STORM WATER INFRASTRUCTURE ASSETS LIFE CYCLE MANAGEMENT

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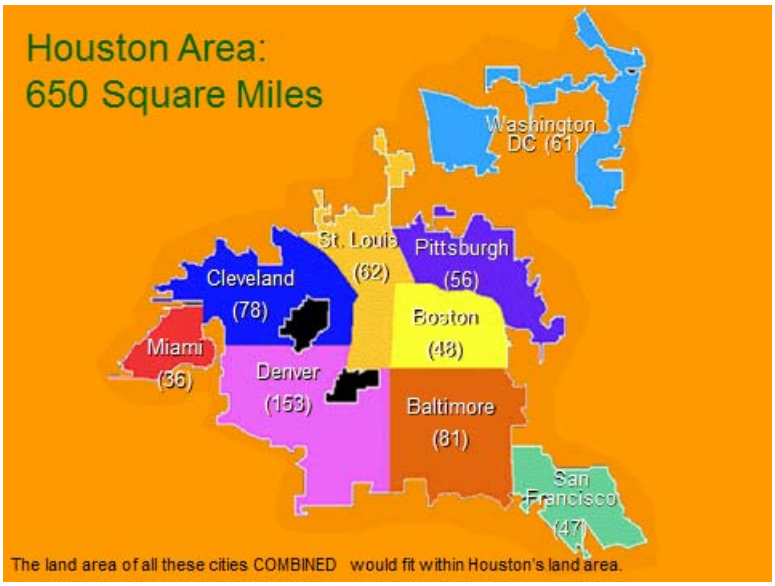
Introduction

The City of Houston storm water system provides rainfall event runoff conveyance for the 650+ square miles of the contiguous City area.[i]

The storm water system infrastructure is comprised of the following categories of asset: [ii]

- 4,300+ Miles of Road Side Ditches
- 3,500+ Miles of Storm Gravity Mains (underground conduits)
- 110,000+ Storm Drainage Inlets (primarily along streets with curbs)
- 76,000+ Storm Water Manholes
- 62+ Miles of Off-Road (Major) Drainage Ditches
- 15 Storm Water Detention Basins



Objectives

The primary objective of the Storm Water Maintenance Branch is to inspect, maintain, and repair existing storm water system infrastructure to assure that the existing system provides the level of drainage protection for which it was designed—maintain the flow of storm water free of debris and foreign objects. [iii]

Infrastructure Assets Life Cycle Management

a. Infrastructure Asset Management Defined

Storm water system infrastructure asset management can be defined as:

Managing infrastructure capital assets to minimize the total cost of owning and operating them, while delivering the service levels customers desire. [iv]

b. Purpose of Infrastructure Asset Management [v]

Inadequate focus on operations and maintenance results in a reactive mode of infrastructure management, with most of the operational resources allocated to emergency response and rehabilitation or replacement of failed components.

Each municipal or regional storm water system owner is responsible for making sure that its system stays in good working order—regardless of the age of components or the availability of additional funds.

Asset management programs with long-range planning, life-cycle costing, proactive operations and maintenance, and capital replacement plans based on cost-benefit analyses can be the most efficient method of meeting this challenge.

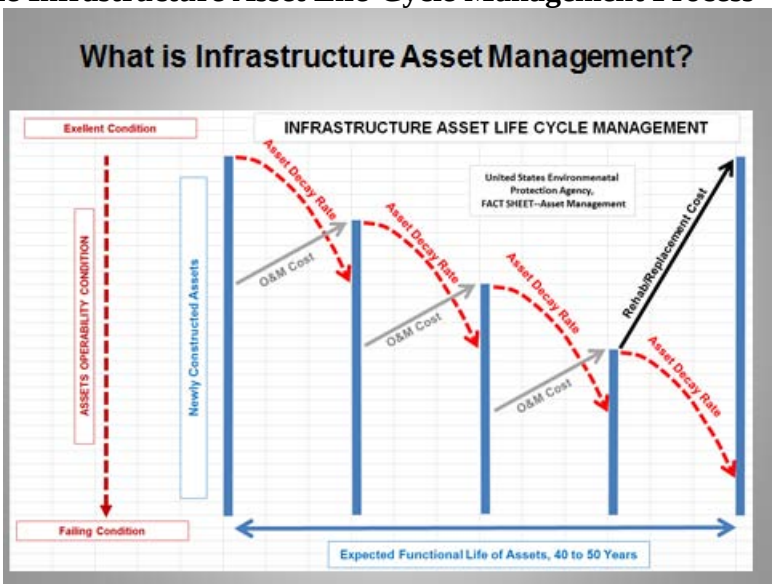
Asset management provides:

- Making sure components are protected from premature failure through proper operations and maintenance.
- Facilitating proactive capital improvement planning and implementation over longer cycles to reduce annual operating costs and overall (operating and capital) costs.
- Reducing the cost of new or planned investments through economic evaluation of options using life-cycle costing and value engineering.
- Focusing attention on **results** by clearly defining responsibility, accountability, and reporting requirements within the organization.

c. Management Planning and Control Required for Asset Management [vi]

Asset management is a **continuous process** that guides the acquisition, use, and disposal of infrastructure assets to optimize service delivery and minimize costs over the asset's entire functional life.

Figure 1—The Infrastructure Asset Life-Cycle Management Process



An infrastructure asset is any long-lived capital asset that is operated as a system or network—storm water conveyance system.

Key elements of asset management are:

- Level of service definition
- Selection of performance goals

- Information system
- Asset identification and valuation
- Failure impact evaluation and risk assessment
- Condition assessment
- Rehabilitation and replacement planning
- Capacity assessment and assurance
- Maintenance analysis and planning
- Financial management

Continuous improvement

These elements should be implemented by everyone in the organization, involving management, financial, engineering, administrative, and field work.

d. **Categories of asset life cycle management** includes operation and maintenance of the storm water infrastructure comprised of three major categories of types of processes:

Asset inspection/planning

Determine asset service level capability; Analyses and planning to identify and prioritize operation and maintenance activities.

Maintenance

Clear, clean, and/or repair portions of the storm water system which have site conditions which impair the ability of the system component assets to convey storm water.

Obsolescence renewal

Replaces each year at least the minimum estimated portion of the complete storm water system which exceeds its functional life.

e. **Infrastructure asset management for financial reporting** has been encouraged of all municipalities over 100,000 population since 2005.

In recognition that municipalities historically have not adequately utilized full accrual accounting principles in managing their infrastructure assets, the Government Accounting Standards Board (GASB) issued GASB Statement No. 34. The goal of Government Accounting Standards Board (GASB) Statement No. 34 is to help public works departments go from the traditional dire-need maintenance approach to one of preventive maintenance and renewal using the modified accounting approach. [vii]

For municipalities to utilize the modified (infrastructure asset accounting) approach, **it is required for the municipality to establish a system to manage infrastructure assets and standard operating procedures**.

These GASB procedures (using the modified approach) are to establish a minimum condition level at which the infrastructure network is maintained.

At least once every three years, you must inspect and rate the entire network to see if you are meeting or exceeding your established minimum condition goals.

If a municipality uses the modified (asset accounting) approach, it must utilize standardize inspection procedures and tracking and reporting processes.

All of this can be built into one management system that incorporates asset inventory-inspection systems for capital assets with a work order management system.

- **An infrastructure asset life cycle management system.**

Storm water drainage systems are long-lived assets that do not literally get replaced, but rather are periodically rehabilitated to maintain a certain quality and condition over a long period of time.

Therefore it does not make sense to depreciate (the alternative fixed asset accounting method) the value of storm water assets over time to a potential zero book value since these assets are never replaced, are always in service, and are providing our community with serviceability and value. (Reference Figure 1—The Infrastructure Asset Life-Cycle Management Process).

Full accrual accounting **reflects the life cycle costs** necessary to adequately operate and maintain the storm water system infrastructure.

Infrastructure Assets Inspection, Analyses, and Planning

Optimizing the cost-effective operability of the storm water infrastructure system throughout its expected functional life involves:

- **Inventory**

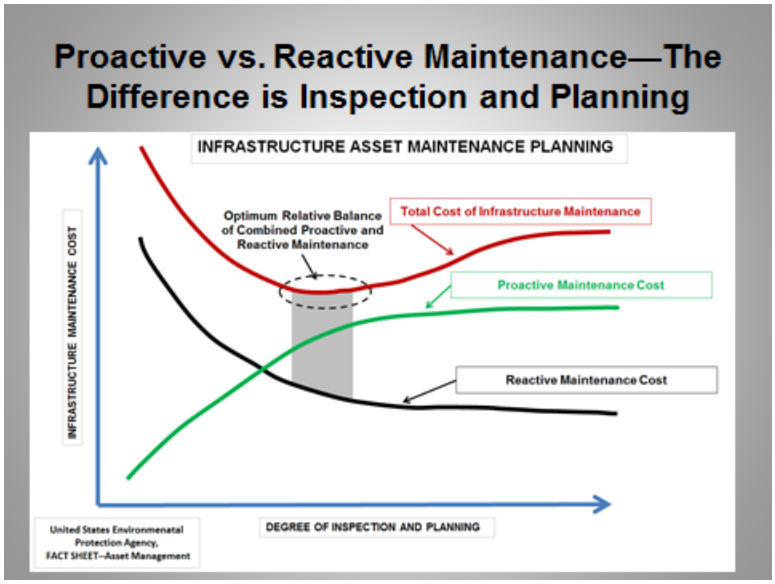
Inventory of the storm water system assets (quantify the assets comprising the complete system)

- **Condition assessement and operability gap analysis**

Service Level operability determination of the asset sub-systems—GAP analysis of the expected functional operability of system components compared to evaluated actual condition of the system components—Gap Analysis of asset operability

- **Closing the gap**

Determination and implementation of management options for “bridging the Gap” between expected Service Level and actual determination of asset service level condition (optimizing the cost-effective execution of maintenance, repair, and replacement over the functional life of the assets)



Reactive maintenance will always be required to some extent since all pending asset failures cannot be identified a priori. [viii]

However, if only reactive maintenance (repair at failure) is used; the costs of maintenance repairs are higher due to emergency response costs.

Asset management is intended to maintain storm water system components over long planning cycles, and finally replaced when deterioration outweighs the benefit of further maintenance—**Costs are distributed over the life of the asset.**

Necessary Management Information for Asset Management

Management Information Systems, including Geographic Information Systems (GIS), needed to utilize Infrastructure Asset Management include:

- Accurate system maps identifying pertinent storm system component assets
- Data related to system capacity and system inspections
- Inventory of system assets and condition
- Records of preventive operation and maintenance activities
- Schedules and budgets for routine operations and maintenance activities and planned rehabilitation and replacement projects

The US Army Corps of Engineers owns and operates over 690 flood control and navigation structures. The program is led nationally through the USACE headquarters office and executed by 41 District offices.

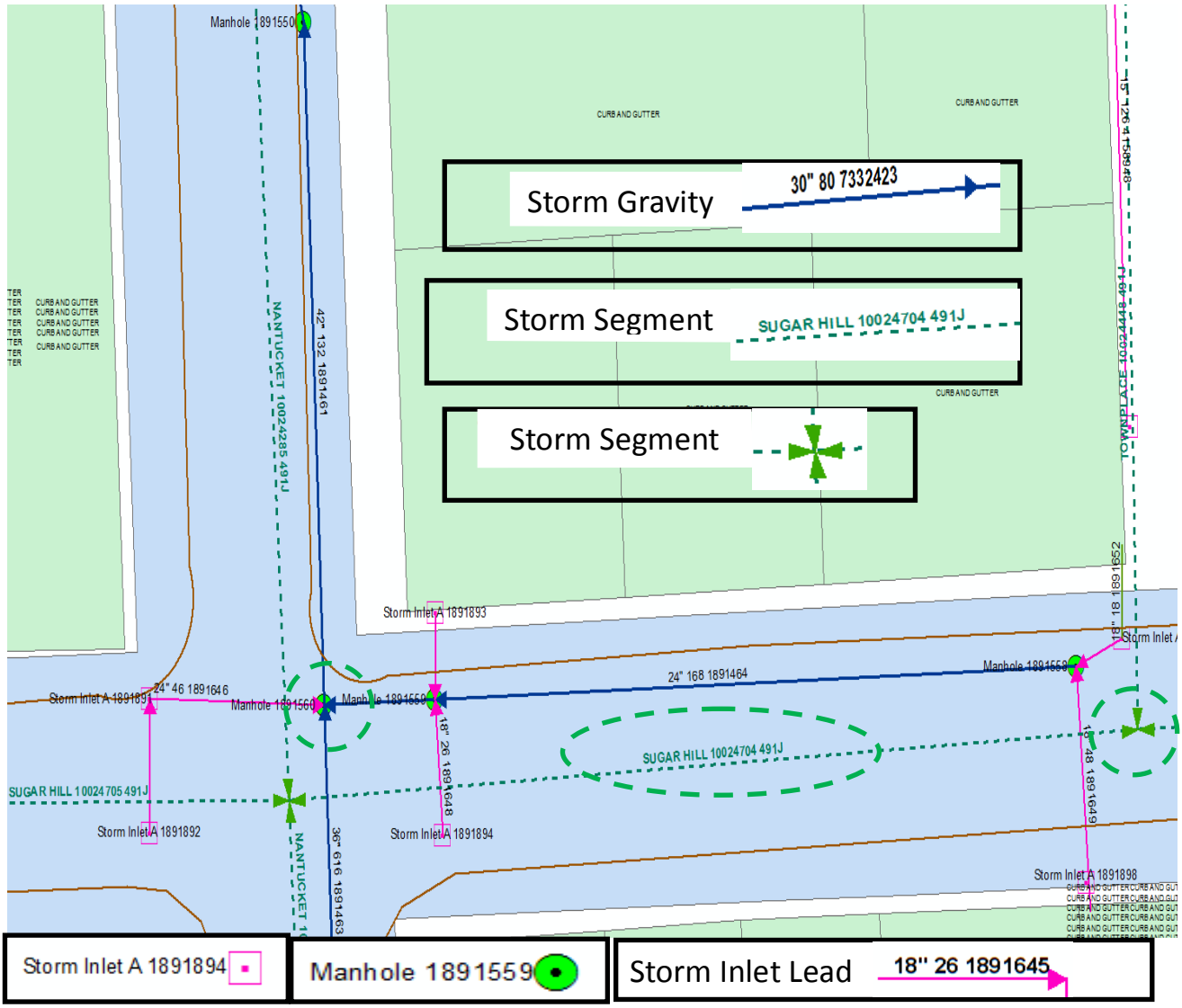
The Dam Safety Program includes both routine and non-routine dam safety activities. Routine activities are led and executed by the geographic district office while non-routine activities are led by regional Dam Safety Production Centers.

Routine activities include program management, inspections, instrumentation evaluation and maintenance, dam safety training, emergency preparedness, and periodic assessments.

Non-routine activities include further evaluation of issues of concern (Issue Evaluation Studies), planning of modifications to address issues of concern9 Dam Safety Modification Studies, and modification design and construction. These activities are identified and prioritized with a risk-informed program.

Significant routine and non-routine activities ongoing within the Southwestern Division will also be discussed.

City of Houston Geographic Management Information System (GIMS) [ix]



The primary categories of asset life cycle management tasks include:

1) Inspection
2) Maintenance
3) Obsolescence renewal

				(1)	(2)	(3)
Category	Estimated Assets Functional Life (yr)	Approx. Total Assets in SWMB System (GIMS)	Unit of Assets in SWMB System	INSPECTION Annual Inspection Best Practices Targets [inspect at least once every 10 years]	MAINTENANCE Annual Maintenance Best Practices Targets [maintain at least 2 times during its expected functional life]	OBSOLESCENCE RENEWAL Annual Obsolescence Renewal Targets
1) ROAD SIDE DITCHES [length is 2 times the approximate ditch length calculated from GIMS data]	40	4,314	Miles	inspect each ditch portion a minimum of 4 times in its expected operational life; inspect at least 1 time each 10 years	perform routine maintenance on each ditch at least 2 times in its expected operational life; maintain at least 1 time each 20 years	complete replacement at end of its expected operational life: 2.5% of the complete system replaced/renewed annually
2) STORM GRAVITY LINES:	50	3,531	Miles	inspect each underground pipe portion a minimum of 5 times in its expected operational life; inspect at least 1 time each 10 years	perform routine maintenance on each ditch at least 2 times in its expected operational life; maintain at least 1 time each 25 years	complete replacement at end of its expected operational life: 2.0% of the complete system replaced/renewed annually
3) COMBINED MANHOLES/ INLETS	50	187,349	Each	inspect each a minimum of 5 times in its expected operational life; inspect at least 1 time every 10 years	perform routine maintenance on each manhole/inlet at least 2 times in its expected operational life; maintain at least 1 time each 25 years	complete replacement at end of its expected operational life: 2.0% of the complete system replaced/renewed annually
Inlets	50	110,691				
Storm sewer manholes	50	76,658				

				(1)	
Category	Estimated Assets Functional Life (yr)	Approx. Total Assets in SWMB System (GIMS)	Unit of Assets in SWMB System	INSPECTION Annual Inspection Best Practices Targets [inspect at least once every 10 years]	INSPECTION Annual Inspection Best Practices Targets [inspect at least once every 10 years]
1) ROAD SIDE DITCHES	40	4,314	Miles	inspect each ditch portion a minimum of 4 times in its expected operational life; inspect at least 1 time each 10 years	At least 216 miles of Road Side Ditches Inspected each year
2) STORM GRAVITY LINES:	50	3,531	Miles	inspect each underground pipe portion a minimum of 5 times in its expected operational life; inspect at least 1 time each 10 years	At least 353 miles of Storm Gravity Lines each year
3) COMBINED MANHOLES/ INLETS	50	187,349	Each	inspect each a minimum of 5 times in its expected operational life; inspect at least 1 time every 10 years	Insepction of at least 1,875 Storm Manholes and Inlets per year
Inlets	50	110,691			
Storm sewer manholes	50	76,658			

(2)

Category	Estimated Assets Functional Life (yr)	Approx. Total Assets in SWMB System (GIMS)	Unit of Assets in SWMB System	MAINTENANCE Annual Maintenance Best Practices Targets [maintain at least 2 times during its expected functional life]	MAINTENANCE Annual Maintenance Best Practices Targets in SWMB System Assets Units
1) ROAD SIDE DITCHES	40	4,314	Miles	perform routine maintenance on each ditch at least 2 times in its expected operational life; maintain at least 1 time each 20 years	At least 216 miles of Road Side Ditches maintained each year
2) STORM GRAVITY LINES:	50	3,531	Miles	perform routine maintenance on each ditch at least 2 times in its expected operational life; maintain at least 1 time each 25 years	At least 141 miles of Storm Gravity Mains maintained each year
3) COMBINED MANHOLES/ INLETS	50	187,349	Each	perform routine maintenance on each manhole/inlet at least 2 times in its expected operational life; maintain at least 1 time each 25 years	At least 7,494 Storm Manholes and Inlets maintained each year
Inlets	50	110,691			
Storm sewer manholes	50	76,658			

(3)

Category	Estimated Assets Functional Life (yr)	Approx. Total Assets in SWMB System (GIMS)	Unit of Assets in SWMB System	OBSOLESCENCE RENEWAL Annual Obsolescence Renewal Targets	OBSOLESCENCE ANNUAL RENEWAL Best Practices Targets in SWMB System Assets Units
1) ROAD SIDE DITCHES	40	4,314	Miles	complete replacement at end of its expected operational life: 2.5% of the complete system replaced/renewed annually	At least 108 miles of Road Side Ditches Re-Established each year
2) STORM GRAVITY LINES:	50	3,531	Miles	complete replacement at end of its expected operational life: 2.0% of the complete system replaced/renewed annually	At least 71 miles of Storm Gravity Mains Replaced each year
3) COMBINED MANHOLES/ INLETS	50	187,349	Each	complete replacement at end of its expected operational life: 2.0% of the complete system replaced/renewed annually	At least 3,747 Storm Manholes and Inlets Replaced each year
Inlets	50	110,691			
Storm sewer manholes	50	76,658			

Conclusions

Storm water system infrastructure asset management provides a **systematic management methodology** for:

- Inspecting and evaluating operability of storm water system assets and sub-systems
- Planning and executing scheduled operation and maintenance activities
- Optimizing the cost-effective operability of storm water system assets throughout their expected functional life

[i] Street and Drainage Division Presentation/Operations Summary, 2012, p. 3.
[ii] Street and Drainage Division Presentation/Operations Summary, 2012, p. 5.
[iii] Street and Drainage Division Presentation/ Summary, 2012, p. 5.
[iv] FACT SHEET—Asset Management for Collection Systems, United Stated Environmental Protection Agency (EPA), p. 1.
[v] Ibid., p. 2.
[vi] Ibid., pp. 2-3.
[vii] GASB 34 Requirements—Benefits of the Modified Approach, Public Works Magazine, September, 2010.
[viii] Ibid., p. 2.
[ix] City of Houston Geographic Management Information System (GMIS).