NAPA SANITATION DISTRICT

HAZEN AND SAWYER - TASK ORDER No. 6
SWRF BURIED METALLIC PIPING CONDITION ASSESSMENT
PROJECT (CIP 20706)

Date: _____

Issued under Professional Services Agreement dated December 14, 2015.

To: Hazen and Sawyer

Project Description:

SWRF Buried Metallic Piping Condition Assessment Services

Description of Scope of Services to be performed by Consultant under this Task Order:

See Exhibit 'A' – Scope of Services

Description of Services to be Provided by District:	See Exhibit 'A' –Scope of Work
Deliverables:	See Exhibit 'A' –Scope of Work
Consultant Project Manager:	Allan Briggs, PE
Consultant Quality Control Manager:	Marc Solomon, PE
Schedule to Perform Services:	See Exhibit 'B' – Fee Estimate
Time & Materials Not-to-Exceed Cost Limit:	$99,650
	See Exhibit 'C' –Project Schedule

APPROVALS:

HAZEN AND SAWYER

By: _____ _____
Authorized Representative Date

NAPA SANITATION DISTRICT

By: _____ _____
Purchasing Agent Date

NSD Account No.: CIP 20706

EXHIBIT A

Napa San SWRF Buried Metallic Piping Condition Assessment - Phase 1

BACKGROUND

Napa San's (District's) Soscol Water Recycling Facility (SWRF) was constructed in 1979 and has undergone several upgrades and renovation projects since its initial construction. Some of the piping systems from the original construction, and from subsequent projects, are unprotected metallic piping. In recent years, corrosion and deterioration have been observed in areas where buried metallic pipes have been exposed.

Napa San is in the process of implementing an agency-wide asset management program. There is a need to develop mapping of pipe segments and criticality rankings for buried metallic piping assets at the SWRF, which will then be incorporated into the asset management program and combined with condition assessment results to develop strategies for their maintenance and/or replacement. The findings and recommendations of this condition assessment effort may lead to subsequent design and construction work to rehabilitate and/or replace portions of selected piping systems.

The District is anticipating completing this work under two (2) Task Orders. Phase 1 (T.O.6) is expected to consist of a desktop analysis of record information, including drawings, specifications, construction/operation records, and interviews with Operations staff. Phase 1 shall produce a technical memorandum that provides criticality rankings and anticipated conditions of each active piping system and recommends further condition assessment and field verification efforts. A GIS database that includes each buried metallic piping system based on record information shall also be created under this task for future incorporation into Napa San's asset management system.

A Task Order for Phase 2 will be issued after completion of Phase 1. Phase 2 is anticipated to include field-based non-destructive condition assessment, updates to the GIS database based on observed conditions, and a report summarizing findings and recommendations within an asset management framework.

Based on subsequent discussions with the District, the original scope of work as defined in the RFP has been reduced to a more focused pilot assessment project of select buried infrastructure as described in the subsequent section. The asset inventory and asset management processes and practices implemented and support tools will be structured to allow expansion to the entire treatment plant after completion of the pilot project.

SCOPE OF WORK

We understand that aging infrastructure, and reliability are compelling reasons for the District to take a proactive approach to managing infrastructure assets. The District has a number of underground pipes, some that have already failed and others that are close to the end of their useful life, and has chosen to implement an approach to developing a condition assessment program that prioritizes the upcoming inspection projects. Unlike above-ground assets, visual inspection of underground pipes is a significant undertaking and requires proper planning to focus on the right locations to spend the limited budgets more effectively.

The following steps are essential to development of a condition assessment program:

- Asset Inventory and Consolidation of Available Data
- Risk-Based Prioritization of Assets

This detailed project scope is to provide engineering services for the Phase 11, or the Desktop Condition Assessment. Phase 1 will include the Desktop Analysis of the condition of the buried metallic piping. Services to be provided by Hazen for the final design services include the following tasks as delineated below and expanded in greater detail in the subsequent paragraphs:

- Task 1 – Asset Inventory and Data Consolidation
- Task 2 – Risk Based Prioritization of Assets
- Task 3 – Field Verification Recommendations
- Task 4 – Project Management

Phase 2 which includes the Field Verification Condition Assessment and Recommendations will be scoped after Phase 1 is completed and is anticipated to include the following:

- Complete the field verification condition assessment
- Update the GIS based on field verification findings
- Finalize R&R recommendations
- Provide a prioritized list with cost estimates (link to budget)

For this task order, the area of focus will be one of the following metallic pipeline designations as determined in conjunction with the District:

1. Older pipes that were installed during the original construction that are 8 inches and larger.
2. Pipelines identified by an initial high-level assessment as having high consequence of failure (scores of equal or higher than 4 out of 5). This could potentially include the 2W and/or 3W pipeline systems.
3. Pipes concentrated in a geographical sub-section of the plant not to exceed a 400 ft x 550 ft area.

Task 1 – Asset Inventory and Data Consolidation

During Task 1, the Asset Inventory and Data Consolidation stage, the Hazen team will compile all existing information about the buried piping and develop a GIS database that will be used as an inventory of the buried metallic piping, for the risk model and will aid in the determination of the initial assessment of remaining useful life. Task 1 includes the following subtasks:

Subtask 1.1 Review of Information

In this subtask, the Hazen team will collect and review all relevant background information and data for the District's existing treatment plant buried piping and conduit infrastructure including the maintenance, repair and rehabilitation history, soils reports, corrosion data, record drawings, and various reports and any other information relevant to the project. Hazen will use this review to develop a GAP analysis of data/information needs. It is assumed that CAD files are available for the Carollo design drawings. If CAD drawings are not available and the asset inventory has to be developed from As-built drawings, the asset inventory will be limited to 8" diameter or larger. As much as possible, the Hazen team will try to resolve any discrepancies with the record drawings based on readily available information.

Subtask 1.2 Asset Inventory Development

Hazen will use the information gathered to develop the asset register/inventory with attributes. The establishment of accurate comprehensive inventory data is the foundation on which the condition assessment of the buried infrastructure will be built. Hazen will conduct a Data Review and Gap Closure Workshop with the District to review the preliminary asset inventory, assess data gaps and capture institutional knowledge to close some of the data gaps. Once remaining data gaps (missing assets and attributes) are identified, the process continues with the development of mitigation plans to help close the data gaps and prioritization of data collection efforts. Working with the District staff, strategies to close the data gaps will be identified.

Only when a complete asset inventory with complete hierarchy and list of assets and critical attributes including size, material, install year is available can an overall consistent and cost-effective condition assessment approach be developed.

Developing an asset register includes the following core elements:

- **Asset Definition.** Defining an asset will allow the District to inventory assets at the right level of granularity. The current asset definition needs to be reviewed and adjusted to support underground assets. Change in main attributes such as size and material should be incorporated in the asset definition.

- **Asset Hierarchy.** An asset hierarchy provides a structured framework for organizing assets. A hierarchy will enable the District to easily locate an asset and obtain data (e.g., size, risk, remaining life) required to evaluate the condition. The hierarchy must have a structured relationship (parent-child) allowing consistent roll-up/roll-down of asset data. The existing hierarchy needs to be refined to support inventory of underground assets. For example, inventory of a pipeline that is connecting two separate locations can create complications in a location-based hierarchy because the pipe belongs to two different locations in the plant. Setting rules such as grouping pipes under upstream locations and identifying the downstream location in the asset description could be a potential solution.

- **Asset Classification.** An asset class can be defined as a group of assets with similar type, function, useful life, and pricing attributes (e.g., size, material, process). Developing asset classes improves productivity by allowing the risk and condition assessment logics to be applied to a group of assets rather than to each asset individually.

- **Data Standards.** Data standards identify data attributes required to support development of a condition assessment program. There are common attributes (e.g., year of install, replacement cost, asset naming/numbering) and specific attributes (e.g., type, diameter, length, and material) for each asset class. A consistent approach toward the understanding, collecting, and managing of asset data is key to a successful inventory of the assets. The table below is a list of suggested attributes.

Start Location	End Location	Material	Diameter	Length	Install Year	Rehab Year	Gravity or Pressurized
Aeration Basin Distribution Structure	Aeration Basin #4	Ductile Iron	36 in	145 ft	1998	N/A	Gravity

Subtask 1.3 Develop GIS Database

Converting the asset data to an Esri ArcGIS format provides the basics needed for initial implementation of the District's buried infrastructure condition assessment program. Enhancement of the data quality and asset attributes will provide the District with a higher level of confidence in the prioritization of renewal activities while providing the information visually. Our team proposes to compile the existing asset data into a centralized GIS database (asset register). This GIS database will also be used for the risk model.

Subtask 1.4 Review of the Data

Once the GIS database has been developed and reviewed for missing information and verification of information, the Hazen team will look at trends based on location, materials, service etc. and determine the assets remaining useful life based on age, material, maintenance history and environmental factors such as soil type. Hazen will present this preliminary information in a Desktop Condition Assessment Criteria Workshop and modify based on District staff input.

Task 1 Deliverables

- Focus Area Identification, Data Review and Gap Closure Workshop
- Draft and Final Complied Asset Register and Historical Data (Microsoft Excel Spreadsheet)
- Desktop Condition Assessment Criteria Workshop
- Buried Infrastructure GIS Database

Task 2 – Risk Based Prioritization of Assets

The Hazen team will develop a risk-based prioritization process that combines structural scores, service defects and criticality of pipe segments. The risk-based approach minimizes the District's business risk exposure, provides excellent credibility ,and benefits overall operations. Risk is the probability of an event (i.e., a failure) occurring combined with consequence of failure should it occur. As represented in the risk formula below, risk assessment will be composed of three key elements.

Subtask 2.1 Determination of Probability of Failure

The Hazen team will collaborate with District staff to develop levels of service criteria and analyze the probability of failure (PoF) and consequence of failure (CoF) for each pipe segment by considering the following criteria:

Probability of Failure	Consequence of Failure
Physical Attributes: The physical pipe attributes used to indicate risk are pipe age and deterioration curves associated with size, material, type of joints and geographical location. **Maintenance History:** Two sets of data will be used to indicate the failure history of each pipe. One is the number of repairs for each pipe, and the other will be the status of valves on each pipe. Pipes with a larger number of repairs and more valves in poor condition are considered higher risks. **Environmental Attributes:** Soil conditions that are more corrosive can result in premature pipe failure. **Service Pressure:** Information if available can be used to predict pressures. Higher pressures increase the relative likelihood of failure.	**Plant Disruption:** Isolation analysis will determine how much of the piping network would be affected if a pipe was shut off for repair. This can be done by piping in all directions until valves are identified that would isolate the subject pipe. Pipes that affect numerous processes when shut off would receive a higher risk score. **Hydraulics/Flow:** Flow (as calculated by the hydraulic model) also will be used to assign a score for consequence of failure to each pipe. Pipes with high flow rates are carrying flow from one part of the system to another, not just the local area. Using flow instead of velocity helps reduce the risk of over-weighting smaller pipes that may be overloaded but do not transport significant flow. **Safety**: Risk of physical harm from high pressures or chemicals. **Potential for Adverse Publicity:** Loss of reputation or trust, negative media coverage. **Redundancy:** For pipe segments with an existing parallel pipe or existing loop the consequence of failure would be reduced. **Economic Impacts:** A higher cost of repair if failure occurs as well as the potential for regulatory fines would be used to assess higher risk on pipe segment .

Subtask 2.2– Risk Assessment Methodology Workshop

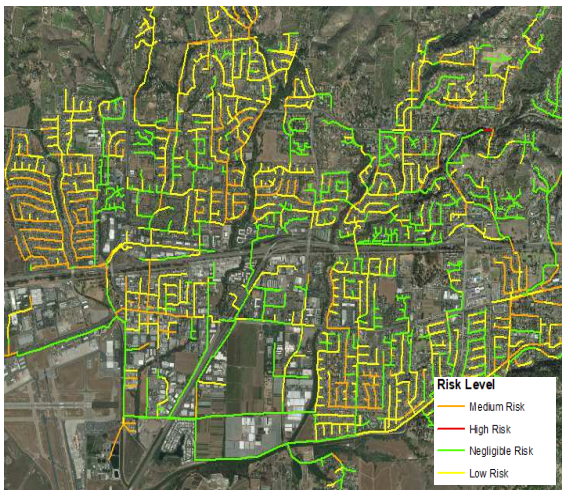
Through a workshop, the Hazen team will work closely with District staff to establish the criteria, an assigned weighting percentage and overall scoring for each similar to the example table shown below. These criteria will be used as the basis for development of the risk profiles.

Below Ground Piping –Criteria and Weighting

PoF Criteria and Weighting		CoF Criteria and Weighting	
Attribute Category	**Weighting**	**Attribute Category**	**Weighting**
Physical Attributes	15%	Plant Disruption	20%
Maintenance History	35%	Hydraulics/Flow	20%
Environmental Attributes	25%	Safety	20%
Service Pressure	25%	Redundancy	25%
		Economic Impacts	15%

Subtask 2.3– Risk Assessment Results Workshop

The Hazen team will develop risk profiles based on the PoF and CoF scores. Assets will be grouped into high risk, medium risk, and low risk categories based on their overall risk score as shown in the following figure The risk results will be presented to and reviewed with the District in a workshop. Based on comments from the workshop these risk results will be finalized and used to provide recommendations for maintenance and renewal of assets.

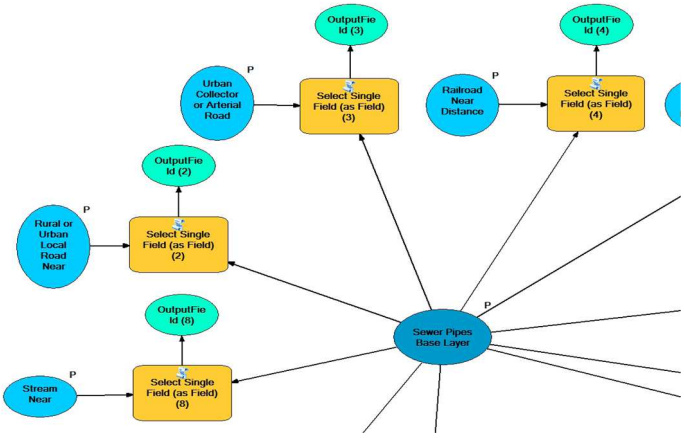


Subtask 2.4 : Risk Assessment TM (Draft and Final)

Based on the desktop condition assessment results, our team will estimate the refurbishment and replacement costs using our local knowledge, databases such as RS Means, and our own cost databases from similar projects. A risk-based prioritized renewal budget will be estimated and categorized into short-, medium- and long-term to minimize the District's business risk exposure while meeting the minimum level of service requirements. Hazen will document the methodology and findings of the Risk Assessment in a draft Risk Assessment TM. The District will review the draft TM and provide comments that will be incorporated into the final version of the Risk Assessment TM.

Subtask 2.5 : GIS-Based Prioritization Model

A prioritization model will be developed to automate the risk-based prioritization process. The prioritization model will be programmed into ArcGIS ModelBuilder which is a visual programming language for building geoprocessing workflows. The ArcGIS ModelBuilder built-in application is a graphical environment that allows the user to visualize, create, and run a geoprocessing workflow or geoprocessing model. In the context of geoprocessing, a model strings together a sequence of connected GIS processes as shown in the screenshot below.



Setting up a GIS-based model not only allows the risk analysis to be done in a much shorter amount of time but also allow users to change the assumptions of the analysis or weighting associated to each parameter and generate new results without having to manually perform a spatial analysis. In addition, once new pipelines are added to the system, or the existing pipelines are modified, the model will

automatically assign CoF, PoF and Risk scores to each pipe segment and prioritize based on the updated risk results.

Task 2 Deliverables

- Risk Assessment Methodology Workshop
- Risk Assessment Results Workshop
- Draft and Final Risk Results and Renewal Recommendations Technical Memorandum (PDF)
- Draft and Final GIS-Based Risk Model Using Esri ModelBuilder

Task 3 – Technology Evaluation for Field Verification Recommendations

Based on the Level 1 Desktop Condition Assessment and the Risk Assessment results, the Hazen team will identify where Level 2 (non-destructive, non-intrusive) and Level 3 (intrusive) field verification methods are required, identify the technologies to be used for field verification and then summarize the findings for field verification recommendations.

Subtask 3.1 Identify Verification Requirements

Using the Level 1 Desktop Condition Assessment analysis and the GIS risk-based model, the Hazen team will identify segments of buried piping that require more detailed field verification. Field verification methods will be grouped into Level 2 methods (non-destructive, non-intrusive) and Level 3 methods (intrusive). The team will look to use Level 2 methods in as many cases, while only recommending Level 3 methods where absolutely necessary.

Subtask 3.2 Draft Technology Selection TM

Based on the results of desktop condition assessment, material, service and access limits, the Hazen team will identify the appropriate technologies to be used for Level 2 and level 3 field verification of the segments of assets that have been earmarked for field verification. The Hazen team will identify the appropriate subconsultants with the specialized skills and experience needed to support the Level 2 and Level 3 verification efforts under Task Order #2. Hazen will document these recommendations in a draft TM.

Subtask 3.3 Technology Review Workshop

Once the pipe segments requiring field verification have been identified, and documented, these recommendations will be presented and reviewed in a workshop with the District.

Subtask 3.3 Draft Technology Selection TM

The Hazen team will revise the Draft Technology Selection TM based on District Staff comments from the Technology Review Workshop. The Final Technical Memorandum will include the final recommendations for field verification as well as the technologies to be used for the field verification.

Task 3 Deliverables

- Workshop Agenda and Meeting Notes
- Draft and Final Field Verification Technical Memorandum

Task 4 Project Management

The Project Management task will include the following subtasks:

Subtask 4.1 Team Management

Hazen and Sawyer (the Consultant) shall provide general project management to include oversight and coordination of the efforts, and staffing/personnel administration of any sub-consultants during the project.

Subtask 4.2 Monthly Reporting and Invoicing

Under this task, Hazen shall review and issue monthly invoices as well we provide monthly report that shall update the District's project manager on the project status including the project schedule and budget updates. Hazen shall also provide weekly updates on the work completed during the previous week and a two week look ahead on tasks to be completed.

Subtask 4.3 Kick-off Meeting

For the Kickoff meeting, Hazen will have up to four (4) team members attend an initial project kick-off meeting with the District. At the kickoff meeting with District Staff, Hazen will discuss the work plan, obtain relevant additional historical pump station data and review of the existing as-built record drawings,

Subtask 4.4 Review Meetings

The following Project Management meetings with the District are anticipated:

- Monthly coordination meetings – Hazen anticipates monthly coordination meetings to review the project schedule and budget.
- Weekly project calls – Hazen will conduct weekly project calls to update on status of the project and weekly outstanding items to keep the project moving.

Task 4 Deliverables

The following deliverables are associated with Task 9:

- Work Plan
- Kick-Off Meeting Agenda and Minutes
- Monthly Invoices and Monthly Reports

Attachments

Attached to this scope of work are the following:

- Attachment A – Level of Effort and Fee Estimate
- Attachment B – Preliminary Project Schedule

EXHIBIT B - Level of Effort and Fee Estimate Napa San Buried Metallic Piping Condition Assessment

Hazen

Napa Sanitation District			PIC	Project Manager	Technical Reviewer/QA/QC	Technical Reviewer/QAQC	Asset Management	Condition Assessment Lead	Condition Assessment Support	GIS	Hydraulics	Estimating	Staff Engineer	CAD	Admin	H&S Loaded Labor Cost		Total Fee
Napa San Buried Metallic Piping Condition Assessment			Marc Solomon	Allan Briggs	Dawn Guendert	Sean Fitzgerald	Sean Pour	Ben Romero	Jerimy Borchardt	Janet Ortega	Sam Valdez	Chris Portner			Vanessa Avila		Other Direct Costs (ODCs)	
		Billing Rate	$280	$240	$245	$250	$190	$250	$200	$130	$175	$175	$130	$130	$130			
Task 1	Asset Inventory and Data Coonsolidation		0	14	8	0	44	8	8	80	16	16	60	0	4	$ 41,600	$ 400	$ 42,000
	1.1	Review of Information		4	2		8	4	4	8	4		12					
	1.2	Asset inventory Development		6	2		16			24	4	16	16				$ 200	
	1.3	Develop GIS Database		2	2		12			40	4		16				$ 200	
	1.4	Review of the Data		2	2		8	4	4	8	4		16		4			
Task 2	Risk Based Prioritization of Assets		2	12	12	2	50	8	0	52	8	8	38	0	2	$ 33,140	$ 400	$ 33,540
	2.1	Determination of Probability of Failure					16	2		12	4		8					
	2.2	Risk Assessment Methodology Workshop		4	2		8	2		6			6				$ 200	
	2.3	Risk Assessment Results Workshop		4	4		8	2		6	4		8				$ 200	
	2.4	Risk Assessment TM (Draft & Final)	2	2	4	2	12	2		12		8	16		2			
	2.5	GIS-Based Prioritization Model		2	2		6			16								
Task 3	Technology Evaluation for Field Verification		0	6	6	2	4	8	10	0	0	0	20	0	2	$ 11,030	$ 200	$ 11,230
	3.1	Identify Verification Requirements					8	2	4									
	3.2	Draft Technology Review TM		2	2	2	8	2	2				8					
	3.3	Workshop		2	2		4	2	2								$ 200	
	3.4	Final Technology Review TM		2	2	2	4	2	2				12		2			
Task 4	Project Management		6	32	4	0	6	4	0	0	0	0	0	0	0	$ 12,480	$ 400	$ 12,880
	4.1	Team Management		12														
	4.2	Monthly Invoicing and Reporting		12														
	4.3	Kick-Off Meeting	2	2	4		4	4									$ 200	
	4.4	Review Meetings	4	6			2										$ 200	
		Total Cost - All Tasks														$ 98,250	$ 1,400	$ 99,650

EXHIBIT C - Napa San Buried Metallic Piping Condition Assessment Schedule

Hazen

Napa Sanitation District			2019							2020					
Napa San Buried Metallic Piping Condition Assessment			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Task 1	**Asset Inventory and Data Coonsolidation**														
	1.1	Review of Information													
	1.2	Asset inventory Development													
	1.3	Develop GIS Database													
	1.4	Review of the Data													
Task 2	**Risk Based Prioritization of Assets**														
	2.1	Risk Assessment													
	2.2	Risk Assessment Review and Reporting													
	2.3	GIS-Based PrioritizationModel													
Task 3	**Field Verification Reocmmendations**														
	3.1	Identify Verification Requirements													
	3.2	Technology Selection													
	3.3	Recommendations													
Task 4	**Project Management**														
	4.1	Team Management													
	4.2	Monthly Invoicing and Reporting													
	4.3	Kick-Off Meeting													
	4.4	Review Meetings													