Comparison of Alexandria's FY2023-32 Stormwater CIP with CASSCA Study Findings

A Report to the Ad Hoc Stormwater and Flood Mitigation Advisory Group

July 2022

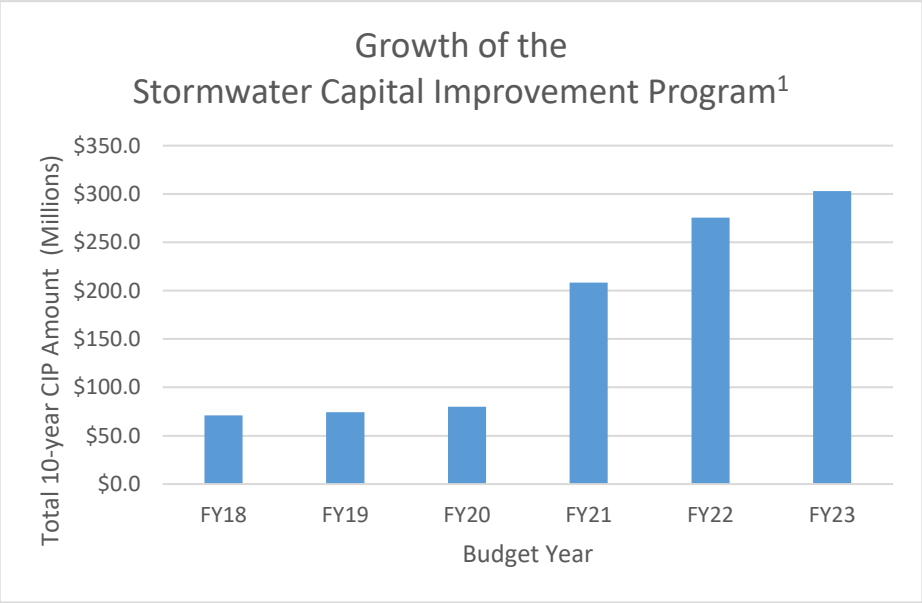
Purpose

This paper analyzes whether the flood mitigation projects contained in Alexandria's Stormwater Capital Improvement Program* for 2023 to 2032 will adequately address the major problem areas identified by the recent storm sewer capacity study (i.e. CASSCA Report).

*note: For this report, two wet weather mitigation projects from the Sanitary Sewer CIP are considered as part of Alexandria's Stormwater CIP

Introduction

To address neighborhood flooding due to increasingly severe rainstorms, City Council has substantially increased Alexandria's Capital Improvement Program (CIP) for stormwater infrastructure. The Stormwater CIP accompanies the city budget approved by Council each year. It identifies the flood mitigation projects and activities that the City intends to fund over the next ten years.



The graph at left illustrates the four-fold increase in the Stormwater CIP* over the past five years.

Because the CIP is a 10-year look into the future, it does not precisely identify every project that will be undertaken during that period. It does, however, present the broad categories of projects and activities to which city funds will be allocated.

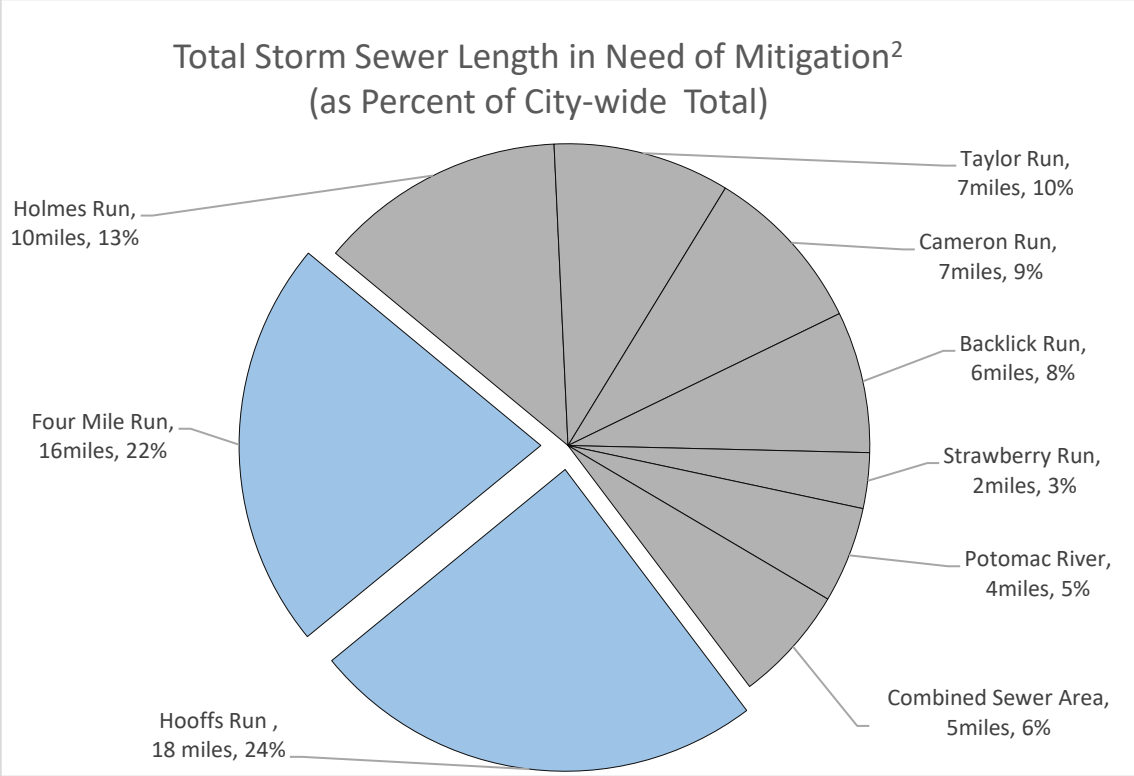
The Capacity of Alexandria's Storm Sewer System

Prepared in 2016, the *City of Alexandria Storm Sewer Capacity Analysis* (CASSCA) report is a comprehensive review of the storm sewer system. The report assesses the city's ability to handle an extreme rain storm that may occur only once in ten years. The report is based on a computer simulation that identified where overflows are most likely to occur during an extreme rain storm.

In simple terms, the computer simulation tested the capacity of the actual storm sewer pipes that run under the streets of Alexandria. Large diameter pipes can move more gallons of stormwater per minute than small diameter pipes. That difference matters during the intense short-duration rainstorms that are becoming more frequent as our climate changes. The report identifies the specific locations where the diameter of Alexandria's storm sewer pipes are inadequate during moments of peak flow. During

those moments, the stormwater can no longer flow down street-level sewer grates; in some cases, the stormwater rises up through manholes in the street.

The report considers the eight distinct watersheds of Alexandria. Ranging in size from three square miles to one-half of a square mile, each watershed has its own network of storm sewers. Each of the watersheds drain to a different natural waterway. The report found that the extent of inadequately-sized storm sewer pipes varies markedly among the various watersheds. Naturally, the largest watersheds have more miles of pipes, and hence, more pipes of inadequate diameter. However, in addition to that, the larger watersheds also have a higher proportion of their pipes that are inadequately-sized.



The report found that the about 46% of the city's inadequately-sized storm sewer pipes are found in the Hooffs Run and Four Mile Run watersheds. Stated more precisely:

1. There are 139 miles of storm sewer pipes in Alexandria.
2. A computer simulation of a 10-year storm found that 74 miles of those pipes are inadequately-sized. (i.e. during the storm's peak, they are full, and in some cases, beginning to surcharge through manholes.)
3. The Hooffs Run watershed contains 18 miles of inadequately-sized sewer pipes. The Four Mile Run watershed contains 16 miles. These two watersheds represent 26 percent and 23 percent of the city-wide total, respectively.

There are limitations to how the CASSCA findings can be used. As a computer simulation, its projections are only as good as the inputted assumptions concerning the intensity of the 10-year storm, as well as the dimensions and configuration of Alexandria's storm sewers. Further, the study did not consider other factors that can affect flooding, such as the level of sewer maintenance or the condition of the

sewer grates at street level. Regardless, the report identifies where the City should first focus its flood mitigation efforts. And with some reasonable assumptions, it offers a useful starting point for assessing the adequacy of the Alexandria's planned stormwater investments.

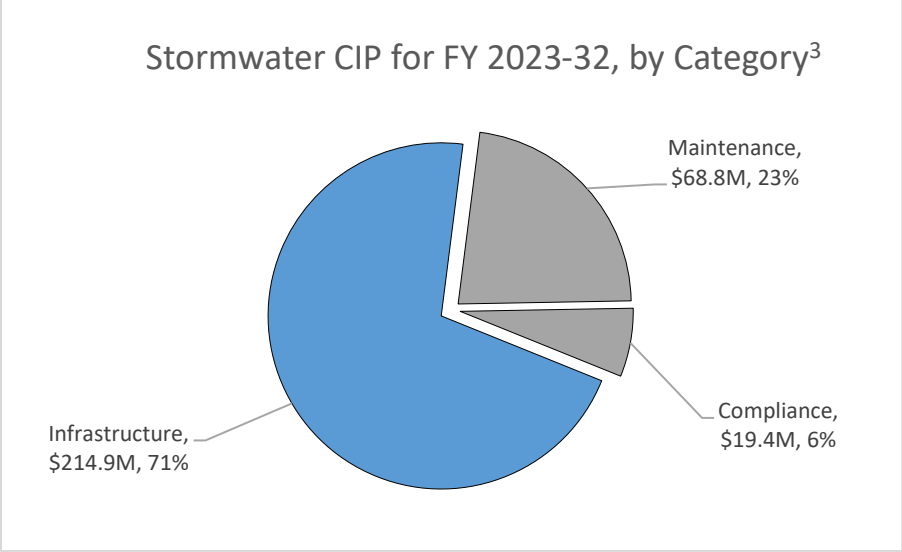
The Stormwater Capital Improvement Program for FY 2023 to FY 2032

The current Stormwater CIP and parts of the Sanitary Sewer CIP contains twenty-five stormwater-related projects and activities that are planned for the next ten years. As a planning document, it contains accurate cost estimates for well-defined projects that are scheduled to start within the next year, as well as approximate cost estimates for still-undefined projects that are several years from initiation.

In considering the Stormwater CIP, it is useful to categorize its projects as:

> *Infrastructure-building* – those projects associated with creating or expanding stormwater capacity in the form of new pipes and conveyance, as well as retention, diversion, and pumping, facilities.
>
> *Maintenance* – those projects and activities associated with the upkeep and repair of existing stormwater infrastructure.
>
> *Compliance* – those activities associated with meeting federal and state water quality standards as required for permit approval.

Each of the twenty-five projects and activities of the Stormwater CIP can be assigned to one of the three categories (see appendix). The figure below illustrates that over two-thirds of the planned investments will be directed toward the construction of new infrastructure to increase the capacity of Alexandria to handle extreme rain storms.

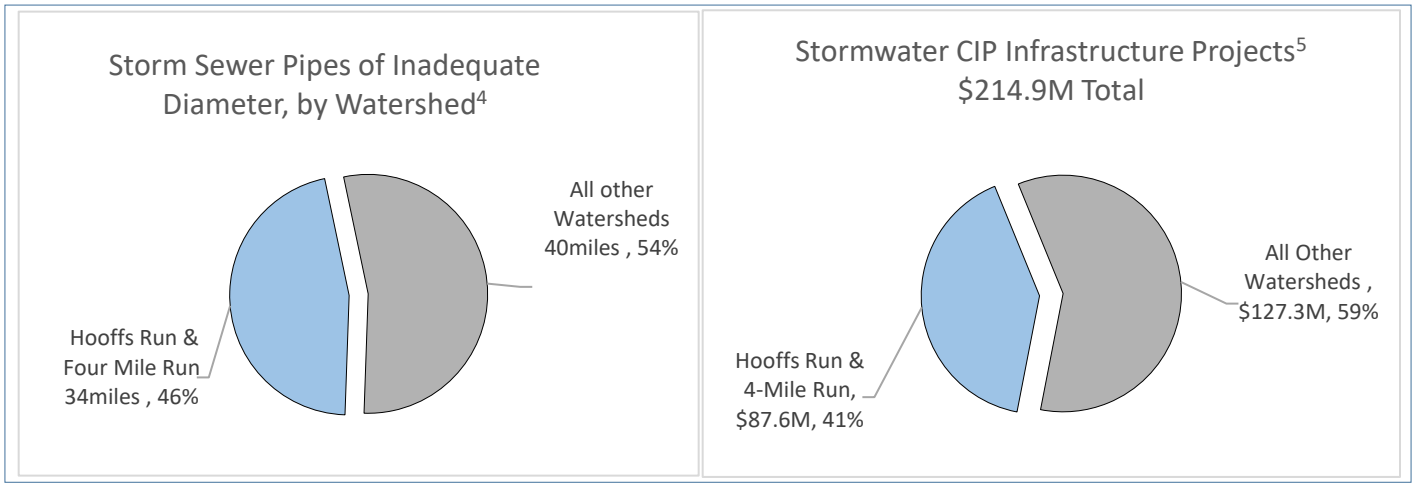


Because of the huge increase in the Stormwater CIP in just the past two years, the City has not precisely defined all of the projects that will be funded by the $215 million set aside for capacity building infrastructure. Two of the largest line items of the CIP are budgetary placeholders for unspecified "Capacity Projects" for $69M in the years after 2026 and $46M for "Spot Improvements" throughout the entire period. Spot Improvements are identified in an on-going manner as rain storms and resident complaints reveal flooding problems that can be resolved with construction projects that can be completed in less than a year.

The Stormwater CIP, however, does contains specific descriptions and cost estimates for major capacity-building infrastructure projects in the two most flooded watersheds identified in the CASSCA Report: Hooffs Run and Four Mile Run. This overlap between the cost estimates in the Stormwater CIP and the storm sewer capacity assessment of the CASSCA report allows us to assess whether the $215M in infrastructure investments planned in the Stormwater CIP are adequate to address the city-wide flooding problem.

Is the Stormwater CIP large enough to solve Alexandria's flooding problem?

It is difficult to compare the findings the CASSCA Report with the city's Stormwater CIP. The report is based on a computer simulation that considered the sewer system's configuration and pipe diameters. The Stormwater CIP is a list of projects informed by a more detailed understanding of Alexandria's topography, existing infrastructure, and resident concerns. Despite these differences, the overlap of the



two documents regarding the Hooffs Run and Four Mile Run watersheds enables a high-level analysis that considers the relative proportions of total Stormwater CIP budget and total miles of inadequately-sized sewer pipes that the two watersheds represent.

This analysis begins with two simple assumptions:

1. The CASSCA report found that about 46% of the inadequately-sized storm sewer pipes are in the Hooffs Run and Four Mile Run watersheds. Let's assume that indicates that about 46% of the city's stormwater problem resides in those watersheds.

2. The city's engineers have already defined two major capacity-building projects – valued at $88 million total – for the same two watersheds. Let's assume that the $88 million investment is sufficient to address the major flooding problems in the two watersheds.

If these assumptions are true – that about half of Alexandria's flooding problem is in the two watersheds, and $88 million is adequate to solve their flooding problems – then, about $88M may be required to solve the remaining 50% of the city's flooding problem. Currently, about $127 million of the Stormwater CIP is set aside for as-yet unspecified infrastructure projects. In fact, the CIP contains a line item titled, "Capacity Projects" that represents $69 million of $127 million currently unspecified.

These assumptions are presented with considerable caution. Only when the Hooffs Run and Four Mile Run projects are completed will we know whether the investment is adequate for severe rain events. Nonetheless, at this early stage in Alexandria's stormwater program, and using a simple *ceteris paribus* analysis, the FY 2023 Stormwater CIP appears to be appropriately allocated to address Alexandria's most urgent stormwater* flooding problems.

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*this analysis did not consider flooding associated with the climate-related tidal rise of the Potomac River

Next Steps and a Role for the Ad Hoc Committee

As stated earlier, the Stormwater CIP is simply a planning document. It is a projection of future years' budget requirements – not a guarantee that those funds will be available in the future. Funds are appropriated and made available upon City Council's approval of the current year's budget. And even then, funds that are appropriated for a specific project in the current may not be actually expended. Especially for large infrastructure projects, the actual expenditure of funds is often dependent on the completion of a design, approval of permits, and the award of a construction contract.

Fortunately, Alexandria's budget staff makes a wealth of budget execution data available to the public. The city publishes the *Quarterly Capital Project Status Report* that presents the value of actual expenditures for each of the projects in the Capital Improvement Program. The table, at right, was constructed from the most recent status report.

Project	FY20 Planned Expenditures from FY20-29 CIP	Actual Expenditures during FY20
Four Mile Run Channel Maintenance	$600,000	$0
Green Infrastructure	$350,000	$31,350
MS4-TMDL Compliance	$1,255,000	$0
NPDES/MS4 Permit	$160,000	$73,616
Storm Sewer Capacity Assessment	$475,000	$0
Storm Sewer System Spot Improvements	$300,000	$502,241
Stormwater BMP Maintenance CFBP	$135,000	$14,618
Strawberry Run Stream Restoration	$550,000	$179,574
Stream & Channel Maintenance	$450,000	$63,926
Taylor Run Stream Restoration	$1,695,000	$263,204
Total	$5,970,000	$1,128,529

The table illustrates the difference between the aspirations of the CIP and actuality of project management. The Council-approved Stormwater CIP for FY 2020-2029 planned for almost $6 million to be spent on ten projects during FY 2020. At the end of the FY2020 fiscal year, only a little over $1 million was actually expended.

Certainly, this difference can be attributed to the impact of the COVID pandemic that froze many government activities during 2020. Also during this period, the expansion of the city's stormwater programs created many new projects that needed time to become fully staffed and ready to execute.

Working with City staff, the Ad Hoc Committee could play a beneficial role in monitoring the extent to which the millions of dollars of capacity-producing projects of the Stormwater CIP are actually expending funds according to the plans approved by City Council. As the projects get underway, the committee could continually revisit the initial conclusion contained this document that the Stormwater CIP appears adequate for the stormwater flooding challenge facing Alexandria.

Appendix: Data Sources and Calculations used in the creation of the document.

To prepare this paper, we had to make several approximations to include the portion of Old Town known as the "Combined Sewer Area". This area – approximately 0.9 square miles - was omitted from the CASSCA Study. Further, the capital improvements planned for the Combined Sewer Area are presented in the City's CIP for Sanitary Sewers – not in the CIP for Stormwater Sewers. The following footnotes associated with the five graphs describe the calculations associated with each graph:

1. In addition to planned projects of the Stormwater CIP, two projects from the Sanitary Sewer CIP are included in this graph: Combined Sewer Assessment and Rehabilitation ($4.3M) and Combined Sewer Wet Weather Mitigation ($10.5M).
2. This is a total approximation. To approximate the miles of insufficient sewer pipe in the Combined Sewer Area, we multiplied the "Area of the Combined Sewer Area" (0.9 square miles) times the "Average Density of miles of sewer pipe per square mile" as the bordering Potomac watershed (9.62 miles of sewer per square mile) times the "Percent of Insufficient sewer pie" for the entire Alexandria watershed (53%). The results is an estimated 4.59 miles of insufficient sewer pipe in the Combined Sewer Area.
3. The Combined Sewer Assessment and Rehabilitation ($4.3M) and Combined Sewer Wet Weather Mitigation ($10.5M) from the Sanitary Sewer CIP are considered Maintenance and Infrastructure investments, respectively. See table on following page.
4. The approximated 4.59 miles of insufficient sewer pipe from the Combined Sewer Area are added to the corresponding estimates (69 miles) for the eight other watersheds from the CASSCA Report.
5. In addition to the capacity-building projects of the Stormwater CIP, this also includes the Combined Sewer Wet Weather Mitigation ($10.5M) project from the Sanitary Sewer CIP.

Data Sources:

Page 1 graph – City of Alexandria website, Management and Budget, Budget Archives, CIP Documents
Page 2 graph - City of Alexandria Storm Sewer Capacity Analysis (CASSCA) report, Table 4-2
Page 3 graph - City of Alexandria website, Management and Budget, FY2023 Proposed Budget, CIP Documents
Page 5 table - City of Alexandria website, Management and Budget, Budget Archives, FY20-29 CIP, and Capital Project Status Reports for 4th Quarter FY2019 and 4th Quarter FY2020 (to determine FY2020 actual expenditures)

Summary of FY2023 Stormwater CIP (note CIP page numbers), plus relevant Sanitary Sewer projects

Project	CIP Page	Type	Watershed	Prior Approps	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY23 -32
Braddock & West	13.4	Infrastructure	Hooff's Run	$0.000	$0.198	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.198
Storm Sewer Spot Improvements	13.24	Infrastructure	City-wide	$11.166	$5.907	$4.011	$4.122	$4.228	$4.337	$4.540	$4.606	$4.688	$4.812	$4.937	$46.188
Large Capacity (Commnwlth&Glebe)	13.12	Infrastructure	4-Mile Run	$0.000	$26.407	$12.632	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$39.039
Large Capacity (Hoofs Run Culvert)	13.13	Infrastructure	Hooff's Run	$0.000	$0.000	$16.176	$32.352	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$48.528
Green Infrastructure	13.9	Infrastructure	City-wide	$2.311	$0.000	$1.550	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$1.550
Storm Sewer Capacity Projects	13.22	Infrastructure	City-wide	$26.686	$0.000	$0.000	$0.000	$15.950	$15.200	$13.675	$6.700	$6.350	$4.000	$7.000	$68.875
Stormwater Utility Implementation (?)	13.26	Infrastructure	City-wide	$1.673	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Spot Project - Hume Ave Bypass	13.20	Infrastructure	4-Mile Run	$1.070	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Spot Project - Mt Vernon Cul-De-Sac	13.21	Infrastructure	Hooff's Run	$0.830	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
CS Wet-Weather Mitigation*	San CIP	Infrastructure	CombSewer Area												$10.500
Sub-Total				**$43.736**	**$32.512**	**$34.369**	**$36.474**	**$20.178**	**$19.537**	**$18.215**	**$11.306**	**$11.038**	**$8.812**	**$11.937**	**$214.878**
Percent of CIP				**53%**	**84%**	**84%**	**82%**	**67%**	**75%**	**68%**	**51%**	**60%**	**46%**	**54%**	**71%**
Stormwater BMP Maintnce CFMP	13.25	Maintenance		$0.520	$0.286	$0.304	$1.575	$1.623	$0.317	$0.327	$0.336	$0.347	$0.357	$1.792	$7.264
Small-Midsize Stormwater Mntnce	13.19	Maintenance		$0.000	$0.581	$0.614	$0.649	$0.686	$0.724	$0.766	$0.809	$0.854	$0.901	$0.923	$7.507
Flood-proofing Grant Program	13.7	Maintenance		$0.750	$0.769	$0.789	$0.809	$0.830	$0.851	$0.873	$0.895	$0.918	$0.941	$0.965	$8.640
Stream & Channel Maintenance	13.28	Maintenance		$7.429	$0.881	$0.908	$0.935	$0.963	$0.992	$1.021	$1.052	$1.084	$1.116	$1.150	$10.102
Four Mile Run Channel Maintenance	13.8	Maintenance		$3.475	$0.936	$0.000	$0.300	$0.300	$0.000	$1.251	$2.900	$0.000	$0.300	$0.300	$6.287
Inspection & Cleaning CFMP	13.11	Maintenance		$3.852	$1.268	$1.457	$1.578	$1.695	$1.835	$2.006	$2.220	$2.496	$2.862	$3.304	$20.721
Hoofs Run Culvert Maintenance	13.10	Maintenance		$0.000	$0.000	$0.000	$0.000	$1.616	$0.000	$0.000	$0.000	$0.000	$2.510	$0.000	$4.126
Taylor Run Stream Restoration	13.29	Maintenance		$4.540	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Cameron Station Pond Retrofit (?)	13.5	Maintenance		$4.723	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
City Facilities Stormwater BPMs (?)	13.6	Maintenance		$1.633	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Strawberry Run Stream Restoration	13.27	Maintenance		$1.645	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Lucky Run Stream Restoration	13.14	Maintenance		$2.853	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
CS Assessment & Rehabilitation*	San CIP	Maintenance	CombSewer Area												$4.130
Sub-Total				**$31.420**	**$4.721**	**$4.072**	**$5.846**	**$7.713**	**$4.719**	**$6.244**	**$8.212**	**$5.699**	**$8.987**	**$8.434**	**$68.777**
Percent of CIP				**38%**	**12%**	**10%**	**13%**	**26%**	**18%**	**23%**	**37%**	**31%**	**47%**	**38%**	**23%**
MS4 - TMDL Compliance Improvements	13.15	Compliance		$5.605	$1.300	$2.100	$1.800	$2.050	$1.750	$2.000	$2.575	$1.500	$1.000	$1.750	$17.825
NPDES/MS4 Permit	13.17	Compliance		$1.150	$0.000	$0.170	$0.172	$0.174	$0.175	$0.177	$0.179	$0.181	$0.182	$0.186	$1.596
Sub-Total				**$6.755**	**$1.300**	**$2.270**	**$1.972**	**$2.224**	**$1.925**	**$2.177**	**$2.754**	**$1.681**	**$1.182**	**$1.936**	**$19.421**
Percent of CIP				**8%**	**3%**	**6%**	**4%**	**7%**	**7%**	**8%**	**12%**	**9%**	**6%**	**9%**	**6%**
Total CIP				**$81.911**	**$38.533**	**$40.711**	**$44.292**	**$30.115**	**$26.181**	**$26.636**	**$22.272**	**$18.418**	**$18.981**	**$22.307**	**$303.076**