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EVALUATION OF GASB-34 MODIFIED APPROACH
REQUIREMENTS TO IDENTIFY STRENGTHS AND
WEAKNESSES IN CURRENT MUNICIPAL ASSET
MANAGEMENT SYSTEMS FOR SEWER AND WATER
INFRASTRUCTURE

presented by

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has been accepted towards fulfillment
of the requirements for the

M.S. degree in Construction Management

Mohammad Najafi
Major Professor's Signature

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**EVALUATION OF GASB-34 MODIFIED APPROACH REQUIREMENTS TO
IDENTIFY STRENGTHS AND WEAKNESSES IN CURRENT
MUNICIPAL ASSET MANAGEMENT SYSTEMS FOR
SEWER AND WATER INFRASTRUCTURE**

By

Amanda Rae Simpson

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ABSTRACT

EVALUATION OF GASB-34 MODIFIED APPROACH REQUIREMENTS TO IDENTIFY STRENGTHS AND WEAKNESSES IN CURRENT MUNICIPAL ASSET MANAGEMENT SYSTEMS FOR SEWER AND WATER INFRASTRUCTURE

By

Amanda Rae Simpson

Asset management is becoming a necessary means of conducting business. With rising costs and decreasing funds, making the most out of the available funds is essential, and asset management is an important tool for achieving this. The Government Accounting Standards Board statement number 34 (GASB-34) recognizes this problem, and allows for a financial reporting method which takes asset management practices into account. This method is called the modified approach. The Association of Metropolitan Sewerage Agencies (AMSA) suggests that using the modified approach will eventually be required by lending agencies and other monitors. This research surveyed several cities in the state of Michigan to determine what asset management practices were currently being used. Recommendations were then made on the essential steps needed to achieve compliance with the GASB-34 modified approach requirements. These recommendations can be used to help municipalities and other agencies wishing to use the modified approach for GASB-34 reporting.

Dedicated to My Loving Parents

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Chapter 1

INTRODUCTION

1. INTRODUCTION

“Out of Sight, Out of Mind.” It is one of the most famous and favorite idioms in today’s American culture. The saying suggests the idea that when something is not in sight, it is simply forgotten about. This idiom has been used to refer to everything from a forgetful husband to homeless children to the future of Afghanistan. It is used here, however, on a subject the majority of the public depends on every day: the nation’s crumbling infrastructure. The “out of sight, out of mind” approach has been taken with regards to sewer and water infrastructure for far too long. With most of the nation’s underground infrastructure being laid in the 1950’s, it is now at the end of its useful life, and requires serious maintenance or replacement. With continuous rising costs, tightening budgets, and an ASCE Infrastructure Report Card grade of D- for the nation (ASCE, 2005), keeping the infrastructure in working condition that allows for the comforts of everyday life is a challenge faced nation-wide.

1.1 Motivation

On December 21, 2005, a sinkhole approximately ten feet wide and ten feet deep opened up near a bank building in Newport, OR. A sewer line that was installed in 1950 and runs 25 to 30 feet below the building failed, causing the sinkhole that now blocks entry to the business and threatens the foundation of the building. A state of emergency was declared so that the city could forego its normal bidding process of soliciting bids for the project. (Card, 2005)

Outside Pittsburgh, Pennsylvania, an overpass bridge collapsed dropping onto an interstate, injuring five motorists on December 27, 2005. While the possibility of truck impacts is being investigated as to the cause of the collapse, state officials say the overpass had reached the end of its service life. State officials closed a 3-mile section of the highway to clean up debris, effecting around 33,000 motorists per day. The overpass, for which specifications for emergency repair are being prepared, services approximately 500 motorists per day. (Barnes, 2005)

Infrastructure failures like the two mentioned above happen all too often and cost the tax payers millions of dollars. The cost of emergency repairs is significantly higher than scheduled maintenance, not to mention additional costs of emergencies such as the potential foundation damage to the building and the social costs of traffic disruptions and the five injured people.

The primary question here is why these infrastructure disasters were allowed to happen. In both cases, local governments and utility owners stated that the infrastructure had reached the end of its service life, yet action was not taken to remedy the problem until an emergency status had been reached. As the water and wastewater infrastructure enters its “replacement era,” it becomes more important to implement asset management concepts, where assets are regularly monitored and maintained to a certain performance level. Additionally, while emergencies and accidents are inevitable, their frequencies can be significantly reduced by proper management techniques.

1.2 Problem Statement

In June of 1999, the Government Accounting Standards Board (GASB) issued Statement 34 (GASB-34) creating one of the largest changes in state and local government financial reporting (Maze, 2001). This statement requires that government agencies report their major infrastructure assets on an accrual basis, and can do so either by using depreciation or the “modified approach.” As a result of short notice and lack of asset management practices, most government agencies, both state and local, use the depreciation method of reporting. This method, however, carries little information for infrastructure asset management and maintenance, and therefore, provides no service to the end user: the tax payers and consumers who are faced with disruptions.

The “modified approach,” on the other hand, takes on an asset management strategy to accounting reporting, and requires the integration of several departments and detailed asset information. However, it may seem time consuming and costly initially to set up, which explains why most governments have elected to use the depreciation method. As outlined in this research, the main advantage of the modified approach is that it provides useful information with regards to assets, their conditions, and their current value. It also takes steps to ensure effective long-term management of major infrastructure assets, which is not only cost-effective, but also increases public safety. The modified approach requires accountability to both the government and the public, and this method is recognized and supported by agencies such as the Environmental Protection Agency (EPA) as the preferred reporting method. The Association of Metropolitan Sewerage Agencies (AMSA) predicts that reporting using the modified approach will eventually be

required by lending institutions and other monitors. Other professional organizations such as American Society of Civil Engineers (ASCE) have started similar initiatives that promote an asset management approach to managing infrastructure. One of these efforts, entitled Practice, Education and Research for Sustainable Infrastructure (PERSI) seeks to advance and incorporate concepts and knowledge of sustainability into the standards and practices used throughout the life cycle of infrastructure systems. (ASCE, 2005 a)

One aspect of the problem, therefore, lies in the conversion of GASB-34 compliance reporting from the depreciation method to the modified approach. This research identifies specific areas of asset management that are currently being practiced by the majority of local governments and municipalities, and determines if these practices are acceptable for the GASB-34 modified approach reporting method. It also identifies and makes recommendations on asset management practices that can be implemented to bring a local government and municipality up to GASB-34 compatibility.

1.3 Goals and Objectives

By evaluating GASB-34 requirements, the overall goal of this research was to assist local governments and communities in effectively managing their underground infrastructure. The main objective of this research was to use the GASB-34 modified approach requirements to identify areas of strength and weakness in current asset management practices in sewer and water municipalities. The following activities were used to realize this objective.

1. Reviewed the definitions and methodologies of asset management;
2. Reviewed the GASB-34 requirements and parameters;
3. Surveyed a minimum of four to six cities in Michigan with populations greater than 20,000 on their current asset management practices that are specific to GASB-34 modified approach compliance;
4. Identified areas of asset management that need to be improved or changed to meet the GASB-34 modified approach requirements; and
5. Prepared recommendations for municipalities and local governments to bring their asset management program up to GASB-34 modified approach reporting requirements.

1.4 Scope and Limitations

This research was conducted based on the following parameters:

- The research was limited to known asset management practices and the requirements of the GASB-34 modified approach reporting method;
- Due to limited resources and nature of this research, only a select number of local governments and municipalities were surveyed;
- Only sewer and water infrastructure was considered for this research;
- Only cities in Michigan with populations over 20,000 were considered for this research. It was assumed that these cities will represent asset management practices currently utilized in Michigan, as smaller cities are unlikely to have any asset management practices currently in place (Brown, 2006).

1.5 Organization of the Thesis

This thesis is comprised of five chapters. The first chapter offers a brief introduction to the problem area, as well as the motivation, goals, objectives, and limitations of the research. The second chapter gives background information on asset management, GASB-34 requirements, and previous research in this area. Chapter Three presents the methods used to achieve the goals and objectives presented in Chapter One. Chapter Four presents the data gathered from the survey along with the analysis of the data. Chapter Five outlines the suggestions made as a result of the data gathered in Chapter Four, along with a validation of these suggestions by city officials. Chapter Five also includes the conclusions, recommendations, and areas for future research.

Chapter 2

LITERATURE REVIEW

2. LITERATURE REVIEW

The previous chapter outlined the background, goal, and need for this research. This chapter provides a detailed literature review that covers asset management methodologies, the GASB-34 requirements, and previous research in the field of asset management.

2.1 Asset Management Definitions

Asset management is a very broad term that can encompass several meanings. This section aims to identify recognized definitions and methodologies of asset management in the infrastructure industry.

The Association of Metropolitan Sewerage Agencies (AMSA) defines asset management for water and wastewater agencies as “managing infrastructure capital assets...to minimize the total cost of owning and operating them while delivering the service levels customers desire,” (AMSA, 2002). The AMSA also recognizes asset management as a means of ensuring “the best decision at all levels of the asset’s life-cycle to optimize performance, reduce risk and minimize cost,” (AMSA, 2002).

An essay by Paralez and Muto, published by the American Water Works Association (AWWA), defines asset management as “a philosophy of business that is reflected in a strategy of operating, maintaining, refurbishing and replacing infrastructure and system assets based on customer service standards (such as pressure, quality, reliability, response) and economic standards (such as life-cycle costing, debt service) and capital

management,” (Paralez and Muto, 2002). Paralez and Muto also cite the Seattle Public Utilities working definition in their essay as “a way of doing business that maximizes the public’s return on their investment in utility infrastructure by implementing utility-wide strategies that emphasize reliability in the assets and processes so that the desired levels of service are provided to our customers in the most cost-effective manner,” (Paralez and Muto, 2002).

The International Infrastructure Management Manual (IIMM) states that the goal of asset management is to “meet a required level of service in the most cost-effective way through the creation, acquisition, maintenance, operation, rehabilitation and disposal of assets to provide for present and future customers,” (IIMM, 2002).

The American Society for Civil Engineers & Civil Engineering Research Foundation (ASCE & CERF) is developing concepts and frameworks for asset management of infrastructure, but has not recognized one single definition of asset management, although several publications on asset management have been published through the ASCE (Baik, 2003). One definition presented at an ASCE conference states simply that asset management is “the application of good business practices which enable the utility to consistently provide a desired level of service for the minimum long term cost,” (Derr, 2004).

While there is no universally accepted definition of asset management (Baik, 2003), all the definitions previously described have the same key points: to meet a level of service

that is satisfactory to the customers, and to provide that service in the most cost-effective manner.

2.2 Benefits of Asset Management (AM)

Future funding considerations is one of the main reasons why asset management practices are so crucial. The Water Infrastructure Network estimates that the U.S. will have to invest \$23 billion per year more than current investments for the next 20 years in order to replace infrastructure and meet regulatory requirements (WINow, 2001). Having the funding for the future sewer and water infrastructure needs is problematic. Private citizens currently pay 90% of the total cost to build, operate, and maintain water and wastewater systems (WINow, 2001). Increased taxes and fees will help pay a portion of the future funding requirements, but if local governments were to close the funding gap alone, it would result in the doubling of user rates and result in economic hardship for at least one-third of the population (WINow, 2001). Federal funding will be imperative to the future water and wastewater rehabilitation and replacement programs. Because waters are shared across state and local boundaries, federal help to local governments will benefit the entire nation (WINow, 2001). Having an AM system will allocate funding to the most crucial parts of the infrastructure, maintaining service level in a cost effective manner.

The benefits of AM are numerous, but the main reason for having AM is because it is a good business practice that provides both short- and long-term benefits to the utility and

its customers (AMSA, 2002). Additional benefits as outlined by the AMSA are as follows:

- Defines an orderly and logical program of repair and replacement of capital facilities and equipment;
- Develops a comprehensive inventory of capital assets;
- Creates a valuable financial planning tool intended to smooth financial programming and maintain realistic replacement spending;
- Creates logical justifications to help elected officials understand utility's need to maintain reserves;
- Provides necessary funds for operating personnel to maintain equipment and perform major cyclic repairs without having to compete for scarce public resources;
- Provides lower overall rates for the public;
- Reduces rate shock;
- Creates better equipment managing and results in longer equipment lives; and
- Creates a better matching of resources and financial needs. (AMSA, 2002)

According to Water Infrastructure Network, investing in water and wastewater systems will pay substantial dividends to the public health, environment, and the economy (WINow, 2001). By preventing pollutants from reaching the rivers, lakes, and coastlines, water treatment plants prevent water-borne disease, make America's waters safe for swimming and fishing, and preserve natural treasures such as the Great Lakes (WINow, 2001). Having an AM system in place will assure that scarce funding is allocated to the

assets that need it the most, and will maintain a standard of service that is acceptable to customers.

2.3 Asset Management Framework

All owners practice some form of asset management (AM). However, a formal AM system indicates a dedication to a cost-effective, systematic, and sustainable infrastructure. This section outlines the asset management methodologies for three separate organizations: the National Asset Management Steering (NAMS) Group that published the International Infrastructure Management Manual, the Association of Metropolitan Sewerage Agencies (AMSA), and the American Water Works Association. All three agencies have a slightly different approach to implementing a sophisticated asset management program (AMP) and to identify the components and needs of an AMP.

2.3.1 National Asset Management Steering (NAMS) Group's

International Infrastructure Management Manual 2002 (IIMM)

The IIMM was published in 2002 and was developed jointly by the New Zealand National Asset Management Steering (NAMS) Group and the Institute of Public Works Engineering of Australia. The manual has become a staple to asset managers, and is referenced in most asset management research. The following information has been modified or taken directly from the IIMM.

The IIMM identifies the following elements as a key portion to any AMP:

1. Taking a lifecycle approach;

2. Developing cost-effective management strategies for the long-term;
3. Providing a defined level of service and monitoring performance;
4. Managing risks associated with asset failures;
5. Sustainable use of physical resources; and
6. Continuous improvement in asset management practices. (IIMM, 2002)

The steps for preparing an asset management plan outlined by the IIMM, as illustrated in Figure 2.1, include:

- Step One: Identify Objectives;
- Step Two: Outline the AM Plan Structure and Content;
- Step Three: Write the Plan;
- Step Four: Have the Plan Reviewed; and
- Step Five: Update the Plan. (IIMM, 2002)

The following sections further explain above steps.



Figure 2. 1 Steps for Preparing AM Plans, Modified from IIMM 2002

Identify Objectives. The first step, to identify objectives, determines who the target audience of the plan is, what that audience already knows about the organization, what the desired information from the plan is, and how the information is intended to be used. This step also identifies the level of detail and extent of information to which the target

audience will have access. Determining this lays the boundaries the asset management program will have.

Outline AM Plan Structure and Content. The outline of the AMP structure and content can be either very detailed or very general, depending on the set objectives of the AMP. This step requires the AM team to define how assets will be grouped for reporting purposes. For example, sewer lines can be categorized by type or by location. Other factors influencing the decision on how to categorize assets include: the number and the value of assets, if the assets are managed in similar ways, the scale of maintenance and operational costs, where the assets are in their lifecycle, the depth of asset information available, and the structure of management and service delivery contracts. (IIMM, 2002)

Write the Plan. There is no ideal structure to an AMP, however the IIMM outlines nine sections that can be included in an AMP to serve as a guideline for developing one. There are nine steps that include:

- Executive Summary;
- Introduction;
- Levels of Service;
- Future Demand;
- Lifecycle Management Plan;
- Financial Summary;
- Asset Management Practices;
- Plan for Improvement and Monitoring; and

- References and Appendices. (IIMM, 2002)

These steps are discussed in more detail below.

Executive Summary. The executive summary should be a separate document that gives an overview of the entire AM plan, and include general information emphasizing the key issues of asset management. (IIMM, 2002)

Introduction. The introduction to the AMP should provide the reasons for preparing the AMP and a justification for owning and operating the assets covered in the AMP. It should include:

- **Background:** which covers the purpose of the plan, relationship with other planning documents, infrastructure assets included in the plan, key stakeholders in the plan, and the organization structure;
- **Goals and Objectives of Asset Ownership:** which cover the reasons and justification for asset ownership and links to organization vision, mission, goals, and objectives;
- **Plan Framework:** including the key elements of the plan; and
- **Basic and Advanced AM:** outlining a basic to advanced approach of AM, and defining the sophistication and limitations of the particular AMP.

Having a basic understanding of the AMP and the reasons why it is being implemented is the purpose of the introduction. (IIMM, 2002)

Levels of Service. This section should clearly define the levels of service that are proposed for the AM plan, and should include the following information:

- Customer Research and Expectations;
- Strategic and Corporate Goals;
- Legislative Requirements;
- Current Level of Service; and
- Desired Level of Service.

Details within each of these categories should be provided so that the desired outcome of the AMP is specific and quantifiable. (IIMM, 2002)

Future Demand. Predicting the growth needs of the assets will be beneficial for planning purposes and asset allocation. This section addresses those needs with the following categories:

- **Demand Forecast:** factors influencing demand should be mentioned in this section, along with a detailed projection of growth or decline of demands on services, anticipated changes in customer expectations, and the impact of changes in demand on asset utilization;
- **Changes in Technology:** use of new technology and its effects on providing future services should be outlined in this section, along with the obsolescence of current practices; and
- **Demand Management Plan:** this section should describe non-asset solutions available as alternatives to asset-based solutions (i.e., demand

management, insurance, and managed failures) and also summarize new works programs and costs.

Understanding the future demand of an asset system will allow for good planning and resource allocation. (IIMM, 2002)

Lifecycle Management Plan. This section aims to outline exactly what is planned in order to manage and operate the assets at the agreed level of service while optimizing lifecycle costs. There are five subsections to the lifecycle management plan, and they are as follows:

- Background data;
- Routine maintenance plan;
- Renewal/replacement plan;
- Creation/acquisition/augmentation plan; and
- Disposal plan. (IIMM, 2002)

The background data should include the physical parameters of the assets, such as age, size, mix, material, location and current issues. Also this section should include a summary of total asset parameters in table or graph formats, an overall plan of asset system or network, and how to obtain part-by-part asset information. The capacity and performance of the asset, condition of the asset, valuations of the asset, and historical data should also be included in the background data of the lifecycle management plan. (IIMM, 2002)

The routine maintenance plan includes the regular day-to-day work that is necessary to keep the assets operating, including emergency repair for portions of assets. The maintenance plan should include the current trends and issues of the assets (i.e., spending and complaints), current and past levels of service, and the maintenance decision-making process, both planned and unplanned. Also included in this section should be standards and specifications defining the materials, methods, and service standards that have been set in order to meet the level of service, and the risks associated with alternative standards. A summary of future costs should also be included, such as forecasting planned and unplanned maintenance work and costs, noting deferred maintenance as an associated risk, and outlining how maintenance will be funded. (IIMM, 2002)

Renewal/replacement consists of major work that restores, rehabilitates, replaces, or renews an existing asset to its original capacity. It does not increase the asset's design capacity. Work that increases design capacity is considered new works expenditure, and does not apply in this section. The renewal/replacement plan should follow the similar format of the maintenance plan, and include a renewal plan that shows how replacements/renewals are identified and to what standards they are replaced, the end of life projections, and the renewal decision-making process. The renewal standards need to be set defining the materials, methods, and service standards to meet required levels of service, and the risks associated with alternative standards. This section also includes a summary of future costs, including a forecast program of replacements and costs, cash flow forecast of costs, deferred renewals, risk analysis, and identification of how replacements will be funded. (IIMM, 2002)

The creation/acquisition/augmentation plan is for new works, which include any upgrade or improvement which exceeds the previous asset's capacity. Upgrades and improvements are a result of growth and/or social and environmental needs. This process should begin with selection criteria that outline a formal procedure for ranking asset creation/acquisition projects, have standards and specifications that define the materials, methods, design standards, and risks associated with alternatives, and have a summary of future costs. (IIMM, 2002)

Disposal plan is the final step in an asset's lifecycle and includes any activity related to disposing of a decommissioned asset, including the sale, demolition, or relocation of the asset. For the disposal plan, future disposal needs should be forecasted and include the time and cost of the disposal, and a cash flow forecast of income/expenditure from asset disposal should also be formulated. (IIMM, 2002)

Figure 2.2 shows the components of the lifecycle management plan that is described above.

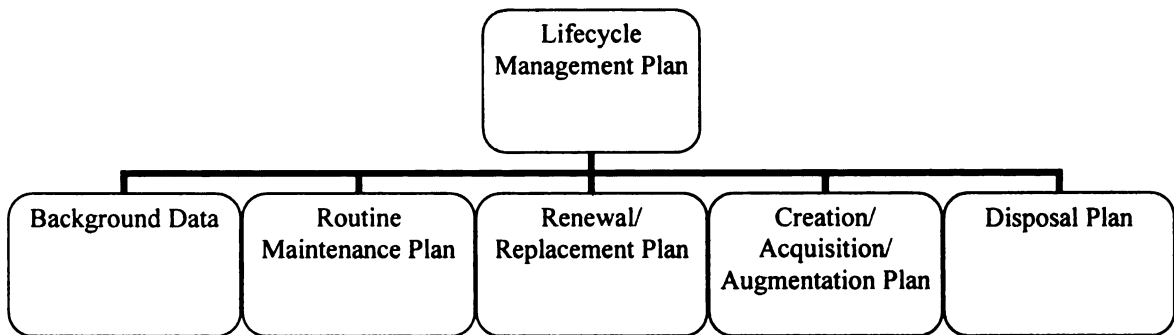


Figure 2. 2 Lifecycle Management Plan Components Identified in IIMM 2002

Financial Summary. The financial summary should contain the financial requirements from all the information previously presented. The financial summary should include the following:

- **Financial statements and projections:** should be prepared for a minimum of 10 years, and include cash flow forecasts by year, breakdown of expenditure by service groups, breakdown of expenditure into routine maintenance, renewal and new works expenditures, and trends from the previous two to three years;
- **Funding strategy:** should provide details of how expenditure will be funded and determine whether any planning is needed to smooth out variations in cash flow;
- **Valuation forecasts:** forecast of future value of asset and valuation methodology and forecast of depreciation; and
- **Key assumptions made in financial forecasts:** essential for the reader to understand the accuracy of the financial forecasts and how they can be improved.

The financial summary provides detailed information on the current and future value of assets, and outlines how future expenditures will be funded. (IIMM, 2002)

Asset Management Practices. This section will outline the information available on the assets, the information systems used, and the processes used to make decisions on how the asset will be managed. The accounting and financial systems portion must detail: the accounting system and any changes that have been made as a result of the AMP, define the differences between maintenance, renewal, and new works expenditure, and provide details of accounting standards and guidelines that must be complied with. The asset management systems portion must detail the types of data available for AM decision making, state the quality, reliability, and adequacy of the data, define the software (if any) used to store and analyze data, state where the information is stored and how often data is collected. Information flow requirements and processes must also be defined, stating the key information flows to and from the AMP, the processes used to make decision on AM for replacements, renewals and acquisitions. Additionally, state the formal project ranking system (if any), define the process to make the best decision, and state if the process takes into account risk cost, lifecycle costs, performance prediction, and optimized decision making. Also, key standards and guidelines influencing AM attributes should be stated in this section. (IIMM, 2002)

Plan Improvement and Monitoring. A key portion of an AMP is to have a means for monitoring and improving it. This section of the plan details the performance measures,

improvement program, and the monitor and review procedures that will be used to continuously monitor and improve the asset management plan. (IIMM, 2002)

References and Appendices. The plan will undoubtedly have been created using outside documents and resources. This section of the asset management plan should include any references used along with any necessary appendices, such as asset data, capital expenditure programs, etc. that would be important references for others who are being introduced to the AMP. (IIMM, 2002)

Figure 2.3 shows the nine sections discussed above that outline a written asset management plan as laid forth by the 2002 IIMM.

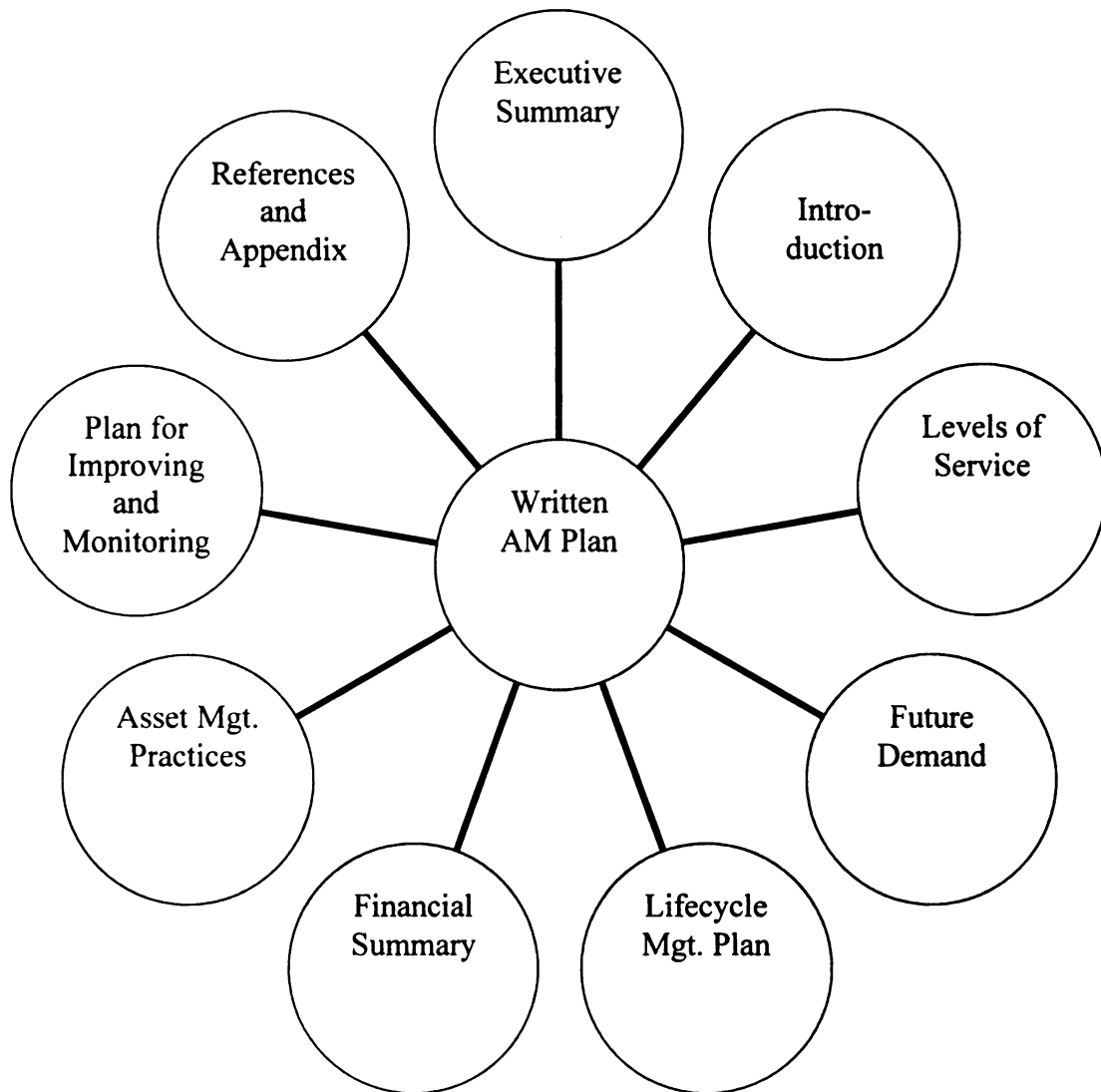


Figure 2. 3 Components of the Written Asset Management Plan Identified in the IIMM 2002

The nine sections discussed above outline the sections within an asset management plan. The AMP is probably the most time- and resource-consuming step in the asset management process, but it entails the majority of the “work” that needs to be put forth to implement an asset management system. The AMP should be a working document within

the asset management process, and is not expected to be complete at the beginning. The following two steps are the last in the asset management planning process:

Review of the Plan. Once the plan has been compiled, a person with expertise in asset management should look over the plan and identify its strengths and weaknesses as well as its ability to meet any disclosure or other criteria. (IIMM, 2002)

Update the Plan. The plan should be a working document that is constantly updated as customer expectations change, AM systems improve, assets are added to the network, and if any other changes occur that would affect the AMP. (IIMM, 2002)

2.3.2 Association of Metropolitan Sewerage Agencies (AMSA)

According to AMSA, the primary reason to implement asset management is because it is a good business practice that provides short- and long-term benefits to the utility and its customers. AMSA defines five major elements of asset management:

1. strategy;
2. asset retention;
3. tool integration;
4. business process redesign; and
5. outreach and reporting. (AMSA, 2002)

Figure 2.4 illustrates the basic building elements for a quality asset management program as outlined by the AMSA.

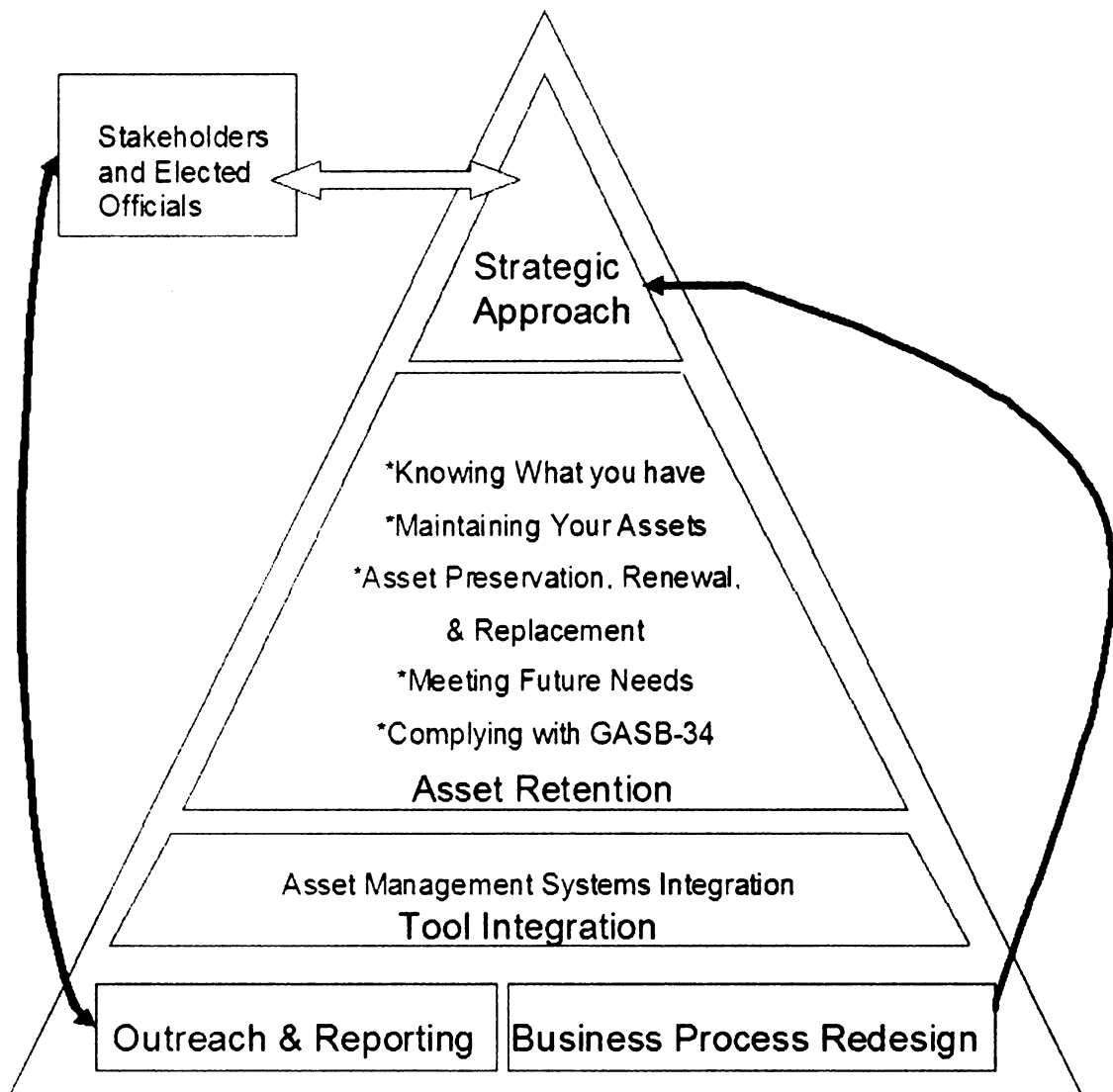


Figure 2. 4 Elements of Asset Management, Modified from AMSA 2002

Strategy. The development of a strategy integrates the policies and performance standards with the selection of asset management tools. The strategy is always in the development stage as it should be revisited periodically to ensure a continuous improvement cycle. The strategy outlined guides the asset management process, as it provides the formula that defines how the relationships between human resources/labor relations policies, information management policies, continuous improvement policies,

and financial policies will be resolved in order to provide optimal service delivery. The steps recommended by the AMSA to develop an asset strategy are as follows:

- Develop appropriate asset management objectives and integrate them with other agency goals;
- Charter and empower a cross-disciplinary asset management team;
- Develop appropriate targets and measurements to meet identified objectives; and
- Adopt related asset management policies to ensure a successful program.

(AMSA, 2002)

Asset Retention. Asset retention occurs after the strategy has been developed, and includes an inventory of assets and their maintenance, preservation of value and function, and replacement strategies. This step also includes the integration of needs to meet growth and regulatory demands into the asset retention model and determine the financial requirements to meet those needs, and to plan for attaining the necessary resources. Asset retention includes steps such as inventory of the assets, maintaining the assets, asset preservation, renewal, and replacement, meeting of future needs, and complying with the GASB-34. (AMSA, 2002)

Inventory. Having a complete inventory of assets is the first step for managing assets. Before a complete inventory of assets is done, the level of asset inventory should be defined. For example, an entire pump system can be considered as a single asset, or the pump, motor, and frame can all be accounted for individually. Regardless of the level of

inventory to be completed, an inventory database should be readily accessible and include the following information:

- Size and/or capacity;
- Construction materials;
- Location;
- Installation date;
- Original cost;
- Replacement cost;
- Condition assessment;
- Performance assessment;
- Original service life; and
- Estimate of remaining useful life.

An information audit within the company can be very useful to determine the type of information available and the format it is in for the multiple inventories often held by each utility or organization. (AMSA, 2002)

Maintenance. Performing systematic maintenance on assets allows for the optimal performance at minimal cost. There are two types of maintenance: planned or proactive maintenance, and unplanned or reactive maintenance. Proactive maintenance includes preventative maintenance and predictive maintenance. Preventative maintenance includes routine activities such as cleaning and adjusting, and is performed at predetermined fixed intervals, such as calendar days or number of uses. Predictive maintenance includes activities that are not regularly performed by preventative maintenance, but will delay or

prevent total failure of the asset which would result in an unplanned maintenance activity. An example of predictive maintenance would include vibration analysis or ultrasonic monitoring, and is usually used on critical or costly assets where the benefit of predictive maintenance outweighs the cost. For example, ultrasonic monitoring would be beneficial on a large water main running under a busy highway because the cost of monitoring it is far less than the costs incurred from an emergency repair, which would include closing the highway, emergency maintenance, and the loss of water to numerous communities and any other unforeseen costs. Corrective maintenance is a type of unplanned or reactive maintenance, and usually follows a failure or shutdown of an asset so that it can be repaired or restored. If corrective maintenance is not suitable for bringing the asset back to its design life, then the asset should be scheduled for renewal or replacement.

The maintenance of assets needs to be balanced between planned and unplanned maintenance schedules so that the cost of maintenance activities is minimized. Figure 2.5 illustrates the deterioration and renewal strategies for an asset which results in the effective management and operation of the asset. This figure demonstrates several maintenance activities during the life of the asset with continued deterioration process until the point that a major renewal/rehabilitation/replacement is required. After the renewal process, asset starts a new life with a new cycle of maintenance activities and deterioration process. (AMSA, 2002)

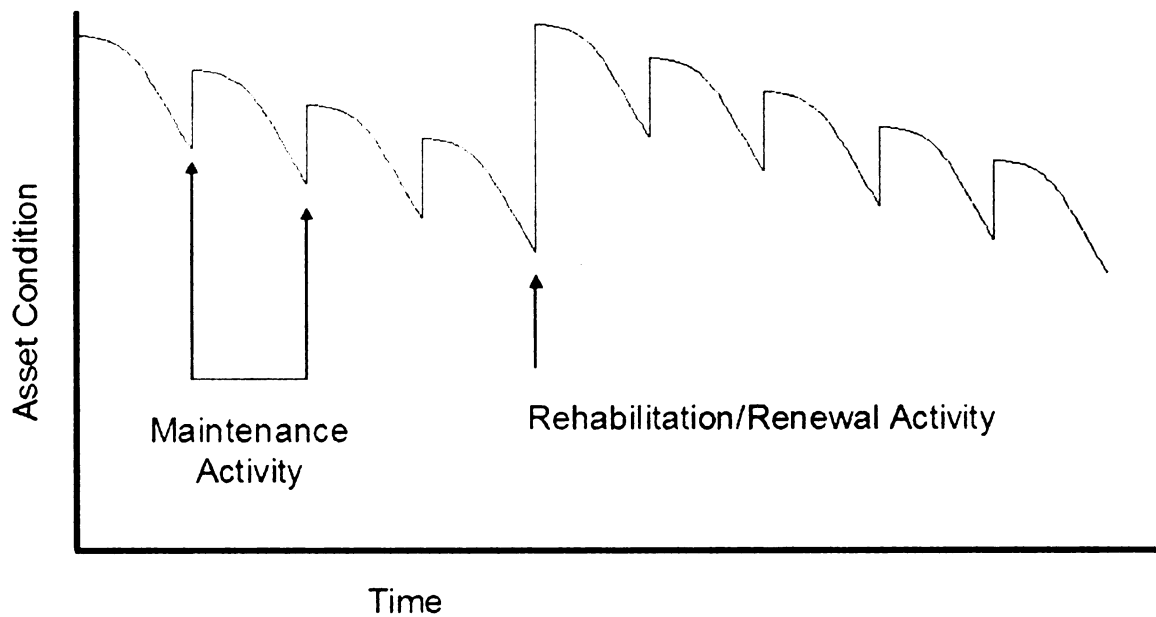


Figure 2. 5 Asset Deterioration and Renewal, Modified from AMSA 2002.

Preservation, Renewal, and Replacement. All assets will deteriorate with use and/or time regardless of the quality and quantity of preventative maintenance done. Therefore, it is essential to have a renewal and replacement strategy in place so that when an asset deteriorates beyond its useful life, the proper means are in place to renew it. A proper renewal and replacement program integrates other aspects of an asset management system. The AMSA identifies the following as basic elements of an asset rehabilitation program:

- Asset inventory;
- Asset condition assessment;
- Renewal and replacement;
- Analysis programs;

- Evaluation of management alternatives; and
- Risk evaluation . (AMSA, 2002)

Meeting Future Needs. Financial planning is essential to an asset management program because it determines the resources available throughout the life-cycle of the assets. Knowing the future needs of the assets help set financial requirements for the future that will keep the utility running smoothly. The capital improvement requirements as identified by the AMSA include the following:

- **Correcting deficiencies:** inventory and condition assessment of previously neglected assets;
- **“Normal” renewal and replacement:** commit to ongoing renewal and replacement of assets to avoid emergency intervention;
- **System growth requirements:** plan for growing communities and customers and balance new capital investment needs with renewal and replacement needs; and
- **Addressing regulatory mandates:** balance renewal and replacement requirements with new treatment process mandates and regulatory requirements. (AMSA, 2002)

Tool Integration. Tool integration is the process of implementing software or other management tools that help to mainstream the flow of information. The tool integration process is where significant efficiency gains can be made within the organization. The main tools that can be helpful are the ones that integrate the asset retention process, such

as software that consolidates multiple databases for asset inventory and purchasing systems. Integrating asset management tools gives the municipality control of the information, and is often most effective when integration tools are phased into the company culture. The AMSA outlines the following primary components of an integrated asset management system:

- Maintenance Management Systems (MMS): contains asset inventory, work order management and history, condition assessment, and rehabilitation prioritization;
- Customer Information System/Relationship Management (CIS or CRM): payment history, work order history by customer location, customer correspondence, service billing, contact management and credit management;
- Purchasing and supply chain management: inventory management and asset allocation to work orders, procurement, order management, warehouse management, forecasting and pricing;
- Finance and human resources: billing, accounts receivable and accounts payable, general ledger, tax accounting and reporting, budgeting and forecasting, activity-based costing, job/project based costing, valuation, and cash and debt management;
- Mapping and asset inventory management: CADD or GIS-based mapping system;

- Capital asset management: applications for inventory analyzing and condition assessment to support decision making for capital improvement plans;
- Application database(s): central database storing information from the above-mentioned applications; and
- Business processes: formally defined standardized business processes employed by the organization to enter, maintain, and retrieve data in the above-mentioned applications and to exchange data between those applications.

Information management is crucial to asset management. The ability to retrieve information and use it in a meaningful way is essential to a successful asset management process, and using existing technology and tools to do so can streamline efficiency. A database management system can store information on all aspects of an asset. For example, database management system for a sewer main will contain information such as the sewer main's physical properties (size, type, location, etc.), its maintenance log, the costs related to the sewer main, future maintenance plans, and inventory associated with the sewer main. When this information is cataloged into the database management system, it is readily accessible and the information can be used to make decisions regarding the management of the asset. (AMSA, 2002)

Business Process Redesign. The business process redesign aspect of asset management allows for feedback from within the municipality in order to continuously align and refine management practices. This process optimizes communication and decision-

making by integrating all divisions within the organization. By having company-wide awareness of asset conditions and strategies, and allowing for feedback by the company and its stakeholders, the business process can be refined to its optimal efficiency for the assets it maintains. The success of business process redesign depends on leadership, stakeholder involvement, having a common goal, a positive atmosphere, communication, training, resources, and setting performance measures. The process for redesigning as identified by the AMSA includes the following steps:

- Setting the stage;
- Assessing the existing process;
- Comparing to best-practices;
- Designing the improvements; and
- Implementing the new process. (AMSA, 2002)

Figure 2.6 shows the continuous process for business redevelopment.

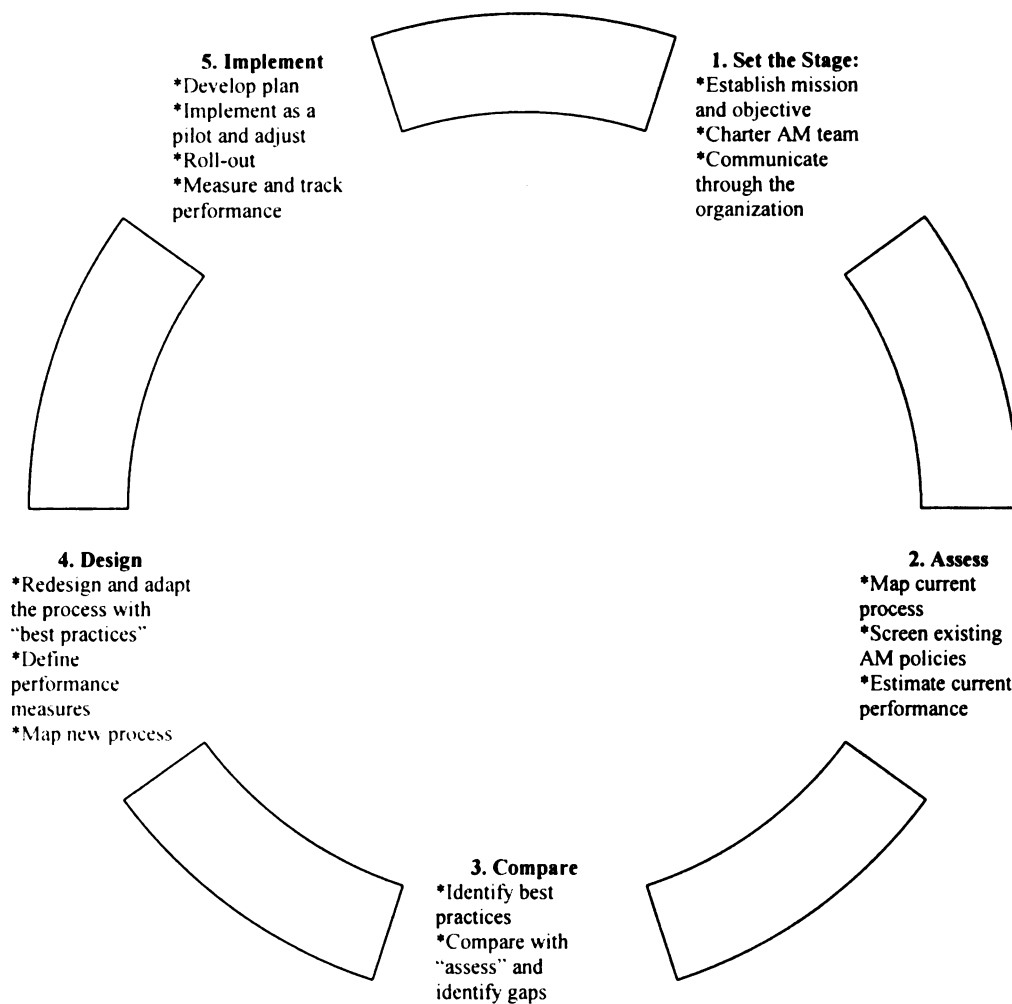


Figure 2. 6 Business Redesign Process, adapted from AMSA 2002

Outreach and Reporting. The outreach and reporting step is crucial to communicate asset condition, investment alternatives, and potential risks to internal decision makers and external stakeholders. Asset management programs can be costly to implement, but the benefits are realized over the long term. Educating the governing board and stakeholders on asset management practices and investments will ensure their

understanding of the long-term benefits of asset management and see the money spent on asset management programs as money well spent.

AMSA has outlined a thorough process for implementing an asset management program, and the basics have been discussed above. Because there are many steps and processes involved in an asset management program, it is beneficial to set up an asset management team which encompasses leaders from each division in the organization to promote and communicate the goals and objectives of the asset management program within the organization as well as to facilitate implementation. Long term benefits will be obtained by taking the time and resources to implement a thorough asset management system that is appropriate for the organization. (AMSA, 2002)

2.3.3 American Water Works Association (AWWA)

In 2002, the AWWA published a paper entitled “Creating an Asset Management Strategy: An Asset Management Template,” by Paralez and Muto in the AWWA Trends in Water Series book entitled *Assessing the Future: Water Utility Infrastructure Management*. A summary of the asset management strategy as outlined by AWWA follows:

- **Clear strategic drivers:** asset management is about arriving at both a technical and a strategic solution, requiring decisions about levels of service, predictions of demand, tolerance for risk, and other political and social trade-offs;

- **Asset knowledge:** an asset management strategy requires knowledge about the key infrastructure assets of the utility including condition information, historic failure information, performance data, maintenance history, and other asset-related information because it is critical for developing predictive models, optimum maintenance plans, and building plans for replacement or expansion of the infrastructure;
- **Integration of knowledge:** a cohesive asset management plan requires the integration of customer, financial, engineering, operations, and maintenance data from numerous input sources; and
- **Subject-matter expertise/competencies:** the appropriate use of the data requires subject matter expertise, and the competencies needed to develop, evaluate and apply this understanding need to be part of the overall strategic investment of the utility. (Paralez and Muto, 2002)

The above steps have been identified as crucial elements for successful implementation of an asset management strategy. The following questions as identified by Paralez and Muto (2002) are the ingredients of an asset management strategy:

- *What do you own?* This includes asset identification and geographic location. Typically this involves a complete inventory of all assets, cataloged by type and providing a level of detail about the component to be maintained;
- *What is it worth?* This includes asset financial data, including replacement cost;
- *What is its condition?* This includes physical description data, including all subsystems (equipment hierarchy). Operational performance data and condition monitoring, including maintenance backlog. For each component, historical

performance data, maintenance history, failure incidents, materials, installation, cost, age, material type manufacturer, and other information would also be included;

- *What is the remaining service life?* Estimations of useful physical and economic life of this asset;
- *What is the maintenance strategy?* This includes operational procedures, preventive/predictive/condition-based maintenance schedules, criticality of the asset to the system performance in order to meet business objectives, target and/or designed level of service, etc.;
- *What are other current practices?* Relevant decision support methods in use for repair-versus-replace decisions for assets; for selection of asset quality; for maintenance program for maintenance strategy; for data management, etc.;
- *What is the replacement strategy?* Estimated replacement or refurbishment that is ahead of useful physical or economic life of the asset, ahead of decline in unacceptable level of service, ahead of unacceptable maintenance/repair costs, etc.;
- *What levels of service do you want to provide?* This includes minimum performance and/or service standards such as pressure and flow, response time, system reliability, etc.; and
- *What are the existing and future performance demands?* Estimations of projected population growth, business expansion, consumer usage trends, etc.

The above questions can be used to gather and organize the data that will be needed to create an asset management strategy. Paralez and Muto cite the IIMM 2000 in their version of an asset management framework. The asset management activities are components of either a basic or advanced asset management cycle. These activities may include:

Basic Cycle

- Collecting data and measure performance;
- Existing asset knowledge;
- Identifying levels of service (prompted by strategic drivers: customer, regulatory, financial, political, legislative, environmental, etc.);
- Predicting demand (prompted by strategic drivers: population and business growth, customer use trends, demand management tools, etc.);
- Assessing financial cash flows (yields a product: financial plan, business plan);
- Preparing a basic asset management plan;

Advanced Cycle

- Assess condition and measure performance;
- Conduct failure mode analysis (historic failure data, predictive modeling, etc.);
- Assess risks of failures;
- Evaluate/select treatment options; and
- Identify optimal solutions (yields a product: operation and maintenance plan, demand-management techniques, asset creation and disposal tactics). (Paralez and Muto, 2002)

2.3.4 Comparison of Asset Management Strategies

The three strategies outlined above summarized three different strategies to implement an asset management program. Table 2.1 shows the summary of each asset management methodology used.

Table 2.1 Comparison of Asset Management Methodologies

IIMM	AMSA	AWWA
Step 1: Identify Objectives	Element 1: Strategy	Step 1: Have Clear Strategic Drivers
Step 2: Outline the AM Plan Structure and Content	Element 2: Asset Retention	Step 2: Have Knowledge of Assets
Step 3: Write the Plan	Element 3: Tool Integration	Step 3: Integration of Knowledge
Step 4: Have the Plan Reviewed	Element 4: Business Process Redesign	Step 4: Subject-matter Expertise/Competencies
Step 5: Update the Plan	Element 5: Research and Reporting	

While each program is unique, they all have similar underlying practices. Every asset management system must have an outlined strategy to work from. Additionally, knowledge of the physical properties of all assets (size, type, location, function) and their condition is essential. An operation, maintenance, repair and replacement program is also necessary to have, along with a short- and long-term outlook for financial planning. In all three cases, the AMP is a working document, and is constantly being updated and revisited to meet the needs of the utility. These are the key components of an asset management system as identified from the above implementation methods.

2.4 Government Accounting Standards Board Statement 34

The previous section identified strategies for implementing an asset management plan. This section addresses the requirements and importance of the GASB-34 as it relates to asset management.

The Government Accounting Standards Board is an independent agency responsible for developing standards of state and local governmental accounting and financial reporting that result in useful information for users of financial reports and guide and educate the public (GASS, 1999).

The Government Accounting Standards Board statement number 34 (GASB-34) was issued in June of 1999. While there are many reporting standards required within the GASB-34, this research is only concerned with the specific aspect of it redefining the requirements for reporting major capital infrastructure assets in government financial statements. For the first time, infrastructure assets must be reported in the agency's financial statements (AMSA, 2002). The GASB-34 does not have the power of law, however, the GASB defines the Generally Accepted Accounting Principles, or GAAP. Financial statements must comply with GAAP to receive an unqualified opinion from auditors, which is extremely important to agencies, especially if bonds have been or are intended to be issued (Harlow, 2000). Before the GASB-34, most cities and counties used cash accounting to account for their assets, in which physical assets appear on the books only during the year in which they are constructed (Maze, 2000). GASB 34 requires that major capital assets be accounted for using accrual accounting, meaning that their costs must be charged over the life of the asset (Maze, 2000). GASB 34 allows the accrual accounting to be calculated one of two ways, either by depreciation or by the modified approach.

2.4.1 Historical Cost/Depreciation

The first method of GASB-34 is straight-line depreciation, where:

$$\text{Annual depreciation} = (\text{historical cost} - \text{salvage value}) / \text{useful life in years}$$

This method depreciates the asset over its useful life and is reported in the statement of activities portion of the financial report (AMSA, 2002). In determining the assets service life, the agency should consider its present condition and how long the asset is expected to meet service demands, along with the general guidelines from professional or industry organizations, information on comparable assets of other governments, internal information, and manufacturer recommendations (AMSA, 2002).

2.4.2 Modified Approach

The second method of the GASB-34 is the “modified approach,” which incorporates the benefits, or values, of maintenance activities into the asset value reporting process (Maze, 2000). This requires that the agency have an asset management system that maintains an up-to-date inventory of all eligible assets, performs condition assessments and summarizes the results using a measurement scale, and estimates each year the annual amount required to maintain and preserve the eligible assets at the condition level to be self-set by the governing agency (AMSA, 2002). Additionally, the agency must document that the eligible infrastructure is being preserved at or above the condition level which was self-established (AMSA, 2002). This method allows a more realistic asset value to be recorded, because infrastructure assets are not depreciated, they are maintained and preserved to meet or exceed standards for condition, and while parts of the asset may be renewed, it is still fundamentally the same asset (Maze, 2001).

The method used is at the discretion of the reporting agency, and because most local governments do not have an asset management system in place, the depreciation method is chosen because it is easiest to implement (Maze, 2003). GASB 34 is flexible, however, and will allow an agency to switch from one reporting method to another. Since the modified approach supplies more detailed and accurate information about the condition and funding requirements for assets, it is more beneficial if this method is used. However, the modified approach implies that the agency has a working asset management system in place. Table 2.2 is modified from Figure 8.2 of the AMSA and shows the pros and cons of both reporting methods.

Table 2.2 Choosing a Reporting Method (Modified from AMSA 2002)

Choosing a Reporting Method			
Depreciation		Modified Approach (Asset Preservation)	
Pros	Cons	Pros	Cons
Easier to implement; requires less data and deliberation	Does not address actual asset condition	Provides information on asset condition (if condition is good. Some managers/boards may consider this a con if condition is bad)	Initial investment setting up the process is more costly, especially if no databases exist from other sources
Finance personnel and auditors are more familiar and comfortable with this approach	Gives perception that assets are being allowed to deteriorate	Sets quantified targets for asset condition (if met. Some managers/boards may consider this a con if targets are not met)	More of an intellectual challenge
Relatively simple financial reporting	Does not account for investments in maintenance and rehabilitation	Provides documented explicit costs of preserving assets	If condition level falls to below targets, must revert to depreciation method
Lower risk of negative audit report	Does not represent real value of the asset. Represents unreasonable low cost of service in older systems	Real value of asset is documented	If condition levels fall below targets, may be seen as failure of management
Not a measure of management effectiveness	Depreciation factors bear little relationship to actual changes in asset condition	Quantified performance measures allow trends to be checked and projections to be made	Provides information on asset condition (Pro if condition is good. Some managers/boards may

Choosing a Reporting Method			
Depreciation		Modified Approach (Asset Preservation)	
Pros	Cons	Pros	Cons
			consider this a con if condition is poor)
	Does not address “overhang” liabilities arising from deferred maintenance and rehabilitation	Variable future funding needs can be easily translated into rates	Sets quantified targets for asset condition (Pro if met. Some managers/boards may see this as a con if targets are not met)
	Meaningless to customers and public. Viewed as unreliable or incomplete way to report costs	Involves policy makers and all utility managers, not just finance personnel	Failure to maintain stated condition level could result in the need to secure funding for reinstating the level, political issues, or where infrastructure failure occur, liability situations
		Provides meaningful information for customers and public	
		Satisfies asset management expectations of CMOM	
		Probably will be required under any new federal financing program	
		Eventually, will be expected by lending institutions and other monitors	

2.4.2.1 Asset Management Requirements of the GASB-34 Modified Approach

The GASB-34 modified approach requires the government to manage infrastructure assets using an asset management system that has the following characteristics:

1. Have an up-to-date inventory of eligible infrastructure assets;
2. Perform condition assessments of the eligible infrastructure assets and summarize the results using a measurement scale; and

3. Estimate each year the annual amount to maintain and preserve the eligible infrastructure assets at the condition level established and disclosed by the government.

The government must also document that the eligible infrastructure assets are being preserved approximately at or above a condition level established and disclosed by the government in accordance with the following documentation:

1. Complete condition assessments of eligible infrastructure assets are performed in a consistent manner at least every three years;
2. The results of the three most recent condition assessments provide reasonable assurance that the eligible infrastructure assets are being preserved approximately at or above the condition level established and disclosed by the government

(GASB-34, 1999).

The above are the requirements that must be met in order to use the GASB-34 modified approach of reporting for infrastructure assets. Table 2.3 compares the requirements for meeting the depreciation method of reporting versus the modified approach of reporting under the GASB-34.

**Table 2. 3 Comparing the Depreciation and Modified Approaches
(Modified from AMSA 2002)**

Reporting Requirements Comparison	
Depreciation	Modified Approach
Summary Infrastructure assets will be reported in the statement of net assets based on historical costs and will be depreciated over their useful lives	Summary Infrastructure assets will be reported in the statement of net assets based on historical costs. Report all preservation costs as expense and no report of depreciation -Demonstrate that assets are being preserved and an asset management system is in place -Require condition information and required versus actual maintenance/preservation
Requirements	Requirements

Reporting Requirements Comparison	
Depreciation	Modified Approach
Historical cost includes: -Estimated historical cost -Replacement cost or current cost, which is then deflated back to the acquisition date, is an acceptable method for estimating -Original cost	An asset management system must: - Have an up-to-date inventory of eligible infrastructure assets - Perform condition assessments of the eligible infrastructure assets and summarize the results using a measurement scale - Each year estimate the annual amount to maintain and preserve the eligible infrastructure asses at the condition level established and disclosed by the organization
Procedures Depreciation expense should be reported in the statement of activities. Depreciation expense should be measured by allocating the net cost of depreciable assets (historical cost less estimated salvage value) over their estimated useful lives in a systematic and rational manner. It may be calculated for: -a class of assets -a network of assets -a subsystem of a network -individual assets	Procedures The organization must document that assets are being preserved through normal expenditures at an acceptable level established by that government entity. - Complete condition assessments of eligible infrastructure assets are performed in a consistent manner at least every three years - The results of the three most recent condition assessments provide reasonable assurance that the eligible infrastructure assets are being preserved approximately at or above the condition level established and disclosed by the organization If eligible infrastructure assets meet the requirements of GASB-34 paragraphs 23 and 24 and are not depreciated, all expenditures made for those assets (except for additions and improvements) should be expensed in the period incurred. Additions and improvements to eligible infrastructure assets should be capitalized. Additions or improvements increase the capacity, efficiency, or extend the life of infrastructure assets rather than preserve the useful life of the assets.

2.5 Additional Research in Asset Management and GASB-34

Asset management is an extensive topic and applies to all owned assets, including but not limited to buildings, roads, bridges, parks, and sewer and water infrastructure. The research being done in all areas of asset management is extensive. Several research projects involve asset management software and decision-making support systems. Condition assessment is also widely researched. This section is divided into three

sections: management tools, decision-support systems, and condition assessment, and will give an overview of the current research that has been completed in the general topic of asset management.

2.5.1 Current Research in Asset Management Tools

Managing an entire city's assets is a very complicated and tedious process that requires numerous people. The mass of information that needs to be catalogued and accessible to city officials is enormous. The information then needs to be used for planning and maintenance purposes. For that reason, numerous research studies have been conducted to develop solutions for storing and processing all the information necessary for planning and maintaining public resources.

Geographic Information Systems (GIS) are very versatile which makes them ideal for municipalities that need to catalogue numerous types of information. The GIS is an excellent base for information for an asset management system, and several researchers have expanded the GIS capabilities to further the usefulness of GIS for implementing an asset management program. For example, Zhang (1996) developed an infrastructure management system (IMS) that was GIS based and multi-media integrated for a visual IMS. The visual IMS has the capability of handling a wide variety of data and information visually, analyze them spatially, and present the results graphically (Zhang, 1996). Additionally, Jia (1996) researched a client/server-based intelligent GIS shell for a transportation agency. The intelligent GIS shell integrates the spatial analysis capabilities of a GIS with the knowledge reasoning procedures of a knowledge-based expert system

using client/server technology, creating an operational environment in which to perform spatial queries, searches, and other operations (Jia, 1996).

Modeling and optimization techniques have also been researched as a means to assist in managing infrastructure. Watkins (1997) evaluated optimization models and applied them to water resource problems, concluding that when optimization models are used in the proper context, they can promote the understanding of complex systems and help in evaluating the tradeoffs involving risk (Watkins, 1997). Jiang (2001) also researched modeling and optimization techniques, specifically for maintenance systems, addressing preventative replacement at optimal times for the system's health. Jiang uses two types of models, age-based and condition-based models, and the results apply to a range of systems, including infrastructure and manufacturing.

2.5.2 Current Research in Decision Support Systems

The decisions that need to be made regarding the operation and maintenance of assets are extensive and involve numerous variables. Simplifying these decisions by creating decision support systems (DSS) and knowledge-based systems for asset management is a popular research topic.

A DSS was developed by Kim (1998) to assist in achieving a sustainable development plan for transportation systems for the Commonwealth of Virginia. The research aimed at developing a transportation planning model for state highway management, and focused on managing the physical condition of the state highway system at an acceptable level

through a state-dependent prioritization strategy to achieve sustainable development (Kim, 1998). Another DSS research for the transportation industry involved developing a DSS for evaluating pavement maintenance alternatives and finding the optimum pavement maintenance strategy to minimize costs over the life-cycle of the pavement (Hammad, 1999).

Several researchers have developed DSS for sewer and water infrastructure as well. A DSS was developed for water distribution network rehabilitation that selects for each pipe in a network the rehabilitation alternative that minimizes the cost of not only the rehabilitation, but all maintenance costs for that pipe over a predetermined time period (Kleiner, 1997). Another DSS was developed for large combined sewer systems to assist asset managers in decision-making regarding sewer maintenance and rehabilitation plans with limited access to sewer condition data (Wirahadikusumah, 1999). Other research in sewer DSS created a demand forecasting model that uses artificial neural networks, where the forecasted demand identifies critical areas that need to be expanded (Chung, 2001).

2.5.3 Condition Assessment Tools and Methods

One of the key aspects of asset management is to know what condition the assets are in, and to know when they will need to be serviced or replaced. Condition assessment techniques for all types of materials and assets have been created through previous research studies.

AbdelRazig (1999) proposes a DSS model using image processing and neural networks for defect recognition and measurement, in which digital images of the asset are taken and analyzed for defects. Neural networks “learn” by example and are designed to mimic human expertise. Box (1997) uses neural network algorithms to detect electrical arcing faults in an underground electric distribution network. Neural networks are also used in the research of Heiler (1996) as a means of sorting through the massive amount of data produced by ground penetrating radar, a condition assessment tool used to conduct infrastructure condition assessments.

Inspection of underground infrastructure is difficult and often neglected until the circumstances are crisis-based. There are several inspection methods for underground infrastructure that can be used to monitor the condition of the asset to assure it is maintained before it fails. These methods are reviewed below.

Closed Circuit Television System (CCTV). For the CCTV method, a camera is placed in the pipe and is controlled above ground by a skilled technician using a control panel in a television studio. The camera picks up images of the pipe and still photos can be taken at any time for record keeping. CCTV accuracy depends on the skill of the operators and the quality of the images taken. The CCTV method is cost effective and can locate any object or defect in the pipe. (Sinha, 2004)

Laser-Based Scanning Systems. A laser-based scanning system is still a relatively new technology, but is extremely accurate and, because it downloads data directly to a

computer, it reduces operator error. The laser can evaluate the shape of the pipe and its defects by using a laser diode to create a profile of the pipe. These systems are limited to the part of the pipe that is above the waterline, but the technology is still developing. (Sinha, 2004)

Ultrasonic Inspection (Sonar). The sonar inspection uses a high frequency sound wave that travels through the pipe and reflects back whenever there is a change in the density of the material. This technology can detect voids, pits, and cracks in the pipe. Evaluation using this method can be difficult. (Sinha, 2004)

Other Methods. Other, less popular methods of pipe inspection include eddy current testing, which is an electromagnetic technique that can detect discontinuities in tube walls, and acoustic emission monitoring which monitors sounds (usually undetectable to the human ear) made by a material in use or under load (Sinha, 2004). Table 2.4 compares current sewer inspection techniques including those listed above along with others.

Table 2. 4 Current Sewer Inspection Techniques: A Comparison
(Najafi and Gokhale, 2005)

Technique	Where to Use	What Will be Found
Inspection of the Inner Surface		
Conventional CCTV	Empty pipes, partially filled pipes above the water surface	Surface cracks, visible deformation, missing bricks, some erosion, visual indications of exfiltration/infiltration
Stationary CCTV	Pipes with less than 160 m distance between manholes	As CCTV
Light Line CCTV	Pipes where deformation is an issue	Better deformation measurements and CCTV results
Computer-Assisted CCTV	As CCTV, currently small diameter pipes only	As CCTV but with quantitative measurements of damage
SSET	Pipes of diameter ranging from 8	As CCTV, but with higher

Technique	Where to Use	What Will be Found
	to 24 inches	sophistication and accuracy; can measure deformation of pipes
Laser Scanning	Partially filled pipes, empty pipes	Surface cracks, deformations, missing bricks, erosion losses
Ultrasound	Flooded pipes, partially filled pipes, empty pipes	Deformation measurements; erosion losses; brick damage
Inspection of Pipe Structure and Bedding Condition		
Microdeflections	Rigid sewer pipes	Overall mechanical strength
Natural Vibrations	Empty sewer pipes	Combined pipe and soil condition, regions of cracking, regions of exfiltration
Impact Echo	Larger diameter, rigid sewers	Combined pipe and soil condition, regions of wall cracking, regions of exfiltration
Inspection of Bedding		
Ground Penetrating Radar	Inside empty or partially filled pipes	Voids and objects behind pipe walls, wall delaminations, changes in water content in bedding material

2.5.4 Asset Management and GASB-34 Research

Previous research in asset management often cites the GASB-34 as a recent trend in financial reporting and the GASB-34 is often listed as a motivation for research in asset management. The valuation of assets is pertinent to an asset management system, and the GASB-34 provides for two valuation methods: depreciation and modified approach. Baik (2003) states that “asset valuation has received special attention since the GASB issued Statement 34,” and presents his research on a valuation method that incorporates the changes in the asset condition due to deterioration (Baik, 2003). Asset valuation with regards to the GASB-34 is also mentioned by Zongzhi (2003) as both an essential portion of an asset management system as well as a means of ensuring justifications for budget requests and fostering strategic investment decisions.

Infrastructure-orientated magazines and associations have written articles regarding the importance of complying with GASB-34 and on ways to implement its requirements.

Water Online printed an article in October of 2000 on complying with GASB-34, and *Technology News* published a series of articles on GASB-34 implications on infrastructure and the importance of implementing them. The U.S. Department of Transportation held a meeting and a peer exchange to discuss the status of implementing the GASB-34 and whether the modified approach or depreciation method would be used.

In *Pipelines 2005*, published by ASCE, a paper entitled “The Modified Approach to GASB 34 and the Effect on Pipeline Materials Selection,” by Dennis Dechant was published. In this paper, the author uses the modified approach requirements to suggest methodologies for selecting pipeline material and management and maintenance strategies. Dechant proposes that distribution systems and transmission mains be evaluated as separate subsets due to the extent of the consequences yielded when one fails over the other. The failure of a distribution system is often less eventful than the failure of a transmission main due to the size of failure, lack of service to numbers of people, and time to repair. Separating the piping into two subsets is due to the cost of corrosion protection, evaluation of risk, and cost and consequence of failure. Failure due to corrosion can be controlled and predicted to some degree of certainty, and this ability to document the method of controlling corrosion on pipe with metallic components is critical to the use of the modified approach (Dechant, 2005).

Due to the smaller size of distribution systems, a qualified corrosion professional can predict the frequency of failures in a system to some degree of accuracy, and with this information a maintenance repair and replacement schedule can be implemented that will

keep the subset at a condition established as acceptable. This would be considered as maintenance costs for GASB 34, and meets the requirements of the modified approach (Dechant, 2005).

Transmission mains are larger and are not part of a periodic replacement program, and because its failure would yield much larger consequences than a distribution system, a corrosion protection system would be a beneficial investment. The lifecycle cost-benefit of a corrosion protection system ranges from 7 to 42 times benefit to cost ratio, making it a good investment for large diameter pipes. The corrosion protection system can be installed either during initial construction or at the first sign of unacceptable corrosion, and a maintenance schedule can be implemented to maintain the pipeline at an acceptable condition. This maintenance and periodic replacement of the protection system can be identified, scheduled, and quantified, making the GASB 34 modified approach a feasible reporting method when this strategy is used (Dechant, 2005). Dechant's suggestions on separating distribution systems from transmission mains when managing and reporting on assets is economical and efficient, and also meets the GASB 34 modified approach requirements.

2.6 Chapter Summary

This chapter presented an overview of the previous research done in asset management. AM methodologies, GASB-34 requirements, and AM tools were reviewed. The next chapter presents the methodologies used to achieve the goals and objectives of this research as outlined in Chapter One.

Chapter 3
METHODOLOGY

3. METHODOLOGY

The previous chapter presented an introduction and literature review which provided the crucial background for this research. This chapter presents the methodology that was used in this thesis for the development of recommendations for sewer and water municipalities to bring their asset management practices into compliance with the GASB-34 requirements.

3.1 Methodology for Activity One

The first activity of this research was to review the definitions and methodologies of asset management. This activity was completed in Chapter Two by completing a literature review. Definitions were obtained from the IIMM, AMSA, AWWA, and several previous research efforts were identified. Methodologies for implementing an asset management program were outlined as laid forth by the IIMM, AMSA, and AWWA to give an overview of different types of asset management practices.

3.2 Methodology for Activity Two

The second activity of this research was to review the GASB-34 modified approach requirements and parameters. This activity was also completed in Chapter Two. An overview of the GASB-34 was presented, along with a description of the two methods for meeting the standard: the modified approach and the depreciation approach. A table outlining the requirements of each method was also presented.

3.3 Methodology for Activity Three

The third activity of this research was to survey a minimum of six cities in Michigan with populations greater than 20,000 on their current asset management practices that would be essential to meet the GASB-34 requirements. Small water and sewer systems, identified as those serving populations of 10,000 or less, are at the beginning of the advanced asset management journey, with few cities having even heard of asset management (Brown, 2006). Because asset management is a key portion of this study, this population was doubled and cities in Michigan with populations over 20,000 were considered for this research. It is assumed for this research that a city with population of 20,000 will have a basic knowledge of asset management and would have vested interest in implementing an asset management program, if one is not already in place. The survey is used to identify the trends of asset management practices in Michigan and their correlation to the GASB-34 modified approach requirements.

3.3.1 Questionnaire Development

A questionnaire was developed that was comprised of sixteen questions. These questions were developed from the GASB-34 modified approach requirements. Each component of the GASB-34 requirement was asked in the form of a yes or no question. Nine questions were directly related to the GASB-34 requirements. The remaining seven questions were for additional information that assisted in data analysis and the creation of recommendations. Of the total, thirteen questions were yes/no or multiple choice, and three questions were short answer. The questionnaire was written so that it would take a knowledgeable municipal manager less than twenty minutes to complete. The survey was

submitted to the University Committee on Research Involving Human Subjects (UCHRIS) and was given an exempt status due to its nature of strictly public material. A complete copy of the questionnaire is included in Appendix A.

3.3.2 City Selection and Data Collection

Census data was used to determine eligible cities in Michigan with populations over 20,000. Cities were randomly selected and were contacted by phone or email to determine their willingness to participate. Cities that agreed to participate in the research were sent the questionnaire via email, unless another method was preferred and specified (i.e. fax, postal service, etc.). It was requested that surveys be returned via email, fax, or postal service within three business days. Water and wastewater superintendents and/or the city engineers were contacted to complete the survey. Due to resource limitations and the nature of this research, it was assumed that the cities who returned the survey would provide representative data of the asset management practices in Michigan as they relate to the GASB-34. While the number of surveys returned lack significant statistical value, they do act as case studies to represent current practices and needs for improvements. The results of the survey were used to develop a set of recommendations which provide practical ways for implementations of asset management and GASB-34 concepts.

3.4 Methodology for Activity Four

The fourth activity of this research was to identify areas of asset management that need to be improved or modified to meet the requirements of the GASB-34 modified approach. The data collected in this research is qualitative, and detailed statistical analysis was not

used for the majority of the analysis. Instead the method of qualitative analysis of coding was used. Thirteen questions in the questionnaire are closed-ended questions, and were analyzed using a coding matrix where variables are in columns and each city has a row with its respective responses coded by number and entered in it. Analysis of the matrix yielded the GASB-34 compliant and non-compliant cities, along with the number of cities meeting each specific requirement needed for compliance with the GASB-34. The coding matrix used can be seen in Appendix C results matrix.

Three questions from the questionnaire yielded open-ended questions. These questions were only answered by two cities participating, and the responses to these questions have been integrated into the text of the analysis.

3.5 Methodology for Objective Five

The fifth activity of this research was to prepare recommendations for municipalities and local governments to bring their asset management program up to GASB-34 modified approach reporting requirements. Areas of strength and weakness with regards to the compliance of the GASB-34 were identified based on the number of cities using the modified approach requirements. Each requirement must be met and is equally important for complying with the GASB-34, and therefore they all have an equal weight. The strengths and weaknesses for this research were made on the basis of a simple majority-rule. This method has been proven as an efficient means of decision making by research done at the University of Florida (Vecellio, 1998). Any requirement that received a negative response for 50% or more of the cities yielded a weakness, whereas those

requirements that were met by the majority of the cities (at least 50% plus one) were considered strengths. The recommendations made included a combination approach to the GASB-34 modified approach using asset management practices as identified in the literature review. These recommendations are discussed in depth in Chapter Five.

Each city that participated in the original questionnaire was asked to respond to the list of recommendations. The questions asked were yes/no format with a comment section for each question, and addressed issues such as feasibility, financial and managerial strain on the government, and potential problems the implementation of these techniques would bring. The responses were entered into a coding matrix with variables in columns and the cities in rows. Analysis of the responses yielded the feasibility of the recommendations and potential issues that will have to be addressed before implementing them. The questionnaire sent can be seen in its entirety in Appendix B, and the coding matrix used to evaluate the questionnaire can be seen in Appendix D.

3.6 Chapter Summary

This chapter presented the methodologies that were used to conduct this research. The next chapter details the data analysis for this research.

Chapter Four
DATA ANALYSIS

4. DATA ANALYSIS

The previous chapter outlined the methodologies used in this research. This chapter analyzes the data collected from the survey using the methodologies set forth in Chapter Three.

4.1 Data Acquisition

All cities chosen were contacted by telephone to determine their interest in participating. If no one was available, a message containing the nature of the research was left. Cities were contacted twice to participate, after which the unresponsive city was deemed uninterested. Of the 22 cities contacted, 17 were reached. All 17 agreed to participate in the survey. The survey was emailed to 15 participants and faxed to two. Participants were given three business days to complete the survey and return it. Of the 17 that agreed to take the survey, nine were returned on time. Once the surveys were returned, the results were entered into a coding matrix from which the data can be analyzed. One of the surveys was eliminated from analysis due to conflicting answers, resulting in eight usable surveys for data analysis. Figure 4.1 below illustrates the population of the survey and participation breakdown.

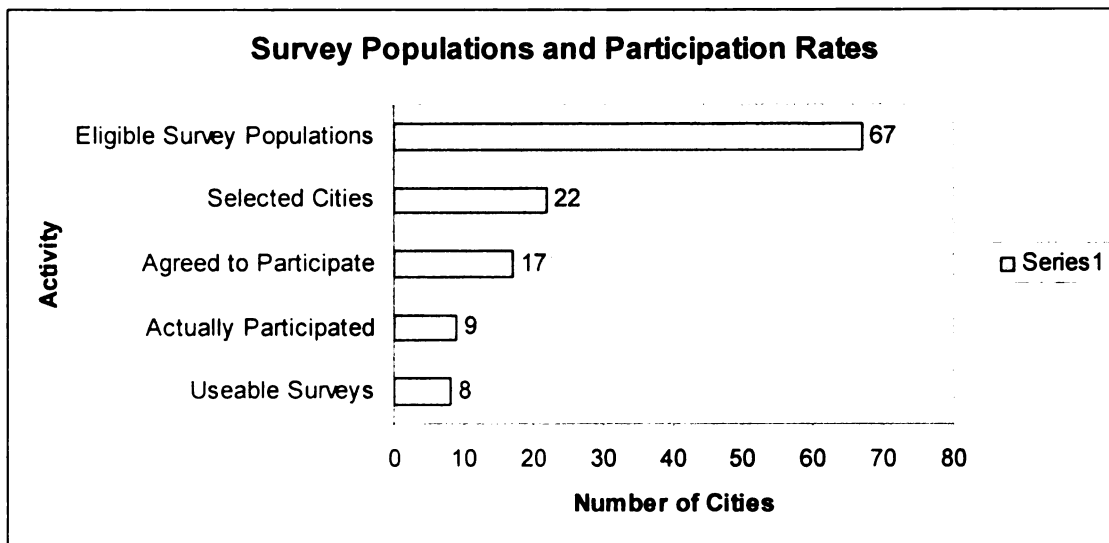


Figure 4. 1 Survey Populations and Participation Rates

4.2 GASB-34 Questions

The survey contained thirteen yes/no questions with three questions which had a second portion for a total of sixteen questions. The survey in its entirety can be seen in Appendix A. Nine of the questions related directly to the requirements of the GASB-34. The questions are as follows:

- Do you have a formal asset management system for sewer and/or water infrastructure?
- Do you have an up-to-date inventory of your sewer and/or water assets?
- Do you have a consistent and documented process for conducting condition assessments?
- Do you perform condition assessments of all your major sewer and/or water assets at least every three years?

- Have you defined and documented an acceptable condition level for your sewer and/or water assets?
- Are the results of your condition assessments summarized using a measurement scale?
- Do you document the results of the condition assessment?
- Do you annually estimate the funding amount needed to maintain and preserve sewer and/or water infrastructure at a certain condition level?
- Do the results of the last three condition assessments provide reasonable assurance that the sewer and water infrastructure assets are being preserved at (or above) the condition level you have established and documented?

The above questions are aimed directly at the GASB-34 modified approach requirements. In order to use the modified approach, the city must have answered “yes” to all the above questions, of which none did. All cities were asked as a part of the survey which reporting method they currently use, and all cities being used in this study reported that they currently use the depreciation method.

4.3 Individual City Data

The eight cities being evaluated in this study vary in population from 20,000 to 138,000. The GASB-34 identifies five specific requirements that a reporting agency needs to meet to use the modified approach method. This survey broke those five requirements down into specific pieces, resulting in nine asset management tasks that need to be performed to use the modified approach. None of the cities surveyed yielded a positive response to

all of the requirements, and therefore, none of the respondents qualify for using the modified approach under the GASB-34. The lowest number of requirements met by a respondent city was one out of nine, or 11.1%, and the highest number of requirements met by a respondent city was eight of nine, or 88.9%. The average number of requirements met by the responding cities was 4.5 out of nine, or 50%. Figure 4.2 shows the percentage of requirements met by each city, and Figure 4.3 shows the number of requirements met by each city.

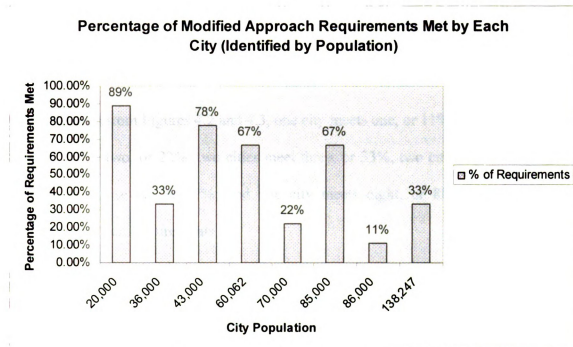


Figure 4. 2 Percentage of Requirements for Modified Approach Met by Each City

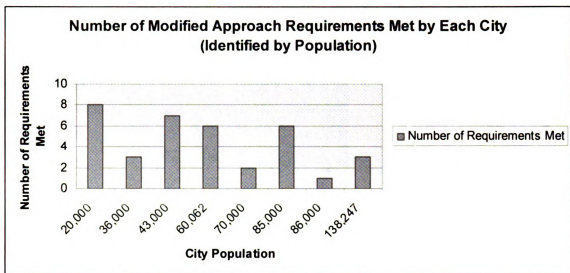


Figure 4. 3 Number of Requirements Met for Modified Approach by Each City

As can be seen from Figures 4.2 and 4.3, one city meets one, or 11% of the requirements, one city meets two, or 22%, two cities meet three, or 33%, two cities meet six, or 66%, one city meets seven, or 77%, and one city meets eight, or 88% of the GASB-34 modified approach requirements.

Additionally, the population of the city seems to have a small correlation with the number of GASB-34 modified approach requirements met. Figure 4.4 shows a correlation between the city population and the percentage of GASB-34 requirements met.

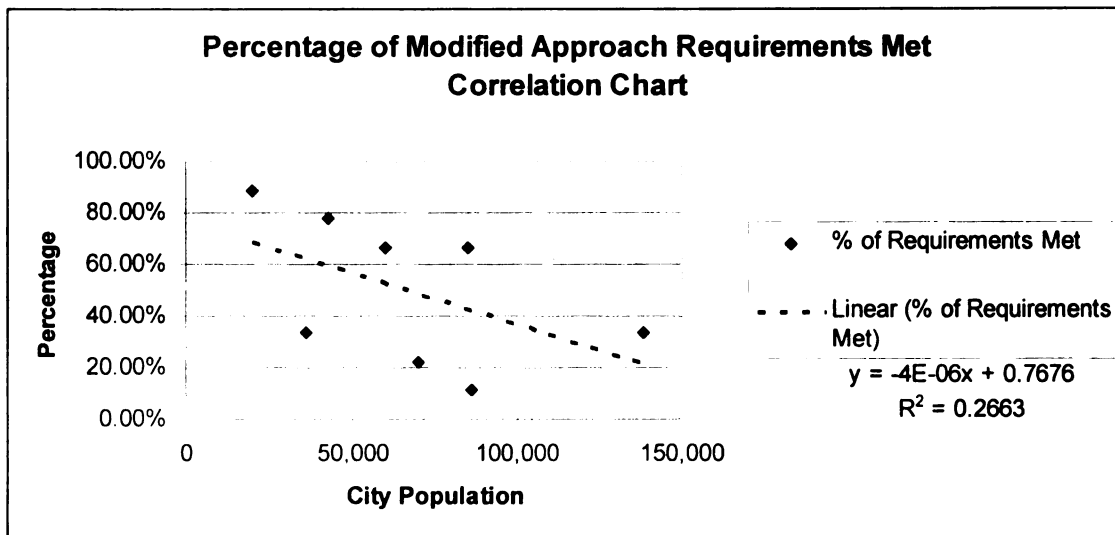


Figure 4. 4 Correlation Between City Population and GASB-34 Modified Approach Requirements Met

As can be seen from Figure 4.4, there is a small correlation between population and met requirements. Although the R^2 value of 0.2663 is very small, there is a downward trend as can be seen by the trend line, where as population goes up, the number of requirements met goes down. This might be due to bigger cities being behind the smaller cities in their asset management practices, since big cities are currently facing more problems which do not give them the opportunity to plan an effective asset management scheme.

4.4 GASB-34 Requirement Data

Each requirement was formulated into a yes or no question that each city responded to. A positive, or “yes” response means they met the requirement, and a negative or “no” response means they did not.

The first requirement is that the city or organization has a formal asset management system. Of the eight respondents, four had positive responses and four had negative responses, resulting in 50% of the respondents having a formal asset management system.

The second requirement is that there is an up-to-date inventory of all major assets. Seven of the eight cities responded positively to this requirement, meaning that 87.5% of the participating cities meet the requirement of having an up-to-date inventory. Of the seven cities that have an up-to-date inventory, four of them are contained in a computerized database, where the other three are contained in both a computerized database and paper files.

The third requirement is that there is a consistent and documented process for condition assessment. Only three of eight cities have this, yielding a 37.5% positive response rate for this requirement.

The fourth and fifth requirements also yielded a 37.5% positive response, which include conducting condition assessments for at least once every three years, and having a defined and documented acceptable condition level from which to rate assets. Three cities or 37.5% reported not conducting condition assessments at all, and five cities conduct them less frequently than every three years.

The sixth requirement, stating that the condition assessments are summarized by using a measurement scale yielded a 0% positive response. None of the cities that participated in this study currently do this.

The seventh requirement of the GASB-34 modified approach is that the condition assessment results are documented. Five of the eight cities responded positively to this, resulting in 62.5% compliance for this requirement.

The eighth requirement is that the funding needs for maintaining assets are estimated each year. Seven of the eight participating cities answered “yes” to this requirement, yielding 87.5% compliance for this requirement.

The ninth and final requirement is that the last three condition assessments performed provide reasonable assurance that the assets are being maintained at an acceptable condition level. Half, or 50% of the eight participating cities responded positively to this question. Figure 4.5 shows the breakdown of the percentages of cities meeting each requirement.

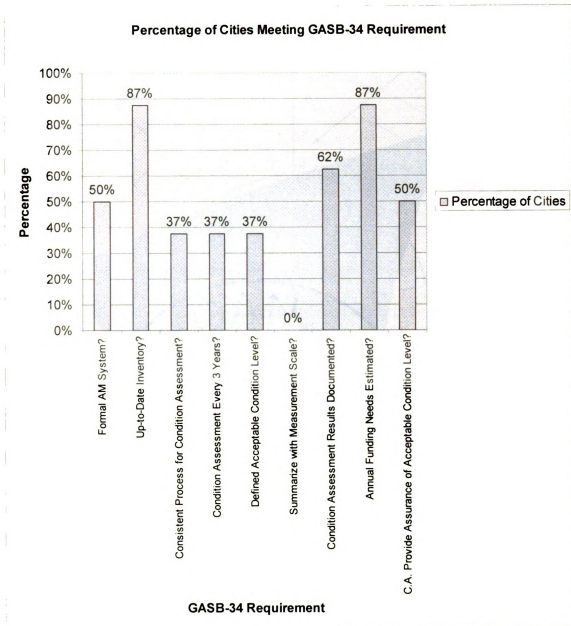
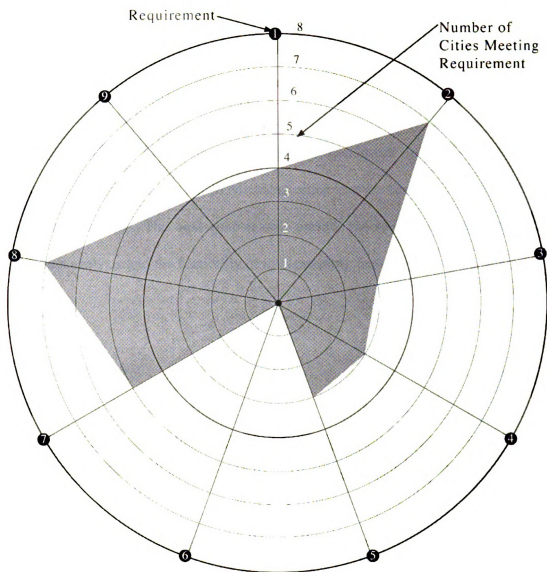


Figure 4. 5 Percentage of Cities Meeting Each GASB-34 Requirement

Figure 4.6 shows the GASB-34 requirements met by each city, but the star illustrates more graphically where Michigan cities currently are with regards to meeting all GASB-34 requirements. If all Michigan cities met every requirement of the GASB-34, then the circle would be completely filled.



KEY

- 1: Formal Asset Management System
- 2: Up-to-date Inventory
- 3: Consistent Process for Condition Assessment
- 4: Perform Condition Assessment Every Three Years
- 5: Defined Acceptable Condition Level
- 6: Summarize Condition Level Results with Measurement Scale
- 7: Document the Condition Level Results
- 8: Estimate Annual Funding Needs to Maintain Infrastructure
- 9: Condition Assessments Provide Assurance of Acceptable Condition Level

Figure 4. 6 Star Diagram Illustrating Number of Cities Meeting Each GASB-34 Requirement

As illustrated in Figures 4.5 and 4.6, there are several requirements that require attention by Michigan cities.

4.5 Chapter Summary

This chapter focused on evaluating the survey conducted to determine the asset management practices being used in Michigan cities that are compliant with the GASB-34 modified approach. The next chapter will present the recommendations made as a result of this analysis and the feasibility of implementing those recommendations.

Chapter Five

CONCLUSIONS AND RECOMMENDATIONS

5. CONCLUSIONS AND RECOMMENDATIONS

The previous chapter analyzed the data collected from the surveys. This chapter uses this data analysis to identify strengths and weaknesses and then to make recommendations. Strengths and weaknesses were identified according to the methodology set forth in Chapter Three. The weaknesses identified were used to make suggestions for municipalities that if implemented, would bring their asset management practices up to meet the GASB-34 modified approach requirements. This chapter also validates the feasibility of implementing the suggestions with a second survey. Finally, this chapter provides conclusions of this study as well as ideas for future research.

5.1 Analysis of Results

As determined by the methodology set forth in chapter three, all asset management strengths and weaknesses as they relate to the GASB-34 requirements for surveyed cities were identified by using a majority-rule. That is, requirements that had a 50% or less positive feedback response were considered a weakness within the GASB-34 requirements. As can be seen in Figure 4.5, there are six weaknesses that resulted from this study that should be addressed by the individual cities.

More than half of the responding cities have an up-to-date inventory of their assets, document their condition results, and annually estimate the amount of funding needed to maintain their assets at an appropriate condition level. These are the asset management strengths within the GASB-34 requirements, and the suggestion to implement them will not be made for these requirements since they are already performed by more than half of

the respondents. However, it should be noted that these three requirements are essential for fulfilling not only the GASB-34 requirements, but also in sustaining an efficient asset management program. The fact that the majority of cities already have these practices in place suggests that they are currently an everyday means of business and essential for the management of the municipality. For the few cities that do not have these asset management practices in place, implementing these three requirements would be a starting point, and then addressing suggestions that coincide with the weaknesses below would be applicable as a second phase.

The following suggestions would, if implemented, bring the majority of cities into compliance with GASB-34 modified approach requirements. These suggestions were created based on a result of 50% or more of city participants responding negatively to the requirements in the survey:

1. Implement a formal asset management program;
2. Implement a consistent and documented process for conducting condition assessments of the assets;
3. Increase the number of condition assessments to once at least every three years;
4. Define and document an acceptable condition level from which to rate assets;
5. Summarize the results of the condition assessment by using a measurement scale;
and
6. Use the last three condition assessment results to verify that the set condition level is being maintained.

5.1.1 Implementing Suggestion One

The first recommendation is to implement a formal asset management plan. Three methodologies were laid out in Chapter Two of this research as a means of implementing asset management program; however they all have a similar first step. Before an asset management program can be implemented, there needs to be a plan or strategy. The strategy, while always in the development stage, is the first step because the strategy outlines the consecutive steps for implementing a formal asset management program. The goals and objectives of the asset management program should be outlined and documented, and appropriate personnel should be given the authority and means to meet those goals. It is also important to develop a means of measuring the progress of the objectives, and implement policies company-wide that support the objectives of the asset management program. Once the strategy is written, the formal asset management process begins as each step of the strategy is implemented.

5.1.2 Implementing Suggestion Two

The second recommendation is to implement a consistent and documented process for conducting condition assessments of the assets. This is important to assure that the assets are being evaluated on the same quality scale every year. Cities can make their own condition assessment scale, or can use one that has been previously published. To implement a condition rating system, a measurement scale should be determined. The measurement scale can be numeric (one through five, for example) or qualitative (excellent, good, fair, poor) in nature, but each level of the scale should be defined with both words and photos describing the quality the asset should be in. All employees

conducting inspections should be trained on the condition assessment rating system and should be given a copy while conducting the inspections so that all assets are properly and consistently rated. Table 5.1 shows a rating system example for culverts that is outlined in the National Cooperative Highway Research Program (NCHRP)'s Synthesis 303, Assessment and Rehabilitation of Existing Culverts. Similar rating systems can be created for sewer and water pipe condition assessments.

Table 5. 1 Example Rating System for Culverts

FHWA Culvert Inspection Rating Guidelines for Corrugated Metal Culvert Barrels (Arnoult 1986)	
Rating	Condition
9	New Condition
8	<i>Shape:</i> good, smooth curvature in barrel - Horizontal: within 10 percent of design <i>Seams and Joints:</i> tight, no openings <i>Metal:</i> - Aluminum: superficial corrosion, slight pitting - Steel: superficial rust, no pitting
7	<i>Shape:</i> generally good, top half of pipe smooth but minor flattening of bottom - Horizontal Diameter: within 10 percent of design <i>Seams and Joints:</i> minor cracking at a few bolt holes, minor joint or seam openings potential for backfill infiltration <i>Metal:</i> - Aluminum: moderate corrosion, no attack of core alloy - Steel: moderate rust, slight pitting
6	<i>Shape:</i> fair, top half has smooth curvature but bottom half has flattened significantly - Horizontal Diameter: within 10 percent of design <i>Seams and Joints:</i> minor cracking at bolts is prevalent in one seam in lower half of pipe. Evidence of backfill infiltration through seams or joints <i>Metal:</i> - Aluminum: significant corrosion, minor of core alloy - Steel: fairly heavy rust, moderate pitting
5	<i>Shape:</i> generally fair, significant distortion at isolated locations in top half & extreme flattening of invert - Horizontal Diameter: within 10 percent to 15 percent greater than design <i>Seams and Joints:</i> moderate cracking at bolts is prevalent in one seam in lower half of pipe. Deflection of pipe caused by backfill infiltration through seams or joints <i>Metal:</i> - Aluminum: significant corrosion, moderate of core alloy - Steel: scattered heavy rust, deep pitting
4	<i>Shape:</i> marginal significant distortion throughout length of pipe, lower third may be kinked - Horizontal Diameter: within 10 percent to 15 percent greater than design <i>Seams and Joints:</i> moderate cracking at bolts is prevalent in one seam in lower half of pipe. Deflection caused by loss of backfill through open joints <i>Metal:</i> - Aluminum: extensive corrosion, significant of core alloy, scattered perforations - Steel: extensive heavy rust, deep pitting
3	<i>Shape:</i> poor with extreme deflection at isolated locations, flattening of crown, crown radius 20 to 30 feet - Horizontal Diameter: in excess of 15 percent greater than design <i>Seams and Joints:</i> 3 inch long cracks at bolt holes in one seam <i>Metal:</i> - Aluminum: extensive corrosion, attack of core alloy, scattered perforations - Steel: extensive heavy rust, deep pitting, scattered perforations
2	<i>Shape:</i> critical, extreme distortion and deflection throughout pipe, flattening of crown, crown radius over 30 feet. - Horizontal Diameter: in excess of 20 percent greater than design <i>Seams and Joints:</i> plate cracked from bolt to bolt on one seam <i>Metal:</i> -Aluminum: extensive perforations due to corrosion - Steel: extensive perforations due to rust
1	<i>Shape:</i> partially collapsed with crown in reverse curve; <i>Seams:</i> failed; <i>Road:</i> closed to traffic
0	<i>Pipe:</i> totally failed; <i>Road:</i> closed to traffic

5.1.3 Implementing Suggestion Three

The third recommendation is to conduct a condition assessment of every asset at least once every three years. For most cities, this means conducting assessments more often; however a few cities are not doing it at all. Knowing and keeping an accurate record of asset condition will allow for proper planning of maintenance and renewal strategies.

5.1.4 Implementing Suggestion Four

The fourth recommendation is to define and document an acceptable condition rating from which to rate and maintain assets. This means, for example, when using a numeric condition rating system from one through five, where one is failing and five is like new, the city decides that an acceptable condition for the assets to be in is a three. The acceptable rating should be a condition in which asset failure is highly unlikely and the asset is in acceptable working condition. All assets, when being rated, should meet the acceptable rating, and those that do not should be restored to a level of condition equal to or greater than the acceptable rating.

5.1.5 Implementing Suggestion Five

The fifth recommendation is to *summarize* the results of the condition assessment for all assets using a measurement scale. The measurement scale, like the condition assessment scale, is arbitrary and can be any scale the municipality is comfortable with. The idea is that there is a consistent method by which to rate assets and to summarize them.

5.1.6 Implementing Suggestion Six

The sixth suggestion is to use the last three condition assessments to verify that the assets are being maintained at the acceptable condition level set in recommendation four. This is the last requirement in the GASB-34 modified approach requirements because it relies on all the other requirements to be fulfilled first.

5.2 Benefits of Implementing GASB-34 Modified Approach Strategies

Implementing changes to the entire management practice of any business can be difficult and sometimes costly; however, there are numerous benefits to implementing these changes. Some of the benefits as outlined by the AMSA were included in Table 2.1. Proper asset management practices can save thousands of dollars in emergency repair costs by conducting routine maintenance. It is also very beneficial for proper financial planning and budget forecasting.

5.3 Validation and Verification of Suggestions to Raise Compliance with GASB-34

The above suggestions were sent to the eight participants whose surveys were used in this study. They were asked to answer seven questions regarding the suggestions that were made. Below are the questions each participant was asked. Appendix B provides the entire second survey and the accompanying instructions that were sent out.

- Does your organization ever desire to use the GASB-34 modified approach for financial reporting for the sewer and/or water infrastructure? Why or Why Not?
- Has your organization considered the above suggestions before? If so, which ones and why?

- Do you currently have the resources to implement the above changes?
- What additional resources would you need to implement the above suggestions?
- What problems/benefits do you see arising if you were to implement the above changes?
- Are these recommendations feasible to implement in the next five years?
- Has participating in this study made you aware of information you previously did not know?

There was also a section left open for additional comments. Six of the participants responded to this survey with their feedback and comments.

Figure 5.1 shows the breakdown of cities that desire to use the modified approach.

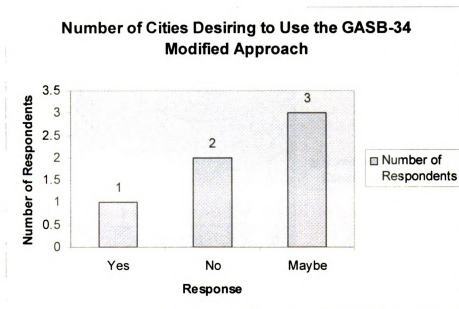


Figure 5. 1 Number of Cities Desiring to Use the GASB-34 Modified Approach

As can be seen in Figure 5.1, one city answered yes to wanting to use the modified approach, and two cities said no. One city that responded “no” stated that this gives a higher priority than they could afford, suggesting that if proper funding were in place, this would be considered as an option. The other three cities replied “maybe,” one city stating that more time, staff, and funding would be needed to use this method, and another city reporting that they “will need to discuss the pros versus cons with city officials.” Some of the pros and cons of implementing each method are outlined in Table 2.1.

Of the six suggestions made as a result of the first survey, Figure 5.2 shows the breakdown of the number of suggestions each city has currently considered implementing.

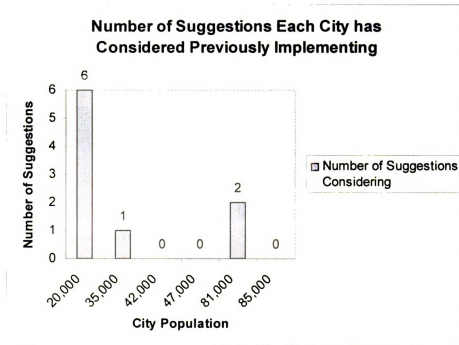


Figure 5. 2 Number of Suggestions Each City has Previously Considered Implementing

As can be seen in Figure 5.2, all of the suggestions have been considered by one city, and none have been considered by three cities. One city has considered the first suggestion of implementing a formal asset management system as well as the fourth suggestion of implementing establishing a defined acceptable condition rating from which to rate assets. Another city is also considering implementing a defined acceptable condition rating system from which to rate assets.

As with any public agency, funding and resources are extremely limited. Only two cities reported having the resources needed to implement these changes, but noted that it would strain the current resources. All other cities reported not currently having the resources necessary to implement these suggestions. Figure 5.3 illustrates this.

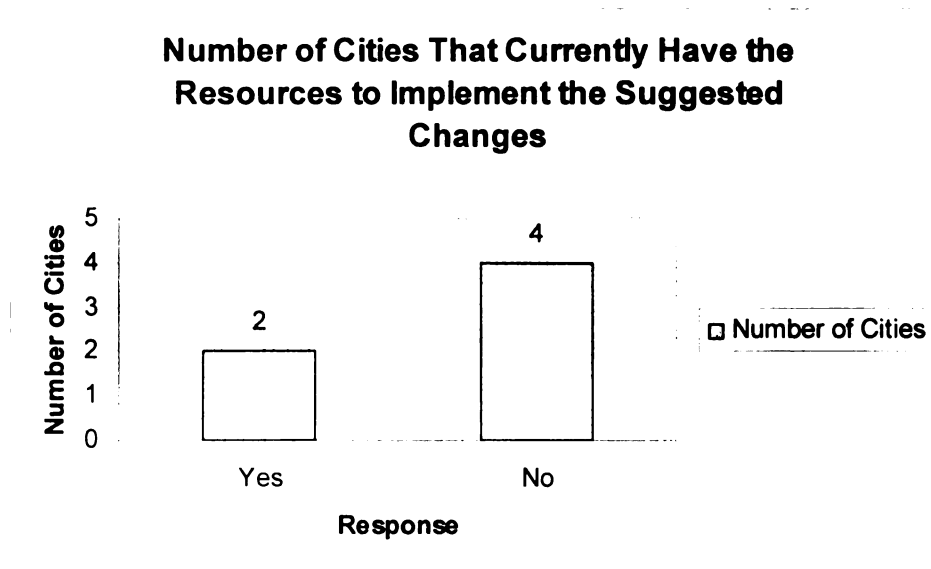


Figure 5. 3 Number of Cities that Currently Have the Resources to Implement the Suggested Changes

Additional resources needed to implement the suggestions as mentioned by these cities included funding, personnel, and time. Figure 5.4 shows the breakdown of the number of cities identifying these resources as necessary to implement these suggestions.

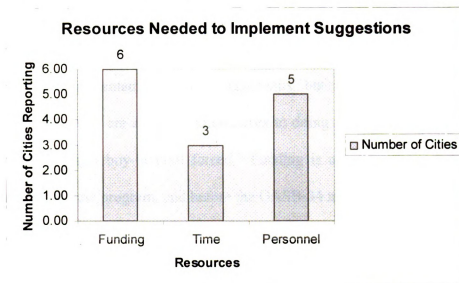


Figure 5. 4 Resources Needed to Implement Suggestions

All cities identified funding as a main resource that would need to be increased to implement the suggestions. One city stated that it would need “funding, and with that time and personnel would be available.” It is clear that funding is a scarce resource, and implementing an asset management system that incorporates the suggestions made in this research may be costly at the onset. However, as one participant stated, implementing these suggestions “takes resources away from other priorities, but helps with programming and budgeting.” Another participant stated that a “change in any facet of life or work is difficult to make as most municipalities are working with less and less each year, and new programs take a great deal of time and resources to implement and

maintain.” While the initial cost may seem high, the long term benefits of an asset management program are exponential.

Implementing these changes in the next five years is not feasible under current situations for four of the six respondents, and the other two would strain their resources to do so. One respondent commented “excellent suggestions, but since there is consistently a funding issue and there are available alternatives to doing actual condition assessments, do not expect a major buy-in until forced.” Funding is always a main concern when implementing any new program, and before the GASB-34 modified approach is used as a means of determining bonding or monetary stature, the resources need to be made available to implement the above suggestions.

Awareness of asset management practices and the GASB-34 is also a problem. Five of the six cities giving their feedback reported that participating in this study made them aware of issues they previously did not know.

5.4 Recommendations for Cities and Municipalities

The research has shown that there are several weaknesses in current city asset management programs within the GASB-34 modified approach requirements. It was clear from the second survey that most cities identified a lack of resources, primarily funding, as one of the main reasons the modified approach requirements will not be feasible to be readily implemented. The primary reason for conducting this research was the prediction by the AMSA that using the modified approach will soon be required by

lending agencies and other government monitors. Due to the current status of the cities as shown in this research, most cities would not be able to comply with this requirement in the event their funding depended on it. While there is no immediate threat of such requirements being put into place, implementing the modified approach to receive funding is a very possible obstacle several cities will have to overcome in the future. For this reason, the following recommendations are being made to assist cities and municipalities improve their asset management system within the parameters of the GASB-34:

1. **Continue using the depreciation method of financial reporting.** The depreciation method is simple to use and there is no current need to deviate from it. It is important, however, that each municipality look to the future and have a plan for implementing the modified approach in the event it becomes a requirement to get funding.
2. **Use a combination approach to asset management within the GASB-34 modified approach requirements.** As shown in this research, it is not feasible for most cities to currently implement all the GASB-34 modified approach requirements. It is possible, however, to evaluate current practices and look at integrating some of the requirements into the everyday workings of the municipality. As shown in Figure 4.5, most cities currently have an up-to-date inventory of their assets and estimate the funding needed to operate yearly, so no attention would be needed to be focused on this issue. Therefore, taking steps to implement a formal condition assessment rating program would be a logical next step. This would for the most part be a one-time cost to create a document that

could be used throughout the lifetime of the assets. Once the document is created establishing the acceptable condition level within the condition assessment rating system would be very simple. Since the majority of cities are doing condition assessments anyways (see Appendix A and Appendix C), using the condition rating system would benefit the knowledgebase and accuracy of the municipality's condition assessments and increase the number of requirements met within the GASB-34 modified approach. Implementing a formal AM system would also be a logical next step, which would also be for the most part a one-time cost but will benefit the organization throughout its service lifetime. Implementing these steps slowly and as funding becomes available will improve management practices and decrease the pressure in the event using the modified approach becomes necessary for funding.

3. **Phase in the modified approach.** It may not be cost effective to implement the modified approach requirements to all assets; however, implementing the modified approach's asset management requirements may be appropriate for large assets that would have a costly impact if they fail. For example, referring back to Dechant's research (2005), the transmission main serving an entire community would have a much more expensive and drastic impact if it failed than a distribution main serving only a neighborhood. Therefore, taking the resources to inspect that transmission main every three years and report in compliance with the modified approach may be appropriate considering the consequences of their failure. Separating assets and prioritizing their value to determine which assets will become modified approach compliant will allow for a slow phase-in of

modified approach compliance. It should be noted, however, that the modified approach method of reporting does not need to be implemented to make the assets GASB-34 modified approach compliant. The assets can still be reported using the depreciation method, unless there is financial or other regulatory needs that would require the modified approach. However, as mentioned previously, having assets managed according to modified approach is beneficial in the event that lending agencies or other government monitors determine it will be required to receive funding.

5.5 Research Contributions

The contributions of this research include the following:

1. **Established current GASB-34 modified approach compliance areas.** This research surveyed and evaluated eight cities on their asset management practices as they relate to the GASB-34 modified approach. The current status of compliance is fully outlined in Chapter Four.
2. **Identified strengths and weaknesses within the GASB-34 modified approach.** Each requirement under the GASB-34 modified approach was determined to be either a strength or weakness within the state of Michigan. Each weakness was identified and the methodology needed to implement that requirement was outlined in sections 5.1.1 through 5.1.6 of this chapter. Implementing these suggestions would bring most cities into GASB-34 compliance.
3. **Identified obstacles preventing implementation of GASB-34 modified approach requirements.** The obstacles preventing the modified approach's full

implementation were discussed in Chapter Four. While debatable, surveyed cities identified lack of resources as the main obstacle preventing its full implementation.

4. **Made recommendations that are currently feasible to begin implementation of the GASB-34 modified approach requirements.** The recommendations listed in section 5.10 of this chapter will assist governmental agencies to start implementing GASB-34 modified approach requirements now.
5. **Created awareness.** Five out of six cities stated that they learned something new from participating in this study. Creating awareness of the need for asset management systems and the policies that revolve around it is essential, and involving Michigan city officials in this study assisted with this issue.

5.6 Recommendations for Future Research

This research was based on a literature search and on the availability and willingness of city officials to participate in the survey. Due to time constraints, the sample size was limited and smaller cities and cities outside of Michigan were not considered for this research. The limitations of this research, however, did not impede on the expected deliverables. Based on the results of this research, the following are some suggestions for future research:

1. Analysis of current asset management practices in small communities. As shown in Figure 4.4, there is a slight trend of asset management strategies as they relate to the GASB-34 and the population. Determining what asset management

practices are currently being done in small communities will help gain a knowledge base and starting point for asset management within all communities;

2. Analysis of the GASB-34 modified approach as an efficient means of asset management practices. This study assumed that the GASB-34 modified approach included asset management practices that were effective for both management and life-cycle cost. However, the actual benefits of the GASB-34 modified approach requirements in the long run are unknown;
3. Comparative analysis of yearly operation and maintenance costs for cities with and without asset management programs, both short- and long-term;
4. Analysis of return on investment for implemented asset management programs;
5. Life cycle cost analysis for assets involved in an asset management program;
6. Assessment of funding sources for implementing asset management programs. Funding was identified as a key component of the obstacles preventing the implementation of these asset management practices. The compilation of resources available for cities wishing to improve their management practices would be a beneficial contribution to the public in general;
7. Analysis of asset management practices needed for different sized municipalities. Because not all cities have the same needs for asset management, it would most likely not be cost effective to implement an asset management system as thorough as those outlined in Chapter Two for smaller cities. However, some asset management practices would be beneficial. A study analyzing the most cost-effective asset management practices that serve communities of different sizes would assist with identifying asset management strategy priorities;

8. Educating local governments and decision makers on benefits of asset management and how to implement it;
9. Improvement of management practices and implementation of asset management strategies utilizing current funding;
10. Analysis of new technologies such as using smart pipes, which monitors itself, as a cost-effective and feasible option for new capital projects; and
11. Using latest techniques in condition assessment, geographic information systems (GIS), computer aided design (CAD), etc., in a comprehensive asset management scheme.

5.7 Conclusions

This research identified strengths and weaknesses of current asset management programs with regards to the GASB-34 modified approach requirements. Asset management strategies and previous research were discussed in Chapter Two of this research, and the methodology for attaining the goal of this research was laid out in Chapter Three. Chapter Four of this research presented the data collected and its analysis. The recommendations and validation that this research resulted in was laid out in Chapter Five.

The suggestions made in this research will be initial steps for municipalities wishing to implement a comprehensive asset management program and to use the GASB-34 modified approach; however it is clear that without substantial funding, additional resources, informing, training and educating of current staff and political leaders, using

this method of reporting and resulting asset management programs will not be feasible for many cities.

APPENDICES

Appendix A: GASB-34 Compliance Survey

Principle Investigator: Mohammad Najafi, Ph.D.

Research Assistant: Amanda Simpson

The Construction Management program at Michigan State University is conducting a research project to assess the current compatibility of government asset management practices with the GASB-34 modified approach means of reporting. The research will help identify areas of asset management practices that need improvement in order to meet the modified approach reporting standards. You are being asked to participate as a city or municipal manager.

As a participant in this research, you will be asked to complete a 13 question survey on the current asset management practices in your governmental agency. Additionally, your comments will be sought regarding the recommendations that are made as a result of this survey in a few weeks.

Your assistance is voluntary and you may choose to terminate your involvement in this study at any time during the project. If you are uncomfortable answering any part of the survey, you may leave those sections unanswered. Your privacy will be protected to the maximum extent allowable by law. You will not be identified by name. The estimated time for the survey is 10 to 15 minutes. As a participant, you may request a copy of this consent letter for your records.

If you have any questions about this project, you may contact Dr. Mohammad Najafi, Construction Management Program, Michigan State University at (517) 432-4937. If you have questions about your rights as a research participant, please feel free to contact Peter Vasilenko, Ph.D., Director of the Human Subject Protection Programs at Michigan State University: (517) 355—2180, fax: (517) 432-4503, email: irb@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

I voluntarily agree to participate in this study.

<i>Subject Name</i>	<i>Occupation</i>	<i>Signature</i>	<i>Date</i>
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<i>Witness Name</i>	<i>Occupation</i>	<i>Signature</i>	<i>Date</i>
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INTRODUCTION

In June of 1999, the Government Accounting Standards Board (GASB) issued Statement 34 (GASB-34) creating one of the largest changes in state and local government financial reporting. The statement requires that governments report their major infrastructure assets on an accrual basis, and can do so either by using depreciation or the “modified method.” As a result of short notice and a lack of asset management practices, most governments, both state and local, use the depreciation method of reporting. This method, however, carries little value of information to the end user, whoever it may be.

The “modified approach” takes on an asset management strategy to accounting reporting, and requires the integration of several departments and detailed asset information. It is time consuming and costly to set up, which explains why most governments have elected to use the depreciation method. However, the modified approach provides useful information with regards to assets, their condition, and their current value. It also takes steps to ensure effective long-term management of major infrastructure assets, which is not only cost-effective, but also increases public safety. The modified approach requires accountability to both the government and the public, and the approach is recognized and supported by agencies such as the Environmental Protection Agency (EPA) as the preferred reporting method. The Association of Metropolitan Sewerage Agencies (AMSA) predicts that reporting using the modified approach will eventually be required by lending institutions and other monitors.

The problem, therefore, lies in the conversion of GASB-34 compliance reporting from the depreciation method to the modified approach. This research aims to identify areas of asset management that are currently being practiced by municipalities, determine if these practices are acceptable for the GASB-34 modified approach reporting method, and if not, make suggestions on asset management practices that can be implemented to bring the municipality up to GASB-34 compatibility.

Survey Instructions:

Please read the following questions and answer them to the best of your knowledge.

PLEASE ONLY CONSIDER SEWER AND WATER INFRASTRUCTURE ASSETS WHEN ANSWERING THESE QUESTIONS. This study is specific to sewer and water infrastructure only. The questions below are specific to the asset management requirements of the GASB-34 modified approach, and do not reflect a holistic asset management program alone.

City: _____ (Do you prefer your city to remain anonymous in the results portion of this research? Yes No)

City Population: _____

Your Position: _____

1. What GASB-34 compliance method do you currently use for reporting sewer and/or water infrastructure?

Modified

Depreciation

2. Do you have a formal asset management system for sewer and/or water infrastructure?

Yes

No

2A. Do you have an asset management coordinator?

Yes

No

3. Do you have an up-to-date inventory of your sewer and/or water assets?

Yes

No

4. What format is your sewer and/or water asset inventory in?

Computerized database

Paper/files

Both

Other _____

5 Do you have a consistent and documented process for conducting condition assessments? (i.e. is the condition assessment repeatable?) (For example, using the NASSCO Pipeline Inspection Guidelines would be considered having a consistent and documented method)

Yes

No.

6. Do you perform condition assessments of all your major sewer and/or water assets?

Yes

No

6a. Do you perform condition assessments of all your major sewer and/or water assets at least every three years?

Yes

No

7. How often do you perform condition assessments?

8. Have you defined and documented an acceptable condition level¹ for your sewer and/or water assets?

Yes

No

9. What is your condition rating system²? Please explain.

¹ The acceptable condition level is an established point in the condition rating system that marks the asset in acceptable condition. The acceptable condition level should be established and documented by administrative or executive policy, or by legislative action.

² How are your assets rated? Do you use the NASSCO Pipeline inspection guidelines, or have you developed your own or adapted from another method. You may attach a copy of your guidelines to answer this question if you like.

10. Are the results of the condition assessments summarized using a measurement scale?

Yes

No

10b. If so, how?

11. Do you document the results of the condition assessment?

Yes

No

12. Do you annually estimate the funding amount needed to maintain and preserve sewer and/or water infrastructure at a certain condition level?

Yes

No

13. Do the results of the last three condition assessments provide reasonable assurance that the sewer and water infrastructure assets are being preserved at (or above) the condition level you have established and documented?

Yes

No

Not Applicable

If you have any questions regarding the content of this survey, please contact Amanda Simpson at 517.353.3885 or at 517.749.6322.

Thank you for taking the time to complete this survey. Please return to Amanda Simpson by email at simps117@msu.edu, by fax at 517.355.7711 or by postal service at

7 Farrall Hall

Michigan State University

East Lansing, MI 48824

Appendix B: Second Survey

June 29, 2006

RE: GASB-34 Asset Management Study

Thank you for participating in the survey that I conducted as a part of my research to fulfill my master's thesis requirements. As a result of the survey, I have made recommendations to be included in the results portion of my thesis. To validate the recommendations, I would appreciate it if you would respond to the attached questions. Feel free to write as little or as much as you would like, but the more feedback you give the more useful it will be.

BACKGROUND

As you know, the survey revolved around the asset management requirements needed to use the modified approach reporting technique for the GASB-34.

The GASB-34 requirements are as follows:

1. Have an up to date inventory of eligible infrastructure assets
2. Perform condition assessments of the eligible infrastructure assets and summarize the results using a measurement scale
3. Estimate each year the annual amount to maintain and preserve the eligible infrastructure assets at the condition level established and disclosed by the government.
4. Complete condition assessments of eligible infrastructure assets are performed in a consistent manner at least every three years
5. The results of the three most recent condition assessments provide reasonable assurance that the eligible infrastructure assets are being preserved approximately at or above the condition level established and disclosed by the government.

The original survey had nine questions that addressed each issue in the above five requirements. All original survey questions that yielded more than 50% of a positive response were not considered for recommendations. Three of the nine requirements yielded this response. The other six resulted in recommendations, as listed below.

Recommendations:

1. **Implement a formal asset management program**
2. **Implement a consistent and documented process for conducting condition assessments of the assets**
3. **Increase the number of condition assessments to once at least every three years**
4. **Define and document an acceptable condition level from which to rate assets**
5. **Summarize the results of the condition assessment by using a measurement scale**
6. **Use the last three condition assessment results to verify that the set condition level is being maintained**

SECOND SURVEY QUESTIONS

Please take a moment to answer the below questions. Thank you!!

- 1. Does your organization ever desire to use the GASB-34 modified approach for financial reporting for the sewer and/or water infrastructure? Why or Why not?**

Answer: Yes No Maybe

Comments:

- 2. Has your organization considered the above suggestions before? If so, which ones, and why?**

Answer: Yes No
Which Ones? Recommendations 1 2 3 4 5 6

Comments: Why?

- 3. Do you currently have the resources to implement the above changes?**

Answer: Yes No

Comments:

- 4. What additional resources would you need to implement the above suggestions?**

Answer: People Funding Time Other? _____

Comments:

- 5. What problems/benefits do you see arising if you were to implement the above changes?**

Answer: Funding Issues Communication Issues Agreement Issues

Comments:

- 6. Are these recommendations feasible to implement in the next five years?**

Answer: Yes No

Comments:

7. Has participating in this study made you aware of information you previously did not know?

Answer: Yes No

Comments:

8. Additional Comments:

Thank you again for your participation. It is greatly appreciated. Please email this back to Amanda Simpson at amanda@amanda.edu, or fax it to 517.432.8108, attn: Amanda Simpson.

I will be sure to email you a copy of my final report when it is complete. You can expect it around the first of August. Thank you again for your cooperation, this would not have been possible without it.

Sincerely,
Amanda Simpson

APPENDIX (For the Second Survey)

The following are more specific means of implementing the above recommendations.

Implementing Recommendation One

The first recommendation is to implement a formal asset management plan. Three methodologies were laid out in Chapter Two of this research as a means of implementing asset management program; however they all have a similar first step. Before an asset management program can be implemented, there needs to be a plan or strategy. The strategy, while always in the development stage, is the first step as the strategy outlines the steps to implementing a formal asset management program. The goals and objectives of the asset management program should be outlined and documented, and appropriate personnel should be given the authority and means to meet those goals. It is also important to develop a means of measuring the progress of the objectives, and implement policies company-wide that support the objectives of the asset management program.

Implementing Recommendation Two

The second recommendation is to implement a consistent and documented process for conducting condition assessments of the assets. This is important to assure that the assets are being evaluated on the same quality scale every year. Cities can make their own condition assessment scale, or can use one that has been previously published. To implement a condition rating system, a measurement scale should be determined. The measurement scale can be numeric (one through five) or qualitative (excellent, good, fair, poor) in nature, but each level of the scale should be defined with both words and photos describing the quality the asset should be in. All employees conducting inspections should be trained on the condition assessment rating system and should be given a copy to keep with them while conducting the inspections so that all assets are properly and consistently rated. Figure 1 below shows an example rating system for culverts that is outlined in the National Cooperative Highway Research Program (NCHRP)'s Synthesis 303, Assessment and Rehabilitation of Existing Culverts.

FHWA Culvert Inspection Rating Guidelines for Corrugated Metal Culvert Barrels (Arnoult 1986)	
Rating	Condition
9	New Condition
8	<i>Shape:</i> good, smooth curvature in barrel - <i>Horizontal:</i> within 10 percent of design <i>Seams and Joints:</i> tight, no openings <i>Metal:</i> - <i>Aluminum:</i> superficial corrosion, slight pitting - <i>Steel:</i> superficial rust, no pitting
7	<i>Shape:</i> generally good, top half of pipe smooth but minor flattening of bottom - <i>Horizontal Diameter:</i> within 10 percent of design <i>Seams and Joints:</i> minor cracking at a few bolt holes, minor joint or seam openings potential for backfill infiltration <i>Metal:</i> - <i>Aluminum:</i> moderate corrosion, no attack of core alloy - <i>Steel:</i> moderate rust, slight pitting
6	<i>Shape:</i> fair, top half has smooth curvature but bottom half has flattened significantly

	- <i>Horizontal Diameter</i>: within 10 percent of design <i>Seams and Joints</i> : minor cracking at bolts is prevalent in one seam in lower half of pipe. Evidence of backfill infiltration through seams or joints <i>Metal</i> : - <i>Aluminum</i>: significant corrosion, minor of core alloy - <i>Steel</i>: fairly heavy rust, moderate pitting
5	<i>Shape</i> : generally fair, significant distortion at isolated locations in top half & extreme flattening of invert - <i>Horizontal Diameter</i>: within 10 percent to 15 percent greater than design <i>Seams and Joints</i> : moderate cracking at bolts is prevalent in one seam in lower half of pipe. Deflection of pipe caused by backfill infiltration through seams or joints <i>Metal</i> : - <i>Aluminum</i>: significant corrosion, moderate of core alloy - <i>Steel</i>: scattered heavy rust, deep pitting
4	<i>Shape</i> : marginal significant distortion throughout length of pipe, lower third may be kinked - <i>Horizontal Diameter</i>: within 10 percent to 15 percent greater than design <i>Seams and Joints</i> : moderate cracking at bolts is prevalent in one seam in lower half of pipe. Deflection caused by loss of backfill through open joints <i>Metal</i> : - <i>Aluminum</i>: extensive corrosion, significant of core alloy, scattered perforations - <i>Steel</i>: extensive heavy rust, deep pitting
3	<i>Shape</i> : poor with extreme deflection at isolated locations, flattening of crown, crown radius 20 to 30 feet - <i>Horizontal Diameter</i>: in excess of 15 percent greater than design <i>Seams and Joints</i> : 3 inch long cracks at bolt holes in one seam <i>Metal</i> : - <i>Aluminum</i>: extensive corrosion, attack of core alloy, scattered perforations - <i>Steel</i>: extensive heavy rust, deep pitting, scattered perforations
2	<i>Shape</i> : critical, extreme distortion and deflection throughout pipe, flattening of crown, crown radius over 30 feet. - <i>Horizontal Diameter</i>: in excess of 20 percent greater than design <i>Seams and Joints</i> : plate cracked from bolt to bolt on one seam <i>Metal</i> : - <i>Aluminum</i>: extensive perforations due to corrosion - <i>Steel</i>: extensive perforations due to rust
1	<i>Shape</i> : partially collapsed with crown in reverse curve; <i>Seams</i> : failed; <i>Road</i> : closed to traffic
0	<i>Pipe</i> : totally failed; <i>Road</i> : closed to traffic

Figure 1: Example Rating System for Culverts

Implementing Recommendation Three

The third recommendation is to conduct a condition assessment of every asset at least once every three years. For most cities, this means conducting assessments more often; however a few cities are not doing it at all. Knowing and keeping an accurate record of asset condition will allow for proper planning of maintenance and renewal strategies.

Implementing Recommendation Four

The fourth recommendation is to define and document an acceptable condition rating from which to rate and maintain assets. This means, for example, when using a numeric condition rating system from one through five, where one is failing and five is like new, the city decides that an acceptable condition for the assets to be in is a three. The acceptable rating should be a condition in which asset failure is highly unlikely and the asset is in acceptable working condition. All assets, when being rated, should meet the

acceptable rating, and those that do not should be restored to a level of condition equal to or greater than the acceptable rating.

Implementing Recommendation Five

The fifth recommendation is to *summarize* the results of the condition assessment for all assets using a measurement scale. The measurement scale, like the condition assessment scale, is arbitrary and can be any scale the municipality is comfortable with. The idea is that there is a consistent method by which to rate assets and to summarize them.

Implementing Recommendation Six

The sixth recommendation is to use the last three condition assessments to verify that the assets are being maintained at the acceptable condition level set in recommendation four. This is the last requirement in the GASB-34 modified approach requirements because it relies on all the other requirements to be fulfilled first.

Benefits of Implementing GASB-34 Modified Approach Strategies

Implementing changes to the entire management practice of any business can be difficult and costly, however, there are numerous benefits to implementing these changes. Some of the benefits, as outlined by the AMSA, are below:

1. Provides information on asset condition
2. Sets quantified targets for asset condition
3. Provides documented explicit costs of preserving assets
4. Real value of assets are documented
5. Quantified performance measures allow trends to be checked and projections to be made
6. Variable future funding needs can easily be translated into rates
7. Involves policy makers and all utility managers, not just finance personnel
8. Provides meaningful information for the customers and public
9. Satisfies asset management expectations of CMOM
10. Probably will be required under any new federal financing program
11. Eventually, will be expected by lending institutions and other monitors.

(AMSA 2002)

FAX COVER SHEET

DATE: _____

TO: AMANDA SIMPSON
7 FARRALL HALL
EAST LANSING, MI 48824

PHONE: 517.749.6322
FAX #: 517.432.8108

FROM: _____

PHONE: _____

RE: GASB-34 Asset Management Survey #2.

Thank you!

Appendix C: Results Matrix

Population	Question 1	Question 2	Question 2A	Question 3	Question 4	Question 5	Question 6	Question 6A	Question 8	Question 10	Question 11	Question 12	Question 13	Sum Mod. Req's	Can This City Use Modified Approach ?
86,000	D	0	0	0	CD	1	0	0	0	0	0	0	0	1	NO
36,000	D	1	1	1	B	0	0	0	0	0	0	1	0	3	NO
43,000	D	1	1	1	CD	1	1	0	1	0	1	1	1	7	NO
20,000	D	1	1	1	CD	1	1	1	1	0	1	1	1	8	NO
60,062	D	0	0	1	CD	0	1	1	1	0	1	1	1	6	NO
70,000	D	0	0	1	B	0	0	0	0	0	0	1	0	2	NO
138,247	D	0	0	1	CD	0	1	0	0	0	1	1	0	3	NO
85,000	D	1	0	1	B	0	1	1	0	0	1	1	1	6	NO
69,000	M	0	0	1	CD	0	0	0	0	0	1	1	1	1	NO
SUM	0	4	3	7	0	3	5	3	3	0	5	7	4		
	0	50.00%	37.50%	87.50%	0.00%	37.50%	62.50%	37.50%	37.50%	0.00%	62.50%	87.50%	50.00%		
Need Rec?	YES	YES	YES	NO	YES	YES	NO	YES	YES	YES	NO	NO	YES		
Yes=1															
No=0															

Appendix C cont.

Formal AM	Up to Date Inventory?	Consistent Process for Condition Assessment?	Condition Assessment Every 3 Years?	Defined Acceptable Condition Level?	Summarize with Measurement Scale?	Condition Assessment Results Documented?	Annual Funding Needs Estimated?	C.A. Provide Assurance of Acceptable Condition Level?	Sum Mod. Req's	Can This City Use Modified Approach?	% of Mod. Req's Met
Population	System?										
20,000	1	1	1	1	0	1	1	1	8	NO	88.89%
36,000	1	1	0	0	0	0	1	0	3	NO	33.33%
43,000	1	1	0	1	0	1	1	1	7	NO	77.78%
60,062	0	1	0	1	0	1	1	1	6	NO	66.67%
70,000	0	1	0	0	0	0	1	0	2	NO	22.22%
85,000	1	1	0	1	0	1	1	1	6	NO	66.67%
86,000	0	0	1	0	0	0	0	0	1	NO	11.11%
138,247	0	1	0	0	0	1	1	0	3	NO	33.33%
4	7	3	3	3	0	5	7	4	4.5		
50.00%	87.50%	37.50%	37.50%	37.50%	0.00%	62.50%	87.50%	50.00%			
YES	NO	YES	YES	YES	YES	NO	NO	YES			

Appendix D: Second Survey Matrix

Cities are identified by population. The three tables list how they answered each question for the second survey. Questions are in the first row, each answer is in the respective row to the city and question it is in response to.

Population	Ever desire to use Modified Approach?	Considered before at all?	Currently have resources?
20,000	Maybe	Yes: All #1 and #4; currently finalizing a pavement management system which incorporates field data to rate/evaluate existing pavement in the city and develops proposed fixes to bring the pavement to condition level desired	Yes
81,000	Maybe; would need more time, staff, and funding		No
35,000	No; may give a higher priority than we can afford	#4	No
42,000	Maybe; will need to discuss pros versus cons with city officials	No	No
47,000	Yes	No	Yes
85,000	No	No	No

Appendix D cont.

Population	Additional Resources Needed?	Problems/Benefits?	
20,000	P/F	Takes resources away from other priorities, but helps with programming and budgeting	
81,000	P/F/T	Funding; change in any facet of life or work is difficult to make as most municipalities are working with less and less each year, and new programs take a great deal of time and resources to implement and maintain.	
35,000	P/F/T	Funding and Agreement issues	
42,000	Funding, with that time and personnel would be available	Once specific needs were found, regulatory agencies may force changes without funding in place	
47,000	People/Funding/Time	Funding	
Population	Feasible in next 5 years?	Participation made aware?	Additional Comments Made
20,000	Yes	No	None
81,000	No	Yes	None
35,000	No	Yes	None
			Excellent suggestions, since there is consistently a funding issue and there are available alternatives to doing actual condition assessments, I would not expect major buy in to until forced.
42,000	Doubtful, funding would be approved since the other method is allowed	Yes	
47,000	Yes	Yes	None

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