# Crossing the Connecticut River - Big Pipes and Endangered Prehistoric Fish

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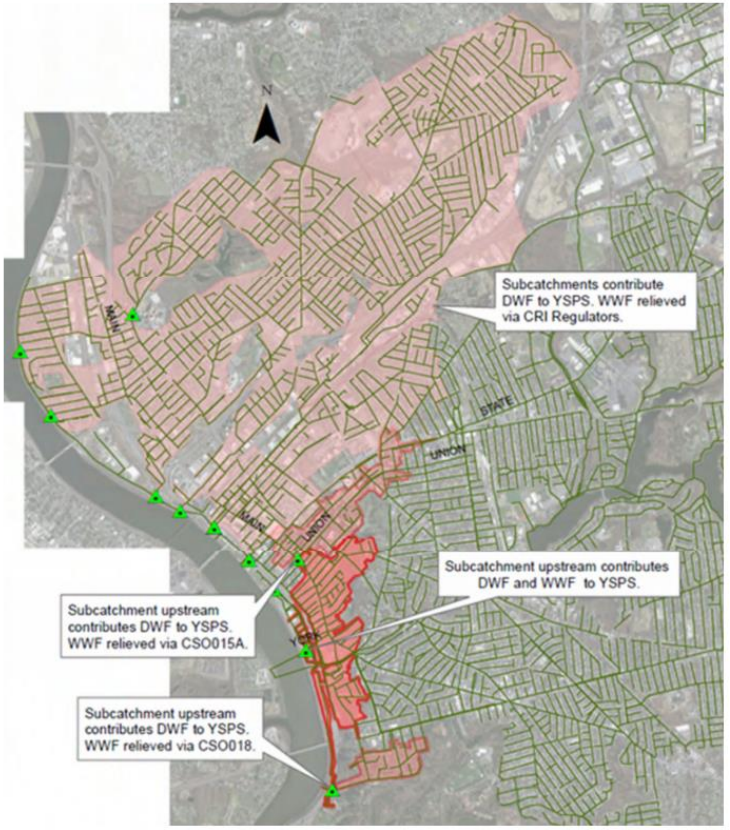
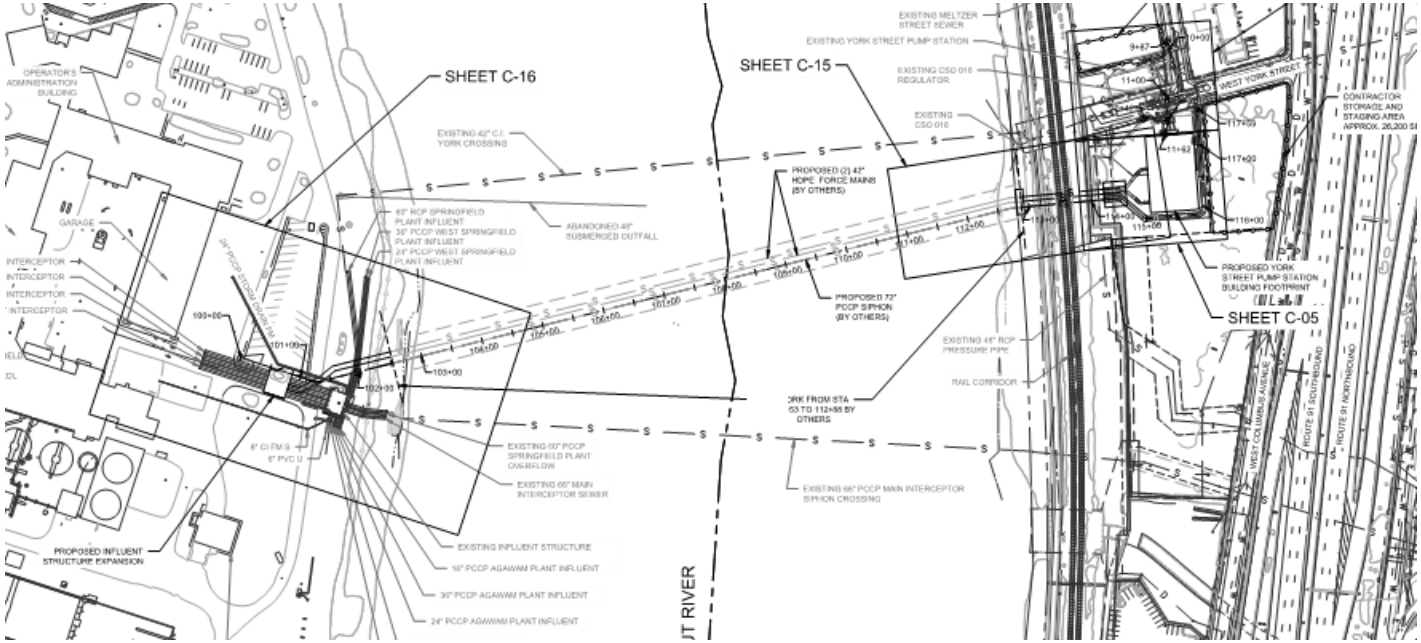
# Springfield, MA

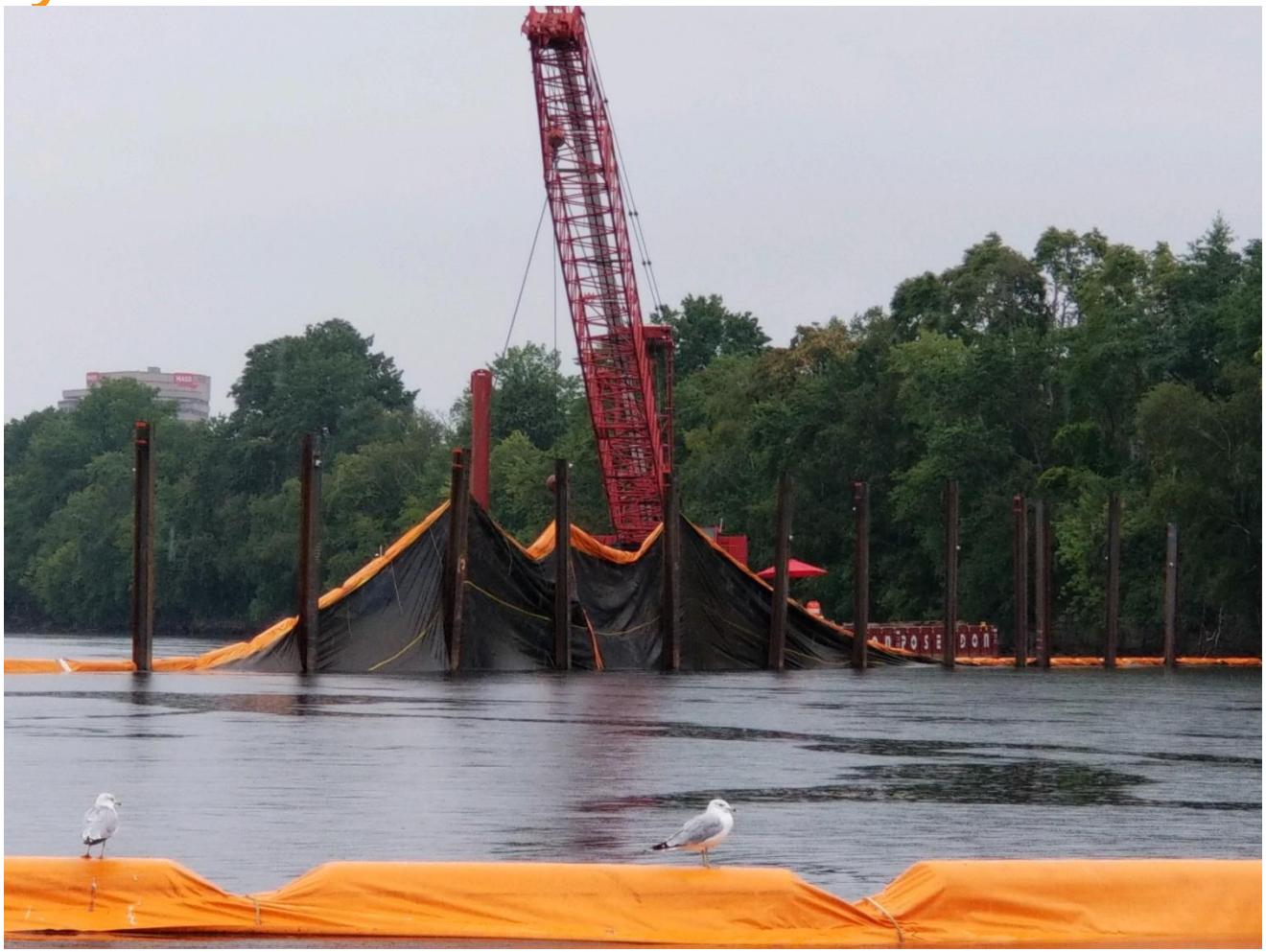

- Springfield Water and Sewer Commission (SWSC)
- Two collection systems
  - Main Intercepting Sewer
  - Connecticut River Interceptor

# The Project

- Phase 2 of SWSC's Integrated Wastewater Plan (IWP)
- Implementation of the IWP is driven by Administrative Order from MassDEP
- Project is currently being Constructed under Ch149A (Construction Manager at Risk alternative delivery method). Contractual Substantial Completion in April 2023



# Turbidity and Exclusion Curtains



# Curtains – Why?

Wildlife Exclusion

- Multiple species of Federally and State listed endangered Sturgeon – prehistoric fish!
- NHESP and NOAA consultations through permitting process required physical exclusion from work zone

Turbidity control

- Downstream endangered mussels impacted by sedimentation, turbidity control limited extents of relocation
- Water quality

Zoom+ Yellow lampmussel shell. © Allen Barlow

**Shortnose Sturgeon**

Acipenser brevirostrum

**Protected Status**

**ESA ENDANGERED**
*Throughout Its Range*

**CITES APPENDIX I**
*Throughout Its Range*

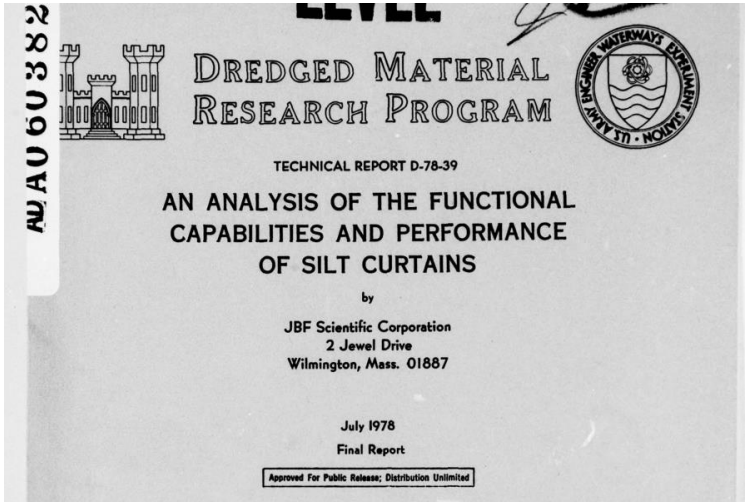
**Quick Facts**

| | |
|---|---|
| **WEIGHT** | Up to 50 pounds |
| **LENGTH** | Up to 4.5 feet |
| **LIFESPAN** | Average of 30 years but may live up to 67 |
| **THREATS** | Bycatch, Dredging, Habitat degradation, Habitat impediments (e.g., dams), Water pollution, Water withdrawals |
| **REGION** | New England/Mid-Atlantic, Southeast |

# Curtains – Design ACOE

ACOE – 1976 Analysis of loading and behavior

- -Impact of quantity of tension cables and location
- -Impact of weighting and placement
- -Impact of slack on curtain bottom lifting



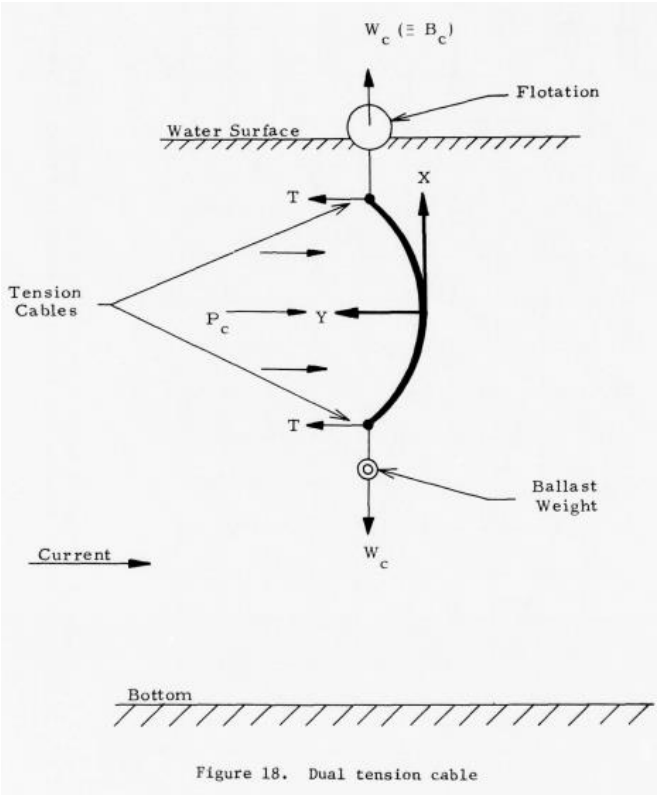



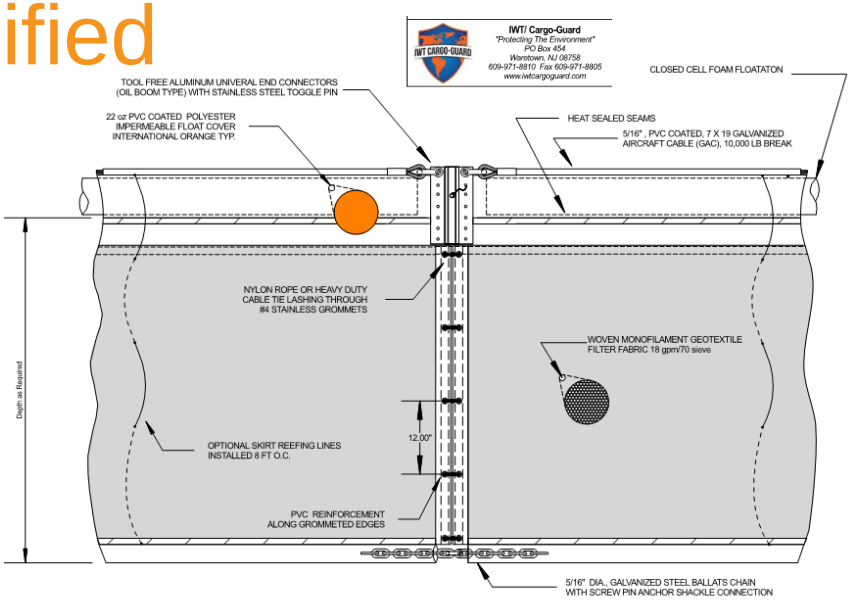

Figure 18. Dual tension cable

# Curtains – What We Specified

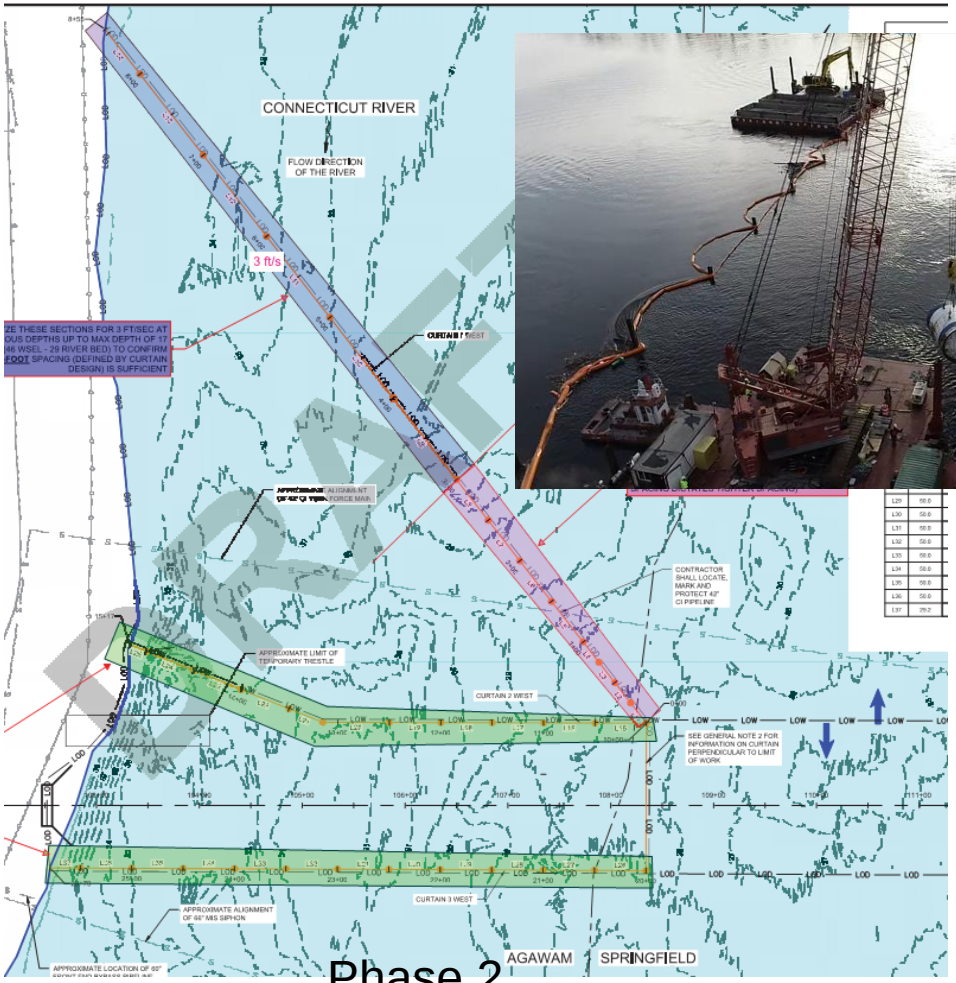
Geotextile type material – permeable enough to reduce the substantial loading, fine enough to capture sediment and not ensnare fish

Weighting – every last bit of it

Length – Full length plus slack to minimize lifting

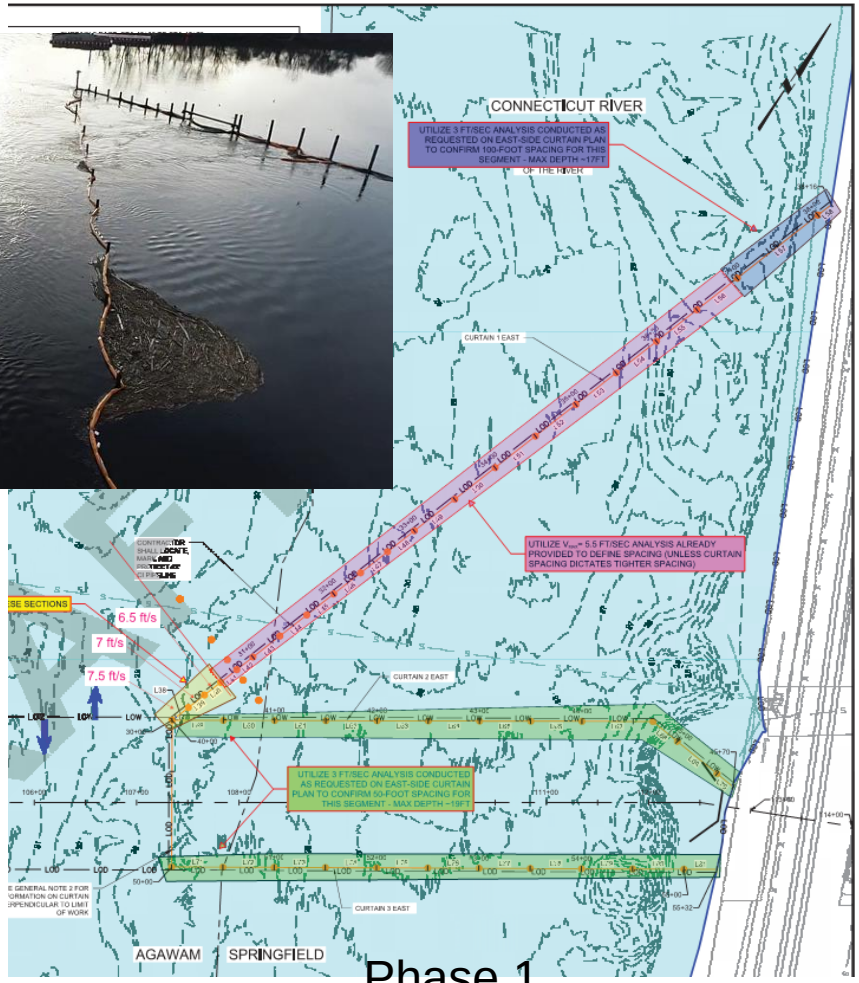



# Curtains – What We Used




Phase 2



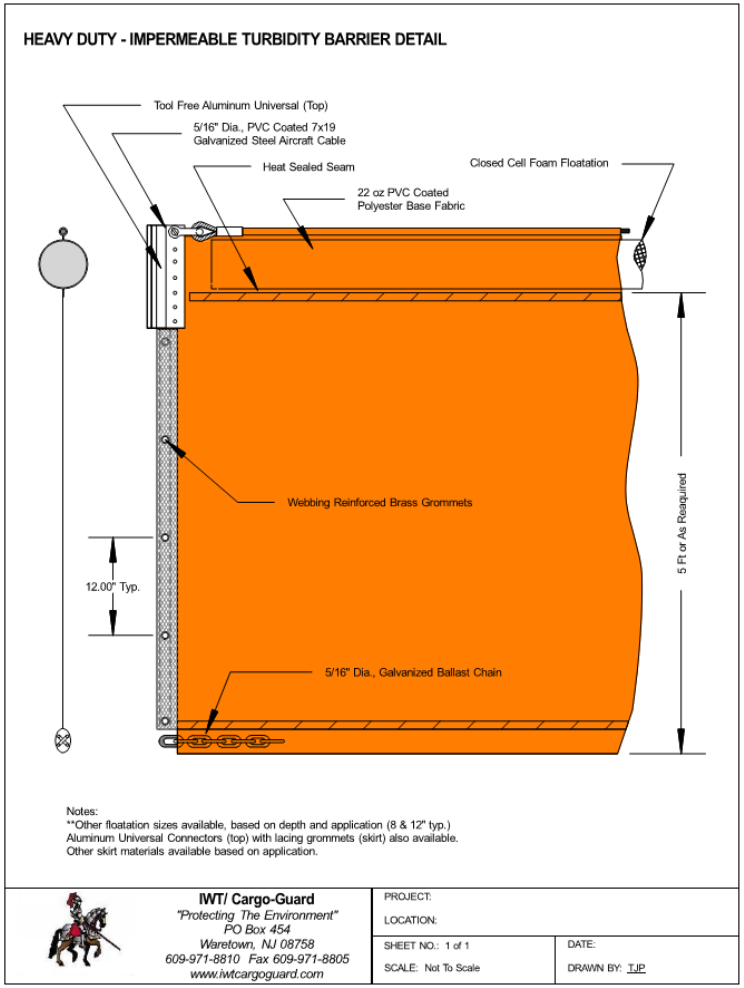



Phase 1

# Curtains – Lessons Learned

Permeable geotextile won't capture fines from glacial till

- Additional partial height impermeable curtain forces sediment lower in water column – falls out within the allowable distance downstream

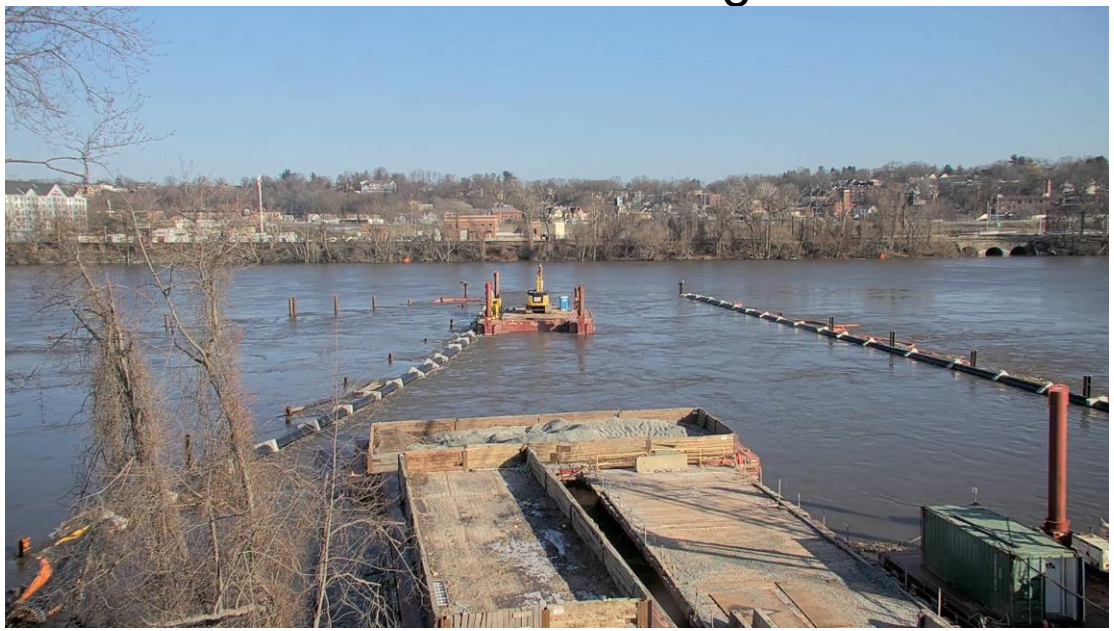


# Curtains – Lessons Learned

Slack and weighting are insufficient to keep the curtain fully on the bottom

- Eliminate slack – impinges on the workzone

- Sweeps at start of shift to ensure no Sturgeon in work zone



# Marine Pipeline Design

# 42” HDPE design –Unconstrained Buckling

Many design conditions to consider:

- -Flood conditions
- -Rail loading
- -Traditional dead load from backfill

Unconstrained Buckling controlled our design

- -No underwater control of backfill around pipeline to ensure support

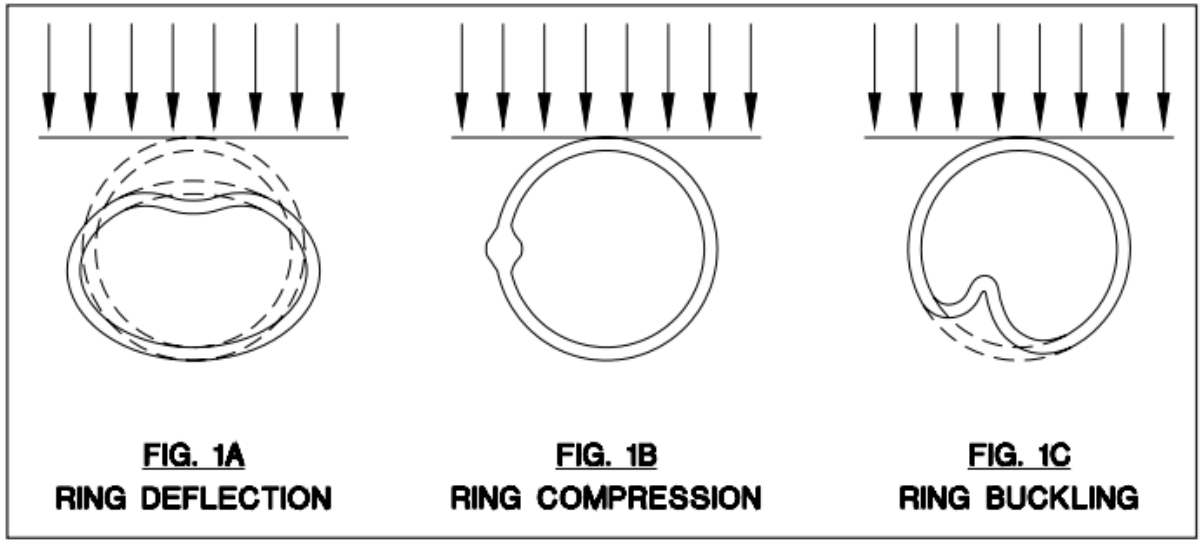


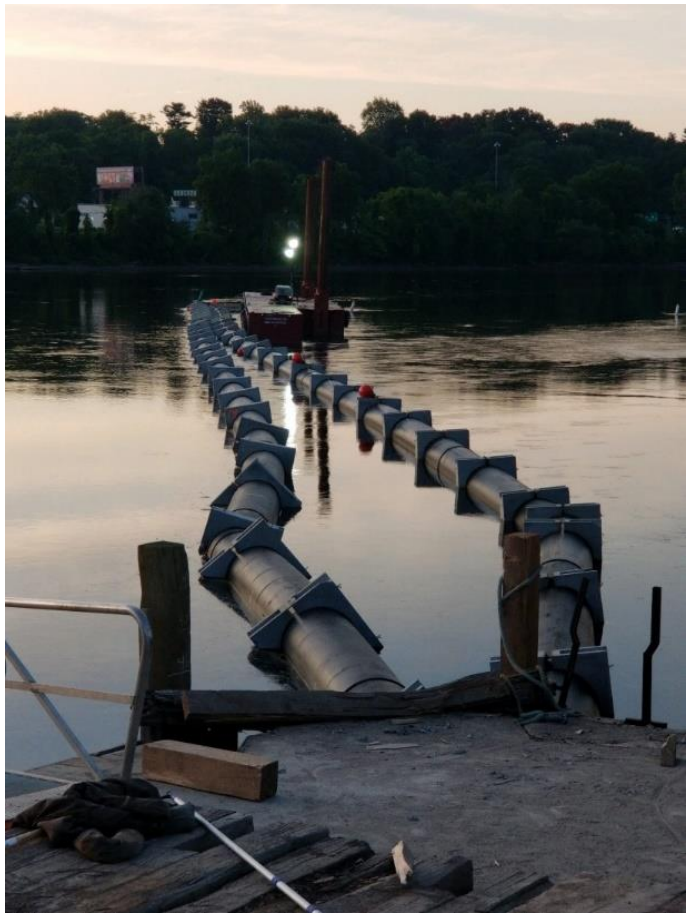

*Figure from Chapter 6 PPI PE handbook*

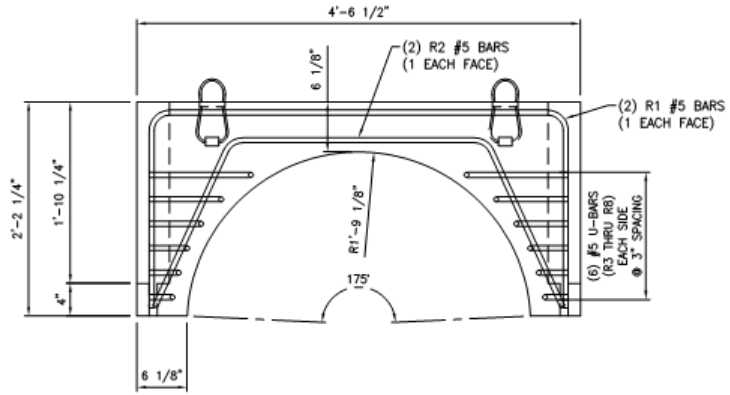
# 42” HDPE design – Buoyancy

HDPE is buoyant!

Design collars to make pipe roughly neutrally buoyant full of air
- Aid in Construction

Design backfill to ensure no floatation once installed





# 42” HDPE Float and Sink

With Pipeline & Collars designed for neutral buoyancy

-Pipe can be staged and maneuvered using tugs

-Sinking can be directly controlled by slow introduction of water\bleeding air

-Sinking is reversible by reintroducing air

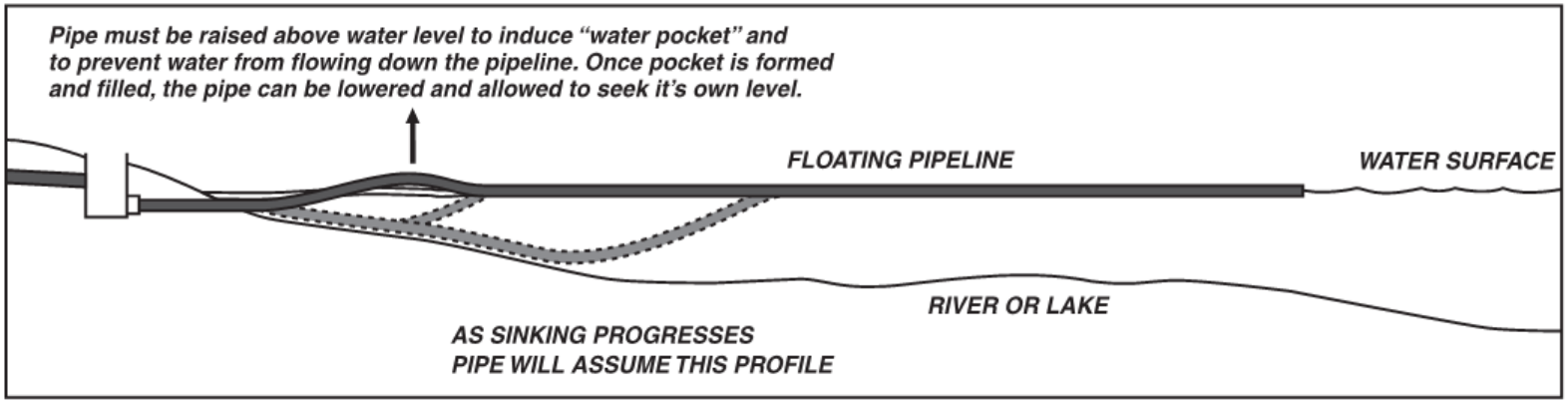



**Figure 7** An induced water pocket initiates the submersion of the pipe and, as the pocket enlarges, it allows the submerging to gradually progress forward

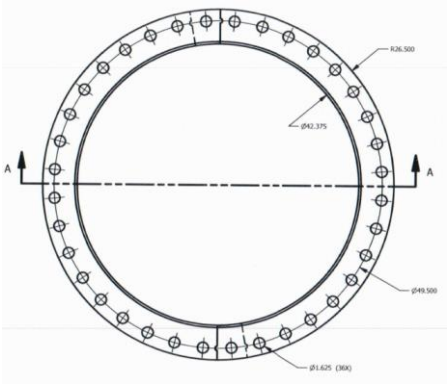
*Figure from Chapter 10 PPI PE handbook*

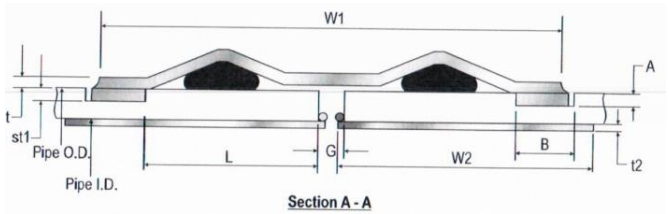
# 42” HDPE Float and Sink

# 42” HDPE Special Connections

42” installed in 2 segments – Eastern shore (tunnel connection) to mid-river and mid-river to Western shore)

- Two flanged joints, one special coupling at the tunnel connection






Victaulic Style 232 Type 2
Restrained Couplings

# 72” Bouyancy

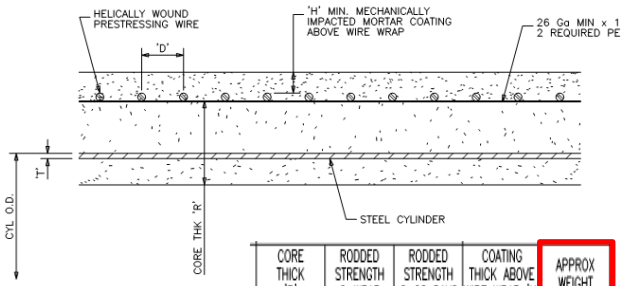
PCCP is not Buoyant!

(… unless it’s full of air!)

Planned for future dewatering for inspection

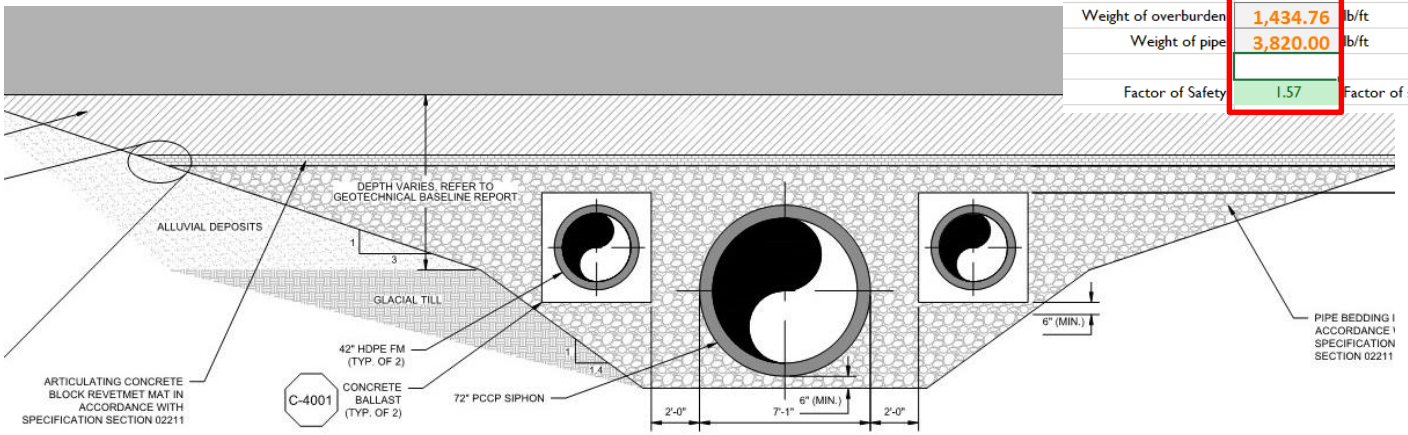
- Extra heavy wall pipe
- Backfill (revetment mat) as insurance

E–301 HEAVY WALL EMBEDDED CYLINDER PRESTRESSED CONCRETE PIPE
DOMESTIC MATERIALS REQUIRED




| CORE THICK 'R' (IN) | RODDED STRENGTH @ WRAP (PSI) | RODDED STRENGTH @ 28 DAYS (PSI) | COATING THICK ABOVE WIRE WRAP 'H' (IN) | APPROX WEIGHT (LBS/FT) |
|---|---|---|---|---|
| 12 1/2 | 3000 | 5500 | 3/4 | 3820 |

| | | | | |
|---|---|---|---|---|
| Buoyant force | 3,344.09 | lb/ft | | |
| Weight of overburden | 1,434.76 | lb/ft | 173.69 | psf |
| Weight of pipe | 3,820.00 | lb/ft | 1.14 | FS without overburden |
| Factor of Safety | 1.57 | Factor of safety should be approximately 1.5 | | |

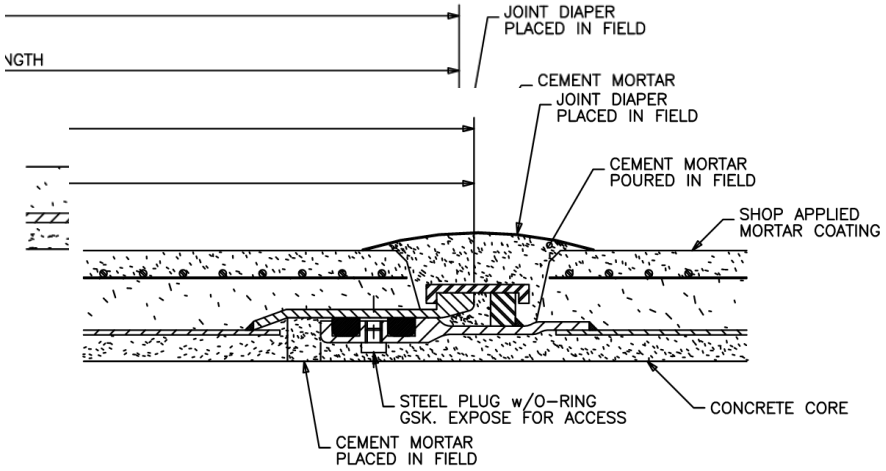



RIVERINE TRENCH DETAIL C-4000
SCALE: N.T.S.

# 72” Thrust

Combined Sewer Siphon
- Gravity sewer\low pressure

Even low pressure results in large forces in large diameter pipe!




| | | | |
|---|---|---|---|
| **PROGRAM** | **TRDP v1.1** | **Sheet no.** | 1 of 1 |
| **PROJECT** | Connecticut River Crossing | **Date** | 6/26/2018 |
| **LOCATION** | Springfield MA | | |
| **DESIGNED BY** | GOLeary | | |
| **CHECKED BY** | | | |
| **COMPANY** | Kleinfelder | | |
| **DESCRIPTION** | vert at levee | | |

**Pipeline Information**

| | | | |
|---|---|---|---|
| Pipe Type (ECP, LCP, BWP, RCP) | ECP | Cylinder Outside Diameter, $D_y$ | 75.5 in. |
| Internal Diameter, ID | 72 in. | Minimum Cylinder Thickness | 0.06 in. |
| Core Thickness, $h'_c$ | 5.5 in. | Bend Angle, Δ | 22.5 deg |
| Mortar Coating Thickness, $h_m$ | 1 in. | Centerline Length of Fitting, $L_b$ | 3.72 ft |
| Core Outside Diameter, OD | 83 in. | Pipe Laying Length (First Pipe), $L_{p1}$ | 10 ft |
| Pipe Outside Diameter, $D_o$ | 85 in. | Pipe Laying Length (Typical Pipe), $L_p$ | 20 ft |

**Joint Properties**

| | |
|---|---|
| Joint Type (Welded or Harnessed) | Harness |
| Joint Diameter, $D_j$ | 76.375 in. |
| Joint Slack | 0.0625 in. |

**Material Properties**

| | |
|---|---|
| Concrete Strength, $f'_c$ | 4500 psi |
| Steel Cylinder Yield Strength, $f_{yy}$ | 36000 psi |

**Pressures**

| | |
|---|---|
| Working Pressure, $P_w$ | 20 psi |
| Transient Pressure, $P_t$ | 0 psi |
| Field Test Pressure, $P_{ft}$ | 50 psi |
| $P_{weff} = \max(P_w, P_{ft}/1.25, (P_w + P_t)/1.4)$ | 40 psi |

**Soil Information (Table 9-1 - Soil Type Selection Guide)**

| | |
|---|---|
| Soil Type (I through V) | IV |
| Soil Stiffness, k | 1100 psi |
| Soil Unit Weight, γ | 112 pcf |
| Pipe to Soil Friction Coefficient, μ | 0.4 in. |
| Soil Cover, H | 5 ft |
| Angle of Internal Friction, Φ | 20 deg |

| Bend Angle (deg) | Centerline Length of Fitting (ft) | Thrust (kip) | Total Footage Required (one side) | Total Heavy Gage Footage (one side) |
|---|---|---|---|---|
| 22.5 | 3.72 | 89 | 10 | 10 |

**Required Lengths for One Side**

| Cylinder Thickness (in.) | 0.5 | 0.4375 | 0.375 | 0.3125 | 0.25 | 0.1875 | 0.1644 (8 GA) | 0.1345 (10 GA) | 0.1046 (12 GA) | 0.0747 (14 GA) | 0.0598 (16 GA) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Length Needed (ft) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.3 | 0 |
| Number of Pipes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |

# Questions?


## Acknowledgements

- Steven Frederick, Director Wastewater Operations, SWSC
- Joshua Schimmel, Executive Director, SWSC
- Bill Fuqua, SWSC (Ret.)
- Stantec Team
- Daniel O'Connell's Sons Team
- MassDEP & Clean Water Trust



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