SCHOOL MEADOW BROOK
AQUIFER PROTECTION STUDY

Walpole, Massachusetts

September 1983

IEP inc.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF MAPS

LIST OF MAPS

LIST OF APPENDICES

1.0 INTRODUCTION

IEP, Inc. was retained by the Town of Walpole during June, 1983 to undertake a study of the School Meadow Brook aquifer and watershed located in Walpole, Sharon and Foxboro, Massachusetts (see Figure 2.1). The purpose of the study was to perform a hydrogeologic investigation which would identify through the use of geologic and land use maps the location and physical characteristics of the aquifer which provides the majority of Walpole's drinking water from groundwater wells. Four high yield wells - Washington Wells 2,3,4 & 6 - are located in the School Meadow Brook Aquifer. Based upon the hydrogeologic analysis a land use survey of areas critical to groundwater recharge and pollution prevention was performed.

The intent of this report is to: (1) provide the town with a prioritized list of immediate recommendations for aquifer protection and (2) serve as the required basis for further study and application for funding for land purchase under the DEQE Chapter 286 Aquifer Land Acquisition Program.

1.1 Method

The study was divided into three (3) phases. Phase 1 consisted of delineating the aquifer boundaries and physical characteristics. A map of the surficial and subsurface geology of the aquifer had not been previously prepared. The surficial geology of the entire School Meadow Brook watershed including the extensive potions located in Foxboro and Sharon were mapped in the field by an IEP geologist. Available existing subsurface data including test boring and production well logs, seismic surveys and highway borings (Rt. 1 & 95) were compiled and evaluated using a standardized format. A significant portion of the early weeks of the study were spent assembling, analyzing and locating existing pertinent data points. The data sources used are listed in the references. A complete Data Points Map (Figure 1) and Surficial Geology Map (Figure 2) were prepared on the 1" = 500' scale topographic base map (USGS enlargement). A second, more detailed base map on an aerial photo base at a scale of 1" = 200' was prepared for the Walpole portion of the School Meadow Brook watershed. Test wells located in the field and shallow monitor wells driven by IEP during this study are plotted on this base map. Test well pumping data and long-term pump test records were then analyzed along with observed watertable drawdowns to determine the aquifer hydraulic properties. Numerical computer modeling was used to simulate well pumage under varying conditions.

Phase 2 consisted of a Land Use Survey which involved a review of Walpole, Sharon and Foxboro zoning bylaws followed by field identification of existing industrial businesses and other potentially hazardous land uses. The Walpole DPW Maintenance facility which includes a 26,000 gallon underground fuel storage depot and road salt storage shed was a major focus of this land use survey. Field inspections were conducted at the DPW facility and at three industries along Route 1 which were felt to be potentially hazardous.

Phase 3 consisted of preparing a prioritized list of recommendations for protecting and monitoring ground water quality within the School Meadow Brook Aquifer. Conceptual design plans and cost estimates for improvements at the DPW facility were prepared. An annual groundwater monitoring program with recommended monitor well locations was formed along with a Contamination Response Action Plan. The Action Plan addresses measures to be taken in the event of a groundwater contamination incident at either the DPW facility or along Rt. 1 & 95 upgradient of the Washington Street wells. A map showing Significant Groundwater Areas, including areas which contribute groundwater flow to the wells and recommended land parcels to purchase under the Ch. 286 program, was prepared.

2.0 AQUIFER DELINEATION

The aquifer delineation consited of (1) mapping and evaluating the watershed surficial geology, (2) describing the regional hydrogeologic setting and (3) preparing a groundwater favorability map showing the aquifer saturated thickness contours and potential high-yield well areas.

2.1 Surficial Geology

The purpose of the surficial geologic investigation was to examine and determine the mode of deposition of the unconsolidated deposits of gravel, sand, silt and clay which overlie the bedrock. An understanding of the glacial geologic processes which formed these deposits and the sequence of the de-glaciation events allows the geologist to predict the physical properties of the deposits. Based on surficial geology and existing test well records, the most favorable aquifer areas - those areas with 40 feet or more of permeable, saturated sand and gravel suitable for high-yield gravel-packed well development - can be located. Understanding the physical properties (grain size, sorting, degree of compaction) of the surficial deposits is essential in understanding the characteristics of the groundwater aquifer.

Glacial processes occurring in Walpole had two major effects: (1) preexisting bedrock topography was scoured and eroded, and (2) the bedrock surface was covered with unconsolidated deposits of varying thicknesses. Although New England was glaciated numerous times during the Pleistocene Epoch, only deposits of the last glaciation (Late Wisconsin) are recognized here. This glaciation began 26,000 years before the present and ended approximately 13,000 years ago.

The movement of glacier ice removed all previously formed soils, incorporated this material into the ice, and used the material to abrade and polish the bedrock surface. The material eroded from the land surface during glacial advance became incorporated into the ice and was transported southward. It was during this glacial advance that the bedrock valley underlying School Meadow Brook was scoured and deepened.

Glacial deposition consisted of two types: deposition of material directly by the ice (till), and deposition of material melted from the ice and then transported and deposited by meltwater streams (stratified drift). The distribution of these surficial materials is presented on the Surficial Geologic Map (Figure 2).

Glacial sediments deposited directly by glacier ice with relatively no influence of meltwater are called till (hardpan). Till is best described as an unsorted to poorly sorted, unstratified mixture of sand, gravel, and boulders, with some silt and clay. Till plastered upon the surface of the bedrock by the moving ice is called lodgement till. Till may also be deposited as the ice wastes (or melts), and is then called ablation till. Glacial till is generally thin, less than 20 feet, but can be as thick as 200 feet in drumlins. The extent of glacial till exposed within the School Meadow Brook watershed area is minimal. Glacial till and bedrock are exposed on Bluff Hill and Pierce Hill in Sharon and to the south on Dudley Hill in Foxboro, in the headwaters area of School Meadow Brook. Glacial till is generally very dense and does not transmit groundwater readily Till has low permeability and infiltration rates and is therefore of little importance as a groundwater aquifer. Well yields in till are suitable only for domestic use where 10 gallons per minute (gpm) or less is needed.

As the glacial ice front retreated from south to north through Walpole - that is, as it melted faster than it advanced - a margin of stagnant ice developed beyond the active ice front. Sediment-laden meltwater streams, flowing off of the melting active ice, carried the debris southward and deposited it in various depositional environments. In the stagnant ice zone, depressions and cracks developed in the ice blocks and enlarged due to melting. These holes and cracks filled with sorted sands and gravels from stream sediments.

After glacier ice melting was complete, piles of free standing stratified sands and gravels were left. These stratified drift deposits are called kames, kame terraces, eskers and kettle holes. Where temporary lakes occured at lower elevations in the valley, fine-grained sand and silt were deposited.

The resulting topography consists of kame terraces draped up against the till/bedrock upland hills with kames and eskers leading up to them in the valley. By determining the elevation range and texture of the deposits the depositional sequence was determined. Four terrace sequences were found within the School Meadow Brook watershed. Their designation and range of elevations is as follows:

Sequence	Elevation Range
Qfc_1	280-310 msl
Qfc_2	250-270 msl
Qfc_3	230-240 msl
Qfc_4	190-200 msl

The oldest sequence designated as Qfc_1 has an elevation range from about 310 to 280 feet above sea level. It consists of a kame terrace deposited against the eastern hills, and kames deposited in the central part of the aquifer and along the western edge of the watershed. As the ice melted further northward and downward sequence Qfc_2 was deposited with a top elevation of about 260 feet above sea level. It is a kame terrace around the oldest sequence with eskers leading to the terrace. Qfc_3 has a top elevation of about 230 to 240 feet. There were also kame terrace and kames located in the northern section of the aquifer. Unit Qfc_4 is the lowest and most recent glacial unit in the area and is found from elevations 190 to 200 feet above sea level.

Where kettle holes intersect the water table a lake or swamp developed. Many of these lakes gradually filled with sediment and organic material and become swamps. The valley of School Meadow Brook in Walpole is the primary wetland area, with many other kettle hole wetlands found within the watershed.

The stratified drift kame and esker ice contact deposits are the coarsest and most permeable sediments within the watershed and are therefore the most favorable for groundwater resource development.

The five existing municipal wells near Washington St. in the School Meadow Brook aquifer - Washington Wells #2,3,4,5 & 6 - are located in Qfc_3 and Qfc_4 stratified drift deposits adjacent to School Meadow Brook which serves as a major source of groundwater recharge.

2.2 Regional Hydrogeologic Setting

The School Meadow Brook watershed encompasses approximately 1,865 acres. The headwaters of the brook originate from a series of ponds located south of Pine Street near the Walpole, Foxboro, and Sharon town lines. Betweeen Pine St. and Route 1, stream flow is in a northeasterly direction, with a moderate drop in elevation of 60 feet over a distance of 2500 feet. Downstream of Route 1, School Meadow Brook slowly meanders through a shrub swamp dominated wetland area, until it passes under Washington St. at a distance of approximately 4700 feet. Downstream of Washington St. two small tributaries flow into School Meadow Brook before its confluence with the Neponset River.

The precipitation that falls on the watershed is either taken up by plants or evaporates (evapotranspiration), percolates downward to the groundwater table, and/or leaves the watershed through surface flow. The relative percentage of each component depends on the infiltration capability of the unit that the precipitation lands on or flows over. Glacial till has a low infiltration capability and therefore most of the precipitation runs off. Stratified sands and gravels have a higher infiltration rate and, therefore, a greater percentage of the precipitation infiltrates downward to the groundwater table (recharge). For this reason, stratified drift deposits are almost always the primary recharge areas for municipal wells, as well as being those areas most important in terms of groundwater protection.

In the School Meadow Brook watershed approximately 75% of the surface area consists of stratified sands and gravels with a much smaller percentage as glacial till or fine grained swamp deposits. The estimated aquifer safe yield (groundwater withdrawal which can be maintained on a long term basis) of 2.4 mgd (G&M, 1966) was calculated based upon average recharge rates of 0.6-0.9 million gallons per day per square mile (mgd/mi.^{2}) for stratified drift and 0.3-0.4 mgd/mi.^{2} for glacial till.

School Meadow Brook is the sole surface water outflow from the watershed. School Meadow Brook has a tributary from the east and two streams that join in the south to drain the watershed in Foxboro and Sharon. All three tributary streams flow beneath, and collect runoff, from both Route 1 and Route 95.

Where the streams flow over sand and gravel deposits they have a direct connection with the underlying aquifer and a great impact on aquifer recharge and groundwater discharge. Stream segments which flow across glacial till and fine-grained silts and thick swamp deposits, which have low infiltration rates, are usually not in direct connection with the aquifer and recharge the aquifer very slowly. This is important in the wetland/brook floodplain adjacent to the town well fields where groundwater is stored in the surface swamp deposits during the winter and spring high streamflow periods and then slowly released during the summer peak pumping periods.

The aquifer is comprised of coarse grained stratified sand and gravel deposited directly above the glacial till. Precipitation falling on the glacial till collects mostly on the surface and runs off. A greater proportion of the water falling on the sand and gravel deposits infiltrates to the water table. Thus, the aquifer is recharged primarily by water infiltrating through the sand and gravel deposits fringing the basin, mostly kame terraces and kames. It is for this reason that sand and gravel deposits adjacent to high yield wells are referred to as primary recharge areas. The fine grained sediments that collected in the kettle holes and valley bottom act as an aquitard, that is, they restrict groundwater flow either up or down. This has the effect, described above, of storing water for release during summer low flow periods.

2.3 Aquifer Saturated Thickness

All available subsurface exploration data including test borings and seismic refraction surveys were collected and tabulated in a table contained in Appendix A. Primary data sources were the 1959 Fay, Spofford & Thorndike study, the 1966 Geraghty & Miller study, the 1973 U.S.G.S. Hydrologic Data Report, and roadway boring logs drilled during the design of I-95. Long term 8" test well and production well pump test records and logs for Washington Wells 4,5 & 6 were also studied. Logs for the 188 2-1/2" wells which comprised the now unused Washington St. tubular well field were generally shallower than recent deep gravel-packed wells and were not as informative for determining the aquifer properties.

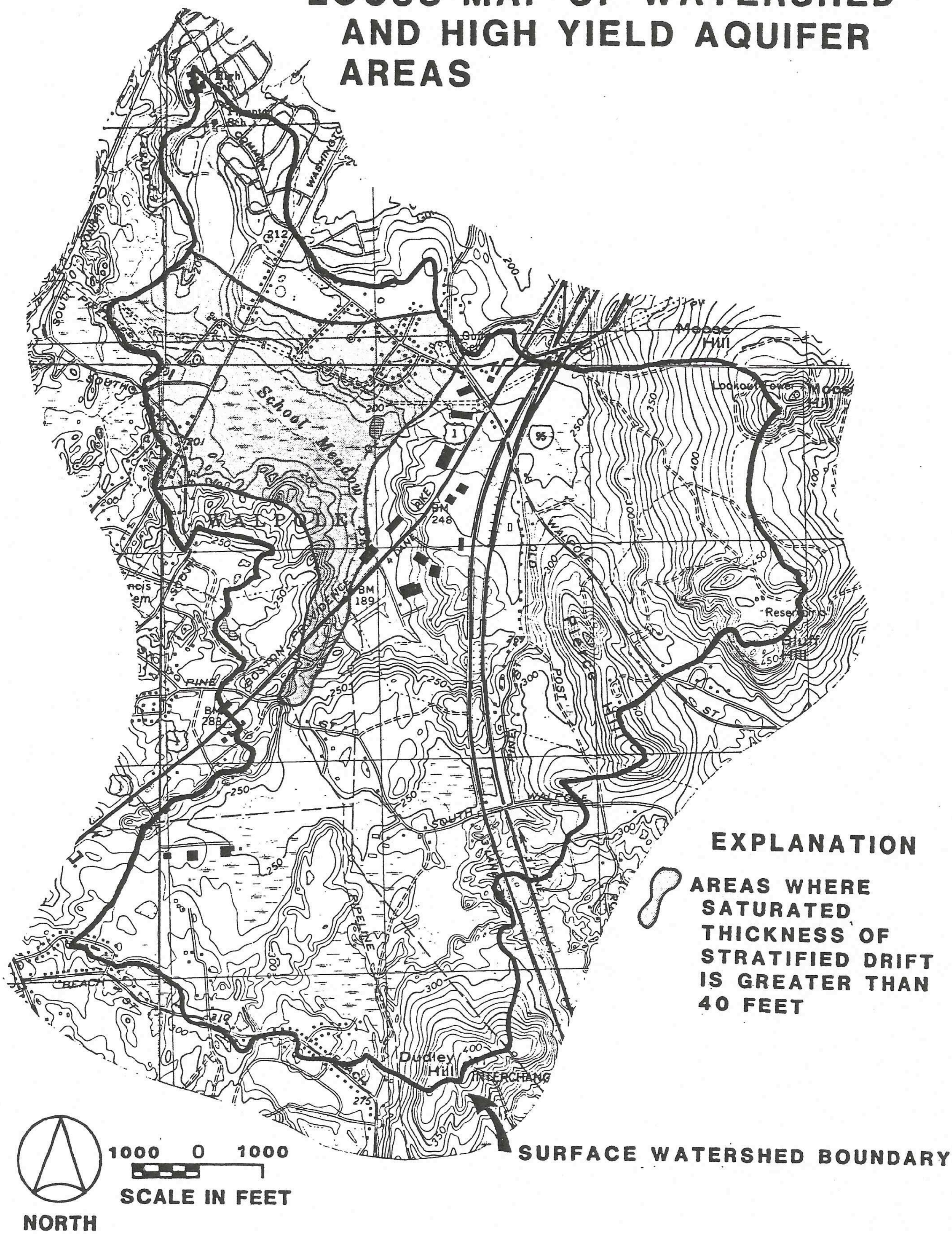
For each data point, as located on Figure 1, the saturated thickness of stratified sand and gravel was determined. A contour diagram of the saturated thickness data points was then prepared as shown on Figure 4 - Groundwater Supply Favorability Map. This can be considered as a 'location map' for the groundwater aquifer. The zero saturated thickness line is the geologic contact between glacial till and stratified drift. The deepest portions of the aquifer and the areas recommended for any test well exploration are those areas which have a saturated thickness greater than 40 feet.

As seen in detail on Figures 4 & 7 the deepest portion of the School Meadow Brook aquifer lies beneath Washington St. and the DPW garage and extends out of the watershed continuing westward beneath Cedar Swamp. Figure 2.1 is a reduced scale aquifer map which delineates the high yield aquifer area - that area with >40 feet of saturated statified sand and gravel.

The saturated thickness ranges recorded within the School Meadow Brook Aquifer ($0-60^+$ feet) have been correlated with aquifer transmissivities and ranked according the reported range of well yields. As can be seen on the legend for Figure 4 - Groundwater Favorability, the highest potential well yields (100-1000 gpm) occur in those areas where the saturated thickness is greater than 40 feet and the corresponding transmissivity is greater than 30,000 gpd/ft. Transmissivity is a measure of the saturated soils ability to transmit water and is expressed, in gpd/ft, as the flow possible through the entire saturated thickness of the aquifer.

Two areas outside of, but adjacent to, the School Meadow Brook aquifer which have sufficient saturated thickness of stratified drift to warrant further exploration for groundwater supply are Cedar Swamp and Traphole Brook. Both these areas have not been fully investigated and are the only remaining watersheds in Walpole which have the necessary geological characteristics to support long term groundwater withdrawal.

FIGURE 2.1
LOCUS MAP OF WATERSHED AND HIGH YIELD AQUIFER AREAS



SCHOOL MEADOW BROOK AQUIFER PROTECTION STUDY
TOWN OF WALPOLE, MASSACHUSETTS

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3.0 AQUIFER CHARACTERISTICS

Figure 3.3 is a generalized schematic of a buried valley aquifer similar in configuration to the School Meadow Brook aquifer. This schematic illustrates two important groundwater aquifer concepts: recharge areas and brook-aquifer interactions. Because of the significantly different recharge potential of till versus stratified drift, stratified drift recharge areas are termed primary and till recharge areas are termed secondary. In this section the recharge areas for each well - the surface areas which contribute groundwater flow to the wells - will be discussed. Installation of numerous shallow observation wells was undertaken in order to measure the brook-aquifer interaction during well pumpage. Based on these measurements, and analysis of pumping test records, numerical computer models were developed which calculated the cone-of-depression (area of water table drawdown) for each well. This cone of depression data was incorporated with recharge area delineations to develop a Significant Groundwater Areas map (Figure 3.2) which defines 3 zones for groundwater protection in accordance with the Mass. DEQE Ch. 286 Aquifer Lands Acquisition Program.

3.1 Well Recharge Areas

The primary recharge area for the existing Washington Wells includes the School Meadow Brook wetland and floodplain located west and east of Washington Street. The cone of depression for each municipal well as determined through a combination of field monitor well measurements and computer modeling extends to, and during extreme droughts, beneath and beyond School Meadow Brook. This aspect of the study is discussed in Sections 3.3 and 3.4. The primary recharge area also includes the stratified drift uplands north of the municipal wells and south of Common Street, an area of residential development which is predominantly sewered and not felt to be a major source of potential groundwater contamination. The primary recharge area which is of critical importance to groundwater quality consists of the stratified drift deposits south and east of the Washington Wells. It is in these two areas that the major potential contamination sources exist: (1) the DPW Maintenance Facility, (2) unsewered residential areas, (2)industrial developments and (4) Route 1 & I-95. Surface runoff and groundwater flow from all these sites flows into or beneath School Meadow Brook and has the potential to contaminate any of the 4 operating wells.

The greatest potential source of groundwater contamination within the pumping wells cone-of-depression/primary recharge area is the fuel storage depot at the DPW garage. This 26,000 gallon underground storage depot is within the pumping well influence of Washiongton Well #2 and through School Meadow Brook has a hydrologic connection to Washington Well #4. That is, pollutants which seep into the groundwater system from the fuel storage area will be drawn downward and into Well #2. This contamination, if not contained, could also enter School Meadow Brook, flow a short distance, and then be drawn into Well #4 as induced infiltration through the streambed. A secondary source of contamination at the DPW facility is the salt storage shed. A detailed discussion of the entire DPW Maintenance Facility is contained in Section 5.0.

The secondary recharge area to the School Meadow Brook aquifer is considered to be that area outside of the sand and gravel aquifer area which contributes surface or groundwater flow into the primary recharge/cone of depression zone. For the Washington Street wells the secondary recharge areas most critical to aquifer protection are the till uplands which form the headwaters of School Meadow Brook which then flows through the industrial zones of Foxboro and Sharon upgradient of Route 1. This area also collects runoff and deicing salts from Route 1 & I-95. Existing land uses are shown on Figure 5 - Land Use and described in Section 4.0 - Land Use Survey.

3.2 Observation Well Installation

Ten observation wells were installed during July and August, 1983 within the School Meadow Brook aquifer by IEP, Inc. personnel. These wells were located in order to accurately monitor water table drawdowns between the pumping Washington Wells 2,4 & 6 and School Meadow Brook. Six wells were installed on the northern side of School Meadow Brook, three on the southern side and one adjacent to Washington Well #2 near the DPW garage, for a total of ten 1-1/4" observation wells.

The wells consist of a brass well screen, galvanized 1-1/4" pipe and a cap. The screens used were 30" long and were covered with a 60 mesh brass gauge, creating openings in the guage of 0.060 inches. The screens are joined to 5' lengths of 1-1/4" galvanized pipe with drive couplings and are driven to the desired depths (6.7-15.4 feet deep) with a 40 pound piston-style hammer.

In all cases, the well screens were driven completely through the overlying organic layer and into the underlying geologic unit. This eliminates the possibility of elevated water table readings because of perching created by the relatively impermeable organic layer. The thickness of the organic layer encountered along School Meadow Brook ranged from three to six feet.

Figure 3.1 is a surveyed locus plan which shows the location of all IEP installed well points and existing test wells which were used for groundwater monitoring. A total of 25 wells were located, surveyed and monitored during the course of this study. The existing test wells which were used are 2-1/2" test wells left from previous test well explorations and long term pump tests. Old wells from the abandoned Washington Street tubular well field were not located in the field and were not used for monitoring.

The table in Appendix B lists the top of pipe elevation for each observation well; the groundwater levels measured on 8/15/83 were found to be the lowest measured during the study and are also listed. These measurements were used to illustrate the water table topography and drawdown on Figure 6.

Two monitor wells were installed near gravel-packed well No. 5 in order to determine the impact pumping Washington Wells #2 & #3 has on water table elevations near the brook. Well point one (WP1) was installed at the brooks edge 210' southwest of Well No. 5. A stake was driven in the brook in order to monitor surface water elevations. WP2 was installed 130' from Well No. 5 in the wetland. Including the existing 2-1/2" monitor wells, five wells are now available for monitoring water table drawdown elevations around well #5 and between pumping wells #2 & #3. These wells are also suitable for groundwater quality sampling near the brook at Washington St.

WP3 and WP4 were installed in the wetland southwest of Washington Well No. 3. WP3 was installed at the brooks edge along with a staff gauge to monitor surface water levels. Including the five 2-1/2" monitor wells, there are now six observation wells in the immediate vicinity of Washington Well No. 3.

Six observation wells are located around Washington Well No. 6 consisting of four existing 2-1/2" wells and IEP installed monitor wells, WP5 and WP6. WP5 was located 480' south of Well 6 near the wetland/upland border. WP6 was installed at the approximate edge of the poorly channeled brook, 575' from Well 6.

One well point WP9 was installed 228' west of Washington Street in the wetland adjacent to Washington Well No. 2. WP9 and 2-1/2" observation well TW-1 were used to monitor drawdowns in the water table caused by the pumping of Well No. 2.

The three remaining wells were installed on the southern side of School Meadow Brook using the access road across from Washington Well No. 2. WP8 was located approximately 500' further east of WP7, across the brook from Washington Well No. 3. These three monitor wells were used in determining watertable drawdowns across the brook from the pumping wells.

Groundwater monitoring was concentrated on the east side of Washington St. because of the extensive wetlands in the area and because numerous test wells were already in the area. Well drawdowns and well interference from both Washington Well #2 & #6 could be monitored in this area as well as the drawdowns from pumping #3 & #5. Washington Wells #3 & #5 were not operating during this study. Well #5 is not approved for use and Well # 3 was shut down due to pumping of nearby Well #6. It was felt that the 3 existing observation wells surrounding Washington Well #4 were sufficient for estimating the pumping cone of influence in that area. An 8 day pump test on the 12" production test well at Wahsington Well #4 was available for this site and provided an adequate data base.

3.3 Brook-Aquifer Interaction

Prolonged pumping of the Washington St. Wells results in a phenomenon known as "induced infiltration" whereby the watertable drawdown extends laterally over time until the 'cone of depression' intersects the surface water of School Meadow Brook. Water from the brook then begins to leak downward through the streambed and is drawn towards the pumping well. Because School Meadow Brook flows on top of a 2-6 foot thick layer of relatively impermeable organic deposits the rate of downward leakage or induced infiltration is relatively slow.

Permeability tests were performed at 3 sites near the brook to measure the rate at which water flows through the organic deposits. A range of permeabilities from 1-5 gpd/ft^2 was recorded. This is extremely slow when compared with the aquifer permeability of from 500-1500 gpd/ft^2. Geraghty & Miller (1974) in their Artificial Recharge Feasibility Study noted this when recommending removal of organic deposits and damming of the brook as a possible way to increase groundwater recharge. The damming of School Meadow Brook at the DPW facility and the small pond created help to reduce drawdown at Well #2 by supplying a constant source of recharge.

The cone of depression can extend beyond the brook during severe drought/pumping conditions; although it was not observed to do so during this study. The drawdown levels measured on August 15, 1983 with Washington Well #6 pumping 1.3 mgd, #2 pumping 0.25 mgd and #4 pumping 0.67 mgd influenced water levels up to, but not beyond, the brooks edge. This is evidenced by the water levels in WP7 and TW-75 which had daily fluctuations of about 0.2 feet, while well WP6 fluctuated 0.5 feet daily due to the pumping of Well #6. In other words, during mid-August 1983 surface water on the south side of School Meadow Brook was near WP7 was apparently not being drawn towards Washington Well #6. However, surface water flowing in the stream channel did appear to be leaking into the groundwater aquifer and flowing into Well #6/

When induced infiltration occurs adjacent to the pumping wells, surface water of a given quality is drawn down into the well. Certain relatively soluble constituents of the surface water (bacteria, metals, phosphorus) are filtered; however many highly soluble and mobile inorganic constituents (nitrate, sodium, chloride,) as well as organic hydrocarbons, are not effectively filtered and move directly with the groundwater flow towards the well.

In order to estimate the percentage of surface water which is induced into the wells numerical computer modelling was performed. Based upon the pump test and observation well data the specific aquifer properties: transmissivity, permeability, saturated thickness and effective storativity were estimated.These values were then input to a two-dimensional groundwater flow simulation model which predicts the cone-of-depression for varying pumping conditions.

Analytical analysis, using desk top methods, to determine the cone-of-depression around a pumping well often results in a perfect circle surrounding the well, with drawdown depicted as equal at any point equidistant from the well. In reality, the water table drawdown gradient between the Washington Wells and the brook is less than the drawdown gradient betwween the wells and the upland areas. This is because School Meadow Brook acts as a partial stream intercept. A summary of the Washington Well characteristics is listed below.

Table 3.1 Summary of Washington Wells Characteristics

Well No.	Date of Service	Design Pump Rate (gpm)	Well Depth (ft.)	Saturated Thickness (feet)	Drawdown (feet)	Specific Capacity (gpm/ft.)
2	1970	500	63	60	22	38.6
3	1973	350	58	58	21	18
4	1976	750	45	42	13	52.8
5	1982	500	60	53	-	-
6	1982	1000	72	64	25	40

Transmissivity values for the 5 Washington Wells range from 45,000 - 90,000 gpd/ft, based on pump test and observation well monitoring. Transmissivities were also estimated from boring logs by assigning a hydraulic conductivity or permeability value to the material based on the grain size classification found in the boring log. These transmissivities are listed in the Data Points Tables in the units of ft^2/ day, which can be converted to gpd/ft by the conversion factor 7.48 gaL/ft^3.

IEP used a watertable version of the Prickett-Lonnquist Aquifer Simulation Model (PLASM) to simulate the cone-of-depression observed for Wells #2,4 & 6 pumping at the rates mentioned above for August 15, 1983. PLASM is a two-dimensional model, that is, the aquifer is assumed to be one single homegeneous, isotropic layer. The finite differenc alternating implicit method is used to solve the partial differential equations for groundwater flow in a horizontal plane. The model results calibrate closely to the observed conditions when an induced infiltration recharge of 25-40% of the total withdrawal is assumed. Thus, School Meadow Brook contributes 25-40%

and the groundwater zone contributes 60-75% of the water pumped from the School Meadow Brook Aquifer.

The intent of these simulations was to identify the maximum practical limits of the cone-of depression which occurs in the Washington Street Wellfield - and thus identify the primary recharge areas which should be protected from the possibility of groundwater contamination.

3.4 Significant Groundwater Areas

The School Meadow Brook aquifer and the 4 operating municipal wells are extremely susceptible to groundwater contamination from hazardous waste disposal. The occurence of freon 113, a commonly used organic hydrocarbon degreaser, in trace concentrations in well #2 is an example of the direct connection between the deep groundwater wells and the shallow surface water/groundwater zone. At least two industries along Route 1 are known to use freon 113 in their industrial process. School Meadow Brook has been shown to provide a considerable amount of recharge through induced infiltration. Any hazardous chemicals introduced into the surface water either from the DPW Facility or from the highway and industrial sources along Route 1 have the potential to contaminate one or all of the pumping wells. Surface water flow in the brook will transport contaminants much faster than normal groundwater flow. Furthermore, recorded maximum and minimum flows for School Meadow Brook at Washington St., reported in the USGS Hydrologic Data Report, are 5.95 cfs and 0.06 cfs. This suggests an extremely low dilution capacity of the brook to reduce contaminant concentrations (IEP, 1977). Regular monitoring of surface and groundwater quality in the immediate vicinity of the DPW and Route 1 will greatly reduce the risk for contamination of the wells by alerting the town to a groundwater contamination problem before contamiants reach the well. Average groundwater flow velocities within the aquifer are 1-5 ft/day. Thus, a spill at the DPW gasoline depot, 650 feet from Washington Well #2 would take a minimum of 130 days to reach the well.

A map of Significant Groundwater Areas (see Figure 3.2) has been prepared in accordance with the Mass. DEQE Ch. 286 Aquifer Lands Acquisition Application Form. This map delineates three seperate groundwater protection zones:

Zone 1 — 400 foot radius surrounding each well or the area designated by DEQE for protection of the supply.

Zone 2 — Aquifer area which contributes water to each well under the most severe pumping conditions, i.e. 180 days continuous pumping at the safe yield during summer/drought conditions. The limit of this zone is defined as the locus of points where the water table drawdown during pumping is less than 0.1 feet.

This cone-of-depression is then extended upgradient to the boundary of the sand and gravel aquifer.

Zone 3 — The drainage area as determined by topography and geology which contributes surface and groundwater flow into Zone 2.

Within the Town of Walpole portion of the School Meadow Brook watershed only Zones 1 and 2 are found. Aquifer lands proposed for acquisition under the Ch. 286 program are shown on Figure 3.2 and listed on a priority basis in Section 7.0 - Recommendations.

4.0 LAND USE SURVEY

4.1 Existing Land Uses

The land uses in the School Meadow Brook aquifer are of four types - open space, residential, commercial/industrial and highway. Each use has a distinct effect on the aquifer.

OPEN SPACE constitutes a considerable portion of the watershed. This open space is mostly swamp land and abandoned agricultural areas within the Walpole Town Forest. Open space land is an asset to aquifer protection. It insures few sources of pollution and undisturbed attenuation capabilities of the soils. However, unless the land is dedicated open space land, it is always subject to development pressure.

RESIDENTIAL single family developments have a limited effect on the aquifer. Almost all of the residential areas north of the Washington Wells along Common St. are sewered, thus reducing the quantity of septic leachate being introduced into the watershed. These sewered residential areas are not felt to pose a threat to municipal well water quality.The remaining sources of potential groundwater contamination are from lawn fertilizers, animal wastes and the relatively small quantities of de-icing salts used by individual homeowners.

COMMERCIAL AND INDUSTRIAL areas in the watershed are concentrated along Route 1. The types of businesses present in the watershed include manufacturing plants for metals, chemicals and carpentry; sales and service facilities including truck sales, motels, restaurants and professional offices. The existing commercial/industrial uses in the watershed are shown on Figure 5, the Land Use Map.

The manufacturing plants use and generate byproducts that can be harmful to water quality. If handled or disposed of improperly, these byproducts can severely affect an aquifer. Numerous municipal and private wells in

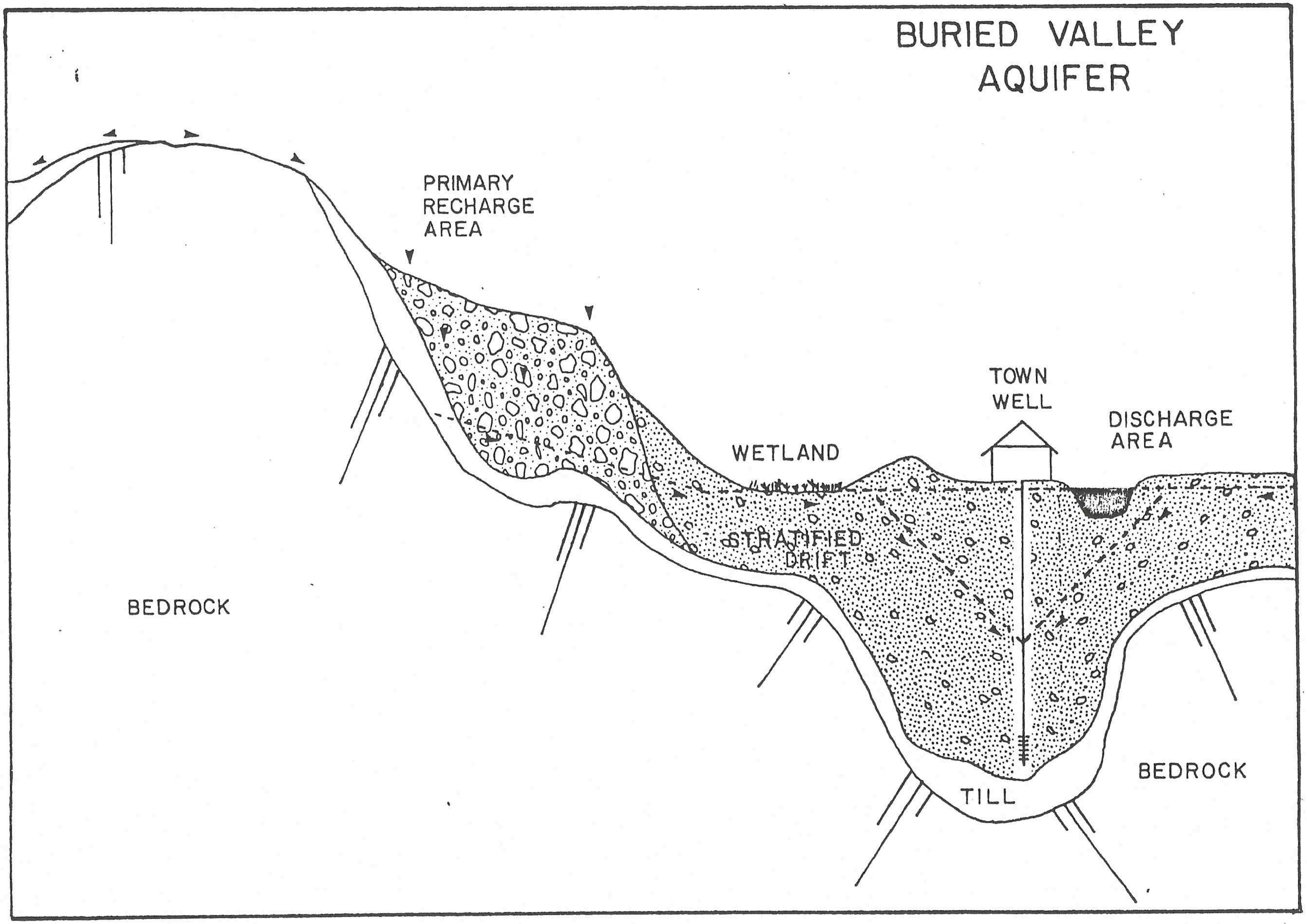

BURIED VALLEY
AQUIFER
PRIMARY
RECHARGE
AREA
WETLAND
TOWN
WELL
DISCHARGE
AREA
STRATIFIED
DRIFT
BEDROCK
TILL
BEDROCK

FIGURE 3.3

toxic, radiological on unhealthful contaminants to the aquifer, rendering it unuseable for a public drinking water supply.

In addition to examining the existing land uses, the potential for a future adverse land use was also addressed. Zoning maps and bylaws for the towns of Foxborough, Sharon and Walpole were examined and are discussed below. The non residentially zoned areas of these towns are shown on Figure 5.

4.2 Zoning Bylaws

Existing zoning bylaws for the Towns of Foxboro, Sharon and Walpole have been reviewed. Zoning districts for each town are shown of Figure 5 - Land Use and also on Figure 8 on the 1" = 200' air photo base map.

Foxborough

Both General Business and Limited Industrial zoning districts occur within the School Meadow Brook watershed, while a Special Use district lies just to the west of the watershed boundary. These districts are shown on the Land Use Map (Figure 5). The remaining land area in Foxborough is zoned Residential R-4;0.

Residential district R-40 is designed "to promote agricultural uses and low density residential uses and to allow other selected uses which are compatible with the open and rural character of the town." From an aquifer protection perspective, the R-40 district regulations are very compatible with water supply concerns. The minimum lot sizes are 40,000 square feet (s.f.) for single family homes and 20,000 s.f. for cluster development, although the inclusion of common open land must bring the total land area per dwelling unit up to 40,000 s.f. in a cluster development. These large lot sizes will safeguard against excessive housing density in unsewered areas where the land's ability to adequately filter and rejuvenate the waste could be exceeded. Therefore, current zoning in R-40 adequately addresses the most obvious adverse effect that residential land use has on water quality - the loading of nitrate and phosphorus concentrations in the groundwater. The permitted uses outlined in Table 2-5 of the Town of Foxborough Zoning Bylaws (revised June 1980) for district R-40 are all compatible with water supply protection concerns.

General Business district GB is designed for "retail commercial and service uses." There are several permitted or special use permit uses in this district which could pose a threat to the groundwater in the event of an accidental spill. Retail sale of high, medium and low hazard materials (use groups A, B-1 and B-2, respectively) are permitted in this district. Industrial uses (use group D) and research and development laboratory facilities are subject to special use permit approval. The use group categories referred to above will be discussed below.

The Limited Industrial district is designed for " broad spectrum of clean industries operating under high performance standards." However, high, medium and low hazard uses, as well as industrial uses and research and development laboratory facilities are permitted in this district. The land zoned LI in the School Meadow Brook watershed is currently undeveloped, and due to the nature of the uses allowed in this district, could be developed into a land use adverse to water quality.

The Special Use district is designed "to encourage the innovative and creative design on commercial and industrial development... which could produce detrimental effects on neighboring properties if not strictly controlled as to location and design." Medium and low hazard uses, industrial uses and research and development laboratory facilities are permitted in this district.

The Town of Foxborough defines high, medium and low hazard uses as use groups A, B-1 and B-2, respectively, in their zoning bylaws. Specific uses for each group are outlined in the bylaw; however, the general definitions of these groups are summarized below. Use group A includes "the storage, sale, manufacture or processing of highly combustible or explosive products or materials which are likely to burn with extreme rapidity or which may produce poisonous fumes or explosives." Use group B-2 includes "the storage, sale, manufacture or processing of noncombustible materials, and of low hazard wares that do not ordinarily burn rapidly." Industrial use group D includes "fabricating, assembling or processing of products or materials... except those involving highly combustible, flammable or explosive products and materials of the high hazard use group."

Thus, the General Business, Limited Industrial and Special Use districts all allow land uses that could be detrimental to water quality. However, one potential safeguard to future development in the School Meadow Brook aquifer exists in the Zoning Bylaws. The Foxboro Planning Board may require the applicant to submit an environmental impact statement for "a building or structure or use on environmentally sensitive lands." It would be prudent for the Foxboro Planning Board to exercise this option on any future applications within the watershed to screen out land uses that could adversely effect water quality in the aquifer.

The Town of Walpole should also express its concerns to Foxboro officials on proposed developments in Foxboro which might impact the School Meadow Brook Aquifer.

Sharon

The land in Sharon within the School Meadow Brook watershed is zoned Residential A and Light Industrial. The residential district has a 40,000 s.f. minimum lot size which is a safeguard against groundwater contamination from septic leachate. The only potential threat to water quality from this district involves the "scientific research or scientific development or related production" use which is allowed under a special permit "provided that the Board finds that the proposed accessory use does not substantially derogate from the public good." Hopefully a use that would endanger groundwater quality in the aquifer would be denied within the watershed.

The Light Industrial district is the only manufacturing/industrial zoning district in Sharon. The specific permitted uses are outlined in the Zoning Bylaws (amended April 1982), however, it appears that most industrial uses are allowed. The only prohibited uses are planning mills and 'the manufacture, compounding, processing, packaging or treatment of... fish or meat products, sauerkraut, vinegar, yeast, and rendering of fats and oils.' About half of the light industrial land is undeveloped and the developed portion is always subject to changes in tenants of the existing buildings. With such vague wording in the zoning bylaws, this area is subject to a host of potential adverse land uses which could endanger the School Meadow Brook aquifer.

Sharon has a Water Resource Protection District "to protect public health by preventing excessive degradation of groundwater utilized for public water supply." Unfortunately, the School Meadow Brook watershed is not included in this district. It would be prudent for the Town of Sharon to include the School Meadow Brook aquifer in the Water Resource Protection District.

Walpole is the only town which relies on School Meadow Brook as a source of potable water and thus must take the initiative in working for aquifer protection immediately outside of the town boundaries.

Walpole

The residential land in Walpole falls into three zoning districts: R-A, R-B and Rural, with minimum lot sizes of 30,000 s.f., 20,000 s.f. and 40,000 s.f., respectively. Although these lot sizes are equal to or smaller than the minimum sizes in adjacent towns, much of the R-A and R-B zones are in sewered areas so large septic leachate loadings in the groundwater are not a problem. Furthermore, the bylaw requires that any residence designed for more than one family be connected to the public sewer system. Therefore, the permitted residential uses in Walpole appear to be compatible with water quality protection.

Both the Limited Manufacturing (LM) and Industrial areas in Walpole allow uses that are adverse to protection of the aquifer. The allowed uses are similar in both districts. No prohibited uses are outlined for the Industrial district while bulk storage of petroleum or petroleum products and bulk processing of wood or lumber are prohibited in the LM district. Dry cleaning or dying works, carpet cleaning plants and research, experimental or testing laboratories require special permit approval in LM but are allowed without a permit in the I district. The complete list of use regulations is included in Section 3-B of the Walpole Zoning Bylaws (appended October 1982).

The business district allows public service and retail establishments that should not be adverse to water quality concerns. However, light manufacturing as an accessory use is allowed and could be a potential threat to water quality. No warehousing of goods to be sold is allowed in this district.

The worst potential threat to water quality involves the largely underdeveloped LM and I districts where many adverse land uses are permitted under the existing bylaws. It would be in the town's best interest to establish a water resource protection district and/or require the submittal of an environmental impact statement for any proposed development in the watershed.

4.3 Site Inspections

Site inspections were conducted with Mr. Warren Bushway, Walpole Board of Health Agent on September 2, 1983 of three industries along Route 1: Metal Bellows Mfg., Walsh Chemical, and Datamedix, Inc.

Metal Bellows Mfg. performs metal plating and machining of metal parts. The use of degreaser solvents within the plant is restricted to one room which cointains no floor drains. The primary solvents used are freon, methylene chloride, and 1,1,1-trichloroethylene. All solvents are used in a self-contained watertight tank and stored in metal drums in a concrete lined vault prior to being removed from the site by a licensed hazardous waste hauler. The Metal Bellows plant also has a NPDES permit issued through the EPA which allows them to discharge water from the site into a tributary of School Meadow Brook directly behind the plant. Past records indicate that the discharge water quality falls within the required limits.

Walsh Chemical manufactures a latex compound used in furniture fabric and upholstery. The materials used in this process - marblewhite 200 & 300, swanee clay and latex are not classified as hazardous materials. Thus, the potential for groundwater contamination from this site is extremely low. A concrete holding tank in the rear of the facility is currently undergoing improvements including an earthen berm to be placed at the rear of the parking lot to prevent any overflow of latex during loading and unloading from reaching the main channel of School Meadow Brook which flows behind the site.

Datamedix, Inc. manufactures medical ambulatory monitoring equipment at their plant on Route 1 directly across from Walsh Chemical. The only hazardous organic hydrocarbon used in the plant is located in the Wave Solder Room where printed circuit boards are cleaned in an enclosed machine. The industrial chemical used is Genclean - a predominantly 1,1,1-trichloroethylene solvent.

IEP personnel also viewed the abandoned gravel pit on Route 1 which is currently the site for the proposed Walpole Park South Light Industrial Development. This site is a primary recharge area to the town wells and thus any adverse land use on the site could have a devastating impact on the School Meadow Brook Aquifer. IEP is in agreement with Geraghty & Miller (1973) that the results of an accidental or intentional spill of certain compounds from a source at this site could be disastrous to the water supply because groundwater flow from this site is directly towards School Meadow Brook. The site is within Zone 2 (see Figure 3.2) where maximum protection of groundwater quality is essential. We concur with the Geraghty & Miller conclusion that development at this site should be limited to residences and/or office buildings served by sewers.

5.0 DPW MAINTENANCE FACILITY ASSESSMENT

The existing central fuel depot which is located off of Washington Street in front of the town's main DPW garage consists of three recently installed underground fuel storage tanks. Due to the fact that the fuel depot is located 650' from Washingtoin Well #2, it represents a potential source of groundwater contamination. The road salt storage shed, and the use and/or storage of sewer cleaning solvents, waste oil and lubricants which occurs in the service bays is also of concern within the close proximity of the wells.

Two (2) 10,000 gallon steel tanks and one (1) 6,000 gallon steel tank are buried in a concrete vaults. All 3 tanks have a diameter equal to 8 feet. Although the intent of the original design concept for the fuel depot was to make the vault water tight, this is not the case. Groundwater has penetrated the walls and/or floor of the vault and is reportedly in contact with the outside walls of the steel tanks throughout the year. An existing groundwater observation well is monitored weekly by DPW employees to measure groundwater levels within the concrete vault and to check for the possible leakage of fuel. Measured groundwater levels range between 63 and 75 inches below the surface. Water quality samples are not routinely taken from the monitoring well. No sensors, gas detectors or leak detectors are installed for monitoring of the buried fuel tanks on a 24-hour per day basis. However, DPW personnel do record stored fuel levels on a daily basis.

The entire fuel depot area is paved. However, there are no berms or catch basins with oil and grease traps to capture possible fuel spills during actual storage tank filling or during daily vehicular filling. Although filling operations are closely monitored to avoid the inadvertent spilling of fuel, the potential for an accidental spill does exist. Because no spill containment facilities are present at the fuel depot, the potential for contamination of surface water and groundwater exists.

5.1 Fuel Storage Alternatives

Improvements and/or alternatives to the current manner in which fuel is stored in the existing three underground steel tanks should be evaluated and considered for future possible implementation. Although the present system appears to be effective, the potential for a significant loss of fuel and the resultant contamination of the groundwater is great. Due to the location of the fuel tanks adjacent to Washington Well #2, risks need to be minimized and uncertainties eliminated.

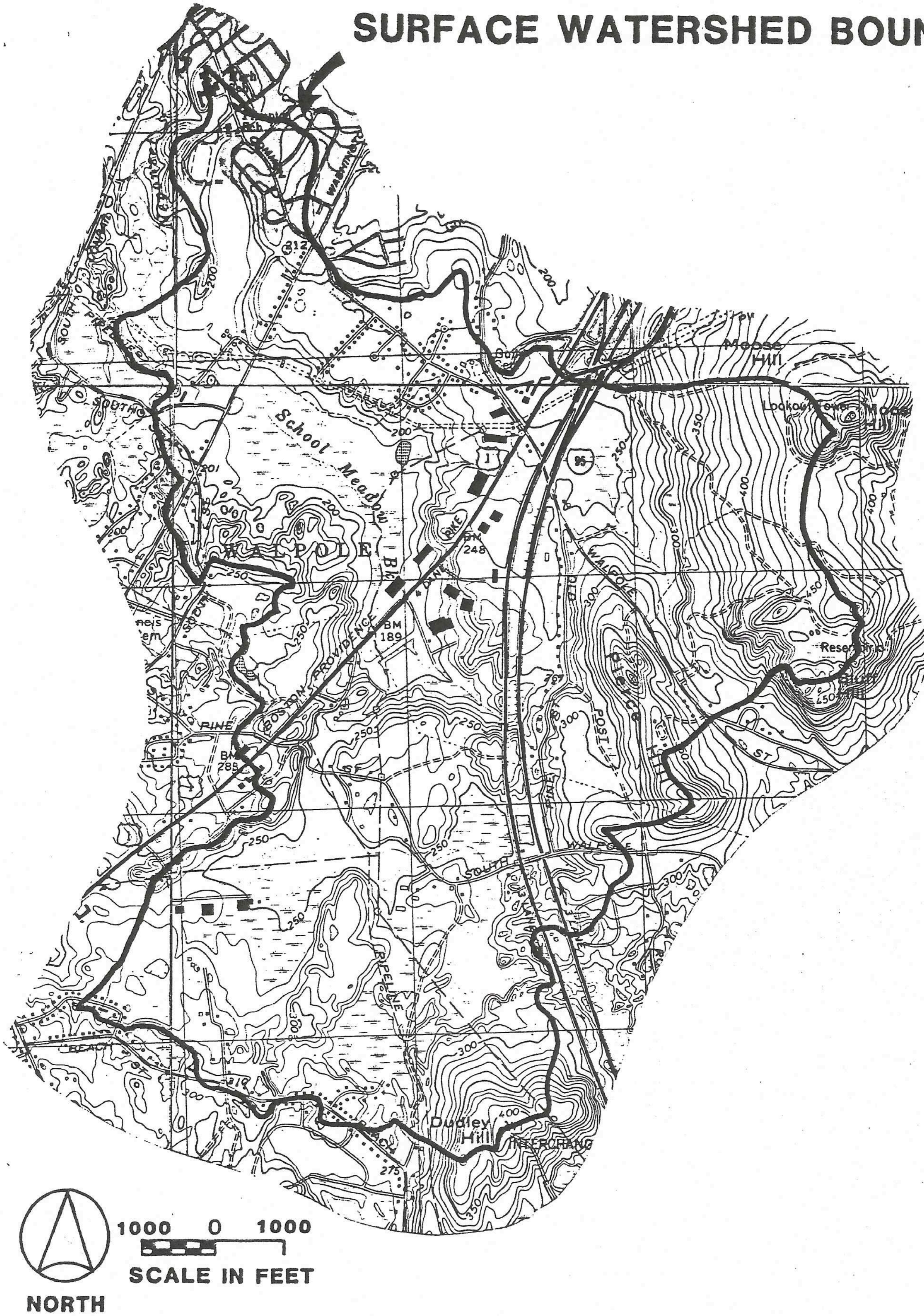
Three (3) specific alternatives have been evaluated:

- Continue with present fuel depot operation - i.e. "do nothing."
- Relocate existing storge tanks above maximum groundwater levels and re-construct vault.
- Relocate entire DPW complex to an entirely new site not within a highly environmentally sensitive area.

The first alternative - "do nothing" - would not require additional town funds and would be extremely easy to implement. DPW personnel would continue to monitor fuel levels on a daily basis and check the groundwater monitoring well on a weekly basis to detect possible future fuel leaks. However, should a major leak develop it is most probable that groundwater contamination will result and that Wells #2 & #4 would be contaminated and possibly forced to shut down.

Of primary concern in the fact that portions of the fuel tanks (approximately one-third) are situated below groundwater levels in direct connection with the groundwater aquifer. The second alternative evaluated involves the raising of all 3 steel tanks by approximately 6 feet to insure that the entire tank is above groundwater throughout the year. A new raised concrete slab would have to be constructed. The reconstructed slab should be made totally water tight with the existing concrete walls to provide a spill/leak sum capable of effectively capturing and containing any fuel that may escape from the steel tanks. Such a system would provide an adequate secondary

SURFACE WATERSHED BOUNDARY



SCHOOL MEADOW BROOK AQUIFER PROTECTION STUDY
TOWN OF WALPOLE, MASSACHUSETTS

Additional protection from larger spills can be gained with the placement of curbing along the entire perimeter of the paved surface located in front of the main DPW garage. Catch basins with oil and grease traps would also be needed to intercept any spilled fuels prior to discharge to adjacent surface waters. Estimated construction costs amount to $25,000.

It is suggested that higher priority should be given to constructing a spill containment system for the pump island area. Such a system would provide adequate protection where the majority of fuel transfers occur.

A larger drainage containment system for the overall paved DPW garage area, including the access road, would provide protection in case of fuel being spilled accidently by vehicles arriving and departing the fuel depot and garage area. The need for such a system should only be considered after the smaller spill containment system for the pump island area has been constructed.

A conceptual design sketch of the proposed spill prevention measures discussed in the preceeding paragraphs is on the following page.

5.3 Site Inspection Summary

A site inspection of the entire DPW Facility was performed in order to assess potential hazards other than the readily recognized Fuel Depot and Salt Storage Shed.

The DPW Water Dept. Garage and office area located north of the brook consists of buildings for equipment maintenance, vehicle storage, and storage of chemicals and paint. Stored material include fuel oil for heating, paint, and sewer line cleaning agents. Total volume of stored material is less than 1000 gallons.

Only one building drain was observed and no drain was present in areas where sewer line cleaning agents were stored. This practice should be maintained. In general, no flagrant potential hazards were noted. Overall cleanup of the entire area is recommended and removal of oil spill stains in maintenance areas is advised. Long term, lower priority recommendations are to re-pave the entire area and construct curbing and an appropriate drainage system.

The DPW Main Garage consists of an office/equipment maintenance area, oil storage room, 2-bay vehicle maintenance area and 12-bay vehicle storage area.

All motor oil is stored in a seperate oil storage room which has no drains to allow spilled fluid to leak into the ground. Four 55 gallon were being stored at the time of the site visit. No improvements are recommended here.

Recent improvements in the 2-bay vehicle maintenance area have been done to expose piping system in order to readily detect possible system leakage. Some lubricant is stored in 5-10 gallon containers. All drainage is to the hydraulic system sump.

In the 12-bay vehicle storage area floor drains are present with one drain for every 2 bays. The drains are reportedly connected to drainage leaching pits located in the rear of the building. No sumps are believed to be present. Installation of sumps with capped outlet tees prior to leaching pits is recommended.

6.0 CONTAMINATION RESPONSE ACTION PLAN

The two main potential groundwater contamination sources in the School Meadow Brook watershed are (1) the Walpole DPW Facility located south of Washington Wells #2 & #4 and (2) the industrial/highway corridor along Route 1 & I-95 situated 1/2 mile east of Washington Well #6, the Towns highest yield groundwater well. A third potential source are the two pipelines located within the watershed - Shell Oil and Algonquin Gas.

The following simplified plan contains a list of recommended actions to be taken in the event of a hazardous waste incident within the watershed.

DPW FACILITY

If a petroleum products loss occurs from the underground storage tanks or during filling/pumping the following steps should immediately be taken:

1. Shut down wells #2 and #4 until the extent of contamination can be determined. Pumping of these wells will draw contaminated groundwater beneath the DPW facility into the wells.

2. Inspect the groundwater monitor wells in the vicinity of the tanks for the prescence of hydrocarbons. If present, immediately contact a licensed pollution control contractor.

3. If needed, install additional monitor wells surrounding the depot to locate the contamination plume and begin to draw off the gasoline which is floating on top of the groundwater.

4. If the tanks are leaking remove the contents and determine the amount lost.

5. Continue pumping of the monitor wells in the area of the spill in order to create a trough in the water table and, hopefully, isolate the contaminant.

ROUTE 1/I-95

1. A surface spill or highway accident which results in immediate contamination of School Meadow Brook should be contained as quickly as possible by a pollution control contractor by erecting a boom or other form of dike to prevent flow of contaminated surface water downstream to the well fields.

2. Shut down Washington Wells #3 & #6. These wells are located furthest upstream and would likely be effected before #2 & #4.

3. If contamination is detected as far downstream as Washington Street shut down of the entire Washington Well Field must be considered.

4. Groundwater contamination detected in the 2 monitor wells recommended for this area near the town line should be compared with existing health standards. Samples from the municipal wells should immediately be taken.

5. Attempt to locate the potential source by contacting individual companies, sampling School Meadow Brook tributaries and roadway drainage (if flowing). Review files on record with the Boards of Health to identify possible users of the compounds found.

7.0 SUMMARY AND RECOMMENDATIONS

This aquifer protection study has consisted of two major tasks: (1) geologic investigations undertaken in order to delineate and characterize the School Meadow Brook aquifer and (2) land use surveys designed to assess the existing or possible potential for groundwater contamination in areas shown to be critical for aquifer protection.

As a result of this study the following prioritized recommendations for action to be taken to protect Walpoles groundwater resources along School Meadow Brook have been formulated:

Priority #1. Apply for funding for aquifer land acquisition under the Mass. DEQE Ch. 286 Program. This has been given highest priority because the application period is currently open and applications will only be accepted until October 31,1983. The following land parcels are recommended, in order of priority, for consideration for purchase in the form of outright purchase, purchase of developoment rights, or easements as shown on Figure 3.2:

1. Parcel north of Well #5 and south of Common St.
2. Parcel south of Well #4.
3. Parcel(s) where Day Camp is located east of Well #6.
4. Parcels south of Town Forest along Providence Turnpike within the Limited Manufacturing zoning district.

Priority #2. Reconstruction/improvement of the DPW gasoline storage depot should be undertaken. The three gasoline storage tanks are currently located in a non-watertight concrete vault lying partly below the water table. Ideally, the tanks should be removed from the aquifer area so that no potential for contamination would exist. As this is not deemed to be immediately feasible the facility should be reconstructed to raise the tanks above the water table. The underlying concrete vault should also be raised and designed such that any leakage from the tanks would be contained in a water tight structure above the annual high water table elevation. Cost estimates are as follows:

<u>Fuel Storage Improvements</u>

1. Empty existing tanks, remove existing cover, remove and dispose of sand fill, temporarily remove 3 tanks, construct new raised concrete slab, (elev. = 95.0), reinstall tanks, provide leak/spill containment system, and provide leak monitoring system.
   Estimated Cost $40,000

2. Construct partial concrete block building to protect raised tanks from vandalism/accidents
   Estimated Cost $25,000

<u>Spill Prevention Measures</u>

1. Spill containment system to surround existing pump island including the construction of grease/oil trap/seperator.
   Estimated Cost $ 5,000

2. Complete surface drainage system for paved surfaces leading to DPW garage in the vicinity of the gasoline depot. All drainage to be discharged to grease/oiltrap/seperator.

Estimated Cost $25,000

TOTAL COST $95,000

Many small hidden costs could be involved in this project including the cost for gasoline during construction, cost to dispose of sand fill if it is found to be contaminated, and possible damage to the tanks during removal. To be fully certain of having sufficient funds the Town should appropriate $125,000 for this project.

Priority #3. A Groundwater Monitoring Program should be implemented which would involve drilling of observation wells with multi-level samplers at several locations. Two permanent groundwater monitor wells drilled and screened through the entire saturated thickness of the aquifer should be installed within 100 feet of the gasoline storage tanks between the storage tanks and Well #2. A third monitor well should be located approximately 100 north of the salt storage shed between the shed and School Meadow Brook to monitor sodium concentrations as well as other possible contaminants.

Two additional monitor wells should be drilled near School Meadow Brook upgradient of Well #6. One well should be located north of the confluence of the tributary with the main channel and downgradient of Metal Bellows. This well will serve to monitor groundwater quality from the northern area of Route 1. The second well should be located along the brook west of Walsh Chemical to monitor groundwater inflows from the southern watershed areas. Surface water sampling locations should be established at each well location.

Estimated Cost $7,500

Quarterly testing for volatile organic hydrocarbons should be performed on each well and surface water sample site.

Estimated Cost $7,000 (yearly)

If sampled on a quarterly basis these wells would provide an indication of groundwater contamination <u>before</u> it reaches the downgradient well fields. The initial years cost to install and sample quarterly would be $14,500. After that, sampling costs, if maintained on a quareterly basis would be no more than $7,000/year.

Priority #4 A Water Resource Protection District Zoning Bylaw should be implemented to protect the School Meadow Brook Aquifer. Model bylaws are readily available. A bylaw such as this would protect critical parcels such as the proposed Walpole Park South proposed development which is currently being reviewed by the town boards.

Priority #5 Meetings should be held with representatives of Shell Oil and Algonquin Gas to review their latest protection and monitoring procedures for the pipelines which traverse the watershed.

Priority #6 The Town of Walpole should meet with Board of Health and Planning Board officials in Sharon and Foxboro to review with them the contents of this report. An effort should be made to establish a regular working relationship with the proper officials to discuss water resource protection and to initiate aquifer protection measures in those sensitive areas which border the Walpole town line.

Selected References

Brackley, R.A., W. B. Fleck and R. E. Willey, 1973. Hydrologic Data of Neponset and Weymouth River Basins, Massachusetts: U.S. Geological Survey/Massachusetts Hydrologic Data Report No. 14.

Brackley, R.A., W. B. Fleck and W. R. Meyer, 1973. Hydrology and Water Resources of the Neponset and Weymouth River Basins, Massachusetts. U.S. Geological Survey Hydrologic Investigations Atlas HA-484.

Mass. Department of Environmental Quality Engineering, 1981. Road Salts and Water Supplies - Best Management Practices.

Fay, Spofford & Thorndike, Inc., 1958. Report Regarding Improvements to the Town's Water Works System.

Fay, Spofford & Thorndike, Inc., 1959. Report Regarding Ground-Water Explorations, 1958.

Fay, Spofford & Thorndike, Inc., 1964. New Sources of Water Supply for Walpole.

Geraghty and Miller, Inc., 1966. Investigation of Ground-Water Resources in the Town of Walpole, Massachusetts.

Geraghty and Miller, Inc., 1969. Summary of Water Management Program, Walpole, Massachusetts.

Geraghty and Miller, Inc., 1971. Results of the 1970 Water Management Program, Walpole, Massachusetts.

Geraghty and Miller, Inc., 1973. Results of the 1972 Water Management Program, Walpole, Massachusetts.

Geraghty and Miller, Inc., 1973. Letter report to Walpole Town Manager regarding impact of Pine Street Development on Washington Street Well Field.

Geraghty and Miller, Inc., 1974. Artificial Recharge Feasibility Study, Town of Walpole, Massachusetts.

IEP, Inc., 1977. Water Quality and Aquatic Biological Assessment: DEQE File 280-12 (Sharon) Prepared for the Town of Walpole.

IEP, Inc., 1977. Geologic and Hydrogeologic Investigations: DEQE File 280-12 (Sharon) Prepared for the Town of Walpole.

Metcalf & Eddy Engineers, 1967. Report to Board of Water Commissioners, Town of Walpole, Massachusetts on Additions and Improvements to Water Systems.

Metropolitan Area Planning Council, 1982. Underground Fuel-Storage Manual.

Weston & Sampson Engineers, Inc., 1980. Report on Water System Master Plan, Town of Walpole, Massachusetts.