ARCADIS Design & Consultancy for natural and built assets

Town of Franklin, MA

FINAL REPORT

Beaver Street Interceptor Alternatives Analysis

March 2021

4496057.0000

,

FINAL REPORT

Beaver Street Interceptor Alternatives Analysis

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Date:

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EXECUTIVE SUMMARY

This Report presents the findings and recommendations of the Beaver Street Interceptor (BSI) Alternatives Analysis. The purpose of this analysis is to: assess the existing condition of the BSI; project future connections and flows within the BSI tributary area; develop a hydraulic model and complete a capacity assessment; evaluate alternatives for renewal or replacement of the BSI; and provide recommendations and preliminary project cost estimates to assure reliable, long-term conveyance of the Town's sanitary sewer flows.

The BSI, constructed in 1914, has been in continuous service for 106 years. Other than routine maintenance, no improvements to the interceptor have been made since its construction. Since 2003, the Town has contracted for cleaning, internal investigation, and condition assessment of the BSI on a recurring 5-year basis. Extensive manhole inspections and cleaning and closed-circuit television (CCTV) inspection of the pipes were last completed in 2013 and 2014, respectively. Results of these investigations have shown signs of increasing deterioration and worsening conditions of the pipes and manholes, most notably increased tuberculation, cracks, manhole and pipeline infiltration, and root intrusion.

This Report is formatted as follows:

- Section 1 provides a detailed description of the BSI and the tributary collection system.
- Section 2 includes a summary of previous investigations and existing conditions, as supplemented by the latest inspection reports in Appendices A and B.
- Section 3 presents the BSI tributary area future buildout analysis and flow projections.
- Section 4 presents the hydraulic model of the interceptor and describes how it was utilized to conduct a capacity assessment, evaluating current and future available capacity under various flow conditions and design storm events (refer also to Appendix C – Hydraulic Model Technical Memorandum).
- Section 5 presents detailed descriptions and a comparison of the alternatives evaluated for renewal or replacement of the BSI, and a summary of costs for each alternative. A detailed breakdown of Project Cost Estimates is provided in Appendix E.
- Section 6 presents the Recommended Plan and Implementation Schedule, including a discussion of potential utilization of the Massachusetts Department of Environmental Protection (DEP) State Revolving Fund (SRF) loan program.

Hydraulic Model and Capacity Assessment

Results of the baseline hydraulic model showed the existing BSI has the necessary capacity to convey the existing sanitary flow under the design storm events. However, when projected future flows were applied to the hydraulic model, results showed the existing BSI is at its full

capacity under the 10-year, 24-hour storm event and above capacity under the 25-year, 24-hour storm event, resulting in project sanitary sewer overflows (SSOs).

Summary of Alternatives

Three alternatives were evaluated to determine the required rehabilitation, replacement, and realignment options for the BSI to provide the required capacity and reliability for conveyance of sewage from the tributary collection system. The hydraulic model was applied to each alternative under the flow conditions and storm events described above and detailed in Section 4. A summary of each alternative with preliminary construction cost estimates are shown in **Table ES-1**. A detailed breakdown of construction cost estimates is included in Section 5.4 and Appendix E.

Table ES-1: Summary of Alternatives and Costs

Alternative	Brief Description	Cost
Alternative No. 1	Rehabilitation of the BSI	$9,000,000
Alternative No. 2	Replacement of BSI in its current configuration	$17,000,000
Alternative No. 3	Rehabilitation of the BSI upstream of Beaver Street and a realignment of the BSI to West Central Street.	$25,000,000

Comparison of Alternatives

Each alternative was evaluated on the criteria listed in **Table ES-2**, below. Based on discussions with the Town DPW, each of these criteria was assigned a relative weight or level of importance to develop a weighted average score and ranking of Alternatives. Each alternative received a rating from 1 to 5 for each of the criteria, with 1 representing a highly disadvantageous rating and 5 representing a highly advantageous rating.

Table ES-2: Comparison of Alternatives

Parameter	Relative Weight or Level of Importance	Alternative No. 1	Alternative No. 2	Alternative No. 3
Preliminary Project Cost Estimate	20%	5	3	2
Reliability of Design/Operation	10%	3	3	5
Risk of Overflows	20%	2	4	5
Environmental Concerns/Risk	15%	2	2	5
Maintenance	10%	3	3	2
Accessibility/Easements	15%	1	1	4
Impacts to Residents/Businesses	5%	4	4	3
Permitting Requirements	5%	2	1	3
	100%			
Weighted Average		**2.8**	**2.7**	**3.8**

(1) – Highly Disadvantageous, (2) – Disadvantageous, (3) – Neutral, (4) – Advantageous, (5) – Highly Advantageous

Recommended Plan and Implementation Schedule

Alternative No. 3, included as **Figure ES-1,** has the highest of the three weighted average scores at 3.8 and is considered the best option for the Town. Alternative No. 1 and Alternative No. 2 have weighted average scores of 2.8 and 2.7, respectively.

Based on the comparison of alternatives analysis included in Section 5.5 and ongoing discussions with the Town, it is recommended that the Town proceed with Alternative No. 3 – Rehabilitation and Realignment of the BSI. While the preliminary project cost estimate for Alternative 3 is the highest; improving environmental impacts, access, maintenance, and SSOs along the BSI far outrank Alternatives No. 1 and No 2.

A proposed schedule for implementation is shown in **Table ES-3**. A detailed schedule is included in Section 6.

Table ES-3: Project Implementation Schedule

Project Milestone	Anticipated Schedule
Design (Siting, Geotechnical, Survey, Permitting, Pump Station and Pipeline Design)	February 2021 – July 2022
SRF PEF and Loan Application	August 2021 and August 2022
Project Bidding/Award	August 2022 – September 2022
Construction Phase	October 2022 – April 2025

N

Rehabilitation of 1,900 LF of Existing 24" Reinforced Concrete and Vitrified Clay Pipe with Cured-in-Place Pipe Lining

1,000 LF of New 15" PVC Sewer

Proposed Beaver Street Pump Station Force Main - 5,000 LF of 20" HDPE Pipe

Proposed Franklin Village Mall Pump Station Force Main - 700 LF of 6" HDPE Pipe

Proposed Grove Street #3 Pump Station Force Main 2,400 LF of 8" HDPE Pipe

Abandon 1,000 LF of Existing Gravity Sewer and Redirect Flow to the Proposed Grove Street #3 Pump Station

Abandon 5,000 LF of Existing 24" Gravity Sewer

Location of Historic Overflow. Risk of Overflow Mitigated by Abandoning Downstram Sewer and Redirecting Flow to the Proposed Beaver Street Pump Station

1,000 LF of New 18" PVC and 500 LF of 24" PVC to Redirect Flows to the Proposed Beaver Street Pump Station

Rehabilitation of 3,300 LF of Existing 18" and 20" Cast Iron Gravity Sewer with Cured-in-Place Pipe Lining

Replace/Upsize 900 LF of Existing 16" Cast Iron Pipe with New 18" PVC

Location of Historic Overflow. Risk of Overflow Mitigated by Increasing Downstream Pipe Size.

Rehabilitation of 1,150 LF of Existing 16" Cast Iron Gravity Sewer with Cured-in-Place Piping Lining

Mine Brook Circle Pump Station

Proposed Grove Street #3 Pump Station

Proposed Franklin Village Mall Pump Station

Proposed Beaver Street Pump Station

Public Works Pump Station

Franklin Village Mall

Beaver Pond

Mine Brook Interceptor

OAK STREET

POND STREET

WEST CENTRAL STREET

GROVE STREET

BEAVER STREET

UNION STREET

WASHINGTON STREET

MH53 MH52 MH51 MH50A MH50 MH49 MH48 MH47A MH47 MH46A

MH32 MH31 MH30 MH29 MH28 MH27 MH26 MH25 MH24 MH23 MH22 MH21 MH20 MH19 MH18 MH17 MH16 MH15 MH14 MH13 MH12 MH11 MH10 MH9 MH8 MH7 MH6 MH5 MH4 MH3 MH2A MH2 MH1

PS

495

Legend

- Historic Sanitary Sewer Overflow
- Existing Sewer Manhole
- Existing Pump Station
- Existing Gravity Sewer
- Existing Pump Station Force Main
- Watercourse
- Waterbody
- Wetland/Environ... Sensitive Area

0 Feet 2,000

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor Alternatives Analysis

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FIGURE ES-1

Alternative No. 3 - Rehabilitation and Realignment of the Existing Beaver Street Interceptor

March 2021

1 INTRODUCTION

This report presents a summary of the sanitary sewer investigations and evaluations conducted on the Beaver Street Interceptor (BSI) and provides an alternatives analysis for renewal and replacement of the existing interceptor. The work consists of the following interrelated tasks aimed at continuing the Town's efforts for the long-term proper conveyance of sanitary sewer flows to the Charles River Pollution Control District (CRPCD) Water Pollution Abatement Facility:

(1) Condition assessment of the BSI to identify structural deficiencies, infiltration sources, and operation and maintenance concerns.

(2) Tributary buildout analysis to project future flows to the BSI at each of its loading points.

(3) Hydraulic model and capacity assessment based on current and future flows to identify problem areas.

(4) Renewal/replacement alternatives analysis for conveyance of the Town's sanitary sewer flows, including consideration of permitting and environmental impacts, accessibility and maintenance issues, and short-term and life-cycles cost analyses.

The Beaver Street Interceptor (BSI) was originally constructed in 1914 and discharged to the former Franklin Wastewater Treatment Plant on Pond Street (aka, the sewer beds). The BSI conveys over 70% of the Town's sewage with an average daily flow (ADF) of approximately 1.5 million gallons per day (MGD) of sewage flow through the pipeline. The interceptor includes 59 manholes and approximately 2.3 miles (11,932 LF) of pipe, extending from the intersection of Cottage Street and Union Street to the easement behind Pond Street, near the Interstate 495/Route 140 interchange, where it discharges to the Mine Brook Interceptor, as shown in **Figure 1**. Due to its age, the risk and consequence of failure, and the percentage of the Town's sewer flows conveyed by the interceptor, the BSI is considered Franklin's most critical sewer asset.

The BSI is comprised of 16-inch to 24-inch cast iron (CI) pipe, reinforced concrete (RC) pipe, and vitrified clay (VC) pipe. Table 1 outlines the composition of the BSI.

Table 1: Summary of Beaver Street Interceptor Pipe Composition

Pipe Material	Length (LF) by Pipe Diameter			
	16-inch	18-inch	20-inch	24-inch
Cast Iron	1,869	2,267	966	4,919
Reinforced Concrete	-	-	-	935
Vitrified Clay	-	-	-	976
Total	1,869	2,267	966	6,830

The Town installed a permanent flow meter at manhole MH50A in 2011 to measure and report the total flow discharged to the Mine Brook Interceptor. In the spring of 2017, the Town implemented a town-wide metering program as part of their Collection System Master Plan, which comprised of eighteen meters designed to isolate major sewersheds in town. Locations of the permanent flow meter and sub-areas tributary to the BSI are shown on **Figure 1**. Flow data collected during the town-wide metering program was compared to the data collected at the permanent meter and utilized for this alternatives analysis.

The BSI receives flow from thirteen tributary sub-areas. The Milliken Avenue Pump Station provides a majority of the wastewater flow to the BSI, discharging approximately one-half mile upstream of Manhole 1. Major loading points include:

- Manhole 1 at Cottage Street
- Manhole 4 at Saxon Street
- Manhole 15 at McCarthy Street
- Manhole 29 at Beaver Street
- Manhole 32 at Panther Way connection in Beaver Street Easement
- Manhole 41 at Grove Street connection in Beaver Street Easement
- Manhole 46A at Pond Street connection in easement at the I-495/Route 140 interchange

MEDWAY

BELLINGHAM

NORFOLK

WRENTHAM

WRENTHAM

N

495

495

495

Mine Brook

Beaver Pond

Mine Brook Circle Pump Station

Franklin Village Mall

Public Works Pump Station

Legend

- Beaver Street Interceptor
- Beaver Street Interceptor Sewershed
- Right of Way
- Railroad
- Watercourse
- Waterbody
- Wetland/Environmentally Sensitive Area
- Municipal Boundary

Miles

0 0.5 1

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor Alternatives Analysis

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FIGURE 1

Beaver Street Interceptor And Tributary Sewershed

March 2021

2 EXISTING CONDITIONS ASSESSMENT

Since 2003, the Town has contracted for cleaning, internal investigation, and condition assessment of the BSI on a recurring 5-year basis. Extensive manhole inspections and closed-circuit television (CCTV) inspection of the pipes were last completed in 2013 and 2014, respectively. Arcadis presented findings of the investigation and recommendations for the continued efforts of the Operation and Maintenance and Asset Management Program in the Beaver Street Interceptor – Sanitary Sewer Investigations Report, dated December 2014.

2.1 Summary of Manhole Inspections

Of the 59 manholes located along the BSI, 55 were inspected (30 surface inspections and 25 internal inspections). Manhole condition assessments were based on structural integrity, sources of inflow and infiltration, presence of roots and other blockages, and ease of accessibility for maintenance and operation.

A majority of the manholes inspected were in good structural condition with minimal defects. On a condition rating scale of 1-to-5, with 5 representing the worst condition, eight manholes received a condition rating of 3 and only one manhole, MH 31, received a condition rating of 4 due to excessive root intrusion. No manholes received a condition rating of 5. The most common structural defects included missing mortar and loose or missing bricks on walls and corbels.

A total of sixteen manholes showed signs of active infiltration, including presence of mineral deposits and wet walls, corbels, and pipe connections. Six manholes had active infiltration leaking into the system. A majority of manholes with active infiltration of signs of infiltration were located between Cottage Street and Beaver Street.

Intrusive roots, ranging from light/minor to heavy were observed in twenty-three manholes. The majority of these manholes are located within the Beaver Street Easement (MH29 – MH42) and the Pond Street Easement (MH46 – MH53), with the most severe located in the Beaver Street Easement. Severe root intrusion can cause blockages, reduced capacity within the system, and lead to infiltration through cracks, holes, and joints during periods of high groundwater.

A majority of manholes are located within roadways or within easements easily accessible by standard cleaning and maintenance equipment. Manholes located within the Beaver Street Easement are more difficult to access and pose the most maintenance and capacity challenges. Additionally, manholes located in the Franklin Village Plaza are over 40 feet deep, which is well above the BSI average manhole depth of 10 feet.

Manhole inspection logs are included in **Appendix A**.

2.2 Summary of Closed-Circuit Television (CCTV) Inspections

Cleaning and CCTV inspection for all pipe segments was completed in the summer of 2014, during a period of low groundwater, and flows were controlled in order to inspect as much of the pipe's circumference as possible. Prior to inspection, the BSI was hydraulically cleaned to remove all sediment and debris. Approximately eight cubic yards of debris had accumulated and was removed since the BSI was last cleaned six years prior. Inspections recorded structural defects (e.g. cracks, tuberculation), active infiltration, evidence of infiltration (e.g. mineral deposits), evidence of operational problems (e.g. indication of surcharging), and blockages or potential for blockages (e.g. root intrusion, debris). Each observed defect and overall condition of pipe segments were noted and recorded.

The BSI was found to be in good structural condition, however all segments of the BSI constructed of cast iron pipe showed light to moderate tuberculation and corrosion above the centerline of the pipe. From review of the CCTV inspections completed in 2008, the buildup of tuberculation and corrosion has increased overtime. No sections were at immediate risk of failure or showed significant reduction in diameter due to tuberculation, however the overall condition of the pipes has worsened.

There was no active infiltration observed during the CCTV inspections, however there were sections with evidence of infiltration, mainly consisted of observed wetness and mineral deposits around joints, service connections, and/or on the pipe barrel. CCTV inspections performed in 2008 observed multiple sections with visible infiltration; inspections performed in 2014 were during a period of low groundwater when infiltration is typically less prevalent.

Intrusive roots have been a continuing issue for all five VCP segments, with light to medium roots at most joints, while all CIP and RCP sections were free of roots. Significant roots can not only inhibit flow and reduce capacity but can lead to separated joints causing decreased structural integrity and higher likelihood of infiltration into the pipe.

CCTV inspection logs and videos are included in **Appendix B**.

2.3 Summary of Condition Assessment

While the pipes and manholes along the BSI did not show signs of immediate risk of failure from the 2014 and 2015 investigations, the assets are aging and showing signs of worsening conditions. A large portion of the BSI is located in wetlands and other environmentally sensitive areas where the consequence of failure is extremely high. Additionally, the inaccessible and deep manholes in the Franklin Village Plaza pose significant challenges for an emergency response if the system were to fail.

Based on the condition of the BSI, consequence of failure, and accessibility constraints, a complete upgrade to the BSI is recommended to improve the reliability of the collection system as a whole. The alternatives evaluated for the upgrade are discussed in Section 5 of this Report.

3 TRIBUTARY BUILDOUT ANALYSIS AND FLOW PROJECTIONS

A tributary buildout analysis was conducted to project future flows to the BSI at each of its loading points. Flow projections were based on data collected during the 2017 Flow Monitoring Program, planned new connections, a 50-year population projection, and a town-wide planning and buildout analysis.

Planned new connections include housing developments, new residential buildings, connections from existing commercial buildings and warehouses, a new hotel, and new breweries. Estimated flows for each planned connection were determined based on industry standard “Title 5” flows. Many of these connections went into service after 2017, so their flows were not captured in the 2017 Flow Monitoring Program. To adjust the meter data, flows associated with each planned connection were allocated to the appropriate BSI loading point based on their location within the BSI tributary area to determine the estimated flows to the BSI in 2020.

A study by the University of Massachusetts Donahue Institute, titled “Long-term Population Projections for Massachusetts Regions and Municipalities”, published in 2018, was utilized to estimate the 50-year population projection. The study consisted of state-wide, county-wide, and town-wide population projections through the year 2040. Results of the study were extrapolated to determine an estimated population increase of 15% from 2020 to 2070 in the Town of Franklin.

The town-wide planning and buildout analysis evaluated planning and zoning maps to determine available parcels and regions within the town where potential new developments or industries may arise as well as potential future connections to the sanitary sewer from existing facilities and dwellings. Results of this analysis showed a higher potential for growth in areas outside of the BSI tributary area, with significantly less than 15% increase within the BSI tributary area.

Ultimately, the more conservative approach for projecting future flows to the BSI was selected for the hydraulic model and capacity assessment, which resulted in a 15% increase to the estimated 2020 sanitary flows at each BSI loading point.

4 HYDRAULIC MODEL AND CAPACITY ASSESSMENT

A hydraulic model of the existing BSI and tributary pipes 12-inches in diameter and larger was developed using existing record drawings and information available from the Town’s Geographic Information System (GIS) database. Additional measurements were taken during a field survey to confirm various dimensions as well as piping and manhole configurations. The hydraulic model was used to evaluate the current and future available capacity of the BSI under various flow conditions, including the industry design standard 10-year, 24-hour storm event (5.22” of rain in a 24-hour period) and the selected design 25-year, 24-hour storm event (6.39” of rain in a 24-hour period).

Data incorporated and calibrated into the baseline hydraulic model included:

- BSI pipe diameter, material, and slope;
- Flow data collected in the spring of 2017 at various tributary loading points, as part of the Collection System Master Plan;
- Flow data from the permanent meter at the downstream end of the BSI, installed in 2011;
- Flow data from the tributary Milliken Avenue Pump Station;
- Rainfall data from the rain gauge located at 257 Fisher Street, Franklin MA; and
- Design Storm Depths developed using NOAA Atlas 14, Vol 2 (2004).

Results of the baseline hydraulic model showed the existing BSI has the necessary capacity to convey the existing sanitary flow under the 25-year, 24-hour design storm. The model shows several locations where the hydraulic grade line is above the crown of the pipe, indicating surcharging within the manholes, however it did not indicate any sanitary sewer overflows (SSOs). The Town did experience a significant, historical storm event in March of 2010, which resulted in three SSOs along the BSI. Approximately 6.3 inches of rain fell within a 48-hour period and the groundwater at the USGS groundwater monitoring well located in Norfolk, MA was at a historic high. SSOs were reported at manholes MH7, MH8, and MH32, as indicated on **Figure 2.**

Additional data incorporated and calibrated into the projected 50-year hydraulic model included:

- Additional flows from planned new connections, as described in Section 3;
- Additional 15% flows based on the population projection, as described in Section 3.
- Design Storm Depths developed using NOAA Atlas 14, Vol 2 (2004).

Results of the projected 50-year hydraulic model showed the existing BSI is at its full capacity under the 10-year, 24-hour storm event and above capacity under the 25-year, 24-hour storm event, with an SSO indicated at manhole MH9 and the hydraulic grade line above the crown of the pipe from Cottage Street to manhole MH46 off of Pond Street.

Based on results of the hydraulic model, the BSI is undersized and does not have sufficient capacity to reliably convey the projected future flows. Three alternatives were evaluated to determine the required rehabilitation, replacement, and realignment options for the BSI to provide the required capacity. A hydraulic model was developed and analyzed for each alternative and are described in the following section. The hydraulic model and results are summarized in a memorandum included as **Appendix C.**

N

Mine Brook Interceptor

POND STREET

OAK STREET

MH53

MH52

MH51

MH50A

MH50

PS

Mine Brook Circle Pump Station

Permanent Sanitary Flow Meter Location (MH-50A)

Location of 2017 Flow Monitoring Program Meter No. 15

MH49

MH48

MH47A

MH47

MH46A

MH46

MH45

MH44

MH43

WEST CENTRAL STREET

Franklin Village Mall

MH42

MH41

MH40A

MH40

MH39

MH38

MH37

MH36

MH35

MH34

SMH 498

MH33

MH32

MH31

MH30

MH29

MH28

MH27

MH26

MH25

MH24

MH23

MH22

MH21

MH20

MH19

MH18

MH17

MH16

MH15

MH14

MH13

MH12

MH11

MH10

MH9

MH8

MH7

MH6

MH5

MH4

MH3

MH2A

MH2

MH1

Location of 2017 Flow Monitoring Program Meter No. 19

Location of 2017 Flow Monitoring Program Meter No. 16

Location of 2017 Flow Monitoring Program Meter No. 14

Location of 2017 Flow Monitoring Program Meter No. 20

Mine Brook

Location of Historic Sanitary Sewer Overflow

Location of Historic Sanitary Sewer Overflow

495

BEAVER STREET

GROVE STREET

Beaver Pond

PS

Public Works Pump Station

UNION STREET

A STREET

WASHINGTON STREET

Legend

- Beaver Street Interceptor Manhole
- Historic Sanitary Sewer Overflow
- Beaver Street Interceptor
- Existing Sewer Manhole
- Existing Pump Station
- Existing Gravity Sewer
- Existing Pump Station Force Main
- Watercourse
- Waterbody
- Wetland/Environ... Sensitive Area

0 1,000 2,000 Feet

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor Alternatives Analysis

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FIGURE 2

Beaver Street Interceptor
Existing Conditions

March 2021

5 ANALYSIS OF RENEWAL/REPLACEMENT ALTERNATIVES AND COSTS

Based on results of the Existing Conditions Assessment and the Hydraulic Model/Capacity Assessment it is apparent the existing BSI has surpassed its intended lifespan and design capacity. As the condition of the interceptor worsens, the risk of failure and SSOs increases. Given the high consequence of failure or exceedance of capacity, Arcadis evaluated three alternatives for renewal and replacement of the BSI. Technologies considered in the alternative analysis include pipeline rehabilitation with cured-in-place pipe lining (CIPPL), open-cut pipe replacement, construction of new sewer pump stations and piping realignment, manhole rehabilitation/replacement, and installation of new manholes. Each of the three alternatives evaluated consists of a combination of several of these technologies.

All technologies considered address structural concerns of the BSI. Design considerations when developing the three alternatives include: construction and Operation and Maintenance (O&M) cost; reliability of design and operation of the system; risk of SSOs; environmental concerns; maintenance and accessibility challenges; easement requirements; permanent and temporary impacts to residents and businesses; and permitting requirements.

The three alternatives selected for evaluation and presented at the Franklin Town Council Meeting on October 21, 2020 are shown below. The presentation in included in **Appendix D**.

- Alternative No. 1 – Rehabilitation of the Existing BSI
- Alternative No. 2 – Replacement of the Existing BSI
- Alternative No. 3 – Rehabilitation and Realignment of the Existing BSI

5.1 Alternative No. 1

Recommended improvements for Alternative No. 1 are shown on **Figure 3** and include:

- Cured-in Place Pipe Lining of approximately 11,350 LF of gravity sewer
- Replacement/upsizing of approximately 900 LF of gravity sewer with PVC pipe
- Construction of approximately 5 new sewer manholes and rehabilitation of 54 existing sewer manholes

5.1.1 Evaluation of Alternative No. 1

Alternative No. 1 consists of replacement/upsizing of approximately 15% of the BSI from 16” to 18” with new PVC pipe and new sewer manholes from manhole MH8 to MH12, and rehabilitation of approximately 85% of the BSI with CIPPL and internal manhole rehabilitation.

Pipe replacement and upsizing recommendations were developed based on results of the hydraulic model and the locations of historic SSOs (MH7 and MH8). By increasing the diameter

of the pipes, the capacity of these pipe sections, as well as several upstream pipe sections, is increased, mitigating the risk of future SSOs in these locations.

Pipeline rehabilitation by CIPPL and internal manhole rehabilitation are cost-effective trenchless methods of revitalizing the collection system that have been utilized throughout the Town's system for collector sewers 12 inches in diameter and smaller. This has been a proven method of extending the lifespan of existing sewers where capacity, accessibility for operation and maintenance, environmental impacts, and risk of SSOs are not considered major concerns.

As discussed in earlier sections, operation, and maintenance of the BSI in the existing alignment poses significant accessibility challenges through the Beaver Street Easement and along the Franklin Village Plaza. Additionally, rehabilitation of the existing pipes and manholes does not provide any additional capacity in the system, which can lead to surcharging of the sewer manholes and SSOs into environmentally sensitive areas. Due to the minimal capacity increase, the risk of SSOs occurring through the Beaver Street Easement and at the historic SSO location of MH31, as shown on **Figure 3**, is not mitigated by constructing Alternative No. 1.

The preliminary project cost estimate for Alternative No. 1, which includes engineering services and construction costs, is approximately $9 Million. A project cost breakdown is included in **Appendix E**.

N

Rehabilitation of 6,900 LF of Existing 24" Cast Iron, Reinforced Concrete and Vitrified Clay Gravity Sewer with Cured-in-Place Pipe Lining

Location of Historic Overflow. Risk of Overflow Not Mitigated, due to No Capacity Increase of Sewer

Rehabilitation of 1,000 LF of Existing 20" Cast Iron Gravity Sewer with Cured-in-Place Pipe Lining

Rehabilitation of 2,300 LF of Existing 18" Cast Iron Gravity Sewer with Cured-in-Place Pipe Lining

Replace/Upsize 900 LF of Existing 16" Cast Iron Gravity Sewer with New 18" PVC and 5 New Serer Manholes

Location of Historic Overflow. Risk of Overflow Mitigated by Increasing Downstream Pipe Size.

Rehabilitation of 1,150 LF of Existing 16" Cast Iron Gravity Sewer Cured-in-Place Pipe Lining

Legend

- New Sewer Manhole
- Rehabilitation of Existing Sewer Manhole
- Historic Sanitary Sewer Overflow
- Rehabilitation of Existing Sewer Pipe
- New Sewer Pipe
- Existing Sewer Manhole
- Existing Pump Station
- Existing Gravity Sewer
- Existing Pump Station Force Main
- Watercourse
- Waterbody
- Wetland/Environmentally Sensitive Area

Feet
0 1,000 2,000

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor Alternatives Analysis

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FIGURE 3

Alternative No. 1 - Rehabilitation of the Existing Beaver Street Interceptor

March 2021

5.2 Alternative No. 2

Recommended improvements for Alternative No. 2 are shown on **Figure 4** and include:

- Replacement of approximately 11,350 LF of gravity sewer with like-sized PVC pipe
- Replacement/upsizing of approximately 900 LF of gravity sewer with PVC pipe
- Replacement of 59 sanitary sewer manholes

5.2.1 Evaluation of Alternative No. 2

Alternative No. 2 consists of replacement and upsizing of approximately 15% of the BSI from 16" to 18" with new PVC pipe and new sewer manholes from manhole MH8 to MH12, and replacement of approximately 85% of the BSI with like-sized PVC pipe and new sewer manholes.

Similar to Alternative No. 1, Alternative No. 2 provides sufficient capacity increase to mitigate SSOs at the historic SSO locations of MH7 and MH8, but does not provide any accessibility, O&M, or capacity benefits through the Beaver Street Easement or along the Franklin Village Plaza.

Open cut pipe and manhole replacement is considered the traditional method of pipe repair for sections that cannot be rehabilitated with CIPPL, typically caused by pipe configuration (e.g. changes in pipe size or alignment) or other defects within the existing pipe that would impede installation of the CIPPL. There are several drawbacks and limitations to the open cut method when compared to rehabilitation with CIPPL including: additional bypass requirements; longer construction duration; increased environmental impacts caused by excavation work; and increased health and safety risks and constructability challenges with deep manholes and sewers.

Aside from the sections of pipe that are recommended to be upsized from 16" to 18", which is also included in the Alternative No. 1 recommendations, there are no benefits in terms of accessibility, O&M, or capacity from replacing the pipes, as opposed to rehabilitation with CIPPL. As described in the Comparison of Alternatives section, Alternative No. 2 is the least desirable alternative and was evaluated more as a standard baseline for comparison of Alternative No. 1 and Alternative No. 3.

The preliminary project cost estimate for Alternative No. 2, which includes engineering and construction costs, is approximately $17 Million. A project cost breakdown is included in **Appendix E**.

N

Mine Brook Interceptor

POND STREET

OAK STREET

OAK STREET

PS
Mine Brook Circle
Pump Station

MH53
MH52
MH51
MH50A
MH50
MH49
MH48
MH47A
MH47
MH46
MH46A
MH45
MH44
MH43
MH42
MH41
MH40A
MH40
MH39
MH38
MH37
MH36
MH35
MH34
MH33
MH32
MH31
MH30
MH29
MH28
MH27
MH26
MH25
MH24
MH23
MH22
MH21
MH20
MH19
MH18
MH17
MH16
MH15
MH14
MH13
MH12
MH11
MH10
MH9
MH8
MH7
MH6
MH5
MH4
MH3
MH2

495

Replace 750 LF of 40'+ Deep Gravity Sewer

WEST CENTRAL STREET

Franklin Village
Mall

GROVE STREET

Replace 6,900 LF of Existing 24" Cast Iron,
Reinforced Concrete and Vitrified Clay
Gravity Sewer with 24" PVC Pipe

Mine Brook

Location of Historic Overflow. Risk of Overflow Not
Mitigated, due to No Capacity Increase of Sewer

BEAVER STREET

Replace 1,000 LF of Existing 20" Cast Iron
Gravity Sewer with 20" PVC Pipe

Replace 2,300 LF of Existing 18" Cast Iron
Gravity Sewer with 18" PVC Pipe

Beaver
Pond

PS
Public Works
Pump Station

Replace/Upsize 900 LF of Existing 16"
Cast Iron Gravity Sewer New 18" PVC

Location of Historic Overflow. Risk of Overflow
Mitigated by Increasing Downstream Pipe Size.

Replace 1,150 LF of Existing 16" Cast Iron
Gravity Sewer with 16" PVC Pipe

UNION STREET

COTTAGE STREET

PS

GROVE STREET

WASHINGTON STREET

495

Legend

- New Sewer Manhole
- Historic Sanitary Sewer Overflow
- New Sewer Pipe
- Existing Sewer Manhole
- PS — Existing Pump Station
- Existing Gravity Sewer
- Existing Pump Station Force Main
- Watercourse
- Waterbody
- Wetland/Environmentally Sensitive Area

Feet
0 1,000 2,000

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor
Alternatives Analysis

ARCADIS Design & Consultancy for natural and built assets

FIGURE 4

Alternative No. 2 - Replacement of
the Existing Beaver Street Interceptor

March 2021

5.3 Alternative No. 3

Recommended improvements for Alternative No. 3 are shown on **Figure 5** and includes:

- Cured-in Place Pipe Lining of approximately 6,400 LF of gravity sewer
- Replacement/upsizing of approximately 900 LF of gravity sewer with PVC pipe
- Construction of approximately 2,000 LF of new gravity sewer with PVC pipe
- Abandonment of approximately 5,000 LF of sewer within the Beaver St. Easement
- Construction of approximately 19 new sewer manholes and rehabilitation of 30 existing sewer manholes
- Construction of three new pump stations (Beaver Street, Grove Street #3. and Franklin Village Plaza)
- Construction of three associated force mains, totalling approximately 8,100 LF

5.3.1 Evaluation of Alternative No. 3

Alternative No. 3 consists of replacement/upsizing of approximately 15% of the BSI from 16" to 18" with new PVC pipe and new sewer manholes from manhole MH8 to MH12, rehabilitation of approximately 45% of the BSI with CIPPL and internal manhole rehabilitation, abandonment of approximately 40% of the BSI along the Beaver Street Easement and the Franklin Village Plaza, construction of three new sewer pump stations and associated force mains, and realignment/construction of approximately 2,500 LF of new gravity sewer.

Recommendations for renewal and replacement of the BSI from Cottage Street to Beaver Street are the same as described in Alternative No. 1. Pipe replacement and upsizing recommendations were developed based on results of the hydraulic model and the locations of historic SSOs (MH7 and MH8) to increase capacity and mitigating the risk of future SSOs in these locations.

Alternative No. 3 provides a long-term solution to the accessibility, O&M, and capacity challenges caused by the existing BSI alignment by abandoning and rerouting sewers in the most problematic and inaccessible areas. The proposed Beaver Street Pump Station (BSPS) would intercept flows that currently flow north through the Beaver Street Easement and also receive flows from Panther Way by way of a new gravity sewer. The BSPS would then pump flows from Beaver Street, then northerly along West Central Street (Rt. 140) through a new 20" force main, discharging to a new gravity sewer on Old West Central Street. The portion of the BSI that is proposed to be abandoned also currently receives tributary flow from Grove Street at the Interstate 495 crossing and from the Franklin Village Plaza. These tributary lines will be redirected to the proposed Grove Street Pump Station #3 and the proposed Franklin Village Plaza Pump Station, as shown on **Figure 5**.

Alternative No. 3 provides sufficient capacity for the projected flow rates through the BSI, eliminates all accessibility challenges, mitigates risk of SSOs and other environmental concerns, and eliminates the need to maintain the mile-long Beaver Street Easement.

The preliminary project cost estimate for Alternative No. 3, which includes engineering and construction costs, is approximately $25 Million. A project cost breakdown is included in **Appendix E**.

N

Rehabilitation of 1,900 LF of Existing 24" Reinforced Concrete and Vitrified Clay Pipe with Cured-in-Place Pipe Lining

1,000 LF of New 15" PVC Sewer

Proposed Beaver Street Pump Station Force Main - 5,000 LF of 20" HDPE Pipe

Proposed Franklin Village Mall Pump Station Force Main - 700 LF of 6" HDPE Pipe

Proposed Grove Street #3 Pump Station Force Main 2,400 LF of 8" HDPE Pipe

Abandon 1,000 LF of Existing Gravity Sewer and Redirect Flow to the Proposed Grove Street #3 Pump Station

Abandon 5,000 LF of Existing 24" Gravity Sewer

Location of Historic Overflow. Risk of Overflow Mitigated by Abandoning Downstram Sewer and Redirecting Flow to the Proposed Beaver Street Pump Station

1,000 LF of New 18" PVC and 500 LF of 24" PVC to Redirect Flows to the Proposed Beaver Street Pump Station

Rehabilitation of 3,300 LF of Existing 18" and 20" Cast Iron Gravity Sewer with Cured-in-Place Pipe Lining

Replace/Upsize 900 LF of Existing 16" Cast Iron Pipe with New 18" PVC

Location of Historic Overflow. Risk of Overflow Mitigated by Increasing Downstream Pipe Size.

Rehabilitation of 1,150 LF of Existing 16" Cast Iron Gravity Sewer with Cured-in-Place Piping Lining

Mine Brook Circle Pump Station

Proposed Grove Street #3 Pump Station

Proposed Franklin Village Mall Pump Station

Franklin Village Mall

Proposed Beaver Street Pump Station

Public Works Pump Station

Beaver Pond

Mine Brook Interceptor

OAK STREET

POND STREET

GROVE STREET

BEAVER STREET

WEST CENTRAL STREET

UNION STREET

WASHINGTON STREET

MH53 MH52 MH51 MH50A MH50 MH49 MH48 MH47A MH47 MH46A

MH32 MH31 MH30 MH29 MH28 MH27 MH26 MH25 MH24 MH23 MH22 MH21 MH20 MH19 MH18 MH17 MH16 MH15 MH14 MH13 MH12 MH11 MH10 MH9 MH8 MH7 MH6 MH5 MH4 MH3 MH2A MH2 MH1

PS

495

Legend

- Historic Sanitary Sewer Overflow
- Existing Sewer Manhole
- Existing Pump Station
- Existing Gravity Sewer
- Existing Pump Station Force Main
- Watercourse
- Waterbody
- Wetland/Environ... Sensitive Area

Feet
0 1,000 2,000

Town of Franklin, Massachusetts

Beaver Street Sewer Interceptor Alternatives Analysis

ARCADIS Design & Consultancy for natural and built assets

FIGURE 5

Alternative No. 3 - Rehabilitation and Realignment of the Existing Beaver Street Interceptor

March 2021

5.4 Costs

A preliminary project cost estimate was developed for each alternative. A summary for each alternative is included in **Table 2** and a detailed breakdown of each cost is included in Appendix E. The costs presented in Table 2 are in today's dollars (2020) and construction costs were escalated 3% per year to the assumed mid-point of construction. For each alternative presented, the mid-point of construction is 2024.

Costs presented in Table 2 also include design, bidding, permitting, engineering services during construction, uniformed police officers, and a 25% planning level contingency.

Table 2: Summary of Costs

Alternative No. 1[(1)] – Rehabilitation of Existing BSI	
Description of Work	**Preliminary Project Cost Estimate**
Engineering Design Services	$444,982
Preliminary Construction Cost Estimate	$7,216,903
Engineering Services During Construction	$998,399
Uniformed Police Officers	$339,716
Total Project Cost Estimate	$9,000,000
Alternative No. 2 [(2)] – Replacement of Existing BSI	
Description of Work	**Preliminary Project Cost Estimate**
Engineering Design Services	$925,652
Preliminary Construction Cost Estimate	$13,745,276
Engineering Services During Construction	$1,823,403
Uniformed Police Officers	$505,668
Total Project Cost Estimate	$17,000,000
Alternative No. 3 [(3)] – Rehabilitation and Realignment of Existing BSI	
Description of Work	**Preliminary Project Cost Estimate**
Engineering Design Services	$1,511,500
Preliminary Construction Cost Estimate	$19,890,836
Engineering Services During Construction	$2,466,100
Uniformed Police Officers	$1,131,564
Total Project Cost Estimate	$25,000,000

Notes: (1,2) A breakdown of the preliminary project cost estimate for Alternatives No. 1 and 2 are provided in Table E-1 and E-2 in Appendix E. (3) A breakdown of the preliminary project cost estimate for Alternative No.3 is provided in Tables E-3.1 through E-3.6 in Appendix E.

5.5 Comparison of Alternatives

As discussed, parameters considered in the comparison of alternatives include: construction and Operation and Maintenance (O&M) cost; reliability of design and operation of the system; risk of SSOs; environmental concerns; maintenance and accessibility challenges; easement requirements; permanent and temporary impacts to residents and businesses; and permitting requirements. Based on discussions with the Town DPW, each of these parameters was assigned a relative weight or level of importance to develop a weighted average score and rank the Alternatives. Each alternative received a rating from 1 to 5 for each of the parameters with 1 representing the least advantageous and 5 representing the most advantageous. Parameters, relative weight or level of importance, ratings, and weighted average scores are shown in **Table 3** below.

Table 3: Comparison of Alternatives

Parameter	Relative Weight or Level of Importance	Alternative No. 1	Alternative No. 2	Alternative No. 3
Preliminary Project Cost Estimate	20%	5	3	2
Reliability of Design/Operation	10%	3	3	5
Risk of Overflows	20%	2	4	5
Environmental Concerns/Risk	15%	2	2	5
Maintenance	10%	3	3	2
Accessibility/Easements	15%	1	1	4
Impacts to Residents/Businesses	5%	4	4	3
Permitting Requirements	5%	2	1	3
	100%			
Weighted Average		**2.8**	**2.7**	**3.8**

(1) – Highly Disadvantageous, (2) – Disadvantageous, (3) – Neutral, (4) – Advantageous, (5) – Highly Advantageous

Alternative No. 3 has the highest of the three weighted average scores at 3.8 and is considered the best option for the Town. Alternative No. 1 and Alternative No. 2 have the second and third highest weighted average scores at 2.8 and 2.7, respectively.

6 RECOMMENDED PLAN AND IMPLEMENTATION SCHEDULE

Based on the comparison of alternatives analysis included in Section 5.5 and ongoing discussions with the Town, it is recommended that the Town proceed with Alternative No. 3 – Rehabilitation and Realignment of the BSI. While the preliminary project cost estimate for Alternative 3 is the highest; improving environmental impacts, access, maintenance, and SSOs along the BSI far outrank Alternatives No. 1 and No. 2.

6.1 Project Financing – State Revolving Fund

The Massachusetts Department of Environmental Protection (MADEP) Division of Municipal Services (DMS) administers the State Revolving Fund (SRF) loan program, which offers affordable loan options to cities and towns to improve water and wastewater facilities and infrastructure to assist with compliance with federal and state water quality requirements.

It is recommended that the Town apply for SRF funding for the construction of Alternative No 3. While design engineering services are not SRF eligible, construction, construction phase engineering services and bidding and award services are eligible.

The annual timeline associated with applying for and obtaining an SRF loan is as follows:

- June: DMS issues solicitation of proposals for SRF financial assistance for the next calendar year
- August: Applications, called Project Evaluation Forms, along with supporting documentation, are due to DMS. The information provided in the PEF allows the Division to rate and rank projects based upon the severity of the problem being addressed
- Fall: Projects selected to receive SRF financing are published in a Draft Intended Use Plan (IUP). The IUP lists proponents, project name and cost, for the selected projects.
- Jan – March: Final IUP and Priority List is distributed

Once a project is included on the IUP, proponents must secure local borrowing authorization of the cost of the project by June 30 of the IUP year. Proponents must complete and submit a Loan application with buildable plans and specifications, by Oct 15 of the same year. Once a proposal is approved by DMS, the proponent has 6 months to initiate construction. An estimated monthly drawdown schedule for Alternative No. 3 is shown as **Table 4.**

Franklin, MA
Beaver Street Interceptor Renewal/Replacement
Table 4 - Estimated Monthly Drawdown Schedule

CY	Month	Monthly Drawdown	Cumulative Drawdown
2021	Mar	$83,972	$83,972
	Apr	$83,972	$167,944
	May	$83,972	$251,917
	Jun	$83,972	$335,889
	Jul	$83,972	$419,861
	Aug	$83,972	$503,833
	Sep	$83,972	$587,806
	Oct	$83,972	$671,778
	Nov	$83,972	$755,750
	Dec	$83,972	$839,722
2022	Jan	$83,972	$923,694
	Feb	$83,972	$1,007,667
	Mar	$83,972	$1,091,639
	Apr	$83,972	$1,175,611
	May	$83,972	$1,259,583
	Jun	$83,972	$1,343,556
	Jul	$83,972	$1,427,528
Design Complete	Aug	$83,972	$1,511,500
Bidding	Sep	$9,950	$1,521,450
(SRF Drawdown)	Oct	$9,950	$1,531,400
Begin Construction	Nov	$754,613	$2,286,013
	Dec	$754,613	$3,040,626
2023	Jan	$754,613	$3,795,239
	Feb	$754,613	$4,549,852
	Mar	$754,613	$5,304,465
	Apr	$754,613	$6,059,077
	May	$754,613	$6,813,690
	Jun	$754,613	$7,568,303
	Jul	$754,613	$8,322,916
	Aug	$754,613	$9,077,529
	Sep	$754,613	$9,832,142
	Oct	$754,613	$10,586,755
	Nov	$754,613	$11,341,368
	Dec	$754,613	$12,095,981
2024	Jan	$754,613	$12,850,594
	Feb	$754,613	$13,605,206
	Mar	$754,613	$14,359,819
	Apr	$754,613	$15,114,432
	May	$754,613	$15,869,045
	Jun	$754,613	$16,623,658
	Jul	$754,613	$17,378,271
	Aug	$754,613	$18,132,884
	Sep	$754,613	$18,887,497
	Oct	$754,613	$19,642,110
	Nov	$754,613	$20,396,723
	Dec	$754,613	$21,151,335
2025	Jan	$754,613	$21,905,948
	Feb	$754,613	$22,660,561
	Mar	$754,613	$23,415,174
	Apr	$767,213	$24,182,387
End Construction	May	$767,213	$24,949,600
Close-Out	Jun	$12,600	$24,962,200
	Jul	$12,600	$24,974,800
	Aug	$12,600	$24,987,400
	Sep	$12,600	**$25,000,000**
Total:		**$25,000,000**	

6.2 Project Implementation Schedule

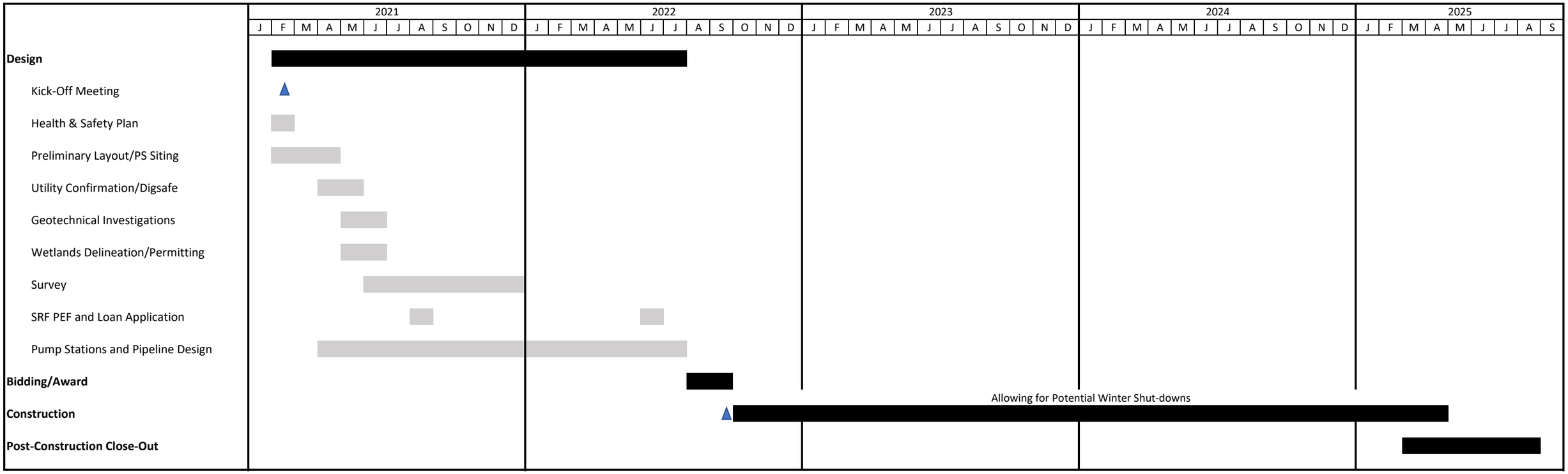
A proposed schedule for implementation is shown in **Table 5 and Figure 6**.

Table 5: Project Implementation Schedule

Project Milestone	Anticipated Schedule
Design (Siting, Geotechnical, Survey, Permitting, Pump Station and Pipeline Design)	February 2021 – July 2022
SRF PEF and Loan Application	August 2021 and August 2022
Project Bidding/Award	August 2022 – September 2022
Construction Phase	October 2022 – April 2025

Town of Franklin, MA
Beaver Street Interceptor Rehabilitation and Replacement

Figure 6 - Project Implementation Schedule



APPENDIX A

Manhole Inspection Logs, May 2013

APPENDIX B

CCTV Inspection Logs, August 2014 – September 2014

APPENDIX C

Hydraulic Modeling Technical Memorandum

APPENDIX D

Beaver Street Interceptor Replacement

Alternatives Analysis

Franklin Town Council Meeting Presentation – October 21, 2020

APPENDIX E

Detailed Cost Estimates

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