SEWER MASTER PLAN
for the
TOWN OF MERRIMACK,
NEW HAMPSHIRE

APRIL 2013

WRIGHT-PIERCE
Engineering a Better Environment

WRIGHT-PIERCE
Engineering a Better Environment

Water
Wastewater
Infrastructure

April 12, 2013
W-P Project No. 12378A

Mr. James Taylor, Assistant Director of Public Works
Merrimack Wastewater Treatment Facility
36 Mast Road
Merrimack, New Hampshire 03054

Subject: Final Sewer Master Plan
Town of Merrimack, New Hampshire

Dear Jim:

We are pleased to provide you with 12 paper copies and one electronic (PDF) copy of the final Sewer Master Plan. This Plan reflects updates based upon input received from the Town and from our internal QA/QC review process. The Town and Wright-Pierce put a significant effort into conducting the evaluation and preparing this plan and we appreciate the input, information and time that you and your staff have provided.

We hope that the final Plan meets or exceeds your expectations and we look forward to future opportunities to work with the Town. Should you have any questions, please do not hesitate to contact me or Kattie at (207) 725-8721.

Very truly yours,

Christopher A. Dwinal, P.E.
Senior Project Manager

CAD/kmc
Enclosures

cc: Rick Seymour, Town of Merrimack
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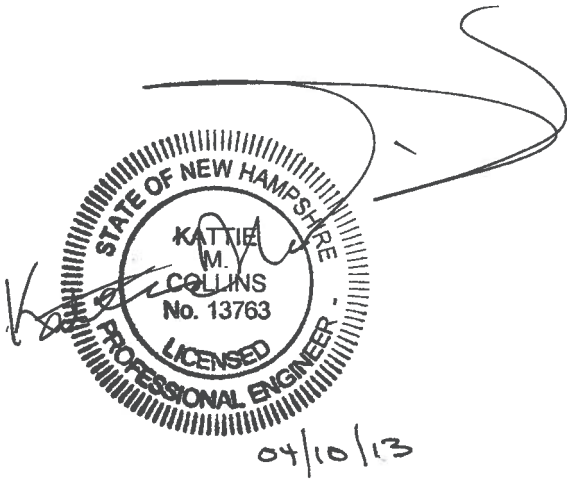
TOWN OF MERRIMACK, NEW HAMPSHIRE

SEWER MASTER PLAN

APRIL 2013



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TOWN OF MERRIMACK, NEW HAMPSHIRE
SEWER MASTER PLAN

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EXECUTIVE SUMMARY

ES.1 BACKGROUND

The Town of Merrimack, New Hampshire is centrally located within one hour of Boston, one hour off the seacoast and one hour from the mountains. As such, this thriving community of 26,500 residents is highly desirable and attracts significant residential development as well as retail business, industrial and institutional development. The wastewater needs for approximately a third of the community and part of Bedford to the north are served by a large, primarily gravity, collection system, six pump stations and a 5.0 MGD wastewater treatment facility (WWTF) located on Mast Road. While there are some exceptions, the majority of the wastewater collection system was constructed in the early 1970s.

In 1977, Hamilton Engineering Associates developed a Facilities Plan for Interceptors and Trunk Sewers which has served as a guide to the Town for sewer extensions over the past 35 years. Underwood Engineers was retained in the early 1990s to develop a revised assessment of sewer needs and a revised plan for sewer extensions. However, the Underwood study was never approved or accepted by the Town. Currently, through its Sewer Use Ordinance, the Town still requires that proposed developments requiring sewer connections be reviewed in consideration of the proposed sewer implementation/phasing plan that was established in the Hamilton study. Given that the recommendations for the Hamilton Study are nearly 40 years old, the Town recognized the need to develop a new sewer master plan to guide the Town for the next 20 years.

ES.2 EXISTING CONDITIONS

The following is a brief summary of the existing gravity collection system, pumping stations and wastewater treatment facility. It also includes a discussion of the non-sewered areas in Merrimack, current septage quantities treated in Merrimack, and the current flows and loads at the WWTF.

ES.2.1 Gravity Collection System

The Town of Merrimack has two collections systems which serve wastewater needs for approximately one third of the community and part of Bedford to the north. The smaller of the two systems flows to Nashua and serves the southwest area of Merrimack bounded by Erik Street, Naticook Road and Continental Boulevard. The larger of the two systems serves the remainder of the sewered population in Town, including most of the area to the east of the F. E. Everett Turnpike as well as portions of central Merrimack and northeastern Merrimack. Figure A-1 in Appendix A shows the two collection systems.

ES.2.2 Pumping Stations

The Town owns and operates six pump stations. The five pump stations considered as part of this study are as follows:

- Pearson Road Pump Station
- Souhegan Pump Station
- Burt Street Pump Station
- Thornton's Ferry Pump Station
- Heron Cove Pump Station

There are two suction lift style pump stations, two dry well/wet well pumps stations with centrifugal style pumps, and one ejector style station that were constructed between 1972 and 1998. Section 2 includes additional information about each pump station including pumping capacities, service areas and existing flows.

ES.2.3 Wastewater Treatment Facility

The Town is served by a 5.0 MGD activated sludge WWTF located on Mast Road with the final treated effluent discharging to the Merrimack River which has been in operation since 1970. The facility includes an influent pumping station, equalization tanks, primary clarifiers, aeration basins, secondary clarifiers, sodium hypochlorite disinfection, sodium bisulfite dechlorination,

and solids thickening and dewatering systems. The facility also includes a septage pretreatment unit upstream of septage equalization and pumping facilities and a biosolids composting facility. Many of the unit processes have been upgraded since 1972, but some of the equipment is original to 1972.

ES.2.4 Non-Sewered Area

As can be seen in Figure A-1, a significant portion of Merrimack is not currently served by public sewer. Developed properties in these areas are primarily residential and are served by privately owned on-lot septic systems consisting of a septic tank and a subsurface disposal field.

The Town's draft Community Master Plan[1] indicates that approximately 17% of Merrimack's land area is currently vacant/undeveloped (3,700 acres distributed among 266 parcels, not including permanent open space); 69% of this land is zoned as residential, 29% is zoned as industrial and 2% is zoned as commercial. The majority of these undeveloped parcels are in areas not currently served by public sewer.

ES.2.5 Septage

For properties served by on-lot septic systems, the solids collected in the septic tank must be pumped out and disposed of in a manner consistent with New Hampshire regulations. As such, the WWTF has septage receiving capabilities which are adequate to treat the septage for the Town and a number of surrounding communities. The Town currently treats approximately 5.2 million gallons of septage per year (1.4 million gallons from sources within the Town).

ES.2.6 Current Flows and Loads

The current wastewater flows and loads for the Town of Merrimack (less the flows that are pumped to Nashua for treatment) are summarized in Table ES-1 below. With an average design

[1] 2012 Master Plan Update, Merrimack, New Hampshire, June 2011 Draft, Vanesse Hangen Brustlin, Inc., Chapter 2.

capacity of 5.0 MGD, the plant is more than adequately sized to handle the existing flows and loads.

TABLE ES-1: CURRENT FLOWS AND LOADS (NOVEMBER 2009-JULY 2012)

	Average	Maximum Month	Maximum Hour
Flow (MGD)	1.78	2.65	4.86
BOD_5 (mg/L)	372	550	--
TSS (mg/L)	599	769	--

ES.3 POSSIBLE FUTURE CONDITIONS

Although the entire Town of Merrimack was taken into consideration for the future sewer extension planning, the majority of the effort was centered on the following areas:

- Areas where sewer would flow by gravity into the existing collection system
- Areas that are close to the existing collection system and could be easily connected
- Areas where there is a known environmental concern
- Areas where there is a known interest for development
- Areas where there a concern about the ability of the lots to support individual septic systems

The planning period used for facilities planning is traditionally 20 years; therefore, the projections made in this Sewer Master Plan are through the year 2033. The intent is to provide a roadmap for any sewer extension projects that may occur during the next 20 years.

ES.3.1 Future Flow Projections and Cost Estimating

Section 3.5 includes a detailed explanation of how future flows were estimated. In general, an average daily flow (ADF) for each project was calculated by assuming 210 gallons per day (GPD) of flow from each residential parcel in the project area and an infiltration rate of 300 GPD per inch-diameter mile of sewer (GPD/In-Diam-Mi). For interceptor and pump station sizing, peaking factors between 3 and 4 were used to determine peak daily flows (PDF) as follows:

$$PDF = (ADF \times PF) + \text{Infiltration Allowance}$$

Cost estimating was based on unit prices developed for the various components of the projects. In addition to construction costs, allowances were included as follows: contingency (20%), engineering services (20% for design, inspection, etc.) and legal and administrative costs (2% for financing fees, etc.). Refer to Section 3.6 for additional information.

Average daily flows and costs for each project are summarized below in Table ES-2.

ES.3.2 Summary of Proposed Projects

A total of 38 potential future sewer extension projects were developed. Table ES-2 in Section ES.6, lists each of the 38 projects including the projected average daily flow, number of residential sewer users to be served, project cost and cost per GPD of flow for each project. Note that the project number is based on the project ranking which is discussed in Section ES.6.

A summary of each of the projects is provided in Section 3.6 including a conceptual description of the sewer to serve the area, the basis for the flow projections (number of residential units, assumptions made regarding any proposed future development, etc.), the projected sanitary flow and infiltration allowance, and the estimated cost of the conceptual plan for the area. Figure 3-1 at the end of Section 3 is a map showing all of the proposed projects. In addition, an inset of each project area has been included with each project description.

Many of the proposed projects are dependent on another downstream project being constructed first. The individual project descriptions in Section 3 indicate whether or not there are downstream projects that must be completed first.

ES.4 HYDRAULIC MODELING

The Town selected the Souhegan River interceptor and the Baboosic Brook interceptor for hydraulic modeling in order to evaluate how increased flow rates from select proposed projects would impact the interceptors. InfoSWMM by Innovyze was selected to develop the working

hydraulic model. It is a fully ArcGIS integrated dynamic rainfall-runoff simulation model that allows the user to create, edit, modify, run, map, analyze, and design sewer network models and instantly review, query and display simulation results from within ArcGIS.

Flow metering in both interceptors was performed by the Town from March 2012 and October 2012 and the data was used to develop the existing conditions for the interceptors. Flow metering showed that the sewer system in the metered areas experiences little to no response to rainfall events which indicates minimal inflow or infiltration related to wet weather.

ES.4.1 Souhegan River Interceptor

For purposes of the modeling effort, the Souhegan River interceptor was assumed to start at the Madeline Bennett Middle School and run east and southeast to the main interceptor in Railroad Avenue along the Merrimack River. The interceptor also includes the Conifer Street siphon. The existing conditions model run predicted that the interceptor, under peak flow assumptions, is operating at approximately 0.32 MGD above the siphon and 0.84 MGD below the siphon (6% to 33% capacity). The model also predicted that the siphon is operating at approximately 22% to 26% of its capacity.

The future conditions model run predicted that the interceptor, under peak flow assumptions (if all of the proposed projects were constructed), would operate at approximately 0.8 to 1.21 MGD (10% to 60% capacity) above the siphon and at 1.80 MGD (less than 50% capacity) below the siphon. At the Conifer Street siphon, the model predicts a peak future flow rate of 1.21 MGD, which is just under the model-calculated low-end siphon capacity of 1.24 MGD. Therefore, the Souhegan River interceptor and Conifer Street siphon are estimated to have adequate capacity to handle future projected flows.

ES.4.2 Baboosic Brook Interceptor

For purposes of the modeling effort, the Baboosic Brook interceptor was assumed to start at Bedford Road near Pearson Road and run south and east to the main interceptor that runs cross-country parallel to Front Street and the Merrimack River. The existing conditions model run

predicted that the interceptor, under peak flow assumptions, is operating at approximately 0.48 MGD at the downstream end (18% to 44% capacity).

The future conditions model run predicted that the interceptor, under peak flow assumptions (if all of the proposed projects were constructed), would operate at approximately 0.57 MGD in upstream sections and 2.31 MGD at the downstream end (22% to 48% capacity). Therefore, the Baboosic Brook interceptor is estimated to have adequate capacity to handle future projected flows.

ES.5 EXISTING INFRASTRUCTURE NEEDS AND COSTS

The existing collection and treatment facilities were also considered to determine whether or not there was adequate additional capacity available to handle the proposed sewer extension projects. In general, it was determined that the existing facilities do have adequate capacity to handle the increase in flow with a few exceptions. The following recommendations address the capacity limitations and other concerns identified.

- The sewer crossing beneath the F. E. Everett Turnpike at Executive Park Drive is difficult to access for maintenance and/or repair due to the steep grade and distance from the road. Additionally, the pipe is hung within a culvert that conveys a stream beneath the Turnpike and is vulnerable to damage when the stream swells during spring months and wet weather events. We recommend that a pump station be constructed on Executive Park Drive and that flows be routed to the existing interceptor in Continental Boulevard to replace the existing crossing.
- GIS data indicates that several sections of the existing 8-inch diameter sewer on Turkey Hill Road, Bon Avenue, Bigwood Drive, and part of the cross country sewer to Executive Park Drive were installed at less than minimum slope and one is completely flat. If Projects 27, 29, 30 and 34 are constructed, projected flows will likely be approaching or exceeding the capacity of the pipe. We recommend that the Town conduct flow metering on Bigwood Drive to define existing flows and to determine the remaining capacity of the existing sewer prior to the approval for a study of any of the above projects.

- If all the proposed projects were constructed that are intended to drain to Thornton's Ferry Pump Station, the projected future flow at the pump station will be approximately 6.19 MGD. As the current estimated capacity of the pump station is 4.32 MGD, we recommend a capacity upgrade. Per the Town's capital improvements plan, the Thornton's Ferry Pump Station is scheduled for an upgrade within the next two to five years.
- If all the proposed projects were constructed, the projected future flow at the WWTF will be approximately 6.5 to 7.4 MGD. Although the WWTF is theoretically designed to handle a peak flow of 10 MGD, there is a known bottleneck that limits influent flow to 7 MGD while the equalization tanks are offline. If/When future peak flows approach 7 MGD, the Town will need to perform an evaluation of the WWTF to identify and address hydraulic bottlenecks and to determine whether or not a third secondary clarifier will be required in order to continue to meet permit requirements during periods of high flows.
- Although the remaining four pump stations have adequate capacity to handle existing and projected flows, upgrades to these stations should be completed as needed to replace aging equipment. Specifically, Souhegan Pump Station is also scheduled for an upgrade within the next two to five years per the Town's capital improvements plan to replace aged equipment.

ES.6 PRIORITY RANKING OF FUTURE PROJECTS

A list of five criteria was developed to priority rank the 38 proposed projects. Each project was given a rating for each criterion and then the total project score was tabulated. The criteria selected are as follows:

- Impediments to onsite septic system treatment
- Accessibility to the existing collection system
- Consistency with Community Master Plan and interest/demand for project
- Environmental concerns
- Unit cost

Table ES-2 is a list of all proposed projects ordered by final project ranking and includes the project scores and the cost-benefit ratio for each project (the total cost of each project divided by the project score to develop a unique number that factors the cost for the project per point of score). The cost-benefit ratio is used as a tie breaker when the project score for two or more projects is equal. Table ES-2 also includes the additional sewer users to be served, the projected average daily flow, the estimated project cost, and the unit cost (cost per gpd) for each project.

The top five projects listed in Table ES-2 ranked high primarily because of the following factors:

- Low unit cost
- Good access to the existing collection system
- Consistency with Community Master Plan or interest/demand for the project
- Environmental concerns

ES.7 CURRENT WASTEWATER FUNDING AND OTHER FUNDING ALTERNATIVES

ES.7.1 Summary of the Current Wastewater Enterprise Fund

The Town of Merrimack operates the wastewater collection, pumping and treatment system as an enterprise fund; that is, the costs to operate, maintain, and perform capital upgrades to the system are funded by the system users, not the entire tax base of Merrimack.

The Town's Enterprise Fund is comprised as follows:

- Sewer Fund: This fund can be used for operations, maintenance and capital improvements on existing wastewater infrastructure.
- Sewer Trust Fund: This is a capital reserve fund which can only be used for capital expenditures on the existing wastewater infrastructure.

Table ES-2: Project Ranking

Project Area Description	Add. Residential Sewer Users	Avg. Day Flow (GPD)	Project Cost	Cost per GPD	Imped. to Onsite Treatment	Access to Existing Collect. System	Consist. w/CMP and Interest/ Demand	Environ. Concerns	Unit Cost	PR S
ke East Collector Sewers	45	9,500	$1,060,000	$112	4	5	2	5	3	
Road North Collector Sewers	109	29,100	$1,770,000	$61	2	5	4	3	5	
Drive Collector Sewers	35	8,400	$590,000	$70	2	5	4	2	5	
Boulevard Interceptor Extension (Alt. A)	222	60,400	$2,080,000	$34	1	5	3	4	5	
ad North Collector Sewers	109	27,400	$2,150,000	$79	1	4	4	3	5	
North Collector Sewers	147	36,600	$3,530,000	$96	4	3	2	4	4	
y North Interceptor Extension and Pump Station No. 9	Comm./Indust.	61,200	$1,900,000	$31	1	5	5	0	5	
ke Road Interceptor Extension, Phase I	80	21,600	$2,480,000	$115	3	5	3	2	3	
Collector Sewers and Pump Station No. 5	145	35,500	$4,080,000	$115	5	5	3	0	3	
errimack Interceptor Extension, Phase II	105	30,200	$4,100,000	$136	4	4	2	4	2	
Boulevard Interceptor Extension (Alt. B with Pennichuck PS flows)	222 + Pennichuck	408,400	$5,410,000	$13	1	3	3	4	5	
Road Collector Sewer	22	5,400	$490,000	$90	3	5	2	1	4	
nt Road East Collector Sewers	77	18,600	$1,480,000	$80	3	5	2	0	5	
Drive Collector Sewers and Pump Station No. 6	118	28,500	$3,410,000	$119	3	5	3	1	3	
South Collector Sewers	31	7,600	$680,000	$89	3	5	2	0	4	
eet Collector Sewers	38	9,600	$1,000,000	$104	3	5	2	0	4	
ke South Collector Sewers and Pump Station No. 2	186	46,300	$5,640,000	$122	3	2	2	5	2	
n Collector Sewer	24	6,100	$650,000	$107	2	5	2	1	3	
North Collector Sewers	37	9,200	$860,000	$94	2	4	2	1	4	
North Collector Sewers	31	8,100	$980,000	$121	4	5	2	0	2	
Road Collector Sewers	61	15,700	$1,770,000	$113	3	4	2	1	3	
ke North Collector Sewers and Pump Station No. 1	161	38,900	$5,390,000	$139	3	2	2	5	1	
errimack Interceptor Extension, Phase I	24	7,100	$1,150,000	$163	2	5	2	3	0	
Southwest Collector Sewers	54	13,700	$1,430,000	$105	2	2	2	2	4	
Collector Sewers	20	5,200	$630,000	$121	2	5	2	0	2	
South Collector Sewers	33	9,400	$1,540,000	$163	2	5	2	2	0	
enue Collector Sewers and Pump Station No. 8	45	11,000	$1,710,000	$156	2	4	2	2	1	
Southeast Collector Sewers	84	21,700	$2,500,000	$115	2	2	2	2	3	
ad West Collector Sewers and Pump Station No. 7	97	25,300	$3,950,000	$156	3	3	2	2	1	
ad East Collector Sewers	126	33,000	$4,000,000	$121	2	4	2	1	2	
Collector Sewers and Pump Station No. 4	86	22,900	$4,190,000	$183	2	4	2	3	0	
South Collector Sewers	13	3,900	$720,000	$185	2	5	2	0	0	
errimack Interceptor Extension, Phase III	22	6,600	$930,000	$141	1	3	2	2	1	
oad Collector Sewers	96	24,000	$3,100,000	$129	2	3	2	0	2	
Drive Collector Sewers and Pump Station No. 3	61	16,300	$3,280,000	$202	2	3	2	2	0	
ke Road Interceptor Extension, Phase III	22	6,800	$1,050,000	$154	2	3	2	0	1	
ke Road Interceptor Extension, Phase II	28	8,500	$1,340,000	$157	2	4	2	0	0	
ke Road South Collector Sewers	44	12,300	$1,840,000	$150	1	2	2	2	1	
TOTALS[2]:	**2,638**	**1,089,600**	**$82,780,000**							

The Town of Merrimack also has a Sewer Line Extension Fund, funded by all taxpayers and not just sewer users, with a current balance of approximately $860,000. This fund is intended specifically to cover all or a portion of sewer extensions projects that benefit the Town of Merrimack.

With $696,486 per year in current debt, and an anticipated $803,622 per year in debt once the Phase 2 WWTF and Compost Facility upgrades are completed, the Town may wish to forego any additional major capital projects until the compost facility bond is retired in FY 2014/2015 and the interceptor bond is retired FY 2017/2018. In the interim, the Town can utilize the sewer trust fund for necessary small capital projects and utilize the $860,000 in sewer line extension funds to construct collection system improvements that cannot be funded with the enterprise fund.

ES.7.2 Funding Alternatives

The following is a list of potential funding alternatives available for the recommended projects outlined in this Sewer Master Plan. Detailed descriptions of each alternative can be found in Section 7.

- Sewer User Charges (Sewer Rental Charges)
- Sewer Connection Charges
- Sewer Extension Charges
- Wastewater Grants and/or Loans
- Ad Valorem Taxes/Town Bonds

It is assumed that private developers will be responsible for costs associated with sewers and pump stations that would serve new development (e.g. Project 7, DW Highway North Interceptor Extension and Pump Station No. 9). The facilities will be constructed according to Town standards, and typically, the sewers constructed in the Town right-of-ways or easements would be accepted as Town-owned sewers at the successful completion of the project.

In general, the Town does not plan to participate in funding projects to serve existing residential neighborhoods that are currently served by on-lot subsurface disposal systems (e.g. Project 1, Naticook Lake East Collector Sewers). If these projects are constructed, it is assumed that the property owners to be served would fund the projects.

Table ES-3 summarizes the suggested funding mechanisms for each project.

TABLE ES-3
POTENTIAL FUNDING MECHANISM FOR EACH PROJECT

Project No./ Rank	Project Area Description	Funding Alternatives			
		Sewer Extension Charges	Grant/ Loan[1]	Ad Valorem Taxes/Town Bonds[1]	Developers[2]
1	Naticook Lake East Collector Sewers	X	X	X	
2	McQuestion Road North Collector Sewers	X			X
3	Mayflower Drive Collector Sewers	X			
4	Continental Boulevard Interceptor Extension (Alt. A)	X	X	X	X
5	Bedford Road North Collector Sewers	X			X
6	Patten Road North Collector Sewers	X			
7	DW Highway North Interceptor Extension and Pump Station No. 9	X	X	X	X
8	Baboosic Lake Road Interceptor Extension, Phase I	X	X	X	
9	Clay Street Collector Sewers and Pump Station No. 5	X			
10	Northern Merrimack Interceptor Extension, Phase II	X			
11	Continental Boulevard Interceptor Extension (Alt. B)	X	X	X	X
12	Back River Road Collector Sewer	X			
13	Camp Sargent Road East Collector Sewers	X			
14	Ministerial Drive Collector Sewers and Pump Station No. 6	X			
15	Davis Road South Collector Sewers	X			
16	Bancroft Street Collector Sewers	X			
17	Baboosic Lake South Collector Sewers and Pump Station No. 2	X	X	X	
18	Pheasant Run Collector Sewer	X			
19	Davis Road North Collector Sewers	X			
20	Cathy Street North Collector Sewers	X			
21	Woodridge Road Collector Sewers	X			

Project No./ Rank	Project Area Description	Funding Alternatives			
		Sewer Extension Charges	Grant/ Loan[1]	Ad Valorem Taxes/Town Bonds[1]	Developers[2]
22	Baboosic Lake North Collector Sewers and Pump Station No. 1	X	X	X	
23	Northern Merrimack Interceptor Extension, Phase I	X			X
24	Patten Road Southwest Collector Sewers	X			
25	Craig Drive Collector Sewers	X			
26	Wire Road South Collector Sewers	X			
27	Stevens Avenue Collector Sewers and Pump Station No. 8	X			
28	Patten Road Southeast Collector Sewers	X			
29	Amherst Road West Collector Sewers and Pump Station No. 7	X			
30	Amherst Road East Collector Sewers	X			
31	Bean Road Collector Sewers and Pump Station No. 4	X			
32	Cathy Street South Collector Sewers	X			
33	Northern Merrimack Interceptor Extension, Phase III	X			
34	Naticook Road Collector Sewers	X			
35	Greatstone Drive Collector Sewers and Pump Station No. 3	X			
36	Baboosic Lake Road Interceptor Extension, Phase III	X	X	X	
37	Baboosic Lake Road Interceptor Extension, Phase II	X	X	X	
38	Baboosic Lake Road South Collector Sewers	X			

Notes:

1. The Town may wish to consider funding select projects that would provide a benefit to the entire Town with a grant/loan package and/or ad valorem taxes/bonds. Examples of projects with public benefits include projects that would improve environmental conditions of a public resource such as Baboosic Lake or Naticook Lake (especially if NHDES begins pressuring the Town to eliminate the individual septic systems on the lakes) or projects that would support the economic development of the Town such as extending sewer to areas which would allow commercial development.
2. The Town may wish to require the developer to provide funding for those projects that extend sewer to areas where there is interest for new commercial or residential development.

Section 1

WRIGHT-PIERCE
Engineering a Better Environment

SECTION 1

INTRODUCTION

1.1 BACKGROUND

The Town of Merrimack, New Hampshire is centrally located within one hour of Boston, one hour off the seacoast and one hour from the mountains. As such, this thriving community of 26,500 residents is highly desirable and attracts significant residential development as well as retail business, industrial and institutional development. The wastewater needs for approximately a third of the community and part of Bedford to the north are served by a large, primarily gravity, collection system, six pump stations and a 5.0 MGD wastewater treatment facility (WWTF) located on Mast Road. While there are some exceptions, the majority of the wastewater collection system is just over 40 years old.

Since the original collection system, pump stations and WWTF were constructed in the 1970s, the Town has undertaken multiple studies/master plans to identify needs within the collection system for upgrades and expansions to better serve the Town. These studies include:

- Master Plan for Priorities of Sewer Construction, December 1974, Anderson-Nichols & Company
- Facilities Plan for Interceptors and Trunk Sewers, Merrimack, NH, February 1977, Hamilton Engineering Associates
- Sewer Master Plan Study, May 1991, Underwood Engineers, Inc.
- Thornton's Ferry Pump Station Evaluation Report, April 2011, Underwood Engineers, Inc.
- Souhegan Pump Station Evaluation Report, April 2011, Underwood Engineers, Inc.
- Sewer Study for J.W.F. Real Estate & Development Corp., Baboosic Lake Road, Merrimack, New Hampshire; August 31, 1998; Keach-Nordstrom Associates, Inc.

Both the Anderson-Nichols and Hamilton Engineering Associates studies evaluated sewer extensions to pick up increased growth along the Daniel Webster Highway corridor as well as sewer extensions to the west of the F.E. Everett Turnpike due to widespread septic system failures. In the early 1990s, Underwood Engineers was retained to develop a revised assessment of sewer needs and a revised plan for sewer extensions. However, the Underwood study was never approved or accepted by the Town because the plan called for numerous pump stations with a capital cost in the tens of millions of dollars.

Currently, through its Sewer Use Ordinance, the Town still requires that proposed developments requiring sewer connections be reviewed in consideration of the proposed sewer implementation/phasing plan that was established in the 1977 Hamilton study. Recently, Town officials and developers have questioned if the findings and recommendations of the 35-year-old Hamilton study are still valid today. Due to changing times and changing mindsets on design, development and land use, the Town recognized the need to develop a new sewer master plan to guide the Town for the next 20 years.

1.2 SCOPE OF STUDY

This section includes a brief discussion of the scope of the work involved in updating this Sewer Master Plan.

1.2.1 Review of Existing Conditions

The following is a list of tasks completed and documentation reviewed to identify existing conditions during the preparation of this Plan. The existing conditions of the Town's sewer system are discussed in Section 2.

- The Town's GIS data were reviewed to confirm the current sewer service areas.
- Pump station flow data, as-built drawings and design data were reviewed to determine additional capacity available to accommodate future growth and to identify needs for any future upgrades.

- The previous studies and master plans referenced in Section 1.1 were reviewed in order to fully understand previous recommendations and how they have helped to guide sewer expansion projects over the past 35 years.
- Several site visits were completed to tour pump station facilities, the existing collection system and the existing topography.
- Information on failed septic systems was reviewed at the New Hampshire Department of Environmental Services (NHDES), Subsurface Systems Bureau offices.

1.2.2 Assessment of Future Sewer Service Needs

The following is a list of tasks completed and documentation reviewed to assess the future sewer service needs for the Town. Possible future conditions are discussed in Section 3 and existing infrastructure needs and costs are discussed in Section 5.

- Select chapters of the draft 2012 Master Plan Update prepared by Vanasse Hangen Brustlin, Inc (VHB) for the Town of Merrimack related to land use and economic development were reviewed to identify the future growth areas in the Town. (Note: To differentiate between the draft 2012 Master Plan Update and this Sewer Master Plan, the draft 2012 Master Plan Update will be referred to as the Community Master Plan.)
- Meetings were held with representatives of the Town to discuss the 2012 draft update to the Community Master Plan, to determine the areas planned for growth and to identify sewer needs in those areas.
- Topographic, soils, wetland (and other environmental features such as lakes and rivers), and water distribution system mapping were reviewed to assist in developing and prioritizing the proposed sewer extension projects.
- Current zoning requirements were reviewed to identify restrictions on future development.
- Based on the growth areas identified from the draft Community Master Plan as well as potential future areas that may be served by public sewer, flow projections were made for those areas and the impacts to the existing collection system and pump stations were evaluated.

1.2.3 Development of Hydraulic Model

The following is a list of tasks completed and documentation reviewed to develop a hydraulic model for two of the main interceptors in Town. Hydraulic modeling is discussed in Section 4.

- As-built drawings and GIS data were reviewed and utilized to prepare a limited hydraulic model for two Town-selected interceptors.
- Flow data collected by the Town along the interceptors was reviewed and used to calibrate the hydraulic model.
- The calibrated model was used to identify limitations within the modeled interceptors based upon current and projected future flows.

1.2.4 Development of Priority Ranking Criteria

The following is a list of tasks completed to develop a system to rank and prioritize the recommended projects. Priority ranking of projects is discussed in Section 6.

- Based on input provided by the Town, previous studies and our experience, a list of five criteria was developed to evaluate the proposed projects.
- A workshop was completed with Town staff using several example projects to ensure that the priority ranking system would accurately prioritize the projects.

1.2.5 Development of Sewer Master Plan

The following is a list of tasks completed to develop the sewer master plan. The prioritized list of proposed projects and financing options are discussed in Sections 6 and 7.

- Conceptual plans were developed for extending sewers to serve the areas of Town identified in Section 3 that are not currently served by public sewer and the costs for these improvements were estimated.
- For the two interceptors that were modeled, the projected future flows were input to ascertain downstream impacts.

- Cost estimates were prepared for improvements to existing facilities required to accommodate future flows.
- The conceptual projects were input into the priority ranking matrix to develop a prioritized list of expansions.
- Methods to finance future capital projects were evaluated.

Section 2

SECTION 2

EXISTING CONDITIONS

This section includes a discussion of the existing conditions of Merrimack's sanitary sewer collection system, pumping facilities and wastewater treatment facility (WWTF); a discussion of the non-sewered area of the Town; and a summary of existing flows.

2.1 GRAVITY COLLECTION SYSTEM

The Town of Merrimack has two collections systems which serve wastewater needs for approximately one third of the community and part of Bedford to the north. The smaller of the two systems flows to Nashua and serves the southwest area of Merrimack bounded by Erik Street, Naticook Road and Continental Boulevard. The larger of the two systems serves the remainder of the sewered population in Town, including most of the area to the east of the F. E. Everett Turnpike as well as portions of central Merrimack and northeastern Merrimack. Figure A-1 in Appendix A shows the two collection systems.

The smaller of the systems consists of approximately 200 manholes and 7.4 miles of gravity sewer and force main which drain to Pennichuck Pump Station for conveyance to the Nashua collection system. This pump station also accepts flow from a portion of Nashua. The Town has entered into an agreement with the City of Nashua whereby the Town owns and operates their portion of the collection system as well as Pennichuck Pump Station and the City owns and operates their portion of the collection system. Each municipality owns half (350 GPM) of the pump station's design capacity (700 GPM) and Merrimack is currently at its limit.

The larger of the systems consists of approximately 1,750 manholes and 73.7 miles of gravity sewer and force main, four inverted siphons, five pump stations and a 5.0 million gallon per day (MGD) WWTF. While there are some exceptions, the majority of the wastewater collection system was constructed in the 1970s and 1980s, and to date, most of the capital improvement projects to the wastewater system have been focused on the WWTF on Mast Road. Figure 2-1 at the end of this Section depicts the drainage areas for each pump station within the collection

system as well as the southeast portion of the collection system that drains by gravity directly to the WWTF.

2.2 PUMPING STATIONS

The Town owns and operates six pump stations. The five pump stations considered as part of this study are described below. Table B-1 in Appendix B summarizes more specific information on pumps, force mains, generators, etc. for each pump station.

2.2.1 Pearson Road Pump Station

Pearson Road Pump Station (see Figure 2-2 below) is located near the intersection of Pearson Road and Grapevine Road and has been in operation since 1997. The station collects primarily residential flows from several developments in Bedford as well as a small neighborhood in Merrimack (Note that Figure 2-1 only shows the portion of the Pearson Road Pump Station drainage area that is in Merrimack). It is a suction lift style station with a small building that houses two self-priming pumps, discharge piping and valves, pump controls, electrical panels and an emergency generator. The pumps, motors and generator are original to the pump station.

According to the plans and the nameplate data on the pumps, the pumps were designed to pump 315 gallons per minute (GPM). Based on the station's flow meter, one pump has a current capacity of 230 GPM and the other has a capacity of 200 GPM which may be a result of operating without being completely primed or worn impellers. The pumps operate in a lead/lag sequence and are manually alternated weekly.

The station has a six inch diameter, ductile iron force main which discharges to the gravity sewer in Windover Lane. The total length of the force main is approximately 2,650 linear feet.

FIGURE 2-2: PEARSON ROAD PUMP STATION

The station was also provided with a ferric chloride chemical feed system for odor control; however the chemical system has not been used since the Town took over ownership of the station.

2.2.2 Souhegan Pump Station

Souhegan Pump Station (see Figure 2-3 below) is located off Railroad Avenue adjacent to where the Souhegan River empties into the Merrimack River. It is one of the Town's two original pump stations which have been in operation since 1972. The station collects residential, commercial and some industrial flows from northeastern Merrimack as depicted in Figure 2-1, including flows from the Pearson Road Pump Station. It includes a dry well/wet well style building that contains one small and two large vertical centrifugal style pumps, discharge piping and valves, pump controls, electrical panels and an emergency generator. A comminutor has also been provided with a bypass channel and manual bar rack. The pumps and motors are original to the pump station; however, significant upgrades have been proposed in the 2011 evaluation of the station completed by Underwood Engineers, Inc. The generator was replaced in 2011.

Based on the plans and the nameplate data on the pumps, the large pumps were designed to pump 1,200 GPM and the small pump was designed to pump 400 GPM. The large pumps have an actual capacity that is slightly lower than designed, likely due to wear of the pumps. However, based on the station's flow meter, the small pump has a current capacity of 900 GPM. It is suspected that either the impeller was replaced to increase the capacity of the pump or that the actual total dynamic head condition of the system was less than designed. The pumps operate in a lead/lag/lag-lag sequence and are manually alternated weekly.

FIGURE 2-3: SOUHEGAN PUMP STATION

The station has a 14 inch diameter, cast iron force main which discharges to the 21 inch diameter gravity interceptor that runs parallel to the railroad tracks along the Merrimack River. The total length of the force main is approximately 560 linear feet.

2.2.3 Burt Street Pump Station

Burt Street Pump Station (see Figure 2-4 below) is located at the corner of Burt Street and Dover Street and has been in operation since 1977. The station collects residential flows from a small neighborhood as depicted in Figure 2-1. It is a below-grade ejector style station with a small building that houses an emergency generator, a hatch to access a below-grade chamber, pump controls and electrical panels. The two ejectors are located in the chamber below along with the

compressors, an air storage tank, discharge piping and valves. The pumps and motors are original to the pump station; the generator was replaced in 2000.

FIGURE 2-4: BURT STREET PUMP STATION

Based on data provided by the Town, the ejectors were designed with a capacity of 100 GPM each. There is no flow meter at this pump station as it is an ejector style station; therefore, the daily flow is estimated by multiplying the number of times each ejector cycles by the design capacity of the ejectors (100 GPM each). The ejectors operate in a lead/lag sequence and are manually alternated weekly.

The station has a four inch diameter, ductile iron force main which discharges to the gravity sewer at the intersection of Dover Street and Derry Street. The total length of the force main is approximately 225 linear feet.

2.2.4 Thornton's Ferry Pump Station

Thornton's Ferry Pump Station (see Figure 2-5 below), the Town's largest pump station, is located on Griffin Street. It is one of the Town's two original pump stations which have been in operation since 1972. The station collects residential, commercial and some industrial flows from northern half of Merrimack as depicted in Figure 2-1 including flows from Pearson Road,

Souhegan and Burt Street Pump Stations. It includes a dry well/wet well style building that contains one small and two large vertical centrifugal style pumps, discharge piping and valves, pump controls, electrical panels and an emergency generator. A comminutor has also been provided with a bypass channel and manual bar rack. The pumps and motors are original to the pump station; however, significant upgrades are proposed in a 2011 evaluation of the station completed by Underwood Engineers, Inc.

FIGURE 2-5: THORNTON'S FERRY PUMP STATION

Based on the plans and the nameplate data on the pumps, the large pumps were designed to pump 1,600 GPM and the small pump was designed to pump 750 GPM. However, based on the station's flow meter, one large pump has a current capacity of 2,380 GPM and the other has a current capacity of 3,050 GPM; the small pump has a current capacity of 1,000 GPM. It is suspected that either the impellers were replaced to increase the capacity of the pumps or that the actual total dynamic head condition of the system was less than designed. The pumps operate in a lead/lag/lag-lag sequence and are manually alternated weekly.

The station has a 14 inch diameter, cast iron force main which discharges to the 21 inch diameter gravity interceptor that runs parallel to the railroad tracks along the Merrimack River. The total length of the force main is approximately 400 linear feet.

2.2.5 Heron Cove Pump Station

Heron Cove Pump Station (see Figure 2-6 below) is located off Al Paul Lane and has been in operation since 1998. The station collects residential wastewater from a small community in southeastern Merrimack as depicted in Figure 2-1. It is a suction lift style station with a small building that houses two self-priming pumps, discharge piping and valves, pump controls, electrical panels and an emergency generator. The pumps, motors and generator are original to the pump station.

FIGURE 2-6: HERON COVE PUMP STATION

Based on the plans and the nameplate data on the pumps, the pumps were designed to pump 350 GPM. The actual capacity was not verified using the flow meter as Town personnel were working on the pumps at the time of the site visit. The pumps operate in a lead/lag sequence and are manually alternated weekly.

The station has a six inch diameter, ductile iron force main which discharges to the gravity sewer at the intersection of Al Paul Lane and Manchester Street. The total length of the force main is approximately 1,035 linear feet.

2.3 WASTEWATER TREATMENT FACILITY

The Town is served by a 5.0 MGD activated sludge WWTF located on Mast Road with the final treated effluent discharging to the Merrimack River. The facility has been in operation since 1970. The facility includes an influent pumping station, equalization tanks, primary clarifiers, aeration basins, secondary clarifiers, sodium hypochlorite disinfection, sodium bisulfite dechlorination, and solids thickening and dewatering systems. The facility also includes a septage pretreatment unit upstream of septage equalization and pumping facilities and a biosolids composting facility. Many of the unit processes have been upgraded since 1972, but some of the equipment is original to 1972. Underwood Engineers, Inc. completed a comprehensive plant evaluation in January 2011 which indicated that the facility is currently treating flows at less than half of its design capacity (see Table 2-2 in Section 2.5 below). Wright-Pierce is currently working with the Town on the preliminary design of a $7.08 million upgrade to the WWTF and composting facility and a Phase III upgrade has been recommended for the future.

2.4 NON-SEWERED AREAS

As can be seen in Figure B-1, a significant portion of Merrimack is not currently served by public sewer. Developed properties in these areas are primarily residential and are served by privately owned on-lot septic systems consisting of a septic tank and a subsurface disposal field. According to the draft Community Master Plan[1], approximately 97 percent of the residential lots in Town have single-family homes which encompass 93 percent of the total residential acreage. In areas not served by public sewer, the current zoning ordinance requires minimum lot sizes of 0.9 acres (slight soil limitations for septic systems) to 2.3 acres (severe soil limitations for septic systems) for single-family homes and 1.84 acres (slight soil limitations for septic systems) for two-family homes. Two-family homes are not allowed in areas with moderate or severe soil limitations. Multi-family homes (more than two units) are not allowed in areas that are not served by public sewer. For parcels meeting these requirements, on-lot septic systems can provide a cost-effective and acceptable means for wastewater treatment and disposal, especially for those areas served by public water and not dependent on a private on-lot well. The majority

[1] 2012 Master Plan Update, Merrimack, New Hampshire, June 2011 Draft, Vanesse Hangen Brustlin, Inc., Chapter 2.

of northern and southwestern Merrimack is served by public water with the exception of a number of small neighborhoods; southeastern Merrimack does not have access to public water (refer to Figures 6-3 in Section 6 for a map of the existing water distribution system).

VHB's draft plan also indicates that approximately 17% of Merrimack's land area is currently vacant/undeveloped (3,700 acres distributed among 266 parcels, not including permanent open space); 69% of this land is zoned as residential, 29% is zoned as industrial and 2% is zoned as commercial. The majority of these undeveloped parcels are in areas not currently served by public sewer.

2.4.1 Septic System Replacements

Septic system replacements are typically required when an existing subsurface system fails due to age, poor soils, damage, etc. A typical lifespan of a subsurface disposal system can range anywhere from <5 to >30 years depending on the system construction, type of soil, depth to the groundwater table and the use of the system by the property owners. The Merrimack Building Official and the Subsurface Systems Bureau at the New Hampshire Department of Environmental Services (NHDES) were contacted regarding historical records of septic system failures. Unfortunately, there was little useful information available. The Town has not yet converted to electronic record keeping and keeps a paper file for each septic system, so each file would have to be reviewed individually to identify failed systems. Additionally, historical records often do not indicate the mode of failure. NHDES did not have any significant data on file.

2.4.2 Septage Disposal

For properties served by on-lot septic systems, the solids collected in the septic tank must be pumped out and disposed of in a manner consistent with New Hampshire regulations. It is recommended that septic tanks be pumped out every three to five years to reduce the risk of excessive solids overflowing the septic tank and clogging the disposal field. The WWTF has septage receiving capabilities which are adequate to treat the septage for the Town as well as a

number of surrounding communities. Septage data based on septage received at the WWTF from 2009 to 2010 is summarized in Table 2-1 below.

TABLE 2-1: SEPTAGE QUANTITIES (2009-2010)

	Merrimack Septage	Total Septage Received
Average Monthly Volume (Gal.)		
January-March	40,500	172,800
April-June	140,600	526,600
July-September	123,100	509,900
October-December	141,900	548,300
Average Annual Volume (Gal.)	1,338,600	5,272,600

2.5 CURRENT FLOWS

The following is a brief discussion on the current flows for the WWTF and for each pump station. In addition, the BOD_5 and TSS are summarized for the WWTF. Note that the Town's SCADA system has historically trended daily flow data only for the Souhegan, Burt Street and Thornton's Ferry Pump Stations. In order to determine flows for the Pearson Road and Heron Cove Pump Stations for this Plan, trending of daily flow data was added to the SCADA system in January of 2012.

2.5.1 Wastewater Treatment Facility

The current wastewater flows and loads for the Town of Merrimack (less the flows that are pumped to Nashua for treatment) are summarized in Table 2-2 below. As noted previously, the plant is more than adequately sized to handle the existing flows and loads.

TABLE 2-2: CURRENT FLOWS AND LOADS (NOVEMBER 2009-JULY 2012)

	Average	Maximum Month	Maximum Hour
Flow (MGD)	1.78	2.65	4.86
BOD_5 (mg/L)	372	550	--
TSS (mg/L)	599	769	--

2.5.2 Pearson Road Pump Station

Historical daily flow data for January 1, 2012 to July 15, 2012 indicates that the average daily flows for the pump station range from 8,900 gallons per day (GPD) to 73,000 GPD with an overall average of 39,800 GPD. Information is not available on peak instantaneous flow at this station. According to the Town, only one pump operates at a time when they are operating properly (i.e. completely primed and not clogged). Compared with a peak pumping capacity of 388,000 GPD (based on one pump operating at 200 GPM), it appears that there is more than adequate capacity to handle current flow conditions.

2.5.3 Souhegan Pump Station

Historical daily flow data for January 1, 2009 to July 15, 2012 indicates that daily flows for the pump station range from 306,800 GPD to 1,631,600 GPD with an overall average of 555,800 GPD. The Souhegan Pump Station Evaluation Report prepared by Underwood Engineers, Inc. indicates that the peak recorded instantaneous flow rate for this pump station was 2,000 GPM during a wet weather event in March of 2011. However, based on a review of the circular flow charts for the largest wet weather events from 2009 to 2012 and the peak recorded daily flow rate, we estimate that the current peak instantaneous flow rate for the station is around 1,130 GPM. Although the historical flow charts do show a peak instantaneous flow rate of about 2,000 GPM on April 4, 2010 and March 6, 2011; these occurrences are momentary spikes and occur several days after the day with the peak flows for each rain event. It is assumed that these spikes were caused by an extra pump being turned on during routine maintenance at the pump station, but it is not clear whether this flow rate was achieved with two or three pumps operating. Regardless, as noted in Section 2.2.2, each of the large pumps has a current capacity of slightly less than 1,200 GPM; therefore there is adequate capacity to handling current flow conditions.

2.5.4 Burt Street Pump Station

Historical daily flow data for January 1, 2009 to July 15, 2012 indicates that daily flows for the pump station range from 10,700 GPD to 62,200 GPD with an overall average of 26,200 GPD. Information is not available on peak instantaneous flow at this station. According to the Town,

only one ejector operates at a time when they are operating properly (i.e. adequate air supply from the air compressor).

It should be noted that there is a significant increase in typical average daily flows between August and September of 2010; the average daily flow for January 2009 to August 2010 is 19,900 GPD and the average daily flow for September 2010 to July 2012 is 32,100 GPD which is about a 60% increase in flow. As this pump station serves a very small neighborhood and the number of homes served by the station did not change, it is possible that the ejectors/compressors were required to cycle more frequently (due to an unidentified maintenance issue) which would cause an inflated daily flow total. As noted above, flow is calculated by multiplying the number of cycles per day times the design capacity of 100 GPM.

The Town installed a portable area-velocity style flow meter in the manhole upstream from the pump station from September 9 to 24, 2012. The data indicates flows varying from 6,000 GPD to 18,000 GPD which are considerably less than the historically recorded flows from the pump station. Due to the low flows from the very small collection area (approximately 50 homes), it is possible that the portable meter data is not completely accurate as the meter requires a certain flow depth and velocity to operate properly. However, in general, it appears to confirm that the trended daily flow data for the station is significantly higher than actual flows. Additionally, as of January 2013, flows appear to have returned to normal over the past few months.

Although the actual capacity of the ejectors is unknown, it still appears that there is adequate capacity to handle existing flows as there have been no reported overflows to date.

2.5.5 Thornton's Ferry Pump Station

Historical daily flow data for January 1, 2009 to July 15, 2012 indicates that daily flows for the pump station range from 750,000 GPD[2] to 4,050,700 GPD with an overall average of 1,278,500 GPD. The Thornton's Ferry Pump Station Evaluation Report prepared by Underwood

[2] Note that the minimum recorded daily flow rate is estimated as there are a number of data points that are much lower which are likely outliers as they are less than the average daily flow from Souhegan Pump Station which pumps to Thornton's Ferry Pump Station.

Engineers, Inc. indicates that the peak recorded instantaneous flow rate for this pump station was 3,000 GPM during a wet weather event in March of 2011. The report also indicates that the maximum pumping capacity of the pump station is about 3,000 GPM with all three pumps online. As such, it appears that the pump station is operating at capacity during peak wet weather events.

2.5.6 Heron Cove Pump Station

Historical daily flow data for January 1, 2012 to July 15, 2012 indicates that the average daily flows for the pump station range from 7,200 GPD to 14,100 GPD with an overall average of 9,400 GPD. According to the Town, only one pump operates at a time when they are operating properly (i.e. completely primed and not clogged). Compared with an assumed peak pumping capacity of 504,000 GPD (based on one pump operating at 350 GPM), it appears that there is adequate capacity to handle current flow conditions.


BURT ST PS
Mallard Point Siphon
Souhegan River Siphon
Conifer Street Siphon
SOUHEGAN PS
80 Acre Siphon
THORNTONS FERRY PS
Wastewa Treatmer Facility
PENNICHUCK PS
HERON COVE PS
Merrimack
Litchfie
BURT ST
DERRY ST
KEARNS DR
SANDHILL RD
HILLSIDE TER
TWIN BRIDGE RD
RAILROAD AVE
WILSON HILL FD
OLD BLOOD RD
OOTA RD
JADE RD
SUMMIT RD
CROSS ST
DANFORTH RD
HASSELL RD
MERRILL RD
WATKINS RD
HUTCHINSON RD
FALMER DR
GREELEY ST
JENNIFER DR
POISSON WAY
LONGWOOD LN
WHITTIER RD
STAR DR
DRIVEWAY A709
GREENS POND RD
INDUSTRIAL DR
UNKNOWN RD A502
CONTINENTAL BLVD
THORNTON FD W
HUST RD
DUCK POND LN
SUNDOONTER
HARRIS POND RD