CITY of HARRISONBURG

Sanitary Sewer

Management Plan

FY2020

February 19, 2021

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I. INTRODUCTION

Harrisonburg's Sanitary Sewer system assets are managed by either the Harrisonburg Public Utilities Department (HPU) or the Harrisonburg Rockingham Regional Sewer Authority (HRRSA). As shown in the caption, the Current Asset Replacement Value (CARV) directly managed by HPU approached $122M in FY2020 and was comprised mostly of interceptor and collection pipe networks. HPU manages all customer accounts. HRRSA, in contrast, managed $300M+ in CARV assets that were comprised of interceptor pipe networks and a 22.0 MGD Enhanced Biological Nutrient Removal (ENR) treatment facility.

Sanitary Sewer Management Plan Update

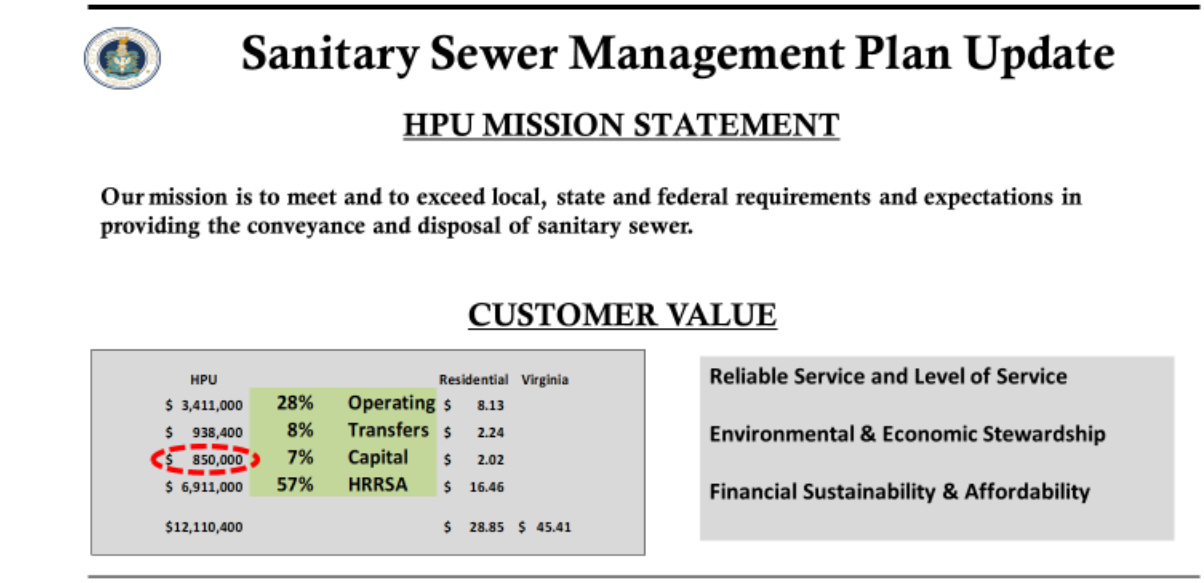
SANITARY SEWER SYSTEM ASSETS

C/O HPU	**$122M CARV** **184 miles pipe; 5,332 manholes, 6 pump stations** ***Sanitary Sewer Management Plan*** ***City Code of Ordinances Title 7, Chapter 3***
C/O HRRSA	**$300M+ CARV;** **53% Treatment / 7% to 93% interceptors** ***HRRSA Annual Report of Operations*** **8 person HRRSA Board - *Members Service Contract***

HRRSA publishes an Annual Report of Operations that is a sister document.

II. HPU MISSION AND CUSTOMER VALUE

HPU is guided by a mission to meet mandates and expectations while delivering customer value in service, stewardship, and finances. As shown in the caption below, HPU's biggest challenge is raising capital for the commitment to environmental and economic stewardship in the more specific agenda to replace aging assets and to abate infiltration & inflow.



Sanitary Sewer Management Plan Update

HPU MISSION STATEMENT

Our mission is to meet and to exceed local, state and federal requirements and expectations in providing the conveyance and disposal of sanitary sewer.

CUSTOMER VALUE

HPU			Residential	Virginia
$ 3,411,000	28%	Operating	$ 8.13	
$ 938,400	8%	Transfers	$ 2.24	
$ 850,000	7%	Capital	$ 2.02	
$ 6,911,000	57%	HRRSA	$ 16.46	
$12,110,400			$ 28.85	$ 45.41

Reliable Service and Level of Service

Environmental & Economic Stewardship

Financial Sustainability & Affordability

III. SERVICE, STEWARDSHIP AND FINANCES

The strategic roadmap underlying the SSMP is a decision process that balances customer service, environmental and economic stewardship, and financial management in making decisions and in undertaking actions.

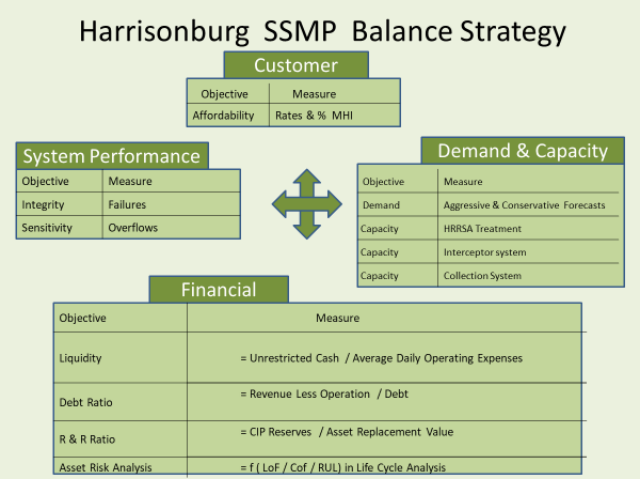


Figure 1

Four failure modes can give foundation to benchmarking service, stewardship, and financial management. The modes of failure are capacity, performance, mortality, and obsolescence.

1) Capacity: Capacity is a failure mode that benchmarks hydraulic induced sewer overflows that are evaluated in terms of probable frequency of occurrence. The goal for any location of overflow in the Harrisonburg Sewer System is less than one event every ten years.

2) Functionality: The functionality performance failure mode is termed as "System Integrity"; it provides a benchmark for uninterrupted service to the customer. The "Integrity" goal for the Harrisonburg Sewer System is less than the national median of 9.6 backups per year 100 miles of pipe. The Mean Time Between Failure (MTBF) goal for each pipe asset in the Harrisonburg Sewer System is one backup at less than once every ten years.

3) Mortality: Developing a comprehensive retirement and replacement (R&R) schedule is an analysis in determining remaining useful life (RUL) for the collection of system assets. Current practices at HPU have used the "Manufacturer's Anticipated Service Life" (MASL) to forecast long term financial funding requirements through the Capital Improvement Program (CIP). HPU is continuously moving deeper into RISK management (condition assessment and criticality analysis) to applying asset management principles to routine decisions for rehabbing or retiring an asset.

4) Obsolescence: Obsolescence is a failure mode that identifies materials that do not support goals of the SSMP.

As a perspective to HPU management in FY2020, 28 % of costs served to provide a reliable and acceptable level of service as compared to 64% of costs to provide environmental and economic stewardship.

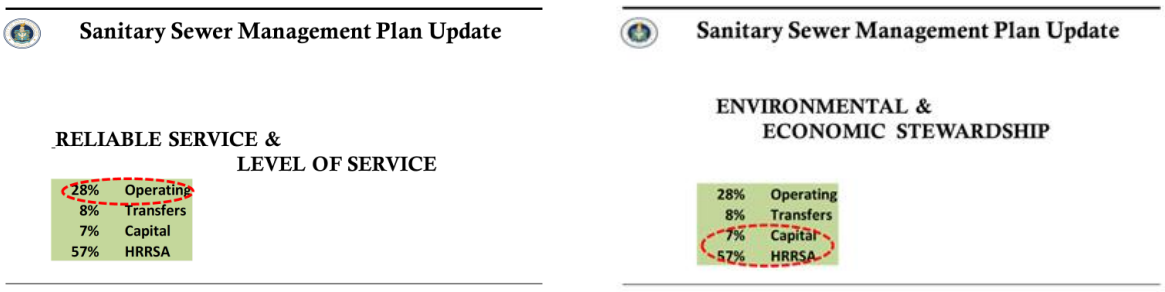


Figure 2

IV. SSMP OBJECTIVES

Eleven (11) key objectives of the SSMP are summarized below:

Sanitary Sewer Management Plan Update

Objective # 1	Annual Update the SSMP
Objective # 2	Sales & Treatment Volumes
Objective # 3	HRRSA Treatment Capacity
Objective # 4	HRRSA Interceptor Capacities
Objective # 5	City Interceptor Capacities
Objective # 6	Collection Integrity – "Backups"
Objective # 7	RUL – Asset Retirement
Objective # 8	Obsolescence - Asset
Objective # 9	Long Term Financial Model – Rates & Revenue
Objective #10	AMPS – Expense Management
Objective #11	Financial Overview

V. EXECUTIVE SUMMARY SCORECARD:

The following is an executive scorecard summary. The summary provides high level explanation of each objective and provides similar explanation of HPU status for each objective as applicable at the end of FY2020. Sections of the SSMP which follow provide deeper detail to these objectives.

SSMP Framework

SSMP Objective #1	Status - FY 2020
Objective #1 requires HPU to monitor and update the SSMP annually.	**Objective #1 has been met for FY2020 with publication of the February 19, 2021 edition of the SSMP.**

Capacity Mode: Annual Average Sales and Treatment

SSMP Objective #2	Status - FY 2020
Objective #2 requires HPU to monitor and forecast sales of sewer commodity in terms of annual average daily (AAD) flows.	**Objective #2 analysis: At 12.8 MGD capacity at HRRSA, Harrisonburg has ample allocation to accommodate its current and future sewer sales.**

Capacity Mode: M3CM AAD and Treatment

SSMP Objective #3	Status - FY 2020
Objective #3 requires HPU to monitor and forecast the maximum three consecutive month (M3CM) in terms of annual average daily (AAD) flows versus allocated treatment capacity at HRRSA.	**Objective #3 analysis: Considering the effect of I&I upon forecasted future sales, treatment requirements would exceed allocated treatment capacity in 7 of the 11 annual periods that were studied. Prior to FY2020, Harrisonburg has not exceeded hydraulic capacity, however; we have undesirably leveraged available unused hydraulic capacity to accommodate I&I. Therefore, I&I reduction is an SSMP goal that must keep pace with sales growth such to make available the leveraged capacity.**

Capacity Mode: HRRSA Interceptors

SSMP Objective #4	Status - FY 2020
Objective #4 requires HPU to be consistent with the HRRSA planning agenda for its interceptor capacities.	**Objective #4 Analysis: Maintaining compatibility with the future ILOS for the HRRSA interceptors will engage Harrisonburg into shared capital funding and into coordinating demand through planned land development and / or through I&I abatement.**

Capacity Mode: City Owned Interceptors

SSMP Objective #5	Status - FY 2020
Objective #5 of this SSMP requires an update to the 1989 Black's Run Interceptor Study in ILOS format and to then replace the original CIP strategy to match the recommendations from the updated study.	**Objective #5 Analysis: The HPU ILOS adopted the 10-year storm Level of Service which showed one (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor; remediation by $1.5M in CIP improvements are now included in the HPU Sewer CIP Program. The study will be repeated adding forecasted future sewer sales. Results from the analysis of future conditions will guide future CIP and I&I agenda.**

Performance Mode: Integrity and MTBF

SSMP Objective #6	Status - FY 2020
Objective #6 requires continuous monitoring of system integrity and MTBF sensitivity and to use these benchmarks as drivers for asset management.	**Objective #6 Analysis: The HPU sewer system has improved to industry defined second quartile performance for sewer backups at 7.4 failures per 100 miles of pipe. A total of 29 pipes failed to maintain the 'once per ten years failure" target and are thus focus for maintenance and R&R.**

Mortality Mode: RUL by MASL and RISK

SSMP Objective #7	Status - FY 2020
Objective #7 of this SSMP requires HPU to forecast the retirement date and value of its asset inventory.	Objective #6 Analysis: HPU sewer rates must generate $587,000 for asset retirement each year over the next twenty-five years.

Capacity Mode: Obsolescence

SSMP Objective #8	Status - FY 2020
Objective #8 requires HPU to maintain a pipe inventory for materials types with a concern for obsolescent pipe types.	Objective #8 Analysis: HPU maintains a pipe inventory for materials types with inventory divided equally among clay, concrete, and PVC materials.

Asset Management Implementation at HPU

SSMP Objective #9	Status - FY 2020
Objective #9 requires HPU to manage a Long-Term Financial Model (LTFM) to identify funding and expenses that are necessary to meet sewer asset management goals.	Objective #9 Analysis: The HPU-Econics Long Term Financial Model for FY2022 Sewer Budget suggested a rate increase of 2.25% per year through 2023-2027, 2.00% per year 2028 through 2034 and then 1.0% per year through 2034-2045.

Asset Management Implementation at HPU

SSMP Objective #10	Status - FY 2020
Objective #10 requires the development and implementation of individual Asset Management Plans (AMPS) for sewer pipes and manholes to guide the use of all identified drivers in making asset management decisions.	**Objective #10 Analysis: In FY2020 the following asset management activities were completed in coordination with defined asset management plans for sewer pipes and manholes:** • **FY2020 CCTV completed 11 miles of condition assessments for sewer pipe.** • **FY2020 sewer flushing provided service to 8.4% of the sewer asset inventory.** • **For FY2020, 47% of manhours and 36% of cost was directed to planned maintenance.** • **During FY2020 HPU allocated $1.05M to CIP and conducted 2,397 feet of pipe R&R.** • **During FY2020 baseline flow monitoring was completed for ILOS status. The data will provide a baseline for five years interval comparisons.** • **HPU completed smoke testing in 102,107 feet of sewer in FY2020.**

Benchmarking HPU Management

SSMP Objective #11	Status - FY 2019
Objective #11 requires monitoring selected sewer enterprise fund financial benchmarks	***Objective #11 Analysis FY2020:*** • ***HPU's sewer cash revenue collections approached nearly 104% of budgeted revenue.*** • ***HPU's sewer cash expenses were managed at 94% of budgeted allocations.*** • ***HPU's Unencumbered Fund Balance exceeded goals at 41% of cash revenue (versus 25%) and excluded $1,456,000 in land holdings.*** • ***HPU's customer residential monthly bills for water plus sewer at $44.80 per month was at 56% of the statewide survey benchmark for 5000 gallons per month.*** • ***HPU's customer residential annual average bill was $530 for water plus sewer, this was 0.94% of the average household median income (HMI) of Harrisonburg at $57,029. The monthly bill at 2.0% of HMI would have a financial stress threshold at HMI of $26,880 / yr.*** • ***HPU fully funded the asset retirement ACSO for FY2020, but a significant amount of funds came from a transfer from unencumbered fund balance.*** • ***The transfer from Fund Balance to meet ACSO is not a sustainable strategy as our LTFM indicates a 2.25% annual rate increase will be required for 2023-2027, 2.00% 2028-2034, and 1.00% 2034-2045.***

VI. Stewardship-Capacity Mode: AAD Sales and Treatment Capacity

Objective #2 requires HPU to monitor and forecast sales of sewer commodity in terms of annual average daily (AAD) flows.

a) Historic Analysis of Sales

Shown in the **Figure 3** below are sewer sales by the Harrisonburg Department of Billing. Average annual growth rates for the most recent periods of 20 years, 10 years, 5 years, and one-year were -0.6%, +13%, +5.0%, and -1.0%, respectively.

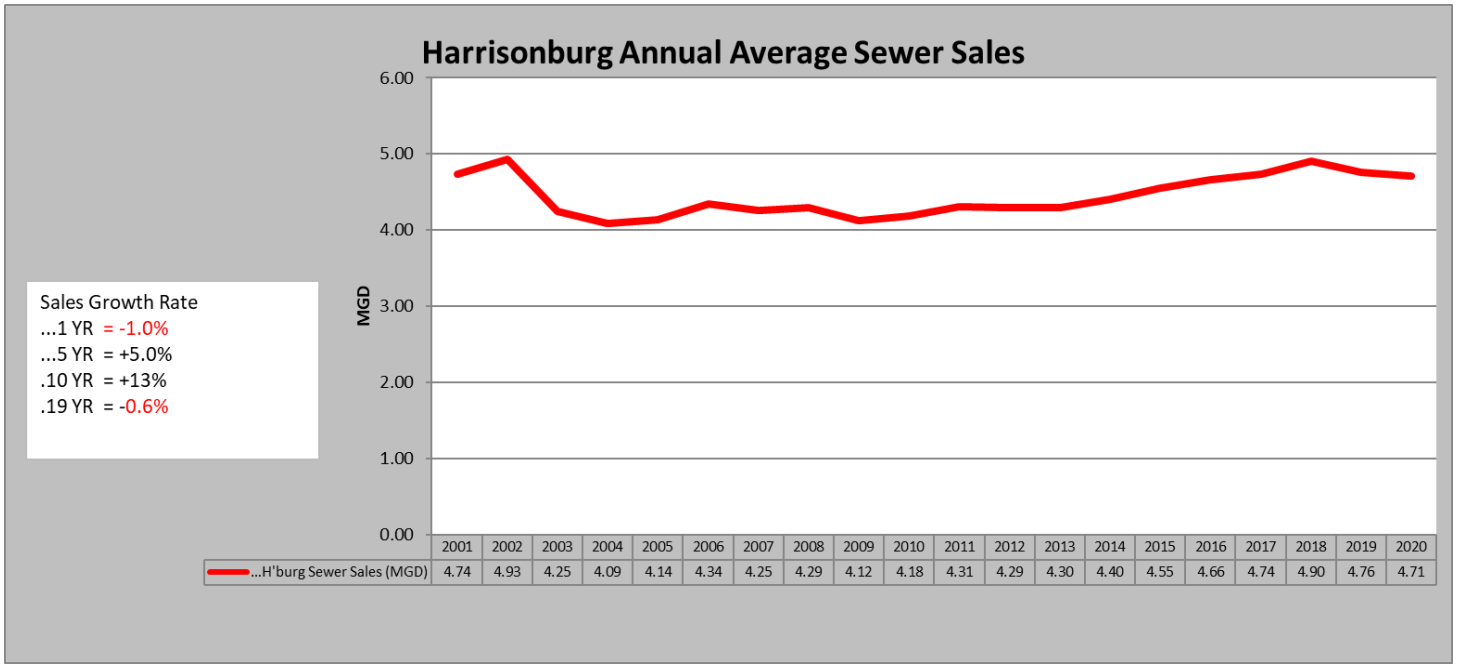


Figure 3

b) Forecast Analysis of Sales

A team of Harrisonburg City Departments have optimized the methodology and enhanced the use of GIS capabilities to better evaluate existing city water demands. *(Note that water sales were analyzed and are presumed to have generated 10%-20% higher estimates as compared to sewer sales. This is an acceptable level of safety for this analysis.)* Using most recent sales and land use data from FY2020, the City departments of Economic Development, Community Development, IT & GIS, City Manager and Public Utilities have determined the existing consumption per acre rates for all zoning types in the City.

Developed Lands, Existing Land Use *includes lawn and irrigation meter use*	**Consumption per acre**	**Consumption per unit (million gal/day)**	**Total Consumption**
COMMERCIAL - LODGING	0.001975	0.002580	0.126
COMMERCIAL - OFFICE	0.000286	0.000183	0.060
COMMERCIAL - RETAIL SERVICE	0.000400	0.000430	0.406
GOLF COURSES	0.000014	0.000521	0.005
INDUSTRIAL	0.002184	0.006506	1.243
INSTITUTIONAL	0.000462	0.000213	0.116
MIXED USE	0.003207	0.000116	0.052
PARKS AND RECREATION	0.000036	0.000543	0.015
PUBLIC FACILITIES	0.000066	0.000227	0.019
RESIDENTIAL - MULTI-FAMILY	0.001259	0.000116	0.786
RESIDENTIAL - SINGLE FAMILY ATTACHED	0.000577	0.000099	0.257
RESIDENTIAL - SINGLE FAMILY DETACHED	0.000224	0.000111	0.415
RESIDENTIAL SINGLE FAMILY GREATER THAN 2 ACRES	0.000013	0.000119	0.002
ROW	0.000000	#DIV/0!	0.000
SCHOOLS, COLLEGES, AND UNIVERSITIES	0.000855	0.004086	0.874
VACANT	0.000030	0.000096	0.001
BASELINE TOTAL			**4.377**

The team then applied the consumption per acre rates to respective vacant lands to forecast future internal City water sales. The forecast suggested an additional 3.119 MGD in growth for desired future land uses as shown below:

Vacant Lands, Land Use Guide	gal/day per unit	Number of units per ac	Multiplier value (mgd/ac)	Apply to ac from LUG	Growth Factor	Projected Use (mgd)
Conservation, Recreation, Open Space	-	-	0.000041	15.9	-	0.001
Low density residential	-	-	0.000350	143.7	-	0.050
Low density mixed residential	104	10	0.000001	618.2	-	0.643
Neighborhood residential	-	-	0.000420	60.6	-	0.025
Medium Density Residential	114	15	0.000001	77.0	-	0.132
Medium Density Mixed residential	114	20	0.000001	151.4	-	0.345
High density Residential	118	24	0.000001	5.7	-	0.016
Mixed Use	-	-	0.001418	317.0	-	0.449
Limited Commercial	-	-	0.000513	42.9	-	0.022
Commercial	-	-	0.000513	208.1	-	0.107
General Industrial	-	-	0.002102	567.6	-	1.193
Governmental/Quasi-Governmental	-	-	0.000798	140.3	1.2	0.134
Institutional	-	-	0.000546	2.0	1.2	0.001
USE BY FUTURE LAND USE GUIDE MULTIPLIERS TOTAL						3.119

c) Sales Versus Treatment

Harrisonburg treats its sewer as a member at the Harrisonburg Rockingham Regional Sewer Authority (HRRSA). The contract service agreement between HRRSA and its five members (Bridgewater, Dayton, Harrisonburg, Mount Crawford, and Rockingham County) directly defines member allocation by hydraulic capacity in million gallons per day (MGD). The HRRSA facility is rated at 22.0 MGD with Harrisonburg's allocation at 12.8 MGD (58%).

An initial analysis was to compare current and future sewer sales against allocated capacity at HRRSA. Preliminary discussions suggested a future expansion at HRRSA may increase its total capacity to 28.0 MGD; Harrisonburg would have opportunity to purchase additional capacity to 16.2 MGD (58%).

	FLOW	CAPACITY MGD
Existing Sewer Sales	4.3 MGD	
Future Sewer Sales	3.2 MGD	
Max Sewer Sales	7.5 MGD	12.8 MGD
		16.2 MGD

Objective #2 analysis: At 12.8 MGD capacity at HRRSA, Harrisonburg has ample allocation to accommodate its current 4.3 MGD sales plus its forecasted future sewer sales at 7.5 MGD.

VII. Level of Service-Capacity Mode: M3CM ADD and Treatment

Objective #3 requires HPU to monitor and forecast the maximum three consecutive month (M3CM) sewer demand in terms of annual average daily (AAD) flows versus allocated treatment capacity at HRRSA.

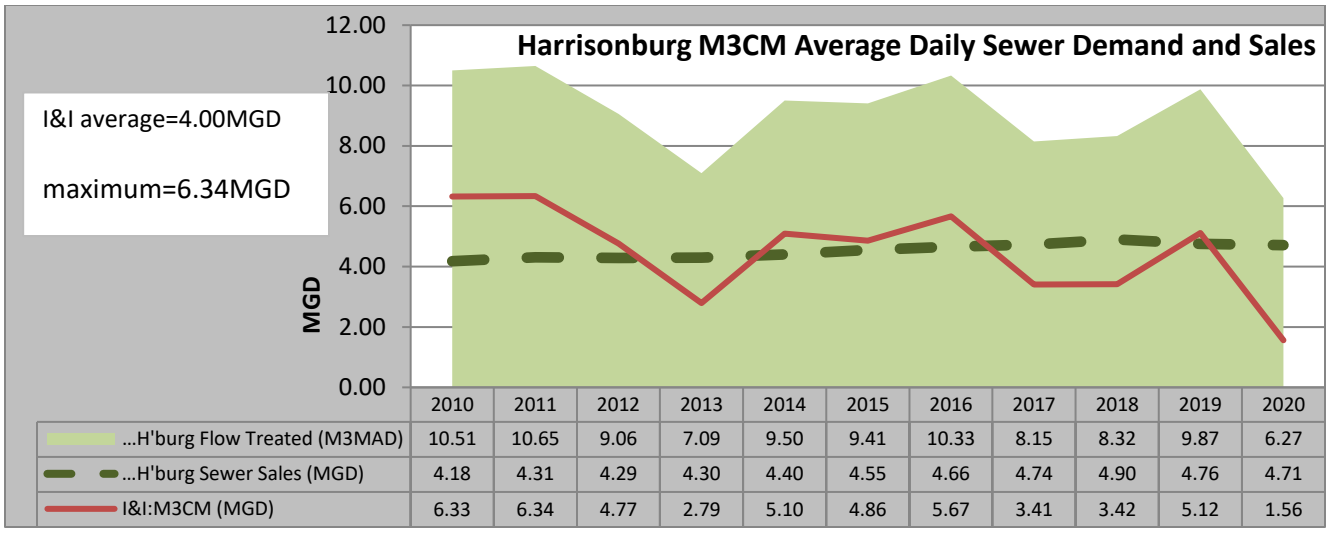
Definition of allocated capacity for each member jurisdiction at HRRSA is set forth under the HRRSA service agreement and refers to the maximum 3 consecutive months (M3CM) flow. The use of allocated flow is the sales of sewer as detailed in the preceding section of this plan; however, plus infiltration and inflow (I&I) which is an undesirable component that must be included in the evaluation.

Rainfall-derived "infiltration" refers to rainfall runoff that filters through the soil before entering a sanitary sewer system through damaged pipe sections, leaky joints, or poor manhole connections; duration is generally longer than experienced with inflow.

Rainfall-derived "Inflow" is the water that enters a sanitary sewer system directly by way of depressed manhole lids and frames, downspouts, sump pumps, foundation drains, areaway drains, and cross connections with storm sewers. Inflow occurs and peaks shortly after rainfall and then tapers quickly.

a) Historic Analysis of Demand

Demand is equal to sales plus I&I. Shown in the figure below for the period of 2010 through 2020 is a historic comparison of sewer sales by the Harrisonburg Department of Billing versus Harrisonburg's demand at the HRRSA sewer treatment plant. Whereas the latter has been consistently the larger; the difference is largely caused by I&I. This extraneous source of water is driven by unfavorable sewer system configuration and asset conditions as well as incurred weather conditions. The maximum recorded M3CM I&I was 6.34 MGD and the average was 4.00 MGD.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
…H'burg Flow Treated (M3MAD)	10.51	10.65	9.06	7.09	9.50	9.41	10.33	8.15	8.32	9.87	6.27
…H'burg Sewer Sales (MGD)	4.18	4.31	4.29	4.30	4.40	4.55	4.66	4.74	4.90	4.76	4.71
I&I:M3CM (MGD)	6.33	6.34	4.77	2.79	5.10	4.86	5.67	3.41	3.42	5.12	1.56

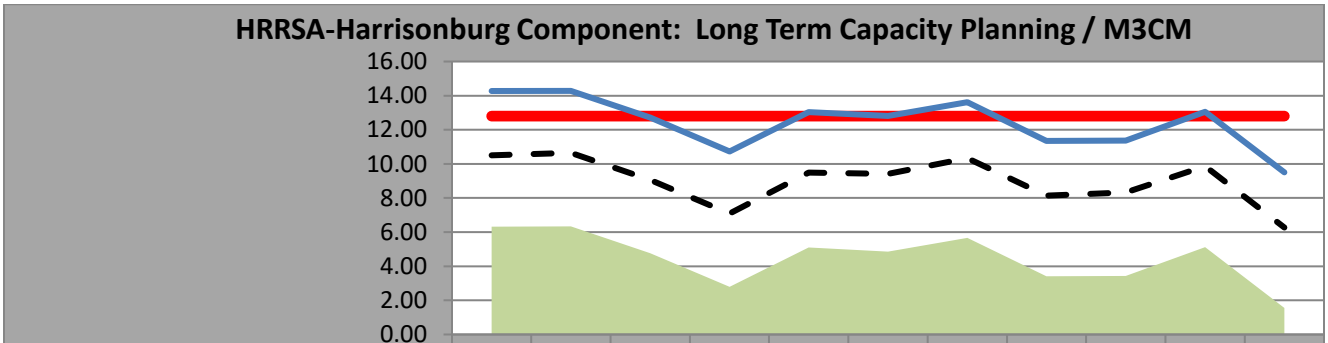
Figure 4

b) Forecast Analysis of Demand

Forecasting future demand is somewhat difficult because the I&I component is not a constant (as compared to sales) but more related to incurred weather. Therefore, the future demand and needed treatment capacity can be estimated by displaying future demands added upon previous trends. The following are components of future demands:

- Future growth in City sales:
  3.2 MGD as determined in the previous section
- Reserved sales for Michaels and Daley
  0.26 MGD
- Future I&I effect: The analysis assumed zero reduction in existing system and zero addition with future growth. Other allowances can provide opportunities for additional sensitivity analysis.

The results shown in **Figure 5** indicate that available capacity of 12.8 MGD will not always support the future treatment requirement.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I&I:M3CM (MGD)	6.33	6.34	4.77	2.79	5.10	4.86	5.67	3.41	3.42	5.12	1.56
HRRSA Capacity (C)	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80
Historical HRRSA-Hburg Flows	10.51	10.65	9.06	7.09	9.50	9.41	10.33	8.15	8.32	9.87	6.27
…PRT Sewer Sales + M3CMI&I (MGD)	14.27	14.28	12.71	10.74	13.04	12.80	13.61	11.35	11.37	13.06	9.50

Figure 5

Objective #3 analysis: Considering the effect of I&I upon forecasted future sales, treatment requirements would exceed allocated treatment capacity in 7 of the 11 annual periods that were studied. Prior to FY2020, Harrisonburg has not exceeded hydraulic capacity, however; it has undesirably leveraged available unused hydraulic capacity to accommodate I&I. Therefore, I&I reduction is an SSMP goal that must keep pace with sales growth such to make available the leveraged capacity.

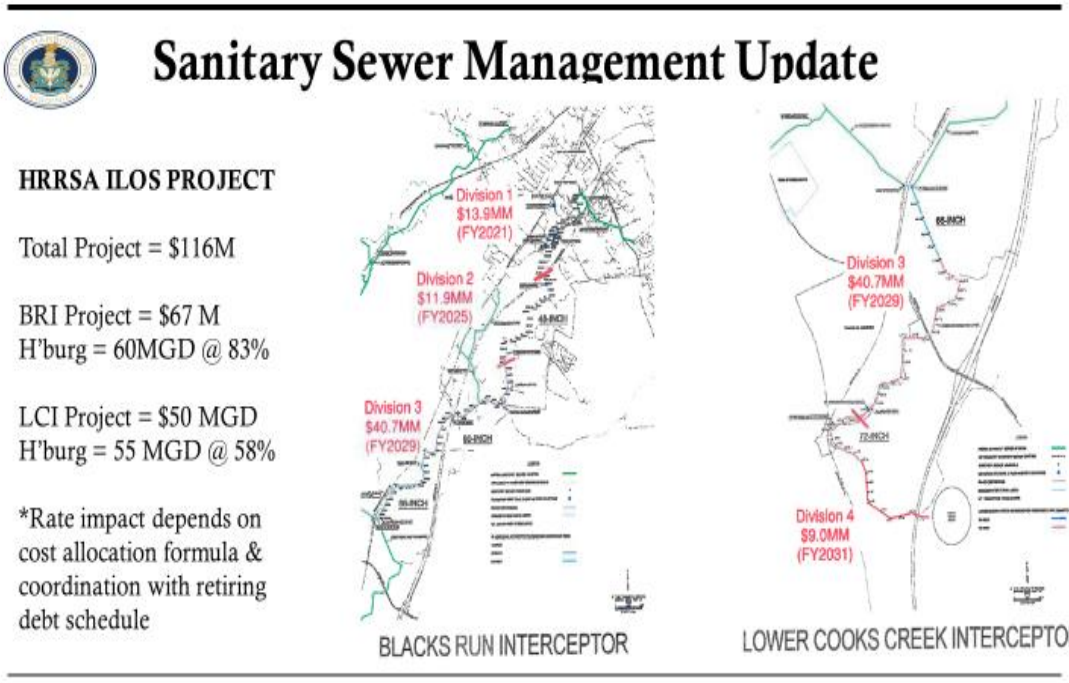
VIII. Level of Service- Capacity Mode: HRRSA Interceptors

Objective #4 requires HPU to be consistent with the HRRSA planning agenda for its interceptor capacities.

HRRSA owns and operates interceptor sewer pipes that extend through certain sections of the City and then southward beyond the City limits to the treatment facility in Mount Crawford. HRRSA has defined and named its interceptor system into three divisions. Two divisions are geographically located in the upper system and they are named Upper Cooks Creek Interceptor (UCCI) and Blacks Run Interceptor (BRI). The lower section has been named Lower Cooks Creek Interceptor (LCCI); it receives flow from UCCI plus BRI and then conveys the combined flow to the HRRSA treatment plant.

Using unvalidated assumptions for future needs, HRRSA completed a study for forecasted future flows and corresponding needed sewer capacities if the treatment facility is expanded from 22 MGD to 28 MGD. A summary of the capital improvement master plan for BRI and LCCI is shown below; UCCI pipe capacities will not be expanded in this project.

Figure 6



Objective #4 Analysis: Maintaining compatibility with the future ILOS for the HRRSA interceptors will engage Harrisonburg into shared capital funding and into coordinating demand through planned land development and / or I&I abatement.

Below is the annual debt schedule provided in the HRRSA ILOS study.

- 2023-2042 Div. 1 Bond $ 847,519 per year
- 2027 -2046: Div. 2 Bond $ 718,516 per year
- 2031-2050: Div. 3 Bond $2,471,766 per year
- 2033-2052: Div. 4 Bond $ 544,836 per year

Division 1 improvements are currently under construction with some modifications to the original masterplan. The post improvement capacity as recommended for UBRI and the Harrisonburg East Interceptor was 75 MGD with 60 MGD allocated to Harrisonburg. After further evaluation, upper sections of UBRI (Stone Springs Road to Purcell Park) have been retained in capacity at 17 MGD but with structural restoration by slip lining existing pipe. Division 1A project is in the amount of $750k from Prism Contractors & Engineers, Inc. of Williamsburg, Virginia. Division 1B project is in the amount of $4.8M from Garney Companies, Inc. of Chantilly, Virginia. These projects will be completed in 2021.

The revised future demand and capacity relationship in the Upper BRI section is summarized:

- 17 MGD pipe capacity
- 14 MGD allocated to Harrisonburg

IX. Capacity Mode: City Owned Interceptors

Objective #5 requires an update to the 1989 Black's Run Interceptor Study in ILOS format and to then to replace the original CIP strategy to match the recommendations from the updated study.

a) HPU ILOS Program History

Harrisonburg owns and operates its own interceptor sewer pipes that generally run from north to south in the City. The City interceptors deliver flow to the HRRSA interceptors that have been referenced in the previous section of this document. Over the years, the City and HRRSA interceptors have undergone evaluations as shown in the progression chart below.

Figure 7

As shown in Fig. 7, a study conducted by Wiley & Wilson in 1989 has guided HPU CIP investments into the Blacks Run Interceptor Program. The study provided a 22 years plan to upgrade interceptor capacities to meet future growth forecasts. Most recommendations have been completed; refer to Appendix D for a status update. The study is outdated and was not framed in the format of ILOS that was performed under the HRRSA capacity studies.

b) HPU RJN ILOS Study

HPU currently has RJN contracted to update the W&W study in the ILOS format; the 8 tasks involved in this process are shown in Fig. 8. RJN has progressed through task 6; tasks 7 and 8 are anticipated to be completed in 2021. The RJN study began with data from the 1989 WW study; integrated the substantial improvements made by HPU since 1989, integrated flow data that was collected between 2018 through 2020 and then has identified existing ILOS status.

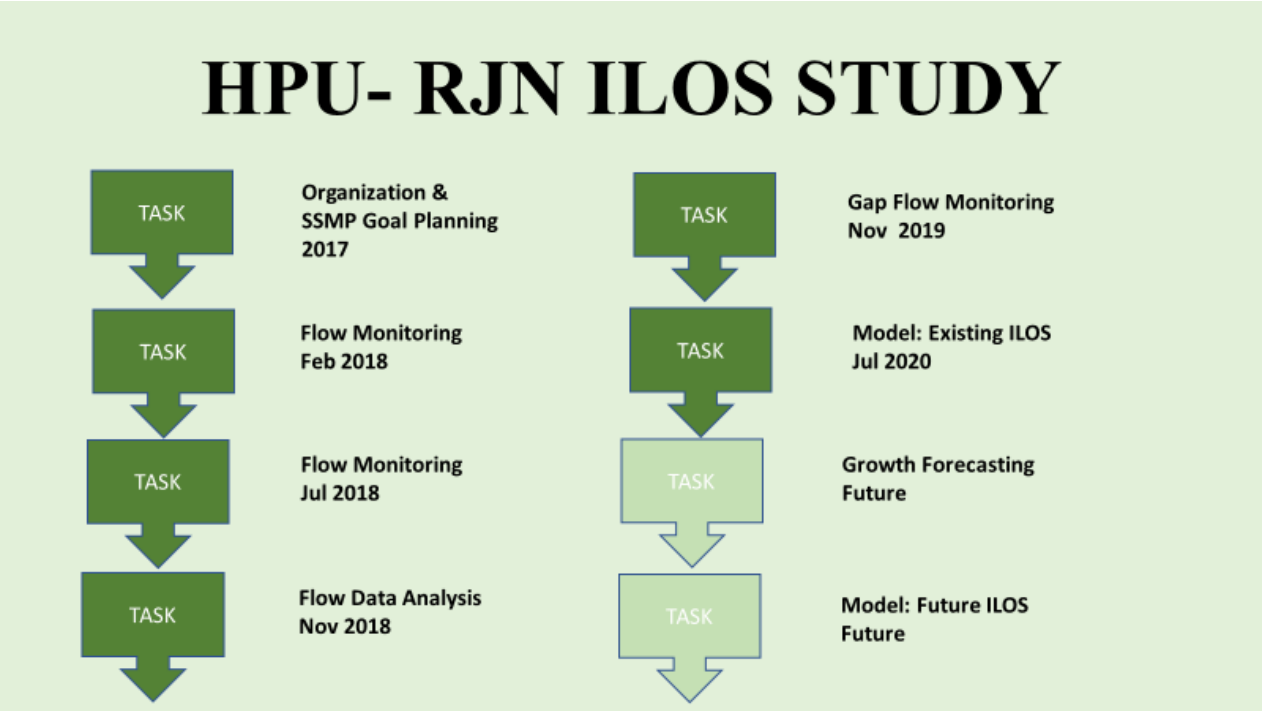
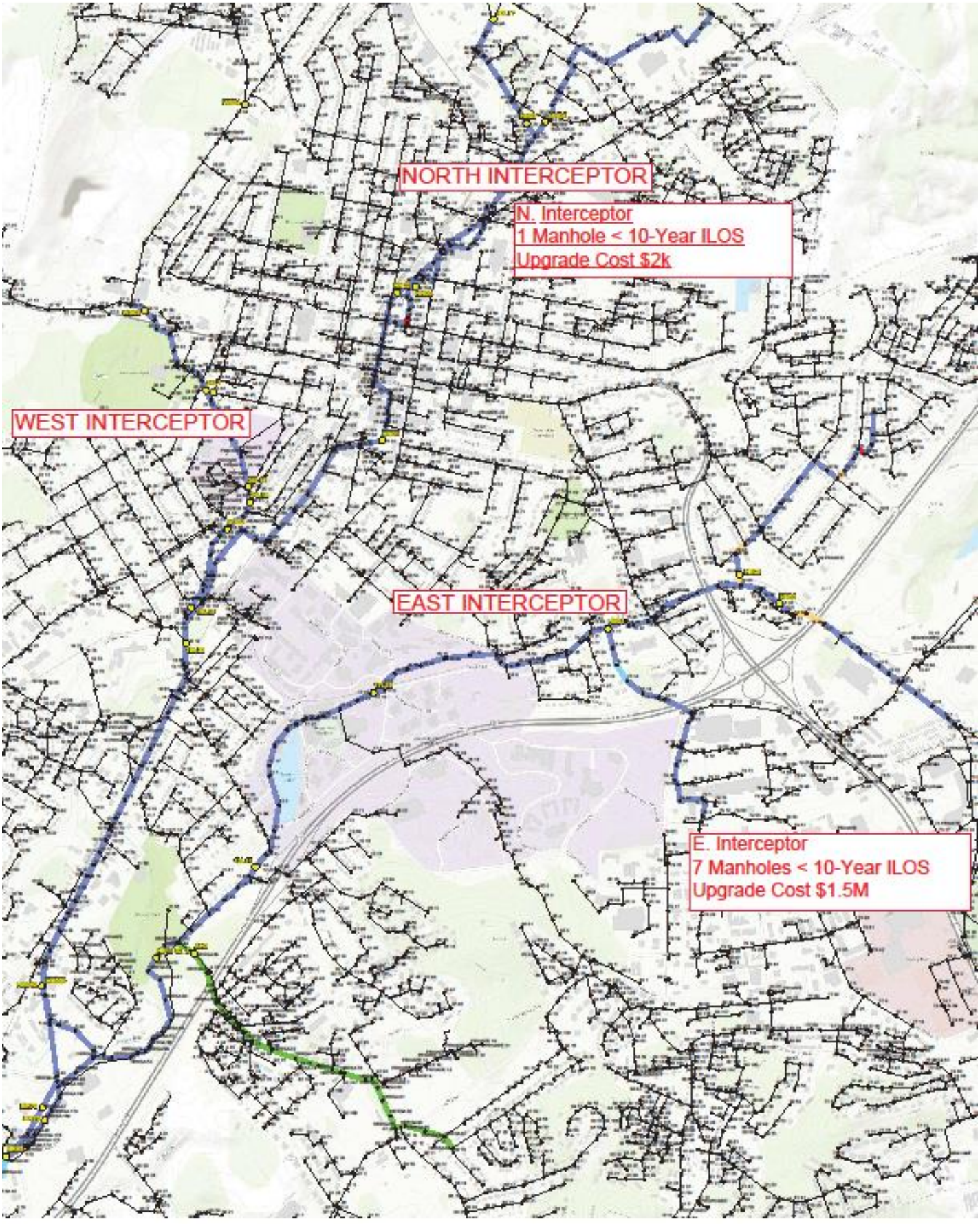


Figure 8


NORTH INTERCEPTOR
N. Interceptor
1 Manhole < 10-Year ILOS
Upgrade Cost $2k
WEST INTERCEPTOR
EAST INTERCEPTOR
E. Interceptor
7 Manholes < 10-Year ILOS
Upgrade Cost $1.5M

The conclusions for City ILOS existing conditions were provided by RJN in July 2020 with reference to wet weather capacity analysis performed under three design storm conditions: 2 years- 24-hour storm, 5 years- 24-hour storm, 10 years - 24-hour storm. The study referenced capacity conditions as pertained to the City's East, North, and Western, Blacks Run Interceptors.

- Western Blacks Run Interceptor (WBRI) is comprised of subsystems that included the "Lower West Interceptor (LWI)", "Upper West Interceptor (UWI)", "North Interceptor (NI)" and the "West Spur Interceptor (WSI)".
- Eastern Blacks Run Interceptor (EBRI) is an extension of the HRRSA UBBI and includes the "Blue Ridge Drive Interceptor (BDI).

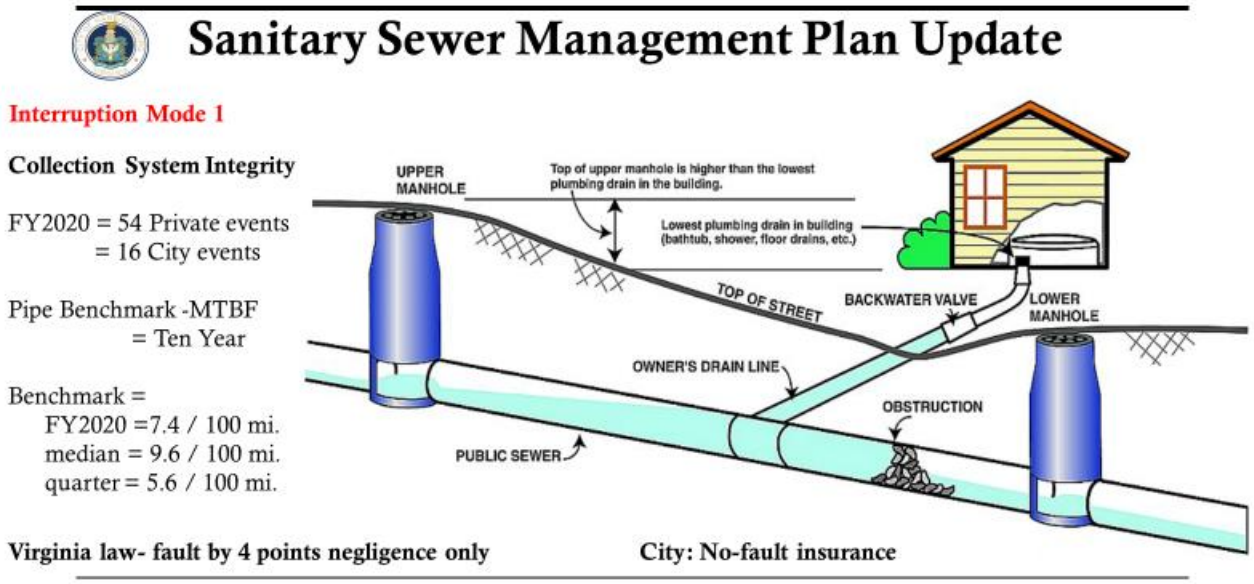
Objective #5 Analysis: The HPU ILOS adopted the 10-year storm Level of Service which showed one (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor; remediation by $1.5M in CIP improvements are now included in the HPU Sewer CIP Program. The study will be repeated adding forecasted future sewer sales. Results from the analysis of future conditions will guide future CIP and I&I agenda.

X. Reliable Service - Performance Mode; Integrity and MTBF

Objective #6 requires continuous monitoring of system integrity and MTBF sensitivity and to use these benchmarks as drivers for asset management.

a) System Integrity:

Failure means a loss of capacity resulting from a flow restriction in gravity or pressurized wastewater systems. Examples include blockages from debris inappropriately deposited by users or blockages caused by substandard pipe structural condition. Integrity analysis is a driver for maintenance decisions.



RELIABLE SERVICE & LEVEL OF SERVICE

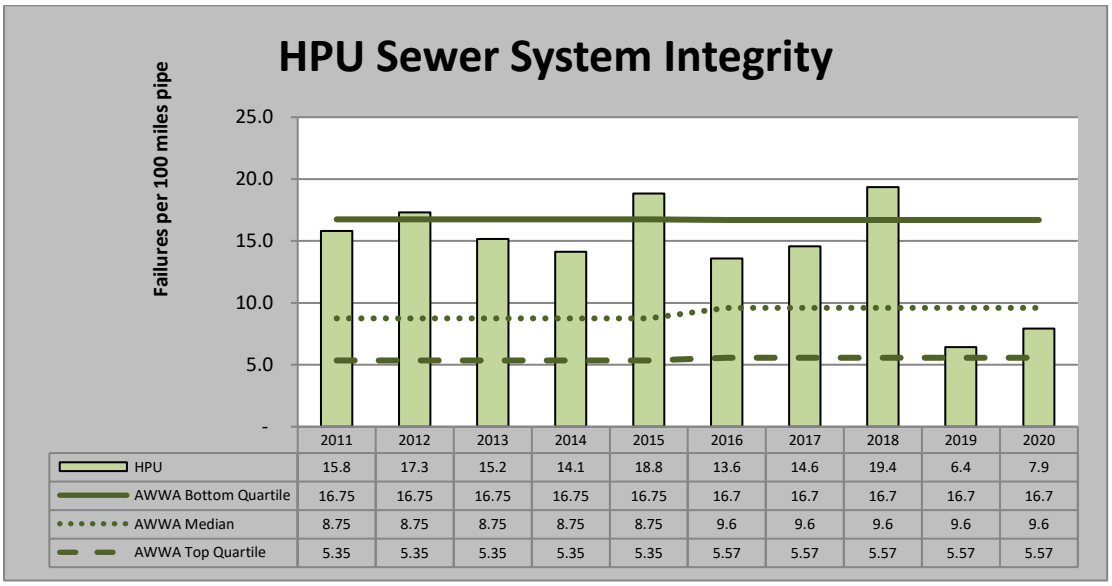
Benchmark for Integrity:

The integrity benchmark of a sewer system measures the frequency of collection system failures per 100 miles of collection piping= [100 * [(# public failures) / Total Miles of Pipe]].

AWWA Published Benchmarks

Top Quartile	5.6 stoppages per 100 miles pipe
Median	9.6 stoppages per 100 miles pipe

Referring to AWWA industry benchmark, Harrisonburg Sanitary Sewer System integrity rating has performed most frequently in the third and fourth quartiles since 2011; but has advanced to the second quartile in FY2020. The HPU trend is shown in Figure 9 below:



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HPU	15.8	17.3	15.2	14.1	18.8	13.6	14.6	19.4	6.4	7.9
AWWA Bottom Quartile	16.75	16.75	16.75	16.75	16.75	16.7	16.7	16.7	16.7	16.7
AWWA Median	8.75	8.75	8.75	8.75	8.75	9.6	9.6	9.6	9.6	9.6
AWWA Top Quartile	5.35	5.35	5.35	5.35	5.35	5.57	5.57	5.57	5.57	5.57

Figure 9

b) Customer Sensitivity for Integrity:

HPU desires to deliver a LOS of ten years to its customers; it expects to have a backup failure occur to a customer habitat no more than once per ten years. Shown below is the distribution of Mean Time Between Failure (MTBF) frequency in the Harrisonburg Sanitary Sewer System. For FY2020, 29 pipes did not meet the Harrisonburg 10 years ILOS benchmark for MTBF and are the focus of maintenance and R&R.

Sanitary Sewer Pipe MTMF 2020

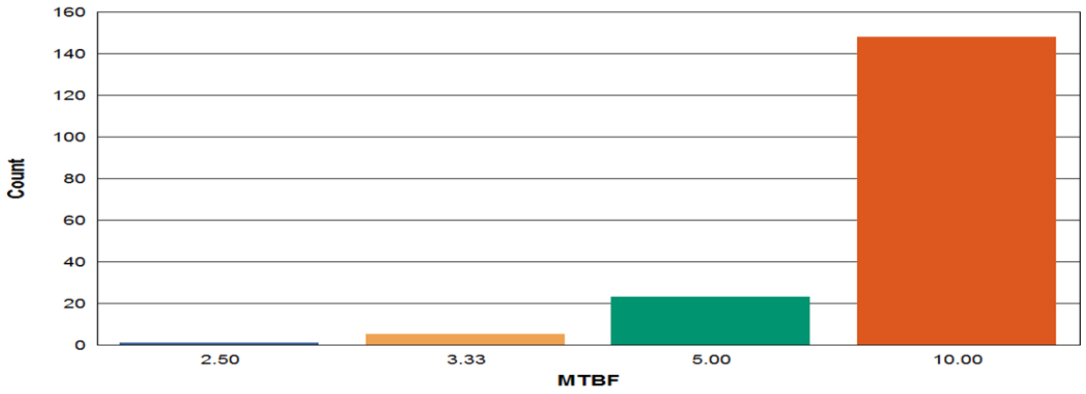


Figure 10

	TOTAL	2.5	3.33	5.00	10.00
TOTAL	177	1	5	23	148

Objective #6 Analysis: The HPU sewer system has improved to industry defined second quartile performance for sewer backups at 7.4 failures per 100 miles of pipe. A total of 29 pipes failed to maintain the once per ten years failure target and are thus focus for maintenance and R&R.

XI. Mortality Mode: RUL by MASL and RISK

Objective #7 of this SSMP requires HPU to forecast the retirement date and value of its asset inventory.

Asset management is the practice of managing infrastructure capital assets to minimize the total cost of owning and operating these assets while delivering the desired service levels through the following formal tools. The first key decision process in asset management is to determine when the individual assets may need rehabilitated or replaced. Retirement funding requirements are forecasted using the Manufacturer's Anticipated Service Life (MASL) for each asset type (sewer pipes, manholes, etc.). As HPU moves forward in maturing asset management, RISK principles will replace MASL principles.

As shown in the table and Figure 11 below; the HPU sewer enterprise fund will need to retire $12,890,379 of its $122,254,458 asset inventory between 2022 and 2046. The cost of replacement on schedule at 2.5% inflation rate will be $15,569,278 with a uniform ACSO of $586,948 / yr.

ACSO Analysis

Code ID#		Sewer Fund Description	100% CARV	Net Book Value	25 Yr. CARV	%	25 Yr. $	ASCO
911161	48641	Blacks Run Interceptor	$ 25,893,920	$ 14,798,496	$ 1,799,578	7%	$ 2,194,937	$ 87,797
911161	48734	Metering System	$ 2,758,462	$ 2,036,566	$ 1,058,851	38%	$ 1,301,296	$ 26,026
911161	48735	Collection & Transmission Assets	$ 89,168,473	$ 51,253,462	$ 8,944,524	11%	$ 10,127,644	$ 405,106
911161	48736	Pumps	$ 1,620,077	$ 791,750	$1,087,426	67%	$1,450,470	$ 58,019
911161	48757	Facilities (1,2)	$ 2,813,526	N/A	N/A		$ 494,931	$ 10,000
911161		Total	$ 122,254,458	$ 68,880,274	$ 12,890,379	11%	$ 15,569,278	$ 586,948

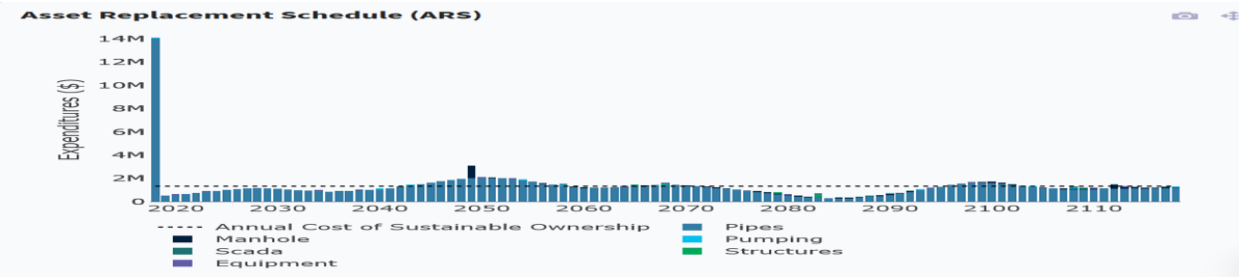


Figure 11

Objective #7 Analysis: HPU sewer rates must generate $587,000 for asset retirement each year over the next twenty-five years.

XII. Obsolescence Mode

Objective #8 requires HPU to maintain a pipe and manhole inventory for materials types with a concern for obsolescent pipe types.

Cohort Groups	Inventory (feet)	% of System
Cast Iron	478	0%
Clay Tile	280,066	29%
Terracotta (clay)	8,366	1%
Concrete	344,286	36%
Ductile Iron	20,732	2%
HDPE	829	0%
PVC	309,395	32%

Cohort Groups	Inventory Totals	% of System
Brick Manholes	272	5%
Concrete Manholes	5,426	95%

Objective #8 Analysis: HPU maintains a pipe inventory for materials types with inventory divided equally among clay, concrete, and PVC materials.

XIII. Asset Management at HPU

a) Long Term Financial Model (LTFM):

Objective #9 requires HPU to manage a Long-Term Financial Model (LTFM) to identify funding and expenses that are necessary to meet sewer asset management goals.

Harrisonburg VIRGINIA

Sanitary Sewer Management Plan Update

Long Term Financial Model

Rate drive revenue
2.25% 2023-2027
2.00% 2028-2034
1.25% 2034-2045
Non-rate driven revenue Growth-1.0 %

Operating expenses Transfers

ACSO----------$587,000 /yr.
I&I Capital--------$250,000/yr.
Growth Capital---$100,000/yr.

FINANCIAL SUSTAINABILITY & AFFORDABILLTY

Objective #9 Analysis: The HPU-Water Worth Sewer Long Term Financial Model for FY2022 Budget suggested a rate increase of 2.25% per year through 2023-2027, 2.00% per year 2028 through 2034 and then 1.0% per year through 2034-2045.

b) Asset Management Plans (AMPS):

Objective #10 requires the development and implementation of individual Asset Management Plans (AMPS) for sewer pipes and manholes to guide the use of all identified drivers in making asset management decisions.

Objective #10 Analysis: In FY2020 the following asset management activities were completed in coordination with defined asset management plans for sewer pipes and manholes:

- ***HPU has developed asset AMPS and therein integrated asset management maintenance activities into baseline schedules of sewer management, I&I abatement program and Field Utilities work management.***
- ***FY2020 CCTV completed 11 miles of condition assessments for sewer pipe.***
- ***FY2020 sewer flushing provided service to 8.4% of the sewer asset inventory.***
- ***For FY2020, 47% of manhours and 36% of cost was directed to planned maintenance.***
- ***During FY2020 HPU allocated $1.05M to CIP and conducted 2,397 feet of pipe R&R.***
- ***During FY2020 baseline flow monitoring was completed for ILOS status. The data will provide a baseline for five years interval comparisons.***
- ***HPU completed smoke testing in 102,107 feet of sewer in FY2020.***

i. Integrated Asset Management

a. Decision Strategy

Shown below is the decision tree that is conveyed in the HPU Sewer Pipe AMP. Identified are various activities (predictive, preventive, repair' and R&R) used by HPU under both scheduled and unscheduled agendas. Further detail and outputs from these activities are provided later in this section.

HPU SEWER MAIN ASSET MANAGEMENT DECISION TREE

	FAILURE MODE	UNSCHEDULED				SCHEDULED		
	EVENTS	Progression →				Progression →		
	Performance							
1	Sewer Main Backup	Flushing	CCTV	Repair			(1) CCTV	Repair
2	Staff Recommendations						CCTV	Repair
3	MTBF:							
4	Infiltration & Inflow					Flow Monitor	(2) CCTV Smoke Test	(3) Repair, R&R
	Structural							
5	Age/RUL-MASL						(2) CCTV	(3) Repair, R&R
6	Paving Schedule:						(2) CCTV	(3) Repair, R&R
7	CIP Project Integration						(2) CCTV	(3) Repair, R&R
	Capacity							
8	Sewer Main Surcharge or Overflow					Flow Monitor	(2) CCTV	(3) Repair, R&R
	Obsolescense							
9	See Age/RUL-MASL						(2) CCTV	(3) Repair, R&R

(1) CCTV	Three backups in the sewer main trigger a CCTV inspection.
(2) CCTV	HPU targets 100% CCTV inspection of its sewer main inventory over ten years. Failure mode events are used to prioritize the schedule of CCTV work.
(3) CCTV	Risk based selection is a tool of asset management that is preferred for selection and for prioritizing repair and replacement.

A project is currently active to optimize the HPU computer maintenance management system (CMMS) to better schedule activities and to formulate data into useful information in the asset management decision processes.

b. Maintenance Planning

HPU invests considerable City employed resources into sewer system management. We highly value a strong planned agenda versus a more reactionary mode of operation. Shown below is the HPU Field Utilities Division "Maintenance Baseline Schedule" which defines the goals as were set forth for FY2020:

Preventative Maintenance Baseline Schedule

	Total	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun -20
Gravity Main - CCTV Main - PM	**1794**	118	118	118	118	118	150	454	246	118	118	118	528
Gravity Main - Dye Testing - PM	**252**	0	84	84	84	0	0	0	0	0	0	0	366
Gravity Main - Easement	**631**	0	0	62	62	0	127	127	129	0	62	62	0
Gravity Main - Flow Isolations - PM	**225**	0	0	0	0	0	0	0	0	75	75	75	0
Gravity Main - Flushing - PM	**160**	0	0	40	40	40	40	0	0	0	0	0	0
Gravity Main - Grease Run - PM	**364**	52	0	52	0	52	0	52	0	52	0	104	0
Gravity Main - Root Run - PM	**102**	17	0	17	0	17	0	17	0	17	0	17	0
Gravity Main - Smoke Testing - PM	**372**	0	93	93	93	93	0	0	0	0	0	0	0
Manhole - Inspection - PM	**66**	6	6	6	6	6	6	6	6	6	6	6	0
Total	**3966**	**193**	**301**	**472**	**403**	**326**	**323**	**656**	**381**	**268**	**261**	**382**	**894**

Shown in the summary as follows is the SPI-CPI performance report that provides indication as to how Field Utilities performed.

SPI is an indicator of quantity of work performed with a value of 1.0 being exactly on target. Less than 1.0 indicates less than desirable performance in the quantity of work performed and greater than 1.0 indicates that work quantity exceeded the baseline goal.

CPI is an indicator of cost of the work performed and uses the same format.

ACTIVITY	SPI	CPI
Gravity Pipe CCTV	O.73	0.53
Gravity Pipe Flushing	1.00	1.34
Smoke Testing	1.00	1.19
Manhole Inspection	0.53	0.00
Easement Maintenance	0.32	0.43
Grease Routine	0.82	0.67
Root Routine	0.83	1.13

c. R&R Planning

Shown below is the HPU R&R component of the decision tree above. Item 3 in the decision tree references condition assessment or Likelihood of failure (LOF), and criticality or Consequence of Failure (COF), and their product of Risk (= LOF * COF); these parameters are inscribed in green in the process below.

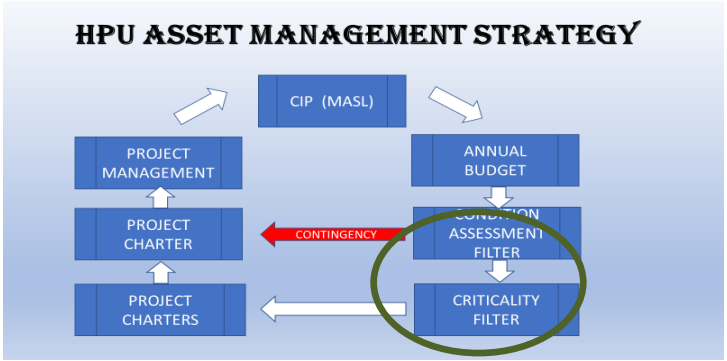
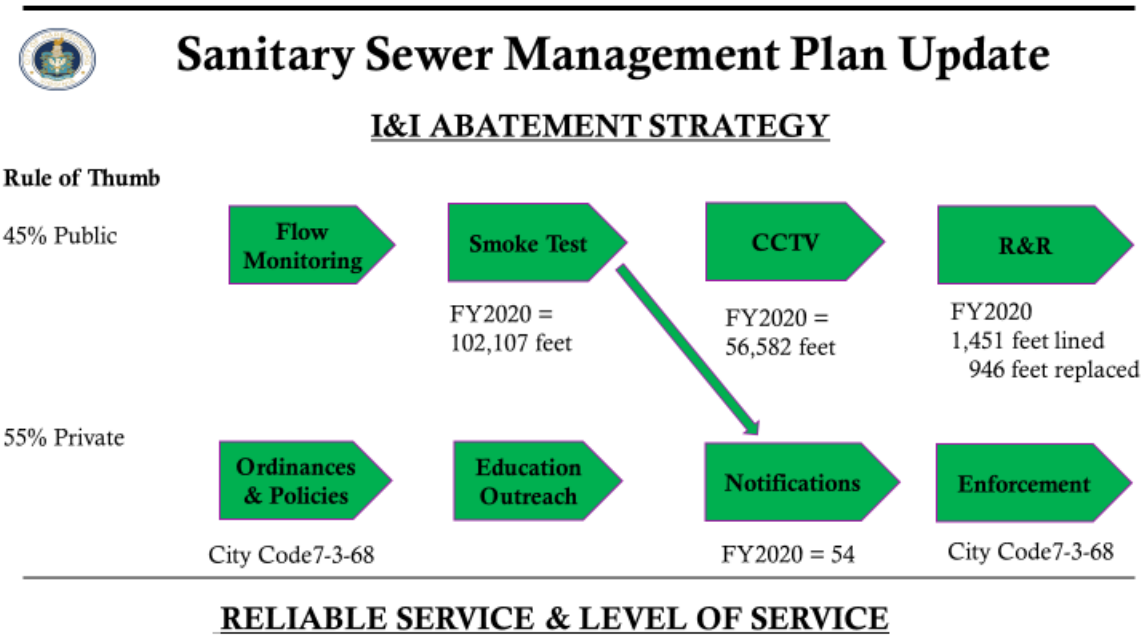


Figure 14

ii. Infiltration & Inflow Abatement

The HPU I&I program is designed to address both public and private sources of I&I. Publications have generalized that fifty five percent (55%) of all I&I comes from the private sector stating that without I&I abatement in the private sector little more than 5-10% I&I reduction will be achieved. Shown below is the HPU Public-Private I&I abatement strategy.



The HPU Public Sewer System management strategy for I&I abatement has integrated flow monitoring, smoke testing, CCTV inspection, repair, and R&R. HPU has the following database of information to prioritize it asset management.

- RJN ILOS study 2018 through 2020
- CCTV structural score database 2013 through present
- CCTV I&I score database: 2013 through present
- EMU Part 1 I&I Study - 1997
- PHR&G SSES - 1983 & 1989
- Blue Ridge Drive I&I Study - 1996
- Hillandale I&I Data Summary - 1995
- Park View FPS Sewer Study – 1994
- Pleasant Hill Sewer Study – 1997
- South Hampton Sewer Study – 1998

The HPU approach toward private I&I abatement an integration of Ordinances, education outreach AND ENFORCEMENT of the public system activities described previously. A summary of inputs and outputs for this program in FY2020 is shown below:

.

Inflow and Infiltration WO's

From: 7/1/2019 **To:** 6/30/2020

WORKORDERID	DESCRIPTION	REMEDIATION TYPE	STATUS	Date	LABOR	EQUIPMENT	MATERIAL	TOTAL
109572	Gravity Main - Replacement	Infiltration	CLOSED	9/4/2019	$20,078.76	$7,295.00	$14,894.23	$42,267.99
109601	Manhole - Replacement	Infiltration	CLOSED	7/12/2019	$13,594.63	$7,092.41	$5,339.01	$26,026.05
110100	Manhole - Repair - Scheduled	Infiltration	CLOSED	9/11/2019	$182.94	$2.88	$0.00	$185.82
110908	Gravity Main - Repair - Scheduled	Inflow	CLOSED	7/17/2019	$70.32	$0.00	$0.00	$70.32
111109	Sewer Service Renewal	Infiltration	CLOSED	7/16/2019	$1,788.43	$790.10	$727.44	$3,305.97
111133	Gravity Main - Repair	Infiltration	CLOSED	7/31/2019	$2,017.25	$385.00	$4,868.95	$7,271.20
111242	Sewer Lateral - Repair	Infiltration	CLOSED	7/25/2019	$0.00	$0.00	$0.00	$0.00
111381	Gravity Main - CCTV Main - PM	Infiltration	CLOSED	8/7/2019	$158.40	$0.00	$0.00	$158.40
111668	Manhole - Repair - Scheduled	Infiltration	CLOSED	9/4/2019	$84.90	$0.00	$19.53	$104.43
113927	Gravity Main - Repair - Scheduled	Infiltration	CLOSED	3/31/2020	$0.00	$0.00	$0.00	$0.00
					$37,975.63	**$15,565.39**	**$25,849.16**	**$79,390.17**

Inflow and Infiltration WO's Private Only

From: 7/1/2019 To: 6/30/2020

Work Order Id	Description	Priority	Status
116197	Type 2 Notification Sewer I&I	3	CLOSED
116198	Type 2 Notification Sewer I&I	3	CLOSED
116199	Type 2 Notification Sewer I&I	3	CLOSED
116200	Type 2 Notification Sewer I&I	3	CLOSED
116201	Type 2 Notification Sewer I&I	3	CLOSED
116202	Type 2 Notification Sewer I&I	3	CLOSED
116203	Type 2 Notification Sewer I&I	3	CLOSED
116204	Type 2 Notification Sewer I&I	3	CLOSED
116205	Type 2 Notification Sewer I&I	3	CLOSED
116206	Type 2 Notification Sewer I&I	3	CLOSED
116212	Type 2 Notification Sewer I&I	3	CLOSED
116213	Type 2 Notification Sewer I&I	3	OPEN
116214	Type 2 Notification Sewer I&I	3	CLOSED
116215	Type 2 Notification Sewer I&I	3	CLOSED
116216	Type 2 Notification Sewer I&I	3	CLOSED
116217	Type 2 Notification Sewer I&I	3	CLOSED
116218	Type 2 Notification Sewer I&I	3	CLOSED
116799	Type 2 Notification Sewer I&I	3	OPEN
117660	Type 2 Notification Sewer I&I	3	OPEN

iii. Activity: Asset Inventory

Asset Register / Inventory: FY2020 sewer asset inventory for collection and transmission was $115.0M. The breakout among assets is shown below:

FY 2020 Sewer System Asset Management Inventory

Current Asset Replacement Value ($)	Net Book Value ($)	Annual Depreciation ($)
202 Miles of Pipes $107,748,393	Pipes $61,425,958	Pipes $ 661,694
5,698 Manholes $7,314,000	Manholes $ 4,626,000	Manholes $ 41,900

Assets are field located by GPS coordinates and retained in GIS asset registers

iv. Activity Predictive Maintenance:

As defined in the AMPS, sewer pipe CCTV inspection has been the single most important predictive maintenance activity in HPU's Linear "Asset Management". ***FY2020 CCTV completed 11 miles of condition assessments for sewer pipe.*** *As* shown below, *since* 2008 HPU has inspected 107 miles of sanitary sewer main, or 53% of system inventory of 202 miles; pipe scoring began in FY2013

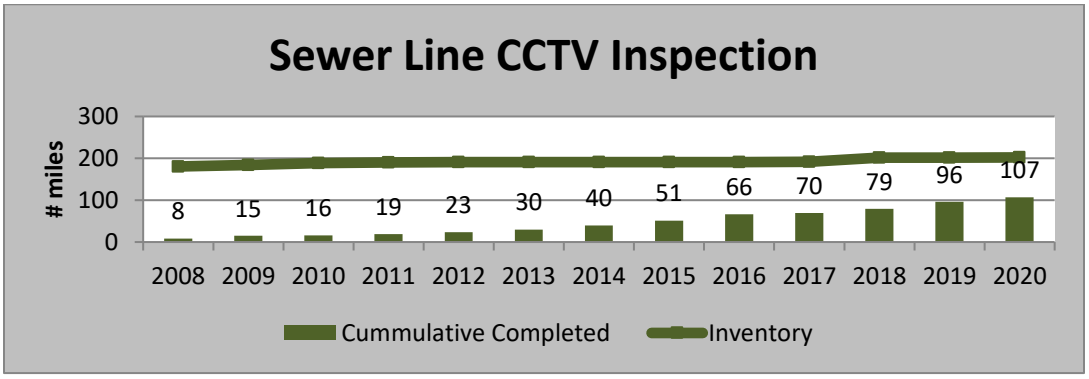


Figure 15

Scores for structural condition assessment and I&I assessments that were output from the CCTV inspections are shown as follows.

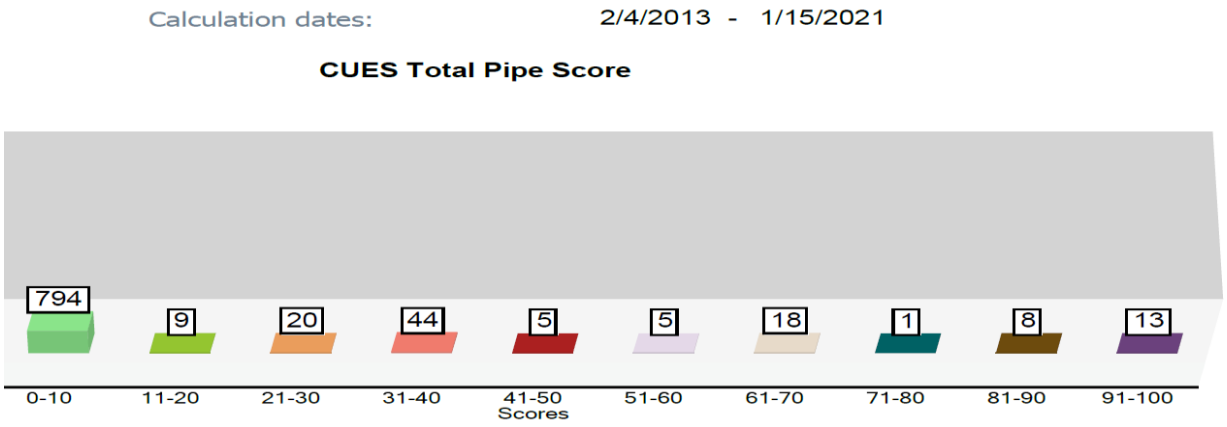


Figure 16

Pipes with Infiltration Scores from CCTV	
Severity Code	**Total Number of Pipes**
Light	13
Medium	15
Severe	2

v. Activity Preventive Maintenance:

*S*trategies for scheduling preventive maintenance and for using retrieved data are being summarized in AMPS as discussed earlier. ***FY2020 sewer flushing provide service to 8.4% of the sewer asset inventory.*** Sewer pipe flushing has been the single most important preventive maintenance activity in HPU's Linear "Asset Management". HPU progress for preventive cleaning is shown below. Since 2008 HPU has cleaned 268 miles of sanitary sewer main with purpose to improve system integrity. HPU will continue to perform flushing preventive maintenance and focus upon troubled areas that our CMMS system has identified as high probability for blockage.

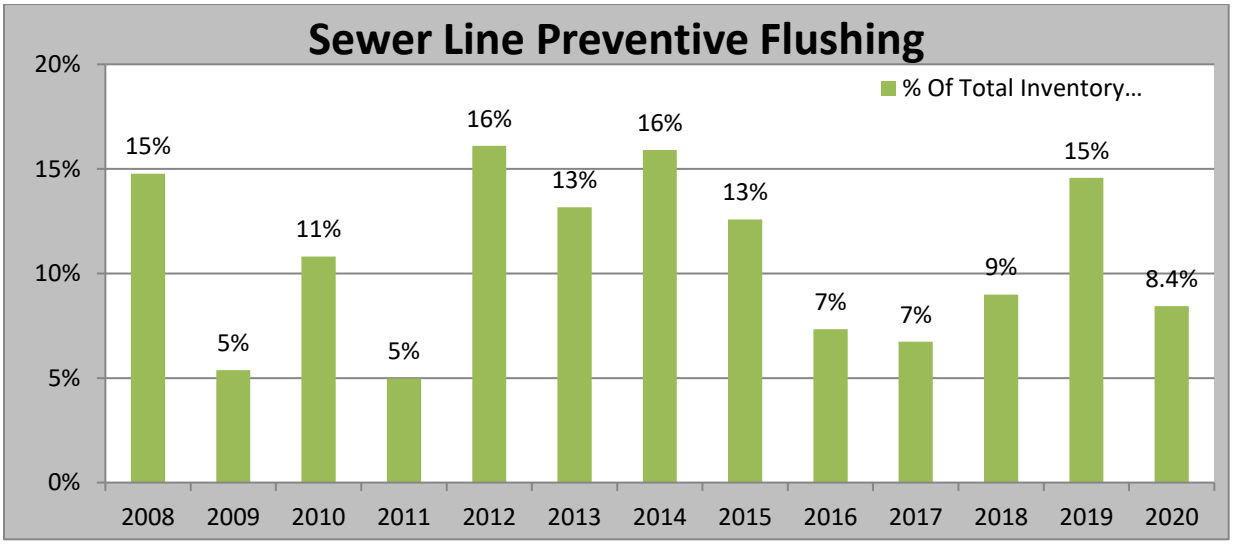


Figure 17

vi. Activity Repair Maintenance:

Unplanned (corrective) maintenance is disruptive and is accompanied with high ancillary costs in fiscal, social, and environmental terms. AMPS are drafted to provide continuous improvement by enhancing the presence of planned maintenance (predictive + preventive + corrective) and to facilitate the absence of unplanned (corrective) disruptive maintenance. Shown below is output from the HPU CMMS system. ***For FY2020, 47% of manhours and 36% of cost was directed to planned maintenance.***

BENCHMARK	TOP QUARTILE	MEDIAN	BOTTOM QUARTILE	HARRISONBURG FY2020
PLANNED Hrs. MAINTENANCE	79%	69%	48%	47%
CORRECTIVE MAINTENANCE HRS / 100 mi. pipe	381	1,257	2,665	1,996

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Sewer Assets Program Summary

From: 7/1/2019 To: 6/30/2020

Harrisonburg VIRGINIA

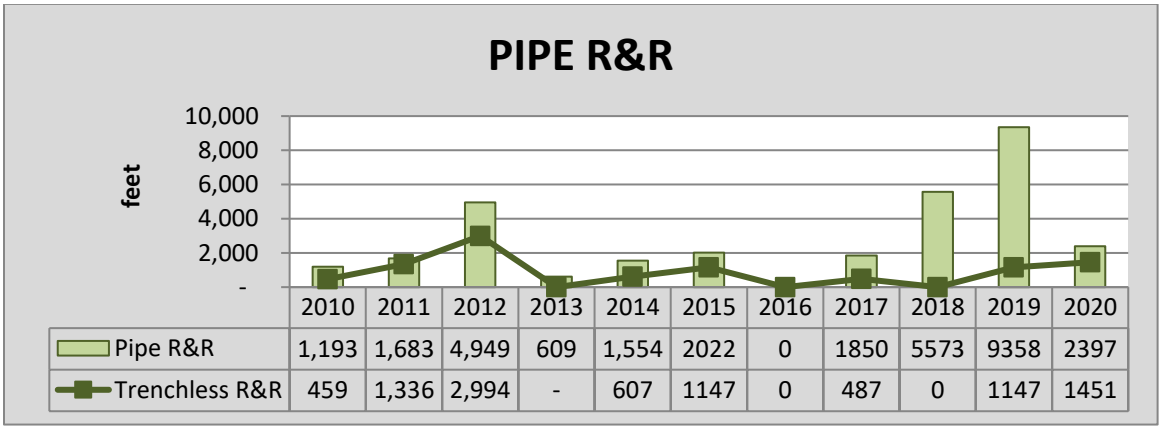
	TOTALHOURS	LABORCOST	EQUIPMENTCOST	MATERIALCOST	TOTAL COST
Billable Services	485.50	$ 13,568.95	$ 5,699.97	$ 4,421.27	$ 23,690.18
New Installation	532.50	$ 14,514.39	$ 6,974.84	$ 6,409.73	$ 27,898.96
Other	295.30	$ 8,258.78	$ 2,510.78	$ 2,152.39	$ 12,921.95
Preventative Maintenance (PM)	1,671.85	$ 45,108.78	$ 12,065.33	$ 1,386.55	$ 58,560.66
Rehab & Replace (CIP)	2,029.00	$ 54,686.60	$ 21,699.60	$ 32,484.41	$ 108,870.61
Repair	1,996.00	$ 56,287.34	$ 23,910.15	$ 32,329.24	$ 112,526.73
Replace	3.00	$ 111.49	$ 120.00	$ 0.00	$ 231.49
Scheduled Repair	133.00	$ 3,809.00	$ 787.28	$ 840.18	$ 5,436.46
Program Totals:	7,146.15	$ 196,345.32	$ 73,767.94	$ 80,023.77	$ 350,137.04

…Harrisonburg Planned maintenance = 1,804 hours / 3,801 = 47%
…Harrisonburg Corrective maintenance = 1,996 hours *(202 miles / 100 miles) = 4,032 hours per 100 miles.

vii. Activity Rehab & Replacement (R&R) through CIP:

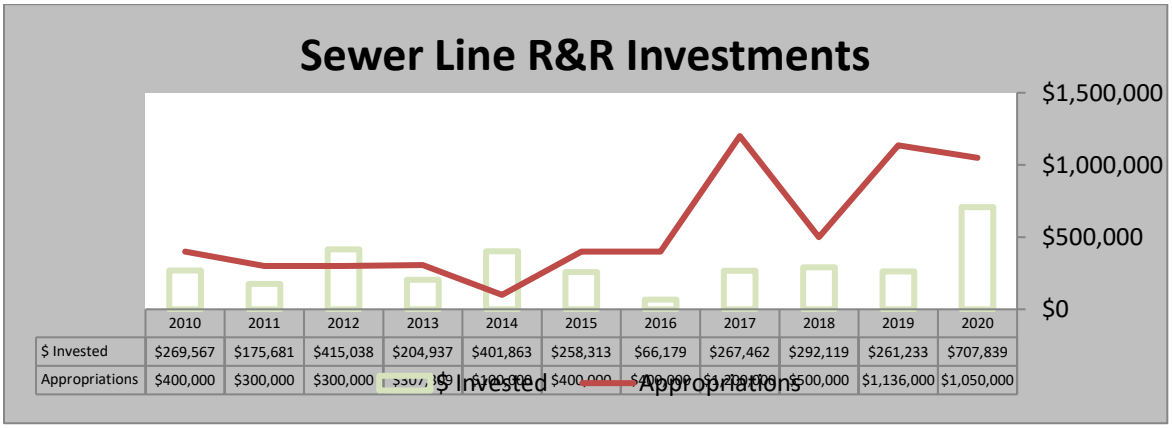
With funding available to rehab and retire assets, the application of project selection and then project management is paramount into effective and efficient results. HPU encourages PMI endorsed project management principles to plan and complete effective and efficient projects. ***During FY2020 HPU allocated $1.05M to CIP and conducted 2,397 feet of pipe R&R.*** Shown below is past rehab and retirement (R&R) projects completed using CIP funding between 2010 and 2020 included:

Total R&R = 2,397 feet
R&R by trenchless technology methods = 1,451 feet (61%)
R&R by conventional open cut technology = 946 feet (39%)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Pipe R&R	1,193	1,683	4,949	609	1,554	2022	0	1850	5573	9358	2397
Trenchless R&R	459	1,336	2,994	-	607	1147	0	487	0	1147	1451

Figure 18



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
$ Invested	$269,567	$175,681	$415,038	$204,937	$401,863	$258,313	$66,179	$267,462	$292,119	$261,233	$707,839
Appropriations	$400,000	$300,000	$300,000	[illegible]	[illegible]	$400,000	[illegible]	[illegible]	$500,000	$1,136,000	$1,050,000

Figure 19

viii. Activity Flow Monitoring

During FY2020 baseline flow monitoring was completed for ILOS status. The data will provide a baseline for five years interval comparisons.

The majority of flow testing in FY2020,was conducted by RJN under the City Interceptors ILOS study. As noted earlier for the ten years level of service, the study which showed one (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor. The study also divided the City into subsections with identified area of high I&I and thus preferred areas for future flow monitoring

a) RJN recommendations for Task Order 3.1 Blacks Run Interceptor Monitoring for Model Development

Full manhole inspections and smoke testing of the HN01 and HN02/HN05 area is recommended to identify sources of infiltration and inflow. Additionally, the HE02 area should be reviewed in order to identify excessive flow sources in the Harrisonburg East system.

Specific recommendations are detailed in Section 5 of the RJN report but summarized below:

• Task 3.2 Model calibration results should be used to determine if any additional flow metering is required.

• Task 3.2 model work should be completed to determine the location of capacity constrained areas. Options to address these findings should be investigated by implementing modeling Phase 2, which involves using the hydraulic model to conduct alternative analysis.

• Based on the results of this report, comprehensive manhole inspections and smoke testing are recommended in the HN02/HN05, HN01, and HE02 areas to investigate excessive inflow.

• Based on the results of this report relative to infiltration, night flow isolation weir measurements are recommended in the HN01 and HN02/HN05 areas.

• Use the flow isolation results to prepare a focused CCTV inspection schedule for the HN01 and HN02/HN05 areas.

• A pilot project for full Sanitary Sewer Evaluation Survey (SSES) in HN01 is recommended to initiate the program, evaluate results, and provide guidance for program continuance. It should include manhole inspections, smoke testing, flow isolations, and CCTV pipe inspection.

b) RJN recommendations for Task Order 3.3 Lower Blacks Run Interceptor Monitoring for Model Development

The most downstream basin BR57/BR65 area should have full manhole inspections and smoke testing of this area is recommended to identify sources of infiltration and inflow.

Specific recommendations are detailed in Section 5 of the RJN report but summarized below:

•Based on the results of this report, comprehensive manhole inspections and smoke testing are recommended in the BR57/BR65 area to investigate excessive inflow.

•Based on the results of this report relative to infiltration, night flow isolation weir measurements are also recommended in the BR57/BR65 area.

•Use the flow isolation results to prepare a focused CCTV inspection schedule for the BR57/BR65 area.

ix. *Smoke Testing*

The second component for I&I abatement is smoke testing. HPU attempts to complete 92,500 feet of smoke testing per year. This amounts to approximately 10% of the collection system, which allows for a 10 years system wide completion cycle. ***HPU completed smoke testing in 102,107 feet of sewer in FY2020.*** Shown below is the completed activity schedule.

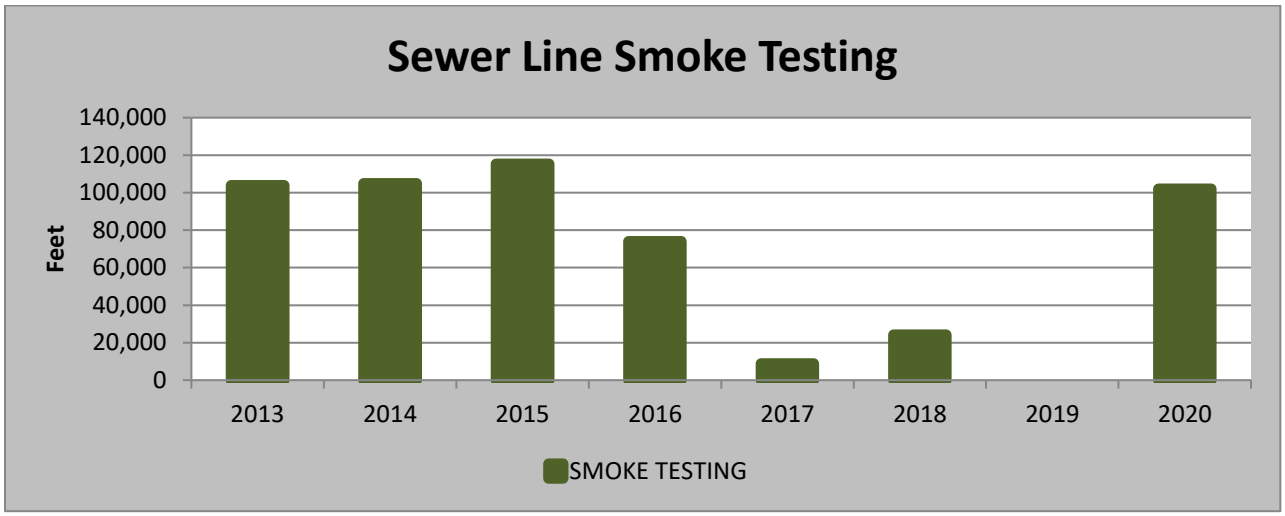


Figure 20

XII Financial Benchmarks-

Objective #11 requires monitoring of selected sewer enterprise fund financial benchmarks; the objective is complete as shown below:

FINANCIAL BENCHMARK	Target	FY 2020 Sewer Benchmark Target Actual
Received Cash Revenue % Budgeted	>100%	104% $11,275,700 $12,008,311
Expended Cash Expenses % Budgeted (includes $1.456M loan)	<100%	94% $14,108,164 $13,331,273
Unencumbered Fund Balance as % of cash revenue	>25%	41% $2,461,785 $4,943,997
5,000 gallons water plus sewer per month (vs Virginia control survey)	<100%	56% $80.14 $44.80
5,000 gallons as % HMI (=$57,029 Harrisonburg)	<2.00%	0.94% $1,141 $538 $26,880
% Annual Cost Sustainable Operations (ASCO)	>100%	202% $586,948 $1,186,848
Long Term Financial Model: Rate APR required	N/A	2.5%: 2021-2033

- ***In Fy2020 HPU's sewer cash revenue collections approached nearly 104% of budgeted revenue.***
- ***HPU's sewer cash expenses were managed at 94% of budgeted allocations.***
- ***HPU's Unencumbered Fund Balance exceeded goals at 41% of cash revenue (versus 25%) and excluded $1,456,000 due from a loan.***
- ***HPU's customer residential monthly bills for water plus sewer at $44.80 per month was at 56% of the statewide survey benchmark for 5000 gallons.***
- ***HPU's customer residential annual average bill was $530 for water plus sewer, this was 0.94% of the average household median income (HMI) of Harrisonburg at***

$57,029. The monthly bill at 2.0% of HMI would have a financial stress threshold at HMI equal to 6,880 / yr.

- *HPU fully funded the asset retirement ACSO for FY2020, but a significant amount of funds came from a transfer from unencumbered fund balance.*
- *The transfer from Fund Balance to meet ACSO is not a sustainable strategy as our LTFM indicates a 2.25% annual rate increase will be required for 2023-2027, 2.00% 2028-2034, and 1.00% 2034-2045.*

Appendix A: Sewer Pipe Asset Management Plan (AMP)

HPU ASSET MANAGEMENT PLAN: SANITARY SEWER PIPE

This Asset Management Plan (AMP) document serves to capture Harrisonburg Public Utilities' (HPU) practices in performing its perpetual responsibilities for its sanitary sewer pipes. HPU uses, "Asset Management" principles, "Project Management" principles, a "Computer Maintenance Management System (CMMS)", and a "Long Term Financial Model (LTFM)"to support the implementation of this AMP.

Asset Management is an organized method of introducing, operating, preserving, improving and disposing of various assets in a cost-effective way while meeting defined performance goals. The following table provides a presentation of the HPU Asset Management Decision Tree for sewer pipes as pertains to the sequence of activities that provide predictive maintenance, preventive maintenance, repair maintenance and rehabilitation & replacement (R&R).

HPU SEWER MAIN ASSET MANAGEMENT DECISION TREE

	FAILURE MODE	UNSCHEDULED			SCHEDULED		
	EVENTS	Progression →			Progression →		
	Performance						
1	Sewer Main Backup	Flushing	CCTV	Repair		(1) CCTV	Repair
2	Staff Recommendations					CCTV	Repair
3	MTBF:						
4	Infiltration & Inflow				Flow Monitor	(2) CCTV Smoke Test	(3) Repair, R&R
	Structural						
5	Age/RUL-MASL					(2) CCTV	(3) Repair, R&R
6	Paving Schedule:					(2) CCTV	(3) Repair, R&R
7	CIP Project Integration					(2) CCTV	(3) Repair, R&R
	Capacity						
8	Sewer Main Surcharge or Overflow				Flow Monitor	(2) CCTV	(3) Repair, R&R
	Obsolescense						
9	See Age/RUL-MASL					(2) CCTV	(3) Repair, R&R

(1) CCTV	Three backups in the sewer main trigger a CCTV inspection.
(2) CCTV	HPU targets 100% CCTV inspection of its sewer main inventory over ten years. Failure mode events are used to prioritize the schedule of CCTV work.
(3) CCTV	Risk based selection is a tool of asset management that is preferred for selection and for prioritizing repair and replacement.

HPU ASSET MANAGEMENT PLAN: SANITARY SEWER PIPE

Project Management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. HPU adopts the PMI's *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* as its guideline where the project management processes integrate ten knowledge areas (Integration, scope, time, cost, quality, procurement, human resources, communications, risk management and stakeholder management) into five project phases:

1. Initiating
2. Planning
3. Executing
4. Monitoring and Controlling
5. Closing

Long Term Financial Model: HPU uses the Waterworth Long Term Financial Model (LTFM) to annually update a 25 years plan for sewer/authority rates using revenue and expenditure projections. The model targets maintaining a cash position (unappropriated fund balance plus capital contingency reserve) as selected by HPU. The model includes revenue inputs for growth and adjustments to both rate derived revenue and non-rate derived revenue. The model also includes inputs for operating, capital and debt expenses from the annual budget and from the annual Capital Improvement Program (CIP); inflation is applied to these expenses.

Computer Maintenance Management System (CMMS): HPU uses the "City Works" software that has been crafted specifically for HPU. The software provides scheduling, documentation and reporting of work activities. The framework has been crafted to denote a service response versus a work order; the latter is relevant to logging activities against an HPU asset. Work orders differentiate between scheduled maintenance and unscheduled maintenance and construction.

Scheduled maintenance includes predictive and preventive agendas as well as some repair. The software has been developed to provide baselines for scheduled maintenance as well as reports that have crafted after project management principles using indexes to quickly benchmark status with respect to time and cost control.

HPU ASSET MANAGEMENT PLAN: SANITARY SEWER PIPE

Sewer Pipe AMP Components are

I. **Materials Selection:** HPU sets forth product materials in its official "Approved Materials Library" based on considerations for reliability, lifecycle cost and inventory management. In some instances, but not applicable to sewer pipes, a manufacture and model are specifically identified in the library.

II. **Quality Assurance for Installation:** HPU has set forth its standard for installation within its published "City of Harrisonburg Design and Construction Standards Manual". This manual is approved by the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (VDEQ) to follow state of Virginia law and policy. Included within the HPU standard is a quality compliance requirement using hydrostatic testing.

III. **Quality Control for Contracted Installation:** The Harrisonburg Construction Management Team (CMT) inspects all contracted installations for compliance with the "City of Harrisonburg Design and Construction Standards Manual". The CMT withholds acceptance into the City Sewer System until the installation meets full compliance.

IV. **Quality Control for HPU Installation:** HPU staff who make installations are held to the same execution and final product standards as for installations made under contracted arrangements.

V. **Management of inventory:** HPU uses GIS as its repository for maintaining its inventory of assets. For each asset, the GIS system includes a specific paired identity in nomenclature; one is a unique GIS id number and the other is an asset id number.

Database functionality: As a feature of the database functionality, each asset is provided selected attributes. These selected attribute fields are part of the HPU GIS database; the fields for sanitary sewer pipe are included in Figure 1.

The inventory of assets and their attributes must be initially collected and then maintained to be accurate as follows:

- As-built drawings are priority sources for original entries and for updates.
- Harrisonburg land development records have been correlated to a cohort of default assumptions based on practices from the time of installation. These cohort assumptions have been used in the absence of more reliable data.

- On-going closeout of CMMS work orders for predictive maintenance, preventive maintenance, repair and construction require update of asset attributes as collected from the field.

Geographic Functionality: As a feature of geographical functionality, asset location is provided coordinates of latitude and longitude that have been collected from field survey.

The inventory and the attributes are maintained accurate as follows:

- An original survey of GPS coordinates was collected in the early 2000s using seasonal employees and hand drawn "milar" records from the Office of Community Development.
- Continuous collection of coordinates for new assets are a requirement of the current day installation closure process.

VI. Predictive Maintenance (PdM): PdM provides immediate data about an asset to allow HPU to make a condition assessment. In some cases, PdM data can be used to forecast an assets deterioration and ultimate failure. For sewer pipes, HPU uses PdM practices that include CCTV inspection, smoke testing and flow monitoring.

A. CCTV: Structural pipe scores and operation pipe scores are made and recorded during the inspection process. These scores are presented as a benchmark for Likelihood of Failure (LOF). CCTV inspections, both unscheduled and scheduled, hold their respective places of importance in the HPU AM Decision Tree. Unscheduled CCTV results are used to validate a needed immediate structural pipe repair. Scheduled CCTV results are the most significant tool used to prioritize R&R projects.

Scheduled CCTV: The foundation goal for scheduling CCTV work is a ten years inspection cycle for the HPU sewer pipe inventory. This work is performed both internally and by contractor pending Field Division resources and available contract funding. Several criteria determine priority of inspection:

- Service Failure Benchmark for Mean Time Between Failure (MTBF)
- Infiltration & Inflow
- Age
- Remaining Useful Life (RUL) per Manufacturer's Anticipated Service Life (MASL)
- Staff recommendations

Un-Scheduled CCTV: Active interruption, or a threat thereof, to reliable sewer service is a justification for unscheduled CCTV work to be performed as a diagnostic tool. This type of work is generally recognized to be emergency in nature.

B. Smoke Testing: Introducing smoke into the sewer system during dry periods is a means of predictive maintenance that has purpose to locate sources of inflow and infiltration (I&I). These sources are generally structural pipe deficiencies or some form of unacceptable connections to the sewer pipe. As shown in the decision tree, smoke testing is a PdM activity performed earlier in the Decision Tree as determined in consideration of know I&I indicators or in combination with the ten years inspection cycle for the HPU sewer pipe inventory.

C. Flow Monitoring: Introducing wet weather flow monitors at strategic locations within the sewer system pipe network is a means of predictive maintenance that has purpose to identify inflow and infiltration (I&I) effects. Progressive relocation of these monitors from larger service areas to smaller areas can allow for collection of data producing generalized to location specific information. As shown in the decision tree, smoke testing is a PdM activity that occurs earliest in the sequences.

VII. Preventive Maintenance: HPU engages scheduled sewer flushing as its primary tool for preventive maintenance. The goal of preventive sewer flushing is to pre-empt possible sewer backups. Several criteria are used to determine the sewer flushing schedule:

- The planned CCTV schedule provides opportunity for simultaneous flushing operations.
- Sewer lines with higher MTBF and no structural concerns are candidates for routine flushing (generally FOG induced causes)
- Sewer lines with higher MTBF and awaiting repair or R&R scheduling are candidates for routine flushing.

VIII. Repair Maintenance: HPU considers a repair as one of two events; either a response to a sewer backup or a point repair to the pipe.

Sewer repair by flushing: A backup is an interruption to service caused by an obstruction to flow in the pipe. This can be induced by unacceptable debris in the pipe or by a pipe structural or operational failure. HPU provides 7/24/365 service response for such events. The procedure carries response expectations, CMMS documentation and stakeholder management procedures.

A point repair is an activity performed to remedy a physical structural deficiency in the pipe. From the perspective of asset management, a point repair does not add life to the sewer pipe.

IX. Rehabilitation & Retirement:

Funding Strategy: Determining and providing adequate funding for the retirement of sewer pipe assets is a major inclusion in the Waterworth Long Term Financial Model (LTFM). Each asset is determined a retirement date and a retirement cost. The retirement costs for every asset is tabulated for every year in the future year. When the sums of all costs are averaged over a given period, this is termed the "Average Cost of Sustainable Operations (ACSO)" and is a significant input expense to the financial model.

R&R Strategy: Assets are generally rehabilitated or replaced under a planned construction project. Funds for capital projects are first pursued under the LTFM and then allocated under the annual budget process, Once funds have been allocated, the Project "Initiation Phase" requires an initial business decision to determine if funds will be further allocated for the particular project to proceed.

As noted earlier, HPU uses the CCTV predictive maintenance outputs obtained from its PdM section of the Asset Management Program to validate the project business decision. CCTV pipe scores for condition assessment are synonymous with "Likelihood of Failure (LOF)" and are one primary criterium used to determine the priorities for R&R projects. As second criterium is the criticality of the asset or "Consequence of Failure (COF)". The product of COF X LOF is RISK. HPU looks forward to advancing RISK as the principle for sewer pipe management. '

Figure 1, Sanitary Sewer Pipe Attribute List From ArcGIS

Field	Value
City	Harrisonburg
COF	3.95
Condition	0
Condition Date	8/9/2018 7:16:34 AM
created_date	<null>
created_user	<null>
Date_Last_Flushed	<null>
DateLastSmokeTested	<null>
GlobalID	{69D037B4-C618-4279-9924-9445A2ADB2F3}
ID	11L50
Interceptor	<null>
last_edited_date	7/1/2020 1:43:54 PM
last_edited_user	SCYZICK
LAST_INSPECTED	9/22/1997
LOCATION	11L50: BUTLER ST
Material	Concrete Pipe
Mgmt_Group	Sewer Interceptors
Notes	<null>
Pipe Length	260.563655
pipe_shape	<null>
PLANDATE	1963
planlink	P:\scans\Utility_Plans\Sewer\Project 6212 Division A Sewer Improvements.pdf
POF	<null>
Shape	Polyline
Shape.STLength()	260.563655
Size_	27
STATUS	IN SERVICE
Sub Basin	<null>
Surface_condition	<null>
Unique_Id	27524
Warranty Date	<null>

Sewer Manhole Asset Management Plan (AMP)

HPU ASSET MANAGEMENT PLAN: MANHOLES

This Asset Management Plan (AMP) document serves to capture Harrisonburg Public Utilities' (HPU) practices in performing its perpetual responsibilities for its sanitary sewer manholes. HPU uses, "Asset Management" principles, "Project Management" principles, a "Computer Maintenance Management System (CMMS)", and a "Long Term Financial Model (LTFM)"to support the implementation of this AMP.

Asset Management is an organized method of introducing, operating, preserving, improving, and disposing of various assets in a cost-effective way while meeting defined performance goals. The following table provides a presentation of the HPU Asset Management Decision Tree for manholes as pertains to the sequence of activities that provide predictive maintenance, preventive maintenance, repair maintenance and rehabilitation & replacement (R&R).

Project Management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. HPU adopts the PMI's *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* as its guideline where the project management processes integrate ten knowledge areas (Integration, scope, time, cost, quality, procurement, human resources, communications, risk management and stakeholder management) into five project phases:

1. Initiating
2. Planning
3. Executing
4. Monitoring and Controlling
5. Closing

Long Term Financial Model: HPU uses the Waterworth Long Term Financial Model (LTFM) to annually update a 25 years plan for sewer/authority rates using revenue and expenditure projections. The model targets maintaining a cash position (unappropriated fund balance plus capital contingency reserve) as selected by HPU. The model includes revenue inputs for growth and adjustments to both rate derived revenue and non-rate derived revenue. The model also includes inputs for operating, capital and debt expenses from the annual budget and from the annual Capital Improvement Program (CIP); inflation is applied to these expenses.

Computer Maintenance Management System (CMMS): HPU uses the "City Works" software that has been crafted specifically for HPU. The software provides scheduling, documentation and reporting of work activities. The framework has been crafted to denote a service response

versus a work order; the latter is relevant to logging activities against an HPU asset. Work orders differentiate between scheduled maintenance and unscheduled maintenance and construction.

Scheduled maintenance includes predictive and preventive agendas as well as some repair. The software has been developed to provide baselines for scheduled maintenance as well as reports that have crafted after project management principles using indexes to quickly benchmark status with respect to time and cost control.

Manhole AMP Components are

I. **Materials Selection:** HPU sets forth product materials in its official "Approved Materials Library" based on considerations for reliability, lifecycle cost and inventory management.

II. **Quality Assurance for Installation:** HPU has set forth its standard for installation within its published "City of Harrisonburg Design and Construction Standards Manual". This manual is approved by the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (VDEQ) to follow state of Virginia law and policy. Included within the HPU standard is a quality compliance requirement using hydrostatic testing.

III. **Quality Control for Contracted Installation:** The Harrisonburg Construction Management Team (CMT) inspects all contracted installations for compliance with the "City of Harrisonburg Design and Construction Standards Manual". The CMT withholds acceptance into the City Sewer System until the installation meets full compliance.

IV. **Quality Control for HPU Installation:** HPU staff who make installations are held to the same execution and final product standards as for installations made under contracted arrangements.

V. **Management of inventory:** HPU uses GIS as its repository for maintaining its inventory of assets. For each asset, the GIS system includes a specific paired identity in nomenclature; one is a unique GIS id number and the other is an asset id number.

Database functionality: As a feature of the database functionality, each asset is provided selected attributes. These selected attribute fields are part of the HPU GIS database; the fields for sanitary sewer manholes are included in Figure 1.

The inventory of assets and their attributes must be initially collected and then maintained to be accurate as follows:

- As-built drawings are priority sources for original entries and for updates.
- Harrisonburg land development records have been correlated to a cohort of default assumptions based on practices from the time of installation. These cohort assumptions have been used in the absence of more reliable data.
- On-going closeout of CMMS work orders for predictive maintenance, preventive maintenance, repair, and construction require update of asset attributes as collected from the field.

Geographic Functionality: As a feature of geographical functionality, asset location is provided coordinates of latitude and longitude that have been collected from field survey.

The inventory and the attributes are maintained accurate as follows:

- An original survey of GPS coordinates was collected in the early 2000s using seasonal employees and hand drawn "milar" records from the Office of Community Development.
- Continuous collection of coordinates for new assets are a requirement of the current day installation closure process.

VI. Predictive Maintenance (PdM): PdM provides immediate data about an asset to allow HPU to make a condition assessment. In some cases, PdM data can be used to forecast an assets deterioration and ultimate failure. For manholes , HPU uses PdM practices that include smoke testing and inspections.

A. Inspections: Manholes are currently scored with the following CMMS inspections:

1. Manhole Wet Weather Phase 1 Inspection
2. Manhole Wet Weather Phase 2 Inspection
3. Manhole Wet Weather Phase 3 Inspection
4. Manhole Wet Weather Phase 4 Inspection
5. Sewer Manhole Inspection
6. Smoke Testing Field Inspection

These scores are presented as a benchmark for Likelihood of Failure (LOF). Inspections, both unscheduled and scheduled, hold their respective places of importance in the HPU AM Decision Tree. Unscheduled inspections are used to validate a needed immediate structural repair. Scheduled inspections are the most significant tool used to prioritize R&R projects.

Scheduled Inspections: The foundation goal for scheduling inspection work is a ten year inspection cycle for the HPU manhole inventory. This work is performed both internally and by contractor pending Field Division resources and available contract funding. Several criteria determine priority of inspection:

- Service Failure Benchmark for Mean Time Between Failure (MTBF)
- Sub sheds with a high Infiltration & Inflow response to rainfall
- Age
- Remaining Useful Life (RUL) per Manufacturer's Anticipated Service Life (MASL)
- Obsolesce of brick and block manholes
- Staff recommendations

Un-Scheduled Inspections: Active interruption, or a threat thereof, to reliable sewer service is a justification for unscheduled inspection work to be performed as a diagnostic tool. This type of work is generally recognized to be emergency in nature.

B. Smoke Testing: Introducing smoke into the sewer system during dry periods is a means of predictive maintenance that has purpose to locate sources of inflow and infiltration (I&I). These sources are generally structural deficiencies or some form of unacceptable connections to the manhole. As shown in the decision tree, smoke testing is a PdM activity performed earlier in the Decision Tree as determined in consideration of know I&I indicators or in combination with the ten years inspection cycle for the HPU sewer manhole inventory.

VII. Preventive Maintenance: HPU engages scheduled sewer flushing as its primary tool for preventive maintenance. The goal of preventive sewer flushing is to pre-empt possible sewer backups. Several criteria are used to determine the sewer flushing schedule:

- The planned CCTV schedule provides opportunity for simultaneous manhole inspections.
- Sewer lines with higher MTBF and no structural concerns are candidates for routine flushing (generally FOG induced causes)

- Sewer lines with higher MTBF and awaiting repair or R&R scheduling are candidates for routine flushing and subsequent manhole inspections.

VIII. Repair Maintenance: HPU considers a repair as one of two events; either a response to a sewer backup or a point repair to the manhole.

Sewer repair by flushing: A backup is an interruption to service caused by an obstruction to flow in the collection system. This can be induced by unacceptable debris in a pipe or manhole. In addition, a pipe or manhole structural failure can create a backup. HPU provides 7/24/365 service response for such events. The procedure carries response expectations, CMMS documentation and stakeholder management procedures.

A point repair is an activity performed to remedy a physical structural deficiency in the manhole. From the perspective of asset management, a point repair does not add life to the sewer manhole.

IX. Rehabilitation & Retirement:

Funding Strategy: Determining and providing adequate funding for the retirement of sewer manhole assets is a major inclusion in the Waterworth Long Term Financial Model (LTFM). Each asset is determined a retirement date and a retirement cost. The retirement costs for every asset is tabulated for every year in the future year. When the sums of all costs are averaged over a given period, this is termed the "Average Cost of Sustainable Operations (ACSO)" and is a significant input expense to the financial model.

R&R Strategy: Assets are generally rehabilitated or replaced under a planned construction project. Funds for capital projects are first pursued under the LTFM and then allocated under the annual budget process, Once funds have been allocated, the Project "Initiation Phase" requires an initial business decision to determine if funds will be further allocated for the particular project to proceed.

As noted earlier, HPU uses the inspection outputs obtained from its PdM section of the Asset Management Program to validate the project business decision. Manhole scores for condition assessment are synonymous with "Likelihood of Failure (LOF)" and are one primary criterium used to determine the priorities for R&R projects. As second criterium is the criticality of the asset or "Consequence of Failure (COF)". The product of COF X LOF is RISK. HPU looks forward to advancing RISK as the principle for sewer manhole management.

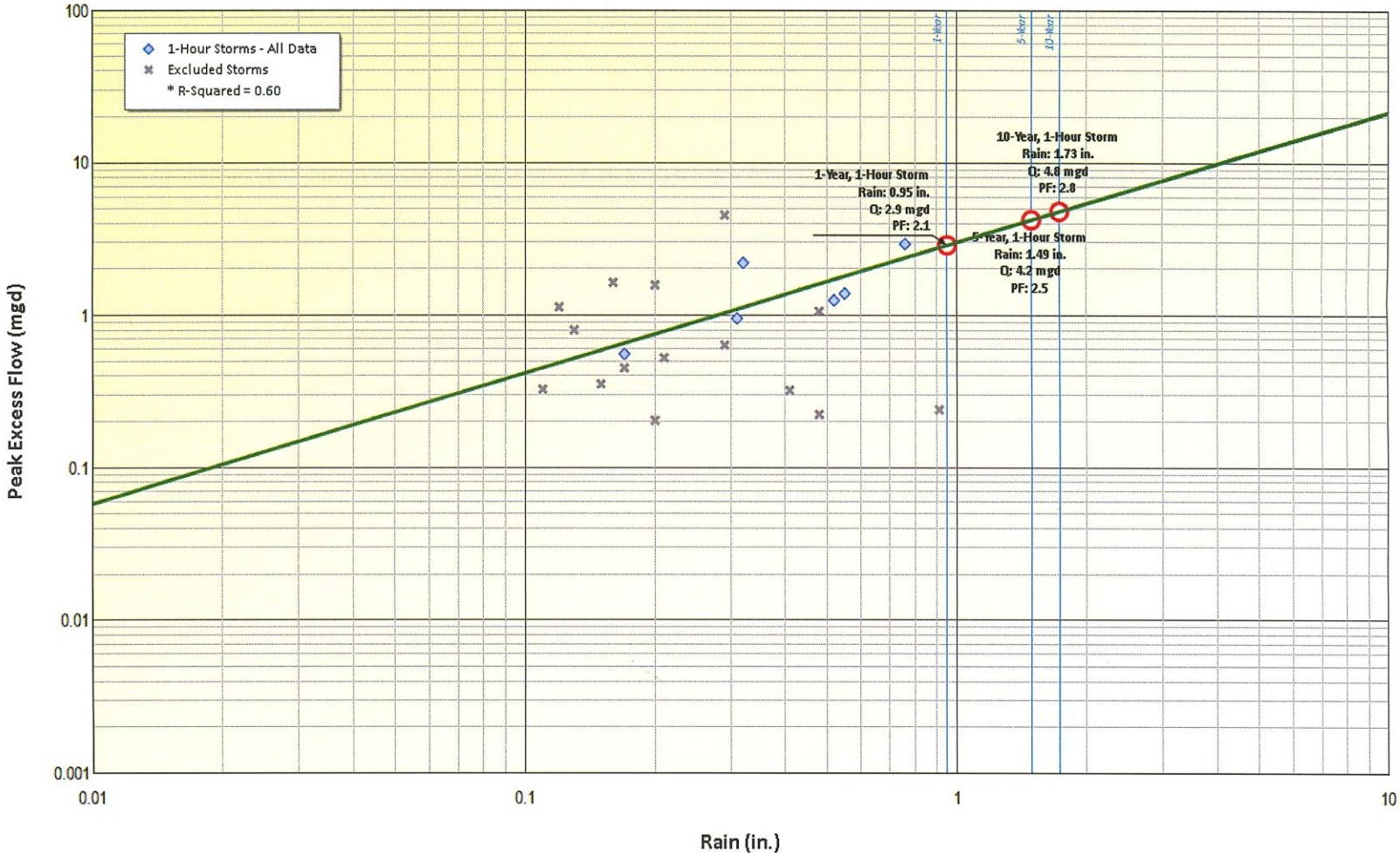
Figure 1, Sanitary Sewer Manhole Attribute List From ArcGIS

Field	Value
City	Harrisonburg
COF	<null>
Condition	<null>
Condition Date	<null>
created_date	<null>
created_user	<null>
Date_Last_Smoke_Tested	<null>
GlobalID	{03E21A5D-D49C-4EB7-8801-22C2E780E29A}
ID	97 46
Interceptor	<null>
last_edited_date	6/14/2019 3:37:53 PM
last_edited_user	SCYZICK
Last_Inspected	<null>
Line in Pipe	<null>
Location	97 46: 1221 GREENDALE RD
Material	Concrete
Mgmt_Group	Collection and Transmission
Notes	
Number of Rings	<null>
PLANDATE	2007
planlink	P:\scans\097\97 IJKLM The Crossings Section 1.pdf
POF	<null>
scan_date	2/13/2012
Shape	Point
Status	IN SERVICE
Sub Basin	<null>
surfacecondition	<null>
Unique_Id	34290
Warranty Date	<null>

Appendix C: Q vs. I Graphs

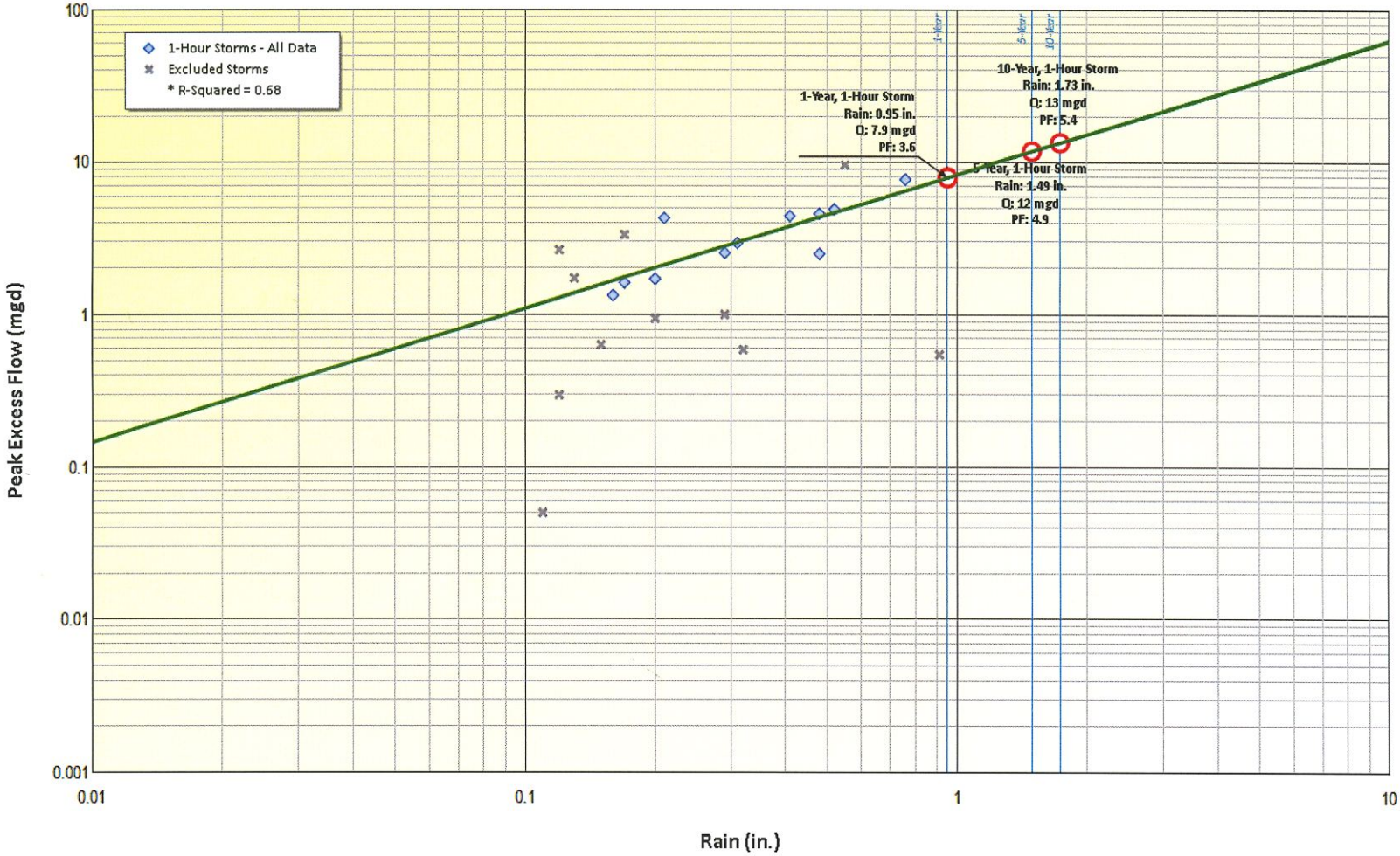
1-Hour Flow vs. Rainfall Regression

Basin HB1152_1



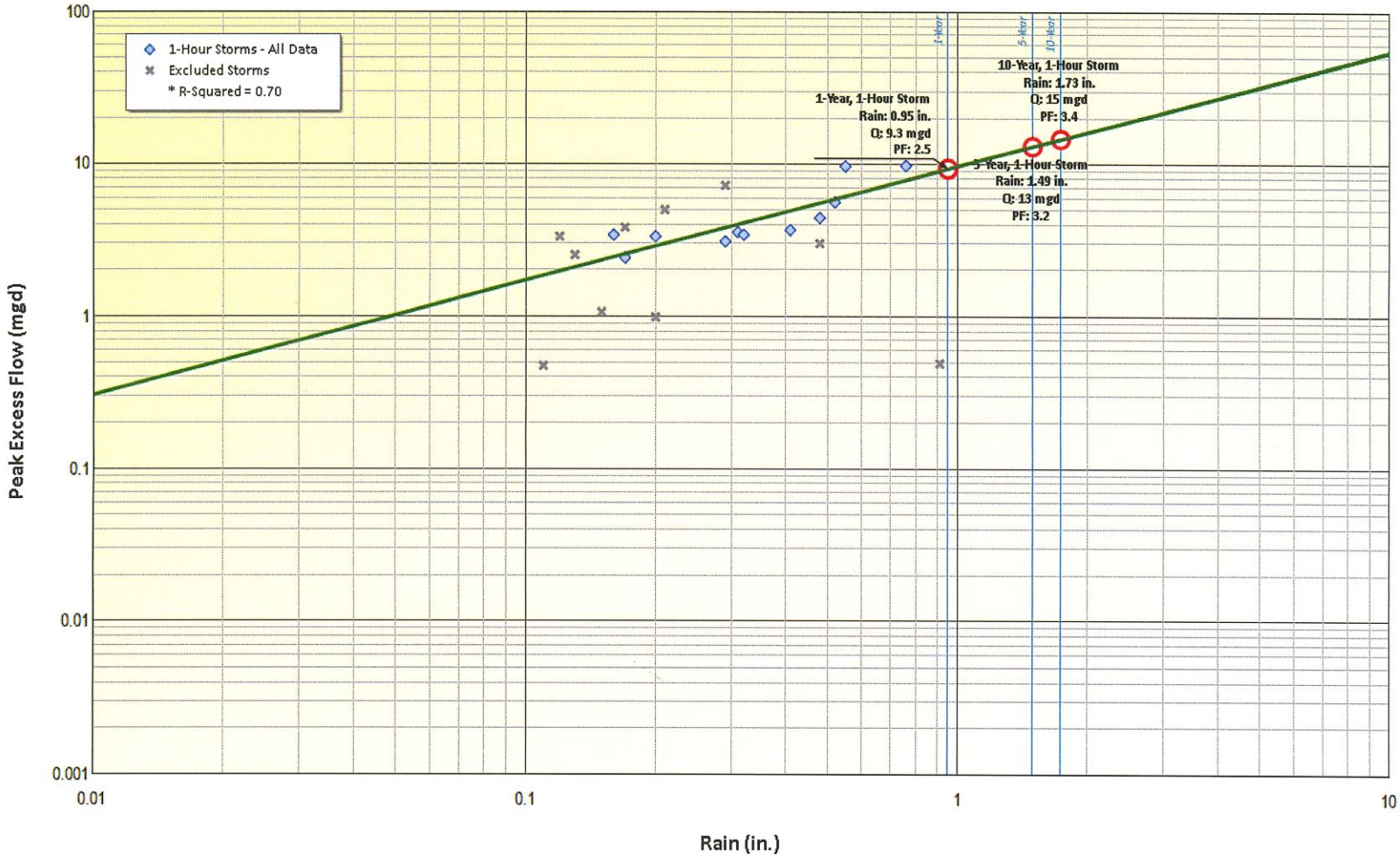
1-Hour Flow vs. Rainfall Regression

Basin HB540/HB550



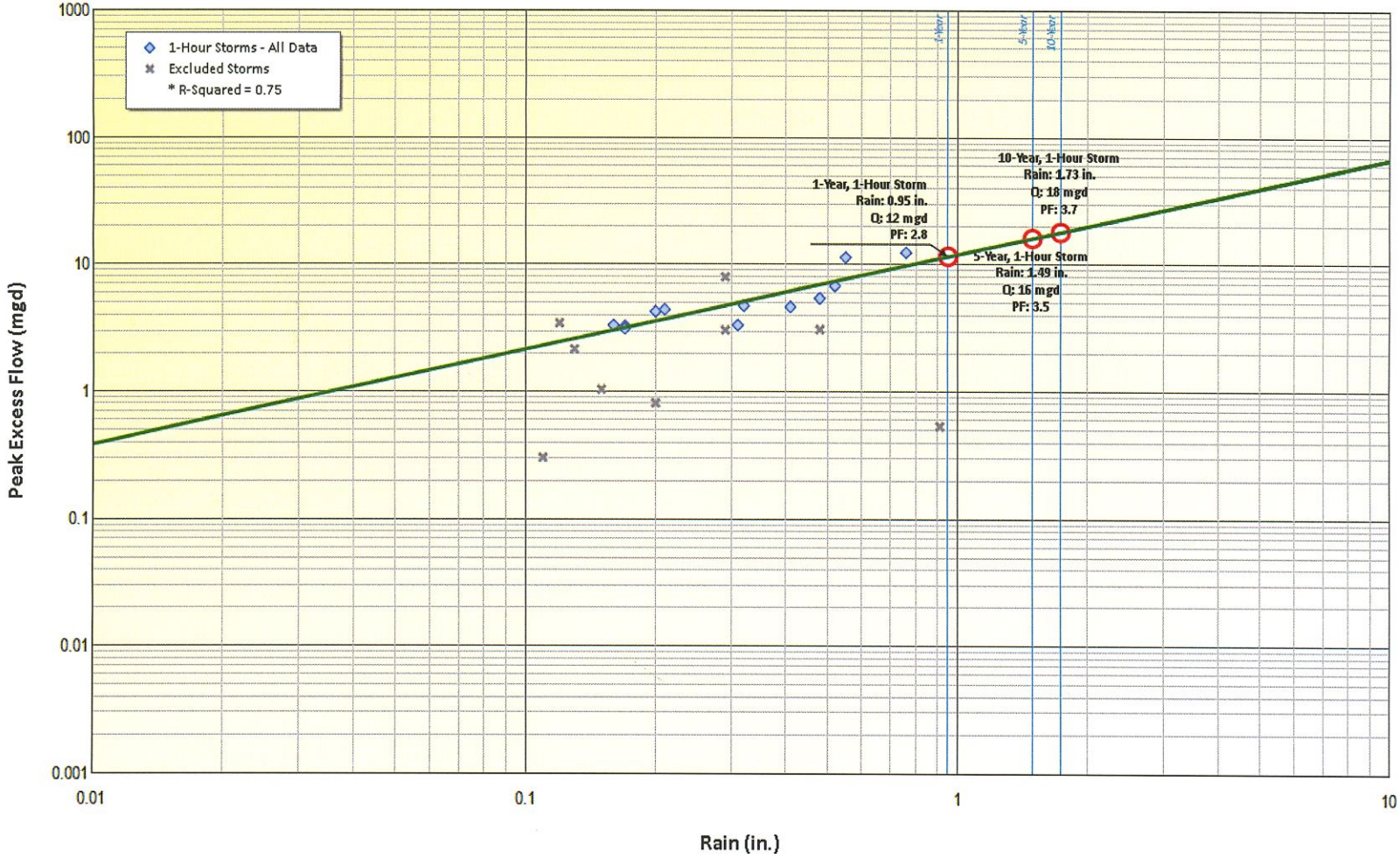
1-Hour Flow vs. Rainfall Regression

Basin BR75/BR70



1-Hour Flow vs. Rainfall Regression

Basin BR57



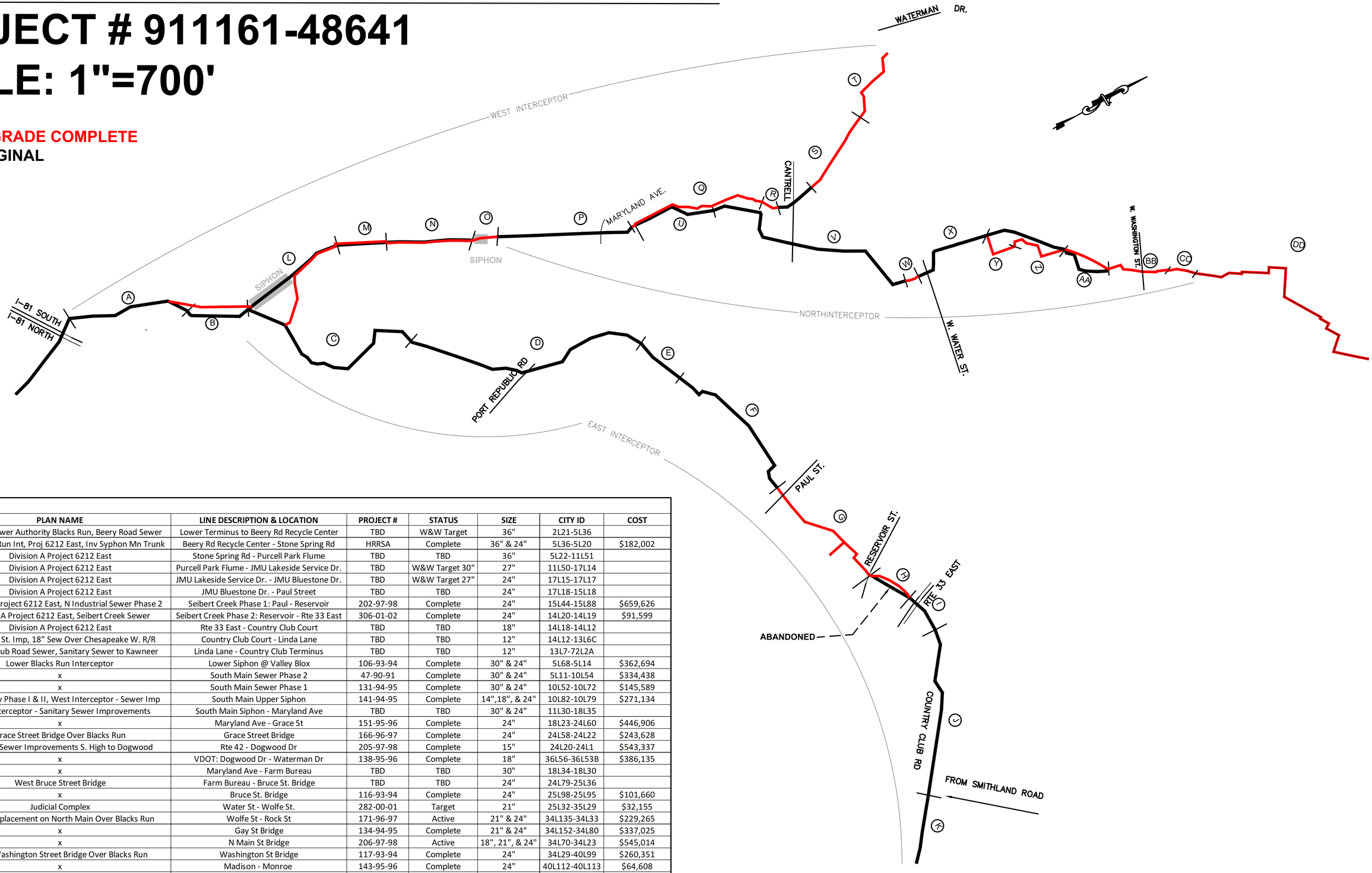
Appendix D: Blacks Run Interceptor Improvements

BLACKS RUN INTERCEPTOR PROGRAM

PROJECT # 911161-48641

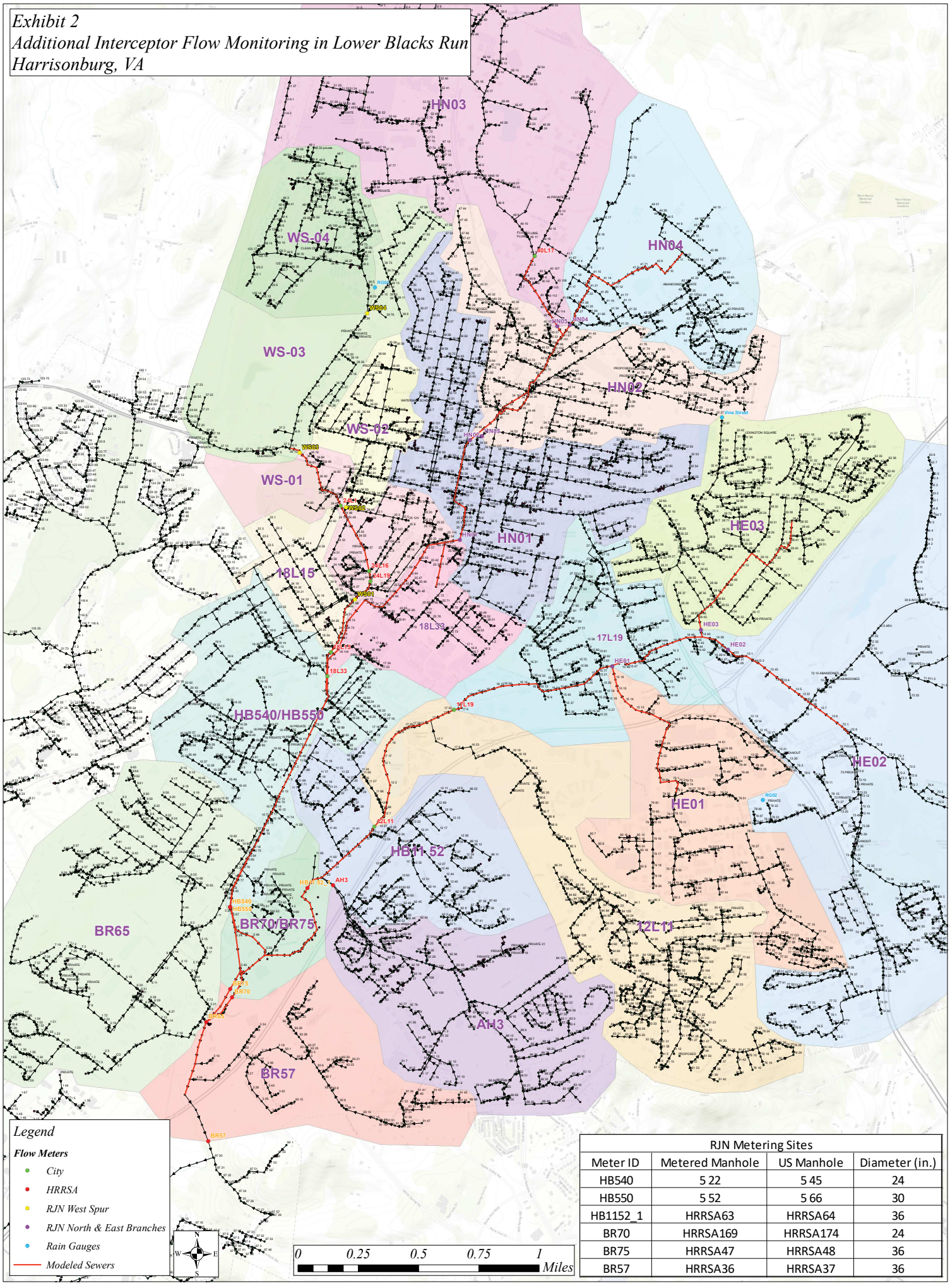
SCALE: 1"=700'

RED = UPGRADE COMPLETE
BLACK= ORIGINAL



AREA	PLAN NAME	LINE DESCRIPTION & LOCATION	PROJECT #	STATUS	SIZE	CITY ID	COST
A	Regional Sewer Authority Blacks Run, Beery Road Sewer	Lower Terminus to Beery Rd Recycle Center	TBD	W&W Target	36"	2L21-5L36	
B	Low Blacks Run Int, Proj 6212 East, Inv Syphon Mn Trunk	Beery Rd Recycle Center - Stone Spring Rd	HRRSA	Complete	36" & 24"	5L36-5L20	$182,002
C	Division A Project 6212 East	Stone Spring Rd - Purcell Park Flume	TBD	TBD	36"	5L22-11L51	
D	Division A Project 6212 East	Purcell Park Flume - JMU Lakeside Service Dr.	TBD	W&W Target 30"	27"	11L50-17L14	
E	Division A Project 6212 East	JMU Lakeside Service Dr. - JMU Bluestone Dr.	TBD	W&W Target 27"	24"	17L15-17L17	
F	Division A Project 6212 East	JMU Bluestone Dr. - Paul Street	TBD	TBD	24"	17L18-15L18	
G	Division A Project 6212 East, N Industrial Sewer Phase 2	Seibert Creek Phase 1: Paul - Reservoir	202-97-98	Complete	24"	15L44-15L88	$659,626
H	Division A Project 6212 East, Seibert Creek Sewer	Seibert Creek Phase 2: Reservoir - Rte 33 East	306-01-02	Complete	24"	14L20-14L19	$91,599
I	Division A Project 6212 East	Rte 33 East - Country Club Court	TBD	TBD	18"	14L18-14L12	
J	Reservoir St. Imp, 18" Sew Over Chesapeake W. R/R	Country Club Court - Linda Lane	TBD	TBD	12"	14L12-13L6C	
K	Country Club Road Sewer, Sanitary Sewer to Kawneer	Linda Lane - Country Club Terminus	TBD	TBD	12"	13L7-72L2A	
L	Lower Blacks Run Interceptor	Lower Siphon @ Valley Blox	106-93-94	Complete	30" & 24"	5L68-5L14	$362,694
M	x	South Main Sewer Phase 2	47-90-91	Complete	30" & 24"	5L11-10L54	$334,438
N	x	South Main Sewer Phase 1	131-94-95	Complete	30" & 24"	10L52-10L72	$145,589
O	S Main Sew Phase I & II, West Interceptor - Sewer Imp	South Main Upper Siphon	141-94-95	Complete	14",18", & 24"	10L82-10L79	$271,134
P	West Interceptor - Sanitary Sewer Improvements	South Main Siphon - Maryland Ave	TBD	TBD	30" & 24"	11L30-18L35	
Q	x	Maryland Ave - Grace St	151-95-96	Complete	24"	18L23-24L60	$446,906
R	Grace Street Bridge Over Blacks Run	Grace Street Bridge	166-96-97	Complete	24"	24L58-24L22	$243,628
S	Sanitary Sewer Improvements S. High to Dogwood	Rte 42 - Dogwood Dr	205-97-98	Complete	15"	24L20-24L1	$543,337
T	x	VDOT: Dogwood Dr - Waterman Dr	138-95-96	Complete	18"	36L56-36L53B	$386,135
U	x	Maryland Ave - Farm Bureau	TBD	TBD	30"	18L34-18L30	
V	West Bruce Street Bridge	Farm Bureau - Bruce St. Bridge	TBD	TBD	24"	24L79-25L36	
W	x	Bruce St. Bridge	116-93-94	Complete	24"	25L98-25L95	$101,660
X	Judicial Complex	Water St - Wolfe St.	282-00-01	Target	21"	25L32-35L29	$32,155
Y	Bridge Replacement on North Main Over Blacks Run	Wolfe St - Rock St	171-96-97	Active	21" & 24"	34L135-34L33	$229,265
Z	x	Gay St Bridge	134-94-95	Complete	21" & 24"	34L152-34L80	$337,025
AA	x	N Main St Bridge	206-97-98	Active	18", 21", & 24"	34L70-34L23	$545,014
BB	West Washington Street Bridge Over Blacks Run	Washington St Bridge	117-93-94	Complete	24"	34L29-40L99	$260,351
CC	x	Madison - Monroe	143-95-96	Complete	24"	40L112-40L113	$64,608
DD	North Industrial Sewer - Phase 2	Ashby Ave - Wilson Ave	202/212-97-98	Complete	18", 15", & 20"	41L19-42L41	$661,831
EE	x						$437,570
FF	Monroe Street Sanitary Sewer	Jefferson St - North Liberty St	165-96-97			41L75-40L13	
						TOTAL	$6,336,566

Exhibit 2
Additional Interceptor Flow Monitoring in Lower Blacks Run
Harrisonburg, VA



RJN Metering Sites			
Meter ID	Metered Manhole	US Manhole	Diameter (in.)
HB540	5 22	5 45	24
HB550	5 52	5 66	30
HB1152_1	HRRSA63	HRRSA64	36
BR70	HRRSA169	HRRSA174	24
BR75	HRRSA47	HRRSA48	36
BR57	HRRSA36	HRRSA37	36