City of Fort Saskatchewan

Asset Management Review

- Draft

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Executive Summary

The purpose of this report is to first provide a compilation of existing asset management practices internal to the City of Fort Saskatchewan, and then develop a strategy and framework moving forward to building an effective asset management program.

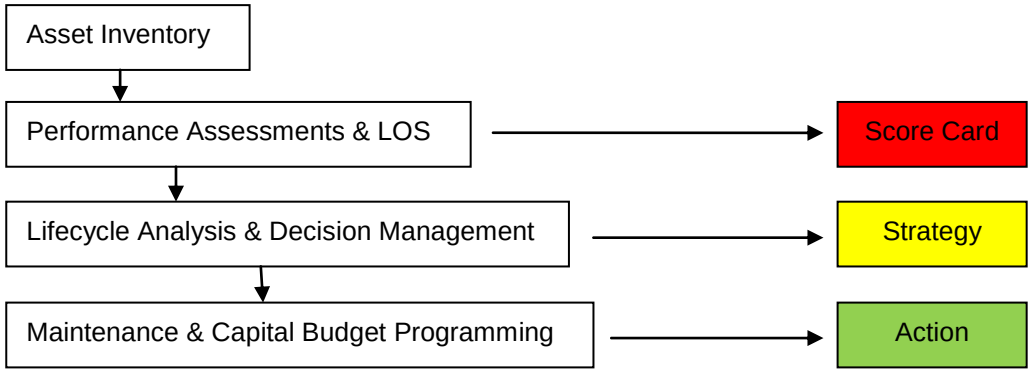
Ultimately, the over-arching objective of asset management is to; "*maximize the value for taxpayers, while ensuring infrastructure sustainability over time"*. By doing so, the City evolves into a proactive practice in addressing issues before they become problems. This is based on the fundamental practice of "*doing the right treatments to the right infrastructures over the right time*". This evolves the culture in how tangible capital assets are managed through the lifecycle; which the results are proven to realize both financial net benefit and level of service improvements to the community.

In practice, an effective asset management system includes an asset inventory, performance & level of service assessment, lifecycle analysis & decision management, maintenance & capital budget programming, and monitoring & program management.

In conclusion, the City of Fort Saskatchewan is currently in a developing state of asset management. Within the various asset management components, and within the various business units, the asset management readiness level varies from "undeveloped" to "developed and functioning adequately". The strategy is to build around the strengths of what is working. The recommendations to implement an asset management program are summarized as follows:

- The asset management system should be deployed in smaller manageable steps, with evaluation of the milestone success and process refined before moving forward to the next step.
- Place highest priority on the asset management components that are required for the functionality of the asset management system as a whole. More specifically, this would include developing the Performance Criteria and the Asset Management Database. The Asset Management Database would be the central asset management hub, storing the inventory of each tangible capital asset, corresponding performance assessment data collected over time, and the resulting level of service. This would be implemented to serve all business units, involving all the City's asset groups.
- The next priority would be the asset management components that are not system dependent, but required to deliver asset management solutions. More specifically, these would include Performance Assessments & Level of Service, Lifecycle Analysis & Decision Management, and Maintenance & Capital Budget Programming. Based on the need and readiness of each of the City's asset groups, it may be prudent to begin implementing these components with a pilot project involving the Public Works and Engineering asset groups. Then, upon successful delivery of these groups, expanding out to the remainder of the City's asset groups.
- There are asset management components that are desirable, but may not be an asset management requirement. This would include the Monitoring & Program Management component. This may be an item for implementation upon successful implementation of the other asset management components; with the needs and functionality reassessed at that time.

The proposed asset management framework will engage both Council and senior administration by first providing an understanding of the state of the infrastructure and then moving forward to informed decisions to delivering an infrastructure program with the desired level of service targets in mind.



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1. Introduction

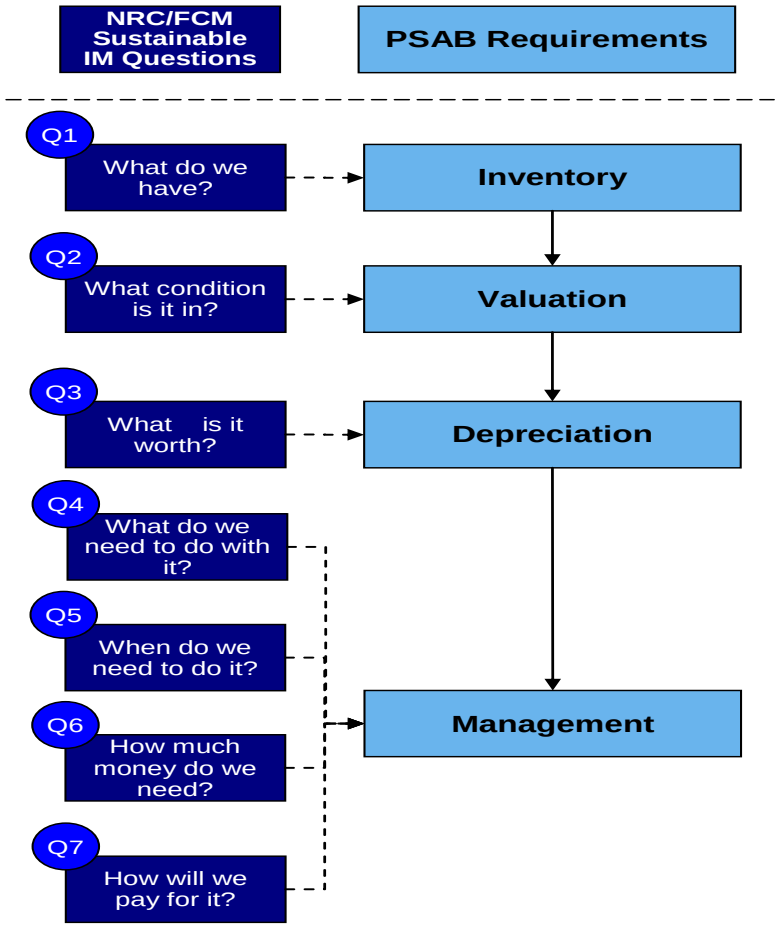
The City of Fort Saskatchewan is undertaking a review of its current asset management practice. Then based on best practices considerations the City would like to develop a framework to develop its asset management system around.

The City is currently structured as follows in relation to asset management:

- Corporate Services:
  - Finance – Champion of the Tangible Capital Assets (TCA) inventory list and management of budget roll-ups
  - Information Technology – Champion of the Geographic Information System (GIS) and other related asset management systems including Work Tech (i.e. Work orders and tracking)
- Infrastructure and Planning Service:
  - Fleet – Manages mobile equipment (i.e. rolling stock) used for all business units, with the exception of Protective Services (Fire)
  - Facilities – Manages the building envelopes, including standard building components (i.e. HVAC, electrical, plumbing, etc), for all business units
  - Engineering – Provides the engineering services require for all business units, including development of capital programming for Public Works Roads (incl. Bridges, Sidewalks & Curb and Trails) and Utilities (i.e. Water Distribution and Wastewater Collection)
- Community and Protective Services :
  - Recreation – Manages the recreation assets (i.e. swimming pools, etc.) within the facility building envelope, uniquely specific for those recreation functions.
  - Culture – Manages the culture assets (i.e. art and specialized equipment) within and external to the facilities building envelope. Manages directly the smaller culture related facilities.
  - Fire – Manages fire protection assets, including specialized equipment and fleet all related to the fire protection unit.

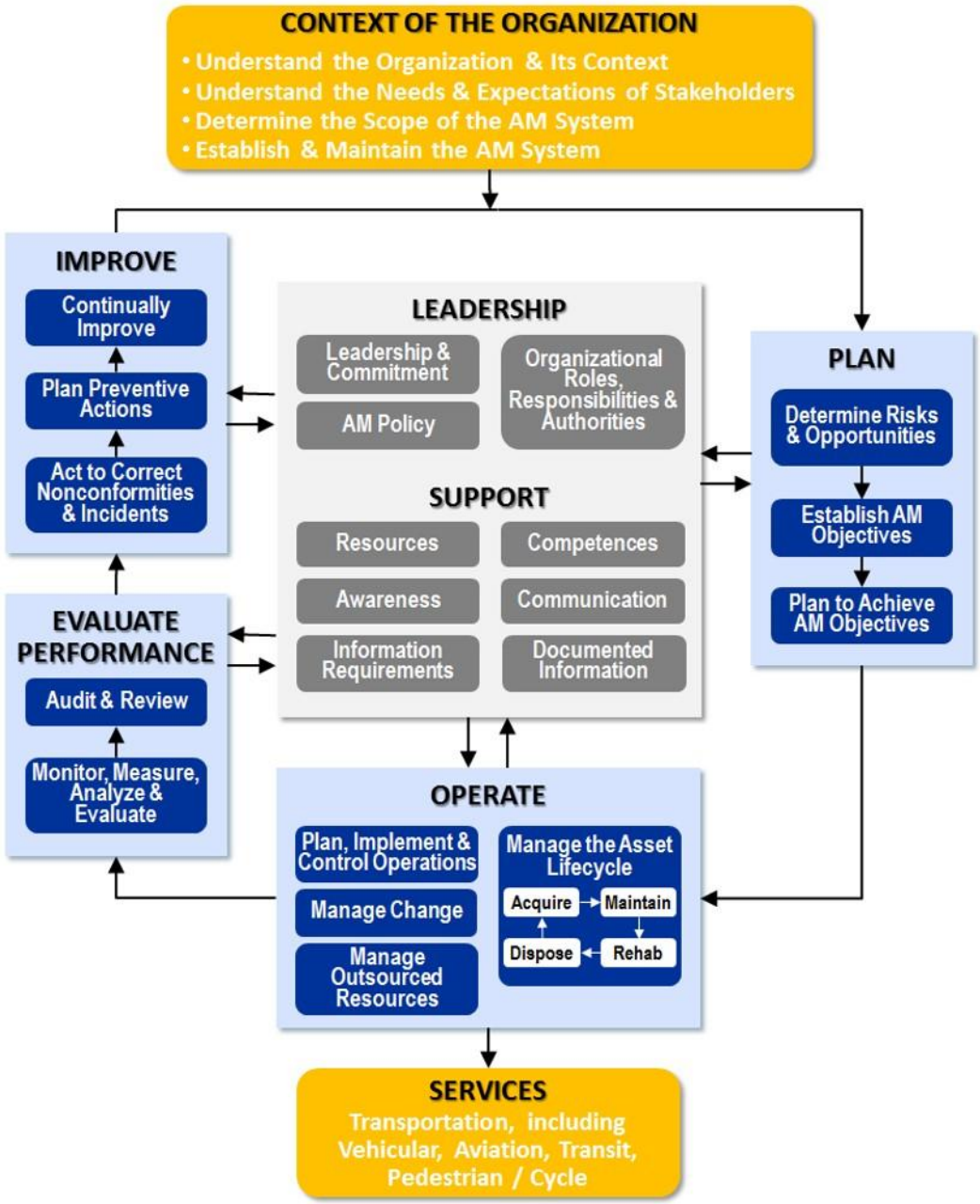
The NCR/FCM “National Guide for Sustainable Infrastructure (i.e. InfraGuide)”, is the Canadian standard for asset management and it provides a direct and step-by-step approach to developing an asset management program. It is proven to be very effective and presents the implementation of asset management in relation to seven questions:

Figure 1 – NRC/FCM National Guide for Sustainable Infrastructure – Seven Steps



ISSO 55000, is the international standard for asset management, they structure the framework of asset management into the following components. In summary, the framework begins with understanding the internal context (i.e. mission and vision) and external context (i.e. social, economic, and financial). Then there is an iterative approach of numerous factors. But at the end, it is to improve the overall service of the organization. Once the components of asset management are in place, this standard looks internally at leadership, resources, and commitments in sustaining and maintaining an effective asset management program.

Figure 2 – ISO 55000 Asset Management Framework



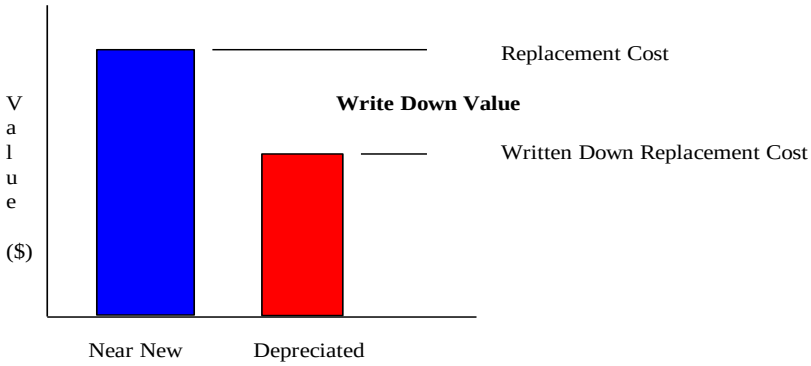
In consideration of both national and international standards, one can frame an organization's practice of asset management into the following components. This will be the basis for assessment in reviewing the City's asset management initiatives and developing a framework around them.

- Asset Inventory – This is where the physical attributes and valuation of the assets are stored. As required by the Standards Section PS-3150, all municipalities were to have developed a tangible capital assets (TCA) database. Each asset segment or element should be documented by a single Asset Identification number. Complementing this, a geographic information system (GIS) tags on the Asset Id, often referred to as a Spatial ID, for the linear assets (i.e. roads, sidewalks, water distribution, and wastewater (storm and sanitary) collection), so these assets can be identified and referenced using mapping media instead of spreadsheet media.

- Performance Assessments and Level of Service (LOS) – Performance assessments typically involve field level inspections of each infrastructure asset contained within the TCA. It is based on a well defined criteria specific for each asset group. The framework for most asset management assessments is **severity** (i.e. minor, moderate, major, and severe) and **extent** (proportion of the asset within each of the defined severity levels). Through defined threshold levels (i.e. consideration for risk), this is used to compute the overall **condition state**. The elements assessed are specific for each asset group (i.e. building, treatment facility, road, sidewalk, water distribution, wastewater collection, and fleet). The assessments are often developed around the assets physical condition, utilization (capacity) and functional adequacy. The computed condition state (i.e. good, fair, and poor) is the asset's current level of service (LOS).

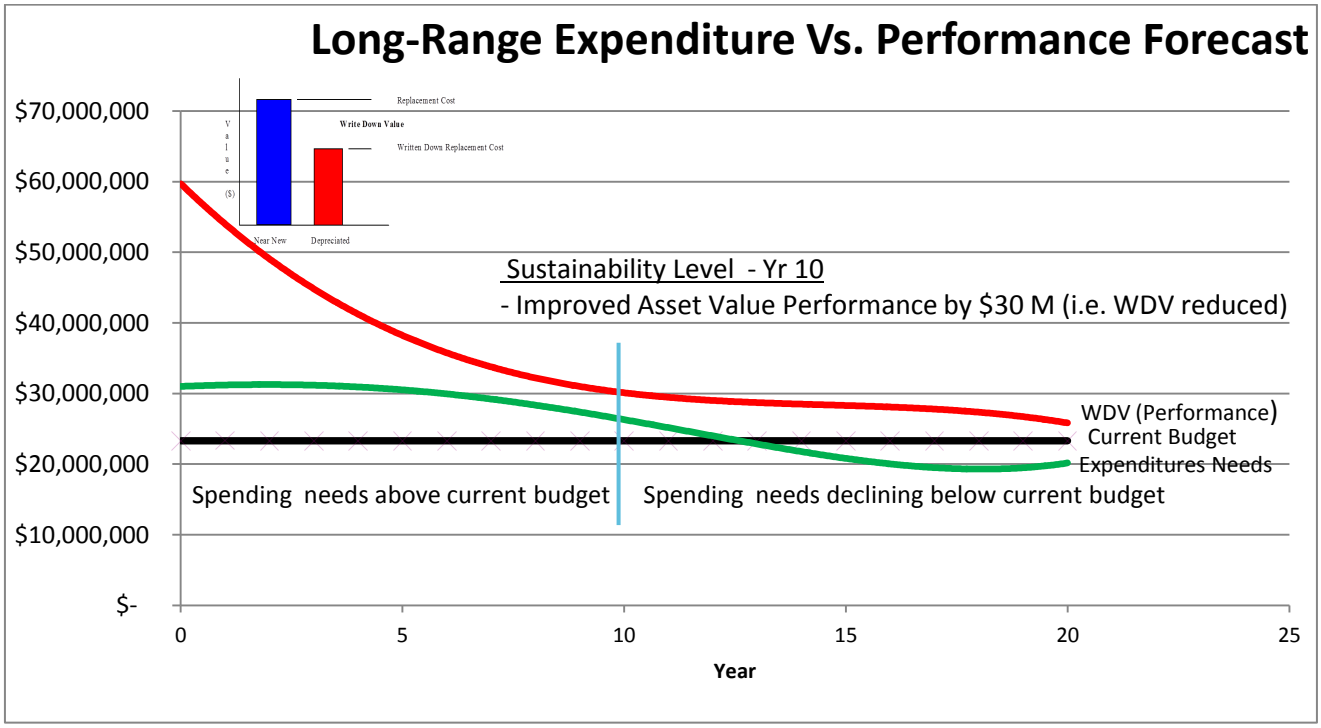
Asset valuation is another form of assessing the asset's level of service. It is related to the condition state, but often calculated on the basis of the asset Write-Down-Value (WDV). This is calculated as the cost to bring the tangible capital asset back to a near new condition state.

Figure 3 – Asset Valuation



- Lifecycle Analysis and Decision Management – The purpose of lifecycle analysis is to minimize overall costs over the infrastructure lifecycle and deliver a plan for infrastructure sustainability, including consideration for risk. There is a "sweet spot" of planned maintenance or capital rehabilitation for a targeted level of service that will deliver this objective; often referred to as the **sustainability level**. This is illustrated in the example Figure 4, where the assets overall WDV is high at $60 Million, indicating a higher level of deterioration. Current maintenance and capital expenditures are running at $22 Million. With a short-term expenditure increase to $31 Million, over a ten year period, the asset valuation is expected to improve by $30 Million. This would provide a noticeable LOS improvement, in which the municipality would begin to operate at a higher level of service and lower costs. The sustainability level is determined from lifecycle analysis, based on "doing the right treatments to the right infrastructures at the right time". This aids in the decision management in determining optimal LOS targets and spending levels.

Figure 4 – Sustainability Level



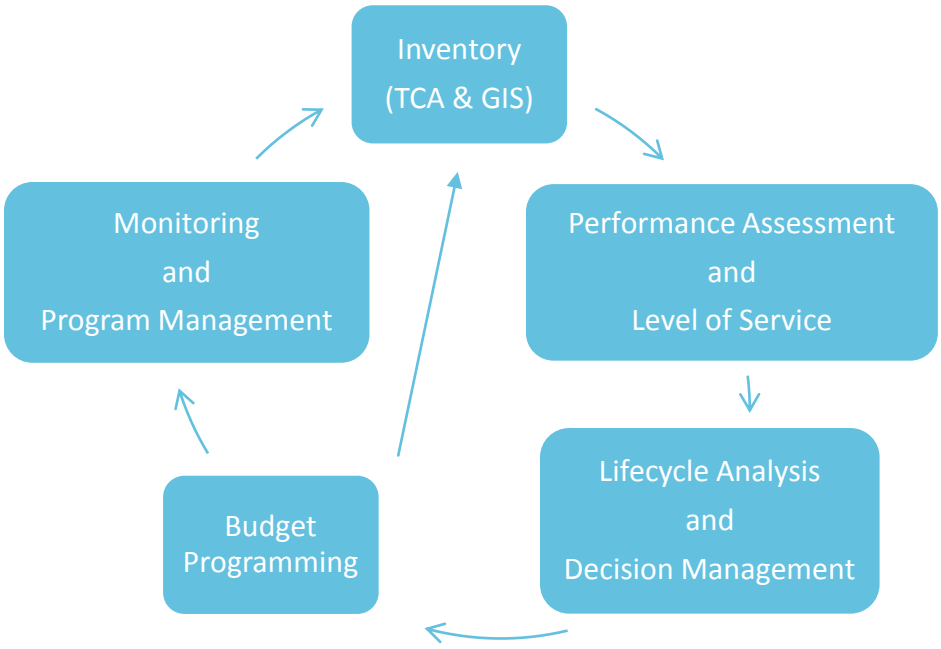
- Maintenance and Capital Budget Programming – With the sustainability level (i.e. LOS and Expenditures) in perspective, the next step involves detailing the maintenance and capital program in line with delivering the sustainability plan. Often, these details were used in the lifecycle analysis. At this point it is compiling the information for budget programming, discussion, and debate (i.e. Council); leading to approval.
- Monitoring and Program Management – The approved budget program is deployed through the year until the next budget cycle. During this period, works need to be monitored as to what is completed and variations (i.e. cost and asset improvements) from the approved program. In addition, the condition state of the asset needs to be monitored on an ongoing basis, including recording spot and continuous performance assessments. It is particularly important to record water distribution pipe/valve failures; when they occur and the condition state at the time of failure. The pipe sample extraction, during maintenance activities, and associated testing is illustrated in figures 5a and 5b.

Figure 5a – Water Main Sampling During Repairs

Figure 5B – Sample Testing

The overall asset management process through each of the above steps is cyclical.

Figure 6 – Asset Management Applied Process



In order to deliver a positive Return on Infrastructure Investment (ROII), the delivery of asset management needs to be cognisant of the following:

- Efficient – The processes should not be extraordinarily resource exhaustive above current staffing and outsourced levels
- Effective – The results have to deliver net benefit, often described as "maximizing the value for taxpayers while ensuring infrastructure sustainability over time"

The ROII is two-fold. First, the asset management program needs to realize a positive net benefit considering the change in expenditures to the change in asset valuation (i.e. performance). Whether the municipality spends more or less depends on where it is at in relation to its sustainability level. The net benefit can be positive, even if spending increases; as long as the return shows increased value to the tangible capital assets that exceeds the maintenance and capital expenditure increase.

Second, the asset management process cannot be overwhelmingly exhaustive that the amount of asset management activity will take away from the net benefits the program is meant to deliver on. In other words, the overhead component is too great for the net benefit it delivers.

2. Current Internal Asset Management Practice

Currently, the City of Fort Saskatchewan has no structured approach or governance to asset management. The policy and procedure is limited to one related element of asset management, Tangible Capital Assets. Business units are implementing some elements of asset management; but the approach is inconsistent between business units and the results may not be as effective as could be.

Based on interviews with a cross section of staff from various business units, including samples of information provided, the following summarizes the current practices of asset management within each of the following asset management components.

2.1 Asset Inventory

The Tangible Capital Assets (TCA) data is stored in the Fixed Assets Register in Microsoft Dynamics GP. This is structured such that it contains the following asset management relevant information:

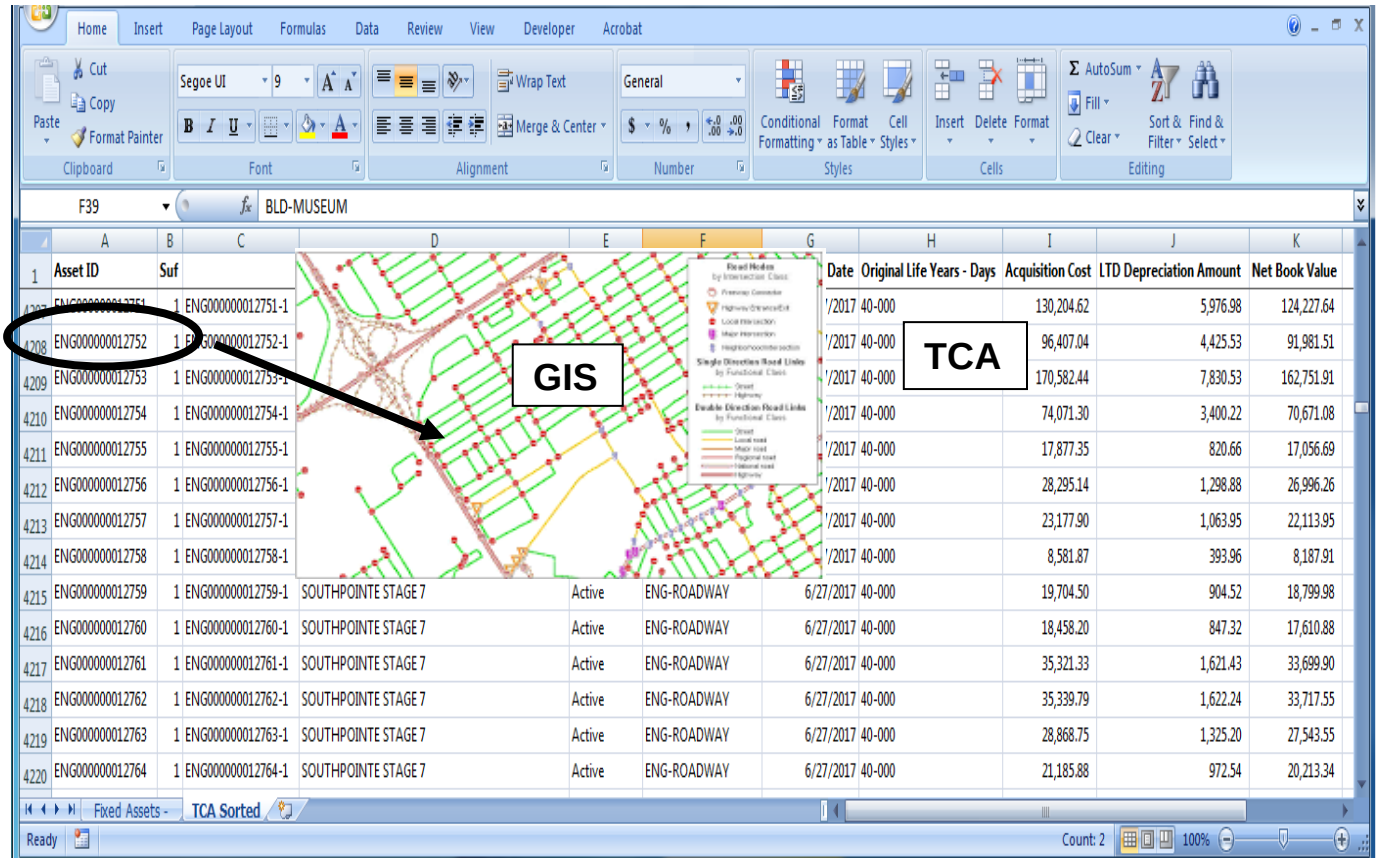
- Asset ID – Unique numerical reference for each asset item, which does provide multiple record numbers for the same asset; given each betterment.
- Asset Class ID – Provides the asset group, but not always in relationship to the homogeneous nature of the asset group. As example, the road surface, subsurface, sidewalk and curb is all listed under "ENG-ROADWAY", while there is a separate Asset Class ID for each building. The asset groups are not completely understood.
- Asset Theoretical Service Life – The expected time in service, in years.
- Asset Valuation (Acquisition Date, Cost, Depreciation, Book Value) – Based on the time and cost of acquisition and the theoretical service life, it uses a straight line depreciation in determining its net book value. There are assets in service today with zero net book value.

It was observed that various business units are maintaining separate asset inventories, but it is not in line with the Fixed Assets Register. As example, the Engineering unit within Infrastructure Planning Services maintains a comprehensive road inventory. However, the "Element ID" used to identify the asset does not link to the Tangible Capital Assets, Asset ID.

The Geographic Information System (GIS) is just being set up in ESRI ArcGIS. While there is some line work initiated, the attributes of the infrastructure assets (i.e. dimensions, material, age, etc) are not in place.

The Tangible Capital Assets and the Geographic Information System should be referencing the same "Asset ID" for the same asset. Currently, the common identifier is not in place.

Figure 7 – City of Fort Saskatchewan TCA and GIS Asset Inventory Example



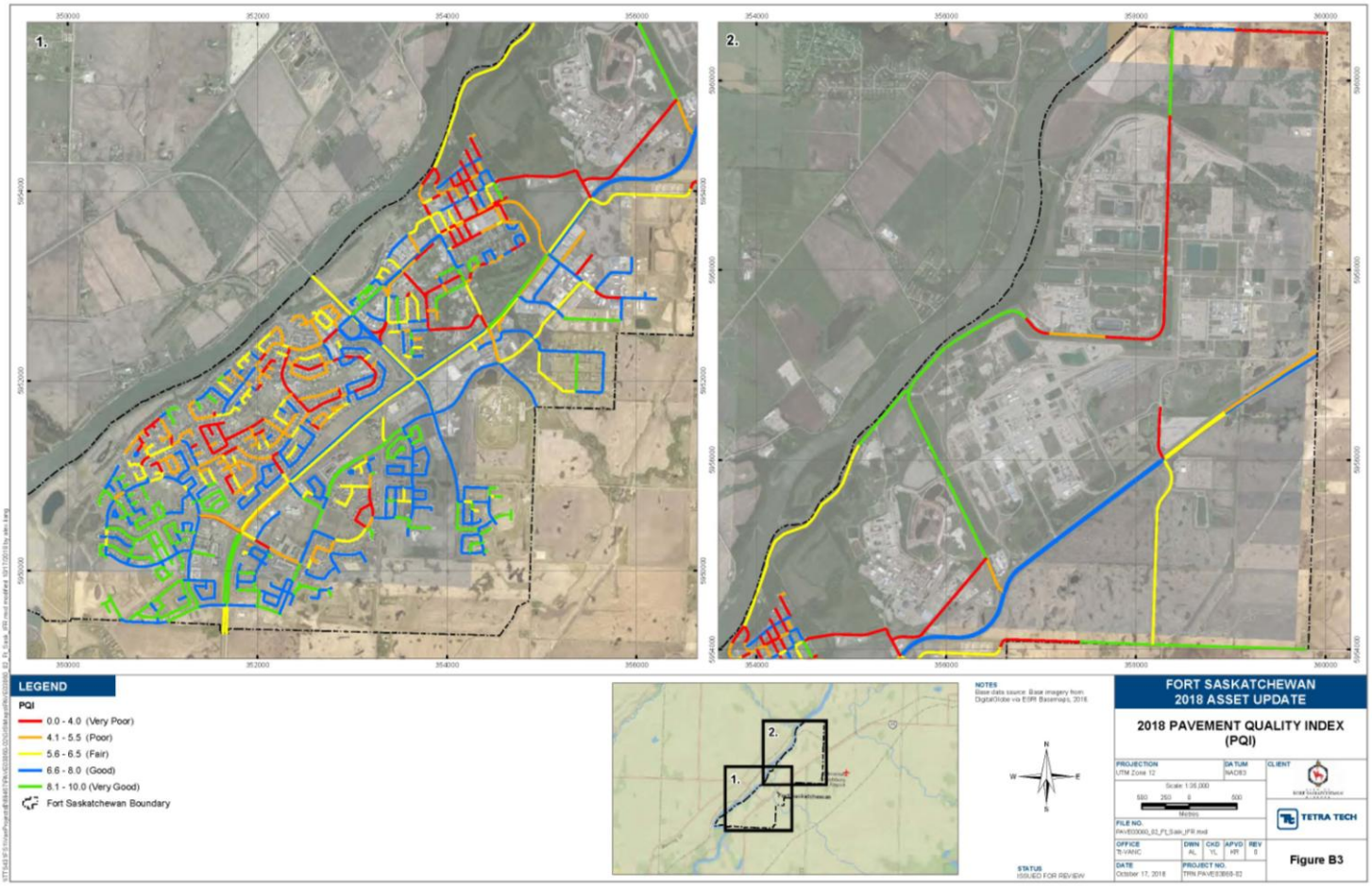
	Asset ID	Suf						Date	Original Life Years - Days	Acquisition Cost	LTD Depreciation Amount	Net Book Value
4208	ENG000000012752	1	ENG000000012752-1					/2017	40-000	96,407.04	4,425.53	91,981.51
4209	ENG000000012753	1	ENG000000012753-1					/2017	40-000	170,582.44	7,830.53	162,751.91
4210	ENG000000012754	1	ENG000000012754-1					/2017	40-000	74,071.30	3,400.22	70,671.08
4211	ENG000000012755	1	ENG000000012755-1					/2017	40-000	17,877.35	820.66	17,056.69
4212	ENG000000012756	1	ENG000000012756-1					/2017	40-000	28,295.14	1,298.88	26,996.26
4213	ENG000000012757	1	ENG000000012757-1					/2017	40-000	23,177.90	1,063.95	22,113.95
4214	ENG000000012758	1	ENG000000012758-1					/2017	40-000	8,581.87	393.96	8,187.91
4215	ENG000000012759	1	ENG000000012759-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		19,704.50	904.52	18,799.98
4216	ENG000000012760	1	ENG000000012760-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		18,458.20	847.32	17,610.88
4217	ENG000000012761	1	ENG000000012761-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		35,321.33	1,621.43	33,699.90
4218	ENG000000012762	1	ENG000000012762-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		35,339.79	1,622.24	33,717.55
4219	ENG000000012763	1	ENG000000012763-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		28,868.75	1,325.20	27,543.55
4220	ENG000000012764	1	ENG000000012764-1	SOUTHPOINTE STAGE 7	Active	ENG-ROADWAY	6/27/2017	40-000		21,185.88	972.54	20,213.34

2.2 Performance Assessments and Level of Service

The City does not have a structured performance assessment criteria defined for any of its asset groups. The City does not have an approach for determining the asset Level of Service (LOS) for most of its asset groups. However, it was observed the City does perform a quantitative field level performance assessment and Level of Service determination for a few of its asset groups.

The City uses a third party consultant to complete a performance assessment on the paved roadways, paved trails, and sidewalks using combination of automated and manual collection methods. The performance assessment is computed to a Pavement Quality Index (PQI) and Sidewalk Distress Severity, which determines the LOS. The process is running independently within the Engineering unit of Infrastructure and Planning Services. They maintain their own inventory.

Figure 8 – City of Fort Saskatchewan Existing Pavement Management System Output



The City also conducts a quantitative performance assessment of its wastewater collection (i.e. Sanitary and Storm) asset group. This asset group has undergone CCTV sewer photography which has a structured assessment framework under the standard NASSCO Pipeline Assessment Certification Program (PACP). The 1-5 Grading system is a measure of Level of Service.

Severity

- Grade 1 – Excellent condition with only minor defects detected. Near new condition state. Greater than 50 years RSL
- Grade 2 – Good condition with defects have not begun to deteriorate. 20 to 50 years RSL.
- Grade 3 – Fair condition with moderate defects that will continue to deteriorate. 10 to 20 years RSL expected.
- Grade 4 – Severe defects that will become grade 5 defects within the foreseeable future. 5 to 10 years RSL expected.
- Grade 5 – Severe defects that require immediate action. 0 to 5 years RSL expected.

Figure 9a -
Grade 3 Structural

Figure 9b -
Grade 5 Structural

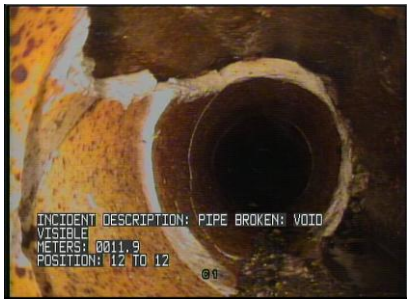


Figure 9c -
Grade 5 O&M

Some of the City's other asset groups, such as Art and Buildings undergo professional inspections. While these somewhat form performance assessments, it does not quantify the asset's LOS. In many cases the City's operations staff base the asset condition state and Level of Service on their personal subjective understanding. In many cases, in particular to the Fleet asset group, the asset's Theoretical Service Life (TSL) in relation to the asset's age is used in determining the asset Remaining Service Life (RSL). The Remaining Service Life becomes the basis of the Level of Service assessment.

In summary, there are various levels of performance assessments and Level of Service determination throughout the various asset groups. The approach being used for the roadways, sidewalks, and wastewater collection asset groups is the most consistent with the practice of asset management.

2.3 Lifecycle Analysis and Decision Management

The City is conducting lifecycle analysis on its Paved Roads and Paved Trails asset groups. This is observed through its dTIMS pavement management system, which is quantitative based on the previous condition assessment. Decision management works on principles of optimization programming, which is based on addressing issues early before they become problems. This is a preferred approach over priority programming, which is based on worst-first and not as effective in decision management. While the lifecycle analysis used for the Paved Roads asset group delivers a capital renewal program (i.e. resurfacing), it currently does not address the preservation maintenance component. This is a key element in decision management, as preservation maintenance can play a significant role in minimizing lifecycle costs and deferring the more expensive capital renewal treatments. As such, the overall paved roads network can realize an improved level of service by integrating preservation maintenance and capital renewal within the lifecycle analysis and decision management approach.

Figure 10 – City of Fort Saskatchewan Existing Paved Roads Lifecycle Analysis

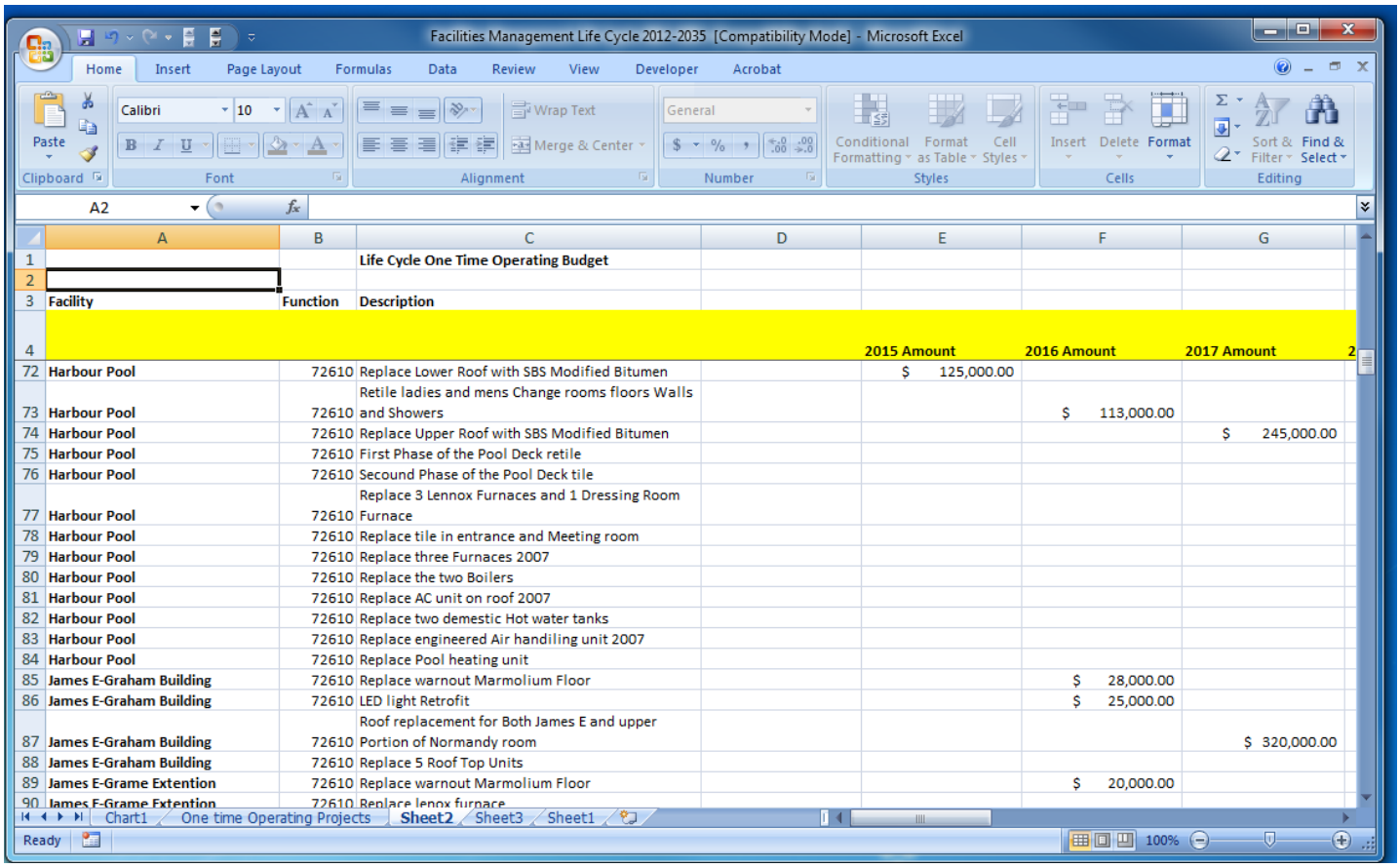
							Paving Plan		
	ElementID	Road	Fro	To	From_Street	To_Street	Treatment	TRT Year	TRT Cost
15	0001-0010	100 AV	0	96	79 ST	80 ST	Mill_Overlay_50mm	2031	$29,956
16	0001-0020	100 AV	96	219	80 ST	81 ST			
17	0001-0030	100 AV	219	309	81 ST	82 ST	Mill_Overlay_50mm	2034	$32,165
18	0001-0040	100 AV	310	401	83 ST	83A ST			
19	0001-0050	100 AV	401	493	83A ST	84 ST	Mill_Overlay_50mm	2037	$34,391
20	0001-0060	100 AV	494	584	85 ST	85A ST	Mill_Overlay_50mm	2038	$35,937
21	0001-0070	100 AV	584	674	85A ST	86 ST	Mill_Overlay_50mm	2036	$30,819
22	0001-0080	100 AV	675	877	87 ST	87A ST	Mill_Overlay_50mm	2027	$54,739
23	0001-0090	100 AV	877	966	87A ST	88 ST	Mill_Overlay_50mm	2028	$26,906
24	0001-0100	100 AV	967	1318	SHERRIDON DR	100 ST			
25	0001-0110	100 AV	1318	1635	100 ST	101 ST			
26	0001-0120	100 AV	1635	1740	101 ST	102 ST	Mill_Overlay_50mm	2027	$38,959
27	0001-0130	100 AV	1740	1829	102 ST	103 ST	Mill_Overlay_50mm	2031	$36,588
28	0001-0140	100 AV	1829	1915	103 ST	104 ST	Mill_Overlay_50mm	2029	$33,730
29	0001-0150	100 AV	1915	2009	104 ST	105 ST	Mill_Overlay_50mm	2030	$39,267
30	0001-0160	100 AV	2009	2100	105 ST	106 ST	Mill_Overlay_50mm	2029	$36,286
31	0001-0170	100 AV	2100	2187	106 ST	107 ST	Mill_Overlay_50mm	2028	$33,514
32	0001-0180	100 AV	2187	2289	107 ST	108 ST	Mill_Overlay_50mm	2030	$42,359
33	0001-0190	100 AV	2289	2391	108 ST	109 ST	Mill_Overlay_50mm	2022	$32,824
34	0001-0200	100 AV	2391	3285	109 ST	114 ST	FDR	2026	$812,375
35	0002-0010	100 ST	0	99	88 AV	HWY 15 EB	Mill_Overlay_50mm	2033	$42,101
36	0002-0020	100 ST	100	199	96 AV	96A AV			
37	0002-0030	100 ST	199	298	96A AV	97 AV			

Analysis Results | Dictionary

Ready

The Building Facilities and Recreational Equipment asset groups utilize in-house developed Lifecycle Spreadsheets. The application is lifecycle in that expenditures and treatment activities are forecast years into the horizon. However, the approach is not quantitative based. It is not based on a measured condition state and there is no performance prediction methodology, unlike the pavement management approach illustrated above. The expenditure allocation and targeted areas of spending is based on a subjective knowledgebase approach.

Figure 11 – City of Fort Saskatchewan Existing Buildings Lifecycle Analysis



The Culture Equipment and Artifacts asset group maintains a Reserve Funding Spreadsheet, which forecasts expenditures (withdrawals) into the future. However, as per the Building Facilities and Recreational Equipment asset groups, it falls short of lifecycle analysis fundamentals of Level of Service performance prediction and minimizing lifecycle costs. It is a subjective approach to decision management, based on the knowledgebase of the staff managing these infrastructure assets.

For the fleet (vehicles and machinery) asset group, planned maintenance and unit replacement is managed using the “WorkTech” system. Level of service is based on age in comparison to its theoretical service life. The actual replacement time is strongly aligned with its theoretical service life, which is the decision process.

In summary, the approach to lifecycle analysis and decision management is unique and independently managed within each Department and asset group.

2.4 Maintenance and Capital Budget Programming

The City uses a budgeting financial module called “FMW”, which downloads financial data from Microsoft Dynamics GP; and uploads budget submissions from each department.

The process is consistent throughout the City and managed by the Financial Services Department. The function of Financial Services is to provide budget roll-up. There is oversight of budget needs. However, requests are based on informal and often qualitative assessments, not a formalized and quantitative approach.

The City is in the process of implementing a new Priority Based Budgeting System. The practice of asset management determines infrastructure renewal priorities. There may exist a parallel decision process between Priority Based Budgets and Asset Management.

2.5 Monitoring and Program Management

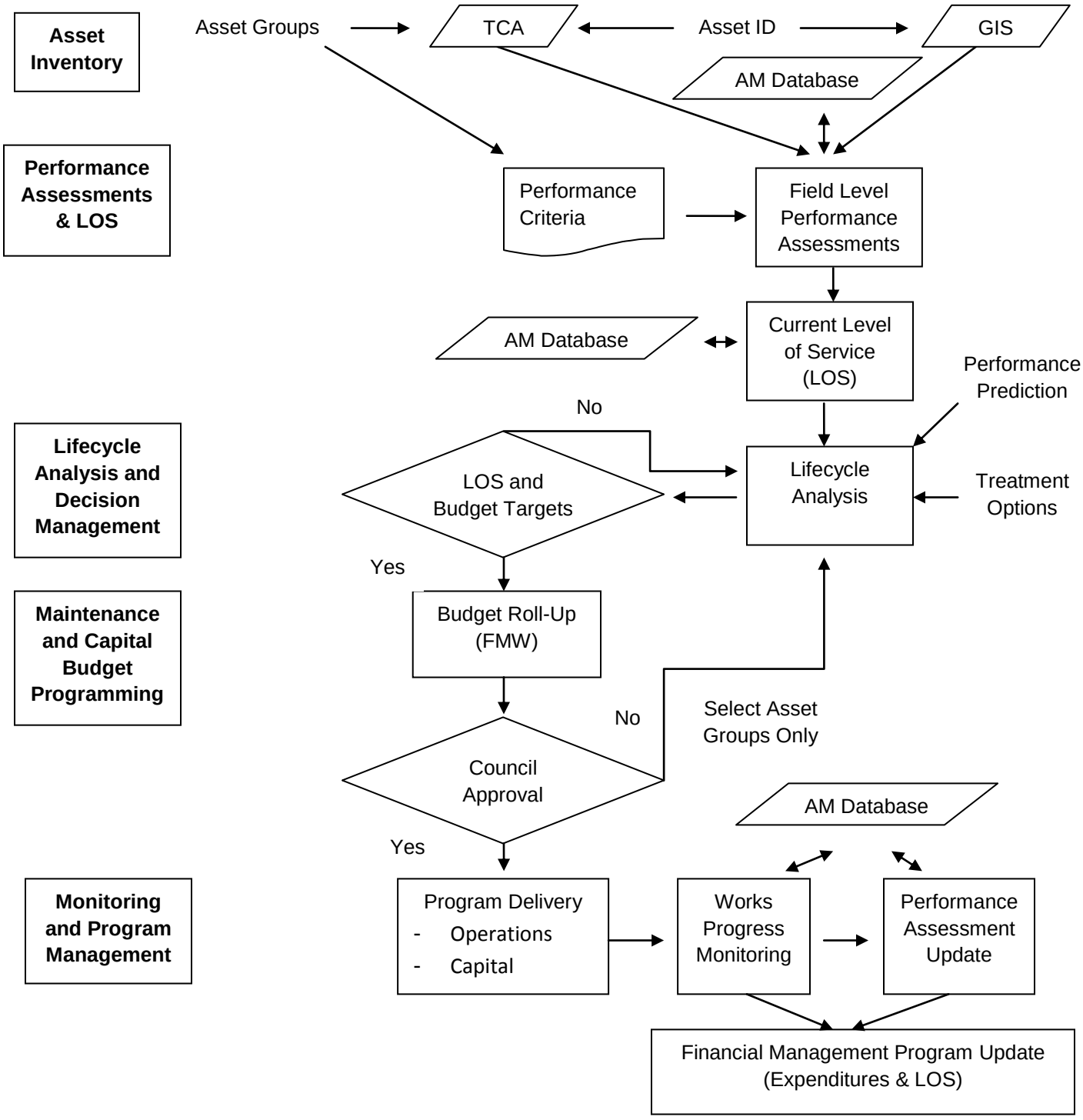
At the project level, recording work activities (completed work) are completed for those asset groups using the WorkTech system. This includes Fleet Maintenance, Roadways Maintenance, and Parks Maintenance. Such was attempted for the Facilities asset group, using WorkTech, but was unsuccessful.

At the project level, the financial system module (FMW) does provide opportunity to batch report financial updates. However, it falls short of reporting progress on works completed and Level of Service changes as a result. It is not a real-time (i.e. Dashboard) reporting system.

3. Recommended Asset Management Framework

In consideration of industry recognized best practice, our experience with what works, and the current state of asset management practice within the City of Fort Saskatchewan, this study developed an asset management framework (Figure 12). The following sections provide narrative and further illustration on each asset management component.

Figure 12 – Recommended Asset Management System Framework



3.1 Asset Inventory

- Tangible Capital Assets Database – This is a central database typically housed in a Financial ERP System. The TCA database should have one record for each Asset ID. If there is a need for auxiliary records related to the Asset ID, it should be through a one-to-many relationship. Then the TCA needs to be housed in a relational database format (i.e. not a spreadsheet style format). The key fields for asset management purposes are Asset ID, Asset Group, Replacement Cost (RC), Write-Down-Value (WDV), Condition State, and Remaining Service Life (RSL); while the fields for financial management purposes are Acquisition Date, Historic Cost, Theoretical Service Life (TSL), and Book Value.

  It is important to tie down the primary asset groups, with each Asset ID referencing one of these groups. For the City of Fort Saskatchewan, the following may be the appropriate asset groups.

  - Roads
  - Sidewalks & Curbs
  - Trails
  - Bridges
  - Water Reservoirs
  - Water Distribution
  - Wastewater Collection Mains
  - Wastewater Collection Manholes and Catch Basins
  - Wastewater Lift Stations
  - Building Facilities
  - Recreation Equipment
  - Culture Equipment & Artifacts
  - Fire Equipment
  - Information Technology
  - Fleet (Vehicles & Machinery)

- Geographic Information System (GIS) – The Geographic Information System is used primarily for the linear asset groups (i.e. Roads, Sidewalks & Curbs, Trails, Water Distribution, and Wastewater Collection). Its main purpose is to reference (i.e. identify) the asset segments spatially (i.e. map) versus a table listing. The GIS often contains attribute information about each linear Asset ID, including Asset Group, Length, Width/Diameter, and Material. The key relational field to the Tangible Capital Assets database is the Asset ID. In Geographic Information System, the identifying field is often referred to as the Spatial ID. This can differentiate from the Asset ID and often do as the two systems operate independently. However, it is logistically easier if the Geographic Information System and the Tangible Capital Assets reference the same Asset ID for the same asset.

- Asset Management (AM) Database – This is the key data repository for asset management. It is based on one-to-many relational database fundamentals. For each Asset ID it holds one record identifying the inventory data. This would include classification of the assets (i.e. asset group, functional, structural, and capacity, etc.), physical (i.e. dimensions, material, etc.) and asset valuation (i.e. Replacement Cost, etc.). Then it holds many records on numerous performance measures and numerous years of condition assessments.

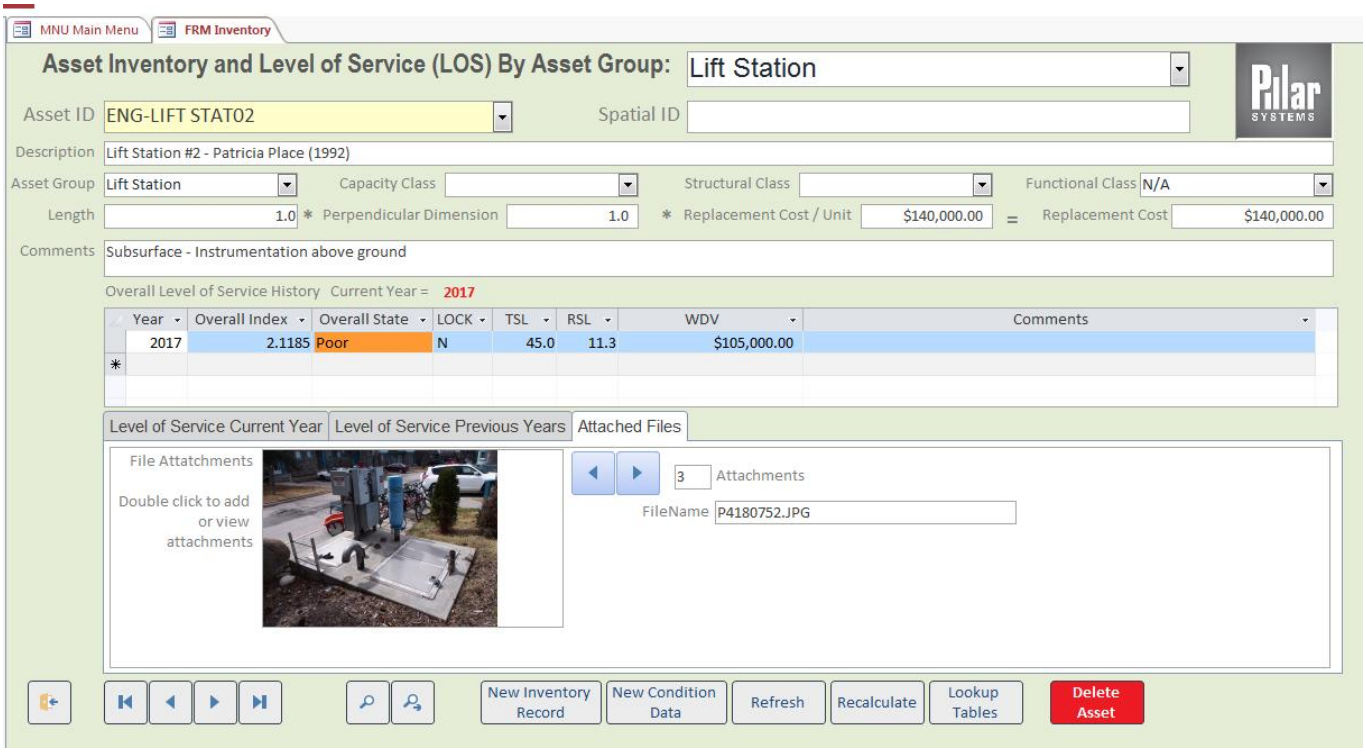
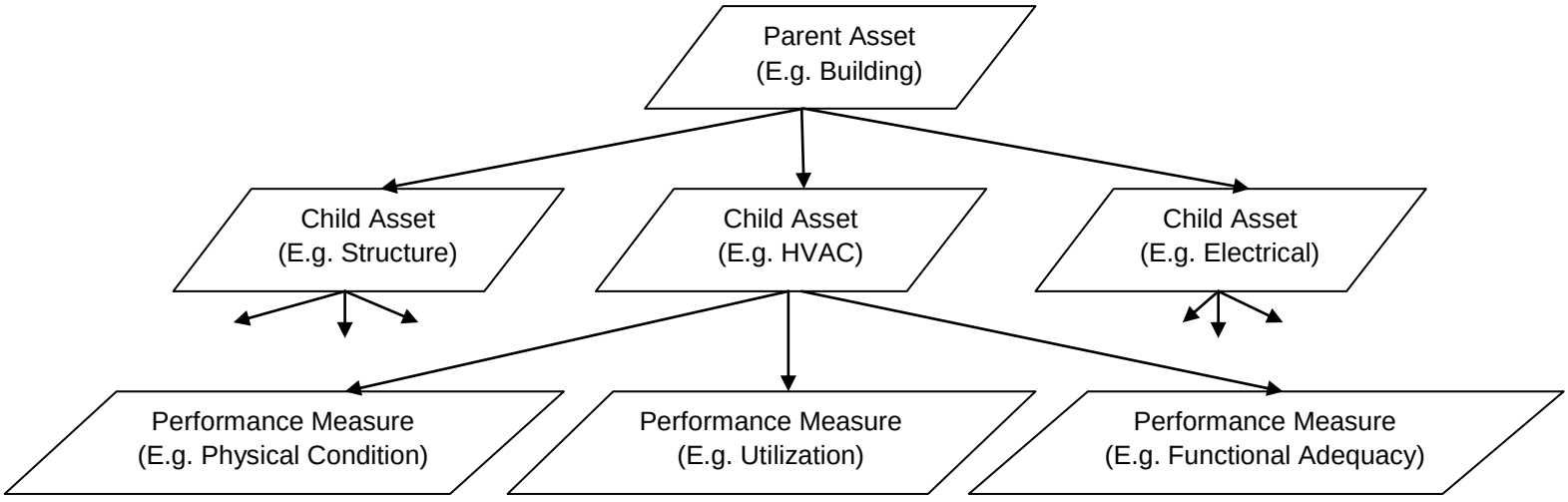


Figure 13 – Example of Asset Management Database – Inventory and Performance Data

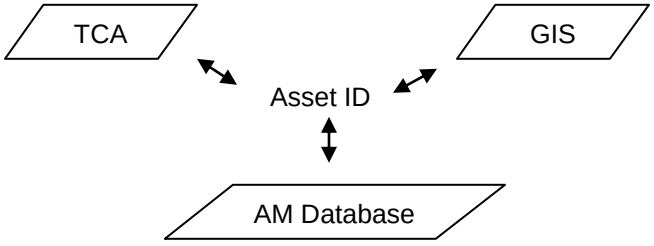
The Asset Management Database can be designed to also support a one-to-many relationship between the parent asset and child assets (i.e. components of the parent asset). Then for each child asset, the many condition types.

Figure 14 – Relational Data Structure



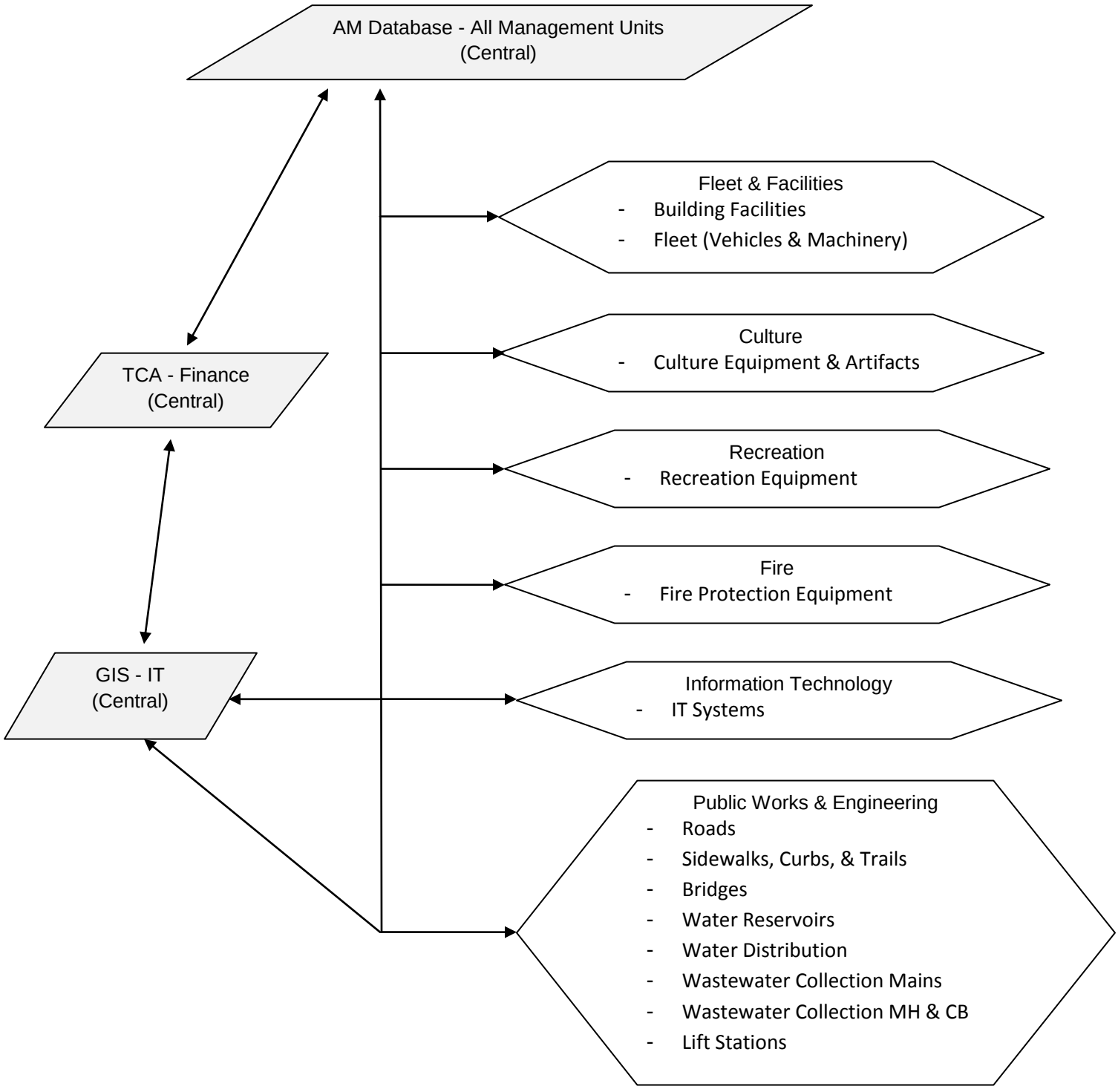
The Asset Management Database can provide object database connectivity (OBDC) link direct to the Tangible Capital Assts database and the Geographic Information System. Information can be shared via a live link between the Tangible Capital Assets database and the Geographic Information System on the Asset ID, which is unique for each tangible capital asset. As such, the functions of asset management can be done independent of financial systems, but with the sharing of information as appropriate to the business unit.

Figure 15 – Asset ID Relational Link



The Asset Management Database can be operated centrally as a repository for all of the City's tangible capital assets or independently for each management unit. One option is to house the Asset Management Database centrally, but with access provided to the City's management units for management independence of their respective asset groups. This would be implementable and risk adverse to system dependency and discrepancy.

Figure 16 – Central Asset Management Database Scenario



3.2 Performance Assessments and Level of Service

Each of the identified asset management units will need to develop performance assessment criteria specific for its defined asset groups (i.e. Building Facilities, Equipment & Artifacts, IT Systems, Recreation Equipment, Roads, Sidewalks & Curbs, Trails, Water Distribution, and Wastewater Collection).

Performance Criteria

Performance criteria are defined in a document, often based on a severity-extent approach to defining performance assessments for each of the listed asset groups. Severity defines how severely physically deteriorated, depreciated, functional, or capacity level the infrastructure asset is operating at. The example below shows the performance criteria definition for the wastewater collection asset group.

Definition – Wastewater Collection (Structural)

The assessment will be based on a partial network assessment using CCTV sewer photography and NASSCO's Pipeline Assessment and Certification Program (PACP). The performance assessments for the Structural condition type will follow the standard 5-point grading system:

Severity

- None (Grade 1) – Excellent condition with only minor defects detected. Near new condition state. Greater than 50 years RSL
- Minor (Grade 2) – Good condition with defects have not begun to deteriorate. 20 to 50 years RSL.
- Moderate (Grade 3) – Fair condition with moderate defects that will continue to deteriorate. 10 to 20 years RSL expected.
- Major (Grade 4) – Severe defects that will become grade 5 defects within the foreseeable future. 5 to 10 years RSL expected.
- Severe (Grade 5) – Severe defects that require immediate action. 0 to 5 years RSL expected.

Extent

The extent is the proportion of readings within each of the above severity categories

Following establishment of the criteria, a performance assessment needs to be conducted for each Asset ID contained in the registry. The performance assessment can take a variety of forms, from automated data collection methods, manual inspections, sampling & testing, to records review. These are established in the assessment criteria.

Field Level Performance Assessments

The City is already undertaking automated performance assessment techniques for the Roads and Wastewater Collection asset groups; and to some extent experimented with Water Distribution automated performance assessments. The City should continue and expand around these practices where appropriate to do so.

Figure 17a – Pavement Performance Assessment

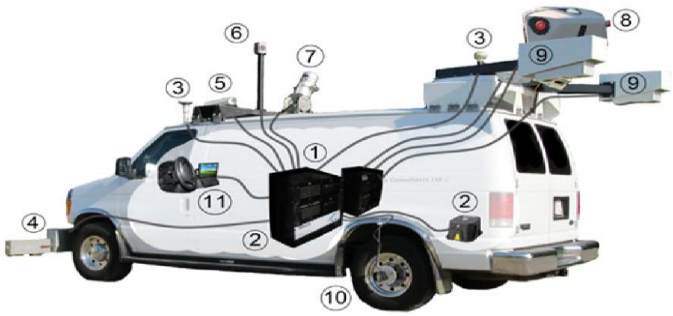
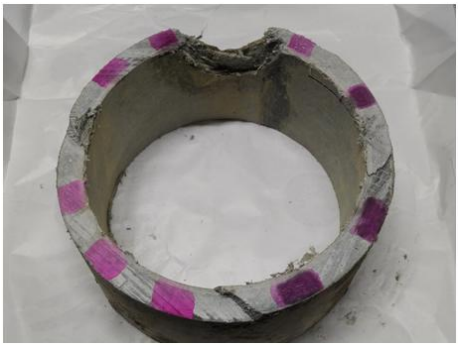


Figure 17b – Sewer Performance Assessment

Figure 17c – Water Main Performance Assessment

Alternatively, sampling and testing during maintenance repairs is an appropriate alternative for the Water Distribution asset group.

Figures 18abc – Water Distribution Sample Extraction Performance Assessment



Performance assessments follow three primary performance measures. The following are the performance measures used by the Alberta Ministry of Treasury Board in computing their State of the Infrastructure report:

- Physical Condition – Measure of the physical condition state, deterioration, or depreciation
- Utilization (Capacity) – A measure of the infrastructure size in comparison to its use or volume
- Functional Adequacy – A measure if the infrastructure has the functionality to serve its intended use.

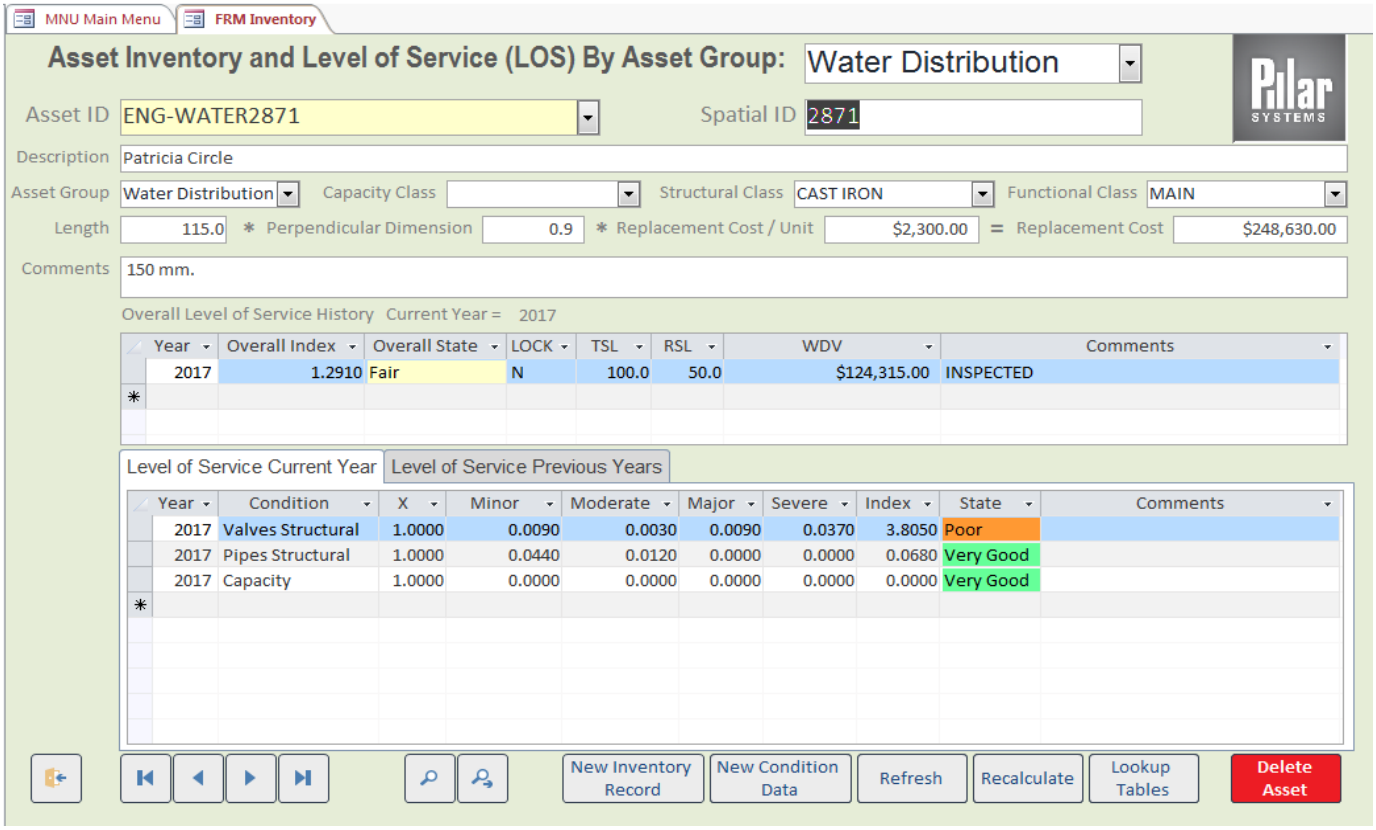
In municipal asset management applications, physical condition often references several performance types physically measured. Therefore, developing the performance criteria for municipalities may involve a blend using the above three performance measures with other more detailed performance measures. Ultimately, for lifecycle analysis, the performance measures need to relate to a treatment that can be applied.

Appendix A illustrates potential performance measure groupings and the data acquisition method for each of the currently identified asset groups. It is expected this would be adjusted as each business unit will develop its own condition assessment criteria unique to their operations.

Once the data is collected, it needs to be entered or imported into an Asset Management Database. This would be the severity-extent data as per each performance measure unique for each asset group. The following is an example of the extents for each of the minor, moderate, major, and sever severity levels for each performance measure in the Water Distribution asset group.

AM Database

Figure 19 – Example of Asset Management Database – Inventory and Performance Data



The current Level of Service is a function of the measured severity levels to predefined Threshold Levels (THL). Threshold Levels build risk into the decision process. In the example above there is a high level of tolerance for pipe deterioration at the minor severity level (90%), but a very low tolerance for deterioration at the major or severe severity levels (i.e. 20% and 5% respectively), which is in the high risk point of failure.

Current Level of Service (LOS)

The condition index is based on the ratio of the measured severity levels to the predefined threshold levels. Condition state is based on condition index ranges.

$$INDEX = CWF^* \left(\frac{\%severe}{SeTH} + \frac{\%major}{MaTH} + \frac{\%moderate}{MoTH} + \frac{\%minor}{MiTH} \right)$$

Where: %severe = severe condition extent; SeTH = severe threshold level of extent
%major = major condition extent; MaTH = major threshold level of extent
%moderate = moderate condition extent; MoTH = moderate threshold level of extent
%minor = minor condition extent; MiTH = minor threshold level of extent
CWF = condition weighting factor

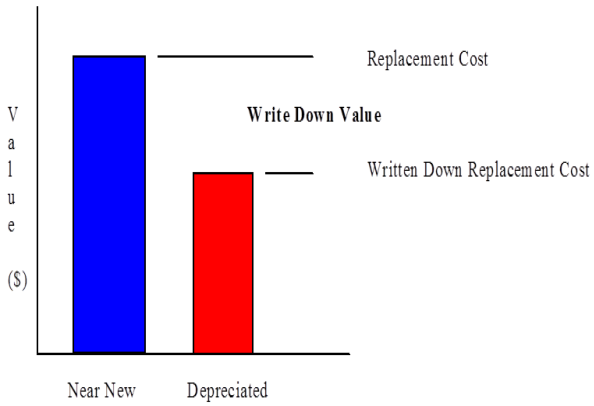
Table 1 – Condition State Range Definitions

Condition State	Index From	Index To
1. Very Good	0.0	0.5
2. Good	0.5	1.0
3. Fair	1.0	2.0
4. Poor	2.0	4.0
5. Very Poor	4.0	>

The condition state is one measure of Level of Service (LOS). In the example, illustrated in Figure 19, the overall condition state, considering the valves, the pipe, and the capacity is "Fair".

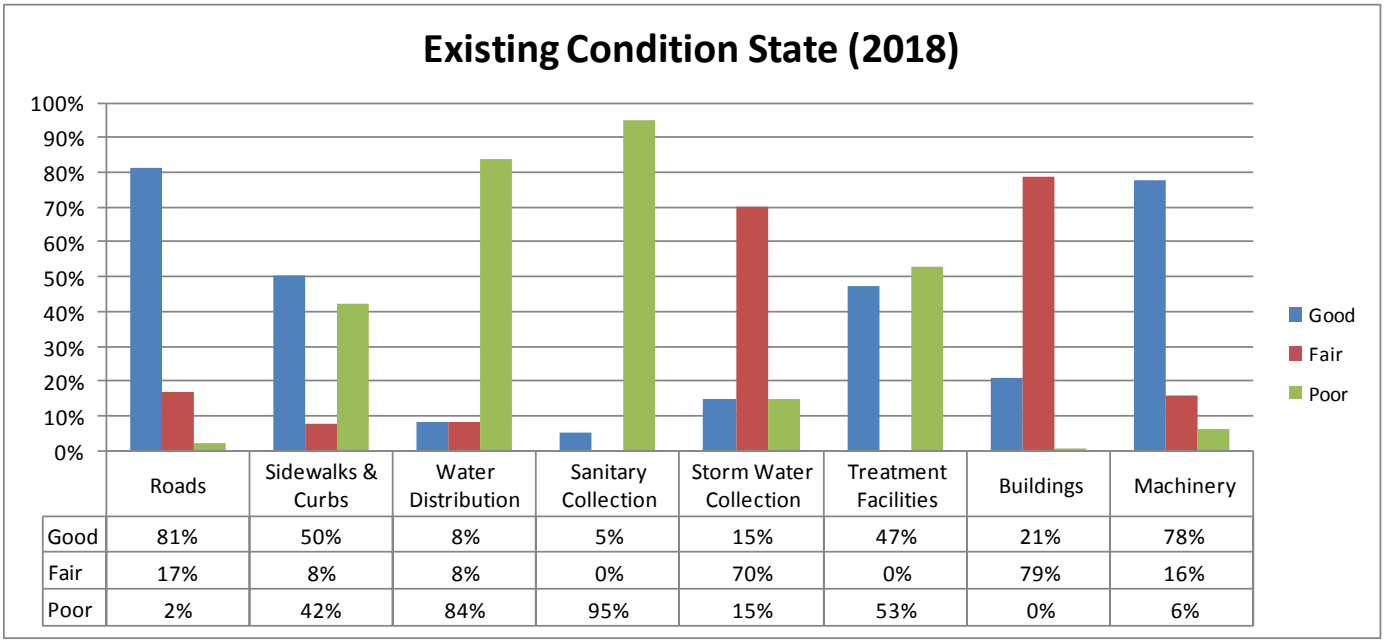
Figure 20 – Asset Valuation

In terms of asset valuation (i.e. monetary performance), the Write-Down-Value (WDV) is proportionate to the condition state. In reference to the same example illustrated in Figure 19, with the "Fair" condition state, the Write-Down-Value is $124,315 from its original Replacement Cost of $248,630. This is another measure to describe the asset Level of Service.



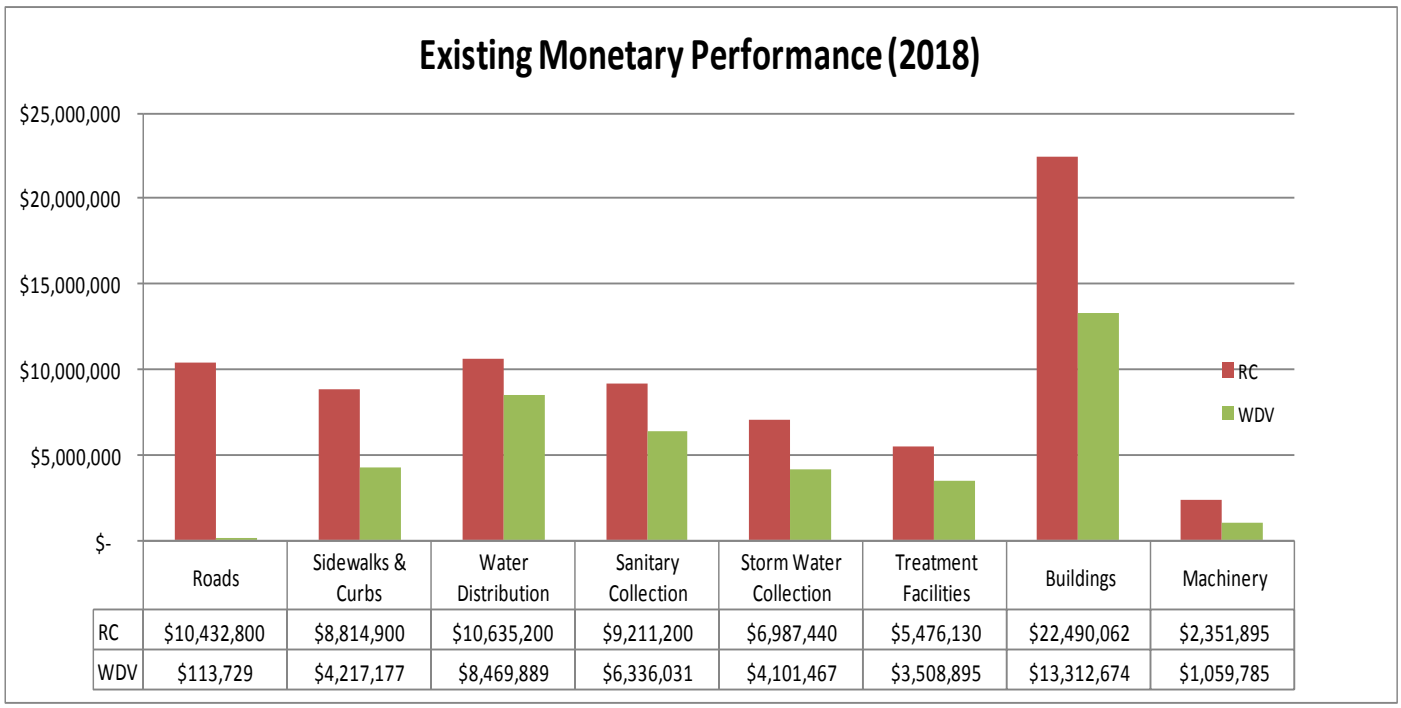
Considering all asset groups, the existing LOS may be illustrated either as a function of condition state or asset valuation. This is illustrated as a municipal exampled in Figures 21 and 22. Both Level of Service performance measures deliver the same message, but in different formats. Regardless of the unique nature of the performance assessment criteria for each asset group, the Level of Service reporting is seamless between asset groups.

Figure 21 – Example Performance Summary – Condition State



	Roads	Sidewalks & Curbs	Water Distribution	Sanitary Collection	Storm Water Collection	Treatment Facilities	Buildings	Machinery
Good	81%	50%	8%	5%	15%	47%	21%	78%
Fair	17%	8%	8%	0%	70%	0%	79%	16%
Poor	2%	42%	84%	95%	15%	53%	0%	6%

Figure 22 – Example Performance Summary – Asset Valuation (Monetary Performance)



	Roads	Sidewalks & Curbs	Water Distribution	Sanitary Collection	Storm Water Collection	Treatment Facilities	Buildings	Machinery
RC	$10,432,800	$8,814,900	$10,635,200	$9,211,200	$6,987,440	$5,476,130	$22,490,062	$2,351,895
WDV	$113,729	$4,217,177	$8,469,889	$6,336,031	$4,101,467	$3,508,895	$13,312,674	$1,059,785

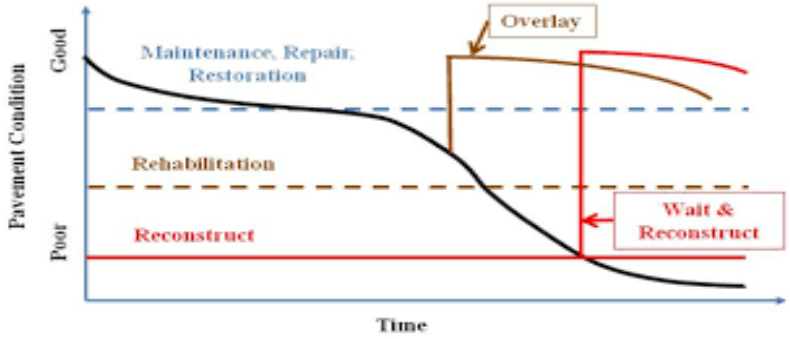
3.3 Lifecycle Analysis and Decision Management

Lifecycle Analysis

Lifecycle analysis involves utilizing the condition data to basically conduct two functions. The first is to predict the infrastructure performance (i.e. Level of Service) into the future. The second is to select the appropriate treatments over the lifecycle that will minimize costs and deliver a plan for infrastructure sustainability (i.e. sustainable Level of Service).

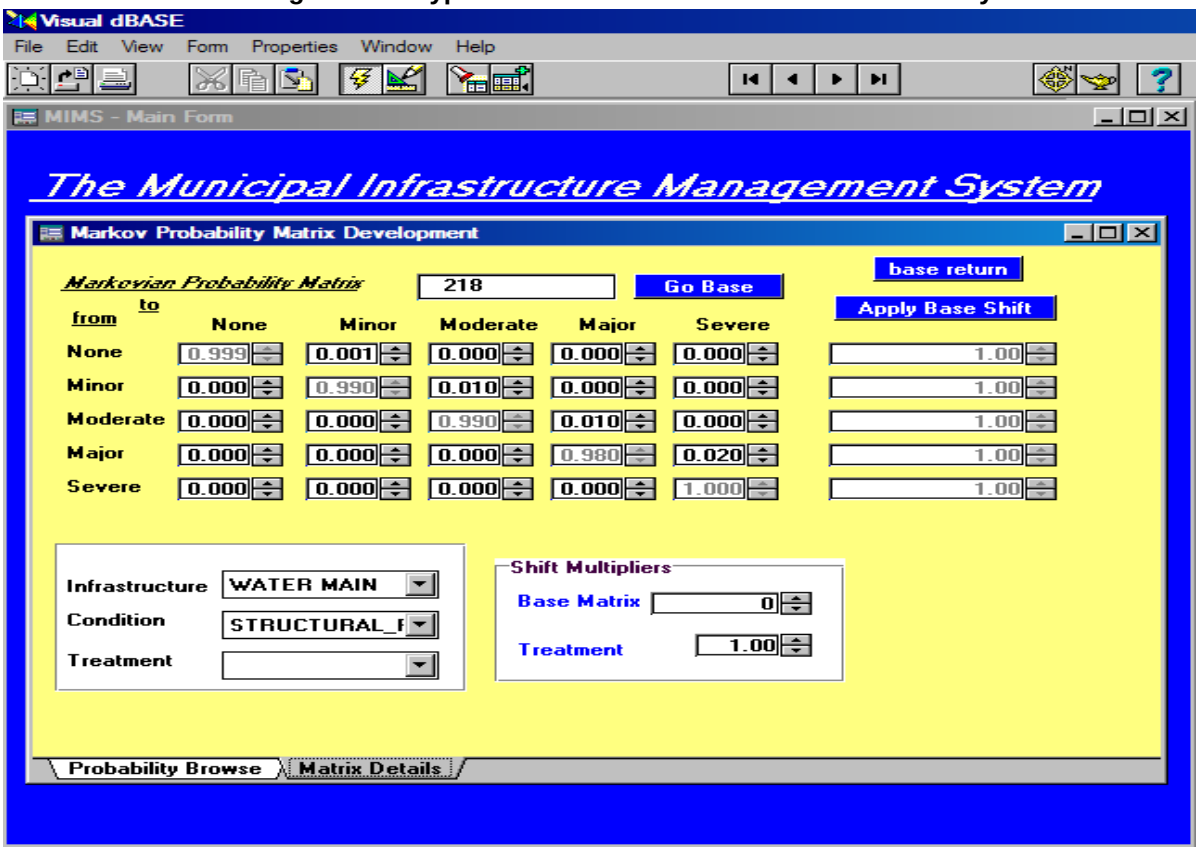
Figure 23 illustrates the concept of Level of Service deterioration over time (curved lines), with infrastructure renewal options (vertical lines) that bring in an element of betterment. There are various systems and technologies that use performance prediction methods in its lifecycle analysis. The City is currently doing this with their pavement management system (i.e. dTIMS). The approach the City is using is indicative of the Figure 23.

Figure 23 – Typical Lifecycle Performance Curve



The performance prediction methods that provide the greatest reliability use the raw severity-extent data. This is used with probabilistic modeling principles of moving from one severity level to another in a one year period, as illustrated in Figure 24 in reference to a Water Distribution example.

Figure 24 – Typical Performance Deterioration Probability Matrices



Through the asset's lifecycle, numerous treatment options are tested; from maintenance to capital renewal. As illustrated in Figure 25 for the Water Distribution asset group, the "Pipe Burst" Treatment is an option for Condition State 4 (Poor), with the unit cost applied. In this example, the treatment is effective in mitigating all severity levels (i.e. minor, moderate, major, sever), as the entire pipe is replaced. Other treatments, such as "Pipe Failure" are only designed to address specific severity levels and unit costs applied accordingly, as only a proportion of the pipe is mitigated.

Figure 25 – Typical Treatment Strategy – Water Main Pipe Bursting

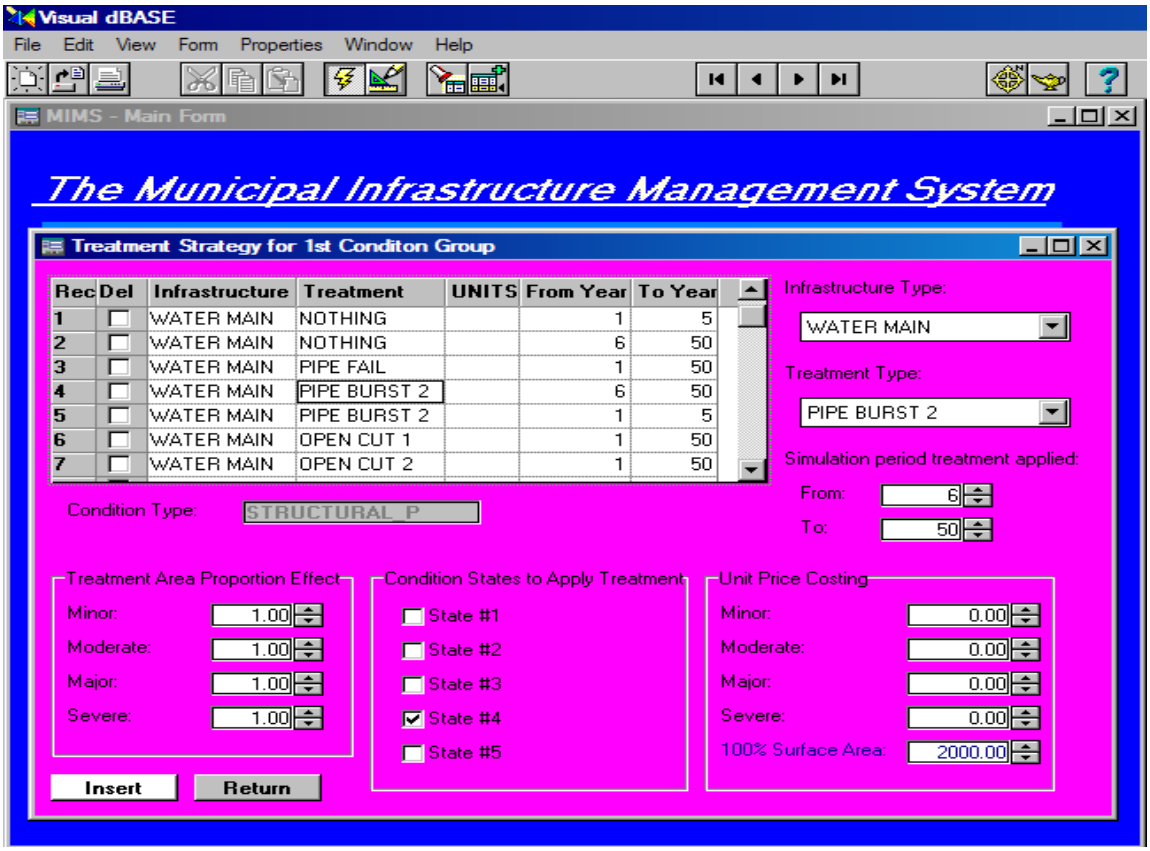
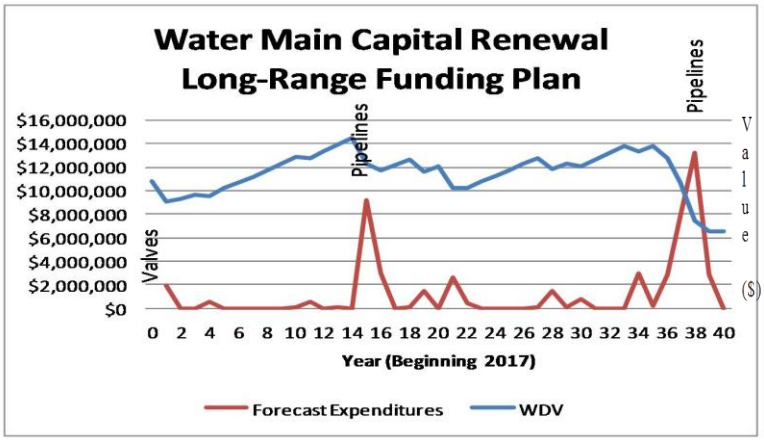


Figure 26 – Treatment Illustration - Water Main Pipe Bursting

For all Water Distribution pipe segments, the Figure 27 is an example of the cost and Level of Service projections over the life cycle. In this example, it is showing continuous deterioration of the Water Distribution network until about year 14. At this time, there is an expectation for significant pipe replacement (i.e. pipe bursting), in which the level of service will improve (i.e. reduced write down value).

Figure 27 – Optimal Expenditure Levels vs. Performance



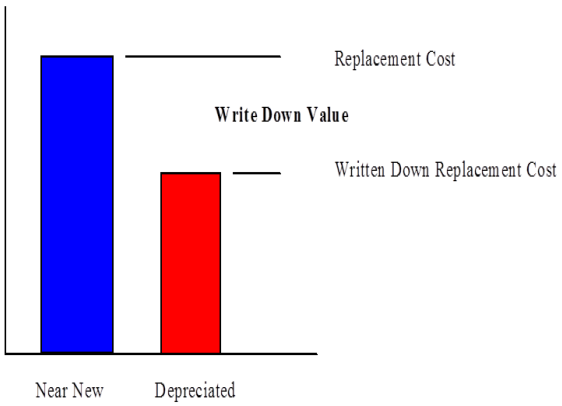


Figure 28 – Optimal Treatment Selection

Over time the cost of maintenance repairs and risk grows. Replacement (i.e. capital renewal) should be triggered at a point when lifecycle costs are minimized.

During the lifecycle, preservation enhancing treatments, such as seals, applied mid-life, can effectively extend the service life deferring expensive replacement costs.

It is important that the lifecycle analysis includes the wide variety of maintenance and capital treatment options so it can minimize lifecycle costs and deliver a plan for infrastructure sustainability.

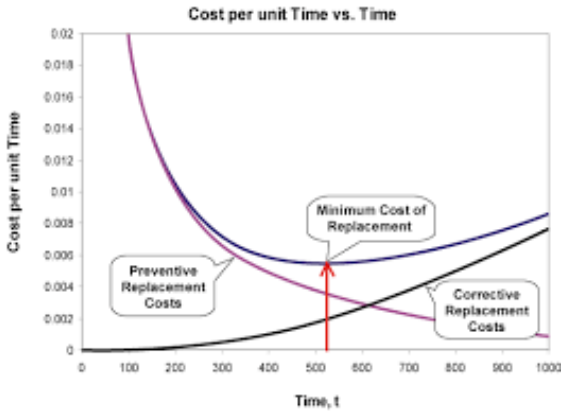
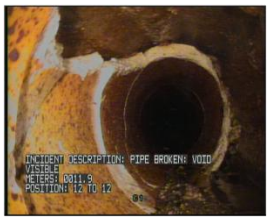


Figure 29a - Mid-Life Preservation Maintenance

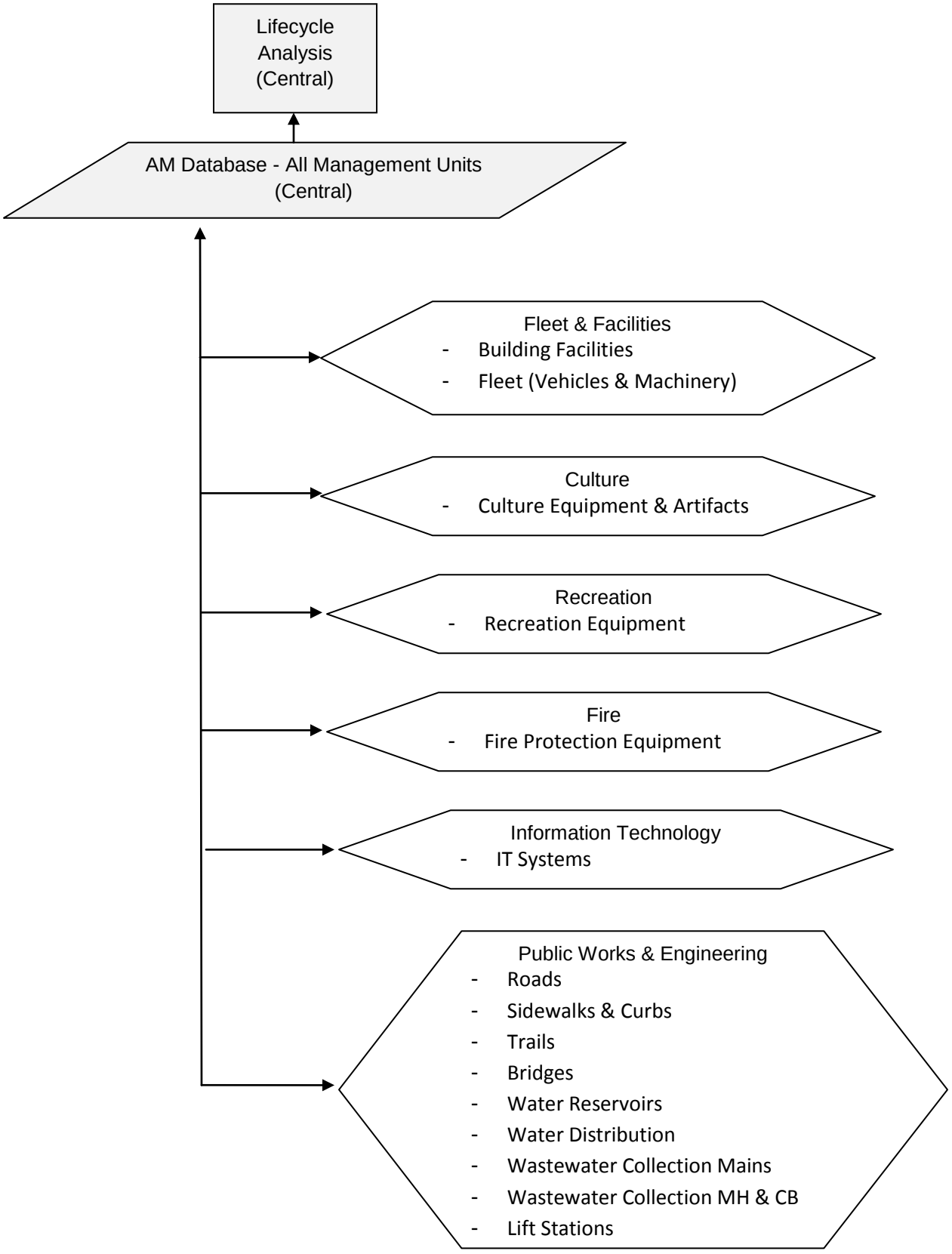
Vs

Figure 29b - End of Life Replacement



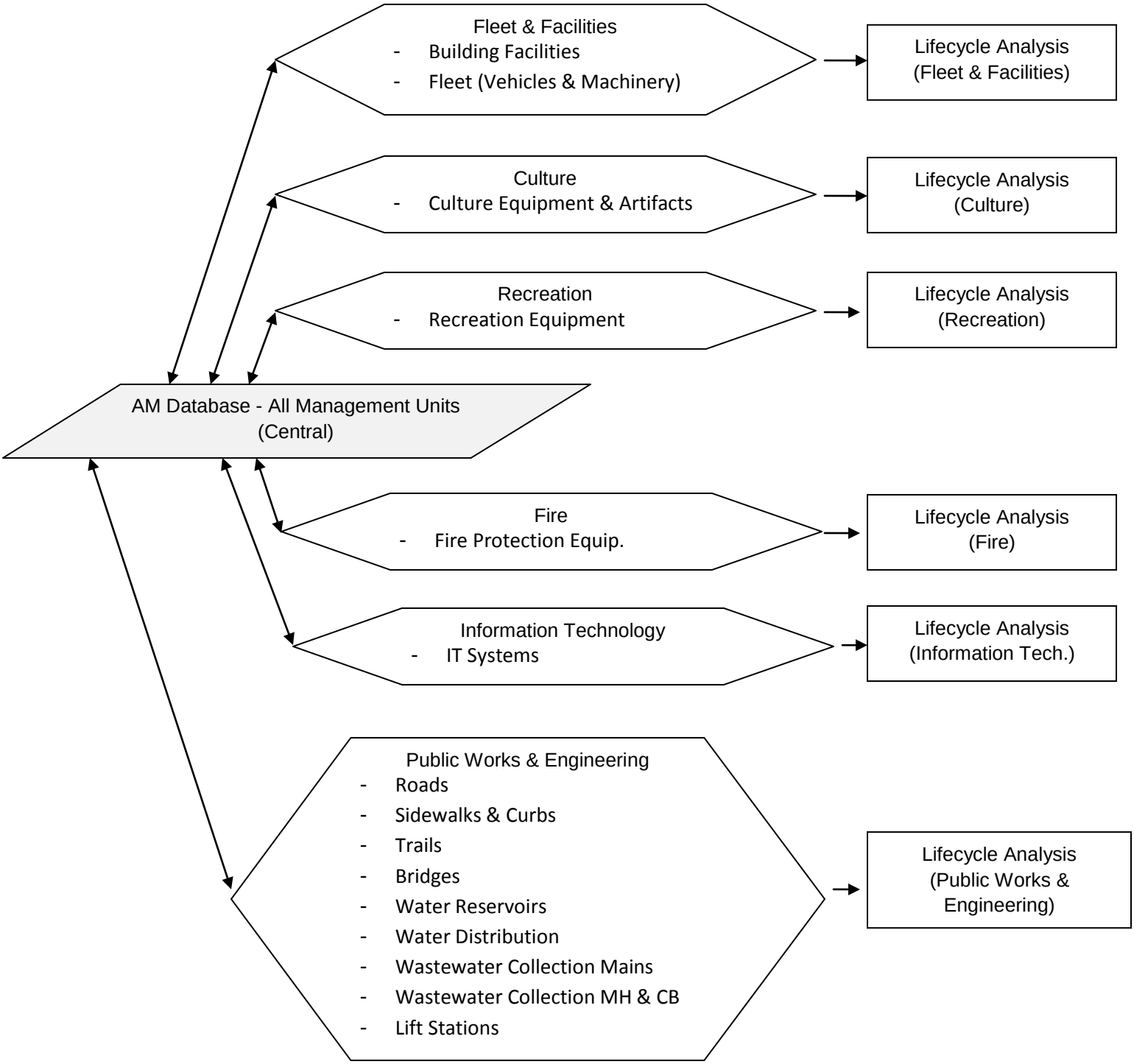
Delivery of Lifecycle Analysis can take two options. The first option is a central lifecycle analysis by a City staff or outsourced specialist with information fed by the performance data housed by the central data repository. All asset groups would potentially follow the same lifecycle analysis process.

Figure 30 – Option 1 – Centralized Lifecycle Analysis



The second option will allow the lifecycle analysis to grow and evolve independently within the business units, which is more in line with the existing organizational culture. In this option, the lifecycle analysis could be very different and involving a variety of systems technologies between the individual business units. However, it does provide the opportunity for each unit to evolve as suited to the history (past practice), culture, and functions. For the City of Fort Saskatchewan, this may be the preferred option as it allows each business unit to improve and evolve to best practices, instead of an abrupt change.

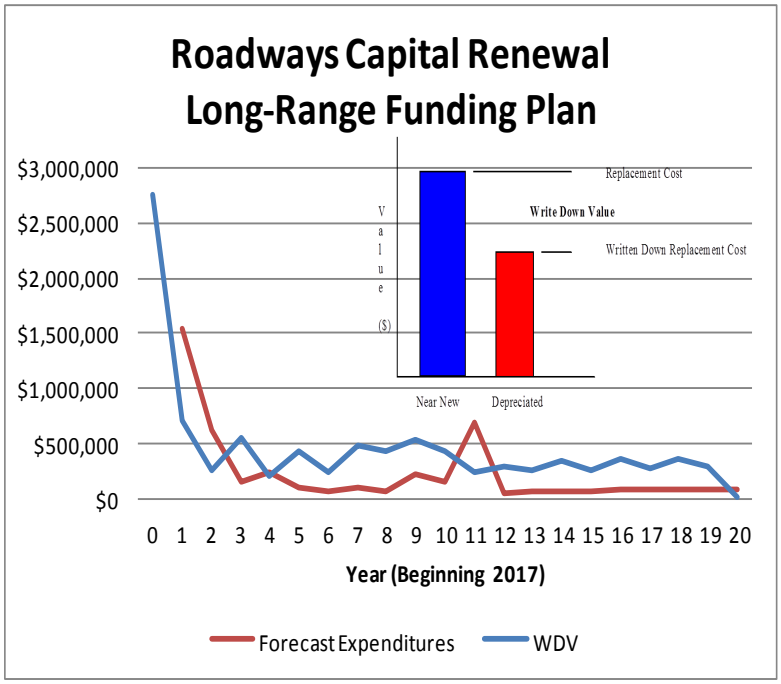
Figure 31 – Option 2 – Decentralized Lifecycle Analysis



Regardless of the lifecycle analysis procedure used by each business unit, the deliverables and reporting need to be seamless between each unit and asset group. The deliverables need to include a target budget and forecast Level of Service.

As example, the following roadway analysis is forecasting a target Level of Service improvement (i.e. reduced Write-Down-Value by $2.3 Million) with a short-term (5-Year) expenditure target of $0.532 Million/year. Then once the sustainability reached, expenditure needs are expected to drop to $0.230 Million/year. At this targeted Level of Service, the municipality would be expected to operate at a higher Level of Service and lower maintenance and capital expenditures.

Figure 32 – Lifecycle Analysis Example – Performance Prediction and Treatment Selection



Roadways	Optimization 5-year	Optimization 20-year
Program Expenditures		
- Total Period Expenditure (M$)	$2.662	$4.607
- Annualized Expenditure (M$/yr)	$0.532	$0.230
Monetary Performance		
- WDV (initial)	$2.759	$2.759
- WDV (End)	$0.427	$0.012
Improved Perf (+)	$2.332	$2.747
Annual Perf Change (M$/yr)	$0.466	$0.137
	17%	5%
Condition State/Index		
- Index (initial)	14	14
- Index (End)	8	7
Improved Condition (+)	6	7
Annual Condition Change (/yr)	1.2	0.4
Annual Condition Change (%/yr)	9%	3%
ROII - Annualized (%/yr)	188%	160%
- (100% = Stabilization Level)		

The resulting maintenance and capital program to deliver the above objectives is summarized as follows:

Table 2 – Example - Roadways Five-Year Maintenance and Renewal Summary

Treatment Activity	Length (m)	Cost ($/yr)
Maintenance		$30,000
Micro-Surfacing (i.e. Micro-Seal)	16,009	$340,000
Resurfacing (i.e. Repaving)	1,446	$162,000
Average Annual Cost		**$532,000**
Total Cost Over 5-Years		**$2,660,000**

The lifecycle summary, including all asset groups is seamlessly presented in the example of Tables 3-5, showing budget to expenditure need comparisons (i.e. financial gap) and the resulting Level of Service projections as a result of the lifecycle analysis and optimization strategy.

Table 3 – Example – Lifecycle Analysis Program Summary

				Financial Gap		Total Expenditure Needs		
				Needs to Budget				20 Year
	Historic	Short-Range	Long-Range	Surplus (+); Deficit (-)		20 Year	20 Year	Monitary
	Budget	(10 Year)	(11-20 Year)			Budget	Expenditure	Performance
	Allocation	Needs	Needs	Short-Range	Long-Range	Allocation	Needs	Change
Asset Group	(M$/yr)	(M$/yr)	(M$/yr)	(M$/yr)	(M$/yr)	($)	($)	($)
Roads	$ 275,464	$ 116,665	$ 569,933	$ 158,799	$ (294,469)	$ 5,509,280	$ 9,132,320	$ 296
Sidewalks & Curbs		$ -	$ 664,650	$ -	$ (664,650)	$ -	$ 9,969,750	$ 3,396,755
Water Distibution	$ 75,400	$ 1,100,859	$ -	$ (1,025,459)	$ 75,400	$ 1,508,000	$ 5,504,295	$ 8,469,889
Sanitary Collection	$ 75,400	$ 552,573	$ -	$ (477,173)	$ 75,400	$ 1,508,000	$ 2,762,865	$ 6,336,031
Storm Water Collection		$ -	$ 193,440	$ -	$ (193,440)	$ -	$ 2,901,599	$ 4,101,467
Treatment Facilities	$ 792,245	$ 935,420	$ 1,255,274	$ (143,175)	$ (463,029)	$15,844,900	$ 23,506,205	$ 1,537,928
Buildings	$ 273,406	$ 272,765	$ 303,339	$ 641	$ (29,933)	$ 5,468,120	$ 5,913,905	$ 2,341,327
Machinery	$ 149,984	$ 283,272	$ 277,103	$ (133,288)	$ (127,119)	$ 2,999,680	$ 5,572,898	$ -
Total	**$ 1,641,899**	**$ 3,261,554**	**$ 3,263,738**	**$ (1,619,655)**	**$ (1,621,839)**	**$32,837,980**	**$ 65,263,837**	**$ 26,183,694**

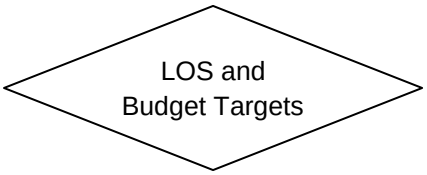
Table 4 – Example - Current (2018) Level of Service

	Condition State					
Asset Group	Good	Fair	Poor	RC	WDV	RSL
Roads	81%	17%	2%	$ 10,432,800	$ 113,729	99%
Sidewalks & Curbs	50%	8%	42%	$ 8,814,900	$ 4,217,177	52%
Water Distribution	8%	8%	84%	$ 10,635,200	$ 8,469,889	20%
Sanitary Collection	5%	0%	95%	$ 9,211,200	$ 6,336,031	31%
Storm Water Collection	15%	70%	15%	$ 6,987,440	$ 4,101,467	41%
Treatment Facilities	47%	0%	53%	$ 5,476,130	$ 3,508,895	36%
Buildings	21%	79%	0%	$ 22,490,062	$ 13,312,674	41%
Machinery	78%	16%	6%	$ 2,351,895	$ 1,059,785	55%
Totals				**$ 76,399,626**	**$ 41,119,648**	

Table 5 – Example - Projected (2038) Level of Service

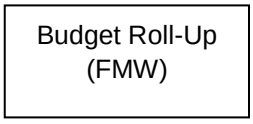
	Condition State					
Asset Group	Good	Fair	Poor	RC	WDV	RSL
Roads	96%	4%	0%	$ 10,432,800	$ 113,433	99%
Sidewalks & Curbs	73%	15%	12%	$ 8,814,900	$ 820,422	91%
Water Distribution	100%	0%	0%	$ 10,635,200	$ -	100%
Sanitary Collection	96%	4%	0%	$ 9,211,200	$ 66,086	99%
Storm Water Collection	100%	0%	0%	$ 6,987,440	$ -	100%
Treatment Facilities	100%	0%	0%	$ 5,476,130	$ 1,970,967	64%
Buildings	67%	0%	33%	$ 16,462,062	$ 10,971,347	33%
Machinery	78%	16%	6%	$ 2,351,895	$ 1,059,785	55%
Totals				**$ 70,371,626**	**$ 15,002,040**	

The decision management involves determining if the budget targets and the Level of Service targets are reasonable and within the corporate strategic mandate. This is typically assessed through the corporate leadership. The corporate leadership would determine which asset group strategy would be submitted for budget consideration and which asset group would return to the lifecycle analysis for revision under the guidance of new parameters.



3.4 Maintenance and Capital Budget Programming

The results of the lifecycle analysis would be used to submit the maintenance and capital budget programs through the existing financial system functionality (i.e. FMW).



It is the prerogative of Council to accept or reject any part or the entire submitted budget program. It would be expected that some asset groups may be returned back to the lifecycle analysis under the guidance of new parameters.

3.5 Monitoring and Program Management

Program Delivery
- Operations
- Capital

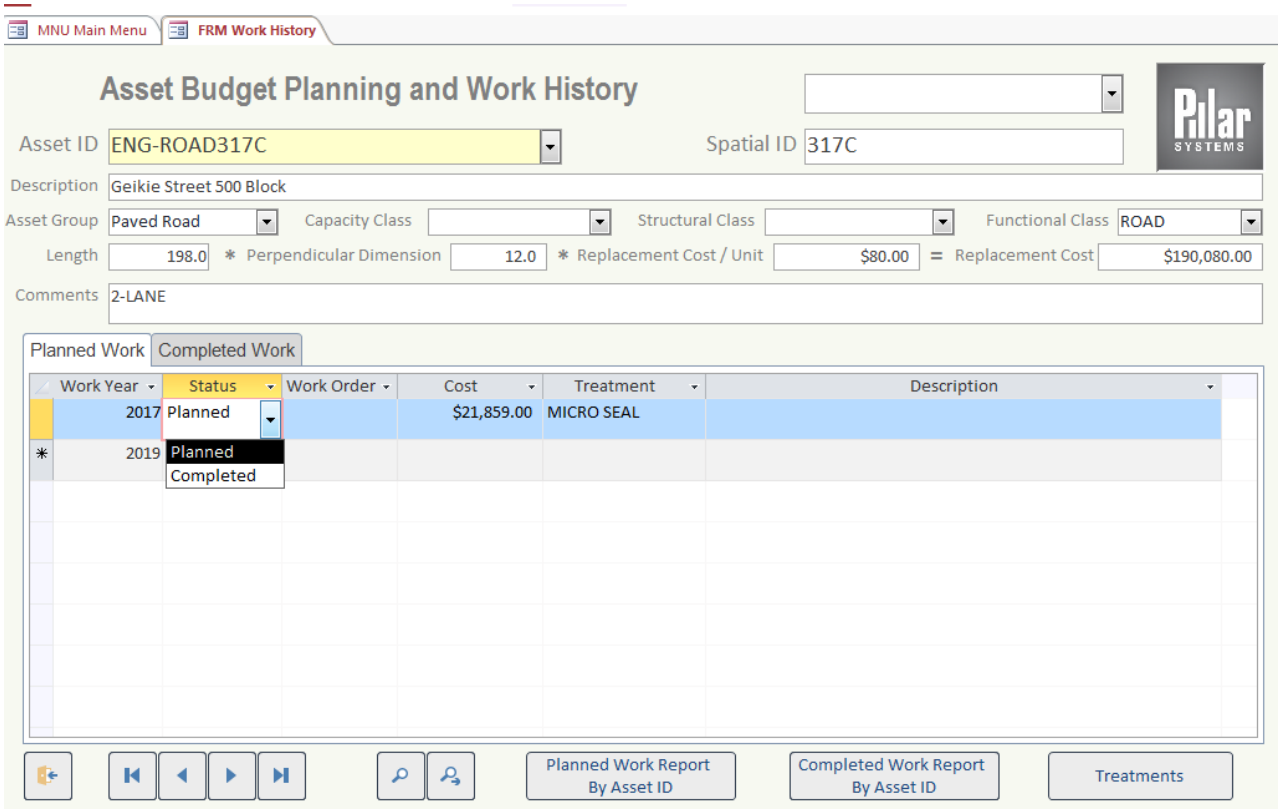
On approval of the maintenance and capital budget programs, the asset management program is delivered though the budget year.

Works are delivered through a variety of means, including internal operations (via. work orders) or through contract (i.e. via purchase orders or contractual agreement). The works program should be monitored and managed for overall financial management and program level adjustments.

Works Progress Monitoring

The maintenance and capital programs should be updated within any of a number of asset management systems. The City is currently using “Work Tech” for some of its business units (i.e. Public Works Roads). Regardless of the chosen system, it is important to monitor the progress of each Asset ID that is programmed for maintenance or capital works. Planned works become completed works.

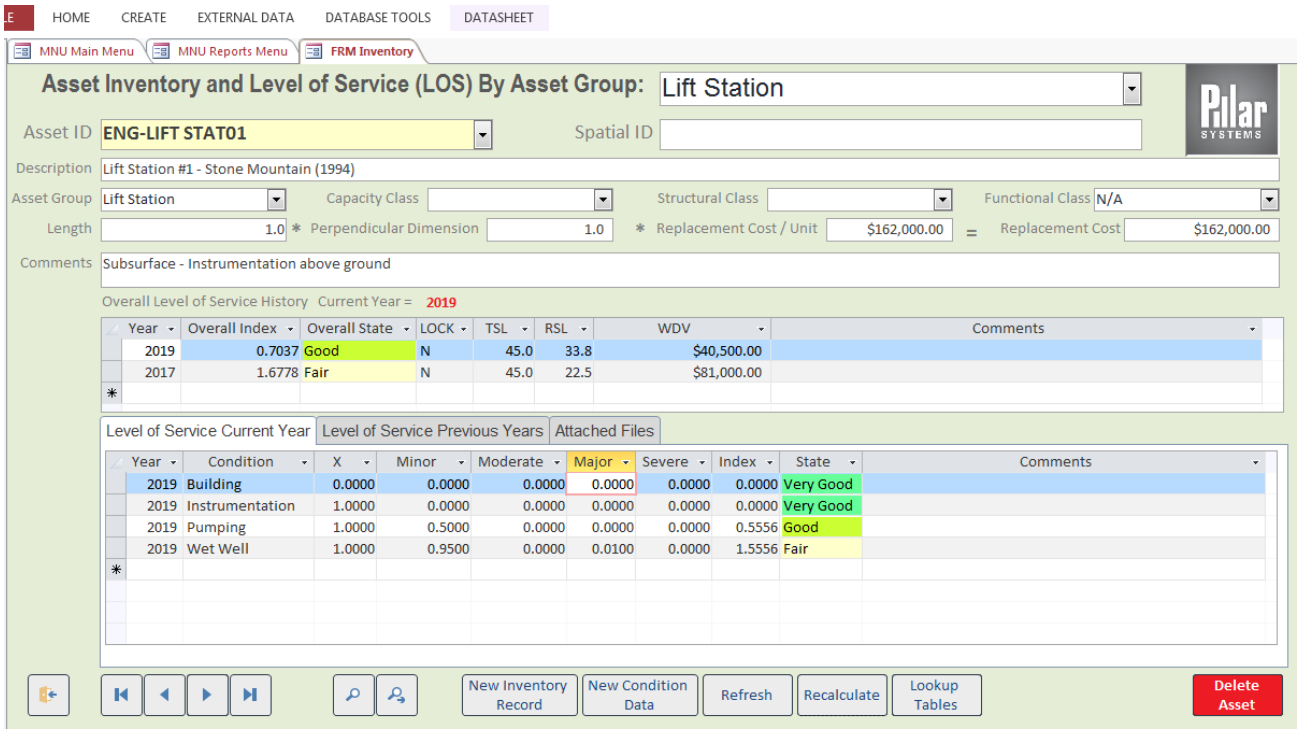
Figure 33 – Example - Monitoring Planned and Completed Works



Upon completion of works, the Asset ID condition state should be updated. In the example illustrated in Figure 34, the lift station had a “Fair” overall condition state assessed in 2017 due to substandard instrumentation. In 2019, the instrumentation was updated and the overall condition state updated to “Good”.

Performance Assessment Update

Figure 34 – Example – Performance Assessment Updates after Work Completed



Upon completion of works, these updates may be made within the Asset Management Database.

Then this information would be centrally updated to the City’s financial system as part of overall program monitoring and control.

AM Database → Financial Management Program Update (Expenditures & LOS)

It would be desirable for the central reporting system to be in a ‘Dashboard’ real-time reporting framework, providing updates from the field as they occur on financial expenditures, works completed, and Level of Service updates as a result of the completed works.

4. Gap Analysis

The systems gap is the difference between the recommended asset management systems framework to what exists today. The following sections highlight the systems gap in relation to each of the 5 asset management components. In part, it is a reflection on the high level elements involving policy, procedure, governance, and overall asset management strategy.

The following provides a readiness level assessment based on the following scale:

1. Undeveloped
2. Development beginning
3. Developed, but requires improvement
4. Developed and functioning adequately
5. Developed and recognized as an industry best practice (i.e. considered as an example for other municipalities to follow)

The gap analysis details for each asset management component are contained in Appendix B. These are summarized in Table 6.

Table 6 – City of Fort Saskatchewan Existing Readiness Level Summary

Component	Readiness Level (1-5)	Comments
Asset Inventory	1-3	• Tangible Capital Assets database partially functioning • Geographic Information System in development • No Asset Management Database
Performance Assessments & Level of Service	1-3	• No performance assessment criteria • Level of Service partially developed for some Engineering & Public Works asset groups (i.e. roads, sidewalks, trails, sanitary sewer)
Lifecycle Analysis & Decision Management	1-3	• Most developed for roads using lifecycle optimization technology • Beginnings for other asset groups, but subjective based
Maintenance & Capital Budget Programming	2-4	• System process in place for rolling up the budget submissions from the various management units • The quality of the submissions in developmental stage due to the preparation from the preceding lifecycle analysis and decision management stage.
Monitoring & Program Management	1-2	• Minimal Project level monitoring occurring • Program level systems in place (i.e. FMW) but only partially functioning with no dashboard reporting for decision makers to monitor the financial, works completed, and Level of Service changes in real time throughout the delivery of the asset management program.

5. Strategy

The City of Fort Saskatchewan wishes to develop an integrated condition (i.e. performance) based asset management system. The purpose of this asset management program is to manage their Tangible Capital Assets effectively that will maximize the value for taxpayers, while delivering infrastructure sustainability over time.

The primary objectives of the asset management program should deliver the following:

- Maintain a relational Asset Management Database that houses single line records for the inventory of each Tangible Capital Asset; and the many supporting performance assessment records collected over time.
- Establish performance criteria based on a structured severity-extent approach common to all asset groups, but with definitions unique for each asset group. The foundation of performance criteria is based on the assets physical condition, functional adequacy, and utilization (capacity); were there may be multiple performance criteria representing any one of these. Asset valuation (i.e. Replacement Cost to Write-Down-Value) is assessed as a function of the Tangible Capital Asset's performance criteria.
- To conduct re-occurring performance assessments based on the defined criteria.
- To conduct lifecycle analysis for each asset group based on performance prediction into the future and treatment selection that will minimize costs and deliver a plan for infrastructure sustainability.
- To develop maintenance and capital budget programs based on delivering the infrastructure sustainability plan.

The secondary objective of the asset management program may be considered upon implementation of the primary objectives:

- Establish a City-wide system for monitoring the delivery of the asset management program including real-time dashboard reporting of works completed, actual expenditures, and reassessed Tangible Capital Asset performance resulting from the maintenance and capital program delivery.

Based on the asset management gap analysis and the City's overall readiness level, the following highlight a strategic approach that would support effective implementation:

- There are asset management components that are fundamental to the functionality of the asset management system as a whole. These should have the most immediate implementation priority.
- There are asset management components that are required to deliver asset management solutions, but will not bring down the entire system. These are the second most immediate in the implementation priority.
- There are asset management components that are desirable, but may not be an asset management requirement. These would be the third most immediate in the implementation priority. These components may be deferred until the other components are functioning, with the need reviewed at that time.
- The asset management system should be deployed in smaller manageable steps. Each step is a milestone for evaluation on its success. Each step may be further refined before moving on to the next step. These incremental steps may be used as a template for future steps and may influence subsequent deployment

of the remainder of the asset management plan. There is benefit in not moving too far ahead and to reassess and adjust at each milestone before moving forward.

- A pilot project is a prudent incremental step. A pilot project implementation around the Public Works & Engineering asset groups (i.e. Roads, Sidewalks & Curbs, Trails, Bridges, Water Reservoirs, Water Distribution, Wastewater Collection, Lift Stations) would be a logical starting point for the following reasons:
    - The asset management practice around performance assessments & LOS and lifecycle analysis is the most developed. Implementation is a natural transition from the existing practice.
    - The water distribution and wastewater collection asset groups are expected to be the most critical and should have the highest implementation priority.
    - The Public Works & Engineering asset groups have the greatest asset value and will have the greatest benefit to the City upon implementation.

Based on the proposed strategy, Appendix C contains the supporting Asset Management Policy.

6. Implementation Plan

The following implementation plan is based on a logistical approach to improving and building asset management functionality in sequential steps. In essence, it is a roadmap to deploying an asset management program.

The following color associated with a component illustrates the relative importance/priority of the implementation component:

- High Priority – Required for functionality of the asset management system as a whole
- Medium Priority – Not system dependent, but required to deliver asset management solutions
- Low Priority – Desirable, but may not be an asset management requirement

Table 7 – Asset Management Implementation Plan

Component	Action Item	Year	Comments
Asset Inventory Update			
Tangible Capital Assets (Inventory)	• Define Asset Groups • Verify Asset ID's	2019	Limited Asset Groups which condition assessment criteria can be identified around. One Asset ID per asset. Supporting transactions created in a child table related to the parent Tangible Capital Assets table.
Geographic Information System (Inventory)	Complete implementation	2020	Desired for Geographic Information System Spatial ID to be the same identifier as the Tangible Capital Assets Asset ID.
Asset Management Performance Criteria and Database			
Performance Criteria	• Involves all City business units including all asset groups • Criteria developed in a document for each asset group • Develop the threshold/risk levels for each defined severity level.	2020	Working group facilitation with each department representative(s) responsible for the asset group. Criteria should be condition based (i.e. physical condition, capacity, functional adequacy) in severity (minor, moderate, major, sever) – extent (%) format. The condition types listed in the criteria need to be indicative of treatment options, to be developed later for the lifecycle analysis.
Asset Management Database	• Develop for central application to house all asset groups. • Upload asset inventory for all asset groups.	2020	Build or purchase existing software to house the asset inventory and condition assessment data as per the condition elements identified within the previously developed Performance Criteria. In addition, it should include asset valuation in terms of replacement cost and write-down-value. The AM Database is a one-to-many database relationship: • Having one parent asset with the option for many child assets (components of the parent asset) • Having one line item per parent asset or

Component	Action Item	Year	Comments
			child asset and many performance assessment records.
Pilot Project (Public Works & Engineering Asset Groups) - Initial			
Performance Assessment & Level of Service	• Implement as pilot project for Public Works and Engineering Asset Groups: ○ Roads ○ Sidewalks & Curbs ○ Trails ○ Bridges ○ Water Reservoirs ○ Water Distribution ○ Wastewater Collection ○ Lift Stations • Input/Import data to the Asset Management Database	2021	Based on previously developed performance criteria. This will require some modification of historic performance assessments and information processing. The actual performance assessment may use a combination of in-house and outsourced resources to collect the data.
Lifecycle Analysis and Decision Management	• Develop process and implement for Public Works and Engineering Asset Groups. • Conduct a review with general management on program costs and resulting Level of Service performance attained.	2021	May consider alternate/parallel lifecycle analysis methods to compare results of historic analysis to others that may improve the end results. The performance criteria may influence the selected system analysis utilized for the asset group. Expected outsourced lifecycle modeling analysis similar to what is being done for the Roads asset group.
Maintenance and Capital Budget Programming	• Public Works & Engineering Asset Groups ○ Submit newly developed decision management process through FMW. • Remaining Asset Groups ○ Submit as per historic decision management process through FMW.	2021	The process of submitting the maintenance and capital program is somewhat unchanged. The main difference is the content, in which the Public Works & Engineering asset groups have undergone a condition assessment and lifecycle analysis leading to the budget programming submission.
Review Period			
All Components	Public Works and Engineering • Assess results • Process adjustments for second year trial	2021	Review and adjust if necessary
Monitoring & Program Management	Public Works and Engineering • Defer	TBD	Desired, but not required. Future consideration.
Pilot Project (Public Works & Engineering Asset Groups) - Refined			
• Performance	Process refined and repeated	2022	Approach should be streamlined, including

Component	Action Item	Year	Comments
Assessments & LOS • Lifecycle Analysis & Decision Management • Maintenance & Capital Budget Programming.			selecting one of alternate/parallel analysis approaches considered in initial pilot.
Full Implementation – All Asset Groups (Expected on-going process)			
• Performance Assessments & LOS • Lifecycle Analysis & Decision Management • Maintenance & Capital Budget Programming.	Pilot project to be used as guidance in extending to all asset groups: ○ Roads ○ Sidewalks & Curbs ○ Trails ○ Bridges ○ Water Reservoirs ○ Water Distribution ○ Wastewater Collection ○ Lift Stations ○ Building Facilities ○ Fleet (Vehicles & Machinery) ○ Culture Equipment & Artifacts ○ Recreation Equipment ○ Fire Protection Equipment ○ IT Systems	2023	The performance assessment framework consistent among all asset groups. The lifecycle analysis may vary between asset groups. Regardless of the lifecycle analysis process, the delivery of the maintenance & capital budget still remains the same for all asset groups through FMW. The end result in the corporate delivery of the asset management program remains seamless between asset groups.

7. Conclusions and Recommendations

7.1 Conclusions

The following conclusions are drawn given the findings of this report.

- The City is in a developing asset management state, with varying levels of readiness between business units and associated asset groups.

- There are two critical and immediate asset management development needs. The first is developing the Performance Criteria, which is the foundation for assessing the infrastructure Level of Service. The second is implementing an Asset Management Database to house the current asset inventory, house future condition data, and calculate the infrastructure Level of Service (i.e. State of the Infrastructure) on an on-going basis moving forward. The Asset Management Database needs to accommodate one (inventory) to many (performance data) functionality. It needs to house the raw (severity-extent) condition data and compute the resulting condition state (i.e. Level of Service) from the raw data. This can be a critical element later in the lifecycle analysis modeling.

- Consideration for "Risk" is addressed early in the performance criteria through defined threshold levels associated with each performance measure. These in part define the asset's current and forecast Level of Service through the lifecycle analysis. Decision management is continually inclusive of the consequence of risk in determining the appropriate expenditure levels, Level of Service, and resulting maintenance & capital budget program.

- The Public Works & Engineering asset groups (i.e. roads, sidewalks & curbs, trails, bridges, water reservoirs, water distribution, wastewater collection, lift stations) are the most asset management ready due to performance data collected, Level of Service determination, and some lifecycle analysis using advanced optimization technology (i.e. Roads). By the readiness scale, this would be considered "Development Beginning" to "Developed but Needs Improvement".

- Even with the asset management advancements in the Roads asset group, the process can evolve including refinement of performance measures to be assessed; refinement of the performance criteria; utilizing a standardized Level of Service assessment consistent with the other asset groups within the City; utilizing the severity-extent condition data in the lifecycle analysis instead of the indexed values; and integrating maintenance & capital renewal within the lifecycle analysis. While the City is running an acceptable Roads lifecycle analysis, other technologies can improve on the analysis reliability, resulting in improved decision management moving forward into maintenance and capital budget programming. This will realize additional financial and infrastructure sustainability benefits to the City.

- Initial pilot project implementation involving the Public Works and Engineering asset groups from the Asset Inventory to the Maintenance & Capital Budget Programming components would provide the City with a strong understanding of the true potential of infrastructure asset management. This experience would prove valuable for implementation of the City's remaining asset groups moving forward.

- While implementation of the Monitoring & Program Management component provides additional benefit, it can be deferred. Deferring Monitoring & Program Management may be prudent so the City may focus first on reaching the desired functionality on the other asset management system components before moving forward with this component.

- The Asset Management Strategy led to the development of an Asset Management Policy that may be adopted by Council.

- Upon appropriate implementation, the results of the asset management program should realize a Return on Infrastructure Investment (ROII) considering the investment cost of the maintenance and capital expenditures versus the benefit of improved Level of Service (i.e. asset valuation). This is also in consideration of the overhead costs of managing the asset management program.

- The resulting asset management program should provide insight and engagement to Council and senior administration in capturing the following:
    - Report Card – Upon completion of the performance assessment and level of service
    - Strategy – Upon completion of the lifecycle analysis in deriving the infrastructure sustainability plan
    - Action– In developing the resulting maintenance and capital program that will deliver the infrastructure sustainability plan

- The asset management implementation may bring forward an asset management champion that may provide support to all City business units in the continued delivery of its asset management program.

7.2 Recommendations

The following recommendations are drawn given the above noted conclusions.

- That the City adopts the strategy, policy, and implementation plan as presented in this report.

Appendix A

Performance Measure Groups

Performance Measure Groups

Asset Group	Performance Measure	Data Acquisition Method	Comments
Roads (Paved)	Rutting	Automated	
	Thermal (Lineal) Cracking	Automated	
	Fatigue Cracking	Automated	
	Ravelling (Surface Condition)	Automated	
	FWD (Structural)	Testing	Optional
	Roughness	Automated	
	Grade (relative to top of curb)	Manual Inspections	Determination of overlay potential
	Capacity (traffic)	Records Review	V/C LOS analysis within the City's TMP
Sidewalks & Curbs	Cracking	Manual Inspections	
	Spalling (i.e. open surface texture)	Manual Inspections	
	Vertical Differential (Distortion)	Manual Inspections	Paving stones only
Trails (Paved)	Thermal (Lineal) Cracking	Manual Inspections	
	Fatigue Cracking	Manual Inspections	
	Ravelling (Surface Condition)	Manual Inspections	
Bridges	Abutments – Physical Condition	AT – BMIS (records)	Standardized assessment
	Piers – Physical Condition	AT – BMIS (records)	
	Span (Girders) – Physical Condition	AT – BMIS (records)	
	Deck – Physical Condition	AT – BMIS (records)	
	Rail – Physical Condition	AT – BMIS (records)	
Water Reservoirs	Tank Structure - Physical Condition and Capacity	Manual Inspections Master Planning Records	Specialized Peak flow & fire flow supply volume
	Pumping – Physical Condition, and Capacity	Records Review	
Water Distribution	Structural Pipes (remaining wall thickness)	Testing	
	Structural Valves	Records Review	Failures
	Capacity (sizing)	Records Review	Hydraulic models
Wastewater Collection (Sanitary & Storm)	Structural (NASSCO PACP Grade)	Automated	CCTV
	O & M (NASSCO PACP Grade)	Automated	CCTV
	Capacity (As per CCTV assessment)	Records Review	CCTV interpretation or hydraulic models
Wastewater Lift Stations	Instrumentation – Physical Condition and Functional Adequacy	Manual Inspections	
	Pumping – Physical Condition, and Capacity	Records Review	

Asset Group	Performance Measure	Data Acquisition Method	Comments
	Wet Well – Physical Condition, and Capacity	Manual Inspections	Specialized
	Building Envelope – Physical Condition and Functional Adequacy	Manual Inspections	
Building Facilities	Civil	Manual Inspections Records Review	Staff discussions and review of formal inspection reports
	Exterior Building	Manual Inspections Records Review	
	Interior Building	Manual Inspections Records Review	
	Plumbing	Manual Inspections Records Review	
	HVAC	Manual Inspections Records Review	
	Electrical	Manual Inspections Records Review	
Recreation Equipment	Physical Condition	Manual Inspections Records Review	Condition state or remaining service life
	Capacity	Records Review	Is it the right size
	Functional Adequacy	Knowledge Base	Is it the right piece of equipment for the job
Culture Equipment & Artifacts	Physical Condition	Manual Inspections Records Review	
	Capacity	Records Review	N/A for Artifacts
	Functional Adequacy	Knowledge Base	
Fire Equipment	Physical Condition	Manual Inspections Records Review	
	Capacity	Records Review	
	Functional Adequacy	Knowledge Base	
Information Technology	Physical Condition	Manual Inspections Records Review	
	Capacity	Records Review	
	Functional Adequacy	Knowledge Base	
Fleet (Vehicles & Machinery)	Body & Frame	Manual Inspections	Staff discussions and review of maintenance management records
	Power Train	Manual Inspections	
	Brakes & Steering	Manual Inspections	
	Fuel & Electrical	Manual Inspections	
	Cooling & Heating	Manual Inspections	
	Lights & Windshield	Manual Inspections	
	Hydraulics	Manual Inspections	
	Attachments	Manual Inspections	

Appendix B

Gap Analysis

Gap Analysis

1.1 Asset Inventory

The following are three fundamental asset inventory components that are centrally managed (i.e. Corporate Services for all City business units)

- Tangible Capital Assets (TCA)
  - Missing definition of asset group. There should be a select few asset groups.
    - Roads
    - Sidewalks & Curbs
    - Trails
    - Bridges
    - Water Reservoirs
    - Water Distribution
    - Wastewater Collection Mains
    - Wastewater Collection Manholes and Catch Basins
    - Wastewater Lift Stations
    - Building Facilities
    - Recreation Equipment
    - Culture Equipment & Artifacts
    - Fire Equipment
    - Information Technology
    - Fleet (Vehicles & Machinery)
  - The current Tangible Capital Assets database contains multiple records for the same Asset ID. The Tangible Capital Assets database should contain only one record for each Asset ID with supporting transactions included in a sub-table indicative of a one-to-many relationship housed in a relational database environment.
  - The depreciated amount is not indicative of the condition state of the asset, in particular to assets with zero book value, the asset is still operating. The accounting net book value of assets should be regularly compared to performance assessments utilizing a calculated Write-Down Value as the performance measure to assess for impairment. Depreciation rates and methods should be regularly reviewed and adjusted based on the usage, physical condition, technological developments, and changes in laws.
  - Readiness Level = 3
- Geographic Information System (GIS)
  - Not developed for asset management
  - The new ESRI ArcGIS platform is only partially developed and missing the asset attributes (i.e. physical characteristics of the older assets).
  - No Spatial ID reference to the Asset ID linking the asset to that within the Tangible Capital Asset database. It is desirable for this to be the same reference.

- Readiness Level = 2

- Asset Management Database
  - There is no system in place for storing and managing asset inventory and condition assessment data. This is structured around a one-to-many relationship with one record per Asset ID and many performance assessment records. The Asset Management Database is an important function as it is the pivot point for all asset management functions. The Tangible Capital Assets database could evolve to be the Asset Management Database if contained within a relational database environment.

  - Readiness Level = 1

1.2 Performance Assessments and Level of Service

- Performance Assessment Criteria – All Asset Groups
  - There are no criteria established for conducting condition assessments and determining Level of Service.

  - Readiness Level = 1

- Level of Service - Roads, Sidewalks & Curbs, Trails, Bridges, and Wastewater Collection Mains asset groups
  - External service providers and the Alberta Government (i.e. Bridges) are providing some order of Level o f Service assessment. However, the LOS assessment for these asset groups is not consistently defined; in particular, to condition state (i.e. very good, good, fair, poor, very poor) and asset valuation (i.e. write-down-value), which should be uniquely assessed for each asset group, but seamless in reporting between asset groups.

  - Readiness Level = 2-3

- Level of Service – Remaining Asset Groups
  - No LOS assessment in place

  - Readiness Level = 1

1.3 Lifecycle Analysis and Decision Management

- Roads
  - Optimization lifecycle analysis being conducted using dRoads system managed by an external service provider. The lifecycle analysis is missing the maintenance component. The LOS performance projections into the future are not using a City defined LOS criteria consistent with all asset groups.

  - Readiness Level = 3

- Sidewalks & Curbs and Trails

- While these asset groups have undergone a condition assessment, there is no LOS performance prediction and lifecycle analysis determining the optimal sequence of maintenance and capital treatments over time.

- Readiness Level = 2

- Bridges, Water Reservoirs, Wastewater Lift Stations, and Information Technology
  - No lifecycle analysis in place

  - Readiness Level = 1

- Water Distribution
  - The City is using theoretical service life as the lifecycle decision factor for replacement. However, it is not a strong indicator for actual remaining service life and consequence of risk. It should be using condition assessment (i.e. testing of pipe samples extracted during maintenance repairs) as the basis for the lifecycle analysis.

  - Readiness Level = 2

- Wastewater Collection Mains, Manholes & Catch Basins
  - While these asset groups have undergone a condition assessment (i.e. NASSCO PACP), there is no LOS performance prediction and lifecycle analysis determining the optimal sequence of maintenance and capital treatments over time. The City is using theoretical service life as the lifecycle decision factor for replacement. However, it is not a strong indicator for actual remaining service life and consequence of risk. The NASSCO rating should continue to be the basis for the lifecycle analysis.

  - Readiness Level = 2

- Building Facilities
  - The City's lifecycle analysis workbooks are missing quantitative LOS performance prediction measures as the decision management criteria in selecting the treatment schedule. Treatment selection is knowledge-based, subjective, and uncertain of the LOS return on infrastructure investment (ROII).

  - Readiness Level = 2

- Recreation Equipment, Culture Equipment and Artifacts, and Fire Equipment
  - The City's lifecycle analysis workbooks are missing quantitative LOS performance prediction measures as the decision management criteria in selecting the treatment schedule. Treatment selection is knowledge-based, subjective, and uncertain of the LOS ROII.

  - Readiness Level = 2

- Fleet (Vehicles & Machinery)
    - The City is using WorkTech to develop its fleet replacement program. However, the decision process appears to be theoretical service life, which is not a strong indicator of actual remaining service life. A condition based LOS assessment would be more reliable. Missing also is the maintenance component in the decision process.

    - Readiness Level = 2

1.4 Maintenance and Capital Budget Programming

- Systems
    - The City has a functioning central budget system (i.e. Great Plains, FMW module). It is centrally operated and seamless between business units in rolling up budget submissions.

    - Readiness Level = 4

- Budget Program Results
    - The drawback is the programming information submitted from the lifecycle analysis for each asset group is, for the most part, still in a development state.

    - Readiness Level = 2

1.5 Monitoring and Program Management

- Monitoring Works Completed
    - Some asset groups (i.e. fleet) initiated monitoring 'works completed' using WorkTech. However, for most asset groups works completed is not systematically monitored.

    - Readiness Level = 2

- Condition Assessment Updates
    - LOS not updated after works complete.

    - Readiness Level = 1

- Central Financial and Progress Updates
    - The financial system module FMW supports partial level of progress reporting on a quarterly batch reporting basis. However, it does not provide real-time reporting, and LOS updates. This should be functioning as a dashboard reporting so decision makers can monitor the financial, works completed, and LOS changes through the delivery of the asset management program.

    - Readiness Level = 2

Appendix C

Asset Management Policy

COUNCIL POLICY

XXX-XXX-C

Asset Management Policy

Date Issued: September 3, 2019 – R_____#

Mandated by: Council

Current Revision: September 3, 2019

Cross Reference:

- Asset Management Procedure FIN-___-A
- Tangible Capital Assets Policy FIN-018-C
- Operating and Capital Budgets Policy FIN-024-C

Next Review: January 1, 2022

Responsibility: City Manager

1. PURPOSE

To establish a governance framework and provide guidance regarding the management of the City's Tangible Capital Assets necessary for the delivery of municipal services.

2. POLICY

The City shall develop Asset Management Plans for each Tangible Capital Asset or class of Tangible Capital Assets that establishes:

2.1 An inventory of Tangible Capital Assets containing sufficient information to support Asset Management Plans;

2.2 Performance criteria and ongoing monitoring schedules;

2.3 Lifecycle analysis and decision management practices that are proactive and maximize value for taxpayers;

2.4 Maintenance and capital programs that are sufficiently detailed to facilitate consideration in the annual budget, in accordance with the City's Operating and Capital Budgets Policy FIN-024-C; and

2.5 Monitoring and program management schedules for reporting the ongoing delivery of maintenance and capital works, including work completed, costs, and performance reassessment

3. DEFINITIONS

3.1 *Asset Management* – means managing the inventory, Level of Service determination, and maintenance and capital renewal strategy to deliver a program for Infrastructure Sustainability.

3.2 *Asset Management Plan* – means the result of integrated processes involving performance and Level of Service assessments, lifecycle analysis, and developing maintenance and capital budget program.

3.3 *Capital Renewal* – means major works of a capital contract nature used to renew the whole of the Tangible Capital Asset to a near-new condition or state.

3.4 *City* – means the City of Fort Saskatchewan.

3.5 *Council* – means the municipal Council for the City.

3.6 *Infrastructure Sustainability* – means the Tangible Capital Asset is sufficiently funded and operating at a Level of Service that will minimize lifecycle costs, including the consequence of Risk to the City's operations, services, and safety to the general public.

3.7 *Level of Service* – means a defined measure that quantitatively illustrates the performance of Tangible Capital Assets.

3.8 *Maintenance* – means operational activities to sustain parts of the Tangible Capital Asset in an operational state

3.9 *Risk* – means the quantified consideration for the consequence of a failed or deteriorated Tangible Capital Asset, including consideration for the probability of the risk event and the impact of the risk event.

3.10 *Tangible Capital Asset* – has the meaning defined in the City's Tangible Capital Asset Policy FIN-018-C.

4. GUIDING PRINCIPLES

4.1 Inventory:

4.1.1 The City shall maintain inventories of all its Tangible Capital Assets in accordance with the City's Tangible Capital Asset Policy FIN-018-C.

4.1.2 The City shall maintain performance assessment records of all its Tangible Capital Assets.

4.2 Performance Assessments & Level of Service:

4.2.1 The City shall maintain and manage Tangible Capital Assets at levels defined by Council to provide municipal services while ensuring public safety.

4.2.2 The City shall monitor Levels of Service and standards to ensure that they meet/support community and Council goals & objectives.

4.3 Lifecycle Analysis & Decision Management:

4.3.1 The City shall endeavor to deliver effective Asset Management programs that will maximize the value for taxpayers while ensuring Infrastructure Sustainability over time.

4.3.2 The City's Asset Management program shall be proactive, and be designed to address issues before they become an immediate Risk.

4.3.3 The City shall deliver lifecycle analysis projections and analysis based on the principles of doing the right treatments, to the right Tangible Capital Asset, at the right time.

4.3.4 The City shall endeavor to determine the Infrastructure Sustainability level, as the optimal Level of Service and expenditure level.

4.3.5 The City shall consider Risk as a component of its lifecycle analysis.

4.3.6 The City shall identify the funding gaps between the optimal expenditure level and current budget allocations.

4.3.7 The City shall plan for and provide stable long-term funding to sustain the Tangible Capital Assets at the determined Infrastructure Sustainability level.

4.4 Maintenance & Capital Budget Programs:

4.4.1 The City shall establish maintenance and capital budget programs through the use of lifecycle performance prediction, treatment selection, and costing principles.

4.4.2 The City shall integrate corporate, financial, business, technical and budgetary planning for Tangible Capital Assets.

4.4.3 The City shall approve budget programs based on a program strategy that is consistent with corporate environmental, sustainability, and social goals.

4.5 Monitoring & Program Management

4.5.1 The City shall integrate the Asset Management program into operational plans throughout the organization.

4.5.2 The approved maintenance & capital budget program shall be responsibly monitored and managed, including adhering to periodic financial and progress reporting.

5. AUTHORITY / RESPONSIBILITY TO IMPLEMENT

City Manager is authorized to establish procedures for the implementation of this Policy which are consistent with the governing principles.