TOWN OF SHERBORN
GROUNDWATER PROTECTION STUDY

Sherborn Groundwater Protection Committee
c/o Town Administrator
Town Hall
Sherborn, MA

June, 2003

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ACKNOWLEDGEMENT

This report was prepared under the guidance of the Sherborn Groundwater Protection Committee. The Committee provided Woodard and Curran with the available studies, reports, and previously compiled information on the town and directed the focus of this study. The Committee Members were also helpful in offering their comments, understanding of past activities in town and preferences to Woodard & Curran over the course of this effort. In particular, Ms. Daryl Beardsley was instrumental in guiding the consultants' efforts towards a meaningful understanding of the town's water resources goals.

The Committee Members' local knowledge and critical review of materials prepared by Woodard & Curran helped this study to achieve its objective of organizing the array of past information and focusing on key areas of Sherborn where groundwater resources are most sensitive and warrant further protection efforts.

1. INTRODUCTION

1.1 SCOPE OF STUDY

The Town of Sherborn, Groundwater Protection Committee, retained Woodard & Curran to review several years' worth of previous groundwater studies prepared for the Town and prepare an updated and consolidated bibliography of these materials. A key interest of the Town in undertaking this review of past groundwater studies was to assess the accuracy, currency and relevance of the previous information with regard to today's issues and concerns about groundwater quality and availability in Sherborn for possible future development of public water supplies.

A goal of the updated groundwater review was also to identify the elements of groundwater protection measures that Sherborn should be planning for in its long-term resource protection activities. With increasing pressures from development both inside and outside of town, there was concern that not beginning the process of seeking long-term groundwater protection measures now would jeopardize the town's ability to seek such measures in the future. The study, therefore, included recommendations for future activities that Sherborn may undertake in its groundwater protection efforts.

This study also presents a series of hydrogeological maps that were prepared using the available data from previous studies plus updated information from the U.S. Geological Survey (USGS) and Massachusetts Geographical Information System (GIS) Office. These maps incorporated the data collected from the bibliographic review and depict the hydrogeologic conditions in and around Sherborn. The maps provide a foundation for examining present groundwater conditions, the influences on groundwater in Sherborn and future trends that may influence public water supply planning.

1.2 APPROACH AND ANALYSES

The approach taken in this groundwater review and assessment was to first collect and review a broad range and number of previous groundwater studies prepared by others. These past studies dated back over fourteen years and included a wide range of disparate reports and findings that were prepared over time for various purposes yet, when combined, afforded a wealth of information about the town. The reports included studies prepared for Sherborn, studies prepared for adjoining and nearby towns, and various mapping of aquifer and related hydrogeologic conditions. Section B of this report presents the bibliographic review by Woodard & Curran of this material.

The next step was to consolidate all of this material into a coherent understanding of the relevant groundwater conditions in and affecting Sherborn. This was accomplished using data from the existing reports plus USGS and Mass GIS. Woodard & Curran then prepared a series of hydrogeological maps showing the groundwater flows, aquifer favorability, groundwater elevation contours and velocities and surficial geology. The mapping also included a combined map showing areas in Sherborn of special concern for groundwater protection, which becomes the basis for assessing the additional actions that Sherborn may take to protect its aquifer resources.

2. SHERBORN BIBLIGRAPHY OF AVAILABLE REPORTS

2.1 LIST OF AVAILABLE REPORTS PROVIDED TO WOODARD & CURRAN

- Armory Engineers, 1990. Zone II for the Medfield Water Department by Amory.
- Charles River Watershed Association, 1999. "Holliston Environmental Zoning Report GIS and Hydrologic Analyses." December 30.
- Clean and Green, 1999. "A History of Cadilac Paint & Varnish Co." June 27.
- Conway School of Landscape Design, 1995. Open Space and Recreation Plan Update Prepared for Sherborn, Massachusetts.
- Daylor Consulting Group, Inc., 2001. "Addendum No. 1 to the Comprehensive Permit Application at 59 Whitney Street, Sherborn".
- Earth Tech, 1997. Zone IIs for Holliston Water Department Wells No. 1, 2, 5 and 6.
- Griffin Engineering Group, 2001. "Natick Golf Course Project, Environmental Monitor's Progress Report." May 1.
- Griffin Engineering Group, 2001. "Natick Golf Course Project, Baseline Environmental Sampling." August 20.
- Lycott, 1989. "Water Resources Investigation, Town of Sherborn, Sherborn, Massachusetts." December 31.
- MADEP/DWS/UIC, 1991. Zone II for the Millis Water Department.
- Sherborn Conservation Commission, 1999. WPA Form 5- Order of Conditions for the Natick Golf Course
- Tata & Howard, 1999. Letter Report from Susan Morin (Tata & Howard) to Robert Reed, Sherborn Town Administrator. Re: Sherborn Sanitary Landfill, Groundwater Quality Monitoring Program.

2.2 DATA SUMMARY TABLE

The following table summarizes the information contained in the list of available reports provided to Woodard & Curran. This data is also keyed to the synopsis of the reports presented in Section 2.3.

Table 1 - Data Summary, Town of Sherborn

Reference	Site/Location	Subsurface Data and Figures Provided in Report	Other Information to acquire	Bibliography (Entries of Note)
1) Armory Engineers, 1990	1) Medfield	1) Zone II Figure for Well # 6 in Medfield extends into Sherborn	1) Final New Source Approval Report for Well No. 6	1) None
2) Charles River Watershed Association, 1999	2) Holliston	2) Holliston Maps which contain information relevant to Sherborn along the Sherborn/Holliston Town Line: Figure 1: Very High Priority Land Figure 2: High Priority Land Figure 3: Moderate Priority Land Figure 4: New Development Figure 5: Undeveloped Land as of 1999.		2) DEM, 1988. Charles River Basin: Inventory and Analysis of Current and Projected Water Use. Earth Tech, Inc. 1999. Comprehensive Wastewater Management Plan & Draft EIR, Phase II Document, Holliston, MA, Two volumes.

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
3) Clean and Green, 1999	3) Cadilac Paint& Varnish Co., 409/415 Eliot St., Ashland (Near Sherborn)	3) Description of subsurface contamination. Subsurface work completed, but actual boring logs, monitoring wells, permeability test results not provided. Figures in Report: Figure 1: Site Location Figure 3: Site Plan Showing Soil Excavation, Stock Pile and Former UST Location Figure 5: Site Plan Showing Rubbish Pit and Test Pits Figure 6: Monitoring Well Location Plan Figure 5: Original Groundwater Contours Figure: Site Layout	3) Information to obtain from the MADEP files: Boring logs and Monitoring well installation logs (Guild Drilling) Geophysical Survey by Weston Geophysical. Permeability test results Water quality results from Quarterly Sampling	3) Bewick Assoc., 1986. 21E Environmental Audit Report to Cadilac Paint, July 11. J.B. Plunkett Associates, Inc., 1989. "Risk Assessment" J.B. Plunkett Associates, Inc. Short Term Measures at Cadilac Paint & Varnish Co.

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
4) Conway School of Landscape Design, 1995	4) Sherborn	4) Maps of Sherborn: Surficial Geology Soils Suitable for Septic Systems Poor Filter and Hydric Soils Watershed and Surface Water Wetlands and 100-Year Floodplain Aquifers Rare Species Habitats Protected Lands (Public & Private) Action Plan	4) Obtain borings logs & well data drilled in Sherborn since 1989 to update Maps: (Surficial Geology & Aquifers) MassGIS to Update Rare Species Habitats Map	4) Middlesex County Soil Survey (1991)

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
5) Daylor Consulting Group, 2001	5) 59 Whitney St., Sherborn	5) Figures/Plans: Figure 1: Contributing Drainage Area for the 100 Year Floodplain Calculations Figure 2: Site Topographic Map and 24 in. culvert under railroad tracks Figure 3: Plan showing 168.1 Elevation,100 Year Floodplain Calculations Figure 4: Floodplain Compensation Figure 5: Isolated Land Subject to Flooding Calculations Figure 6: Existing Conditions within Riverfront Area Figure 7: Proposed Site Conditions Figure 8: Proposed Well and Zone 1 Figure 9: Existing Drainage Figure 10: Proposed Drainage Area Flood Insurance Rate Map (FIRM) for Town of Sherborn (250212 003 B) 3 of 6 FIRM for Town of Holliston (250195 002C) (Panel 2 of 8) Figure showing FEMA Flood Zone Boundaries	5) Data on Water Supply Well for Development if Installed	5) None

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
6) Earth Tech, 1997	6) Holliston	6) Zone II Figure for Holliston Wells No. 1,2,5, and 6. The Zone II for Holliston Wells No. 5 and 6 extends into Sherborn.	6) Final New Source Approval Report for Wells No. 5 and No. 6	6) None
7) Griffin Engineering Group, 2001	7) Natick Golf Course Project Located in Natick/ Sherborn	7) Site Plan (showing golf course, monitoring wells, and vernal pools)		7) None
8) Griffin Engineering Group, 2001	8) Natick Golf Course Project: Located in Natick/ Sherborn	8) Sampling Results: Five monitoring wells in Natick Three monitoring wells in Sherborn Four surface water sampling spots in Sherborn Two surface water sampling spots in Natick Two sediment sampling locations in Natick Two sediment sampling locations in Sherborn	8) Obtain boring logs and monitoring well installation logs from existing wells	8) None

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
9) Lycott, 1989	9) Sherborn	9) Monitoring Wells Installed (Six Locations including boring logs) Geophysical Survey Specific capacities, potential yields and transmissivities calculated Maps of Sherborn: 1) Data Location Map 2) Depth-to-Bedrock Map 3) Bedrock Geology Map (missing) 4) Soils Map (missing) 5) Groundwater Flow Map 6) Water-Quality-Hazards Map (missing) 7) Water Resources Map (missing)	9) Obtain borings logs & well data drilled in Sherborn since 1989 to update Maps: Soils Map, Bedrock Geology Map, Water Quality Hazards Map, Water Resources Map)	9) Snow, Bayard. 1939. Special Water Committee Correspondence. Oct. 16. BSC Robinson & Fox 1984. Phase 1 Hydrogeologic Study.
10) MADEP/ DWS/ UIC, 1991	10) Millis	10) Figure showing Zone II in Millis extending into Sherborn	10) Final New Source Approval Report for the Village St. Well/South End Pond Well	10) None
11) Sherborn Conservation Commission, 1999	11) Natick Golf Course Project Located in Natick/ Sherborn	11) Establishes Requirements for Baseline Water Quality Testing and Future Monitoring		11) None

Table 1 - Data Summary, Town of Sherborn				
Reference	**Site/Location**	**Subsurface Data and Figures Provided in Report**	**Other Information to acquire**	**Bibliography (Entries of Note)**
12) Tata & Howard, 1999	12) Sherborn Sanitary Landfill	12) Sampling Results: Five monitoring wells One surface water station	12) Obtain boring logs and monitoring well installation logs from existing wells	12) None

2.3 SYNOPSIS OF AVAILABLE REPORTS

This section presents a synopsis of the reports provided to Woodard & Curran. Information that is relevant to the Town of Sherborn in these documents is highlights in **bold**.

(1) Armory Engineers, 1990. Zone II for the Medfield Water Department

This is a figure which shows the Zone II for Well No. 6 located in the northwest portion of Medfield. This Zone II also extends into the southeast portion of Sherborn. **The Final New Source Approval Report for Well No. 6 should provide additional subsurface information such as boring logs of test wells and the hydrogeology of this area which falls along the Medfield/Sherborn town line.**

(2) Charles River Watershed Association, 1999. "Holliston Environmental Zoning Report GIS and Hydrologic Analyses."

The Charles River Watershed Association identified sensitive water resource areas for the Town of Holliston using GIS methodology. A series of maps were generated designating sensitive water resource areas which are those areas that have a significant potential impact on groundwater and surface water resources. The area that is relevant to the Town of Sherborn is the abutting northeastern portion of Holliston which is also the area of Dopping Brook. This area is shown delineated on a number of maps which are noted on Table 2 below along with their significance to Sherborn.

Table 2 Charles River Watershed Association (1999) Holliston Maps and Relevancy to Sherborn	
Holliston Maps	**Significant Features to Sherborn**
1) Very High Priority Land (Figure 1)	1) An area that falls along the NE Town Line of Holliston (borders Sherborn) is marked as Very High Priority Land. These lands are defined as an area that contributes to public water supply wells as defined by Zone II's (p. 3).
2) High Priority Land (Figure 2)	2) Areas that fall along the NE Town Line of Holliston (borders Sherborn) are marked as High Priority Land. These lands include medium-and-high-yield aquifers that lie beyond active Zone II's and areas within a 200 ft buffer of surface water features, including streams, ponds, and wetlands (p. 3).
3) Moderate Priority Land (Figure 3)	3) Areas that fall along the NE Town Line of Holliston (borders Sherborn) are marked as Moderate Priority Land. These lands include sand and gravel deposits, alluvium and glacial till. Also, areas within a 500-ft buffer of surface water features, including streams, ponds, and wetlands (pp. 3 and 6).
4) New Development (Figure 4)	4) An area located in the very NE corner of Holliston contains a new development. Areas developed since 1991 were considered to be areas of new development (p. 8).
5) Undeveloped Land as of 1999 (Figure 5)	5) Areas within Holliston that fall along the NE Town Line of Holliston (borders Sherborn) are shown to contain undeveloped Land.

(3) Clean and Green, 1999. "A History of Cadilac Paint & Varnish Co." June 27.

The Cadilac Paint and Varnish Company consisted of about 2.9 acres **in Ashland, MA near the Sherborn town line**. The Company is a former paint and varnish company which began in 1938 and ceased operations in 1985. In 1986-1987, approximately fourteen underground storage tanks (USTs) were removed from the site. In February 1987, Solvent Recovery Systems was hired to remove 9000 gallons of dirty solvent generated by Cadilac and illegally stored on the site (background). During 1987, Weston Geophysical completed seismic at the site which identified the location of about 80, 55-gallon buried drums that were excavated from the southwest corner of the site (STM). All seismic data was submitted, samples from test wells and borings as well as the test pits dug around the "dump" area were

submitted to the MADEP. During the risk assessment, in-situ permeability testing was conducted. **As a result, there should be a great deal of subsurface information available regarding soils types, permeability and depth to groundwater that can be obtained and reviewed from reports at the MADEP.**

Compounds detected at this site include toluene, ethylbenzene, xylene, 1,1 dichloroethane, methylene chloride, acetone, MIBK, 1,2 dichloroethylene, 1,1,1 trichloroethane, 1,2 dichloroethane, chloroform, vinyl chloride, tetrachloroethylene, and trichloroethylene. Elevated levels of toluene, ethylbenzene, and xylene have been found in groundwater at the site. The off-site groundwater flow direction could not be determined. J.B. Plunkett Associates completed a Risk Assessment (RA) for the Cadilac Paint & Varnish Co in 1989. The RA addressed off-site drinking water wells as the primary exposure points for contamination migrating from the site. The risk for these exposure points was evaluated using concentrations of contaminants **detected in on-site bedrock wells** located at the downgradient (hydraulically) end of the site. These wells are located about 500 to 1,000 feet upgradient of domestic water supply wells. The total site hazard indices calculated for drinking water exposures at the site exceeded the MA requirements for total site non-cancer risk. Methylene chloride and 1,1 dichloroethane were detected in low levels in drinking water wells off-site. The report concluded that "exposure point concentrations measured in groundwater on-site presently indicate a slight potential for adverse effect to human health and the environment." **Since Sherborn is close to this site and the groundwater flow direction in fractured bedrock could not be determined, the potential exists that contaminants may have reached the bedrock aquifer in Sherborn.**

During 1990 and 1991, J.B. Plunkett Associates, Inc. excavated the following from the site: piping associated with the tanks, contaminated soils, the rubbish pit, an abandoned 1000 gallon UST. Quarterly groundwater monitoring found a decrease in primary contaminant concentrations following these additional excavations.

(4) Conway School of Landscape Design, 1995. Open Space and Recreation Plan Update Prepared for Sherborn, Massachusetts.

The following maps of Sherborn were completed. Each of these maps were described as not sufficiently detailed for planning purposes.

1) Surficial Geology. This map shows glacial till in the central and western part of Sherborn comprising 50-60% of the deposits in Sherborn. Sand and gravel deposits are located along the northeast, east and west portions of Sherborn and comprise 20-30% of the deposits in Sherborn. Swamp deposits comprise 15-20% of Sherborn. This figure also shows the location of frequent bedrock outcrops. The source of the map was Lycott Engineering, Surficial Geology Map, Water Resources Investigation, Town of Sherborn. This is a 1989 source and there is likely additional subsurface information currently available in the Town of Sherborn that can be added to the information provided on this map.

2) Soils Suitable for Septic Systems. This map shows that two-thirds of Sherborn lands are constrained for septic system. Constrained areas were described as those areas where the installation of septic systems is prevented or requires expensive engineered systems. The source of the map was the Middlesex County Soil Survey 1991.

3) Poor Filter and Hydric Soils. Poor filtered soils (limited filter capability) were described as located in the north, east, and west over sand and gravel deposits. Hydric soils were described as evenly

distributed around Sherborn. Many hydric soils are wetlands. The source of this map was the Middlesex County Soil Survey.

4) Watershed and Surface Water. This map shows Sherborn to fall within two watersheds. Eighty-two percent of Sherborn is located within the Charles River Watershed and eighteen percent is located within the Sudbury River Watershed. The Sudbury River Watershed is located in the northwest portion of the Town of Sherborn. The source of this map is Sherborn's 1975 Master Plan Water Favorability Map, USGS Map.

5) Wetlands and 100-Year Flood Plains. Map shows areas designated as forested wetlands, emergent or scrub-shrub wetlands, 100-year flood plain, and water bodies. The source of this map is the National Wetlands Inventory, Firm-Flood Insurance Rate Map.

6) Aquifers. Map distinguishes aquifers that are defined as Moderate/HighYield and Primary Recharge Area/ Moderate Yield. Groundwater resources were described as concentrated along the west, north and east borders of Sherborn. The source of the map was Lycott Engineering, Water Resources Map compiled for Water Resource Investigation, Town of Sherborn. This is a 1989 source and there is likely additional subsurface information currently available in the Town of Sherborn that can be added to the information provided on this map.

7) Rare Species Habitats. This map shows three different areas which include the following: 1) Estimated habitats of rare wetlands wildlife. 2) High priority site of rate species and 3) State certified vernal pools. This map is based on information from the Massachusetts National Heritage Endangered Species Program.

8) Protected Lands (Public and Private). This map identifies protected properties and categorizes these properties according to their degree of protection. This map is based on information from the 1991 Town of Sherborn Zoning Map, Betty Dowse. This map is likely to have changed since this time based on new development in Sherborn.

9) Action Plan (Proposed). This map shows proposed trail links that connect bands of open space in Sherborn.

(5) Daylor Consulting Group, Inc., 2001. "Addendum No. 1 to the Comprehensive Permit Application at 59 Whitney Street, Sherborn".

The project is located off of Whitney Street in Sherborn, Massachusetts and north to northeast of Dopping Brook. The Town of Holliston bounds the parcel to the south, a Consolidated Rail easement bounds the parcel to the east, Whitney Street bounds the parcel to the north and the Town of Ashland bounds the parcel to the west. The proposed project consists of the construction of fifty-two housing units and about 2,380 feet of roadway. There is proposed development within the Riverfront Area of Dopping Brook. The existence of a 100-year floodplain was identified on the site. This report showed that the 100-year/24-hour storm event resulted in a maximum 100-year floodplain elevation of 168.1 at the site based on hydrologic calculations. This area was found to be within a 100-year floodplain of Dopping Brook which is a Bordering Land Subject to Flooding according to the Sherborn Wetland Regulations. Another area located in the northwest corner of the site and consisting of a series of depressions was found to be an Isolated Land Subject to Flooding.

This report also proposes a well that will serve as a source of water supply for the new project. **If this well has been installed it would provide another source of hydrogeologic information for the Town of Sherborn**. Figures provided in this report include the following: 1) Figure 1 shows the contributing drainage area for the 100 year floodplain calculations. 2) Figure 2 shows topography of the area and the location of the 24 inch culvert under the railroad tracks. 3) Figure 3 shows the location of the 168.1 elevation for the 100 year floodplain calculations. 4) Figure 4 shows floodplain compensation at the site. 5) Figure 5 is labeled ILSF (isolated land subject to flooding) calculations and shows drainage areas contributing to an area that fits the requirements of an ILSF. 6) Figure 6 shows existing site conditions and the 200 ft buffer from the riverbank of Dopping Brook referred to as the Riverfront Area. 7) Figure 7 shows proposed conditions at the site. 8) Figure 8 shows the proposed well and Zone1. 9) Figure 9 shows the existing drainage in the vicinity of the site. 10) Figure 10 is the proposed drainage where run-off is split into three distinct regions. There are also figures of the FIRM (Flood Insurance Rate Maps) for the Town of Sherborn and Town of Holliston

(6) Earth Tech, 1997. Zone IIs for Holliston Water Department Wells No. 1, 2, 5 and 6.

This is a figure which shows the Zone II for Wells No. 5 and No. 6 which borders the Holliston Town Line. This Zone II also extends slightly into the southwestern portion of Sherborn. The Final New Source Approval Report for Wells No. 5 and No. 6 should provide additional subsurface information such as boring logs of test wells located in this area which borders the Holliston/Sherborn town line.

(7) Griffin Engineering Group, 2001. "Natick Golf Course Project, Environmental Monitor's Progress Report." May 1.

Information provided which describes the on-going work and proposed work at the Natick Golf Course. A site plan is provided which shows the Natick Golf Course and the location of monitoring wells and vernal pools.

(8) Griffin Engineering Group, 2001. "Natick Golf Course Project, Baseline Environmental Sampling". August 20.

Groundwater, surface water and sediment samples were collected for the Natick Golf Course and Recreation Area as required by the Order of Conditions from the Natick and Sherborn Conservation Commissions. These samples were used to establish baseline conditions prior to the application of fertilizers and pesticides on the golf course. The results of sampling from five monitoring wells in Natick and three wells in Sherborn was presented. The results of surface water sampling from four locations in Sherborn and two locations in Natick was presented. Additionally, sediment samples were collected from two locations in Natick and Sherborn. Samples were analyzed for metals, nutrients, and pesticides. Elevated concentrations of metals including arsenic, barium, cadmium, chromium and lead were detected in the monitoring wells located in Sherborn. Dalapon, a chlorinated pesticide, was detected up to 0.52 ug/l in samples collected from monitoring wells and 0.33 ug/l in one surface water sample. **Hydrogeologic information from the installation and monitoring of these wells will provide additional subsurface information to Sherborn**.

(9) Lycott, 1989. "Water Resources Investigation, Town of Sherborn, Sherborn, Massachusetts."

This study was done to assess the characteristics of water-bearing materials within the town. It was done through a program of monitoring well installations and geophysical surveys at 11 different locations within the town. Monitoring wells were installed at six different locations and geophysical surveys were conducted at five locations. The locations of the wells and geophysical surveys are noted on Table 3 below. One monitoring well was installed at each location. Specific capacities were determined by

pumping each monitoring well was a centrifugal pump and measuring drawdown . Potential yields, transmissivities were also calculated and water quality samples collected from the wells. The geophysical surveys were used to determine the thickness of saturated material and the depth to bedrock. Lycott also generated eight maps which are described on Table 3. The sources of information that were used to generate these maps is also listed on Table 3. Lycott commented on their Groundwater Flow Map and stated that because of limited water level data for shallow wells within the town, it was not possible to contour the groundwater flow in this area.

Table 3
Lycott, 1989. Water Resources Investigation, Town of Sherborn Subsurface Investigations,
Data Collection/Interpretation and Document Request

Subsurface Investigations	
Monitoring Well Locations	**Geophysical Surveys**
1) South Main Street and Bullard Street	1) South side of Whitney Street near the Conrail railroad tracks.
2) 46 Western Avenue	2) 177 Farm Road
3) Hollis Street near Western Avenue	3) 63 Bullard Street
4) 43 Forest Street	4) South Main Street near Goulding Street
5) West of 172 Forest Street	5) 192 Farm Road
6) Eliot Street near the Natick Town Line in Audubon's wildlife sanctuary	
Data Collection/Interpretation	
Interpretation	**Sources of Information Used**
1) Data Location Map	1) Files at the Sherborn (BOH, Building Inspectors Office) and MDEM driller well logs (p. 2).
2) Depth-to Bedrock Map	2) See Above.
3) Bedrock Geology Map	3) USGS Bedrock maps for Holliston, Natick, Medfield, and Framingham Quadrangles (p.2).
4) Soils Map	4) US Department of Agriculture Soil Conservation Service (p.2).
5) Groundwater Flow Map	5) Water levels from new wells installed and from other shallow wells in town (BOH), geophysical surveys and topography (pp.

Table 3 Lycott, 1989. Water Resources Investigation, Town of Sherborn Subsurface Investigations, Data Collection/Interpretation and Document Request	
	2,18).
6) Water-Quality-Hazards Map	6) RCRA and Site Assessment files at the MDEP and from a town wide survey of USTs and businesses (p. 2).
7) Surficial Geology Map	7) USGS Surficial maps for Holliston, Natick, Medfield, and Framingham quadrangles (p. 2).
8) Water Resources Map	8) Areas delineated on map were based on the Water Resources Protection By-Law from the Hydrogeologic Implementation Committee (p. 2). Boundaries on the Water Resources map were based on geophysical survey results and evaluation of surficial geologic boundaries (p. 24).
Previous Investigations to Obtain	
1) Snow, Bayard. 1939. Special Water Committee Correspondence. October 16.	
2) BSC Robinson & Fox. 1984. Phase I Hydrogeologic Study.	

(10) MADEP/DWS/UIC, 1991. Zone II for the Millis Water Department.

This is a figure which shows the Zone II for the Village St. Well/South End Pond Well located in the northeastern portion of Millis. This Zone II also extends into the southeast corner of Sherborn. **The Final New Source Approval Report for this well should provide additional subsurface information such as boring logs of test wells and the hydrogeology of the area which fall along the Millis/Sherborn town line**.

(11) Sherborn Conservation Commission, 1999. WPA Form 5- Order of Conditions for the Natick Golf Course

This Order of Conditions applies to a nine-hole municipal golf course located on about 120 acres of land in the towns of Natick and Sherborn, located west of Route 27. The land in Natick was used in the recent past as a landfill and was expected to be capped in 1999. The land in Sherborn was used for agricultural type purposes. This Order is for 19.9 acres in Sherborn that will be leased by Natick.

The proposed project is located in and around an area bounded by at least two vernal pools, an intermittent stream traversing a section, significant areas of bordering vegetated wetlands. The Sudbury Aqueduct runs through the site. The project proposes alteration and replication of a wetland meadow that has been degraded by agricultural activities. Biological surveys found the presence of the habitats of two state-listed Species of Special Concern: the Mystic Valley Amphipod and a panmicitc population of spotted turtles.

Pre-Construction requirements included baseline water quality testing from monitoring wells and surface water locations. **Hydrogeologic information will be available to the Town of Sherborn from the installation of these wells**. Surface water samples would be collected from vernal pools in at least four places closest to the golf course. Other surface water samples were also to be collected as shown on a site plan that was not included. During the month of October of each year, a report was to be submitted with the results of monitoring wells and surface water testing.

(12) Tata & Howard, 1999. Letter Report from Susan Morin (Tata & Howard) to Robert Reed, Sherborn Town Administrator. Re: Sherborn Sanitary Landfill, Groundwater Quality Monitoring Program.

Groundwater and surface water samples were collected from the Sherborn Sanitary Landfill during the Spring/Fall 1999 sampling round. Five monitoring wells and one surface water station were sampled. Benzene was detected equal to the Maximum Contaminant Level (MCL) of 5.0 ug/l in one well (MW-2) located in the northeast portion of the landfill property. The remaining VOCs were detected below available MCLs. Concentrations of iron and manganese were detected at levels above their SMCLs. **Since this report refers to monitoring wells there should be additional subsurface information available such as boring logs and monitoring well installation logs.**

3. SHERBORN HYDROGEOLOGICAL CONDITIONS

3.1 OVERVIEW OF TOWN'S GROUNDWATER CONDITION

Groundwater in Sherborn, as in all locations on this earth, is a story of water constantly on the move. In the broadest sense, all groundwater derives from precipitation; whether from the recurring showers such as the region has been experiencing over the recent months or paleo-groundwater presently "mined" in the American West that is derived from long ago melted glaciers and that fell as snow even before that. The groundwater flow continually works its way to the ultimate base sea level, the ocean. At times groundwater becomes surface water and later may return to groundwater as it moves downhill. The types of materials the precipitation encounters as it moves through the ground as groundwater determine its quality, where it will go and the ease with which we humans can tap into and utilize this resource.

The groundwater story in Sherborn was largely determined during the last glacial period and especially near the end of that period, during glacial melting and retreat some 12,000 to 10,000 years ago. The stream valleys on the east and west flanks of town (Charles River-Farm Pond-Indian Brook valleys and the Bogastow Brook-Dopping Brook valleys, respectively) are the principal locations of ice contact deposited soils, mainly sands and gravels, which have meaningful potential as aquifers. Many of these materials were deposited within or near the ice front where melt waters were moving quickly and carried and deposited the coarse sands and gravels that are so favorable today as aquifers sources.

In contrast, topography in the center of Town is generally of higher elevation caused, in part, by higher and more shallow bedrock and has been coated with deposits of compact till characterized as a dense, compact homogeneous mix of fine to coarse soils where finer materials fill the voids between coarser materials allowing little connected void space for the storage and flow of groundwater. Thus, precipitation in the center of town tends to runoff quickly to the steep sided steams in the interior and, ultimately, to the lower valleys on the flanks of the Town and, thence, out of town. Because of this condition, there are few areas with significant potential aquifer yield value in the center of Sherborn. The minor yield aquifer areas that have been mapped there are thin and have very limited watershed recharge areas. The few broad flat swamps in the area result from groundwater perched on the till and bedrock locations and can give the false suggestion of potential aquifers having significant yield.

In addition to the unfavorable conditions of non-aquifer materials in the center of town, the Town is split north to south into approximately a one third/two thirds division by the Suasco Rivers (Sudbury, Assabet and Concord Rivers) watershed and Charles River watershed, respectively. Surface water and groundwater flow out of the northern 1/3 of town to the Suasco basin and from the southern 2/3rds of town to the Charles River basin. Thus, precipitation over most of Sherborn does not stay in town very long to become and recharge groundwater resources, but instead leaves town due to poor infiltration conditions or in response to the groundwater divide. However, groundwater and surface waters that flow out of town to the Charles River system from both the eastern and western valley aquifer systems does then return to Sherborn and flow along the eastern aquifer border of the Town and become potentially available for use by the Town in that aquifer system. This, then, gives Sherborn a strong vested interest in the "health and well being" of the Charles River.

The key message of the Town's "groundwater story" is one which has been known from previous studies: That is, Sherborn is not rich in water resources because it lacks through-going aquifer systems, such as exist in Natick with the Sudbury and Lake Cochituate systems and in the Charles River system in the south of town. The lack of readily available high yielding aquifers within the Town has limited the

development a Town-wide public water system and makes the entire town a "working aquifer" of individual private wells for its predominantly residential population.

The widely dispersed private water withdrawal points across Sherborn complicates the issue of groundwater protection. Unlike communities with municipal wells, Sherborn has no single wellhead area(s) that it can protect with stringent land use restrictions designed to protect its long-term water supply. The reality is that even "benign" residential land use can, if not properly sited and maintained, pose threats to the water supply from one neighbor to another via septic systems, homeowner underground oil tanks, and small businesses. The Town should also recognize potential groundwater quality threats from through-going systems such as roadways, rail lines, power lines and pipelines which may contain chemicals, pesticides or hazardous materials that could in an accident percolate to the groundwater.

In addition to managing its own land uses and maintaining adequate controls on site activities, the Town has an interest in the actions of others, both private development and development by neighboring municipalities, as it seeks to protect its present aquifer quality and preserve its options for a future municipal water supply, should one be needed.

This study endeavors to present the existing hydrogeological conditions, both assets and vulnerabilities, through a series of maps illustrating the groundwater story described above. In so doing it is hoped to point out the types of future "tools" the Town can gather to effectively understand its groundwater characteristics in order to protect its groundwater resources.

It should be noted that, through the production of the five accompanying maps, there is now available for the first time hydrogeological information for Sherborn that is registered to the State Plane Coordinate System (a survey base for all official state mapping) that can in subsequent efforts be precisely related to town data, such as assessors maps or maps of other town departments, for use in future deliberations by Town boards and officials of actions that can be taken to identify and protect groundwater resources in the Town.

3.2 HIGHLIGHTS OF KEY AREAS OF GROUNDWATER SENSITIVITY

Among the key findings of this hydrogeological study for the Town of Sherborn are the following:

- The southeastern area of town along the Charles River has one of the most favorable aquifers in Sherborn. As such, it warrants strong protection and use controls.

- Another favorable aquifer area is in the vicinity of Farm Pond. It too should be protected, and opportunities to enhance recharge should be pursued.

- The downtown area of town does not include high yield aquifers, but non-residential land uses and activities on this location should be monitored to minimize the potential for groundwater degradation.

- The Dopping Brook/Bogastow Brook aquifer along the town line with Holliston is "thin" and not rated as highly productive. Nonetheless, the activities and land uses both in Sherborn and across the town line should be monitored to minimize potential groundwater degradation.

- A watershed divide is located across the northern corner of the town separating the Suasco Rivers basin from the Charles River basin. Flows from the Surasco basin generally travel out of town to Framingham.

- The northeastern portion of town near the Natick town line has an aquifer rated as moderate yield that could serve the Town's future needs. However, proximity to both the Natick and Sherborn landfills may compromise the viability of this potential source. Monitoring of groundwater quality in this area is important.

Overall, it will be helpful to Sherborn to examine the possible establishment of an "aquifer protection overlay district" in its zoning rules as a means to designate the highest yield aquifer areas in the town that warrant additional protection and land use controls.

4. HYDROGEOLOGICAL CONDITIONS MAPS

4.1 DESCRIPTION OF HOW MAPS WERE DEVELOPED AND HOW TO USE THEM

The maps presented with this report were developed using a combination of data sources. Geological data from earlier reports to the Town were made available to Woodard & Curran and are summarized in the bibliography presented in Section 2. These sources were important to this work as they provided both historical background information and findings from those respective sources. In addition to these sources, the study utilized various published sources of geologic and hydrogeologic data from the U.S. Geologic Survey (USGS) and Massachusetts GIS Office (MassGIS) that are cited on the maps.

The maps showing hydrogeological conditions have several uses to the Town. Indications of most favorable aquifer areas and areas with highest estimated groundwater velocities will guide the town toward locations to collect additional subsurface information in order to prepare the most appropriate and "bullet proof" aquifer protection zoning. These same areas and the noted areas of Special Concern will alert the Town to locations where special vigilance is necessary in the event of proposed development.

The maps taken together provide the "groundwater story" of the Town. They reflect the hydrogeologic conditions in Sherborn upon which present land use patterns and activities are built and become the foundation for future water resources planning and protection. The culmination of the mapping information is reflected in Figure 4 that illustrates surficial water resource features, groundwater contours and inferred flow direction and velocity, and six areas of the Town where "special concerns" are noted for water resources planning and protection.

Each figure is described in the following section with its map. The narrative provides a description of each figure's source, purpose and application to this groundwater study. Taken together with the previous studies and data sources of the Town, this report is the starting point for the Town to begin considering what further steps are needed to investigate and confirm with field testing groundwater conditions and establish expanded controls, such as an aquifer protection zoning overlay district, for groundwater protection. Only then can Sherborn determine whether potential future public water supplies may be warranted.

4.2 MAP #1 – ASSUMED GROUNDWATER FLOW

Figure 1 is a USGS topographic base map of the Town of Sherborn and the immediate surrounding area. The USGS topo base displays not only topography, but hydrographic features, stream, ponds, swamps, and rivers. These surface water features are significant in any groundwater study because they typically represent the "local base level" for groundwater; that is, the level to which all local, near surface groundwater flows. In the absence of some special conditions, these surface water features are assumed to represent groundwater elevation as well.

Figure 1 has superimposed on the base map a series of arrows which represent the estimated direction of groundwater flow. This information was presented to the Town previously in the 1989 Water Resources Investigation completed by Lycott Environmental Research, Inc. The estimated groundwater flow directions are based on a combination of actual groundwater elevation measurements in wells, interpretations from some seismic investigations and surface water elevations and basins. A quick look at the flow arrows illustrates how groundwater is leaving town in a generally radial pattern toward the

eastern and western aquifer valleys and to the north and south in response to the large river basin divide between the Charles River and the Suasco (Sudbury, Assabet and Concord Rivers) systems.

In north Sherborn, in the vicinity of Bare Hill, Paul Hill and Brush Hill, the Mass GIS system has interpreted the basin divide between the Suasco and Charles Rivers somewhat differently than the Lycott mapping. This alternate basin configuration is noted on the map with the blue arrows. According to Mass GIS, groundwater flow is consistent towards the Suasco basin, generally northward and eastward.

Figure 1 should be used to develop a basic understanding of the general patterns of groundwater movement within Sherborn.

Figure 1: Assumed Groundwater Flow and Basins

4.3 MAP #2 – AREAS FAVORABLE FOR TOWN WATER RESOURCES

Figure 2 shows the Sherborn town outline with major streets and roads and the same hydrographic features shown on Figure 1. In addition, Figure 2 presents the inferred locations of the most favorable aquifer materials for potential water supply development. This information is derived from USGS Sources and is based on mapping of geologic conditions. The most densely cross hatched or deepest colors are the most favorable areas of sand and gravel deposits for water supply. The most favorable conditions are considered to be the areas capable of delivering the greatest amount of groundwater to a well.

The principal aquifers on the east and west borders of the Town can be seen on this figure. The central portion of Town is largely uncolored, indicating the conditions of generally no sand and gravel materials, hence poor water resources potential, as described in Section 3.1.

We have drawn upon two sources of existing and published geologic mapping to develop this figure. One source is the USGS Hydrogeologic Atlas for the town (noted as sources in the title block). The second source is aquifer yield potentials as presented on the MassGIS data base for the Town of Sherborn. Both sources are based on mapping by the USGS, and together they present the most complete picture (using available secondary sources) of groundwater favorable geology.

Figure 2: Areas Favorable for Town Water Resources

4.4 MAPS #3 AND #4 – ESTIMATED GROUNDWATER CONTOURS AND AREAS OF SPECIAL CONCERN

Figures 3 and 4 present the map of Sherborn with Town outline, major and minor surface water basins and the hydrographic features of the Town. The purpose of these figures is to show the estimated groundwater elevations and, where possible, associated estimated groundwater velocities. This information goes one step beyond the estimated groundwater flow directions shown on Figure 1 by including groundwater velocities that can indicate potential flow directions where land use activities could be a concern. Figure 4 calls attention to areas of special groundwater concern for the Town of Sherborn. These interpretations, though based on estimates, can provide the Town with initial guidance in prioritizing its efforts at protection of groundwater quality and resources.

The estimated groundwater elevations were based on all available information from previous town-wide studies (see Section 2). In addition, mapped elevations of surface water features were assumed as representations of approximate groundwater elevations (the concept of this approach is discussed in the text for Figure 1).

Another typical hydrogeologic assumption has been used in developing the estimated groundwater elevation contours. That is, in the absence of information to the contrary, groundwater surface is assumed to mimic the ground surface topography. Thus, starting from the assumed or known groundwater elevations described above, estimated groundwater surface contours were drawn for reasonable distances away from the data points at slopes which mimic the ground surface.

With estimated groundwater elevations in hand and with surficial geology available (as mapped on Figure 5) it was possible to use standard hydrogeology formulas to develop estimated lines of groundwater flow and velocity. The various surficial geology formations were assigned hydrologic conductivities (permeabilities) based on mapped materials, the USGS favorability atlases and a USGS groundwater model for the upper Charles River Basin. These hydrologic conductivities were used in the groundwater velocity calculations.

The resulting lines of groundwater flow (shown in green) and associated groundwater velocities in feet per day (small black number) are shown on both Figures 3 and 4. In addition, to continue the overall groundwater flow context, direction of flow arrows are added to various streams.

Figure 4 utilizes the base map from Figure 3 with the addition of six selected areas of special groundwater concern where the Town is advised to direct special attention regarding groundwater protection. These "areas of Special Concern" are listed in the map's title block and numbered in the center of each symbol.

The first of these areas (#1) is one of the most favorable aquifers in town at the southeast corner along the Charles River. Immediately on the opposite shore and sitting on the same aquifer is the former Medfield State Hospital and its wastewater disposal beds. It is understood that the hospital is slated for redevelopment. The Town should follow very closely any redevelopment plans for the Hospital with respect to possible groundwater quality impacts at the site from reuse plans or from its wastewater disposal facility. Degraded water quality in the aquifer on the Medfield side of the river could limit the potential yield available to Sherborn in the future. This area of concern (#1) is called out because of its superior potential for water supply and because of the potential threat that might be posed by inappropriate (or uncontrolled) reuse of the former hospital site, its former or new wastewater systems, or its surrounding lands.

Area #2 is listed because it is also one of the best aquifers available to the Town and it is situated almost wholly within Sherborn giving the town significant control over this potential future supply. The Town should be very careful about activities and land uses allowed along Forest Street, Lake Street and Farm Road with regard to groundwater quality. The wetlands and ponds in the aquifer area are significant surface water features which might be impacted by any well withdrawals. Thus, the town should jealously guard the natural aquifer recharge and pay close attention to possible opportunities to enhance recharge from storm water, and protect the quality of that recharge.

Area #3 is the Dopping Brook/Bogastow Brook aquifer along the Holliston town line. The portion of aquifer material within Sherborn is rather thin and as a result the aquifer is not rated as highly productive. However, the aquifer might be exploited by use of a well field of multiple withdrawal points which could take advantage of recharge from the brooks. This fact was recognized during recent concerns expressed about development on the Holliston side of the brooks.

Area #4 is the "Downtown" portion of Sherborn. Aquifer materials here are thin and of rather low favorability; however, the area is immediately upgradient of one of the better aquifers in the northeast portion of Town. Thus, groundwater quality in the center of Town should be protected. It is understood that there have been previous problems with groundwater quality from highway salt and leaking petroleum tanks in this area. The Town should continue necessary steps to improve and protect groundwater quality in the area.

Area #5 is a section of Town where groundwater moves out of town to aquifers in other communities: To Framingham and possibly via stream discharge to Course Brook into Natick. In this area Sherborn can take action to protect the aquifer for both its potential use and the use by adjoining towns.

Area #6 is in the northeast portion of Town near the Natick town line. This aquifer is ranked as moderate yield, but is of considerable area and could be quite useful to Sherborn as a potential source. However, the proximity of the Sherborn and Natick landfills may compromise the viability of the aquifer further downstream along Indian Brook. Sherborn should remain engaged in the monitoring of groundwater quality effects from the landfills.

Figure 3: Estimated Groundwater Elevation Contours with Flow Direction and Estimated Velocities

Figure 4: Areas of Special Concern for Groundwater

4.5 MAP #5 – SURFICIAL GEOLOGY

Figure 5 presents basic surficial geology data for the Town of Sherborn. It was used in calculating the hydraulic conductivities for Figures 3 and 4. An inspection of this figure and comparison to Figure 2 illustrates how the surficial geologic materials dictate the favorability of certain areas for potential water supply. It shows that the central portion of town is covered with the pervasive glacial till and in some locations the perched swampy soils described in the town's groundwater conditions (see Section 3.1). The areas of favorable sand and gravel deposits corresponding to the higher yield aquifers are reflected generally along the north-eastern and south-westerns borders of town.

The data on this Figure is drawn from the four USGS surficial geology maps which provide full coverage of the Town.

Figure 5: Surficial Geology

5. FUTURE NEEDS AND STUDIES

5.1 DATA GAPS AND NEEDS

A number of information gaps and data needs still exist before Sherborn can fully address its groundwater protection needs. There are three categories of needs that Sherborn can obtain. These are:

1. Compilation of existing data and mapping;

2. Collection of monitoring well data; and

3. Expanded Zoning protection.

Compilation of existing data and mapping can begin immediately, depending on the availability of town personnel to do the work versus hiring outside consultants. A first step would be converting town assessor's records to a mapped digitized database that is registered to the State Plane Coordinate System. This would allow records on each town lot to be keyed into a mapping format with accompanying lot data (dimensions, house lot location, and improvements). The Planning Department is another source of data that may already have a digitized system of baseline data to which additional data and mapping can be added. The key element in this data collection and mapping is the initial data conversion to a digitized format and its mapping onto the State Plan Coordinate System.

Another step is to add Board of Health data to the database. Key information here would include locations of individual wells and septic systems, groundwater well logs of depth and water quality. Additional information on conservation land resources, open space and recreation lands, commercial and agricultural properties and many more categories of land use activities could be added to the database. As part of the data collection effort, digitized information from the U.S. Department of Agriculture National Resource Conservation Service (NRCS) soils data can be added onto the system and maps of the town. Where additional site-specific data exists from Board of Health records of individual lots, these can be added to the NRCS database.

As a parallel step, the Town may consider whether to undertake a town-wide digital database and mapping "Needs Assessment". Such an assessment would be carried out as a first step to define the specific needs of town departments and officials in compiling, organizing and using the range of public information and data sources that are presently decentralized and unformatted. The Assessors Department, Planning Board, Board of Health and Department of Public Works are the most likely users that would be integrated digitally and with mapping in such a system.

A Town field data collection and monitoring well program is a next important step. It is advisable for two reasons: (1) It will provide important confirmation of hydrogeologic conditions, such as groundwater flow contours, water table depth and sub-surface stratigraphy, necessary to establish additional zoning controls over land uses; and (2) it also can serve as an initial groundwater investigation of potential aquifer yields. A monitoring well investigation program would establish areas of the Town where potential high yield aquifers exist, where groundwater flows and directions are most vulnerable to development impacts, and where strictest controls by the town of land uses and activities are warranted.

Expanding the local zoning by-law protection would be another technique available to Sherborn. This could entail creating an "aquifer protection overlay district" to the existing zoning controls of the Town.

Such as district would, typically, involve designating those areas of town where the highest yield aquifers are located and warrant having special protection through increased land use controls. For example, one of the most ubiquitous groundwater quality threats is the presence of underground oil storage tanks. Appendix D in the Lycott report (1989) presents the results on an underground storage tank (UST) survey completed by the Town. It shows that at that time there were some 120 residential UST in Town, many of them located in the favorable aquifer areas of eastern Sherborn. The maps presented in the Woodard & Curran study will be helpful in determining which locations may require regulatory oversight by the Town. An aquifer protection district could impose more stringent controls on UST to limit the installation of these potential contamination sources and strictly control their use in areas where aquifer yield and groundwater quality are concerns.

5.2 BUDGETING FOR FUTURE STUDIES

The scope of further groundwater protection activities has not been defined at this time. A general plan of additional activities as presented in Section 5.1 can be used as a planning and budgeting tool for the Town as it goes forward with its groundwater resources protection activities.

The categories of activities described below are intended to be general tasks and budgets that will be further refined when specific tasks are requested by the Town. In cases where activities could be carried out by town employees, the accompanying budget figures are provided as cost references for comparable services provided by a consultant.

Task 1: Compilation of Assessors and Planning Board Data ..... $6,000 – $15,000

Task 2: Compilation of Board of Health and USNRCS Data ..... $10,000 – $20,000

Task 3: Digital Database Needs Assessment ..... $7,000 – $15,000*

Task 4: Monitoring Well Investigation ..... $24,000 – $50,000
(approx. $1,200 per well, assume 20 to 40 wells)

Task 5: Zoning By-Law & Overlay District..... $10,000 - $20,000

*GIS Mapping can be a widely varied undertaking depending on the extent of coverage, data applications and number of town users identified. Therefore, a "needs assessment" is recommended as a first step.