	Added Ballasted Flocculation Process (e.g. CoMag or Actiflo)		to meet lower P permit limits	secondary/tertiary clarifiers needed - New proprietary process - Increased energy demands
F	Chemical Precipitation with Added Effluent Filtration (Cloth, Granular or other Filter Media) Process	P	- Ability to meet permit limits - Additional benefit in effluent solids removal	- New major process required - Forward flow pumping required to meet hydraulic requirements
		Nitrogen Removal Technologies		
G	Modify Secondary RBC Process to Add Anoxic Stage (Submerged RBC) for Denitrification	N	- Makes use of existing RBCs – Limits impacts during construction - Similarity to current process equipment	- Dated technology - Significant space requirement - May not meet permit limit alone
H	Modify Secondary RBC Process to Add Anoxic Zone (MBBR Media Anoxic Reactor) for Denitrification	N	- Makes use of existing RBCs – limits impacts during construction	- Significant space requirement - Limited successful applications available - May not meet permit limit alone
I	Modify Secondary RBC Process to Add Anoxic Zones (Liquid Phase) for Denitrification	N	- Makes use of existing RBCs – limits impacts during construction	- Significant space requirement - Limited successful applications available - May not meet lowest N permit limit alone
J	Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process – Deep Bed Filter	N (and P)	- Makes use of existing RBCs – limits impacts during construction - May be used to address P removal - Additional benefit in effluent solids removal	- Significant space requirement - Forward flow pumping required to meet hydraulic requirements
K	Modify Secondary RBC Process to Add New Effluent Denitrification Filter Process – BlueWater Filter	N (and P)	- Makes use of existing RBCs – limits impacts during construction - May be used to address P removal - Additional benefit in effluent solids removal	- Significant space requirement - Forward flow pumping required to meet hydraulic requirements - New proprietary process
L	Replace RBC Process with New Sequencing Batch Reactor (SBR) Secondary Process	N	- Limited space for footprint required -Secondary clarifiers not required	- Requires demo of existing RBCs and major change in process operations

				- May not meet permit limit alone - Forward flow pumping required to meet hydraulic requirements
M	Replace RBC Process with New Membrane BioReactor (MBR) Secondary Process	N	- Produces very high quality/low solids effluent -Secondary clarifiers not required -Effluent filter not required	- Requires demo of existing RBCs and major change in process operations - Energy intensive process requires pumping for forward flow - May not meet permit limit alone
N	Replace RBC Process with New Activated Sludge Secondary Process (MLE)	N	- Less complex process	- Requires demo of existing RBCs and major change in process operations - May not meet permit limit alone
O	Replace RBC Process with New Activated Sludge Secondary Process (A_20)	N	- Less complex process	- Requires demo of existing RBCs and major change in process operations - May not meet permit limit alone
P	Replace RBC Process with New 4-stage Bardenpho Secondary Process	N	- Demonstrated ability to meet lower N permit limits	- Requires demo of existing RBCs and major change in process operations
		Nitrogen and Phosphorus Removal Technologies		
Q	Replace RBC Process with New 5-stage Bardenpho Secondary Process	N and P	- Demonstrated ability to meet lower N permit limits - Enhanced biological P removal will reduce chemical requirements	- Requires demo of existing RBCs and major change in process operations

In order to consistently meet both the nitrogen and phosphorus permit limits, a combination of nitrogen and phosphorus removal alternatives described above will be required. Most of the nitrogen removal technologies can be combined with chemical precipitation of phosphorus using metal salts. The major differences include the mode of removal of precipitated flocc – gravity methods (clarifiers, batch settling or ballasted settling) or physical barrier methods (filters or membranes).

Based on our review of the available processes, the advantages and disadvantages and the site specific characteristics including space and current processes (both wet and solids stream), we believe the following options should be considered further.

1. Alternative I - Refurbish the existing RBCs , add new suspended growth denite zones in

either post only, pre- and post-anoxic, or step feed anoxic configuration, with multi-point chemical feed for phosphorus removal and effluent polishing filters.

2. Alternative L - Replacement of the existing RBC process with and SBR activated sludge configuration, with multi-point chemical feed for phosphorus removal and effluent polishing filters.

3. Alternative Q - Replacement of the existing RBC process with a new five stage Bardenpho process, with multipoint chemical feed for phosphorus and polishing filters.

A more detailed discussion of the implementation requirements for these final three process alternatives is presented in the following section.

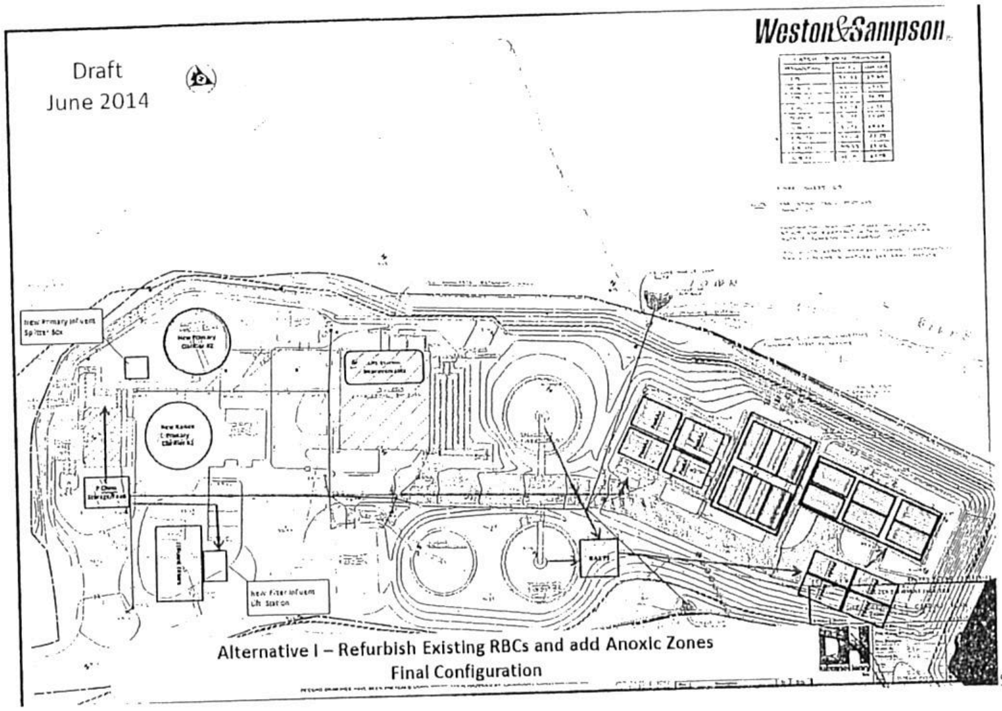
5.5.2 Detailed Conceptual Review of WWTF Process Alternatives

Each of the three WWTF process alternatives identified for further review in the screening discussion above were reviewed in further detail for implementation considerations. The following information and supporting figures provide details on how these options would be implemented at the Bridgewater WWTF.

5.5.2.1 Alternative I - Modify Secondary RBC Process to Add Anoxic Zones

Alternative I includes refurbishing the exiting RBC process, adding new suspended growth denite zones in either post-anoxic only, pre- and post-anoxic, or step feed anoxic configuration, combined with multipoint chemical feed for phosphorus removal and effluent polishing filters. This approach could be employed in two ways at Bridgewater, as a post-anoxic zone only, following the RBCs, or as both a pre- and post-anoxic zone, to take advantage of the available carbon in the influent for denitrification. A pre-anoxic zone (such as provided in an MLE process) alone would not achieve the proposed effluent total nitrogen limits. In either case, a suspended growth anoxic zone will require additional secondary clarifiers at the plant due to the increased solids load resulting from the suspended biomass. In addition, a new activated sludge recycle pump station will be required to maintain the biomass levels in the reactor. The post anoxic zone would be most efficient using an external carbon source requiring the installation of a chemical storage and feed system. All applicable suspended growth activated sludge system will also result in an increase in waste solids production over fixed film type systems that will increase thickening and dewatering capacity needs. It is expected, however, that this can be accommodated by extending processing time on exiting solids handling equipment such that solids handling expansion is not required.

Figure 5-9: Alternative I-Refurbish Existing RBC's and add Anoxic Zones Final Configuration depicts the conceptual layout for this alternative.



Alternative I - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1
3. Modify Primary Effluent Lift Pumps and Piping to discharge 50% of flow to new raised primary and50% to remain to RBCs through existing FM
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBCs.

Phase 2: New Tertiary Effluent Filters
The filters provided in this phase will provide more reliable solids removal for the secondary effluent while the new secondary treatment systems are constructed.

1. Construct New Tertiary Sand Filters complete with filter influent lift station and Connect New Phosphorus Chemical Feed to Filters for effluent Polishing.

Phase 3: RBC Refurbishment
Under this upgrade approach the primary anoxic zones will provide some soluble BOD removal. This combined with the enhanced primary clarification reduces the total surface area of the RBC

system required at design flows and loads. This approach reduces the current 14 RBC shafts by two (less than 10%). The BOD removal afforded by the new pre-anoxic zones together with the use of higher density media on the new RBC shafts will offset the reduction in the number of shafts. This eliminates the need for the third battery of RBC tanks which will be converted to the post anoxic zones in the subsequent stage limiting the additional footprint required for this option.

Due to access limitation for construction and maintenance of process performance during construction the proposed staging addresses the replacement of battery 1 and 2 of the RBC shafts before building the pre and post anoxic zones. Two refurbished batteries providing 12 shafts together with the enhanced primary and secondary clarification and the new effluent tertiary filters is sufficient to handle current plant flows. Beginning with the second battery minimizes the number of shafts out of service during construction. The first battery would follow.

1. Provide for bypass and or split of flow to batteries 1 and 3 of the RBC to allow the middle battery 9battery 2) to be removed from service.
2. Remove existing 4 RBC shafts and drives in Battery 2 and refurbish concrete tanks and install 6 new RBC shafts in the refurbished tanks.
3. Bring refurbished batter 2 on line and isolate Battery 1.
4. Remove Existing 6 RBC shafts in Battery 1, refurbish tanks and install 6 new RBC shafts in Battery 1 and bring on line.

Phase 4: Pre- and Post-Anoxic Zones and RAS PS
This phase provide the necessary pre and post anoxic zones needed to reduce the nitrate levels. Using a suspended sludge approach for these zones requires the establishment and maintenance of suspended biomass and a return sludge pump station. The pre-anoxic reactors and RAS Pump Station can be constructed essentially independent of the operation of the rest of the facility as upgraded in prior phases without compromising treatment and then being tied in once completed. Once this is complete, the post anoxic zones can be constructed in the existing RBC battery 3 tankage. The post anoxic carbon storage and feed system if required is expected to be installed on the ground floor of the RAS PS above the below grade RAS wet well and pump room.

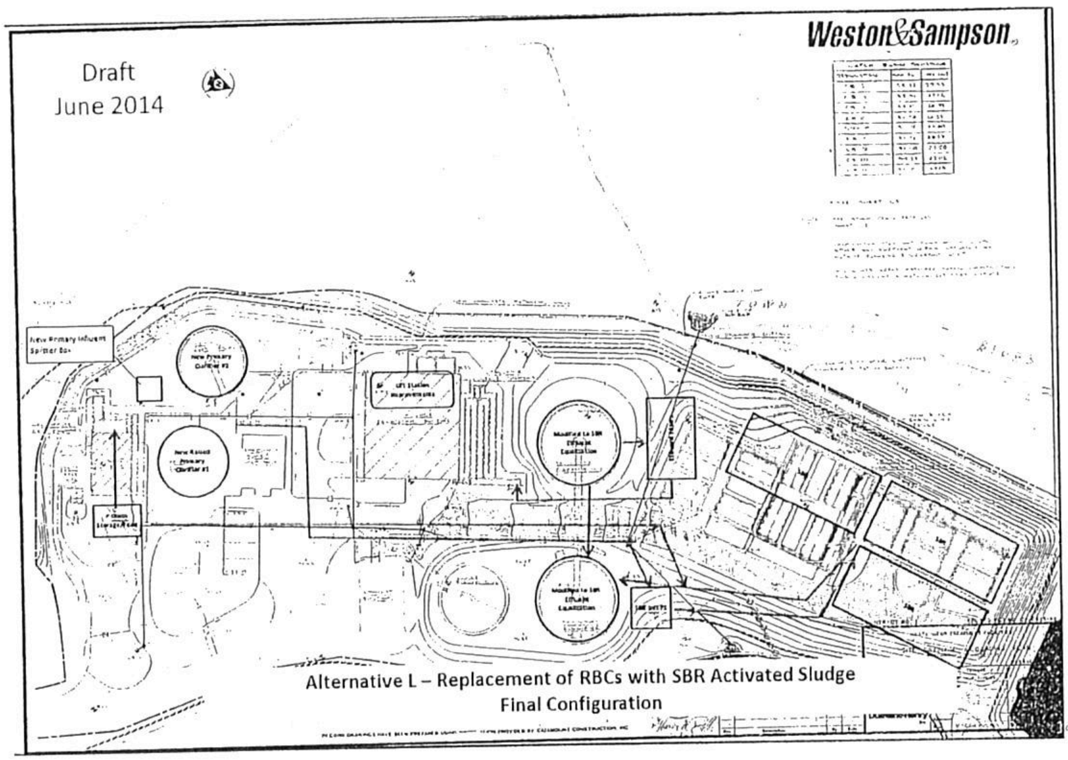
1. Construct the new return sludge pump station, Pre-anoxic zones, reroute the influent to them and bring them on line.
2. Remove the third battery of existing RBC shafts from service and convert the tankage to post anoxic zones and install the carbon storage and feed equipment in the RAS PS and bring all on line.

Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.2 Alternative L – Replace RBC Process with New SBR
Alternative L includes replacement of the existing RBC process with and SBR activated sludge configuration, with multi point chemical feed for phosphorus removal, and effluent polishing filters. Due to their batch intermittent mode of operation, a minimum of two SBRs would need to be constructed and operated under a modified 4 hour operating cycle (2 hours fill/react, 2 hours settle decant or something similar) to allow continuous influent flow once in service. Splitting flow intermittently to one SBR and the existing RBCs is not practical for maintaining treatment during construction. The batch SBR operation will require either influent or effluent equalization. In this case because effluent filters and chlorination will be employed SBR effluent equalization will be required at a minimum. Because the SBRs will not require final clarifiers the existing final clarifies

could be employed with modifications for equalization. In addition the tertiary filters will require equalization of influent flow and therefore in this option are constructed in the final phase with the last SBR.

Figure 5-10: Alternative L - Replacement of RBCs with SBR Activated Sludge Final Configuration depicts the conceptual layout for this alternative.



Alternative L - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1.
3. Modify Primary Effluent Lift Pumps and Piping to discharge 50% of flow to new raised primary and50% to remain to RBCs through existing FM.
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2.
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2.
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBC battery 2 and 3.

Phase 2: SBR #1 and #2 Construction w/ Effluent Equalization

This phase provides for the construction of two SBR reactors and the requisite SBR influent lift station as well as conversion of one existing final clarifier to SBR effluent equalization.

1. Demolish RBC battery 1.
2. Construct New SBRs #1 and 2, new SBR influent lift station and convert Final Clarifier #2 to SBR Effluent Equalization.
3. Tap RBC influent line into lift station and connect SBR effluent to new equalization (Final Clarifier #2).
4. Bring New SBRs on Line with Equalization.

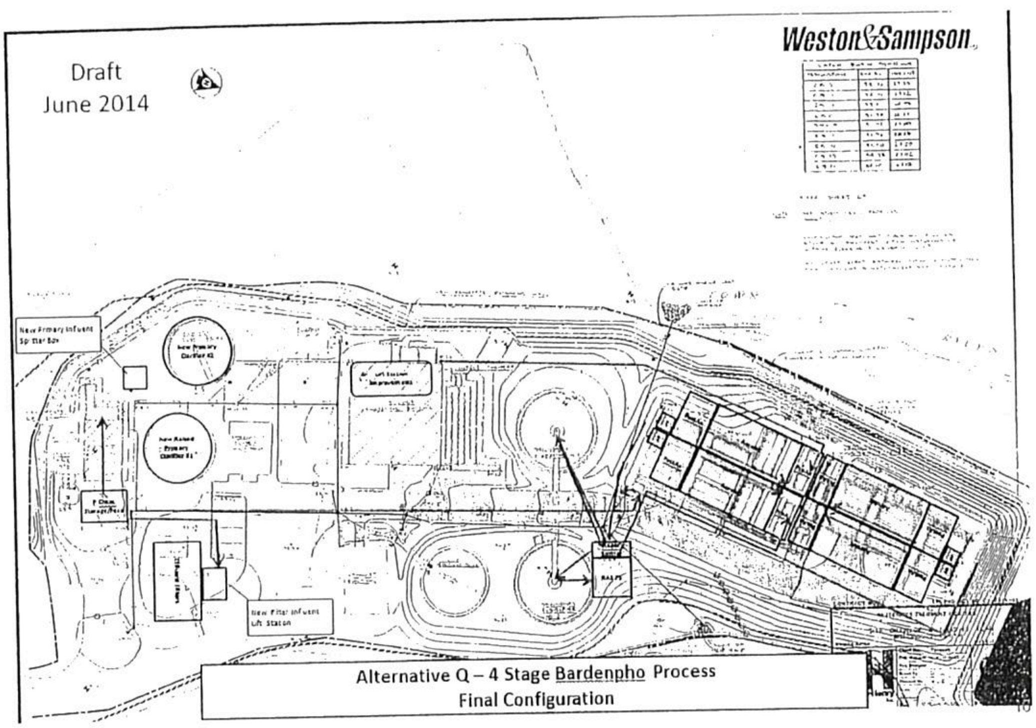
Phase 3: SBR #3 Construction w/ Additional Effluent Equalization and New Tertiary Filters

1. Demolish remaining RBC batteries.
2. Construct new SBR #3.
3. Convert Final Clarifier #1 to additional SBR Effluent Equalization.
4. Construct New Tertiary Filters using SBR effluent Equalization tanks as influent wet well.
5. Bring all elements on line.

Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.3 Alternative Q – Replace RBC Process with New Bardenpho Process

Alternative Q includes replacing the existing RBC based secondary treatment with a new activated sludge based 4-Stage Bardenpho process. As with the prior option this alternative includes rebuilding and raising the primary clarifiers and new tertiary effluent filters. Figure 5-11: Alternative – Q 4 Stage Bardenpho Process Final Configuration depicts the conceptual layout for this alternative.



Alternative Q – 4 Stage Bardenpho Process
Final Configuration

Alternative Q - Required Components/Staging:

Phase 1: Primary Clarifier, Chemical Feed and Influent Lift Station Reconstruction
Phase one improvements provide improved primary clarifier performance by providing a more conventional clarifier depth as well as coagulant addition capability (alum or Ferric). This improved primary clarifier performance will serve to offload the exiting secondary treatment system allowing for staged replacement with the new activated sludge tankage in subsequent phases.

1. Build New Phosphorus Chemical Storage and Feed Facility and Feed Lines to Influent prior to Primaries and to RBC effluent splitter to provide enhanced primary and secondary TSS removal.
2. Decommission and demo existing Clarifier #1 and rebuild as raised Clarifier #1
3. Modify Primary Effluent Lift Pumps and piping to discharge 50% of flow to new raised primary and 50% to remain to RBCs through existing FM.
4. Decommission and demo existing Clarifier #2 and rebuild as raised Clarifier #2.
5. Modify remaining Pumps in Primary Effluent Lift Station to discharge to New Primary #2.
6. Bring new Enhanced Primary Clarification fully on line with Gravity flow to RBCs.

Phase 2: New Tertiary Effluent Filters
The filters provided in this phase will provide more reliable solids removal for the secondary effluent while the new secondary treatment systems are constructed.

1. Construct New Tertiary Sand Filters complete with filter influent lift station and Connect New Phosphorus Chemical Feed to Filters for effluent Polishing.

Phase 3A: RBC Battery 1 Replacement with New Bardenpho Reactors
This phase will upgrade the secondary system in a stepwise fashion to a new activated sludge based Bardenpho process complete with new return sludge pump station. Phase 3A will provide two new trains of activated sludge based treatment which together with the enhancements provided in the prior phases will be capable of treating 100% of current flows. A minimum of one half of the existing RBC will remain in service with chemically enhanced final clarification followed by the new tertiary effluent filters as added contingency against washout during construction. The Bardenpho reactor design anticipated here would employ the newer invent style mixer aerators with deck mounted blowers located on the reactors themselves. This eliminates the need for a new blower structure and the additional space required for it on this tight sight and the associated aeration headers and diffusers.

1. Construct new Final Clarifier Splitter Box and Return Sludge Pump Station.
2. Demolish first of three existing batteries of RBCs (Battery 1) and construct two parallel trains of the Bardenpho process including connection of RAS pump station to new process train. Keeping the remaining RBCs and final clarifiers in service during construction.
3. Startup two new trains of secondary treatment process tanks and establish full treatment at current flows with the new system.

Phase 3B: RBC Batteries 2 and 3 Replacement with New Bardenpho Reactors

1. Demolish remaining RBCs and construct last two parallel trains of new secondary process tanks.

Upon completion of the upgrades the secondary process will have one redundant train at design flow of 1.44 MGD, while the primary and final clarifiers will not. The redundancy/capacity provided by the fourth train in the secondary treatment process tankage can be used to compensate for loss of either one primary or one final clarifier. The effluent filters provide for one redundant unit under average daily flow and load.

Construction sequencing figures supporting this alternative are included in Appendix G: WWTF Alternatives Construction Sequencing.

5.5.2.4 Cost Comparison of Final Process Alternatives

One of the primary challenges of reviewing and comparing process alternatives is appreciating the implications that each alternative has on the overall cost to upgrade the WWTF, while in parallel understanding the costs for WWTF improvements that are relatively independent of the selection of these alternatives. A key example of this is that each of the three key process alternatives will need to be supported by a chemical precipitation and multi-barrier system to meet the phosphorus effluent limits. All three options discussed above are therefore are assumed to include chemical feed systems and a new effluent filtration system - which is essentially the same for each alternative, and therefore can be omitted from the direct comparison. For the purpose of completeness, we generated planning level costs for the total WWTF facility improvement program needed for the Bridgewater plant aligned with each of the final three process alternatives. These fully developed WWTF improvement costs are included for side by side comparison in Appendix J: Bridgewater WWTF Planning Level Cost Estimate.

In this section, we present only the portions of the WWTF costs that are specific to the process alternative selection – this allows a better appreciation for the difference in the capital cost to construct the improvements associated with each process alternative. Table 5-10: Comparison of Process Alternatives 'Partial Costs' includes the process alternative 'partial cost' comparison.

Table 5-10
Comparison of Process Alternatives 'Partial Costs'

Process Component	*Alternative I RBC with New Anoxic*	*Alternative L New SBR System*	*Alternative Q New Bardenpho System*
RBC Modifications	$1,300,000	$125,000	$125,000
New Process Systems	$1,350,000	$3,450,000	$4,200,000
Blowers & Support Systems	$250,000	$1,000,000	$1,200,000
Clarifier & Sludge Pumping Systems	$2,360,000	$2,360,000	$510,000
New Yard Piping	$225,000	$150,000	$150,000
Temporary Flow Handling & Bypass	$100,000	$150,000	$150,000
Subtotal	*$5,585,000*	*$7,235,000*	*$6,335,000*
Unscheduled Costs*	$280,000	$360,000	$320,000

Contractor Mark-up (BOHP)*	$840,000	$1,085,000	$955,000
Construction Cost Subtotal for Comparison of Costs	*$6,705,000*	*$8,680,000*	*$7,610,000*

* These cost/budget items are scaled to the partial costs for comparison, and are not total project costs.

Annual operation and maintenance cost impacts of the alternatives must also be considered in comparing alternatives that vary significantly. In general, the RBC process is very cost effective from an energy standpoint compared to the other processes that use pressurized air systems to aerate the process biology. The other two options tend to be somewhat more expensive from a process operation and maintenance (O&M) cost standpoint. The general cost profile of the three final alternatives is summary in Table 5-11: Process Alternatives Comparative Cost Profiles.

Table 5-X
Process Alternatives Comparative Cost Profiles

Cost Component	*Alternative I RBC with New Anoxic*	*Alternative L New SBR System*	*Alternative Q New Bardenpho System*
Capital Costs	Least Expensive	More Expensive	Most Expensive
Annual Costs	Least Expensive	More Expensive	Most Expensive
Net Comparative Cost Profile	**Least Expensive**	More Expensive	Most Expensive

As can be seen from the comparison, Alternative I, which includes continued use of the RBC process supplemented with the addition of anoxic zones, and the provisions of effluent filtration, offers the most desirable and cost-effective solution to the Town of Bridgewater.

5.5.2.5 WWTF Capacity Considerations

The overall anticipated costs to modernize the WWTF and to improve the WWTF processes to meet the new permit conditions will be very high based on the needs and alternatives developed. Based on the flows and loads presented for future conditions, including planned future development and sewer extensions, additional capacity at the WWTF should be considered. The incremental cost to provide a capacity increase as part of the overall WWTF improvements is expected to be nominal, as most existing process can be adjusted during the upgrades – essentially allowing a rerating of process components to remain in service, while designing new components for the ultimate design flow.

The controlling factor on system treatment capacity is more related to the permit limits – the current and proposed NPDES discharge permit limit the WWTF to an average daily flow of 1.44 mgd. Considering the significance of the permit change impacts on capital and operating costs at the facility, requesting an increase in the NPDES permit to allow for additional capacity makes sense for Bridgewater, and the additional capacity should help to mitigate cost impacts by allowing for additional future system revenues.

The NPDES program allows for increases up to 10% of the capacity for the system to be considered 'deminimus' – essentially having limited impact on the receiving water. In addition, the Massachusetts Environmental Policy Act (MEPA) program allows for changes to surface water discharges from WWTFs up to 100,000 gpd without significant additional environmental assessment. For planning purposes, the plan for improvements to the Bridgewater WWTF should therefore move forward with a future design capacity to include a deminimus capacity increase, and the nominal future design capacity for the upgraded facility should be 1.54 mgd, ADF.

5.5.3 Other Wastewater Management Alternatives

There are possible courses of action that the town can take to address the wastewater management needs that are not related to physical improvements to facilities. Some examples of these actions include management steps to help mitigate the needs – frequently these actions seek to reduce costs of compliance.

An example of a key management approach would be to appeal the new discharge permit conditions. The Town of Bridgewater has already begun a dialogue with EPA through the commentary on the draft NPDES permit (the most recent comment letter is included in Appendix F: New Draft of NPDES Permit for WWTF & Comment Letter). Other communities have engaged in formal appeals of permit conditions, which can include protracted legal battles. Where the permit conditions are unusually significant for Bridgewater, a permit appeal approach may be a reasonable step. The town must assess the likelihood of the success of an appeal, and also weigh the legal costs to pursue an appeal.

A second approach that has been used in other regions is nutrient trading to address the new nutrient limits in the discharge permit. Nutrient trading for nitrogen impacts has been successfully employed in Connecticut to limit impacts to Long Island Sound. This program works by having the removal of total nutrient loads being non location specific – essentially a plant such as Bridgewater which is not readily adapted to nitrogen removal, could partner with a larger plant that can more efficiently remove nitrogen. The goal is to achieve the same load reduction on the receiving water, but to do so more economically and making best use of existing infrastructure (which varies greatly from plant to plant).. Unfortunately, EPA and Massachusetts DEP have not positioned the Taunton River basin to employ nutrient trading methods. While this option could offer long-term benefits, and could help mitigate impacts on Bridgewater ratepayers, the implementation steps to engage such a program may be challenging – particularly the need to get DEP and EPA support.

5.6 Stormwater Management Alternatives

As discussed in Section 4.4, the permit for stormwater discharges from Small Municipal Separate Storm Sewer Systems (MS4 Permit) was re-issued by the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) on April 4, 2016, and becomes effective on July 1, 2017. The permit requires Bridgewater to implement best management practices for the six minimum control measures discussed in Section 4.4 to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. The MS4 Permit clearly defines the requirements and establishes timeframes for implementation. Since the MS4 Permit is a federally mandated permit, there is little opportunity for deviation from the established requirements, therefore an alternatives analysis was not performed in the context of stormwater management.

6.0 RECOMMENDED PLAN

The recommendations from the CWMP are presented in this section. The discussion is separated into information on the plan selection process, as well as specific components for the Recommended Plan for various water resource management systems and practices.

6.1 Plan Selection

This section of the comprehensive plan presents recommendations for water resource management in the Town of Bridgewater. The process of plan selection has included review of the existing and future conditions, review of needs for various system components, as well as overall programmatic needs, consideration of the findings of past planning efforts and studies, consideration of alternatives, and consideration to stakeholder and public input from public participation efforts. The recommended plan is intended to be consistent with the community's needs and best interests, but also to help establish a plan for regulatory compliance.

The most challenging component of the plan selection is the process change required to meet the new discharge permit conditions for the Bridgewater WWTF. The review of the final three process alternatives suggests that the Bardenpho process, which is the most proven process to meet the required 5 mg/l total nitrogen limit, is more invasive and disruptive to the site and existing WWTF systems to implement. The preferred alternative is the addition of new anoxic zones to be combined with continued use of the RBC process at the WWTF. While this process is expected to meet the new nitrogen limit, it is a less commonly applied solution (suspended growth biological denitrification with attached growth aerobic biological treatment and nitrification), and may require more significant modifications if EPA further lowers the effluent limit for total nitrogen to 3 mg/l (as they have proposed for the Taunton WWTF). The recommended process of modifying the RBC to include new anoxic zones for denitrification was selected for its lesser impact on the WWTF, lower total cost to construct and operate, and its favorability for the WWTF operations staff, who have demonstrated their effectiveness for operating the RBC process to achieve near complete nitrification.

The recommended plan presented herein is subject to further local review and approval, or modification, based on a continuing public participation effort. Local stakeholder support of the recommended plan is crucial considering the significant financial investment needed by the Town of Bridgewater to support the implementation of the recommendations.

6.2 Recommended Plan - General

The recommended plan presented herein has many components, which are organized generally into general management and programmatic recommendations, wastewater management and sewer extension recommendations, wastewater treatment and disposal recommendations, water supply recommendations, and stormwater management recommendations. Information on each of these components of the overall recommendations from the comprehensive planning effort is further presented in the following sections.

6.3 Management and Programmatic Recommendations

Over the course of planning, a number of observations have been made on overall management approaches and programs employed by the Town of Bridgewater, or ones that should be considered. A number of the general and programmatic recommendations are presented herein.

6.3.1 Water Reuse

As recent weather patterns in New England have reminded us, water is an increasingly scarce resource. This scarcity is true in the Bridgewater area – and throughout the Taunton River basin. Water resources need careful management and conservation to ensure the best future availability of water locally. One step that the community can take is to seek opportunities for reuse of treated effluent to supplement the need for clean public water. Effluent reuse is an appropriate step for communities where highly treated effluent can be generated that meets the Massachusetts water reuse standards, and where applications for safe reuse exist in the community. Notable reuse options include irrigation and landscape watering, industrial water uses (e.g. cooling water), institutional and commercial toilet flushing, and indirect reuse through aquifer recharge.

Bridgewater has effluent reuse opportunities in several of these areas, notably:

- Potential reuse for toilet flushing at Bridgewater State University (BSU) buildings could be feasible. This option presents reasonably strong opportunities, as the BSU campus has a number of major buildings and facilities located within one half mile of the Bridgewater WWTF.
- Potential reuse for heating/cooling makeup water at BSU could also be feasible based on the proximity of the BSU campus to the WWTF.
- Potential reuse for irrigation and landscape watering, in both general open spaces (greenspace) and at athletic fields and parks. Again, BSU's athletic complex and a number of its fields and open spaces lie within one half miles of the Bridgewater WWTF.

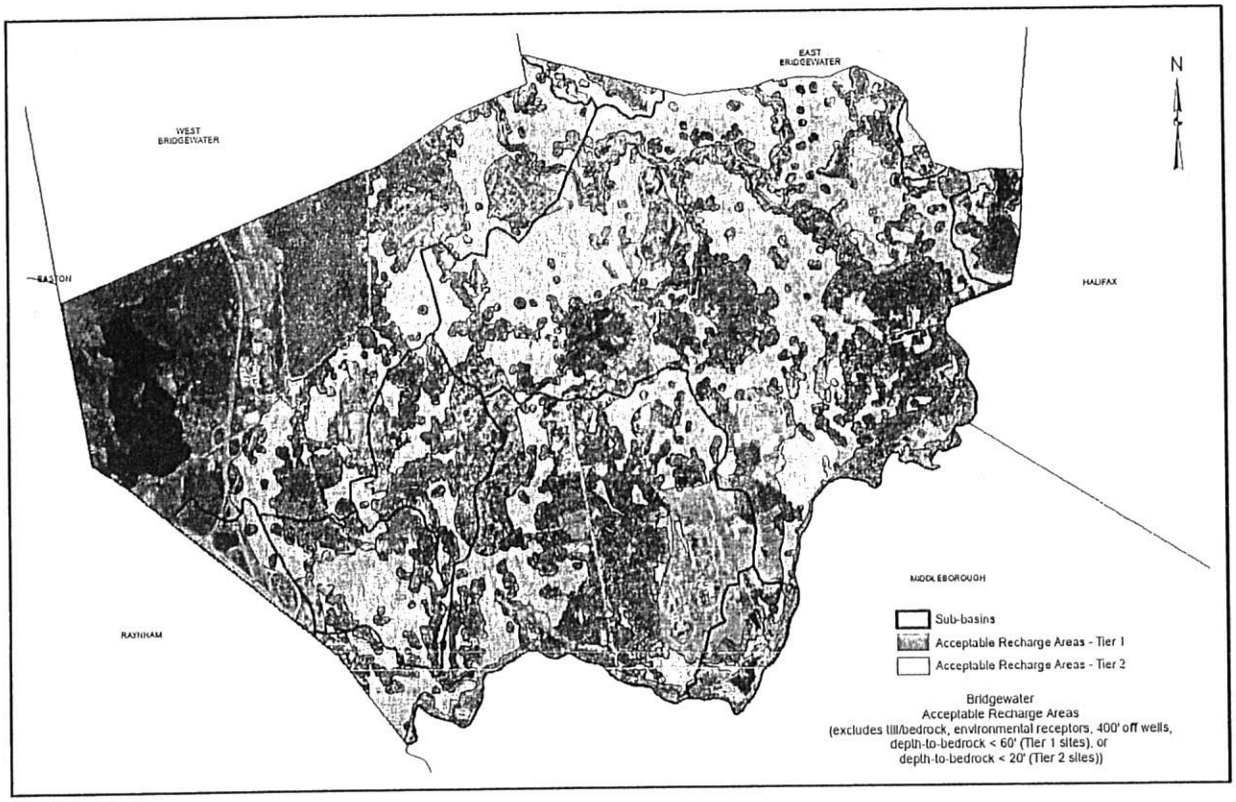
The reuse of highly treated effluent is a proven and safe water management practice, having been employed for many decades in other parts of the United States and overseas. This practice of reuse for landscape watering in now common in Florida and the southwest, and is becoming more readily used in all regions. Treated effluent also can provide added benefits when used for landscape watering, as it contains nutrients (nitrogen and phosphorus), which are beneficial to support plant growth.

Reuse of treated effluent for irrigation and landscape watering would be a positive step for Bridgewater, and would help to reduce permitted discharges to the surface waters – As irrigation uses primarily occur during the dryer summer months, the contribution of these practices can limit demand on potable water supplies, while helping to protect groundwater levels and sustain local water balances.

6.3.2 Groundwater Recharge Considerations

The planning analysis included performing a basic analysis of groundwater recharge considerations for possible future discharge of stormwater or wastewater effluent. The analysis was based on the key geo-physical conditions, includes depth and permeability conditions of soils. In the event that the town pursues stormwater management or alternative wastewater discharges – including effluent reuse for landscape watering as discussed earlier in this section of the CWMP, beneficial areas for recharge have been screened. These acceptable recharge areas are presented on Figure 6-1: Acceptable Recharge Areas.

Figure 6-1
Acceptable Recharge Areas



6.3.3 Regional Coordination

There are a number of properties in Bridgewater that are connected to sewer systems other than the town system, including a small number of properties connected through Raynham to the Taunton regional system. The town should continue to consider regional partnerships with neighboring communities, and with State owned facilities like the MCI Bridgewater facility, to address specific localized wastewater needs that may arise over the planning period. This may include negotiating to connect key properties with critically failing on-site systems to regional systems when they cannot otherwise be rehabilitated, and cannot cost-effectively be connected to the Bridgewater system. Continued open communication with neighboring communities and systems should be maintained by the Bridgewater system management.

6.4 Recommended Wastewater Management & Sewer System Extensions

The recommended plan for the majority of properties in Bridgewater that are presently not connected to sewers and are served by on-site (septic) systems is to continue to be served by these on-site solutions. On-site systems are a reliable and environmentally sound long-term solution for these properties, and no information has been found to suggest on-site solutions cannot provide appropriate wastewater management for these properties for the forseeable future. There have been a number of specific needs areas identified in this report that require consideration of off-site solutions, and those are discussed further as follows.

Consistent with the findings of the town's previous planning reports, the future extension of sanitary sewers to various areas of identified need is warranted. The Recommended Plan for wastewater management was developed by compiling the specific recommendations for each subarea presented in Section 5.4 of this report. The subareas recommended for sewering include the following areas.

- Lakeside Drive Area
- Goodwater Way/ Pleasant Street Area
- Dundee Drive/ Aberdeen Lane Area
- Norlen Park Area
- Bayberry Circle/ Ashtead Road Area
- Atkinson Drive Area
- Whitman Street Area
- Hayward Street Area

6.4.1 Lakeside Drive Area

This subarea consists primarily of residential properties. The varied topography divides this area into two sections. The lower-lying parcels may be served gravity sewer, and the more variable grade upland parcels should be served with low pressure sewer. A pump station will be connected to the existing sewer force main on Pleasant Street by a new force main at the intersection of Pleasant and Lakeside. Figure 5-2 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 17,400 gpd and the peak flow estimate is 95,600 gpd.

Table 6-1
Lakeside Drive Area Sewer Connection

Component	Approx. Qty	Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	5,500 lf	$230	$1,265,000	59
Low Pressure Sewer	2,100 lf	$150	$315,000	22
Force Main	2,200 lf	$100	$220,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$2,300,000	81

6.4.2 Goodwater Way/ Pleasant Street Area

This area consists primarily of residential properties. The proposed layout consists entirely of low pressure sewer, connecting to the existing pump station on Pleasant Street. Figure 5-2 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 6,200 gpd and the peak flow estimate is 33,900 gpd.

Table 6-2 Goodwater Way/ Pleasant Street Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	0	$230	0	N/A
Low Pressure Sewer	1,375 lf	$150	$206,250	28
Force Main	0	$100	0	N/A
Pump Station	0	$500,000	0	N/A
		Total	$206,250	28

6.4.3 Dundee Drive/ Aberdeen Lane Area

This subarea has varied topography and therefore requires the use of gravity sewers and low pressure sewers with individual grinder pumps. This area consists primarily of residential properties. The proposed layout consists of low pressure sewer on the circle of Dundee Drive and the portion of Red Wing Drive depicted in the needs area. The remaining streets are proposed to be serviced by gravity sewer connecting to a pump station on a parcel at the southernmost part of Vernon Street within the needs area. Figure 5-3 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 15,000 gpd and the peak flow estimate is 82,300 gpd.

Table 6-3 Dundee Drive/ Aberdeen Lane Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	4,400 lf	$230	$1,012,000	39
Low Pressure Sewer	1,800 lf	$150	$180,000	25
Force Main	5,600 lf	$100	$560,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$2,342,000	64

6.4.4 Norlen Park Area

This area consists primarily of residential properties. The proposed layout consists entirely of low pressure sewer, connecting to the existing pump station on Pleasant Street. Figure 5-4 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 13,900 gpd and the peak flow estimate is 76,200 gpd.

Table 6-4 Norlen Park Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	0 lf	$230	$0	0
Low Pressure Sewer	5,688 lf	$150	$853,200	63
Force Main	0 lf	$100	$0	N/A
Pump Station	0	$500,000	$0	N/A
		Total	$853,200	63

6.4.5 *Bayberry Circle/ Ashtead Road Area*

This area consists primarily of residential properties. The proposed layout consists entirely of gravity sewer, connecting a proposed pump station on Cross Street. The pump station is connected by force main to an existing sewer at the intersection of Stephanie and South Street. Figure 5-5 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 28,400 gpd and the peak flow estimate is 156,100 gpd.

Table 6-5 Bayberry Circle/ Ashtead Road Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity Sewer	10,600 lf	$230	$2,438,000	109
Low Pressure Sewer	0 lf	$150	$0	N/A
Force Main	10,200 lf	$100	$120,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$3,058,000	109

6.4.6 *Atkinson Drive Area*

This area consists primarily of residential properties. This subarea is varied topography and therefore requires the use of gravity sewers and low pressure sewers with individual grinder pumps, force mains, and pump stations. A proposed pump station is located at the intersection of Stephanie and South Street. Figure 5-6 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 21,100 gpd and the peak flow estimate is 116,200 gpd.

Table 6-6 Atkinson Drive Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Sewer
Gravity Sewer	3,700 lf	$230	$851,000	55
Low Pressure Sewer	4,000 lf	$150	$600,000	41
Force Main	14,000 lf	$100	$1,400,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$3,351,000	96

The Douglas, Atkinson and Fiske Drive area has been the subject of recent past discussions for sewer extension locally, and the residents of the area were not principally supportive

6.4.7 Whitman Street Area

This area consists primarily of residential properties. This subarea is varied topography and therefore requires the use of gravity sewers and low pressure sewers with individual grinder pumps, force mains, and pump stations. Whitman Street is proposed to be entirely serviced by gravity sewer. Tukoosa Circle and Darlene Drive are both connected by low pressure sewer to the gravity sewer on Whitman Street. The gravity sewer flows to a proposed pump station in front of parcel number 220 on Whitman Street and is connected on Wood Road to the existing sewer by force main. Figure 5-7 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 9,000 gpd and the peak flow estimate is 49,600 gpd.

Table 6-7 Whitman Street Area Sewer Connection				
Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity	3,000 lf	$230	$690,000	22
Low Pressure	1,100 lf	$150	$165,000	19
Force Main	1,000 lf	$100	$100,000	N/A
Pump Station	1	$500,000	$500,000	N/A
		Total	$1,455,000	41

6.4.8 Hayward Street Area

This area consists primarily of residential properties. This subarea is varied topography and therefore requires the use of gravity sewers, low pressure sewers with individual grinder pumps, force mains, and pump stations. Hayward Street is proposed to be entirely serviced by gravity sewer. Arrowhead Drive and Yoke Drive are both connected by low pressure sewer to the gravity sewer on Hayward Street. The gravity sewer flows to a proposed pump station in front of parcel number 245 on Hayward Street and is connected on Wood Road to the existing sewer by force main. Figure 5-8 depicts the proposed sewer connection layout and the table below details the proposed components.

For this area the estimated flow is 14,300 gpd and the peak flow estimate is 78,700 gpd

Table 6-8
Hayward Street Area Sewer Connection

Component	Approx. Qty	Approx. Unit Cost	Approx. Component Cost	Properties Served
Gravity	2,100 lf	$230	$483,000	25
Low Pressure	2,000 lf	$150	$300,000	24
Force Main	0 lf	$100	$0	N/A
Pump Station	1	$500,000	$0	N/A
			$783,000	49

6.4.9 *Summary of Sewer Extension Recommendations*

The recommendations for sewer system extensions are summarized in Table 6-9, which presents the planning level construction costs and the number of parcels served in each area.

Table 6-9
Summary of Planned Sewer Extension Areas

Area	Total Cost	Properties Served
Lakeside Drive Area	$2,300,000	81
Goodwater Way/ Pleasant Street Area	$206,250	28
Dundee Drive/ Aberdeen Lane Area	$2,342,000	64
Norlen Park Area	$853,200	63
Bayberry Circle/ Ashtead Road Area	$3,058,000	109
Atkinson Drive Area	$3,351,000	96
Whitman Street Area	$1,455,000	41
Hayward Street Area	$783,000	49
Total of All Sewer Areas	$14,348,450	531

The average construction cost per property served for all the areas taken together is approximately $27,000 per parcel. These area planning level costs for construction, and are intended to be somewhat conservative, but do not include allowances for engineering or contingencies. As with all planning level costs, many variables can affect the actual project costs – especially when excavation plays a major role in the proposed work.

6.5 Wastewater Treatment and Disposal Recommendations

As detailed in the prior sections of this planning report, significant improvements are needed at the Bridgewater WWTF. These improvements are driven by two major factors – the pending changes to the WWTF discharge permit conditions, as issued by the U.S. EPA, and the general need for modernization and capital restoration of the WWTF, resulting from age and condition of the WWTF systems. These needs are supplemented by opportunities for improvements in efficiency (including energy savings) and improvements in operability and reliability (substantially driven by technology changes over the life of the WWTF). The overall goal is to restore the facility to a condition and capability that will provide for Bridgewater's needs for the next 20 years.

As presented in the discussion of alternatives (included in Section 5 of this report), the magnitude of the needed improvements to the WWTF is significant – and will be costly. Notably, these improvements and higher costs to implement the recommendations are a result of:

- The fact that the current WWTF process (rotating biological contactors) was never planned to provide total nitrogen removal (which is more easily adapted into other treatment processes).
- The site limitations on the existing WWTF site, which is surrounded (along more than 80% of the site perimeter) by water and wetlands.

In general terms, the WWTF recommendation is to provide for capital improvements to the facility to allow the WWTF to meet future permit conditions and to generally restore the facility life. As discussed in the alternatives considerations, the recommended plan should include rerating the WWTF to increase the average daily flow treatment capacity to 1.54 mgd, and the permitting to support the improvements should include requesting a commensurate increase in the new NPDES discharge permit.

The recommended WWTF improvements are presented as follows, summarized by process area. For some recommendations, a discussion of possible phasing is presented to help improve the affordability of the recommended plan.

6.5.1 Headworks (Preliminary Treatment) and Septage Receiving

Improvements recommended to the WWTF headworks and preliminary treatment systems are generally required for modernization and operability. Recommended headworks improvements include:

- Replace the raw wastewater sewage grinder with a new influent screen. The screen will need to be located in the existing influent channel structure. A new enclosure will be needed to house a container for collection of screenings to be disposed of off site. A screenings wash/press system will be needed to process raw screenings to reduce organic and water content of screenings, and to convey screenings from the new screen to the screenings storage container. The new screenings storage enclosure needs to be minimized in size, as the enclosed area will be subject to odors and humidity, and the cost to treat the air from this area can add significantly to the cost of the improvements.

- Rehabilitate the existing grit removal system to restore its useful service life. The grit chamber and collection screw system should be refitted and repaired, as needed. A new grit transfer pump should be provided to replace the existing grit pump in the headworks basement. The grit dewatering system (cyclone and degritter/classifier screw) should be rebuilt to restore its service life. The grit blowers and their controls should be replaced with a new energy efficient blower and air control package.
- Rehabilitate the septage receiving tanks and septage transfer pump systems. The existing receiving tanks and the larger storage tanks should be drained, cleaned and inspected, and any defects in the tankage should be repaired. The mixer systems should be replaced or rehabilitated, and valving for the septage transfer pump systems should be refitted, as needed to restore their service life. Septage storage tank covers and hatches should be refitted and repaired, as needed.
- Rehabilitate the existing headworks building and its building systems to restore the facility service life. The headworks building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical system (heating and ventilating) also needs upgrade, and should be replaced with more energy efficient equipment.

6.5.2 Forward Flow Pumping

The existing primary effluent pumping system located in the basement of the operations building lifts flow from the primary clarifier effluent box to the existing secondary biological process. The current hydraulic configuration of the WWTF leaves the primary clarifiers low in the ground, which made them initially difficult to construct with good quality, and subjects them to significant groundwater hydrostatic pressure, and impacts their accessibility for maintenance. In order to lift the primary clarifiers in the hydraulic profile of the WWTF, the following improvements are recommended:

- Provide modifications to yard piping to convey the effluent from the aerated grit chamber to the forward flow pumping system in the operations building basement. Provide new forward flow pumps, piping and valving in the operations building basement to function as primary influent pumps. While the new forward flow pumps will be subject to greater solids than the existing primary effluent pumps, the addition of screening to the preliminary treatment should mitigate any maintenance concerns with the new primary influent pumps. Provide modifications to the yard and process piping to convey flows from the new forward flows pumps to the primary clarifiers.

6.5.3 Primary Treatment

The primary clarifiers are in poor condition and are problematic from an operational viewpoint. The reconfiguration of the hydraulic profile and changes to the forward flow pumping system will allow for new primary clarifiers to be constructed with proper structural conditions and allow improved operator access for maintenance. The recommended improvements include:

- Demolish the two existing primary clarifiers, and provide two new primary clarifiers in their place. The new primary clarifiers will be elevated in the hydraulic profile to allow the water surface to be at or above grade. The new clarifiers should be 45 feet or more in diameter, and the raised elevation should allow for improved clarifier sidewall depth. New clarifier mechanisms, drives, bridges, launders, and ancillary piping and valves should be provided as part of the work. Effluent from the raised primary clarifiers will flow by gravity to the secondary treatment process.

The new primary clarifiers should be designed to allow the continuation of co-settling, if the operators choose to continue that process. It is anticipated that flow split into the primary clarifiers will be addressed at the forward flow pumping by feeding each clarifier with a dedicated primary influent pump.

6.5.4 Secondary Treatment with Nitrification/Denitrification

The existing secondary biological treatment system at the Bridgewater WWTF is suffering from age and limited by the original process selection and facility design. The plant operations staff have been replacing RBC media and support systems actively as these aging systems continue to fail at the site. The secondary clarifiers were sized for the attached growth process, but the sizing leaves little capability to modify the process for enhancing treatment.

The biological treatment system improvements are the mechanism by which the Bridgewater WWTF will comply with the new discharge permit limits for total nitrogen, and will provide part of the solution for phosphorus removal as well. The process for nitrogen removal includes a need for full nitrification – which is substantially achieved by the existing RBC system, as well as an effective denitrification process. The proposed process will provide new anoxic zones before and after the aerobic RBC treatment process to best support nitrogen removal in the process. The improvements to the biological treatment system will also address the hydraulic limitations of the existing RBC tanks and channels, and provide for improved clarification. The recommended improvements include:

- Rehabilitate the existing RBC system to replace all media not recently replaced by the operations staff, and repair or replace all shaft support systems, drives and bearings. This work is intended to provide a rejuvenated biological treatment system to provide for the biological oxidation of organic loads and provide full nitirification of ammonia and organic nitrogen sources.
- Modify the RBC process tank to include the ability to supplement with diffused air to assist with aerobic treatment and to keep suspended biological growth in suspension. Add a new system of small blowers with piping, valves and controls to provide mixing/process air as needed. The new blowers are expected to require limited space and should be located in the operations building, or in outdoor enclosures.
- Modify the tanks and channels in the RBC process areas to add freeboard to accommodate peaks WWTF flows without overtopping. Constructing wall extensions on the existing tanks and channels is likely the most cost effective method of addressing this existing deficiency.
- Construct new pre-anoxic zone tankage, with ancillary systems to include mixers and recycle piping and valves, along with a flow splitter box to distribute flows. Based on our planning level calculations, the pre-anoxic tanks are currently proposed to be configured as four separate tanks with a total volume of approximately 220,000 gallons. The pre-anoxic tanks will receive influent flow from the primary clarifier effluent, and new return sludge flows from the secondary clarifiers and internal mixed liquor recycle pumping systems. Effluent from these tanks will flow by gravity to the RBC system for aerobic treatment.

- Construct new post-anoxic anoxic zone tankage, with ancillary systems to include mixers and recycle piping and valves, along with a flow splitter box to distribute flows. Provide new internal mixed liquor recycle (IMLR) pumping system to provide for internal biosolids returns. Based on our planning level calculations, the post-anoxic tanks are currently proposed to be configured as four separate tanks with a total volume of approximately 330,000 gallons. These post-anoxic zone tanks will receive flow by gravity from the RBC treatment process, and effluent from the post-anoxic zones will flow by gravity to the secondary clarifiers.
- Rehabilitate the two existing secondary clarifiers, including repairing the center columns, sludge collector mechanisms, and bridges, and providing new drives. Construct a new secondary clarifier flow splitter structure, which will be useable for the initial two, and future three clarifier configuration.
- Modify the existing waste sludge pumping system, including pumps, valves and piping, to provide for return sludge capabilities to support the new treatment process. The improvements are expected to include refitting/rebuilding the existing pumps, and adding two new return sludge pumps with appropriate controls. The sludge pumping system should be capable of delivering return sludge to the biological process, or wasting sludge to either the sludge holding tanks or to the primary clarifiers for co-settling.
- If necessary based on actual plant loadings observed, construct a new third secondary clarifier. This recommendation is based on the projected loadings on the two existing clarifiers from the modified biological process, which exceed the preferred loadings under design conditions. The new clarifiers should be 50 feet or more in diameter, and should allow for improved clarifier sidewall depth, but actual sizing should be confirmed in design.

We have recommended provisions for a third secondary clarifier, to be constructed under a future contract as a phased approach, as there is a strong possibility that this third clarifier may not be needed in actual operating situations. Preliminary design of the WWTF improvements should confirm the need for additional clarification capacity, and include detailed recommendations for sizing, location and load conditions that would require the additional capacity.

6.5.5 Effluent Filtration

No effluent filtration is provided at the current WWTF, and no such process was envisioned during the initial facility planning. The phosphorus limits provided in the draft discharge permit by EPA are lower than facilities can traditionally meet by biological phosphorus removal (Bio-P) and chemical precipitation with gravity settling alone. In order to consistently meet the new phosphorus limits, effluent filtration should be included in the overall recommended plan. The recommended filtration improvements include:

- Construct a new effluent filtration system to treat effluent from the secondary clarifiers. The specific process selection should be refined through a preliminary design and piloting study, but the planning level recommendation would be for a packaged cloth media system to be provided.
- The filter system will require additional secondary effluent pumping to fit the filter into the hydraulic profile, and allow for gravity return to the disinfection process. The new forward flow pumps could be located in the new filter building structure.
- The effluent filter system would require a new filter building be constructed at the site,

located in front of (south of) the administration building.

Some facilities in New England have shown the ability to meet limits around 0.2 mg/l total phosphorus using multi-barrier precipitation and settling approaches. Because of the high capital and operating cost of adding effluent filtration to the plant, and the possibility that the plant staff may be able to meet the new limit with the other proposed WWTF improvements, the recommendation for the Bridgewater WWTF is to initially defer the construction of the effluent filtration. Setting the effluent filtration into a later WWTF improvements phase makes good economic and environmental sense. In addition, deferring the effluent filter to a later phase will allow the ability to consider any new or changed WWTF discharge permit conditions that may arise in the next round of permit renewals, and allow the plant staff to best adapt the newly improved WWTF processes to achieve optimum treatment.

6.5.6 Disinfection

The disinfection process needs modernization, and should be changed to comply with the operators request to provide a change from gas systems to liquid chlorination and dechlorination systems. The proposed changes also provide an opportunity to improve the efficiency of the disinfection system, which will help to control chemical costs over time. The recommended disinfection improvements include:

- Replace the existing gas chlorination system with a new liquid hypochlorite storage and feed system. System should include two new hypochlorite storage tanks, a system of pumps to allow chlorine feed to disinfection, as well as for process control, day tanks, a fill station, and ancillary systems to support the liquid feed process.
- Replace the existing sulfur dioxide gas de-chlorination system with a new liquid bisulfite dechlorination system. System should include new bisulfite storage tanks, at least two feed pumps, and ancillary systems to support the feed process. The bisulfite system requires design for a dedicated space with proper ventilation requirements due to the properties of the liquid chemical.
- Provide for enhanced mixing in the chlorination feed and dechlorination feed locations within the contact tank. Submersible mixers are the preliminary recommended option.

6.5.7 Solids Dewatering

Solids dewatering has not been a problem at the plant and the operators experience very good results from their dewatering and composting operations. However, the existing systems have essentially reached the end of their useful service life, and modernization of these systems is needed. The recommended improvements for solids dewatering include:

- Rehabilitate the sludge press feed pumping systems located in the operations building lower level. Existing sludge pumps will either be rebuilt or replaced with new positive displacement sludge feed pumps.
- Replace the existing belt filter press equipment with new dewatering presses. The need for different equipment is limited in this area because of the proximity to final composting operations. We anticipate that similar belt filter press equipment will be selected as replacement for the existing systems.
- Renovate and rebuild the sludge conveying systems that transport dewatered sludge from

the presses to the storage garage.

- Replacement of chemical feed systems and controls to support the solids dewatering. The plan includes providing for polymer (liquid) make-up, aging and feed systems, along with provisions for chemical feed for odor conditioning (permanganate), subject to the needs of the dewatering operators.
- Renovate the solids dewatering area and storage/receiving garage to improve air handling (heating and ventilating) systems.

6.5.8 Solids Composting

Improvements recommended to the solids (sludge) composting systems are generally limited to modernization needs. Recommended composting area improvements include:

- Provide limited repairs to the compost buildings, composting air blower systems, and compost screen system. Compost operations rolling stock – including trucks and loader, are expected to be updated through the WWTF operations budget, and are not included in the capital improvement recommendations.

6.5.9 Chemical Feed and Storage

Chemical feed and storage improvements are needed to support the new biological treatment processes. Critical chemical feed systems at the WWTF include metal salts for phosphorus precipitation (currently ferric chloride), soda for alkalinity and pH control, sludge conditioning chemicals (polymer and permanganate, or equivalent), and a carbon source to support denitrification. Chemicals for the disinfection (chlorination and dechlorination) process are included in the disinfection recommendations. Chemical storage and feed recommendations include:

- Modify the existing ferric chloride storage and secondary containment facility to include a weather enclosure (roof system) over the secondary containment area.
- Provide improvements to the pumping, piping and controls for ferric chloride to allow feed to multiple points. At least three feed points should be supported – to primary clarifier influent to allow chemically enhanced primary treatment (CEPT), to the back end of the biological treatment process to promote flocculation for settling in the secondary clarifiers, and at a third point in the sludge processing system (sludge holding or dewatering filtrate return) to allow side stream fixing of any phosphorus released from biological solids. A future ability to feed ahead of the effluent filter system may also be needed, but should be phased for inclusion with the filter construction.

6.5.10 Instrumentation & Controls

Facilities constructed in the period when the Bridgewater WWTF was built generally have outdated or non-functional instrumentation and control (I&C) systems. In more complex treatment processes, reliable modern I&C systems are needed to monitor and assist operators in maintaining process control. These systems are more critical for plants with extremely challenging effluent limits, as have been provided for the Bridgewater WWTF. New I&C systems are needed as a key part of modernization, but also to support the new process changes. I&C recommendations include:

- Provide new process monitoring instrumentation for each new process and system added to the WWTF. Provide a new I&C system including system control and data acquisition (SCADA) capabilities to allow monitoring and appropriate level of control for each process and unit operation. The new I&C system should include a redundant head end system to be located in a dedicated plant control room. The system should also allow for remote access to plant operating information by operators via internet connection.

6.5.11 WWTF Buildings

The WWTF buildings need general modernization, and also have some defined space needs. This section focuses on the administration and operations building needs. Headworks building needs and certain process area needs for heating and ventilating systems were discussed in other process areas. The recommended improvements include:

- Rehabilitate the existing operations building and its building systems to restore the facility service life. The operations building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical systems (heating and ventilating) also need upgrade, and should be replaced with more energy efficient equipment.
- Provide an addition to the administration building to provide new dedicated (separate male and female) staff restrooms, and new dedicated (separate male and female) staff locker rooms, and additional control and electrical room space to support new electrical systems and new I&C systems.
- Rehabilitate the existing operations building and its building systems to restore the facility service life. The operations building needs roof replacement and building envelope (door, window and sealing system) improvements. The building mechanical systems (heating and ventilating) also need upgrade, and should be replaced with more energy efficient equipment.

6.5.12 Electrical Systems

As with instrumentation, plants of the age of the Bridgewater WWTF have outdated electrical systems. The electrical codes and industry practices have changed several times over the past few decades, and improvements to critical processes need to include modernization of electrical systems. Comprehensive electrical system improvements are typically refined in the final facility design, but for planning purposes, the electrical improvements should be expected to include:

- Replacement of critical electrical systems, including new primary transformer and secondaries, if needed, and new primary electrical switchgear to serve the facility.
- Replacement of outdated motor controls centers (MCCs), and provision of new MCCs to meet modern arc-flash and lock-out tag-out (LOTO) code requirements.
- Updating of raceways, conduits, pull boxes and handholds, and replacement of wiring where needed.
- New building lighting systems to meet modern energy codes.
- Refitting or replacement of the standby electrical generator and automatic transfer switch, to meet design standards for the upgraded plant.

The town should be sure to pursue utility rebates to support the costs of electrical system refitting (e.g. lighting or variable speed drive motor controls) that are eligible for local incentives.

6.5.13 WWTF Site Improvements

The WWTF site does not present any need for improvements in and of itself, but will need to be improved to allow full access to all buildings and process areas following the completion of the new WWTF process changes. Site improvements will generally include the following:

- New yard piping, with appropriate valves and access pits/manholes, to support the process changes.
- General site grading to accommodate new buildings and tankage.
- New walkways to provide operator access to the process areas.
- New roadways/driveways to provide for service vehicle access throughout the site.
- New site lighting to provide for safe operations.
- Drainage improvements to meet new site runoff control requirements for industrial sites.

6.5.14 Temporary Provisions

In order to construct the recommended WWT F improvements on the existing site, a number of temporary provisions will be needed. These temporary provisions include staging, temporary construction support, flow handling and bypass facilities, and temporary electric and support systems. These challenges affect the construction budget both directly, by adding costs, and indirectly, by adding complexity to the project (which can dissuade contractors from bidding the construction work aggressively).

6.5.15 Summary of Recommended WWTF Improvements

The improvements recommended for the WWTF as presented above provide a comprehensive capital improvement program (CIP) for the facility. Such a comprehensive CIP typically has a significant capital cost to implement. Planning level costs were developed for the recommended capital improvements to the WWTF, and are summarized by process area in the following Table 6-9: Summary of Recommended WWTF Improvements.

Table 6-9
Summary of Recommended WWTF Improvements

Process Area	*Recommended Improvements*	*Planning Level Cost*
Headworks & Septage Receiving	New influent screen with enclosure, refit grit removal system, refit septage pumping.	$1,010,000
Forward Flow Pumping	Relocate forward flow pumping ahead of primary clarifiers, and refit systems.	$450,000
Primary Treatment	Remove existing primary clarifiers and build two new clarifiers.	$2,050,000
Secondary Treatment with Nitrification & Denitrification	Refit RBC system, add new pre-anoxic and post-anoxic zone reactors, refit existing and add one new secondary clarifiers.	$5,260,000
Effluent Filtration	New effluent filtration system, with forward flow pumping, in new building.	$2,500,000
Disinfection	Refit disinfection to include new liquid hypochlorite and bisulfite feed systems.	$235,000
Solids Dewatering	Renovate solids dewatering system and support systems.	$1,275,000
Solids Composting	Minor equipment refit of solids composting facility.	$100,000

Chemical Feed & Storage	Upgrade existing and provide new chemical storage and feed (ferric, alkalinity, carbon).	$250,000
Instrumentation & Controls	Plant-wide instrumentation upgrade with new instruments and SCADA head end.	$700,000
WWTF Buildings	Refit operations and administration building, and new 1,000 sf building addition.	$960,000
Electrical Systems	Replace main plant switchgear and MCCs, and upgrade electrical systems.	$1,460,000
WWTF Site & Yard Piping	New and replacement yard piping, and general site improvements.	$795,000
Flow Handling & Bypass	Provide temporary flow handling and bypass systems during construction.	$100,000
Unscheduled Items (Budget)	Allowance for construction of items not specifically identified in planning process.	$860,000
Contractor & Sub Mark-ups (BOH&P)	Contractor and sub-contractor mark-up for bonds, insurance, overhead and profit.	$2,700,000
Subtotal		*$20,705,000*
Construction Contingency (20%)	Contingency to address unanticipated changes in costs.	$4,141,000
Engineering during Construction (14%)	Engineering services during construction, including administration and on-site efforts.	$2,900,000
Construction Total		*$27,746,000*
Admin., Legal and Management (2%)	Cost allowances for administrative, finance and legal costs, and project management.	$550,000
Engineering Design & Permitting (10%)	Engineering services for preliminary and final design, and project permitting.	$2,770,000
Total Planning Budget		*$31,100,000*

A process flow diagram for the proposed WWTF process and operational changes is included in Figure 6-2: Flow Diagram. A site plan showing the rough locations for the planned additional buildings and tankage is included in Figure 6-3: Site Plan. Additional information and detail on costs for the recommended WWTF improvements is included in Appendix J: Bridgewater WWTF Planning Level Cost Estimate.

6.6 Energy Efficiency and Energy Management

The Bridgewater water and sewer systems include many components that are outdated and in need of modernization. As such, these systems offer opportunities to improve energy efficiency. As water and sewer systems (particularly pumping and treatment) are typically one of the largest energy consumers in a community, system changes could yield significant annual costs savings. In addition, system changes could be eligible for rebate assistance from the local utility, and possibly other incentive programs offered by the state. The most notable areas identified for possible energy savings through the planning work include the following:

- Bridgewater WWTF – Major process equipment uses significant energy resources on a continuous basis. The best opportunities for improvements include air blowers and pumps, where efficient motors and variable speed drives, combined with smart control logic can greatly mitigate major energy use. In addition, process selection can affect energy conservation – the recommendation to keep the RBC process in place recommends the lowest energy impact process at the WWTF, despite some risks that this could increase costs under future discharge permit actions. Also, building heating and ventilating systems, as well as lighting systems can be modernized, which can provide significant life-cycle energy savings.

- Sewer Pump Stations – Sewer pumping systems offer the same opportunities for improving efficiency of pumping equipment. Similarly, building heating, ventilating and lighting systems can be improved.
- Water Pump Stations – Water pumping systems (wells and booster stations) also offer the same opportunities for improving efficiency of pumping equipment. Where systems are housed in structures, building heating, ventilating and lighting systems can also be improved.

Additional opportunities for positive energy management steps may exist in Bridgewater, as well as opportunities to implement some renewable energy strategies. The town should continue to identify and pursue energy management as a means to control operational costs and conserve resources. We recommend that the town include energy savings and management as specific goals in each of their public works projects going forward, including, as a minimum:

- Selection of processes that offer the best profile for long-term annual energy costs – as an example, treatment processes that are high energy consumers should be avoided, if possible. The selection of the RBC process to remain in place at the WWTF offers these types of benefits. The deferral of the effluent filter process until absolutely needed is a second key example of this recommendation.
- Unless technical reasons prohibit such an approach, providing for premium efficiency motors in all process equipment in the water and sewer systems. This would be incorporated into water pumping system projects, sewer pump station projects, and wastewater treatment projects.
- Unless technical reasons prohibit such an approach, providing for variable speed drives (a.k.a. variable frequency drives, or VFDs) in all process equipment in the water and sewer systems. This would be incorporated into water pumping system projects, sewer pump station projects, and wastewater treatment projects.
- Where applicable, improving building envelopes to provide for more energy efficient heating and cooling of structures, process areas and personnel space.
- Where applicable, improving building heating, ventilating and air conditioning (HVAC) systems to improve energy efficiency, including the use of modern climate control systems.
- Where applicable, refitting all buildings and sites with new energy efficient (LED or similar) lighting systems.

6.7 Water System Recommendations

It is recommended that the Town continue with the implementation of the Capital Improvement Plan for their water system, including the following upgrades: 1) increasing the size/capacity of undersized sections; 2) looping (additional water main connections) certain sections to improve reliability and circulation; and 3) replacing asbestos/concrete (A/C) main nearing the end of its service life.

The BWD should continue to evaluate additional well supply sites to increase operational flexibility and reliability. The Town has purchased land at Beech Street next to the Titicut Conservation Parkland for a possible additional well.

BWD should continue replacement of meters as needed to extend service life and improve data accuracy.

The Bridgewater Water Department should also continue with the comprehensive water conservation program that they currently have in place.

Average water consumption per person per day is typically estimated to be 75 to 80 gallons per day (gpd). Bridgewater's water records show a per capita daily use of between 45 and 61, with a 10-year average of 51. The American Water Works Association (AWWA) estimates that of daily indoor water use 26.7% is for toilets, 18.5% is for bathing, 23.1% is for clothes and dishwashing, 18% is for faucets and other uses, and 13.7% is for leaks. AWWA estimates that 50-70% of total daily use is lawn and garden watering. AWWA also estimates if all homes installed water saving devices, water consumption would be reduced by approximately 30%.

Even in towns where water supply is not an issue, water conservation programs have many benefits. They result in reduced flows to the municipal sewer system and on-site systems, they save money for both the Town (water supply and utility costs) and the residents (water and sewer bills and heating of hot water), and they help raise awareness about water quality and conservation issues. Water conservation programs can be aimed at a variety of audiences, from school children to adults.

6.8 Stormwater Management Recommendations

Planning level costs were developed for compliance with the new MS4 Permit. Table 6-10: Summary of 2016 EPA MS4 Permit Requirements & Cost to Comply outlines the requirements of the MS4 Permit and provides an estimated compliance cost for the five year life of the permit and the 10-year timeframe allotted for implementation of the Town's illicit discharge detection and elimination program. The Town will need to invest an estimated $1.5 to $2.2 million over the next ten years to comply with the permit. Complying with the requirements related to impaired waters and implementing the Illicit Discharge Detection and Elimination Program will carry the largest financial burden.

The implementation and continued operation of a stormwater management program can have significant cost implications. In addition, changes in environmental focus and regulatory requirements dictating improved stormwater quality have significantly increased the cost of maintaining a stormwater program. It is recommended that the town consider alternative methods for raising the funds required to meet and sustain the additional financial demands of stormwater management. A wide variety of funding mechanisms are available including, but not limited to Stormwater Utilities, Revenue Bonds, Enterprise Funds, State Revolving Fund Loans, Impact Fees, Special Assessments, and System Development Charges.

7.0 ARRANGEMENTS FOR IMPLEMENTATION AND FINANCING

This section of the CWMP includes information on the steps needed to implement the recommendations of the plan, and options for the financing and funding of project costs. Implementing the recommended programs and improvements will present challenges – both administrative management and financial challenges. Issues to be addressed before the plan can be implemented include space considerations, phasing and timing considerations, and project cost, funding and financing approaches.

7.1 Implementation Considerations

Each of the recommendations of this plan includes a number of steps needed to proceed. A large part of these are the local and regulatory approvals that support the actions needed. A few of these steps include:

- Completing the review of the CWMP by stakeholders in Bridgewater, including appointed and elected committees and boards, to refine the recommendations, and build support for moving forward.
- Submitting the draft CWMP report to Massachusetts DEP for their review and comment.
- Based on public and stakeholder input, prepare the final report.
- To the degree needed, and deemed appropriate by the town based on the intent to proceed with recommendations, proceed with regulatory approval of the CWMP through the MEPA process, including filing and Environmental Notification Form (ENF), as appropriate.
- Again depending on the town's intentions, respond to the requirements of the Secretary's certificate on the ENF, including proceeding with an Environmental Impact Report (EIR), if required.
- The town should pursue discussions with the U.S. EPA to finalize the NPDES permit for the WWTF, and to request that the new NPDES permit includes revised limits – particularly for the increase in discharge capacity recommended for the WWTF.
- Bridgewater must begin the process of appropriating funds to complete the WWTF improvements project. This should include setting an item on the warrant for the next financial Town Meeting, and putting in place the local support-building steps to ensure that the public is educated as to the need for approval of the funds.
- Assuming that SRF funding will be pursued for the recommended work, prepare and file a Project Evaluation Form (PEF) with Massachusetts DEP to request listing on the Intended Use Plan (IUP) for SRF funding. These submittals are typically due in August for funding of projects in the following calendar year.
- Assuming that the town chooses to pursue zero percent SRF financing for the WWTF improvements, begin the process of modifying local regulations to include growth management provisions required to meet the zero percent program requirements.
- Further local decision making is needed on how the local share of project costs will be allocated. Generally, WWTF improvements can be paid for by taxes, user fees or other fees. The allocation options need to be considered, and a plan adopted. If new fees are adopted, changes to the local sewer regulations and/or governing bylaws may be needed.
- Local public discussions are needed to decide an implementation schedule for the sewer extension projects. Based on the acceptability of cost impacts from these projects, the town may elect to stagger these projects over a period of time, to defer several project areas, or to take no action initially.

Additional implementation steps will need to be identified and refined following review and

discussion of the CWMP recommended plan locally.

7.2 Funding and Financing

There are a variety of funding sources available to assist with capital project costs for municipal projects. The most applicable programs are the State Revolving Fund (SRF) programs, which are administered by Massachusetts DEP, and will fund water and wastewater projects. A general discussion of these funding programs is presented here. After funding is determined for the project, decisions must be made on the local allocation of costs. This is crucial as the days of grant funding are gone, and project funding will consist of primarily of loans. For the purposes of this report, we have focused this discussion on the funding and financing of the wastewater recommendations of the CWMP.

7.2.1 SRF Financing

The primary mechanism in the Commonwealth of Massachusetts for financing public wastewater projects is currently the State Revolving Fund (SRF), as administered by the Massachusetts DEP and the Massachusetts Clean Water Trust (MCWT, or the Trust). This program provides assistance to cities and towns in the form of low interest loans to cover eligible project costs. The current program in Massachusetts provides for loans at an interest rate of 2% per year, which is lower than the current interest rates otherwise available to the Town for municipal bonds. Based on information provided by the Town's fiscal agent, the likely current bond rate would be 2.4%. SRF financing can cover the eligible construction costs of the project, including the cost of engineering during construction, but related costs for design are generally not eligible under the program. To apply for funding, a Project Evaluation Form (PEF) must be submitted. A competitive process for rating projects occurs annually, and the projects that demonstrate the highest needs and most complete planning are made eligible for funding by placement on the state's Intended Use Plan (IUP).

In addition to the standard interest rate of 2%, there are also 0% SRF loans available for certain projects. The zero percent loan program was developed to assist municipalities with projects focused mainly on the environmental control of nutrients – which in the case of Bridgewater is the primary driver for the most expensive plan component, the WWTF improvements. To apply for the 0% interest rate, the following additional criteria must be met by the project and applicant:

- The project is primarily intended to remediate or prevent nutrient enrichment of a surface water body or a source of water supply.
- The applicant is not currently subject, due to a violation of a nutrient-related total maximum daily load standard or other nutrient based standard, to a MassDEP enforcement order, enforcement action by the United States Environmental Protection Agency, or subject to a state or federal court order relative to the proposed project.
- The applicant has a Comprehensive Wastewater Management Plan (CWMP) approved pursuant to regulations adopted by MassDEP.
- The project has been deemed consistent with the regional water resources management plan, if one exists.
- The applicant has adopted controls, subject to the review and approval of MassDEP in consultation with the Department of Housing and Economic Development. Furthermore, where applicable, any regional land use regulatory entity, intended to limit wastewater flows to the amount authorized under the land use controls that were in effect on the date the Secretary of the Executive Office of Energy and Environmental Affairs issued a certificate for the CWMP pursuant to the Massachusetts Environmental Policy Act, M.G.L. c. 30, §§ 61-62H, and the MEPA regulations at 301 CMR 11.00.

Legislation also limits the cost of loans available at 0% to thirty-five percent of the Clean Water State Revolving Fund (CWSRF) IUP capacity in any given year. For example, a $300M CWSRF IUP could finance up to $105M at 0% interest. If eligible projects for 0% interest loans in excess of $105M are proposed, MassDEP will afford the zero percent interest rate to projects in rank order as listed on the IUP. In that instance, highly ranked projects that are eligible would be financed at zero percent, while lower ranked eligible projects would receive the standard 2% interest rate.

The intention is that Bridgewater would pursue a 0% interest SRF loan for financing of the upgrades and expansion of the Bridgewater WWTF. However, since a 0% interest rate is not guaranteed, loan repayment costs in this section have been calculated assuming that a 2% interest SRF loan will be obtained. In addition, the community has not as yet organized efforts to address land use controls that are also required in accordance with Section 23 of Chapter 259 of the Acts of 2014, to access 0% interest loan funding.

In addition to pursuing SRF financing for the WWTF upgrade and expansion, it is recommended that the Town also pursue SRF financing to cover the cost of the proposed sewer extensions. The sewer extensions would ultimately be paid for using a combination of state and local funds. It is assumed that available state funding for the projects would be in the form of a 2% interest rate SRF Loan, financed over a 20-year loan period. A 30-year loan period may also be possible; however, it could come with a higher interest rate (nominally a rate of 2.4%, more or less). Local funds to finance the project will include a combination of funds raised through betterment assessments for sewered properties and possibly limited funds raised through taxation. Sewer Enterprise Fund retained earnings could also be used, as available. Sewer rates (i.e. user charges) are distributed proportionately among the users of the system, are typically based on water usage, and would be used to cover the operation and maintenance costs of the completed system, and WWTF upgrades that benefit all system users. The impacts of the proposed upgrades at the WWTF on sewer user rates are presented later in this report.

New SRF Program Provisions in 2016

Several new provisions were recently added to the SRF funding program, as a result of changes to the underlying federal regulations. The most notable of these changes that will impact the funding of Bridgewater's projects include:

- The need to comply with the American Iron & Steel (AIS) Act provisions, which requires construction contracts to include requirements for some iron and steel containing materials and equipment purchased.
- The need to prepare and maintain a Fiscal Sustainability Plan (FSP) that reviews the financial provisions of the community related to utility management, and demonstrates that the community has provisions in place to provide for the proper funding of system operation and maintenance.
- Provisions for allocating some portion of funds to help with project affordability for communities with lower per capita incomes, with adjustments factored in for unemployment or population change disadvantages.

The affordability assistance provision replaces the previous Environmental Justice (EJ) provision that has been in place for SRF funding in Massachusetts. The affordability criteria includes a calculation which assigns each community in Massachusetts a rating based on per capita income (PCI), adjusted for employment rates and population trends. Communities where this adjusted PCI falls below the Massachusetts average are eligible for some degree of principal forgiveness in their project funding. The eligibility for principal forgiveness has been allocated by Massachusetts into three categories, with ascending benefits:

- Tier 1 for communities with less than 100% but more than 80% of the state average adjusted PCI.
- Tier 2 for communities with less than 80% but more than 60% of the state average adjusted PCI.
- Tier 3 for communities with less than 60% of the state average adjusted PCI.

The amount of principal forgiveness each funding year is allocated by the Trust to include some fraction of the total SRF funding pool. This pool of funding is divided by the qualifying communities with funded projects, with Tier 1 communities receiving a half share, Tier 2 communities receiving a full share, and Tier 3 communities receiving one and a half shares. Based on the current year data provided by the Trust, Bridgewater is currently a Tier 2 community, with a rating of 78.41% of the Massachusetts average adjusted PCI. This is based on the following data:

Bridgewater – 98.3% employment, ~$26,602 per capita income, 105.47% population adjustment, adjusted PCI ~$26,739.

The total amount available for principal forgiveness for SRF projects each year will vary, as will the number of eligible projects and their project funding values. It is therefore not possible to predict the additional funding that will be available to Bridgewater projects through principal forgiveness. However, based on the expected possible range of total contributions and historic number of qualifying projects, this funding may be anticipated to result in project savings ranging from a fraction of a percent to as high as several percent of the total eligible project costs.

7.2.2 Other Financing Options

Other options for financing of public utility projects exist, but significant funds may less readily available for large capital projects as proposed. Some of these other funding sources include:

- Federal Funding under U.S. Department of Agriculture – Rural Development (RD): Funding of utility projects under the USDA RD program (previously known as the Farmers Home or FmHA program) continues to be available, and includes loans and possibly grants, depending on project eligibility. These programs are targeted at poorer, rural communities, and eligibility is based on population and income, neither of which are favorable for Bridgewater. The current programs likely to be available to Bridgewater (if any) would be less favorable than the SRF funding.
- Utility Rebates: Rebate money is available from the electric utilities for projects that can demonstrate energy savings. As Bridgewater is serviced by National Grid, the electric rates paid by the town include a contribution which funds these rebate programs. It is therefore appropriate for the town to pursue a return on those rate investments by applying for funding under the current programs. A significant amount of work to be undertaken at the WWTF could result in energy savings. Therefore, rebates present a realistic option to help defray some of the project costs.
- Specialized State Funding Programs: From time to time, Massachusetts offers incentive funding programs related to special initiatives. The latest examples of this type of program are energy and water conservation incentives, offered through the Massachusetts Clean Energy Center (CEC). In recent years, CEC offered a 'gap funding' program, which helped cover the cost differential between some facility improvements directed at saving energy, and the available rebates that could be recovered for those improvements from the utilities.

7.2.3 *Specific Funding Information for Recommended WWTF Improvements*

The costs of the recommended plan for the Bridgewater WWTF improvements present a significant financial challenge to the town. The availability of SRF funding alone will not make the project inexpensive, but the possible availability of zero percent funds could make the work more affordable. The costs to borrow the project capital costs by bonding the total costs and repaying over a 20 year period were calculated for three scenarios:

- All costs are bonded directly by the town at a nominal annual interest rate of 4%.
- Construction costs are bonded through the SRF program at an annual interest rate of 2%, and ineligible costs (typically including design and administrative costs) are bonded at 4%.
- Construction costs are bonded through the SRF program at the preferred interest rate of 0%, and ineligible costs (typically including design and administrative costs) are bonded at 4%.

The annual debt service repayment costs for each of these financing options (all assuming 20 year financing period) is presented in Table 7-1: WWTF Improvements Financing Comparison.

Table 7-1
WWTF Improvements Financing Comparison

Description of Cost	*Local Bonding 4% Interest*	*SRF Bonding 2% Interest*	*SRF Bonding 0% Interest*
Total Capital Cost	$31,100,000	$31,100,000	$31,100,000
Annual Debt Service Payment (20 years)	$2,289,000	$1,945,000	$1,634,000

The benefits of the SRF zero percent financing are clearly significant, and lacking other major funding options, the Town of Bridgewater should engage Massachusetts DEP in discussions to support zero percent funding for the project.

7.2.4 *Specific Funding for the Sewer System Extensions*

Similar to the WWTF improvements, the recommended sewer extensions may be funded by SRF bonds. Requirements are similar, though the available funding for the sewer extensions is expected to be limited to 2% loan financing (zero percent funding is not expected to be available for sewer extensions in Bridgewater). If Bridgewater's sewer extension projects are determined to be eligible for SRF funding, there may be possible availability of some principal forgiveness (as discussed in the prior section of this report) to assist with project affordability.

The annual debt service repayment costs for each of the proposed sewer areas, assuming 2% SRF loan financing (20 year financing period) are presented in Table 7-2: Sewer Project Financing Summary. The capital costs presented in this table for calculating debt repayment amounts include an additional allowance of 35% over the planning level construction costs, in order to account for engineering services during construction and a contingency budget.

Table 7-2 Sewer Project Financing Summary			
Sewer Extension Area	*Construction Cost*	*Total Construction Budget*	*Annual Debt Service (2% SRF Bond)*
Lakeside Drive Area	$2,300,000	$3,105,000	~$190,000
Goodwater Way/ Pleasant Street Area	$206,250	$279,000	~$17,000
Dundee Drive/ Aberdeen Lane Area	$2,342,000	$3,162,000	~$194,000
Norlen Park Area	$853,200	$1,152,000	~$71,000
Bayberry Circle/ Ashtead Road Area	$3,058,000	$4,129,000	~$253,000
Atkinson Drive Area	$3,351,000	$4,524,000	~$277,000
Whitman Street Area	$1,455,000	$1,965,000	~$121,000
Hayward Street Area	$783,000	$1,058,000	~$65,000

The challenge with funding the costs for sewer extensions lies in building local support for the sewer extensions projects, in parallel with assigning a locally acceptable fraction of the project costs to individual property assessments. Local cost allocation strategies are discussed in the next section.

7.2.5 Allocation of Local Costs

The most likely and significant funding source for wastewater projects are loan programs. The lack of significant grant funds still leaves the town in need of deciding how to raise revenues to repay the debt service from these project loans. In general, there are three significant methods for recovering utility project costs, including:

- User charges and fees (charged to the system users, in proportion to actual use).
- Property tax revenues (from general levy taxes charged to all property owners in a community of district).
- Special assessments, including betterments and privilege fees (generally assigned to users on a distributed per unit served basis, but many programs vary depending on assessment basis).

The recovery of costs for sewer extensions, as proposed for Bridgewater, often use some combination of these three revenue sources, but in Massachusetts there is a recent focus on betterment assessments to the properties served by the project. Any costs not included in the betterment assessment amounts can be recovered through taxes or user charges.

The recovery of costs for WWTF improvements, as proposed for Bridgewater, typically relies on user charges and taxes. These limited options and the significant project costs bring a question of affordability to light for the proposed project. Therefore, the discussion of phasing the work, as presented in the description of the recommended plan is a potentially critical component of project implementation planning.

7.2.6 *Other Local Cost Recovery Options*

The high capital costs of the recommended WWTF improvements will present a significant financial challenge to Bridgewater to complete the needed work and maintain affordable rates. The Bridgewater situation is somewhat different from many communities in that a large fraction of the existing flows, and the future flows, are attributed to Bridgewater State University (BSU), a state facility. The special conditions that exist in communities hosting a higher education institution must be considered in managing projects with significant local costs. The most notable difference is the lack of tax revenue from the large amount of sewered property controlled by the university. In comparison, the BSU existing and proposed flows represent approximately 12.5% of the total average daily flow capacity of the town's WWTF. In planning to allocate local costs for the proposed WWTF improvements, the town should consider recovering some portion of costs from BSU through the Commonwealth of Massachusetts.

Discussions should be initiated between the Town of Bridgewater and the state – this discussion may be best started through the town's local legislative contingent (senator and representative). Recognizing that BSU does pay user charges for its sewer system use, it would be reasonable to request that any portion of the costs allocated to areas other than user charges (i.e. taxes) have a fraction of recovery directly from the state. In addition, because future capacity must be included in the WWTF costs, and those flows are not seen (and cannot be billed for user charges) during a significant part of the debt service period, it may also be appropriate to request a direct contribution of funds for the fraction of future flows allocated for BSU. By way of magnitude, this future flow component alone from BSU could be approximately 3% of the total WWTF capacity (ADF basis) – that means a contribution on the order of $1 million or more could be appropriate for this future capacity.

7.3 Adaptive Management & Integrated Planning

In moving forward to finalize the CWMP with Water Resources components, the Town of Bridgewater should look to two key approaches to help guide the implementation of the planned efforts. First, the town should seek to employ an adaptive management strategy. This approach suggests that the best results can be achieved by implementing changes in measured steps, and monitoring progress to determine what actions are working best. This adaptive management approach then recognizes that the planned actions may be revisited periodically, informed through the measurement of progress made, and then additional action plans can be refined. This means that the CWMP becomes more of a living document, subject to constant optimization. This approach is quite relevant to the proposed WWTF improvements plan, which if not done carefully could over-tax the town's resources, and limit its ability to continue other environmentally or socially important efforts. The initial part of this should be to carefully track the progress of other basin permits and regional WWTF improvements with EPA. If regional efforts can be adjusted, the unusually challenging part of the Bridgewater improvements – namely the nitrogen removal, may be able to be managed by best practices basin wide – rather than through overly costly WWTF improvements in every location. As a minimum step, the town needs to obtain permission to phase the WWTF improvements – again with the goal of making measured progress. This adaptive management approach is an overall important aspect of the recommendations of this CWMP.

The second key aspect the town needs to consider is reviewing the needed efforts for all of its water resources projects in coordination with the EPA's Integrated Planning (IP) policy. This policy allows for communities to consider their water resource and environmental project needs collectively, and allocate financial resources to the most effective areas. The main focus from EPA's position is the affordability, and projects with cost impacts exceeding the EPA fractions of local per capita incomes can be supported by extended compliance schedules. The longer time to implement

8.0 PUBLIC PARTICIPATION

This section of the CMWP report describes the stakeholder outreach and public participation efforts included as part of the planning process. The methods of public and local stakeholder outreach are discussed herein, including completed and proposed efforts. Copies of presentations made through the course of the planning work are included in Appendix I: Public Presentations.

8.1 Local Public Meetings

The planning team, in coordination with the Bridgewater Water and Sewer Department management staff, provided periodic local updates to the Town of Bridgewater through meetings with and presentations to the Water & Sewer Commission. Meetings included providing information on the scope and preliminary findings of the planning effort, and requesting input from the commissioners and public in attendance on local water resources issues. Copies of the meeting presentations are appended to this report.

8.2 Coordination with Town Departments

The planning work has included a process of data collection and coordination of information on ongoing and planned initiatives in Bridgewater. This coordination has included meeting and corresponding with various town departments to best capture the innate knowledge of the town staff. Specific meetings and coordination have occurred with the Public Works/Highway, Conservation and Planning Departments.

8.3 Bridgewater State University Outreach

The most significant individual user of the town utilities is Bridgewater State University (BSU). From the outset, the planning team collected information on existing usage and planned future changes to the BSU facility needs. Working through the Water and Sewer Department management, coordination was completed with the facility, including corresponding with the facility management and meeting to discuss the current and future water and sewer needs. Information on BSU water use and wastewater flows, and copies of coordinating correspondence is included in Appendix A: Bridgewater State University Planning Information & Correspondence.

8.4 CWMP Review Public Meetings and Public Hearings

Following presentation of the draft CWMP to the Bridgewater Water & Sewer Commission at a future public meeting, the town will schedule a formal public hearing to review the recommendations and accept formal public comments on the CWMP.

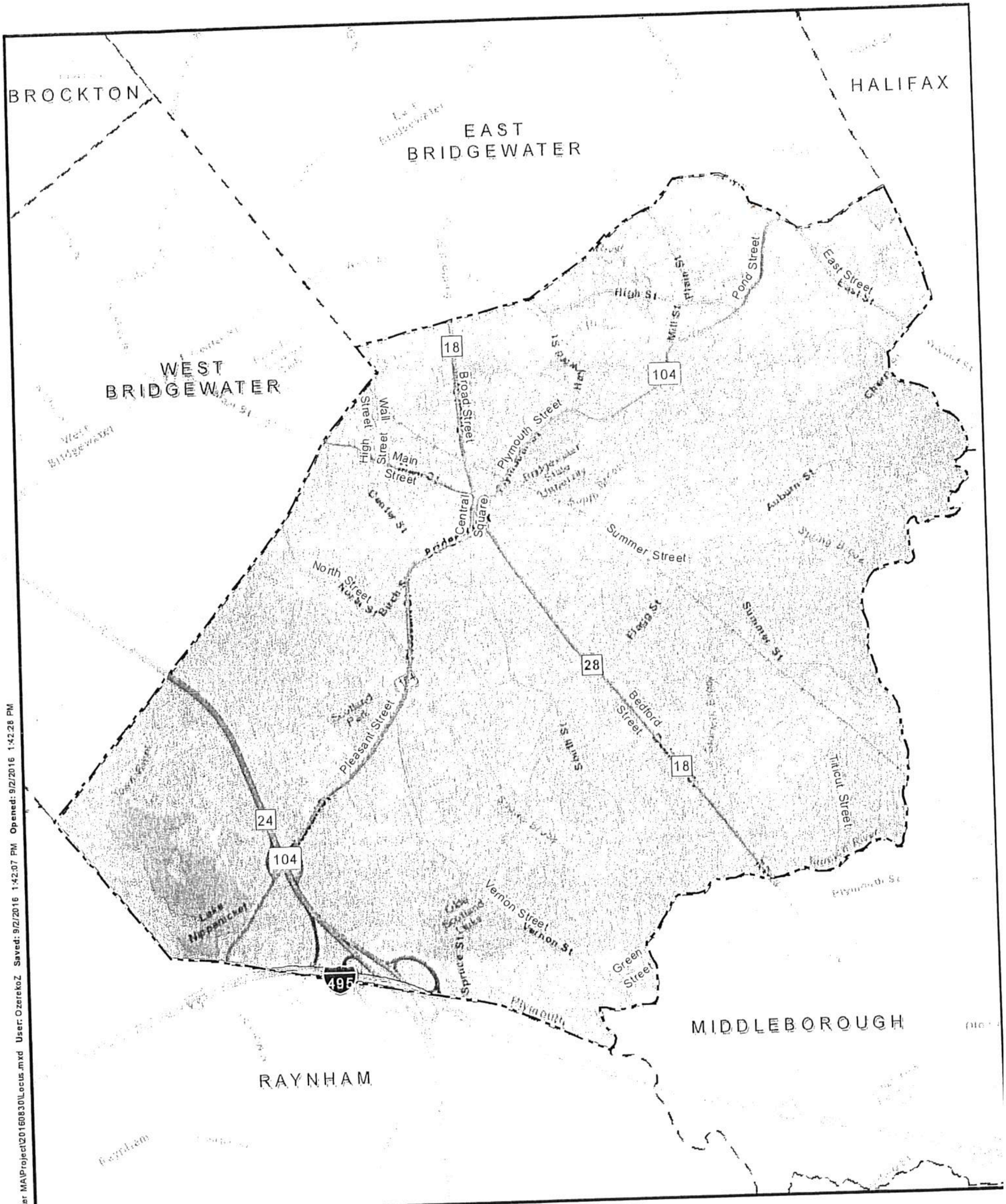


FIGURE 1-1
TOWN OF BRIDGEWATER, MASSACHUSETTS

LOCUS MAP

Weston & Sampson

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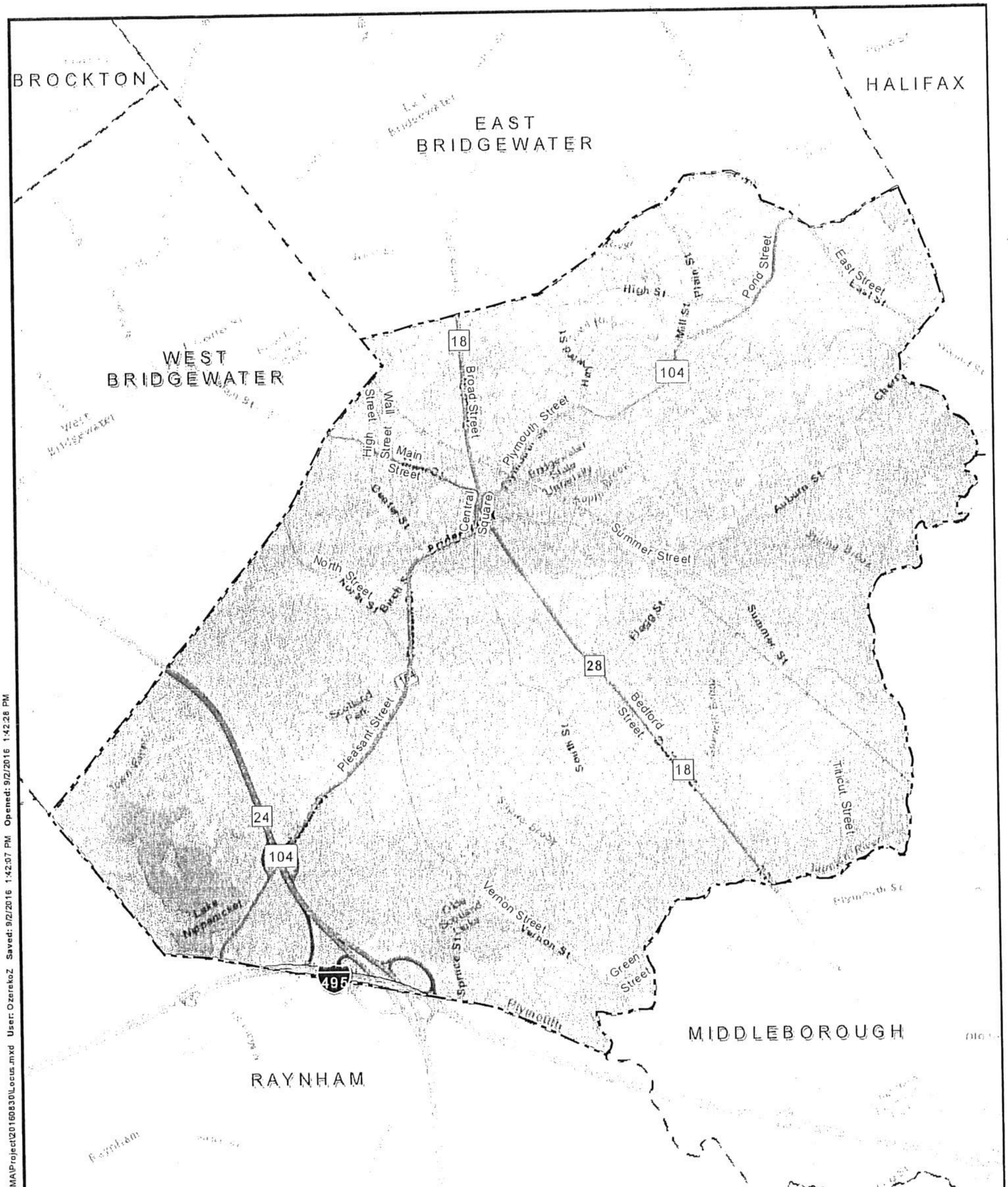

FIGURE 1-1
TOWN OF BRIDGEWATER, MASSACHUSETTS

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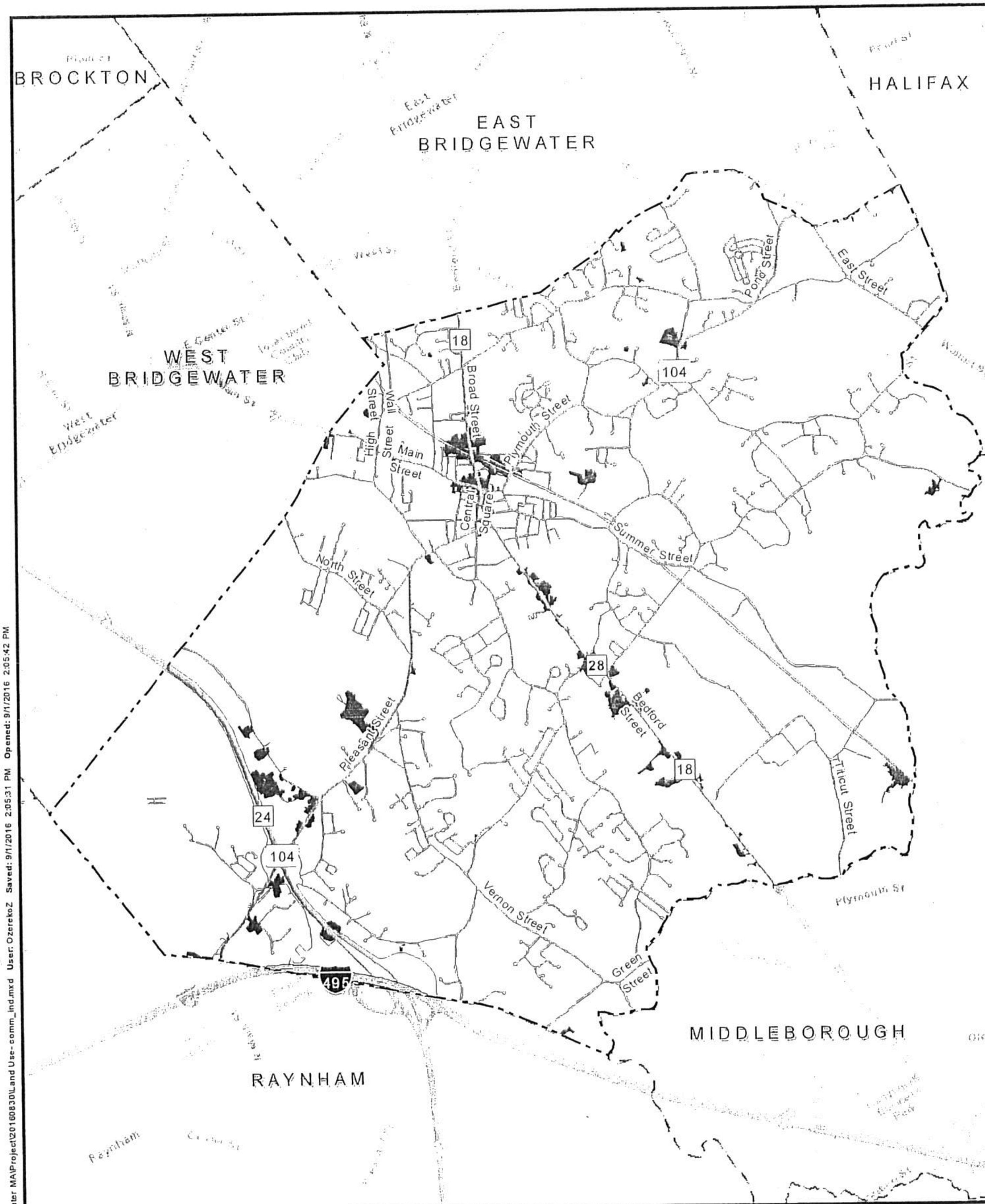

FIGURE 2-2
TOWN OF BRIDGEWATER, MASSACHUSETTS

EXISTING COMMERCIAL/INDUSTRIAL LAND USE (2005)

Land Use
Commercial/Industrial

1 0 1
Miles

N

Weston & Sampson

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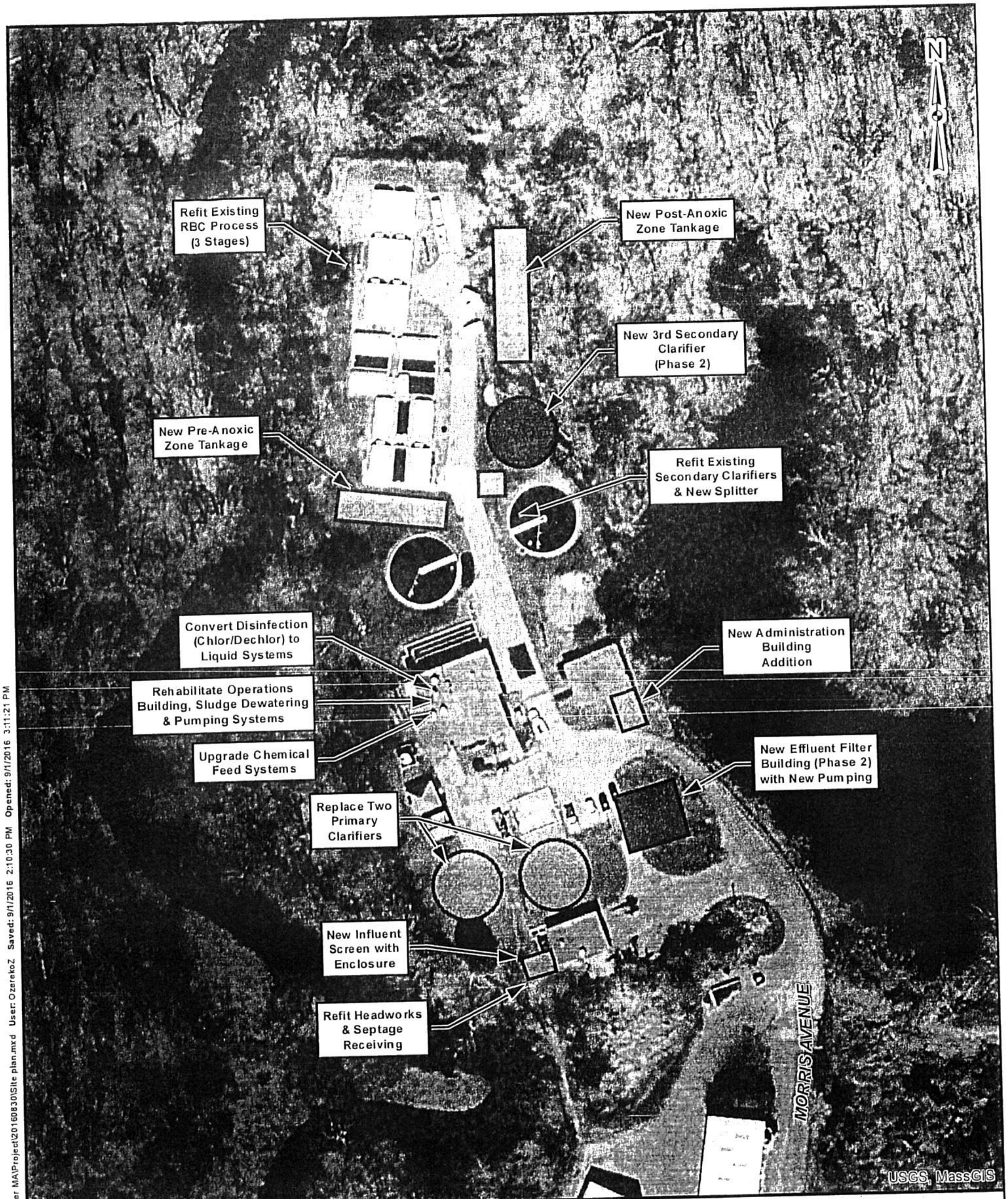

FIGURE 6-3
TOWN OF BRIDGEWATER, MASSACHUSETTS
PROPOSED WWTF MODIFICATIONS

Site Plan

Proposed Modifications

- Phase 1
- Phase 2

100 0 100
Scale In Feet

Weston & Sampson

Table 3-9: Summary of 2016 EPA MS4 Permit Requirements and Implementation Timeframes

Item No.	Requirement	When
	SECTION 1 - INTRODUCTION	
1.7.2	Prepare & Submit Notice of Intent to EPA/DEP	90 days from Permit Effective Date (ED) - By September 29, 2017
1.9.1	Documentation Regarding Endangered Species	90 days from ED
1.9.2	Documentation Regarding Historic Properties	90 days from ED
1.10.2	Develop Stormwater Management Plan (SWMP) - Phase I (see list of required elements in permit)	1 year from ED
1.10.2	Update SWMP - Phase II (see list of required elements in permit)	2 years from ED
1.10.2	Update SWMP - Phase III (see list of required elements in permit)	4 years from ED
1.10.2	Update SWMP concurrent with deadlines in Appendix F and H	Concurrent with App F/H deadlines; then annually thereafter
	SECTION 2 - NON-NUMERIC EFFLUENT LIMITATIONS	
	2.1 - WATER QUALITY BASED EFFLUENT LIMITATIONS	
2.1.1.d	Eliminate WQ violations	60 days of awareness
	2.1 - DISCHARGES TO IMPAIRED WATERS	
2.2	Identify outfalls/interconnections subject to TMDL or Impaired Water w/o TMDL	In SWMP (1 year from ED); Annual Reports
2.2.1	Requirements related to an Approved TMDL	Timelines identified below
	BACTERIA / PATHOGEN TMDL	
F.A.III.1.a.i.1	Distribute residential message on pet waste management (over/above 2.3.2)	Annually
F.A.III.1.a.i.1	Disseminate required public ed. info to dog owners	At license renewal (or similar)
F.A.III.1.a.i.1	Send public ed. materials to septic system owners	Not specified; assume annually
F.A.III.1.a.i.2	2.3.4 IDDE - Catchments to Bacteria/Pathogen Impaired Waters to be ranked Problem or High	With 2.3.4; 1 year from ED
2.2.2	Requirements for Water Quality Limited Waters (w/o TMDL)	Timelines identified below
	IMPAIRED - NITROGEN (INCLUDES TRIBUTARIES)	
H.I.1.a.i.1	Distribute clippings/fertilizer message to required audiences	Annually in April/May
H.I.1.a.i.1	Distribute pet waste management message to Residential	Annually in June/July
H.I.1.a.i.1	Distribute leaf litter disposal message to Residential/Business/Commercial	Annually August-October
H.I.1.a.i.2	2.3.6 Ordinance to require BMPs optimized for Nitrogen removal	With 2.3.6; 2 years from ED
H.I.1.a.i.2	2.3.6.1.b to include consideration of BMPs to reduce Nitrogen	With 2.3.6.1.b; 4 years from ED
H.I.1.a.i.3	2.3.7 Slow-release fertilizer requirements for MS4-owned property	With 2.3.7; 1 year from ED
H.I.1.a.i.3	2.3.7 Grass-clippings procedures for MS4-owned property	With 2.3.7; 1 year from ED
H.I.1.a.i.3	2.3.7 Sweep streets/lots >1/yr spring	Sweep at least once/year
H.I.1.b	Complete Nitrogen Source Identification Report	With Year 4 Annual Report
H.I.1.c	Complete Retrofit Evaluation, including implementation plan & schedule	With Year 5 Annual Report
H.I.1.c	Plan/install at least one structural BMP demonstration project	6 years from ED
H.I.1.c	Install remaining BMPs	As per plan/schedule in Year 5 Annual Report
H.I.1.c	Track/report BMP installations & estimated Nitrogen removal	Annual Report after installation; not later than Year 6
	IMPAIRED - PHOSPHORUS (INCLUDES TRIBUTARIES)	
H.II.1.a.i.1	Distribute clippings/fertilizer message to required audiences	Annually in March/April
H.II.1.a.i.1	Distribute pet waste management message to Residential	Annually in June/July
H.II.1.a.i.1	Distribute leaf litter disposal message to Residential/Business/Commercial	Annually August-October
H.II.1.a.i.2	2.3.6 Ordinance to require BMPs optimized for Phosphorus removal	With 2.3.6; 2 years from ED
H.II.1.a.i.2	2.3.6.1.b to include consideration of BMPs that Infiltrate	With 2.3.6.1.b; 4 years from ED
H.II.1.a.i.3	2.3.7 Grass-clippings procedures & blowing prohibited for MS4 property	With 2.3.7; 1 year from ED
H.II.1.a.i.3	2.3.7 Sweep streets/lots >1/yr spring	Sweep at least once/year
H.II.1.b	Complete Phosphorus Source Identification Report	With Year 4 Annual Report
H.II.1.c	Complete Retrofit Evaluation, including implementation plan & schedule	With Year 5 Annual Report
H.II.1.c	Plan/install at least one structural BMP demonstration project	6 years from ED
H.II.1.c	Install remaining BMPs	As per plan/schedule in Year 5 Annual Report
H.II.1.c	Track/report BMP installations & estimated Phosphorus removal	Annual Report after installation; not later than Year 6
	2.3 - REQUIREMENTS TO REDUCE POLLUTANTS TO THE MAXIMUM EXTENT PRACTICABLE	
	Public Education & Outreach	
2.3.2.a-d	Distribute at least 2 messages to 4 required audiences	Spaced over 5yr permit term
2.3.2.e	Identify method to evaluate effectiveness of message	Not specified
2.3.2.f	Modify ineffective messages/methods	Before next message distribution
2.3.2.g	Report on messages	Annual Report
	Public Involvement & Participation	
2.3.3.a	Make SWMP & Annual Report available to public	Continuous
2.3.3.b	Provide public opportunity to participate in review/implementation of SWMP	Annual Report
2.3.3.c	Report on Public Participation	Annual Report
	Illicit Discharge Detection & Elimination	
2.3.4.a	Develop IDDE Bylaw/ordinance	by May 1, 2008

Table 3-9: Summary of 2016 EPA MS4 Permit Requirements and Implementation Timeframes

Item No.	Requirement	When
2.3.4.2.a	Eliminate illicit discharges	60 days of Awareness
2.3.4.4.a	Mitigate SSOs	Expeditiously as possible
2.3.4.4.b	Identify where SSOs have discharged to MS4	1 year from ED
2.3.4.4.c	Report SSOs to EPA verbally; to EPA/DEP in writing	Verbal=24 hours; Written=5 days
2.3.4.4.d	Report on SSO inventory/mitigation/correction	Annual Report

Table 3-9: Summary of 2016 EPA MS4 Permit Requirements and Implementation Timeframes

Item No.	Requirement	When
2.3.4.5.a	Map MS4 System - Phase I (see list of required elements in permit)	2 years from ED
2.3.4.5.b	Map MS4 System - Phase II (see list of required elements in permit)	Update annually; 100% by 10 years from ED
2.3.4.5.e	Report on progress of map	Annual Reports
2.3.4.6	Develop written IDDE program	Must include in SWMP; 1 year from ED
2.3.4.6.a	Cite legal authority (bylaw/ordinance) in IDDE plan	In IDDE Plan/SWMP (1 yr from ED)
2.3.4.6.b	IDDE Program responsibilities	In IDDE Plan/SWMP (1 yr from ED)
2.3.4.6.c	Program Procedures	In IDDE Plan/SWMP (1 yr from ED)
2.3.4.7.a	Outfall/Interconnection inventory and initial ranking	1 yr from ED (include in IDDE/SWMP)
2.3.4.7.b	Dry weather outfall/interconnection screening & sampling of high & low priority ranks	3 years from ED
2.3.4.7.b.i	Written screening and sampling procedure	In IDDE Plan/SWMP (1 yr from ED)
2.3.4.7.c.iii	Follow-up ranking of outfalls/interconnections	Continuous w/data collection; 100% by 3 years from ED
2.3.4.8.a & b	Catchment investigation written procedure	18 mos. from ED (include in IDDE/SWMP; 1 year from ED)
2.3.4.8.a	Start investigation of catchments associated with Problem Outfalls	2 years from ED
2.3.4.8.a	Complete investigation of catchments associated with Problem Outfalls	7 years from ED
2.3.4.8.a	Complete investigation of catchments found to have Sewage Input	7 years from ED
2.3.4.8.a	Investigations of catchments associated with all High- and Low-Priority outfalls	10 years from ED
2.3.4.8.c.i	Document the presence or absence of System Vulnerability Factors (SVFs)	Annual Report
2.3.4.8.c.ii.2	Wet weather sampling of outfalls/interconnections with ≥1 SVF	Upon completion of dry weather investigation, but before catchment marked as complete (see 2.3.4.8.a for deadlines)
2.3.4.8.e.i	Report on illicits removed	Annual Report
2.3.4.8.e.ii	Confirmatory outfall or interconnection screening	1 year from removal of discharges
2.3.4.9	Report on IDDE Program progress	Annual Report
2.3.4.10	Scheduled ongoing screening	Once every 5 years
2.3.4.11	Training	Annually
	Construction Site Stormwater Runoff Control	
2.3.5.a	Continue Construction Site Stormwater Runoff Control Program from 2003 permit	Continuous
2.3.5.c.i	Develop/modify ordinance/bylaw to include required elements	By May 1, 2008
2.3.5.c.ii	Develop written site inspection/enforcement procedures	Must include in SWMP; 1 year from ED
2.3.5.c.iii	Requirements for sediment/erosion BMPs	Not specified
2.3.5.c.iv	Requirements for waste control	Not specified
2.3.5.c.v	Written site plan review procedures	1 year from ED (include in SWMP)
	Post-Construction Stormwater Management	
2.3.6.a	Continue Post-Construction Stormwater Management Program from 2003 permit	Continuous
2.3.6.a.ii	Develop or modify existing bylaw/ordinance to include required minimum elements	2 years from ED
2.3.6.a.iii	Require submission of as-built drawings + assure long-term O&M (add to ordinance or regs)	In SWMP; 2 years from ED
2.3.6.b	Develop report assessing street design and parking lot guidelines	4 years from ED
2.3.6.c	Assess local regulations to allow green practices	Report progress annually; complete 4 years from ED
2.3.6.d	Identify ≥5 permittee-owned properties to potentially be modified with BMPs	4 years from ED
	Good Housekeeping & Pollution Prevention for Permittee-Owned Operations	
2.3.7.a.i	Develop written O&M procedures for municipal activities	2 years from ED
2.3.7.a.ii	Inventory municipal facilities	2 years from ED
2.3.7.a.ii	Develop procedures/evaluation for Parks/Open Space, Bldgs/Facilities & Vehicles/Equipment	2 years from ED
2.3.7.a.iii.1	Develop written O&M program for MS4 infrastructure	2 years from ED
2.3.7.a.iii.2	CB inspection/cleaning: maximize in construction areas & no sump >50% full	In SWMP; Annual Reports
2.3.7.a.iii.2	Investigate excessive sediment	In SWMP; Annual Reports
2.3.7.a.iii.2	Log/report CB cleaning	Annual Reports
2.3.7.a.iii.3	Establish/implement sweeping program for streets/parking lots	Sweep at least once/year
2.3.7.a.iii.3	Documentation and targeted sweeping plan	2 years from ED
2.3.7.a.iii.4	Ensure proper storage of CB cleanings & street sweepings to prevent runoff	NA
2.3.7.a.iii.4	Report miles cleaned & amount of material removed (sweeping)	Annual Reports
2.3.7.a.iii.5	Establish procedures for winter road maintenance	Part of 2.3.7.a.iii.1; 2 years from ED
2.3.7.a.iii.5	Establish inspection/maintenance procedures for structural BMPs (inspect at least annually)	Part of 2.3.7.a.iii.1; 2 years from ED
2.3.7.a.iii.6	Implement inspection and maintenance for stormwater treatment structures	≥ Annually
2.3.7.a.iv	Report on all GH/PP requirements	Annual Report
2.3.7.b	Write/implement SWPPP for required facilities as per 2.3.7.b	2 years from ED
2.3.7.b.ii.4.g	Cover salt piles or piles containing salt	2 years from ED
2.3.7.b.ii.4.h	Conduct Training	Annually
2.3.7.b.iii	Conduct quarterly routine inspections; one during wet-weather	2 years from ED; then Annual Report
2.3.7.b.iii	Repair/replace inoperative controls identified during inspection	Before next storm event
2.3.7.b.iii	Report on inspections	Annual Report
2.3.7.b.iv	Maintain written records of all SWPPP activities	Continuous
3.0	**ADDITIONAL REQUIREMENTS FOR DISCHARGES TO SURFACE DRINKING WATER SUPPLIES & TRIBUTARIES**	

Table 3-9: Summary of 2016 EPA MS4 Permit Requirements and Implementation Timeframes

Item No.	Requirement	When
3.0.a	Make MS4 discharges to drinking water sources a priority in SWMP	Continuous; Annual Report
3.0.b	For MS4 discharges to drinking water sources, provide treatment/spill prevention	Continuous; Annual Report
3.0.c	Avoid direct discharges to Class A waters	Continuous; Annual Report
	4.0 PROGRAM EVALUATION, RECORDKEEPING & REPORTING	
4.1.a	Self-evaluate compliance with the permit	Annually
4.1.b	Evaluate BMP effectiveness & change if needed under provisions of permit	Annual Report
4.2.a	Must keep records for ≥5yrs; make available to public	Continuous
4.3.b	Submit results of outfall monitoring	Annual Report
4.3.c	Submit results of all other stormwater or water quality monitoring	Annual Report
4.4	Submit Annual Report 90 days from the close of each reporting period (Sept.30)	Annual Report

Table 6-X: Summary of 2016 EPA MS4 Permit Requirements and Estimated Cost to Comply

Item No.	Requirement	When	Estimated Cost
	SECTION 1 - INTRODUCTION		
1.7.2	Prepare & Submit Notice of Intent to EPA/DEP	90 days from Permit Effective Date (ED) - By September 29, 2017	$10,000
1.9.1	Documentation Regarding Endangered Species	90 days from ED	
1.9.2	Documentation Regarding Historic Properties	90 days from ED	
1.10.2	Develop Stormwater Management Plan (SWMP) - Phase I (see list of required elements in permit)	1 year from ED	$15,000 - $25,000
1.10.2	Update SWMP - Phase II (see list of required elements in permit)	2 years from ED	
1.10.2	Update SWMP - Phase III (see list of required elements in permit)	4 years from ED	
1.10.2	Update SWMP concurrent with deadlines in Appendix F and H	Concurrent with App F/H deadlines; then annually thereafter	Budget $5,000/yr in Years 2 - 5 for annual updates
	SECTION 2 - NON-NUMERIC EFFLUENT LIMITATIONS		
	2.1 - WATER QUALITY BASED EFFLUENT LIMITATIONS		
2.1.1.d	Eliminate WQ violations	60 days of awareness	Cost included under IDDE under Item 2.3.4.2.a.
	2.1 - DISCHARGES TO IMPAIRED WATERS		
2.2	Identify outfalls/interconnections subject to TMDL or Impaired Water w/o TMDL	In SWMP (1 year from ED); Annual Reports	Cost included under 1.10.2. (1)
2.2.1	Requirements related to an Approved TMDL	Timelines identified below	Cost included under F.A.III.1.a.i.
	BACTERIA / PATHOGEN TMDL		
F.A.III.1.a.i.1	Distribute residential message on pet waste management (over/above 2.3.2)	Annually	$2,500 - $3,500 per year over 5 year permit term
F.A.III.1.a.i.1	Disseminate required public ed. info to dog owners	At license renewal (or similar)	
F.A.III.1.a.i.1	Send public ed. materials to septic system owners	Not specified; assume annually	
F.A.III.1.a.i.2	2.3.4 IDDE - Catchments to Bacteria/Pathogen Impaired Waters to be ranked Problem or High	With 2.3.4; 1 year from ED	Cost included under 2.3.4.7.a.
2.2.2	Requirements for Water Quality Limited Waters (w/o TMDL)	Timelines identified below	Cost included under H.I.1.a.i.
	IMPAIRED - NITROGEN (INCLUDES TRIBUTARIES)		
H.I.1.a.i.1	Distribute clippings/fertilizer message to required audiences	Annually in April/May	$2,500 - $3,500 per year over 5 year permit term
H.I.1.a.i.1	Distribute pet waste management message to Residential	Annually in June/July	
H.I.1.a.i.1	Distribute leaf litter disposal message to Residential/Business/Commercial	Annually August-October	
H.I.1.a.i.2	2.3.6 Ordinance to require BMPs optimized for Nitrogen removal	With 2.3.6; 2 years from ED	Cost included under 2.3.5.c.
H.I.1.a.i.2	2.3.6.1.b to include consideration of BMPs to reduce Nitrogen	With 2.3.6.1.b; 4 years from ED	
H.I.1.a.i.3	2.3.7 Slow-release fertilizer requirements for MS4-owned property	With 2.3.7; 1 year from ED	Cost included under 2.3.7.a.i.
H.I.1.a.i.3	2.3.7 Grass-clippings procedures for MS4-owned property	With 2.3.7; 1 year from ED	Cost included under 2.3.7.a.i.
H.I.1.a.i.3	2.3.7 Sweep streets/lots >1/yr spring	Sweep at least once/year	Cost included under 2.3.7.a.iii.3.
H.I.1.b	Complete Nitrogen Source Identification Report	With Year 4 Annual Report	$15,000 to $25,000
H.I.1.c	Complete Retrofit Evaluation, including implementation plan & schedule	With Year 5 Annual Report	$10,000 to $15,000 (cost will vary depending on the number of properties identified)
H.I.1.c	Plan/install at least one structural BMP demonstration project	6 years from ED	$25,000 to $75,000 (includes engineering design & construction)
H.I.1.c	Install remaining BMPs	As per plan/schedule in Year 5 Annual Report	$75,000 to $225,000 (Depends on number of permittee owned properties for retrofit opportunity within the drainage area. Assume 3 additional locations. Budget $25,000 to $75,000 per location for design & construction.)
H.I.1.c	Track/report BMP installations & estimated Nitrogen removal	Annual Report after installation; not later than Year 6	(1)
	IMPAIRED - PHOSPHORUS (INCLUDES TRIBUTARIES)		
H.II.1.a.i.1	Distribute clippings/fertilizer message to required audiences	Annually in March/April	Cost included under H.I.1.a.i.1.
H.II.1.a.i.1	Distribute pet waste management message to Residential	Annually in June/July	
H.II.1.a.i.1	Distribute leaf litter disposal message to Residential/Business/Commercial	Annually August-October	
H.II.1.a.i.2	2.3.6 Ordinance to require BMPs optimized for Phosphorus removal	With 2.3.6; 2 years from ED	Cost included under 2.3.5.c.
H.II.1.a.i.2	2.3.6.1.b to include consideration of BMPs that Infiltrate	With 2.3.6.1.b; 4 years from ED	

Table 6-X: Summary of 2016 EPA MS4 Permit Requirements and Estimated Cost to Comply

Item No.	Requirement	When	Estimated Cost
H.II.1.a.i.3	2.3.7 Grass-clippings procedures & blowing prohibited for MS4 property	With 2.3.7; 1 year from ED	Cost included under 2.3.7.a.i.
H.II.1.a.i.3	2.3.7 Sweep streets/lots >1/yr spring	Sweep at least once/year	Cost included under 2.3.7.a.iii.3.
H.II.1.b	Complete Phosphorus Source Identification Report	With Year 4 Annual Report	$15,000 to $25,000
H.II.1.c	Complete Retrofit Evaluation, including implementation plan & schedule	With Year 5 Annual Report	$10,000 to $15,000 (cost will vary depending on the number of properties identified)
H.II.1.c	Plan/install at least one structural BMP demonstration project	6 years from ED	$25,000 to $75,000 (includes engineering design & construction)
H.II.1.c	Install remaining BMPs	As per plan/schedule in Year 5 Annual Report	$75,000 to $225,000 (Depends on number of permittee owned properties for retrofit opportunity within the drainage area. Assume 3 additional locations. Budget $25,000 to $75,000 per location for design & construction.)
H.II.1.c	Track/report BMP installations & estimated Phosphorus removal	Annual Report after installation; not later than Year 6	(1)
	2.3 - REQUIREMENTS TO REDUCE POLLUTANTS TO THE MAXIMUM EXTENT PRACTICABLE		
	Public Education & Outreach		
2.3.2.a-d	Distribute at least 2 messages to 4 required audiences	Spaced over 5yr permit term	$10,000 - $20,000 for 5-year permit term (Varies depending on whether materials are readily available or need to be developed from scratch.)
2.3.2.e	Identify method to evaluate effectiveness of message	Not specified	
2.3.2.f	Modify ineffective messages/methods	Before next message distribution	
2.3.2.g	Report on messages	Annual Report	(1)
	Public Involvement & Participation		
2.3.3.a	Make SWMP & Annual Report available to public	Continuous	-
2.3.3.b	Provide public opportunity to participate in review/implementation of SWMP	Annual Report	$2,500 - $5,000 for 5-year permit term (assumes at least one activity annually over five years and that volunteer organizations will assist)
2.3.3.c	Report on Public Participation	Annual Report	(1)
	Illicit Discharge Detection & Elimination		
2.3.4.a	Develop IDDE Bylaw/ordinance	by May 1, 2008	Completed under 2003 Permit.
2.3.4.2.a	Eliminate illicit discharges	60 days of Awareness	Budget $25,000 to $50,000 per year over 10 years as an allowance for removal of illicit connections.
2.3.4.4.a	Mitigate SSOs	Expeditiously as possible	Town Forces
2.3.4.4.b	Identify where SSOs have discharged to MS4	1 year from ED	
2.3.4.4.c	Report SSOs to EPA verbally; to EPA/DEP in writing	Verbal=24 hours; Written=5 days	
2.3.4.4.d	Report on SSO inventory/mitigation/correction	Annual Report	(1)
2.3.4.5.a	Map MS4 System - Phase I (see list of required elements in permit)	2 years from ED	$75,000 - $100,000
2.3.4.5.b	Map MS4 System - Phase II (see list of required elements in permit)	Update annually; 100% by 10 years from ED	
2.3.4.5.e	Report on progress of map	Annual Reports	(1)
2.3.4.6	Develop written IDDE program	Must include in SWMP; 1 year from ED	$2,500 - $5,000
2.3.4.6.a	Cite legal authority (bylaw/ordinance) in IDDE plan	In IDDE Plan/SWMP (1 yr from ED)	
2.3.4.6.b	IDDE Program responsibilities	In IDDE Plan/SWMP (1 yr from ED)	
2.3.4.6.c	Program Procedures	In IDDE Plan/SWMP (1 yr from ED)	
2.3.4.7.a	Outfall/Interconnection inventory and initial ranking	1 yr from ED (include in IDDE/SWMP)	$10,000 - $15,000
2.3.4.7.b	Dry weather outfall/interconnection screening & sampling of high & low priority ranks	3 years from ED	$50,000 - $100,000
2.3.4.7.b.i	Written screening and sampling procedure	In IDDE Plan/SWMP (1 yr from ED)	Cost included under 2.3.4.6.
2.3.4.7.c.iii	Follow-up ranking of outfalls/interconnections	Continuous w/data collection; 100% by 3 years from ED	$5,000 - $7,500
2.3.4.8.a & b	Catchment investigation written procedure	18 mos. from ED (include in IDDE/SWMP; 1 year from ED)	Cost included under 2.3.4.6.
2.3.4.8.a	Start investigation of catchments associated with Problem Outfalls	2 years from ED	Budget $100,000 to $150,000/yr allowance in Years 2 to 10 for IDDE investigation and sampling. Budget

Table 6-X: Summary of 2016 EPA MS4 Permit Requirements and Estimated Cost to Comply

tem No.	Requirement	When	Estimated Cost
2.3.4.8.a	Complete investigation of catchments associated with Problem Outfalls	7 years from ED	to 10 for IDDE investigation and sampling. Budget $25,000 to $50,000 allowance in Years 2 to 10 for CCTV inspection and dye testing to investigate illicit connections. Budget allowance for removal of illicit connections included under 2.3.4.2.a.
2.3.4.8.a	Complete investigation of catchments found to have Sewage Input	7 years from ED	
2.3.4.8.a	Investigations of catchments associated with all High- and Low-Priority outfalls	10 years from ED	
2.3.4.8.c.i	Document the presence or absence of System Vulnerability Factors (SVFs)	Annual Report	Cost included under 2.3.4.7.c.iii.
.3.4.8.c.ii.2	Wet weather sampling of outfalls/interconnections with ≥1 SVF	Upon completion of dry weather investigation, but before catchment marked as complete (see 2.3.4.8.a for deadlines)	Budget $100,000 to $125,000
2.3.4.8.e.i	Report on illicits removed	Annual Report	(1)
2.3.4.8.e.ii	Confirmatory outfall or interconnection screening	1 year from removal of discharges	$2,500 - $5,000
2.3.4.9	Report on IDDE Program progress	Annual Report	(1)
2.3.4.10	Scheduled ongoing screening	Once every 5 years	After IDDE Investigation is Complete and illicit discharges identified have been removed (10 years from permit effective date).
2.3.4.11	Training	Annually	Budget $2,500 - $3,500 annually.
	Construction Site Stormwater Runoff Control		
2.3.5.a	Continue Construction Site Stormwater Runoff Control Program from 2003 permit	Continuous	-
2.3.5.c.i	Develop/modify ordinance/bylaw to include required elements	By May 1, 2008	Completed under 2003 Permit.
2.3.5.c.ii	Develop written site inspection/enforcement procedures	Must include in SWMP; 1 year from ED	Budget $10,000 to $15,000 to make all required ordinance updates & develop written procedures.
2.3.5.c.iii	Requirements for sediment/erosion BMPs	Not specified	
2.3.5.c.iv	Requirements for waste control	Not specified	
2.3.5.c.v	Written site plan review procedures	1 year from ED (include in SWMP)	
	Post-Construction Stormwater Management		
2.3.6.a	Continue Post-Construction Stormwater Management Program from 2003 permit	Continuous	-
2.3.6.a	Adopt regulatory mechanism that regulates runoff from new development/redevelopment	By May 1, 2008	Completed under 2003 Permit.
2.3.6.a.ii	Develop or modify existing bylaw/ordinance to include required minimum elements	2 years from ED	Cost included under 2.3.5.c.
2.3.6.a.iii	Require submission of as-built drawings + assure long-term O&M (add to ordinance or regs)	In SWMP; 2 years from ED	
2.3.6.b	Develop report assessing street design and parking lot guidelines	4 years from ED	$2,500 - $5,000
2.3.6.c	Assess local regulations to allow green practices	Report progress annually; complete 4 years from ED	$2,500 - $5,000
2.3.6.d	Identify >5 permittee-owned properties to potentially be modified with BMPs	4 years from ED	$2,500 - $5,000
	Good Housekeeping & Pollution Prevention for Permittee-Owned Operations		
2.3.7.a.i	Develop written O&M procedures for municipal activities	2 years from ED	$7,500 - $10,000
2.3.7.a.ii	Inventory municipal facilities	2 years from ED	Town Forces
2.3.7.a.ii	Develop procedures/evaluation for Parks/Open Space, Bldgs/Facilities & Vehicles/Equipment	2 years from ED	Cost included under 2.3.7.a.i.
2.3.7.a.iii.1	Develop written O&M program for MS4 infrastructure	2 years from ED	
2.3.7.a.iii.2	CB inspection/cleaning: maximize in construction areas & no sump >50% full	In SWMP; Annual Reports	Budget $10,000 to $15,000 per year additional. Current catch basin cleaning frequency may need to be increased to ensure that catch basins remain <50% full.
2.3.7.a.iii.2	Investigate excessive sediment	In SWMP; Annual Reports	
2.3.7.a.iii.2	Log/report CB cleaning	Annual Reports	(1)
2.3.7.a.iii.3	Establish/implement sweeping program for streets/parking lots	Sweep at least once/year	Budget $10,000 to $15,000 per year additional. (Sweeping of streets and parking lots will need to be increased from once per year to twice per year in regulated areas to meet the impaired waters requirements included under F.H.I.1.a.i.3 and H.II.1.a.i.3. Cost only reflects anticipated increase in sweeping required and not current expenditures for street sweeping.)

Table 6-X: Summary of 2016 EPA MS4 Permit Requirements and Estimated Cost to Comply

tem No.	Requirement	When	Estimated Cost
.3.7.a.iii.3	Documentation and targeted sweeping plan	2 years from ED	Cost included under 2.3.7.a.i.
.3.7.a.iii.4	Ensure proper storage of CB cleanings & street sweepings to prevent runoff	NA	Town Forces
.3.7.a.iii.4	Report miles cleaned & amount of material removed (sweeping)	Annual Reports	(1)
.3.7.a.iii.5	Establish procedures for winter road maintenance	Part of 2.3.7.a.iii.1; 2 years from ED	Included under 2.3.7.a.i.
.3.7.a.iii.5	Establish inspection/maintenance procedures for structural BMPs (inspect at least annually)	Part of 2.3.7.a.iii.1; 2 years from ED	
.3.7.a.iii.6	Implement inspection and maintenance for stormwater treatment structures	≥ Annually	Town Forces
2.3.7.a.iv	Report on all GH/PP requirements	Annual Report	(1)
2.3.7.b	Write/implement SWPPP for required facilities as per 2.3.7.b	2 years from ED	Budget $7,500 to $10,000 per SWPPP. (Assume SWPPP will need to be developed for DPW Facility and Transfer Station already has a SWPPP in place.)
.3.7.b.ii.4.g	Cover salt piles or piles containing salt	2 years from ED	Town Forces
.3.7.b.ii.4.h	Conduct Training	Annually	Budget $2,500 - $3,500 annually.
2.3.7.b.iii	Conduct quarterly routine inspections; one during wet-weather	2 years from ED; then Annual Reports	Town Forces
2.3.7.b.iii	Repair/replace inoperative controls identified during inspection	Before next storm event	Town Forces
2.3.7.b.iii	Report on inspections	Annual Report	(1)
2.3.7.b.iv	Maintain written records of all SWPPP activities	Continuous	-
	3.0 ADDITIONAL REQUIREMENTS FOR DISCHARGES TO SURFACE DRINKING WATER SUPPLIES & TRIBUTARIES		
3.0.a	Make MS4 discharges to drinking water sources a priority in SWMP	Continuous; Annual Report	-
3.0.b	For MS4 discharges to drinking water sources, provide treatment/spill prevention	Continuous; Annual Report	-
3.0.c	Avoid direct discharges to Class A waters	Continuous; Annual Report	-
	4.0 PROGRAM EVALUATION, RECORDKEEPING & REPORTING		
4.1.a	Self-evaluate compliance with the permit	Annually	$7,500 - $10,000/yr (It is anticipated that first year annual costs will be higher than subsequent years.)
4.1.b	Evaluate BMP effectiveness & change if needed under provisions of permit	Annual Report	
4.2.a	Must keep records for >5yrs; make available to public	Continuous	
4.3.b	Submit results of outfall monitoring	Annual Report	
4.3.c	Submit results of all other stormwater or water quality monitoring	Annual Report	
4.4	Submit Annual Report 90 days from the close of each reporting period (Sept.30)	Annual Report	
		Planning Level Estimate for Permit Compliance:	**$1,150,000 - $2,140,000**