SACRAMENTO STATE

A Toolkit for Stormwater Asset Management and Funding

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ENVIRONMENTAL FINANCE CENTER AT SACRAMENTO STATE

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1. Introduction

Communities throughout the United States are making investments in managing stormwater. As stormwater management becomes a higher national priority, municipalities are managing and building systems to provide flood protection and comply with National Pollutant Discharge and Elimination System (NPDES) permits. The US Environmental Protection Agency's (EPA) Environmental Finance Centers throughout the country are supporting this goal and providing expertise and tools to improve local stormwater management capacity.

The EPA's Region 9 Environmental Finance Center at Sacramento State (EFC) developed a free stormwater financing toolkit to assist communities in sustainable stormwater program management and funding. The toolkit guides users in estimating costs for maintaining current assets, ensuring permit compliance, and projecting costs for future infrastructure. It also allows users to record data, calculate cost of service, and evaluate stormwater utility rate structures, including an ability-to-pay analysis for residential property owners. The toolkit was assembled as part of the EFC's municipal assistance activities and tested in real-life municipal stormwater planning. Like most analysis and modeling efforts, data collection and integration constitutes the majority of the work. In undertaking asset management, utility managers will have to develop or update inventories of their system assets. Unit and program cost data will need to be gathered from accounting records and external sources, while property and census data will need to be assembled to estimate key factors that support utility billing systems. The toolkit and this document were developed to guide the user in not just what to do, but also how to do it and where to get necessary data. After this introduction, the document is divided into the following sections:

2. Background
3. Evaluating Program Costs and Evaluating Revenues
4. Toolkit Preview

Section 2 discusses the needs, challenges, and approaches for funding stormwater programs. Section 3 describes how asset management can be used to develop and refine stormwater funding programs. It references various spreadsheet-based workbooks that comprise the stormwater funding toolkit. Section 4 lists each of the toolkit materials and how the items can be assembled to evaluate program costs and potential revenue from stormwater utility fees.

About the EFC at Sacramento State

The EPA Region 9 EFC is operated by the Office of Water Programs (OWP) at California State University, Sacramento (Sacramento State). The EFC at Sacramento State assists EPA Region 9 state and local governments, tribal communities, and non-profits with financial planning, asset management, and data analysis. The goal of the EFC is to support these entities in building the capacity to sustainably fund environmental and public health programs for residents.

2. Background

Throughout the US, municipalities pay for water management and infrastructure in many ways. Traditionally, water supply systems use revenue from water sales to fund operations and maintenance. Wastewater and stormwater services are often funded through connection and use charges, with property owners paying a one-time fee to connect with existing municipal systems and then paying monthly or annual fees based on intensity of use. In some areas of the western US, designated special districts have jurisdiction to assess residents with "special" fees to pay for services and infrastructure development. Such districts have been used extensively in California for many types of activities, dating back to the establishment of authority for irrigation districts in 1887 through the state's Wright Act. More recent examples include two of the largest water supply and management organizations in Southern California, the Metropolitan Water District of Southern California and the Water Replenishment District of Southern California, that were formed by legislative edict and subsequent voter approval for the purposes of supplying water and managing groundwater recharge.

As municipalities in the US grew in the 19th Century, they first organized water supply and then wastewater management activities to promote public health (Tarr et al. 1984). Stormwater management came late to the scope of municipal duties, as local and federal investments in water treatment and supply were bolstered to solve critical public health challenges (NRC 1984). While the Clean Water Act dates to 1948 and its major amendments to 1972, regulations for "nonpoint" contaminant sources such as stormwater were only brought into the regulatory framework after amendments in 1987. Through these amendments (Water Quality Act of 1987), federal and state regulators began developing program requirements for key polluters and cities (first larger municipalities and later small and mid-sized municipalities) to control stormwater runoff. Partly as a result of the relatively recent development of regulations and program duties, funding mechanisms for water and wastewater operations are more established than for stormwater. In western states, funding gaps are common in the stormwater sector (Hanak et al. 2013).

Today, national-level interest continues to grow in building capacity for communities to manage stormwater, though the reasons differ throughout the country. In some areas, the effects of stormwater on regional water bodies are burdening economies and harming recreational assets. Elsewhere, communities look to use green infrastructure to simultaneously address stormwater needs and enhance urban streets and landscapes, with benefits for property values and amenities. In drier parts of the US, communities hope to capitalize on capturing stormwater as a way to enhance increasingly scarce water supplies. No matter the goals of stormwater management, agencies and national organizations are increasingly recognizing funding gaps that cities face in addressing stormwater management needs (NMSA 2018).

Cities are expanding stormwater programs and establishing dedicated stormwater utilities. In the absence of dedicated funds for stormwater management, cities pay for stormwater infrastructure and permit compliance by cobbling together funding sources. They draw on general funds, use line-item funding streams such as fees for newly developed land, and work with other municipal departments to fund joint

activities. These options pose several challenges. First, using general funds means that stormwater infrastructure competes directly with other services. Second, localities throughout the country have varied and unequal opportunities for raising revenue, resulting in disparities in municipal capacity to establish revenue streams. In California, localities face unique constraints in raising revenue because a voter-approved 1996 ballot measure (Proposition 218) requires local taxes and fees to meet certain requirements for expenditures or be approved through popular vote. This was subsequently applied to stormwater through a legal decision. Finally, funding stormwater programs through general fund sources may unevenly disperse the costs of compliance and management. For example, industrial facilities or large commercial building tenants may not pay enough in taxes to address their contributions to runoff from their sites and its impact on water quality. The best way to align risk and funding contributions is through fees based on impervious surface cover, with high-risk land uses such as automotive facilities or industrial sites potentially incurring additional charges.

To stabilize funding, some municipalities implement more dedicated funding streams. Municipal stormwater utility fees and taxes are one approach to assessing residents for stormwater costs. Rate structures can be based on a variety of methods that incorporate data for socio-demographic and land use characteristics. Additionally, municipalities often assign connection charges to builders and developers for interconnecting new properties with existing systems. Some residents or businesses might be assessed inspection fees related to NPDES permit compliance to pay for stormwater permitting activities. For larger new developments, municipal regulations can even require developers to implement neighborhood or regional stormwater management infrastructure, referred to as green infrastructure (GI), low impact development (LID), best management practices (BMPs), and stormwater capture measures (SCMs).

Municipalities also use other methods to raise revenue for stormwater management. Some reapportion or leverage funds from other relevant departments. For example, stormwater managers can work with transportation sector managers to implement SCMs near roads and other transit features. Additionally, states such as California rely heavily on voter-approved, general obligation bond funding for water infrastructure planning and development projects (Ajami and Christian-Smith 2013). Several voter-approved proposition measures over the past decade, including Proposition 1 (2014), Proposition 84 (2006), and Proposition 68 (2018) contained funding for stormwater planning and development.

Beyond regional funding, some national-level funding sources support stormwater management. The Clean Water State Revolving Fund from the EPA offers low-interest loans for stormwater infrastructure improvements and restoration projects, among other activities. Municipal borrowers identify a source for paying back the loans over time, which can include stormwater utility fees, developer fees, and other fees not directly related to stormwater management (EPA 2016).

Additionally, innovative revenue sources are being explored or implemented. Stormwater infrastructure improvements can be funded jointly among municipal departments and other agencies. In the city of Long

Beach, CA, for instance, the municipality partnered with the California State Department of Transportation to undertake stormwater infrastructure improvements that included a highway corridor. Some commercial or industrial businesses that already comply with stormwater permits are also potential partners for regional projects. Other resource sectors offer inspirational ideas for new funding sources. The electricity sector, for example, has on-bill charges that are assessed at a fixed rate and used to pay for consistent infrastructure costs such as electricity transmission lines. In California, a "public goods" charge is included for all rate-payers to fund renewable energy research and implementation programs (Quesnel and Ajami 2018).

Other mechanisms allow municipalities to finance some costs of stormwater management with debt-based funding sources. In recent years, several innovative public bond initiatives have emerged that are potentially applicable to stormwater and water management (Stanford et al. 2015, Jacques 2018). For instance, environmental impact bonds (EIBs) are "pay-for-performance" arrangements, where a municipality floats a bond and investors are repaid only when the funded assets yield expected results. In recent years, several municipalities, including Washington, D.C., have used EIBs to fund infrastructure. A related category of environmental-focused bonds are "green" bonds dedicated to climate or environmental purposes. The San Francisco Public Utilities Commission has used several rounds of green bond funding to support water, wastewater, and stormwater infrastructure projects (SFPUC 2017). Finally, through recent clarifications to accounting standards, bond funding can be used to pay for activities that do not generate municipal assets, such as distributed green infrastructure or rebate programs. For all these funding sources, municipalities must have revenue sources to make long-term payments (with interest) for the life of the bond.

The quickly emerging landscape of alternative funding mechanisms for stormwater provides many opportunities for creativity. However, it also generates uncertainty, especially for funding and financing mechanisms with limited track records. Moreover, while financing mechanisms (i.e., loans and bonds) can be useful, they must ultimately be paid back with interest, creating long-term debt obligations. Revenues are always necessary. Municipalities are encouraged to survey all of these options when devising a long-term strategy that supports stormwater programs and new infrastructure in their communities.

3. Evaluating Costs and Revenues

Stormwater program management requires assessing current and future costs and identifying potential revenue sources. Asset management is a key process that helps identify and prioritize current and future program costs to support long-term investments. It assists in developing sustainable revenue and assessing financial impacts on communities and municipalities. The EFC used asset management principles in developing guidance materials for municipalities to estimate stormwater program costs and evaluate potential revenue that will be needed to sustain their programs. Asset management, which traditionally focuses on maintaining reliability of current systems, can be combined with NPDES permit compliance requirements and long-term stormwater management plans with capital improvements (for both water quality and drainage improvements) to capture the suite of services needed for stormwater programs and utilities.

The EFC's approach to developing sustainable stormwater funding involves a multi-step procedure:

1. Create an asset inventory
2. Define levels of service (LOS) for maintaining assets
3. Estimate program costs for
    a. Operation and maintenance (O&M) of existing assets
    b. Permit compliance activities
    c. Capital & O&M for future infrastructure
4. Engage stakeholders and solicit input
5. Conduct an ability-to-pay analysis
6. Develop a rate structure
7. Determine remaining funding gaps
8. Recommend additional revenue options
9. Public education and outreach

Each of these steps is described below, with references to various components of the EFC stormwater financing toolkit.

A. Creating an Asset Inventory

A variety of asset management tools can assist in estimating a municipality's total stormwater program costs. They all allow municipal stormwater managers to document the process of creating and prioritizing an organized inventory of stormwater infrastructure, which may include gravity mains, detention basins, GI, manholes, and other components. Available tools range from simple tabular templates such as that provided by the EPA (Figure 1) to sophisticated proprietary software databases that may contain built-in cost resources and/or decision making functionality (Figure 2).

Example System Inventory Worksheet

Date Worksheet Completed/Updated: 8/14/02

Asset	Expected Useful Life	Condition	Service History	Adjusted Useful Life	Age	Remaining Useful Life
Well 1 (1993)	30	Good		30	9	21
Well 1 pump	10	Good	Rehab (1996)	10	9	1
Well 2 (1993)	30	Good		30	9	21
Well 2 pump	10	Good	Rehab (1998)	10	9	1
Pumphouse (1993)	30	Good		30	9	21
Electrical components	10	Some corrosion	Rehab (1994)	10	9	1
Chlorinator (1993)	10	Good	Rehab (1998)	5	3	2
Storage tank 1 (1993)	40	Good	Rehab (2000) - $17,000	40	9	31
Storage tank 2 (1993)	40	Good	Rehab (2000) - $17,000	40	9	31
Storage tank 3 (2000)	40	Almost new		40	2	38
Distribution System:						
Hydrants (15)	40	Unknown		40	9	11
Valves (45)	40	Unknown	6 valves don't work	40	9	11
6-inch (PVC)	60	Unknown		60	9	51
4-inch (PVC)	60	Unknown		60	9	51
2-inch (PVC)	60	Unknown	Repair breaks (2/year)	60	9	51

EXAMPLE Prioritization Worksheet

Date Worksheet Completed/Updated: 8/14/02

Asset	Remaining Useful Life	Importance	Redundancy	Priority (1 is high)
Well 1 (1993)	21	Needed for service	Other well, but need backup	6
Well 1 pump	1	Needed for service	Other well, but need backup	3
Well 2 (1993)	21	Needed for service	Other well, but need backup	6
Well 2 pump	1	Needed for service	Other well, but need backup	3
Pumphouse (1993)	21	Needed for service	Other well, but need backup	6
Electrical components	1	Needed for control	No redundancy - corrosion	2
Chlorinator (1993)	2	Mandatory	No redundancy - need backup	1
Storage tank 1 (1993)	31	Need for fire flow and demand	Other tanks	6
Storage tank 2 (1993)	31	Need for fire flow and demand	Other tanks	6
Storage tank 3 (2000)	38	Need for fire flow and demand	Other tanks	6
Distribution System:				
Hydrants (15)	11	Needed for public safety	Other hydrants	5
Valves (45)	11	Needed for isolation	Other valves, but some are out of service	4
6-inch (PVC)	51	Needed for delivery	No redundancy	6
4-inch (PVC)	51	Needed for delivery	No redundancy	6
2-inch (PVC)	51	Needed for delivery	No redundancy	6

EXAMPLE Required Reserve Worksheet*

Date Worksheet Completed/Updated: 8/15/02

Asset (list from highest to lowest priority)	Activity	Years until action needed	Cost ($)	Reserve required current year
1. Chlorinator	Replace	2	$2,000	$1,000
	Purchase redundant unit	1	$2,000	$2,000
2. Pumphouse - Electrical	Replace with controller	1	$2,000	$2,000
3. Well Pumps	Replace Well 1 pump	1	$5,000	$5,000
	Replace Well 2 pump	1	$5,000	$5,000
	Next Replacements (2 well pumps at $5000 each)	10	$10,000	$1,000
4. Valves	Replacement (45 valves at $500 each)	31	$22,500	$726
5. Hydrants	Replacement (10 hydrants at $2,000 each)	31	$20,000	$645
6. Pipe	6-inch (2500 ft. at $20/ft.)	51	$107,000	$2,098
	4-inch (2500 ft. at $20/ft. - replace 4-inch with 6-inch)			
	2-inch (2000 ft. at $20/ft. - replace 2-inch with 6-inch)			
	(Total is 15,100 ft. at $20/ft.)			
7. Storage	Rehabilitate 3 tanks (1 every 8 years, 1993 and 2000 tanks)	5	$30,000	$10,000
	Replace - 2 tanks (1993 tanks)	31	$40,000	$1,290
	1 tank (2000 tank)	38	$20,000	$526
			Total reserve in the current year	$36,399

*Note: The Required Reserve Worksheet only helps you account for the additional funds you will require to rehabilitate or replace your asset. Standard O&M costs are not included in this calculation.

EXAMPLE Budgeting Worksheet

Date Worksheet Completed/Updated: 8/15/02

Revenues		Expenses		Net Income	
Service Fees	$299,971	Maintenance	$59,320	Total Revenues:	$255,930
Fees and Service Charges (late fee, connection fee, fire fee, etc.)	$5,289	Utilities (power, telephone)	$3,992	Total Expenses:	$245,072
Impact Fees (demand fee, system development fee, etc.)	$175	Salaries and Benefits	$76,689	Net Income (Revenue - Expenses):	$10,358
Secured Funding		Equipment Cost	$1,371		
Interest		Chemicals	$40,512		
Other		Monitoring and Testing	$8,096		
		Rent or Mortgage			
		Insurance	$1,952		
		Professional Services (legal, accounting, engineering, etc.)	$900		
		Training Costs	$1,000		
		Billing Costs	$2,500		
		Fees (state PWS fee,franchise fee, conservation fee, etc.)	$500	Additional Reserves Needed	
		Security	$609	Total Required Reserves:	$39,625
		Other (debt payments, taxes, miscellaneous, etc.)	$53,630	Net Income:	$10,358
Total Revenues:	$255,430	Total Expenses:	$245,072	Additional Reserves Needed (Income - Required Reserves):	-$29,267

Figure 1 Simple asset management templates (EPA 2003)

The EFC developed an asset inventory workbook as part of its asset management toolkit. The asset inventory method followed in the workbook is a synthesis of several documented asset management approaches. Two resources proved particularly useful. The City of Grand Rapids, Michigan, developed a mathematical method as part of creating its *Stormwater Asset Management and Capital Improvement Plan* (Grand Rapids 2016) and the EPA developed and documented a simple method in *Asset Management: A Handbook for Small Water Systems* (EPA 2003). Combining the Grand Rapids mathematical methods with elements from the EPA method, which is easier to follow but lacks details to support decision making, allowed the EFC to develop a robust and user-friendly workbook template for stormwater programs.

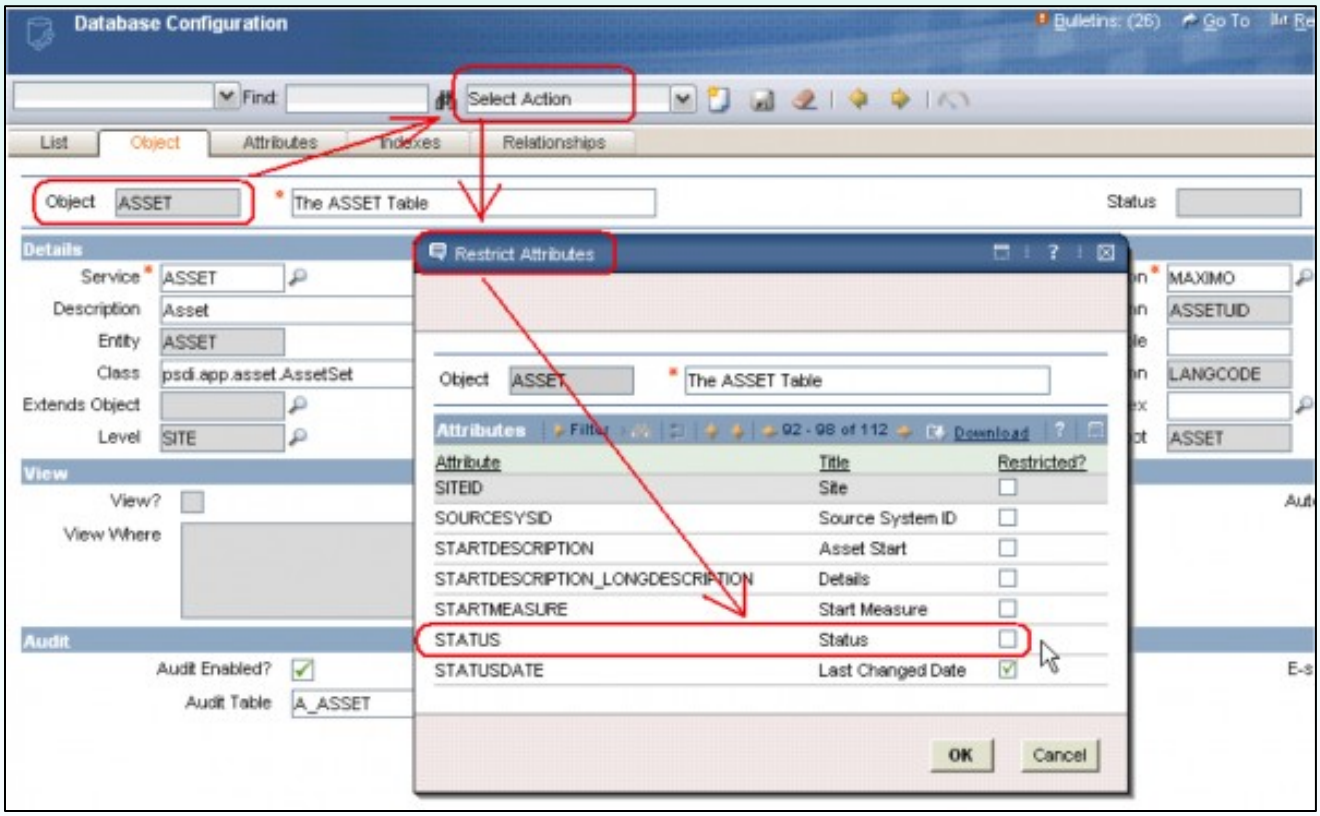


Figure 2 Commercial asset management software (IBM 2018)

The EFC asset inventory workbook stores common asset characteristics, such as asset type, material, age, and estimated expected life (EEL). Managers can use the collected data in the asset inventory to develop criteria for prioritizing maintenance and replacement tasks. The prioritization criteria should estimate the risk of failure. Two approaches are common. First, failure risk can be assessed based on the estimated remaining life, which is the difference between the expected life of the asset and its current age. Older assets, especially expensive assets, would be prioritized for replacement. Second, a more complex prioritization criteria can incorporate both the likelihood and the effects of failure.

This more complex procedure to prioritize based on failure risk uses two estimated values: the probability of failure (POF) and the consequence of failure (COF). The POF estimates the likelihood of asset failure compared to other assets, based on an assessment of the asset's age and condition. The COF estimates the impacts of a component outage, based on knowledge of the difficulty and cost for replacement, as well as impact on other community assets, services, and resources. The asset inventory workbook estimates these POF and COF scores to evaluate an overall risk of failure. The overall risk, then, helps determine

and prioritize assets for repair or replacement in current and future years, based on an identified level of service (LOS), as described below.

B. Defining Level of Service

Level of service (LOS) is a measure of the quality or expected reliability that must be provided by an agency to meet a community's basic needs and expectations (Grand Rapids 2016). It describes the extent of O&M activities performed for assets and can have varying degrees of scope and scale. An LOS can meet maintenance and repair needs as they arise (a reactive level), or more proactively undertake system maintenance and renewal activities prior to failures (a preventive level). In the end, a selected LOS must meet community expectations for performance and equity.

The EFC method uses an LOS approach similar to that used by Grant Rapids, categorizing O&M activities to help distinguish and define multiple levels. Defining multiple levels allows municipalities to compare options and solicit stakeholder input in determining how to best serve the community and make good on investments. The categories of O&M activities are:

- Inspections, including activities such as visual assessments and in-pipe inspections with cameras,
- Preventive maintenance actions performed to increase the effective life of the asset or improve its performance, such as patching cracks in a pipe or removing accumulated sediment,
- Corrective maintenance to fix a problem with an asset, including repairs and partial replacement, but not considering full replacement of assets, and
- System renewal, or the complete removal and replacement of assets.

The EFC method recommends a baseline LOS intended to identify O&M activities currently performed (or to be performed). An example of the baseline LOS is provided in Table 1. The baseline LOS represents a minimum service effort needed based on a limited O&M budget and usually without an asset management plan. There are no scheduled preventive maintenance operations or system renewals planned. Instead, assets are replaced or repaired as they fail.

Successive, more advanced levels of service will increase the type and frequency of inspections and maintenance, and accelerate the process of replacing assets. A more proactive (higher) LOS would replace assets before their end-of-life and reduce the risk of failures and outages. A higher LOS plan may have larger upfront costs for maintenance, but be more cost-effective when considering total life-cycle costs that preserve assets for a longer period.

Table 2 and Table 3 show examples of higher levels of service. The LOS in Table 2, which is more proactive than the baseline, shows that every asset type has a plan for system renewal and inspection. Most asset types also have plans for corrective and preventive maintenance of components.

Table 1 Baseline level of service (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal
Gravity Mains	---	Respond to failures and complaints for all sewer components.	---	---
Force Mains	Visual inspection every 2 weeks during pump station inspection.	---	---	---
Catch Basins	---	Clean 2,500 annually and perform corrective maintenance.	---	---
Outfalls	---	---	---	---
Detention Basins	---	---	---	---
Culverts	---	Clean debris and perform corrective maintenance.	---	---

Table 2 Moderate level of service (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal
Gravity Mains	PACP[1] CCTV[2] inspect pipes greater than 75 years old over 10 years.	Replace 15% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% of inspected sewers over 10 years.	Replace every 150 years.
Force Mains	Visual inspection every 2 weeks during pump station inspection. PACP CCTV inspect every 15 years.	---	---	Replace every 100 years.
Catch Basins	Clean and inspect 25% annually (approx. 4,264). Record and monitor debris levels for cleaning prioritization.	Clean 2,500 annually and perform corrective maintenance.	Replace 15% of assets that have reached end of EEL over 10 years.	Replace every 100 years.
Outfalls	Inspect all outfall points every 5 years per MS4[3] requirements.	Replace top 10% by POF each cycle.	Stabilize bank and erosion control at 5% of assets each cycle.	Replace every 150 years.
Detention Basins	Complete site inspection 3 times annually including routine maintenance.	---	---	Facility renovation every 100 years. Includes regrading, seeding, renew inlet/outlet structures.
Culverts	CCTV/walk/inspect 50% of culverts annually.	Replace/rehabilitate top 5% by POF.	Clean 20% of all assets annually.	Replace every 150 years.

[1] *Pipeline Assessment Certification Program*
[2] *Closed-Circuit Television*
[3] *Municipal Separate Storm Sewer System*

Table 3 Advanced level of service (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal
Gravity Mains	PACP CCTV inspect pipes greater than 50 years old over 10-year period.	Replace 30% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% over 10 years. Clean 20% of all assets annually.	Replace every 125 years.
Force Mains	Visual inspection every 2 weeks during pump station inspection. PACP CCTV inspect every 10 years.	---	---	Replace every 100 years.
Catch Basins	Clean and inspect 35% annually (approx. 5,969). Record and monitor debris levels for cleaning prioritization.	Replace 30% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% of inspected catch basins over 10 years.	Replace every 75 years.
Outfalls	Inspect all outfall points every 3 years to satisfy MS4 requirements.	Replace top 10% by POF each cycle.	Stabilize bank and erosion control at 10% of assets each cycle.	Replace every 125 years.
Detention Basins	Complete site inspection 3 times annually including routine maintenance.	---	---	Facility renovation every 75 years. Includes regrading, seeding, renew inlet/outlet structures.
Culverts	CCTV/walk/inspect 50% of culverts annually.	Replace/rehabilitate top 10% by POF.	---	Replace every 125 years.

The EFC method suggests establishing the baseline LOS as current O&M activities. Defining successive LOS, however, can be a difficult, even daunting, task. When using the probability and consequence of failure approach to assessing failure risk and replacement priority of an asset, the POF and COF scores provide a useful starting point. As noted, that the POF estimates how likely an asset is to fail compared with other assets, based on an assessment of the asset's age and condition, while the COF estimates the impacts of a component outage based on knowledge of the difficulty and cost for replacement, as well as impact on other community assets, resources, and services. The POF and COF can be combined through a simple table or matrix (Figure 3) to qualitatively categorize and compare risks associated with component failures. The risk categories are:

- High COF and high POF—high risk
- High COF and low POF—moderately high risk (due to high COF)
- Low COF and high POF—moderately low risk (due to low COF)
- Low COF and low POF—low risk

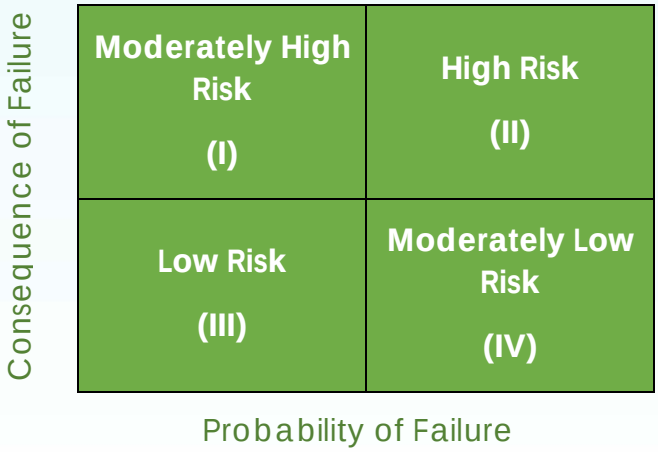


Figure 3 Matrix of asset risk categories based on COF and POF

Assets falling into higher risk categories should be given higher priority for O&M activities. The matrix (categories) can be used to help define LOS options beyond the baseline. The EFC recommends using improvements to the baseline to define a high LOS and a moderate LOS.

A high LOS plan is intended to both reduce failure risk and improve long-term cost optimization over the baseline LOS. In particular, the goal of a high LOS is to reduce failure of assets with high consequences or probabilities of failure, while maximizing the effective life of low-risk assets. To do this, a schedule is developed that: 1) prioritizes replacement of assets with high consequences or probabilities of failure

(quadrants I, II, and IV in Figure 3), and 2) establishes inspection and preventive maintenance activities for all assets to reduce failure risk before scheduled replacement.

For high LOS plans, the following steps are recommended:

1. Establish system renewal schedules—High-risk assets (i.e., those in quadrant II of Figure 3) should receive the highest priority for replacement due to high probability and consequence of failure. Moderately high-risk assets (quadrant I) should have the next highest priority for replacement, as their consequence of failure is high. Assuming a high LOS plan follows a proactive program that seeks to minimize failures, moderately low-risk assets (quadrant IV) would be next on the schedule for replacement because, although the consequence of failure is relatively low, the likelihood is high. Low-risk assets (quadrant III) can be scheduled for replacement at the end of their expected effective life.
2. Establish inspection schedules—Once a system renewal timeline is established, determine the inspection schedule that will prevent asset failure until the asset is scheduled for replacement. The inspection schedule will be more frequent than in the baseline LOS, and more types of inspection activities may be necessary. It may be most efficient to schedule inspections according to asset categories, where a percentage of the assets within the same category are inspected on the same frequency and revisited on a regular schedule. For example, if there are 10,000 drain inlets and they predominantly have a low risk of failure, a reasonable inspection schedule might be 1,000 drain inlets per year, with all drain inlets inspected on a ten-year cycle.
3. Establish preventive maintenance schedules—Similar to inspection schedules, establish preventive and corrective maintenance schedules to prevent failure until the asset's scheduled time of renewal. This will likely be more frequent than that for the baseline LOS and may include more types of maintenance activities. A good source for determining maintenance activities and frequencies is the manufacturer recommendations.

A moderate LOS plan is intended as an improvement upon the baseline LOS, but not to the extent of the high LOS. The goal of the moderate LOS is to reduce corrective action and failure of assets with high consequences of failure and delay failure of assets with low consequences. To do this, a schedule is developed to: 1) prioritize replacement of all assets with high consequences of failures, and 2) establish inspection and preventive maintenance activities for all assets to reduce the probability of failure. For moderate LOS plans, the following steps are recommended:

1. Establish a system renewal schedule—As with the high LOS, high-risk assets (quadrant II) should have the highest priority for replacement, moderately high-risk assets (quadrant I) should have second priority, and low-risk assets (quadrant III) can be inspected and maintained with replacement planned for the end of their expected effective life. Moderately low-risk assets (quadrant IV) can merely be inspected and maintained to maximize their effective life, in lieu of

making their replacement a priority. Although their probability of failure is high, the consequence is relatively low, justifying delay of replacement until failure occurs. An increase in inspections of these assets will help minimize costs and consequences.

2. Increase the frequency of inspections and maintenance used for the baseline LOS—Inspections and preventive maintenance have a low cost relative to corrective maintenance or system renewal. Increasing these activities can reduce asset failure rates and prolong asset life.

C. Estimating Costs

The EFC method for estimating costs associated with municipal stormwater programs breaks expenses into the following three groups:

- O&M of existing assets
- Permit compliance
- Future buildout

Typical expenses associated with each of these are summarized below.

Costs for O&M of Existing Assets

Costs associated with O&M of the existing infrastructure system, including both gray (drainage) and green (retention and infiltration) assets, must be estimated. The asset inventory and LOS drive the cost estimates. Presumably existing costs will represent the existing (baseline) LOS, while future costs will depend on the desired future LOS, including inflation estimates.

Data for these estimates can originate from a number of sources. For instance, a municipal stormwater management department may have records of the costs associated with the LOS activities. Existing engineering cost guides, such as *RS Means*, provide unit values to estimate costs through bottom-up approaches. Data for unit and fixed costs of various materials and labor can come from similar engineering projects. For instance, other municipal departments may have local costs for excavating soil, removing pavement to install or replace pipes, or hiring contractors to conduct routine inspections. Surrounding municipalities may have data from similar projects of use for estimating costs of engineering and planning. In 2017, the American Society of Civil Engineers published a handbook, written by experts, with costs for building and maintaining green infrastructure (Clary and Piza 2017). In 2019, the EFC will publish a guide on benefit-cost assessments for stormwater program management, along with a survey from existing sources of available data for permit compliance and infrastructure costs in California and elsewhere.

The Grand Rapids example (2016) nicely demonstrates how to organize expenses associated with O&M activities for existing assets. Table 4 shows costs associated with the baseline LOS (defined in Table 1), while Tables 5, 6, and 7 show the increasing costs associated with more frequent program activities and system renewal actions (i.e., the higher LOS presented in Table 2 and Table 3). Comparing the cost

estimates for several LOS scenarios allows utility managers to see opportunities and tradeoffs in the aggressiveness of maintenance and associated costs.

The costs presented in Table 4 through Table 7 are considered "Year 1," or current costs. Costs for future years can be projected by applying inflation factors. The EFC toolkit includes worksheets for documenting and calculating O&M activities and associated costs.

Table 4 Baseline LOS annual cost (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal	Total
Gravity Mains	$0	$200,000	$0	$1,537,000	$1,737,000
Force Mains	Same as pump station inspections	$0	$0	$0	$0
Catch Basins	$0	$600,000	$0	$0	$600,000
Outfalls	$0	$0	$0	$0	$0
Detention Basins	$0	$0	$0	$0	$0
Culverts	$0	$20,000	$0	$0	$20,000
Subtotal of Asset Classes	***$0***	***$820,000***	***$0***	***$1,537,000***	***$2,357,000***
O&M (inspection, corrective and preventive maintenance)					$820,000
Capital Renewal (system renewal)					$1,537,000
Total					**$2,357,000**

Table 5 Low-moderate LOS annual cost (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal	Total
Gravity Mains	$110,000	$299,000	$647,000	$2,439,000	$3,495,000
Force Mains	$200			$1,000	$1,200
Catch Basins	$639,000	$24,000	$14,000	$560,000	$1,237,000
Outfalls	$28,000	$66,000	$1,200	$12,000	$107,200
Detention Basins	$6,500			$11,300	$17,800
Culverts	$9,700		$43,000	$11,000	$63,700
Subtotal of asset classes	***$793,400***	***$389,000***	***$705,200***	***$3,034,300***	***$4,921,900***
O&M (inspection, corrective and preventive maintenance)					$1,887,600
Capital Renewal (system renewal)					$3,034,300
Total					**$4,921,900**

Table 6 High-moderate LOS annual cost (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal	Total
Gravity Mains	$212,000	$598,000	$1,207,000	$ 2,927,000	$4,944,000
Force Mains	$300	$0	$0	$1,400	$1,700
Catch Basins	$894,000	$48,000	$26,000	$746,000	$1,714,000
Outfalls	$47,000	$142,000	$6,000	$14,000	$209,000
Detention Basins	$6,500	$0	$0	$15,000	$21,500
Culverts	$9,700	$86,000	$0	$14,000	$109,700
Subtotal	***$1,169,500***	***$874,000***	***$1,239,000***	***$3,717,400***	***$6,999,900***
O&M (inspection, corrective and preventive maintenance)					$3,282,500
Capital Renewal (system renewal)					$3,717,400
Total					**$6,999,900**

Table 7 Advanced LOS annual cost (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventive Maintenance	System Renewal	Total
Gravity Mains	$482,000	$996,000	$3,252,000	$8,388,000	$13,118,000
Force Mains	$500	$0	$0	$1,800	$2,300
Catch Basins	$1,276,500	$80,000	$94,000	$1,119,000	$2,569,500
Outfalls	$47,000	$142,000	$27,000	$1,700	$217,700
Detention Basins	$6,500	$0	$0	$22,500	$29,000
Culverts	$19,300	$0	$86,000	$17,000	$122,300
Subtotal of Asset Classes	***$1,831,800***	***$1,218,000***	***$3,459,000***	***$9,550,000***	***$16,058,800***
O&M (inspection, corrective and preventive maintenance)					$6,508,800
Capital Renewal (system renewal)					$9,550,000
Total					**$16,058,800**

Costs for Permit Compliance

Cities of all sizes must comply with NPDES permits. Required activities can be categorized according to common, primary elements of NPDES permits, including:

1) Construction Site Stormwater Runoff Control
2) Illicit Discharge Detection and Elimination
3) Industrial and Commercial Management
4) Pollution Prevention/Good Housekeeping for Municipal Operations
5) Post-Construction Stormwater Management for New/Re-Development
6) Public Education, Outreach, Involvement, and Participation
7) Water Quality Monitoring
8) Overall Stormwater Program Management

In addition, municipal programs must address long-term planning activities required for statewide trash policy compliance, total maximum daily load (TMDL) compliance, and watershed management coordination. Costs associated with each of the core permit elements and long-term planning actions must therefore be assessed as well. Typical expenses include administrative and maintenance staff labor, equipment, materials, and, in some cases, contracted services. Once current or recent costs have been determined, costs for future compliance can be estimated using inflation factors.

Care should be taken to avoid duplicating costs. For example, some permit compliance activities and costs (e.g., good housekeeping for municipal operations) may have already been accounted for under O&M of existing assets. Also, some permit-required activities, such as those required for TMDL compliance, can qualify as either "long-term planning for permit compliance" or as future buildout costs (see the next subsection). Municipal planners and managers have discretion in where to claim these expenses, so long as they are not duplicated.

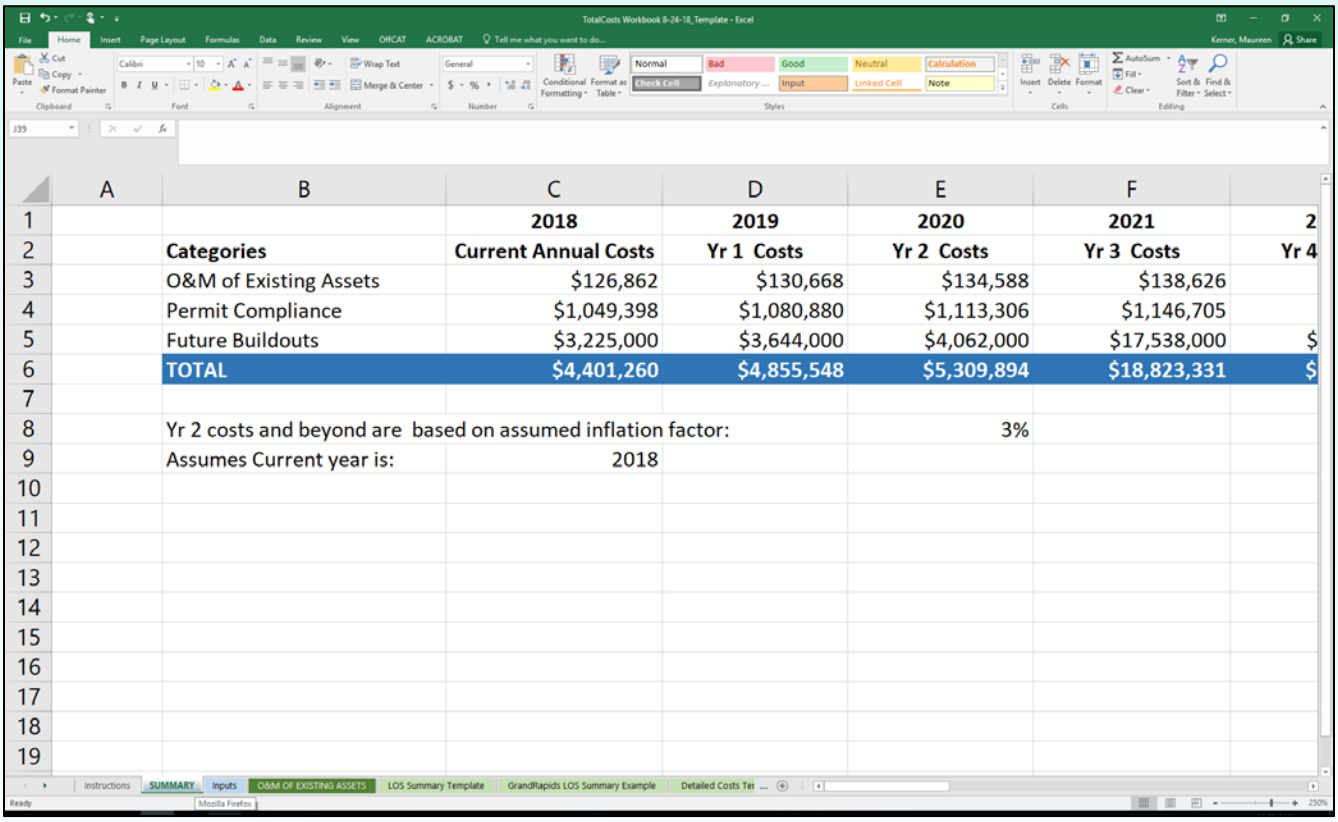
A screen shot of the EFC worksheet for total permit compliance costs is shown in Figure 5. Figure 6 shows one of the EFC's permit compliance core element cost worksheets.

Costs for Future Buildouts

Many municipalities throughout the US are struggling to update existing stormwater systems. In addition, meeting Clean Water Act regulations may require additional infrastructure investments and future system buildouts. Incorporating these costs into an asset management plan means projecting costs into the future based on what municipal leaders, stormwater managers, and regulators deem necessary to meet future goals for water quality and flood mitigation.

The extent of plans for future buildouts varies widely across communities. In some parts of western North America, municipalities are planning for significant investments in new stormwater infrastructure—both centralized and distributed—for water quality, drainage, and even water supply goals. Within EPA's Region 9, southern California communities, for instance, have outlined infrastructure investment plans to invest in future urban stormwater systems that meet NPDES requirements, including TMDLs of discharges to receiving waters. Some are planning stormwater capture projects for direct use or groundwater recharge. Yet, in other parts of EPA Region 9, municipalities have no plans for significant new investments. Thus, future buildout costs may or may not be incorporated in the estimates.

In estimating costs for future buildouts, cost estimates may be real or nominal. Real costs are adjusted for inflation, so the costs of a project in future years can be directly compared to the cost in a current year. Nominal costs, on the other hand, are not adjusted for inflation and are reported as the amount that must be spent in that year, which can be useful when comparing expenses to revenues. Both are valid methods of reporting financial projections, but detailed descriptions of assumptions are necessary to incorporate the estimates into asset management.



	A	B	C	D	E	F	
1			2018	2019	2020	2021	2
2		Categories	Current Annual Costs	Yr 1 Costs	Yr 2 Costs	Yr 3 Costs	Yr 4
3		O&M of Existing Assets	$126,862	$130,668	$134,588	$138,626	
4		Permit Compliance	$1,049,398	$1,080,880	$1,113,306	$1,146,705	
5		Future Buildouts	$3,225,000	$3,644,000	$4,062,000	$17,538,000	$
6		TOTAL	$4,401,260	$4,855,548	$5,309,894	$18,823,331	$
7							
8		Yr 2 costs and beyond are based on assumed inflation factor:			3%		
9		Assumes Current year is:	2018				

Figure 4 Screenshot of the summary worksheet in the EFC total costs workbook

There are many other factors and methods for projecting future costs, such as whether to report costs as a total dollar amount, a unit cost (dollar amount per value, such as gallons of runoff captured), or life-cycle costs. A unit cost or life-cycle cost approach can be useful for comparing project values and investments, but they can be quite complex.

The EFC toolkit includes a worksheet for documenting costs associated with future buildouts (as well as permit compliance and existing system maintenance), based on real, total dollar costs. Attachment B provides further discusses the task of projecting future expenses using unit or life-cycle costs.

Category #	Activities	Current Annual Costs	Yr 1 Costs	Yr 2 Costs	...	Yr 17 Costs	Yr 18 Costs	Yr 19 Costs	Yr 20 Costs
1	Construction Site Stormwater Runoff Control	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
2	Illicit Discharge Detection and Elimination	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
3	Industrial and Commercial Management	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
4	Pollution Prevention/Good Housekeeping for Municipal Operations	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
5	Post Construction Stormwater Management for New/Re-Development	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
6	Public Education, Outreach, Involvement, and Participation	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
7	Water Quality Monitoring	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
8	Overall Stormwater Program Management	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
9	Long-Term Planning (e.g., Trash Amendment, TMDL Compliance, Watershed Management Coordination)	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
					...				
	Subtotal	**$0**	**$0**	**$0**	**...**	**$0**	**$0**	**$0**	**$0**
	Yr 2 costs and beyond are based on assumed inflation factor:	3%							
	Assumes Current year is:	2018							

Figure 5 Screen shot of EFC permit compliance costs summary worksheet

Water Quality Monitoring

Cost Items	Labor Costs			Miscellaneous Costs				Total Cost		Existing Funding	Funding Source
	# FTE	Salary + Fringe + Accrual	Labor Cost	Units	Cost/Unit	# of Units	Miscellaneous Cost				
Labor - student intern			$ -					$ -			
Labor - stormwater staff			$ -					$ -			
Materials			$ -					$ -			
Equipment			$ -					$ -			
Travel			$ -					$ -			
Regional/State program fees			$ -					$ -			
QAPP/SAP preparation			$ -					$ -			
Sample collection			$ -					$ -			
Sample laboratory analysis			$ -					$ -			
Third party modeling/analysis/reporting			$ -					$ -			
Training			$ -					$ -			
Other:			$ -					$ -			
Totals			**$ -**				**$ -**	**$ -**		**$ -**	

Typical Activities	**Assumptions and References**
QAPP/SAP preparation	
Sample collection	
Sample laboratory analysis	
Data analysis and reporting	
Fee paid for joint monitoring effort conducted by Watershed Group	

Figure 6 Screen shot of EFC worksheet for a core permit compliance

Assembling Total Costs

Once the costs for each type of municipal stormwater program component (existing and future infrastructure) are estimated, they can be combined to estimate total annual program costs. The EFC toolkit's total costs workbook summarizes costs from across the program elements, and contains all the worksheets for permit compliance, existing asset O&M, and future buildout costs. . shows a screenshot of the EFC total costs workbook summary worksheet.

D. Engaging Stakeholders and Soliciting Input

As public servants, municipal stormwater managers have a responsibility to communicate with residents and stakeholders. Even more important, the success of stormwater management depends on public engagement and participation. Public engagement and input throughout the process of stormwater management helps solidify public support in an era when new local taxes and spending are often challenged.

After undertaking internal steps to create an asset inventory and better understand the condition of existing systems, stormwater managers can engage key community groups, municipal leaders, and residents. At this stage, they will have data to start discussions with the public, but listening to community input is just as important as providing information. Utility managers can organize working groups or public meetings to communicate needs and gaps in current stormwater programs. This helps build support for later activities that may require approval by elected leaders or voters.

Engaging key stakeholders early helps shape the trajectory of rate structures and fees. For instance, in a successful 2018 popular ballot measure for stormwater management in Los Angeles County, county officials formed an advisory group of community leaders and experts that framed how the funds were to be spent. The measure approved by county leaders for popular vote was highly detailed and documented, including procedures to allocate funds between large regional projects and the many underlying agencies that contribute to the region's permit. The ballot measure's success was rooted in the stakeholder processes that helped build support and demonstrate how municipal agencies would responsibly use the new tax dollars.

E. Conducting an Ability-to-Pay Analysis

An ability-to-pay analysis (APA) estimates economic impacts of stormwater fees on residents, businesses, industry, and the municipal government. The EPA developed an APA methodology to determine fees for maintaining combined sewer systems as part of its *Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development* (EPA 1997). In 2012, the EPA Office of Water and Office of Enforcement and Compliance Assurance reevaluated that document and determined the methodology could also be used for separate stormwater and wastewater systems (EPA 2012). The EPA's

APA method, which provides a high-level estimate of APA for residents in a community, is organized as follows:

1. Estimate the total annual program costs—In the case of storm water quality and drainage, this is the sum of the permit compliance costs and the costs for maintaining the chosen LOS.
2. Determine residential share of costs—This involves calculating the percentage of the total annual program costs attributable to residential users.
3. Calculate the cost per household (CPH)—This is done by dividing the residential portion of costs by the number of residences.
4. Calculate the residential indicator (RI)—To determine if the CPH would be a reasonable fee to charge residential users, the EPA developed a residential indicator (RI). The RI describes the proposed fee as a percentage of median household income (MHI) and is calculated by dividing the CPH by the MHI.
5. Identify a value or range of potential fees—EPA's 1997 guidance states that if the RI is less than one percent, the financial impact will be low. If the RI for a single service (e.g., drinking water, stormwater, or wastewater) is between one and two percent, it is considered mid-range, and over two percent is a higher impact. Ultimately, however, these values are assumptions and can be assessed in relation to community conditions and input. In addition, for water utility services, the guidance states that best practices simultaneously consider the financial impact of water supply, wastewater, and stormwater costs for a household, rather than consider them each individually, although no clear guidance exists to benchmark the impact of these combined fees (NAPA 2017; EPA 2012). Using the established ranges, if the RI is too large, the project team can reduce the CPH to lower the financial impact. Lowering the CPH could result in a funding gap that would need to be covered by alternative revenue sources. Additional funding sources are discussed in Section G.

Often, MHI is based on U.S. Census Bureau data for an entire municipality. Several standard rules-of-thumb exist as benchmarks for affordability, derived from EPA reports. For instance, a commonly used threshold for assessing the affordability of rates for household total expenditures for water services (water and sewer) is 4% of MHI.

However, using MHI to determine if a proposed fee will cause financial hardship has drawbacks, and the rule-of-thumb percentages for affordability lack empirical grounding. The MHI for areas within a municipality can vary widely and is not an equitable measure of affordability for lower-income households (USCM 2014). Assistance can be offered to low-income customers in the form of a reduced or waived fee, depending on income level. The utility will have to factor in such revenue losses from low-income assistance programs, potentially charging higher rates for other properties to make up shortfalls.

In fact, using percentage thresholds for spending in relation to city-wide or regional MHI metrics of water rate affordability is coming under more scrutiny among water planners. For instance, recent research identified alternative methods deemed more equitable to assess affordability, including estimating disposable income of residents in a city based on economic surveys, or judging the cost of water services in relation to hours of minimum wage (Teodoro 2018). These metrics have been applied to water and sewer rates, but not stormwater. Such methods provide useful innovations to the current metrics. They may not, however, be useful for small municipalities or non-metro areas due to data availability, or be too data intensive for local communities to undertake.

As an alternative, the EFC has used US Census data from the 2014 American Community Survey (ACS) to estimate MHI for communities at a more granular level. The ACS reports MHI at the level of census tracts or block groups (as opposed to an entire municipality). There are typically many block groups within a municipality. For estimating fee impacts, a useful method to address the potential disproportionate impacts of fees on low-income communities within a municipality is to estimate fees in relation to the block groups with the lowest reported MHI. This addresses some of the issues of low-income impacts, while still making the methods applicable to areas without detailed economic survey data for expenditures. Ultimately, a combination of metrics and community input can be used to judge affordability of any new rates or fees. Guidance on this and other considerations in developing an equitable fee structure is in the next section and in Attachment A.

The EFC toolkit allows for recording and assessing ability-to-pay data in the toolkit's rate structure workbook, which is described in the following section. Methods for gathering and assessing APA data are included in that discussion as well.

F. Developing a Rate Structure

Once a CPH has been estimated, a preferred rate structure can be developed. The EFC toolkit includes a rate structure workbook to be used for developing a rate structure and conducting a fiscal capability analysis. The workbook includes a worksheet template (Figure 7) for tabulating municipal characteristics required for rate structure development.

Types of Rate Structures

The existing literature (for example, the EPA report *Funding Stormwater Programs* 2009) presents several basic methods for assessing stormwater fees: flat fees per parcel, equivalent residential unit (ERU), intensity of development (IOD), and equivalent hydraulic area (EHA). In addition, combinations of these methods are possible, whereby one method is applied to one land use type and another method is used for other land uses. Appendix A of this report summarizes basic methods for developing rate structures, while the EFC website (http://www.efc.csus.edu) offers additional resources to help understand details for each method.

No one method for assessing stormwater fees is correct. Communities in EPA Region 9 have used variations of all these methods to adopt fees. For instance, in Culver City, CA, residents approved a municipal stormwater fee that is a flat annual rate for each property. In Sacramento, CA, properties are assessed a charge for drainage services based on building or lot size and land use type. For residences, monthly fees are assigned according to the number of rooms in a house, which is readily available through tax assessor records and aligns with how the local water supply utility traditionally charged for water. Non-residential properties are assessed per square foot of area. These are examples of simpler methods to devise stormwater fees, which can be easier for utilities to implement and communicate to the public during the approval process.

Example: Applying the ERU Method

Several studies estimate that the ERU method is used by 80 percent or more of stormwater utilities (EPA 2009, Campbell et al 2018). The main advantages of the ERU method are its ease to both implement and explain to the public. However, the ERU method does not equally distribute the costs of managing stormwater across properties with more impervious surface area than the average, so property owners with greater impervious area may pay the same amount as property owners with less impervious surface area. The ERU method also does not take into account runoff from pervious areas. Although pervious surfaces often have lower runoff impacts than impervious ones, pervious areas still contribute some degree of runoff and pollutants. The ERU method results in billing each customer based on impervious area, which is determined using a multi-step procedure such as:

1. Determine the average impervious area of a parcel (one ERU) using a representative sample of buildings in the utility's service area. Traditionally, the ERU has focused on residential buildings, but average imperviousness could be assessed for various other land use categories (e.g., commercial and industrial), which could better align fee assessments with contributing properties.
2. Assign a tariff rate for the ERU (dollar amount/ERU) based on the CPH calculated during the APA. If the CPH had a low RI, it is likely the project team will price one ERU equal to the CPH. If there is concern about the financial impact this will have, a fraction of the CPH can be applied.
3. Adapt the ERU rate to community needs. For instance, larger residences, multi-family residences and apartment buildings, and commercial and industrial properties could be assessed separately to reflect how a community views the contribution of these properties to stormwater runoff. Commercial and industrial properties could even be assessed on a parcel-specific basis, as there are often fewer of these types of properties. Such approaches can help create equitable rate structures and potentially reduce financial impacts on lower income households as part of credits and low-income assistance accommodations that are built into the rate structure (discussed later in this section).

For large single-family residences, the impervious area of the parcel can be converted to an equivalent amount of ERUs by dividing the total impervious area by the ERU. This requires more initial work than

assigning all single-family residences a single fee, but it generates more revenue from larger properties and makes the fee system easier for the public to understand because the fees are more closely related to the amount of stormwater generated.

To streamline the billing process and make the rate structure easier for the public to understand, some municipalities implement tiered rates. For example, if one ERU is calculated as 1,000 square feet (ft^2) of impervious area, a residential-tiered rate structure can be extrapolated by knowing the total lot size of a property, which is typically in assessor data. Assuming that the average imperviousness is consistent across residential lot sizes, the tiered rate could charge larger lots a higher fee through multiple ERU tiers, such as:

- 1 ERU: Impervious area between 0 ft^2 and 1,250 ft^2
- 2 ERUs: Impervious area between 1,250 ft^2 and 3,000 ft^2
- 3 ERUs: Impervious area between 3,000 ft^2 and 6,000 ft^2
- 4 ERUs: Impervious area greater than 6,000 ft^2

This tiered approach can be employed for all properties, or refined to include values specific to land use type.

Gathering, Integrating, and Analyzing Data

Assessing fiscal impact means collecting data from many sources and estimating impacts for various rate structures. More complex methods require more data collection. In particular, developing a municipal stormwater fee that is based on actual property conditions requires understanding the characteristics of impervious surface cover within a municipality. Impervious surface cover can either be estimated for each property, or statistical analysis can estimate the average percentage of cover across parcels. These are used to develop a rate structure, where properties are assessed a unit charge per square footage of surface cover based on property-level estimates or average values across land use types.

As noted, it is often easier to assign rate schedules based on assessments of average imperviousness across property types. This requires estimating imperviousness for only a sample set of properties, a much easier task. Generally, a procedure similar to below is necessary:

1. Collect geospatial data for parcel boundaries, municipal territories, and land use—The first step is to collect spatial data that supports an analysis of land use distribution in the region where a stormwater (or other) fee will be enacted. Municipalities typically have the necessary land use and municipal boundary data, specifically the land uses for each parcel and estimates of lot sizes. This data can be used to calculate descriptive statistics of land use and lot size broken down by categories such as single-family residential, multi-family residential, commercial, and industrial. In some cases, the local tax assessor's database may be available, which gives additional building

and property characteristics. The analysis provides a comparative metric for evaluating the validity of derived sample sets.

2. Acquire US Census data for estimating MHI—The best source of MHI data, an important consideration in assessing the affordability of any fees, is the US Census. Census data from the 2014 American Community Survey (ACS) at the block group level (the most recent with high-resolution) can be downloaded for a state and, if capacity exists, joined to geospatial shape files of block groups. The ACS data reports MHI along with MHI brackets such as 0–10 percent of the population, 10–20 percent of the population, and so on. For communities assisted by the EFC, the reported average MHI values for each block group in the respective service territory were mapped. Then, the MHI data from the associated block group was joined to the collection of properties located within the block group, yielding a more detailed assessment of MHI. This allowed for assessing distributions of MHI across properties to the highest level of spatial resolution possible.

3. Analyze geographic dispersion of income, land use, and lot size—The next step is to develop statistical distributions and categorical breakdowns of property characteristics in the service territory. These include analysis by land use and lot size, along with MHI. Additionally, categorical statistics for multiple criteria such as land use distribution by MHI and lot size by land use type are estimated.

4. Develop a sample set of properties that resemble statistical distributions—To estimate average impervious cover by land use, a representative sample set is needed. The EFC tested several methods, including using a spatially randomized selection of properties and other methods. The chosen method involved selecting properties with a street address ending in the number "1" because it yielded a useful sample that reasonably resembled property-level distributions. The approach constituted approximately a 10 percent sample of properties in a municipality. For instance, in Paso Robles, CA, which has nearly 12,000 properties, approximately 1,000 properties have street addresses that end in the number "1." The data for these properties was extracted and exported for further analysis.

5. Assess impervious surface cover statistics for the sample set of properties—With a sample set assembled, Google Earth and Google Street View imagery can be used to assess impervious surface cover for each property in the sample sets. Google Earth software provides an embedded tool for measuring area, which can be used to assess the area of rooftops, sidewalks, and driveways on a property. In Paso Robles, once the full dataset was populated with property-level assessments of impervious surface area (in square feet), this value was divided by the lot size reported in parcel data to yield the percentage of impervious surface cover. The average imperious surface cover

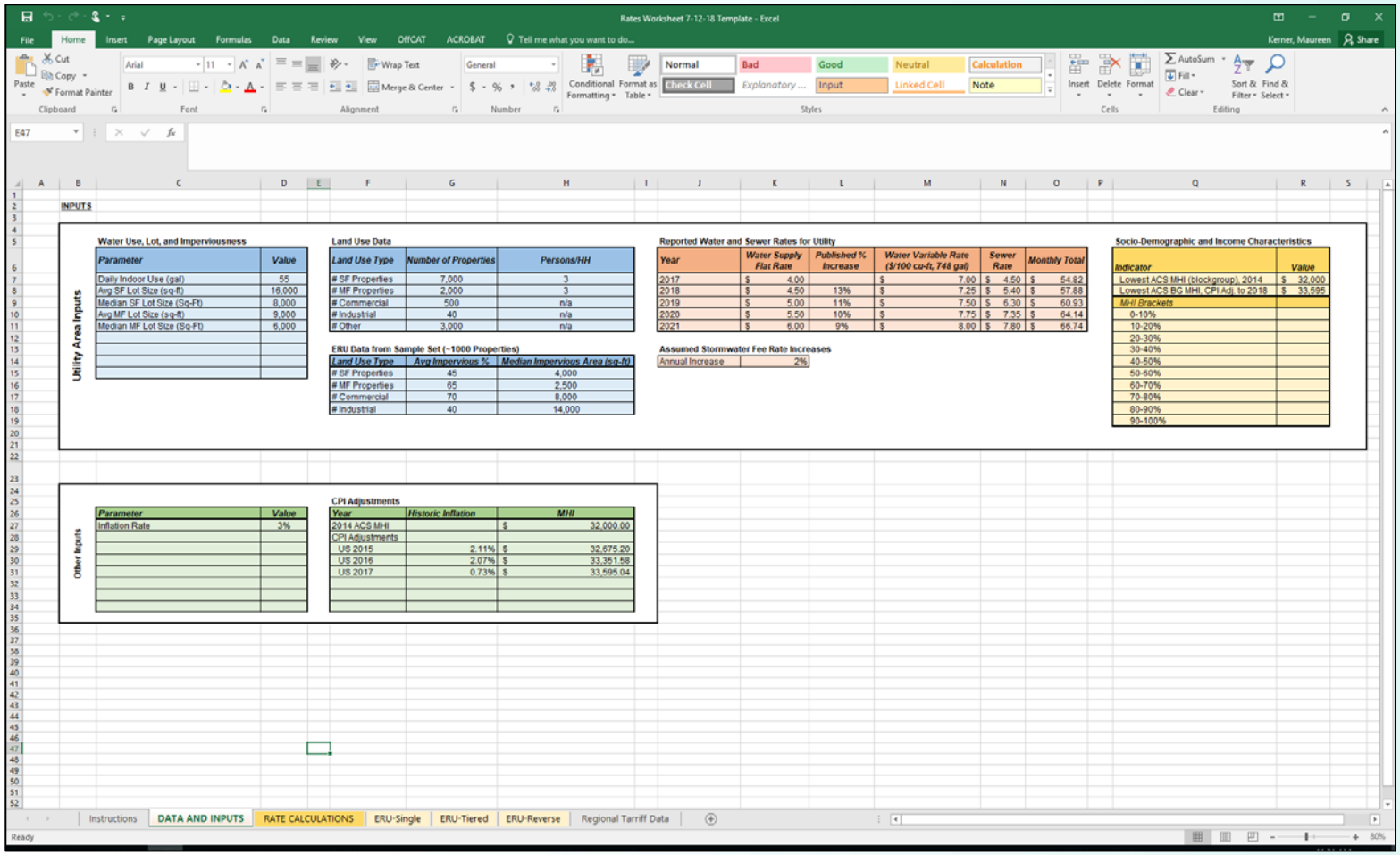
across land use types was recorded, which fed into analysis tools currently under development for devising rate structures and assessing associated equity effects.

The EFC toolkit includes a rate structure workbook that allows municipal program managers to assemble and assess the data for developing rate structures. Further discussion on the workbook is provided in the section *Identifying a Preferred Rate Structure*. Table 8 lists the various datasets that are needed for the entire EFC rate structure methodology, including property and census data as well as the asset inventory and cost estimates discussed previously.

Table 8 Datasets needed for asset management and rate structure development

Dataset	Description	Purpose
Asset inventory	Database of stormwater system assets and characteristics	Developing a plan for maintenance scheduling and renewal costs
Stormwater system and program costs	Unit and programmatic costs for stormwater management activities, including inspections, maintenance, and permit compliance requirements	Estimating total costs that must be covered by the incoming revenue portfolio
Property boundaries and assessor data	Geospatial layer of parcel boundaries in the utility service area, and associated tax roll data for land use, lot size, and other characteristics	Analyzing imperviousness (average or per property) used to develop a rate structure
US Census block group data	American Community Survey data for socio-demographic and economic characteristics	Assessing affordability impacts of rates through socio-economic information
Impervious surface cover	The percentage of impervious surface cover for various land use types properties	Calculating average or parcel-specific imperviousness required for several types of stormwater fees

These procedures were field-tested in coordination with several California communities as part of EFC projects. However, such data analysis can be too costly and time consuming for communities. To address this challenge, as of June 2018, the EFC began assessing the potential to create an open-source, statewide dataset with parcel-level assessments of impervious surface cover, which could support rate structures based on either parcel-specific assessments or the ERU methodology. That work is on-going, and the assessments of impervious surface cover in sample sets for each of the municipalities is serving as a training data set to assess the accuracy of automating methods to create statewide datasets.



INPUTS

Utility Area Inputs

Water Use, Lot, and Imperviousness

Parameter	Value
Daily Indoor Use (gal)	55
Avg SF Lot Size (sq-ft)	16,000
Median SF Lot Size (Sq-Ft)	8,000
Avg MF Lot Size (sq-ft)	9,000
Median MF Lot Size (Sq-Ft)	6,000

Land Use Data

Land Use Type	Number of Properties	Persons/HH
# SF Properties	7,000	3
# MF Properties	2,000	3
# Commercial	500	n/a
# Industrial	40	n/a
# Other	3,000	n/a

ERU Data from Sample Set (~1000 Properties)

Land Use Type	Avg Impervious %	Median Impervious Area (sq-ft)
# SF Properties	45	4,000
# MF Properties	65	2,500
# Commercial	70	8,000
# Industrial	40	14,000

Reported Water and Sewer Rates for Utility

Year	Water Supply Flat Rate	Published % Increase	Water Variable Rate ($/100 cu-ft, 748 gal)	Sewer Rate	Monthly Total
2017	$ 4.00		$ 7.00	$ 4.50	$ 54.82
2018	$ 4.50	13%	$ 7.25	$ 5.40	$ 57.88
2019	$ 5.00	11%	$ 7.50	$ 6.30	$ 60.93
2020	$ 5.50	10%	$ 7.75	$ 7.35	$ 64.14
2021	$ 6.00	9%	$ 8.00	$ 7.80	$ 66.74

Assumed Stormwater Fee Rate Increases

Annual Increase	2%

Socio-Demographic and Income Characteristics

Indicator	Value
Lowest ACS MHI (blockgroup), 2014	$ 32,000
Lowest ACS BG MHI, CPI Adj. to 2018	$ 33,595
MHI Brackets	
0-10%	
10-20%	
20-30%	
30-40%	
40-50%	
50-60%	
60-70%	
70-80%	
80-90%	
90-100%	

Other Inputs

Parameter	Value
Inflation Rate	3%

CPI Adjustments

Year	Historic Inflation	MHI
2014 ACS MHI		$ 32,000.00
CPI Adjustments		
US 2015	2.11%	$ 32,675.20
US 2016	2.07%	$ 33,351.58
US 2017	0.73%	$ 33,595.04

Figure 7 Screen shot of EFC data and inputs worksheet for developing a rate structure

Developing Low-Income Assistance Discounts and Credits

Municipalities can offer a variety of discounts and credits to mitigate the impact of fees on low-income households. Discounts provide assistance based on financial need, while credit programs incentivize building owners to undertake infrastructure improvements on properties that reduce stormwater runoff and contaminants.

Low-income assistance programs offer relief to offset the costs of fees, charges, and taxes. They are targeted at households who experience a more significant impact of fees as a percentage of their income. As such, eligibility is usually tied to a total combined annual household income and number of household members. For instance, the low-income credit assistance program developed by California Water Services Co. (Cal Water) provides a discounted fee to households meeting income eligibility requirements. The income threshold increases with household size. Many credit programs across water and electric utilities have similar structures.

Maximum Household Income (effective June 1, 2017–May 31, 2018)

To be eligible for Low-Income Rate Assistance, your household's gross annual income may not exceed:

Household Size	Total Combined Annual Income
1-2	$32,920
3	$41,560
4	$50,200
5	$58,840
6	$67,480
7	$76,120
8	$84,760

(Add $8,640 for each additional household member)

Figure 8 Low-income credit program eligibility scale (Cal Water 2018)

The assistance that eligible households receive can take many forms (Table 9). For instance, assistance could be exemptions from certain charges, a decreased percentage of a fixed rate charge on a bill, or a lump-sum credit (monthly or annual) provided to households to offset the billed costs of services. Ratepayers typically submit supporting documentation, such as a previous tax return, to demonstrate eligibility.

Another option for providing income-based relief in the water sector is to include a "zero-rate" style exemption. In this structure, a tier or specific type of customer or property is charged at a zero rate, or is

essentially free. As an example, communities could choose to only assess commercial and industrial properties with stormwater fees, using the assumption that these properties disproportionately contribute to stormwater runoff. Utilities could also apply fees to all residents and properties, but have a lower tier whose zero charge attempts to reduce cost burdens for vulnerable populations while providing a baseline amount for health and safety. This is more often used in other sectors such as electricity or water supply, where there is an assumption of an inherent connection between the volume of consumption of a resource and income. Medium- and high-income households that consume more than the base amount needed for subsistence would pay more through the rate structure. The approach provides an easy-to-implement subsidy, though it may not be entirely applicable to stormwater. Table 9 compares zero-rate and income-based options for credits and discounts.

Utilities, however, must compensate for the revenue lost by low-income assistance programs. They can accomplish this by raising fees in other rate tiers or including a fixed charge for low-income assistance. One innovative mechanism is to have an opt-in program, where ratepayers contribute to the fund voluntarily. As an example, a water supply utility in North Carolina used an opt-in program to support a low-income assistance fund (EPA 2016). The program provided rate payers an opportunity to round up their bills to the nearest dollar, with the balance between the billed amount and the collected amount going into the assistance fund.

Many communities offer credits to rate payers for stormwater management-related activities that are not income-based. For example, a residence with disconnected roof downspouts could receive a 25 percent discount on their fee. The installation of a properly constructed rain garden could reduce the fee by a percentage equivalent to the estimated percent capture based on size. Other actions to reduce impervious surface cover and connections to runoff infrastructure, especially on properties with significant areas of imperviousness, can be included for one-time or continual discounts. Total discounts should be limited to something less than 100 percent of the total fee. However, as NPDES compliance costs will exist even if all properties demonstrate 100 percent containment of stormwater.

Identifying a Preferred Rate Structure

The process of identifying a set of promising rate structures is iterative. Ideally, generated revenue would cover total costs. When it does not, alternative funding sources need to be identified.

The enacting governing body, such as a city council or county board of supervisors, must ultimately decide if a proposed tax or assessment structure is fair and appropriate. Comparisons with nearby communities can help gauge the feasibility and equity of a rate structure.

Table 9 Categories of income-based assistance for ratepayers

Option	Summary	Advantages	Disadvantages	Notes
Zero-rate	No residential unit is charged stormwater fees, regardless of income or household size. Higher tiers will be charged a positive rate. Benefits inversely proportional to income.	No expenditures for administration, public outreach, or law enforcement for residential eligibility. Easier to calculate and forecast revenue from commercial and industrial properties.	Would not proportionally benefit low-income households with respect to household size. Non-residential units would pay full amount. May not generate sufficient revenue. Residents use public infrastructure (roads) that contribute to stormwater runoff, but would not pay.	Fees focus on commercial and industrial properties, assuming these properties are the greatest contributors to contamination.
Zero-rate tier	In a tiered stormwater rate structure, the bottom tier (for instance up to 1,000 ft^2 of area) is assessed at a zero rate. Assumes that lower-income households would have smaller properties. Could be implemented in only low-income areas.	May be easier for utilities to implement. Allows an across-the-board credit that would be especially helpful to lower-income residents with small or no property.	Would not allocate assistance appropriately if low-income residents had larger properties.	This approach is more common in sectors where consumers are charged for consumption, such as electricity or water supply.
Income-based exemption or credit	Ratepayers demonstrate eligibility and apply to program. After review and approval, lower bills or end-of-year credit is given to the ratepayer.	Targets relief to low-income ratepayers, accounts for household size, and scales benefits to income level.	Requires resources to manage program, inform low-income ratepayers, and deal with legal appeals to application denials. Would need annual applications to account for fluctuating annual income. Potentially less political support.	Eligibility may be assessed based on enrollment in another low-income credit assistance program.

The EFC surveyed some existing stormwater fee and assessment structures in California. The results are available through the California Stormwater Quality Association (CASQA) Stormwater Funding Resource Portal. The portal also includes a table of existing stormwater fees and taxes in California. Additionally, Western Kentucky University regularly publishes a survey of existing stormwater fees from across the US, providing background information on rate structure approaches and a detailed appendix of historic stormwater fees (Campbell et al 2018).

Finally, assessments of feasibility also require public input. In some communities, voters directly approve municipal revenue-generating proposals, so any rate structure must be capable of gaining political support. All of these considerations must be taken into account when selecting one or more preferred rate structures.

The EFC toolkit supports the iterative process of identifying viable rate structures. After collecting and analyzing the relevant information on community characteristics and existing infrastructure, the rate structure workbook allows a user to input varying fee amounts and assess the associated amount of revenue that could be generated, or use the opposite procedure to derive rates from a preferred amount of total revenue. The estimated program costs for permit compliance, existing management, and future buildouts can be directly compared to revenue estimates from the rate structure workbook, providing a basis for discussion among utility managers and municipal leaders regarding expectations for the stormwater program.

G. Determining the Funding Gap and Additional Funding Options

If the total annual program costs are more than the final annual utility revenue, municipal managers need to explore additional revenue and financing options to bridge the funding gap. Many of these options were highlighted in Section 2.

Potential options all provide funds for projects, but not all are revenue. Funding sources such as sales taxes are revenue-producing, that is, they generate revenue for the municipality. Bonds and loans with interest, however, are financing mechanisms. They can be effective ways to generate capital that pays for projects, but regular bond payments must be paid over the term of the debt via revenue-producing sources. Various options for raising revenues are detailed in this section.

RATES ANALYSIS: Based on an Equivalent Residential Unit of Imperviousness (Single Rate)

6/27/2018

CSUS Office of Water Programs
Environmental Finance Center

ERU Structure

Tiers (Changes by Property Type)	# of SF Properties	# of MF Properties	Commercial	Industrial
1 ERU	4000	700	700	5
2 ERUs	2000	800	200	1
3 ERUs	1000	300	500	25

PROGRAM REVENUE PROJECTIONS*

	Year	1	2	3	4	5	
Residential	Estimated Charge (based on 55 gpd indoor, sewer)	$ 54.82	$ 57.88	$ 60.93	$ 64.14	$ 66.74	
	Stormwater Tarriff (1 ERU)	$ 2.15	$ 2.19	$ 2.24	$ 2.28	$ 2.33	<< Input Decision Variable
	Monthly Bill Estimate (w/ reported rate increases)	$ 56.97	$ 60.07	$ 63.17	$ 66.42	$ 69.07	
	Annual Bill Estimate (w/ reported rate increases)	$ 684	$ 721	$ 758	$ 797	$ 829	
	Subtotal: Revenues from SF Properties	$ 283,800	$ 289,476	$ 295,266	$ 301,171	$ 307,194	
	Subtotal: Revenues from MF Properties	$ 82,560	$ 84,211	$ 85,895	$ 87,613	$ 89,366	
Commercial & Mixed Use	*Subtotal: Revenues from Comm-MU Properties*	$ 67,080	$ 68,422	$ 69,790	$ 71,186	$ 72,610	
Industrial	*Subtotal: Revenues from Industrial Properties*	$ 2,116	$ 2,158	$ 2,201	$ 2,245	$ 2,290	
TOTALS	STORMWATER PROGRAM REVENUE	$ 435,556	$ 444,267	$ 453,152	$ 462,215	$ 471,459	

TOTALS ACROSS ERU CATEGORIES

	Year	1	2	3	4	5
SF Residential	Subtotal: ERU Tier 1	$ 103,200.00	$ 105,264.00	$ 107,369.28	$ 109,516.67	$ 111,707.00
	Subtotal: ERU Tier 2	$ 103,200.00	$ 105,264.00	$ 107,369.28	$ 109,516.67	$ 111,707.00
	Subtotal: ERU Tier 3	$ 77,400.00	$ 78,948.00	$ 80,526.96	$ 82,137.50	$ 83,780.25
MF Residential	Subtotal: ERU Tier 1	$ 18,060.00	$ 18,421.20	$ 18,789.62	$ 19,165.42	$ 19,548.72
	Subtotal: ERU Tier 2	$ 41,280.00	$ 42,105.60	$ 42,947.71	$ 43,806.67	$ 44,682.80
	Subtotal: ERU Tier 3	$ 23,220.00	$ 23,684.40	$ 24,158.09	$ 24,641.25	$ 25,134.07
Commercial & Mixed Use	Subtotal: ERU Tier 1	$ 18,060.00	$ 18,421.20	$ 18,789.62	$ 19,165.42	$ 19,548.72
	Subtotal: ERU Tier 2	$ 10,320.00	$ 10,526.40	$ 10,736.93	$ 10,951.67	$ 11,170.70
	Subtotal: ERU Tier 3	$ 38,700.00	$ 39,474.00	$ 40,263.48	$ 41,068.75	$ 41,890.12
Industrial	Subtotal: ERU Tier 1	$ 129.00	$ 131.58	$ 134.21	$ 136.90	$ 139.63
	Subtotal: ERU Tier 2	$ 51.60	$ 52.63	$ 53.68	$ 54.76	$ 55.85
	Subtotal: ERU Tier 3	$ 1,935.00	$ 1,973.70	$ 2,013.17	$ 2,053.44	$ 2,094.51
TOTALS	Total revenue (should match above)	$ 435,556	$ 444,267	$ 453,152	$ 462,215	$ 471,459

HOUSEHOLD AFFORDABILITY**

	Analysis of Household Affordability					
Blockgroup with Lowest MHI (Most Vulnerable)	*Associated MHI Threshold for Total Monthly Bill*					
	1%	$ 68,368.24	$ 72,085.13	$ 75,803.06	$ 79,702.03	$ 82,882.09
	2%	$ 34,184.12	$ 36,042.56	$ 37,901.53	$ 39,851.02	$ 41,441.04
	Annual Expense of 2018-Adjusted MHI Threshold ($35,432)					
	1%	$ 346.03	$ 356.11	$ 366.19	$ 376.26	$ 386.34
	2%	$ 692.06	$ 712.21	$ 732.37	$ 752.53	$ 772.69
	Disparity					
	1%	$ 337.65	$ 364.74	$ 391.84	$ 420.76	$ 442.48
	2%	n/a	$ 8.64	$ 25.66	$ 44.49	$ 56.13

* Based on nominal costs (in that year) of rates using published rate increases and no additional inflation considerations
** Based on nominal values of Median Household Income values in each year using 3% inflation rate

Figure 9 Screen shot of EFC rate structure worksheet

Revenue Sources

1. Local development and realignment fees—Municipalities directly charge developers a variety of fees for new connections to existing systems, inspection and permitting activities, reviewing site plans, mitigation and impact assessments, and other activities.
2. State government grant programs—While the federal government has limited money available for stormwater-related grants, some states provide grant programs for specific tasks related to stormwater management. For instance, in California, the Integrated Regional Water Management Grant program offers grants for watershed management activities, and the Stormwater Grant Program offers grants to municipalities for municipal stormwater infrastructure. The grant programs are funded through general funds or other sources. They often require a match from communities of revenue or in-kind contributions such as time and labor. Some federal and state grant programs fund specific tasks related to stormwater permit compliance (NPDES activities) or environmental cleanup. Others, such as the Clean Water Act's 319(h) Nonpoint Source (NPS) Grant Program funds activities, monitoring, and outreach for nonpoint sources.
3. Local option sales taxes—In some jurisdictions, special-purpose sales taxes have been enacted with revenues earmarked for a specific task such as developing stormwater infrastructure. In 2016, the Los Angeles region of California passed Measure M designating $860 million of annual revenue from a $0.05 sales tax to transportation projects.
4. Designated special district fees—Some states have various types of "special districts" that are approved to fulfill a designated purpose, such as managing stormwater infrastructure, and have taxable authority within a jurisdiction. In California, benefit assessment districts (created in 1982) provide authority to local governments and other entities to finance municipal infrastructure and operations. The advantage of a special district is that costs and responsibilities are spread over the entire area where the management need exists, not just within existing jurisdictions and cities.

Financing Sources

1. Bonds—Municipalities and states regularly use bonds to finance infrastructure development. Through bonds, governments raise revenue and agree to pay back the fronted cost of capital over time with interest. Therefore, bonds (and loans) do not truly fill funding gaps. Instead, they transfer costs to the future. A variety of bonds are relevant for stormwater infrastructure development, including general obligation bonds, popularly-approved bond propositions (especially in California), "green bonds" that are designated specifically for projects with environmental benefits, and "environmental impact bonds" that assemble public and private partners to build and maintain systems over time to meet water quality goals.
2. Federal and state loan programs—The Clean Water State Revolving Fund is an example of a federal-state loan program that provides an application-based source of capital for building

projects. Loans must be paid back over time. In many states, federal and state funds both contribute to monies available for distribution.

The availability of options varies across states, depending on local legislative acts that provide additional mechanisms of authority to unilaterally or jointly raise funds and implement taxes. A number of resources currently exist that provide significant detail on these options. The EPA hosts the Water Finance Clearinghouse with a repository of qualitative and quantitative information on funding water infrastructure in the US. In 2018, the California State Water Resources Control Board released a document describing existing stormwater funding options especially relevant for California (STORMS 2018). Additionally, as noted, in late 2018, CASQA released a Stormwater Funding Resource Portal that includes current grant and load funding opportunities. The CASQA Stormwater Funding Portal is available at: https://www.casqa.org/resources/funding-resources.

Stormwater-related projects can be cooperatively funded by other agencies or municipal departments based on identified mutual benefits for contributors. Some example projects include investing in capture and use infrastructure, using stormwater to maintain minimum sewer flows, installing trash capture devices, and performing street sweeping.

Finally, if all funding options have been exhausted, funding gaps may be bridged by lowering the LOS and associated stormwater program annual cost. Similar to determining a reasonable CPH, this process can be iterative. Several versions may be necessary to achieve a satisfactory LOS at an acceptable cost.

H. Public Education and Outreach

Ultimately, a stormwater financing plan that includes taxes or fees will need public support and approval. In California, because stormwater parcel taxes are considered to be local taxes subject to the Proposition 218 approval process, public support is necessary.

Public engagement throughout the asset management and finance plan development processes will improve and shape the outcomes. Informing the public of how funds will be spent and long-term plans for financial management will foster confidence that public agencies can responsibly manage new revenues. Once a rate structure is proposed and approved for adoption or public ballot by local leaders, municipalities have a responsibility to inform the public. For voter-approved processes in California, municipalities are required by law to inform residents and/or property owners of a pending ballot measure in advance of voting.

While cities themselves cannot advocate for a voter ballot measure in California, they do have the responsibility to educate voters. Moreover, anecdotal evidence suggests that outreach efforts that solicit input among stakeholders and interested community groups often help foster champions, who rally support, funding, and publicity for the cause as elections approach. Thus, public engagement activities

undertaken earlier in the process can usefully feed into the necessary public education requirements that are part of voter-approved ballot measures.

The methods described above and in the EFC toolkit are intended to provide program managers a starting point to develop a preliminary financing plan that can be shared and used to begin informed conversations. A master plan that details infrastructure needs, current and future spending projections, and plans for equitably distributing revenue is an important, if not essential, product for communicating needs with stakeholders and the public.

Public information programs can be used to facilitate public support. The goal of such programs is to educate community leaders, decision-makers, and the public about the need for stormwater fees and the community benefits of adequately funded stormwater programs. Elements of this program include public meetings, informational pamphlets, a website, and an advisory committee (EPA 2009). The City of Palo Alto, CA—who approved a stormwater utility in 2017—provides a good example of communicating stormwater fee needs, planning, and community outreach using web pages, shown in Figure 10 and available at https://www.cityofpaloalto.org/news/displaynews.asp?NewsID=3679.

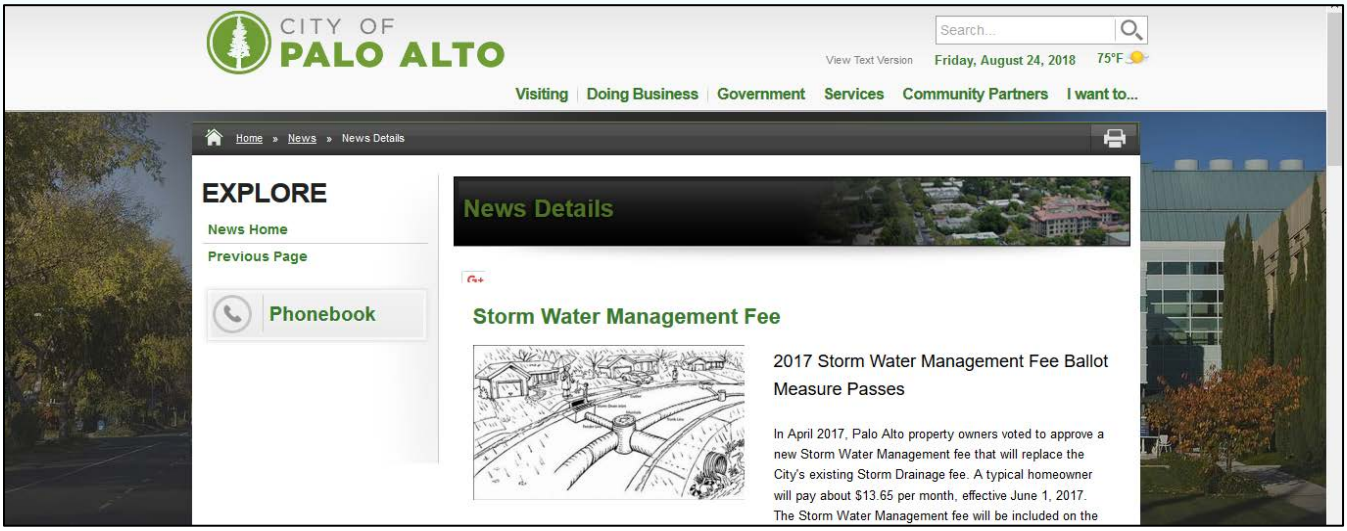


Figure 10 City of Palo Alto stormwater fee process web page

4. Toolkit Preview

The Sacramento State EFC stormwater asset management and funding toolkit consists of three workbook templates to support development of a stormwater utility fee:

1. Asset Inventory Workbook
2. Total Costs Workbook
3. Rate Structure Analysis Workbook

The workbooks and associated contents were highlighted throughout Section 3, and are summarized below. The workbooks were created to support step-by-step procedures. They generally fit together as shown in Figure 11. Each workbook has an "Instructions" tab with more details.

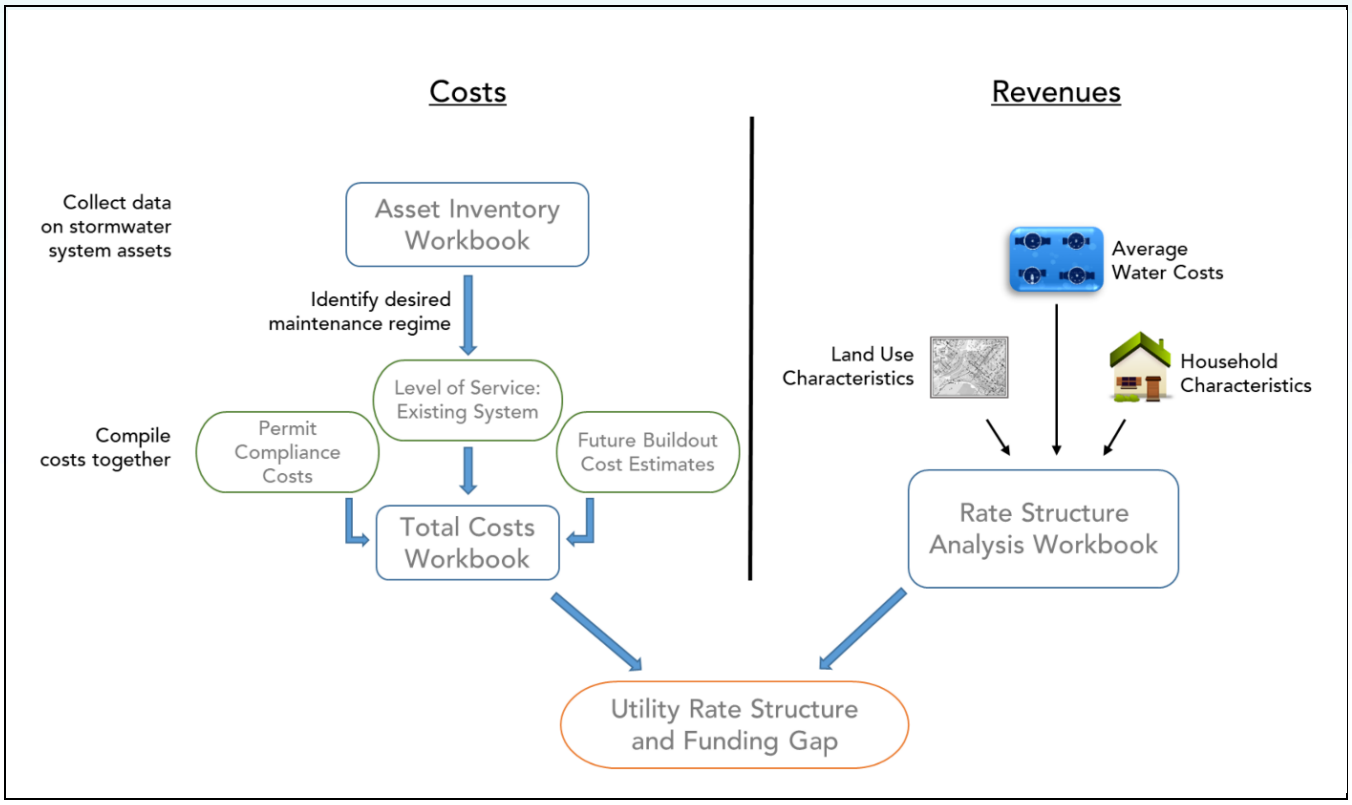


Figure 11 Content and flow of the EFC stormwater financing toolkit

A. Asset Inventory Workbook

The asset inventory workbook aims to list all assets and relevant information to prioritize the assets for maintenance and replacement. The information entered in and calculated by the asset inventory workbook can be used to develop O&M schedules and then cost estimates. The workbook includes the following worksheets:

- Instructions—Descriptions of how to use the workbook.
- Asset inventory—Table listing each asset and various characteristics that are used to calculate POF and COF scores, which in turn are used to prioritize assets for maintenance and replacement.
- Multi-factor COF—Table recording asset characteristics such as proximity to floodplains, buildings, or contaminated soils, than can be used to quantify a COF score. Alternatively, a single factor COF quantitative measure (ranging negligible to severe) can be selected on the asset inventory worksheet to calculate the COF score, making the multi factor COF worksheet unneeded.
- Prioritization—Table summarizing and sorting the assets and characteristics by a combined POF and COF score.
- References—Tables summarizing assumptions and values used in lookup functions in the asset inventory and multi-factor COF worksheets.

B. Total Costs Workbook

The total costs workbook computes an annual sum of O&M costs for existing assets, permit compliance activities, and future infrastructure.

The total costs workbook includes the following worksheets:

- Instructions—Descriptions of how to use the workbook.
- Summary—Table summarizing costs entered and calculated in other worksheets for O&M of existing assets, permit compliance, and future buildout. Costs for future O&M and permit compliance activities are also presented and projected using an inflation factor entered on the inputs worksheet.
- Inputs—Placeholders for manually entered data such as the assumed inflation factor for projecting future costs and year of initial cost estimates.
- O&M costs for existing assets—Table summarizing costs for O&M of existing assets based on a defined LOS and the associated cost estimates from the following worksheets:
    - LOS summary template—Table summarizing O&M activities and costs for various asset categories and LOS

    - Grand Rapids LOS summary example—The LOS summary template populated using information from the City of Grand Rapids, MI, *Stormwater Asset Management and Capital Improvement Plan*.
    - Detailed costs template—Tables detailing specific costs (labor, material, etc.) for O&M activities used to tabulate costs in the LOS summary template.
- Permit costs summary—Table of costs for permit compliance activities, based on detailed cost estimates from the following worksheets:
    - Permit Category 1 costs—Costs for construction site stormwater control compliance
    - Permit Category 2 costs—Costs for illicit discharge detection and elimination compliance
    - Permit Category 3 costs—Costs for industrial and commercial management compliance
    - Permit Category 4 costs—Costs for pollution prevention in municipal operations
    - Permit Category 5 costs—Costs for post-construction stormwater permit compliance
    - Permit Category 6 costs—Costs for public education, outreach, involvement, and education
    - Permit Category 7 costs—Costs for water quality monitoring
    - Permit Category 8 costs—Costs for overall stormwater program management
    - Permit Category 9 costs—Costs for long-term planning (e.g., TMDL compliance or watershed management collaboration)
- Future buildout costs—Table summarizing costs of projects to be constructed in the future.

C. Rate Structure Analysis Workbook

The rate structure analysis workbook includes a generalized method for quantifying the potential revenue from implementing flat fee or equivalent residential unit (ERU) assessments for a community. It aggregates several data sets, which must be collected:

- Land use and parcel data in a municipality
- Estimates of household income
- Existing household costs for water and wastewater utility services

The rate structure analysis workbook includes the following worksheets:

- Instructions—Descriptions of how to use the workbook
- Data and inputs—Tables recording the following:
    - Water use, property sizes, and imperviousness data
    - Land use data
    - Water and sewer utility rates
    - Inflation rates
    - Assumed stormwater fee increases

- ERU-single—Tables that project potential revenue for ERU single rate assumptions entered by the user and calculate the percent of MHI as a measure of affordability
- ERU-tiered—Tables that project potential revenue for ERU tiered rate assumptions entered by the user and calculate the percent of MHI as a measure of affordability
- ERU-reverse—Tables that calculate an ERU based on required revenue
- Regional tariff data—Tables summarizing stormwater utility fees and rate structures implemented by various municipalities in the US

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