Town of Amherst, Massachusetts

Sewer Extension Master Plan

August 2011

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Draft Report

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Section 1
Introduction

The Town of Amherst, located in Hampshire County in western Massachusetts, is approximately 25 miles north of Springfield, Massachusetts. The town covers approximately 28 square miles (17,900 acres). The planning area for this study includes the entire town, but focuses primarily on the areas that do not have existing centralized wastewater collection systems (sewers).

The intent of this study is to update and revise the recommendations included in the October 2005 Sewer Extension Master Plan, which was an update to the town's Wastewater Facilities Plan prepared in 1991. This update does not include an evaluation of the wastewater treatment facilities, but rather focuses on the collection system, identifying areas in need of centralized collection systems.

1.1 Purpose

The purpose of this master plan is to identify need for additional wastewater facilities and to develop a document to guide the town. This document recommends cost effective and environmentally sound methods for collection, treatment, and disposal of wastewater in areas identified to have need within the town. In addition to traditional gravity sewers, alternative systems including low-pressure sewers, vacuum sewers, cluster subsurface systems (community septic systems), package treatment facilities, and Innovative/Alternative treatment systems were evaluated. This update is not intended to meet the Massachusetts Department of Environmental Protection (DEP) Guideline for Comprehensive Wastewater Management Planning.

Several subareas in the town currently experience problems with on-site disposal (septic) systems. These problems are sometimes the result of high groundwater or poor soil conditions. In many cases, however, septic system failures are also the result of improper use or aging systems. Failing septic systems can pose potential public health problems with wastewater leaching into ground and surface waters without proper treatment.

In addition to areas of town experiencing on-site disposal problems, a substantial sewer extension to the Centennial Water Treatment Plant (WTP) in the adjacent Town of Pelham is scheduled as a planned improvement to support WTP upgrades. This upgrade is being financed through non-sewer funds. There are also two potential redevelopment areas in close proximity to Amherst Center and North Amherst Center that are in early planning stages. These areas will be discussed as part of this master plan. The subareas defined for this master plan are:

- Harkness Road Area (Subarea 2);
- Southeast Street Area (3);
- Bay Road Area (4);

- Hulst Road Area (5);
- Wildflower Drive Area (6);
- Shays Street Area (7);
- High Point Drive Area (8);
- Market Hill Road Area (9);
- Leverett Road Area (10);
- Montague Road and North Amherst Center Area (11);
- Meadow Street Area (12);
- Northeast Street Area (13);
- Centennial Water Treatment Plant Area (14); and
- Gateway Corridor Project (Amherst Center) Area (15).

The boundaries of the subareas are shown in Figures 1A and 1B. This report will identify which of the above areas is in need of a centralized collection system, will prioritize the areas for implementation, and will identify a cost effective and environmentally sound solution for handling the wastewater.

1.2 Existing Collection System

Amherst's wastewater collection system, much of which has been in existence since the late 1800s, conveys wastewater from residences, institutions, and commercial establishments to a town-owned and operated wastewater treatment facility. The existing wastewater collection system is a sanitary (non-combined) system that was originally developed for individually sewered areas, each served by a sand filter bed. The individual areas have been connected through intercepting sewers that are the core of the current collection system.

The Amherst Wastewater Treatment Facility has been operating since 1979. Treated effluent is pumped and discharged through a long outfall to the Connecticut River. The capacity of the facility is 7.1 mgd and it currently treats between 4.0 and 4.2 mgd on an average annual basis. Average monthly flows from 2008 to 2010 ranged from 2.57 to 6.46 mgd and daily flows may fluctuate over a wider range. The wastewater originates from the sewered areas of Amherst and a few properties located in Hadley, near the Amherst town line. The flow also includes infiltration from groundwater and inflow from storm events causing short-term flow variations. Approximately 93 percent of the town's population is connected to the sewer system.

Like the existing wastewater treatment facility, the existing collection system was originally designed for future development. The wastewater treatment facility has

available capacity for the additional flow from areas recommended in this report. In general, much of the existing collection system also has available capacity. Two projects, the Middle Street and the Chapel Road/Mechanic Street areas, have been completed since the 1991 Wastewater Facilities Plan was issued. These projects, described below, followed the recommendations of the 1991 Facilities Plan by providing sewers for three areas identified as having the greatest need. In the 1991 plan, these areas were identified as having "Significant" or "Major Need" of wastewater management systems.

No extensive public sewer projects have been completed since the completion of the 2005 Sewer Extension Master Plan. However, substantial progress has been made on the Amherst Hills private residential development, which is also described below.

1.2.1 Middle Street Area Sewers

The Middle Street Area sewer project was completed in July of 2003. This project encompassed the entire Potwine Lane/Middle Street and South Orchard Drive subareas identified in the original 1991 Facilities Plan (original subareas 1 and 2). These areas had the highest need of wastewater management.

The system includes approximately 9,800 linear feet of 8-inch diameter gravity sewer, 2,200 linear feet of 10-inch diameter gravity sewer, and 1,300 linear feet of 2-in and 1-1/2-in diameter pressure sewer. Due to the area's topography, two pumping stations were required; an intermediate pumping station on Middle Street and a pumping station on Potwine Lane that pumps all of the flow from this area. The wastewater from this area is pumped through 1,800 linear feet of 6-inch diameter force main to the gravity sewer farther west on Potwine Lane. This project provided sewers for houses on portions of Middle Street and Bay Road; and completely sewered Potwine Lane, South Orchard Drive, Blossom Lane, Barry Circle, and Sherry Lane.

1.2.2 Chapel Road/Mechanic Street Sewers

The Chapel Road and Mechanic Street sewer project was completed in June of 2004. This project installed sewers in approximately half of the 1991 Subarea 3 as identified in the original 1991 Facilities Plan. The Bay Road and Southeast Street portions of the original subarea were not sewered by this project and accordingly they are included as a study area of the current evaluation.

This project area is served by a single pumping station, located at the intersection of Southeast Street and Mechanic Street. This pumping station discharges flow to the existing sewer on Southeast Street. The pumping station was sized with enough capacity to handle future flows from the remaining portions of Southeast Street and Bay Road as well as the entire Hulst Road subarea which, if sewered, would flow to the new Mechanic Street pumping station. The project includes approximately 4,000 linear feet of 8-inch and 10-inch diameter gravity sewer and 2,400 linear feet of 6-inch diameter force main.

1.2.3 Amherst Hills Sewers

The Amherst Hills private residential development, consisting of approximately 60 residential lots, is located between Old Amherst Road and Subarea 6, adjacent to the Towns of Belchertown and Pelham. The area topography requires a portion of the flow from this area to be collected at a pump station on Station Road, and then pumped back up to one of the proposed gravity sewers. Currently the sewers and pump station have been constructed, but only about 40 percent of the projected 60 homes have been built. The Town of Amherst currently owns and operates the sewer system in this development, including the pump station. The Station Road pumping station has been sited and designed to accommodate additional flow from homes on Station Road located in Subarea 6. The Amherst Hills residential development estimated flows are 13,300 gpd average flow and 72,000 gpd peak hourly flow.

INSERT FIGURES 1A AND 1B HERE

Section 2
Subarea Preliminary Planning

To evaluate Amherst in terms of wastewater facilities needs, subareas were determined and wastewater solutions for each were preliminarily chosen. Engineering criteria were evaluated to determine what type of sewers, appurtenances, or on-site systems would be required for each subarea.

2.1 System Planning Criteria

Several factors are considered during the preliminary planning of wastewater conveying or treatment systems. The existing and future population estimates were used to determine the wastewater flow rates. Wastewater flows were estimated using the 2008 population estimates found in the town's 2010 Master Plan; per capita wastewater estimates; institutional, commercial, and industrial flows; and infiltration and inflow (I/I) contributions. The topography of the area was evaluated when sewer routes were developed. Typical pump station criteria (i.e. flow, pumping rate, and force main diameter) assisted in the selection and placement of required pump stations.

2.1.1 Population and Wastewater Flow Estimates

The 2010 Master Plan lists the total population for the Town of Amherst as 35,962. The 2000 Census lists the number of housing units in Amherst as 9,427 (2010 housing unit data was still unavailable as of July 2011). Dividing the population by the number of housing units gives an average of 3.8 people per housing unit. The Build-Out Analysis and Future Growth Study, prepared by Applied Geographics, Inc. and Philip B. Herr & Associates in October 2002, used the 1990 census which resulted in a lower estimate of 2.6 people per house. This evaluation uses a combination of the 2000 census information and 2010 Master Plan because it is more current as well as more conservative. In terms of developable land, the town's Geographic Information System (GIS) data was used to identify the developable land in the various subareas. The GIS data is more current and accurate as compared to the 2002 Build-Out Analysis and Future Growth Study used for the 2005 Sewer Extension Master Plan. In general, lands coded as "developable" or "potentially developable" in the GIS system were tallied for each subarea and compared to existing zoning designations to estimate future houses for each subarea. In addition, a few select parcels were also assumed to be developable land based on their proximity to proposed sewers.

The 1991 Facilities Plan and 2005 Sewer Master Plan presented average domestic wastewater and I/I components as 60 gallons per day (gpd) per person and 40 gpd per person, respectively. Equation 1 indicates how the average daily flow rate, including I/I, was calculated for each subarea that is primarily residential.

[(Number of houses) x (3.7 people/house) x (60 gpd/person)] +
[(Number of houses) x (3.7 people/house) x (40 gpd/person)] Equation 1

The peak hour flow rate was calculated using a Wastewater Peaking Factor of 5.4 and an I/I Peaking Factor of 2.0, presented as Equation 2.

[(Number of houses) x (3.7 people/house) x (60 gpd/person) x 5.4] +
[(Number of houses) x (3.7 people/house) x (40 gpd/person) x 2.0] Equation 2

The number of housing units quantified for each subarea includes existing houses and reasonable future construction based on developable land; only lots that were zoned and appropriate for residential use were counted for housing units.

Since completion of the 2005 Sewer Extension Master Plan, a few additional, potential growth areas have been identified that include some non-residential areas. In particular, the areas include the Centennial Water Treatment Plant sewer extension project (Subarea 14), the Gateway Corridor Project in Amherst Center (Subarea 15), and the triangular area near North Amherst Center that will be incorporated and analyzed as part of Subarea 11. The 1991 Facilities Plan presented commercial flows as 700 gpd/acre with Wastewater Peaking Factors of 5.0 when commercial flows are predominant, and 2.0 when domestic flows are a greater contribution. Non-residential flows will be calculated using these parameters where applicable.

When considering on-site treatment systems, DEP Title V wastewater flows were calculated to determine the required system size. Title V flow rates are based on 3.0 bedrooms per house, 110 gpd per bedroom, and the number of existing plus future houses.

2.1.2 System Location and Planning

Various methods were used to choose locations of proposed sewers and force mains. A majority of the preliminary layout was prepared on topographical maps. Where applicable, the preliminary designs of street and cross-country sewers were planned in sufficient detail so that downstream facilities could be installed at elevations deep enough to serve a maximum amount of upstream tributary areas. If certain portions of the system are to be installed by private developers, the town should ensure that sewers are the proper depth, diameter, and slope to serve the entire area contributing to them.

Sewer diameters were selected based on minimum design slopes. These slopes ensure a cleaning velocity greater than two feet per second when the sewer is flowing full. In order to ensure that the proposed sewers are capable of transporting peak flows with a factor of safety for any unexpected conditions, the sewer pipe diameters have been selected to transport these flows while flowing less than completely full. For residential sewers (8-inch through 12-inch) the pipe diameters have been selected based on a depth criteria of flowing ½ full at the design capacity. The flow-depth criteria increases to ¾ full as the pipe sizes increase.

The topography and land use category for open parcels of land were considered when evaluating a local on-site wastewater treatment system. System manufacturers were consulted for preliminary estimates on tank sizes and equipment necessary.

2.1.3 Pump Station Planning

In recent years, the typical pump station used throughout the town is a wet-well mounted unit manufactured by Smith & Loveless. The pump station includes a buried wet-well with above-grade mounted pumps and controls. There are currently more than 15 of these pump stations throughout the town. Since the pumps are enclosed above-grade, easier access is available when maintenance is required. Additionally, using the same equipment for each pump station allows for streamlined maintenance, engineering, and spare parts storage. The Smith & Loveless units are recommended for wastewater flows up to 500 gpm (0.72 mgd). Flows in excess of 500 gpm can by handled by the unit, but individual conditions should be evaluated for each system.

2.2 Subarea Preliminary Planning

Subareas were defined so that a needs analysis could be performed and subareas could be ranked according to need. The subareas primarily separated neighborhoods and contributing areas that would flow to a common point. Where possible, the boundaries and identification numbers were kept the same as in the 1991 Facilities Plan and 2005 Sewer Master Plan. Preliminary design was performed for each of the identified subareas in order to facilitate the evaluation of need. The following is a brief description of each subarea, including the preliminary centralized wastewater management solution used in the evaluation. Maps showing soils, land use and developable land, and zoning districts are shown in Figures C, 2 and 4 in Appendix C.

2.2.1 Subarea 1 – Middle Street Area

This subarea was sewered in 2003 and serves portions of Middle Street and Bay Road; and completely serves Potwine Lane, South Orchard Drive, Blossom Lane, Barry Circle, and Sherry Lane.

2.2.2 Subarea 2 - Harkness Road Area

There are approximately 25 existing houses in this subarea. There are no additional developable parcels in Subarea 2. The subarea is bordered by the town line to the east, Subarea 6 to the south, conservation land and residential sub-divisions to the west and north. The minimum lot size for this subarea is 20,000 sq. ft. The boring program indicates that soils in this subarea are mostly sand and gravel.

Most of the parcels in this subarea would be served by gravity sewers conveying flow to the existing sewer on Stony Hill Road. Low-pressure sewers are required to serve the northerly portions of this subarea. The entire east side of Harkness Road as well as the northern section of the subarea is within the Town of Pelham.

2.2.3 Subarea 3 - Southeast Street Area

There are approximately 65 existing houses in this southern subarea. The minimum lot size is 30,000 sq. ft., and there are approximately 5 acres of developable land in this subarea. The boring program indicates that the soils in this subarea are mostly sand and gravel. Adjacent construction on Chapel Road and Mechanic Street also has indicated that the soils are mostly sandy. The subarea is bordered by Subarea 5 to the east, a sewered section of Bay Road to the west, and conservation land to the north and south. This subarea is within the Zone II Aquifer Protection zone.

The parcels in Subarea 3A would be served by gravity sewers conveying flow to the existing sewer on Southeast Street. The parcels in Subarea 3B would be served by gravity sewers conveying flow to the existing sewer on Mechanic Street. No low-pressure sewers or pump stations are required for this subarea.

2.2.4 Subarea 4 - Bay Road Area

There are approximately 25 existing houses in this southwestern subarea. The minimum lot size is 30,000 sq. ft. and there are approximately 10 acres of developable land in this subarea. The majority of land on the north side of Bay Road, in this area, is conservation land. On the south side of the road, behind the existing houses, the land is owned by the Department of Environmental Management/Department of Fish and Wildlife (DEM/DFW). To the east of the subarea is a section of Bay Road that was recently sewered.

The parcels in this subarea would be served by gravity sewers conveying flow to the existing sewer on West Street. No low-pressure sewers or pump stations are required for this subarea.

2.2.5 Subarea 5 - Hulst Road Area

There are approximately 110 existing houses in this southeastern subarea. The minimum lot size is 30,000 sq. ft. The majority of the land in this subarea has been residentially developed, with only about 5 acres of developable land remaining. The boring program indicates that the soils contain a significant amount of silt and other fine grain material. There is conservation land on the north side and DEM/DFW land on the south side of the subarea. This subarea is within the Zone II Aquifer Protection zone, close to the Lawrence Swamp aquifer.

The majority of parcels in this subarea would be served by gravity sewers, with the remaining few served by low-pressure sewers. One pump station at the eastern end of Hulst Road would be required to convey wastewater to the new gravity sewer in Subarea 3A. A portion of the sewers recommended for Subarea 3A, along Bay Road and Southeast Street, would need to be installed subsequent to sewering Subarea 5.

2.2.6 Subarea 6 - Wildflower Drive Area

Subarea 6 is a large, residentially populated area that contains approximately 210 existing houses. There are eight cul-de-sacs in this subarea. There are approximately

20 acres of additional developable land in this subarea. The minimum lot size requirements range from 20,000 to 30,000 square feet. The boring program indicates that the soils are mostly sand with moderate amounts of fine grain material. This subarea is south of Subarea 2 and on the eastern border of the town. Portions of this subarea are within the Zone II Aquifer Protection zone.

The parcels in this subarea would be served by gravity and low-pressure sewers. Two pump stations would be required to convey the wastewater to existing sewers. In addition, a portion of the wastewater along Station Road in the southeast corner of this subarea would flow by gravity to the Station Road pump station that is part of the Amherst Hills private subdivision, but now owned and operated by the town. Approximately two-thirds of the area would flow to the existing sewers on Wildflower Drive or Wood Lot Road and the other one-third would flow to the existing sewer on Belchertown Road via the Station Road pump station.

2.2.7 Subarea 7 - Shays Street Area

There are approximately 20 existing houses in this subarea. The minimum lot size for this subarea is 20,000 sq. ft. There are approximately 2 acres of developable land in this subarea. The boring program indicates that the soils in this subarea are mostly sand and gravel.

Parcels in Subarea 7 would be served with gravity sewers conveying flow to the existing sewer on Southeast Street. No pump stations are required for this subarea.

2.2.8 Subarea 8 - High Point Drive Area

This subarea includes approximately 60 existing houses and is located towards the northeastern corner of the town. The minimum lot size for this subarea is 30,000 sq. ft. and there are approximately 5 acres of developable land. A small portion of this area is located within the Atkins Reservoir watershed. The boring program indicates that there is a significant amount of silt and other fine grain material in this subarea. Shallow groundwater was also evident. Well drained, sandy loam soil overlying ledge is predominant in this subarea.

Parcels in this subarea would be served by gravity and low-pressure sewers. If the gravity sewer in Flat Hills Road is constructed for either Subarea 9A or 13, this subarea could be connected to either. If Subarea 8 is constructed first, a cross-country sewer could be installed that would convey flow from Flat Hills Road to the existing sewer on Market Hill Road near the Atkins Water Treatment Facility.

Since this subarea is far from any existing system, a community package treatment plant with subsurface disposal is an option. However, considering existing and future homes in this subarea, the wastewater flow estimate using Title V design criteria is above the community septic system maximum threshold of 15,000 gpd. Thus, the package plant could only treat a portion of the subarea up to 15,000 gpd. A package treatment plant option would involve facility siting, design, and permitting, as well as the creation of a community agency to oversee the plant operation, maintenance,

repair, regulation, and administration. Currently there are capacity issues on Market Hill Road and Northeast Street so connecting to the existing system will likely require downstream improvements if all flow from Subarea 8 is directed to the town's existing collection system. A more detailed analysis of the various options evaluated for Subarea 8 was completed as part of the 2005 Sewer Extension Master Plan and is included as Appendix F.

2.2.9 Subarea 9 - Market Hill Road Area

Subarea 9 consists primarily of land adjacent to Market Hill and Flat Hills Roads. The subarea is located in the northeastern corner of the town, next to Subareas 8 and 10. Land on the north side of Market Hill Road is adjacent to a stream and will most likely have wetland qualities. Much of the land in this subarea is designated as conservation/agricultural preservation restricted or recreation and cemeteries. However, there are approximately 45 existing houses in this subarea. The minimum lot size for this subarea is 30,000 sq. ft. and there are approximately 62 acres of developable land. It is possible that some of the parcels could be developed, however the topography of this area indicates hills and potentially ledge. Also, the soil boring program indicates that there is a significant amount of silt and other fine grain material.

The existing parcels in Subarea 9A could be served by gravity sewers. The wastewater could flow to the existing sewer on Market Hill Road, near the Atkins Water Treatment Facility. Low-pressure sewers would be required to serve the parcels in Subarea 9B. The low-pressure sewer would connect into the new gravity sewer in Subarea 9A. Currently, there are capacity issues on Market Hill Road and Northeast Street so connecting to the existing system will likely require downstream improvements.

2.2.10 Subarea 10 - Leverett Road Area

Subarea 10 is located in the northeastern corner of the town, bordered by Subarea 9 to the south and the town limits to the north and east. The majority of the existing 65 houses, approximately 45, are bunched in the southwestern portion of the subarea. The minimum lot size for this subarea is 30,000 sq. ft. and there are approximately 35 acres of developable land. There is some conservation land at the eastern end of Leverett Road and a substantial expanse of land designated for recreation and cemeteries in the northwest corner of the subarea. Shallow ledge is visible throughout this subarea.

This subarea can be served primarily with gravity sewers. The northern portion of Leverett Road requires low-pressure sewers for approximately 12 existing houses. The wastewater could flow to the existing sewer on Bridge Street. Homes on East Leverett Road can be served with gravity sewers; however, the direction of flow would be to the east away from the existing sewers. A pump station at the northeastern end of East Leverett Road would be required to convey the wastewater

to the new gravity sewer in the southwestern portion of the subarea. Alternatively, low-pressure sewers could be used to serve this portion of East Leverett Road.

2.2.11 Subarea 11 - Montague Road and North Amherst Center Area

This subarea is located on the northern border of the town. There are approximately 45 existing houses in Subarea 11A, and the minimum lot size for this subarea is 30,000 sq. ft. There are approximately 10 acres of developable land. A portion of the subarea is reserved for recreation or cemetery use or is designated as institutional land or conservation land. Additionally, there is a large stream system within the subarea. Soils in this area include clay, highly permeable sandy loams, sandy soils having high seasonal groundwater, and areas of exposed rock. The parcels in Subarea 11A could be served with gravity sewers conveying flow to a pumping station near the intersection of Montague Road and Summer Street. The pumping station discharge would be connected to the existing sewer on Montague Road.

Since the completion of the Sewer Extension Master Plan in 2005, there has been growing interest in the redevelopment of a triangular portion of land (Subarea 11B) bounded by Montague Road to the east, Sunderland Road to the west, and Cowls Road to the north, including parcels abutting the north and south sides of Cowls Road. Subarea 11B is designated as part of North Amherst Center in the town's Master Plan, which was recently adopted in 2010. The current zoning is village center, allowing for a mix of residential and commercial uses. At the present time, specific, new uses have yet to be identified. The area consists of approximately 40 acres. Exiting 8-inch gravity sewers are located in each of the adjacent roads, tying into a 10-inch gravity sewer that runs southwest via cross country towards Meadow Street. The parcels in Subarea 11B would be served with gravity sewers connected to the adjacent 8-inch gravity sewer in Montague Road. Based on analysis completed on area sewers in 2007 as part of the Patterson Property proposed development, capacity in Montague Road will likely have sufficient capacity to handle anticipated flows from Subarea 11A. However, the sewers and pump stations downstream of Montague Road and Meadow Street would need to be further evaluated to determine if there are downstream capacity issues.

2.2.12 Subarea 12 - Meadow Street Area

Subarea 12 is located in the northwestern corner of the town. There are approximately 25 existing houses, and the minimum lot size for this subarea is 30,000 sq. ft. There are approximately 24 acres of developable land in this subarea. The vast majority of this subarea is conservation or agricultural preservation restricted land.

All parcels in this subarea would be served with gravity sewers. The new gravity sewer would be connected to the existing sewer on Meadow Street. No low-pressure sewers or pump stations are required for this small subarea.

2.2.13 Subarea 13 - Northeast Street Area

Subarea 13 is a large area that includes approximately 95 existing houses. This subarea is south of Subareas 8 and 9 on the eastern side of the town. The majority of the southern portion of this subarea is classified as conservation or agricultural preservation restricted land. Additionally, land at the eastern end of Shutesbury Road is also conservation or agricultural preservation restricted land. There is also a sizeable amount of recreation and cemetery designated land. The minimum lot size for this subarea is 30,000 sq. ft. and there are approximately 113 acres of developable land in this subarea.

The majority of this subarea could be served with gravity sewers. The eastern end of Shutesbury Road and western end of Henry Street requires a low-pressure sewer. Additionally, one pump station would be required at the low point of Northeast Street. The pump station would convey wastewater to the existing sewer on Northeast Street, near Strong Street.

2.2.14 Subarea 14 – Centennial Water Treatment Plant Area

The Centennial Water Treatment Plant (WTP) is located in the adjacent town of Pelham on Amherst Road, a little over a mile east of the Amherst town line. Currently, sludge produced as part of the water treatment process is conveyed to a settling lagoon system, which consists of two unlined earthen bermed basins connected in series. The capacity of the basins is limited, minimizing the amount of coagulant that can be utilized in the water treatment process. In order to remove this limitation and provide more capacity for water treatment sludge disposal, installation of a sewer line connecting to the Amherst sewer system is required. The sewer line will run via gravity from the WTP down Amherst Road in Pelham and connect to the existing 8-inch sewer in Pelham Road at the Amherst town line. This planned improvement is to be funded by non-sewer funds.

2.2.15 Subarea 15 – Gateway Corridor Project Area

The town is currently engaged in a planning process for the Gateway Corridor Project, a mixed use project in Amherst Center. Like North Amherst Center, the Gateway Corridor area was identified as a potential growth area in the town's 2010 Master Plan. The Gateway Corridor Project straddles East Pleasant and North Pleasant Streets in the vicinity of Kendrick Park. The most recent redevelopment concept developed in June 2011 by the town and ACP Visioning + Planning, envisions a mix of uses consisting of 290 residential units, 159,287 square feet of retail, 47,490 square feet of office, 44,460 square feet of lodging, and 3.52 acres of open space. Existing sewers in this area are generally 8-inch diameter gravity sewers. Sewers north of Kendrick Park flow north and west. Sewers south of the park flow south and west. Flow estimates for the proposed project indicate a need for a 12-inch sewer, which would require improvements to the area sewer network. At this time, it is not anticipated that the town will prioritize sewers in this area, but rather will reevaluate the area once project details are finalized, project funding is in place, and design contracts are awarded.

Section 3
Needs Evaluation

3.1 Introduction

The primary goal of this update to the 1991 Wastewater Facilities and the October 2005 Sewer Extension Master Plan is to determine if there is need for additional centralized wastewater management and where that need is located. To accomplish this goal, pertinent data was gathered and evaluated to find the best wastewater disposal method for each of the subareas described in Section 2. For most areas, the evaluation used data on existing on-site disposal system problems, soil and other environmental conditions, and cost benefit factors. The evaluation identified a level of need for each subarea and formed the basis for the prioritization ranking of the subareas. For areas identified for evaluation since 2005 (i.e. areas redeveloping and not currently using on-site systems), the need is based on projected flows and whether or not expansion of the existing sewer system carrying capacity is necessary. The following sections describe the data evaluated in the needs analysis, including the methodology, and present the results of this evaluation.

3.2 Needs Evaluation Methodology and Summary

To perform the evaluation of need, four major criteria were evaluated to assess the relative severity of need for a common wastewater management solution in each subarea. Some need criteria are considered more important than others when determining a subarea's overall need; therefore, a weight factor was assigned to each criterion. Table 3-1 presents the four criteria for determining need and their corresponding weight factors.

Table 3-1
Needs Evaluation Criteria

Criteria	*Weight Factor*
Existing On-site Disposal Problems	35 pts
Soil Limitations	15 pts
Environmental Criteria	10 pts
Cost Benefit	30 pts

Table 3-2 presents the sewer need evaluation for each subarea. Need points for a subarea were determined by multiplying the weight factor of each parameter by a point value between 0 and 5; 5 representing the greatest need. The product of the

Table 3-2
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix Summary

Subarea ID	Neighborhood Description	Existing On-site Disposal Problems (Weight 35 pts)		Soil Limitations (Weight 15 pts)		Environmental Criteria (Weight 10 pts)		Cost Benefit (Weight 30 pts)		Total Need Points	Priority Classification
		Value	Weighted Value	Value	Weighted Value	Value	Weighted Value	Value	Weighted Value		
2	Harkness Road Area	2.0	70	4.0	60	2.0	20	5.0	150	300	Moderate Need
6	Wildflower Drive Area	2.0	70	4.0	60	0.0	0	5.0	150	280	Moderate Need
5	Hulst Road Area	2.7	93	5.0	75	1.0	10	2.0	60	238	Minor Need
3	Southeast Street Area	1.3	47	2.0	30	1.0	10	5.0	150	237	Minor Need
7	Shays Street Area	0.3	12	4.0	60	0.0	0	5.0	150	222	Minor Need
8	High Point Drive Area	2.7	93	5.0	75	5.0	50	0.0	0	218	Minor Need
11A	Montague Road Area	1.7	58	1.0	15	2.0	20	4.0	120	213	Minor Need
13	Northeast Street Area	2.3	82	3.0	45	3.0	30	1.0	30	187	Minor Need
9	Market Hill Road Area	2.0	70	3.0	45	3.0	30	0.0	0	145	No Significant Need
4	Bay Road Area	1.3	47	1.0	15	2.0	20	2.0	60	142	No Significant Need
10	Leverett Road Area	2.0	70	2.0	30	3.0	30	0.0	0	130	No Significant Need
12	Meadow Street Area	0.0	0	2.0	30	2.0	20	2.0	60	110	No Significant Need
11B	North Amherst Center Area	Not Applicable									No Significant Need (at this time)
15	Gateway Corridor Project Area	Not Applicable									No Significant Need (at this time)

Notes:
(1) The cost per house presented for High Point Drive Area (8) includes the downstream improvements that are required in the Market Hill Road Area (9A).

Criteria for Priority Classification		#
> 350	Major (Immediate) Need	0
250 - 350	Moderate Need	2
150 - 250	Minor Need	6
< 150	No Significant Need	6

weight factor and point value is the weighted value for that particular need criterion. Summing the weighted values for each subarea yields the overall need classification, ranging from 0 to 450 need points. Subareas were categorized as follows: more than 350 points had a major (immediate) need; 250 to 350 points had a moderate need; 150 to 250 points had a minor need; and less than 150 points had no significant need. Section 3.3 presents a more complete discussion of each evaluation criteria and the method used to assign a point value to each.

Table 3-2 prioritizes the subareas with those having the highest need at the top. The supporting matrix tables are presented in Appendix A.

This evaluation generally follows the criteria and weights used in the original 1991 Facilities Plan, however, some changes were made in this current evaluation. Based on discussions with town officials and advisory groups, the weight of the environmental criteria category was reduced due to the limited data available within this category and the ability to construct the proposed improvements was also considered as a means to determine the effectiveness of the proposed improvements.

3.3 Evaluation Criteria

3.3.1 Existing On-site Disposal Problems

The existing on-site disposal problems were a main focus of the needs evaluation. This criterion evaluated both problems reported on homeowner questionnaires and the quantity of failed systems as reported by the Town of Amherst BOH. Within this category, each (questionnaire and BOH records) were assigned equal weight.

Approximately 750 houses received questionnaires of which 400 (53%) were returned sufficiently completed to be considered for this evaluation. The goal of the questionnaire was to interpret the homeowners' responses to determine which subareas were more prone to septic system failures. Examples of information reported on the questionnaire included leaching of sewage to the ground surface, odor problems, septic system age, and frequent pumping of on-site systems. Septic tanks that require pumping more than once per year generally indicate a poorly operating leaching field with a high potential for failure. An example of the questionnaire is presented in Appendix B.

The number of residents reporting each of the existing on-site disposal problems was tallied for each subarea. Figure 3, shown in Appendix C with other needs evaluation-related figures, presents locations in the subareas where failures were reported. Addresses include failures reported by the BOH and questionnaires. Failures reported by questionnaires include a positive ("YES") response to one or more of the following questions:

- "Is frequent pumping necessary?";
- "Is pumping necessary more than once per year?";

- "Has there been leaching of the sewage to the ground surface?"; and
- "Have there been odor problems?"

The percentage of homes reporting problems determined the number of points for each category. The average septic system age was calculated from the questionnaires. More points were given for lower average age systems, an indication that systems are failing short of their typical useful life.

The number of failed systems as documented by BOH records between 1991 and 2003 were also tallied for each subarea. The percentage of systems failing per subarea for the period between 1991 and 2003 (compared to total number of homes) was the primary consideration used to assign points as shown in Table 3-3 below:

Table 3-3
Board of Health Failures – Point Distribution

Percentage of Failing Systems (%)	*Need Points*
0 - 10	0
11 – 20	1
21 – 30	2
31 – 40	3
41 – 50	4
> 50	5

It is important to note that neither BOH records nor returned questionnaires are intended to be a complete and accurate list of all failed or failing on-site systems. This data was simply used as a general measure of areas with need for a wastewater management solution. Additionally, many of the on-site systems may be failing not due to an inability of the site to handle on-site waste disposal, but rather may be failing due to lack of maintenance, age of the system, or other factors which do not indicate a need for sewers. The town sanitarian reported several cases where improper management of otherwise functional septic systems caused premature failure. Generally, on-site systems should last 25 years before starting to fail due to age. As a result, the needs evaluation used the average age of on-site systems (as reported on the homeowner questionnaire) to reduce the impact of reported failures. Subareas that reported problems but that had old systems were given less needs points. In addition, while this criterion was assigned the highest weight factor (35 points), its overall input into the evaluation is tempered by other criteria.

3.3.2 Soil Limitations

The ability of a soil to leach wastewater greatly affects how well and how long septic tanks and leaching fields will properly function. Rehabilitation of existing systems or construction of new systems in poor soils is very difficult and sometimes impossible. This category evaluated data from the Natural Resources Conservation Service

(formerly the Soil Conservation Service), BOH inspection and deep-hole analysis records, and soil borings and samples conducted in December 2003 and January 2004. Additionally, housing density was considered since the size of a residential lot affects the placement of septic systems and leaching fields.

Determination of soil leaching capability was based partly on data from the Natural Resources Conservation Service. The Natural Resources Conservation Service maps the location of various soil types and rates each soil type for its suitability in supporting a subsurface disposal system. Figure C, included in Appendix C, classifies soils as having Severe (3), Moderate (2), or Slight (1) disposal limitations. Areas classified as having severe limitations, but are not yet experiencing problems, can be expected to experience higher rates of failure in the future and may require intensive correction measures to overcome soil limitations. Similarly, areas with only slight or moderate limitations are less likely to have significant widespread problems and consistent preventative maintenance may solve existing problems.

The predominant soil classification in each subarea was used in the evaluation. Table 3-4 presents the assignment of need points.

Table 3-4
Soil Limitations – Point Distribution

Severity Rating by Soil Map	*Need Points*
Predominantly 3H (hardpan) with other severe conditions	5
3H	4
3H & 3W (high groundwater)	3
2 and 1 (slight and moderate limitations)	1
1	0

A soil boring program was also conducted to collect soil samples and types, groundwater elevations, as well as to evaluate the ability for on-site disposal and to assist in estimating the cost of constructing new sewer systems in the identified subareas. Borings were advanced to a minimum depth of 15-ft and groundwater elevations recorded. The boring logs are presented in Appendix D.

BOH inspection records often indicated soil types and percolation rates at numerous addresses within each subarea. This data was used to supplement data gathered from the soil boring program.

The Build-Out Analysis and Future Growth Study prepared by Applied Geographics, Inc. and Philip B. Herr & Associates in 2002, as well as the Existing Conditions Report prepared by ACP Visioning &Planning in 2007 and the town's 2010 Master Plan, were consulted for this facilities plan update. The town's most current GIS data were used to determine what portion of the identified subareas were available for future

development. Additionally, topography and other land use designations were also used to identify future development potential.

Land use has changed significantly over the past six decades. In 1952, urban land accounted for only seven percent of the total acreage, and increased to 20 percent by 1972. This development of land parallels the rapid growth of the University of Massachusetts over that time. The expansion of urban activity has primarily consisted of multi-unit housing accommodating the large number of students opting for off-campus housing, and single family homes on large lots. This development has taken up land that was once primarily agricultural and open land, as well as some forest land. Single family homes are still the predominant new structures.

The most significant individual land owners in Amherst are the colleges (University of Massachusetts – 1,135 acres, Hampshire College – 575 acres, and Amherst College – 1,085 acres), the Commonwealth of Massachusetts – 900 acres, and the Town of Amherst – 1,705 acres. This land makes up approximately 20 percent of the total area of the town. Figure 2, in Appendix C, presents the distribution of land ownership, compiled with GIS data.

With smaller lot sizes, there is a greater chance of having on-site disposal problems since there are fewer locations to place an adequately sized leaching field on each lot. Town zoning information was used to determine the minimum lot size in each of the subareas. Table 3-5 presents criteria for the point distribution in the needs evaluation.

Table 3-5
Housing Density – Point Distribution

Typical Lot Size, square feet (ft^2)	*Points*
> 90,000	0
>40,000 – 90,000	1
>20,000 – 40,000	2
>15,000 – 20,000	3
>10,000 – 15,000	4
Residential Clusters	5

3.3.3 Environmental Criteria

Factors affecting or affected by the environment and public health must also be considered. Based on input from town officials and advisory groups, the weight of these criteria was reduced from the original analysis presented in the 1991 Facilities Plan.

Four sub-categories comprise the environmental criteria category: (1) Lawrence Swamp aquifer protection, (2) proximity to surface water, (3) protection of the Atkins Reservoir watershed, a town drinking water source, and (4) town drinking water availability. Within the Environmental Criteria (10 points of the Total Evaluation)

proximity to surface waters, areas within reservoir watersheds, town water availability, and aquifer protection elements were each weighted equally.

3.3.3.1 Lawrence Swamp Aquifer Protection

Much of the town's potable water is withdrawn from the Lawrence Swamp Aquifer through five town operated wells. This aquifer is located in the southeastern portion of Amherst and extends into the neighboring Towns of Belchertown, Pelham, and Granby. The five wells are located within a resource protection area bounded by Bay Road, Southeast Street, and Station Road.

Protection of potable water supplies can often be provided through public sewerage facilities. The proximity of a subarea to a public water supply or other environmentally sensitive areas can often play a major role in assessing need. In this case, however, recommendations provided by the Amherst Aquifer Protection Committee (APC), based on data collected by the Town of Amherst, indicate that the town wells do not reflect any deterioration of water quality as a result of existing on-site wastewater systems. Furthermore, the data indicate that the potential impacts to the aquifer may in fact be negative if sewering proceeds.

In a memorandum prepared by the APC dated November 20, 2000, the APC states:

> "With the exception of Well No. 5, no water supply well shows elevated levels of nitrate. The slightly elevated levels observed in Well No. 5 are most likely the result of agriculture and not domestic sewage… Overall, the groundwater in Amherst is in excellent health. Accordingly, until other evidence is provided, the Committee believes it is inappropriate to use groundwater quality as an argument to justify extension of municipal sewerage."

The five town wells are located significant distances from the subareas, with the exception of Well No. 5, which is located close to Bay Road in Subarea 5 – Hulst Road Area. Sewering the subareas located in the recharge areas for the aquifer will reduce the amount of available recharge to the aquifer, an "unfavorable consequence of sewering" as described by the APC.

Rather than using proximity to the aquifer as a positive criterion to sewer an area, the APC believes that "the greater concern to the aquifer is the potential development that might ensue if the sewer mains are installed." The two major concerns the APC identifies are a change in the water budget and an herbicide/fertilizer hazard. As described briefly above, sewering an area will reduce recharge of the aquifer from on-site wastewater disposal systems. Sewering can have a tendency to increase development in that region. Development also often results in the replacement of natural drainage systems with structural collection and conveyance systems, which generally decrease the amount of stormwater that percolates into the ground in the immediate vicinity. Development also increases the demand for water and "a larger quantity of water will be removed from the aquifer and less water returned to the

aquifer as recharge. This scenario changes the water balance within the aquifer." (APC)

Additionally, as development encouraged by sewering increases, the amount of herbicides and fertilizers applied to lawns also increases. "Herbicides and fertilizers applied to lawns pose a much greater threat to the integrity of the aquifer than the nitrate contributions from the existing septic systems." (APC 2000)

Accordingly, in the evaluation of need, subareas located within the aquifer recharge area (3, 5, 6, & 7) were assigned zero points for the Aquifer Protection subcategory within the Environmental Criteria, and subareas outside of the recharge area were assigned three points. Areas recommended for sewering by the APC or areas that contributed to aquifer quality degradation were assigned five points, however, there were none of these within the town. As described below, wastewater on the ground is a public health problem, especially where streams and other surface waters are in close proximity.

3.3.3.2 Proximity to Surface Water

Protection of ponds, rivers and streams from breakthrough of failed septic systems can best be provided through public sewerage facilities. The proximity to surface waters was used to identify each subarea's impact on public waters. The point values for this subcategory were assigned based on an estimate of how many water bodies and streams are in each subarea. Higher consideration was given to subareas indicating a larger number of on-site system failures.

3.3.3.3 Reservoir Watershed

The point values for the reservoir watershed sub-category were assigned based on an estimate of how much land is in a public drinking water supply reservoir watershed. With all reservoirs located outside of the Town of Amherst, nearly all watershed boundaries are also located outside of the town. Subarea 8 – High Point Drive Area is the only subarea partially within the Atkins Reservoir watershed.

3.3.3.4 Town Water Availability

The availability of town water was used for this evaluation to help assess a potential public health concern. Parcels with an on-site potable water source can be contaminated by nearby on-site wastewater disposal systems, if they are not properly designed or maintained or the soils are not suitable for on-site wastewater disposal. Greater needs points were given to subareas that rely on on-site water sources such as wells and do not have access to the town water distribution system.

3.3.4 Cost Benefit

Seven subcategories comprise the cost benefit category:

- distance to the existing sewer;
- need for a cross-country easement;

- current build-out;
- future development;
- type of sewer;
- pump station need; and
- required downstream improvements.

The point value for this category was determined by adding the points from the seven subcategories and then assigning a total point value between zero and five.

While this category does not alone address need, it does address the effectiveness of providing a centralized solution for wastewater management. As the difficulty to construct a centralized system due to distance from the existing sewer, need for easements, etc. increases, so does the cost of the project and the difficulty to implement it. This increased cost and difficulty, coupled with the reduced support of a project by residents who need to provide easements, own and maintain grinder pumps, etc., reduce the effectiveness of a project and give more weight to the recommendation to remain with on-site disposal systems. As such, these criteria were included in the evaluation. The following sections describe each of these subcategories in more detail.

3.3.4.1 Distance to Existing Sewers

The approximate distance along existing roads or proposed easements from an existing sewer to the largest cluster of homes was estimated for each subarea. With subareas farther from the existing sewer, the cost effectiveness of a centralized sewer system decreases. Many areas in this evaluation, however, are located close (less than 1,000 feet) to existing sewers and were given the highest points available for this subcategory. Table 3-6 presents the point distribution.

Table 3-6
Distances to Existing Sewers – Point Distribution

Distance Along Existing Roadway (ft)	*Points*
> 5,000	0
>4,000 – 5,000	1
>3,000 – 4,000	2
>2,000 – 3,000	3
>1,000 – 2,000	4
0 – 1,000	5

3.3.4.2 Cross-Country Easement Required

As discussed in Section 2, preliminary design of a potential centralized wastewater collection system was conducted for each subarea. If a cross-country easement is required across private land to sewer a neighborhood, the difficulty to implement the project increases. Subareas without cross-country easements were given more points.

3.3.4.3 Build-Out Assessment

The majority of the subareas have been developed into residential properties, though there are still parcels of land that could be sub-divided for residential (or other) buildings in some of the subareas. Build-out represents the relative density of a subarea. Areas with a large number of houses in a small area have a high build-out and the cost-effectiveness of a centralized collection system has a lower cost per house. More points were given to subareas with higher existing build-out conditions. The cost per house evaluation is a good way to determine project effectiveness.

3.3.4.4 Future Development

Population data is an important element of any facilities plan. Areas that do not have significant subsurface disposal problems may begin to exhibit sewer need over the design period with population increases. Likewise, the availability of new sewer facilities may increase the growth on previously undeveloped areas, an undesirable consequence of sewering an area.

Encouraging development within the subareas with the addition of sewers was considered a negative attribute for this analysis. Developable area is based on the town's GIS data. As discussed in Section 2, lands coded as "developable" or "potentially developable" in the GIS system, as well as a few select parcels assumed to be developable land based on their proximity to proposed sewers, were tallied for each subarea and compared to existing zoning designations. These parcels were further evaluated, where applicable, for criteria such as site access and presence of wetlands. Publicly owned land and land designated as permanently or partially protected were typically not considered developable land. Table 3-7 presents the point distribution used for this subcategory.

Table 3-7
Future Development – Point Distribution

Development Encouragement Level	*Points*
Major	0
Significant	1
Moderate	2
Minor	3
Minimal	4
None	5

3.3.4.5 Type of Sewer Required

Preference for this analysis was given to subareas that could be completely sewered by gravity, and therefore had low operation and maintenance (O&M) costs and ease of implementation. If the subarea required only gravity sewers, higher weight was given.

3.3.4.6 Pump Station Required

The number of pump stations was determined during preliminary design for each subarea. These estimates are primarily based on topography; however, they are not expected to change during the final design process. Pump stations increase the annual O&M cost and effort of the town. If no pump stations were required, the subarea was given more points for this subcategory.

3.3.4.7 Downstream Improvements Required

In some cases, sewering a subarea and connecting it to an existing system would require increasing the capacity of the downstream collection system, increasing the project cost and difficulty to implement. Preference was given to subareas that did not require downstream system improvements.

Section 4
Recommended Plan

4.1 Introduction

This section presents descriptions of the recommended improvements to the Town of Amherst collection system, shown on Figures 1A and 1B. Following the evaluation discussed in Section 3, subareas with defined need were further evaluated to determine the most cost effective wastewater collection solution.

4.2 Wastewater Management Alternatives

Wastewater management alternatives evaluated include:

- conventional gravity sewers;
- low-pressure sewers;
- vacuum sewers;
- localized cluster subsurface disposal (community septic systems);
- localized packaged treatment plants; and
- "Innovative/Alternative" wastewater disposal systems.

The no-action alternative was eliminated for each of the areas discussed below because of demonstrated problems with existing on-site systems and a needs analysis that identified at least a minor need for a common collection system in each area.

4.2.1 Conventional Collection System Elements

Regardless of the ultimate disposal of the wastewater (municipal wastewater treatment facility, cluster disposal, etc.) wastewater must be collected from individual buildings and conveyed to the disposal location. Collection systems are most frequently comprised of conventional gravity sewers though topography and depth to bedrock generally dictate the sewer type and layout.

If a section of the sewered community is located in a low lying area where gravity flow to the desired location is not possible, pumping stations and force mains are used to "lift" the wastewater to a location with a higher elevation where the wastewater can resume gravity flow toward the desired destination.

4.2.2 Alternative Collection System Elements

Topography, depth to bedrock and soil characteristics can influence the collection system design and layout. Low-pressure sewers and vacuum sewers are two popular alternatives to gravity sewers. Each alternative can be appropriate given the right site conditions.

Low-Pressure Sewers
If an area of homes is small (generally 30 homes or less), individual private grinder pumps with a low-pressure sewer system is an effective means to provide collection for an area. Low-pressure sewers are generally 6 inches in diameter or less (typically only 2 inches). The slope of the sewer is not important since the system is pressurized, which allows the pipes to follow the natural topography of the land. Therefore, low-pressure sewers may be less expensive to construct than conventional gravity sewers with pumping stations. Often, low-pressure sewers are used to overcome large changes in topography.

Vacuum Sewers
Vacuum sewers operate with a central vacuum source that collects wastewater from individual homes through valved collection pipes. Wastewater stored in a collection tank at the vacuum source is then delivered to the collection system by conventional means. In very flat areas (beach communities, etc.) vacuum sewers can provide an optimum solution for wastewater collection. The topography of all the unsewered areas within the town limits the viability of a vacuum system.

4.2.3 Cluster Subsurface Disposal

A cluster subsurface disposal system consists of a large septic tank and leaching area that serves several buildings up to a whole neighborhood. It can be a very efficient method of disposal under proper soil conditions and flow rates. Title V regulations do not require special permitting for flows less than 10,000 gpd, but a variance is required for flows greater than 10,000 gpd. This variance, however, is valid only for flows less than 15,000 gpd. Operation and maintenance (O&M) costs of a cluster subsurface disposal system are low when pumping is not required, as is the installation cost when compared to that of major interceptors or pumping stations. Such systems find their best applications where small building lots provide insufficient leaching areas, but where a larger undeveloped lot with favorable soil conditions is close by and building lots are in close proximity to each other.

The capital cost per household for cluster systems typically exceeds $35,000 and operation and maintenance costs must also be considered in the analysis.

The cluster system does not protect the groundwater from toxic waste discharges and treats waste to the same level as a conventional private Title V system. Homes connected to the cluster system would transport wastewater through a collection system to the local cluster subsurface disposal system. As such, in a cost-effectiveness analysis, the primary comparison is between the cost of a cluster system (including removal of solids and O&M costs) and the cost of downstream improvements necessary to connect to an existing sewer system with sufficient capacity.

4.2.4 Package Treatment Plants

The relatively sparse development in the unsewered areas of the town dictates that any consideration of new wastewater treatment plants be limited to small prefabricated or package plants. Many types of package units are capable of producing an effluent of

secondary quality for discharge to surface waters or land (sub-surface). Producing effluent of good quality is critically dependent on regular operator attention to control adjustments and equipment maintenance. Traditional and alternative wastewater treatment processes may be used in package facilities, depending on the desired degree of wastewater treatment. A new facility involves siting, access, design, permitting, and often the creation of a community agency to oversee the plant operation, maintenance, repair, regulation, and administration.

Package treatment plants are more labor-intensive and have higher energy costs than interceptors; therefore, new treatment plants are often not considered a viable long-term disposal alternative. Additionally, the difficulty in siting and permitting these facilities makes their success as a viable alternative difficult.

4.2.5 Innovative/Alternative System – Engineered Wetlands

Engineered systems can, under controlled conditions, duplicate the natural purifying processes of fresh water streams, meadows, and wetlands. Using greenhouses to enhance the growth of bacteria, algae, plants, and aquatic animals, wastewater flows through a series of tanks, engineered streams, and constructed marshes that metabolize or bind contaminants. The Solar Aquatics system, by the Ecological Engineering Group in Concord, MA has been used to treat sewage, septage, boat waste, and ice cream processing waste and was used as comparison to other alternatives.

The Solar Aquatics System is made up of three main processing sections: (1) headworks for blending and flow equalization, (2) greenhouse system for biological processing and removal of contaminants, and (3) solids processing for stabilization and composting of sludge and vegetative waste.

The system utilizes a diverse combination of biological components to speed the removal of organic material and nutrients by bacterial degradation. Algae, bacteria, other micro-organisms, higher plants, snails, and other aquatic animals make up the ecosystem food chain involved in the natural purification of wastewater.

The estimated capital cost to treat domestic wastewater to effluent concentrations of 30 mg/L for total suspended solids (TSS) and biochemical oxygen demand (BOD) and 10 mg/L for total nitrogen can range from $5 to $20 per gallon per day for systems greater than 100,000 gpd, to between $25 to $35 per gpd for smaller systems. This cost includes all equipment, greenhouse, leaching field, and wetlands permits. The annual O&M costs can range between $10 and $25 per gpd. The approximate land required for this type of system can range from less than 0.01 acres per 1,000 gpd for small flows (less than 100,000 gpd) to up to an acre or more for flows ranging between 0.5 to 1.0 mgd.

This alternative was evaluated for Subarea 8, an area where local treatment and disposal was considered more competitive. Based on the costs provided, this alternative system was found to be more than twice as expensive as a community septic system or package treatment plant, each of which is more expensive than connection to the existing sewer system through conventional means. While these

types of systems may be cost effective in locations where no other alternative exists, they are simply too costly to be considered in locations where a connection to an existing sewer system is feasible.

4.3 Recommended Improvements

Table 3-2 presented the recommended priority list resulting from the needs evaluation. The priority of the subareas is important to determine the order of construction of the recommended alternatives. There are two subareas with a moderate need and six subareas with a minor need for updated wastewater collection systems. The following sections present descriptions of the recommended improvements for each of these subareas.

4.3.1 Harkness Road Area (Subarea 2)

This subarea is classified as having moderate need, with 300 points, in Table 3.2. As shown in Figure 1B, the recommended sewer system layout to serve properties on Harkness Road south of Stony Hill Road, includes approximately 3,500 linear feet of 8-inch diameter gravity sewer. Flows run north on Harkness Road to the intersection of Stony Hill Road where the sewer joins the existing gravity sewer. The eastern side of this road is located within the Town of Pelham, though the residents on the western side of this road are residents of Amherst. The portion of Harkness Road north of Stony Hill Road is fully within the Town of Pelham (both sides).

4.3.2 Southeast Street Area (Subarea 3)

This subarea is classified as having minor need, with 237 points, in Table 3.2. The recommended sewer system layout, as shown on Figure 1B, includes approximately 6,800 linear feet of 8-inch diameter gravity sewer. Subarea 3A consists of gravity sewer running northwest on Southeast Street to the existing sewer on the northern end of Mechanic Street at the Mechanic Street pumping station. Subarea 3B collects flows from Bay Road and directs them to the existing sewer on the southern portion of Mechanic Street.

Area 3A must be constructed prior to or as part of the construction of the Hulst Road Subarea 5 sewers since flow from the Hulst Road area must flow through this portion of Southeast Street to the Mechanic Street pumping station. The Mechanic Street pumping station was designed with sufficient capacity to handle this flow.

4.3.3 Hulst Road Area (Subarea 5)

This subarea is classified as having minor need, with 238 points, in Table 3.2. The recommended sewer system layout, as shown on Figure 1B, includes approximately 11,700 linear feet of 8-inch diameter gravity sewer, approximately 5,200 linear feet of 4-inch diameter ductile iron force main, 1,100 linear feet of 2-inch diameter low-pressure PVC sewer, and one wet well mounted wastewater pumping station. Some homes on Stage Coach Road would require individual grinder pumps due to the topography of the road. Houses on the northern side of Stage Coach Road are considerably lower in elevation than the roadway, and grinder pumps would be required to pump up to a

new gravity sewer. Additionally, a small number of homes on Bay Road (near the western boundary of Subarea 5) would also require individual grinder pumps. It is recommended that these pumps connect directly to the 4-inch diameter force main.

One pumping station would be required on Hulst Road, as indicated on Figure 1B. This pumping station would collect flow from nearly the entire project area and pump it west on Hulst Road and Bay Road to the proposed gravity sewer on Southeast Street (part of Subarea 3A). The property around the proposed pumping station is mostly wetlands and would be difficult to develop. Locating the pumping station on this property would minimize impact to residents and developed lots in this area.

4.3.4 Wildflower Drive Area (Subarea 6)

This subarea is classified as having moderate need, with 280 points, in Table 3.2. The recommended sewer system layout, as shown on Figure 1B, includes approximately 14,600 linear feet of 8-inch diameter gravity sewer, approximately 2,100 linear feet of 4-inch diameter ductile iron force main, 3,700 linear feet of 1 ½ -inch and 2-inch diameter low-pressure PVC sewer, and two wet well mounted wastewater pumping stations. Numerous areas would require individual home grinder pumps served by the low-pressure sewers. The above quantities do not include the private Amherst Professional Park and Amherst Hills Residential Development, located adjacent to Subarea 6.

One pumping station would be required on Wildflower Drive, as indicated on Figure 1B. This pumping station would collect flow from the entire southern half of the project area, except for a small section on Station Road that will flow into the Amherst Hills residential development pump station on Station Road. The property on the west side of Wildflower Drive at the proposed pump station location is mostly wetlands, and will be difficult to develop. Locating the pumping station on this property would minimize impact to residents and developed lots in this area. Additionally, a second pumping station is proposed on Wood Lot Road, to collect wastewater from the western portion of the subarea. These pumping stations were recommended in a report titled Amherst Woods Sewer Design Study by CDM dated February 6, 2003. This report provides further detail on the Wildflower Drive Area Sewers and is included in Appendix E.

4.3.5 Shays Street Area (Subarea 7)

This subarea is classified as having minor need, with 222 points, in Table 3.2. Subarea 7 consists of approximately 2,000 linear feet of 8-inch diameter gravity sewer directing flow south on Shays Street to the existing sewer on Southeast Street. This is a small subarea that would serve approximately 20 existing homes.

4.3.6 High Point Drive Area (Subarea 8)

This subarea is classified as having minor need, with 218 points, in Table 3.2. The recommended sewer system layout, as shown on Figure 1A, includes approximately 6,900 linear feet of 8-inch diameter gravity sewer, 3,900 linear feet of 2-inch diameter low-pressure PVC sewer, and 1,500 linear feet of 4-inch diameter force main. The

collection system involves both pressure and gravity sewers to direct the flow to a new pumping station on Flat Hills Road. There may be as many as 35 private grinder pumps on Overlook Drive and High Point Drive; however, the alternative of only using gravity sewers would require an additional pumping station on Overlook Drive. Decreasing the number of pumping stations further decreases the capital cost and the annual effort and cost for O&M. A more detailed analysis of the various options for Subarea 8 was completed as part of the 2005 Sewer Extension Master Plan and is included as Appendix F.

The recommended pumping station on Flat Hills Road would convey the wastewater to the high elevation point of Flat Hills Road where the new gravity sewer would begin. This new gravity sewer would continue through Subarea 9 on Flat Hills Road and then Market Hill Road to the existing sewer near the Atkins Water Treatment Facility. Connection into the existing sewer system would also require improvements to the existing downstream sewers because of known capacity issues.

Connections for homes on Flat Hills and Market Hill Roads could be provided during construction, thereby sewering Subarea 9A. These improvements are included in the pipe lengths presented above for Subarea 8 because Subarea 9 on its own does not show a minor or moderate need for sewers.

4.3.7 Montague Road Area (Subarea 11A)

Subarea 11A is classified as having minor need, with 213 points, in Table 3.2. The recommended sewer system layout, as shown on Figure 1A, includes approximately 5,500 linear feet of 8-inch diameter gravity sewer. Flows run south on Montague Road to the low elevation point. A pumping station at this low point conveys wastewater up the hill to the existing sewer on Montague Road.

4.3.8 Northeast Street Area (Subarea 13)

This subarea is classified as having minor need, with 187 points, in Table 3-2. The recommended sewer system layout, as shown on Figure 1A, includes approximately 13,700 linear feet of 8- inch diameter gravity sewer, 2,600 linear feet of 2-inch diameter low-pressure PVC sewer, 1,700 linear feet of 4-inch diameter force main, and one wet well mounted wastewater pumping station. The majority of the flow runs south on Northeast Street to the low elevation point. A pumping station at this low point conveys wastewater to the existing sewer on Northeast Street near Strong Street.

4.3.9 Centennial Water Treatment Plant Area (Subarea 14)

Subarea 14, shown in Figure 1A, was not evaluated as part of the 2005 Sewer Extension Master Plan. However, since completion of the 2005 plan, a sewer to serve the Centennial WTP upgrades has been identified as a need. The topography of the land between the Centennial WTP and the Amherst town line slopes east to west, lending itself to gravity flow. The recommended sewer system layout, as shown on Figure 1A, includes approximately 5,200 linear feet of 8- inch diameter gravity sewer. The

proposed sewer will connect to the existing sewer in Pelham Road at the Amherst town line and will be financed with non-sewer funds.

4.4 Priority List for Recommended Alternatives

Table 3-2 presented the recommended priority list resulting from the needs analysis. The priority of the subareas is important to determine the order of construction of the recommended alternatives. As discussed in Section 3, the four major evaluation factors used to determine the priority list order were existing on-site disposal problems, soil limitations, environmental criteria, and cost benefit. The following is a summary of the areas recommended for sewering with highest priority first.

Subarea 2 – Harkness Road	Moderate Need
Subarea 6 – Wildflower Drive Area	Moderate Need
Subarea 5 – Hulst Road Area	Minor Need
Subarea 3 – Southeast Street Area	Minor Need
Subarea 7 – Shays Street Area	Minor Need
Subarea 8 – High Point Drive Area	Minor Need
Subarea 11A – Montague Road Area	Minor Need
Subarea 13 – Northeast Street Area	Minor Need

Subarea 14 is a planned improvement that needs to be sewered to meet the schedule to bring the Centennial WTP online. While sewer planning for the two areas with "Moderate Need" should begin, it is not necessary to sewer these areas immediately or all at once. Even the subarea with the highest need, Subarea 2, is rated in the middle portion of the "Moderate Need" category.

Subareas with a "Minor Need," Subareas 3, 5, 7, 8, 11A, and 13, have even less priority. However, portions of Subarea 3 on Southeast Street must be constructed to service Subarea 5. Additionally, Shays Street (Subarea 7) is a very small subarea that could easily and inexpensively be sewered and connected to the existing system as part of a larger project.

4.5 Wastewater Flow Rates

4.5.1 Projected Flows

The estimated wastewater flows (expressed in gallons per day) to be generated within the project areas with planned improvements or, moderate or minor need are presented in Table 4-1.

The number of existing homes and the number of vacant, developable lots were used to estimate the amount of wastewater flow for each area. From census data, it was determined that the average number of people per home for the Town of Amherst is 3.8. Domestic wastewater flow was estimated by using a production value of 60 gallons per capita per day (gpcd) based on the original report titled "*Town of Amherst Wastewater Facilities Plan*," dated 1991. Infiltration and Inflow (I/I) was estimated as 40 gpcd also based on the original report. The average domestic wastewater flow was peaked by a factor of 5.4, the commercial wastewater flow was peaked by a factor of 2.0 or 5.0 (Amherst Center, North Amherst Center and Centennial WTP Areas only), and the I/I flow was peaked by a factor of 2.0 to obtain the peak hour wastewater flow estimate.

Table 4-1
Estimated Future Wastewater Flows

Subarea		Average (gpd)	Peak Hour (gpd)
2	Harkness Road Area Sewers	9,500	38,400
3	Southeast Street Area Sewers	25,500	102,900
5	Hulst Road Area Sewers	42,200	170,400
6	Wildflower Drive Area Sewers	87,000	351,600
7	Shays Street Area Sewers	7,600	30,700
8	High Point Drive Area Sewers*	42,200	170,400
11A	Montague Road Area Sewers	19,800	79,800
13	Northeast Street Area Sewers	42,600	171,900
14	Centennial Water Treatment Plant Area	120,600	226,100
	Total	*397,000*	*1,342,200*

**Note: Flow estimates from Subarea 8 also include subarea 9A, because sewer needed to connect Subarea 8 to the system will run through Subarea 9A.*

4.5.2 Improvements to Existing Sewers

In general, the existing sewers in the Town of Amherst were properly designed to have capacity for future development. This development and extension of the sewer system has and will continue to occur in locations anticipated by earlier studies and planning efforts. Because of this, the majority of sewers and facilities in the town (including the wastewater treatment plant) have sufficient capacity to handle additional flows from extensions recommended by this study.

A rough analysis of the existing sewer system was conducted to determine the system's ability to convey peak wastewater flows as well as the projected peak flows. The

sewers studied were downstream of proposed sewer extensions, in areas where new development may cause flow to exceed existing sewer pipe capacities, had reported capacity problems, and/or were 12-inch diameter or greater.

The 1991 Facilities Plan previously identified the Rolling Ridge Trunk Sewer as having capacity problems. The capacity analysis comparisons for the Rolling Ridge Trunk Sewer and the intercepting sewer in East Pleasant, Pine, and Bridge Streets are presented in Table 7-1 of the original 1991 Facilities Plan. According to town officials, surcharging in this area often occurred when filter backwash water from the Atkins Water Treatment Plant (WTP) was discharged to the sewer. To alleviate this problem, the town installed an equalization tank at the WTP which is filled during a backwash cycle and discharges to the sewer at a steadier rate.

Possible solutions for the capacity deficiency in the East Pleasant Street area would include rehabilitation of the sewers upstream of the sewer in order to remove infiltration (which would provide additional carrying capacity, though is not a completely reliable method of increasing capacity), or construction of new relief sewers.

Portions of the Rolling Ridge Trunk Sewer from East Pleasant Street to the end of Rolling Ridge Drive were recently replaced. The new and existing portions of the relief sewer should be flow metered before substantial new flows are added to the upstream sewers. If new sewers are extended to the Leverett Road and Market Hill Road/High Point Drive areas (Subareas 8, 9 and 10), then flow testing and, if warranted, replacement of the final leg of the relief sewer should be constructed.

Another area of concern is the existing sewers and facilities downstream of Subareas 3 & 5 – Bay Road/Hulst Road areas and Subarea 6 – Wildflower Drive Area. It is expected that the pumping stations downstream of these areas will provide sufficient capacity to handle the additional flows. In some cases, however, individual reaches of pipelines may have a theoretical capacity less then the expected flows. Flows from each of these areas will approach the capacity of an 8-inch diameter pipe flowing full at minimum slope. While the hilly topography of Southeast Street and the Wildflower Drive area generally provides greater slope than minimum, pipes laid at a minimum slope may surcharge during peak flows.

Lastly, a rough analysis of existing peak flows in the downstream 8-inch sewer in Pelham Road near Subarea 14 indicates that the pipe is flowing at approximately 60 percent capacity. In order to ensure that sewers are capable of transporting peak flows with a factor of safety for any unexpected conditions, 8-inch sewers are typically selected to transport flows while flowing at a maximum of 50 percent capacity. It is recommended that the flows from the Centennial WTP be released at off peak hours to maximize the capacity of the existing 8-inch sewer in Pelham Road. Over time, if the town decides to allow Pelham residents adjacent to the 8-inch sewer in Amherst Road to connect to the system, it is recommended that flow measurements be taken to verify

existing flows and more accurately assess when the existing Pelham Road sewer needs to be upsized to a 10-inch or 12-inch sewer.

4.6 Anticipated Construction Issues

4.6.1 Rock

During site inspection, minimal rock outcroppings were visible within the areas recommended for improvements. Likewise, the soil borings conducted as part of this investigation did not identify any area with predominant shallow rock. However, due to the hilly topography, it is expected that rock will be encountered in some areas during excavation. Soil borings conducted during final design will help to define the depth and limits of rock.

4.6.2 Soil Conditions

Much of this area includes hilly topography. With the exception of the two pumping station sites in the Wildflower Drive Area, one in the Hulst Road Area, one in Northeast Street Area, one in the High Point Drive Area, and one in the Montague Road Area, only small areas of each project are located in low lying areas. Typically low lying areas are subject to soils with poor bearing capacity. It is expected that over excavation and replacement with suitable fill will be minimized for most of these project areas. Soil borings conducted during final design will help define the location, limits, and depths of unsuitable soils.

4.6.3 Groundwater

As a general rule, groundwater handling problems are not anticipated during construction; however, due to the hilly topography, more extensive groundwater handling may be required for excavations located at the bottom of a hill. More extensive groundwater handling will also be required at some culvert crossings.

4.6.4 Cross-Country Construction – Easements

There is one cross-country pipeline proposed as part of the Hulst Road Area Sewers. Easements will also be required at the six pumping station sites, two as part of the Wildflower Drive Area and one each in the Hulst Road, High Point Drive, Northeast Street, and Montague Road Areas.

4.7 Estimated Project Costs

Table 4-2, Cost Breakdown for Recommended Subareas, contains costs for each of the designated areas of need. This estimate only includes the portion of the sewer systems installed by the town. The table lists estimates for construction including gravity sewers, low-pressure sewers, force mains, pumping stations and contingency. Costs for engineering and land acquisition/easements are also included. The cost estimates do not include any allowance for purchase or installation of private residential grinder pump systems. The costs have not been escalated to the mid-point of construction because no construction schedule has been established. Costs assume initial trench

Table 4-2
Cost Breakdown for Recommended Subareas

Subarea:	1	2	3	4	5	6	7	8	9	10	11A	12	13
		Harkness Road Area	Southeast Street Area	Bay Road Area	Hulst Road Area	Wildflower Drive Area	Shays Street Area	High Point Drive Area [4]	Market Hill Road Area	Leverett Road Area	Montague Road Area	Meadow Street Area	Northeast Street Area
Construction [1]													
Gravity Sewer [2]	already sewered	$382,508	$748,504	$583,393	$1,287,868	$1,607,083	$220,148	$759,512	$610,912	$1,519,024	$599,904	$1,552,046	$1,508,016
Low-Pressure Sewers [2]		$0	$0	$0	$45,406	$152,728	$0	$160,983	$144,472	$111,450	$0	$0	$0
Force Mains [2]		$0	$0	$0	$214,645	$86,683	$0	$61,917	$0	$239,411	$0	$0	$0
Pumping Stations		$0	$0	$0	$210,000	$420,000	$0	$210,000	$0	$210,000	$210,000	$0	$210,000
Land Acquisition/Easement Costs		$0	$0	$0	$20,000	$40,000	$0	$20,000	$0	$20,000	$20,000	$0	$20,000
Construction Contingency (25%)		$95,600	$187,100	$145,800	$444,500	$576,600	$55,000	$303,100	$188,800	$525,000	$207,500	$388,000	$434,500
Subtotal		$478,100	$935,600	$729,200	$2,222,400	$2,883,100	$275,100	$1,515,500	$944,200	$2,624,900	$1,037,400	$1,940,000	$2,172,500
Engineering and Implementation (25%) [3]		$119,500	$233,900	$182,300	$555,600	$720,800	$68,800	**$378,900**	$236,100	$656,200	$259,400	$485,000	$543,100
TOTAL ESTIMATED PROJECT COST (2011 dollars)		$597,600	$1,169,500	$911,500	$2,778,000	$3,603,900	$343,900	**$1,894,400**	$1,180,300	$3,281,100	$1,296,800	$2,425,000	$2,715,600
PROJECT COST PER EXISTING HOUSE SERVED [5]		$23,900	$18,000	$38,000	$25,500	$17,500	$19,100	**$23,000** [6]	$28,800	$50,500	$31,600	$105,400	$29,500

Notes:

(1) Costs based on August 2011 (ENR Cost Index 9088)
(2) Pipeline costs include ALL items (common fill, pavement, fittings, mobilization, etc.)
(3) Engineeering and Implementation costs are based on 10% for Design and 15% for Services During Construction
(4) The recommended plan for Subarea 8 (Option 2) from Appendix F was used to estimate costs.
(5) Project cost per house served presented as a means to compare relative expense of each subarea.
(6) The cost per house presented for Subarea 8 includes the downstream improvements that are required in Subarea 9A.

repaving and a final full-width pavement overlay. Costs are presented in August 2011 dollars.

In terms of financing the design and construction of the sewer improvements in the two subareas with "Moderate Need", if 100 percent of the improvements are funded through the town's sewer enterprise fund, sewer rates would increase by $0.37 per unit or $44.00 a year for the average four person household. In contrast, a 50/50 funding split between the sewer enterprise fund and a user or special fee such as a betterment will increase sewer rates by $0.185 per unit or $22.00 a year for the average four person household. Various funding mechanisms are further discussed in Section 5.

4.8 Permits

4.8.1 Typical Permitting Requirements

The following permits must be applied for and obtained before construction begins on sewer facilities evaluated in this study. It should be noted that private developments must separately apply for and obtain each of the following permits. If no construction is to take place within wetlands or within the 100-foot buffer zone to wetlands (including riverfront area, etc.), the filing with the Conservation Commission is not necessary; however, the Sewer Extension Permit is always required when any new sewerage facilities are constructed.

1. Town of Amherst Conservation Commission Notice of Intent (NOI)

2. Massachusetts Department of Environmental Protection (DEP) Sewer Extension Permit

MEPA ENF Filing
The Massachusetts Environmental Protection Act (MEPA) requires an Environmental Notification Form (ENF) when certain thresholds are surpassed for any proposed sewer project. These thresholds include more than a half-mile of sewers outside existing public traveled ways (cross-country), more than five miles of sewers total, more than 5,000 sq. ft. of disturbed wetlands, or more than a ten percent increase of flow above the existing wastewater treatment facility capacity. Additionally, an Environmental Impact Report (EIR) is required if more than ten miles of sewer are proposed under one project.

The US Environmental Protection Agency (EPA) Permits
EPA National Pollutant Discharge Elimination System (NPDES) Permits are for construction (Construction General Permit) and for dewatering activities (Dewatering General Permit). EPA through its NPDES permit regulates stormwater discharges from construction sites that disturb one acre or more of land; while MASS DEP and EPA Region 1 regulate construction dewatering activities for construction less than 1 acre with dewatering activity. Most of the proposed projects will disturb greater than one acre of land and will therefore require a NPDES Construction General Permit. Note, a separate dewatering permit is not required when a Construction General Permit is needed. Measures to address dewatering discharges, however, must be incorporated

into the Stormwater Pollution Prevention Plan (SWPPP).The construction contractor typically obtains the NPDES permit, which involves the preparation of a Notice of Intent to Discharge. A Notice of Termination must be submitted when construction is completed. This is not a requirement for the town; Contract Documents establish this as a requirement of the General Contractor.

U.S. Army Corps of Engineers Permit (Section 10 and/or Section 404)
Work in wetlands and waterways is regulated by the U.S. Army Corps of Engineers (the Corps) pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. In Massachusetts, the Corps has developed the Massachusetts General Permit (GP) to expedite the evaluation of permit applications and streamline the permitting process. There are three categories associated with the GP: Category I, II and an individual permit. Category I is a pre-discharge notification for projects that impact less than 5,000 square feet of a federally-defined wetland or water body. Work within a waterway (i.e. in-stream work) can only be authorized via a GP I Category if work occurs between July 15 and October 15. In-stream work outside these dates, no matter how small, will require approval as a GP II Category. If impacts to wetlands or waterways are greater than 5,000 square feet, but less than 1 acre, a Category II permit application must be filed. Impacts to one acre or more requires an individual permit.

Based on the proposed layout of improvements, and preliminary assessment of pumping station locations, it is expected that all impacts to wetlands and waterways would meet Category I criteria, and thus a pre-discharge notification to the Corps is required.

4.8.2 Permits Not Expected to be Required

401 Water Quality Certification (from DEP Division of Water Pollution Control)
Section 401 of the Clean Water Act requires that states issue a Certification that any proposed filling of waterways or wetlands will comply with the state's Surface Water Quality Standards. The need for a Water Quality Certification is triggered when a federal permit is needed for filling wetlands or waterways. Impacts to more than 5,000 square feet cumulatively of bordering or isolated wetlands or Land Under Water require 401 review.

Since the impacts to wetlands and waterways are expected to be less than 5,000 square feet, an individual 401 Water Quality Certification is not expected to be required for the proposed improvements.

4.9 Schedule

The schedule for design and construction of the recommended projects can be affected by a number of items. Design and bidding times must account for adequate time to conduct a survey of the project area and allow sufficient time for proper bidding and award of the contract. Similarly, construction times, generally estimated at 70 feet per day per crew, must also account for pumping station fabrication (where required), shop drawing submittals and adequate time for mobilization.

Table 4-3 presents conservative estimates for the duration of design/bidding and construction for each of the recommended subareas. The durations are based on subcontracting a licensed surveyor to provide topography and survey information for design, consideration for the complexity of the project, and number of pumping stations to be installed. Schedule may also be affected by the time of year the project bids (winter construction shutdown) and whether multiple projects are combined.

Table 4-3
Estimated Schedule

Subarea		***Schedule (months)***	
		Design/Bidding	***Construction***
2	Harkness Road Area Sewers	6	6
3	Southeast Street Area Sewers	8	6
5	Hulst Road Area Sewers	12	12
6	Wildflower Drive Area Sewers*	12	12
7	Shays Street Sewers	2	2
8	High Point Drive Area Sewers	10	10
11A	Montague Road Area Sewers	6	8
13	Northeast Street Area Sewers	12	12
14	Centennial WTP Area Sewers	6	6

**Note: Design and construction of the Wildflower Drive Area will be completed in two phases. Design of each phase is anticipated to take 6 months. Construction of each phase is also anticipated to take 6 months, weather permitting. The extent of each of the two phase is described below:*

Phase 1

- *Wildflower Drive pump station, force main, and gravity sewer north of the pump station*
- *Indian Pipe Lane*
- *Fox Glove Lane*
- *Trillium Way*
- *Larkspur Drive*
- *Ladyslipper Circle*

Phase 2

- *Woodlot Road pump station, force main, and gravity sewer*
- *Teaberry Lane*
- *Wildflower Drive south of new pump station*
- *Alyssum Drive*
- *Station Road*
- *Iduna Lane*
- *Cortland Drive*

Section 5
Financing

5.1 Introduction

This section provides a discussion of typical strategies and charges used to finance sewer system expansion costs.

5.2 Types of Charges

The three general approaches typically used by municipalities to finance sewer improvements are ad valorem taxes via the general fund, sewer user fees or charges, or direct charges. Drawing from the general fund allocates the cost of sewer system expansion to all taxpayers proportional to their respective taxable property assessment. User fees generally recover costs based on the specific use of the sewer system, as measured by metered water consumption or a variation thereof. Direct charges or special fees (like betterment assessments) are targeted to those property owners who benefit directly from the addition or extension of a sewer system while not placing an addition cost burden on other community residents. Some communities combine these cost recovery methods to finance system expansion. The proportion of the costs to be derived from each of these general methods varies based on a town's individual structure and needs. Following is a more detailed discussion of the various financing approaches mentioned above.

5.2.1 Ad Valorem Taxes

An issue facing communities as they expand sewer infrastructure is deciding whether or not a portion of the net cost should be recovered from the general populace through ad valorem taxes. Ad valorem taxation, or a tax based on property value, is the simplest method of cost recovery and is widely used to recover a municipality's capital costs. All wastewater system costs not recovered elsewhere are generally added to the municipality's total expenditures for all other purposes, thus factoring into the overall property tax rate for the town. The rationale for such a widespread sharing of the burden is rooted in the health and environmental benefits received by the whole community, the improvement to the quality of life, as well as equity concerns. With ad valorem taxes, the entire town contributes to the program, independent of the direct benefit that a particular property receives.

In Massachusetts, tax increases have become more difficult due to the constraints imposed by Proposition 2½. Therefore, the town needs to consider the likelihood of requiring a tax override petition and/or a debt exclusion vote to raise taxes, depending on other concurrent initiatives in town. From a property owner's perspective, ad valorem taxes are deductible from federal income taxes, compared with user charges or betterment fees, which cannot be deducted.

5.2.2 User Charges

Wastewater user charges are used by many municipalities to recover some or all capital costs in addition to operation and maintenance costs. User charges are used to recover capital costs primarily in those municipalities where wastewater services are generally available throughout the community. Since the passage of tax limitation measures, though, user fees to recover capital costs have become more widespread. There are two basic types of user charges – fixed or flat charges and consumption-based charges. Periodic fixed charges are levied on the existing customers for a variety of purposes such as a service charge, minimum charge, customer charge, etc. Consumption charges on the other hand are based on a rate per unit of wastewater flow. Typically, sewer consumption charges are based on a uniform rate. While user charges provide for equitable allocation of most costs, a problem might occur if a new system is being constructed and all customers in effect become new users. Depending on the timing of the connections, revenue from user fees might be insufficient to recover the full costs of the facilities. In expanding collection systems, like Amherst, that already have sewer customers, existing users can be required to pay a portion of the capital cost due to the economic benefit to those users of additional customers. Increasing the number of customers typically results in lower user fees, by spreading the O&M costs over a greater number of users.

5.2.3 Direct Charges and Special Fees

The direct charge method is based on the premise that costs associated with the new system extensions should be borne directly to those requiring the new service. Direct charges can be used to derive revenue from specifically targeted groups or user types. Direct charges may be considered appropriate when evaluating alternative cost recovery methods. These charges can be used as a mechanism for recovering specifically allocated expenses and they are a way to mitigate the inequity in situations where a larger group is being charged for a benefit exclusive to a smaller (and separate) group.

There are two methods of direct charges: developer exactions and special assessments. Developer exactions are payments negotiated by towns with developers seeking planning and zoning approvals. They are used by a community to recover all or part of the increased public costs associated with a specific development. The developer is typically required to pay the cost of connecting the new development, including any sewer extensions necessary, to the public sewer system. Any infrastructure in the Town's right-of-way is then typically taken over by the town following construction.

Special assessments are fees charged to properties benefitting from the project, often using tax bills to collect the fees. Special assessments can be one-time assessments or spread over time, and they may be assessed when sewer service is extended to a new area or when a customer requests a service connection to his property. This type of direct charge has been used by many communities to recover the capital costs associated with system expansion. Special assessments are preferred by some because

they reduce the impact of project specific costs on the tax rate and user rates, and they provide a direct means of relating or assigning costs to particular customers. These charges include connection fees, availability charges, impact fees, investment fees, hookup fees, betterments, customer contributions, privilege fees, etc.

Simple connection charges have frequently been adopted to recover the cost of making the physical connection to the sewer system. The municipality's cost in this case is usually limited to oversight inspection services to ensure the connection is made to the municipality's standards. Betterment assessments have been used historically to recover the cost of extending sewer lines in front of homes and businesses. Betterments have been and are currently levied by many communities in Massachusetts. Privilege fees have recently been adopted in Massachusetts to recover the cost of lateral sewers, major interceptors, pumping stations and wastewater treatment facilities. Some of the more common direct charges and special fees are discussed in more detail below.

5.2.3.1 Betterments

Betterments are the most common property assessment method used to recover the capital costs associated with infrastructure expansion. Betterments are one-time charges levied against all “bettered” properties. The idea behind the betterment fee is to allocate the costs of sewer expansion to those properties whose value is increased by the availability of central sewer services. The betterment fee serves to collect revenue for the capital costs of the expansion against the increase in property value.

The general power to levy betterment assessments is contained in Chapter 80 of the Massachusetts General Laws (MGL). Sections of the statute provide detail on the procedures of apportionment, division, reassessment, abatement and collection of assessments. Chapter 83 of the MGL provides additional specific guidance on sewer-related betterment assessments, including privilege fees. Among the requirements for betterment assessments are:

- The municipality shall (except in the case of privilege fees), at the request of the owner of the assessed property, apportion all assessments on the unpaid balance into a number of equal annual payments not exceeding twenty. The assessment accrues interest at a rate which cannot exceed two percent above the municipality's borrowing rate for the sewer construction. This payment structure is typically the one used by Massachusetts communities.

- The municipality, in making the order for the betterment assessment of any land which is not built upon, may extend the time of payment of the assessment until it is built upon or for a fixed time. However, interest shall be paid annually, and the assessment shall be paid within three months after the land is built upon or at the expiration of the fixed time.

- An assessment must be a proportional share of the cost of the improvement, and may be fixed only after the project is completed and all costs are known. In total the assessment must not exceed the amount of adjudged benefit.

- Any land, because of its grade or level, that cannot be drained into the sewer system by gravity must have the situation remedied before the assessment can be made. This means that provisions for pumping of the wastewater must be made in those cases before assessments can be made on such properties. This does not apply if only a portion of the land cannot be drained to the sewer.

Chapter 83 of the MGL provides guidance on two types of betterment assessments for sewer facilities: Assessment for Sewer Construction and Assessment for Sewerage Systems. These are summarized at more length below.

Assessment for Sewer Construction
Chapter 83, Section 14 of the Massachusetts General Laws specifically authorizes communities in the Commonwealth to assess and charge betterment fees for the construction of sewers. Furthermore, it describes a particular betterment assessment known as an "assessment for construction." This assessment applies to a person who enters his "particular drain" into a main or common sewer, or who receives benefit remotely by draining his land or buildings. There are three classes of beneficiaries: (1) persons who do not desire to enter their drains into the sewer; (2) those who have lots with no buildings upon them; and (3) those who have houses with drains which they do wish to enter. An assessment under this section must be made according to the value of the land exclusive of buildings, and the charge must reflect a proportionate share of the cost to install the abutting and tributary mains. Section 14 assessments are limited to those persons who enter their drains into the sewer or who receive benefit by remote means.

Assessment for Sewerage Systems
Section 15 of Chapter 83, "assessment for sewerage systems" permits a town to base the assessment on factors other than land values, which include two primary methods, the fixed uniform rate method and the uniform unit method.

The fixed uniform rate method assesses the betterment based on the frontage of land on any way in which a sewer is constructed, the area of land within a fixed depth from the way, or on both the frontage and land area. Conversely, the uniform unit method allocates costs based on a uniform rate per equivalent residential unit (ERU). Determination of the number of potential ERUs for a particular project must be based on restrictions and limitations specified in a town's zoning by-laws. It focuses on the area served by each project, where the construction costs are divided among the total existing and potential sewer units to be served. A unit is equal to a single family residence, with non-residential units put on an equivalent basis. In general, for commercial and industrial customers the equivalent is based on anticipated future use and zoning. Possible methods of calculating equivalent dwelling units include annual water use, water meter size, or any other approved uniform method.

The general process for assessing a sewer betterment fee, based on Massachusetts General Laws, chapters 80 and 83, is illustrated by Figure 5. Some of the key issues that need to be considered as part of this process are documented below:

- It is required that a formal order be passed by the Assessing Board (i.e. town council, board of selectmen, etc.) which details the area of construction to be affected by the sewer extension. It also needs to explicitly state that the area of construction is going to be levied with an assessment.

- The town must place a lien on all properties affected by the sewer extension to ensure payment. The Assessing Board must identify all property and areas that benefit from the sewer extension and upon whom they are planning on imposing the assessment.

- When a reasonable estimate for the construction cost is known, the town will choose its method of assessing the betterment (e.g. uniform unit). If the town waits until the conclusion of the project to total the costs, the method should be chosen within a reasonable timeframe. It will assess the fee to the properties previously identified based on the appropriate method. Payment for the betterment can be paid in one lump sum interest-free within 30 days of the assessment, or in equal annual installments over twenty years.

- Notices and bills containing betterment fees can only be issued when the service has actually been made available to customers in the service area.

Section 15 of Chapter 83 provides for the application of betterment assessments to all land owners in the area in which the town has adopted a sewerage system. Furthermore, it should be noted that assessments which were limited to only those who entered the sewer system have been overturned by the courts.

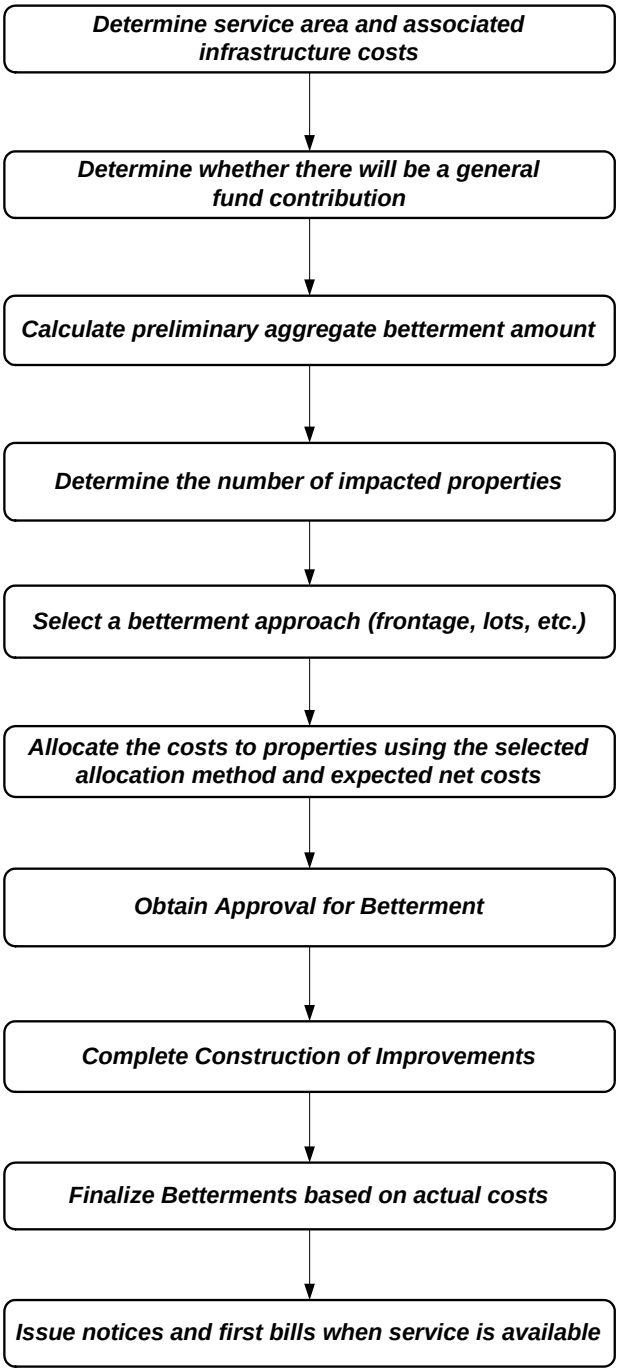
Section 15 further permits a town to charge property owners for sewer construction, basing the assessment on a fixed uniform rate at the estimated average cost of all the sewers. It could be applied to expansion of mains into areas that are developed but not previously served. If this type of assessment were used to recover capital costs in a town, each property owner in that area would be assessed an amount based on the average cost of all expansion facilities needed to serve them.

5.2.3.2 Privilege Fees

Privilege fees are a method of cost recovery that ensure a town receives the appropriate sum from properties that are not assessed the adequate betterment fee at the time they were levied. Betterments generally are assessed as costs are reasonably determined within the sewer extension process, and as such there will be properties that connect to the sewer line after the betterments are assessed. There are variations on the types of privilege fees that can be assessed but the most common is the connection fee. By charging a connection fee, the utility essentially recovers the proportional capacity that is made available to a new user.

The Massachusetts courts have ruled that while multiple methods of assessment may be used by a town, only one method may be used per parcel. This means that while a town may use both a betterment assessment and a privilege fee, it may not employ both the betterment and privilege fees on the same property. The method(s) used to determine the assessments is a key policy issue to be decided by the town. An additional key issue to consider is that the law does not allow for more than the net cost of the facilities to be recovered from any variety of betterments or privilege fees.

Figure 5: Betterment Adoption Process



5.3 Example Community Cost Recovery Methods

Table 5-1 presents a snapshot of how some of various Massachusetts communities pay for their sewer extension programs. These communities are diverse in geographic location, complexity of wastewater collection and treatment system, population served, and land uses. While each distinct community has to decide what they believe to be a fair cost allocation, the examples shown in Figure 5-1 provide a sense of various approaches. Most of the communities rely heavily on betterments and typically use ad valorem taxes to fund costs that are not recovered through betterments. This is an indication that placing too much of the capital cost on the user rate or general fund is likely unsustainable. Most communities are charging betterments using a uniform unit method based on a uniform rate per equivalent residential unit. To pay for continual operation and maintenance costs, both fixed costs per home and consumption-based charges are used, although it appears that more communities are moving towards consumption-based charges based on a percentage of metered water use.

Below is a list of common questions that these and other communities have typically discussed as they determined how best to finance sewer extensions:

Question 1: Should the general ad valorem tax rate be utilized to help pay for a long-term wastewater program and if so what percentage?

Discussion: In constructing a sewer system, a community needs to decide if it benefits the entire community. Those not directly connected to the wastewater program may argue it does not affect them and so they should not pay for it. This is a similar argument to that posed by residents without children in a school system being asked to pay for a new school.

Question 2: Since betterments are generally not tax deductible for a homeowner's income tax purposes, is there a way to limit the cost impact of this payment?

Discussion: A deduction of the betterment amount from the tax assessment is an option to reduce the general tax burden on the betterment payers, but it would raise the overall general tax burden for the town to compensate for the difference. This, in essence, results in a higher percentage paid by the general fund than by the betterment payers.

Question 3: Is there a way to limit the cost impact to users during the first few years when not all sewer customers are connected to the wastewater facilities?

Discussion: There are certain fixed costs associated with operating a wastewater program (labor, power, etc.) that need to be covered even before all the wastewater customers are connected to the system. If the annual cost to operate the system is only recovered via the actual system users during the initial years when most customers are not connected, the initial users would pay a higher amount. That amount would be higher than projected for all users once most are connected. To offset that unfair

Table 5-1
Summary of Community Cost Recovery Methods for Sanitary Sewer Programs

	Kingston	Wareham	Provincetown	Newburyport	Cohasset	Tewksbury	Andover	Dracut	Webster	Concord	Yarmouth
Ad Valorem Taxes (%)	33	0	0	0	50	0	33		15	38	75
Betterments (%)	67	100	100	100	50	100	67		85	50	
Calculation Method [1]	ERU	Initially - Frontage, Revised - ERU		ERU	ERU	ERU	Frontage		ERU		
Typical cost per home	$11,000	$15,000 - $22,000		$19,000	$6,000	$3,000	$17,000 - $20,000				
User Charges						See Comments below		100		12	25
Typical cost per home per year	$650	$600		$285				$520			
Typical cost per 1000 gallons			$18.50		$5.75	$5.60					
Comments	Some capital costs were covered by grants. Current user charges (i.e. operating costs) are charged on a per home basis, but will eventually change to actual water use. Cost recovery for sewer extension was completed before and after the completion of construction. Taxes were increased more than 1.5 years after construction. Approximately 50% of betterments were assessed when the construction contract was signed and the remainder of the betterment was assessed after construction was complete.	Betterments are typically charged on an individual construction contract basis. The total cost of the contract (i.e. design, construction, legal, admin, etc.) is divided by the number of properties served to determine the betterment per home. User rates are based on equivalent dwelling units (EDU), where a single family home equates to one EDU, while commercial properties are based on a multiple of an EDU. Cost recovery typically occurs after completion of construction.		Cost recovery typically occurs after completion of construction.	Cost recovery typically occurs after completion of construction.	Typically betterments have paid for 100% of past sewer extensions. In some cases, the portion not covered by betterments was paid for with user rates. However, user rates are rising fast so the town is looking to shift costs for future sewer extensions from the user rate to ad valorem taxes. Cost recovery typically occurs after completion of construction.	The town uses the frontage betterment calculation method, but adjusts it to include land area to account for flag lots.	The town uses a combination of user rates and connection fees to pay for sewer extensions. However connection fees vary substantially. Existing homes that connect within the first 2 years pay only $200. However, new construction and existing users who do not connect within the first 2 years pay a $7,500 connection fee. User rates are currently a flat fee of $520/year, but the town is looking to switch to a consumption based rate over time.	Each house pays one ERU plus an additional charge for each connection. Larger units pay based on multiples of the flow produced compared with the flow expected from a typical house.		Yarmouth presently has no sewer users. Sewer user charges would begin once sewer extensions are in place and Ad Valorem taxes and water fees would be used to fund early years of the initiative.

Notes

1. Betterment Calculation Methods

Fixed Uniform Rate Method - based on frontage of land on any way in which a sewer is constructed, the area of land within a fixed depth from the way, or both

Uniform Unit Method - based on a uniform rate per equivalent residential unit (ERU)

burden, some communities still charge the projected average user fee as though all users were connected and then have the tax rate make up the difference until the budget is covered from user fees. Provincetown and some other communities have recently utilized this operating cost recovery method. Other communities have charged a flat rate operating fee the first few years based on the projected number of connections, with any costs made up through the tax rate or other potential user-type fees.

Question 4: Do adequately operating or recently upgraded Title 5 systems get a grace period prior to having to connect to an adjacent sewer?

Discussion: Some property owners are faced with a decision today about whether to upgrade and/or replace their current on-site Title 5 systems, which can be a costly investment and a burden if they are then required to connect to a sewer soon after.

To avoid the above scenario, MASS DEP has instituted an escrow account program for communities to use generally for systems over 10,000 gpd. One motel in Yarmouth is in such a program. The program requires minimum upgrades to be made immediately, but then money equal to what would have been required for a full upgrade is put into an escrow account and applied to the sewer connection costs once the sewer becomes available. Amherst could consider adopting a similar type of program for property owners facing immediate Title 5 system upgrades or replacements in areas already identified as needing an off-site wastewater solution.

Some communities require connection to the sewer within 90 days of the sewer being available to the property. This ensures that user fees are being collected to pay for the system and helps to more quickly improve water quality issues. Other communities allow a grace period (perhaps 3 to 5 years) to connect to the new sewers. Each community must find the proper balance that meets its needs of having user fees collected and improving water quality in a timely fashion while not overburdening property owners.

Question 5: Should betterments be assessed to non-buildable lots?

Discussion: Betterments are intended to reflect the benefit to the property owner of the service being provided. If a lot is not buildable, even with access to a municipal sewer system, there is no benefit to the property of having the sewer available. Therefore, those lots cannot be charged betterments. If, however, zoning bylaws change in the future allowing a lot to become buildable, a connection fee may be assessed that could be similar to the betterment charge.

Question 6: Should betterment deferrals be offered?

Discussion: The town is permitted to allow deferrals of betterment payments for vacant lots and/or elderly residents qualifying for other tax deferrals under M.G.L. Chapter 59. For vacant lots, payment deferrals may be allowed for either a fixed period or until the property is built upon. Annual interest payments are still required

to be paid, at a rate of 4 percent per year, and the betterment must be paid within three months after either the land is developed or the fixed time period ends. This option is not commonly elected because the shortfall from deferrals needs to be made up through other means, such as the general tax fund.

Question 7: What is the best means to determine the value of a betterment and when should it be done?

Discussion: Betterment assessments can be the same for all properties with the same equivalent dwelling units, or they can be different based on factors such as frontage or land use, as described above. Using equivalent dwelling units is typically the simplest approach. While betterment amounts are normally estimated early on in a project, betterment assessments by law cannot be finalized until construction is completed and the final cost is known.

Question 8: What is an EDU and how is it calculated?

Discussion: The most common method today of charging betterments is through EDUs. This method determines equal shares by which the betterment portion of the construction costs are then divided. Using the frontage (or linear footage of sewer fronting a property) to calculate betterment assessments requires extensive data collection and several exceptions to the rules to accommodate such scenarios as corner lots. EDUs are generally accepted today as the preferred means since they are easier to determine and considered to be fairer to all. Some general guidance to consider when determining betterments includes:

- One EDU shall be charged for each buildable residential property lot allowed by zoning.
- The method for determining an EDU should be based on water meter sizes (with one EDU equal to a 5/8-inch meter), typical average annual water use (with one EDU equal to 70,000 gallons), or Title 5 flow calculations (with one EDU equal to 330 gpd). Further analysis is required to determine the best means for Amherst.
- Vacant lots that are deemed to be buildable shall be charged one EDU and the town should consider an ordinance to collect connection fees for later development of vacant parcels equivalent to the post-development EDUs.
- Lots that do not abut a street or utility easement, but request a service connection, shall be charged one-half of an EDU initially with payment of the second half due at building permit issuance should the lot be developed in the future.
- Should development occur on any property for which a betterment has not been assessed and a service connection is requested, a service connection fee shall be charged equivalent to the cost of the EDUs the property would have been assessed had they been subject to a betterment.

APPENDIX A

Appendix A
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix

		EXISTING ONSITE DISPOSAL PROBLEMS																							
Sub-area	Sub-area	Leaching to ground			Odors			Slow drains			Pumped > 1/yr			Groundwater near surface			TOTAL NON-BOH (of 25 max) (1)	NON-BOH POINT VALUE (0 to 5) (2)	Average Septic System Age (3)		BOH Failed Systems (4)			TOTAL POINT VALUE (0 to 5) (5)
ID #	Name	#	%	pts	#	%	pts	#	%	pts	#	%	pts	#	%	pts	pts	pts	years	pts	#	%	pts	pts
2	Harkness Road Area	0	0%	0	2	22%	2	1	11%	1	0	0%	0	2	22%	2	5	2	19	3	4	16%	1	2.0
3	Southeast Street Area	0	0%	0	2	5%	1	7	18%	1	0	0%	0	5	13%	1	3	0	20	3	12	18%	1	1.3
4	Bay Road Area	1	14%	1	0	0%	0	0	0%	0	1	14%	1	1	14%	1	3	0	20	3	2	15%	1	1.3
5	Hulst Road Area	6	10%	1	14	24%	2	12	20%	2	1	2%	1	17	29%	2	8	3	24	3	28	26%	2	2.7
6	Wildflower Drive Area	7	6%	1	9	8%	1	11	9%	1	3	3%	1	15	13%	1	5	2	17	3	28	14%	1	2.0
7	Shays Street Area	0	0%	0	1	9%	1	3	27%	2	0	0%	0	0	0%	0	3	0	29	0	3	17%	1	0.3
8	High Point Drive Area	2	7%	1	4	15%	1	6	22%	2	2	7%	1	14	52%	3	8	3	21	3	14	27%	2	2.7
9	Market Hill Road Area	0	0%	0	2	8%	1	3	12%	1	0	0%	0	6	24%	2	4	1	19	3	11	29%	2	2.0
10	Leverett Road Area	1	3%	1	1	3%	1	3	9%	1	1	3%	1	8	25%	2	6	2	23	3	12	19%	1	2.0
11A	Montague Road Area	0	0%	0	3	15%	1	5	25%	2	0	0%	0	2	10%	1	4	1	17	3	8	20%	1	1.7
11B	North Amherst Center Area	Not Applicable																						
12	Meadow Street Area	0	0%	0	0	0%	0	0	0%	0	0	0%	0	2	50%	3	3	0	28	0	2	9%	0	0.0
13	Northeast Street Area	1	2%	1	3	6%	1	2	4%	1	1	2%	1	3	6%	1	5	2	16	3	21	23%	2	2.3
15	Gateway Corridor Project Area	Not Applicable																						
	Total	**18**			**41**			**53**			**9**			**76**							**145**			

Notes:

1. A maximum of 25 points were available for the TOTAL NON-BOH category.
2. The point values for the TOTAL NON-BOH were assigned as follows: 0 points if the total points were 0, 1, 2, or 3; 1 point if the total points were 4; 2 points if the total points were 5 or 6; and 3 points if the total points were 7 or 8.
3. The septic system ages from the questionnaires were averaged for each subarea. The points were assigned as follows: 0 points if the age was >25 years; 3 points if the age was between 10 and 25; and 5 points if the age was less than 10 years. (Based on 2003 Survey)
4. The points for the BOH Failed Systems category were assigned as follows: 0 points if failures were less than 10%; 1 point if between 10 and 20%; 2 points if between 20 and 30; 3 points if between 30 and 40%; 4 points if between 40 and 50%; and 5 points if more than 50% reported failures.
5. The point values for the EXISTING ONSITE DISPOSAL PROBLEMS category were determined by averaging the total NON-BOH point value (0 to 5), the Average Septic System Age point value (0 to 5), and the BOH point value (0 to 5), for a maximum total of 5 for this category.

Appendix A
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix

		SOIL LIMITATIONS					
Sub-area	*Sub-area*	*Soil Type* [6]		*Housing Density* [7]		*TOTAL POINTS (of 15 max)*	*POINT VALUE (0 to 5)* [8]
ID #	*Name*	*SCS*	*pts*	*Lot Size, sq. ft.*	*pts*	*pts*	*pts*
2	Harkness Road Area	3H	4	20,000	3	9	4
3	Southeast Street Area	3H	4	30,000	2	7	2
4	Bay Road Area	3H, 3W	3	30,000	2	5	1
5	Hulst Road Area	3H, 3W, 3S	3	30,000	2	10	5
6	Wildflower Drive Area	3H, 3S	3	20,000	3	9	4
7	Shays Street Area	3H	4	20,000	3	9	4
8	High Point Drive Area	3H, 3S	3	30,000	2	10	5
9	Market Hill Road Area	3H, 3W	3	30,000	2	8	3
10	Leverett Road Area	3H, 3S	3	30,000	2	7	2
11A	Montague Road Area	3H	3	30,000	2	5	1
11B	North Amherst Center Area	Not Applicable					
12	Meadow Street Area	3H, 3W	3	30,000	2	6	2
13	Northeast Street Area	3H, 3W	3	30,000	2	8	3
15	Gateway Corridor Project Area	Not Applicable					
	Total						

Notes:

6. The point values for Soil Type were assigned based on the severity rating on the SCS maps: predominantly '3H' (hardpan) with other severe conditions were assigned 5 points; '3H' were assigned 4 points; '3H and 3W' (high groundwater) were assigned 3 points; '2 and 1' were assigned 1 point; and '1' were assigned 0 points.

7. With smaller lot sizes, there is a greater chance with having on-site disposal problems. Town zoning information was used to determine minimum lot size in each of the subareas. (>90,000 sf = 0 pts, >40,000 to 90,000 sf = 1 pt, >20,000 to 40,000 sf = 2 pts, >15,000 to 20,000 sf = 3 pts, >10,000 to 15,000 sf = 4 pts, residential cluster = 5 pts)

8. Point values for the SOIL LIMITATIONS category were assigned as follows: 1 point if the total points were between 0 and 5; 3 points if the total points were between 6 and 8; 4 points if the total points were 9; and 5 points if the total points were between 10 and 15.

Appendix A
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix

		ENVIRONMENTAL CRITERIA							
Sub-area	*Sub-area*	*Aquifer Protection* (9)		*Proximity to Surface Water* (10)	*Reservoir Watershed* (11)	*Town Water Available* (12)		*TOTAL POINTS (of 18 max)* (13)	*POINT VALUE (0 to 5)* (14)
ID #	*Name*	*%*	*pts*	*pts*	*pts*	*yes/no*	*pts*	*pts*	*pts*
2	Harkness Road Area	n/a	3	0	0	no	3	6	2
3	Southeast Street Area	Zone II	0	3	0	yes	0	3	1
4	Bay Road Area	n/a	3	1	0	yes	0	4	2
5	Hulst Road Area	Zone II	0	3	0	yes	0	3	1
6	Wildflower Drive Area	Zone II	0	1	0	yes	0	1	0
7	Shays Street Area	II/III/n/a	0	2	0	yes	0	2	0
8	High Point Drive Area	n/a	3	4	1	no	3	11	5
9	Market Hill Road Area	n/a	3	3	0	no	3	9	3
10	Leverett Road Area	n/a	3	3	0	no	3	9	3
11A	Montague Road Area	n/a	3	2	0	yes	0	5	2
11B	North Amherst Center Area	Not Applicable							
12	Meadow Street Area	n/a	3	1	0	yes	0	4	2
13	Northeast Street Area	n/a	3	3	0	no	3	9	3
15	Gateway Corridor Project Area	Not Applicable							
	Total								

Notes:

9. The point values for the Aquifer Protection category were assigned as follows: 5 points for APC recommendations, 3 points for areas not in APC defined Zones I or II, and 0 points for areas in APC defined Zones I or II.

10. The point values for Proximity to Surface Water were assigned as follows: 0 points if no surface water is with in the subarea; 1 point if there are minimal streams; 2 points if there is a large stream or waterbody; 3 points if there are several waterbodies or streams; 4 points if there is a large stream system; and 5 points if there are large waterbodies and streams.

11. The point values for Reservoir Watershed were assigned based on an estimate of how much land is in the watershed: 'fully' were assigned 5 points; 'partially' were assigned 3 points; 'minimally' were assigned 1 point; and 'not at all' were assigned zero points.

12. Point values for the Town Water category were assigned as follows: 0 points if Town water is available and 3 points if Town water is not available to the majority of the subarea.

13. A maximum of 18 points were available for the ENVIRONMENTAL CRITERIA category.

14. The point values for ENVIRONMENTAL CRITERIA were assigned as follows: 0 points if the total points were less than 3; 1 point if the total was 3; 2 points if the total was 4, 5 or 6; 3 points if the total was 7, 8 or 9; 4 points if the total was 10; and 5 points if the total was greater than 10.

Appendix A
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix

		COST BENEFIT														
Sub-area	Sub-area	Distance to Existing Sewer [15]		Cross-Country Easement Required? [21]		Build-Out? [16]	Encourage Development?		Type of Sewer Required [17]		Pump Station Required		Requires Downstream Improvements		TOTAL POINTS (of 34 max) [19]	POINT VALUE (0 to 5) [20]
ID #	Name	ft	pts	Y/N	0-3	0-10	None - Major	pts	G, P	pts	#	pts	None/ Minor/ Major	pts	pts	pts
2	Harkness Road Area	0	5	N	3	10	Minimal	4	G,P	2	0	3	None	5	32	5
3	Southeast Street Area	0	5	N	3	10	Moderate	2	G	3	0	3	None	5	31	5
4	Bay Road Area	0	5	N	3	4	Significant	1	G	3	1	2	None	5	23	2
5	Hulst Road Area	3,000	3	Y	2	8	Minimal	4	G,P	2	1	2	Major/Minor [18]	1	22	2
6	Wildflower Drive Area	0	5	N	3	10	None	5	G,P	2	2	1	None	5	31	5
7	Shays Street Area	0	5	N	3	10	None	5	G	3	0	3	None	5	34	5
8	High Point Drive Area	6,800	0	N	3	4	None	5	P	2	0	3	Major	0	17	0
9	Market Hill Road Area	0	5	N	3	4	Major	0	G,P	2	1	2	Minor	3	19	0
10	Leverett Road Area	0	5	N	3	2	Major	0	G,P	2	1	2	None	5	19	0
11A	Montague Road Area	0	5	N	3	10	Moderate	2	G	3	1	2	None	5	30	4
11B	North Amherst Center Area	Not Applicable														
12	Meadow Street Area	200	5	N	3	0	Minor	3	G	3	0	3	None	5	22	2
13	Northeast Street Area	1,500	4	N	3	6	Major	0	G,P	2	1	2	Minor	3	20	1
15	Gateway Corridor Project Area	Not Applicable														
	Total										8					

Notes:

15. The distance from the closest cluster of houses in the subarea to the existing sewer was estimated and the points for Distance to Existing Sewer were assigned as follows: 0 points if existing was more than 5,000 ft away; 1 point if between 4,000 and 5,000 ft; 2 points if between 3,000 and 4,000 ft; 3 points if between 2,000 and 3,000 ft; 4 points if between 1,000 and 2,000 ft; and 5 points if less than 1,000 ft.

16. Points for Build-Out were estimated by the ratio of the length of the proposed sewers and the number of existing houses.

17. Preference to all gravity systems that have low O&M costs was given for this evaluation.

18. While major improvements are required to serve Hulst Road (5), given that the down stream improvements service additional residents, a point value of 1 was assigned.

19. A maximum of 34 points were available for the COST BENEFIT category.

20. Point values for COST BENEFIT were assigned as follows: 0 points if the total points were less than 20; 1 point if the total points were 20; 2 points if the total points were 21, 22 or 23; 3 points if the total points were 24, 25, or 26; 4 points if the total points were 27, 28, 29, or 30; and 5 points if the total points were 31, 32, 33, or 34.

21. The Encourage Development component of the Cost Benefit is based on discussions during the 2005 Sewer Extension Master Plan

Appendix A
Town of Amherst, MA
Sewer Extension Master Plan
Evaluation Matrix

Comparison of Proposed Sewer Pipe to Existing Houses

Subarea ID	*Neighborhood Description*	*Existing Houses*	*Gravity Sewer*	*Pressure Sewer*	*Force Main*	*Total Pipe*	*Pipe Length/ House*	*Buildout Points*
		#	*ft*	*ft*	*ft*	*ft*	*ft/#*	
2	Harkness Road Area	25	3,475	0	0	3,475	139	10
3	Southeast Street Area	65	6,800	0	0	6,800	105	10
4	Bay Road Area	24	5,300	0	0	5,300	221	4
5	Hulst Road Area	109	11,700	1,100	5,200	18,000	165	8
6	Wildflower Drive Area	206	14,600	3,700	2,100	20,400	99	10
7	Shays Street Area	18	2,000	0	0	2,000	111	10
8	High Point Drive Area	57	6,900	3,900	1,500	12,300	216	4
9	Market Hill Area	41	5,550	3,500	0	9,050	221	4
10	Leverett Road Area	62	13,800	2,700	5,800	22,300	360	2
11A	Montague Road Area	41	5,450	0	0	5,450	133	10
11B	North Amherst Center Area	Not Applicable						
12	Meadow Street Area	23	14,100	0	0	14,100	613	0
13	Northeast Street Area	92	13,700	2,600	1,700	18,000	196	6
15	Gateway Corridor Project Area	Not Applicable						
	Total	*763*	*103,375*	*17,500*	*16,300*	*137,175*		

Note:

Subarea 8 quantities include downstream improvements in Subarea 9A.

Point Distribution for Build-Out Component of Cost Benefit Criteria	**ft/#**	**points**
	<150	10
	150-180	8
	180-200	6
	200-300	4
	300-400	2
	>400	0

CDM

APPENDIX B

Dear Resident,

Through its consultant, CDM, the Town of Amherst is conducting a survey as part of a town wide study to determine areas of future sewer needs. Please take a moment to answer the following questions. When complete, please return this postage paid postcard A.S.A.P. Thanks for your help.

HOMEOWNER QUESTIONNAIRE

Street Address:

How many years have you lived at this address?

What do you have? (*check one*)

☐ Septic Tank and Leaching Field ☐ Cesspool

☐ Other Sewage Disposal System _____

Has frequent pumping of your septic tank or cesspool been necessary?

☐ Yes ☐ No More than once per year? ☐ Yes ☐ No

How many people use the sewage disposal system?

How old is your present disposal system?

Have you experienced any of the following problems? (*check all that apply)*

☐ Leaching of sewage to the ground surface ☐ Odor problems

☐ Slow drain or back-ups ☐ Other _____

Do you use any of the following low-flow appliances? (*check all that apply*)

☐ Front loading or reduced volume washing machines

☐ Faucet flow restrictors ☐ Low-flow showerheads

☐ 1.6 gallon per flush toilet ☐ Other _____

Is the groundwater near the surface in your area? ☐ Yes ☐ No ☐ Unknown

Do you think a sewer is needed in your neighborhood? ☐ Yes ☐ No

Do you have any other comments?

For more information, contact:

William Dana Green, Project Manager
Camp Dresser & McKee Inc.
(617) 452-6639

Robert Pariseau, Dir. of Water Resources
Town of Amherst Dept. of Public Works
(413) 256-4050

Appendix B
Homeowner Questionnaire

APPENDIX C

INSERT FIGURES C, 2, 3, AND 4

APPENDIX D

Client: CDM **Location:** 236 HARKNESS ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-2B **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/8/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/8/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	26-50/2	S-1	4"	Dry, Brown, Fine to Coarse SAND, some silt, gravel.
5-7'	50/2	S-2	0	NO RECOVERY Gravel, Cobbles.
10-12'	50/5	S-3	4	Moist, Brown, Fine to Coarse SAND and Gravel, little Silt. Water at 12'.5"
13-15'	50/1	S-4	0	NO RECOVERY ROCK IN TIP, NO VISIBLE H2O, MOIST. END OF BORING AT 15'.0 FEET AUGERED TO 15'.0.

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 591 BAY ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-3A **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/20/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/20/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	50/5	S-1	5"	Dry, Brown, Fine to Coarse SAND, some Gravel, Silt.
5-7'	16-17-26-34	S-2	14"	Dry, Brown, Fine to Coarse SAND, some Gravel, little Silt.
10-12'	12-17-17-27	S-3	12"	Moist, Brown, Fine to Coarse SAND, little Gravel, Silt.
13-15'	9-15-50/5	S-4	0	NO RECOVERY, ROCK IN TIP Drilled to 15'.0 WATER AT 13.'0 END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 817 BAY ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-3B **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/20/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/20/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	36-50/2	S-1	6"	Dry, Brown, Fine to Coarse SAND, some Silt, Gravel.
5-7'	9-11-15-17	S-2	14"	Moist, Brown, Fine to Medium SAND, some Silt.
10-12'	13-20-21-19	S-3	16"	Dry, Brown, Fine to Coarse SAND and Gravel, little Silt.
13-15'	50/5	S-4	0	NO RECOVERY NO APPARENT WATER Augered to 15'.0 feet END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 1753 SOUTH EAST STREET **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-3C **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/13/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/13/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	16-27-50/2-	S-1	9"	Dry, Dark Brown to Brown, Fine to Medium SAND, some Gravel, Silt, Coarse SAND.
5-7'	10-20-27-25	S-2	12"	Dry, Brown, Fine to Coarse SAND, little Gravel, trace Silt.
10-12'	12-17-17-18	S-3	6"	Dry, Brown, Fine to Coarse SAND, little Silt, Gravel.
13-15'	22-50/3	S-4	4"	Moist, Red to Brown, Fine to Medium SAND, some silt. WATER AT 13'.6" END OF BORING AT 15'.0"

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence			PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows	very soft /	soft	trace	0 to 10%
0-4	loose	0-2 3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8 9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30 31+			and	30 to 50%
30-49 50+	very dense					

Client: CDM **Location:** 1166 BAY ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-5D **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/20/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/20/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	27-50/3	S-1	6"	Dry, Brown, Fine to Coarse SAND, some Gravel, Silt.
5-7'	15-9-10-10	S-2	12"	Moist, Brown, Fine to Coarse SAND, little Silt.
10-12'	31-50/4	S-3	0	NO RECOVERY
13-15'	12-15-16-17	S-4	2"	Moist, Brown, Fine to Medium SAND, little Silt. END OF BORING AT 15'.0 FEET NO APPARENT WATER

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence			PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows	very soft /	soft	trace	0 to 10%
0-4	loose	0-2 3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8 9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30 31+			and	30 to 50%
30-49 50+	very dense					

Client: CDM **Location:** 55 HULST ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-5C **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/13/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/13/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	20-50/4	S-1	6"	Dry, Brown, Fine to Coarse SAND, some silt, Gravel.
5-7'	6-7-9-10	S-2	9"	Moist, layered, Brown & Grey Silt, little Fine to Coarse SAND, Gravel, trace Clay.
10-12'	5-8-11-13	S-3	24"	Moist, layered, Brown & Grey Silt, little Fine to Coarse SAND, Gravel, trace Clay. WATER AT 10.'0 FEET
15-17'	2-3-4-4	S-4	24"	Grey, Clay and Silt.
18-20'	3-4-4-4	S-5	24"	Grey, Clay and Silt. END OF BORING AT 20'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density			Cohesive Consistence				PROPORTIONS	
# of Hammer Blows		very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4		loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9		med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29		dense	16-30	31+			and	30 to 50%
30-49	50+	very dense						

Client: CDM **Location:** 28 HULST ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-5B **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 12/30/2003
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 12/30/2003
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	37-47-26-24	S-1	12"	Dry, Dark Brown, Fine to Coarse SAND, some silt, Gravel.
5-7'	2-12-21-30	S-2	10"	Dry, Brown, Fine to Coarse SAND, little Gravel, Silt.
10-12'	33-27-20-19	S-3	0	NO RECOVERY, ROCK IN TIP
13-15'	12-16-16-16	S-4	8"	Moist, Brown, Fine to Medium SAND, little Silt, Coarse SAND. END OF BORING AT 15'.0 FEET NO APPARENT WATER

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 935 BAY ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-5A **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/20/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/20/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	19-50/5	S-1	10"	Dry, Brown, Fine to Coarse SAND, some Gravel, Silt.
5-7'	50/5	S-2	4"	Dry, Brown, Fine to Coarse SAND and Gravel, little Silt.
10-12'	12-17-50/2	S-3	0	NO RECOVERY WATER AT 12'.6"
13-15'	10-12-13-21	S-4	12"	Brown, Fine SAND, some Silt. END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 1309 BAY ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-5E **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 12/30/2003
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 12/30/2003
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	12-20-21-17	S-1	16"	Moist, Red to Brown, Fine to Coarse SAND, some Silt, little Gravel.
5-7'	17-33-32-50/2	S-2	14"	Dry, Brown, Fine to Coarse SAND, some Gravel, little Silt.
10-12'	21-31-43-50/2	S-3	12"	Brown, Fine to Coarse SAND, some Gravel, silt. WATER AT 10.'0 FEET
13-15'	50/2	S-4	0	NO RECOVERY END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 2 TEABERRY LANE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6A **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 12/30/2003
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 12/30/2003
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	17-10-12-13	S-1	14"	Dry, Brown, Fine to Coarse SAND, little Silt, Gravel.
5-7'	20-30-37-50/5	S-2	17"	Dry, Brown, Fine to Medium SAND, trace Gravel, Silt.
10-12'	13-17-23-25	S-3	14"	Dry, Brown, Fine to Coarse SAND, little Silt.
13-15'	12-13-15-20	S-4	12"	Moist, Brown, Fine SAND, little Silt. END OF BORING AT 15'.0 FEET NO APPARENT WATER

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 107 LARKSPUR DR **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.	SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6B **Sheet No.** 1 OF 1

	Casing	Sampler	Core Barrel	Hammer (Weight-lb./fall-30")	Start: 12/31/2003
Type	HSA	SS	N/A	140/30 300/24	Finish: 12/31/2003
O.D. Inch	6.25"	2"		Rig Type: B-53	Driller: JEFF NITSCH
I.D. Inch	4.25"	1 3/8"			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	7-21-35-45	S-1	12"	Dry, Brown, Fine to Coarse SAND and Gravel, trace Silt.
5-7'	50/4	S-2	1"	Dry, Gravel.
10-12'	19-23-19-21	S-3	13"	Dry, Brown Fine to Coarse SAND and Gravel.
13-15'	36-44-41-40	S-4	3"	Dry, Brown to Coarse SAND and large gravel. NO APPARENT WATER END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density			Cohesive Consistence				PROPORTIONS	
# of Hammer Blows		very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4		loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9		med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29		dense	16-30	31+			and	30 to 50%
30-49	50+	very dense						

Client: CDM **Location:** 86/87 LARKSPUR DRIVE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				**SEABOARD DRILLING, INC.** P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6C **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/20/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/20/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	48-50/2	S-1	5"	Dry, Brown, Fine to Coarse SAND and Gravel, little Silt.
5-7'	10-10-12-13	S-2	4"	Dry, Brown, Fine to Medium SAND, little Silt.
10-12'	9-11-11-13	S-3	14"	Dry, Brown, Fine to Medium SAND, little Silt.
13-15'	7-9-15-14	S-4	16"	Dry to Moist, Brown, Fine to Medium SAND, some Silt. NO APPARENT WATER END OF BORING 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 36 TRILLIUM LANE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				**SEABOARD DRILLING, INC.** P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6D **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/9/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/9/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	50/5	S-1	5"	Dry, Brown, Fine to Coarse SAND, Some Gravel, Silt.
5-7'	50/2	S-2	0	NO RECOVERY COBBLES
10-12'	50/1	S-3	0	NO RECOVERY COBBLES NO APPARENT WATER
13-15'	47-50/2	S-4	0	NO RECOVERY ROCK IN TIP, NO VISIBLE H2O, MOIST. END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 26 FOX GLOVE LANE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6E **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/9/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/9/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	50/4	S-1	3"	Dry, Brown, Fine to Coarse SAND, some Gravel, Silt.
5-7'	11-17-20-43	S-2	12"	Dry, Brown, Fine to Coarse SAND and Gravel, trace Silt.
10-12'	17-47-50/1	S-3	8"	Moist, Brown, Fine to Coarse SAND, some Gravel, little Silt.
13-15'	41-50/0	S-4	0	NO RECOVERY NO APPARENT WATER END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 37 WILDFLOWER DRIVE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-6F **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/9/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/9/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	50/3	S-1	0	NO RECOVERY
5-7'	11-20-50/1	S-2	6"	Dry, Brown, Fine to Coarse SAND and Gravel, little Silt.
10-12'	12-18-20-24	S-3	18"	Wet +-8.0', Brown, Fine to Coarse SAND, little Gravel, Silt.
15-17'	27-50/4	S-4	12"	Wet, Brown, Fine to Coarse SAND, some Gravel, little Silt.
18-20'	50/2	S-5	0	NO RECOVERY WATER AT 8'.0 FEET END OF BORING AT 20'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM				SEABOARD DRILLING, INC.	**Test Boring/ Monitor Well ID:** B-7A
Location: 25 STATION ROAD				P.O. BOX 3026 SPFLD, MA 01101	
Project: AMHERST SEWER, AMHERST MA				**DRILLING / SOIL LOG**	**Sheet No.** 1 OF 1
Contractor: SEABOARD DRILLING, INC.					
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/9/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/9/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**
0-2'	26-50/5	S-1	6"	Dry, Dark Brown, to Brown, Fine to Coarse SAND and Gravel, some Silt.
5-7'	44-50/5	S-2	0	NO RECOVERY WATER AT 8'.6"
10-12'	50/5	S-3	0	NO RECOVERY
13-15'	50/1	S-4	0	NO RECOVERY END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density			Cohesive Consistence				PROPORTIONS	
# of Hammer Blows		very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4		loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9		med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29		dense	16-30	31+			and	30 to 50%
30-49	50+	very dense						

Client: CDM **Location:** 73 HUGH POINT DRIVE **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.	SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-8A **Sheet No.** 1 OF 1

	Casing	Sampler	Core Barrel	Hammer (Weight-lb./fall-30")		
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Start:** 12/29/2003	
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Finish:** 12/29/2003	
I.D. Inch	**4.25"**	**1 3/8"**			**Driller:** ROB INGRAM	

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	6-9-14-22	S-1	12"	Moist, Dark Brown, Fine to Coarse SAND, some silt, Gravel, Roots.
5-7'	50/4	S-2	2"	Moist, Brown, Fine to Coarse SAND and Silt, little Crushed Gravel.
10-12'	17-20-23-31	S-3	14"	Moist, Grey to Brown, weathered Rock, little Gravel. Auger Refusal at 13'.0 FEET
13-15'	50/0	S-4	0	NO RECOVERY END OF BORING AT 13'.0 FEET NO APPARENT WATER

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM			SEABOARD DRILLING, INC.	Test Boring/ Monitor Well ID:	B-8B
Location: 115 JUNIPER LANE			P.O. BOX 3026 SPFLD, MA 01101		
Project: AMHERST SEWER, AMHERST MA					
Contractor: SEABOARD DRILLING, INC.			DRILLING / SOIL LOG	Sheet No.	1 OF 1
	Casing	Sampler	Core Barrel	Hammer (Weight-lb./fall-30")	Start: 12/29/2003
Type	HSA	SS	N/A	140/30 300/24	Finish: 12/29/2003
O.D. Inch	6.25"	2"		Rig Type: B-53	Driller: ROB INGRAM
I.D. Inch	4.25"	1 3/8"			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	9-19-37-50/0	S-1	6"	Moist, Brown, Gravel, Fine to Coarse SAND, little Silt.
5-7'	27-16-16-15	S-2	10"	WATER AT 3.'0, Brown, Fine SAND, little Medium to Coarse SAND, Gravel, Silt.
10-12'	20-21-37-40	S-3	14"	Wet, Grey to Brown, Fine to Coarse SAND, some Silt, little Gravel, weathered rock.
13-15'	50/5	S-4	4"	Wet, Grey to Brown, Fine to Coarse SAND, some Silt, little Gravel, weathered rock. Drilled to 15'.0 feet.
				END OF BORING AT 15'.0 FEET

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence			PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows	very soft /	soft	trace	0 to 10%
0-4	loose	0-2 3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8 9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30 31+			and	30 to 50%
30-49 50+	very dense					

Client: CDM Location: 50 OVERLOOK DRIVE Project: AMHERST SEWER, AMHERST MA Contractor: SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 DRILLING / SOIL LOG	Test Boring/ Monitor Well ID: B-8C Sheet No. 1 OF 1
	Casing	Sampler	Core Barrel	Hammer (Weight-lb./fall-30")	Start: 12/29/2003
Type	HSA	SS	N/A	140/30 300/24	Finish: 12/29/2003
O.D. Inch	6.25"	2"		Rig Type: B-53	Driller: ROB INGRAM
I.D. Inch	4.25"	1 3/8"			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	17-50/5	S-1	8"	Moist, Brown, Fine to Medium SAND, some Gravel, silt, Coarse SAND.
5-7'	30-47-50/4	S-2	14"	WATER AT 2'.0, Brown, Gravel, weathered Rock, little Fine to Coarse SAND, Silt.
10-12'	50/2	S-3	0	NO RECOVERY
13-15'	50/0	S-4	0	NO RECOVERY AUGER REFUSAL AT 13'.5" END OF BORING AT 13'.5"

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 330 MARKET HILL ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-9A **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 12/30/2003
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 12/30/2003
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			

Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	FIELD CLASSIFICATIONS AND REMARKS
0-2'	17-31-50/2	S-1	8"	Dry, Brown, Fine to Coarse SAND, little Gravel, Silt.
5-7'	17-30-31-50/4	S-2	10"	Moist, Brown, Fine to Medium SAND, some Silt, little Gravel, Coarse SAND.
10-12'	26-50/3	S-3	6"	Moist, Brown, Fine to Medium SAND, some Silt, little Gravel, Coarse SAND.
13-15'	33-50/0	S-4	4"	Moist, Brown, Fine to Medium SAND, some Silt, little Gravel, Coarse SAND. DRILLED TO 15'.0. END OF BORING AT 15'.0 FEET NO APPARENT WATER

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 444 FLAT HILLS ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-9B **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 12/30/2003
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 12/30/2003
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			
Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**	
0-2'	19-20-50/5	S-1	12"	Moist, Dark Brown, Fine to Medium SAND, some silt, little Gravel.	
5-7'	17-20-19-30	S-2	15"	WATER AT 5'.0, Brown, Fine to Medium SAND, some Gravel, silt, 0-sand.	
10-12'	42-50/5	S-3	0	NO RECOVERY, ROCK IN TIP AUGER REFUSAL 14'.5"	

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

Client: CDM **Location:** 41 LEVERET ROAD **Project:** AMHERST SEWER, AMHERST MA **Contractor:** SEABOARD DRILLING, INC.				SEABOARD DRILLING, INC. P.O. BOX 3026 SPFLD, MA 01101 **DRILLING / SOIL LOG**	**Test Boring/ Monitor Well ID:** B-10A **Sheet No.** 1 OF 1
	Casing	**Sampler**	**Core Barrel**	**Hammer (Weight-lb./fall-30")**	**Start:** 1/13/2004
Type	**HSA**	**SS**	**N/A**	**140/30 300/24**	**Finish:** 1/13/2004
O.D. Inch	**6.25"**	**2"**		**Rig Type: B-53**	**Driller:** ROB INGRAM
I.D. Inch	**4.25"**	**1 3/8"**			
Depth (ft.) Range	Blow Per 6"	Sample NO.	Recovery	**FIELD CLASSIFICATIONS AND REMARKS**	
0-2'	50/4	S-1	0	NO RECOVERY. (Boulders)	
5-7'	50/0	S-2	0	NO RECOVERY Auger Refusal 9'.5" END OF BORING AT 9'.5"	
				NO APPARENT WATER	

SAMPLE PENETRATION RESISTANCE - 140 lb. Wt. Falling 30" on 2" O.D. sampler

Density		Cohesive Consistence				PROPORTIONS	
# of Hammer Blows	very loose	# of Hammer Blows		very soft /	soft	trace	0 to 10%
0-4	loose	0-2	3-4	Med-stiff /	stiff	little	10 to 20%
5-9	med/dense	5-8	9-15	very stiff /	hard	some	20 to 35%
10-29	dense	16-30	31+			and	30 to 50%
30-49 50+	very dense						

APPENDIX E

One Cambridge Place, 50 Hampshire Street
Cambridge, Massachusetts 02139
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fax: +1 617 452-8000

February 6, 2003

Mr. Robert E. Pariseau
Director of Water Resources
586 South Pleasant Street
Amherst, Massachusetts 01002

Subject: Amherst Woods Sewer Design Study

Dear Mr. Pariseau:

In accordance with Work Order No. 2 dated June 24, 2002, Camp Dresser & McKee Inc. (CDM) has completed our study on sewering the Amherst Woods area and is pleased to submit the following recommendations for providing sewerage facilities for this area. Attached you will find a plan showing the proposed sewer configuration, including the current layout of the two proposed private developments in this area.

The project area is located in the southeast section of town, bordered by the Town of Belchertown (East), the Carriage Brook (West), and Station Road (South). The area evaluated in this study includes the following streets: Wildflower Drive, Teaberry Lane, Wood Lot Road, Ladyslipper Circle, Larkspur Drive, Trillium Lane, Foxglove Lane, Indian Pipe Lane, Alyssum Drive, Station Road, Iduna Lane, and Cortland Drive.

With the exception of one proposed development discussed below, the project area is entirely residential, with approximately 197 existing homes and less than 10 vacant lots assumed developable. Existing gravity sewers in this area are located on Wildflower Drive, Wood Lot Road and Old Belchertown Road.

Two private developments are currently proposed within this area. One of these will develop the Amherst Hills area into a residential development accessed from Station Road and Old Amherst Road. Current plans include nearly 60 developable residential lots. The second development will install five office buildings at the northern end of Larkspur Drive with a current proposed total of 50,000 square feet of office space. Current plans indicate that both developments will connect directly to the existing sewer on Old Belchertown Road.

Sewer System Layout

Town Sewer

The recommended sewer system layout, as shown on the attached schematic map, includes approximately 13,200 linear feet of 8-inch gravity sewer, approximately 2,100 linear feet of ductile iron force main, 3,700 linear feet of 1 ½ -inch and 2-inch low-pressure PVC sewer, and two wet well mounted wastewater pumping stations. Numerous areas will require individual home grinder pumps served by the low-pressure sewers. The individual residences requiring grinder pumps are indicated on the attached map. The above quantities do not include the private developments. The two private developments are expected to install a total of 10,600-ft of 8-inch gravity sewer and 2,500-ft of 5-in force main.

One pumping station would be required on Wildflower Drive, as indicated on the attached map. This pumping station would collect flow from the entire southern half of the project area (not including the Amherst Hills private development). The property on the west side of Wildflower Drive at this location is mostly wetlands, and will be difficult to develop. Siting the pumping station on this property would minimize impact to residents and developed lots in this area. Additionally, a pumping station is proposed on Wood Lot Road, discussed further below.

Pumping Alternatives

In the past, the Town has chosen to avoid small pumping stations that would serve only a few houses and install a low-pressure sewer system instead. Building owners served by a pressure sewer must provide their own private grinder pumps to access the system. In this project area, there are four locations where either small pumping stations or low-pressure sewer systems could be selected. For the purpose of this report, we will present a recommended alternative, knowing that the Town could consider the other alternative during design.

The attached map indicates that three of these areas – Fox Glove Lane, Cortland Drive, and Iduna Lane – are recommended to be sewered by a low pressure system, while a conventional pumping station is recommended to serve the fourth – Wood Lot Road/Teaberry Lane. The basis of these recommendations is as follows:

> *Fox Glove Lane* – There is a high point in this road between the cul-de-sac and the intersection with Wildflower Drive. A gravity sewer cannot serve the seven houses at the end of this cul-de-sac because they are significantly lower than the road's high point. Four of these seven houses, those on the south side of the road, are much lower

than the road and would require individual grinder pumps even if a pumping station is located in the cul-de-sac. With more than half of the seven houses requiring grinder pumps for either alternative, a low-pressure system was selected for this area.

Cortland Drive – This steep street has five houses, two of which also abut Station Road. A low-pressure system was selected because of the small number of residences. Central pumping stations are not practical or cost effective for this case because of the extremely low flow from such few houses.

Iduna Lane – This area consists of approximately 22 houses on Iduna Lane and Station Road. A pumping station could be located at the low point of Iduna Lane, with gravity sewers entering from both ends of Iduna Lane, including flow from Station Road. However, due to the steep topography in this area, 10 of the 22 houses would require individual grinder pumps even if a central pumping station with gravity sewers was constructed. Because nearly half of the houses would require grinder pumps under either alternative, a low-pressure system was selected.

Wood Lot Road/Teaberry Lane – This area consists of 26 houses. A central pumping station was selected for this area because of the higher number of houses and because only five houses require grinder pumps under the gravity sewer/pumping station alternative. The pumping station will discharge to an existing manhole (SMH#1841) on Wood Lot Road. This flow then is conveyed to a pumping station on Farm Road, where it is pumped again to SMH#1844, farther along Wood Lot Road. Based on a preliminary analysis, it appears that the existing pumping station on Farm Road. has enough capacity to accept the additional flow from the new area, however this should be confirmed during final design.

Additionally, during final design the potential to connect directly into the existing force main on Wood Lot Road. should also be evaluated. This would eliminate the need to re-pump the new flow. Connection could be made to the existing force main adjacent to SMH#1842.

If a low-pressure system with individual grinder pumps is preferred for this area, its discharge must be to the new manhole at the intersection of Wildflower Drive and Teaberry Lane, not the existing SMH#1841. As Teaberry Lane rises steeply from approximate elevation 200 to elevation 270, individual grinder pumps on Teaberry Lane must discharge uphill toward Wildflower Drive.

In each of these locations, either a conventional pumping station with gravity sewer or low pressure system are feasible, and the Town's preference should be considered during final design in each of these areas.

Private Developments

There are two private developments in the project area currently under planning and/or construction phase. The first, located at the northern end of Larkspur Drive, will consist of five new office buildings with up to 50,000 square feet of office space. The sewer system will be installed by the developer and will include six new gravity manholes and a pumping station to serve the western portion of the property, which is considerably lower than the street. As discussed with the developer at our July 19, 2002 meeting, the sewer and pumping station in this area will remain private: owned, operated, and maintained by the property owner, not by the Town. The private sewer will connect to the Town sewer at the existing manhole on Old Belchertown Road.

This study evaluated several alternative designs for sewering this development to determine if flow from residents on Larkspur Drive or Ladyslipper Circle could contribute to the gravity sewer constructed by the developer. The private sewer would need to be in excess of 20-feet deep to serve the residents of Larkspur Drive. This depth seems unreasonable given that the natural flow of the sewer on Larkspur Drive would be toward Wildflower Lane.

An additional alternative was evaluated which included sewering four to six houses on Ladyslipper Circle by connecting to the pumping station proposed by the developer. As this alternative connected very few homes (6 max.), and would require an easement taking by the town and taking over operation of the private pumping station, this alternative was abandoned. However, at our July 19 meeting with the developer, it was agreed that the development would provide to the Town a utility easement from the proposed pumping station to the private property on Ladyslipper Circle for future consideration of this alternative.

The second development is a private development of the Amherst Hills area, consisting of up to 60 residential lots. The topography of this area requires a portion of the flow from this area to be collected at Station Road, and then pumped back up to one of the proposed gravity sewers. All flow from this area will be conveyed through a cross-country pipeline, as shown on the attached map, and will connect to the existing manhole on Belchertown Road. Once constructed, it is expected that the Town will accept, then own and operate the sewer system, including the pumping station. Since the town will eventually take over operation of the station, the town should ensure that the design meets the town's quality standards.

The original plans for this development included a pumping station located 350-ft off Station Road. In our July 19 meeting, the engineer for this development agreed that the pumping station could be relocated to a point on Station Road. This will allow connection from approximately 13 existing houses on Station Road. The topography of Station Road prevents sewage from these houses from flowing to any other point. Design plans, dated December 2002, received from the Berkshire Design Group confirm that this change has been incorporated. The engineer also agreed that the proposed pumping station would be designed with sufficient capacity to accept this additional future flow. Based on estimated sill elevations for existing houses in this area of Station Road, the gravity sewer installed by the town would connect to the pumping station approximately at elevation 261.0. This elevation must be coordinated during review of the private development design.

The cross-country portion of the sewer system minimizes impacts to wetland areas while attempting to minimize depth. Specific portions of the proposed layout will be difficult for the Town to access during maintenance. The topography at the most upstream cross-country reach drops at a 9% grade. At our July 19 meeting, the Town requested that this portion have paved access for maintenance vehicles. Once the proposed sewer crosses the wetland, it will run beneath a proposed paved common driveway. This location should provide sufficient access for maintenance. The location currently proposed for this cross-country sewer meets the most overall goals when considering the topography in this area, the location of property and Town boundaries, property ownership, and the interest in minimizing impacts to wetlands.

Projected Flows

The estimated wastewater flows (expressed in gallons per day) to be generated within the project area are presented below. Flows estimated by CDM for the two private developments are also presented, but should be confirmed with the private developers. This information must be presented in the Sewer Extension Permit, which must be signed by the town and approved by the DEP.

The number of existing homes and the number of vacant lots were used to estimate the amount of wastewater flow for each street. Conservation land and wetlands were not considered as developable land areas for this project. From census data it was determined that the average number of people per home for the Town of Amherst is 3.7. Domestic wastewater flow was estimated by using a production value of 60 gallons per capita per day (gpcd) based on the CDM report titled *"Town of Amherst Wastewater Facilities Plan,"* dated September 1991. The average domestic wastewater flow was peaked by a factor of 5.4, and

the commercial wastewater flow was peaked by a factor of 4.0, to obtain the peak hour wastewater flow estimate.

	Average (gpd)	Peak Hour (gpd)
Larkspur Dr. Office Park	4,000	16,000
Amherst Hills Residential Development	13,300	72,000
Tributary to Wildflower Dr. (MH#1829)	37,500	203,000
Tributary to Wood Lot Rd. (MH#1841)	6,200	34,000
TOTAL	61,000	325,000

The flow projections to the Wood Lot Road pumping station are presented in the above table. The Wildflower Drive pumping station is expected to receive a peak flow of 115,000 gpd (included in the 203,000 gpd above).

Improvements to the Existing System

We have not evaluated the downstream capacity of the system beyond the limits of the information provided. In discussions with the town, there are no hydraulic restrictions downstream of the connections to the existing system, and pipelines appear to have enough capacity. The town has advised us that there are no known flow capacity problems in the downstream area and has not reported any flooding or frequent surcharges in pipelines downstream of the proposed connection points. Similarly, existing pumping stations appear to have the capacity to accept the additional flow.

Anticipated Construction Issues

1. *Rock*. During site inspection, minimal rock outcroppings were visible within this area, however, due to the hilly topography, it is expected that rock will be encountered in some areas during excavation. Soil borings conducted during final design will help to define the depth and limits of rock.

2. *Soil Conditions*. Much of this area includes hilly topography. With the exception of the two pumping station sites, little of the project is located in low area, typically subject to soils with poor bearing capacity. It is expected that over excavation and

replacement with suitable fill will be minimized. Soil borings conducted during final design will help define the location, limits, and depths of unsuitable soils.

3. *Groundwater*. We do not anticipate groundwater handling problems during construction, however, due to the hilly topography, more extensive groundwater handling may be required for excavations located at the bottom of a hill.

4. *Cross-Country Construction – Easements*. There are no cross-country pipelines proposed as party of this layout. Easements will be required at the two pumping station sites only.

Estimated Project Costs

The opinion of probable project costs is $2,882,000 and is broken down as detailed below. This estimate includes only the portion of the sewer system to be installed by the town, and does not include any capital costs for either of the two proposed developments. The below estimate also does not include any allowance for purchase or installation of private residential grinder pump systems.

Construction - $2,385,000

Gravity Sewers - $1,408,000

Low-Pressure Sewers - $127,000

Force Mains - $73,000

Pumping Stations (2) - $300,000

Improvements to the Existing System - $0

Construction Contingency (25%) – $477,000

Engineering and Implementation Costs (20%) – $477,000

Land Acquisition/Easement Costs - $20,000

The above costs have not been escalated to the mid-point of construction because no construction schedule has been established. Costs assume initial trench repaving and a final full width pavement overlay. Costs are presented in August 2002 dollars.

Permits

The following permits must be applied for and obtained before construction of the sewer facilities evaluated in this study. It should be noted that private developments must separately apply for and obtain each of the below permits.

1. Town of Amherst Conservation Commission Order of Conditions

   The proposed sewer layout for pipelines to be installed by the town has no cross country reaches. Accordingly, there will be no impact to Bordering Vegetated Wetlands (BVW). Work within streets and at the proposed pumping station sites will be within 100-ft buffer zone to BVW in several locations.

2. Massachusetts Department of Environmental Protection (DEP) Sewer Extension Permit

Schedule

Design and bidding of the project would take approximately one year. Construction would also take approximately one year.

We look forward to continuing to work with the Town on this project if design of sewers in this area moves forward. If we can be of further assistance during the planning stage, please contact us.

Very truly yours,

William Dana Green, P.E.
Project Manager
Camp Dresser & McKee Inc.

cc: Ralph Souppa, Jr., CDM

INSERT AMHERST WOODS SEWER

DESIGN STUDY FIGURE

APPENDIX F

Appendix F
Subarea 8 – Detailed Evaluation

Note: *As part of the 2005 Sewer Extension Master Plan, four alternatives were analyzed for Subarea 8 – High Point Drive Area. Anticipated wastewater flows from Subarea 8 have not changed significantly enough to warrant reanalysis of the four alternatives. The original analysis from the 2005 Sewer Extension Master Plan is presented in its entirety below.*

There were four main alternatives considered for the High Point Drive subarea: (1) gravity and pressure sewers and a cross-country gravity sewer that conveys wastewater through an easement to the existing system; (2) gravity and pressure sewers with a pump station that conveys wastewater to new gravity sewers in Flat Hills Road and Market Hill Road connecting to the existing sewer; (3) gravity and pressure sewers with a localized package or Innovative/Alternative treatment system that only serves this neighborhood; and (4) two community septic systems. These four options are presented in Figure 4-1. As discussed earlier, wetlands treatment was also evaluated but was quickly determined to be more than twice the cost of any other alternatives and was therefore not considered further.

Each of these alternatives has advantages, disadvantages, estimated capital costs, and estimated Operations and Maintenance (O&M) costs that were used to develop the recommended plan for this subarea. While Options 3 and 4 do not appear to be cost-effective or logical solutions, both Options 1 and 2 are reasonable solutions. The following sections present the rational for the recommended plan; however, the town should weigh the economic and other costs (permitting, easement taking, etc.) to select the option that best suits the town. The following discussion presents each option as well as the recommended plan.

Local Collection System Options

For each of the options presented below, the collection system will involve both low-pressure and gravity sewers to direct the flow to its designated location (selected from one of the four options). The topography of this area prevents complete gravity flow to the designated location for any of the options. In each of these cases, a pumping station can be used in place of private grinder pump systems; however, this cost is much more expensive. With grinder pumps, however, there may be as many as 35 private grinder pumps on Overlook Drive and High Point Drive. Still, the low-pressure system is the recommended plan for the neighborhood collection system. Costs below for each option include local collection system costs and assume that many of the homes will be served by private grinder pumps.

Option 1 – Gravity and Pressure Sewers with Cross-Country Gravity Sewer

Option 1 includes a cross-country gravity sewer that connects to the existing sewer on Market Hill Road, near the Atkins Water Treatment Plant. A proposed route for the cross-country gravity sewer is presented on Figure 4-1. This option requires the Town to take an easement for the cross-country gravity sewer which could give the landowner an opportunity to develop this land, thereby increasing the population

and changing the character of the area. Development would require new roads, basic utilities as well as additional sewers. On the other hand, the landowner may not be willing to grant the town an easement through this land.

Ledge, potential wetlands, easement clearing, and the steep topography of the cross country route will make construction or this option more difficult. The ledge and steep slopes in the area will require steep pipe slopes and drop connections at manholes ("stepped" sewers). The length of the cross-country sewer (approximately 0.61 miles) requires that an Environmental Notification Form (ENF) be field with the Massachusetts Environmental Protection Agency (MEPA). Construction in or near wetlands will require additional permitting; there is standing water and lower, wet areas near the proposed cross-country route. These issues could increase the construction cost, slow the schedule of this project, and will be more difficult to implement.

The estimated capital cost to construct Option 1 is $974,100, including neighborhood collection sewers, construction contingency, and engineering costs. Construction contingency and engineering implementation were each estimated as 25 percent of the construction cost.

Option 2 – Gravity and Pressure Sewers with Pump Station
Option 2 includes a pump station installed on Flat Hills Road with a force main on Flat Hills Road to the high elevation point. A gravity sewer would then be required on Flat Hills and Market Hill Roads connecting to the existing sewer on Market Hill Road near the Atkins Water Treatment Plant. The length of sewer pipe required for this option is greater than for Option 1, and a pump station on Flat Hills Road is also required. Connections for homes on Flat Hills and Market Hill Roads could be provided during construction, thereby sewering a portion of Subarea 9. While providing a sewer in Flat Hills and Market Hills Roads may encourage "filling-in" of vacant lots and some additional development along these roads, there does not appear to be a large amount of land available for development. Much of the land in this area is very steep and would make locating new homes difficult.

The estimated capital cost to construct Option 2 is $1,746,800, including neighborhood collection sewers, construction contingency and engineering costs. There is an increase in pipe quantities for this option, compared to Option 1, and O&M costs are also considered for the pump station. The total present worth cost of this option is $1,785,200.

Option 3 – Gravity and Low-Pressure Sewers with Localized Treatment System
Option 3 includes a localized treatment system that will treat wastewater from only this subarea. The estimated flow, using the required Title V guideline of 110 gpd per bedroom and the Year 2000 Amherst census data of 3.7 people per house (and therefore approximately 3 bedrooms per house) is higher than the allowable surface water discharge flow. Title V regulations specify that the maximum flow for a

common Title V System is 10,000 gpd. A variance can be obtained for flows greater than 10,000 gpd but less than 15,000 gpd. Considering only existing homes, the wastewater estimate is about 16,000 gpd for this subarea, and future homes (though few) should be included in the flow estimate. The soils in this area have not been confirmed as suitable for a leaching field. A soil analysis may render this option physically unusable.

Since the flows exceed the 15,000 gpd maximum, a single local community, package treatment plant with subsurface disposal is an option for this subarea. The term "package" refers to the assembly of various individual treatment process equipment such as settling tanks, aerators, and disinfection methods, into a compact area. Package plants are typically offered by a single manufacturer who installs pre-assembled equipment in buried tanks or small buildings. These plants can achieve the same degree of treatment as municipal wastewater treatment facilities as long as the operation and maintenance is effectively monitored. Package plants are usually automated so that an operator only has to check performance and conduct periodic maintenance. This option would involve facility siting, design, and permitting, as well as the creation of a community agency to oversee the plant operation, maintenance, repair, regulation, and administration. Traditional and alternative wastewater treatment processes may be used in package facilities, depending on the desired degree of wastewater treatment. The DEP maintains a listing of approved "Innovative/Alternative" technologies; however, the approved technologies are not the only technologies that communities/developments can use. Permitting technologies not already approved are generally cost prohibitive.

The Bioclere system was used to estimate site requirements and cost estimates for Option 3. Future build-out in the neighborhood was considered for the sizing of the system and the future Title V flow is 20,460 gpd. The system, and the necessary leaching fields for discharge, could possibly be installed on town-owned land south of High Point Drive. Figure 4-1 presents a possible layout plan for this option including the easement and access road. This is the closest town-owned land with the required area for the facilities. There are a few vacant lots that could possibly be used to site these facilities; however, on inspection, these appear to be vacant primarily because of their unfavorable conditions.

The estimated capital cost to construct Option 3 is $1,781,400, including neighborhood collection sewers, construction contingency, and engineering costs The estimated annual O&M cost for the treatment system is $60,700 (a 20-year present worth value of $862,500), bringing the total present worth cost of this option to $2,643,900. The annual O&M cost for the treatment system includes general maintenance, licensed operator time, sample analysis, chemicals, power, and sludge disposal. The O&M estimate may change significantly during the design process due to its close dependence on the packaged system selected.

Option 4 – Gravity and Low-Pressure Sewers with Two Community Septic Systems
Since the flows exceed the 15,000 gpd maximum, a single local community, package treatment plant with subsurface disposal is an option for this subarea. However, two separate community septic systems can be used to serve this subarea. Future build-out in the neighborhood was considered for sizing the systems; the future Title V flow is 20,460 gpd. The systems, and necessary leaching fields for discharge, could possibly be installed on town-owned land on High Point Drive and acquired land on Flat Hills Road. A pump station is required to lift the wastewater to the community septic system on Flat Hills Road. Figure 4-1 presents a possible layout plan for this option.

The estimated capital cost to construct Option 4 is $3,551,400, including neighborhood collection sewers, construction contingency, and engineering costs. The estimated annual O&M cost for the treatment systems is $36,510 (a 20-year present worth value of $557,200), bringing the total present worth cost of this option to $4,108,600. The annual O&M cost includes general maintenance and sludge disposal.

Comparison and Recommended Plan
The following table presents the cost estimate for each option with respect to how many existing homes would be served. These costs are the present worth capital and O&M estimates for each option. Power supply and permitting are not included in the costs, which would make Options 3 and 4 even more cost prohibitive.

Present Worth Capital and O&M Cost per Existing Home for Subarea 8

Option	*Homes Served*	*$/home*
Option 1	55	$17,700
Option 2	78	$22,900
Option 3	51	$51,800
Option 4	51	$80,600

Although Option 1 has the lowest cost per home, Option 2 serves 42 percent more homes for only 29 percent more cost per home (the additional homes served are located on Flat Hills and Market Hills Roads). Additionally, providing sewers in Flat Hills and Market Hill Roads (Option 2) may have a lower potential for new development than if the cross-country sewer is provided (Option 1). Wetlands on the north side of Market Hill Road will hinder potential home construction. Lastly, the difficulty required to construct Option 1 includes negotiation and acquiring an easement, very steep cross-country route to clear and maintain, steep "stepped" sewers, exceeding the threshold triggering MEPA permitting process. This difficulty, along with the added benefit of sewering additional homes, suggests Option 2 as the recommended plan.

Appendix F
Town of Amherst, MA
Wastewater Master Plan Update
Subarea 8 Cost Evaluation

		Cross-Country Sewer						Force Main and Pumping Station						Package Wastewater Treatment Facility						Community Septic Systems		
		Option 1A Engineer's Estimate			**Option 1B Engineer's Estimate**			**Option 2A Engineer's Estimate**			**Option 2B Engineer's Estimate**			**Option 3A Engineer's Estimate**			**Option 3B Engineer's Estimate**			**Option 4 Engineer's Estimate**		
		Gravity: Flat Hills Road, some of High Point, and Cross-Country Pressure: Overlook and Juniper, some of High Point			Gravity: Flat Hills Road, High Point, Overlook, and Cross-Country Pressure: Juniper Lane One Pump Station Force Main: High Point			Gravity: Flat Hills, Market Hill and some of High Point Pressure: Overlook and Juniper, some of High Point One Pump Station Force Main: Flat Hills Road			Gravity: Flat Hills Road, High Point, Overlook Pressure: Juniper Lane Two Pump Stations Force Main: Flat Hills and High Point			Gravity: Flat Hills Road, High Point, Overlook Pressure: Juniper Lane and some of High Point			Gravity: Flat Hills Road, High Point, Overlook Pressure: Juniper Lane One Pump Station Force Main: High Point			Gravity: Portions of all streets except Juniper Lane Pressure: Juniper Lane and portions of all other streets One Pump Station Force Main: Flat Hills		
Item No.	**Description** / **Unit**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**	**Estim. Quantity**	**Unit Price**	**Total**
SEWERS																						
	F&I 8-in PVC/DI Sewer (all depths and appurtenances) NEIGHBORHOOD / l.f.	1,500	$110	$165,000	5,000	$110	$550,000	1,350	$110	$148,500	4,850	$110	$533,500	2,600	$110	$286,000	3,400	$110	$374,000	2,700	$110	$297,000
	F&I 8-in PVC/DI Sewer (all depths and appurtenances) TRANSMISSION / l.f.	2,800	$110	$308,000	2,800	$110	$308,000	5,550	$110	$610,500	5,550	$110	$610,500	1,000	$110	$110,000	1,000	$110	$110,000	0	$110	$0
	F&I DI Force Main (all depths and appurtenances) NEIGHBORHOOD / l.f.	0	$36	$0	1,200	$36	$43,200	0	$36	$0	1,200	$36	$43,200	0	$36	$0	1,800	$36	$64,800	0	$36	$0
	F&I DI Force Main (all depths and appurtenances) TRANSMISSION / l.f.	0	$36	$0	0	$36	$0	1,500	$36	$54,000	1,500	$36	$54,000	0	$36	$0	0	$36	$0	500	$36	$18,000
	F&I PVC Pressure Sewer (all depths and appurtenances) NEIGHBORHOOD / l.f.	3,900	$36	$140,400	400	$36	$14,400	3,900	$36	$140,400	400	$36	$14,400	2,200	$36	$79,200	400	$36	$14,400	3,150	$36	$113,400
	F&I PVC Pressure Sewer (all depths and appurtenances) TRANSMISSION / l.f.	0	$36	$0	0	$36	$0	0	$36	$0	0	$36	$0	0	$36	$0	0	$36	$0	0	$36	$0
PUMP STATIONS																						
	F&I High Point Pumping Station, Option 1B / LS			$0		$154,500	$154,500			$0			$0			$0			$0			$0
	F&I Flat Hills Pumping Station, Option 2A, 2B & 4 / LS			$0			$0		$154,500	$154,500		$154,500	$154,500			$0			$0		$154,500	$154,500
	F&I High Point Pumping Station, Option 2B / LS			$0			$0		$0	$0		$154,500	$154,500			$0			$0			$0
	F&I High Point Pumping Station, Option 3B / LS			$0			$0			$0		$0	$0			$0		$154,500	$154,500			$0
	Pump Station O&M, yearly [1] / LS per PS			$0		$2,700	$2,700		$2,700	$2,700		$2,700	$5,400			$0		$2,700	$2,700		$2,700	$2,700
TREATMENT SYSTEM																						
	Localized Treatment System, Option 3A & 3B / LS			$0			$0			$0			$0		$654,900	$654,900		$654,900	$654,900			$0
	Option 3 O&M, yearly [2] / LS			$0			$0			$0			$0		$60,700	$60,700		$60,700	$60,700			$0
	Community Septic Systems, Option 4 / LS per house			$0			$0			$0			$0			$0			$0		$30,000	$1,530,000
	Option 4 O&M, yearly [3] / LS			$0			$0			$0			$0			$0			$0			$0
Capital Cost Subtotal				**$613,400**			**$1,070,100**			**$1,107,900**			**$1,564,600**			**$1,130,100**			**$1,372,600**			**$2,112,900**
Land Acquisition/Easement Cost				$10,000			$10,000			$10,000			$10,000			$10,000			$10,000			$160,000
Construction Contingency 25%				$155,900			$270,000			$279,500			$393,700			$285,000			$345,700			$568,200
Engineering and Implementation 25%				$194,800			$337,500			$349,400			$492,100			$356,300			$432,100			$710,300
Capital Cost				**$974,100**			**$1,687,600**			**$1,746,800**			**$2,460,400**			**$1,781,400**			**$2,160,400**			**$3,551,400**
O&M Present Worth [4]				$0			$38,400			$38,400			$76,700			$862,500			$900,900			$557,200
Total Present Worth Cost				**$974,100**			**$1,726,000**			**$1,785,200**			**$2,537,100**			**$2,643,900**			**$3,061,300**			**$4,108,600**

Notes:

1. Estimated O&M cost for pump stations includes power cost ($0.15/kWh, with 5 hp pumps that operate 5 hours/day) and pump station maintenance of $1,700/yr.
2. Estimated O&M cost for package treatment facility:

Power:	$3,270	$0.16/gpd
Operator:	$31,200	20 hrs/wk at $40/hr
Sample Testing:	$3,600	$300/month
Chemicals:	$1,920	$150/month
Option 3 General Maintenance:	$10,700	2% of treatment system capital cost (not including leach field)
Sludge Disposal:	$10,010	$0.11/gal of sludge
Option 3 O&M Total:	**$60,700**	**per year**

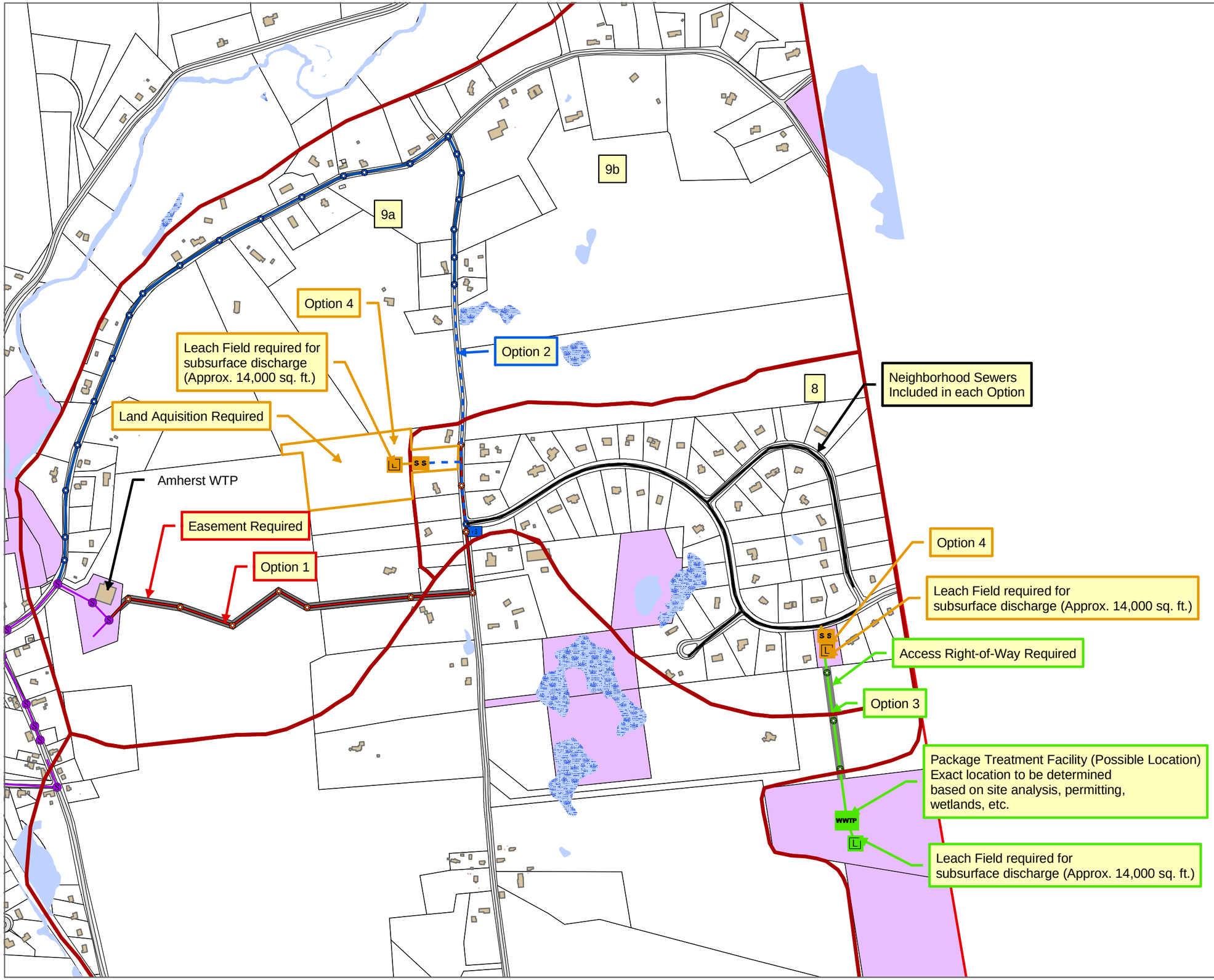
3. Estimated O&M cost for community septic systems:

General Maintenance:	$30,600	2% of treatment system capital cost
Solids Removal:	$5,910	$0.11/gal of sludge
Option 4 O&M Total:	**$36,510**	**per year**

4. O&M Present Worth Cost calculated assuming 20 year life and interest rate of 6.5%.

Subarea 8
High Point Drive Area Sewer Alternatives Analysis

Figure 4-1



0 600 1,200 Feet

Legend

- Existing Sewer Manholes
- Existing Gravity Sewer
- Town Boundary
- Contour Lines
- Parcels
- Building
- Paved Roads
- Town Owned Land
- Double Banked Rivers
- Lake, Resevoir, Ponds
- Marsh, Swamp Boundary
- Proposed Areas

Option 1- Cross Country Gravity Sewer

- Sewer Manholes
- Gravity Sewer

Option 2- Force Main and Gravity Sewer in Flat Hills and Market Hill Roads

- Manholes
- Pump Station
- Gravity Sewer
- Force Main

Option 3-Localized Treatment Facility

- WWTP Package Treatment Facility with Leaching Field
- Gravity Sewer

Option 4-Community Septic Systems

- Pump Station
- Force Main
- S S Septic System with Leaching Field

Neighborhood Sewers (Gravity and Low-Pressure)

- Gravity and Low-Pressure Sewers

Note: Each of the four treatment options includes a slightly different configuration of the gravity and low-pressure sewers to collect wastewater from homes. The configuration depends on the destination of the sewage (option selected) and different configurations are not shown for clarity. Costs for each option include costs of the neighborhood sewers.

CDM

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