



Kevin Olson, PE, Wright-Pierce

# Westminster's Approach to Increasing Sewer System Capacity and Cost- Effectively Lifting its Sewer Connection Moratorium: Inline Storage!

Presented at the 2018  
NEWEA Annual Conference  
Session 28



# Overview

- Introduction
- Existing System
- Project Background
- The Challenge
- Alternatives Considered
- The Solution
- Design and Construction
- Questions and Discussion



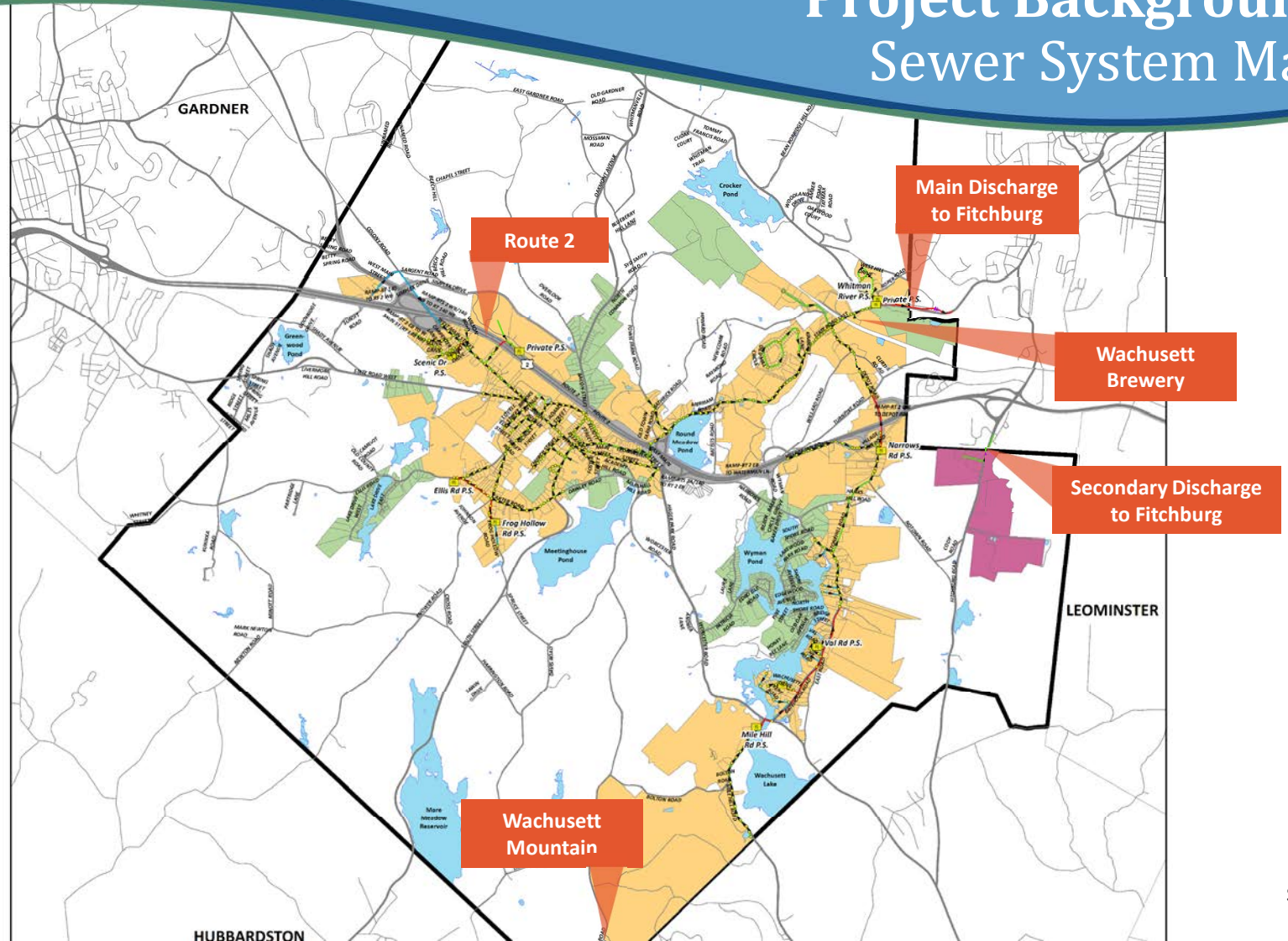
# Introduction

- Town's Collection System – 35 Years Old
  - Wachusett Mountain – 1982
  - Downtown Sewer – mid-1990's
  - Last Major Sewer Extension - 2004
- Wastewater Discharged to City of Fitchburg
  - Via Inter-Municipal Agreement (IMA)
- Two Connection Points
  - Rte. 31
  - Rte. 2A via Whitman River Pumping Station (WRPS)
- 99.8% of Town's Wastewater via WRPS





# Project Background Sewer System Map





# Existing System

- **25.1 Miles of Piping – Gravity (18.9), Forcemain (3.3), Pressure (2.9)**
- **7 Pumping Stations (Mile Hill Rd. PS Owned/Operated by Wachusett)**
- **WRPS Station Influent**
  - 18-inch Diameter PVC Pipe
  - 1,050 Feet between Wachusett Brewing Co. and Pump Station
- **Forcemain**
  - 2,800 feet of 6-inch Diameter PVC Pipe
  - Private PS Connects Directly to this Forcemain
  - Flow metering at Monty Tech HS – Palmer-Bowlus Meter
- **Receiving Sewer (Downstream of PS FM)**
  - Located in Route 2A in Fitchburg
  - 12-inch Diameter VC Sewer



### Whitman River Pumping Station

- Flooded Suction, “Tin Can” Type
- Constrained Site - MA DOT ROW, Wetlands
- Dual wetwells, Steel Drywell
- Centrifugal Pumps, Bubbler Level Control
- Natural Gas Fueled Generator
- Upgraded in 1988 and 2000
- Pump Ragging Problems





## Project Background

- System Capacity Limited by WRPS and Receiving Gravity Sewer
- Sewer Moratorium Implemented
- CWMP Completed in 2007
- CWMP Recommends 5 Sewer Expansion Phases
  - Need to Resolve Capacity Limitation First
  - Phase A – Replace WRPS, Force Main and Receiving Gravity Sewer (in Fitchburg)



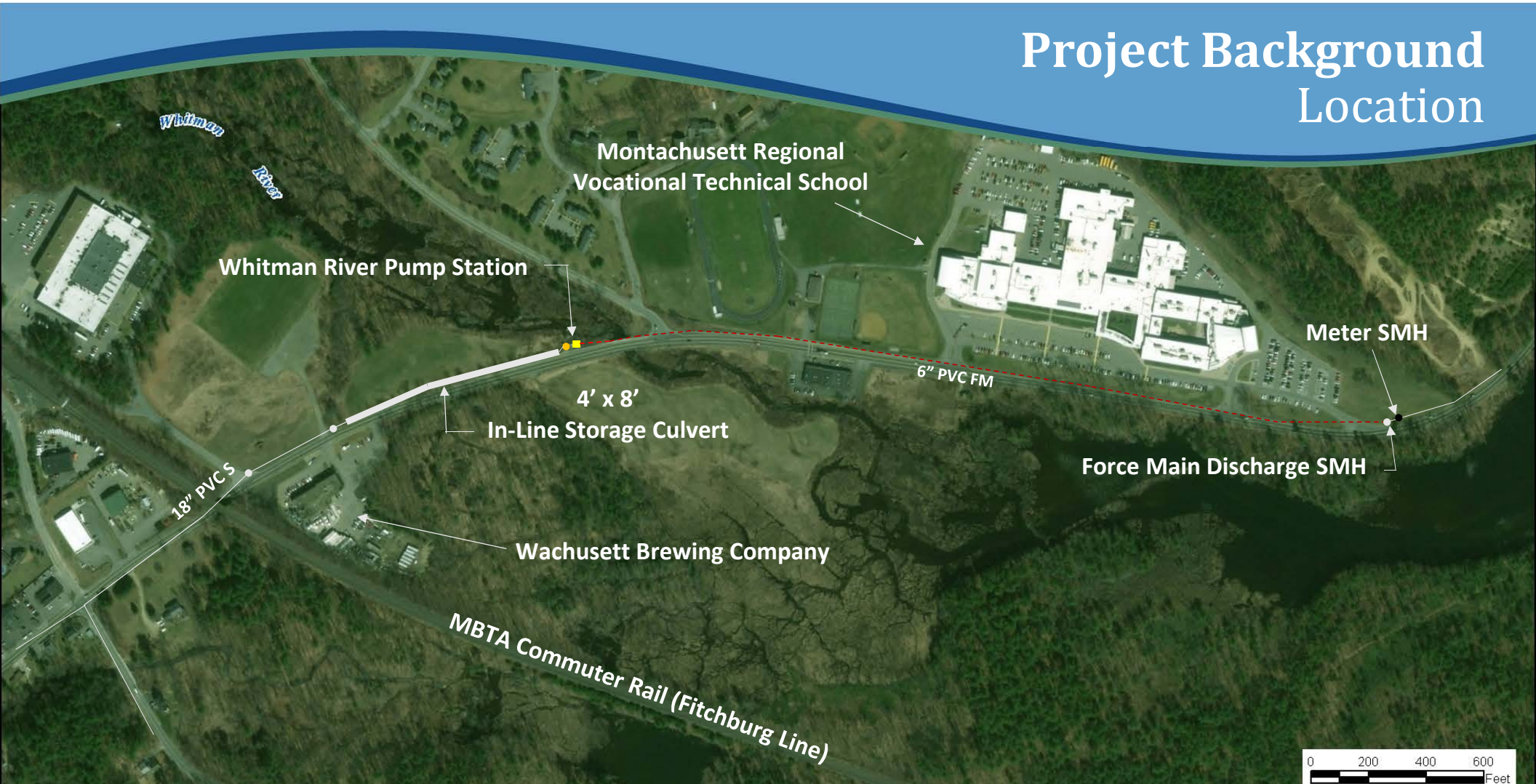
## Project Background

- Town Retains Wright-Pierce in 2008 to Execute CWMP Recommendations
- Complete Phase A
- Initial Project Questions
  - Fitchburg Sewer Capacity Upgrade – How? Who Pays?
  - Size, Type, Location, Cost of New Station
  - Peak Flows? Capacity of New Station?





# Project Background Location



## Project Background Wastewater Flows

<u>Item</u>	<u>Flow</u>
IMA Flow	250,000 gpd
Existing Average Daily Flow	180,000 gpd +/-
Existing Peak Daily Flow	1,000,000 gpd (690 gpm)
WRPS Flow Capacity	550 - 600 gpm +/-
Receiving Sewer Capacity	860,000 gpd (600 gpm) +/-

**Notes:** 1. Whitman River Area Flows only (does not include Route 31 Connection).  
2. Average Daily Flow has Increased from CWMP Flow (135,000 gpd).



## Project Background

### Future Wastewater Flows

<u>Item</u>	<u>Flow</u>
Existing Average Daily Flow	135,000 gpd
Estimated Future Average Daily Flow	165,000 gpd
Estimate Sewer Expansion Flows	200,000 gpd
Phase 1 Sewer Expansion Flow	42,000 gpd
Phase 2 Sewer Expansion Flow	30,000 gpd
Phase 3 Sewer Expansion Flow	25,000 gpd
Phase 4 Sewer Expansion Flow	15,000 gpd
Phase 5 Sewer Expansion Flow	88,000 gpd
Estimated Average Daily Flow	500,000 gpd
Estimated Peak Daily Flow	2,100,000 gpd

**Note:** Flows from CWMP. Current ADF is currently 180,000 gpd +/-.

# Project Background

## Moved Into Preliminary Design Phase

- Performed Flow Metering to More Accurately Determine Peaking Factor/Flow, and Evaluate I/I
- Decided to Eliminate Pump Station and Force Main Upgrade
  - Install Siphon Under River
- Still Need to Increase Capacity of Receiving Gravity Sewer in Fitchburg (i.e., increase pipe size or install second pipe)
- Project Cost Estimate - **\$5M**





# The Challenge

- Overcome Capacity Constraint → Lift Moratorium
- Continue to Manage Sewer User Costs
  - Fitchburg Raised Rates 68% in 2013
- Town Hesitant to Move Forward Due to:
  - Cost
  - Desire/Need to Expand Sewer System
- Consider Alternatives



## Alternatives Considered

### **Discontinue Discharging to Fitchburg**

- Construct WWTF with GWD in Westminster
- Discharge to Gardner via Ashburnham

### **Continue Discharging to Fitchburg**

- Directly to Fitchburg West Pump Station (formerly Fitchburg West WWTF)
- Re-route Whitman River Area Flow to Route 31 (away from WRPS and Rte. 2A Sewer)

## Alternatives Considered

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## Alternatives Considered

Continue Discharging to Fitchburg

- **Consider less Costly Solutions that:**
  - Allow Partial Sewer Expansion to Occur (Phases 1, 2 and 5)
  - Does not Include Receiving Sewer Modifications
- **Evaluated Two Alternatives:**
  - Modest PS Capacity Modifications
  - Storage – offline and inline



## The Solution

- Modest PS Modifications Not an Option due to Receiving Sewer Constraints
  - Eliminated from further consideration
- Storage Options – *Provide Storage for Peak Flows above PS Capacity*
  - **Offline** – costly, need to hold and pump-back, aeration/mixing?, odor control?
  - **Inline** – different, no need to pump-back, less costly, needed to vet with DEP and MA DOT



✓ **Inline Storage Selected (Interim or Long-Term Solution?)**

## Inline Storage Flows

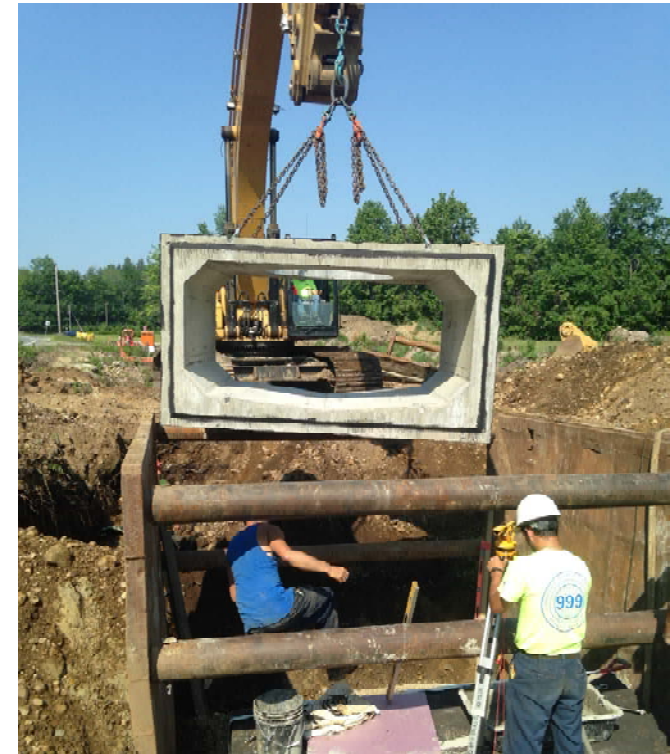
<u>Item</u>	<u>ADF</u>	<u>PDF (gpd)</u>	<u>PDF (gpm)</u>
Existing Flow	--	1,000,000	694
Sewer Expansion Area Flow			
Phase 1	42,000	106,000	74
Phase 2	30,000	74,000	51
Phase 5	88,000	219,000	152
Subtotal:	<i>160,000</i>	<i>400,000</i>	<i>277</i>
Total:	<b>160,000</b>	<b>1,400,000</b>	<b>971</b>

**Note:** Existing Peak Flow Based on Feb. 24/25, 2010 storm.



# Inline Storage Sizing

- Site and Existing System Profile Constraints Dictated Sizing and Design
  - 4' x 8' cross-section, 850 feet, less 10% for interior concrete filleting
  - Provides - 185,000 gallons of storage capacity
- Size will Handle Existing Peak Flows and Phases 1, 2 and 5 Sewer Expansion Flows
- Used EPA SWMM to Vet Sizing



# Inline Storage Modeling

## SWMM Summary

- 5 Scenarios run
- ADF added to hydrograph for entire storm
- PDF added to peak 8 hours of hydrograph
- **Conclusion – box culvert can handle flows 24% higher than peak flows**



TABLE 2  
IN-LINE STORAGE CONDUIT  
SWMM MODEL RESULTS

Model Run	System Geometry	Flow Conditions	1 Pump Operating			2 Pumps Operating			Peak HGL in Storage Conduit		Peak Volume Stored (Gal)	Storage Conduit % Full	Flooding to Grade (Yes/No)
			Pumping Rate (gpm)	Duration (hr)	Total Volume Pumped (MG)	Pumping Rate (gpm)	Duration (hr)	Total Volume Pumped (MG)	U/S	D/S			
1	Existing	Existing	603	53.41	1.932	612	3.73	0.140	678.39	668.76	104	-	No
2	Existing	Future	603	65.66	2.375	612	12.86	0.482	678.45	674.30	10,303	-	Yes
3	Proposed	Existing	603	52.57	1.901	612	4.63	0.170	678.39	668.49	5,190	-	No
4	Proposed	Future	603	53.94	1.951	612	27.50	1.010	678.45	671.67	119,390	64.00	No
5	Proposed	Future*(1.24)	603	41.80	1.512	612	53.33	1.958	678.48	674.11	186,200	100.00	No

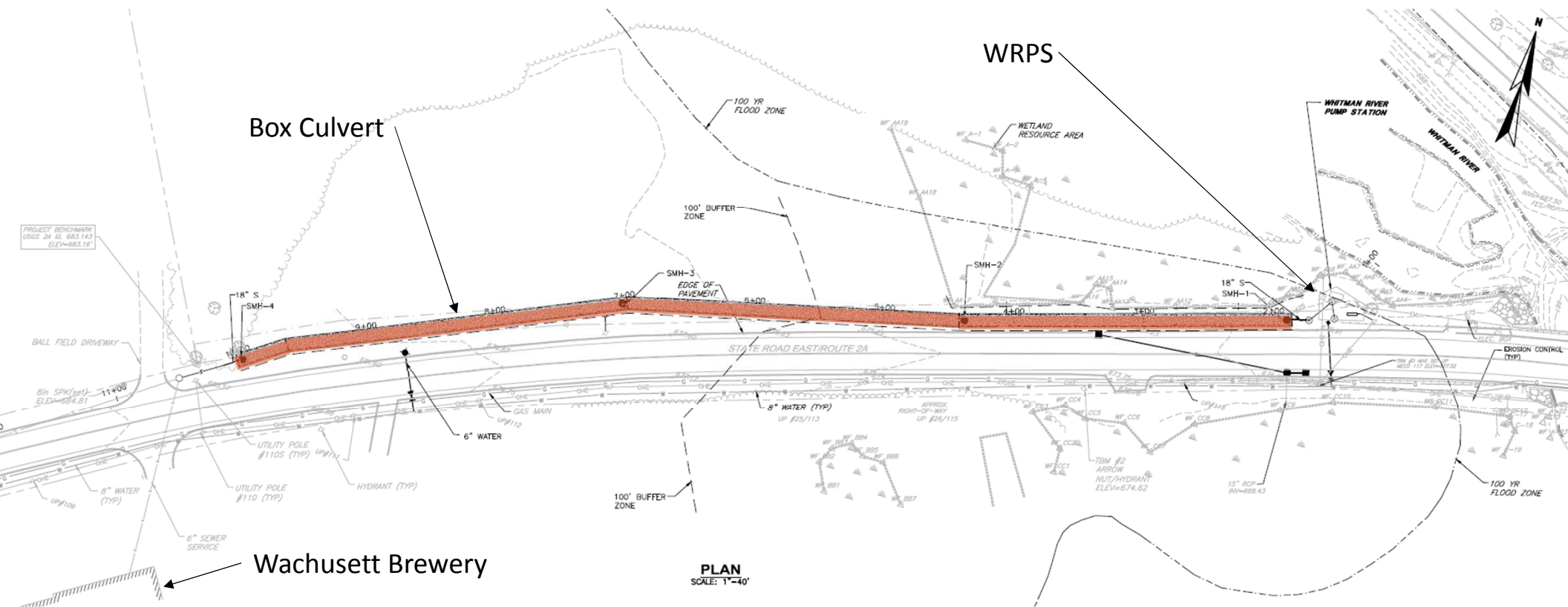
## Design Inline Storage Details

- Replace 18-inch Gravity Sewer with Box Culvert
- Box Culvert Specifics:
  - 4' x 8' Precast Concrete Sections (111 pcs), Various Lengths
  - Exterior Bituminous Coated
  - V-notched Bottom for Scouring Velocity
  - Access Provided via 4 MH Sections
  - Hydrants Provided for Flushing
  - Special Segment Testing Equipment Required





# Design Inline Storage Plan



## WRPS Improvements

- New Pumps/Motors – Flygt N Impeller, Dry-Pit Submersible (20 Hp)
- New Increased Diameter Piping and Valves
- Added VFD's and New Controls Above Grade
- New Emergency Generator (100 Kw)
- New Forcemain Bypass/Pig Launch System
- New Ventilation System
- New SCADA Communication with Private PS



## Other Project Items

- Permitting
  - MA DOT Access Permit – Lengthy Process
  - Wetlands Protection Act
- Water System Extensions/Hydrants (Flushing)
- Drainage Improvements
- Private Station Control Interlock
- Bypass Pumping for Culvert and PS Upgrades







**Pre-Construction**



**Post-Construction**



# Construction Slope Stabilization



## Slide 26

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**FD11**

This photo seemed stretched. I tried to fix it a little but if you have the original I can drop it in and fix it.

Faye DeMoura, 1/19/2018



# Construction

## Inline Storage First Section

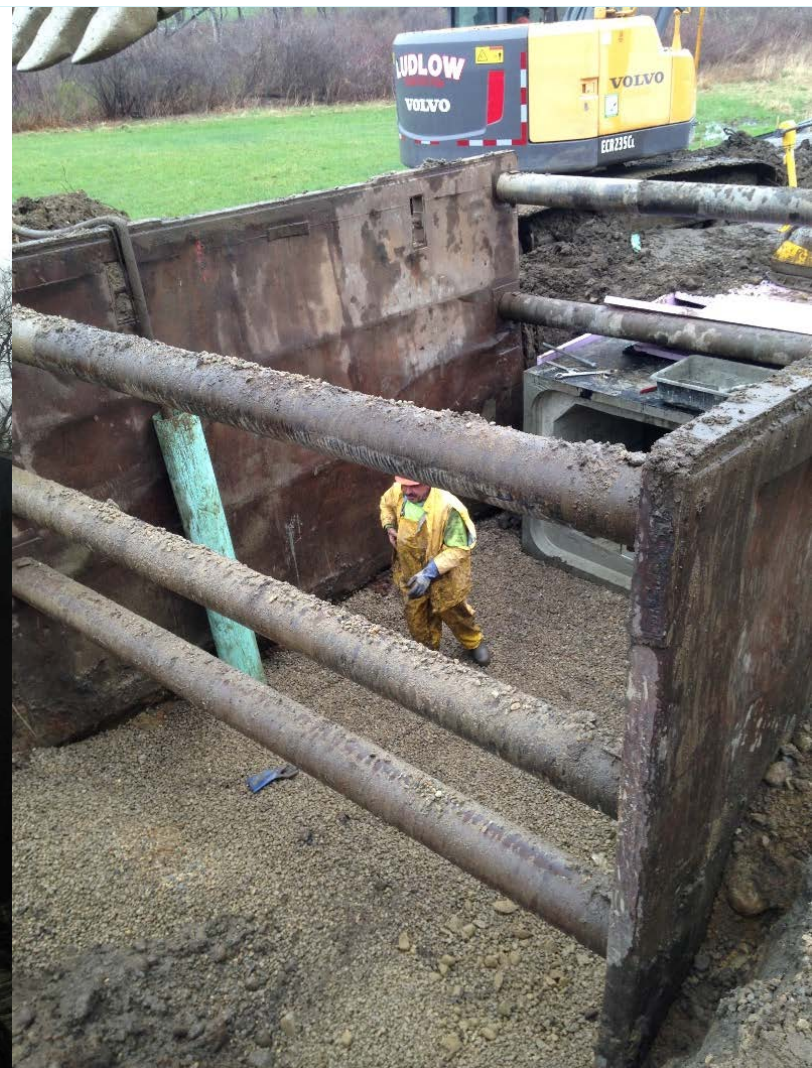




# Construction Impediments









# Construction

## Box Culvert Testing





## Pre-Construction WRPS





# Upgraded WRPS



# Project Funding/Cost

## USDA RD Grant/Loan Funded \$2.5 M

- Grant - \$471,000
- Low Interest Loan - \$2,029,000

## Inline Storage Project - \$2.25M

## I/I Control Plan and SSES = \$0.25M

## Contractor Costs

- Bid - \$1.956 M
- Inline Storage - \$1.15 M
- PS Improvements - \$0.6 M
- Other – Piping, Hydrants, Drainage, etc. - \$0.2 M
- Change Orders Net - \$104K Credit (final cost ~ \$1.852 M)

## I/I Control Plan - \$80K, SSES Pending (\$200K budget remaining)



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## Schedule

<b><u>Item</u></b>	<b><u>Date</u></b>
CWMP	2007
Commence Design of Improvements	2008
Change Improvements Approach	2009 – 2011
Inline Storage Commenced	2012
MA DOT Permitting	2012 – 2015
USDA RD Funding Approval	2015
Inline Storage Design Completed	2016
Bid Opening	Fall 2016
Construction	2016 - 2017
<b>Town Lifts Moratorium</b>	<b>December 2017</b>

## Unique Project Items/Lessons Learned

- MA DOT Coordination
- Quality of Precast Box Culvert Sections
- Box Culvert Joint Testing
- Box Culvert Cleaning Method
- Pump Station Low Level Float Ragging



The Bad



The Good

Slide 35



## Summary

- Think “Out of the Box”
- Different Approach, but Viable Solution!
- Town Saved Nearly \$2.8 in Capital Cost
- Has the “storage volume” been Used Yet?
- Interim or Longer-Term Solution? Time will Tell!



# Acknowledgements



## OWNER

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**Joshua W. Hall, PE**  
DPW Director

**Peter R. Martineau, Jr.**  
Sewer Foreman

**Public Works**  
**Commissioners**

Lorraine J. Emerson

Vance A. Butterfield

Scott H. Ryder, PE



## GENERAL CONTRACTOR

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**Ludlow Construction Co.,  
Inc.**



## FUNDING AGENCY

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**USDA – Rural  
Development  
Grant/Loan**



## ENGINEER

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**Kevin M. Olson, PE**  
Project Manager

**Barry A. Yaceshyn, PE**  
Lead Project Engineer

**All of the Wright-Pierce  
Team!**



Kevin Olson, PE, Wright-Pierce

# Thank You

Westminster's Approach to Increasing Sewer System Capacity and Cost-Effectively Lifting its Sewer Connection Moratorium: Inline Storage!

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