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City of Oxnard

Public Works Integrated Master Plan

OVERALL

**PROJECT MEMORANDUM 1.2.2
COMPUTERIZED MAINTENANCE MANAGEMENT
SYSTEM ASSESSMENT**

REVISED FINAL DRAFT

September 2017



PREFACE

The analysis and evaluations contained in these Project Memorandum (PM) are based on data and information available at the time of the original date of publication, December 2015. After development of the December 2015 Final Draft PMs, the City continued to move forward on two concurrent aspects: 1) advancing the facilities planning for the water, wastewater, recycled water, and stormwater facilities; and 2) developing Updated Cost of Service (COS) Studies (Carollo, 2017) for the wastewater/collection system and the water/distribution system. The updated 2017 COS studies contain the most recent near-term Capital Improvement Projects (CIP). **The complete updated CIP based on the near-term and long-term projects is contained in the Brief History and Overview of the City of Oxnard Public Works Department's Integrated Planning Efforts: May 2014 – August 2017 section.**

At the time of this Revised PWIMP, minor edits were also incorporated into the PMs. Minor edits included items such as table title changes and updating reports that were completed after the December 2015 original publication date.

City of Oxnard

Public Works Integrated Master Plan

OVERALL

PROJECT MEMORANDUM 1.2.2
COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM ASSESSMENT

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COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM ASSESSMENT

1.0 INTRODUCTION

This memorandum summarizes the efforts and findings of the assessment for the City of Oxnard Public Works (“Public Works”, “Department”) computerized maintenance management system (CMMS) needs. This assessment focuses on evaluating and selecting CMMS software to assist with managing enterprise assets, work orders, and other workflows (or “business processes”) for the Department’s Services including Water, Wastewater, Recycled Water, Stormwater, and Streets. This project evaluates what is already working well, where gaps exist for improvement opportunities to best achieve and leverage the benefits of the CMMS, and considers how to leverage previous internal assessment efforts with respect to the City’s CMMS needs and efforts. The purpose of this memorandum is to provide a summary of the information provided by Public Works in relation to their CMMS needs, and develop a shortlist of CMMS software vendors that meet these needs. This memo will recommend up to six software vendors that should be considered by the Department to initiate a request for proposals (RFP) process. The RFP and interview/demonstration process will follow this effort, and ultimately Public Works will need to select one vendor and initiate procurement, implementation, and integration services.

This CMMS assessment considers the Department’s water treatment, water distribution, wastewater collection, wastewater treatment, recycled water, and stormwater assets and associated organizational capabilities and needs. The assessment, its related conversations, and this memorandum consider Public Works’ Enterprise Asset Management (EAM) needs, existing capabilities and tools, and possible improvements. Approaches and recommendations for how asset data should be collected and managed were discussed in this assessment phase with regard to general needs and best practice approaches such as hierarchy, taxonomy, level of detail and others relative for Public Works to use in the Software Selection Phase.

The near-term focus for CMMS at Public Works is on capturing an external assessment of its CMMS needs, selecting a CMMS suitable to its daily needs, and implementing a CMMS to support maintenance and capital planning specifically for the Public Works Department. Additional City Services may be added to the CMMS scope in the future. The long-term objectives of assessing, planning, and implementing EAM and a CMMS for Public Works include:

- Capture asset data attributes to improve its asset hierarchy and inventory to have necessary data reconciled and available to leverage in asset rehabilitation and replacement (“renewal”, “R&R”) management and planning.
- Improve capabilities for managing and planning rehabilitation and replacement of its infrastructure.
- Provide sound justification for rehabilitation and replacement needs and fee adjustment needs.
- Integrate and leverage existing systems and information for asset knowledge capture and retention.
- Pursue its vision of a more strategic, proactive enterprise-wide asset management program and approach in an effort to reduce costs, improve service, and manage risk.

1.1 Project Memorandums (PMs) Used for Reference

The recommendations outlined in this PM are made in concert with recommendations and analyses from other related PMs:

- PM 2.1 - Water System - Background Summary.
- PM 2.4 - Water System - Condition Assessment.
- PM 2.5 - Water System - Supply and Treatment Alternatives.
- PM 2.6 - Water System - Arc Flash Assessment of Blending Stations.
- PM 2.7 - Water System - Cathodic Protection Assessment.
- PM 2.8 - Water System - SCADA Assessment.
- PM 3.1 - Wastewater System - Background Summary.
- PM 3.5 - Wastewater System - Condition Assessment.
- PM 3.6 - Wastewater System - Seismic Assessment.
- PM 3.7 - Wastewater System - Treatment Alternatives.
- PM 3.8 - Wastewater System - Arc Flash Assessment.
- PM 3.9 - Wastewater System - Cathodic Protection Assessment.
- PM 3.10 - Wastewater System - SCADA Assessment.

2.0 THE CONTEXT OF CMMS IN ENTERPRISE ASSET MANAGEMENT

Asset management is a set of principles that are used to guide the best management practices for an agency's assets. The core philosophy of asset management is to manage the maintenance, repair, and replacement of assets in a cost-effective manner, at the lowest risk, while meeting the agency's level of service goals and objectives.

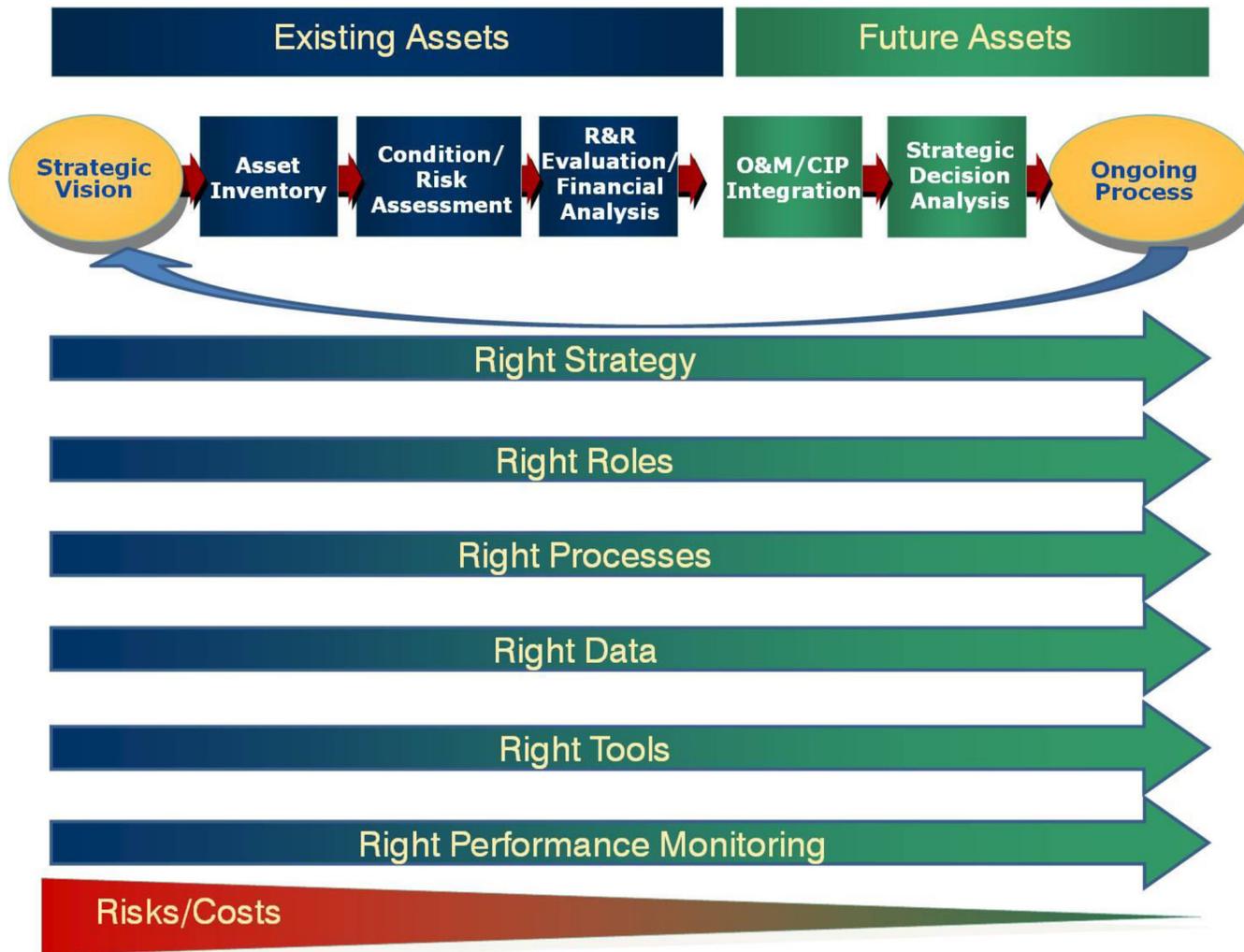
Figure 1 illustrates the steps involved in the development of a mature asset management program.

As shown in the red bar at the bottom of the asset management graphic, through the development of an advanced asset management program, an agency with a mature asset management program and strong tools such as a CMMS, is able to minimize the failure risk of its assets, while maintaining an established level of service and lowering the overall lifecycle costs in managing its assets, and manage workforce transitions and an expanding asset basis.

The selection and implementation of a CMMS is a key foundational component in developing an asset management program, and would support many of the steps shown in Figure 1. Through discussions early in this assessment regarding the assessment's intent, it was concluded that Public Works needs and goals in the near future drive the need first for a CMMS, before a possible larger scale and more robust enterprise-wide information system integration.

A CMMS, which is the focus of this assessment and project memorandum, is an important component of EAM and a larger asset management program. Its intent is to support management, staff, and their conversations, rather than replace them or manage them. Once implemented, it aims to provide consistent and available data and workflow enablement to both staff and leadership to better optimize both efficiency and quality in the management and renewal of an agency's assets. A CMMS needs to be suited well for both the physical assets and business operations of an organization.

The sole focus of this project and assessment is for a CMMS for Public Works wet utilities - water treatment, water distribution, wastewater collection, wastewater treatment, recycled water, and stormwater. The integration of such a CMMS with other software can help to achieve an overall integrated EAM software system for additional strategic benefits. Such an integrated EAM software system typically consists of an integrated platform of CMMS, geographic information systems (GIS), and financial information systems (FIS). Like most agencies, physical assets are at the center of business operations for this organization.



ASSET MANAGEMENT PROCESS

FIGURE 1

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Therefore, the CMMS comprises a large portion of the EAM functionality. In later stages of asset management and software implementation, an EAM solution may be realized through full integration of the organization's information systems. This CMMS assessment considers evaluating needs to allow the Public Works future CMMS system to stand on its own for its wet utilities, or be integrated with other information systems.

CMMS is a helpful tool for operational and maintenance needs as well as for asset management. However, as this organization has recognized, this CMMS tool will require it to have organizational capabilities to implement and benefit from the tool for operations and maintenance (O&M) needs and asset management.

A variety of capabilities and considerations are needed for successful CMMS implementation to make it functional, useful, and conducive to making organizations more efficient in the maintenance and long-term management of its assets. Such considerations include strategy, roles, processes, data, tools, and monitoring of performance results. Thus, a few of the initial workflows most closely tied to interacting with the CMMS were developed, refined, and mapped and are discussed later in this document. Additional detail of these processes may be further refined and document in later phases of the CMMS effort as necessary.

This memorandum is focused on CMMS assessment. The next steps beyond this assessment phase are CMMS software selection and implementation, which are important steps that will lay the foundation for successfully implementing, integrating, and leveraging a CMMS in a more strategic asset management approach to make daily efforts for efficient, minimize costs, manage risk, and attain levels of service committed to customers.

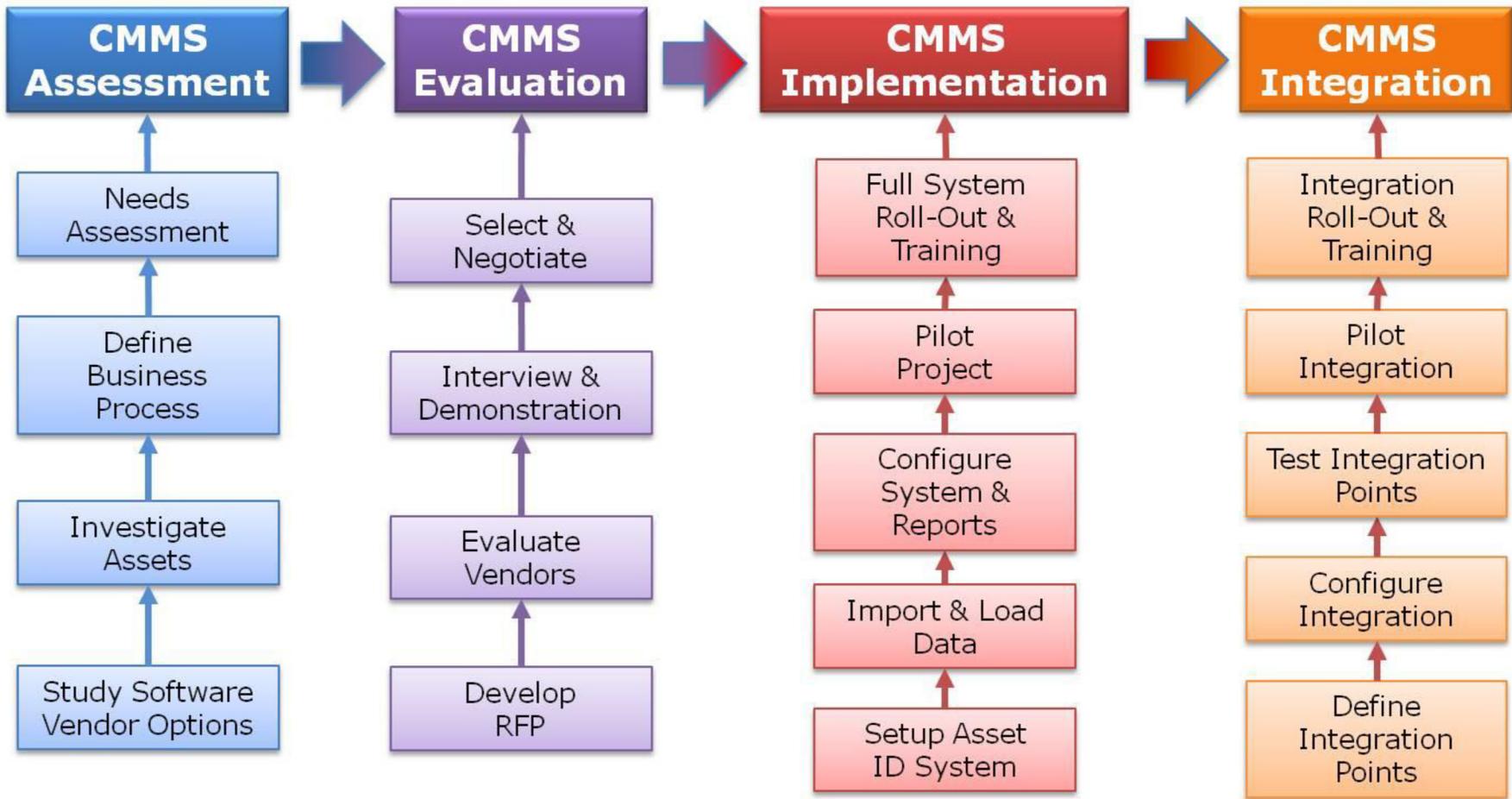
3.0 PROJECT APPROACH

Figure 2 illustrates the CMMS assessment, evaluation, implementation, and integration process. The assessment in this project memorandum focuses on the steps in the first set of (blue) blocks.

This first phase was conducted in spring 2015 and included an assessment and consideration of current assets and processes, recommendations for work order processes, and a recommended list of qualified CMMS software vendors, along with budget estimates.

The assessment phase included several steps as they relate to CMMS to help identify the needs, capabilities, and existing gaps related to implementing a CMMS system:

- *Survey of Needs and Capabilities* – A survey was developed, discussed, and populated with responses by Public Works staff to key questions and aspects of CMMS as they pertain to the Department. This is included in Appendix A.



CMMS ASSESSMENT, EVALUATION, IMPLEMENTATION, AND INTEGRATION

FIGURE 2

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- *Infrastructure Assets* – Carollo worked with the Department to assess how infrastructure asset types, scale, processes, and practices relate to CMMS selection.
- *Collection and Evaluation of Information* – Public Works provided a variety of information for Carollo’s review related to the processes, data, and existing tools that the agency uses for managing assets, capital planning, and maintenance.
- *Business Process Workshops and Development* – Select key CMMS business processes were discussed, documented, examined, and refined to better communicate and enable Public Works to understand how a CMMS could best be incorporated into its business processes. These are included in Appendix B.
- *CMMS Assessment Project Memorandum and Shortlist of Software Options* – This document includes a summary of the Phase 1 assessment efforts and rationale for a recommended shortlist of software options.
- *Budget-Level Estimates* – Based on the survey, Carollo Engineers (Carollo) knowledge, and vendor capabilities, initial budget-level estimates of candidate CMMS software costs were developed. These may be used as guidance in developing a range of costs to consider including in Public Works’ future budget cycles.

Results of this effort are discussed later in this document.

4.0 CURRENT PRACTICES ASSESSMENT

4.1 Survey

Carollo prepared a CMMS survey and distributed it to Public Works staff to initiate the needs assessment and to aid in the preliminary budget-level cost estimates. This survey is provided in Appendix A.

The survey was comprised of around 25 multi-part questions and related to functionality and user requirements, technical requirements, assets, integration, and implementation and support. The survey was tailored specifically to Public Works’ scale, operations, facilities, asset types, and situation to develop targeted discussion and direction around key decision points that would chart the path to developing a shortlist of CMMS software candidates to meet Public Works’ goals and needs related to CMMS.

The survey revealed the following CMMS requirements of Public Works:

- **Functionality:** Public Works needs its CMMS to be capable of tracking internal and external service and work requests, corrective work orders and work management, preventive maintenance, staff resource planning and utilization, asset management data, capital projects, contracts, lock-out/tag-out, inventory, and timekeeping only for completing WOs - not for integration with Public Works’ Enterprise Resource

Planning (ERP) system. The tracking of work requests of external contractors is also needed. The treatment plants may need the CMMS to track their fleet vehicles and equipment.

- **Users:** The number of likely users by CMMS activity, mobility needs, and technical capability and access were identified. Anticipated additional users in the short and mid-term future were also identified, where applicable.
- **Technical:** Software hosting options were discussed including internal/self-hosting and external/cloud-based hosting. In general, Public Works prefers to host its CMMS internally, as it does its other software systems. However, it is open to exploring cloud options, in which case, bandwidth and cost should be considered. Existing operating systems, databases, hardware, and software were also identified. Both hardware and software will need to be tracked in the CMMS.
- **Asset Data:** The types, sizes, and quantities of assets to be captured in the CMMS were identified. An asset hierarchy, registry, and taxonomy will need to be refined in future phases of the CMMS effort. It is envisioned that the GIS be centric for the asset registry and remain the master record of assets. In this arrangement, the GIS would continue as the main asset data repository, and the CMMS would be the tool to share this GIS data and additional data about assets with other systems because of the CMMS's greater integration capabilities. All assets would have unique asset identifiers (IDs) that are linked with asset records in the GIS database. Standardized asset types or classes should be developed for groups of assets that have similar data fields – for example, typical asset types may include buildings, piping, pumping equipment, appurtenances, biological and chemical treatment equipment, basins, electrical equipment, instrumentation, HVAC equipment, and many others typical of such facilities. Public Works has adopted a standard ESRI ArcGIS information model for its GIS database. Its model is the Local Government Data Model for water, sewer, and storm water. This model will provide a consistent structure with an asset-based structure that can easily be integrated with the CMMS asset data.
- **Integration:** Software and systems needing some level of integration with the CMMS were identified. The preferred method of software systems integration would either be database or web services, of which cost is a key consideration. The CMMS will need to integrate with Public Works':
 - GIS (ESRI ArcGIS 10.3, Local Government Data Model for water, sewer, and stormwater).
 - Procurement.
 - Inventory.
 - CCTV Inspection Software (WinCan 8, inspection videos and data).

- Supervisory Control and Data Acquisition (SCADA, run-times, condition, performance).
 - Project management software (projects, budgets, CIP plans).
 - Document management system (electronic documents, records).
 - GPS locators (location identification, vehicle tracking).
 - Inspection photos/video (non-CCTV).
- At later integration phases, integration of the CMMS with other Public Works information systems could be considered. These systems include:
 - Financial/ERP accounting system (SunGard Public Sector H.T.E. purchasing, inventory, fixed assets, GL codes, budget/cost, employees, projects).
 - Fleet management software (fleet maintenance).
 - Fuel management software (fleet fuel usage).
 - StreetSaver pavement management CMMS.
 - Enterprise reporting/business intelligence (BI) tools (reporting, analysis, dashboards).
 - **Implementation and Support:** Public Works is expecting to have an outside vendor convert and upload necessary data to the CMMS from existing data sources to provide an asset registry base to start use of the CMMS. Public Works will then perform the CMMS database population and building from present day forward. Some historical data may be brought into the CMMS, depending on the level of effort required and staff availability. Having the software implementation provider conduct a majority of software configuration offsite would be acceptable to Public Works if adequate documentation is provided to communicate any possible configuration questions that may be required for an upgrade. The number of types of users to be trained based on the technical capabilities of the CMMS were identified and were based on the number of people in each department. The Public Works Information Technology (IT) Department envisions that an outside contractor would perform customization, configuration, and application support beyond the standard CMMS software base installation and would expect to need outside technical support for upgrades. Public Works would also prefer that an outside contractor procure the server and hardware required for the CMMS based on vendor recommendations.

4.2 Business Processes

The purpose of mapping business processes is to understand how workflows are performed, how they may be optimized, and to communicate these aspects to the participating roles. Workflows are also fundamental to the implementation and configuration of CMMS software, and may help in determining the best-fit CMMS for an agency's needs.

Three business processes that are central to asset and maintenance management and thus CMMS were examined for each Public Works' vertical assets and linear assets. The processes were mapped with consideration of how they presently are and how they could be improved or refined for the CMMS effort. These included the following processes:

- Work Orders (WO).
- Asset Change Administration (ACA).

These processes are further detailed below. The maps of these business processes are included in Appendix B. The maps proceed generally from left to right and from top to bottom. These particular maps were developed with Public Works staff at the level of understanding that would need applied when implementing a CMMS for Public Works. Examining these maps from other perspectives and uses than CMMS may require them to be revised with different details for such other applications. Also, once the selection of a particular CMMS occurs, these processes may need revision to accommodate the chosen software. Finally, additional detail may be built out in these maps in future CMMS phases.

4.2.1 Work Order Process

The Work Order (WO) process is the business process required of an organization to identify, request, prioritize, assign, instruct, document, and communicate preventive and corrective maintenance for assets, or to change existing assets, or install new assets. The WO process does not include capital projects.

The WO process is desired by Public Works to be the priority area of focus of the CMMS initially, and to serve as the pilot process in which to incorporate the CMMS initially. The intent of focusing on one process for the CMMS initially is to keep the implementation of the CMMS simple to avoid failures or deter staff from using it. This approach will also help train staff, refine the CMMS usability, prove progress early to management, and accomplish staff buy-in and participation with utilizing the CMMS for one of Public Works most important CMMS workflows. The existing WO processes were examined and mapped with the help of Public Works staff.

Overall, the aim is to accomplish process improvements, standardize the WO process in an appropriate manner that does not disable the ability to achieve existing successes and service levels and utilize the CMMS in a manner supplemental to existing roles rather than implementing new roles. Once implemented and integrated, and with sufficient staff training and data population and build-out, the intent is for the CMMS to be a useful tool to expedite the administration of the WO process and allow staff to focus more time on its specialized work rather than the CMMS to just be another task to complete and adding to administration.

The development of the future WO process map took into account personnel and facilities having unique approaches and needs required, but also recognized some similarities to typical industry approaches that could be incorporated as well. This will help the organization to have the capabilities to utilize and benefit from implementing a CMMS.

Below are some of the highlights in the WO business process maps:

- The current WO process involves a significant amount of paperwork and manual effort. The future process aims to alleviate some of this burden and quality risk by making some of it electronic, automating some of it, and thus achieving the goal of having a central and accessible repository of necessary asset operation and maintenance information, which would be the CMMS.
- The future process's map has aimed to standardize terminology. The business process maps recognize that a work request is initiated in the various Services. Similar attempts were made to standardize other terminology among the Department's Services where practical.
- Classification identification and procedures, including lock-out/tag-out and others, are very important for personnel safety in many facilities in all Services. These have been incorporated into the future combined process.
- Data and documentation are important elements for operation and maintenance, capital planning, and in utilizing a CMMS. Thus, documentation and how it connects to the CMMS is included in the future WO process.
- Both the existing and future processes recognize that interaction is needed between the facilities managers and superintendents to coordinate, prioritize, assign, and review WOs and their staff resources.
- The future process acknowledges that the process may need to be repeated if follow-up work is required. The existing WO needs to be closed out when its work is completed, whether or not follow-up work is needed.
- The future process shows the connection from the WO process to the ACA process if a change to an asset is required. The ACA process is further discussed in the ACA section of this memorandum.
- Preventive maintenance, will have its WOs generated by the "Planner" role of Public Works Services. This planner role is typically envisioned to be that of the facility managers and superintendents at the facilities for the services and the City's engineers, depending on the type of work needed, type of facility, and how Public Works practically recognizes the responsibilities of these.

4.2.2 Asset Change Administration Process

The field and office administration processes necessary to perform when an asset undergoes a change were developed and mapped as a formalized process. Data needs to be captured and documentation of changes needs to occur when an asset changes. These need to be populated in the CMMS attributes for assets. These also need to be utilized in operations, maintenance, asset management, capital planning, and other initiatives. An asset change management form may be developed during later phases to attach to WOs to record asset change data and information. Also, an asset tag often needs to be updated when an asset is changed.

An asset is considered to undergo a change when it undergoes a replacement, relocation, rehabilitation, modification, removal, or installation. The intent of this process is to align asset records in the CMMS, on its tag, with the present actuality of the asset's characteristics, history, and current state in a manner consistent with CMMS and tagging requirements.

Some key elements of this process to recognize include:

- The ACA process could utilize a new Public Works role of CMMS Manager to execute portions of the process.
- For capital project asset changes, data will be provided by the Engineering Division. For operations and maintenance asset changes, data will be provided by the field crews that change assets.
- The CMMS Manager will be responsible for making sure the necessary asset attributes are provided in an appropriate format by these roles to enable the CMMS to be the central data repository for asset information.
- The process also includes the asset tagging process that is triggered by asset changes.
- Work flow elements were developed for improving and standardizing the process by which outside contractors submit asset information for assets and facilities on which they have performed work. A specific form will need to be developed to capture required information and data in the format and completeness required by Public Works. This form could be developed during the implementation phase.

5.0 EXISTING INFORMATION SYSTEMS

This section describes the existing information systems in use by Public Works staff for activities related to maintenance and asset management. Many software elements interact across a utilities information system boundary. This memorandum is focused on the CMMS, but since this software could touch many different information systems across the

organization, understanding what these systems are and how the CMMS could interface with these other software packages is important.

Figure 3 illustrates the complex interaction between typical information systems within an organization. Other parts of an organization, such as CIP processes, are not included in this figure, simply for clarity. The acronyms used in this figure are further explained below. As seen in this figure, it is easy for the CMMS to touch the majority of information systems used in an organization.

EAM and ERP are typical terms used in asset management. EAM typically consists of the integration of CMMS, GIS, and FIS systems, while ERP typically consists of the integration of CMMS, CIS, and FIS systems. EAM, specifically the CMMS component, is the focus of this document. It is recognized that Public Works desires to hone the CMMS system and its implementation before integrating with other information systems.

5.1 Computerized Maintenance Management Systems

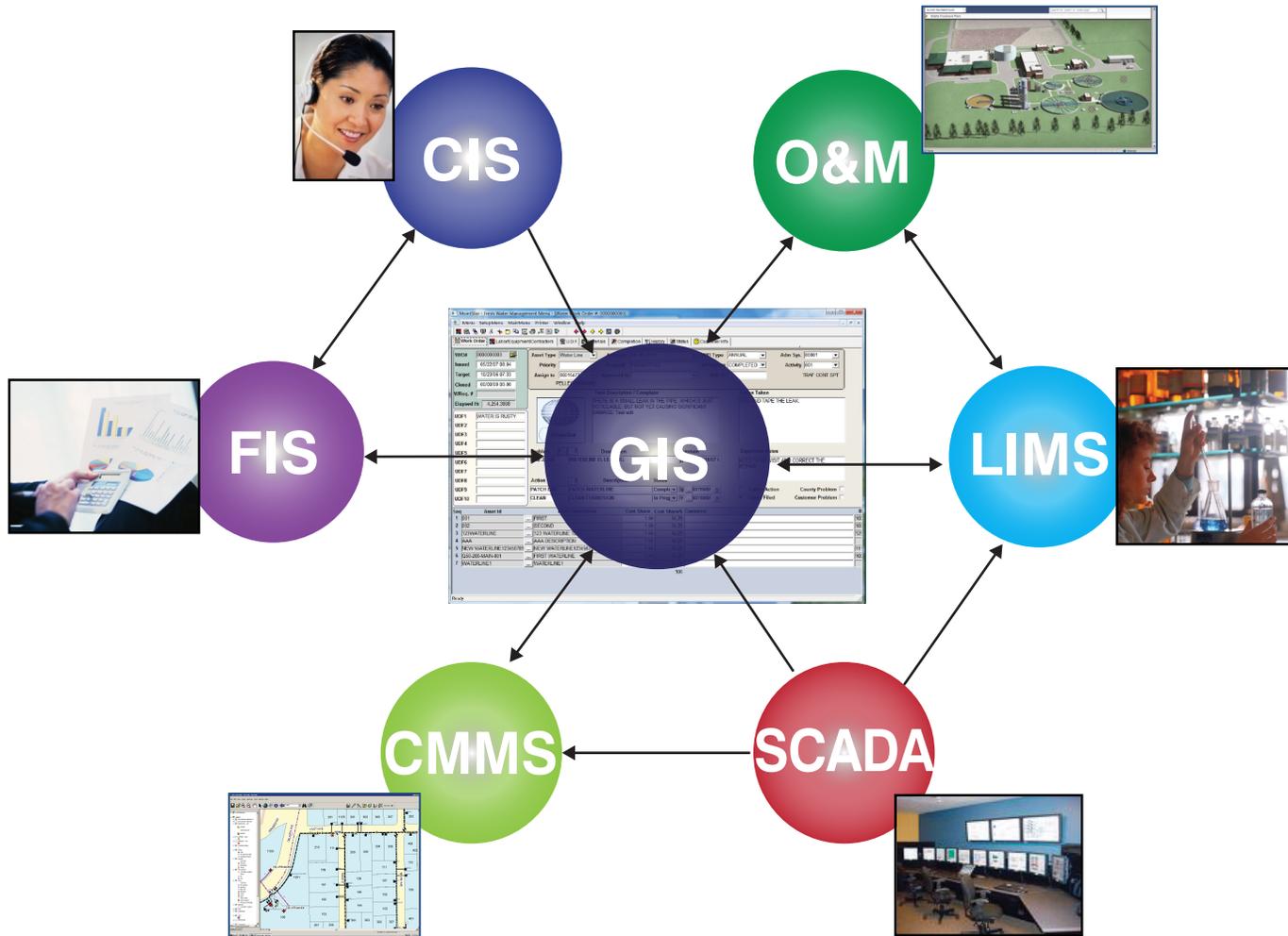
All organizations utilize some type of maintenance management system, but many do not have a formal CMMS. A maintenance management system can consist simply of paper documents that store information on when maintenance was performed on certain assets. A more formal maintenance management system may consist of organized WOs that document the “who,” “what,” “why,” “when,” “where,” and “how” maintenance was performed. Furthermore, a CMMS software can be used to perform not only the WO process but also organize a myriad of other information important to tracking maintenance activities and asset information to help organizations perform their activities in a more cost-effective, preventive manner.

5.1.1 Definition

At its most basic, a CMMS is a relational database that allows management of information specific to maintaining assets and facilities. The market for CMMS software is extensive and is applied across the globe from the largest private Fortune 500 companies to the smallest public utilities. Thousands of CMMS products exist, but only a small subset of these products is most applicable to water utilities such as Public Works. Most of these software packages utilize a custom database application that includes forms to enter information on assets as well as produce a myriad of reports.

Some of the reasons to use a CMMS include:

- Proper preventive maintenance reduces equipment downtime.
- Protects and extends life of assets.
- Helps operations and maintenance staff be more productive.



TYPICAL INFORMATION SYSTEMS INTERACTIONS

FIGURE 3

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- Helps predict annual staffing requirements.
- Supports manufacturers' warranties.
- Regulatory agency requirements, where applicable.

A CMMS can be used for many purposes. Some of the features of a CMMS that can be applied in the case of Public Works facilities include:

- Maintaining asset/equipment inventory.
- Scheduling of "preventive" maintenance through a formal service and WO process.
- Tracking of "unscheduled" repairs.
- Tracking the cost of labor and materials.
- Managing parts and materials inventory, if desired.
- Budgeting for equipment maintenance and repair.
- Recording equipment history from installation to replacement.

Many different people in an organization can use a CMMS. In Public Works' case, the main Services that will use CMMS initially include:

- Water Treatment.
- Water Distribution.
- Wastewater Collection.
- Wastewater Treatment.
- Recycled Water.
- Stormwater.

The purpose of a CMMS is to make the jobs of maintenance personnel easier by letting them focus on their duties while not overburdening them with data and administrative responsibilities. Therefore, the selection of a good CMMS not only involves the features of the software, but also the processes that will be put in place to efficiently collect, store, and report the data that are being used.

5.1.2 Current CMMS Procedures

Public Works currently has Infor/Hansen EAM Version 7 as its CMMS for managing maintenance work for its water, wastewater, recycled water, and stormwater assets.

Maintenance work on these assets is currently tracked and planned using some combination of Hansen, hard copy log books, electronic Excel spreadsheets, and custom Access databases. Street Services tracks the maintenance of its assets in a CMMS by StreetSaver.

Various challenges have been encountered in the Hansen implementation and routine usage. It is rather robust for the needs of the City and the wide variety of users who need to use it are often challenged. This results in the Hansen CMMS not being used or leveraged for beneficial use as much as it could be and instead being an additional burden to staff who already have a high workload and other responsibilities. A variety of options exist to address these issues, including:

- Upgrading the existing Hansen version stepwise across each version from 7 to the present 11th version and refining the business practices utilized, or
- Utilizing an interface between Hansen and the user that is more user friendly to a wider variety of staff and is more customized to the water sector's operational staff, or
- Replacing Hansen with a simpler, more applicable, and more widely useable CMMS.

5.1.3 Integration of CMMS with other Information Systems

Other information systems that Public Works may choose to integrate with the selected CMMS in future phases of the CMMS effort include the following The CMMS will need to integrate with Public Works:

- GIS - ESRI ArcGIS 10.3, Local Government Data Model for water, sewer, and storm water.
- CCTV Inspection Software - WinCan 8, inspection videos and data.
- Supervisory Control and Data Acquisition - SCADA, run-times, condition, performance.
- Procurement.
- Inventory.
- Project management software -Primavera, projects, budgets, CIP plans.
- Electronic document management system (EDMS) -EMC Documentum ApplicationXtender version 6.5 electronic documents, records.
- GPS locators (location identification, vehicle tracking).
- Inspection photos/video (non-CCTV).
- Infor MP2/Microsoft Access for wastewater treatment plant asset management.

The CMMS potentially may be considered for integration with the following systems at a later time (these are much lower priority for Public Works at this time):

- Financial Information System (FIS) / Enterprise Resource Planning (ERP) accounting system (SunGard Public Sector H.T.E., purchasing, inventory, fixed assets, general ledger (GL) codes, budget/cost, employees, projects).
- Fleet management software (fleet maintenance).
- Fuel management software (fleet fuel usage).
- Enterprise reporting /Business Intelligence (BI) Tools (WIMS - Work Information Management System; for reporting, analysis, and dashboards).
- Operations Manual Database.
- StreetSaver pavement management CMMS.

Brief descriptions of these systems follow, with a focus towards the potential future integration with Public Works' selected CMMS. Many of these possibilities could be considered in a future integration phase of the CMMS once the CMMS has been selected and the base implementation completed. Portions of this information were assembled in Carollo's July 12, 2013 memorandum for the Oxnard Recycled Water Retrofit Program, entitled "Water/Wastewater Information Technology Status and Recommendations".

5.2 Computerized Maintenance Management System (CMMS)

The City uses the Infor Hansen CMMS version 7 for maintenance management of its water and wastewater treatment facilities, as well as its water distribution, wastewater collections, and recycled water systems. Hansen version 7 is an outdated system that has been replaced by a completely new and revised version 8 that was released over 8 years ago, and that has now progressed to version 11. Version 8 was released prior to Hansen being acquired by the software company Infor. It is unknown how long Infor will continue to support Hansen version 7, and most customers such as the City are being encouraged to upgrade as soon as possible.

The City has never fully implemented and utilized Hansen Version 7 as it has primarily been a work order and preventive maintenance scheduling tool for the treatment plants. It is our understanding that Hansen contains incomplete data for the distribution and collection systems, and has no integration with other City information systems such as GIS, which limits Hansen's ability to support an asset management program. Info Tech is used for computer hardware and software inventory relying on various spreadsheets.

5.3 Geographic Information System

The GIS is well-established at Public Works, well-maintained, and contains important information for the CMMS to reference and to use in Public Works' greater asset management effort. Public Works has a well-developed and supported GIS that is based on the Esri Enterprise ArcGIS version 10.3, SQL Server 2012 software with the Local Government Data Model for water, sewer, and storm water. The GIS has geodatabase features for water, wastewater, and recycled water. The data contained in these geodatabases is the most accurate and complete record of the asset data for the water distribution, wastewater collection, and recycled water systems. Public Works is also taking advantage of GIS capabilities such as ArcGIS Server for web-based map viewing, network models for system connectivity, and spatial database versioning for change management. The web applications are built on Esri HTML5/JavaScript API.

The GIS is mainly used for mapping, location, and asset data purposes. It would be very valuable if the geodatabase had connectivity information between assets (e.g., pipe to node to pipe reference) so that future asset management or hydraulic modeling would be able to use the content of the GIS without major reformatting. This is not part of this study's scope.

5.4 CCTV Inspection Software

Public Works has been using the WinCan 8 software for the CCTV video inspection and data collection of the pipelines within the wastewater collection system. This effort did not involve an assessment of the current CCTV program and of related software, so limited information exists on the application of the WinCan 8 software. However, linking the CCTV software to asset and facility records in the CMMS may be useful in the future. This possibility would be addressed at a future integration phase of the CMMS once the CMMS has been selected and the base implementation completed.

Public Works is performing CCTV inspection of its sewer pipelines and manholes. The inspection data is made available on the network. . The City does not currently maintain a centralized application and database of the CCTV pipeline inspections.

5.5 Supervisory Control and Data Acquisition

Public Works uses the Rockwell Automation RSVIEW32 and FactoryTalk as the SCADA software platform for monitoring and control of its water and wastewater facilities and remote sites. Historical operations databases reside on SQL server that are not currently, but have the potential to be, integrated with other information systems such as GIS and CMMS.

Public Works could consider future integration of the SCADA system to the CMMS for functionality such as automated WOs that are triggered based on equipment run times, condition, and statistical performance data. This possibility would be addressed at a future integration phase of the CMMS once the CMMS has been selected and the base implementation completed.

5.6 Project Management Software

Public Works utilizes a hosted version of Primavera for some project management aspects.

5.7 Financial Information System (FIS) / Enterprise Resource Planning (ERP) System

Public Works uses SunGard's H.T.E. information system as its FIS or ERP software. H.T.E. is a transactional system that provides centralized financial accounting for Public Works with the typical modules of general ledger, accounts receivable, accounts payable, and fixed assets, among others. The Department uses H.T.E. for accounting functions including modules for general ledger, accounts payable, accounts receivable, projects, contracts, timekeeping, and payroll.

As part of the CMMS selection, Public Works could evaluate the capabilities of the CMMS software, versus the existing ERP, to determine whether certain functions such as inventory should reside fully in one system, or should share information through integration. The current plan is to keep all financial and cost management functions in the existing ERP including timekeeping, purchasing, inventory, projects, and contracts, with integration to the CMMS to provide information on WO materials, services, and equipment utilization. A more detailed investigation and definition of the integration requirements should be developed once the CMMS has been selected and the base implementation completed.

The water and wastewater-related asset data currently contained in Public Works' H.T.E. is not at a detailed level sufficient for maintenance and asset management. H.T.E. has a work management module that provides basic service request and work order capabilities, but this module is not currently in use by the Department. This module was formally evaluated by others and found to be insufficient for the Department's needs.

5.8 Electronic Document Management System

Public Works is currently using the EMC Documentum Application Xtender version 6.5 software only for scanning, storage, and retrieval. It is desired that eventually the CMMS has the capability to store, link, and retrieve asset and WO related documentation, such as contracts and drawings that are stored in the EMC system. Public Works would also like to evaluate the built-in capabilities of the CMMS alternatives for electronic document management, and the ability for future integration to other EDMS software such as Microsoft SharePoint. These possibilities would be addressed at a future integration phase of the CMMS once the CMMS has been selected and the base implementation completed.

5.9 Enterprise Reporting / Business Intelligence Tools

Public Works currently uses Work Information Management System (WIMS), some Crystal Reports and also Microsoft Access 2010 database for enterprise reporting and business intelligence. Public Works would like to consider the capabilities of the CMMS to leverage

these existing tools for these purposes, in addition to the built-in CMMS reporting and analysis functionality. This possibility would be addressed at a future integration phase of the CMMS once the CMMS has been selected and the base implementation completed.

5.10 Fleet / Fuel Management Software

Public Works currently uses the AssetWorks FleetFocus version 12.1.5 system for fleet management. An upgrade is expected near the end of 2015. In the future, Public Works could use the FuelFocus system in AssetWorks for fuel management or the new CMMS as the primary fleet maintenance management tool with potential future integration to fleet fuel cards for fuel management. This possibility would be addressed at a future integration phase of the CMMS after CMMS selection and base implementation completed.

5.11 StreetSaver CMMS

StreetSaver is a CMMS used by Oxnard's Streets Services for pavement management. It is maintained separately from Public Works, but both services departments wish to integrate the schedule of StreetSaver with that of Public Works' future CMMS for better coordination for maintenance and capital improvements projects to better optimize resources and avoid field work conflicts and rework.

6.0 CMMS NEEDS ASSESSMENT

The CMMS evaluation consisted of a multi-step approach that included a review of Public Works' goals and needs related to CMMS.

As the first step in this effort, Carollo met with Public Works to discuss the high-level goals and needs for maintenance and asset management with the Information Technology (IT) and GIS departments and reached out to its Water, Wastewater, Recycled Water, and Stormwater Services. The following general goals were identified during this meeting to consider:

- Asset management that integrates engineering, operations, and finance.
- Asset inventory and data management.
- Cost tracking for operations and maintenance (O&M) at asset level.
- Preventive maintenance planning and scheduling.
- Work order management and tracking.
- Resource availability, tracking, and planning.
- Inventory and spare parts management.

- Condition assessment and inspection of assets.
- Repair, rehabilitation, and replacement planning (capital and O&M planning).
- Asset history tracking.

For several of these high-level goals, Public Works further discussed the needs and requirements for a CMMS to support existing business processes and information systems. These requirements should be further detailed as the requirements to be included in an RFP for CMMS software and implementation services. The Departments preliminary responses are included in Appendix A.

7.0 CMMS ELEMENTS

Figure 4 illustrates the following general functional categories that were considered for the enterprise-wide CMMS. Details of these categories and requirements are discussed below.

7.1 Asset Inventory

Below are the asset types that the CMMS should support in an asset inventory. Assets that are not directly related to one of the water asset systems (e.g., buildings and computer equipment) may be managed differently depending on the capabilities of the selected CMMS.

The potential needs for CMMS functionality for Fleet assets should be evaluated to determine whether streets need to be tracked in this CMMS, and if so, whether non-pavement vertical traffic assets should have priority.

Assets that Public Works may manage with the CMMS include:

- Vertical Assets:
 - Water treatment plant assets (i.e., pumps, clarifiers, chemical treatment, etc.).
 - Wastewater treatment plant assets (i.e., grit pumps, solids works, biological reactors, chemical treatment, etc.
 - Recycled water plant assets (i.e., pumps, basins, etc.).
 - Roofs.
 - HVAC.
 - Coatings.



CORE ELEMENTS OF A CMMS

FIGURE 4

CITY OF OXNARD

PM NO. 1.2.2 – COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)
PUBLIC WORKS INTEGRATED MASTER PLAN



- Linear Assets:
 - Water distribution system assets (i.e., pumps, pipes, hydrants, valves/gates, canals, turn outs, etc.).
 - Wastewater collection system assets (i.e., barscreens, clarifiers, pumps, VFDs, digesters, etc.).
 - Stormwater collection system assets (i.e., pipes, manholes, etc.).
 - Recycled water distribution system assets (i.e., pressurized pipes, pump stations, etc.).
- Fleet vehicles and equipment (later, after implementation of wet assets):
 - Cars and trucks.
 - Portable equipment.
 - Boats.
 - Trailers.
- Street Assets (later, after CMMS implementation of wet assets):
 - Roads – not onsite (i.e., pavement, curb & gutter, sidewalks, lighting, etc.).
 - Intersections (i.e., traffic signals, roundabouts, etc.).
 - Bridges (i.e., bridge, abutment, railings, sidewalks, etc.).
 - Signs (i.e., overhead, ground-level, street markings, etc.).
- Assets Related to the Above:
 - Electrical, instrumentation, and control (EI&C) equipment.
 - Buildings and support equipment.
 - Security protection equipment, fencing, and gates.
 - Landscaping.

7.2 Service Requests and Work Orders

This is the functionality needed to manage incoming service requests, and the resulting WOs that are generated to track the work completed. These tasks may include:

- Manage service requests from both internal work requests from staff and potential external requests from customers that are managed through the operations center.
- Manage reactive and corrective WOs for maintenance activities.
- Ability to issue permits, and conduct inspections, and manage.

- Ability to view, open, and complete service requests and WOs using a GIS map interface.
- Manage staff WO assignments, resource availability, and historical performance.

7.3 Preventive Maintenance (PM) Tasks and Schedules

Preventive maintenance activities need to be scheduled, tracked, and managed in the CMMS. The frequency of each PM activity is tailored to the individual equipment, and PM activities are logged as they are completed and verified annually. Examples of the types of preventive maintenance activities that Public Works conducts include:

- Semi-annual inspection of uninterruptible power supply units.
- Annual maintenance of main breakers.
- Scheduled lubrication of bearings.
- Annual or seasonal exercising of valve operators.
- Others.

7.4 Inventory Management and Purchasing

This is the functionality needed to manage inventory and spare parts for maintenance of the assets. These features may not be a priority initially, but may be something that is desired to integrate slowly into work process with the CMMS. This type of feature typically includes:

- Integration with the inventory data for parts checkout, stock availability, and materials costing on WOs.
- Integration with the procurement system to initiate purchase requests and track order fulfillment and receipt of parts and materials.

7.5 Condition Assessment and Renewal Planning

These are the activities and data needed for asset management-based renewal (rehabilitation and replacement, R&R) planning, including condition and risk assessment of the facilities and systems. Examples include:

- Conduct video inspections of major linear underground infrastructure such as pipes, etc.
- Perform ongoing inspection and condition assessment of above ground equipment and facilities.
- Conduct inspections of below ground equipment where accessible.

- Evaluate criticality (consequence of failure), vulnerability (likelihood of failure), and risk of asset failures.
- Determine estimated remaining useful life of assets to assist in planning repair, R&R needs.
- Prioritize asset R&R needs based on condition, criticality, vulnerability, and risk for CIP development, budgeting purposes, and scenario analyses of the same.

7.6 Reporting and Documentation

These are the general reporting and documentation functions needed to help manage the maintenance and asset management programs:

- Flexible reporting tools across CMMS, GIS, and other database sources.
- Integrated reporting using some Crystal Reports and also Microsoft Access Database.
- Customizable reports that integrate maps on asset condition, service requests, WOs, pipe breaks and leaks, equipment and process failures, and repairs.
- Customizable reports on asset condition, WOs, and preventive maintenance status.
- Integration with the EDMS for storage and linking of data and documents.

The evaluation of CMMS software continues with understanding the different functional and technical requirements necessary to support the use of the software.

8.0 CMMS FUNCTIONAL NEEDS

Based on discussions with Public Works and the detailed survey discussed above, the following functional needs are necessities:

- **Work Orders** – Internal and external service and corrective WOs.
- **Scheduling** – preventive maintenance scheduling.
- **Cost Accounting** - integral to the application of asset management.
- **Staff/Equipment** – resource planning and utilization, and contract tracking for ongoing maintenance.
- **Fleet Management (eventually)** – include vehicles and equipment for which fleet personnel are responsible.
- **Lock-out/Tag-out** – and other classifications.

- **Confined Space Entry** - for safety.
- **Timekeeping** –to track hours of WO completion.
- **Asset Management** – inspections, condition assessments, risk prioritization, remaining useful life determination, rehabilitation and replacement, scenario analysis.
- **Mobile applications** – accessible, useable, able to access and synchronize updates back to the CMMS even when cellular signal is temporarily absent.

Non-necessary functional requirements that Public Works may want to consider at some future time include:

- **Inventory Management** –Would like integration with WOs.
- **Capital Projects Tracking** – only for rehabilitation and replacement.

9.0 CMMS TECHNICAL REQUIREMENTS

Public Works has various technical requirements and standards regarding their network infrastructure, servers, licensing, and other technical aspects for the CMMS as listed below. Further information on these aspects are discussed in Section 5.

9.1 Server/Network Platform

- Server – Microsoft Windows Server 2012 virtualized with VMWare.
- Database – Microsoft SQL Server 2012.
- Number of Users/Licenses – 55 named users or 20 concurrent users.

9.2 Client Platform(s)

- Workstations – A variety of workstations/desktops makes and models with Microsoft Windows. Overall Public Works is upgrading from Windows XP to Windows 7.
- Mobile – A variety of laptop makes and models with Microsoft Windows. Overall Public Works is upgrading from Windows XP to Windows 7. A few laptops run Windows 8.

9.3 GIS Integration

- ESRI ArcGIS 10.3.
- ArcGIS Server – for web-based GIS use.
- Mobile GIS apps – planned for use with mobile laptops, tablets, and other devices.

9.4 CCTV Integration

- Integration with WinCan software is needed.

9.5 Other Integration (FIS/ERP, EDMS, etc.)

- Later integration with the ERP for financial data, inventory management, and purchasing is optional for the future.
- Later Integration with the EDMS for storage and linking of electronic documents is desired.
- SCADA integration is desired for runtimes to trigger PMs, and for integrated reporting.
- The existing CMMS is Infor Hansen EAM. If existing challenges and upgrading this software to the present version is possible and justified, then either this software may be retained and upgraded to the current version, or an additional software interface could be used to make it more useable for municipal water assets (and others) at Public Works.

10.0 CMMS SOFTWARE SELECTION PROCESS

When selecting a new CMMS for utility-wide maintenance and operations there are at least five primary issues that should be considered. These include:

- Longevity of software and vendor – Where will they be in 5, 10, 25 years?
- Support options (number and availability) – Where can you get help?
- Software ease-of-use and user-friendliness – Will your people use it?
- Software functionality and capabilities – Will it do what you need?
- Total lifecycle cost for software, implementation, maintenance, and support – What is the return on investment (ROI)?

These questions along with other information documented previously in this document were used to guide these initial CMMS software recommendations.

10.1 CMMS Software Alternatives

As stated earlier, there are many options for CMMS on the market today. Carollo typically categorizes CMMS software, into two divisions (or tiers). These two tiers are generally used to categorize large and smaller products, but other criteria also distinguish the software in each tier.

10.1.1 Tier 1 CMMS Software

Tier 1 CMMS software are developed and maintained by large software vendors that serve many different markets, but also provide products that are directly applicable to the water industry. Several of these products listed by vendor are included below:

- IBM Maximo.
- Oracle EAM and WAM.
- Infor EAM and Hansen.
- SAP.

These companies are obviously very large and serve a varied industry base, but provide very good products and services to many larger water utilities.

10.1.2 Tier 2 CMMS Software

Tier 2 CMMS software are developed by more niche companies that usually began within the water utilities sector or the public utilities sector. These software tend to be more customized for typical water utilities but do not always integrate as easily with other information systems that may be used by a public agency, such as FIS and Customer Information System (CIS) software, whereas Tier 1 products typically have these components as part of their software suite. It should also be noted that there are many third party software products that are specifically available to integrate Tier 2 software with other enterprise information systems.

Some of the Tier 2 CMMS software that is in use by other water utilities and was considered for Public Works include (in alphabetical order):

- Accela.
- Azteca Cityworks.
- Cartegraph.
- eMaint.
- Schneider Electric/Invensys Avantis.
- Lucity.
- Maintenance Connection.
- MaintStar.

- NEXGEN.
- TabWare.

There are many other software packages on the market that qualify as Tier 1 or Tier 2 products, but the list above include CMMS products that represent the majority of the market share in the water utility industry.

10.2 Software Shortlist

Based on Carollo's experience with the above products, discussions, the survey; and specific discussions with the vendors in relation to Public Works' needs, a shortlist of recommended software products/vendors for the CMMS was developed from the hundreds of potential options in the CMMS software market. Generally, these would be able to eventually be integrated with the City's existing StreetSaver CMMS in some manner. This shortlist includes the following products/vendors (listed in alphabetical order):

- Azteca Cityworks.
- IBM Maximo.
- Existing Infor Hansen (Upgrade).
- Schneider Electric/Invensys Avantis.
- Lucity.
- Maintenance Connection.

These vendors are expected to provide a representative cross-section of Tier 1 and Tier 2 products with varying capabilities and options applicable to Public Works' needs. Details of each of the shortlisted CMMS options listed above, along with a summary of their major pros and cons, are described in the following sections.

10.2.1 Azteca Cityworks

Cityworks is a CMMS software that is built on top of, and as extension of, the ESRI ArcGIS platform. The user interface is the GIS application, so there is no other GIS viewer or custom integration needed. Azteca Systems, the Cityworks software vendor, was founded in 1986 in Sandy, Utah, and has approximately 500 customers throughout the U.S. and the world. Azteca does not typically self-perform the software installation, configuration, and implementation tasks, as they prefer to focus on software development and let third-party certified integrators perform the required end customer services. Therefore, a third-party software integrator would be recommended by Azteca to assist with the implementation.

The Cityworks CMMS is a very powerful, GIS-based, maintenance and asset management system, particularly for linear assets such as water distribution and wastewater collection

systems. The GIS-based user interface makes it very easy to use to find assets, create WOs, and search and report on the data. Cityworks also has a management dashboard that supports workflows and user customization of an “inbox” to show relevant and timely information. While all the same functionality is available, using Cityworks for vertical assets is potentially more cumbersome than other options because the assets do not appear on GIS and must be found using a separate interface with hierarchical lists and searches. Cityworks also has more limited integration with SCADA and financial data when compared to other leading CMMS alternatives. Finally, the Cityworks licensing model is typically based on an ongoing annual service agreement and software maintenance costs that may be more expensive than some alternatives.

Cityworks Pros:

- GIS-based user interface and data model is powerful and easy to use for linear assets.
- Extensive customer list of users with water and wastewater linear assets.
- Common perception of software as being user-friendly.
- Web-based and mobile versions for use by field staff with full functionality.
- Leverages existing Public Works investment in GIS technology.

Cityworks Cons:

- Potentially more cumbersome to use for vertical facility assets.
- Inventory management functionality is a separate application that is not fully integrated.
- Limited integration with SCADA and financial data that must be customized.
- Annual service agreement and software maintenance can be more costly than some alternatives.

10.2.2 IBM Maximo

IBM acquired the MRO Maximo software in 2006 and has continued to enhance and integrate it with other IBM software products. While Maximo is considered to be Tier 1 software, it has been used extensively by many mid-size water and wastewater agencies throughout the United States. It has robust functionality that supports almost limitless customization, extensibility, and integration for asset and maintenance management. However, the powerful features of Maximo typically come at the expense of software complexity, implementation difficulty, and overall cost.

The Maximo software includes six primary modules built on a fully, web-based, service-oriented architecture. These modules include asset management, work management, service management, contract management, inventory management, and procurement management. Its numerous modules may or may not overlap with functionality of other existing information systems. Maximo has out-of-the-box integration solutions for GIS and SCADA software which would need limited configuration to function properly.

Maximo Pros:

- Web-based software that is powerful, flexible, and fully functional.
- Extensive number of agencies using the software for complex water and wastewater assets.
- Integrates with GIS, ERP, and SCADA applications.

Maximo Cons:

- Perception that software is not as user-friendly as some alternatives.
- Extensive forms that would need to be customized during implementation.
- Software implementation and configuration are typically more extensive and costly than other alternatives.

10.2.3 Infor Hansen Version Upgrade

Upgrading Public Works' existing Infor Hansen to each version beyond the existing seventh version that Public Works has to Version 11 could be an option. It is included as an option because of its possibility to salvage existing efforts and progress while addressing some of the more challenging issues discovered. The upgrades must progress through each subsequent version beyond seven to reach 11 because each upgrade has specific elements that only it addresses. A substantial cost and effort exist to upgrade from the current version 7 due to the complete rewrite of the software beginning with version 8. However, Infor has been helping to make the migration path easier and less costly due to many customers leaving for other software options.

Infor EAM is an advanced enterprise asset management system that has been in the utility CMMS software market for a long time. The software was originally owned by a company called Datastream and marketed in various versions including MP2, MP5, and 7i since the early 1990s. Infor is a large \$3 billion software conglomerate that purchased Datastream in 2006 (along with a similar Hansen CMMS product in 2007) and rebranded the 7i software as Infor EAM. Infor also purchased Lawson, an ERP software, in 2011. The latest Infor EAM Enterprise v11 is a very complete system that is used across a broad spectrum of industries including healthcare, food and beverage, education, government, oil and gas,

and water utilities. Infor EAM is entirely web-based and operates on a Java platform, with either Microsoft SQL Server or Oracle databases.

As expected of a Tier 1 CMMS software, the Infor EAM product has extensive functionality that is directly applicable to needs, including solid WO, service request, preventive maintenance, mobile device, and lockout/tagout capabilities. While it supports linear assets, and has a GIS integration module, these capabilities are lacking when compared with other CMMS options. Likewise, Infor EAM has typically been more difficult to integrate with SCADA and financial data, though with the acquisition of Lawson, there has been news that Infor is working on a module to integrate the EAM and ERP products. The module may perform well, or it may require improvement. While there are many thousands of Infor EAM clients throughout the world, the recent reports of customer service experience (that Carollo is aware of) have been less than stellar.

Infor EAM Pros:

- Web-based software that is powerful, flexible, and has proven core maintenance management functionality.
- Extensive number of agencies using the software for complex water and wastewater assets.
- Integrates with GIS and SCADA applications, with potential future out-of-the-box integration with Infor Lawson ERP.
- Could offer Public Works a step-wise upgrade approach to salvage existing Hansen efforts and progress.

Infor EAM Cons:

- Perception that software is not as user-friendly as some alternatives.
- Implementations are typically more difficult and costly due to the complex functionality and extensive configuration required.
- Recent poor reports of customer service and support.
- Has already proved to be a challenging implementation for Public Works.

10.2.4 Schneider Electric/Invensys Avantis

Avantis is a CMMS software that was sold by the company Invensys, until their recent acquisition by Schneider Electric in January 2014. Invensys was primarily known for its Wonderware SCADA product, which is one of the dominant players in the water utility SCADA software market. Certain modules of Avantis are still dependent on Wonderware functionality. Avantis has been a player in the CMMS market since the early 2000s, primarily for industrial clients that are also using Wonderware for their SCADA system. The

latest version is Avantis PRO 5.0.5 which is Microsoft .NET based. With the new Schneider Electric ownership, there is expected to be further, and potentially accelerated, development in the Avantis product line.

Because of its primary use in industrial applications, particularly for oil, gas, and electric utilities, Avantis has powerful features for asset management, condition monitoring, process optimization, and predictive maintenance. Another module is focused on safe facility operations and lockout/tagout requirements. The Avantis SCADA integration is one of the best in the CMMS industry, and while it is biased towards Wonderware, it can be configured with any SCADA system that uses OPC (Open Productivity and Connectivity) data access, including GE Proficiency. GIS integration with ESRI ArcGIS is also available through an add-on module. Water utility references for Avantis are not as extensive as some other CMMS alternatives.

Avantis Pros:

- Web-based CMMS software that has found proven use in industrial applications, with dedicated functionality for facility safety and lockout/tagout requirements.
- Powerful SCADA integration for condition monitoring, operations optimization, and predictive maintenance.
- Acquisition by Schneider Electric should provide resources for continued support and product enhancement.

Avantis Cons:

- Some functionality has been driven by integration with companion Wonderware SCADA product.
- More limited water utility client references and experience than other CMMS alternatives.
- Integration with ERP may be more difficult than some other CMMS options.

10.2.5 Lucity

Lucity, formerly called GBA Master Series, is well-known CMMS software for water and wastewater utilities that has a substantial customer base in the Midwest due in part to their headquarters location in Overland Park, Kansas. Lucity was originally developed in the mid-1980s by a professional engineering firm for clients in the area, before it was spun off to an independent software company in 2000. The Lucity software has extensive maintenance and asset management functionality that is more specific to water and wastewater utilities than most other CMMS software alternatives. Their latest software is an entirely new web-based version 7.60 that was released within the last 2 years.

Lucity's new web-based software is very flexible and functional for maintenance management of water and wastewater assets. The software has a powerful dashboard interface that can be customized for each user based on their organizational role and need to view high priority items from one screen. Similar to the older client-server application, Lucity is forms-based, with each entry form customizable to a particular utility's terminology, workflows, and data requirements. Lucity has GIS integration through a web-based ArcGIS Server application that would leverage existing ESRI licenses. A SCADA interface may also be possible with some limited programming required for data exchanges.

Lucity Pros:

- Fully web-based software that is flexible, functional, and has good dashboard capabilities.
- Excellent references and customer service experience from agencies using the software for water and wastewater assets.
- Integrates with GIS and SCADA applications with limited configuration or programming.
- More traditional licensing model for on-site software installation with lower ongoing maintenance fees.

Lucity Cons:

- Limited customer experience with relatively new web-based software version.
- Perception that software is not as user-friendly as some alternatives.
- Extensive forms that would need to be customized during implementation.

10.2.6 Maintenance Connection

Maintenance Connection is a feature-rich maintenance and asset management software that has been in business since 1999 and was one of the first completely web-based CMMS options in the market. The software is in use throughout many industries including government, utilities, manufacturing, healthcare, pharmaceuticals, and education. There are a fair number of water utilities that are actively using Maintenance Connection. Initially, the CMMS software was only available as a cloud-based, hosted solution, but has been extended to options for local on-site installation, and a hybrid off-site solution with a client-dedicated hosted server.

A primary strength of Maintenance Connection is that it has a visually appearing user interface and is considered to be easier to use than many other CMMS alternatives. Screens, fields, forms, and workflows are simple to configure and use by maintenance and operations staff. This ease of use translates to its core preventive maintenance and WO

functionality. Maintenance Connection also has basic GIS integration capabilities with an add-on module, though it has found more extensive use for vertical assets in treatment facilities than for water distribution or collection systems. Integration with SCADA and financial data are more challenging, though they can be configured using standard Microsoft web services tools and approaches. Another positive aspect of Maintenance Connection is that their customer support has had some of the best reports of any of the CMMS software alternatives.

Maintenance Connection Pros:

- Easy to use fully web-based software that is flexible, functional, and visually appealing for end users.
- Good record of use for water utilities, manufacturing, and government agencies.
- Multiple software on-site and off-site installation options.
- Excellent reports of custom service and support responsiveness from current software customers.

Maintenance Connection Cons:

- Support for linear assets and GIS integration is not as good as some alternatives.
- Specialized functionality such as support for lockout/tagout is not available out-of-the-box.
- Integration with ERP and SCADA systems may be more difficult than some other CMMS options.

Figure 5 presents a high-level comparison of the functionality provided in each of the CMMS software options, with high-level budget estimates for software licensing, implementation, and integration.

10.2.7 Spatial Wave MAMS and similar Interfaces

Many of the CMMS software options described below have their own strengths and weakness with regards to their user interface friendliness and applicability. In some cases, it may make sense to utilize an additional specialized interface tailored to water industry professionals to make the user experience clearer, easier, and more applicable to the features and information most applicable to this industry.

Such interfaces often make using the software clearer and easier for field staff and mobile solutions, and eliminates the need to learn multiple information system software. Additionally, such interfaces can display information, data, drawings, etc. from multiple information systems. Such interfaces also help mid-sized organizations to be capable of

Software Functionality	CMMS Alternatives					
	Azteca Cityworks	IBM Maximo	Infor EAM	Invensys Avantis	Lucity	Maintenance Connection
Base Functionality						
1. Work Orders	●	●	●	◐	◐	◐
2. Service Requests	◐	●	◐	○	◐	○
3. Preventive Maintenance	◐	●	●	●	●	●
4. Support for Vertical Assets	◐	●	◐	◐	◐	◐
5. Asset Management	○	◐	◐	◐	●	◐
6. Mobile Device Capabilities (iOS)	◐	●	◐	◐	◐	○
7. Support for Linear Assets	●	◐	○	○	◐	○
8. Lockout/Tagout	○	●	●	●	○	○
9. Inventory Management	○	●	●	●	◐	◐
Overall Functionality	◐	●	◐	◐	◐	◐
Ease of Use						
1. User Customizable Dashboard	◐	●	◐	◐	●	◐
2. Reporting and Ad-Hoc Queries	◐	●	◐	◐	◐	◐
3. Ability to Attach Documents	◐	◐	◐	◐	◐	◐
4. Implementation Effort	◐	◐	◐	○	○	◐
5. On-Site Hardware Requirements	○	◐	○	○	○	○
6. Ease of Customization	○	◐	○	○	◐	◐
Overall Ease of Use	◐	○	○	○	○	◐
Integration						
1. SCADA Software/Data Integration	◐	●	○	●	○	◐
2. Financial Software/Data Integration	◐	○	○	◐	◐	◐
3. GIS Software/Data Integration	●	●	○	◐	◐	○
Overall Integration	○	◐	○	◐	○	○
References						
1. Customer Service Experience	◐	◐	◐	◐	●	●
2. Wet Utility References	◐	●	◐	○	●	○
Overall References	◐	●	○	○	●	◐
Budget-Level Cost Estimates (\$000s)*						
Software Licensing	55-85	90-180	90-200	50-80	60-90	55-75
Implementation Services (Year 1)	50-100	100-200	125-200	125-200	75-125	50-100
Integration Services (Year 2)	75-250	75-250	75-250	75-250	75-250	75-250
Estimated Total Software Cost	180-435	265-630	290-650	250-530	210-465	180-425

Legend	
●	Excellent
◐	Good
○	Average
◐	Poor
●	Unacceptable

COMPARISON OF CMMS FUNCTIONALITY
FIGURE 5
 CITY OF OXNARD
 PM NO. 1.2.2 – COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)
 PUBLIC WORKS INTEGRATED MASTER PLAN



implementing and using Tier 1 CMMS software while reducing implementation failures by providing a more user friendly interface that references the Tier 1 CMMS software. For Public Works, such an interface integration that may be useful is one that integrates the CMMS and GIS asset and maintenance information into a single, user-friendly interface.

An example of such an interface is Spatial Wave's Mobile Asset Management Systems (MAMS) software interface. It can be used for water, wastewater, building, parks, roads, and facility assets. MAMS has strong mobile device capabilities and a friendly user interface and specifically aims to be user friendly and functional for the field worker. It also has desktop capabilities.

MAMS Professional is typically used for smaller agencies. MAMS Enterprise is a more robust version typically used for larger agencies that often must use more of an enterprise-wide approach. MAMS maintains integrations with Maximo and Infor EAM (Hansen), has integrated with several of the Tier 2 CMMS software options below. Generally, custom integrations may be developed with CMMSs that have a quality and accessible application program interface (API).

MAMS also has an option to stand on its own as a first step in CMMS implementation. It is simple and user friendly interface can help to get the CMMS data effort and use implemented. Then, this data may be migrated to a Tier 1 or Tier 2 software.

10.2.8 Integrated ERP AM/CMMS Module

The other alternative is to consider an integrated module of an ERP system. It is understood that the City is currently evaluating upgrading or replacing the SunGard HTE system, potentially as part of a larger City-wide information technology master plan, so this could be an opportune time to evaluate the capabilities of an alternative ERP system and its asset and maintenance management modules. It would be too complex for this project memorandum to go into the details of each of the major ERP software vendors and their asset management modules. However, a list of some of the ERP options with more advanced asset and maintenance management capabilities includes:

- Oracle E-Business Suite and EAM Module.
- Oracle ERP and WAM Module.
- Tyler Technologies Eden, Munis, and EnerGov.
- SAP.

The central IT department is developing an IT Master Plan and considering options for upgrading or replacing the current SunGard HTE system with an ERP that contains more robust asset and maintenance management capabilities. However, this process could take the rest of the year for the finalization and implementation initiation of the IT Master Plan, one more year before a new ERP system is selected, and another 18 to 36 months to complete the upgrade or replacement of the existing system. An alternative, and more

expeditious path, is to proceed with the evaluation and selection of a CMMS software while comparing against the current functionality of the SunGard HTE work management module.

This information in this section is intended to provide a general comparison of the shortlisted software packages and other relative options, based on Carollo's knowledge, experience, and previous software evaluations, and is not intended to provide guidance for a final selection by Public Works. The intent of the shortlist is to provide a reasonable number of vendors who could provide proposals and demonstrations of their products, from which Public Works will ultimately select one for its CMMS. Carollo recommends that this shortlist be further narrowed down to two or three vendors to provide software demonstrations, based on a review of the proposals, cost estimates, and reference checks.

11.0 CMMS PROCUREMENT

Procuring CMMS software is more complicated than just deciding on software features and ordering the software. Because CMMS touches so many different points within an organization, a more formal process is recommended. See Figure 6.

These basic procurement procedures are further detailed below:

1. **Develop and issue an RFP** to a limited number of CMMS vendors. It is recommended that the RFP be distributed to the shortlist of six vendors that can provide the CMMS functionality required and have extensive experience with water utility implementations. These functional and technical requirements will be further refined and customized during procurement and implementation.
2. **Evaluate CMMS Vendor Proposals** based on ability to meet functional and technical requirements, and including a check of client references. Based on this review, it is recommended that Public Works narrow the shortlisted vendors down to two or three for software demonstrations.
3. **Conduct Vendor Demonstrations** of the shortlisted vendor software in 2- to 4-hour interviews with a scripted agenda of vendor qualifications and functional modules to be demonstrated. The agenda will provide a basis for more equal comparison of CMMS vendors and their software functionality.
4. **Select and Negotiate with Preferred CMMS Vendor.** The final step in the CMMS selection process is to negotiate a contract for software and implementation services with the vendor. The prices for software licenses are often negotiable based on various discounts and incentives that the vendor may offer, and this is the time to lock in licenses at the lowest possible cost. Implementation services are also negotiated based on the scope of services to be provided by the vendor, versus the resources to be provided by Public Works or a third-party consultant.

Develop and Issue RFP

Evaluate CMMS Vendor Proposals

Conduct Vendor Demonstrations

Select and Negotiate with Preferred CMMS Vendor

BASIC CMMS PROCUREMENT PROCEDURE

FIGURE 6

CITY OF OXNARD

*PM NO. 1.2.2 – COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)
PUBLIC WORKS INTEGRATED MASTER PLAN*



12.0 CMMS IMPLEMENTATION

This section discusses general issues for implementation of the CMMS, including considerations before implementation and the typical steps that occur during implementation. A cost summary is also included to provide a planning level budget estimate of implementing the CMMS, in addition to the estimates provided for each of the shortlist CMMS options presented in the previous chapter. Further details on implementation will be detailed in later phases.

12.1 Implementation Considerations

Several implementation considerations are noted below. This list will need to be further discussed with Public Works and expanded upon during the next phase:

- Format and availability of current information – Hard copies, Excel spreadsheet, Access DB, Visio, etc.
- Historical data integration – Conversion of hard copy to electronic format.
- Phasing/timing of implementation – Pilot WO process at one location.
- User and administrator training needs.
- Need/desire for integration initially with GIS, and possibly later with SCADA, ERP, and other systems.
- Staff to maintain asset data and manage the system.
- Hardware/software needs and procurement – probably already have the right equipment or can accommodate through typical IT budget.
- Having the possibility to integrate with the City's existing pavement management StreetSaver CMMS scheduling.
- Ease of implementation.

12.2 Implementation Steps

The basic steps for building a CMMS database during CMMS implementation are illustrated in Figure 7.

These steps are further explained below:

- **Create numbering or ID system for assets** – Each asset must have a key identifier so that the software can track it. Finance sometimes use a similar numbering system and identifies many assets with an ID number and a bar code. This does not have to be the same code that will be used for the CMMS, but any correspondence that can be made to track both numbers together (in a separate spreadsheet) would be helpful but not necessary.

Create Asset ID System

Enter records for assets, equipment, labor, vendors, inventory items, and costs (labor, vendor, parts)

Review O&M Manuals and Maintenance Data

Upload Preventative Maintenance (PM) Procedures & Schedule PM Tasks

Create Departmental Reports

BASIC STEPS FOR BUILDING CMMS DATABASE

FIGURE 7

CITY OF OXNARD

PM NO. 1.2.2 – COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)
PUBLIC WORKS INTEGRATED MASTER PLAN



- **Enter records for all assets, equipment, systems, labor, vendors, and inventory items** – Any assets that need to be tracked must be entered into the CMMS. Certain historical data may be useful when the database is being populated. If the inventory module of the chosen CMMS will be used, then much more detailed inventory information will need to be entered. Replacement cost data will also need to be entered and should include costs for labor, vendor assistance, parts, etc.
- **Review O&M manuals and maintenance data** – Manuals should be collected and reviewed so that common procedures and preventive maintenance activities can be properly documented in the CMMS.
- **Upload Preventive Maintenance (PM) procedures and schedule PM tasks** – Common procedures that are done routinely could be entered into the CMMS so this information is readily available to field personnel, especially when mobile information is deployed.
- **Create departmental reports** – The CMMS can produce a variety of reports. Standard reports will need to be selected and/or developed so that daily work activity reports are easily generated. Specific reports can also be developed based on managerial, staff, regulatory, or financial needs.

12.3 Cost Summary

The bottom of Table 1 summarizes an estimate of budget-level costs for CMMS implementation services and software licensing. This general cost information is based on the functional and technical requirements discussed with Public Works and Carollo's prior experience with the CMMS software vendors recommended in this memorandum.

The basis and assumptions for each of the budget line items are presented in the table. The estimates do not include custom programming of CMMS software integration with Public Works' existing information systems because these costs can vary widely based on the selected software and the complexity of desired integration. These cost estimates are preliminary and should be refined with further detail of needs, requirements, and the proposals received from CMMS software vendors.

This estimate of probable costs is intended to provide the Department with a line item cost for CMMS software and services for annual budgeting purposes for the next two fiscal years. The following table summarizes general cost information received from various CMMS software vendors for implementation services and software licensing, based on preliminary functional and technical needs provided by the Department.

Table 1 Compiled Summary of Vendor CMMS Software Cost Estimates Public Works Integrated Master Plan City of Oxnard			
Cost Component	Cost Estimate* (\$000's)	Description	Basis/Assumptions
Software Licensing (Vendor)	40 - 200	<ul style="list-style-type: none"> • Core functionality for assets, service requests, work orders, and PMs • Basic inventory management functionality • Mobile functionality • Year 1 	<ul style="list-style-type: none"> • 55 named users or 20 concurrent users • 120 total users for service requests • Low estimate for enterprise license agreement (ELA) • High estimate for user and module-based licensing • No add-on integration
Software Implementation Services (Vendor)	50 - 300	<ul style="list-style-type: none"> • Implement core functionality for assets, service requests, work orders, and PMs • Implement GIS fleet management, inventory management, and mobile functionality • Year 1 	<ul style="list-style-type: none"> • Software installation • Software configuration for core modules • Limited data conversion and population for core functionality • Software testing • Basic training
Estimated Total Cost for Year 1	\$90 - \$500		
Annual Software Maintenance/Support (Vendor)	15 - 150	<ul style="list-style-type: none"> • Provides vendor support and software upgrades and patches • Starts in Year 2 • Recurs each year of use 	<ul style="list-style-type: none"> • Low estimate 20% of licensing fee • High estimate for enterprise license agreement (ELA) • Annual cost incurred indefinitely
Software Integration Services (Vendor)	75 - 300	<ul style="list-style-type: none"> • Integration software and implementation services for SCADA and ERP • Additional business process implementation and training • Year 2 through completion 	<ul style="list-style-type: none"> • Varies widely based on specific integration points, data flows, and selected software capabilities • May require multiple phases and years of implementation
Estimated Total Cost for Year 2	\$90 - \$450		
Note: * = Cost estimates are preliminary and subject to change based on detailed evaluation of requirements and negotiation of specific software licensing and services with selected vendor applicable to this specific Owner. Cost estimates are based on an approximate accuracy range of -15% to -30% on the low side to +20% to +50% on the high side.			

13.0 RECOMMENDATIONS

This CMMS assessment allowed observations into CMMS needs and preferences at Public Works. CMMS recommendations are included below and preliminary observations for enterprise asset management needs are discussed in Appendix C.

Effort and challenges exist with implementing any CMMS system. Public Works recognizes these challenges and benefits and wants to make sure that staff is able to utilize the CMMS to assist them in their work rather than adding a burdensome challenge once it is implemented. For these reasons, CMMS implementation at Public Works should be straightforward and stepwise, ideally by piloting a specific process with the build-out and use of CMMS, such as the WO process, which also happens to be one of the highest drivers and most important workflows for implementing a CMMS at the Department. The growth period while implementing a CMMS will present challenges but the objective and ultimate reward is to provide access to asset information so that staff may perform their jobs while reducing the administrative time required of them for administering maintenance and asset data.

13.1 CMMS Recommendations

Carollo recommends that Public Works proceed in the next phase of work to request proposals from the shortlisted CMMS vendors described in Section 7. The RFP should be developed based on the high-level requirements included in this report, detailed further with functional and technical specifications, and sent to these vendors to initiate the procurement process. Based on a review of the proposals received, along with preliminary reference checks, Carollo recommends narrowing the shortlist down to two or three preferred CMMS vendors that will be invited to provide software demonstrations. The review of the proposals, reference checks, and software demonstrations will provide the basis for Public Works' selection of a CMMS vendor to proceed with software implementation. Table 1 includes summary costs for Year 1 and Year 2 activities for procuring and implementing a CMMS. The cost estimate total ranges for implementation each of these first two years are shown in Table 1. These cost estimates include software and implementation costs for both vendor and consultant services. An information interface, such as Spatial Wave's MAMS mentioned above, could be initially implemented for an additional \$15,000 to \$50,000, depending on the number of licensed devices desired.

13.2 Observed Asset Management Needs

As discussed, EAM is more than solely a CMMS. The primary purpose of this assessment was CMMS. However, during this assessment, the assessment team was able to become somewhat exposed to the existing asset management endeavors that Public Works has underway already, its plans for the future, and its needs.

Carollo has identified some asset management steps that Public Works may want to take to address its needs, current and future assets, and future visions for more fully leveraging the CMMS. Preliminary insights and recommendations with regards to EAM at Public Works are discussed in Appendix C. These EAM recommendations generally include pursuing the following:

- Develop or refine levels of service.
- Document business drivers.
- Create an asset management plan.
- Quantify Asset Risks to Construct Mid- and Long-Term Renewal Forecasts ("Risk-Based CIP").
- Evaluate asset rehabilitation and replacement.
- Integrate O&M and CIP analysis.
- Map business processes.
- Refine an asset data framework.
- Develop continuous improvement performance dashboard.

13.3 Maintenance and Staffing Recommendations

Adequate staffing is necessary to support the implementation of the recommendations contained in this report for an enterprise-wide CMMS and an asset management program. In addition to the changing roles of staff in the maintenance management process, the most successful agencies have also implemented dedicated staff positions to support the ongoing development of these programs. These positions typically include:

CMMS Manager – This position would be a full-time resource for the selected enterprise-wide CMMS. This role would be the resource to direct and assist with the implementation and configuration of the CMMS, would develop customized reports, provide end user training and technical support, manage the quality of data and its structure in the CMMS, and make sure that the CMMS becomes integrated into the business practices of Public Works as intended.

Asset Program Manager – This position is typically full-time and a supervisory level person to direct and manage the implementation of the asset management program as outlined in the previous section. The position would also assist with overall planning and scheduling of maintenance work, assist with inventory management, and assist with long-term rehabilitation and replacement planning. The Asset Program Manager would provide guidance to the CMMS Manager on the best data standards, business processes, and tools to support the asset management program. This position would also support the necessary

reporting, analysis, and recommendations needed by leadership at Public Works and the City.

14.0 NEXT STEPS

Public Works' needs and preferences for the CMMS were identified, key related business processes were updated or developed and mapped, preliminary asset management enhancements identified, and the ultimate goal of identifying a shortlist of likely CMMS software vendors was attained. The important next steps over the next couple of years include CMMS software evaluation and selection, implementation, integration, and potentially optimization as needed.

Either in parallel to these CMMS software efforts or near the end of them, Public Works can pursue the development of its asset management practice through some of the preliminary asset management enhancements previously mentioned. Like CMMS, the establishment of an asset management program can be a multi-year effort as well, and thus the recommendation may be made to begin pursuing the asset management enhancements in parallel with the CMMS at some point, which would also help to integrate the CMMS better into Public Works so that it can better realize its full power to assist with maintenance, minimize cost, attain service levels, and manage risk.

APPENDIX A - CMMS SURVEY AND RESULTS



WD	WD	GIS/IT
Responder Name: Rod Paniagua	Responder Name: Ruben martinez	Responder Name: Jonathan Houck
Department/Division: Utilities Dept./Water Division	Department/Division: Water Dept.	Department/Division: Information Systems
Title: Senior Water Distribution Operator (Interim)	Title: Senior Meter Repair Worker	Title: Systems Analyst II
E-mail: rod.paniagua@ci.oxnard.ca.us	E-mail: ruben.martinez@ci.oxnard.ca.us	E-mail: jonathan.houck@ci.oxnard.ca.us
Phone: (805) 385-8154	Phone: (805) 385-8152	Phone: 805-385-7838
Date: 5/1/15	Date: 4/29/15	Date: 4/27/2015

If you have questions, please email Shawn Dent at sdent@carollo.com and include WWT#

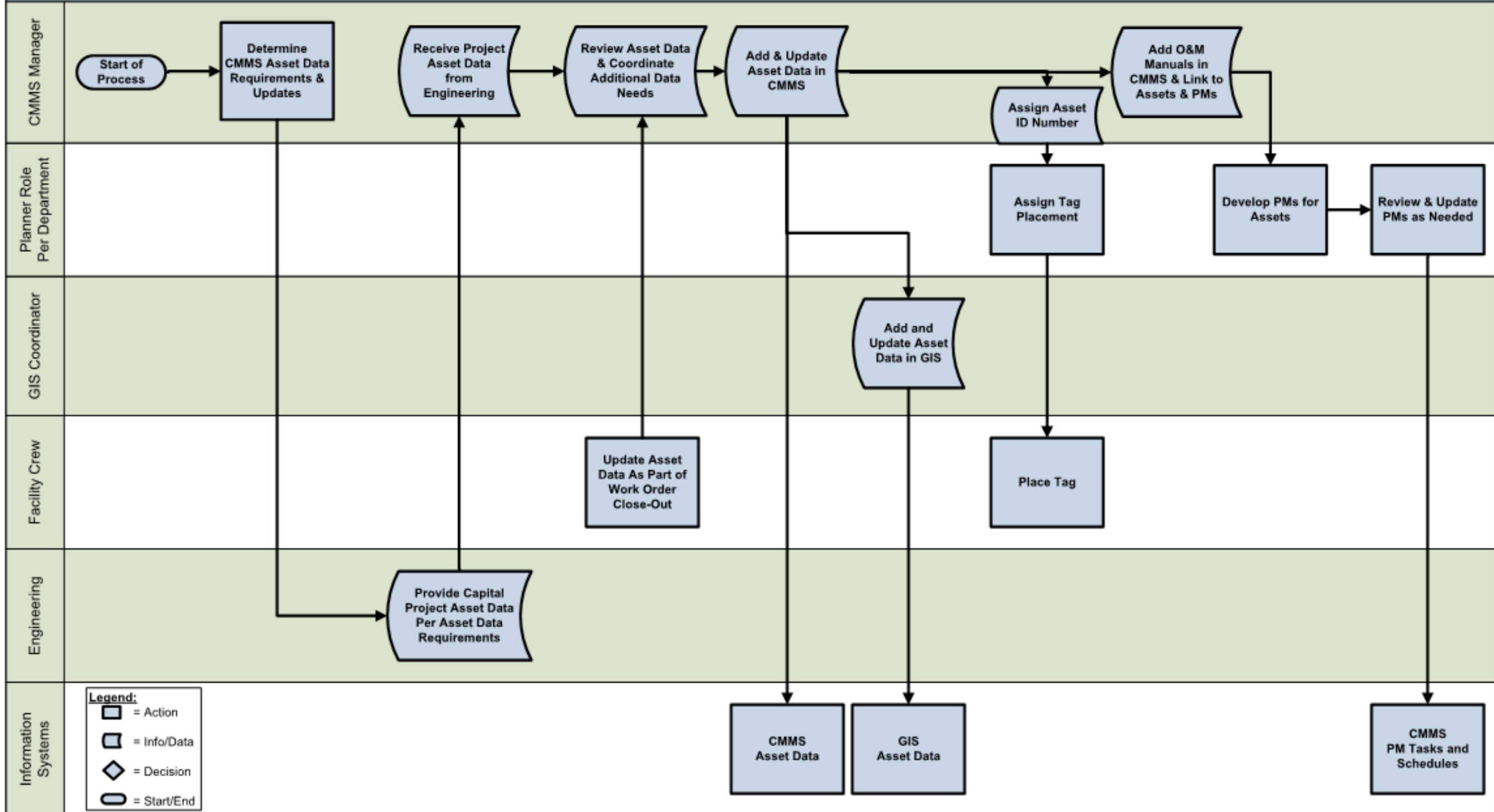
Responder Name: JEFF PALACIO	E-mail: jeff.palacio@ci.oxnard.ca.us	E-mail: rod.paniagua@ci.oxnard.ca.us	E-mail: ruben.martinez@ci.oxnard.ca.us	E-mail: jonathan.houck@ci.oxnard.ca.us
Department/Division: Utilities / Wastewater / Maintenance	Phone: (805) 271-2208	Phone: (805) 385-8154	Phone: (805) 385-8152	Phone: 805-385-7838
Title: Wastewater Maintenance Supervisor	Date: April 30, 2015	Date: 5/1/15	Date: 4/29/15	Date: 4/27/2015

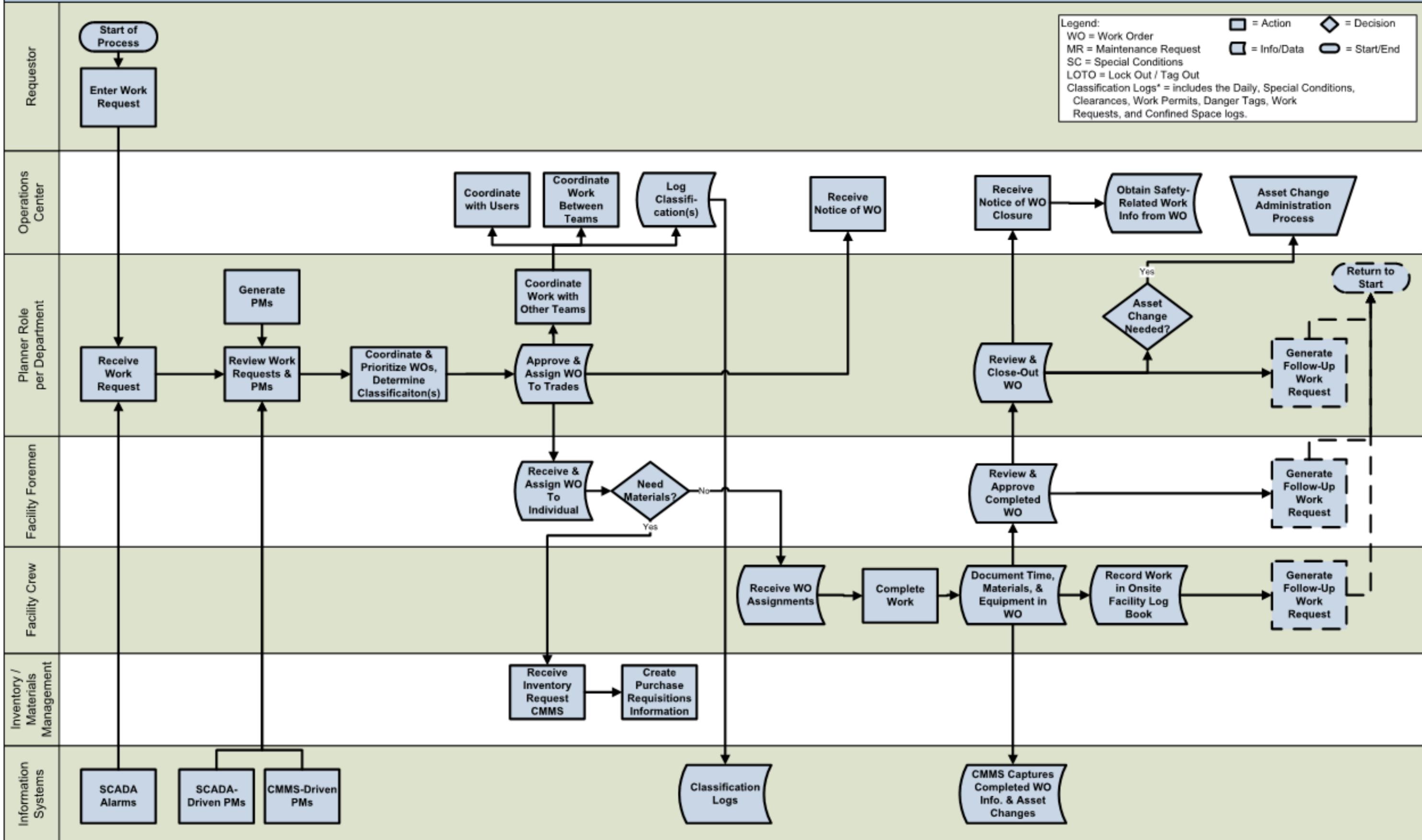
Question No.	Question	Response	Response	Response	Response
FUNCTIONALITY/USERS					
A.	Which of the following functions and activities do you anticipate to utilize in the CMMS? Respond with Yes/No/Maybe/NA with comments for clarification as needed.			YES	
1	Internal service or work requests	YES	YES	YES	Yes
2	External customer/agency service or work requests	NO	YES	YES	Maybe
3	Corrective work orders and work management	YES	YES	YES	Yes
4	Preventive maintenance tasks and scheduling	YES	Yes	MAYBE	Yes
5	Staff/equipment resource planning and utilization	YES	Yes	MAYBE	Yes
6	Inventory management for spare parts and materials	YES	YES	YES	Maybe
7	Asset management (includes inspections, condition assessment, risk prioritization, remaining useful life determination, and R&R projects/costs)	YES	NO	NO	Yes
8	Capital projects management and tracking	YES	NO	NO	Maybe
9	Contracts management and tracking	YES	NO	NO	Maybe
10	Fleet management for trucks, vehicles, and heavy equipment	YES	Maybe	NO	Maybe
11	Permitting, licensing, and land management	NO	NO	NO	No
12	Lock-out/Tag-out	YES	Maybe	NO	No
13	Timekeeping	MAYBE - YES	YES	YES	No
14	Other				
B.	Approximately how many users in your organization are involved in the following activities and would be expected to input to and/or retrieve information from the CMMS on a regular basis (at least weekly)? Estimated ranges are acceptable. Indicate as approximate number of assets for your Public Works Department Service (i.e. Water, Wastewater, Storm, Recycled, Streets):				
1	Internal service or work requests	40 approx.	Approx 4-6	3	
2	External customer/agency service or work requests	yes	Approx 4-6	3	
3	Corrective work orders and work management	30	Approx 4-6	3	
4	Preventive maintenance tasks and scheduling	1-6	Approx 4-6	1-2	
5	Staff/equipment resource planning and utilization	8	Approx 4-6	2	
6	Inventory management for spare parts and materials	8	Approx 4-6	2	
7	Asset management (includes inspections, condition assessment, risk prioritization, remaining useful life determination, and R&R projects/costs)	6	0	0	
8	Capital projects management and tracking	6	0	0	
9	Contracts management and tracking	6	0	0	
10	Fleet management for trucks, vehicles, and heavy equipment	6	0	0	
11	Permitting, licensing, and land management		0	0	
12	Lock-out/Tag-out	15-20	Approx 4-6	0	
13	Timekeeping	6	2	2	
14	Other				
C.	Of the previous users, how many will be potential "Mobile Users" that may need to access the CMMS while in the field (with or without wireless network connection)?	3	14	13	
D.	Approximately how many users will be CMMS "System Administrators" with functionality such as security permissions, database management, software patches/upgrades, custom screens/fields configuration?	6	2	0	
E.	Approximately how many users will be considered CMMS "Power Users" that have the ability to create custom reports, configure workflows, bulk upload/download data, manage asset IDs, etc.?	1-8	Approx 4-6	0-1	
F.	If cost effective, would you consider an Enterprise Licensing Agreement (ELA) that provides unlimited users to all CMMS modules?	YES	MAYBE	MAYBE	
TECHNICAL					
G.	Do you prefer an internal/self-hosted or external/cloud-based CMMS solution, or either based on lowest total cost?	EITHER BASED ON LOWEST COST	N/A	N/A	Self-hosted
H.	If you have an existing CMMS, what is it and its version?	Infor MP2 / VERSION 2.1	HANSEN 7	HANSEN 7	Hansen 7
I.	What is your standard enterprise relational database and version?	Infor MP2 / VERSION 2.1	?	N/A	SQL Server 2012
J.	What is your standard enterprise reporting tool(s) and version?	Infor MP2 / VERSION 2.1	?	N/A	Access 2010, some Crystal Reports
K.	What is your standard server hardware platform and operating system?	WINDOWS XP	SQL Server Windows	N/A	Windows Server 2012 (Virtualized with VMWare)
L.	What is your standard desktop/workstation hardware platform and operating system?	WINDOWS XP	CPU WINDOWS 7	CPU WINDOWS 7	Windows 7 Professional
M.	What is your standard mobile laptop and/or tablet hardware platform and operating system?	N/A	Mac Ipad	DELLS/ WINDOWS	Windows 7 Professional/iOS
N.	What is your standard mobile phone/data provider, hardware, and operating system?	VERIZON WIRELESS	SAMSUNG AND iPhones/ VERIZON	SAMSUNG AND iPhones/ VERIZON	Android/iOS
INTEGRATION					
O.	What existing software/systems do you anticipate needing some level of integration with the CMMS? If applicable, indicate software name, modules, and version(s) and potential integration points (if known).				
1	GIS (mapping, asset locations, vehicle locations, routing)	YES	City GIS	City GIS	Esri ArcGIS 10.3 Desktop/Server
2	Financial/ERP	YES	NO	NO	Sungard Public Sector AKA H.T.E.
3	Procurement	YES	NO	NO	
4	Inventory	YES	NO	NO	
5	Fleet Management Software (fleet maintenance)	YES	NO	NO	
6	Fuel Management Software (fleet fuel usage)	YES	NO	NO	
7	CCTV Inspection Software (inspection videos and data)	YES	NO	NO	WinCan 8

Question No.	Question	Response	Response	Response	Response
8	Enterprise Resource Planning (ERP)/Accounting Software (purchasing, inventory, fixed assets, GL codes, budget/cost, employees, projects)	YES	NO	NO	
9	Timekeeping (labor hours, employees, costs)	YES	YES	YES	
10	Supervisory Control and Data Acquisition (SCADA) (run-times, condition, performance)	YES	NO	NO	
11	Project Management Software (projects, budgets, CIP plans)	YES	NO	NO	
12	Document Management System (electronic documents, records)	YES	NO	NO	
13	Enterprise Reporting/Business Intelligence (BI) Tools (reporting, analysis, dashboards)	MAYBE	NO	NO	WIMS
14	GPS Locators (location identification, vehicle tracking)	YES	NO	MAYBE	
15	Inspection Photos/Video (non-CCTV)	YES	NO	NO	
16	Other				Street Saver (Pavement)
P.	Is a standard ESRI ArcGIS geodatabase model being used (e.g. Water Utilities, Pipeline, Local Government, Streets, Light/Power)? List the versions, modules and packages.	NOT AT THIS LOCATION			Local Government Data Model for Water, Sewer, Storm
Q.	Do you have a preferred method of software systems integration (e.g. web services, API, middleware, database ETL)?	DATABASE. DEPENDING ON COST			Web Services, Database Synchronization
IMPLEMENTATION AND SUPPORT					
R.	Do you anticipate having an outside vendor convert and upload data into the CMMS from existing data sources (hard copy, spreadsheets, databases, etc.)? If so, what are these existing data sources and what is an estimated number, format, and size of records to be converted for the following?	YES, all information in on a local data base in maintenance shop. Total size of all data information is approx. 6.9 MB			Yes
1	Assets (see above list)	mp2 - 450	YES HANSEN	YES HANSEN	Will need to provide GIS export to
2	Preventive Maintenance Tasks/Schedules	mp2 - 181	MAYBE	MAYBE	
3	Previous Work Order History	mp2 - 30,000 from June 2006	YES HANSEN	YES HANSEN	
4	Warehouses/Inventory/Spare Parts	0	YES	YES	
5	Vehicles	45	YES	YES	
6	Personnel	0	N/A	N/A	
7	Projects	0	N/A	N/A	
8	Contracts	0	N/A	N/A	
9	Labor/Equipment/Material Costs	0	YES	MAYBE	
10	Other				
S.	Would it be acceptable for the software implementation provider to conduct a majority of the software configuration off-site/remotely?	YES	MAYBE	MAYBE	
T.	What are the numbers of users that are anticipated to be involved in CMMS training for the following roles (may match the number of users/licenses):		14	13	
1	System Administrators (database management, software patches/upgrades, security permissions, custom screens/fields configuration, etc.)?	6	0	0	2
2	Power Users (custom reports, configure workflows, bulk upload/download data, manage asset IDs, etc.)	1-6	Approx 14	0-1	
3	End Users (service requests, work orders, PMs, inventory, etc.)	8	Approx 4-6	3	
4	Train-the-Trainer (to be used for training staff to train end users)	5	Approx 4-6	3	
U.	Will you procure the required server and client hardware for the CMMS or will the software vendor be expected to include this in their implementation contract?	Either depending on hardware requirements	N/A	N/A	
V.	What level of ongoing technical support do you typically expect from a software vendor from 1 to 5 (1-little/no support and 5-highest level support available)?	5 for at least the first 12 months to insure we completely understand the software, then 3	3	3	
W.	For ongoing application support, will your organization provide its own customization and configuration or do you anticipate relying on outside vendors or 3rd party providers?	What ever the city implement will be ok with WW maintenance section	N/A	N/A	
ASSETS					
X.	Which of the following asset types or classes do you intend to manage with the CMMS? If possible, estimate the number of individual assets (ranges are acceptable). Indicate as number of assets for each Public Works Department Section (i.e., Water Treatment, Distribution, Collection, Wastewater Treatment, Recycled, Stormwater, Streets): Also, please attach your current asset hierarchy structure for each Service (Water				
	Structural Assets:				
1	Structure: Occupied Space, Buildings	13 - 20 WW Maintenance	N/A	N/A	
2	Structure: Contains Flow - Channels, Junction Boxes, and Basins	20 - 50 WW Maintenance	N/A	N/A	
3	Vaults	25 - 60 WW Maintenance	MAYBE	MAYBE	
4	Manholes	50 - 75 WW Maintenance	N/A	N/A	
	Civil Assets:				
5	Civil: Earthwork/Pond/Landscaping/Grading/Abutments (non-street)	0	N/A	N/A	
6	Facility Roadways and Sidewalks (in-the-fence)	0	N/A	N/A	
7	Landscaping	0	N/A	N/A	
8	Fencing/Gates/Physical Security Protection	0	N/A	N/A	
9	Distribution System Piping	0	Approx 600 Miles	N/A	
10	Collection System Piping	0	N/A	N/A	
	Mechanical Assets:				
11	HVAC equipment	25 40 Wastewater Maintenance	N/A	N/A	
12	Process Equipment - Large	40 - 50 Wastewater Maintenance	N/A	N/A	
13	Process Equipment - Small	50 - 100 Wastewater Maintenance	N/A	N/A	
14	Pumps	20 - 100 Wastewater Maintenance	N/A	N/A	
15	VFDs	50 - 70 Wastewater Maintenance	N/A	N/A	
16	Distribution System Piping	0	N/A	N/A	
17	Recycled Water System Piping	0	N/A	N/A	
18	Compressed Air Systems	25 Wastewater Maintenance	N/A	N/A	
19	Fuel Containing or Burning	5 Wastewater Maintenance	N/A	N/A	
20	Yardpiping	0	N/A	N/A	
21	Chemical Equipment	25 - 30 Wastewater Maintenance	N/A	N/A	
22	Odor Control	4 Wastewater Maintenance	N/A	N/A	
23	Valves/Gates/Actuators	20 - 30 Wastewater Maintenance	Approx 16,000	N/A	
24	Hydrants	0	Approx 7,000	N/A	
	Electrical, Instrumentation, and Control Assets:				
25	Switchgear and Transfer Switches	12 Wastewater Maintenance	N/A	N/A	
26	MCC		0 N/A	N/A	
27	Transformers		0 N/A	N/A	
28	Generators	15 Wastewater Maintenance	N/A	N/A	
29	Electrical Equipment		0 N/A	N/A	
30	Instrumentation and Control Equipment		0 N/A	N/A	
31	Flow Meter	12 Wastewater Maintenance	YES	YES	
32	Meters		0 Approx 40,000	YES	
33	Junction Boxes	0	N/A	N/A	
34	Fiber Optic Cable	0	N/A	N/A	
35	Cable - Other	0	N/A	N/A	
36	Cellular Antennas	0	N/A	N/A	
37	Cathodic Protection	0	N/A	N/A	
38	WiFi	0	N/A	N/A	
39	Security Systems (i.e., cameras, remote/auto surveillance.	2 Wastewater Maintenance	N/A	N/A	
40	Site Lighting	0	N/A	N/A	
	Stormwater:				

Question No.	Question	Response	Response	Response	Response
41	Stormwater Piping		N/A	N/A	
42	Catch Basins/Inlets (storm)		N/A	N/A	
43	Culverts		N/A	N/A	
44	Open Channels - Small		N/A	N/A	
45	Wetlands		N/A	N/A	
Water Resources:					
Streets:					
Vehicle/Fleet Assets:					
Office/Ancillary Equipment:					
76	Computers		NO	NO	
77	Servers		NO	NO	
78	Office Furniture		NO	NO	
List and describe other assets here. For additional City services, attach an asset hierarchy:					
MISCELLANEOUS COMMENTS					
Y.	Please provide additional information that is important to you but not covered above regarding CMMS software needs.				

APPENDIX B - CMMS BUSINESS PROCESS MAPS





**APPENDIX C – FUNDAMENTAL ASSET MANAGEMENT
RECOMMENDATIONS SUMMARY**

Discussion on Asset Management Recommendations

The focus of this CMMS assessment for the City of Oxnard Public Works Department project was to evaluate the Department's CMMS needs. However, during this assessment, the assessment team was able to become somewhat exposed to the existing asset management endeavors that the Department already has underway already and some noteworthy needs. Carollo has identified some asset management steps that the Department may want to take to address its needs and potential future assets. These are being identified because the CMMS is a part of the greater asset management effort. Also, to more fully leverage the CMMS in the asset management effort, some consideration must be given to the asset management capabilities and improvement opportunities that exist at the Department. These are identified generally discussed below.

Strategy

- **Develop or Refine Levels of Service.** These are used to determine the direction that daily efforts and decisions need to follow. These also are used to inform the likelihood and consequence of failure criteria used in assigning asset risk and to focus the direction and priorities of the organization on its mission to serve customers with a reliable, high-quality water supply. Metrics, known as key performance indicators (KPI), to measure the attainment of this mission should be developed and reviewed annually. The next generation of Department employees need a more structured approach to deal with key staff retirements and subsequently lost institutional knowledge to still attain such quality performance. The higher mobility of the next generation of employees among employer will also require a greater amount of institutional knowledge to be documented and formalized so that it may be communicated and transitioned more readily. The CMMS is a great tool to utilize in part for this, and the practice of asset management can help to enable it.
- **Document Business Drivers.** They exist, but they need to be documented so that they may be communicated and understood internally now and for reference in the future. Identifying specific business drivers for asset management is important to establish the intent, direction, and priorities of an asset management program. Some such business drivers include data optimization, cost reduction, risk identification and management, project prioritization and coordination and institutional knowledge capture and transfer for coming generational retirements, among others.
- **Create Asset Management Plan.** Asset management is more than a tool, such as CMMS. Asset management is a mindset and an ongoing way of performing daily business. It is a strategic practice requiring organizational capabilities to minimize cost, maximize asset value, meet committed service levels, and manage risk. Establishing a formal asset management program in the near future is important to develop approaches and structures for managing existing assets and potential future ones. An asset management plan is a useful source to develop to document

and communicate key strategies, risks, capital needs, and planned asset management improvements and approaches. The rehabilitation and replacement and CIP business processes should be refined and documented in a map to chart the path to such an asset management program while leveraging the CMMS to expedite such efforts. Such an asset management plan should include the development of the strategy for asset management including mission, vision, guiding policies, barriers to change, and communication planning. The plan should also include an implementation roadmap for asset management practice improvements that clearly itemizes these enhancement activities and indicates their timing and sequencing. Such a plan should also consider the level of effort for staff.

- **Quantify Asset Risks to Construct Mid- and Long-Term Renewal Forecasts ("Risk-Based CIP").** Identifying asset risk based on condition and criticality is useful to prioritize maintenance and capital needs, conduct scenario model development and analyses of cost and risk trade-offs, consider redundancy, and transparently communicate justifiable investment needs, make rate cases, and defend decisions. The criticality component should be tied to specific levels of service for each of the City's service areas (wastewater treatment, streets, etc.). The condition and subsequently vulnerability components may be determined by a desktop analysis, condition assessment in the field, a combination, or by predictive failure analysis built on statistics and sound asset and performance data once established, monitored, and recorded. Risk helps to determine the prioritization and timing of renewal needs and enables scenario/alternatives/what-if analyses.
- **O&M CIP Integration.** This step involves the development and analysis of operations and maintenance costs on an asset-by-asset basis, and comparing these costs to the potential asset renewal costs developed in the previous step. The failure modes for various asset types are determined in order to minimize total capital and O&M costs, and to establish the preferred renewal method for each asset.

Roles & Processes

- **Map Business Processes.** Processes necessary for asset management need to be tied to the roles that participate in them. The processes need to be developed, refined, and communicated, which is often performed by mapping such processes. Some of these processes roles were mapped for this CMMS effort. Other applicable ones exist to consider and may need to be mapped depending on the ultimate CMMS chosen, and asset management needs and preferences.

Data

- **Develop an Asset Data Framework.** Ideally, this will be formulated in tandem with the establishment of CMMS. Not only does data need to be quality, it needs to be consistent, and accessible. The CMMS will help with this for asset data. In organizing the data for the CMMS, an asset hierarchy with a taxonomy and data standards appropriate to the Department's assets will need to be developed. Also, an asset register that identifies where various asset attributes for each asset type

will be housed or sourced from to the CMMS will need to be defined. Some existing taxonomy and hierarchies may be used or improved and revised to utilize in the asset data framework.

Performance Monitoring

- **Develop Continuous Improvement Performance Dashboard:** The idea here is to measure and monitor to the performance of the asset management effort (and other efforts) at the Department to enable performance management and continual improvement. This could be formal dashboard or other tool(s) to monitor the KPIs and factors contributing to them against the committed levels of service to customers. These are useful in helping to attain the levels of service, to communicate and defend performance and decisions to stakeholders, and to document to communicate justification for rate cases. Continuous improvement is the feedback loop from the other steps in the asset management process to develop a continuously evolving and improving living asset management program.

