Owner Derived Tools for Collection System Asset Management; (1) Capacity and Condition ranking, (2) Remote Pump Station Monitoring, and (3) Probability and Severity Analysis.

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ABSTRACT

A presentation on how a medium sized municipal wastewater collection system owner has implemented tools to increase existing wastewater collection system capacity.

The Town of Blacksburg, Virginia, is located on the eastern continental divide in the Appalachian mountains of southwestern Virginia, about a 4 hours drive south of Washington, D.C. It has a growing population of approximately 40,000 people, is home to the largest University in the Commonwealth (Virginia Tech), and is experiencing continued growth with several service, retail, commercial, and high tech industries in the area. The Town owns and operates a diverse wastewater collection system (producing approximately 5.5 million gallons per day) that serves approximately 20 square miles and includes: 135 linear miles of gravity lines, 22 conventional sewer pump stations, and approximately 150 alternative low pressure small diameter (Septic Tank Effluent Pump (STEP)/Septic Tank Effluent Gravity (STEG)) collection units.

In recent years continued development has created additional pressure on the Town's aging infrastructure and required a more aggressive approach by the Engineering and Public Works Departments to maximize capacity in the existing system. The presentation will highlight three simple tools that the Town has employed to gain system capacity in the wastewater collection system and assist decision makers in prioritizing improvement projects. First, a GIS and modeling tool that the Town has employed to establish an Owner defined capacity and condition ranking system for gravity lines, manholes, and pumping stations. Secondly a remote data acquisition system from which system flow data and pumping station performance is monitored on a more real time basis and transferred to a remote computer server system installed by the Town Information and Technology Department. Thirdly, a project prioritizing matrix defined by the probability and severity of a predefined "undesired event" adapted from the Department of Justice Method to Assess the Vulnerability of U.S. Chemical Facilities (Special Report, NCJ 195171, November, 2002).

KEY WORDS

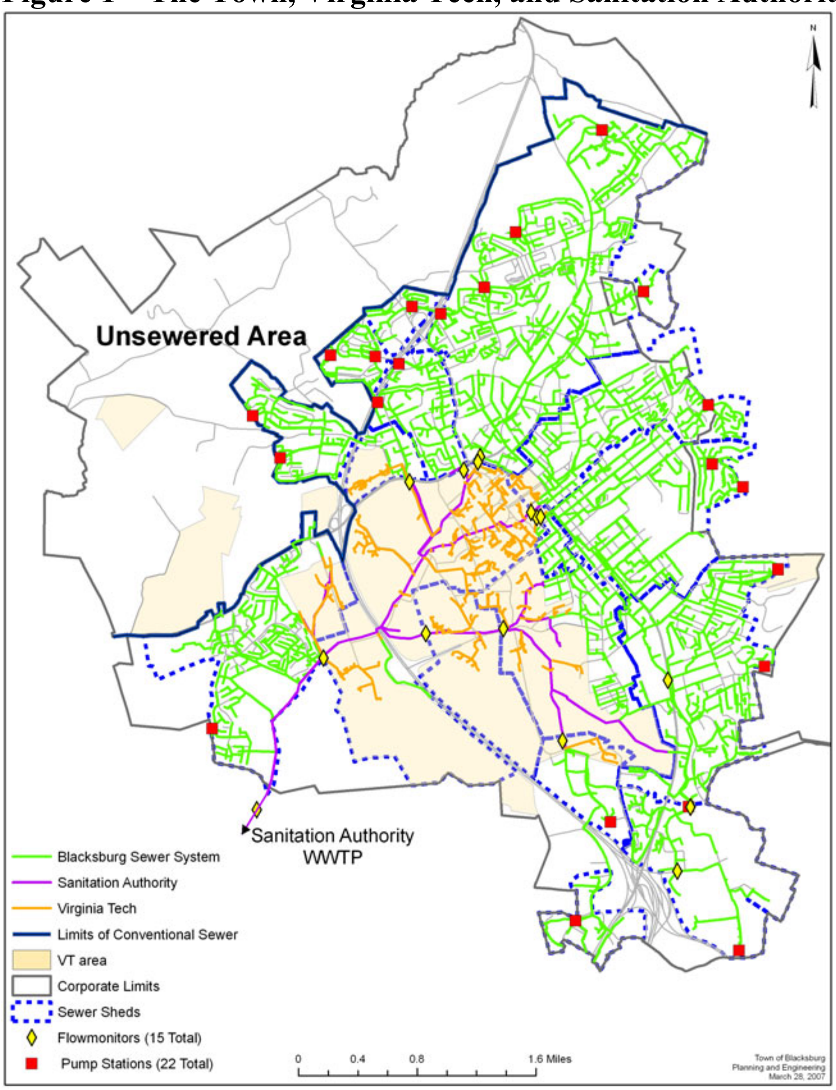
Remote data Acquisition, capacity, condition, probability and severity analysis, asset management, wastewater collection system modeling, GIS.

INTRODUCTION

Blacksburg is the largest Town in the Commonwealth of Virginia with a population of 40,000 people. The Town limits encompass 20 square miles and straddle the eastern continental divide in the Appalachian mountains of southwestern Virginia. In recent years there has been an increase in the frequency of sewer overflows and sewer backups onto private properties from an increase of rainfall derived infiltration and inflow (RDII) into the system. To immediately address the overflow issues the Town Council enacted an interim "RDII offset sewer policy" that required new developments to locate and remove sources of RDII equal to the volume of projected sewer flows. Council also authorized several capital improvement projects to increase line sizes. The Town quickly came to the realization that building bigger pipes and pumping facilities were not cost effective solutions and a system wide Asset Management (AM) approach needed to be investigated.

The Town owns and operates a diverse wastewater collection system as seen in Figure 1

Figure 1 – The Town, Virginia Tech, and Sanitation Authority Sewer Systems



(producing approximately 5.5 million gallons per day) that includes: 17 major sewer sheds, 135 linear miles of gravity lines constructed out of various materials, 15 inline flow metering stations, 22 conventional sewer pump stations, and approximately 150 alternative low pressure small diameter (Septic Tank Effluent Pump (STEP)/Septic Tank Effluent Gravity (STEG)) collection units.

There are two other wastewater authorities that connect into the town collection system; the Virginia Tech campus and the regional Blacksburg/Virginia Tech Sanitation Authority (BVPISA). The Virginia Tech collection system includes approximately 40 linear miles of gravity pipes from the campus located in the center of Town and the BVPISA system includes 20 linear miles of large diameter gravity pipe that conveys all wastewater generated in the Town to a centralized wastewater treatment plant located three miles south of the Town limits. The three wastewater authorities (Virginia Tech, Blacksburg, and BVPISA) maintain their collection systems separately and the BVPISA operates the treatment plant. The BVPISA Board of Directors is made up of representatives from the Town and Virginia Tech.

There are three departments within the Town of Blacksburg that play a part in managing the sewer infrastructure: the GIS department performs mapping of the facilities, the Engineering Department oversees construction designs for capital improvements, and the Public Works department is responsible for maintenance. The Town Council allocates funds, therefore it is critical that the departments work together to evaluate and communicate sewer capacity issues to the Council, which intern sets priorities based upon organizational policies and availability of funds.

The Town of Blacksburg has developed three specific tools to facilitate collection system asset management: (1) a capacity and condition ranking system that can be used by the Engineering and Public works Departments, (2) remote pump station monitoring to increase accessibility of data, and (3) a Probability and Severity Analysis rating system that allows the Town Council to be more involved in prioritizing projects. These Asset Management (“AM”) tools are described in more detail in the subsequent sections.

ASSET MANAGEMENT TOOLS

Over the past five years the Town has employed more effective tools to assess the wastewater collection system, in particular; data loggers, flow metering equipment, GIS software, and SewerCAD modeling software. Theses new capabilities have allowed the Town staff to take a more active role in collecting, analyzing, and sharing operational data within the organization. Without these capabilities the asset management system currently being explored would not be possible.

Data Loggers and Flow Metering Equipment

Currently the Town has fifteen area velocity flow meters, twenty-two amperage data loggers, six wet well pressure transducers, and one centrally located rain gauge, see photos in Figure 2. A part time (20 hours per week) Engineering intern is employed by the Engineering Department to maintain the equipment, down load data, and perform quality control data checks. The Public Works Department maintains the collection system and responds to pumping station alarms, but is not involved with the data collection. Due to the large volume of data being compiled the Engineering Department is currently working on a remote monitoring system to reduce the work load on the Engineering Intern position. The remote system will be described in more detail in a subsequent section.

Figure 2 - Flow Monitoring and Wet Well Level Data Loggers

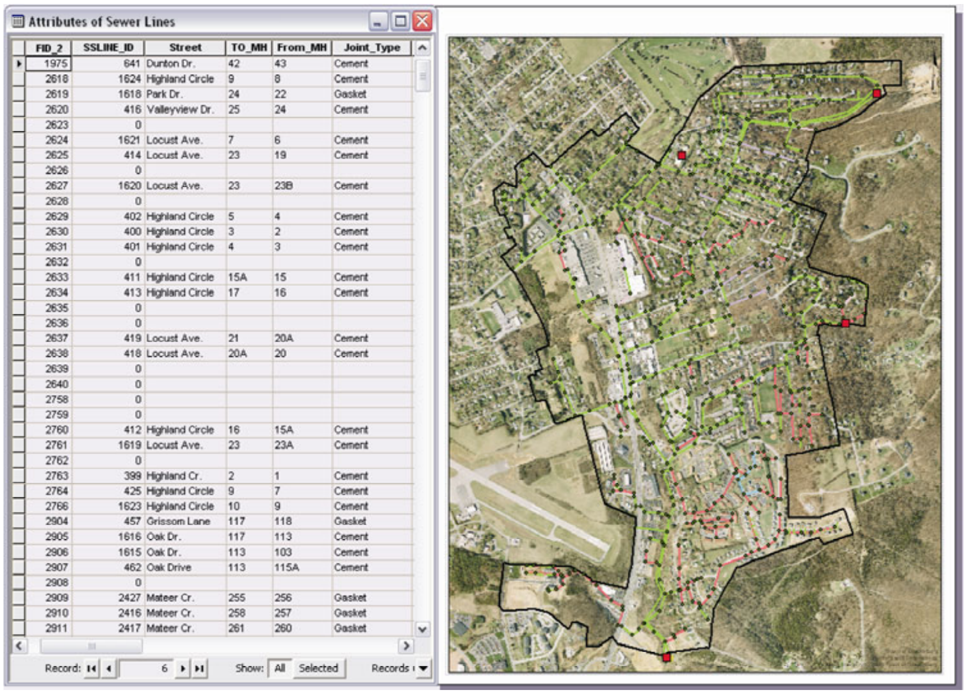
Geographical Information Systems

The GIS Department is the "Gate Keeper" for all pertinent infrastructure and town wide data. Preexisting CAD files are converted to shape files and a global positioning system (GPS) field unit is used to record the location and populate pertinent infrastructure GIS data files. GIS objects can be displayed with up to date aerial information and geospatial analysis can be performed with other organizational data sets, like water and sewer billing records obtained from the Finance Department. Information that is routinely used to evaluate the wastewater collection system such as historical studies, incident reports, pipe lining projects, location of wastewater flow meters, pump stations, and water meter locations, are housed in GIS tables and databases. A typical GIS sewer application ("APR") with accompanying data table is shown in Figure 3. The GIS Department and its ability to maintain up to date database files is the linchpin in the asset management process.

Calibrated Hydraulic Model

The Town procured professional services (Wiley and Wilson LLC, in Lynchburg, Virginia) to complete a system wide hydraulic SewerCAD model that included sewer flows from the Virginia Tech campus, the Town of Blacksburg, and BVPI Sanitation Authority. Previously the Town had a noncontiguous model that met no calibration standards. The hired consultant evaluated model calibration with respect to dry weather and wet weather conditions using water usage data supplied from the Town GIS Department and sewer flow data collected by the Engineering Department. Successful model calibration as defined by the Town was achieved when model output and actual flow meter data where within 10% with respect to peak flow rate and total volume at each meter location. Nine out of a total of thirteen meter locations met the calibration criteria.

Figure 3 - Sewer System GIS Shape Files



FID_2	SSLINE_ID	Street	TO_MH	From_MH	Joint_Type
1975	641	Dunton Dr.	42	43	Cement
2618	1624	Highland Circle	9	8	Cement
2619	1618	Park Dr.	24	22	Gasket
2620	416	Valleyview Dr.	25	24	Cement
2623	0				
2624	1621	Locust Ave.	7	6	Cement
2625	414	Locust Ave.	23	19	Cement
2626	0				
2627	1620	Locust Ave.	23	23B	Cement
2628	0				
2629	402	Highland Circle	5	4	Cement
2630	400	Highland Circle	3	2	Cement
2631	401	Highland Circle	4	3	Cement
2632	0				
2633	411	Highland Circle	15A	15	Cement
2634	413	Highland Circle	17	16	Cement
2635	0				
2636	0				
2637	419	Locust Ave.	21	20A	Cement
2638	418	Locust Ave.	20A	20	Cement
2639	0				
2640	0				
2758	0				
2759	0				
2760	412	Highland Circle	16	15A	Cement
2761	1619	Locust Ave.	23	23A	Cement
2762	0				
2763	399	Highland Cr.	2	1	Cement
2764	425	Highland Circle	9	7	Cement
2766	1623	Highland Circle	10	9	Cement
2904	457	Grissom Lane	117	118	Gasket
2905	1616	Oak Dr.	117	113	Cement
2906	1615	Oak Dr.	113	103	Cement
2907	462	Oak Drive	113	115A	Cement
2908	0				
2909	2427	Mateer Cr.	255	256	Gasket
2910	2416	Mateer Cr.	258	257	Gasket
2911	2417	Mateer Cr.	261	260	Gasket

CAPACITY AND CONDITION RANKING

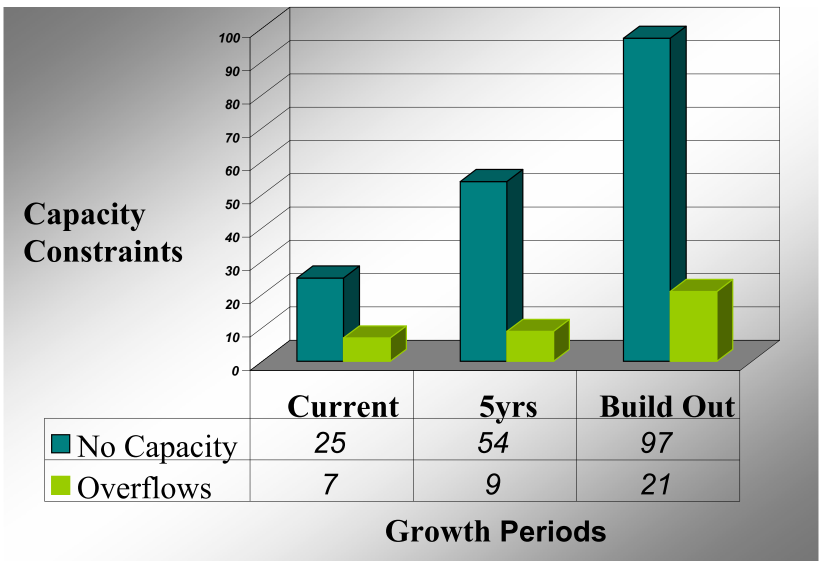
In general there are two conditions when hydraulic systems become incapable of conveying influent flows; (1) a **capacity** constraint when influent flow rates exceed the hydraulic design and (2) a **condition** constraint when materials wear to such an extent they no longer serve the function originally intended by the design. To properly evaluate the extent to which each of these two conditions were affecting the sewer system the Engineering Department developed assessment tools and ranking criteria. The capacity and condition analysis was performed separately on the collection system and pump stations. A more detailed description on each capacity and condition assessment follows.

Collection System Capacity Analysis

Like most communities, capacity in the Blacksburg sewer collection system is consumed primarily by rainfall derived Infiltration and Inflow (RDII) that enters into the system and causes overflow. The SewerCAD modeling tool was used to evaluate capacity of the existing collection system using three potential growth scenarios (current day, 5 yr growth, and build out) and four wet weather conditions (i.e. dry weather, 1-year storm, 5-year storm, and a 10-year storm).

Model runs identified sections of the existing sewer system that experienced capacity constraints and overflows. The number of potential capacity constraints and overflows occurring for three growth scenarios under a 10 year rain storm are shown in Figure 4. The Engineering Department had collected flow data from a 10-year storm event that occurred within the Town on September 24, 2004 and it was used to corroborate model results with known overflow incident reports supplied by the Public Works Department. The modeling analysis identified more than 100 potential capacity problems associated with the current collection system. Capacity constraints were ranked according to a priority matrix defined by the Town Council, which will be discussed in subsequent sections.

Figure 4 – Summary of Collection System Capacity Model Analysis for 10 yr Storm.



Collection System Condition Analysis

The condition of the collection system was evaluated using existing shape files from the GIS department, historical sewer pipe data sheets obtained from the Public Works department, and performing fieldwork to inspect 100 manholes to get a visual "representation" of existing conditions.

The sewer sheds were ranked on the amount of RDII based upon a gallon per inch diameter and mile of pipe basis. Sewer sheds that demonstrated the greatest amount of RDII, as shown in Table 1, were place at the top of the list for future field manhole condition assessments.

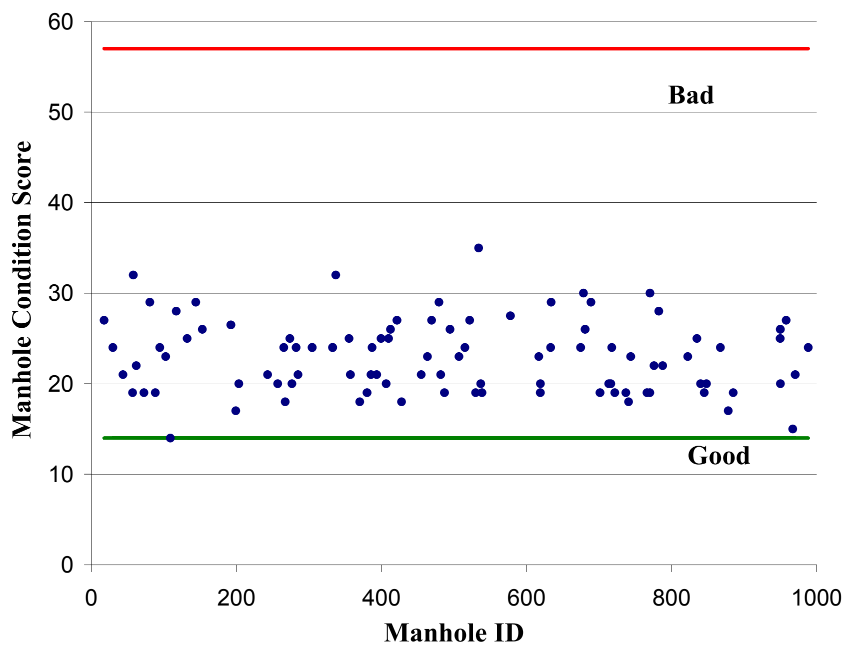
The conditions of existing manholes were evaluated using town defined criteria based upon a modified list of attributes obtained from the National Association of Sanitary Sewer Companies (NASSCO). Due to the limit of resources and time constraints only 100 manholes were visually inspected. The manholes chosen to be inspected were deemed to be the best representation of

Table 1 - Ranking of Sewer Sheds with Worst I/I Rates (top 5 out of 13 total)

Sewer Shed ID	Pipe In*mile	Dry I/I gpd/in*mile	1 Yr Storm gpd/in*mile	5 Yr Storm gpd/in*mile	10 Yr Storm gpd/in*mile
1	11	107	17,198	27,015	34,155
2	25	484	6,969	10,906	19,569
3	100	796	6,864	11,042	13,926
4	142	634	6,338	10,140	12,747
5	188	69	4,104	6,610	11,400

the town wide system based on age, material, and location. Results of the manhole condition survey are shown in Figure 5. Based upon this limited field work the collection system is in adequate condition, but more than 35% of manholes showed signs of I/I.

Figure 5 - Manhole Condition Assessment Rankings



Pump Stations Capacity Analysis

Pump station capacity, on an average daily flow basis, was determined using a Town defined rating calculation based upon maximum pumping capability and an observed maximum influent flow peaking factor measured at each pump station. Capacity ratings were multiplied by a factor of 0.8 to provide an additional level of engineering safety for the reported pump station capacity. The rating calculation is shown below as equation 1. An example of a pump station capacity assessment sheet is shown in Table 2.

(Eq. 1)

$$PS\_Capacity_{average(MGD)} = PS\_Max\_Capacity_{\{Drawdown\ or\ Design\}}(MGD) \div PF_{Influent} \times 80\%$$

Table 2 - Pump Station Capacity Ranking System

CAPACITY ASSESSMENT	1	2	3	4	5	Pump Station No.1
Drawdown Test Maximum PS Capacity (MGD)	-	-	-	-	-	3.30
Designed PS Maximum Capacity (MGD)	-	-	-	-	-	3.10
Sewer shed Influent Peaking Factor	-	-	-	-	-	5.00
Town Rated Average Daily Capacity (MGD)	-	-	-	-	-	0.53
Average Daily Influent Flow (MGD)	-	-	-	-	-	0.80
Average Daily Influent Flow less than Rated PS Capacity?	Yes	-	-	-	No	5
Future Growth Flows by Gravity to PS	Yes	-	-	-	No	1

Pump station capacity was determined by installing data loggers on the main power feed going in to the control panel of each pump station. Figure 6 shows a typical plot of the differential amperage measured at one of the pumping stations. The elevation of the pump "on" and "off" floats and geometry of the wet well were measured and used to determine the "operational" volume for each pumping station. Based upon these know data points three flow components were calculated; (1) influent flow rate prior to the pump running, (2) pumping rate, and (3) volume of flow discharged with each pump cycle. The equations Eq.2, Eq.3, and Eq.4 detail the calculations for each of the aforementioned flow components.

(Eq. 2) Pump Station Influent Flow Calculation

$$Q_{inflow} = \Delta Elev\{_{Pump\text{-}Off} - _{Pump\text{-}On}\}(ft)\} \times Cross\_Sectional\_Area_{wet\ well}\ (ft^2) \div Time_{Pump\text{-}Off}\ (min)$$

(Eq. 3) Pump Station Pumping Rate Calculation

$$Q_{Pumped} = \Delta Elev\{_{Pump\text{-}Off} - _{Pump\text{-}On}\}(ft) \times Cross\_Sectional\_Area_{wet\ well}(ft^2) \div Time_{Pump\text{-}ON}\ (min)$$

(Eq. 4) Pump Station Total Volume Pumped Calculation

$$V_{Pumped} = (Q_{Inflow} + Q_{Pumped}) \times Time_{Pump\text{-}ON}(min)$$

Peak pump station influent flow rates were calculated for periods with documented rain events and a maximum peaking factor was calculated. Diurnal curves for a pumping station for three different days are shown in Figure 7.

Figure 6 –Pump Station Amperage Records

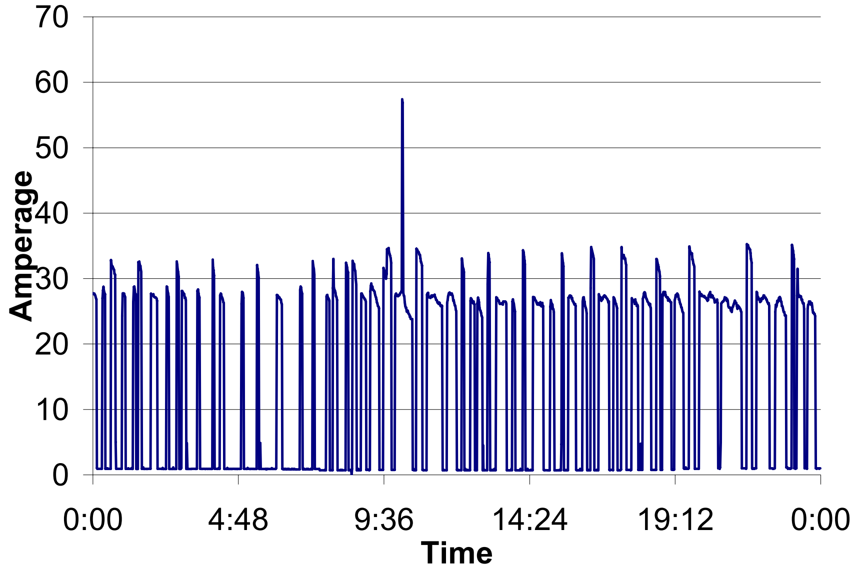
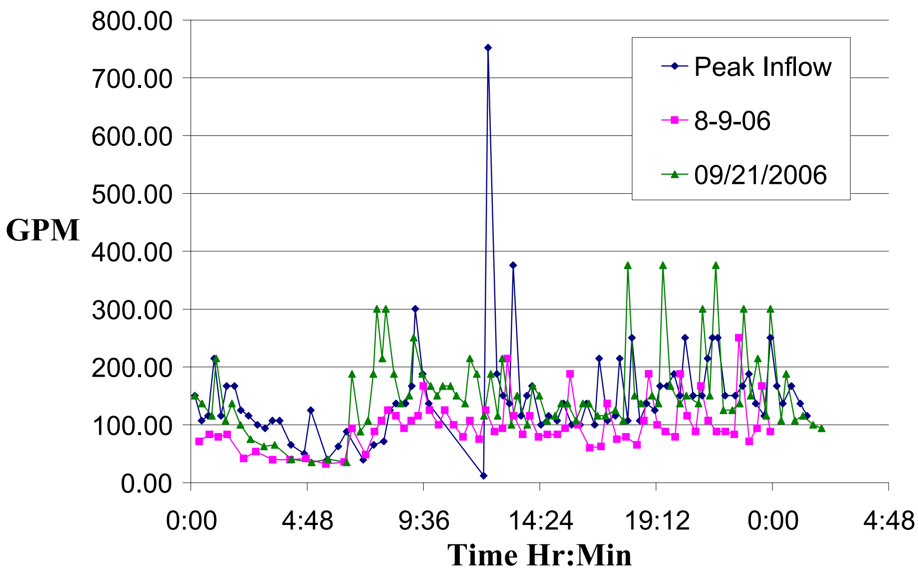
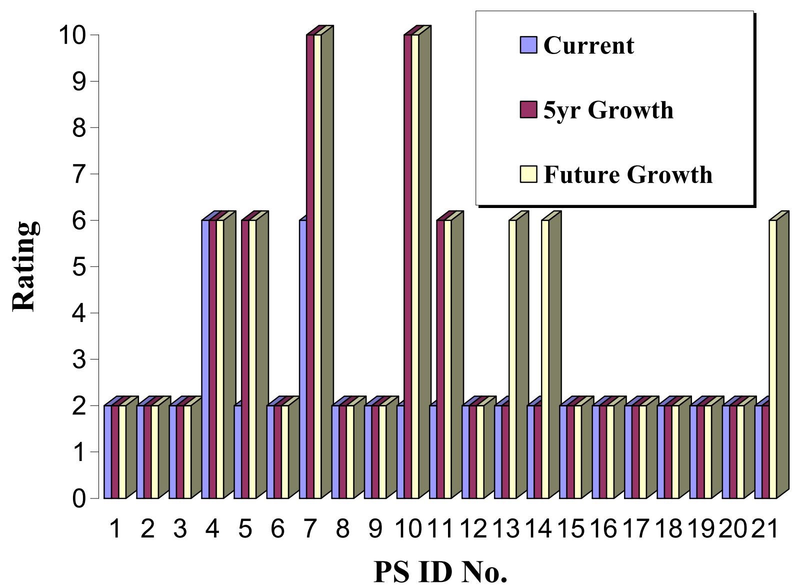


Figure 7 –Pump Station Diurnal Flow Patterns



Pump station capacity ratings were used to identify long term pump station capacity issues associated with the 5 year growth scenario and the ultimate build out projections. Figure 8 shows the results of the pumping station capacity analysis. The analysis identified a total of eight pump stations that have capacity issues. Two pump stations were identified as being below capacity under the current conditions. Overflow records from the Public Works department corroborated that the two identified pump stations have insufficient capacity with routine overflows. The analysis indicates that a total of five pump stations will be under capacity in the next five years and an additional three pump stations will need to be upgraded prior to build out of the sewer service areas.

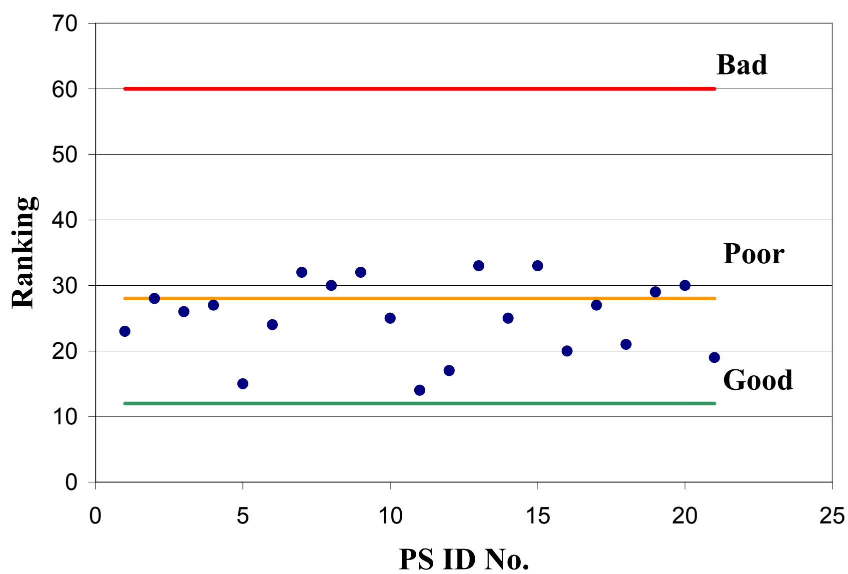
Figure 8 –Pump Station Capacity Assessment



Pump Station Condition Assessment

The condition of each pump station was evaluated based up 12 criteria established jointly by the Engineering and Public Works Departments. A summary of the condition of the Town's pump stations is shown in Figure 9. Pump stations with scores between 10 and 29 were deemed to be

Figure 9 – Pump Station Condition Rankings



in "good" condition and stations with scores above 30 were labeled as "poor" to "bad" condition. Approximately 33% of the existing pump stations are in "poor" condition and require additional capital funds for improvements. A listing of the condition assessment criteria and an example of the ranking system are shown in Table 2.

Table 2 - Pump Station Condition Ranking System

CONDITION ASSESSMENT	1 (Good)	2	3 (Poor)	4	5 (Bad)	Pump Station No.1
Age of Pumps	1-8 yrs	9-16 yrs	17-24 yrs	25-32 yrs	32-40 yrs	3
Age of Controls	1-8 yrs	9-16 yrs	17-24 yrs	25-32 yrs	32-40 yrs	3
Extent of Corrosion	None	odors	-	minor	substantial	4
Wet weather overflows	Improbable	Remote	Occasional	Probable	Frequent	5
Dry Weather overflows	Improbable	Remote	Occasional	Probable	Frequent	3
Uncontrollable Incident Overflows	Improbable	Remote	Occasional	Probable	Frequent	4
Emergency Generator	Yes	-	-	-	No	1
Deviation Between Pumps (%)	1-5%	5-10%	10-15%	15-25%	>25%	2
Deviation From PS Design Rate (%)	+-20%	+-40%	+-60%	+-80%	+-100%	1
FM Velocity (ft/sec)	2-8 ft/sec	-	-	-	<2 or >8 ft/sec	1
Number of Pump Cycles	2-5/hr	-	-	-	other	1
Adequate Wet Well Volume	Yes	-	-	-	No	1
					Condition Ranking Score =	29

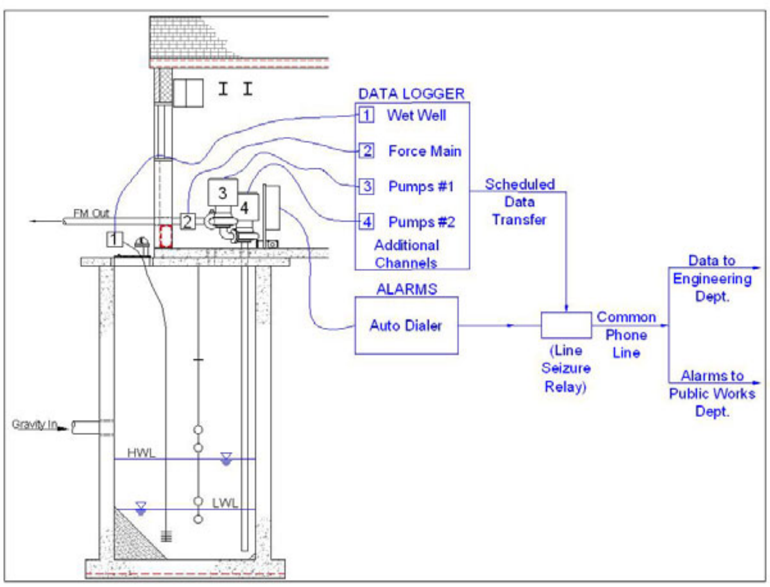
REMOTE DATA ACQUISITION SYSTEM

Working through the AM process the Town has identified four main attributes to a successful data acquisition system; (1) reliability for data collection, (2) quality control and quality assurance (QA/QC) for stored data, (3) flexibility for data analysis, and (4) accessibility for external users. As described in the previous sections the Town relies upon several measuring and data logging devices to evaluate the overall system capacity and condition. Currently there are over 50 data collection points spread throughout the 20 square mile sewer service area; 1 rain gauge, 15 area velocity meters, 22 amperage meters, 6 pressure transducers, and 5 magnetic flow meters. Average measurements from the area velocity flow meters are logged every 15 minutes. Pressure transducer and amperage readings are logged on one minute intervals. There are approximately 55,000 data points logged each day. Several logging devices are available on the market to store one minute interval data for up to six weeks and therefore data retention is not a significant issue. However the ability to check the status of data loggers in a quick and routine fashion is a major constraint. The more time that is spent on data collection and QA/QC analysis means less time is available to use data for system analysis.

In order to streamline the data collection and QA/QC process the Town investigated options for a more automated data collection system. The Town reviewed the option of installing a Supervisory Control and Data Acquisition (SCADA) system. However this option was ruled out due to financial constraints and no interest from the Town to have remote control capabilities. After a lengthy review the Town selected a Telog Enterprise (by Telog Instruments Inc.) data acquisition system package to be installed in a new pump station.

The perceived benefits for the Telog Enterprise data system are as follows: (1) the cost is comparable to a conventional magnetic meter installation, (2) the multi-channel data logger operates in parallel with the standard pump station alarm system, (3) the automatic data transfer uses a common phone line in conjunction with the pump station alarm system, and (4) the data can be viewed and retrieved via the web. A schematic of the pump station remote data logging system layout is shown in Figure 10.

Figure 10 – Schematic of Pump Station Remote Data Logging System



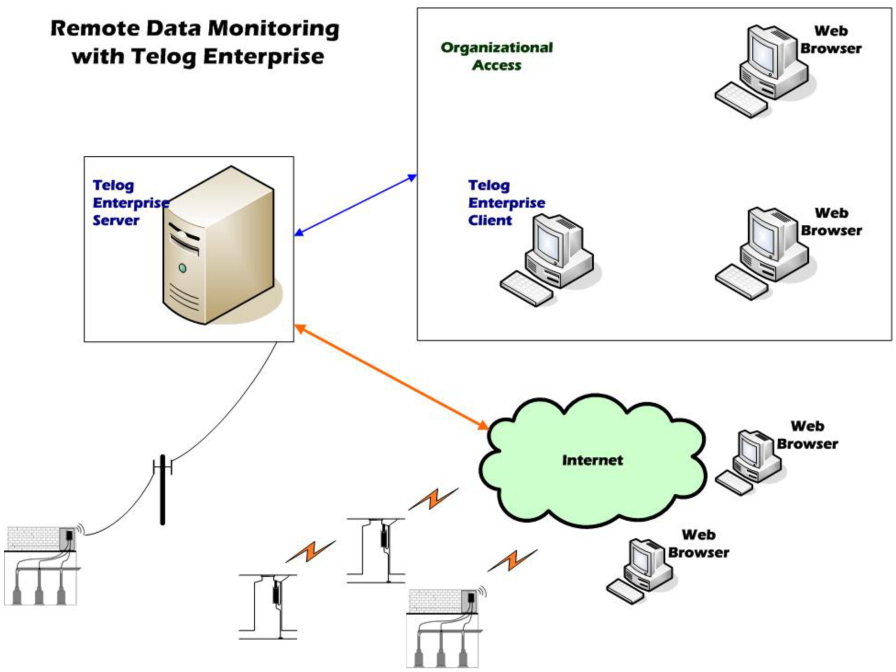
Amperage readings from pumps, wet well static pressure, and dynamic pressure from the discharge force main are logged locally at one minute intervals. At a preprogrammed daily time the local data logger pushes the stored data (referred to as a "data dump") to a centralized computer server located at the Blacksburg IT Department. The Telog Enterprise Client software was purchased and then installed on an existing computer owned by the Town. Data dumps occur via the same telephone line that is installed for the pump control alarm system, which eliminates costs for an additional phone line typically required with a SCADA system. In order to eliminate the data logger system from interfering with the pump station alarm system, the data logger's modem phone line is plugged into a line seizure relay. The line seizure relay allows an alarm status from the pump control panel to "seize" the phone line and instantaneously hang up the data logger signal and send out the alarm to the Public Works department. The data logger device is programmed to resend data after an alarm status has ended and the communication line is no longer tied up by the pump station alarm system. A Telog data logger unit next to a typical pump station auto dialer and alarming system is shown in Figure 11.

Figure 11 – Photograph of Installed 14 Channel Data Logger (left)

A schematic layout of the Telog Enterprise Client data acquisition system utilized by the Town of Blacksburg is shown in Figure 12. The Telog Enterprise Server software is installed on a Town owned computer maintained by the IT department. This server is the data "warehouse" for all data that is collected by the data loggers throughout the Town wide system. There are three ways that the Town transfers raw data into the "warehouse"; telephone modem, cellular modem, or direct down load of data from a field laptop computer. Out of a total of 55 sites where the Town collects data, only three are currently equipped with modems and automatically down load data to the "warehouse' on a daily basis. The remainder and majority of data is down loaded in the field by an Engineering Intern onto a lap top and transferred to the data "warehouse" every 4 to 6 weeks or after a major rain event.

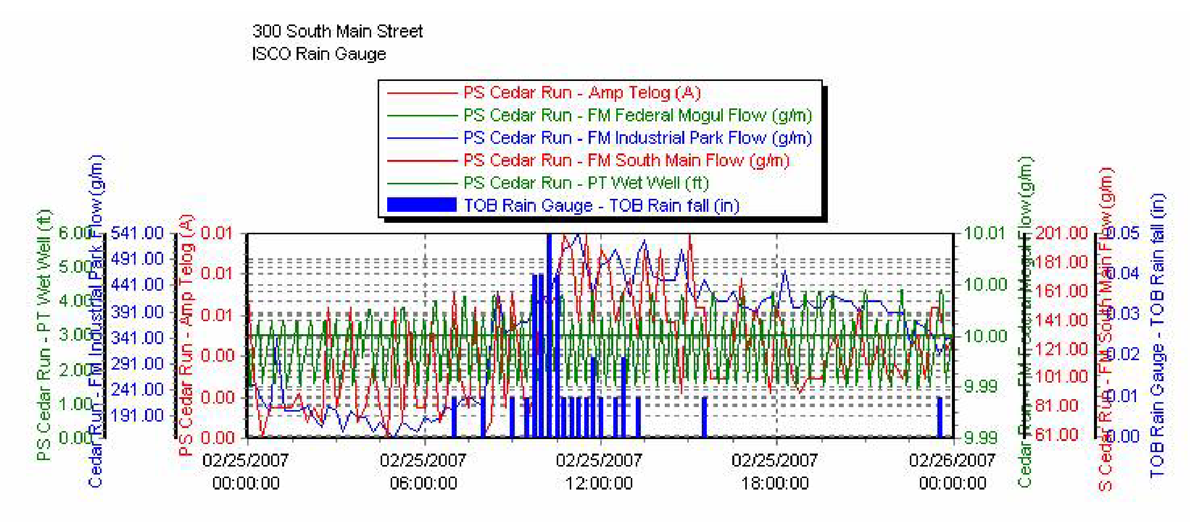
After the raw data is stored in the "warehouse" the Telog Enterprise Client software is used to review and perform a QA/QC check on the data. The flexibility in the Telog Enterprise Client software allows all data from the various data loggers to be entered into and manipulated in the "warehouse" via the Telog Enterprise Client software. Finalized data is stored on the server where it can be viewed internally or externally via a web module.

Figure 12 – Data Warehouse and Export System



A typical display of the data from the Enterprise Client web module is shown in Figure 13. The display allows all data to be viewed based upon a common time stamp. The output in Figure 13 shows wet well levels, pump amperage, influent flows, and inches of rain for a given time interval. The Telog Enterprise Client software has been in use by the Town for less than a year and has not yet been adopted as a Town "standard". However it appears to contain the four main attributes to a complete data acquisition system identified by the Town in the AM process; (1) reliability, (2) quality control and quality assurance (QA/QC), (3) flexibility for data analysis, and (4) accessibility for external data users.

Figure 13 - Telog Enterprise Client Data Output



PROJECT PRIORITY MATRIX

Previous sections in this presentation have highlighted the tools that the Town Of Blacksburg has used to collect data and evaluate issues that affect the sewer collection system today and may occur in the future based upon a projected “build out” scenario and a theoretical rain event. The capacity and condition analysis was performed under three different growth scenarios, (current, 5 years, & build out projections) and four weather events (dry weather, 1 year, 5 year, and 10 year storms) for a total twelve different scenarios. Each scenario identified several hydraulic “constraints” under several different conditions. More than a hundred issues related to the capacity and condition assessment were identified throughout the collection system. The number of issues can quickly become overwhelming and impossible to prioritize if there is not a process to define the severity of a constraint. A project prioritizing matrix that defined the probability and severity of a predefined “undesired event” was developed by adapting a similar approach used by the Department of Justice to Assess the Vulnerability of U.S. Chemical Facilities.

Results from the capacity and condition assessment were ranked based on the probability of overflows and surcharges. The severity of overflows and surcharges vary in terms of occurrence and probability. A frequent event is an overflow or surcharge that occurs once a year or more. A less frequent event occurs every 10 years or less. The levels of probability used for this study are listed in Table 3.

Table 3 - Probability Levels of an Undesired Event

Probability Level	Probability	Specific Event
A	Frequent	Likely to occur on a frequency interval less than or equal to 1 year
B	Probable	Likely to occur on a frequency interval greater than 1 year, but less than every 5 years.
C	Occasional	Likely to occur on a frequency interval greater than 5 years, but less than every 10 years.
D	Remote	Likely to occur on a frequency interval greater than every 10 years.
E	Improbable	So unlikely it can be assumed occurrence may not be experienced.

Severity of overflow is related to the public health or environmental hazard created; an overflow to surface water would be the most severe, and a surcharge that does not exit the collection system would be the least severe. The levels of severity are listed in Table 4.

The probability level of an event and the severity of the event can be combined to form a priority matrix that is then used to establish risk levels that are acceptable to the Town Council. The

Table 4- Severity Levels of an Undesirable Event Consequences

Severity Level	Severity	Characteristic
I	Extreme - Watershed Impact	Wastewater from collection system enters surface water - watershed public health hazard.
II	High - Sewer Overflows	Wastewater from collection system overflows onto the ground - localized public health hazard.
III	Moderate - Individual Homeowner Surcharges	Wastewater from collection system backs up into basements (WIB); no overflow reported - individual homeowner public health hazard.
IV	Low - Exceeds Defined Capacity	Wastewater gravity lines or pump stations surcharge above the defined capacity HGL; no overflow occurs - no apparent health hazard, indicative of impending capacity problems.

priority matrix is shown in Table 5. In the priority matrix, priorities shown in red are the highest, yellow the lowest, and orange in between the highest and lowest. Within each priority, there are additional levels of prioritization, which depend on the volume of overflow or duration of surcharge. Sewer system improvement priorities based upon the priority matrix rating are shown in Table 6. Additional prioritization of individual improvement projects can be made by the Town Council once project cost estimates are determined.

Table 5 – Priority Matrix

	Probability Level				
Severity Level	A-Frequent	B-Probable	C-Occasional	D-Remote	E-Improbable
I - Extreme	AI	BI	CI	DI	EI
II – High	AII	BII	CII	DII	EII
III - Moderate	AIII	BIII	CIII	DIII	EIII
IV – Low	AIV	BIV	CIV	DIV	EIV

Table 6 - Sewer System Improvement Priority Listing

Priority	Pipe Number	Manhole Number	Pump Station	Physical Location	Sub-Sewer Shed
AII	-	-	Hospital	Hospital Drive	I3- Hospital PS
AII	-	-	Givens	Craig Drive	C2B-Givens PS
BII	-	C08263	-	Watson Ave. and Progress St.	C1 - North Main
BI	-	C09101	-	1200 Block of North Main	C1 - North Main
CI	-	C09103	-	1200 Block of North Main	C1 - North Main
CII	-	MH-1070	-	At Sturbridge Pump Station	B2 - Sturbridge
AIV	-	-	Shawnee	U.S. 460	B3 - Shawnee
AIV	C07061	-	-	200 Block of College Avenue	F1 - VT Architect Annex
AIV	C07066	-	-	200 Block of College Avenue	F1 - VT Architect Annex
AIV	C08262	-	-	900 Block of Progress Street	C1 - North Main
AIV	C08263	-	-	900 Block of Progress Street	C1 - North Main
CIV	C08019	-	-	300 Block of Harding Ave.	D1 - Harding Ave.
CIV	C08024	-	-	300 Block of Owens St.	D1 - Harding Ave.

Out of more than one hundred potential capacity and condition constraints identified in the assessment phase of the project, approximately 40% were identified as being of the highest priority. Therefore the prescribed probability and severity analysis facilitated the overall asset management prioritization process for the Town of Blacksburg.

CONCLUSIONS

Like several moderately sized communities in the United States the Town of Blacksburg is experiencing sewer capacity constraints attributed to aging infrastructure and a healthy rate of development. With the increase in construction costs and demand for additional services the organization has had to develop an Asset Management (AM) process that shifts the focus from new construction to maximizing capacity within existing infrastructure. Having worked through the AM process over the last couple of years the Town has identified four components to a successful program; (1) develop an owner derived asset ranking system, (2) employ existing organizational technology, (3) automate data collection, and (4) encourage organizational leaders (i.e. Town Council) to develop a priority matrix. An owner derived asset ranking system connects long term goals with routine maintenance and confirms “buy in” from the organization. The ability to use technologies and processes currently employed by an organization expedite implementation of the AM process and increases the probability of success in the collection of information throughout multiple divisions. Stream lining the data collection process allows more time for review and decision making. A priority matrix defined by decision makers allows the AM process to be directed by the organizational leaders and provides a mechanism by which priorities can be changed and subsequently communicated throughout the organization. The Town is continuing to develop and refine the collection system AM process and looks forward to sharing more information as the program grows and matures.

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