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Final Report: Section 2. Data Collection

Horsley Witten Group, Inc.

SECTION 2

DETAILED DATA COLLECTION AND VERIFICATION PROCESS

An important part of the Phase I effort consisted of developing a high-quality database of key information to further the planning process of the overall Taunton watershed. The data collection and compilation efforts described in this Section were undertaken by Weston & Sampson as a sub-consultant to the Horsley Witten Group, Inc., in support of the Taunton River Watershed Plan. Additional verification and information gathering was completed by the Horsley Witten Group, Inc., particularly for Water Management Act Permit information.

The purpose of this data collection effort was focused on compiling water use and wastewater information relevant to understanding water balance issues as they relate to ecosystem health and sustainability. Tables and summaries of the collected data and their corresponding sources are provided in electronic format for reference. The very large size of the datasets (e.g., detailed data across 108 sub-watersheds) makes it such that the printed versions are of limited use. Summaries of these data are provided within this Section, when relevant.

1.0 WATER AND WASTEWATER SYSTEM MAPPING

1.1. Introduction

Developing an accurate hydrologic balance within the Taunton River Watershed requires the definition and mapping of municipal water and wastewater supply and distribution systems. Data relevant to this task include: water extraction and wastewater discharge volumes and locations, and community water and wastewater infrastructure plans.

Location and extent of community sewer lines are relevant because these lines collect wastewater flow from various users and transfer it to a treatment facility. After treatment, this facility will discharge the wastewater flow into the watershed at a specific location, a receiving area. This receiving area may be a surface water body (e.g., stream, river) or underground (e.g., infiltration). These positive flows into a watershed can account for an important amount of that watershed's recharge. Conveyance of wastewater from one watershed to another may also be substantial, leading to positive or negative water balances in neighboring watersheds. In the water balance tool, an accurate mapping of this wastewater infrastructure is therefore essential.

Conversely, water infrastructure allows the transfer of flow from a source (e.g., well, river) to the end user. This infrastructure represents a negative recharge, as water is taken out of the watershed from either surface water or groundwater bodies and conveyed to residential, commercial, or industrial customers. Individual sources service a variety of customers and water needs, and an accurate mapping of the water infrastructure is therefore essential to the understanding of the water balance. In addition, individuals and

businesses that are not serviced by the water infrastructure are most likely supplied by private wells, which need to be accounted for in the water balance model.

Water and sewer infrastructure is recorded with varying degrees of accuracy in different communities. For example, some communities only have paper maps of their systems, showing a schematic representation of the infrastructure. The maps for these systems are likely not as accurate as other systems that may be electronically mapped using Computer Aided Drafting (CAD) software or other similar engineering programs. However, CAD maps only represent the infrastructure accurately when based on field survey or other verification techniques. They may be schematic only and may not be accurately geo-coded or referenced to known markers. The greatest degree of accuracy in mapping of municipal infrastructure can be provided by properly georeferenced electronic Geographic Information Systems (GIS) mapping. When infrastructure in these GIS maps is geo-referenced to known markers, their representation of a community system can reliably represent the location of piping and system components. These geo-referenced GIS maps may also contain inaccuracies due to the age of a map (e.g., may not account for recent development) or the assumptions made while creating the map (e.g., an entire street segment is serviced by water or sewer).

The following sub-sections describe how water and sewer infrastructure data were obtained and verified, and present the results.

1.2. Methods

In 2002, the Bureau of Resource Protection (BRP) of DEP's Southeast Regional Office (SERO) gathered water and sewer data for most of the communities in the Taunton River Watershed and created a water and sewer map in GIS for planning purposes. This GIS dataset showing municipal water and sewer systems was obtained from DEP and the MA Executive Office of Environmental Affairs (EEA) for use with the understanding that actual water and sewer lines would not be presented in this report or any public forums. In 2002, not all communities had GIS capabilities or wanted to share their infrastructure mapping with the State. They are therefore not all represented in the GIS dataset obtained from DEP. Table 2.1 summarizes the communities for which no data was obtained, either due to a lack of infrastructure in the community, or to a lack of mapping information. A list of all communities with service area maps is provided in electronic format.

Table 2.1. Water and Sewer Line Data not Provided by DEP

Reason for lack of data	Water Service	Sewer Service
No infrastructure in community	Rehoboth and Rochester	Berkley, East Bridgewater, Halifax, Hanson, Lakeville, Norfolk, Pembroke, Plympton, Rehoboth, Rochester, Swansea, and West Bridgewater
No data obtained from DEP for community	Dartmouth, Holbrook, Norfolk, and Walpole	Attleborough, Dartmouth, Easton, Freetown, Holbrook, Kingston, Plymouth, Walpole, and Wrentham

The dataset includes line work for water and sewer mains, which was superimposed to a base map. The MassHighway road layer from MassGIS served as a base map, and road segments were coded as having either water service, sewer service, or both. If a water or sewer main extended only part-way along a road segment, a decision was made, based on density of housing, to represent the main as either running along the complete extent of the road segment, or not at all. This modified DEP sewer and water GIS data is referred to as State data.

In addition, sewer and/or water line information was obtained from certain communities. A complete list of communities in the Taunton River Watershed having provided water and/or sewer line data is available in electronic format. This dataset is referred to as Actual data and was compared to State data for six communities: Abington, Mansfield, Middleborough, Sharon, Stoughton, and Taunton. These six communities represent various stages of development. Middleborough and Sharon are rural communities; Abington, Mansfield, and Stoughton are suburban communities; and Taunton is an urban community. State and Actual data for these six communities were overlaid in GIS, and differences in total linear feet of water and / or sewer between the two maps were calculated. A detail of the calculations is provided in electronic format. As a result of the comparison, it was determined that State data could be improved by obtaining the most current actual datasets where available and updating the infrastructure line work.

Two general differences were noted in the line work from each dataset. First, the State datasets show infrastructure or line work in areas beyond the water and sewer mains represented in the Actual datasets, essentially overestimating the length or amount of infrastructure. As a percentage of total linear feet, the difference ranged between 2 and 30 percent. Secondly, the Actual datasets revealed infrastructure or line work in areas where the State datasets did not depict the presence of water or sewer infrastructure. This was generally in areas of newer development or system expansion. In these areas, the State dataset essentially underestimates the amount of infrastructure. As a percentage of the total linear feet, this percent difference ranges between 8 and 25 percent.

Therefore, each community in the Taunton River Watershed was contacted to obtain more recent and accurate water and sewer main mapping, preferably in GIS or CAD

format. In certain instances, communities only had small amount of either water or sewer main infrastructure within the watershed, and / or electronic mapping was not available. In these instances, paper copy maps or verbal descriptions from local officials were used to create a GIS version of the infrastructure map.

Following exhaustive efforts to contact and request available CAD or GIS mapping from individual municipal systems, Actual water/sewer data of the infrastructure location and extent was received from 17 communities. In communities for which no Actual electronic data was available, State data was used, when available. State and Actual water and sewer infrastructure data were not available for three communities: Dartmouth, Norfolk, and Walpole, but these communities do not have significant area (and therefore infrastructure) within the Taunton River Watershed. In addition, no Actual or State sewer infrastructure data was available in electronic format for three other communities: Easton, Freetown, and Wrentham. For these communities, sewer line information was determined using a combination of verbal descriptions, and hard copy sewer maps.

1.3. Verification Process

DEP was contacted to identify the assumptions used in the mapping process and evaluate the accuracy of the State dataset. DEP confirmed that the State dataset was developed based on the criteria that if more than 50% of a road segment was serviced by water or sewer, then the entire road segment was mapped as having water or sewer infrastructure. In addition, the data represented in the DEP maps reflect a number of years prior to 2002, rather than a single point in time.

Sewer and water maps created from a combination of State and Actual data were distributed to water and/or wastewater superintendents in the pertinent communities to improve mapping accuracy, and incorporate distribution system updates. Comments were received from 28 of the 38 recipients either in verbal or hard copy format. This revised information was incorporated in the infrastructure datasets used for this final report.

1.4. Results

As a result of collecting sewer and water infrastructure data from the State and/or local communities, data for 38 of the 41 communities that have infrastructure were obtained (Rehoboth and Rochester have neither water or sewer infrastructure). Certain communities, such as Dartmouth, Norfolk and Walpole were not pursued for infrastructure data because a very small area of the community is located within the boundaries of the Taunton River Watershed, and therefore provide insignificant infrastructure area as a whole. After excluding the two communities without infrastructure and the three communities with minimal area in the watershed, water and sewer infrastructure data were obtained for all of the remaining 38 communities.

2.0 PARCEL DATA

Digital parcel maps were collected from as many watershed communities as possible to generate water and sewer service area maps, which are described in Sub-Section 3.0. This Sub-Section describes the collection effort for parcel data.

Similar to water and sewer infrastructure data, parcel data for communities in the Taunton River Watershed initially came from through MassGIS. MassGIS obtained consolidated parcel data for numerous Massachusetts communities through an agreement with Banker and Tradesman. These data are therefore considered for internal project use only. The dataset is also referred to as State data in this report. In addition, nine communities within the watershed provided digital parcel data, referred to as Actual parcel data. Similar to water and sewer data, when both State and Actual parcel data were available for a community, the more recent Actual data were used.

Digital parcel maps were collected for 35 of the 43 Taunton River Watershed communities. Nine of these maps were provided by individual communities or their consultants, and State parcel data were used for 26 communities. Parcel mapping was not pursued for Norfolk because a very small section of the community is located within the boundaries of the Taunton River Watershed. Parcel data were not available for seven communities: Brockton, Foxborough, Freetown, Pembroke, Plainville, Plympton, and Rockland. A summary of parcel data source (i.e., State of Actual) for each community within the Taunton River Watershed is provided in electronic format.

3.0 SERVICE AREA MAPS

3.1. Introduction

Water and sewer lines along streets are assumed to service parcels with frontage on that street segment. Service area maps were therefore developed in GIS by creating a buffer around the water and sewer lines, and selecting all parcels intersecting the buffer. The method used to determine the most appropriate buffer width for this mapping exercise is described below.

3.2. Methods

Service area results for varying buffer widths (25 feet, 50 feet and 200 feet) were compared to known service areas in towns for which these were available. Initially, the comparison was undertaken for sewer systems. In the towns of Mansfield, Middleborough and Taunton, the number of parcels being serviced for each different buffer width was calculated. The estimated number of serviced parcels was then compared to the known number of parcels being serviced for Mansfield (Mansfield, 2004), Middleborough (Amory Engineers, 2003) and Taunton (EPAa[1]). The number of parcels calculated using the 50 foot buffer compared most favorably to the actual number

[1] DEP and EPA followed by a lower case letter is a DEP or EPA reference listed at the end of this Section.

for each town. Thus, the 50 foot buffer was used to most accurately represent serviced areas.

To see the difference in estimated and actual parcels being served by water, the 50 foot buffer analysis was also conducted for the water service maps in Mansfield and Middleborough. These values were then compared to the 2006 Annual Statistical Reports which give the number of service connections known to exist for these towns. Table 2.2 shows the results of the buffer analysis in estimating water and sewer connections for Middleborough, Mansfield and Taunton. The best correlation for each community is highlighted in bold.

Table 2.2. Comparison of Actual and Estimated Sewer Service Areas for Different Buffer Widths

State Sewer data	**Middleboro[1]**	**Mansfield[2]**	**Taunton[3]**
using 25' buffer	-22 %	-44 %	-30.3 %
using 50' buffer	**13 %**	-22 %	**-4 %**
using 200' buffer	32 %	**-8 %**	8 %
Actual Sewer data	**Middleboro[1]**	**Mansfield[2]**	**Taunton[3]**
using 25' buffer	-17 %	-19 %	-33 %
using 50' buffer	**9 %**	**-5 %**	-18 %
using 200' buffer	27 %	8 %	**-2 %**

1. *Calculation based on GIS analysis of parcels served vs. total number of parcels given in WSE "Program Evaluation Report - 2004"*
2. *Calculation based on GIS analysis of parcels served vs. total number of parcels given in Mansfield's 2004 "Inflow and Infiltration Overview and Summary"*
3. *Calculation based on GIS analysis of parcels served vs. total number of parcels given in Taunton WWTP 2007 NPDES permit.*

The 50 foot buffer is the best approximation for both and Actual and State data for Mansfield, Middleborough and Taunton. Actual datasets were better approximated by the 50 foot buffer than State datasets, most likely because the State datasets are older and may be missing newer developments that are included in the Actual datasets.

Service area maps were then created for each community using the most current infrastructure and parcel data and a 50 foot buffer around the infrastructure line work. If parcel data were not available for a community, developed parcels were estimated based on 2005 aerial photographs available from MassGIS. Developed parcels were overlaid on water and sewer maps to estimate service areas. In certain cases when only a small area of the town within the Taunton River Watershed was serviced by water and/or sewer and electronic information for these areas was not available, service area maps were created based on hard copy maps or verbal descriptions of the service areas by local officials. Data sources used in creating the estimated service area maps are listed in electronic format.

3.3. Verification Process

Additional comparison of the 50 foot buffer analysis was undertaken based on water and sewer data for three communities: Middleboro, Mansfield, and Taunton. For each community, the estimated number of parcels serviced by water and / or sewer lines was compared to the known number of water and / or sewer service connections. Table 2.3 summarizes the comparison results for each of the three communities.

Table 2.3. Comparison of Actual and Estimated Water and Sewer Service Connection for a 50 Foot Buffer

Data	Middleboro	Mansfield	Taunton
State Sewer	13[(1)] %	-22[(2)] %	-4 [(3)] %
State Water	-20[(4)] %	-21[(4)] %	
Actual Sewer	9 [(1)] %	-5[(2)] %	-18[(3)] %
Actual Water	1[(4)] %	-4[(4)] %	

1. Percentage calculation is based on GIS analysis of parcels served vs. total number of parcels from WSE "Program Evaluation Report - 2004"

2. Mansfield calculation is based on GIS analysis of parcels served vs. total number of parcels from Mansfiled's 2004 "Inflow and Infiltration Overview and Summary"

3. Taunton calculation is based on GIS analysis of parcels served vs. total number of parcels from Taunton WWTP 2007 NPDES permit.

4. Based on 2006 Annual Statistical Report

3.4. Results

Service area maps were created for a total of 38 out of the 43 communities in the Taunton River Watershed. Of the remaining five communities, Rehoboth and Rochester were not mapped because these communities have neither public sewer nor public water service. Maps were not created for the three other communities (Dartmouth, Norfolk and Walpole) because these communities each have insignificant areas within the Taunton River Watershed. These maps are provided in electronic format.

4.0 INFILTRATION AND INFLOW

Inflow and infiltration (I&I) describes the ways that groundwater and stormwater enter into dedicated wastewater or sanitary sewer systems. These sewer pipes are designed strictly to transport wastewater from the various users to the treatment plant. I&I flows can contribute significant amounts of additional effluent, and should be included in the water balance. This flow represents a negative recharge for a watershed as the water flows from the ground to a wastewater system.

An additional analysis of I&I was therefore required for the water balance model to estimate how much groundwater may be transported within the sewer mains due to inflow and infiltration. The length of sewer main for each sub-watershed was calculated using the available sewer mapping. An I&I value for each sub-watershed was estimated using an average I&I rate of one gallon per day per linear foot of sewer main as a

representative value (NEIWPCC, 1998). However, I&I values may vary from town to town based on the age of sewer infrastructure and the level of I&I remediation undertaken to date. Lengths of sewer pipe and estimated I&I for each sub-watershed are provided in electronic format.

5.0 WATER WITHDRAWALS AND DISCHARGES

5.1. Introduction

Water withdrawals and discharges were identified through permits that regulate large water and wastewater flows. These permits include the MA Water Management Act (WMA) Withdrawal Permits, the MA Ground Water Discharge Permits (GWDP) and the National Pollutant Discharge Elimination System (NPDES) Permits. For the purposes of the water balance model, both the location of the discharge / withdrawal and the annual flow volumes were identified for these facilities.

5.2. Water Management Act Withdrawals

5.2.1. Introduction

The WMA regulates large water withdrawals from surface or groundwater sources in Massachusetts. WMA permits are generally required for withdrawals greater than 100,000 gallons per day. Locations that were withdrawing significant volumes of water prior to the registration date of 1988 may have a WMA registration to withdraw a certain volume of water annually, often in addition to a permitted volume. This Sub-Section describes the methods used to obtain WMA permit and registration data, the verification process, and the data collection results.

5.2.2. Methods

A comprehensive list of WMA facilities in the Taunton River Watershed was obtained from the State (DEPc) in July 2007. This list includes facility name, mailing address and permit / registration number. It was enhanced by including the sources for the WMA facilities provided in different documents by the State (DEPd, DEPe) as well as registered / permitted values for each facility. Where facilities had more than one source, the permitted / registered values for each source were estimated by evenly dividing the registered / permitted values among the sources. These sources were precisely located through data received by the State (DEPd, DEPe) and MassGIS.

These facilities were then categorized by "type" with input from State data sources (DEPb, DEPd). Facility type categories include public water supply (PWS), agriculture (AGRI), golf courses (GOLF), cranberry operations (CRAN) and waste management facilities (WMF). These types were used to assist with assigning actual flow values for these facilities.

Reported flows for WMA facilities categorized as PWS facilities were taken from the 2006 Annual Statistical Reports (ASRs) provided by the State (DEPh). Reported flows for the other categories of WMA facilities were also provided by the State in a separate listing (DEPb). Cranberry facilities were not assigned reported flow numbers for purposes of the water balance model since losses due to water use in cranberry bogs are addressed through the use of a negative recharge value on an acre by acre basis, as described in the water budget methodology.

5.2.3. Verification Process

An examination of the permitted / registered values against the reported flow values was conducted to verify accuracy. A reported flow that was less than 5% of the permitted and registered flows was considered to be a suspect value. Likewise, a reported flow that was greater than 100% of the permitted and registered flows was considered to be a suspect value. In five instances, reported flows were either significantly higher or lower than the permitted and registered flows. Verification for both permitted and registered flows and reported flow was requested from the State (DEPj). In two instances, the data originally obtained was in error. For one of these two instances, the water supplier's ASR was incorrectly providing a supply. For the other instance, the water sources for the City of Brockton, we worked with DEP to clarify which sources were physically located within the Taunton River Basin and which were not, and then gathered the pertinent Taunton River Basin withdrawal information. After confirming the correct reported flow values, the database was updated with the correct information. The three other registered users had accurately recorded values when the DEP databases were checked against the reported flows as provided in the ASRs.

5.2.4. Results

The location, permitted / regulated flow values and reported flow information for the WMA facilities and individual sources for these facilities are provided in electronic format. A total of 355 Water Management Act (WMA) permitted and registered sources were identified within the Taunton River Watershed, including 195 cranberry facilities. The WMA water withdrawal information for cranberry facilities was not necessary for the water balance tool since water use for these facilities was estimated as a function of cranberry bog area. We were unable to obtain the location for two non-cranberry facilities, so these were excluded from the water balance. One of these sources, Aquaria Water, was listed as being located in Brockton. This appears to be incorrect and it is believed to be located outside the study area. The other non-located source is a golf course well. Withdrawal volumes for three sources could not be obtained. These included a golf course, a sand and gravel well and a water supply well. However, there is some question as to whether the water supply well may actually be a cranberry operation well. Despite these minimal omittances, we are confident that the water budget analysis results are still representative of the watershed. The full dataset of WMA data collected for this report is provided in electronic format.

5.3. Groundwater Discharge Permits

5.3.1. Introduction

Facilities with these types of permits discharge at least 10,000 gallons per day (gpd) through on-site disposal systems. These discharges are included in the water balance model as positive recharge as the facilities are providing direct sub-surface recharge. This Sub-Section describes the methods used to obtain GWDP data, the data verification process, and results.

5.3.2. Methods

The latest and most up-to-date list of GWDP facilities and associated permitted flows were obtained through the DEP website in August 2007, and are provided for reference in electronic format. Accurate locations (latitude/longitude coordinates) were obtained either through the MassGIS GWDP data layer, or geo-referenced in GIS using the location address noted for the facility on the DEP website. Reported flow values for these facilities were obtained from the 2006 / 2007 Discharge Monitoring Reports (DMRs) from the State (DEPk) for all facilities except one. For the facility with no DMR, a ratio of 0.48 was used between actual flow volumes and permitted flow volumes. This ratio is based on data from facilities in the watershed for which both permitted and actual flows were available.

5.3.3. Verification Process

The MassGIS GWDP data layer was used to verify the GWDP facility list obtained through the DEP website for the Taunton River Watershed facilities. In cases where facilities were noted in the MassGIS database but not in the list taken from the DEP website, the State (DEPi) was contacted for an explanation. The State clarified that the additional GWDP facilities in the MassGIS database were inactive facilities. As such, these were not included in the data collection effort and are not used for the water balance analysis.

5.3.4. Results

The data collection effort for the GWDP facilities resulted in a complete list of GWDP facilities in the Taunton River Watershed that can be accurately mapped. Reported discharge flows associated with all facilities were also compiled. A spreadsheet of these facilities and their associated flows and locations is provided in electronic format.

5.4. Individual NPDES Discharge Permits

5.4.1. Introduction

Facilities with individual NPDES discharge permits include industrial, municipal or other facilities discharging directly into the waters of the United States. These facilities are

considered to be adding flow to a given stream reach since they are discharging water to surface water bodies at a specific location. This Sub-Section describes the methods used to obtain NPDES data, the data verification process, and results.

5.4.2. Methods

A comprehensive list of NPDES facilities, permitted flow values and facility locations was created using information from two different EPA websites, the general EPA website and the Region I EPA website (USEPAb, USEPAd). Accurate locations (latitude / longitude coordinates) for these facilities were obtained from the NPDES permits available online through the EPA website.

Reported flow values for the NPDES facilities were obtained through a Freedom of Information Act (FOIA) request to the US EPA. Reported discharge flow data was requested for the identified individual NPDES permitted facilities within the Taunton River Watershed for all available years. However, data was not received for all years at all facilities. The data gathered from the FOIA request (USEPAe) includes all available historic monthly 12-month average flows for each facility in the Taunton River Watershed.

5.4.3. Verification Process

Facilities were verified visually using 2005 aerial photography obtained through MassGIS. This process showed that the coordinates for one NPDES facility (Inima Water Desalination Plant, under construction) were inaccurately reflected in the DEP website. The correct coordinates were verified for this facility both online with the NPDES permit number and through MassGIS.

5.4.4. Results

A list of all of the NPDES permits and associated discharge locations in the Taunton River Watershed was assembled. Reported flows were obtained for 14 or the 20 NPDES facilities through the FOIA request. The two facilities in West Bridgewater are not located within the boundaries of the Taunton River Watershed, and were not included in the water balance analysis, such that actual flows were available for 13 of the 18 NPDES facilities. A summary spreadsheet of the average monthly flow data from 2001 - 2006 is provided in electronic format.

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