Town of Orangeville

SCADA Master Plan

Task 4
SCADA Master Plan Report v5.0

December 2024

Version	Date	Description of Revision
1.0	June 2024	Draft Submission
2.0	July 2024	Revised based on internal QA/QC (Corix)
3.0	August 2024	Revised based on internal QA/QC (Rick & Tara)
3.1	September 2024	Revised based on Ulteig internal review
4.0	November 2024	Revised based on October 29, 2024 review meeting
5.0	December 2024	Revised based on December 2, 2024 Council draft approval

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Section 1 Executive Summary

1.1 Project Scope

Ulteig Canada Inc. (Ulteig) was retained by the Town of Orangeville to review and evaluate the existing SCADA system in comparison with industry best practices and standards, clarify the Town's vision for the future and to develop recommendations for upgrades and improvements. This effort will guide and support budgets with a comprehensive operating and capital plan (10 years) for critical SCADA assets. This exercise includes engaging the various stakeholders within the Town and defining their vision for the SCADA system including use, upgrades, enhancements, and integration with other Town systems. New technologies and architecture were discussed to ensure efficiency and future proofing to address reduced labour costs and the overall cost of ownership. In addition, technological advances and the current performance of the existing system was considered as part of the strategy to minimize risk associated with technological obsolescence. The master plan identifies a standardized system and the high-level SCADA standard for software, procedures, functionality and hardware that will guide the Town over the next ten years in their development of a unified and robust SCADA system. This project consists of the following key tasks including:

1. Task 0 – Project Management
2. Task 1 – Inventory and Assessment
3. Task 2 – Gap Analysis (Current State vs Vision)
4. Task 3 – Implementation Plan
5. **Task 4 – SCADA Master Plan Report**
6. Task 5 – Project Closure

The final SCADA Master Plan report is a consolidation of all deliverables, including description, summary of the SCADA master plan along with a cash flow analysis, implementation chart that illustrates all action items and how they fit together. As part of the final documentation package, an implementation cost tracking excel sheet is included that captures and compares engineering, equipment, resources, operations, and construction forecasted costs.

1.2 Reference Documents

The following background documents are referenced in the current SCADA master plan report:

1. 23.24342 Orangeville SCADA Inventory & Evaluation v3.0 excel
2. 23.24342 Orangeville Gap Analysis Technical Memo v3.0
3. 23.24342 Orangeville Implementation Plan v5.0
4. 23.24342 Orangeville SCADA Platform Comparison v2.0 excel
5. 23.24342 Orangeville SCADA Packages Cost Estimates v7.0 excel

1.3 SCADA Master Plan Approach

Based on previous assessments of the SCADA system coupled with the SCADA inventory workshops with the Town's personnel, it was determined that the Town of Orangeville's SCADA system must be updated in line with new SCADA Standards which should be developed to ensure uniform approach to SCADA integration. Mature programmable logic controllers (PLCs) like SCADAPack32 and some older models of Allen Bradley controllers should all be replaced by the active lifecycle Rockwell/Allen Bradley ControlLogix/CompactLogix controllers, I/O modules and ethernet cards. The current AVEVA InTouch HMI must be replaced with a more current SCADA and Historian platform. The final SCADA platform will be chosen by the Town separately based on their standard procurement process.

The future development of SCADA standards will ensure consistency and alignment with respect to the electrical equipment, instruments, control panels, alarming philosophy, documentation, historian tags which will allow for streamlined maintenance and operator training. The present system varies widely making new personnel onboarding, troubleshooting and maintenance challenging. The revised SCADA architecture will allow secure remote access from laptops, mobile phones and tablets while maintaining cybersecurity to enable operators to be more efficient and effective instead of having to travel to site frequently. Corporate users will be able to access the SCADA system via DMZ or Cloud servers to obtain real time and historical data, trends, reports, analytics for regulatory submission or internal review.

Currently, operators must access multiple servers, workstations and controllers of different third-party systems before taking appropriate action as the vendor supplied packages are not interconnected. Hence, it is crucial for the new SCADA system to be integrated with all the Town's third-party systems to act as the consolidated source of information, so that operators can be more effective with their time. These third-party systems include proprietary HMIs, grit system, asset management system, traffic management system, rain gauges, water meters, advanced metering infrastructure (AMI), local listening system Hydrant.AI, water pressure/water quality models, GIS, CRM/DWPS corrective action, Lab, chemical deliveries, Building Automation system, plant access control system, CCTV system, Protégé GX door management system and HVAC.

1.4 Master Plan Overview

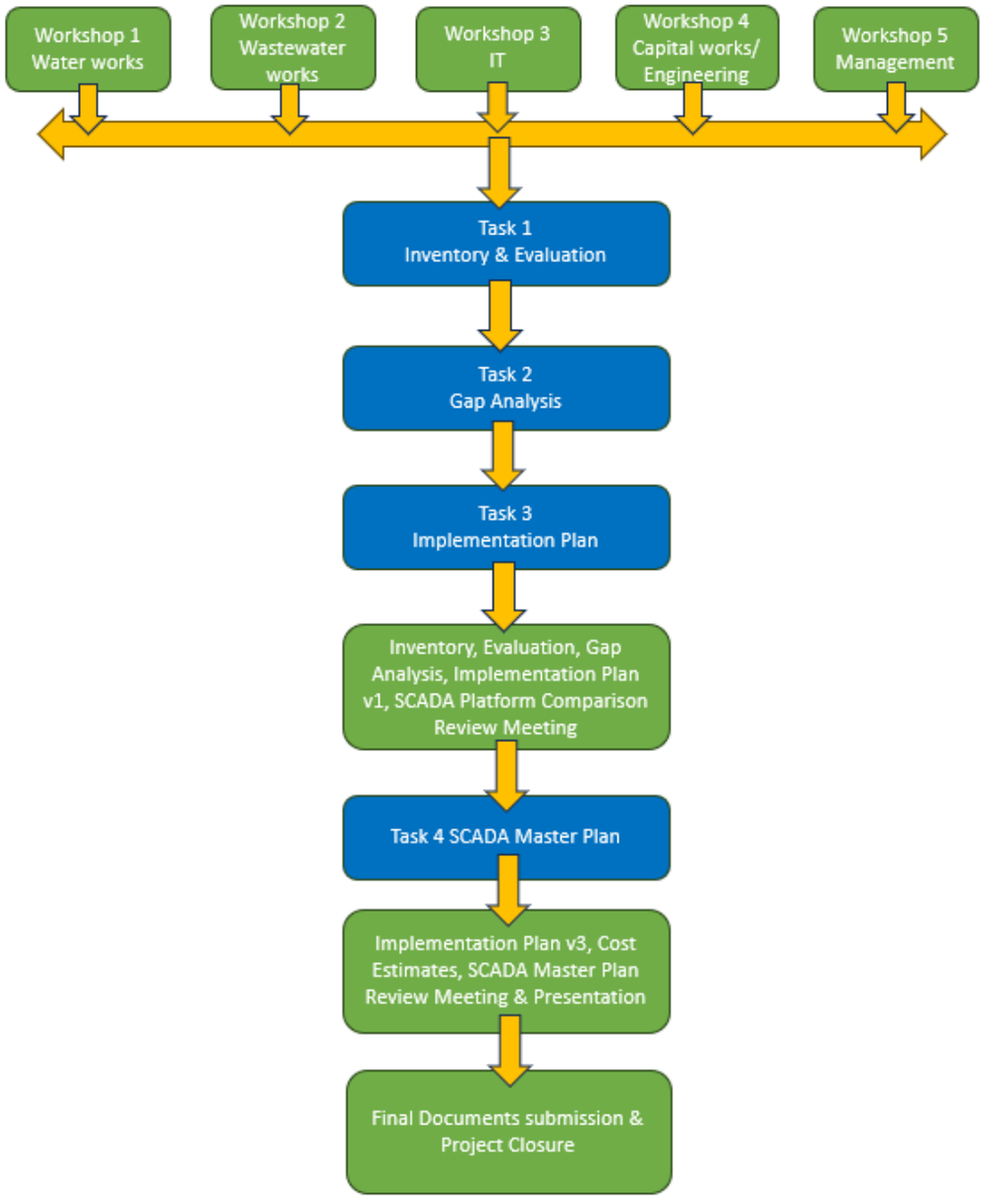

Figure 1 SCADA Master Plan Tasks

1.4.1 Task 1 - Inventory and Evaluation, Workshops 1-5

The objective of the inventory and evaluation was to update the previously completed site survey of all SCADA related hardware, software, networks and databases. The current state of the SCADA and other Town's systems, gaps, and barriers were obtained from the Town's personnel over the course of the following 5 workshops:

- Workshop 1 – with Water Works dated January 17, 2024
- Workshop 2 – with Wastewater works dated November 27, 2023
- Workshop 3 – with IT dated January 18, 2024
- Workshop 4 – with Capital Works/Engineering dated January 18, 2024
- Workshop 5 – with Management dated November 21, 2023

The deliverable for task 1 was the inventory and evaluation excel file that listed out 157 discussion points brought up during the workshops including many deficiencies in the current SCADA system, current state, desired state, recommended solution and the proposed work package which would implement this solution to reach the desired state. These discussion points are classified into the following main categories:

- Alarms
- Asset Management (AM)
- Civil
- Enterprise Resource Planning (ERP)
- Historical/Trends
- Human Machine Interface (HMI)
- Integration
- Network
- Power
- Process
- Regulation
- Security
- Servers
- Standards

The recommendations and proposed work packages from this assessment are carried forward throughout the remaining phases of the master plan with a suggestion of subsequent action plans developed to address them. The work packages form the foundation of the cost estimation and the budgetary proposal for the next 7 to 10 years.

1.4.2 Task 2 - Gap Analysis

The objective of the gap analysis task was to document all the deficiencies brought up in the inventory and evaluation workshops and develop remedial action plans that are aligned with the Town's SCADA vision. This involved identifying potential changes to the SCADA infrastructure, the current workflow of how information is retrieved, how the system is used and the stages that need to be considered to move towards the vision. The deliverable for task 2 was the gap analysis technical memorandum which listed the following deficiencies:

- SCADA standards: In the absence of SCADA standards, several facilities across water and wastewater have inconsistencies.
- PLC hardware: Install base consists of several SCADAPack32 and older Rockwell PLCs that require updating.

- SCADA and Historian platform: Multiple versions of AVEVA InTouch with segregated databases are present and should be updated to a unified modern SCADA system.
- Electrical equipment, control panels, instrumentation and control schematics require standardization across all facilities and sites.
- Regulatory reporting: Historian should auto generate the Ministry format compliant reports.
- Process improvements: Process areas like proprietary HMIs, grit system, filters, process and heat boilers, aeration blowers, chemical building, hand valves, well 6 and 11 pump control valves, Town's PRV valves should be connected to PLC and integrated into SCADA for accurate operations and control with full visibility.
- HMI displays and pop-ups: Revised SCADA HMI displays and pop-ups should implement ISA101 levels 1-4 screen navigation, high performance graphics along with descriptions, notes, standard operating procedures (SOPs), links to drawings and narratives for operator's use.
- Alarms: Revised HMI screens, pop-ups, alarm lists to include intuitive alarm name, description, setpoints, frequency, comments and SOPs to aid operations.
- Integration: Integration of all third-party systems with SCADA including building automation, asset management, CCTV, HVAC, traffic management system, water meters, AMI, CRM, and GIS.
- Other gaps related to the Historian, network, cybersecurity, servers and workstations, analytics and modelling were identified.

Based on the information the Town staff shared, several remedial work packages were discussed and assigned to address each deficiency of the current SCADA system. These work packages were described in the implementation plan.

1.4.3 Task 3 – Implementation Plan

The objective of the implementation plan was to develop a series of action plans in the form of future work packages that systematically address the problematic areas identified in the gap analysis technical memo, inventory and evaluation excel sheet. The action and implementation plan outlines a 7-to-10-year program consisting of short-term SCADA standards and pilot sites (1-3 years), mid-term SCADA remaining sites (5 years), long-term asset management, document management, analytics and systems integration review (6 years and above) and the 10 years inflation adjusted SCADA support and maintenance work packages. The SCADA upgrade work packages were quantified in terms of engineering design and material costs. An optimized schedule of implementation was developed to roll-out the upgrades in a logical and sequential manner minimizing rework and improving effectiveness. The implementation plan was developed in two stages: version 1.0 included all the work packages linked with the gap analysis feedback, and version 2.0-5.0 included the cost estimates, systems integration and the revised content from version 1.0.

1.4.4 Review Meeting 1 (Task 1-3 review, SCADA Comparison)

A review meeting was conducted with the Town to evaluate the deliverables of task 1 inventory and evaluation excel sheet, task 2 gap analysis technical memo and task 3 implementation plan 1.0, which included the work packages information but not the cost estimates. Additionally, a SCADA platforms comparison spreadsheet was presented comparing various modern SCADA systems mapped to the

Town's needs that were identified during the inventory and evaluation workshops. The final SCADA platform will be chosen by the Town separately based on their standard procurement process.

1.4.5 SCADA Master Plan

The final SCADA master plan consolidates all the deliverables with an executive summary. Included is a description and summary of the current master plan along with a cash flow analysis and implementation chart that illustrates all action items and how they fit together. As part of the final documentation package, the implementation cost tracking spreadsheet captures and compares engineering, equipment/material and construction forecasted costs.

1.4.6 Review Meeting 2 (Task 3-4 review)

A final review meeting was conducted with the Town to evaluate the deliverables from task 3 implementation plan v3.1 which includes work packages and their related cost estimates and task 4 SCADA master plan v3.0. A formal SCADA master plan technical presentation was completed to deliver the highlights of the project including the next 7-10 years SCADA upgrade capital and operating costs with a road map for implementing the steps to achieve the long-term SCADA vision for the Town.

1.4.7 Documents revision & closure

All the deliverables including Inventory and Evaluation, Gap Analysis, Implementation plan and SCADA Master plan are revised to accommodate Town's comments from review meeting2, Town's council members feedback and resubmitted.

Section 2 Capital and Operating Cash Flow Analysis

The resulting multi-year phased implementation plan consists of the following annual capital projects forecast (not including SCADA support and maintenance):

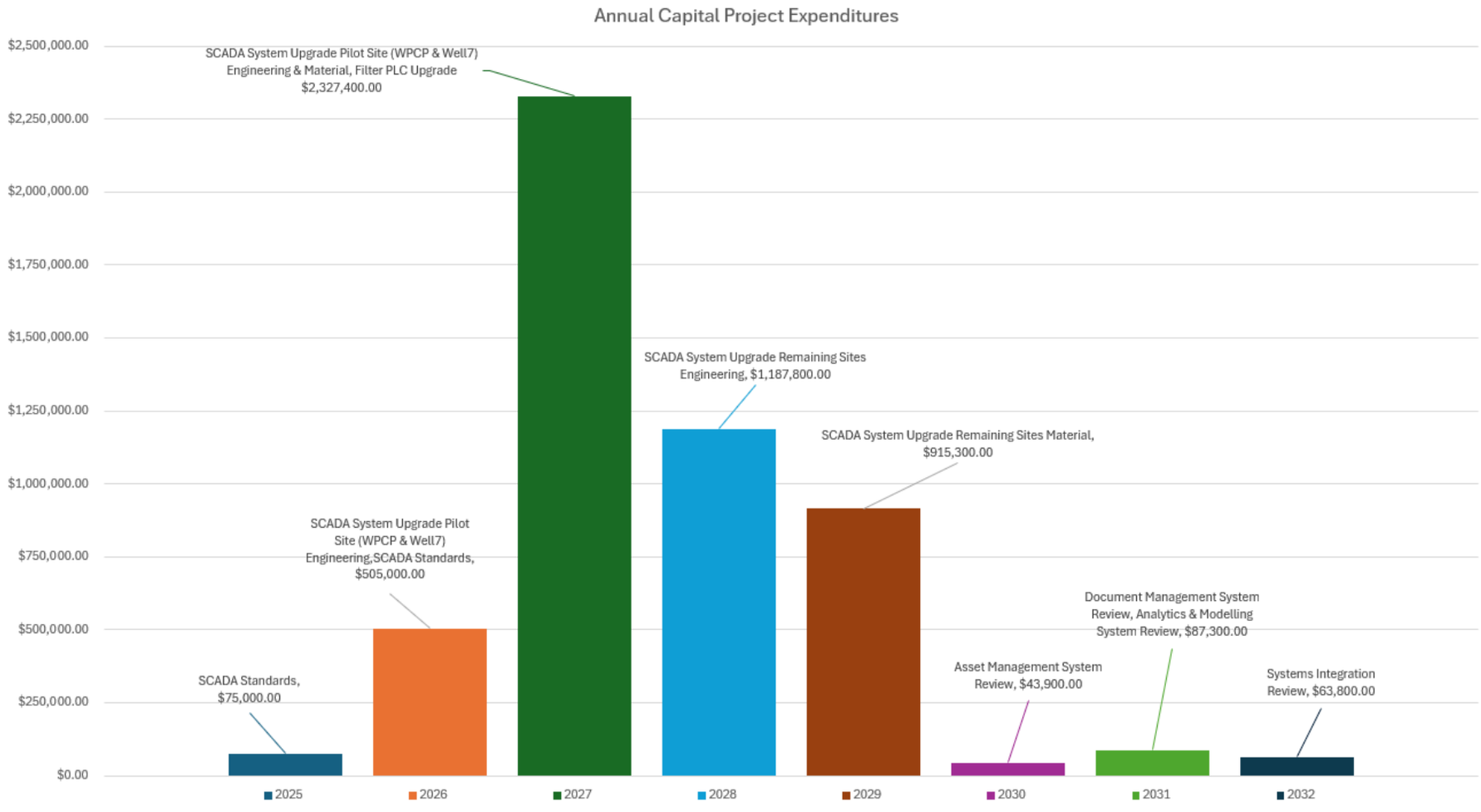

Figure 2 Annual Capital Projects with Estimated Expenditures

The initial standards investment provides the foundation to support the process upgrades, governance and infrastructure upgrades to enable the Town to leverage technology to continue to implement future growth. Subsequent work packages were developed according to risk of failure, impact on operations with respect to regulatory compliance and available resources to manage the design and implementation. Note that only capital projects have been included in the preceding annual forecast. SCADA support and maintenance work package is not included and its cost may vary depending on the SCADA platform chosen. Additionally, the SCADA Standards work package will commence in Quarter 3, 2025 after selection of SCADA Platform.

Table 1 SCADA Master Plan Capital Cost Estimate

Sl. No.	Work Package	Package Cost	Year	Annual Cost	Approved Budget	Balance Remaining
1.1	SCADA Standards	$75,000.00	2025	$75,000.00	$75,000.00	$0.00
1.2	SCADA Standards	$233,200.00	2026	$505,000.00	$505,000.00	$0.00
2.1	SCADA System Upgrade Pilot Site (WPCP & Well7) Engineering	$271,800.00	2026	-	-	-
2.2	SCADA System Upgrade Pilot Site (WPCP & Well7) Engineering	$430,300.00	2027	$2,327,400.00	$3,522,163.00	$1,194,763.00
2.3	SCADA System Upgrade Pilot Site (WPCP & Well7) Material	$1,522,100.00	2027	-	-	-
2.4	Filter PLC Project	$375,000.00	2027	-	-	-
3.1	SCADA System Upgrade Remaining Sites Engineering	$1,187,800.00	2028	$1,187,800.00	$1,195,000.00	$1,201,963.00
3.2	SCADA System Upgrade Remaining Sites Material	$915,300.00	2029	$915,300.00	$0.00	$286,663.00
4	Asset Management System Review	$43,900.00	2030	$43,900.00	$0.00	$242,763.00
5	Document Management System Review	$38,700.00	2031	$87,300.00	$300,000.00	$455,463.00
6	Analytics & Modelling System Review	$48,600.00	2031	-	-	-
7	Systems Integration Review	$63,800.00	2032	$63,800.00	$150,000.00	$369,263.00
	Total:	$5,205,500.00			$5,747,163.00	

2.1 Implementation Summary

The recommended implementation plan is based on the task 1 inventory and evaluation workshops held with water works, wastewater works, IT, capital works/ engineering and management groups and the subsequent task 2 gap analysis with respect to industry standards. The maintenance and upgrade of equipment and systems as well as the implementation of the gap analysis strategies has been grouped into 8 work packages that span a possible 7 to 10 year duration.

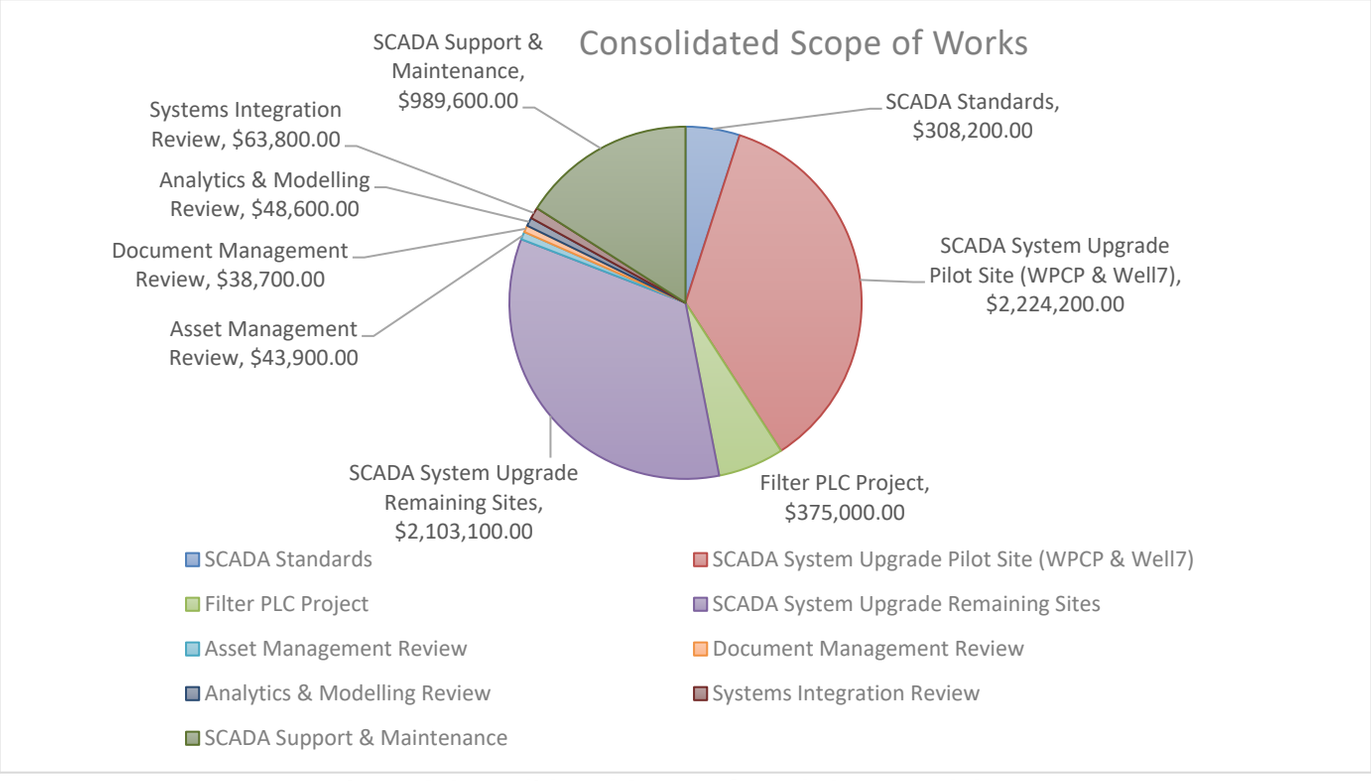

Figure 3 Consolidated Scope of Work Cost Breakdown

The work packages take into consideration a series of short initiatives that will help improve the current systems followed by upgrades as well as equipment lifecycle. The following work packages are listed as:

- Work Package 1 – SCADA Standards Development
- Work Package 2 – SCADA Systems Upgrade (Pilot Sites – WWTP and Well 7)
- Work Package 2a – Filter PLC Project (this is included from previous scope)
- Work Package 3 – SCADA Systems Upgrade (Remaining Sites)
- Work Package 4 – Asset Management System review
- Work Package 5 – Document Management System review
- Work Package 6 – Analytics and Modelling Systems review
- Work Package 7 – Systems Integration review
- Work Package 8 – SCADA Support and Maintenance

2.2 Proposed Implementation Schedule

The proposed implementation schedule is as follows:

Table 2 Proposed Implementation Schedule

Sl. No.	Work Package	Cost	Start	End	Duration
1	SCADA Standards	$308,200.00	Q3, 2025	Q2, 2026	12 months
2	SCADA System Upgrade Pilot Site (WPCP & Well7)	$2,224,200.00	Q3, 2026	Q2, 2028	24 months
2a	Filter PLC Project	$375,000.00	Q3, 2026	Q4, 2027	12 months
3	SCADA System Upgrade Remaining Sites	$2,103,100.00	Q3, 2028	Q2, 2030	24 months
4	Asset Management Review	$43,900.00	Q3, 2030	Q2, 2031	2 months with possible future work on TM approval
5	Document Management Review	$38,700.00	Q3, 2030	Q2, 2031	2 months with possible future work on TM approval
6	Analytics & Modelling Review	$48,600.00	Q3, 2031	Q2, 2032	2 months with possible future work on TM approval
7	Systems Integration Review	$63,800.00	Q3, 2031	Q2, 2032	3 months with possible future work on TM approval
8	SCADA Support & Maintenance	$989,600.00	Q3, 2027	Q2, 2037	10 years, cost will vary depending on SCADA platform
	Total:	$6,195,100.00			

2.3 Work Package Summary

Work packages have been identified throughout the previous inventory and evaluation, gap analysis tasks. It was identified early that the Town requires the development of a formal SCADA standard, SCADA and PLC hardware/software platforms, control panel and document templates. Additionally, it also became evident that work was needed on asset management, document management, analytics and modelling systems and integrating all third-party systems with SCADA. The work packages are structured as follows:

Work package 1 – SCADA standards development will be carried out quarters 3 2025 – Quarter 2 2026 after the final SCADA platform is chosen. The SCADA Standards work package which will define a standardized approach to PLC programming, HMI displays/pop-ups, SCADA and network architecture, hardware and software part numbers used, drawing and document templates, alarming, historian data collection, trend and report templates, panel design, tagging, testing and cybersecurity. The SCADA standards will ensure consistency across the SCADA system to facilitate construction, operation, data management, reporting, maintenance and will ultimately minimize the life-cycle cost of the system. This will also act as the template to be implemented in the subsequent work packages 2 and 3.

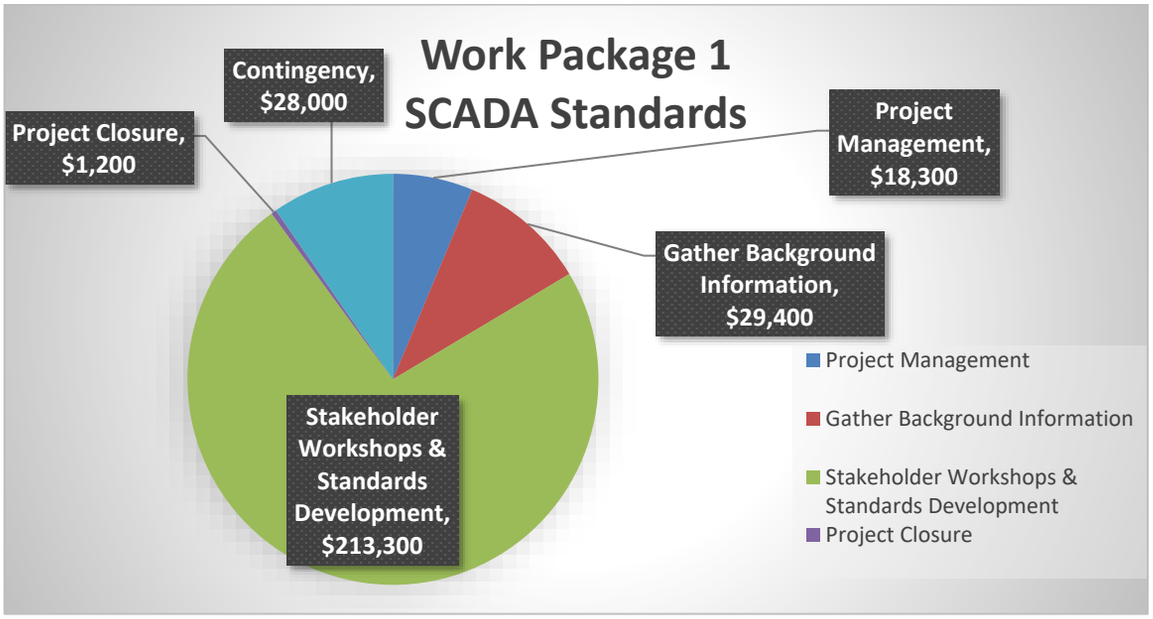

Figure 4 SCADA Standards Cost Breakdown

Work package 2 – SCADA systems upgrade for pilot sites (WWTP and Well 7) will be scheduled for quarter 3 2026 – quarter 2 2028. The finalized standards will be implemented to update the current PLCs and HMI to Rockwell/Allen Bradley CompactLogix/ControlLogix and the new SCADA system. The control panels, field wiring, alarms, historian tags, drawings and other documents will be revised according to the new standards. Field devices such as instruments, pumps, valves, tanks, and generators will be updated if required.

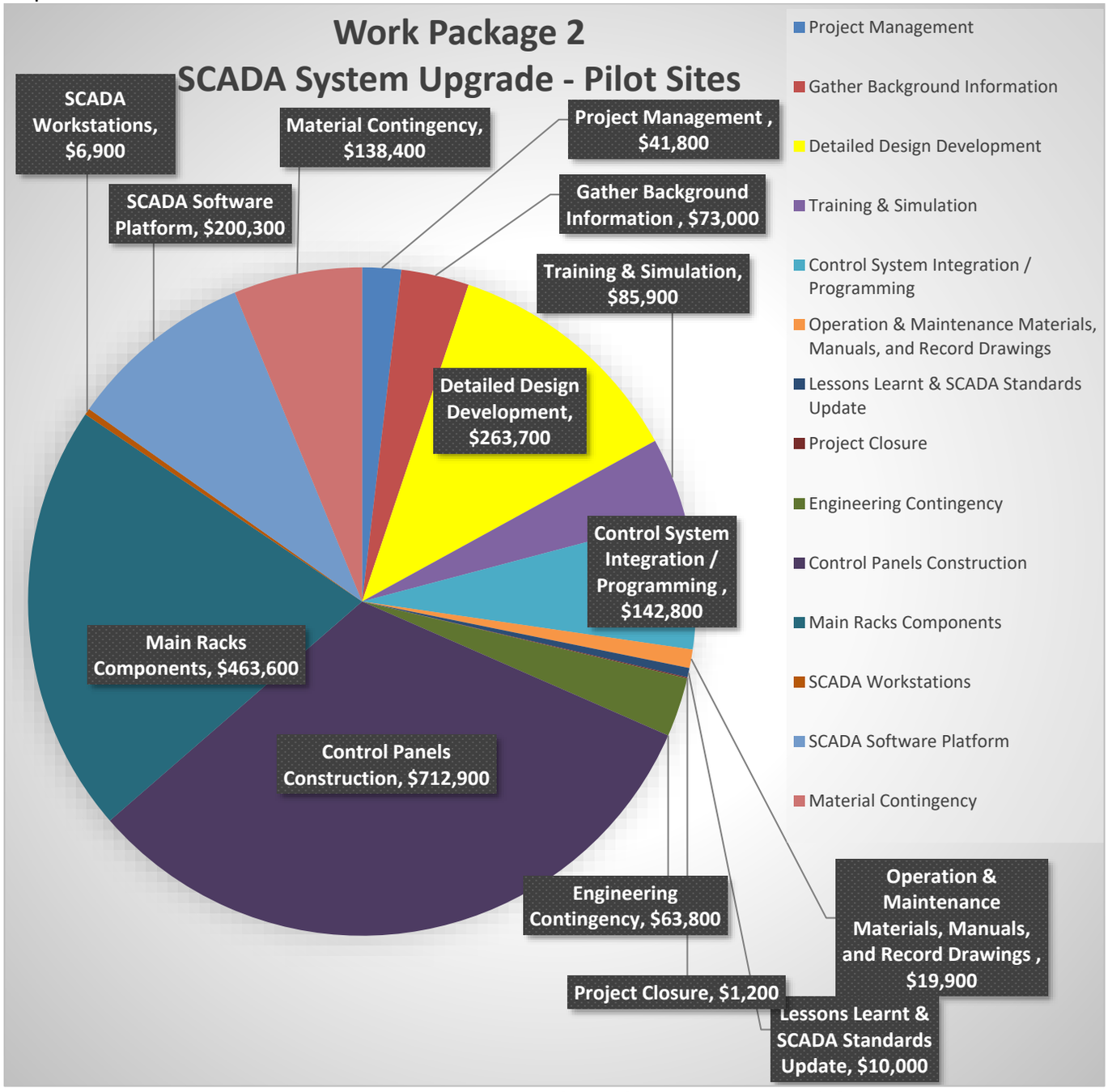

Figure 5 SCADA System Upgrade – Pilot Sites Cost Breakdown

Both water and wastewater require representative pilot sites, hence, the wastewater treatment plant (WWTP) and Well 7 have been selected for the initial implementation along with integration of SCADA with WWTP Building Automation System.

Work package 3 – SCADA systems upgrade for remaining sites is to be scheduled from quarter 3 2028 – quarter 2 2030.

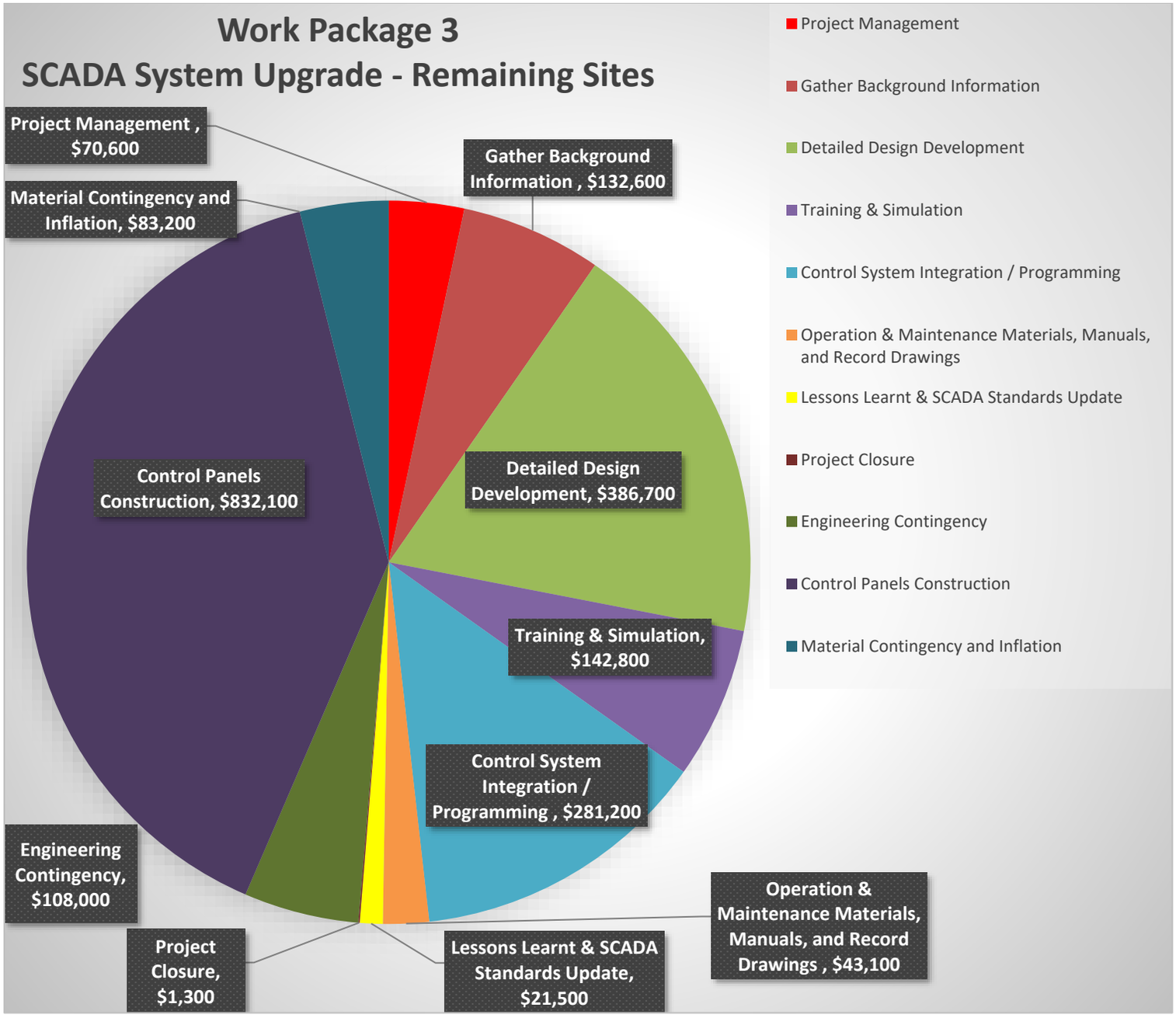

Figure 6 SCADA System Upgrade – Remaining Sites Cost Breakdown

The site commissioning will be scheduled keeping in mind peak demand seasons and other maintenance work. The remaining sites include Wells 2, 5, 6, 8, 9, 10, 11, 12, Standpipe, South Sector Reservoir, Young Court, West Tower, Buena Vista, Well 5 Booster Station and First Street Pumping Station. Once all the sites have been transitioned to the new SCADA system, the existing AVEVA InTouch SCADA can be decommissioned but until then, both the new and existing SCADA systems will run in parallel. Third party systems like Building Automation systems, splash pads, pool treatment, arena systems, Lab and chemical deliveries will also be integrated with SCADA.

Work package 4 – Asset management system review will be completed after quarter 3 2030 to review the possibility of integrating the asset management system with the new SCADA system and having the asset's live data, inventory management screen, work orders pop-ups and asset status detailed pop-ups natively on SCADA. A site investigation will be carried out to review this possibility, followed by preparation of a technical memorandum document with tasks and associated costs to integrate the two systems. A review meeting will then be conducted to review this information followed by revisions to the technical memo, if any. This work package can be a precursor to a more detailed asset management and SCADA integration work package if the Town chooses to move forward with the work proposed in the technical memo.

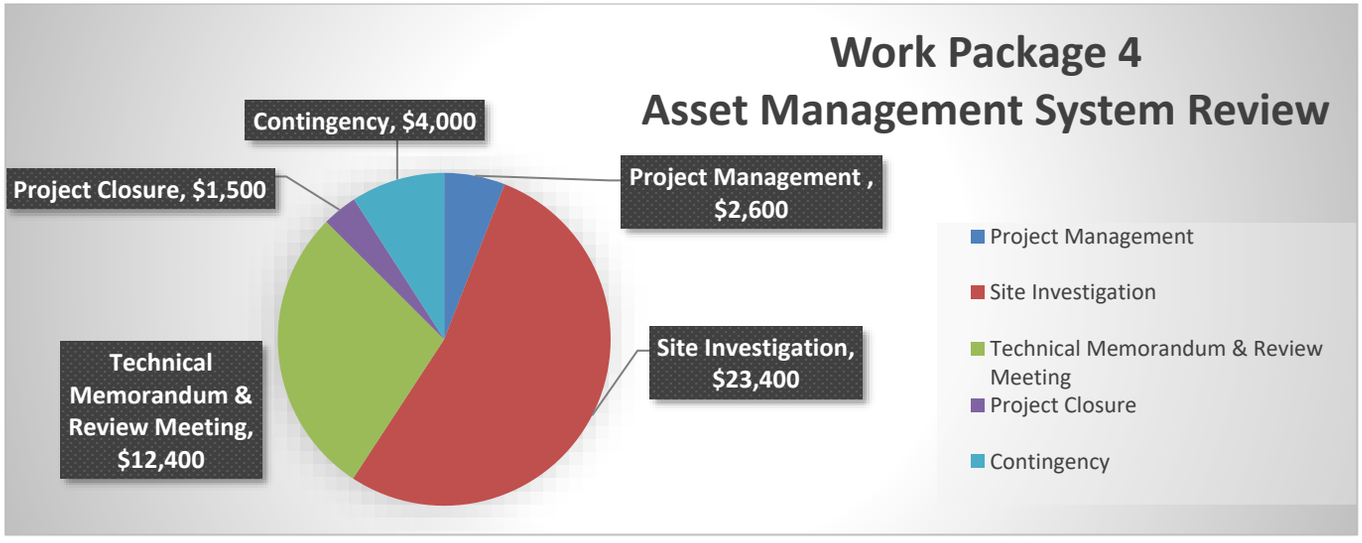

Figure 7 Asset Management System Review Cost Breakdown

Work package 5 – Document management system review to be scheduled after quarter 3 2030 to review the Town's EDMS (Electronic Document Management System)/ EDRMS (Electronic Document and Records Management System). A site investigation will be carried out to review how well the system is acting as a central repository for all documentation and is accessible with appropriate permissions by operators, contractors, consultants, corporate users, IT admins and engineers. This will be followed by the preparation of a technical memorandum with tasks and associated costs to resolve any gaps identified. A review meeting will be conducted to evaluate the information followed by revisions to the technical memo, if any. This work package can be a precursor to a more detailed document management system work package if the Town decides to move forward with the work proposed in the technical memo.

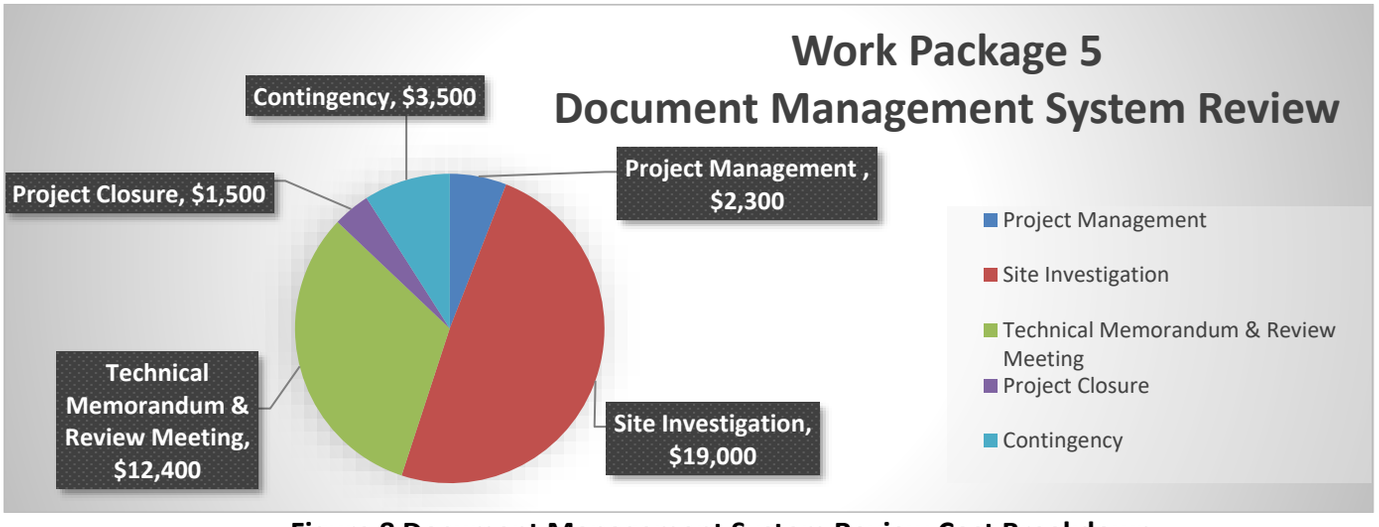

Figure 8 Document Management System Review Cost Breakdown

Work package 6 – Analytics and modelling systems review should be scheduled after quarter 3 2031 to review the current analytics and modelling software implemented by the Town's water and wastewater teams. A site investigation will be carried out to review the efficacy of the analytics systems for modelling the water and wastewater processes, followed by preparation of a technical memorandum with tasks and associated costs to resolve any gaps identified. A review meeting will then be conducted to review this information followed by revisions to the technical memo, if any. This work package can be a precursor to a more detailed analytics and modelling work package if the Town decides to move forward with the work proposed in the technical memo.

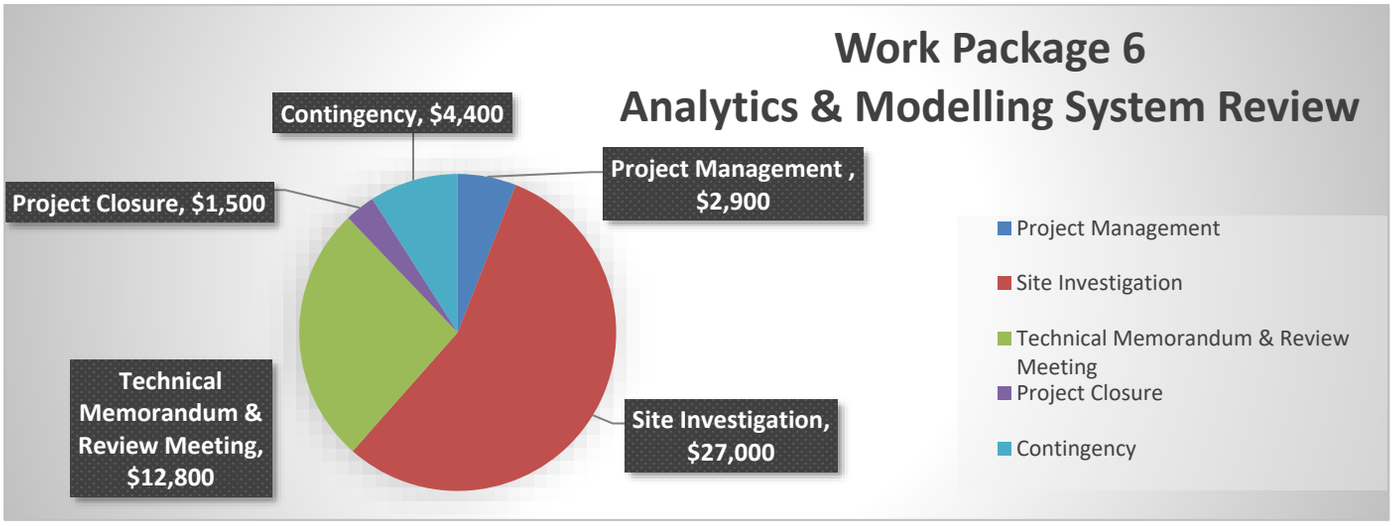

Figure 9 Analytics and Modelling System Review Cost Breakdown

Work package 7 – Systems Integration review will be carried out after quarter 3 2031 to review the possibility of integrating the Town's third-party systems with the new SCADA. Previously, during the development of SCADA standards and SCADA System Upgrade work packages, an attempt is made at either integrating these third-party systems with SCADA by directly connecting them to the PLC I/O or designing the SCADA is such a way to allow for future integration and data interfacing. A site investigation will be carried out to review any third-party system yet to be integrated with SCADA and the possibility of onboarding and visualizing its data on the new SCADA system. This will be followed by the preparation of a technical memorandum document with tasks and associated costs to perform the system integration. A review meeting will be conducted to review this information followed by revisions to the technical memo, if any. This work package can be a precursor to a possible more detailed systems integration work package if the Town chooses to move forward with the work proposed in the technical memo.

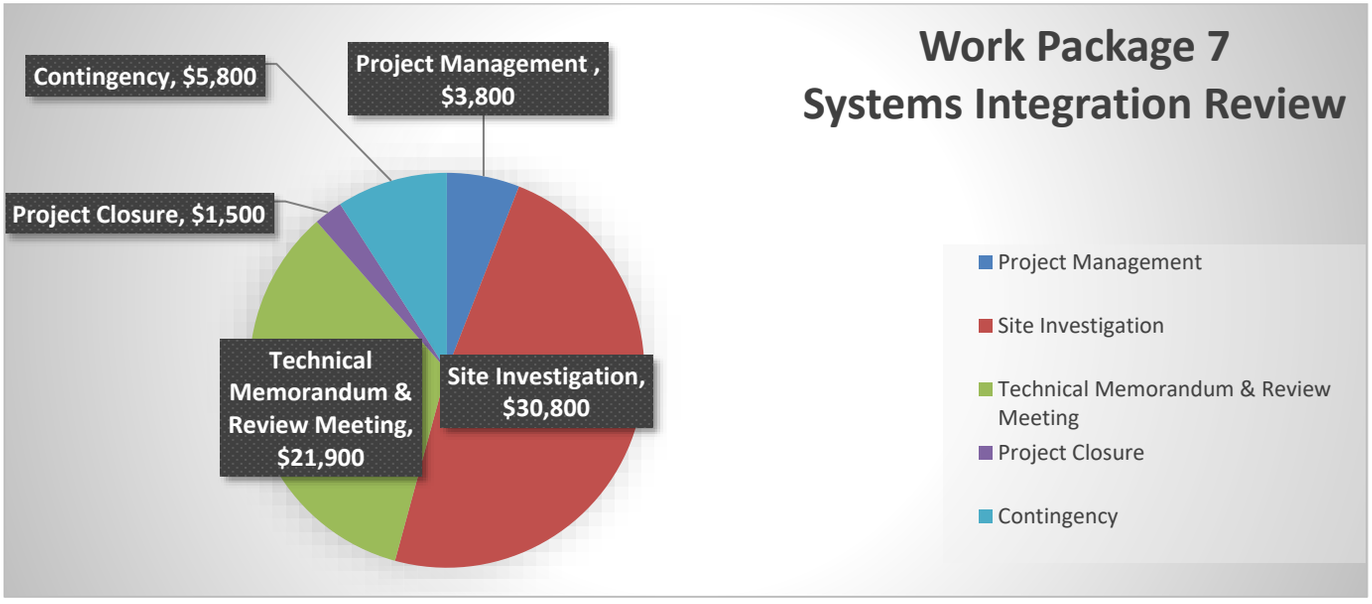

Figure 10 Systems Integration Review Cost Breakdown

Work package 8 – SCADA Support and Maintenance includes system integrator on site and remote support services for a period of 10 years from quarter 3 2027 – quarter 2 2037 after the first SCADA Pilot site upgrade along with SCADA platform vendor remote on-call and email support. For cost estimation, a period of 40 hours x 8 weeks or 320 hours per year of system integrator on-site/remote support has been considered. Note that the SCADA Vendor Support price is only an estimate & will be finalized based on SCADA platform chosen.

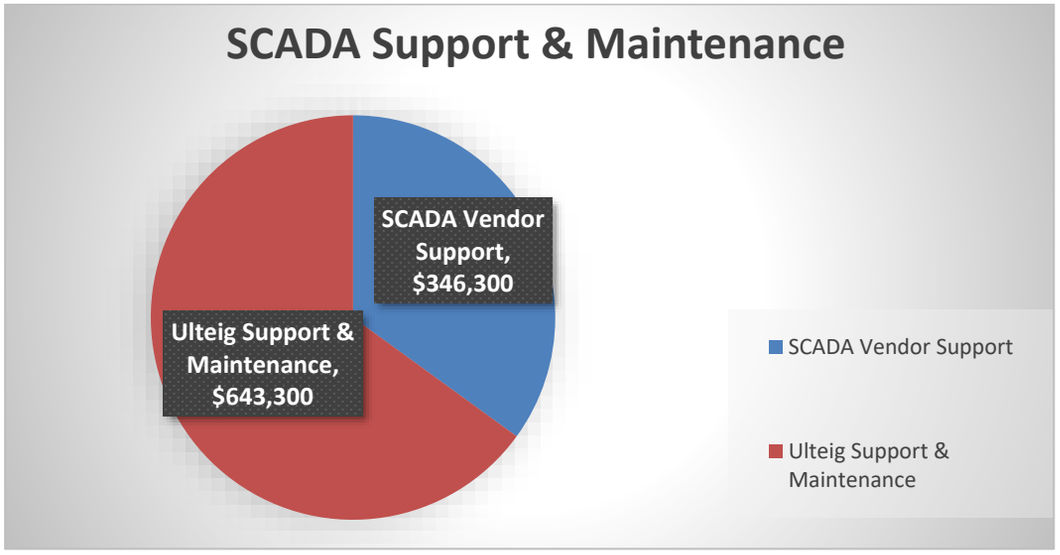

Figure 11 SCADA Support & Maintenance Cost Breakdown

Section 3 Project Closure

The SCADA system master plan has covered all aspects of the SCADA system along with the development of SCADA standards to further enhance and future proof the Town's current SCADA architecture and other third-party systems. It supports the Town's vision and provides a plan for immediate deliverables to build the foundation to support growth with a clear roadmap on how to achieve it to effectively complete the infrastructure upgrades and technology enhancements over the next 10 years to support the communities water and wastewater utility needs.