowing water in culvert

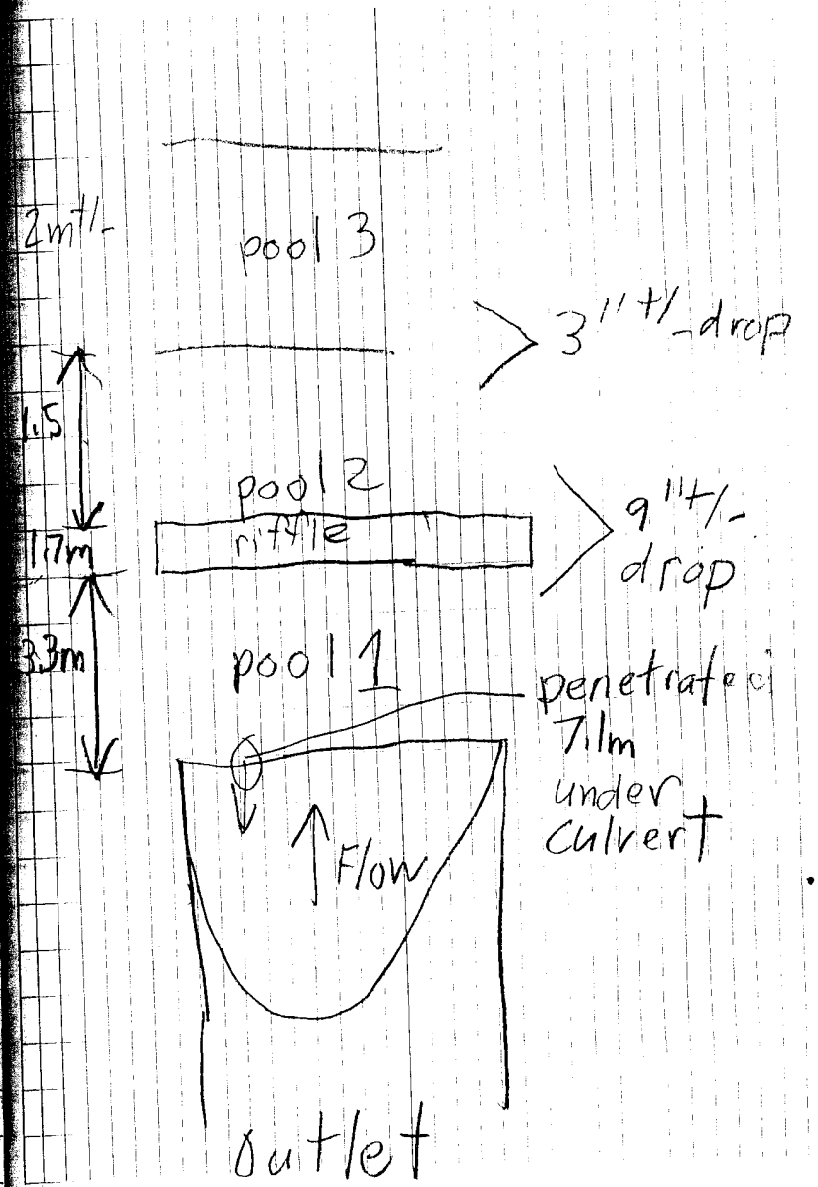
water flowing under culvert

water surface just under the culvert

Water Depth just past outlet @ CL = 5"

- line of rock se first DS riffle 4 to 6" above water surface




2m+/-
pool 3
3" +/- drop
1.5
pool 2
riffle
1.7m
9" +/- drop
3.3m
pool 1
penetrated 7.1m under culvert
Flow
Outlet

Bank full width

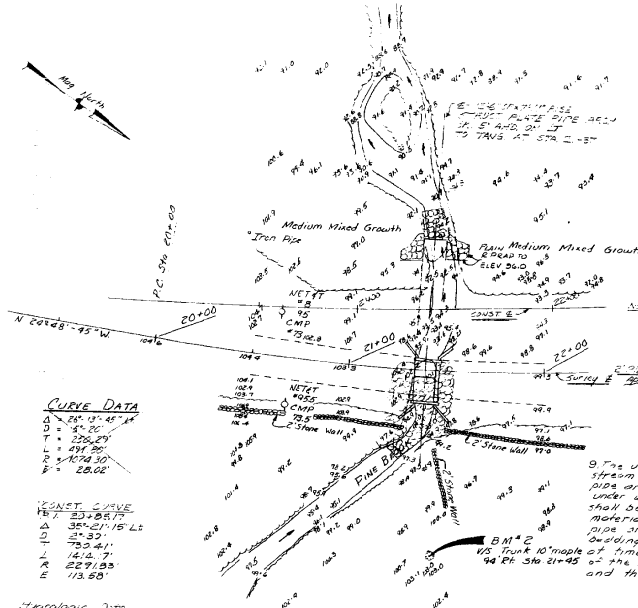
- slightly wider then culvert

- 3.8m +/- DS. 4m from culvert
12.46'

APPENDIX C

Plans of Existing Bridge

F.A.P. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	BR 0186(3)	7	24



CURVE DATA

Δ = 24°-13'-45" Rt
D = 4°-20'
T = 220.29'
L = 434.30'
R = 1374.30'
E = 28.02'

CONST CURVE

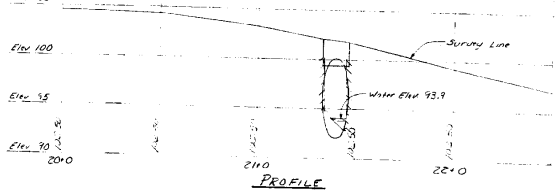
P.B.T. 20+88.79
Δ 38°-21'-15" Lt
D 2°-30'
T 793.41'
L 1412.77'
R 229.183'
E 113.58'

Hydrologic Data

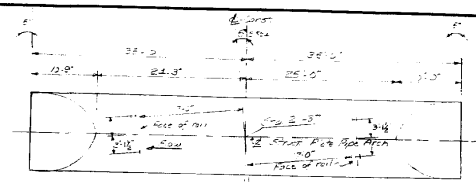
Drainage Area	13 Sq. Mi.
Design Discharge (Q50)	540 Cfs
Mean Velocity (Q50)	12 fps*
High Water (Q50)	94.5±
High Water (Q100)	95.6±
Check Discharge (Q100)	650 Cfs
Mean Velocity (Q100)	13 fps*

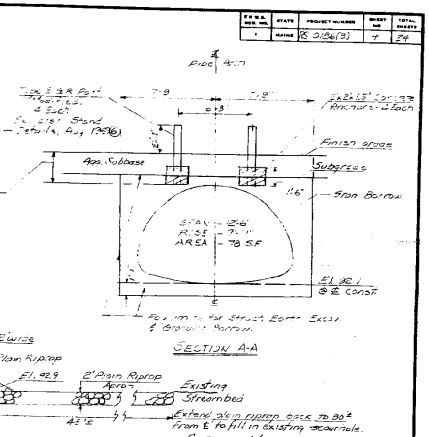
PLAN

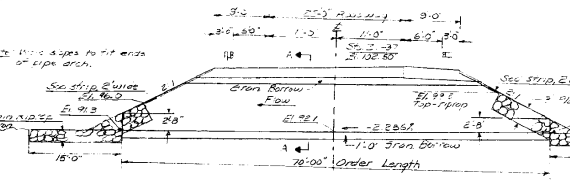
INLET SECTION



PROFILE







ELEVATION

9. The use of cofferdams and the unwatering of the stream will not be a requirement for the installation of the pipe arch. Bedding and backfill material to be placed under water shall be placed uniformly and the pipe arch shall be moved back and forth longitudinally on the bedding material to shape and compact it prior to releasing the pipe arch in its final position as shown on the plans. The bedding material and the pipe arches should not be placed on the Engineer prior to placing the bedding material and the pipe arch.

CONSTRUCTION NOTES

1. Use 180" span, 95" rise Spiral Rib Pipe Arch required. The plates shall be 0.135" thick, bottom and corner plates shall be 0.168" thick. Assemble with ⅝" diam. hot dipped galvanized bolts (ASTM A449), nuts (ASTM A563).
2. Bolt shall be cut to the slope shown on the details.
3. Granular Borrow shall meet the requirements of Subsection 703.19, Material for Underwater Backfill.
4. Granular Borrow may be omitted under the pipe arch if the existing material is suitable.
5. Place 2' wide strip of sod along the top of the riprap one over the pipe arch. Typical detail.
6. Riprap shall be carefully placed around ends of pipe so that no damage to the pipe will result and in such manner that the finished slope will match the ends of the pipe. No separate payment will be made for extra work required to place riprap adjacent to the ends of the pipe. Payment for all labor, materials and equipment necessary to place riprap will be made under Item 610.00 Plain Riprap.
7. Payment for installing the A-Type 3 Old Rail Posts and for the 4 concrete anchors is to be considered incidental to Item 606.56.
8. 2" of soil shall be placed on the slope above the riprap and under seeded area for a distance beyond each end of the riprap limits.

SPECIFICATIONS

DESIGN: AASHTO 1965 "Standard for Highways & Bridges" 1973 Interim Specifications 1974, 1975 and 1976.

CONTRACT: State of Maine Department of Transportation Standard Specifications "Highways and Bridges" Revised to Jan. 1968.

REFERENCE DRAWING
[illegible]

SURVEY NOTES

Stream: Flow is rapid over rock bed. Streambed is gravel and large boulders.

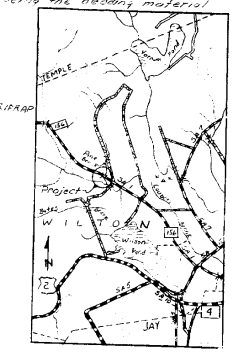
Abutments: Abutments and wing walls are Class C concrete. The top of the downstream wing walls are partly spalled.

Curb: The upstream concrete curb is spalled exposing reinforcing steel. The downstream concrete curb and fascia are spalled exposing reinforcing steel on the curb and fascia.

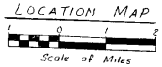
Superstructure and Abutments: Face of concrete abutments and concrete deck are in good condition (Not spalled).

NOTES: EXISTING STRUCTURE

Existing abutments to be removed one foot below from 2.36 of Street Pavement. Drainage and Minor Street. Existing superstructure to be removed and paid for under Item 202.10 Removal of Existing Superstructure Fireproof of Contractor.



LOCATION MAP



Reference 186(3)
Book No. 7651

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PINE BROOK BRIDGE
IN THE TOWN OF
WILTON
FRANKLIN COUNTY

SURVEY & PROFILE
STRUCTURAL PL. PIPE ARCH
BRIDGE NO. 1374
SHEET 12 OF [illegible] AUGUSTA, MAINE

Checked by F.J.T. 5-76
Survey Plotted A.N.N. 1-7-76

PROJECT	DESIGN ENGINEER	BY	DATE
PLANS	DESIGN DETAILED	L.A.A.	11/76
	DESIGN CHECKED		
	REVISIONS		
	FIELD CHANGES		

(RS-0186(3)) 170 of 99 [illegible]

APPENDIX D

Hydrology Data

Project Name:	Wilton	**PIN:**	19295.00
Stream Name:	Pine Brook	**Town:**	Wilton
Bridge Name:		**Bridge No.**	2666
Route No.	156	**USGS Quad:**	
Analysis by:	AWM	**Date:**	11/26/2012

Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999)

Enter data in blue cells only!

	km^2	mi^2	ac	*Enter data in [mi^2]*
A	3.77	1.46	932.7	Watershed Area
W	0.09	0.0363	23.2	Wetlands area (by NWI)
P_c	399567	4942857		watershed centroid (E, N; UTM 19N; meters)
County	Franklin			*choose county from drop-down menu*
pptA	45.6			mean annual precipitation (inches; by look-up)
SG	0.00			sand & gravel aquifer as decimal fraction of watershed A

A (km^2)	3.77	**Conf Lvl**	0.67
W (%)	2.49		

Worksheet prepared by:
Charles S. Hebson, PE
Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov

Ret Pd T (yr)	**Peak Flow Estimate Lower**	**Q_T (m^3/s)**	**Upper**	**Q_T (ft^3/s)**
1.1		1.19		42.1
2	2.00	2.85	4.05	100.5
5	3.43	4.92	7.05	173.6
10	4.53	6.57	9.52	231.9
25	6.06	8.93	13.16	315.3
50	7.28	10.88	16.26	384.0
100	8.57	13.00	19.72	459.1
500	11.79	18.55	29.19	655.1

Reference:

Hodgkins, G., 1999.
Estimating the magnitude of peak flows for streams in Maine for selected recurrence intervals
Water-Resources Investigations Report 99-4008
US Geological Survey, Augusta, Maine

$Q_T = b \times A^a \times 10^{-wW}$

Project Name:	Wilton	**PIN:**	19295.00
Stream Name:	Pine Brook	**Town:**	Wilton
Bridge Name:	0	**Bridge No.**	3987
Route No.	156	**USGS Quad:**	
Analysis by:	AWM	**Date:**	11/26/2012

DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

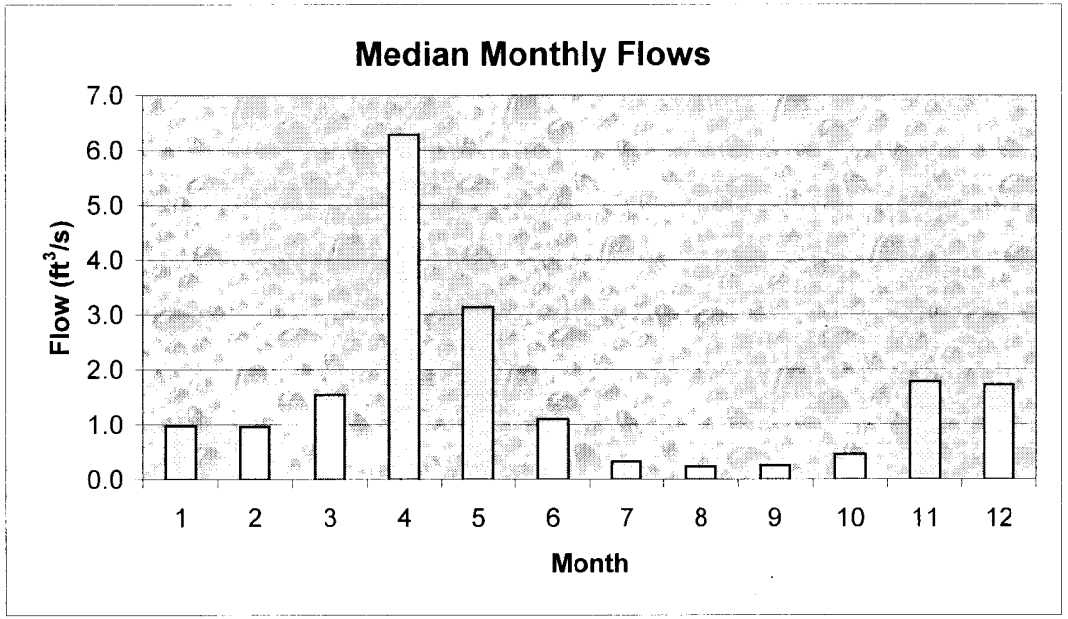
MAINE MONTHLY MEDIAN FLOWS BY USGS REGRESSION EQUATIONS (2004)

Worksheet prepared by:
Charles S. Hebson, PE
Chief Hydrologist
Maine Dept. Transportation
Augusta, ME 04333-0016
207-624-3073
Charles.Hebson@maine.gov

	Value	Variable	Explanation
	1.457	*A*	Area (mi^2)
399567	4942857	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	91.57	*DIST*	Distance from Coastal reference line (mi)
	45.6	*pptA*	Mean Annual Precipitation (inches)
	0.00	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

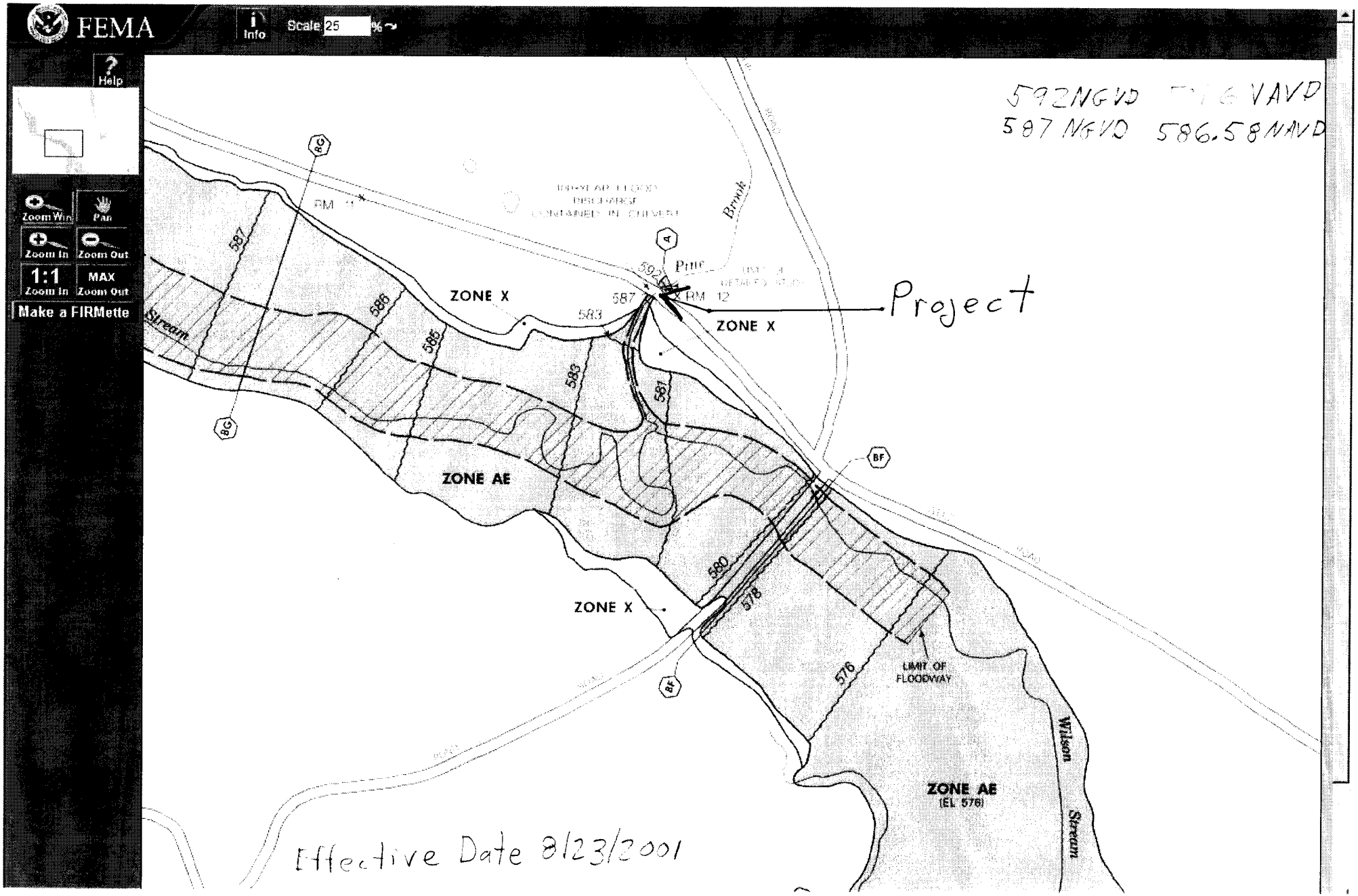
Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**0.98**	0.0277
Feb	**0.96**	0.0273
Mar	**1.54**	0.0436
Apr	**6.28**	0.1780
May	**3.15**	0.0891
Jun	**1.10**	0.0312
Jul	**0.32**	0.0092
Aug	**0.23**	0.0066
Sep	**0.26**	0.0072
Oct	**0.46**	0.0130
Nov	**1.78**	0.0505
Dec	**1.72**	0.0488

Q_{bf}	**7.7**
ann avg	**3.1**
ann med	**1.6**
$Q_{1.002}$	**15.4**
$Q_{1.01}$	22.0
$Q_{1.05}$	33.9
W_{bf}	9.3
d_{bf}	0.7
Q_{bf}	26.8 assume v = 4ft/s



APPENDIX E

Hydraulic Data


FEMA
Info
Scale: 25 %
Help
Zoom Win
Pan
Zoom In
Zoom Out
1:1 Zoom In
MAX Zoom Out
Make a FIRMette
592NGVD 576VAVD
587 NGVD 586.58NAVD
Project
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE AE
(EL 576)
LIMIT OF FLOODWAY
Stream
Wilson Stream
Pine Brook
RM 12
587
585
583
581
580
578
576
Effective Date 8/23/2001

Questions concerning the VERTCON process may be mailed to NGS

Latitude: 44 37 04.34

Longitude: 70 15 58.34

NGVD 29 height: 180.44

Datum shift(NAVD 88 minus NGVD 29): -0.128 meter or 0.42'

Converted to NAVD 88 height: 180.312 meters

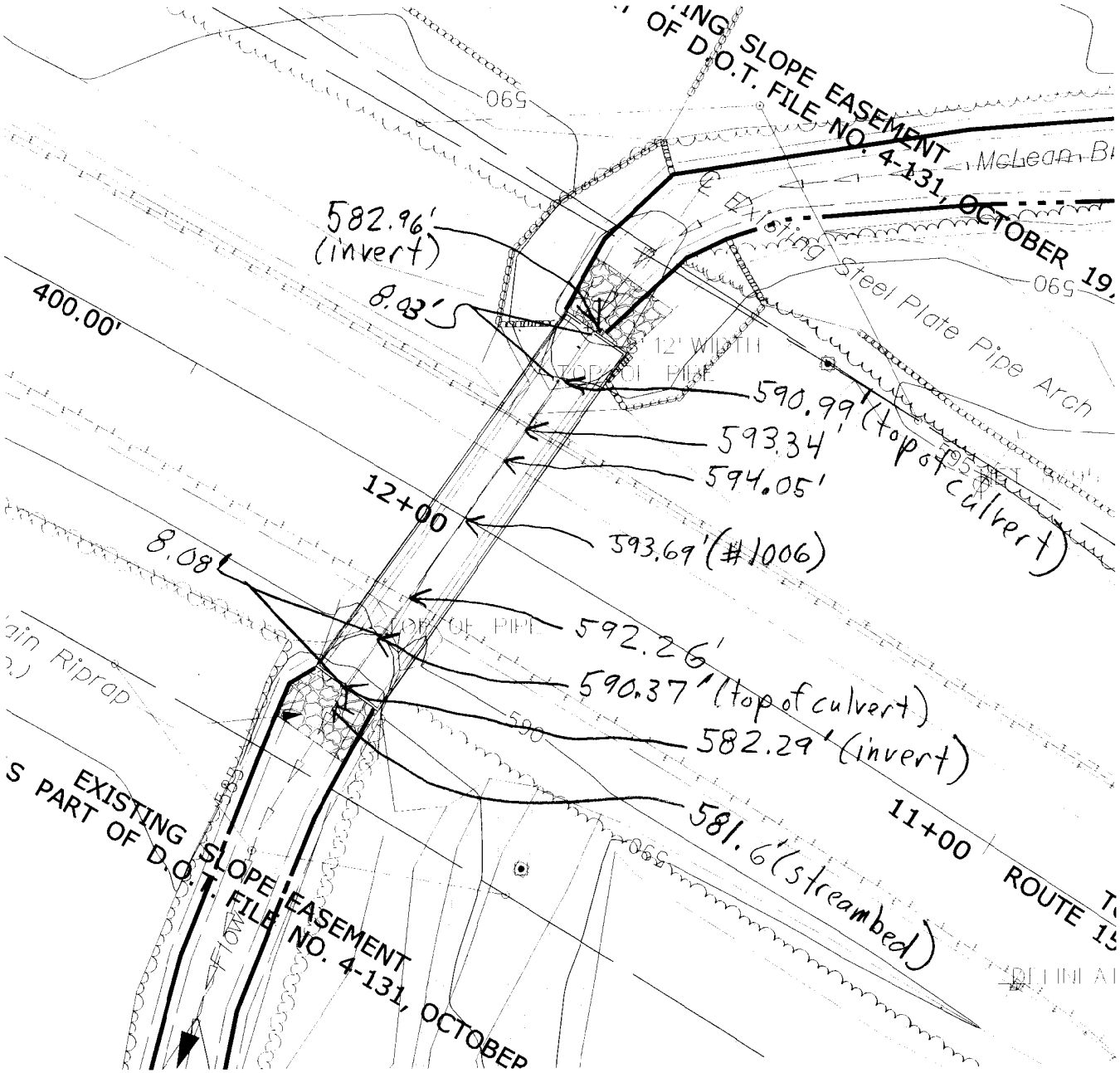
PRELIM. BY _____ DATE _____ PROJ. NO. _____ FILE NO. _____ OF _____
FINAL CHK. BY _____ DATE _____ LOCATION _____ SH. NO. _____ OF _____
ITEM NO. _____ SUBJECT _____

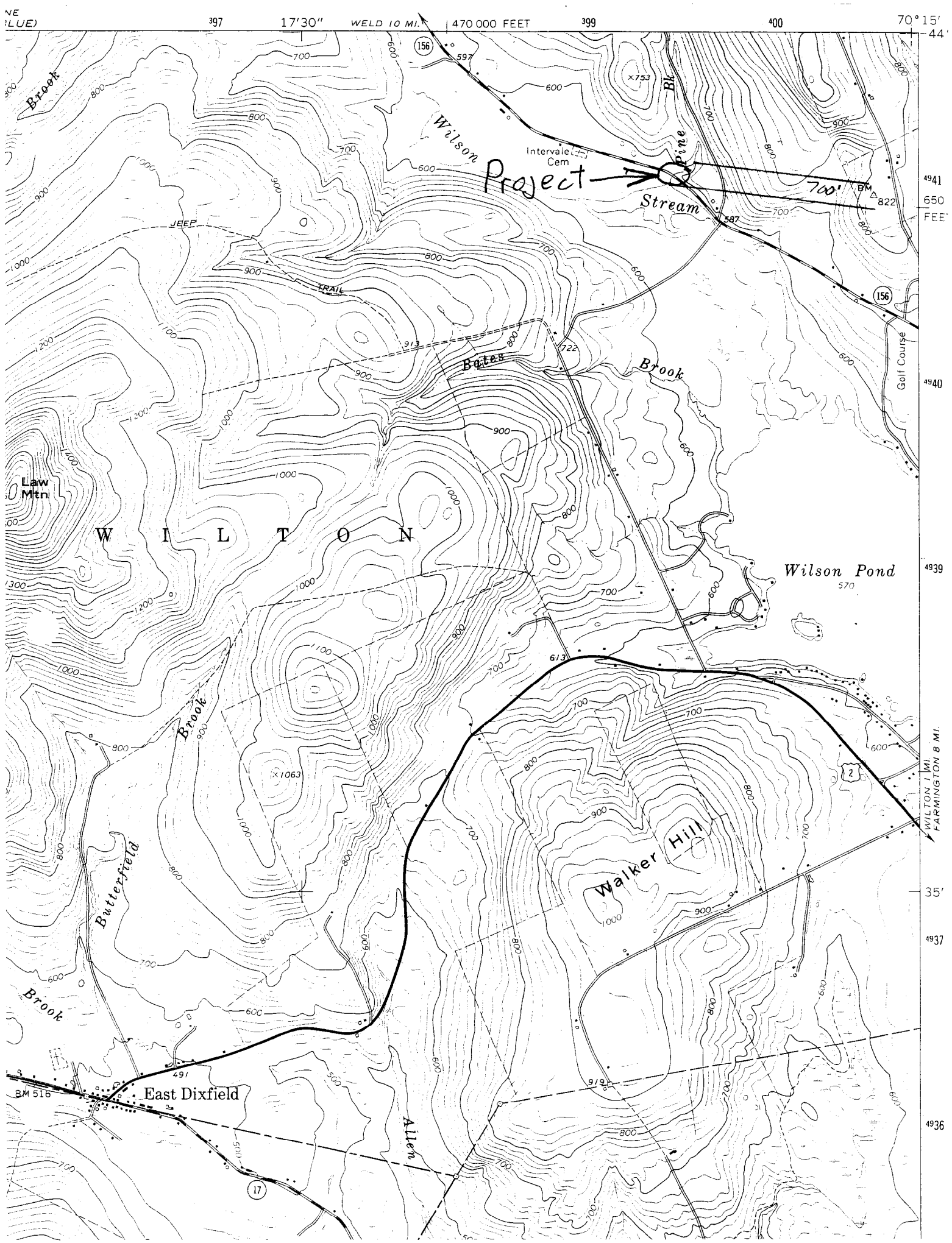
Vertcon Conversion

592' (NGVD) 180.44m (NAVD)

Latitude 44° 37' 04.84"
Longitude 70° 15' 58.34"

180.312 m (NAVD88) 591.57'
say 591.6'


EXISTING SLOPE EASEMENT
OF D.O.T. FILE NO. 4-131, OCTOBER 19
McLean Br
Existing Steel Plate Pipe Arch
590
582.96'
(invert)
8.03'
400.00'
12' WIDTH
TOP OF PIPE
590.99' (top of culvert)
593.34'
594.05'
12+00
593.69' (#1006)
8.08'
592.26'
TOP OF PIPE
590.37' (top of culvert)
582.29' (invert)
581.6' (streambed)
11+00
ROUTE 15
Riprap
EXISTING SLOPE EASEMENT
PART OF D.O.T. FILE NO. 4-131, OCTOBER


17'30"
WELD 10 MI.
470 000 FEET
70°15'
44'
Wilson
Pine
Bk.
Intervale Cem
Project
700'
Stream
BM 822
587
753
597
JEEP
TRAIL
913
722
Bates
Brook
Golf Course
Law Mtn
W I L T O N
Wilson Pond
570
613
Brook
Butterfield
Brook
1063
Walker Hill
WILTON 1 MI.
FARMINGTON 8 MI.
491
BM 516
East Dixfield
Allen
919
4941
650 FEET
4940
4939
35'
4937
4936

annual peaks from the East Wilton gage plus an estimate for the 1987 peak discharges were analyzed using a log-Pearson Type III analysis (U.S. Department of the Interior, 1981). The discharge used in this study and results from the log-Pearson analysis were within 3 percent. The discontinued gage is located approximately at the mid-point of the stream studied.

For this revision, NRCS used the Technical Release No. 20 (TR-20) hydrologic evaluation model (USDA, 1983) to compute discharges on Butterfield Brook, Cram Brook, Ice Pond Brook, Pine Brook, Potash Brook, Sevenmile Stream, Temple Brook, and Wilson Stream upstream of Wilson Pond. The program is a physically based event model that computes direct runoff resulting from any synthetic or natural rainstorm. It takes into account conditions having a bearing or runoff, develops a hydrograph, and routes the flow through stream channels, reservoirs, and natural storage areas. It combines routed hydrographs with those from other tributaries. The program includes provisions for hydrograph separation by branching or diversion of flow and the addition of baseflow. The TR-20 model used historical rainfall data for evaluated frequencies. Modeled storms has a 24-hour duration and a NRCS Type I rainfall distribution.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BUTTERFIELD BROOK					
At U.S. Route 2/State Route 17	1.4	300	575	715	1,010
At More Acres Road	1.3	290	550	680	955
At Private Drive	1.3	280	535	660	925
At Butterfield Road	1.2	270	515	635	885
CRAM BROOK					
At U.S. Route 2/State Route 17	1.8	420	765	920	1,290
ICE POND BROOK					
At Gordon Road	0.9	230	410	495	680
PINE BROOK					
At State Route 156 (Weld Road)	1.4	320	555	665	910

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Butterfield Brook								
A	55[1]	35	174	4.6	477.5	477.5	478.5	1.0
B	715[1]	48	205	3.7	489.2	489.2	489.8	0.6
C	1,495[1]	17	70	9.5	507.3	507.3	508.3	1.0
D	1,775[1]	16	84	7.9	517.0	517.0	517.4	0.4
E	3,744[1]	21	64	9.9	616.0	616.0	616.1	0.1
F	3,926[1]	16	78	9.2	623.3	623.3	624.2	0.9
G	4,500[1]	16	64	9.4	644.7	644.7	645.7	1.0
H	7,175[1]	65	106	4.6	726.5	726.5	727.4	0.9
Cram Brook								
A	140[2]	94	305	3.9	613.8	613.8	613.9	0.1
Ice Pond Brook								
A	420[3]	22	66	7.6	633.4	633.4	634.4	1.0
Pine Brook								
A	830[4]	34	160	4.9	592.2	592.2	592.3	0.1
Potash Brook								
A	158[1]	15	65	5.3	491.5	491.5	492.0	0.5
B	665[1]	9	31	9.8	506.7	506.7	507.4	0.7
C	920[1]	15	51	6.0	514.6	514.6	515.6	1.0
Sevenmile Stream								
A	215[1]	42	336	10.4	520.7	520.7	520.7	0.0
B	5,656[1]	119	595	6.1	564.0	564.0	564.9	0.9
C	7,986[1]	48	334	10.2	592.5	592.5	593.5	1.0
D	10,516[1]	37	338	7.4	626.5	626.5	627.5	1.0
E	10,941[1]	46	280	8.9	632.5	632.5	633.4	0.9

[1]Feet above corporate limits
[2]Feet above confluence with Sevenmile Stream
[3]Feet above confluence with Cram Brook
[4]Feet above confluence with Wilson Stream

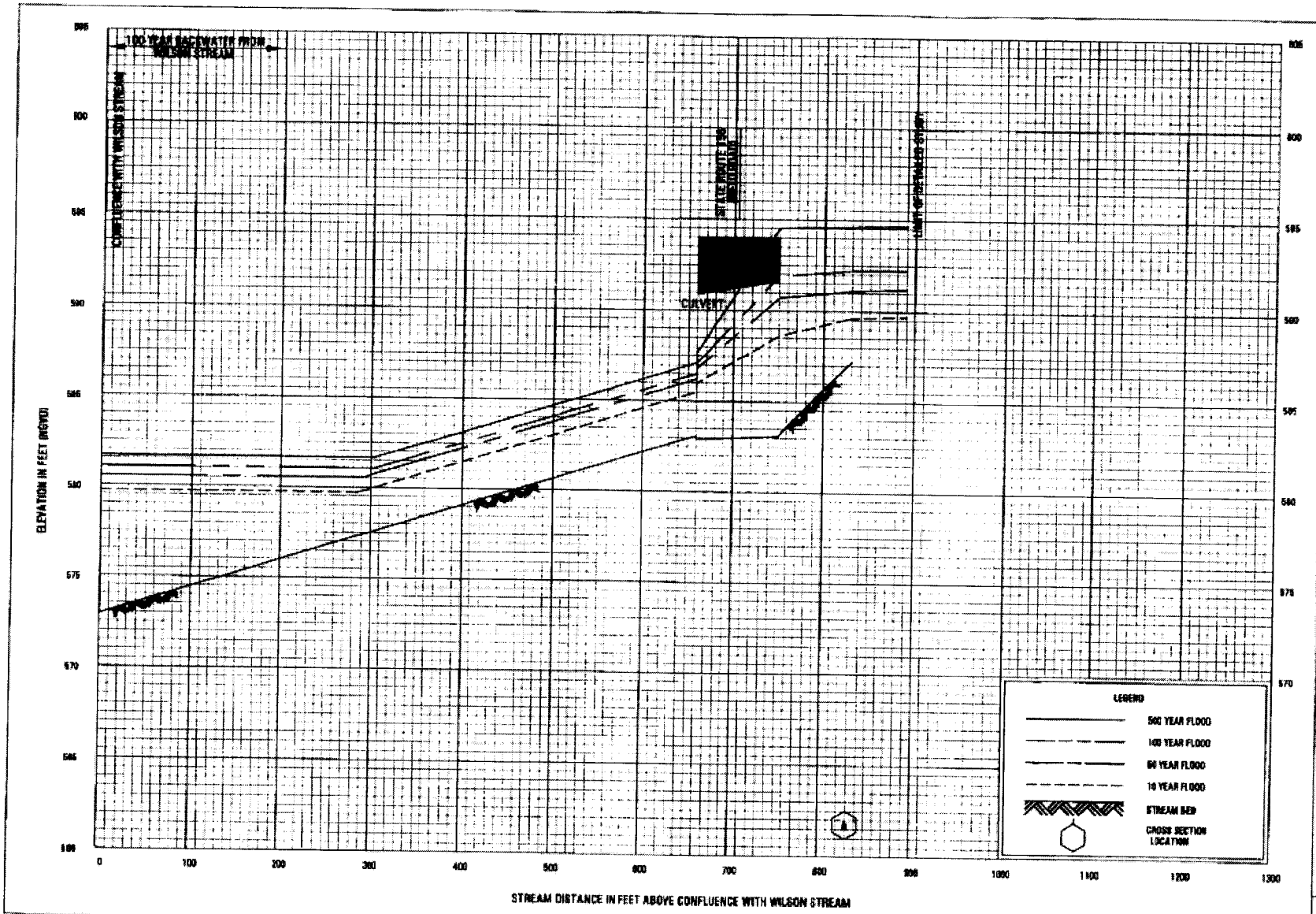
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WILTON, ME
(FRANKLIN CO.)

FLOODWAY DATA

BUTTERFIELD BROOK - CRAM BROOK - ICE POND BROOK - PINE BROOK - POTASH BROOK - SEVENMILE STREAM



FEDERAL EMERGENCY MANAGEMENT AGENCY

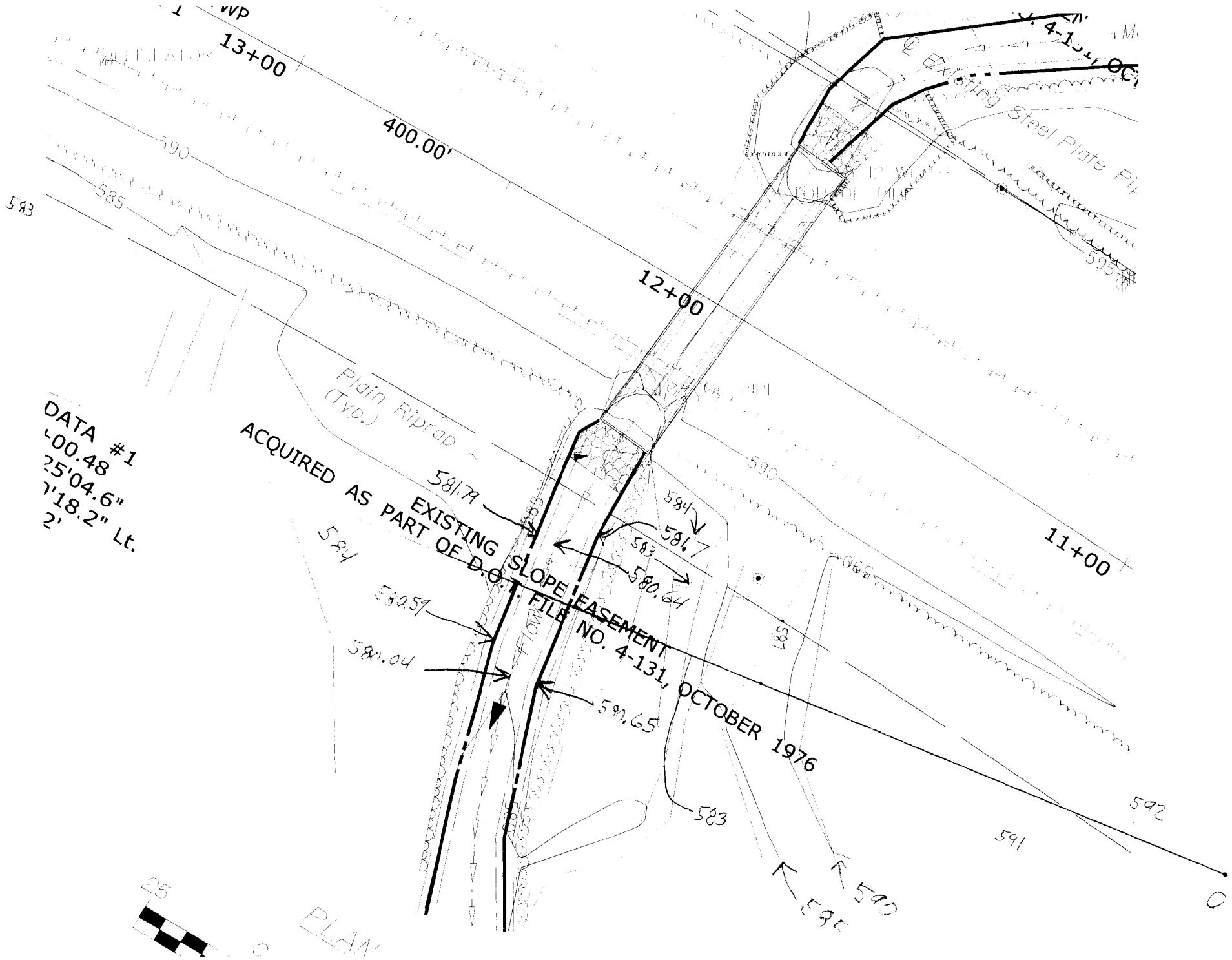
TOWN OF WILTON, ME

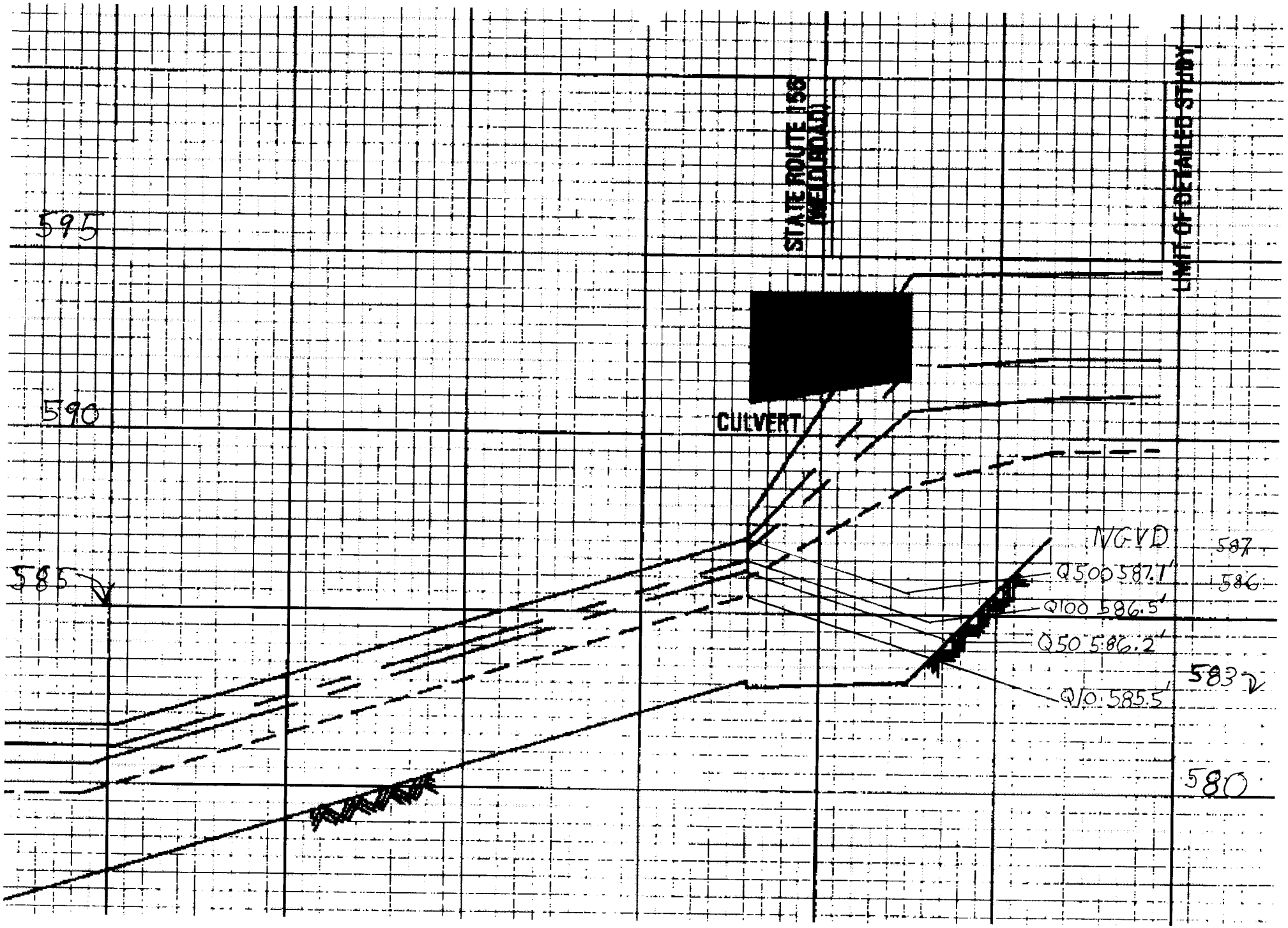
(FRANKLIN CO.)

FLOOD PROFILES

PINE BROOK

08P


13+00
400.00'
12+00
11+00
Existing Steel Plate Pi
Plain Riprap (Typ.)
TOE OF PIPE
FLOW
581.79
581.7
580.64
580.59
580.04
580.65
583
584
585
590
591
592
595
DATA #1
-00.48
25'04.6"
7'18.2" Lt.
2'
ACQUIRED AS PART OF D.O. FILE NO. 4-131, OCTOBER 1976
EXISTING SLOPE EASEMENT
25
PLAN


595
590
585
580
STATE ROUTE 156
(MEDINA ROAD)
LIMIT OF DETAILED STUDY
CULVERT
NGVD
587
586
583
Q500 587.1'
Q100 586.5'
Q50 586.2'
Q10 585.5'

PRELIM. BY _____ DATE _____ PROJ. NO. _____ FILE NO. _____ OF _____
FINAL CHK. BY _____ DATE _____ LOCATION _____ SH. NO. _____ OF _____
ITEM NO. _____ SUBJECT _____

Tailwater rating curve

	Flow cfs	El. NGVD	El. NAVD
Q_0	0		582.29
$Q_{1.1}$	42.1		
Q_{10}	231.9	585.5	585.08
Q_{50}	384.0	586.2	585.78
Q_{100}	459.1	586.5	586.08

Based on FEMA FIS 2001

REPORT FROM BRIDGE MAINTENANCE SUPERVISOR

TOWN: Wilton_____

BRIDGE NO. & NAME_#2666 Pine Brook_____

CLEAR SPAN 12 feet_____

CLEARANCE TO WATER (upstream side):_8 Feet_____

AVERAGE DEPTH OF WATER (upstream side)5 ½ inches_____

SPAN AND RISE DOWNSTREAM: _____
(if significantly different from above)

EVIDENCE OF SCOUR: **none** _____ **slight** _____X_ **much** _____

EVIDENCE OF LENGTH:
unlikely _____ **likely** _____ **positive** _____ **uncertain** ___X___

ADEQUACY OF OPENING:
undersized ____ **appropriate** __X__ **oversized** ____ **uncertain**

____

HIGH WATER INFORMATION

Has water been over the road? ___No___ **Date (if known)** _____

Estimated Depth over the road: _____

Reliability of Estimate: **poor** _____ **fair** ____ **good** ____

Highest known water elevation relative to bottom of bridge: _____
Date (if known) _____

Was high water caused by a downstream constriction:

no ____ **likely** ____ **positive** ____ **uncertain** ____

Was high water caused by ice:
no ____ **likely** ____ **positive** ____ **uncertain** ____

GENERAL COMMENTS: _____

COMMENTS PERTAINING TO UPSTREAM OR DOWNSTREAM BRIDGES:

_____

_____

DEGREE OF FAMILIARITY WITH SUBJECT BRIDGE:
negligible ____ **some** ___X_ **considerable** ____

Reported by: _____Brian Maxham___**Date:** _11/29/2012_____

Existing Culvert

HY-8 Culvert Analysis Report

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 582.96 ft

Outlet Station: 70.00 ft

Outlet Elevation: 582.29 ft

Number of Barrels: 1

Site Data - Culvert 1(Copy)

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 582.96 ft

Outlet Station: 70.00 ft

Outlet Elevation: 582.29 ft

Number of Barrels: 1

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-Existing Br.)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
315.30	586.58	6.28
329.68	586.58	6.28
344.06	586.58	6.28
358.44	586.58	6.28
372.82	586.58	6.28
384.00	586.58	6.28
401.58	586.58	6.28
415.96	586.58	6.28
430.34	586.58	6.28
444.72	586.58	6.28
459.10	586.58	6.28

Tailwater Channel Data - Pine Brook-Existing Br.

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 586.58 ft

Roadway Data for Crossing: Pine Brook-Existing Br.

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-Existing

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.28	6.28	583.54	0.58	0.0*	1-S2n	0.34	0.41	0.34	0.14	1.77	0.00
9.86	9.86	583.76	0.72	0.80	2-M2c	0.54	0.51	0.51	0.22	3.36	0.00
13.44	13.44	583.88	0.85	0.92	2-M2c	0.73	0.60	0.60	0.30	3.62	0.00
17.03	17.03	583.99	0.97	1.03	2-M2c	0.78	0.67	0.67	0.38	3.87	0.00
20.61	20.61	584.10	1.12	1.14	2-M2c	0.84	0.74	0.74	0.46	4.05	0.00
24.19	24.19	584.20	1.19	1.24	2-M2c	0.90	0.80	0.80	0.54	4.21	0.00
25.00	25.00	584.22	1.21	1.26	2-M2c	0.91	0.82	0.82	0.56	4.25	0.00
31.35	31.35	584.38	1.37	1.42	2-M2c	1.01	0.91	0.91	0.70	4.52	0.00
34.94	34.94	584.46	1.45	1.50	2-M2c	1.07	0.96	0.96	0.78	4.66	0.00
38.52	38.52	584.54	1.52	1.58	2-M2c	1.12	1.01	1.01	0.86	4.79	0.00
42.10	42.10	584.61	1.60	3.58	3-M1t	1.18	1.06	4.21	0.94	0.90	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-Existing

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	588.23	5.01	5.27	3-M2t	3.68	3.10	3.59	5.58	7.96	0.00
329.68	329.68	588.38	5.14	5.42	3-M2t	3.79	3.18	3.66	5.65	8.16	0.00
344.06	344.06	588.53	5.26	5.57	3-M2t	3.90	3.26	3.73	5.72	8.35	0.00
358.44	358.44	588.68	5.38	5.72	3-M2t	4.01	3.33	3.79	5.78	8.54	0.00
372.82	372.82	588.82	5.50	5.86	3-M2t	4.13	3.41	3.86	5.85	8.72	0.00
384.00	384.00	588.94	5.60	5.98	3-M2t	4.21	3.47	3.91	5.90	8.86	0.00
401.58	401.58	589.11	5.75	6.15	3-M2t	4.35	3.56	3.98	5.97	9.09	0.00
415.96	415.96	589.26	5.87	6.30	3-M2t	4.47	3.63	4.04	6.03	9.27	0.00
430.34	430.34	589.40	5.99	6.44	3-M2t	4.59	3.71	4.10	6.09	9.45	0.00
444.72	444.72	589.54	6.11	6.58	3-M2t	4.71	3.78	4.15	6.14	9.63	0.00
459.10	459.10	589.68	6.23	6.72	3-M2t	4.83	3.85	4.21	6.20	9.80	0.00

HY-8 Culvert Analysis Report

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-invert line concr

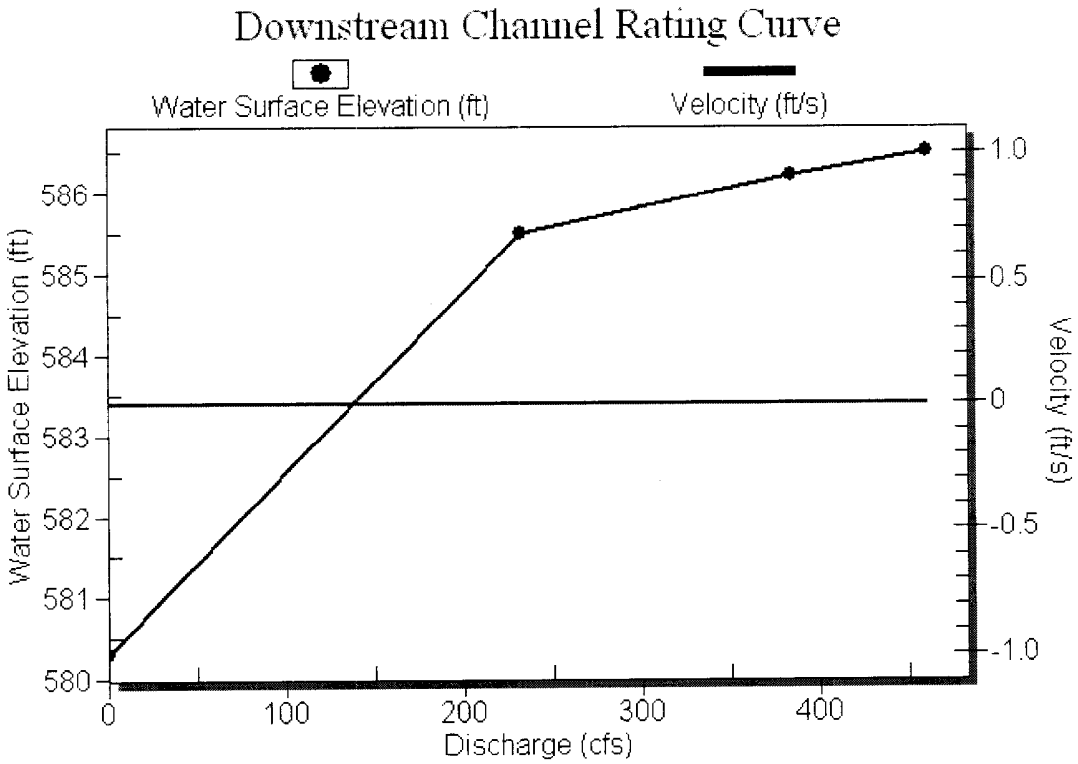
Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
0.00	580.30	580.30	0.00
231.90	585.50	585.50	0.00
384.00	586.20	586.20	0.00
459.10	586.50	586.50	0.00

Tailwater Channel Data - Pine Brook-invert line concrete

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: 580.30 ft

Tailwater Rating Curve Plot for Crossing: Pine Brook-invert line concrete



Roadway Data for Crossing: Pine Brook-invert line concrete

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Culvert Data Summary - Culvert 1

Barrel Shape: User Defined

Barrel Span: 12.10 ft

Barrel Rise: 7.50 ft

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 in

Barrel Manning's n: 0.0330 (top and sides)

Manning's n: 0.0120 (bottom)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Site Data - Culvert 1

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-invert line concrete

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.28	6.28	583.98	0.60	0.0*	1-S2n	0.38	0.42	0.38	0.14	1.80	0.00
28.84	28.84	584.76	1.30	1.38	2-M2c	0.99	0.89	0.89	0.65	4.47	0.00
42.10	42.10	585.06	1.58	1.68	2-M2c	1.22	1.07	1.07	0.94	4.98	0.00
73.97	73.97	585.67	2.18	2.29	2-M2c	1.63	1.43	1.43	1.66	5.92	0.00
96.53	96.53	586.04	2.53	2.66	2-M2c	1.89	1.64	1.64	2.16	6.48	0.00
119.09	119.09	586.39	2.86	3.01	2-M2c	2.13	1.83	1.83	2.67	6.94	0.00
141.65	141.65	586.72	3.17	3.34	2-M2c	2.34	2.02	2.02	3.18	7.34	0.00
164.21	164.21	587.02	3.46	3.64	2-M2c	2.56	2.19	2.19	3.68	7.71	0.00
186.78	186.78	587.32	3.73	3.94	2-M2c	2.77	2.36	2.36	4.19	8.03	0.00
209.34	209.34	587.59	3.99	4.21	2-M2c	2.96	2.51	2.51	4.69	8.35	0.00
231.90	231.90	587.86	4.25	4.53	3-M1t	3.16	2.67	3.79	5.20	5.78	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-invert line concrete

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	588.80	5.19	5.42	2-M2c	3.86	3.20	3.20	5.58	9.48	0.00
329.68	329.68	588.95	5.35	5.57	2-M2c	3.98	3.28	3.28	5.65	9.64	0.00
344.06	344.06	589.11	5.51	5.73	2-M2c	4.09	3.36	3.36	5.72	9.79	0.00
358.44	358.44	589.26	5.68	5.88	2-M2c	4.22	3.44	3.44	5.78	9.94	0.00
372.82	372.82	589.41	5.84	6.03	2-M2c	4.35	3.52	3.52	5.85	10.09	0.00
384.00	384.00	589.53	5.96	6.15	2-M2c	4.45	3.58	3.58	5.90	10.20	0.00
401.58	401.58	589.71	6.15	6.33	2-M2c	4.61	3.67	3.67	5.97	10.36	0.00
415.96	415.96	589.86	6.31	6.48	2-M2c	4.74	3.74	3.74	6.03	10.51	0.00
430.34	430.34	590.01	6.47	6.63	2-M2c	4.87	3.81	3.81	6.09	10.66	0.00
444.72	444.72	590.16	6.62	6.78	2-M2c	5.02	3.88	3.88	6.14	10.80	0.00
459.10	459.10	590.31	6.78	6.93	2-M2c	5.16	3.95	3.95	6.20	10.94	0.00

HY-8 Culvert Analysis Report

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-Existing)

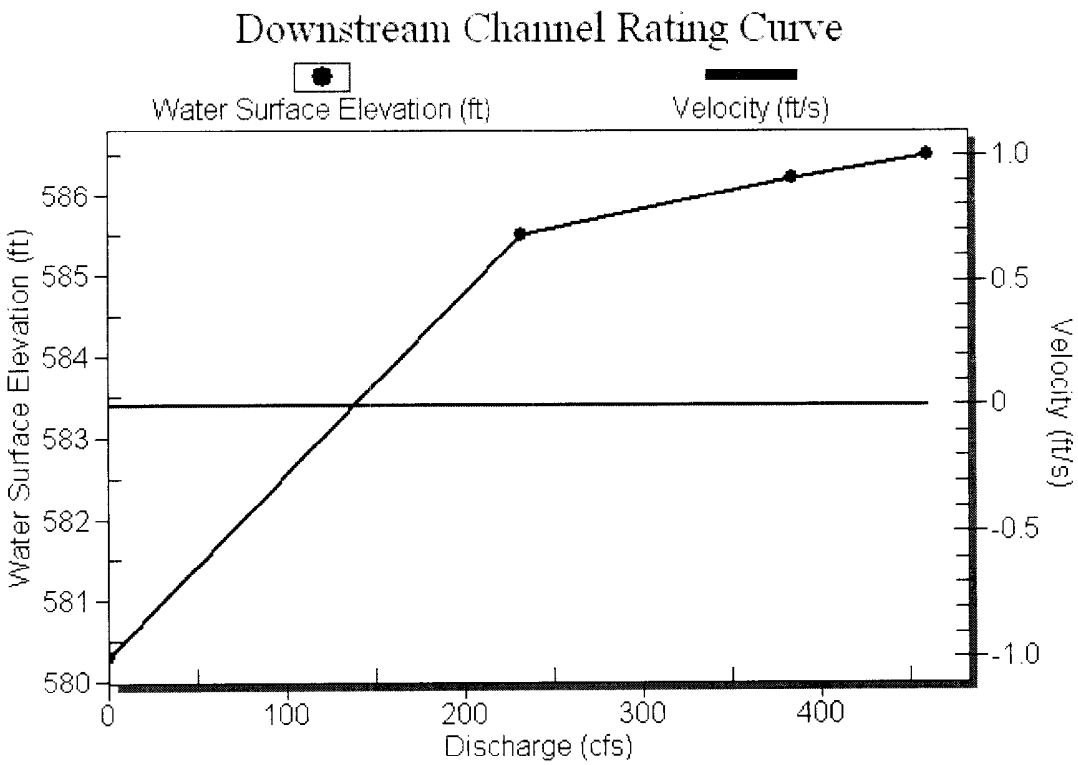
Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
0.00	580.30	580.30	0.00
231.90	585.50	585.50	0.00
384.00	586.20	586.20	0.00
459.10	586.50	586.50	0.00

Tailwater Channel Data - Pine Brook-Existing

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: 580.30 ft

Tailwater Rating Curve Plot for Crossing: Pine Brook-Existing



Roadway Data for Crossing: Pine Brook-Existing

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Culvert Data Summary - Culvert 1

Barrel Shape: Pipe Arch

Barrel Span: 150.20 in

Barrel Rise: 95.20 in

Barrel Material: Steel Structural Plate

Embedment: 0.00 in

Barrel Manning's n: 0.0330

Culvert Type: Straight

Inlet Configuration: Mitered

Inlet Depression: NONE

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-SPR 8 inch thick

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	588.96	5.33	3.44	1-S2n	1.97	3.32	2.55	5.58	13.29	0.00
329.68	329.68	589.11	5.48	3.60	1-S2n	2.01	3.40	2.63	5.65	13.44	0.00
344.06	344.06	589.26	5.63	3.76	1-S2n	2.06	3.49	2.70	5.72	13.61	0.00
358.44	358.44	589.42	5.79	3.92	1-S2n	2.10	3.57	2.77	5.78	13.76	0.00
372.82	372.82	589.57	5.94	4.08	1-S2n	2.15	3.64	2.84	5.85	13.91	0.00
384.00	384.00	589.69	6.06	4.22	1-S2n	2.18	3.71	2.89	5.90	14.02	0.00
401.58	401.58	589.89	6.26	4.43	1-S2n	2.24	3.81	2.98	5.97	14.20	0.00
415.96	415.96	590.06	6.43	4.60	1-S2n	2.29	3.88	3.05	6.03	14.33	0.00
430.34	430.34	590.23	6.60	4.77	1-S2n	2.33	3.96	3.11	6.09	14.47	0.00
444.72	444.72	590.41	6.78	4.95	1-S2n	2.38	4.04	3.18	6.14	14.60	0.00
459.10	459.10	590.59	6.96	5.13	1-S2n	2.42	4.11	3.25	6.20	14.73	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-SPR 8 inch thick

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.28	6.28	584.23	0.60	0.0*	1-S2n	0.13	0.43	0.30	0.14	2.32	0.00
28.84	28.84	585.01	1.38	0.25	1-S2n	0.60	0.92	0.66	0.65	7.67	0.00
42.00	42.00	585.32	1.69	0.45	1-S2n	0.71	1.11	0.80	0.94	7.99	0.00
73.97	73.97	585.96	2.33	0.86	1-S2n	0.90	1.49	1.08	1.66	9.21	0.00
96.53	96.53	586.34	2.71	1.12	1-S2n	1.04	1.71	1.25	2.16	9.92	0.00
119.09	119.09	586.69	3.06	1.36	1-S2n	1.17	1.92	1.41	2.67	10.43	0.00
141.65	141.65	587.02	3.39	1.60	1-S2n	1.30	2.11	1.57	3.18	10.86	0.00
164.21	164.21	587.33	3.70	1.83	1-S2n	1.39	2.29	1.71	3.68	11.25	0.00
186.78	186.78	587.60	3.97	2.06	1-S2n	1.48	2.45	1.85	4.19	11.63	0.00
209.34	209.34	587.86	4.23	2.31	1-S2n	1.56	2.63	1.98	4.69	11.98	0.00
231.90	231.90	588.10	4.47	3.30	1-S2n	1.65	2.78	2.11	5.20	12.28	0.00

HY-8 Culvert Analysis Report

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-slipline)

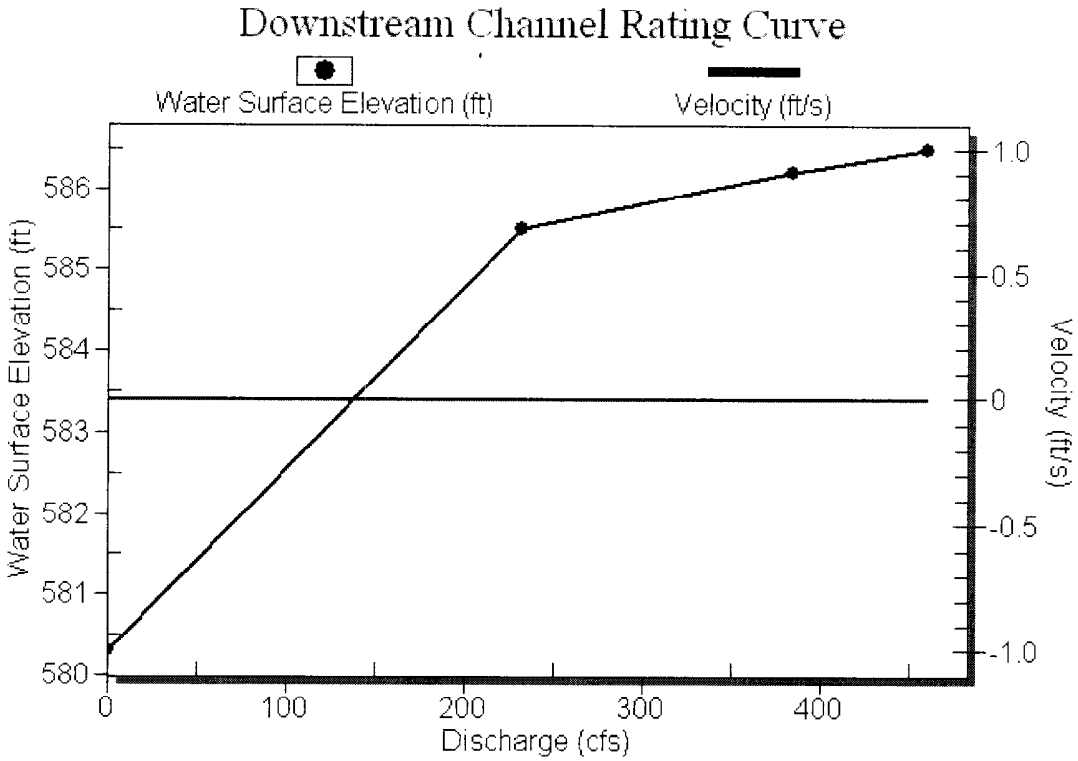
Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
0.00	580.30	0.00	0.00
231.90	585.50	5.20	0.00
384.00	586.20	5.90	0.00
459.10	586.50	6.20	0.00

Tailwater Channel Data - Pine Brook-slipline

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: 580.30 ft

Tailwater Rating Curve Plot for Crossing: Pine Brook-slipline



Roadway Data for Crossing: Pine Brook-slipline

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Culvert Data Summary - Culvert 1

Barrel Shape: Pipe Arch

Barrel Span: 129.00 in

Barrel Rise: 82.00 in

Barrel Material: Aluminum Structural Plate

Embedment: 0.00 in

Barrel Manning's n: 0.0340

Culvert Type: Straight

Inlet Configuration: Mitered

Inlet Depression: NONE

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-slipline

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.28	6.28	584.16	0.64	0.70	2-M2c	0.53	0.46	0.46	0.14	3.18	0.00
28.84	28.84	584.99	1.42	1.53	2-M2c	1.15	0.98	0.98	0.65	4.75	0.00
42.10	42.10	585.34	1.75	1.88	2-M2c	1.39	1.19	1.19	0.94	5.31	0.00
73.97	73.97	586.01	2.38	2.55	2-M2c	1.87	1.60	1.60	1.66	6.24	0.00
96.53	96.53	586.42	2.76	2.96	2-M2c	2.14	1.84	1.84	2.16	6.76	0.00
119.09	119.09	586.79	3.10	3.33	2-M2c	2.41	2.06	2.06	2.67	7.19	0.00
141.65	141.65	587.13	3.42	3.67	2-M2c	2.65	2.27	2.27	3.18	7.59	0.00
164.21	164.21	587.46	3.73	4.00	2-M2c	2.88	2.45	2.45	3.68	7.95	0.00
186.78	186.78	587.77	4.01	4.31	2-M2c	3.11	2.63	2.63	4.19	8.27	0.00
209.34	209.34	588.07	4.29	4.61	2-M2c	3.32	2.81	2.81	4.69	8.56	0.00
231.90	231.90	588.36	4.55	4.91	3-M1t	3.54	2.98	3.71	5.20	6.81	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-slipline

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	589.37	5.51	5.91	2-M2c	4.33	3.52	3.52	5.58	9.86	0.00
329.68	329.68	589.54	5.68	6.08	2-M2c	4.48	3.60	3.60	5.65	10.02	0.00
344.06	344.06	589.71	5.86	6.25	2-M2c	4.64	3.69	3.69	5.72	10.18	0.00
358.44	358.44	589.87	6.03	6.41	2-M2c	4.79	3.77	3.77	5.78	10.32	0.00
372.82	372.82	590.04	6.21	6.58	2-M2c	4.95	3.86	3.86	5.85	10.48	0.00
384.00	384.00	590.17	6.36	6.71	2-M2c	5.10	3.92	3.92	5.90	10.60	0.00
401.58	401.58	590.37	6.59	6.91	7-M2c	5.35	4.02	4.02	5.97	10.78	0.00
415.96	415.96	590.54	6.79	7.08	7-M2c	5.56	4.10	4.10	6.03	10.93	0.00
430.34	430.34	590.70	6.99	7.24	7-M2c	5.93	4.17	4.17	6.09	11.08	0.00
444.72	444.72	590.87	7.20	7.41	7-M2c	6.83	4.25	4.25	6.14	11.23	0.00
459.10	459.10	591.04	7.41	7.58	7-M2c	6.83	4.32	4.32	6.20	11.37	0.00

HY-8 Culvert Analysis Report

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-BF 15' span x 8'rise)

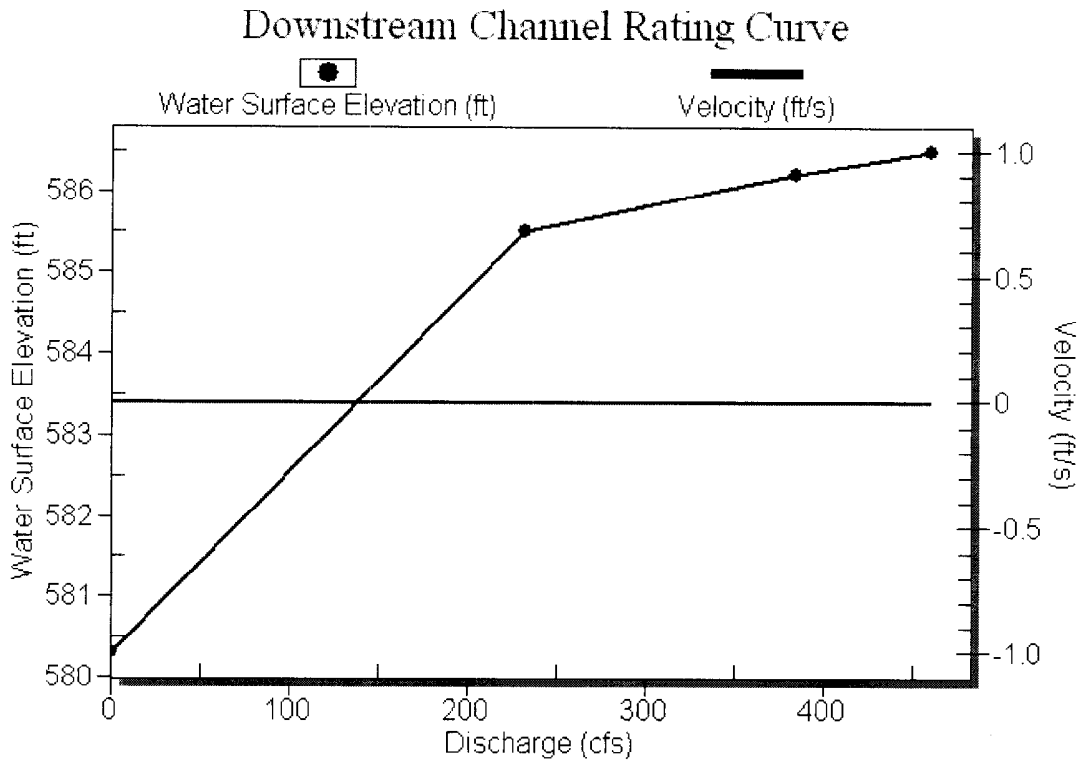
Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
0.00	580.30	580.30	0.00
231.90	585.50	585.50	0.00
384.00	586.20	586.20	0.00
459.10	586.50	586.50	0.00

Tailwater Channel Data - Pine Brook-BF 15' span x 8'rise

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: 580.30 ft

Tailwater Rating Curve Plot for Crossing: Pine Brook-BF 15' span x 8'rise



Roadway Data for Crossing: Pine Brook-BF 15' span x 8'rise

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 581.75 ft

Outlet Station: 70.00 ft

Outlet Elevation: 579.75 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 15.00 ft

Barrel Rise: 8.00 ft

Barrel Material: Concrete

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-BF 15' span x 8'rise

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.28	6.28	584.01	0.26	0.0*	1-S2n	0.09	0.17	0.09	0.14	2.59	0.00
28.84	28.84	584.90	1.15	0.0*	1-S2n	0.40	0.48	0.40	0.65	3.78	0.00
42.10	42.10	585.45	1.70	0.0*	1-S2n	0.57	0.62	0.57	0.94	5.15	0.00
73.97	73.97	586.21	2.46	0.0*	1-S2n	0.77	0.90	0.77	1.66	6.37	0.00
96.53	96.53	586.68	2.93	0.0*	1-S2n	0.92	1.08	0.92	2.16	6.98	0.00
119.09	119.09	586.98	3.23	0.0*	1-S2n	1.07	1.26	1.07	2.67	7.42	0.00
141.65	141.65	587.18	3.43	0.0*	1-S2n	1.18	1.41	1.18	3.18	7.99	0.00
164.21	164.21	587.38	3.63	0.36	1-S2n	1.29	1.56	1.29	3.68	8.50	0.00
186.78	186.78	587.59	3.84	0.90	1-S2n	1.39	1.69	1.41	4.19	8.81	0.00
209.34	209.34	586.88	3.13	1.45	1-S2n	1.50	1.83	1.52	4.69	9.20	0.00
231.90	231.90	587.07	3.32	3.51	1-S1t	1.61	1.96	4.75	5.20	3.25	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-BF 15' span x 8'rise

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	587.77	4.02	2.59	1-S2n	1.93	2.40	1.93	5.58	10.90	0.00
329.68	329.68	587.89	4.14	2.70	1-S2n	1.98	2.47	1.98	5.65	11.09	0.00
344.06	344.06	588.01	4.26	2.81	1-S2n	2.04	2.54	2.06	5.72	11.16	0.00
358.44	358.44	588.13	4.38	2.92	1-S2n	2.09	2.62	2.09	5.78	11.43	0.00
372.82	372.82	588.26	4.51	3.04	1-S2n	2.15	2.69	2.17	5.85	11.44	0.00
384.00	384.00	588.35	4.60	3.13	1-S2n	2.19	2.74	2.20	5.90	11.65	0.00
401.58	401.58	588.50	4.75	3.26	1-S2n	2.24	2.82	2.24	5.97	11.94	0.00
415.96	415.96	588.61	4.86	3.37	1-S2n	2.29	2.89	2.32	6.03	11.96	0.00
430.34	430.34	588.73	4.98	3.48	1-S2n	2.33	2.95	2.35	6.09	12.19	0.00
444.72	444.72	588.84	5.09	3.60	1-S2n	2.38	3.01	2.38	6.14	12.46	0.00
459.10	459.10	588.96	5.21	3.72	1-S2n	2.42	3.07	2.46	6.20	12.42	0.00

HY-8 Culvert Analysis Report

Table 1 - Downstream Channel Rating Curve (Crossing: Pine Brook-1.2 x BF 18' span)

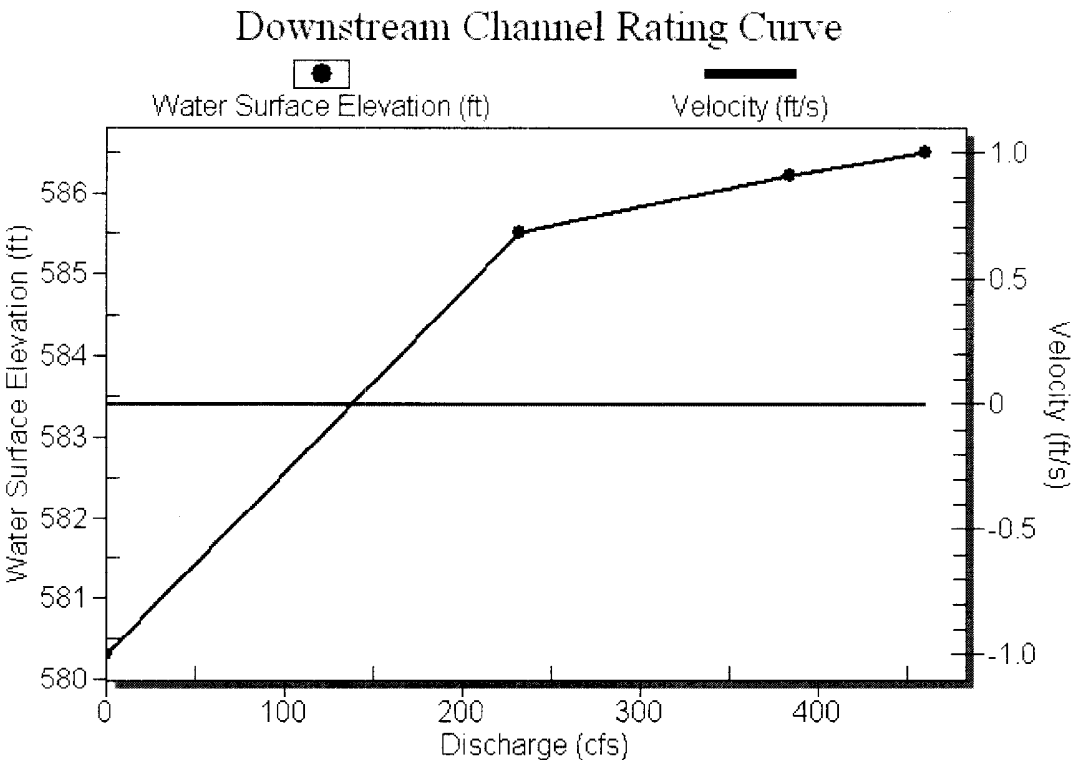
Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
0.00	580.30	580.30	0.00
231.90	585.50	585.50	0.00
384.00	586.20	586.20	0.00
459.10	586.50	586.50	0.00

Tailwater Channel Data - Pine Brook-1.2 x BF 18' span

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: 580.30 ft

Tailwater Rating Curve Plot for Crossing: Pine Brook-1.2 x BF 18' span



Roadway Data for Crossing: Pine Brook-1.2 x BF 18' span

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 ft

Crest Elevation: 593.69 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 18.00 ft

Barrel Rise: 8.00 ft

Barrel Material: Concrete

Embedment: 24.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Site Data - Culvert 1

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-1.2 x BF 18' span

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.23	6.23	582.98	0.23	0.0*	1-S2n	0.10	0.15	0.10	0.14	1.86	0.00
28.80	28.80	583.66	0.91~	0.77	2-M2c	0.48	0.42	0.42	0.65	3.77	0.00
42.10	42.10	584.24	1.49~	1.00	2-M2c	0.61	0.54	0.54	0.94	4.30	0.00
73.93	73.93	584.92	2.17~	1.46	2-M2c	0.86	0.80	0.80	1.66	5.16	0.00
96.50	96.50	585.32	2.57~	1.74	2-M2c	1.03	0.96	0.96	2.16	5.60	0.00
119.07	119.07	585.70	2.95~	0.26	6-FFt	1.17	1.10	1.22	2.67	5.42	0.00
141.63	141.63	585.91	3.16~	2.27	3-M1t	1.30	1.25	1.73	3.18	4.56	0.00
164.20	164.20	586.08	3.33~	2.50	3-M1t	1.42	1.38	2.23	3.68	4.09	0.00
186.77	186.77	586.25	3.50~	2.68	3-M1t	1.55	1.50	2.74	4.19	3.79	0.00
209.33	209.33	586.42	3.67~	2.95	3-M1t	1.66	1.62	3.24	4.69	3.58	0.00
231.90	231.90	586.59	3.84	4.05	3-M1t	1.76	1.73	4.75	5.20	2.71	0.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Pine Brook-1.2 x BF 18' span

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
315.30	315.30	586.69	3.52	3.94	3-M1t	2.13	2.13	4.13	5.58	4.24	0.00
329.68	329.68	586.80	3.62	4.05	3-M1t	2.19	2.19	4.20	5.65	4.36	0.00
344.06	344.06	586.90	3.72	4.15	1-S1t	2.25	2.25	4.27	5.72	4.48	0.00
358.44	358.44	587.01	3.82	4.26	1-S1t	2.30	2.32	4.33	5.78	4.60	0.00
372.82	372.82	587.11	3.92	4.36	1-S1t	2.35	2.38	4.40	5.85	4.71	0.00
384.00	384.00	587.19	4.00	4.44	1-S1t	2.40	2.42	4.45	5.90	4.79	0.00
401.58	401.58	587.31	4.13	4.56	1-S1t	2.46	2.50	4.52	5.97	4.94	0.00
415.96	415.96	587.41	4.23	4.66	1-S1t	2.51	2.56	4.58	6.03	5.05	0.00
430.34	430.34	587.51	4.33	4.76	1-S1t	2.57	2.62	4.64	6.09	5.16	0.00
444.72	444.72	587.60	4.43	4.85	1-S1t	2.62	2.67	4.69	6.14	5.27	0.00
459.10	459.10	587.70	4.53	4.95	1-S1t	2.67	2.73	4.75	6.20	5.37	0.00

PRELIM. BY _____ DATE _____ PROJ. NO. _____ FILE NO. _____ OF _____
FINAL CHK. BY _____ DATE _____ LOCATION _____ SH. NO. _____ OF _____
ITEM NO. _____ SUBJECT Wilton, Pine Brook Bridge

Existing culvert

Cover over culvert including pavement

Downstream end (@GR)
592.26' - 590.37' = 1.89'

Upstream end (@GR)
593.34' - 590.99' = 2.35'

Cover over culvert excluding pavement
Depth depth (4" assumed)

Downstream end (@GR)
1.89' - 0.33' = 1.56'

Upstream end (@GR)
2.35' - 0.33' = 2.02'

Energy Dissipation Factor (EDF)

Energy Dissipation Factor (EDF) (ft-lb/cfs)	Head (ft)	Flow cfs	Volume of pool (ft3)	Length of pool (ft)	Width of pool (ft)	Depth of pool (ft)
0.28	0.5	0.5	55.125	5.25	5.25	2
0.57	0.5	1	55.125	5.25	5.25	2
0.85	0.5	1.5	55.125	5.25	5.25	2
1.13	0.5	2	55.125	5.25	5.25	2
1.41	0.5	2.5	55.125	5.25	5.25	2
1.70	0.5	3	55.125	5.25	5.25	2
1.98	0.5	3.5	55.125	5.25	5.25	2
2.26	0.5	4	55.125	5.25	5.25	2
2.55	0.5	4.5	55.125	5.25	5.25	2
2.83	0.5	5	55.125	5.25	5.25	2
3.11	0.5	5.5	55.125	5.25	5.25	2
3.40	0.5	6	55.125	5.25	5.25	2
3.68	0.5	6.5	55.125	5.25	5.25	2
3.96	0.5	7	55.125	5.25	5.25	2
4.24	0.5	7.5	55.125	5.25	5.25	2
4.53	0.5	8	55.125	5.25	5.25	2
4.81	0.5	8.5	55.125	5.25	5.25	2
5.09	0.5	9	55.125	5.25	5.25	2
5.38	0.5	9.5	55.125	5.25	5.25	2
5.66	0.5	10	55.125	5.25	5.25	2
5.94	0.5	10.5	55.125	5.25	5.25	2
6.23	0.5	11	55.125	5.25	5.25	2
6.51	0.5	11.5	55.125	5.25	5.25	2
6.79	0.5	12	55.125	5.25	5.25	2
7.07	0.5	12.5	55.125	5.25	5.25	2
7.36	0.5	13	55.125	5.25	5.25	2
7.64	0.5	13.5	55.125	5.25	5.25	2
7.92	0.5	14	55.125	5.25	5.25	2

← High Fish Passage Flow 6.28 cfs

Acceptable EDF is 5 or less per MaineDOT Fish Passage Policy and Design guide

Note: minimum prefferred volume is 6 'x 6 'x 2' deep or 72 ft3

Town: Wilton
Bridge name & number: Pine Brook
PIN: 19295.00
Route/Street: Route 156
Stream/River Name: Pine Brook
Description: Invert Lining

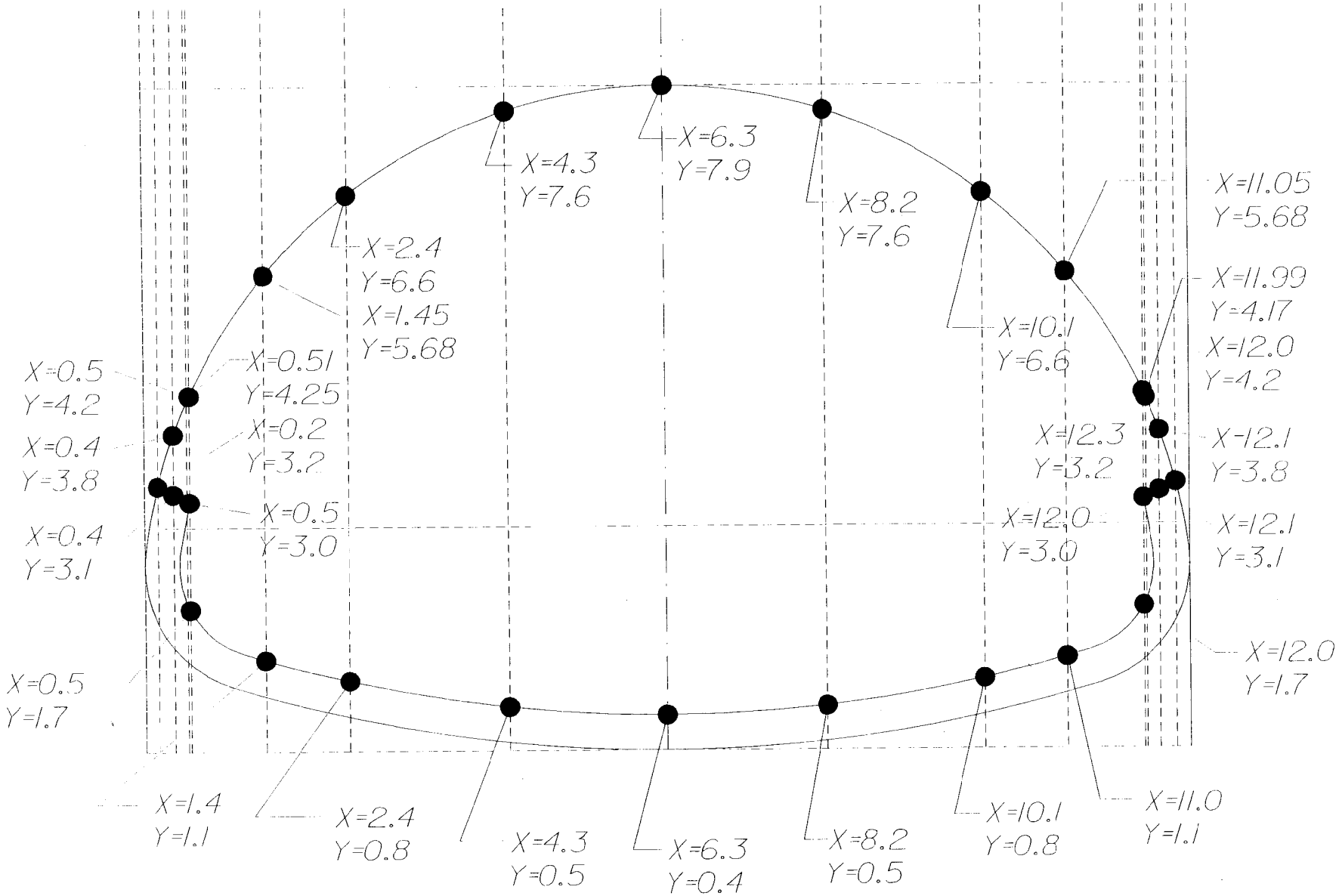
Pool and Weir system elevation - Design Aid

Water surface elevation of downstream pool at low flow:	**581.5**	ft			
Invert elevation at outlet (dowstream end of pipe):	**582.29**	ft			
Invert elevation at inlet (upsteam end of pipe):	**582.96**	ft			
Drop at downstream end of culvert (invert to pool elevation)	0.79	ft	or	9.5	inch
Length of culvert:	**70**	ft			
Slope of pipe	0.96%				
Minimum depth of water:	**0.67**	ft	or	8.0	inch
Height of weir (i.e. notch)	**0.67**	ft	or	8.0	inch
Depth of water backing into weir	**0.17**	ft	or	2.0	inch
Elevation change between notches/weirs:	0.25	ft	or	3.0	inch
Minimum water surface elevation at outlet (downstream end)	582.96	ft			
Minimum water surface elevation at inlet (upstream end)	583.63	ft			
Total change in water surface elevation	2.13	ft			
Minimum number of weirs needed	5				
Minimum weir spacing	6	ft	or	72.0	inch
Maximum weir spacing	26.1	ft			

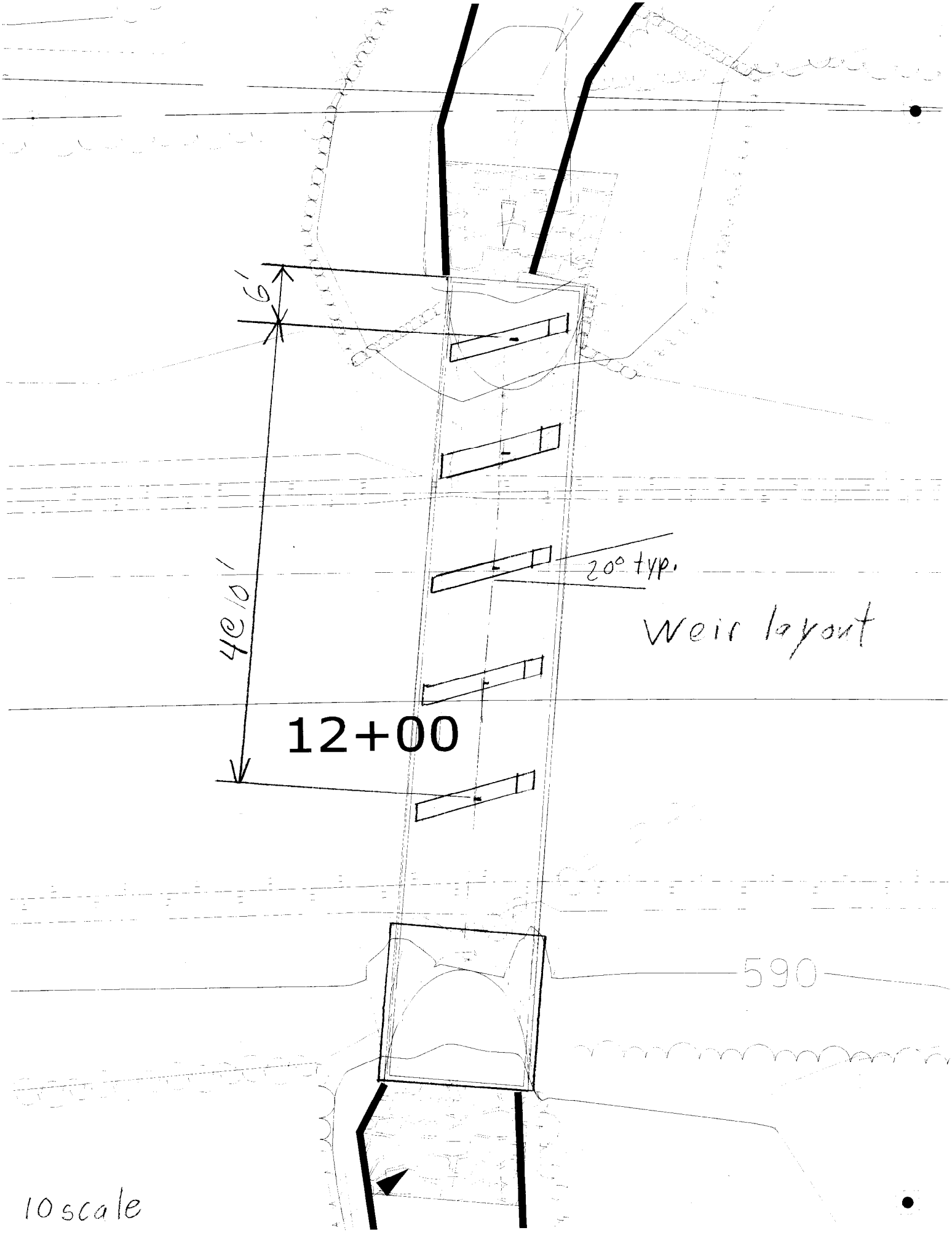
Weir #	Elevation Top of Notch (ft)	Elevation Bottom of Notch (ft)	Water Surface Elevation below weir (ft)	Water Surface Elevation above weir (ft)
1	582.00	581.33	581.50	582.00
2	582.25	581.58	581.75	582.25
3	582.50	581.83	582.00	582.50
4	582.75	582.08	582.25	582.75
5	583.00	582.33	582.50	583.00
6	583.25	582.58	582.75	583.25
7	583.50	582.83	583.00	583.50
8	583.75	583.08	583.25	583.75
9	584.00	583.33	583.50	584.00
10	584.25	583.58	583.75	584.25
11	584.50	583.83	584.00	584.50
12	584.75	584.08	584.25	584.75
13	585.00	584.33	584.50	585.00
14	585.25	584.58	584.75	585.25
15	585.50	584.83	585.00	585.50
16	585.75	585.08	585.25	585.75
17	586.00	585.33	585.50	586.00

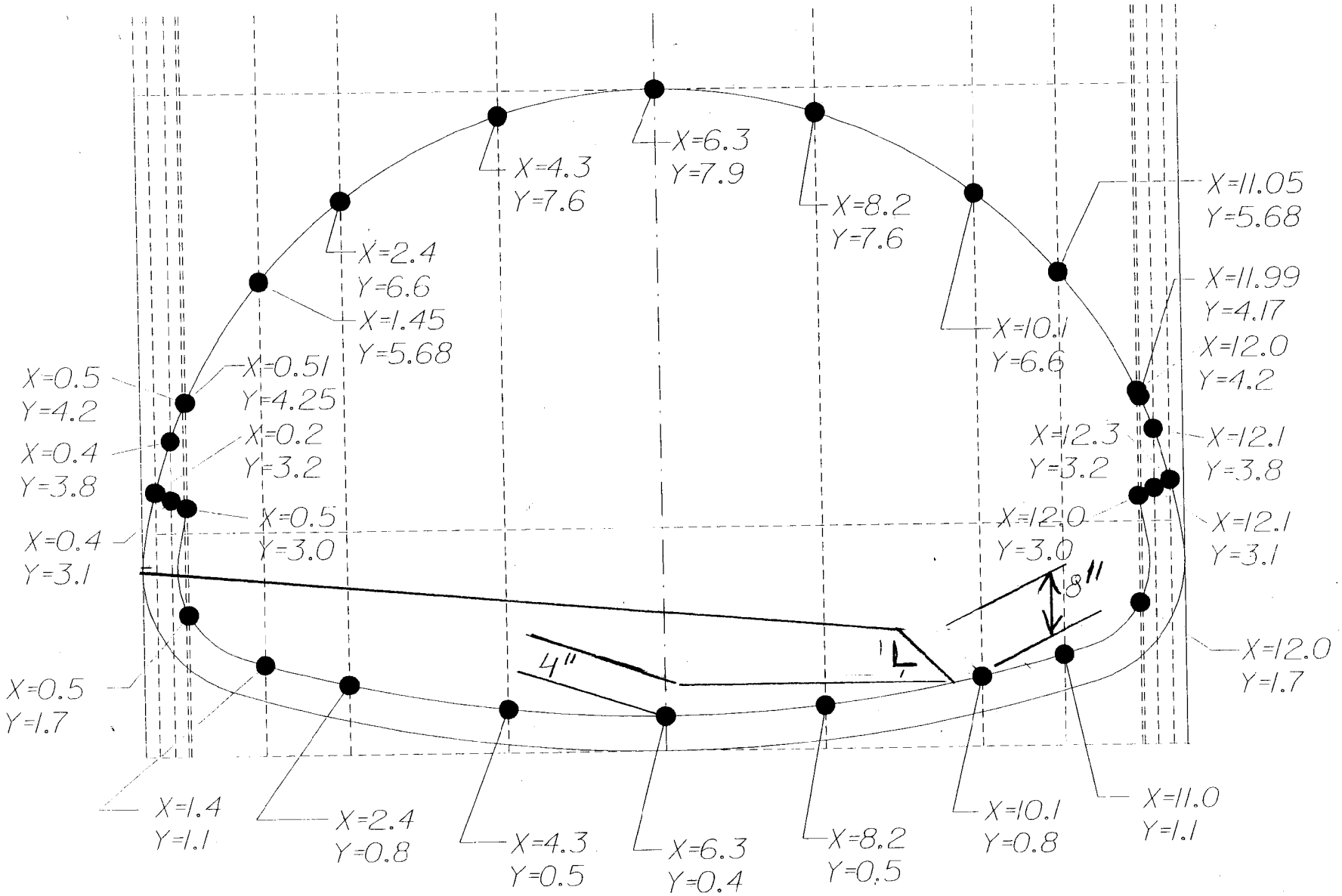
Instructions

Input values into the cells with blue colored text and bold borders

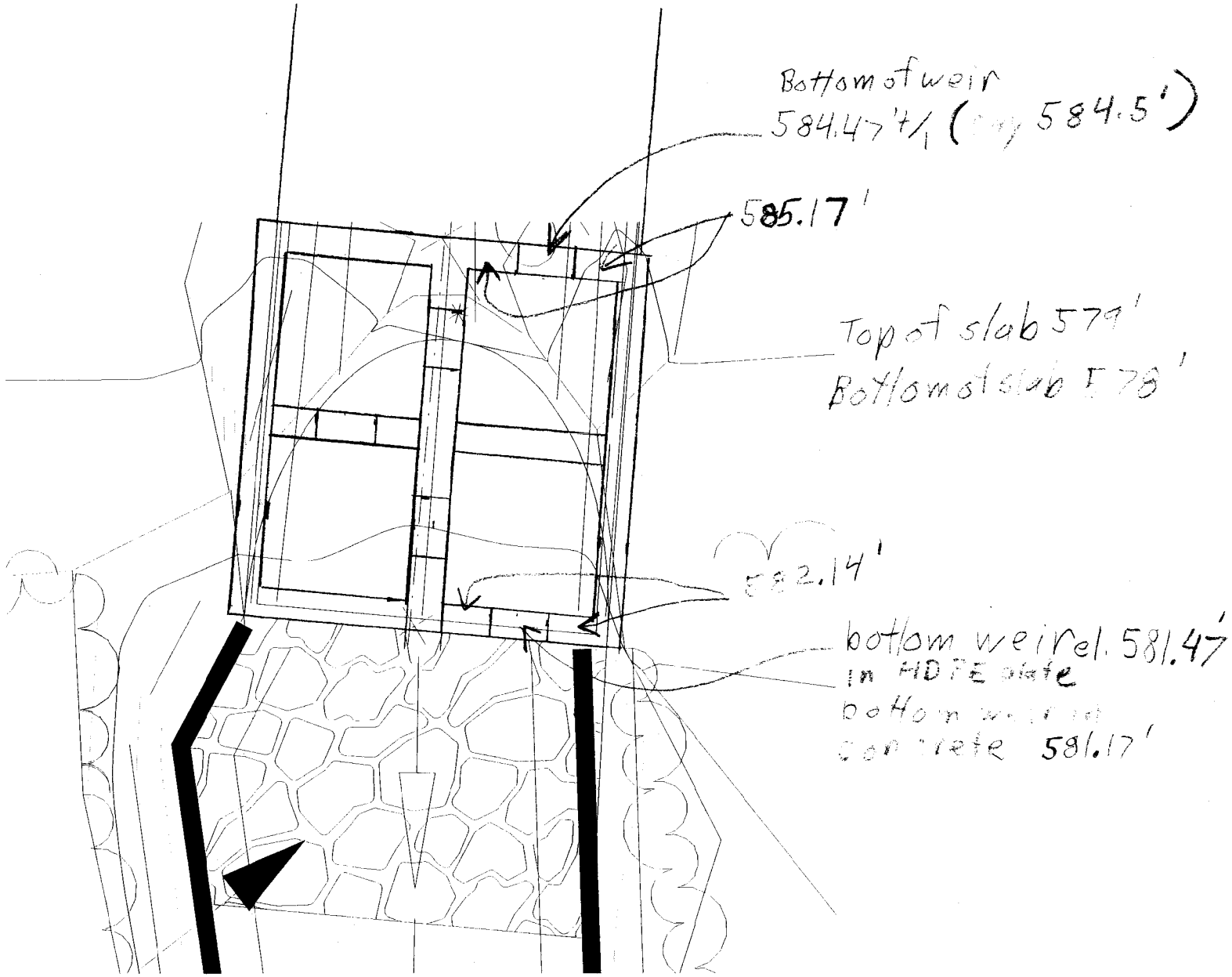


Invert Lining (5")


6'
40'10'
20° typ.
Weir layout
12+00
590
10 scale



Invert Lining (5")


Bottom of weir
584.47'+/- (584.5')
585.17'
Top of slab 579'
Bottom of slab 578'
582.14'
bottom weir el. 581.47'
in HDPE plate
bottom weir in
concrete 581.17'

5 scale

PRELIM. BY MHW DATE _____ PROJ. NO. _____ FILE NO. _____ OF _____
FINAL CHK. BY _____ DATE _____ LOCATION Wilton SH. NO. _____ OF _____
ITEM NO. _____ SUBJECT Pine Brook Bridge

HWIDe Q50

Invert lining

$$\frac{589.53' - 583.38'}{7'-11''-5''} = 0.82$$

Sliplining

$$\frac{590.17' - 583.46'}{6.92'} = 0.97$$

Box culvert 15'x8'

$$\frac{588.35' - 583.38'}{6'} = 0.82$$

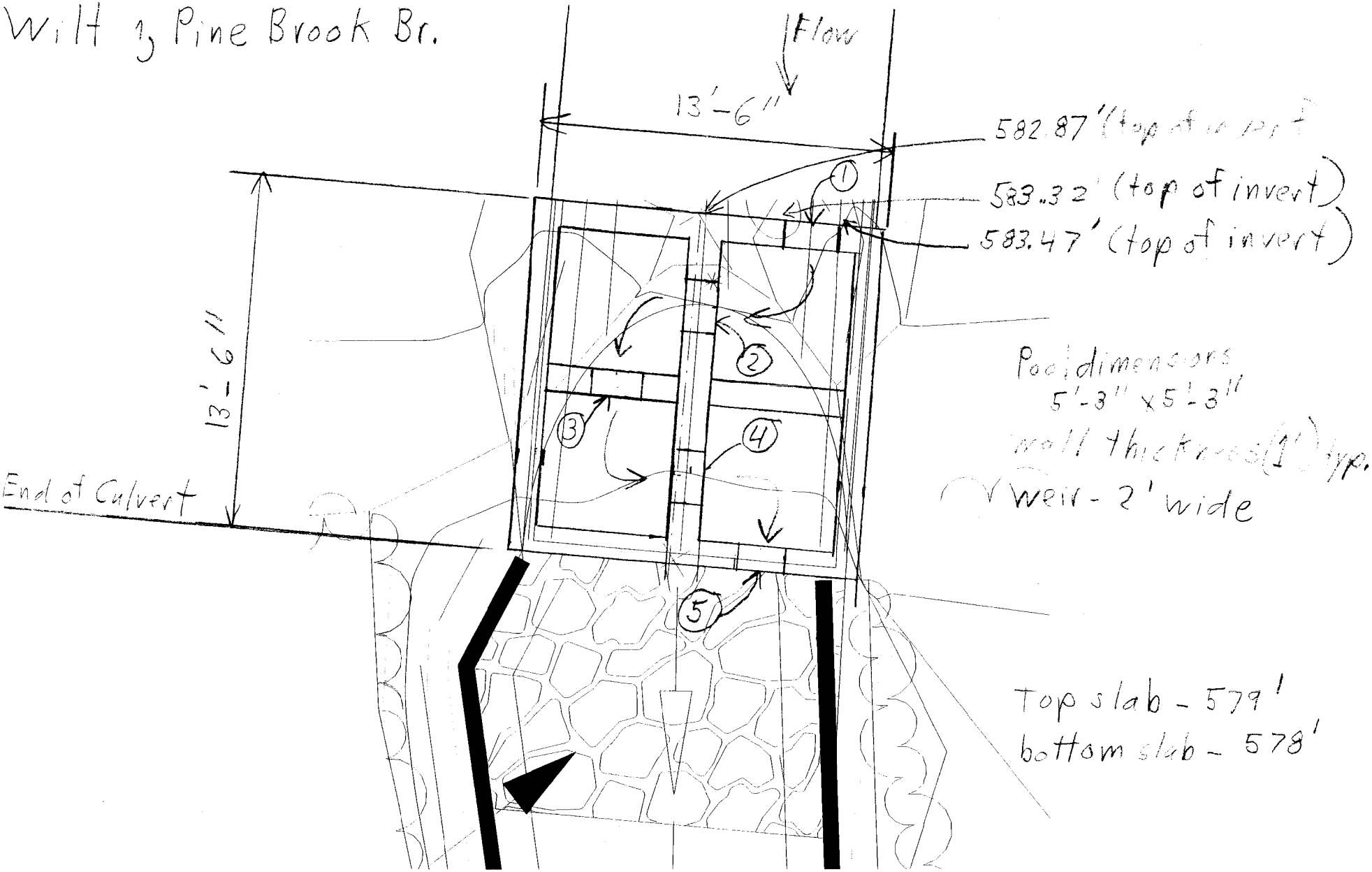
Box culvert 18'x8'

$$\frac{587.19 - 582.75}{6'} = 0.74$$

SPR

$$\frac{589.69' - 583.63'}{7.08'} = 0.86$$

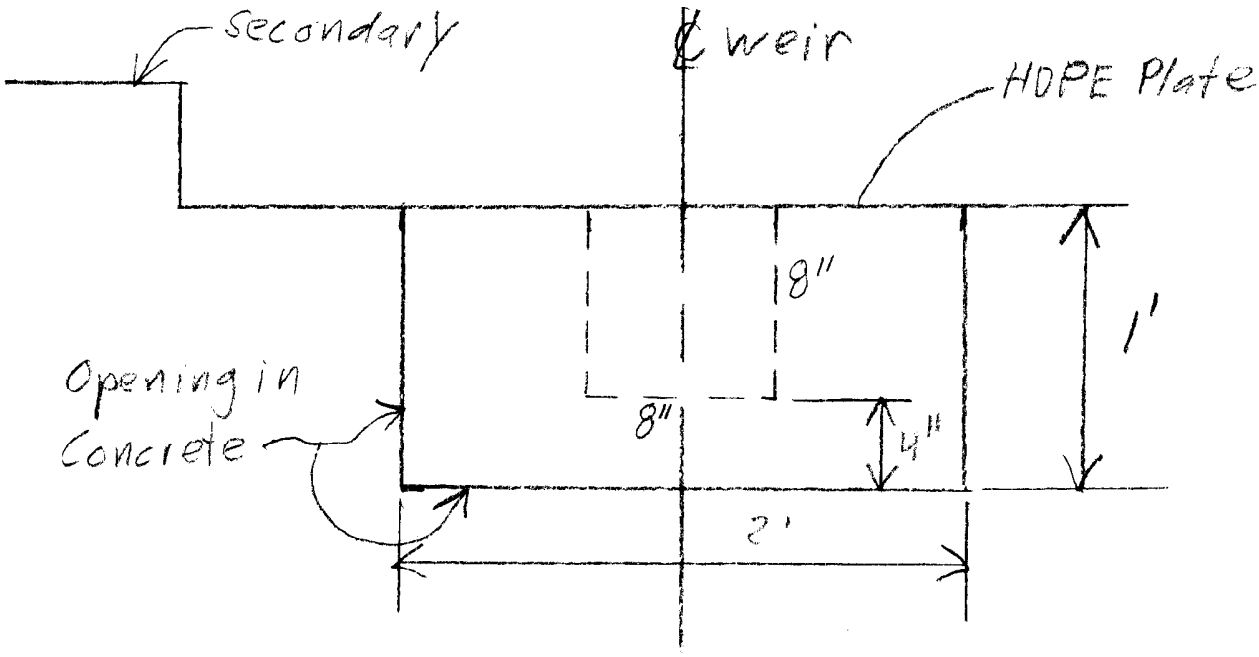
Wilt 1, Pine Brook Br.



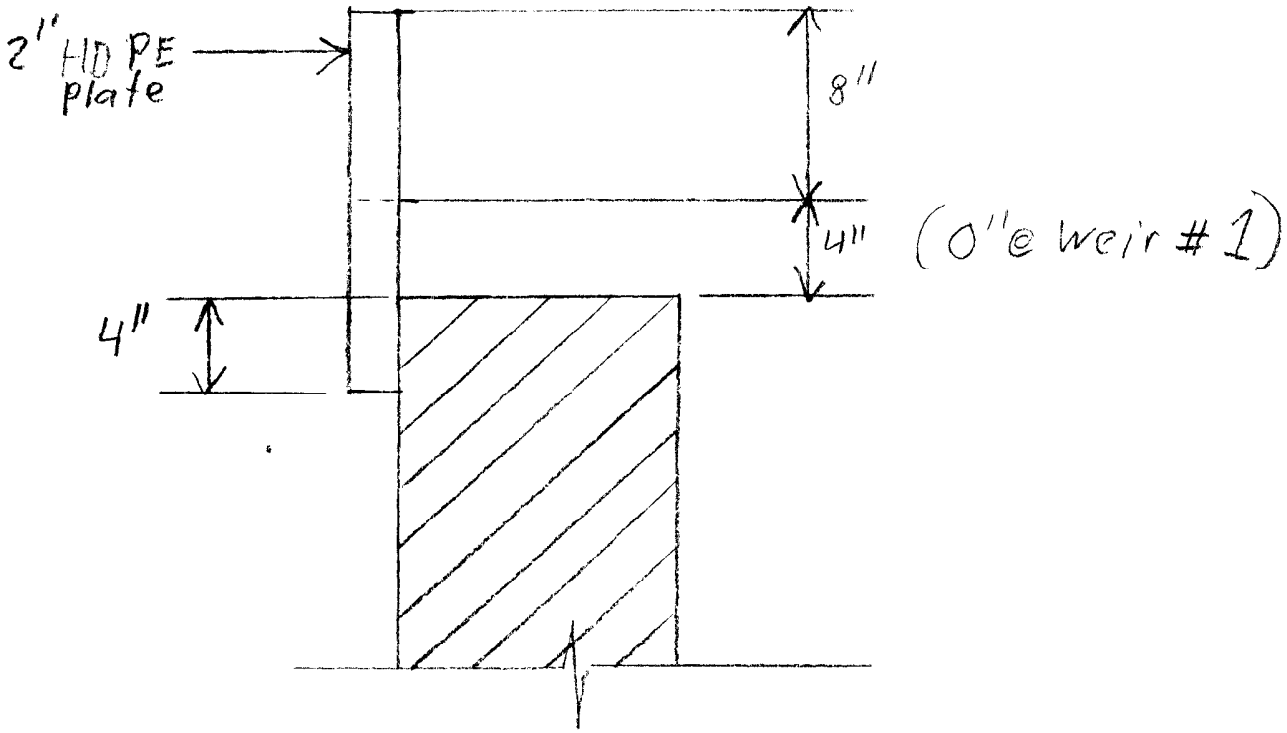
5 scale

Pool system @ outlet

PRELIM. BY MHW DATE _____ PROJ. NO. _____ FILE NO. _____ OF _____
FINAL CHK. BY _____ DATE _____ LOCATION _____ SH. NO. _____ OF _____
ITEM NO. _____ SUBJECT _____



Elevation



Section

1½ scale

STATE OF MAINE DEPARTMENT OF TRANSPORTATION

Wilton, Pine Brook Bridge #2666, WIN 019295.00 (Route 156 over Pine Brook)

Pool and weir system at outlet of culvert

			Fish passage notch/weir			
	Weir Number	top of Secondary notch Elevation (ft)	top of notch Elevation (ft)	bottom of notch in HDPE plate Elevation (ft)	Bottom of Concrete notch Elevation (ft)	bottom of pool or Top of bottom slab Elevation (ft)
Upstream	1	584.67	584.17	583.50	583.50	581.17
	2	584.17	583.67	583.00	582.67	580.67
	3	583.67	583.17	582.50	582.17	580.17
	4	583.17	582.67	582.00	581.67	579.67
Downstream	5	582.67	582.17	581.50	581.17	579.17