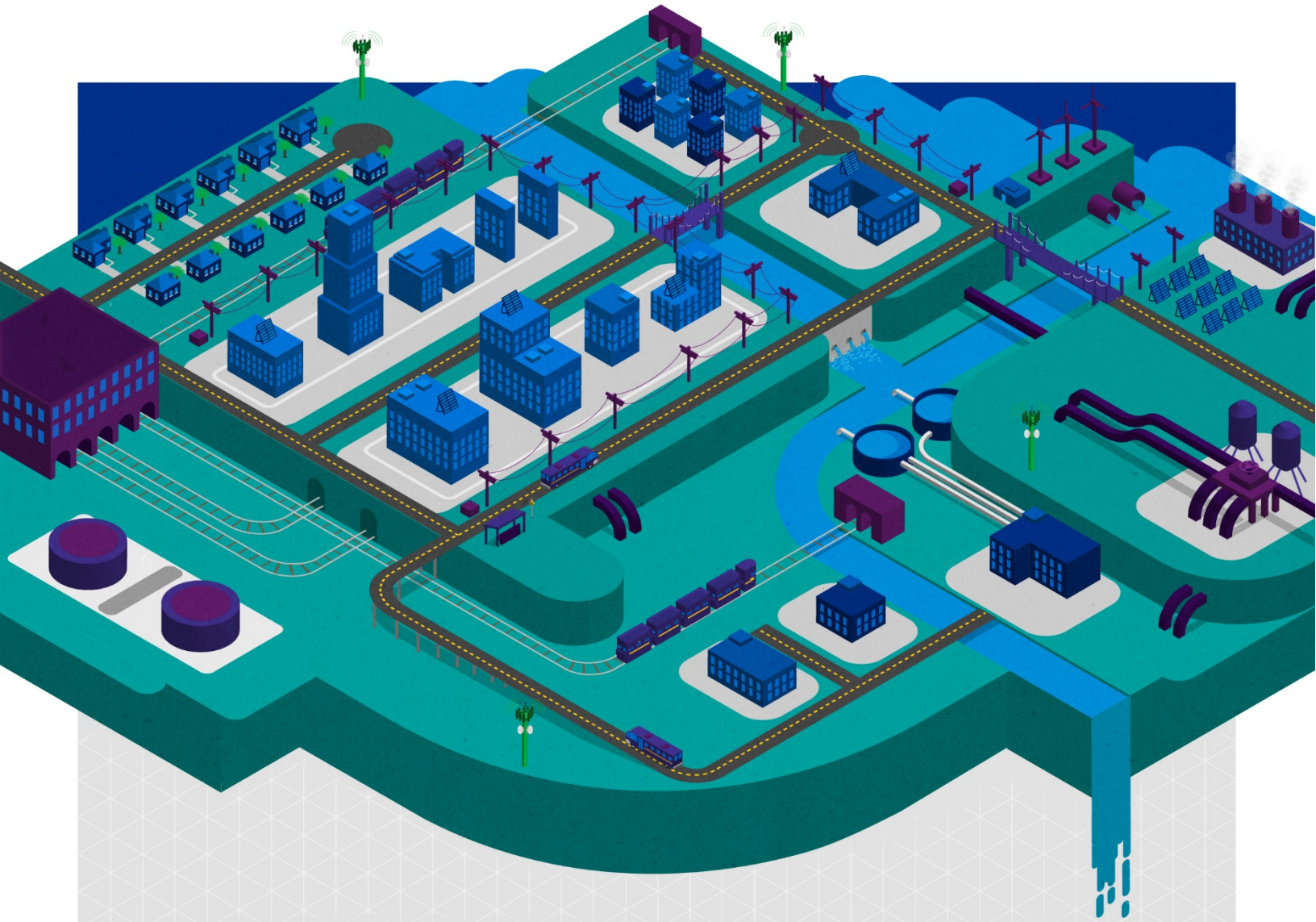

MICHIGAN INFRASTRUCTURE ASSET MANAGEMENT PILOT FINAL REPORT

APRIL 2018

21st CENTURY

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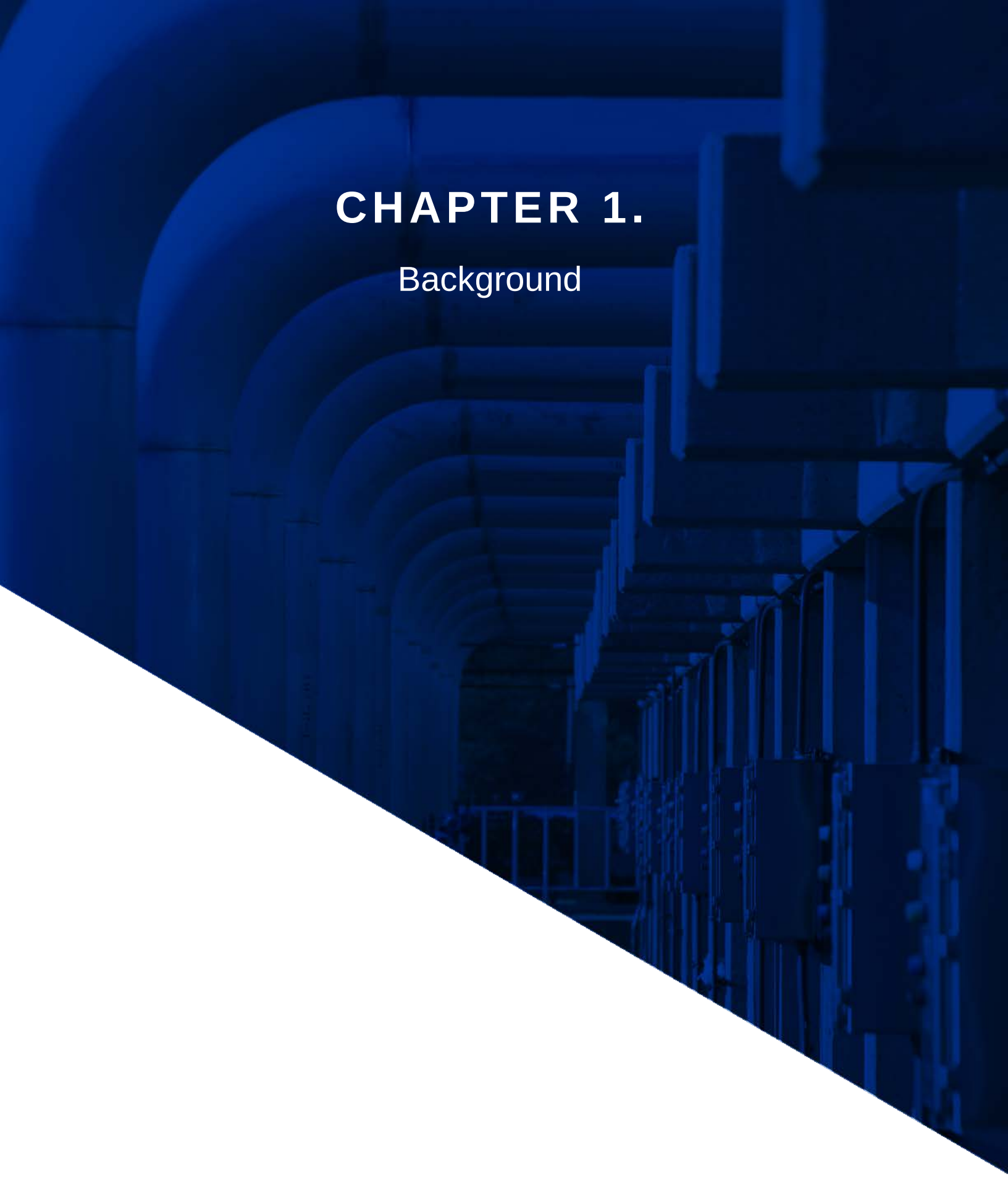


CHAPTER 1.

Background

CHAPTER 1: Background

1.1 Historical Perspective

Sound and modern infrastructure is fundamental to Michigan's future economic prosperity and quality of life. Michigan aims to provide safe, reliable, efficient and cost-effective infrastructure - a 21st century infrastructure system that creates a foundation for the future. By adopting a more comprehensive approach to managing our infrastructure assets, we will be able to better plan, coordinate, manage, and invest in our infrastructure statewide. This will not only result in improvements to our infrastructure assets but will also lead to a more globally competitive business climate by assuring we are achieving the greatest benefits possible for dollars expended. A more comprehensive approach will result in a sustainable infrastructure systems that provides high quality and reliable service for our communities, residents, and businesses.

A key issue in how we manage infrastructure in Michigan is coordination in the way that we plan for and manage infrastructure across and among levels of government, and with private sector entities that build and manage infrastructure. Traditionally, public infrastructure in Michigan has been managed individually by sector. Particularly in the case of water infrastructure, there is limited information regarding the location and condition of mains, lead service lines, and leaks, which complicates investment decisions. Planning and funding cycles for different types of infrastructure are often not coordinated, and public and private infrastructure owners may not be aware of each other's planning and decision-making processes. This results in the inefficient use of public money. For example, when a road is reconstructed or resurfaced, there is often not consistent coordination with water and sewer utilities, gas, electric and communications companies to plan underground projects. As a result, sometimes newly surfaced roads are cut into to enhance or repair underground utilities, increasing costs—potentially compromising the integrity of the new road surface and needlessly affecting public travel.

Existing assets may not be best suited to future needs. Over 85 percent of our infrastructure is 30 to 70 years old, and was therefore built for goals of 30-70 or more years ago. Decision makers should therefore ask themselves 'Has much changed in the past 30-70 years?'

Optimal investment strategies can only result from periodic evaluation of the ability of existing infrastructure to meet future goals. Investment decisions must account for this, including at least the same three possibilities most of us consider with personal investments:

1. Does repairing what I have meet enough of my goals at a better value/cost?
2. Should I replace what I have with the same?
3. Do I need something different than what I had due to different needs or goals from my original investment?

Agencies have repeatedly found that to maximize return on larger investments, more rigorous cost-benefit analysis asking these questions is critical. This analysis is only as good as the quality of the data and assumptions used.

Currently, infrastructure in Michigan exists in silos. There are 619 separate road agencies, 79 transit agencies, 1,390 drinking water systems, 1,080 wastewater systems, 59 electric utilities, 10 natural gas utilities, 83 drain commissioners, and 43 broadband providers. That's over 3,350 entities managing Michigan's infrastructure.

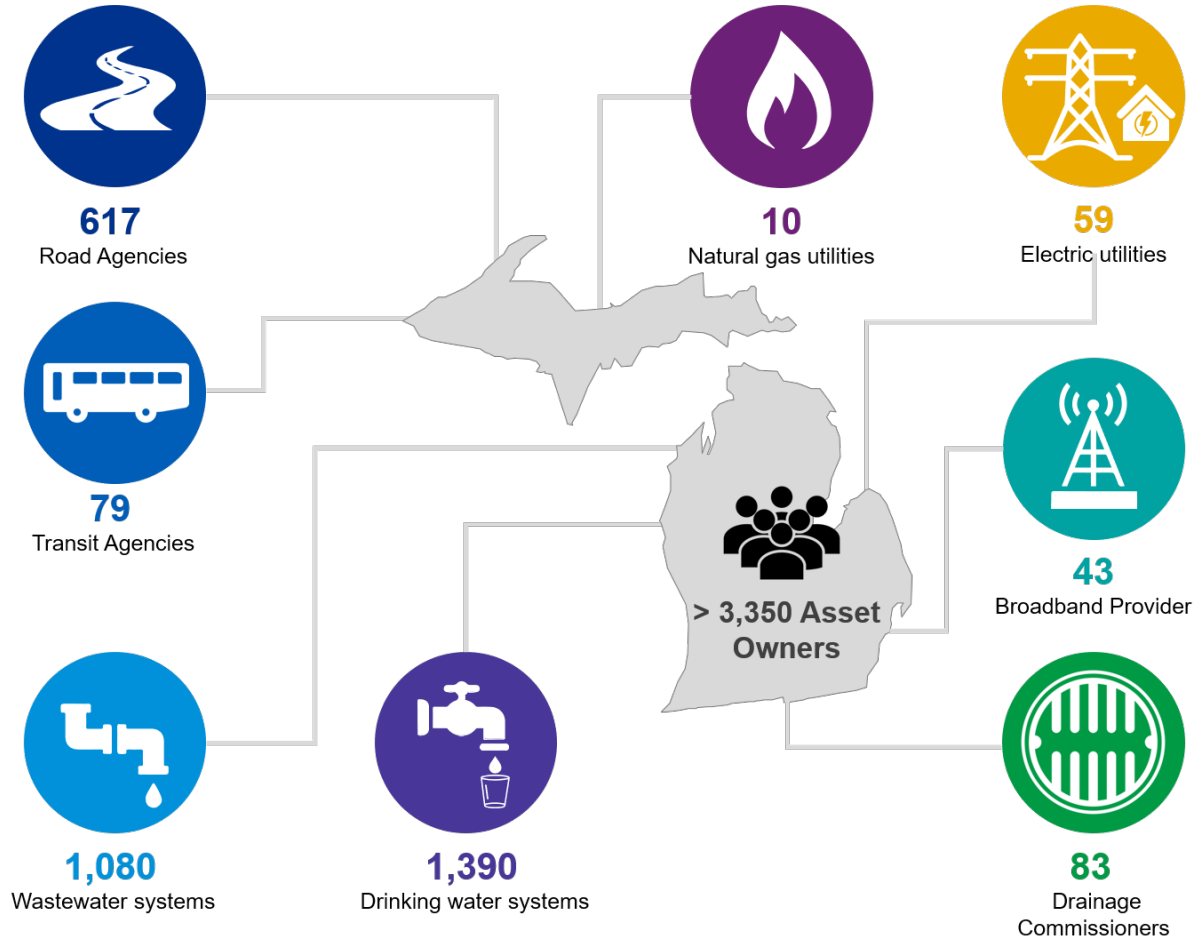


EXHIBIT 1. Asset Owning Entities in Michigan

Coordinated infrastructure planning and management is a necessary foundation to a successful future system. If implemented in a standardized and systematic way across infrastructure types and jurisdictions, asset management can improve coordination and significantly reduce costs. Michigan has been recognized by the Federal Highway Administration as being a national leader in statewide transportation asset management data collection and planning through the Michigan Transportation Asset Management Council (TAMC). However, the same approach to coordinate efforts has not previously been directed at Michigan's underground assets, specifically drinking water, wastewater, and stormwater.

To address the state's current infrastructure needs, as well as identify where Michigan envisions infrastructure fifty years from now, Governor Rick Snyder created the 21st Century Infrastructure Commission on March 10, 2016 when he signed Executive Order 2016-5. Comprised of an advisory board of 27 members representing business, government, nonprofit, academic and communities, the Commission delivered a final report that included 110 comprehensive recommendations and a long-term vision for Michigan.

The 21st Century Infrastructure Commission final report, published on November 30, 2016, included the following principles which guided the Commission as they developed recommendations for creating a 21st century infrastructure system for the state of Michigan:

- Create infrastructure systems that enhance quality of life, enable economic growth, and provide a strong foundation for vibrant communities.
- Promote coordination, cooperation, and communication at all levels of government and infrastructure entities in Michigan.
- Build a culture of strategic investment through asset management which uses a continual improvement model and a risk-based approach, ensuring infrastructure needs are prioritized and funded.
- Asset management is defined as "the practice of identifying and managing infrastructure in a cost-effective and efficient manner based on continuous collection of data"
- Design infrastructure systems that are adaptable, flexible, safe and resilient to changing demographics and technologies, as well as climate impacts and cyber and physical threats.
- Leverage public and private investment and financing resources to ensure adequate investment in and operation of safe, reliable, efficient, and cost-effective infrastructure.
- Prioritize environmental quality and sustainability efforts across all infrastructure sectors.
- Embrace emerging technologies, visionary planning principles, and innovative approaches.

Throughout its work, the Commission identified a set of key solutions to addressing challenges to Michigan's infrastructure systems:

- Effectively collect standardized condition data and implement asset management across the state.
- Better coordination in the way Michigan plans for and manages public infrastructure across and among levels of government
- Greater coordination between public and private sector entities that build and manage infrastructure.

1.2 The Pilot Process

In order to enhance Michigan's position as an infrastructure leader, the 21st Century Infrastructure Commission identified the first key issue facing Michigan in developing a 21st century infrastructure system is determining how to get more value out of our assets over their entire service life. The best way to accomplish this is through asset management—the practice of identifying and managing infrastructure in a cost-effective and efficient manner based on continuous collection of data. Communities that utilize effective asset management can attest that identifying strategic investments in preventive maintenance, repair, and rehabilitation of infrastructure assets is much more cost-effective than reconstructing the "worst first". To create a culture of asset management throughout Michigan across asset

types, the Commission recommended the establishment of a regional infrastructure pilot to identify existing infrastructure data and gaps, determine an appropriate comprehensive database system to house this data, and begin to coordinate amongst asset management data and planning across infrastructure sectors.

The Michigan Infrastructure Asset Management Pilot project set the stage for meaningful collaboration. This initiative engaged a wide range of communities and stakeholders to build a statewide culture of asset management. By understanding the varying conditions, personalities, needs, and nuances of our Michigan communities, we began to develop consistency in how we should approach statewide asset management standards and practices. We believe this methodology will open the door for successful problem solving on a statewide level.

The frequent contact amongst the communities and stakeholders has created a sense of comradery that opened the door for a more coordinated and intentional communication across the state. The process revealed a commonality among statewide asset management issues with agreement that coordinated planning efforts were critical to achieving statewide infrastructure improvement. Recognizing that" we are not in this alone" and "we can do better together" helped position the state to operationalize a comprehensive asset management database and system that will enable local communities to deliver effective asset management principles.

Mark Rambo
City of Kentwood

Keith McCormack,
Hubbell, Roth & Clark

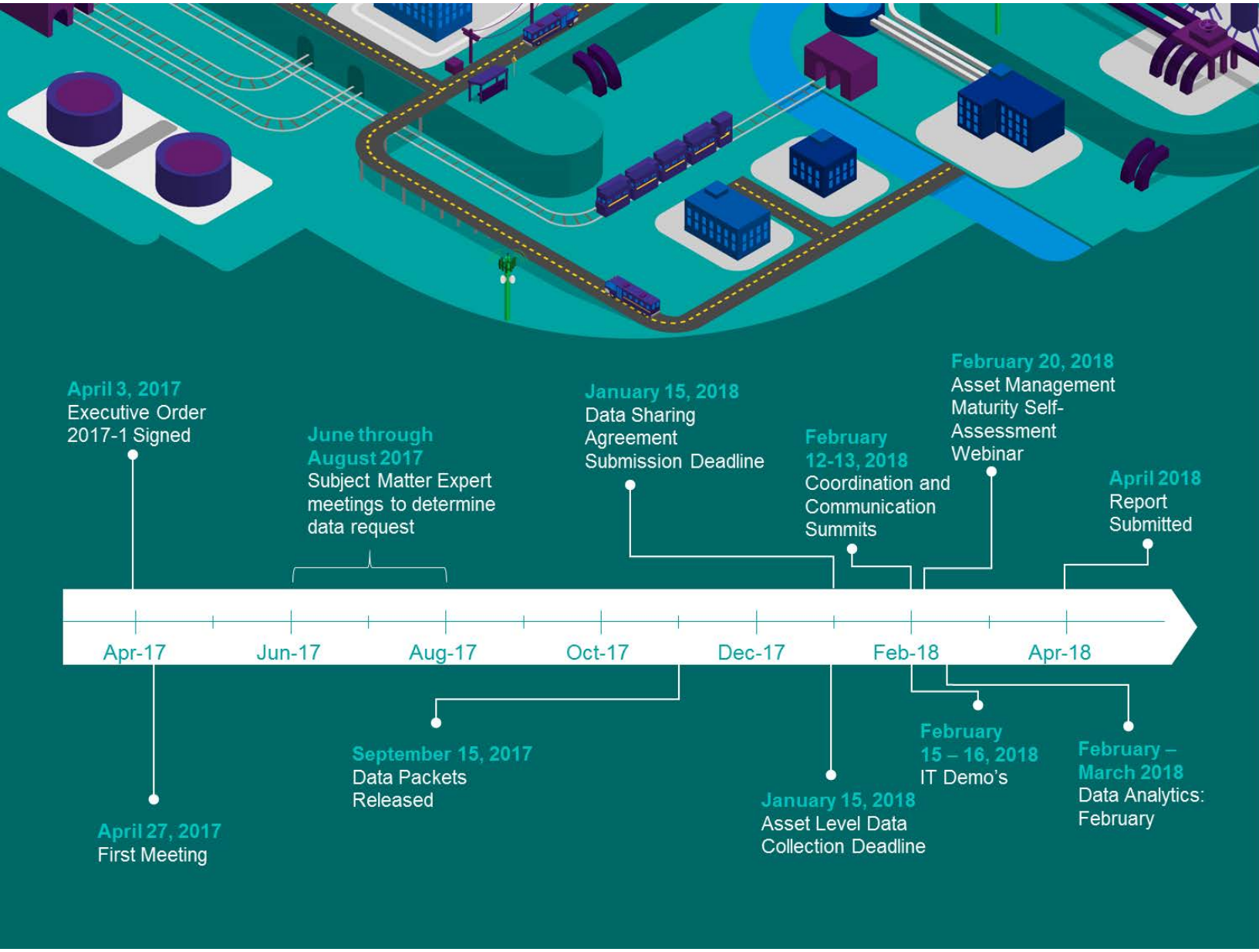
Jacob Eckholm,
City of Muskegon Heights

The Governor signed Executive Directive 2017-1, creating the Regional Asset Management Pilot, tasked with developing an integrated asset management process which will help the state, regions, local governments and utilities make more informed, strategic decisions and coordinated investments. It was recommended that the regional infrastructure pilot identify existing infrastructure data and gaps, determine an appropriate comprehensive database system to house the data, and begin to enable better coordination across infrastructure sectors.

Developing one asset management system that will work for the entire state is a complex task, one that will require agencies and communities from all over the state to work together. This pilot project is the first step in the development of such an integrated system. The next step will be the establishment and codification by the Michigan Legislature of the Michigan Infrastructure Council, a body that will coordinate infrastructure-related goals and develop a long-term strategy for infrastructure assets. The Council will be responsible for:

— Leveraging the results of the Pilot for implementation and maintenance of a common statewide asset management processes and database.
— Developing a long-term, integrated infrastructure strategy for the state, and communicating relevant project information to decision-making bodies.

— Designing, overseeing, and coordinating the distribution of incentives and funding and financing opportunities, with an eye toward ensuring that funding cycles and processes promote cooperation between asset owners and reward projects that address multiple infrastructure needs with a single project.



CHAPTER 2.

The Asset Management Landscape in Michigan

CHAPTER 2: The Asset Management Landscape in Michigan

2.1 Defining Asset Management

The term 'asset management' in its current sense was first used in the 1970's. Since that time numerous definitions have been developed. The most recent definition, contained in the international standard, ISO55000:2014, defines asset management as the "*coordinated activity of an organization to realize value from its assets"* where the realization of value involves balancing costs, risks, opportunities and performance benefits. While this may seem an overly simple definition, its intent is to convey that asset management is a way of doing business that connects the organization's goals and objectives, i.e. how it defines value, with the assets which support them.

What is Asset Management?

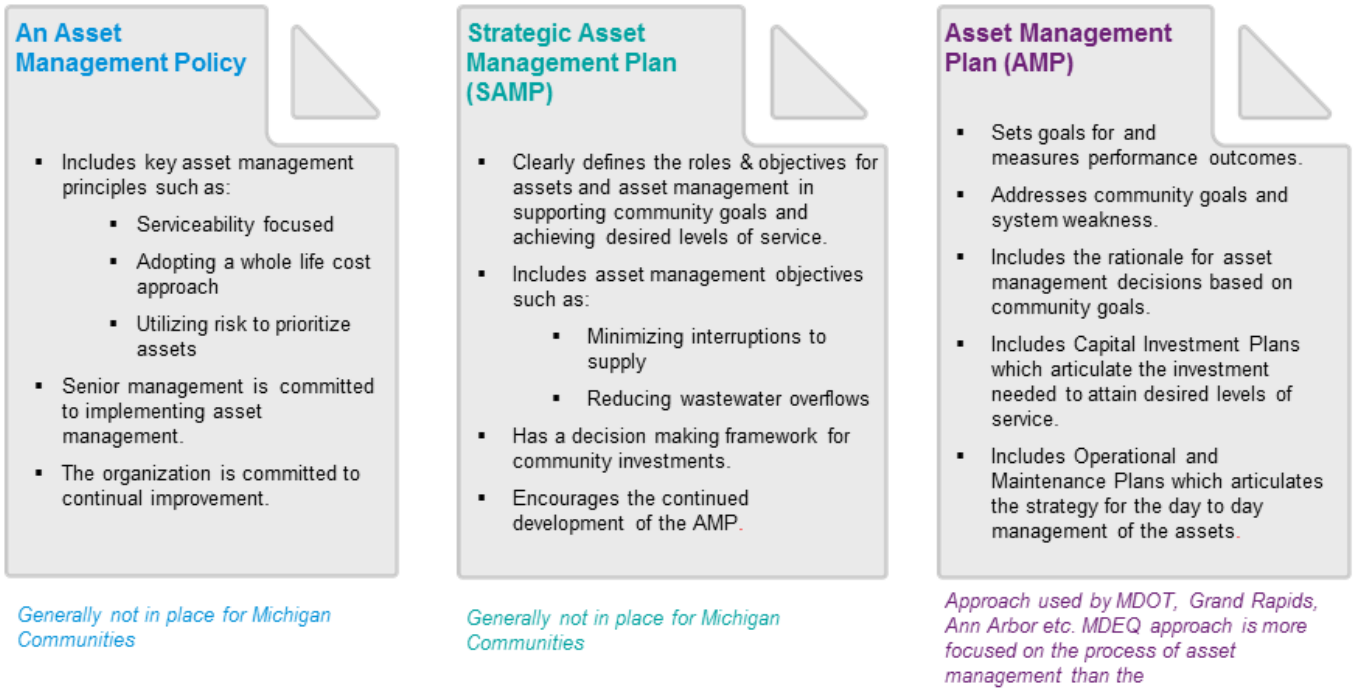


EXHIBIT 2. Key components of asset management

The 21st Century Infrastructure Commission report defined asset management as *"the practice of managing infrastructure in a cost-effective and efficient manner based on continuous collection of data on the location and condition of infrastructure."*

A substantial proportion of the Pilot focused on the defintion of data requirements and the subsequent collection of data from a broad range of communities and agencies. However, throughout the duration of the Pilot there has been a greater understanding that in order to achieve greater benefits from asset management and to make these benefits more sustainable, a broader approach to asset management needs to be taken.

2.2 The State Transportation Perspective

There are approximately 120,000 route miles of paved public roads and over 11,000 bridges in the state of Michigan, the tenth largest system in the nation. These roads are under jurisdictional responsibility of 619 separate road agencies – 535 cities and villages, 83 county road commissions and the Michigan Department of Transportation (MDOT). This means that each of the 619 separate road agencies collect data, prioritize projects and make investment decisions. Transportation asset management in Michigan has evolved towards a more strategic approach, linking goals, investment strategies, data, programs, and projects into a systemic process to ensure achievement of a desired outcome

A. Michigan Transportation Asset Management Council (TAMC)

The Michigan Legislature enacted Public Act (PA) 499 in 2002, creating the TAMC[1] to advise the Michigan State Transportation Commission (STC) on a statewide asset management strategy. The Council was charged with developing common definitions, condition assessments, and data collection procedures. The Council has operated successfully over the past 16 years and has been cited as a national model.

Today, the Council oversees a comprehensive, unified data collection process at the state, county and city/village levels to assess the condition of Michigan's roads and bridges and reports annually to the STC and Michigan Legislature on the results. Their efforts allow all of Michigan's transportation agencies and jurisdictions to make highly informed decisions regarding investment in their road networks. Partnerships formed at the local, state, regional, and national level, along with education and teamwork across all aspects of asset management continue to make the efforts of TAMC a success.

B. Michigan Department of Transportation (MDOT)

The MDOT has a long history of utilizing asset management practices to make strategic investment decisions across its diverse transportation assets. The Department is responsible for all I, US, and M routes in Michigan, which includes 9,668 route miles of roadways (trunkline), 4,773 bridges, and all adjacent infrastructure (i.e. carpool lots, rest areas, noise barriers). MDOT is also responsible for 665 miles of state-owned railroad lines, four state-owned airports and four intercity/ intermodal terminals.

[1] www.michigan.gov/tamc

MDOT Highway Call for Projects

A primary example of MDOT's integration of asset management is the development and selection of highway projects – the MDOT Highway Call for Projects (CFP). This process involves determining the right fix at the right time on the right roadway, and includes reconstruction, resurfacing and preventive maintenance projects.

The CFP is an integrated, annual, year-long process that includes coordination with numerous programs and requires a department-wide partnership effort. Improvement strategies for the road and bridge networks guide project selection and ensure that a mix-of-fixes is incorporated into program development.

C. Local Agency Examples

Several local road agencies have successfully implemented asset management and used their data to gain public support for the adoption of a local road millage. Through the forecasting of conditions and funding projections, agencies are able to define critical gaps between the needs of their road systems and the availability of funding to maintain or improve those needs; examples of this include the cities of Royal Oak and Grand Rapids.

The City of Royal Oak adopted an asset management plan for their road network in 2013. This plan identifies the current condition of all roads, budget information, and various pavement treatments that could be applied to roads in the community and presents several scenarios for the City based on road condition goals and varying budget situations. Based upon this information, the citizens of Royal Oak approved a 2.5-mill tax increase in 2014 for 10 years to improve and upgrade 214 miles of local roads.

In 2017 the City Commission for the City of Grand Rapids approved an asset management plan with a goal of reaching 70 percent of all city streets in fair to good condition by 2030. Through preventive maintenance and an optimized "mix of fixes" approach, the City identified an annual investment level for each year of the plan. As a result, prevention and construction projects are backed by a 2014 plan and voter-approved extension of a local income tax levy for 15 years. City leaders and the community are committed to extending the useful life of this investment through a planned approach utilizing asset management. The City shares information and updates on road construction projects on its website and on social media.

D. Asset Management Tools

One important aspect of support for asset management is the tools used for data inventory, collection, performance monitoring and analysis. According to a survey conducted in 2017[2] 78 percent of respondents from local road agencies indicated they are using a computer-based asset management system to guide decisions in management of the agency's road system. The Roadsoft program developed and managed by Michigan Technological University's Center for Technology and Training (MTU-CTT) provides a solution that is

[2] Michigan Technological University's Center for Technology and Training (MTU-CTT)

financially supported at the state level so local transportation agencies do not have to individually pay for access to it.

TAMC also partners with MTU-CTT to administer trainings, workshops and the annual roadway condition data collection effort training in conjunction with Michigan's regional planning agencies. TAMC has used this partnership, recognizing its importance to local road agencies, to contract with the Michigan Department of Technology and Budget, Center for Shared Solutions to deploy technological applications such as the Investment Reporting Tool (IRT) that interact with Roadsoft for the purpose of integrating roadway condition and improvement history.

Roadsoft' s annual work plan is approximately $819,000, which is funded 80 percent from Federal transportation funds and 20 percent from State of Michigan transportation funds.

2.3 The State Drinking Water, Wastewater, and Stormwater Perspective

The intent of asset management requirements within the Michigan Department of Environmental Quality (DEQ) is to help ensure long-term sustainability of water infrastructure while assisting a utility manager to make better decisions on system improvements and guarantee the system's ability to deliver the necessary level of service. Unlike the MDOT, which is an asset owner, the DEQ operates as a regulatory agency within the state of Michigan, collaborating with local agencies to ensure protection of public and environmental health.

The majority of Michigan's residents (approximately 75 percent) are served by 1,390 community systems that provide water for household, business, and industrial uses as well as fire suppression. Most of these systems were built between 50 and 100 years ago, while some in the state's oldest cities date back to the 1800s. Key elements of many of these systems are quickly approaching, or have already exceeded, their expected lifespan.

Approximately 70 percent of Michigan's residents are served by 1,080 community wastewater treatment systems. These systems convey wastewater from households and businesses to treatment plants where the water is purified and returned to the state's rivers and streams. Significant advancements in treatment systems have occurred since the Clean Water Act was passed in 1972; this has led to significant reductions in combined sewer overflows (CSOs) that discharge untreated sewage into our waterways. However, CSOs continue to vex Michigan communities. In 2015 and 2016, 17.4 billion gallons of untreated sewage flowed into Michigan's waterways.

Throughout the state, approximately 35,000 miles of county drains serve more than 17 million acres of rural, suburban, and urban lands. These drainage systems include open ditches, underground conveyance infrastructure, and retention and treatment systems. More than half of these drains are open ditches, the majority of which are at least 75 years old and a significant portion are over 100 years old. This network of infrastructure has an estimated replacement cost of $20 to $25 billion; however, annual reinvestment is estimated between 0.1 and 0.15 percent. If county drains are presumed to have a 100-year service life, approximately 1 percent of drains should be replaced annually, which equates to $200 to $250 million in annual investments.

In many areas, especially in certain older cities, storm drains are frequently combined with sanitary sewage systems. Compared to other underground infrastructure, there is far less information available about existing stormwater management assets. The Stormwater, Asset Management, and Wastewater (SAW) Program, initiated by the Michigan Department of Environmental Quality in 2013, will provide a wealth of information about the condition of these systems to help communities identify their long-term needs.

CHALLENGES FOR MICHIGAN'S WATER INFRASTRUCTURE

- Lack of funding: Michigan's water infrastructure systems are independent yet connected. While the funding mechanisms that support each type differ, they all face funding shortfalls.
- Lack of information: Compared to other forms of infrastructure, less information is available regarding the condition of water infrastructure assets, making long-term planning difficult.
- Lack of awareness: Water infrastructure systems largely operate out of sight and out of mind, only garnering public attention during times of crisis. In most circumstances, people give little thought to the integrity of their systems as long as water flows from the tap and away in a drain. Awareness throughout the state is growing regarding the importance of investing in water systems, but further attention is necessary.
- Administrative burdens: While existing revolving loan funds provide significant resources to finance water infrastructure, the administrative burdens can deter participation and increase overhead costs for communities.

The DEQ encourages asset management through the regulation of the National Pollution Discharge Elimination System (NPDES) and the Safe Drinking Water Act and the implementation of Stormwater Asset Management and Wastewater (SAW) grants. As the NPDES asset management requirements were being developed, the Stormwater, Asset Management, and Wastewater (SAW) grant and loan program was created to address funding needs in local communities for asset management program development.

In early 2013, the legislation authorizing the SAW program passed, allocating $450 million for grants and loans related to stormwater and wastewater asset management, as well as planning and design of capital improvement projects. Applications were accepted beginning

on December 2, 2013 and on that day 673 applications totaling $541 million in requested funds were received by the DEQ. The majority of grants, roughly 68 percent, were awarded for wastewater and stormwater asset management program development illustrating not only the need for asset management programs, but also the recognition of the importance of asset management practices for operating sustainable systems.

DEQ's Water Resource Division is currently working to better address asset management with all wastewater permit holders. SAW grantees that hold a minor NPDES permit will have asset management requirements written into their respective discharge permit as they come up for renewal. Additionally, the DEQ is currently in discussions internally, and with external stakeholders, regarding a proposed Capacity, Management, Operation and Maintenance (CMOM) permit. This permit would add asset management requirements to those municipalities that own/operate collection systems that discharge to a larger wastewater treatment plant owned by a different entity.

As the statewide pilot project comes to completion and the Michigan Infrastructure Council and Water Asset Management Council are formed, the DEQ will continue to evolve and further refine asset management requirements within the Department and alongside the Michigan Infrastructure Council.

2.4 The Broader Perspective

One aim of the Pilot was to better understand the asset management landscape across Michigan. While the pilot focused on State agency initiatives, there are a number of other ongoing important asset management related initiatives across the state, including:

- MI-American Water Works Association and Michigan Water Environment Association Joint Asset and Infrastructure Management Committee, Survey of Asset Management Software Currently Used in Michigan
- Michigan Rural Water Association Asset Management Assistance Program
- MISS DIG 811 – Detroit Facility Owners Collaboration Project

As the pilot concludes, it will be important to build a greater awareness of all asset management related initiatives across the state and to look for opportunities for collaboration between these initiatives.

2.5 Asset Management Maturity

Asset management maturity can be described as the extent to which the capabilities, performance, and ongoing assurance of communities and agencies are adequate to meet the current and future needs of their stakeholders. Across the state, there are still varying definitions of what asset management is, along with what can be considered best practice. Therefore, as part of the pilot project a high-level asset management maturity assessment was conducted.

The Pilot developed a high-level assessment approach that examined 16 key factors of successful and sustainable asset management that are consistent with recognized industry best practice documents.

Topic	Focus Area		
Organizational Adoption of Asset Management	Asset Management Commitment	1.1	Overall Strategic Planning
		1.2	Resources and Roles & Responsibility in place and understood
		1.3	Learning And Development
	Asset Management/Policy	1.4	Asset Management Policy and Strategy
	Asset Management Governance	1.5	Asset Management Governance
Linking assets to services and outcomes	Level of Service	2.1	Level of Service framework
	Future Trends	2.2	Future Trends (Impact Of Growth, Climate Change, AV, SMART Cities etc.)
Robust Risk Assessment and Prioritization of Investments	Risk & Vulnerability	3.1	Asset Risk Framework
	Prioritization of Investments	3.3	Robust Capital Investment Planning
Life Cycle Management	Optimized Asset Interventions	4.1	Optimized Asset Interventions - Life Cycle Costing
	Asset Management Planning	4.2	Asset Management Plans (AMP)
Asset Management Information Requirements	Asset Information Strategy	5.1	The rationale for collecting data
	Asset Inventory	5.2	Understanding what assets are owned
	Asset Management Information	5.3	What information do we have for each asset
	Asset Management Information Mgt	5.4	Ensuring confidence in the data
	Analysing Data	5.5	What is the data telling us

EXHIBIT 3. Maturity Assessment topics

This assessment, hosted by MTU, assessed an organization against a five-point maturity scale ranging from innocence or unawareness to excellence.

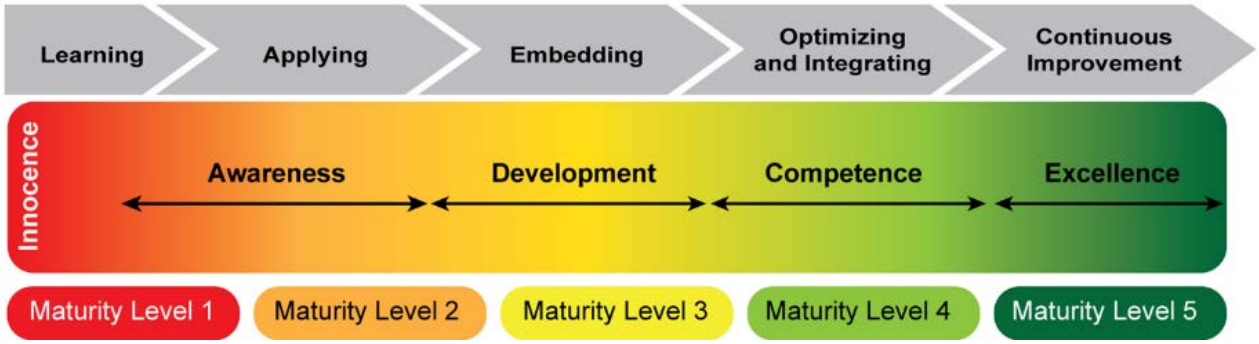


EXHIBIT 4. Maturity Assessment Scale

This type of assessment includes the following benefits:

- Enables a swift assessment of capabilities and competencies.
- Provides a baseline upon which an action plan can be developed to address key gaps and monitor progress over time.
- Identifies strengths and areas of improvement.
- Builds awareness of best practices.

— Enables progress to be tracked and utilized for policy development.

The assessment, carried out in February of 2018, was carried out across a broad range of asset owners, responsible for drinking water, wastewater, stormwater, roads & bridges and private utilities, from across the state.

There were 119 individuals registered to attend the asset management maturity self-assessment web conference. 52 physical sites (multiple attendees at each site) provided responses to the survey questions. Survey respondents were comprised of:

— Townships 11%
— County Road Commissions 19%
— Cites 30%
— Private utilities 2%
— Other 7%
— Not Categorized 23%

The results included in Appendix A represent the output from the assessment for communities/agencies across the state that volunteered to participate. Scores ranged from innocence to excellence, but overall the majority of communities were in the awareness/development phase of their asset management journey. For certain areas, such as those associated with asset data, the scores were higher and this reflects the previous efforts by many of the communities/agencies in this area (See Exhibit 5). However, in areas such as the development of asset management policies, learning and development (see Exhibit 6), utilizing a risk-based approach and understanding the impact of future trends on the asset base, the majority of respondents scored lower, as these focus areas had not previously been considered as part of their asset management programs.

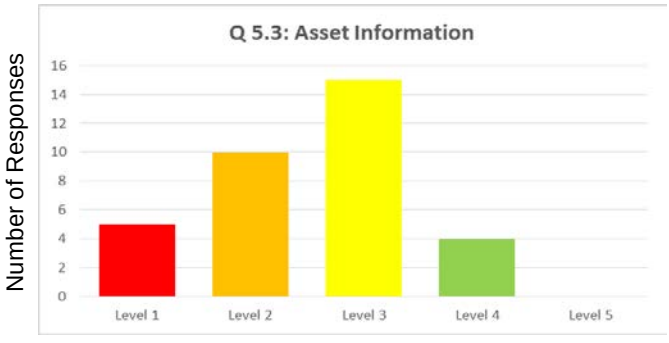


EXHIBIT 5. Maturity Assessment Output – Asset information

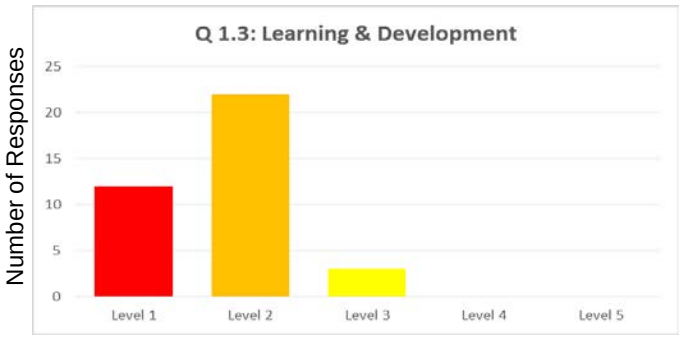
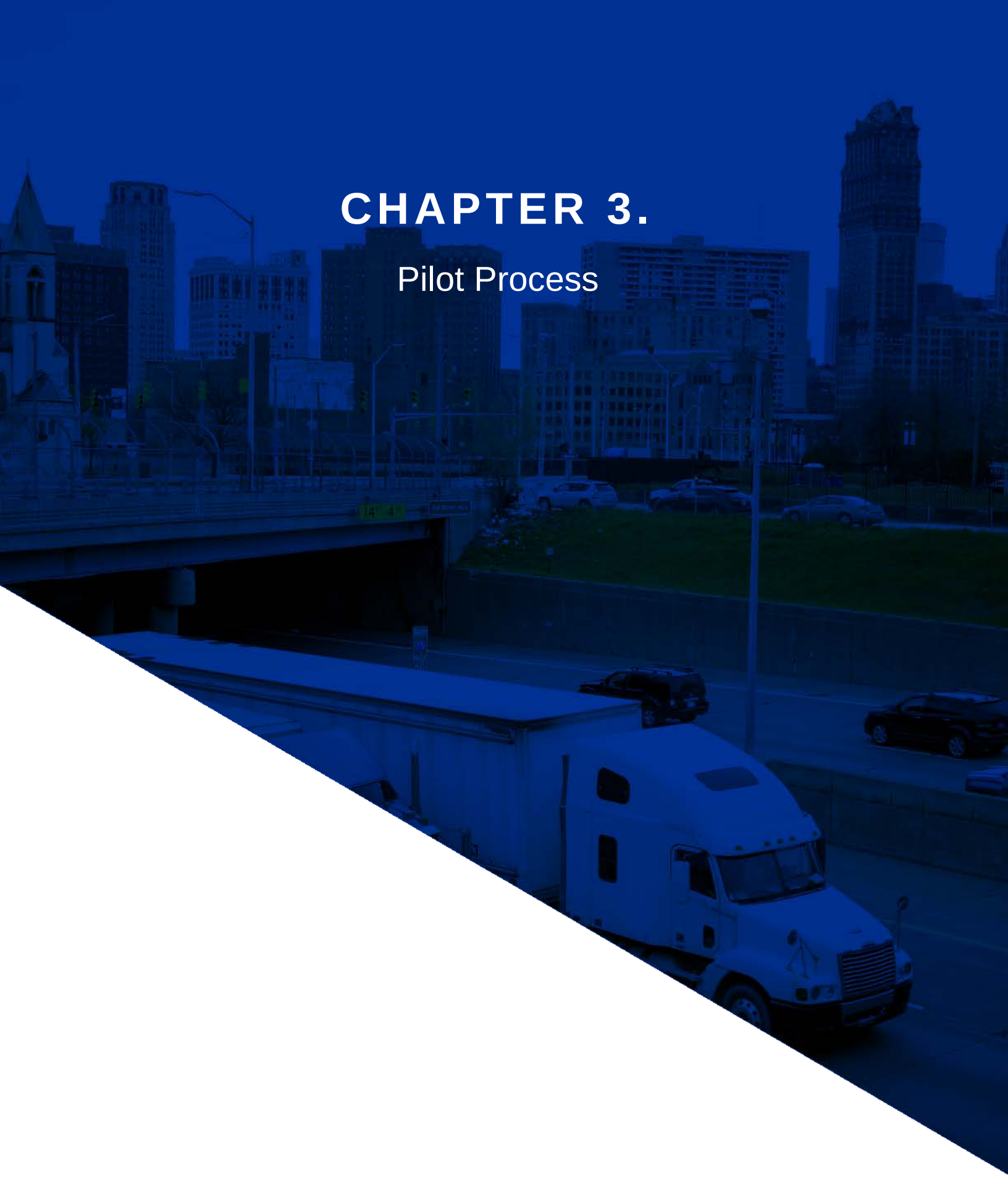


EXHIBIT 6. Maturity Assessment Output – Learning & Development



CHAPTER 3.

Pilot Process

CHAPTER 3: Pilot Process

3.1 Key Goals

The underlying aim of the Pilot was to determine a framework for asset management across the state of Michigan, identify barriers and solutions for common issues, evaluate best practices and lessons learned, and develop a plan for statewide implementation, ultimately improving Michigan's infrastructure systems and enhancing the quality of life for residents, communities, and businesses.

From April 2017 through April 2018, the Pilot brought together experts across the state, at every level of government, and in collaboration with numerous stakeholders to pilot a statewide asset management process across asset classes including transportation, drinking water, wastewater, stormwater, energy and broadband. This unique and nationally significant endeavor studied the complexities of both urban and rural systems across sectors. Through this collaborative effort between west (Prosperity Region 4) and southeast (Prosperity Region 10) Michigan, state departments, and stakeholders, including public agencies and private utilities, the Pilot aimed to create a culture of asset management and began to identify important asset management processes and opportunities for collaboration, coordination, and efficiency.

3.2 Stakeholder Involvement

PILOT VISION

Michigan has:

- A culture of asset management across all infrastructure assets.
- A statewide assessment of our transportation, drinking water, wastewater and stormwater infrastructure.
- A long-term integrated asset management strategy that results in coordination and increased cost efficiencies for utilities and local agencies of all sizes.
- The data and information needed to determine funding levels, and the incentives needed, for strategic infrastructure investments.

PILOT MISSION

- Build a culture of asset management across the state.
- Develop consistency across asset owners in asset standards and management practices.
- Create mechanisms for coordinated planning and communication across asset owners and types statewide.
- Develop a system that will support our understanding of assets and enable us to make informed decisions at a local, regional and state level.

The Directors of the Michigan Department of Environmental Quality (DEQ), the Michigan Department of Natural Resources (DNR), the Michigan Department of Transportation (MDOT), the Michigan Agency on Energy (MAE), the Michigan Public Service Commission (MPSC), the Michigan Department of Technology, Management and Budget (DTMB), the Department of Talent and Economic Development (TED), and the Michigan Department of Agriculture and Rural Development (MDARD), led by key staff from the Executive Office, created the foundation for the Pilot stakeholder group.

The Executive Committee met weekly to determine programmatic, scheduling, and tactical decisions throughout the Pilot. An Advisory Board, consisting of representation from state, regional, and local governments, along with technical experts and infrastructure consultants was established to provide policy direction and guidance for implementation of the Pilot and development of final recommendations.

The two pilot regions chosen to execute the Pilot were comprised of the thirteen counties of the Prosperity Region 4, guided by the Grand Valley Metro Council (GVMC) and the West Michigan Shoreline Regional Development Commission (WMSRDC):

- Mason
- Lake
- Osceola
- Oceana
- Newaygo
- Mecosta
- Muskegan
- Montcalm
- Ottawa
- Kent
- Ionia
- Allegan
- Barry

and the three counties of Prosperity Region 10 guided by the Southeast Michigan Council of Governments (SEMCOG):

- Wayne
- Oakland
- Macomb

EXHIBIT 7. Michigan Prosperity Regions

As SEMCOG is the planning agency for southeast Michigan counties beyond Region 10, the following additional communities participated as well:

- St Clair
- Monroe
- Livingston
- Washtenaw

Throughout the pilot process, Michigan Prosperity Regions 4 and 10 worked closely with the state, local governments and private utilities to develop the process of integrating drinking water,

wastewater, storm water, and transportation assets into a comprehensive program. Numerous stakeholder team meetings, advisory board meetings, regional meetings and Subject Matter Expert workshops, pulled together over 150 industry experts to define the data and data standards and definitions that were most important for the Pilot's data collection process. The Stakeholder Team met monthly throughout the duration of the Pilot and focused on identifying common standards, finalizing policy recommendations and ensuring coordination and communication between the West and Southeast Michigan regions. The Subject Matter Expert group was made up of industry experts including a diverse group representing municipal entities including urban, rural, small, and large communities.

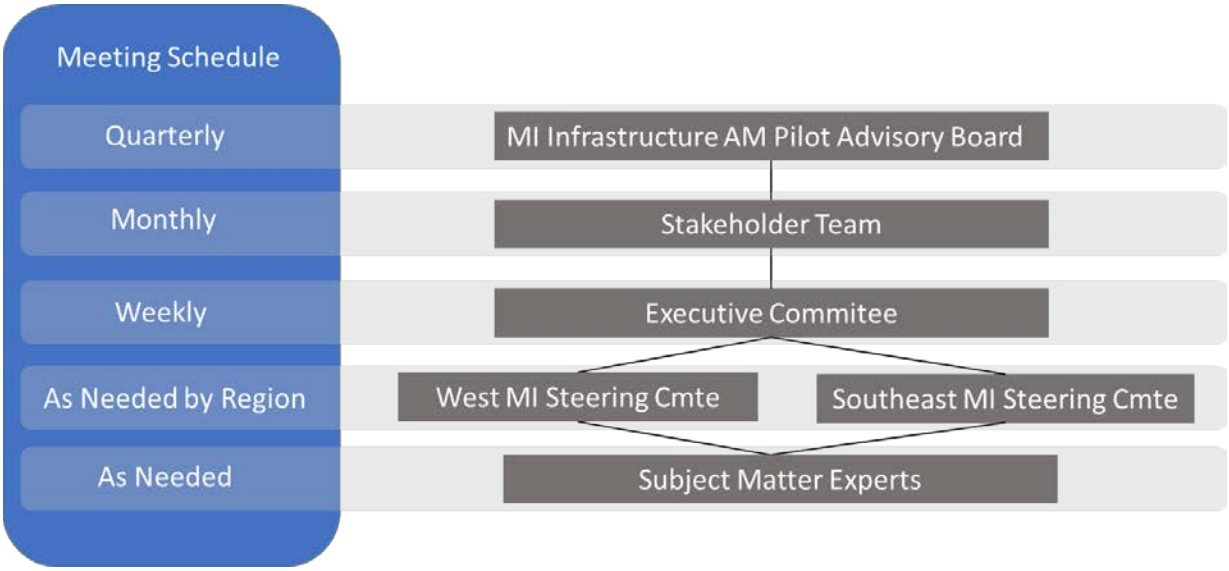


EXHIBIT 8. Pilot Governance Structure

3.3 The Scope of the Pilot – Assets Covered

The aim of the Pilot was to focus on drinking water, wastewater, storm water, transportation, energy, and communication assets, however each of these asset classes contain a broad range of assets e.g. "drinking water" includes above and below ground assets, "transportation" can include all modes of transport – road, ports, rail etc. Early on in the pilot, one of the first tasks was to agree on which assets to include.

From June 2017 through August, over 40 regional representatives, from transportation, drinking water, wastewater and Stormwater entities, came together to identify and define specific assets and data attributes to include in the Pilot.

Transportation: Roads, Bridges and Culverts

Drinking water, wastewater, stormwater: Primary focus on pipes, but with limited data collected on above ground assets.

For below ground drinking water, wastewater and storm assets, the agreed upon asset attributes were as follows:

- Asset ID
- Length
- Material
- Size
- Depth
- Surface Type
- Approximate age of construction
- Condition Grade
- Confidence Grade
- Details of IT system currently in use
- Project Details – start & end date, location and value

For above ground assets a smaller data set was agreed upon:

- Location
- Date of Construction
- Capacity

Incorporating Private Utility Information

For private assets such as communications and energy there were concerns over the need for a state-wide system to include asset level condition data due to the proprietary nature of the data and concerns of the security of the data. Therefore, it was agreed early on that the Pilot study would not be collecting specific asset data such as location and condition grade of specific utility assets but would focus on project level data with the understanding that more work would need to be done to ensure proper protocols were in place before more detailed asset specific information could be shared.

Further details of the data requested for each asset class can be found at:
http://www.michigan.gov/documents/snyder/Drinking_Water_600078_7.xlsx
http://www.michigan.gov/documents/snyder/Storm_Water_600079_7.xlsx
http://www.michigan.gov/documents/snyder/Transportation_600080_7.xlsx
http://www.michigan.gov/documents/snyder/Wastewater_600080_7.xlsx

Within the Subject Matter Expert (SME) groups, there was considerable discussion on other key elements of asset information such as asset risk and Levels of Service, however it was agreed that this information should be defined and collected at a later stage.

In addition to agreeing upon asset attributes, as detailed above, standard definitions were also agreed for each of the attributes such as standard material types.

For Roads and Bridges, the data for federal aid roads and some non-federal aid roads was already held by TAMC, it was agreed that this information would not be requested from the communities, but that the Pilot would work with TAMC to obtain this data. The only data requested from participation communities with regard to roads and bridges was therefore non-federal aid roads data that hadn't previously been reported to TAMC and culvert data.

After agreeing upon the assets and asset attributes, these were included in a data request packet that was then issued to participating communities. The data request packet can be found at: http://www.michigan.gov/documents/snyder/Data_Request_Packet_600251_7.pdf .

While the SME Groups were keen to include the above ground assets in the pilot and data was collected on these assets. The main focus of the data collection phase was on the right-of-way assets.

3.4 Data Collection

The goal of the data collection process was to pull together existing data, as identified by the subject matter experts, to determine what currently exists for public and private utilities, and to determine the potential analyses that could be performed for strategically managing and coordinated projects. Guidelines and procedures were established for the collection of data from volunteer communities that would be used to test the understanding and availability of asset data.

Through in person meetings, events and informational regional roadshows, beginning in September 2017 and continuing into January 2018, communities received Data Request Packets which detailed the data collection requirements and established pilot standards. Volunteer communities' submitted data by way of GIS shapefile or file geodatabase containing the required assets and attributes as identified by the SME. For communities without GIS-based data, Excel spreadsheets, utilizing drop-down menus of the requested information were leveraged. Data dictionaries, where necessary, were also important resources to aid in the translation from local naming conventions to a uniform statewide understanding of the data.

Technical teams from both Regions 4 and 10 worked with the State of Michigan and the Department of Technology, Management, and Budget's Center for Shared Solutions to ensure all data was accurately mapped and integrated with the state's existing Michigan Geographic Framework technology. Further, each Region initiated individual strategies to enhance community participation:

Region 4 – West Michigan:

- Grand Valley Metro Council (GVMC), in cooperation with the West Michigan Prosperity Alliance (RPI Region 4) made available mini-grants to small communities interested in participating in the Pilot but who needed additional resources.
- Numerous meetings and outreach events took place with elected officials, public works directors, city managers and others responsible for infrastructure, all of which contributed to the success of the data collection effort. Additionally, a meeting held for the mayors in Region 4, hosted by the Mayors of Grand Rapids and Hudsonville was an ideal venue to create awareness of its current data collection efforts. Over 30 mayors attended to learn more about the Pilot.

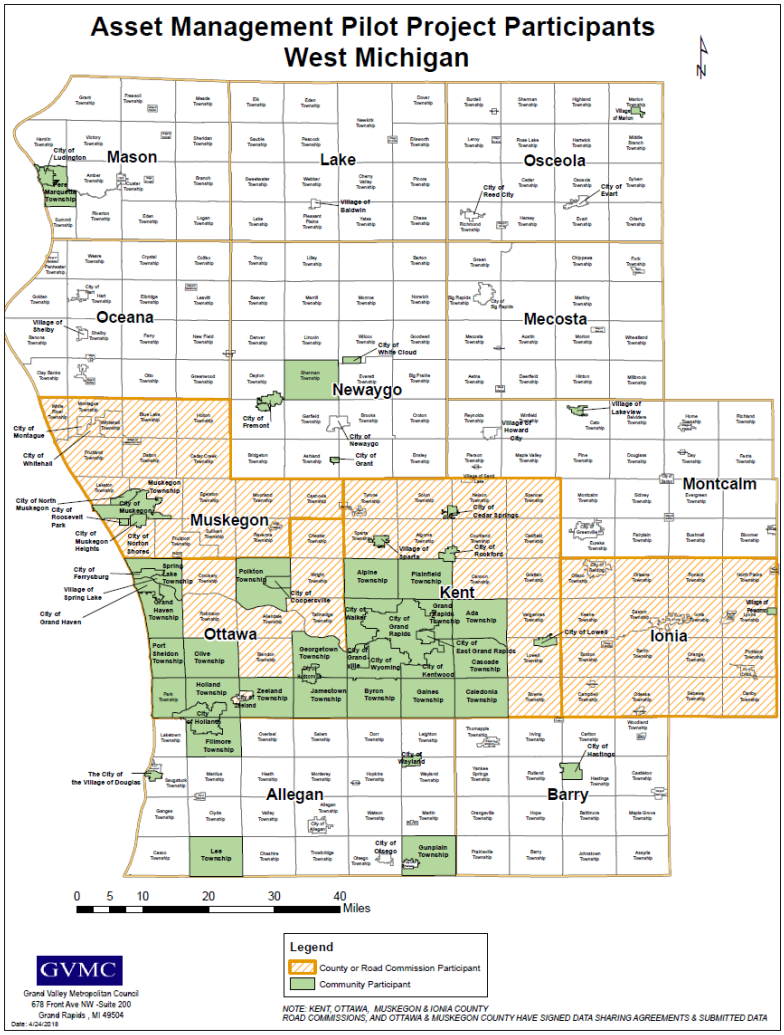


EXHIBIT 9. Pilot Participants - West

- Region 4 is diverse, including both urban and rural communities and the differences with regard to data collection and handling became apparent during the Pilot data collection phase. The urban communities typically have more resources to devote to a GIS system along with employing experts to make best use of the data, specifically for utility systems. However, as the data collection packets were distributed smaller communities generated more questions on the data requirements and format.

Region 10 – Southeast Michigan:

- SEMCOG hosted a number of meetings with elected officials, public works directors, and county drain commissioners to follow up on the Governor's invitation to participate in the asset management pilot program.
- Education and outreach were key aspects of the region's strategy, specifically creating awareness about the goal of the Pilot project, explaining why the project was important, mitigating concerns related to data security, and informing the communities how they could participate. A SEMCOG University was hosted to take a deeper dive on the purpose of the Pilot and to follow up with some communities on a more individual basis.
- Use of consultants, a focus on follow up calls and continual outreach, targeting communities with GIS data, and the innovative use of the ESRI tool were factors leading to the region's success.
- Funding was provided for the translation of existing data into the requested format as developed through the pilot process.

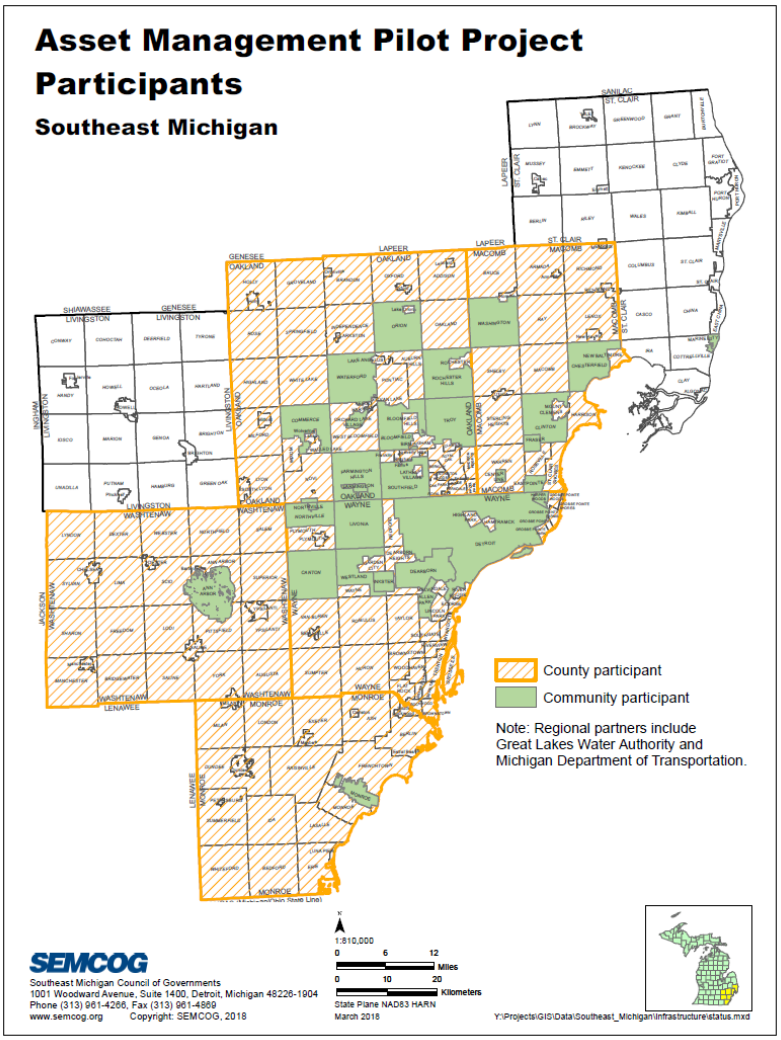


EXHIBIT 10. Pilot Participants – Southeast

In both regions, the process included the following:

- Letters explaining the Pilot were sent to each chief elected official and public works director in the communities.
- Meetings with the consultant community were scheduled to help communicate the message and seek active involvement from the communities/agencies.
- A regional committee was developed, which would meet periodically to both provide input and seek feedback.

— Regular meetings and presentations took place to educate community members, leaders, and senior officials.
— Assistance with the completion of the data sharing agreement was provided.

Collected data and feedback from the Regions helped members of the Pilot continue to identify requirements for a demonstration database. The findings of the Pilot, including what information the communities did or did not have, helped determine what information should be included to inform the statewide asset management program as well as provide an overview of the availability of asset data across the state.

The Pilot assessment received culvert data in both point-based and line-based formats. Point-based culvert features can be converted to line-based features through scripting, if certain attributes are present and some assumptions are made. If pipe length is included in the attribute of the point-based culvert, a script can use the pipe length attribute to create a line feature that splits the distance on both sides of the culvert point. The assumption would be that the culvert is perpendicular to the road unless there is an attribute that would denote the angle that the culvert is positioned in relationship to the roadway. For example, Roadsoft uses a point-based system to collect culverts, but the attributes include a culvert span length as well as a skew angle attribute which outlines the angle of the culvert in relation to the road. With these attributes available with the culvert point location, the Michigan Geographic Framework (MGF) technology can be used to run a script on data upload to generate line-base culvert features being provided by existing Roadsoft data collection systems. The line-based culvert features provide a more distinct location of the entire culvert and also allow the culverts to be connected to hydrography GIS layers for potential flow modeling. As data was received and integrated into the statewide pilot database, it was assessed for completeness and standardization across the attributes to determine what type of information would be available for data analytics, both short-term and long-term.

The date of construction was determined to be a crucial piece of data that can be used as a surrogate for asset condition of underground assets. Where this information was not available, SEMCOG tested a couple of different alternatives during the pilot to estimate the construction date. The first process used a GIS buildings layer containing year-built information to derive estimates for the date of construction for pipes using the construction year of houses in the neighborhood. The second used a training dataset to derive a date of construction based on the pipe material. Varying results were observed in both tests and more analysis on deriving the data of construction should be conducted beyond the Pilot. SEMCOG did observe that the methodology of estimating based on material type had a higher level of significance than utilizing the year built of surrounding neighborhood buildings.

3.5 Data Sharing and Security

Concerns were raised during the 21st Century Infrastructure Commission and at the beginning of the Pilot regarding the need for the State of Michigan to keep asset level data secure to protect critical infrastructure data and ensure public safety. In order to address these concerns during the Pilot, any data submitted was stored by Department of Technology Management and Budget on behalf of the Michigan State Police (MSP) as they have significant expertise in keeping sensitive infrastructure data secure and are well equipped to handle requests for information efficiently and effectively.

Interdepartmental procedures were created to ensure any request for information was handled in accordance with current law while also keeping critical infrastructure data secure. This procedure included detailed responsibilities for the owner of the data, holder of the data, and receiver of the request. A data sharing agreement that articulated rights and responsibilities was signed by each entity submitting information. While the procedure utilized for the Pilot was sufficient and secure, it would not be feasible to scale this procedure in order to handle data submitted to a statewide system.

3.6 Desired IT System Elements

A. Functionality

Throughout the data collection process, all data received was uploaded into a secured database within the Michigan Geographic Framework (MGF) environment. As data was incorporated into the MGF, data analysis was conducted to determine the extensiveness, completeness, and degree of data provided. By evaluating the data provided, Pilot leaders were able to assess the data analytic functionality that could be performed during the Pilot and ultimately what data would be needed for an effective statewide system.

Some examples of system output and reporting functionality that were initially assessed as part of the Pilot included overall asset condition grades, asset life and condition forecasting reports, among others. The reporting and data analytics also included demonstrating how the data, across asset types, could be viewed from a geographic perspective. The pilot also evaluated how the current data might need to be augmented to perform future data analytics and reporting, such as whether available date of construction and material type information will allow communities to perform condition grade analysis.

Local Government Data Collection Asset Management Tiers

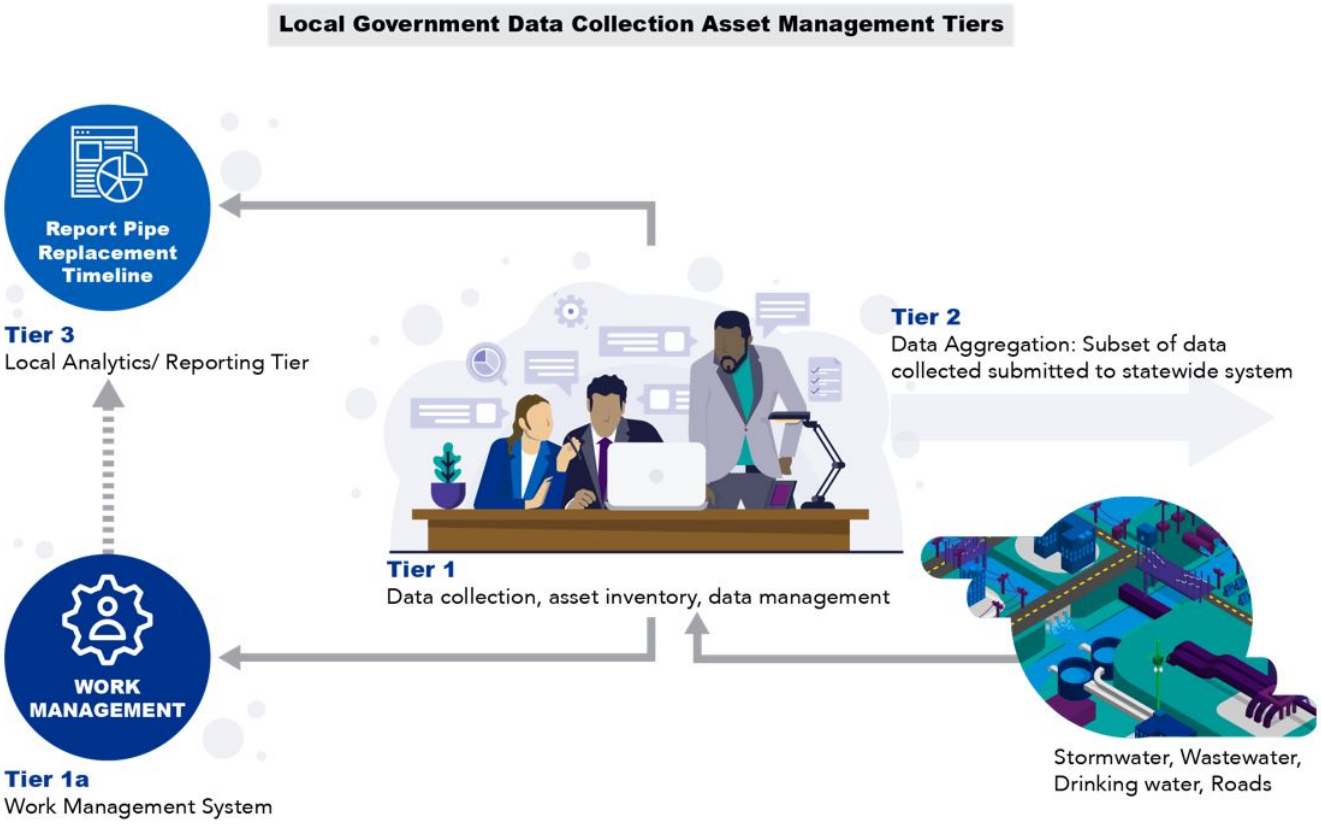


EXHIBIT 11. Local Government Data Collection Asset Management Tiers

Statewide Data Collection Asset Management Tiers

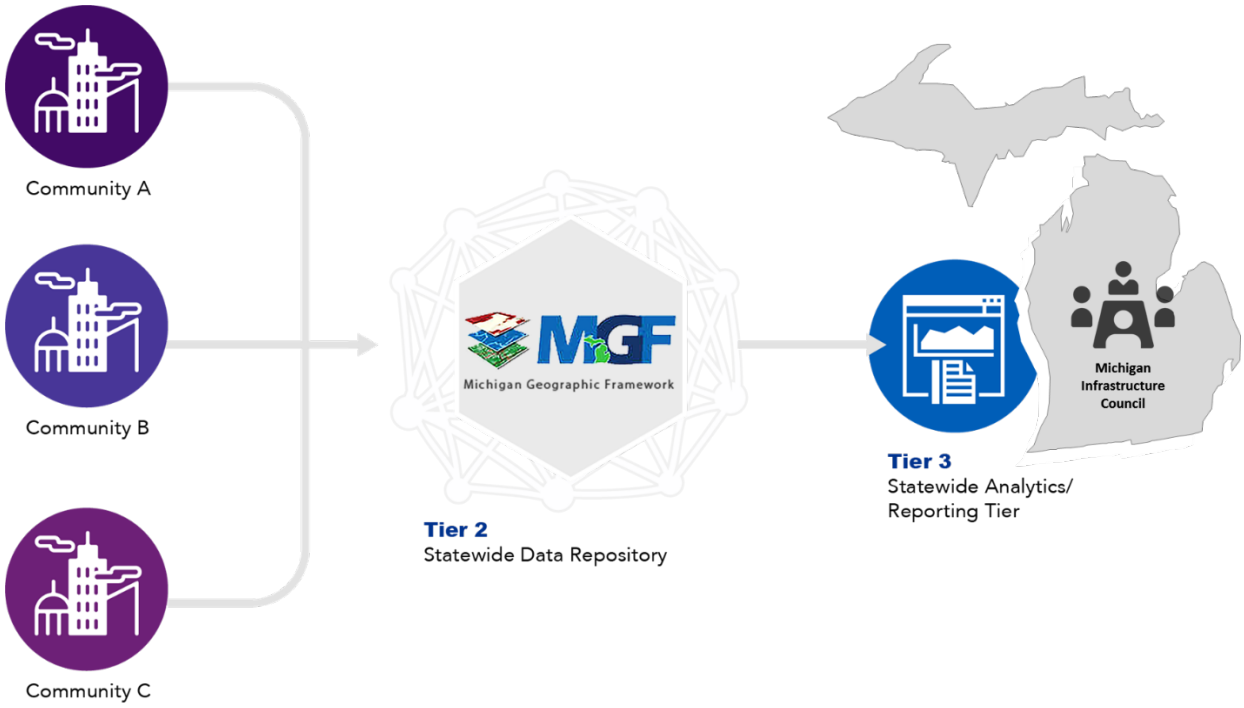


EXHIBIT 12. Statewide Data Collection Asset Management Tiers

B. System Demonstration – Process

One task within the Pilot was to better understand the functionality of currently available asset management IT systems to determine if a recommendation should be made for a statewide system and what that system would be. A number of leading IT service providers were asked to demonstrate the functionality of their Asset Management Software solution, using real asset and project data as provided by the Pilot.

With this in mind, service providers were asked to demonstrate the following as detailed in Exhibit 13.

	Description
Condition Grade Calculator (Current)	Ability to calculate current condition grade based on asset construction/installation date (age).
Condition Grade Convertor	Ability to convert between any condition rating scales.
Asset Depreciation Calculator	Ability to depreciate the historical cost of an asset based on various standard depreciation methods.
Asset Replacement Cost Calculator	Ability to calculate the replacement value of an asset based on various replacement cost methods (e.g. applying standard inflation indices to historic costs).
Deterioration Modeling	Ability to forecast the future condition of an asset given the existing condition.
Life Cycle Calculator	Ability to undertake any number of life cycle cost analysis for any group of assets - Analysis to consider acquisition, operation, maintenance, repair, rehabilitation, disposal and any other external costs that may occur throughout the asset's lifecycle.
Funding Gap Calculator	Ability to calculate annual forecasts of difference between planned and required expenditures to maintain system at an acceptable level.
Project Coordination	Ability to identify projects within a certain vicinity and with similar timescales (both value and number) and assign a project coordination ID.
Asset Coordination	Ability to identify location of right-of-way assets that are the same condition grade.
Data Aggregation and Query Tool	Ability to aggregate various asset attribute information from the asset level to the network (or multiple grouped asset) level and allow running of various types of data searching based on any combination of user defined asset attribute/criteria for the query.
Data QA/QC tools	Ability to allow the user to assess the quality of the data being used to drive the analysis/reporting through developing customized data verification checks to identify outliers.

EXHIBIT 13. IT System demonstration requirements

The IT service providers invited to take part in the Pilot included:

— Michigan Technology University (MTU) - Roadsoft
— Assetic
— SAS
— SADA Systems, Inc.

With each of these being asked to focus on a specific suite of functionality requirements

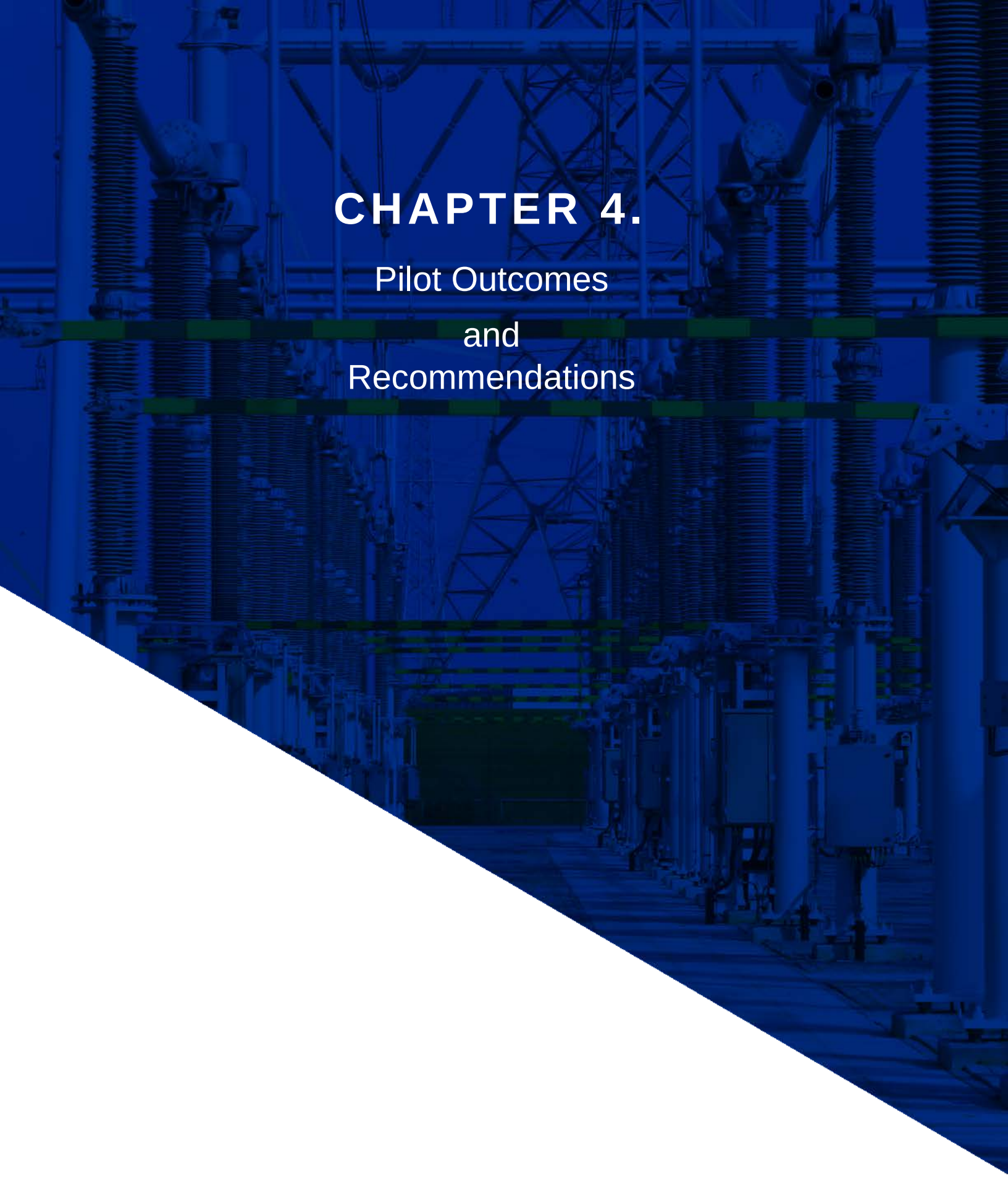
Tier	Assets Covered	IT Provider	Description
Tier 1a and 3	(Drinking Water, Wastewater, Stormwater) and Tier 3 (Roads, Bridges and associated assets)	MTU Roadsoft	GIS-enabled decision support system that includes modules for the field collection, management, and analysis of the infrastructure/data for highway related assets and storm sewer (2018 release), sanitary sewer (pre-release), drinking water (pre-release), private utilities (pre-release)
Tier 1, 1a and 3	All Municipal Asset Types	Assetic	Covers all of the required Tier 1, 1a and 3 functionalities. Includes long term investment planning functionality, with the option to optimize investment within an asset class e.g. optimal lifecycle solution for a roads program, or it can optimize across assets types e.g. optimal program for all assets in the right-of-way, including drinking water, wastewater, storm and roads/bridges, with the results being available in GIS.
Tier 3 (Analytics)	Right-of-way assets	SAS	Provides data analytics and business intelligence services and products. They were asked to demonstrate how they could use advanced data analytics to provide greater insight into the asset data collected as part of the Pilot. The output provided a range of analytics including the visualization of current asset attributes, such as condition, along with forecasting of future asset condition.
Tier 3 (Project Coordination)	Right-of-way assets	SADA Systems, Inc.	dotMaps (SADA's interactive project coordination/planning application) focused on improving coordination of projects in the right-of-way. A web application that enables agencies to plan, coordinate, schedule, and resolve projects in accordance to location, time, attributes and more. dotMaps utilizes Google Maps, ESRI Arc Components and Google Cloud Platform

EXHIBIT 14. IT System demonstration summary

The demonstrations provided a good overview of the functionality currently available in asset management software solutions. The information gathered during these demonstrations and throughout the process of engaging the Subject Matter Experts will be used as a starting point

for the proposed Michigan Infrastructure Council (MIC) to begin discussions on what functionality should be provided in a statewide asset management database.

Additional details about the above IT applications can be found in Appendix H.



CHAPTER 4.

Pilot Outcomes and Recommendations

CHAPTER 4: Pilot Outcomes and Recommendations

4.1 Successes – What Worked

Awareness, Outreach, and Overall Participation:

Pilot leaders wrote and distributed a monthly newsletter that helped spread the message about the Pilot, share successes and milestones, and educate participants about upcoming events and efforts. Over 200 recipients received the newsletter throughout the duration of the Pilot, ensuring that efforts were communicated far and wide.

As a result of proactive outreach, 201 communities, regional entities, and private utilities participated in at least one area of the Pilot process - a significant metric of success. Some participating communities even volunteered their time and resources to assist other local units in participating in the Pilot. It was recognized that building this trust across levels of government and between entities helped ensure success of the Pilot and furthering the goal of creating a statewide culture of asset management.

> *"I have thoroughly enjoyed the opportunity to participate in the Pilot program. This program has provided a voice to the Village of Sparta on the very important topic of infrastructure and what it means not only in our local communities but also across the State of Michigan."*
>
> Julius Suchy
> Village Manager
> Village of Sparta

Data Collection Participation:

Overall, the data collection process was an incredible success, with data collected covering the geography of 158 communities, which significantly surpassed original expectations. This success was partly due to a multi-tiered approach that was used to educate communities about the Pilot, solicit their active involvement and keep them engaged throughout its duration.

To assist with education and data collection, several consultants were engaged to leverage their relationships with existing clients. In the beginning of the project, effort was put into educating consultants on the Pilot and their potential role. Pilot leaders reviewed with consultants their client organizations within the pilot regions and discussed the approaches to convert data to the State standard. Overall, the consulting community was eager to participate and were supportive of the project and its goals. Therefore, it was a successful strategy to have consultants work with their existing clients, to educate them on the purpose of the Pilot, and encourage them to participate. The consultants have detailed knowledge of their client's data, as many of them originally created the data and in many cases already had it in their possession.

Consultants also assisted with moving the data sharing agreements through the local government approval process. The work by consultants allowed regional staff time to focus on the County partners and communities.

"As a city manager, I found the pilot itself accessible and beneficial to our community as we move towards a 'culture of asset management.' As one of the subject matter experts who developed the Pilot, I found the development process engaging and refreshing in the sense that the State of Michigan acknowledged us as system owners as the best minds to determine what was needed."

Jacob Eckholm
City of Muskegon Heights

From a technical viewpoint, having an initial database schema (plan) for each of the assets developed by the SME groups was an important initial step in the process to clearly outline to participating agencies what attributes were being requested for each asset type. This allowed agencies to focus on submitting that specific information, where available, and allowed for data to be in a more standardized format when received by the regions. The data schemas for each asset type were used to create GIS geodatabase schema templates for the regions to use and distribute to the participating agencies, if uploading GIS data. A spreadsheet template was also created for those agencies without GIS data. All of these tools made for a smoother data upload on the Pilot's secured SharePoint site and data integration process in the statewide database.

Leveraging other existing programs for data collection around specific assets supported robust data collection. For example, TAMC has collected pavement ratings for a number of years that feed their analytic information. For the Pilot, TAMC granted permission for DTMB, as the central data agency for TAMC, to pull updates of their pavement condition ratings to include in the assessment. Existing systems containing integrated data can be leveraged to reduce the duplication of effort in submitting data that has already been submitted through another process. As much of this data was in a GIS format, the main focus was to acquire existing community-based GIS formatted data. However, data teams then worked with the remaining communities that do not have the GIS format to submit data in alternative formats. A total of 109 data sharing agreements were signed and subsequently data sets were included in the Pilot.

The collaborative team of state, regional, and local data experts that was convened enabled a successful data collection effort. With DTMB working with the two regions directly throughout the Pilot they were able to work closely with GIS representatives from each region to coordinate data collection activities. This allowed the Pilot's regional leaders to communicate effectively with the participating agencies within their regions to prepare data for upload to DTMB.

During the data collection phase multiple outreach events were held by various parties to communicate the importance of the Pilot process. The weekly conference calls between the state, GVMC, WMSRDC and SEMCOG were very important in order to ensure all parties remained aligned. Also, having set templates in GIS and Excel formats were vital to the success of the data collection phase. The templates were setup to easily import condition data collected by some local units during the DEQ Stormwater, Asset Management and Wastwater (SAW) Program and National Association of Sewer Service Companies (NASSCO) Ratings.

4.2 Lessons Learned:

In addition to the many successes mentioned above there were also a number of lessons learned throughout the Pilot, which include:

Overall Pilot Approach:

> *"The Pilot has been a highly successful public/private, 'proof-of-concept' initiative that permanently changes the way we view infrastructure planning and investment. Thanks to Governor Snyder's leadership and laser focus on critical infrastructure, public and private sector partners can take the lessons learned to develop a comprehensive program that encourages sound, data-driven infrastructure investment decisions in all regions of the state."*
>
> Donald J. Stypula,
> Executive Director
> Michigan Association of Regions

- Pilot leaders made certain that the program had a clear mission, vision and purpose so that it could be easily and directly communicated. This was paramount to success.
- Choosing two diverse regions such as west and southeast proved a fundamental success of the pilot, allowing for half of the state to potentially participate and driving collaboration across the state.
- The length of the Pilot did not allow for private asset owners to submit asset level specific information. However, they were included in collaborative conversations that will be important for ensuring integrated 21st century infrastructure systems in Michigan's future.
- The Pilot needed to provide for multiple ways to communicate the program including face-to-face meetings both in large and small groups, newsletters, numerous public presentations, and canvassing regional members. This was necessary to ensure the message was heard throughout the region.
- The Pilot engaged as many local and regional champions as possible, including 21st Century Infrastructure Commissioners from outside of the pilot regions. This helped to ensure the Pilot was led and owned by infrastructure leaders across the state.
- Enlisting agencies that have historically worked with local agencies on similar projects helped deliver the message and build further trust in the process.
- DEQ's participation in the Pilot was as a collaborative (as opposed to a regulatory body) partner helping to build trust in the process. This was made clear to communities providing data. DEQ is utilizing what they learned throughout the pilot to improve their processes.
- There was overwhelming participation by communities both large and small/urban and rural. However, it was beneficial to have larger cities with resources and talent offering support to smaller communities.

"The Asset Management Pilot has provided essential proof of concept testing. It is clear that Michigan's small and large utility systems are capable of achieving asset management and are hungry for the benefits that collaboration will bring. The partners in this pilot have proven that it's time to take the platform statewide."

Eric R. DeLong
Interim City Manager
Grand Rapids

— Engaging SME to determine the assets to be included in the Pilot, along with standard approaches to data condition and attributes, ensured the most critical assets were included that are meaningful at the local and state level.
— The opportunity to offer mini grants allowed for data collection/submission for those with a demonstrated need.
— Private consultants play a large role in public utility systems and hold a considerable amount of the local data. However, the consistency of that data varies drastically as does the ownership of the data they collect.
— The majority of the participating jurisdictions were able to provide asset data in a GIS format which provides for more detailed analysis based on location of assets and projects.
— The date of construction was identified as a key field for the data analytics around condition grades. Valid date of construction was not available for all drinking water, sewer and stormwater assets.
— For the date of construction field the formats submitted varied, from specific dates to years. In the end, only the year was used for the Pilot to allow for consistency.
— Some participating agencies had abandoned lines mapped in their GIS datasets. Although not part of the data schemas for the Pilot, these should be considered moving forward to determine if there is a benefit to having location-based information for abandoned lines. These lines could be used as conduits for other asset types such as telecommunication-based infrastructure and knowing the locations of the abandoned lines could have benefits.
— It is important to have the right people at the right meeting, i.e. coordination and communications summits. This requires providing adequate advance notice and developing an agenda that is of interest to a broad range of attendees.

4.3 Challenges

Time Constraints:

— Pilot leaders were challenged to develop an appropriate and feasible scope that could be accomplished within a one-year timeframe. This limited the amount of time to educate communities on the Pilot, gain participation, and then work with them to transfer the data into the required format. With any project, timelines must be set to keep things on task, but this can create pressures which can be a limiting factor. Throughout the data collection phase there were deadlines set to review and sign data sharing agreements as well as to submit the data for the project. Multiple jurisdictions communicated they were unable to participate or meet certain deadlines due to limited resources. Because of this, attempts were made to adjust deadlines to increase participation. However, the schedule still proved to be too big of a hurdle for several communities, specifically toward the end of the year when there are competing priorities. In the end, several communities that wanted to participate were not able to do so.

Data Sharing and Security:

— The largest issue for many communities was associated with the initial uncertainty regarding the purpose of the Pilot, why data was being requested, along with concerns regarding the security of the data. A requirement for participation in the Pilot was that all participating agencies had to sign a data sharing agreement. Many participating communities did not agree with the need to sign an agreement and several indicated that it took longer to get the agreement signed within their organization than it did to translate the data into the requested format. For some communities/agencies there were further complications as they requested amendments to the template agreement before signing.

"Seeing people from very different organizations came together around the common goal of making Michigan a better place to live was a great experience. I am really thankful to have been a part of this team and grateful to Governor Snyder for his leadership on this very important issue"

Marco Bruzzano,
DTE Energy

— For several communities/agencies, there was concern over the security of the data. Concerns were raised relative to where the data would reside and assurance that it would be in a safe and secure environment. In order to address these concerns, any data submitted was stored by DTMB on behalf of the Michigan State Police (MSP) as they have significant expertise in keeping sensitive infrastructure data secure and are well equipped to handle requests for information efficiently and effectively. Additional concerns were raised regarding who would be able to view and access the data. A specific concern was with regard to the location of drinking water intakes becoming public. Others were concerned about 'unintended consequences' and liability issues. Further discussion and consideration will be needed to address these concerns as a statewide system is developed.

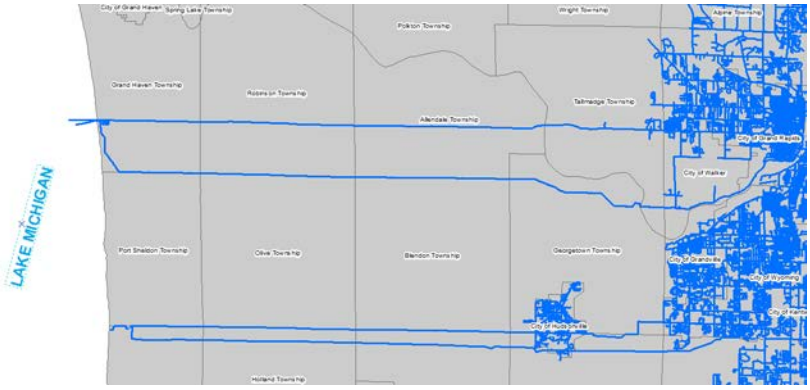
— Although many technical staff understood the value of the Pilot and were interested in participating, senior leaders also needed to understand and agree with the value in order to approve of their respective entity's participation. Therefore, there was a need to educate staff and leadership at all levels.

— Ultimately, some communities were uncomfortable participating in the Pilot given their concern over the potential use of the data and its public release. Trust in the system and the leaders of this effort must be built to overcome these concerns. Further discussions will be required regarding what data should be shared and made public, and what aggregated data will need to remain secure. Additionally, the Council will need to help determine the amount of state level funding that will be needed and the implications of allocating these funds. The proposed Michigan Infrastructure Council will be responsible for leading these important conversations.

Data Collection:

— In collecting the data, another area for improvement is with regard to how to define ownership of the assets. In the GIS templates as well as the Excel templates there was only one field utilized - *"Jurisdiction"* - to identify the entity owning, operating, and maintaining a particular asset. However, there are several instances across the state where a government unit owns an asset, yet may not be responsible for the operation and maintenance or an asset may cross through several jurisdictions.

— For example, the City of Wyoming and City of Grand Rapids own and operate a large drinking water main, often referred to as the "Lake Michigan Lines. These lines cross multiple jurisdictions (2 counties and 6 separate jurisdictions) for each drinking water line. As the state gathers further data, it would be useful to identify ownership and operation/maintenance responsibility in addition to jurisdiction.



— Data requests and how they are made will also need further attention as a statewide system is developed. Requests during the Pilot were dealt with differently by urban and rural communities, with much more follow-up discussions required for the smaller, rural communities that may be at the beginning of their asset management journey or that have limited resources and staff. Therefore, it could be beneficial and efficient to have data request templates tailored for urban and rural entities.

4.4 The Value Proposition

For the roll out of the asset management program statewide to be a success and for it to be sustainable over the long term, it needs to result in value at all levels – at the state, the region and at the local level.

Collection of the Pilot asset data, especially regarding water, wastewater and stormwater, will enable a greater understanding at the state level of the relative condition of these different asset classes, and ultimately will enable more informed discussions with regard to where future funding should be directed. This will benefit local communities in that funding will be focused on those assets in greatest need. A more direct benefit to the local communities, is to further enhance the data collected relative to estimating a condition grade for assets that was not previously available. This information can then be used by local communities for funding discussions and in communication with the public about potential rate increases required to keep the asset in a good state of repair. This in turn will help inspire public confidence and will help residents understand the decisions being made with regard to investment in infrastructure, through increased transparency.

Longer term, the state will have sufficient data to enable a much better understanding of asset deterioration across the state, that can then be made available to those communities who do not currently hold this information. Many communities are not frequently replacing underground pipes and so when the time comes to replace a pipe, they may not have any readily available cost information. If cost data was collected at the state level it could be made available to communities to help them improve their strategies for asset renewal and provide them with cost benchmarks for procurement.

4.4.1 A key consideration for the work carried out by the MIC, WAMC and TAMC should be to ensure that all participants in the statewide asset management database at the local, regional, and state level receive a benefit for participating, make it a 'win-win' e.g. When possible, the state should provide updated aggregate data and information directly back to the communities who submitted their information, so that they can make more informed asset management and investment decisions.

4.4.2 Moving forward the MIC should clearly articulate, to public and private asset owners submitting data to the system, the value-add of participation, including a better understanding of asset performance and cost in the State of Michigan as well as an increased ability to make better informed decisions that align with community priorities.

4.4.3 A great deal of asset data was collected as part of the Pilot. Based on the data collected and future data to be collected, the proposed Michigan Infrastructure Council (MIC), Water Asset Management Council (WAMC), and Transportation Asset Management Council (TAMC) needs to further develop an understanding of asset deterioration, asset replacement costs and asset data collection/maintenance costs. This information should then be made available for use by local communities.

4.4.4 The MIC should create a venue to share asset management best practices, accomplishments, innovations and new ideas across infrastructure owners to promote the culture of asset management.

Many of the other recommendations within this report, such as the provision of Tier 1 asset inventory functionality, asset management policy guidelines, competency framework, training etc. will also directly benefit local communities.

4.5 Building a Statewide Asset Management Culture

Based on the asset management assessment carried out, the state achieved similar scores in the 16 focus areas when compared to a number of other municipal asset owners across North America, where the focus has primarily been on the operational elements of asset management, such as data collection and the implementation of IT systems

Often, the more strategic elements, such as the development of an asset management policy and strategy along with better definition of Levels of Service (LOS) are not as well-progressed. There is typically an underlying assumption that staff are operating the assets to provide a stable LOS that meets the needs of the community. However, as the asset base continues to deteriorate, and communities are being asked to provide a more robust case for funding requests, there is a need to obtain a better understanding of the linkages between investment and customer outcomes, with regard to maintaining or improving service.

Communities have historically relied on an experienced workforce to optimize an aging asset base. However, as more staff approach retirement age, there is an increased need to document practices, processes, and procedures in an attempt to capture knowledge associated with the management of the assets.

In addition to considering the need for data and systems, there is a need to develop an asset management training and education framework to develop the knowledge, skills, and abilities necessary for public infrastructure owners to successfully use asset management in the efficient delivery of service to infrastructure users, and to coordinate work in common right-of-way space.

The prime audience for most training in the field of infrastructure asset management is the technical and managerial staff of infrastructure owners. This includes engineers, technicians, planners, managers, and maintenance staff. This audience is classified by their ability to directly act on the physical assets and will be referred to as “technical audience” in this document. This can be further broken down into the Asset Managers, who will require more advanced asset management competencies and front line staff, who collect data, but don’t always use the data for analysis – for these staff the training is more at an overview level i.e. how is data used to make decisions

Formal Education vs. Training:

The term “formal education” refers to college or university higher education programs, while “training” refers to programs delivered to practitioners that are currently in the workforce. The majority of the recommendations in this report relate to practitioner training as a necessary starting point to influence the state of practice. However, once much of the training need for the current workforce is met, there will be opportunities to develop and encourage the adoption of formal education programs, which will be necessary to meet the needs of infrastructure owners as asset management becomes an institutionalized business practice and they begin to look for educated employees to further this process. A formal education program will help to build a culture of asset management for infrastructure. owners, which is necessary to change the state of practice fully.

The secondary audience for training are the senior management and elected / appointed public officials which can include political leaders, board members, advisory boards, board of directors, or other upper level administrators. This group,

the “decision makers” is classified as being responsible for making high level decisions that directly or indirectly relate to infrastructure, but not necessarily wanting or needing the technical information about the asset in question.

Asset Management Competency Framework: There would be value in developing a statewide asset management competency framework. The framework is made up of a number of roles, each of which have a number of competency units, with each competency unit being further subdivided into a small set of elements of competence. This is the level at which a gap assessment of individuals or generic roles in an organization would take place. Competencies can be further defined to differentiate between the levels of staff within an organization e.g. those who can:

— Direct
— Guide and show
— Work independently
— Contribute

Training would then be developed to address the specific elements of competency levels.

Higher Education

It will be necessary to engage higher education institutions to create tomorrow’s leaders in asset management. Higher education poses an opportunity and a challenge. There is always an attempt to anticipate what skills will be necessary for tomorrow’s workforce, but universities and colleges do not typically develop certificates or degree programs on speculation due to the time, expense and human resources necessary to develop a new program. This fact means that there typically needs to be a developing job market and students willing to be educated in that market before a higher education institution can consider developing new programs.

An advanced degree option should exist to generate future infrastructure leaders by drawing from new civil engineering and business undergraduates, as well as from the existing workforce that wants to be retrained or advance. An infrastructure based Master of Business Administration would be a relatively simple modification of a widely existing and recognized program. This type of a program could draw from students interested in business as well as those interested in engineering.

Asset management is about more than data, it is about technical experts having the tools and information to make strategic, financial and tactical decisions about assets. Data is the starting point and foundation for making better strategic decisions as a state.

Recommendations

4.5.1 The proposed Michigan Infrastructure Council (MIC) should further review and develop a definition of asset management for the state that better portrays the more strategic elements of asset management.

4.5.2 An asset management policy sets down the key principles that underpin asset management within an organization, provides “top down” direction regarding expectations and mandatory requirements and articulates senior management’s commitment. It is therefore a foundational element of building an asset management culture within an

organization. The proposed MIC should develop a draft policy template for adoption as part of Asset Management Plans and implement associated training and encourage use by communities.

4.5.3 Across the state and across the different asset classes, a range of definitions are used for key asset management terms, such as asset management plan, risk, criticality, etc. All of these terms have been defined in international guidelines and standards, where there is general consensus on the terminology and definition. Although the state does not need to necessarily follow international standards, it should use generally accepted and agreed to terms that will be easily understood when communicating across and outside of the state.

4.5.4 The ultimate aim of a community is to provide specified Levels of Service to its customers and defining LOS is therefore a foundational element in building a strategic asset management program. It is recommended that the proposed MIC develop guidelines and associated training to assist communities in developing their LOS framework and measures.

4.5.5 The proposed MIC should develop an asset management competency framework that is sufficiently generic so that it can be applied to a broad range of asset owners. The use of the framework will enable individual organizations to carry out a gap analysis for current staff, and it will also enable consistency of competencies across the state.

4.5.6 There are a range of existing training programs being offered within the state, nationally and internationally (e.g. the IAM[3] Certificate and Diploma and the IPWEA[4] Certificate). The proposed MIC, should make use of existing or develop a standard suite of training packages that can be used for technical and non-technical staff. This training material would be expected to cover a core syllabus, but at the same time communities, universities, the consulting community etc. should be encouraged to develop their own more specific training material. When developing asset management frameworks and training, the proposed MIC should utilize the knowledge and resources of infrastructure organizations such as ASCE, APWA, AWWA, MWEA, TAMC, etc.

4.5.7 The Michigan Department of Environmental Quality (DEQ) should work with the proposed MIC and Water Asset Management Council to further refine asset management requirements within the Department. The DEQ should apply asset management principles across their divisions working towards an outcome of a flexible regulatory framework that allows strategic investments in water infrastructure in a prioritized, collaborative fashion.

4.5.8 The MIC should establish infrastructure goals and develop metrics to assess whether the state is on track to meet those goals.

4.5.9 The MIC should consider what needs to be done to further incentivize an asset management culture in infrastructure/asset managers.

[3] Institute of Asset Management

[4] Institute of Public Works Engineering Australasia

4.6 Facilitating the Data Collection Process

Data submissions from the Pilot ended in late January 2018, however, throughout the data collection process, the data was under review for completeness with regard to the required data attributes. Roads and bridge data had already previously been submitted to TAMC and so it was not necessary for communities and agencies to resubmit this information.

Condition Grade	Percent of Effective Useful Life Remaining
Very Good	> 85%
Good	60 – 85%
Fair	30 – 60%
Poor	10 – 30%
Very Poor	< 10%

EXHIBIT 14. Condition Grade calculation approach

For many of the below ground assets, condition information was typically unavailable. Some larger communities had carried out condition assessments on their wastewater pipes and there was a small amount of condition data available for culverts. However, none of the pilot communities provided drinking water main condition data. Based on the discussions with the SME group, regarding the high costs associated with condition assessments, especially for drinking water mains, this lack of condition data was anticipated. With this in mind the SME group agreed that an age-based approach to assessing condition would provide a reasonable approximation of actual condition. To calculate the current condition grade, the key items of asset data were the date of construction and material type. A range of Effective Useful Life for different material types was used in conjunction with simple *percent of effective Useful Asset Life Remaining* look up table (see Exhibit 14) to provide an approximation of an assets current condition.

As part of the data clean up, localized names for material types had to be rationalized into a common terminology, for examples over 60 different material types were submitted for drinking water main material types, which were re-categorized into 15 drinking water material types.

Exhibit 15 provides a summary of the data collected.*

	Drinking Water	Wastewater	Stormwater	Roads	Bridges	Culverts
Segments/Number	540,121	335,273	324,289	-	4,856	14,338
Miles	15,104	13,505	6,673	23,025**	-	-

* Data from communities that did not sign a data sharing agreement was removed from this dataset prior to the analytics phase of the Pilot.

** Miles of road with condition ratings. 22,462 miles supplied by TAMC plus 563 miles collected direct from communities during the Pilot.

EXHIBIT 15. Data Collection Summary

While the total miles of pipe for which data was submitted, far exceeded the initial expectation, not all of the pipe data, shown in Exhibit 15, included condition grades, or in the absence of condition grades, date of construction. This means that not all of the pipe data collected could be

used for the purposes of assessing overall pipe condition. The percentage of pipe length, for which all of the required data attributes were available were 75 percent (drinking water), 22 percent (wastewater) and 26 percent (stormwater).

Therefore, the sample size was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. In addition, age/condition data may be more readily available for those communities who have progressed further with their asset management programs and may also have better overall condition assets. Data analysis will continue to better understand which communities have available condition data (or age of construction) along with the relative investment levels of those communities, compared with their peer communities.

It is therefore not known whether the following summary condition charts in Exhibit 17 do represent the actual condition for water, wastewater, and stormwater assets across the Pilot areas, however they do demonstrate the type of analysis that can be carried out with the data.

For roads, bridges and culverts the data can be considered more reliable, as the condition data is based on actual condition assessments.

The Pilot was able to take advantage of a rich history of data sharing at the State of Michigan through a partnership with the Enterprise Information Management (EIM) Program which focuses on data management best practices to promote transparency and to improve the quality of service delivery in priority areas such as infrastructure, public safety, education, public health and economic growth. By utilizing the EIM framework the Pilot increased secure data sharing between local, regional and state entities while working toward a centralized data repository for infrastructure assets and analytics/reporting capabilities for the state of Michigan.

Based upon the age of construction and the material type, the condition profile of the assets and the likely replacement profile could be estimated. Similar to above, this information is included for illustrative purposes to demonstrate the type of analysis that can be carried out. It is recognized that the replacement profile shown in Exhibit 18 is a simplistic view of the timing of replacement and the likely future investment need. It assumes that all assets were constructed on a certain date, and will all fail at the same point in time. In reality, there are many factors, in addition to age, that will influence the failure profile for an asset including material specification, design & construction standards, soil type, the operating regime of the asset, environmental considerations such as freeze/thaw cycles or unstable ground conditions due to weather events, the impact of adjacent utilities etc. Consideration of these many factors will result in the failures occurring over a period of time. As the state gathers more data on actual asset failure, a more accurate assessment of future investment needs can be obtained.

In addition to analyzing the age profiles and condition of the assets contained within the pilot areas, along with an assessment of the likely replacement profiles for each individual asset type, an assessment was also carried out to identify locations where there were more than one asset type with either a poor or very poor condition grade. This was done by selecting all PASER rated roads with a rating of poor and then selecting all stormwater, drinking water, and wastewater assets that had a condition rating of poor or very poor, that were in the same vicinity. This resulted in approximately 480 miles of poor condition road being identified, under which there was one or more poor/very poor condition pipes. However, this needs to be put into context. There are a total of 47,339 miles of road in the areas

covered by the Pilot, and the Pilot identified 23,025 miles of road with condition ratings. The smaller roads, which are still to be rated, are likely to overlay a large proportion of the water, wastewater and stormwater pipes and therefore the analysis carried out in the pilot was not able to assess the proximity of poor/very poor assets for these roads. The analysis carried does however demonstrate the advantages of collecting the data in a geospatial format.

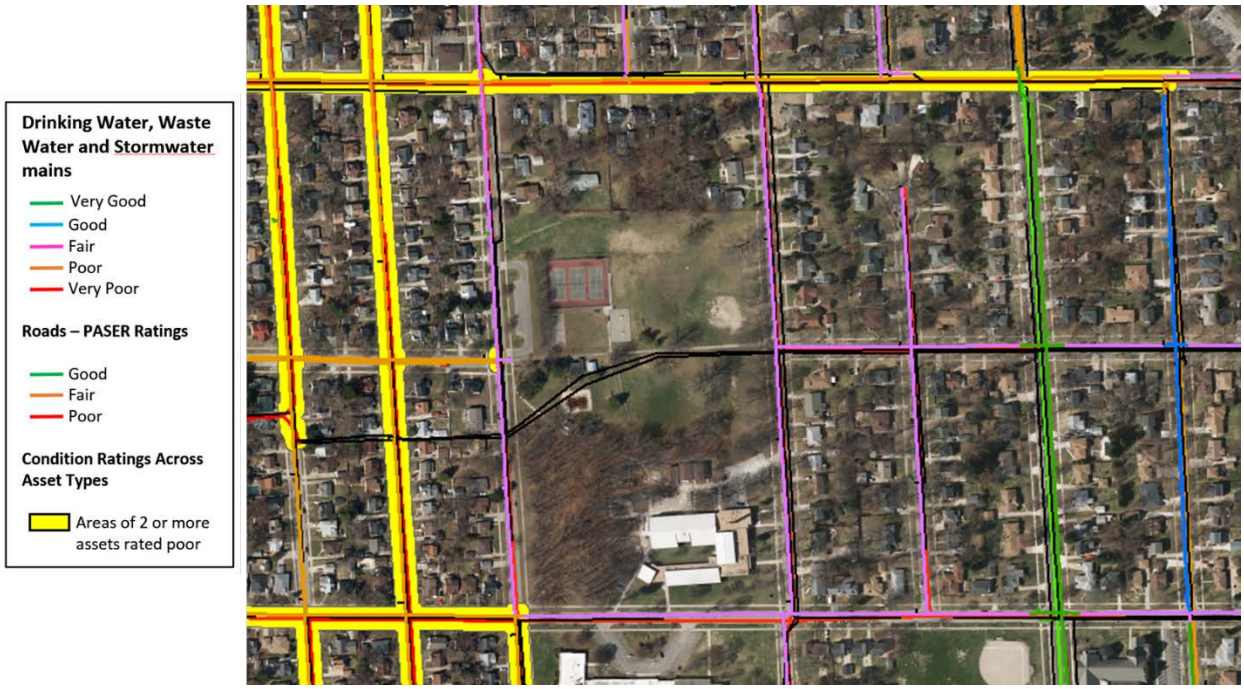
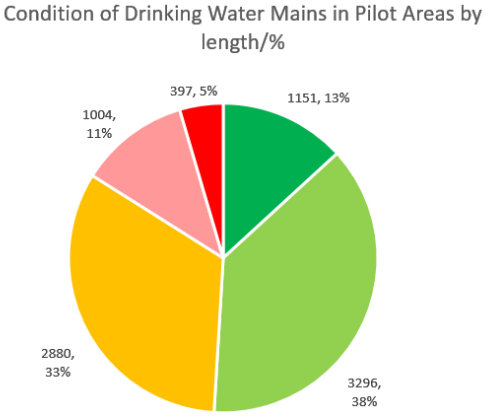


EXHIBIT 16 Example of geospatial analysis to identify areas with two or more poor condition asset types

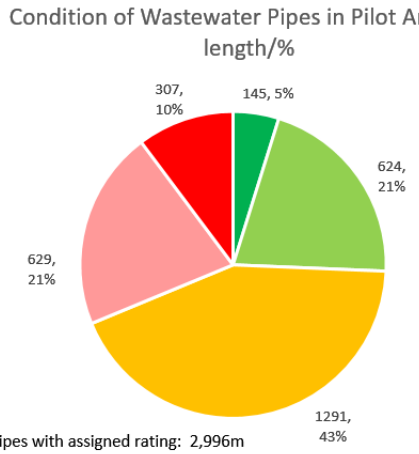
Further output from the data analytics for wastewater, stormwater, roads and bridges can be found in Appendix F.

EXHIBIT 17. Condition rating examples



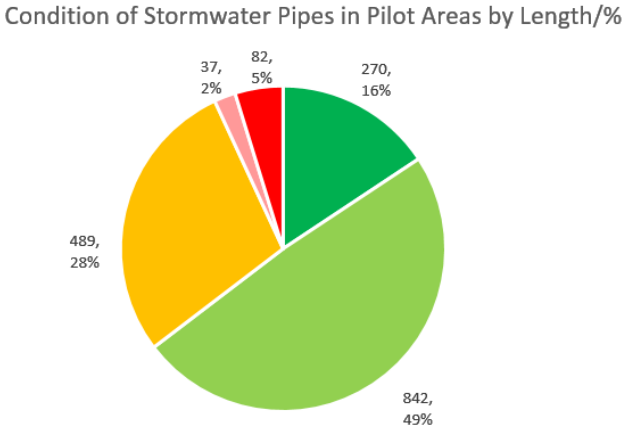
Total Length Pipes with assigned rating: 8,728m

Source: Pilot Regions



Total Length Pipes with assigned rating: 2,996m

Source: Pilot Regions

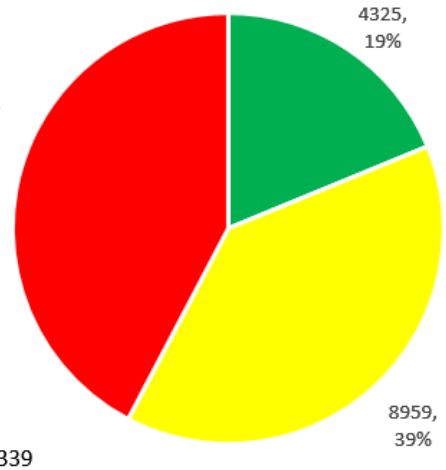


Total Length Pipes with assigned rating: 1,720m

Source: Pilot Regions

Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

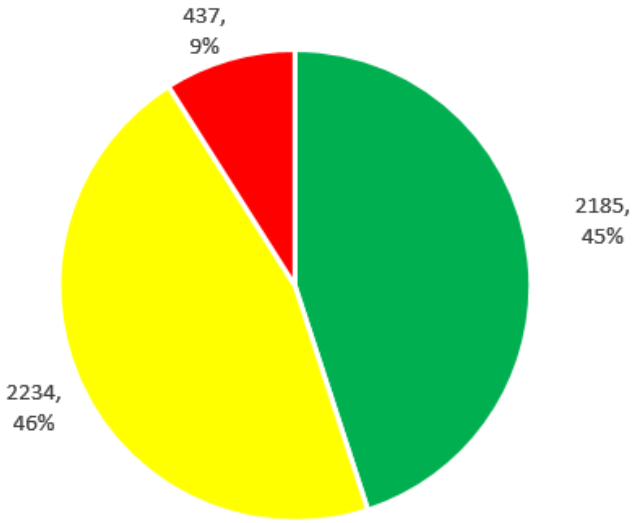
Condition of Rated Roads in Pilot Areas by length/%



Total Centerline Miles: 47,339
Total Rated Centerlines Miles: 23,025

Source: Pilot Regions and TAMC

Condition of Bridges in Pilot Areas by Number/%



Total Bridges: 4,856

Source: TAMC

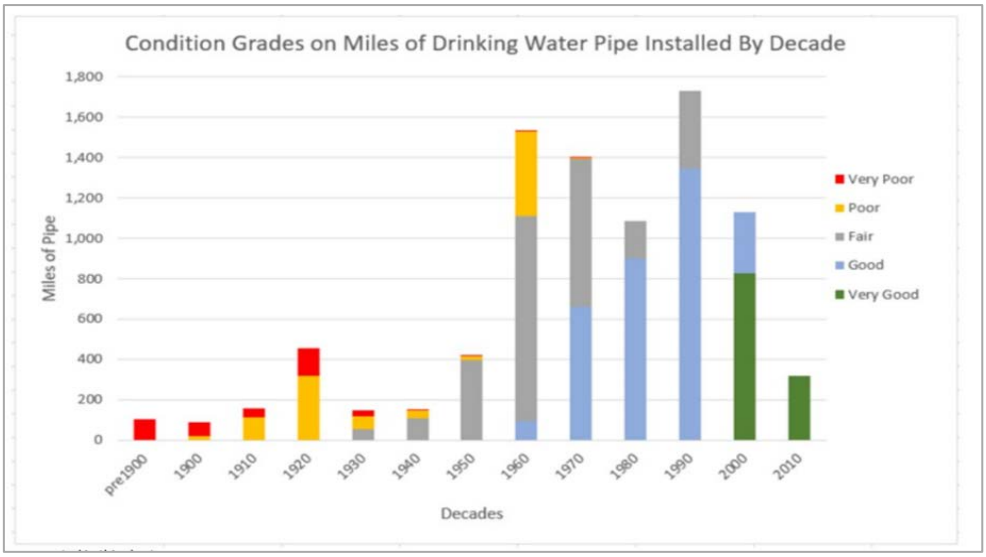
Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

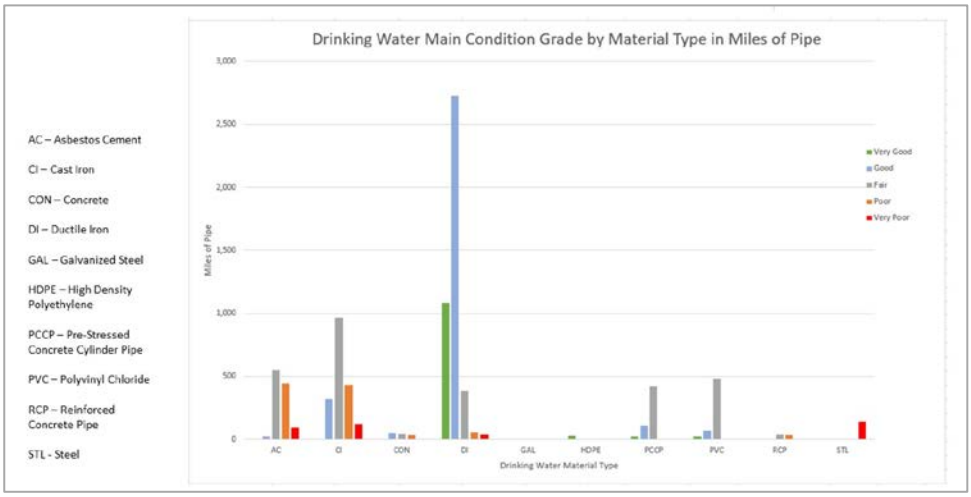
Very Good

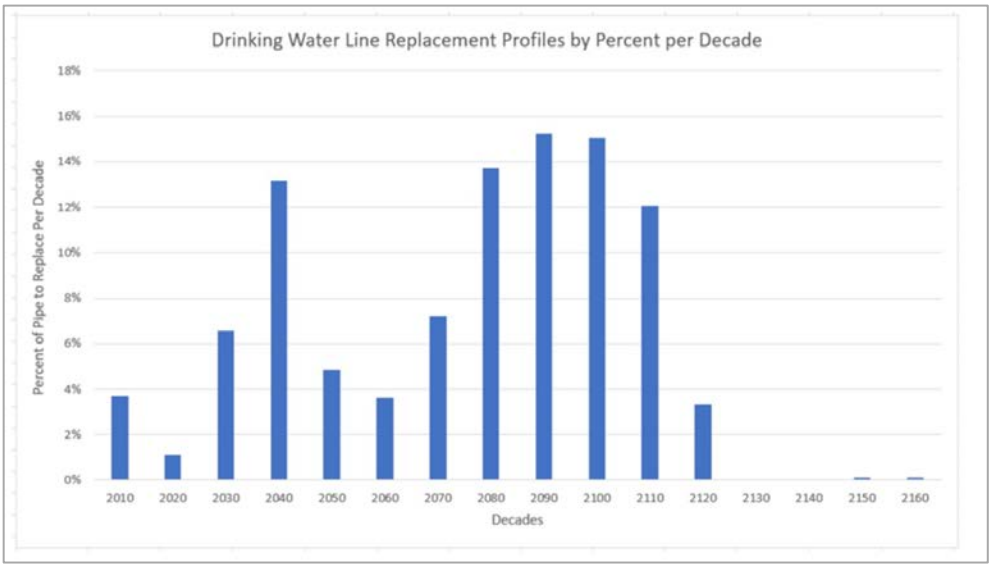
Fair

Very Poor

EXHIBIT 18. Data analytics examples







Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

Project Data

In addition to asset data for water, wastewater, stormwater, roads and bridges, project data for capital projects was also requested from communities. While this data has been collected for a number of years for road and bridge projects, for input into the TAMC Investment Reporting Tool, for the majority of communities this data had not been previously plotted geographically, or shared with other utilities/agencies.

As part of the pilot, communities and private utilities were asked to provide summary data for their capital projects, that would require a road opening, including:

- Project Type (drinking water, wastewater, etc.)
- Start/End date
- Location
- Value (optional)

This initial data request focused on projects planned to begin in 2018. Moving forward, there would be value in looking out over a longer period, such as 5 years, this would enable better forward planning and coordination of projects, However, the data obtained as part of the Pilot does demostrate how the data can be combined across asset types, to provide an overview of all right-of-way project activity in a certain area which enables better communication between all asset owners. A statewide project database, along with the associated processes for its use and maintenance would further enable this.

"The Pilot was a very useful endeavor. The work done was long overdue and will hopefully provide communities with a tool to start looking at their assets in a more holistic way and to be more pro-active, rather than reactive to our infrastructure needs. In order to fix the issues that we all face, we need to work together in a collaborative effort to tackle these problems. The asset management Pilot is one way that can start to help us accomplish that. We were pleased to see so many communities working together to make this a successful project. Clean water knows no boundaries, so it is critical that all of our communities work together as we tackle these issues"

Vincent Astorino
Operations and Flow Manager
Macomb County Public Works

Technical Recommendations

4.6.1 It is recommended that the proposed MIC will facilitate the further collection of asset data (not necessarily fund it) and develop a prioritization approach for data collection, such as asset criticality, along with data collection frequency.

4.6.2 Many agencies have already recognized the value of data about the condition of existing infrastructure. To maximize return on investment it is critical to recognize that infrastructure exists to enable local, regional, or state goals for quality of life such as safety, public health, and economic activity. While condition is a good snapshot of today, in order to improve strategic investment, it is critical to collect, measure, and ensure decision makers see data that tracks progress toward strategic goals. The focus of data collection should therefore be on better understanding performance outcomes as opposed to only focusing on asset condition

4.6.3 There is a wide variety of community systems from sophisticated GIS asset systems to less technical paper/knowledge based approaches. The statewide asset management system, like the Pilot, must work to involve all communities who wish to participate regardless of their current technical capabilities or systems.

4.6.4 The communities involved with the Pilot, commented on the tight timescales related to the data collection phase of the project. When considering a statewide roll out, the MIC, WAMC and TAMC need to consider the time required to collect and verify data from a broad range of asset owners. Many of the time related challenges that were noted will potentially be magnified when this program is scaled up.

4.6.5 As part of the pilot it was found that for some communities, the asset data is owned and managed by third parties such as engineering consultants. It is recommended that a further review of data ownership is carried out at the state, regional and local levels, including the review of contracts between communities and the consulting community. (Note for SAW grants, it is a requirement that data is owned by the public entity.)

4.6.6 It is recommended that the MIC, WAMC, and TAMC work together to coordinate data governance structures for any data collected.

4.6.7 Preliminary data standards were discussed and developed by the SME groups. MIC, WAMC, and TAMC should continue with the further review and development of the data standards, with a specific focus on:

- Defining the age of construction of assets
- Agreeing on a proposed asset condition approach for use across all assets types e.g. 3-point condition scale, 5-point condition scale, 10-point condition scale, etc.
- Additional data to be collected, such as vertical assets

4.6.8 As new technology solutions emerge, there is a need to review both the technology available for the gathering of data, along with the technology solutions available that will enable the better estimation of asset condition. It is therefore recommended that MIC, WAMC and TAMC, continuously, as a coordinated effort, review how emerging technology can be leveraged and recommended for the data collection process which is the single largest cost of any asset management system

4.6.9 For private utility asset owners, it is recommended that data that is already currently submitted e.g. Planned Project Information, is utilized.

4.6.10 Although the data sharing agreement increased the administrative work load for the Pilot significantly, it was necessary to ensure any entity submitting information to the Pilot understood where the data would be housed, who would be able to access the data, and for what purpose the data would be used. This is an industry best practice for the sharing of information and it is recommended that the MIC investigate the possibility of and need for a universal data sharing agreement for any entity submitting data to future asset databases.

4.6.11 As part of the data collection process, interdepartmental procedures were created to ensure any request for information was handled in accordance with current law while also keeping critical infrastructure data secure. While the procedure utilized for the Pilot was sufficient and secure, it would not be feasible to scale this procedure in order to handle data submitted to a statewide system. It is therefore recommended that a change is made to Michigan statute in order to protect this data from being released and potentially have public safety ramifications.

4.6.12 The Pilot recognizes the need for transparency regarding information collected by the proposed MIC, WAMC, and the current TAMC, while also protecting data that is sensitive in nature. To that extent, the Pilot supports the mission of the MIC to revise as needed and create if not otherwise available, a comprehensive drinking water, wastewater, stormwater, transportation, and in some cases public dashboard with a safe level of information viewable by the general public.

4.6.13 The date of construction was identified as a key field to assist in estimating condition grades but was only available on approximately 77 percent of the miles of pipes provided across drinking water, sewer and stormwater assets. It will be important that the proposed MIC, WAMC, and interested parties determine what alternative methods there may be for determining date of construction, where that information might not be captured today in these areas.

4.6.14 Some participating agencies had abandoned utility lines mapped in their GIS datasets. Although not part of the data schemas for the Pilot, these should be considered moving forward to determine if there is a benefit to having location-based information for abandoned facilities.

4.6.15 Where actual condition assessments have been completed, this condition data, along with age and material types, can be used to calibrate the age-based condition approach. It is recommended that the age-based approach to condition assessment be further refined.

4.6.16 State funding has been previously utilized to assist in the collection of asset data e.g. SAW Grants. It is recommended that the proposed MIC further develops and agree upon the required asset data and that any state funded data collection is focused on an agreed upon data set.

4.6.17 The formation and use of the Subject Matter Expert (SME) group proved to be a key element of the Pilot. It is therefore recommended that a SME group continue as part of the statewide rollout and provide input to the process.

Further technical recommendations regarding data can be found in Appendix E.

4.7 Creating the Statewide System

Assessing the needs for a statewide IT system, or systems that would underpin asset management was a key part of the Pilot project. Good practice asset management is reliant on data driven decisions and therefore consideration needs to be given to the collection, storage and analysis of the data. This functionality may not be housed in a single system. The focus was therefore more on defining the required functionality as opposed to trying to select a single system that best fits the needs of the state, regions and local communities. This functionality was defined as:

- Tier 1 – Basic GIS Asset Register
- Tier 2 – Statewide Repository of Data
- Tier 3 – Data Analytics – for both current asset performance and predicted asset performance along with reporting functionality. This Tier also includes project coordination information.

Recommendations

4.7.1 The statewide asset management database should provide local communities the ability to collect, store, and make data driven decisions utilizing a geospatial format which is the industry standard. This will allow the proposed Michigan Infrastructure Council and local asset owners to analyze data across asset types and jurisdictions. This will also lead to increased transparency for all residents in the state of Michigan. It is critical for the statewide database to provide the ability to enable coordinated, long term investment planning at the local, regional, and state level.

4.7.2 Several communities do not have fully populated asset inventories, and often there is an over reliance on staff knowledge, as opposed to data and where more formal inventories do exist they are not always GIS based. With a large proportion of the workforce moving towards retirement, the need to capture this data in a system is becoming more urgent. It is therefore recommended that in partnership with local or regional entities, the proposed MIC provides Tier 1a Functionality (Minimum/Basic level) GIS Based Asset Registry for use at the local level, along with associated training.

4.7.3 The data that is collected from the communities and agencies needs to be housed in a single location where quality control of the data can be carried out and data can be aligned to the state-wide data standards. It is therefore recommended that the Tier 2 data repository is housed by DTMB utilizing the Michigan Geographic Framework (MGF), which will act as a central clearing house for data management and analysis. This will require a more detailed review of the required resources associated with the management of Tier 2.

4.7.4 Tier 3 Functionality (Minimum/Basic level) is required at the region and local level and further advanced functionality will be required at the state level. It is therefore recommended that in partnership with local entities, the proposed MIC provide a statewide IT System (Tier 3) and associated training. Further work is required to decide on whether the solution is developed in house, with a partner or procured will need to be investigated.

4.7.5 The statewide system should enable trending of key metrics associated with the performance of the assets and these should be transparent for public use.

4.7.6 The proposed Michigan Infrastructure Council must identify and remove barriers for communities of all sizes to participate in the system.

4.8 Enabling better coordination

A key part of the mission for the Pilot was to create mechanisms for coordinated planning and communication across asset owners and types statewide. Further, improving coordination and communication between public and private asset owners within the State of Michigan will lead to a greater quality of life for the citizens of Michigan as well as cost savings for both public and private utility owners.

Shortly after the start of the Pilot, private utility representatives and the Pilot Advisory Board met to determine the best way to drive further coordination between public and private entities. It was decided that two summits', one in West Michigan and one in Southeast Michigan would be helpful to initially evaluate what processes are currently being utilized and what opportunities exist for improvement.

The respective summits took place in early February of 2018 in Detroit and Grand Rapids. For each summit, 6-8 communities were chosen to provide a representation of the dialogue that could be possible in the future, given time and resource constraints. Locations were chosen based upon geographic diversity, asset management sophistication, and complexity of current utility coordination. Over 150 representatives from local communities, county road commissions, private gas, electric, and telecommunications utilities attended. During these events, facilitated discussions took place to determine what coordination and communication processes are currently taking place, what practices can be considered a best practice, and what opportunities exist for improvement.

Throughout the Pilot process, broadband access and adoption across the state was raised as an issue the Pilot and MIC should work to address. As the state of Michigan works diligently to expand access to broadband, the construction projects can be included in the coordination and communications discussions between private and public utility owners. To this end, broadband coverage maps were included in the Pilot asset database using data from Connect Michigan, a non-profit in the State of Michigan dedicated to increasing access and adoption of broadband. Examples of these maps can be seen in Appendix G.

Recommendations:

4.8.1 The proposed Michigan Infrastructure Council (MIC) should facilitate the continuation of coordination and communication meetings both at a regional level and at a more focused local level on a regular basis. Appropriate public and private utility representation at meetings is critical in order to allow for productive discussions, with attendees prepared to speak at a high-level regarding current coordination practices, share best practices, and review the previous year's practices to determine opportunities for the coming years.

4.8.2 Local or county level coordination and communication meetings should take place on more frequent occasions such as quarterly or bi-annually focusing on project specific coordination planning.

4.8.3 The proposed MIC should facilitate the creation of a geodatabase of project information from all disciplines, with the goal of facilitating project coordination of planned long-term projects that fall in the common right-of-way, with the understanding that project priorities change and system flexibility is necessary.

4.8.4 Local governments, municipalities, and private utility owners should review current permitting practices for modernization opportunities to minimize public and private resources and time needed to process applications.

4.8.5 The Pilot recommends the MIC continue to discuss the following points:

- Investigate a standardized permitting process, not necessarily one-size-fits-all, but potentially a reduction in the number and variety.
- Further coordination with other utility owners and organizations such as railroad agencies.
- Facilitation of long-term strategies which will help to better coordinate short-term planning.
- Through the project development process look for opportunities to minimize impact to other asset owners.
- A project coordination cost savings allocation model based off the Geospatial Utility Infrastructure Data Exchange (GUIDE) pilot program.

4.9 Resourcing

To standup a statewide asset management system and support an organization such as the proposed Michigan Infrastructure Council (MIC), it will take a team of staff supporting various roles. Following the model of the Transportation Asset Management Council (TAMC), there are support roles needed to manage the day-to-day administration of the TAMC program, to provide data support, training and customer support for the workflows and tools, and to develop annual reports as required in currently proposed MIC legislation. These roles will support the TAMC and the subcommittees throughout the year in managing the operational aspects of the program and the overall objectives of the TAMC program.

The TAMC also strives to lead the nation in data driven decision-making tools. These tools promote transparency and are easily accessed by the public, including:

— Interactive Map – Road and bridge condition information.
— Dashboards – Annual performance measures metrics from finance to safety data.
— Secure Investment Reporting Tool – Detailed information on road and bridge projects available through a secure single sign-on (MiLogin, not accessible to the general public).
— The support roles for the proposed MIC could include, but not be limited to, the following:
— Program support would be led through the Department of Treasury where it is proposed in currently pending legislation, with further technical assistance provided by lead infrastructure departments.
— The role of a central data agency is critical to managing the statewide database, security, and tools for data integration and analytics. It is recommended that DTMB provide this support as the central data agency, similar to its role with the TAMC.
— DTMB would manage the statewide database within the Michigan Geographic Framework infrastructure and leverage existing data integration tools configured specifically for the workflows needed to integrate asset types from multiple agencies. This would include the configuration and management of the database schema, business rules, and workflows to support data quality control and security of the data.
— DTMB as the central data agency would also support the reporting and data analytics tools that would be implemented based on requirements developed by the proposed MIC. These tools could include, but are not limited to, reports, dashboards, interactive maps, charts, and collaboration tools.
— To support all stakeholders of the program, training is a key component to successful adoption of the tools and processes implemented. Training support could include roles such as training through classroom or webinar-based curriculums, helpdesk support for the database upload tools and reporting tools, as well as the development and maintenance of documentation such as user guides and video tutorials. DTMB and Treasury will need to determine how training support is most appropriately staffed.
— Forecasted costs for initial resources needed by the MIC and Water Asset Management Council to implement recommendations associated with the further development, implementation and maintenance of Tier 2 along with the development, implementation and maintenance of the Investment Reporting tool can be found in Exhibit 19. The forecasted costs

were based off of costs incurred by the TAMC when creating and maintaining similar base level systems and programs.

— Additional resources will be needed by the MIC, WAMC, TAMC to accomplish the majority of recommendations set forth in this report.

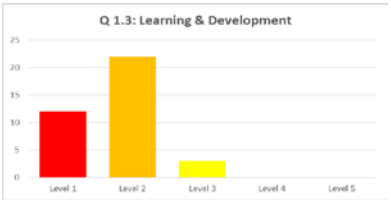
EXHIBIT 19. Forecast Costs

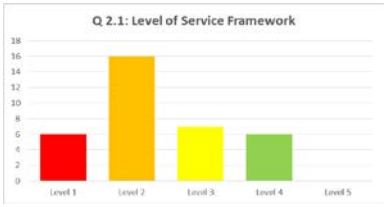
Work Area	Total WAMC + MIC CAPEX (Year 1)	Total WAMC + MIC CAPEX (Recurring)
Prog Mgmt - Project manager	$ 331,000	$ 434,000
Data Support - Support and management of data from agencies	$ 481,500	$ 357,500
Application Dev (& Support) - Investment Reporting Tool	$ 820,000	$ 294,200
Training, conferences	$ 80,000	$ 378,000
Dashboard - Reporting	$ 187,500	$ 187,500
Database servers (server for each environment with software licenses)	$ 88,000	$ 56,000
Support APPS & Infrastructure (covered through existing enterprise funding)	$ -	$ -
Tier 1 and Tier 3 Development, Implementation and Maintenance	To Be Determined	To Be Determined
Totals	**$ 1,988,000**	**$ 1,707,200**

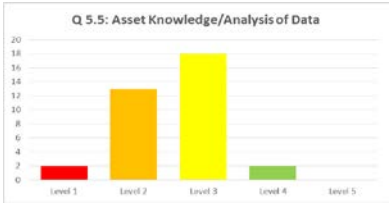
Appendix

Appendices

Appendix A – Asset Management Assessment Results







Appendix B – Subject Matter Expert groups

Stormwater

Bob Belair	Canton Township
Paul Bouman	Muskegon County Roads Commission
Joe Bush	Ottawa County
Kathy Evans	West Michigan Shoreline Regional Development Commission
Dan Fredendall	OHM Advisors
Kelly Green	Michigan Department of Environmental Quality
Wendy Ogilvie	Grand Valley Metropolitan Council

Wastewater

Phil Argiroff	Michigan Department of Environmental Quality
Tim Colling	Michigan Technological University
Bill Dooley	Wyoming Public Works
Laura Doud	Michigan Department of Agriculture and Rural Development
Doug Englesman	Zeeland Clean Water Plant
Matt Farrar	Muskegon County Public Works
Michael Gregg	Michigan Department of Agriculture and Rural Development
Shawn Keough	Wade Trim
Dave Maurice	Canton Township
Keith McCormack	Hubbell, Roth & Clark Engineering
Steven Patrick	City of Coopersville
Carrie Rivelett	City of Grand Rapids
John Schneider	City of Newaygo
John Shay	City of Ludington
Julius Suchy	Village of Sparta

Drinking Water

Mohammed Al-Shatel	City of Muskegon
Jody Caldwell	Great Lakes Water Authority
Eric Delong	City of Grand Rapids
Jake Eckholm	City of Muskegon Heights
Mark Gifford	City of Big Rapids

Mike Mamros	Great Lakes Water Authority
Sue McCormick	Great Lakes Water Authority
John Shay	City of Ludington
Derrell Slaughter	Michigan Public Service Commission (MPSC)
Jeff Small	Great Lakes Water Authority
Dan Stickel	American Water Works Association
Murat Ulasir	OHM Advisors
John Van Uffelen	Holland Public Works

Transportation

John Abraham	Road Commission of Macomb County
Roger Belknap	Michigan Department of Transportation
Paul Bowman	Muskegon County Roads Commission
Steve Bulthuis	Macatawa Area Coordinating Council
Mark Christensen	Montcalm County Road Commission
David Evancoe	Road Commission for Oakland County
Joel Fitzpatrick	West Michigan Shoreline Regional Development Commission
Abed Itani	Grand Valley Metropolitan Council
Joanna Johnson	Michigan Transportation Asset Management Council
Erick Kind	Michigan Department of Transportation
Tony Kratofil	Michigan Department of Transportation
Brad Lamburg.	Barry County Road Commission
Brian Mulnix	West Michigan Shoreline Regional Development Commission
Mark Rambo	City of Kentwood
Bob Schneider	Michigan Department of Environmental Quality
Kelcy Williams	Michigan Department of Transportation
Steve Warren	Kent County Road Commission
Dave Wresinski	Michigan Department of Transportation

Energy and Communications

Roger Blake	AT&T
Marco Bruzzano	DTE Energy
Michael Burns	City of Lowell
Paul Griffith	Michigan Works - West Central
David Koster	Holland Board of Public Works
Matt McCauley	Networks Northwest
Mary Palkovich	Consumers Energy
Scott Stevenson	Telecommunications Association of Michigan
Cathy Wilson	Consumers Energy

Appendix C – Organizations Involved with Data Collection/Sharing

We would like to thank the following participating organizations who were involved with data collection and sharing.

Acacia Park CSO Drain Drainage District
Ada Township
Allendale Township
Alpine Township
Armada Township
Augusta Drain Drainage District
Birmingham CSO Drain Drainage District
Blendon Township
Bloomfield Township
Bloomfield Village CSO Drain Drainage District
Bruce Township
Byron Township
Caledonia Township
Cannon Township
Canton Township
Cascade Township
Chester Township
Chesterfield Township
City of Allen Park
City of Ann Arbor
City of Auburn Hills
City of Berkley
City of Birmingham
City of Bloomfield Hills
City of Cedar Springs
City of Center Line
City of Clawson
City of Coopersville
City of Deaborn Heights
City of Dearborn
City of Detroit
City of East Grand Rapids
City of Eastpointe
City of Ecorse
City of Farmington
City of Farmington Hills
City of Ferndale
City of Ferrysburg

City of Fraser
City of Fremont
City of Garden City
City of Grand Haven
City of Grand Rapids
City of Grandville
City of Grant
City of Grosse Pointe Park
City of Hamtramck
City of Harper Woods
City of Hastings
City of Hazel Park
City of Highland Park
City of Holland
City of Hudsonville
City of Huntington Woods
City of Keego Harbor
City of Kentwood
City of Lake Angelus
City of Lincoln Park
City of Livonia
City of Lowell
City of Ludington
City of Madison Heights
City of Marine
City of Melvindale
City of Monroe
City of Montague
City of Mount Clemens
City of Muskegon
City of Muskegon Heights
City of New Baltimore
City of North Muskegon
City of Northville
City of Novi
City of Oak Park
City of Pleasant Ridge
City of Pontiac
City of Richmond

City of River Rouge
City of Rochester
City of Rochester Hills
City of Rockford
City of Romulus
City of Roosevelt Park
City of Roseville
City of Royal Oak
City of Southfield
City of Sterling Heights
City of Sylvan Lake
City of The Village of Douglas
City of Troy
City of Walker
City of Walled Lake
City of Wayland
City of Westland
City of White Cloud
City of Whitehall
City of Wixom
City of Wyoming
City of Zeeland
Clinton Township
Clinton-Oakland Sewage Disposal System
Commerce Township
Consumers Energy
Crockery Township
Dalton Township
Detroit Water and Sewage Department
DTE
Edwards Relief Drain Drainage District
Evergreen-Farmington Sewage Disposal System
Exeter Township
Fillmore Township
Fort Gratiot Township
Frenchtown Township
Fruitland Township
Fruitport Township
Gaines Township
George H Kuhn Drain Drainage District
Georgetown Charter Township

Grand Haven Charter Township
Grand Rapids Township
Grand Valley Metro Council
Great Lakes Water Authority
Gunplain Township
Harrison Township
Henry Graham Drain Drainage District
Highland Charter Township
Highland Township Water Authority
Holland Charter Township
Huron-Rouge Sewage Disposal System
Ida Township
Independence Charter Township
Ionia County Road Commission
Jamestown Township
Kent County Road Commission
Laketown Township
Lee Township
Lenox Township
London Township
Lower Pettibone Sanitary Drain
Macomb County
Michigan Department of Transportation
Michigan Gas Utilities
Monroe County
Monroe Township
Muskegon County
Muskegon County Road Commission
Muskegon Township
Northville Township
Oakland County
Oakland County Road Commission
Oakland County Water Resources Commissioner's Office
Oakland Township
Olive Township
Orion Township
Ottawa County
Ottawa County Road Commission
Oxford Township
Park Township

Pere Marquette Township
Plainfield Township
Polkton Township
Pontiac Clinton River No 1 Drain Drainage District
Pontiac Water and Sewer System
Port Sheldon Township
Raisinville Township
Ray Township
Redford Township
Richmond Township
Robinson Township
Royal Oak Township
SEMCO
Shelby Township
Sherman Township
Southeast Michigan Council of Governments
Southfield Township
Spring Lake Township
Tallmadge Charter Township
Transportation Asset Management Council
Van Buren Township
Village of Beverly Hills
Village of Lakeview
Village of Lathrup
Village of Marion
Village of Maybee
Village of New Haven
Village of Orchard Lake
Village of Pewamo
Village of Sand Lake
Village of Sparta
Village of Spring Lake
Walled Lake-Novi WWTP
Washington Township
Washtenaw County
Waterford Township
Wayne County
West Bloomfield Township
West Michigan Shoreline Regional Development Commission
White Cloud Sherman Utilities Authority
Whitehall Township
Wright Township - Marne
Zeeland Charter Township

Appendix D – Communications Strategy

Use of a broad range of communication approaches was key to the engagement of stakeholders across the state and to the success of the Pilot.

See below for links to historical newsletters and the Pilot's informational video.

- Monthly newsletters
    - July 2017 (www.michigan.gov/documents/snyder/july_621565_7.pdf)
    - August 2017 (www.michigan.gov/documents/snyder/august_621566_7.pdf)
    - September 2017 (www.michigan.gov/documents/snyder/september_621567_7.pdf)
    - October 2017 (www.michigan.gov/documents/snyder/october_621568_7.pdf)
    - November 2017 (www.michigan.gov/documents/snyder/november_621569_7.pdf)
    - December 2017 (shown below)
- Pilot Video
    - https://www.youtube.com/watch?v=YjKm43rl0YA&feature=youtu.be

MIIAMP

Michigan Infrastructure Asset Management Pilot

DECEMBER 2017

Monthly **NEWSLETTER**

INSIDE THIS ISSUE

Data Collection Wrap-Up

The west Michigan and southeast Michigan regions of the pilot areas are wrapping up the data collection process, each asserting better than expected participation.

The data collection phase of the pilot has now concluded with the pilot receiving data across all asset classes that the subject matter experts decided upon. The State of Michigan's Department of Technology, Management, and Budget (DTMB) team is continuing to compile and format information provided by the regional GIS teams and communities. DTMB has begun the process of analyzing the pilot data to create preliminary reports at an aggregate level. Additionally, data has been submitted by private utility providers within the pilot regions, including gas utility project information. The pilot is also working to include broadband access and coverage in the pilot database. DTMB is working to integrate this private entity data into the overall analytics.

Analyzing the Data

Throughout the data collection process, all data received, which aligns with the data elements identified by the subject matter expert groups, has been loaded into a secured database within the Michigan Geographic Framework (MGF) environment. As data is incorporated into the MGF, data analysis is being conducted to determine what data values are present, how complete they are across the pilot regions and what data analytics can be performed both short and longer term.

System output and reporting requirements that will be assessed as part of the pilot include overall asset condition grades, asset valuation, asset depreciation, and condition forecasting reports, among others. The reporting and data analytics will include demonstrating the geospatial capabilities of the data in looking at information across asset types. As part of the pilot, it will be determined how the current data might also need to be augmented to perform future data analytics and reporting, such as whether available date of construction information will allow communities to perform condition grade analysis.

Region 4 Data Collection Update

The data collection process in the West Michigan Region has been very efficient and smooth with numerous communities from both the rural and urban areas wanting to participate.

While some challenges existed, having readily available templates created was key to the success of the data collection phase. Staff from GVMC and WMSRDC were able to focus in on assisting communities collect and assemble information that the subject matter experts felt was key to the success of the pilot. Subsequent other activities worked well including the ability to offer mini-grant incentives to participate in the pilot, getting consulting firms involved in the data collection process, as well as multiple outreach events that highlighted the project. In total, 59 communities from across Region 4 submitted data. Click here to view the current map.

Region 10 Data Collection Update

The data collection process was met throughout Region 10 with positivity and interest both within and outside the initial pilot area. Education and outreach were key aspects of the regions strategy, specifically creating awareness about the goal of the pilot project, explaining why this project was important, mitigating concerns related to data security, and informing the communities how they could participate. Use of consultants, a focus on follow up calls and continual outreach, targeting communities with GIS data, and the use of the ESRI tool were factors leading to the regions success.

SEMCOG had worked diligently throughout the data collection process and currently has participants in four counties, 28 communities, 3 of which were outside the pilot area as well as additional data from MDOT. Data is anticipated from a few more communities, one additional county and the Great Lakes Water Authority. Click here to view the current map.

Michigan Infrastructure Council (MIC) Update

A key outcome of this pilot is to ensure that the work started sustains and advances in years to come. In addition to implementing a statewide system of asset management, one of the key recommendations of the 21st Century Infrastructure Commission was the need for the creation of the Michigan Infrastructure Council (MIC).Putting in place the MIC is important to enabling conversations on infrastructure conditions, needed investments and integrated strategies to continue into the future. Part of the vision is that the MIC would stand-up and manage the statewide asset management system, along with furthering research and conversations on best practices and strategies for asset management.

Recently, House Bill No.5335, sponsored by Representative VerHeulen was introduced to create the Michigan Infrastructure Council which would be housed within the Department of Treasury. This bill remains top on the Administration's legislative priority list for 2018. Funds from the state's Michigan Infrastructure Fund has been appropriated with the recent passage of House Bill 4320 to establish the council. Additional responsibilities of the council include: providing research and advice on asset management, evaluating existing asset management programs, developing a multiyear program, work plan and budgeting for asset management, and providing annual reports on the state of asset management in Michigan.

Immediate next steps for the MIC are to determine staffing, codification of HB 5335 and then ultimately identifying individuals to sit on the council that will champion 21st century infrastructure systems going forward.

Private Utilities Coordination Summit

Throughout the pilot process, coordination and communication between public and private entities has been a focus and continues to be an area the pilot would like to address. Such collaboration will better enable the communities to more effectively and efficiently manage public right of way projects.

As a result of the work of regional GIS teams, the pilot has received CY 2018 project information from public sector asset owners. Meetings have taken place with private sector gas and electric companies to consider the best way to include their project information in the pilot. Select communities in each pilot region will be invited to attend a region-specific summit this coming February 2018 to help facilitate dialogue regarding coordination and communication of both private and public utility projects in the right of way. Topics of discussion will include:

- Current state of coordination and communication between public and private entities,
- best practices in Michigan and nationally,
- gap analysis of practices to determine where coordination is not evident or could be improved,
- community specific coordination of CY 2018 planned projects, and discussion of long term project planning and coordination.

Revolving Funds Undergoing Redesign

The 21st Century Infrastructure Commission Report (Report) identified an estimated $800 million annual gap in water and sewer infrastructure needs across Michigan. A source of water infrastructure funding that may be underutilized within the state is the Clean Water State Revolving Fund (SRF) and the Drinking Water State Revolving Fund (DWRF). These two funds are administered by the Department of Environmental Quality (DEQ) and receive federal dollars from the US Environmental Protection Agency (EPA) annually, while requiring a state match contribution. Through the Report, the Infrastructure Commission tasked the DEQ with revisions to Michigan's revolving loan funds to help incent changes such as resource recovery and energy conservation while also increasing participation in the SRF and DWRF programs.

During late summer and early fall, the DEQ held internal workshops to begin the revolving loan fund process improvement initiative. Following the internal sessions, four external stakeholder meetings were held across the state to engage customers and create a dialog with the DEQ on what works and what doesn't work within the existing programs. Feedback received from customers was valuable in developing program redesign ideas. Key issues found to need significant change included:

- Pre-planning coordination and communication,
- project plan requirement streamlining,
- update of existing project scoring criteria,
- flexibility in loan terms and interest rates, as well as the timing of the application process.

The DEQ, with the inclusion of external customers, has formed three separate teams charged with working through the specifics of how to implement the above recommendations, including the development of new policies and procedures. In some instances, state legislation may need to be amended. The goal of the teams is to have documents drafted shortly after the first of the year.

The DEQ's target is to annually provide a minimum of $200M of funding through SRF and $50M through DWRF for the next 3-5 years. Additional funding is anticipated to be awarded in the form of loan principal forgiveness. These dollars should help provide a resource for communities to address infrastructure needs.

Meeting Update:

December 14, 1017 – Stakeholder Committee Meeting

The December Stakeholder Committee meeting brought about very informative discussions related to House Bill No. 3553 and the Infrastructure fund, West Michigan and Southeast Michigan data collection process wrap ups, including challenges and key factors for success, current status and upcoming goals around data reporting and analytics, and subsequent recommendations related to data sharing and security. While pilot specific and short-term data sharing and security solutions are in progress, longer-term solutions are concurrently being evaluated. Protecting covered data through FOIA training at the local level and statutory exemptions for critical infrastructure data, as well as mitigating liability concerns through due diligence planning are a few of the forward-looking discussion taking place at the state level.

Attendees at the Stakeholder Committee meeting additionally started reviewing recommendations of the pilot's final report across the topics of IT functionality for a statewide IT system, data collection for public entities including future data governance models, the continued use of the subject matter expert networks, and the further development of asset information were reviewed. Discussions also revolved around recommendations and considerations for the most appropriate state level data standards to incorporate as well as options for assisting smaller communities with future data collection efforts. It was also noted that recommendations on reviewing the impact of technology relative to the data collection process will be important in years to come.

Recommendations currently under development include the continued collaboration and coordination of the private utilities, training and workforce development, the long-term value of the Michigan Infrastructure Council, and the development of a statewide asset management culture.

Upcoming Meetings and Events

January 31, 2018
Michigan Infrastructure Asset Management Pilot Stakeholder Meeting
Romney Building - Lansing, MI
9:00 a.m. – 12:00 p.m.

CNAM 2018 Conference
The Canadian Network of Asset Management will hold its 2018 conference, "Bridging the Gap" in infrastructure finance, engineering and public policy, May 14-17 at Caesars Windsor in Canada. Ideally located across the border from Detroit, this would be a good opportunity for individuals to attend interested in leading edge professional development, idea sharing, workshops and networking with peers in government, academia and industry. Click here for more information.

Reminder

You can access applicable meeting notes, resources, and presentations on the MI Infrastructure Asset Management pilot SharePoint site. If you do not have an account set up please contact Therese Empie at empieT@michigan.gov for additional information.

Communications and Resource Links

Michigan Asset Management Pilot Video:
Michigan Asset Management Pilot

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ayersA@michigan.gov

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elainetaylor@kpmg.com

Appendix E – Technical Recommendations

This appendix continues from the recommendations associated with *Section 4.6 Collecting the Right Data.* This Appendix is focused on those recommendations that are more technical in nature and are associated with GIS and data requirements.

4.6.15 The initial database schemas included standard coded values for attributes such as material type, pipe size, etc. However, there were other values received that will need to be reviewed to update the coded values list and consider if any of these additional values need to be included in a future statewide system.

4.6.16 Additional GIS quality control validations should be established during data integration processes to add more quality control measures that can flag inconsistencies in the data and maintain standardization. Examples would include flagging any pipe diameters that are not valid or pipe diameters that are not valid for a particular material type. Once these business rules are established, the MGF technology can be configured to include them through the data validation process and flag any features that do not meet a business rule which then can send a notification back to the data owner to review.

Include additional quality control checks to flag any duplicated features that are submitted. It was discovered in some areas that pipes seemed to be duplicated and these could be flagged during data integration to notify the data contributors to review.

4.6.17 More automation in the data uploading process should be created in the statewide database leveraging the MGF data integration technology. This should include having data owners log in through the State's single sign-on system to access the interface that would allow them to navigate specific workflows for the types of asset data being submitted and interact with the results from the data validations.

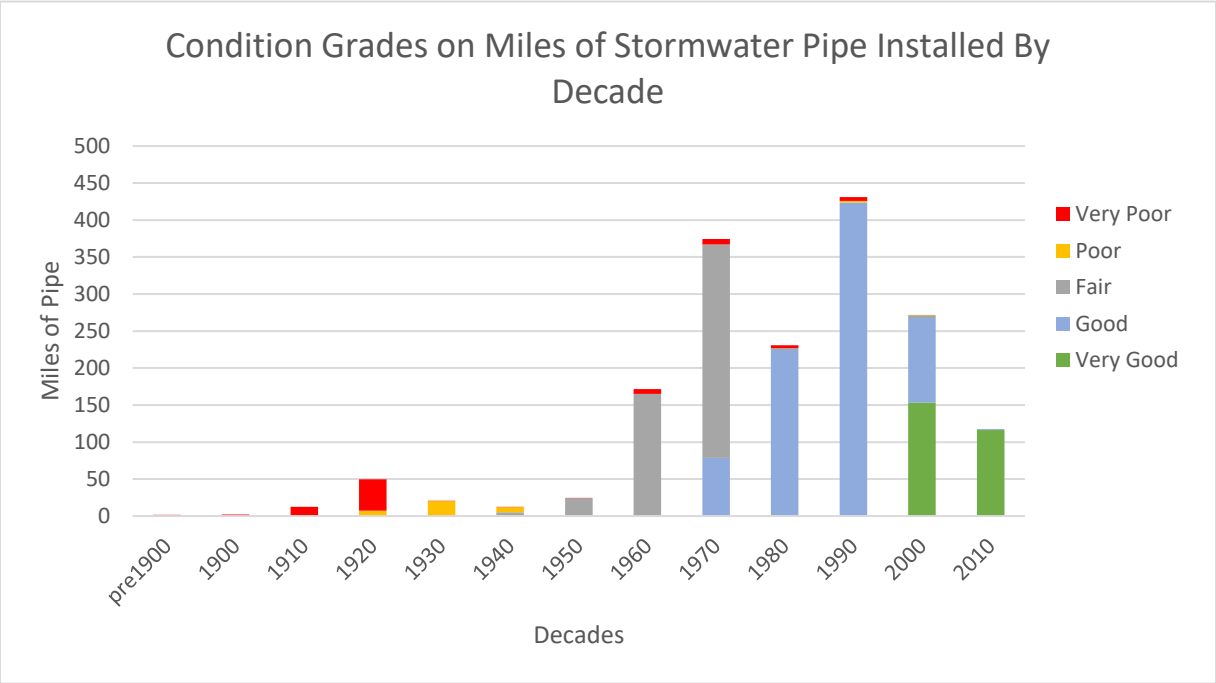
4.6.18 A unique ID standard should be considered in the statewide database. To enable the MGF data integration tools to only upload the changes since the last update rather than replace the entire dataset

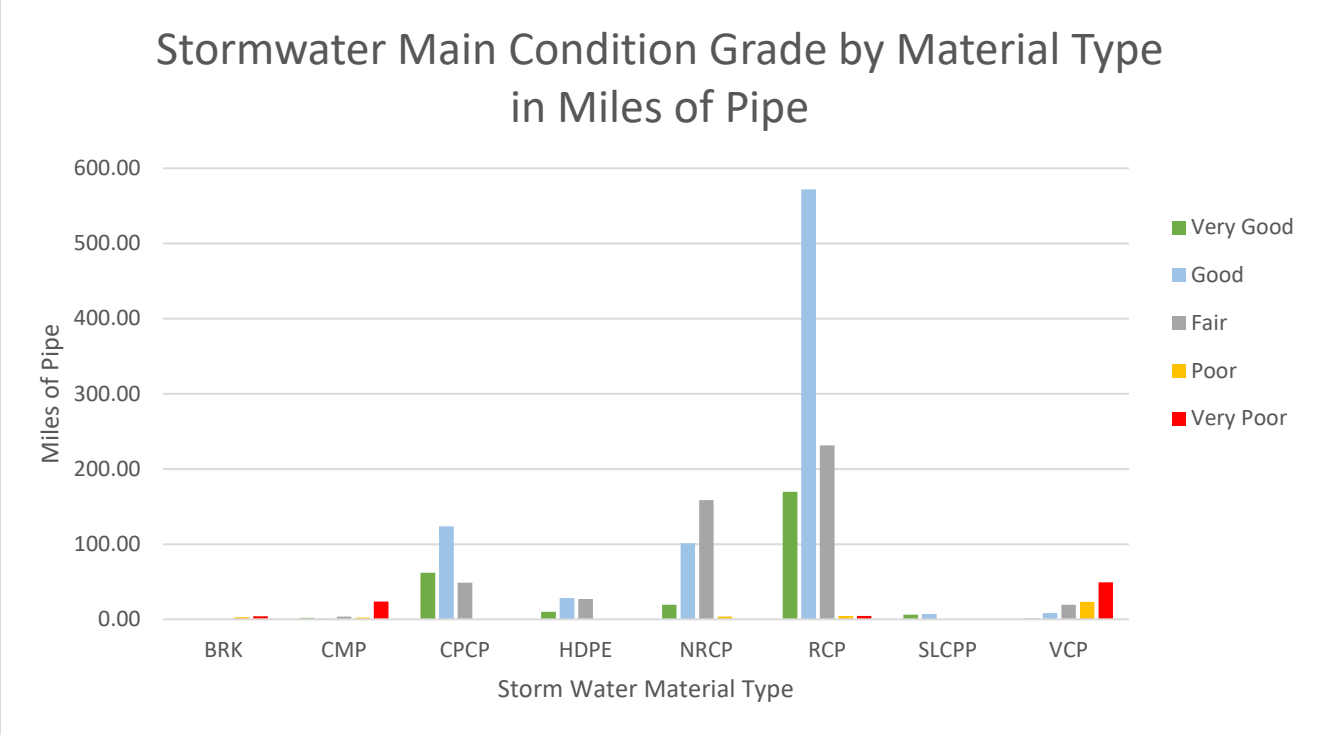
4.6.19 The data schema for the statewide database included a field called 'Jurisdiction' to be able to perform analysis at the jurisdiction level. The jurisdictions were based on city, township and village boundaries. However, it was identified during the data collection process that data owning agencies can own assets outside of a particular jurisdiction, therefore an "Ownership" field should be added to go along with the jurisdiction field to denote more specific asset ownership.

4.6.20 To perform analysis for project coordination across asset types and to determine location of clusters of similar characteristics, the long-term objective must be to inventory asset data in GIS format on a statewide basis. Doing so will require additional study into the jurisdictions across the entire state that have existing GIS data and those that do not. By conducting further research on this, a road map for developing a complete statewide GIS repository can be established longer-term with estimated costs required to complete it.

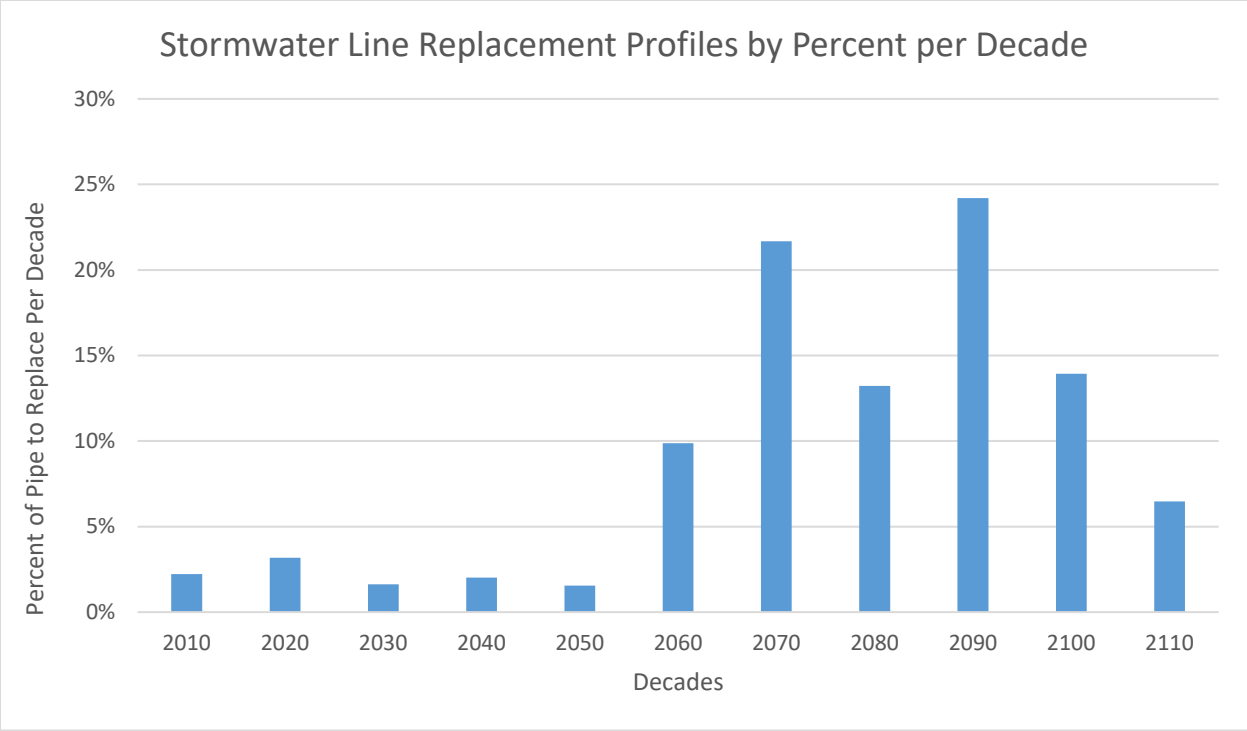
Appendix F – Further Data Analytics

Stormwater



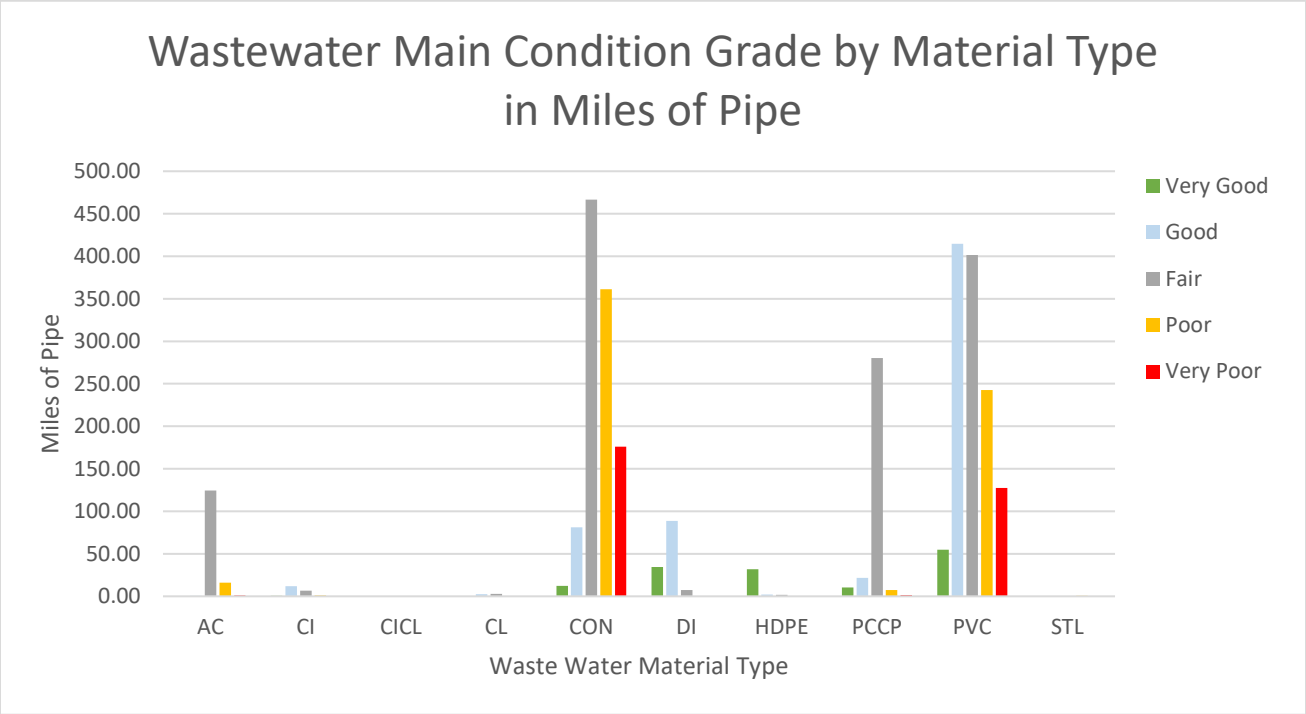


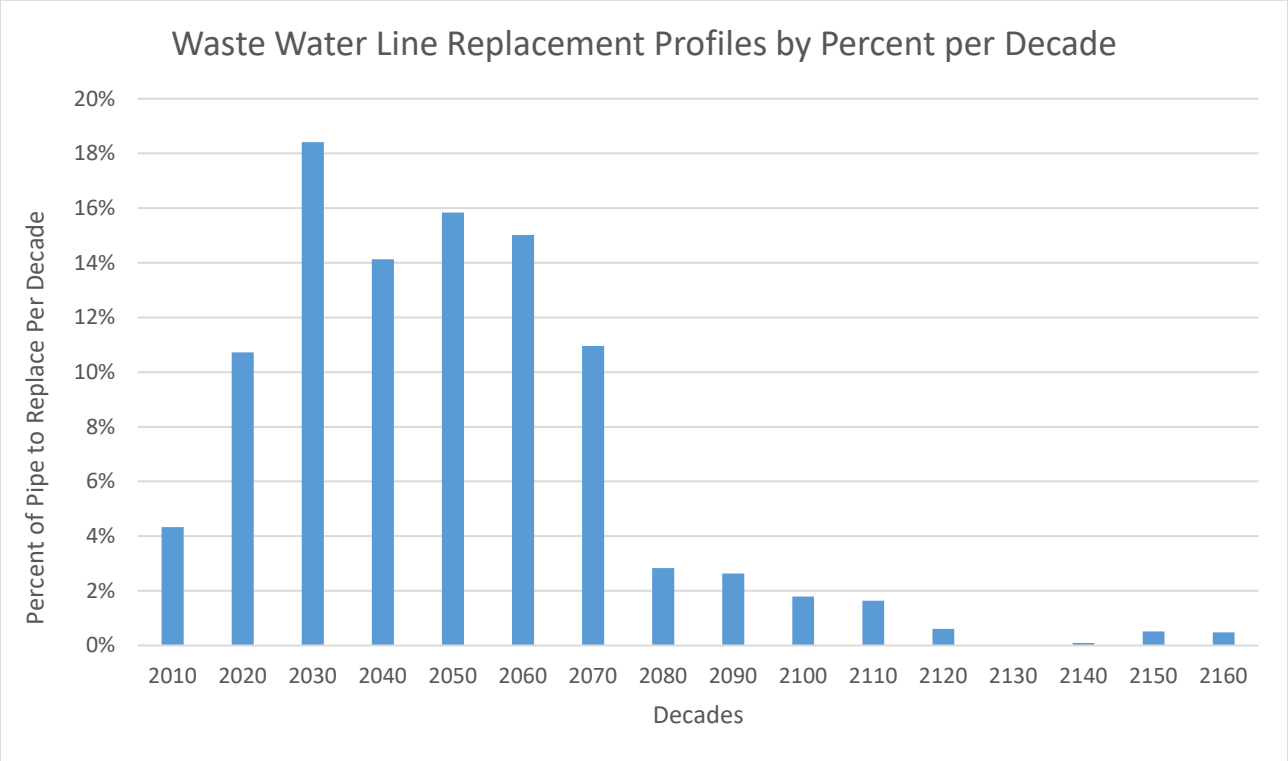
Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.



Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

Wastewater



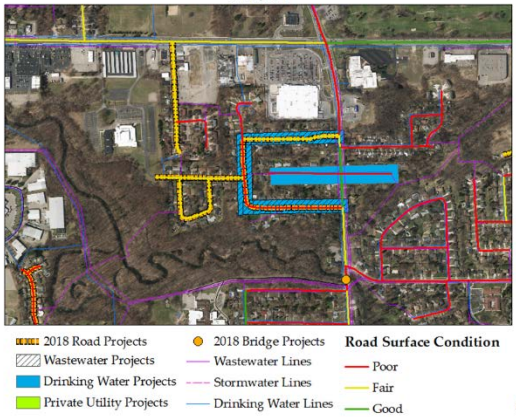


Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

Projects

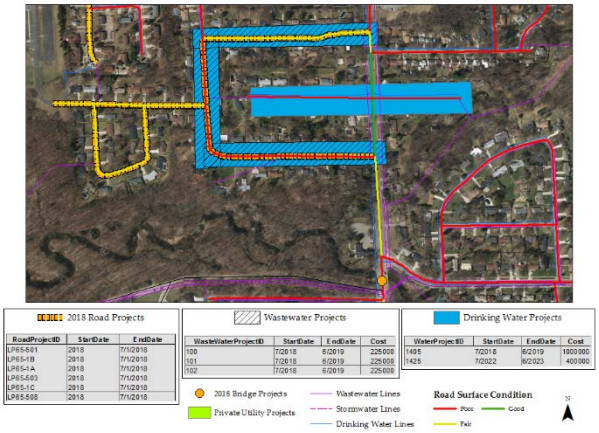
Map 1: All Data Classes Received by Pilot

Grand Rapids, MI



Map 2: Public Drinking Water, Wastewater, Road and Bridge Projects

Grand Rapids, MI



2018 Road Projects

RoadProjectID	StartDate	EndDate
LP65-501	2018	7/1/2018
LP65-1B	2018	7/1/2018
LP65-1A	2018	7/1/2018
LP65-503	2018	7/1/2018
LP65-1C	2018	7/1/2018
LP65-508	2018	7/1/2018

Wastewater Projects

WasteWaterProjectID	StartDate	EndDate	Cost
100	7/2018	6/2019	225000
101	7/2018	6/2019	225000
102	7/2018	6/2019	225000

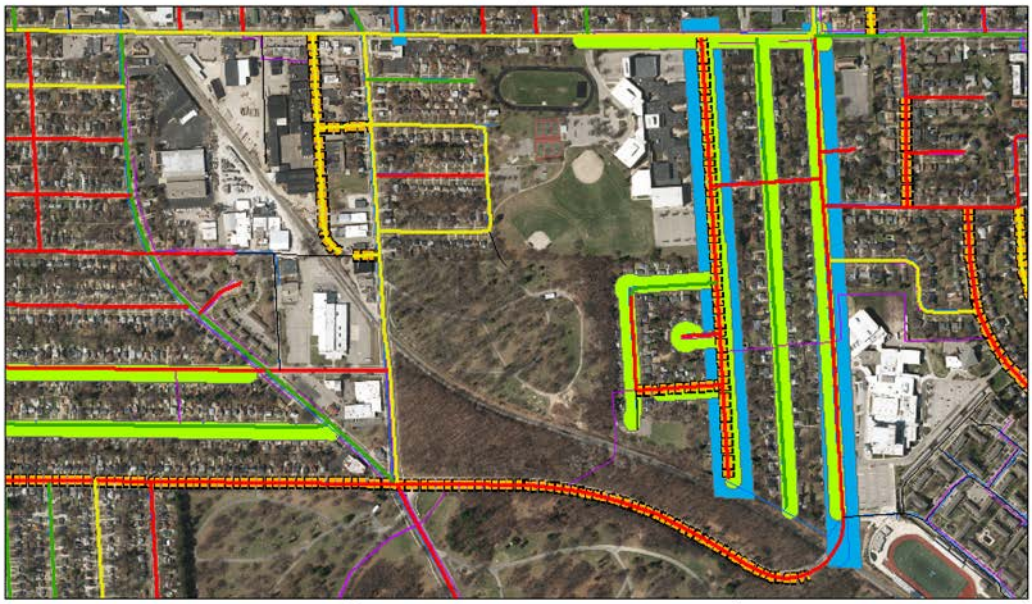
Drinking Water Projects

WaterProjectID	StartDate	EndDate	Cost
1405	7/2018	6/2019	1000000
1425	7/2022	6/2023	400000

2018 Bridge Projects
Private Utility Projects
Wastewater Lines
Stormwater Lines
Drinking Water Lines
Road Surface Condition
Poor
Good
Fair
N

Map 3: DTE Gas, Public Drinking Water and Road Projects

Grand Rapids, MI



2018 Road Projects

RoadProjectID	StartDate	EndDate
LP74-2500 (nLP74-20)	2018	7/1/2018
LP74-1	2018	7/1/2018

Private Utility Projects

PrivateUtilityProjectID	StartDate	EndDate
GRIDGR1802 - Burton	3/2018	11/2018

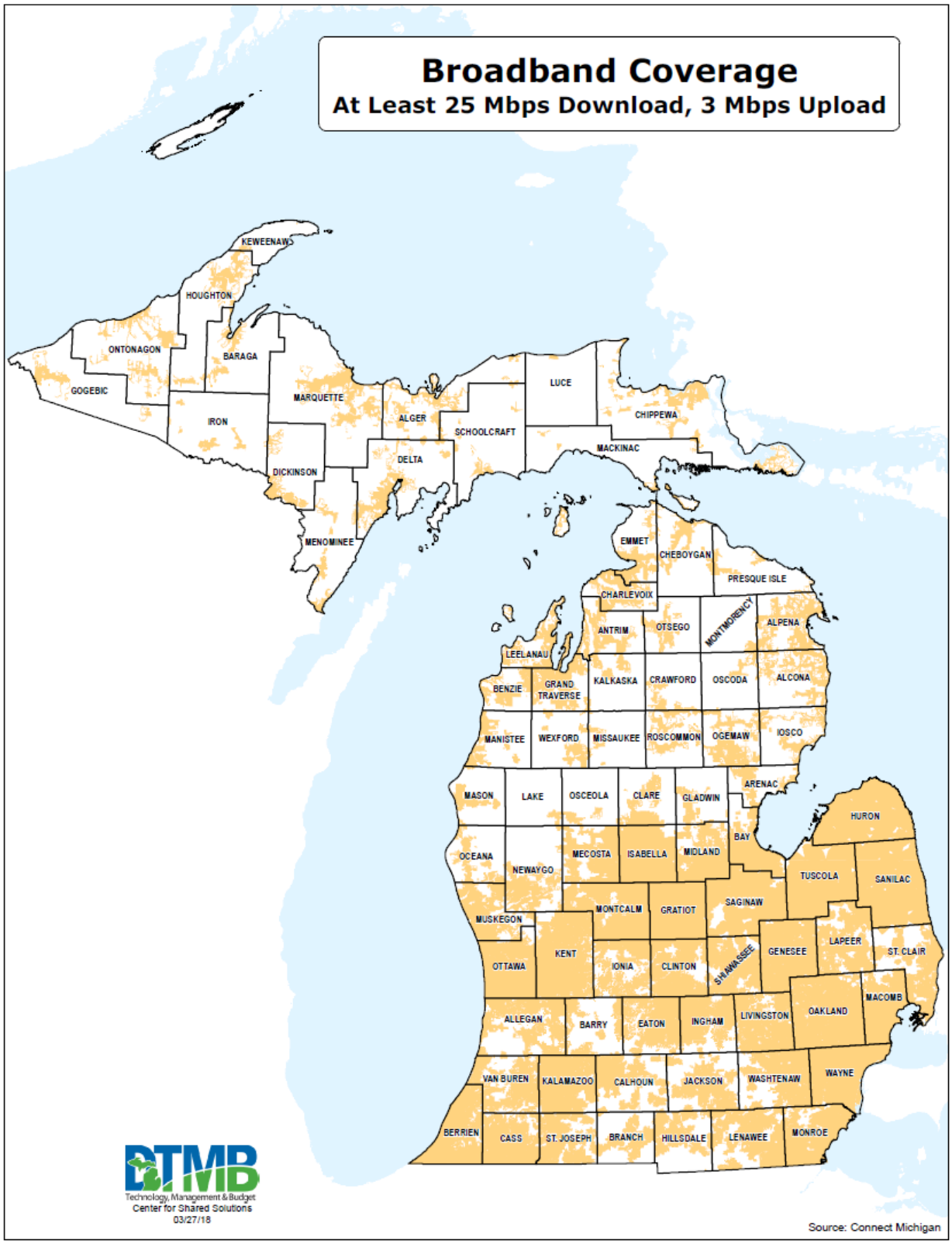
Drinking Water Projects

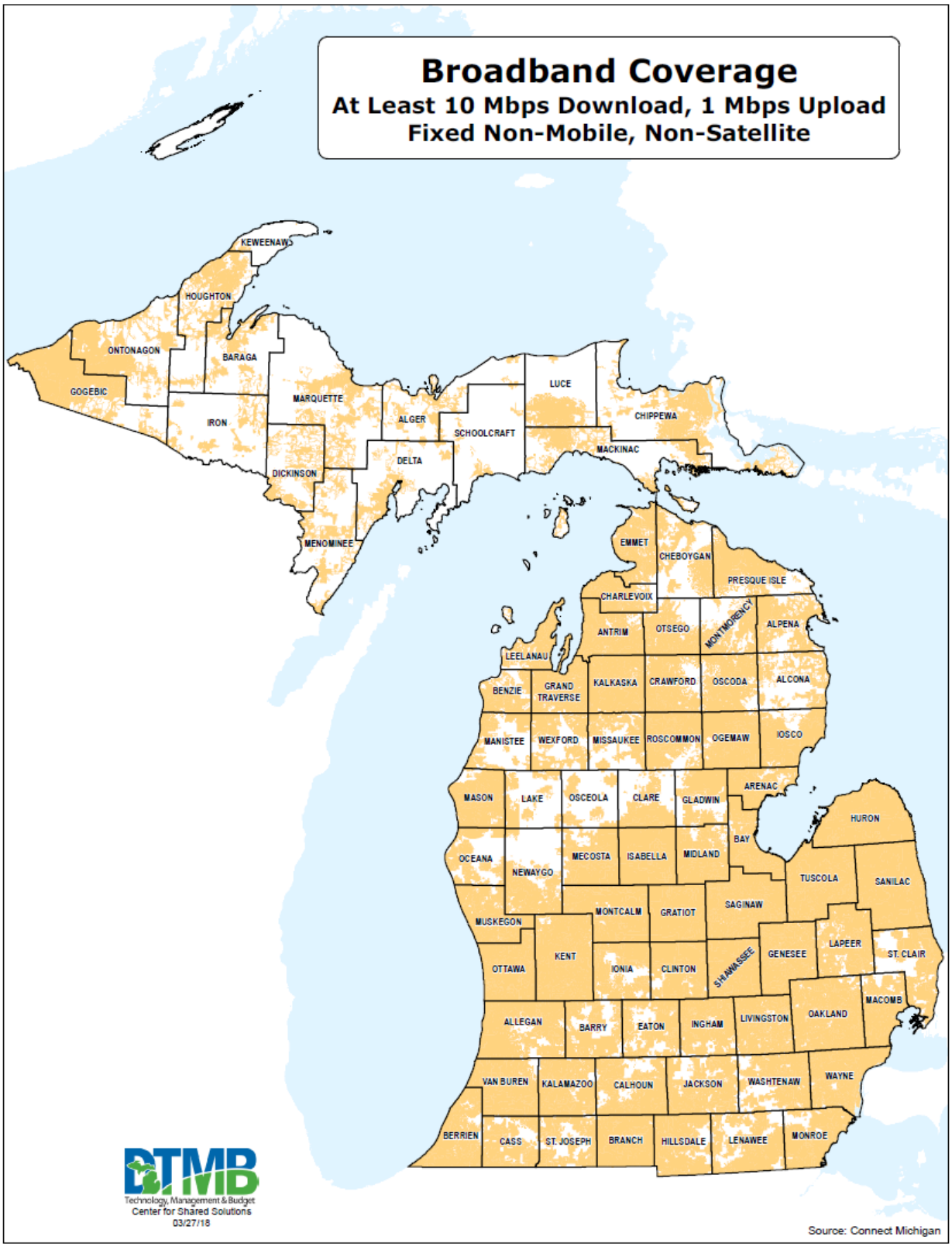
WaterProjectID	StartDate	EndDate
1434	7/2018	6/2019
5225	7/2025	6/2026

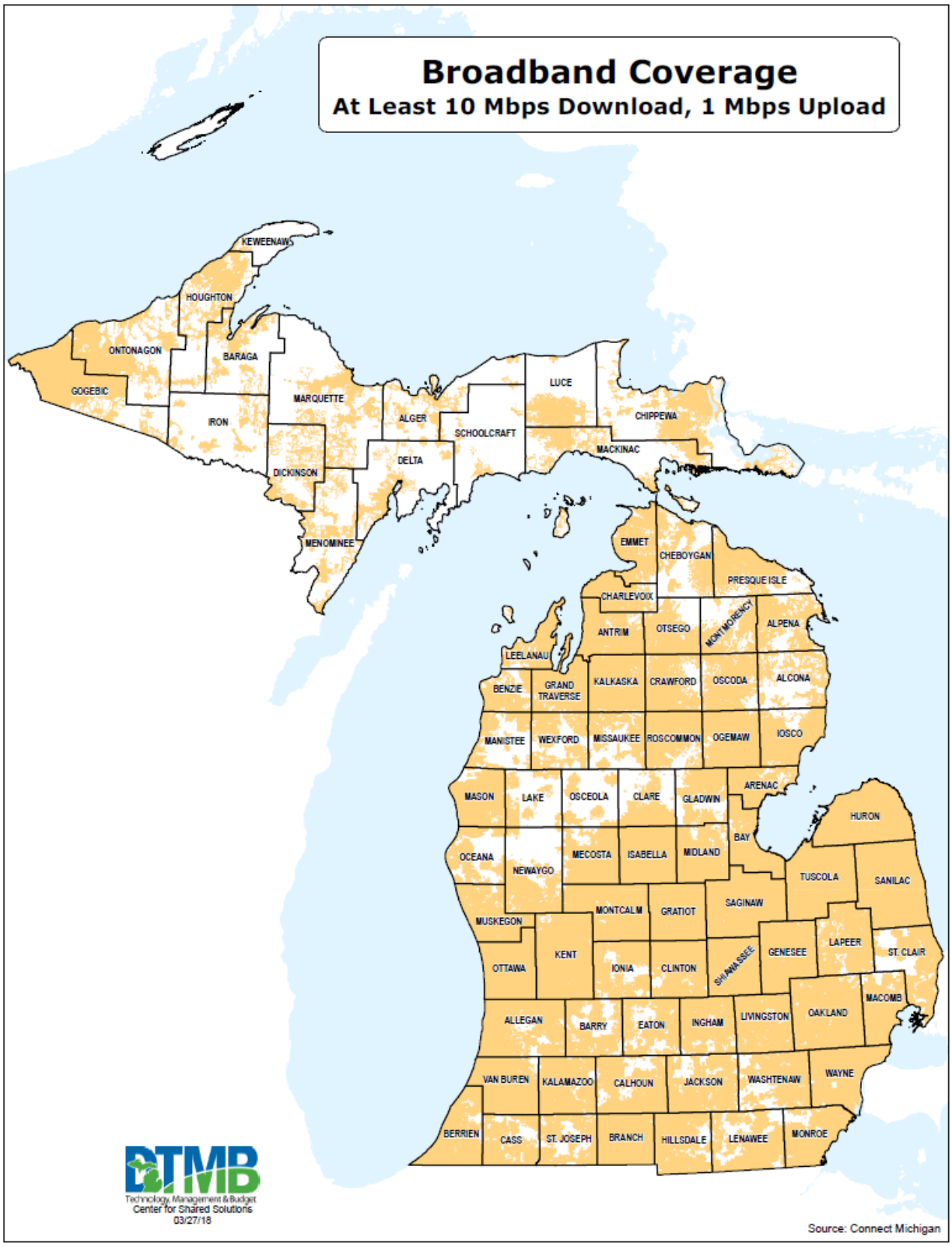
2018 Bridge Projects
Wastewater Projects
Wastewater Lines
Stormwater Lines
Drinking Water Lines
Road Surface Condition
Poor
Good
Fair
N

Note: The sample size of the data collected as part of the Pilot was not considered sufficient to depict an actual representation of condition grades across the Pilot areas and beyond. The results shown are therefore illustrative only and show the type of analysis that can be carried out.

Appendix G – Broadband Coverage




Broadband Coverage
At Least 10 Mbps Download, 1 Mbps Upload
Fixed Non-Mobile, Non-Satellite
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
IRON
ALGER
SCHOOLCRAFT
LUCE
CHIPPEWA
MACKINAC
DELTA
DICKINSON
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ARENAC
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
MONTCALM
GRATIOT
SAGINAW
MUSKEGON
KENT
IONIA
CLINTON
SHIAWASSEE
GENESEE
LAPEER
ST. CLAIR
OTTAWA
MACOMB
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
OAKLAND
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
DTMB
Technology, Management & Budget
Center for Shared Solutions
03/27/18
Source: Connect Michigan


Broadband Coverage
At Least 10 Mbps Download, 1 Mbps Upload
KEWEENAW
HOUGHTON
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IRON
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OGEMAW
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ARENAC
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
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Center for Shared Solutions
03/27/18
Source: Connect Michigan

Appendix H – IT Demonstration

Roadsoft - Tier 1a (Drinking Water, Wastewater, Stormwater) and Tier 3 (Roads, Bridges and associated assets)

Roadsoft is an asset management software package developed and supported by Michigan Technological University (MTU) through an ongoing project with MDOT. Roadsoft began in 1991 and in the 25 years since the first version of Roadsoft was released, it has grown from a basic road inventory system for managing pavement quality to a GIS-enabled decision support system that includes modules for the field collection, management, and analysis of the following infrastructure/data:

- Pavement condition
- Bridges
- Crash data
- Culverts
- Driveways
- Guardrails
- Intersections
- Pavement markings
- Sidewalks
- Signs
- Traffic counts
- Traffic signals
- Stormwater (2018 release)
- *Sanitary sewer (pre-release)*
- *Drinking water (pre-release)*
- *Private utilities (pre-release)*

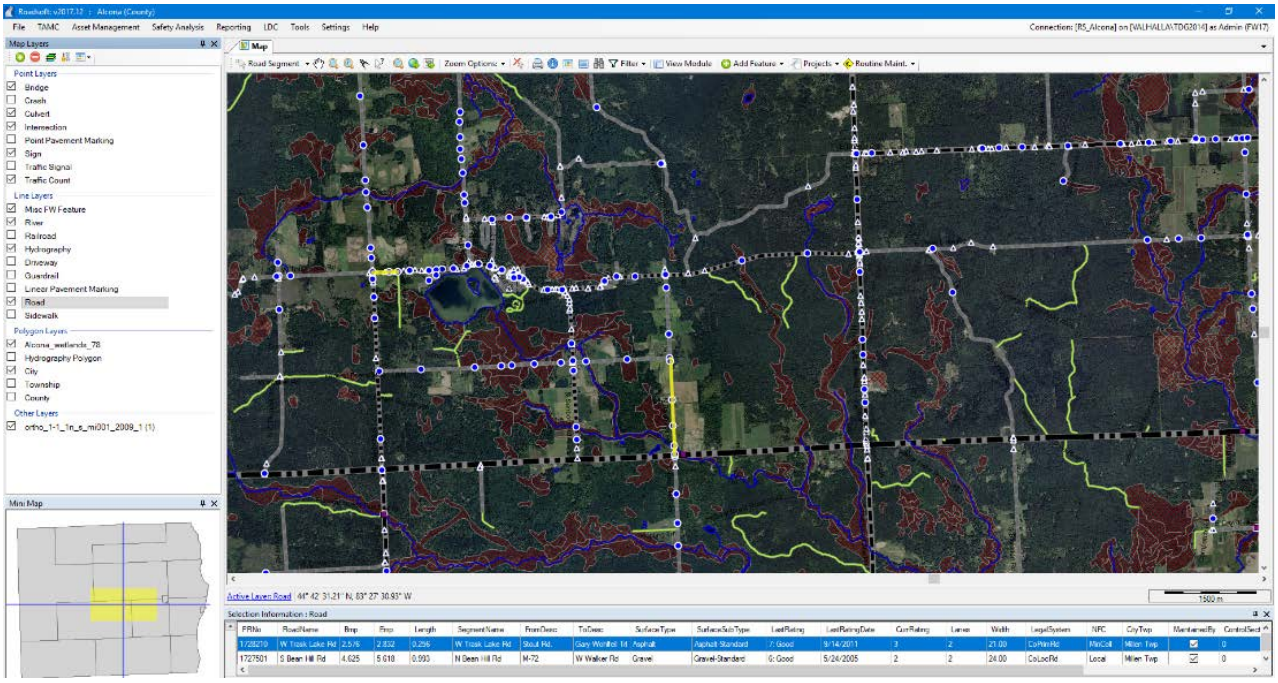


Figure 1: Main Roadsoft interface showing GIS functionality for multiple asset layers

Roadsoft currently provides Tier 1 Data Management functionality for all the roadway features listed above and Tier 1a Work Management functionality for roads, culverts, signs, and guardrails. It integrates into the Tier 2 Statewide Data Repository by allowing the use of the same data at a local, regional, and state level for data collected by the TAMC.

Particular focus has been made to make Tier 3 Data Analytics and Reporting functionality for transportation assets available for use at the local level. This functionality includes tools such as: a deterioration model that estimates the remaining pavement life based on condition data, a network-level model that determines the resulting future pavement condition based on future funding levels, and tools that look at changes to maintenance programs in order to determine the statistical outcome of maintenance interventions.

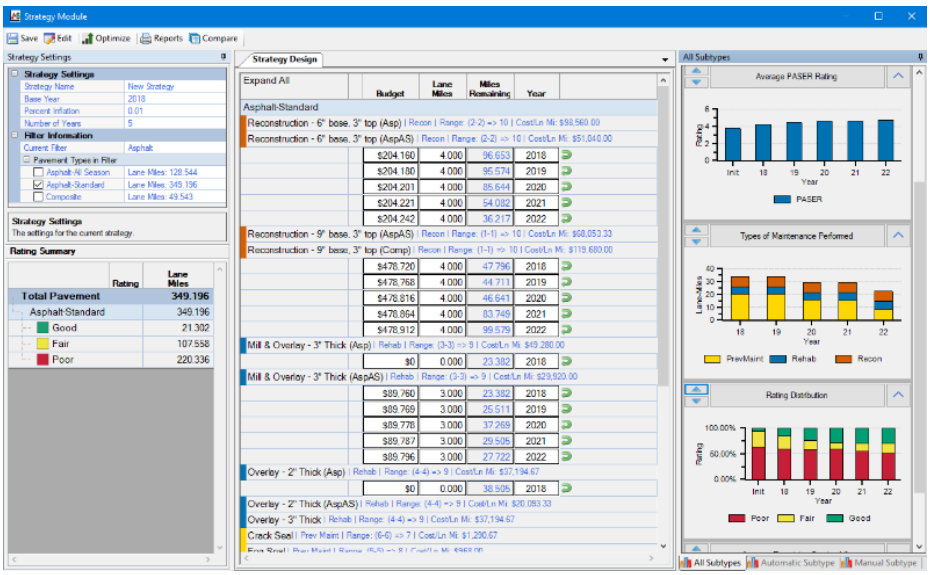


Figure 2: Network model illustrating future asset condition based on a planned level of investment

In 2018, basic Tier 1 storm sewer functionality will be complete with further development in future years to be determined by user need. The storm sewer functionality is currently in pre-release (beta test) status. The intent is to continue to build Tier 2 and Tier 3 functionality into the storm sewer module as users' needs develop.

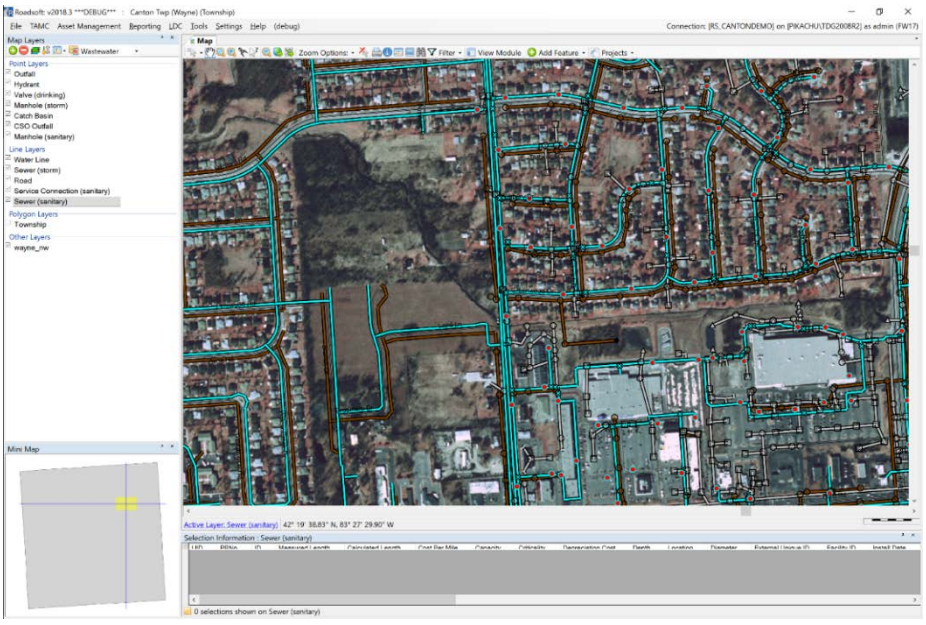


Figure 3: Utility Suite with pilot data showing stormwater, drinking water, sanitary sewer, and road data

Work on the storm sewer module was leveraged to create a framework of basic functionality for managing drinking water, sanitary sewer, and private utilities. This functionality is being developed into the Roadsoft Utility Suite, which will allow users to manage their transportation infrastructure concurrently with

public and private underground utilities in the same software.

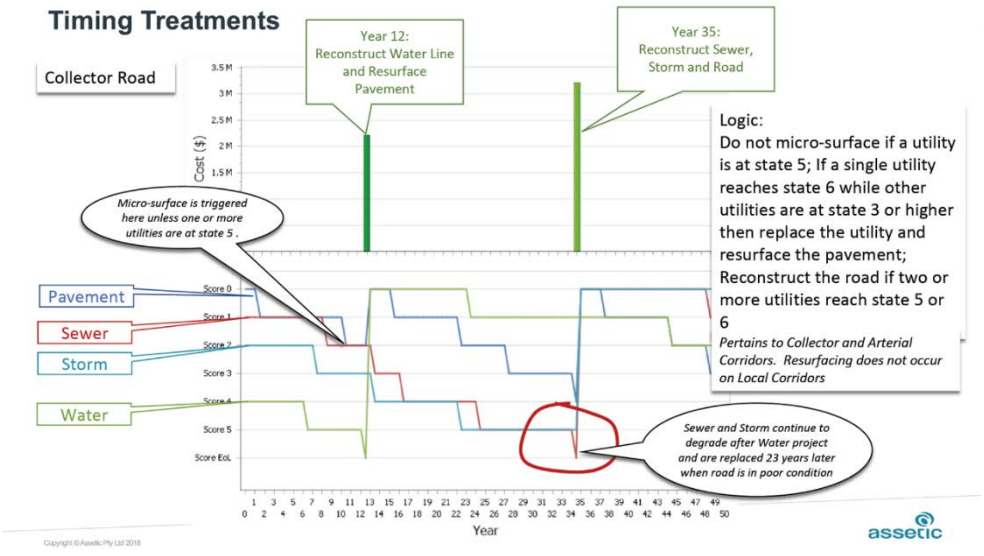
The storm sewer functionality of the Utility Suite is currently funded and planned for completion using transportation funding. However, the other portions of the Utility Suite—the drinking water, sanitary sewer, and private utility portions—do not yet have an identified funding source.

Assetic - Tier 3 (Predictive Analytics)

Assetic has a suite of asset management IT solutions that include Tier 1, 1a and 3 functionality. They are a global company with numerous projects within North America including several in Michigan. Their IT solution can be used for a broad range of asset types including both above and below ground assets and has the ability to optimize investment within an asset class e.g. optimal lifecycle solution for a roads program, or can optimize across assets types; e.g. optimal program for all assets in the right-of-way, including drinking water, wastewater, storm and roads/bridges, with the results being available in GIS.

Assetic is a Software-as-a-Service (SaaS) offering which delivers asset data management, enables collaboration and benchmarking, and is accessible anywhere, anytime. Assetic utilizes AWS, the world's leading cloud infrastructure service provider, ensuring the highest standards in data security and disaster recovery.

Assetic is able to connect with other common business systems including GIS, finance, document management, customer relationship management, SCADA and other third-party systems with open data sources.



Timing Treatments across asset types

A number of software modules that were relevant to the Pilot include:

Assetic Assets

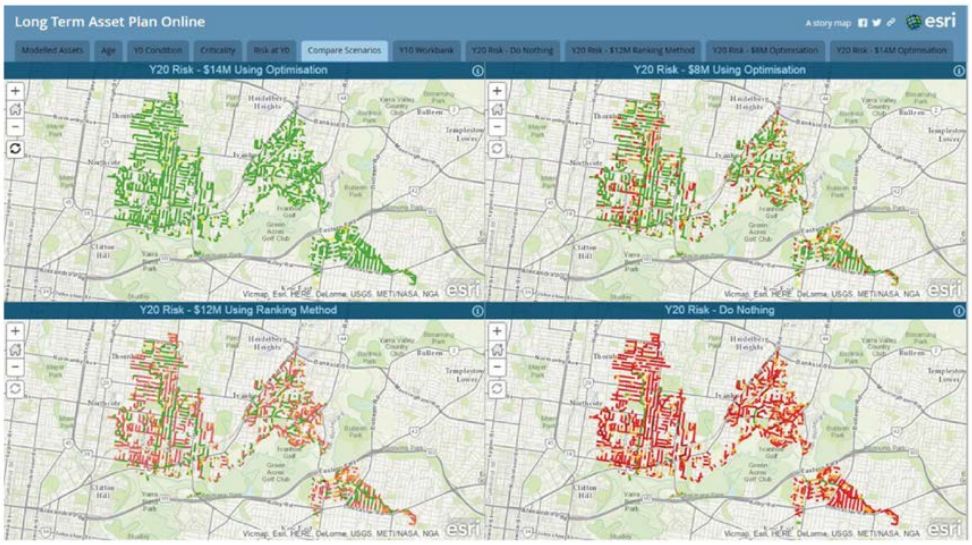
The Assetic Assets module is an intelligent asset register pre-configured for over 100 asset classes. Built in-line with international standards and best-practices, it is the central hub of asset data including attributes, service level information, valuations, risk management and reporting.

Assetic Assessments

Access to accurate asset data is the first step in successful strategic asset management practice, and capturing this information in an objective, repeatable manner is essential. Assetic Assessments ensures all asset data is captured efficiently and stored in a central location, enabling informed decision making and optimized capital expenditure.

Assetic Predictor

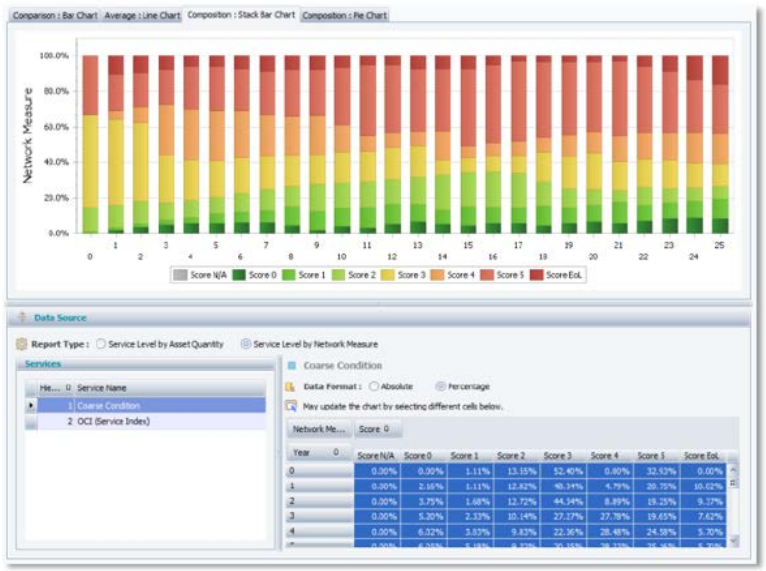
Assetic Predictor is a predictive modeling and decision support tool for long-term planning of infrastructure assets. It enables organizations to optimize service level outcomes and capital and maintenance expenditure. Industry-specific algorithms accurately predict the future behavior of assets given available funding levels and enable scenario comparisons to aid decision-making.



Predictor Model Outputs: Spatial/GIS

Assetic Mobility

Assetic Mobility increases efficiency and visibility across all aspects of asset management by connecting the field to the office, delivering faster decision making, improved processes, and lower costs. The iOS and Android apps streamline key Assetic Maintenance and Assessments processes, while ensuring field staff capture data and execute.



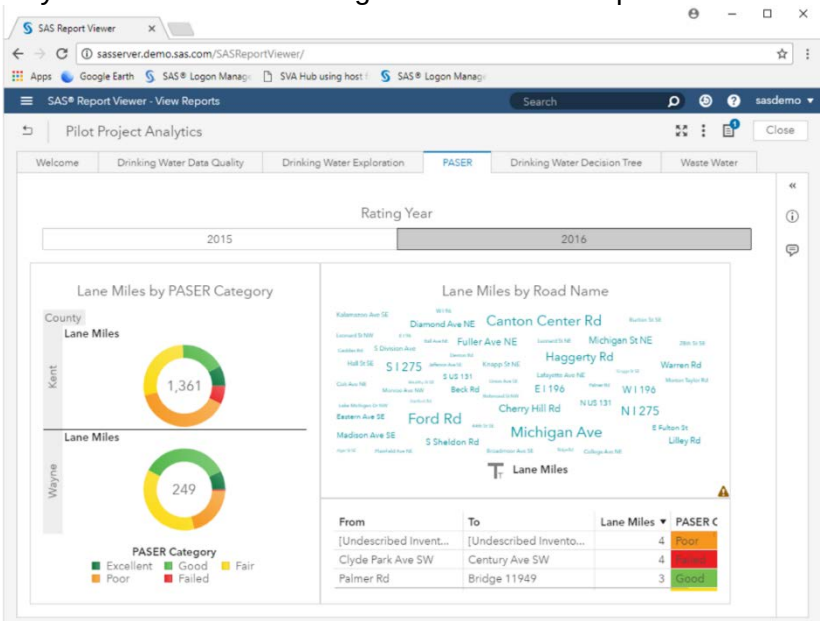
Predictor Model Outputs: Asset Service Levels

Tier 3 (Analytics)

SAS once stood for "statistical analysis system." It began at North Carolina State University as a project to analyze agricultural research. Demand for such software capabilities began to grow, and SAS was founded in 1976 to help customers in all sorts of industries – from pharmaceutical companies and banks to academic and governmental entities. SAS – both the software and the company – thrived throughout the next few decades. Development of the software attained new heights in the industry because it could run across all platforms, using the multivendor architecture for which it is known today. While the scope of the company has spread across the globe, the encouraging and innovative corporate culture has remained the same.

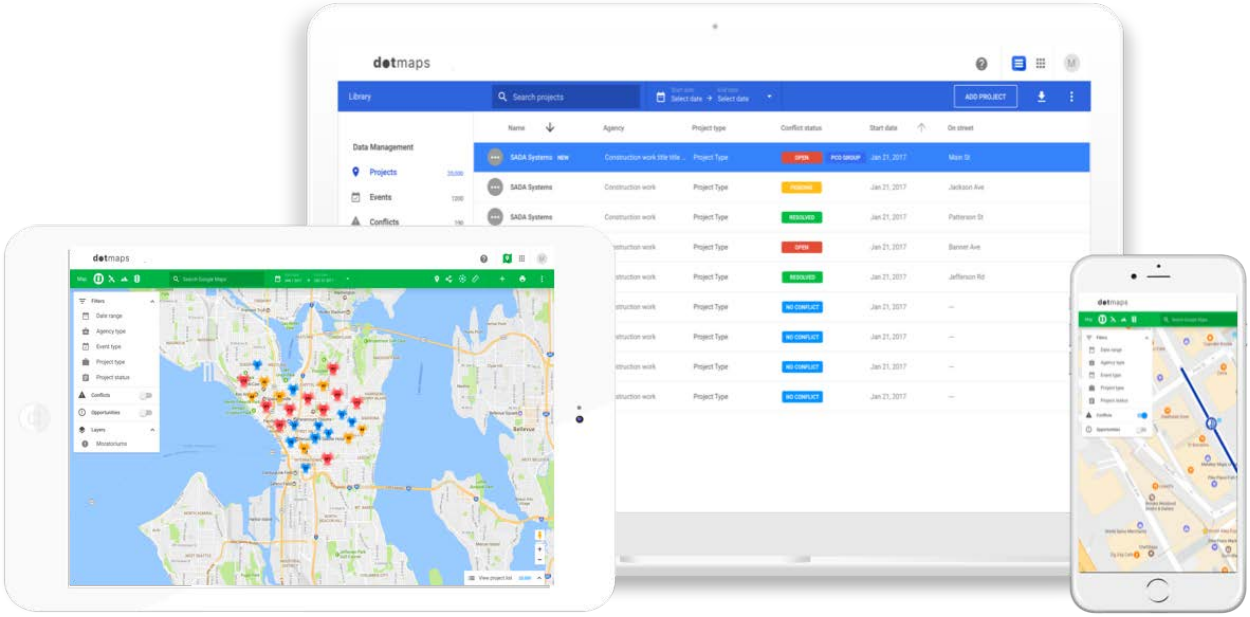
SAS is proud to partner with 96 of the top 100 companies on the 2017 Fortune Global 500® and 100 percent of U.S. Government Cabinet Departments and Agencies as valued customers. SAS currently supports over 600 government Departments, Ministries, Offices, and Agencies around the world. SAS has over 14,000 employees and in 2017 was ranked #37 on Fortune's list of the 100 best companies to work for. With two physical offices in Michigan and more than 20 Michigan-based employees, SAS works with dozens of private and public sector customers in the state to use advanced analytics software to help organizations obtain value through insights in their data.

SAS has a broad range of data analytics and business intelligence services and products and for the pilot they were asked to demonstrate how they could use advanced data analytics to provide greater insight into the asset data collected as part of the pilot.

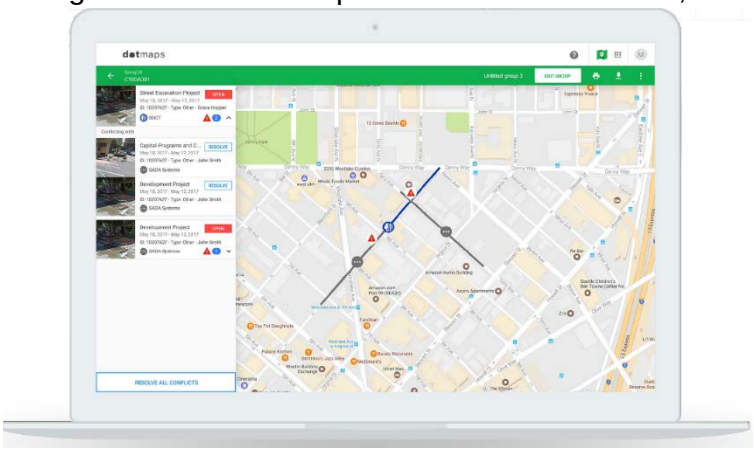


Tier 3 (Project Coordination)

SADA Systems, Inc. was originally founded in 2000 as a software development firm. They were one of the first original partners with Google and are now the largest Google Maps partner in the world.



dotMaps is a software as a service (SaaS) web application that enables agencies to plan, coordinate, schedule, and resolve projects in accordance to location, time, attributes and more. dotMaps is a project management solution for the public right-of-way, utilizing Google Maps, ESRI Arc Components and Google Cloud Platform. This web and mobile based application is currently implemented in several state, cities and counties. For example the City of Chicago implementation of dotMaps, has over 1,500 active users on the system across multiple departments, over twenty-five external agencies and hundreds of private contractors. The system is currently integrated with four department GIS databases, and serves as a comprehensive repository for all scheduled projects in the city.



The product focuses on creating projects and tracking, searching, reporting in accordance to phase, creator, agency, and more. Key Features include:

User Interface. The dotMaps visualization interface is organized into mapping, tabular and calendar components. The mapping interface is based on the experience found on maps.google.com. Users can display and filter projects on the map according to agency type, project type, timeframe, associated permits, and more.

Opportunities and Conflicts. One of the core functions of the dotMaps application is the identification of opportunities and conflicts in the right-of-way, as the result of projects, events etc; and ultimately facilitating the resolution/realization of these events. dotMaps allows for all of these conflicts and opportunities to be addressed within the application itself, facilitating communication between the relevant agencies for the purpose of coordination. These reports also include critical information, the status of the conflict, any associated documents, and a transcript of communication on the conflict/opportunity.

Calendar. The dotMaps application allows for event planning and scheduling via the calendar interface. Calendar conflicts will display along with associated iconography, event, agency, and more. Each event has a color-coded representation of the event with the city being able to add/remove/update events.