Santa Clara Valley Water District

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Item No.: *5.1.

BOARD AGENDA MEMORANDUM

SUBJECT:
Water Utility Asset Management and Maintenance Program Update.

RECOMMENDATION:
Receive update on the District's Water Utility Asset Management and Maintenance Program.

SUMMARY:
Background and Purpose of Update
The Board of Directors has adopted the following Board Governance Policies that provide guidance on managing and maintaining Water Utility assets:

E-2.1. Current and future water supply for municipalities, industries, agriculture, and the environment is reliable.

E-2.2. Raw water transmission and distribution assets are managed to ensure efficiency and reliability.

E-2.3. Reliable high quality drinking water is delivered.

EL-6. The BAOs shall protect and adequately maintain corporate assets.
6.4. Maintain an Asset Management Program

In addition, at the Board Strategic Direction and Priorities Special Board meeting on October 4, 2016 and in subsequent Board Policy and Planning Committee discussions, issues, challenges, strategies and opportunities associated with water supply infrastructure were identified. They include: aging, vulnerability, understanding the District's level of risk, and knowledge of operations and maintenance (O&M) priorities. The Board also identified several outcomes to address these issues and challenges, including: continuing existing asset management strategies and looking at best practices, reviewing O&M prioritization process similar to the Capital Improvement Program (CIP) process, and elevating the role of O&M.

This update provides a semi-annual update on the asset management program as scheduled in the Board Policy Planning Calendar and describes: 1) Water Utility asset management planning and prioritization process and how this process drives annual maintenance and capital projects; 2) Water

Utility maintenance and prioritization of daily maintenance work; 3) Performance Monitoring and Improvement program; and 4) additional Water Utility asset management activities.

Asset risk, operations priorities, security, and watershed and administration asset management programs are planned to be covered in future Board updates.

1. Water Utility Asset Management Planning and Prioritization Process
One objective of asset management is to optimize asset performance and renewal strategies to minimize lifecycle costs while providing required levels of service at an acceptable level of risk. To meet this objective, the water utility asset management program carefully plans, prioritizes, and monitors asset renewal work for all water utility assets.

The District owns approximately 8,000 water utility assets. The replacement value of these assets was estimated at $7.05 Billion in the 2014 District-wide Asset Management Plan. The 8,000 assets include the District's dams, pipelines, pump stations, water treatment plants, purification center, recharge ponds, and wells. Examples of specific assets include: large civil structures such as spillways, pipelines, operations buildings; mechanical equipment such as pumps, valves, and HVAC equipment; electrical components such as transformers, motors, and electrical control panels; and instrumentation such as temperature or pressure monitoring devices. Assets with an individual replacement value of at least $2,500 or that are critical to continuous operation are included in the inventory.

Establishing Preventive and Planned Maintenance Schedules
The Water Utility has established maintenance schedules for all existing assets. When a new facility is constructed, staff adds the new assets (tanks, pipe, pumps, valves, electrical panels, instruments, etc.) to the asset register and establishes an asset's maintenance schedule. Maintenance schedules are typically based on manufacturers' recommendations, subject matter expertise, and maintenance schedules for similar existing assets. Schedules are optimized periodically based on field and operating conditions. For example, if a pump is due for a re-build, but has not been in service as long as expected, the re-build may be delayed.

There are two types of maintenance activities that are scheduled: preventive maintenance work and planned work. Another type of maintenance, corrective maintenance, is unscheduled because it addresses unplanned failures. The 'Water Utility Maintenance Program' section of this memo provides further information on corrective maintenance.

- Preventive Maintenance (PM) work is planned routine maintenance to prevent premature asset failure, such as an oil change for a gear box. PM activities occur weekly, monthly, quarterly, semi-annually, or annually, depending on the activity. When a PM work task becomes due for an asset, Maximo, the District's computerized maintenance management system, automatically generates a work order for maintenance staff to perform the task. The water utility completes approximately 14,000 PM work orders each year.

- Planned Work (PW) refers to planned asset rehabilitations and replacements, such as a pump rebuild or tank re-lining. PW activities occur less frequently, usually every 5 to 10 years. The

water utility's annual maintenance planning process is used to identify what PW activities are due each year, and to prioritize, execute and track PW, as described below.

Annual Maintenance Planning Process

Asset management program staff track PW schedules and develop forecasts of future infrastructure rehabilitation and replacement costs using a software application 'Asset Management Planning Tool' (AMPT). AMPT contains a database of all assets and their scheduled rehabilitations and replacements, and the costs of the rehabilitations and replacements. Staff also generates 100-year financial projections of all asset rehabilitation and replacement projects for all assets using this tool.

Each year staff uses AMPT to develop a list of all PW activities required for all water utility assets for the next five years. The list is validated and prioritized by an internal cross-functional team of maintenance, operations, engineering, and asset management staff. The PW list is prioritized based on asset risk. Rehabilitation of higher risk assets is prioritized above rehabilitation of lower risk assets. Asset risk is measured by probability and consequence of failure.

- Probability of Failure measures how likely an asset is to fail based on its condition. For all scheduled PW projects, staff confirms field condition and estimates remaining asset life. If assets are found in good condition, PW projects are rescheduled to future years.

- Consequence of Failure measures the impact of asset failure on service delivery, public safety, community property, the environment, finances, and reputation These parameters are measured using the consequence of failure matrix shown in Attachment 1. For example, if an asset failure could cause an entire water treatment plant shutdown and stop service delivery, it has a high consequence of failure.

Projects to rehabilitate high risk assets (poor condition and/or high consequence of failure) are considered high priority, and are planned for implementation sooner than projects for lower risk assets. Additional information on asset risk assessment and how probability and consequence of failure are measured is provided in Attachment 1. In addition, a Board update on asset risk is scheduled for summer 2017, which will provide more detail on asset risk assessment.

From 2006 to 2016, the list of PW activities was compiled into the 'Annual Maintenance Work Plan'. These annual plans identified the PW projects for the following fiscal year. In 2017, staff began publishing a Five-Year Maintenance Work Plan to better plan, budget, and schedule the labor and resources needed for the projects. The Five-Year Maintenance Work Plan is a rolling five-year plan, and is updated annually. The Five-Year Maintenance Work Plan does not currently include rehabilitation or replacement of dam assets because dam maintenance requirements are driven by the State of California Department of Safety of Dams (DSOD) and Federal Energy Regulatory Commission (FERC). DSOD and FERC annual inspections identify required maintenance activities which the District implements.

PW Project Execution as Capital or Operating Projects

The PW projects in the Five-Year Maintenance Work Plan are budgeted and executed as either operating projects, small capital projects, or individual capital projects, as described below. In past

Annual Maintenance Work Plans, many PW projects were executed as operating projects. In recent years, the Water Utility has shifted to executing most PW projects as small capital projects, as most PW projects include an asset replacement or major rehabilitation, which constitutes a capital investment.

- Operating Projects: PW projects that involve inspection or testing activities are not capital investments and are conducted under one of the maintenance operating projects identified in the District's budget (i.e., Raw Water T&D General Maintenance, Rinconada WTP General Maintenance). Biannual electrical testing or chemical tank inspection are examples of PW activities budgeted under operating projects. These projects are completed by maintenance staff and may require engineering, environmental and/or contractor support.

- Small Capital Projects: Smaller scope replacement or rehabilitation projects, for example a single pump re-build, are planned, bundled and executed in the Water Treatment, Treated Water Transmission, Raw Water Transmission, or San Felipe Reach 1-3 Small Capital Improvement Projects in the District's five-year CIP. The scopes of each of the Small Capital Improvement Projects change annually based on the work identified in the Five-Year Maintenance Work Plan. The replacement of the chain and flight system in the sedimentation basins at Penitencia Water Treatment Plant is an example of a PW project completed in the Water Treatment Small Capital Improvement Project in 2016. These projects are completed by maintenance staff and may require engineering, environmental and/or contractor support.

- Individual Capital Projects: Occasionally, the PW projects can be grouped together to create an individual capital project. In this case, staff initiates a new project in the CIP for the PW. On average, one new capital project is identified in the Five-Year Maintenance Work Plan each year. One example is the Vasona Pumping Plant Upgrades, a project in the District's current five-year CIP. Several pumps, motors, drives, valves, and other equipment within the pump station were due for replacement in 2016. The multiple asset replacements were combined into one project, to be executed under the CIP.

  In addition, the pipeline inspection and rehabilitation projects are identified in the Five-Year Maintenance Work Plan and are executed as individual capital projects. For the past five years, pipeline inspection and rehabilitation projects have been budgeted and executed in the Five-Year Pipeline Rehabilitation Capital Project. This project is closing, and the inspections and rehabilitations planned for the next ten years will be budgeted and executed in the Ten-Year Pipeline Rehabilitation Capital Project.

FY17-21 Five-Year Maintenance Work Plan

The current Five-Year Maintenance Work Plan for FY17-21 is provided in Attachment 2. The projects are grouped by facility in the plan. As an example, the FY17 PW projects for Rinconada Water Treatment Plant are listed below. There are fewer projects than usual at RWTP in recent years due to the Rinconada Reliability Improvements Project currently underway which will replace much of the existing plant.

- Clean and inspect alum-ferric storage tanks 1, 2 and 3; Estimated cost: $36,000
- Clean, inspect, and paint phosphoric acid tanks 1 and 2; Estimated cost: $26,000

- Electrical system testing; Estimated Cost: $22,000
- Inspect and repair motors and rebuild pumps for More Avenue Pump Station units 3 and 4 Estimated Cost: $53,000
- Replace batteries in raw and treated water uninterruptible power systems; Estimated Cost: $5,300

The FY17-21 Maintenance Work Plan identifies $6.1M of asset rehabilitation and replacement work in FY17, $3.7M in FY18, $8.0M in FY19, $7.7M in FY20, and $6.0 in FY21. The estimates for FYs 18 through 21 will change as work lists are refined annually.

The projects in the District's FY17-21 CIP that originated in past Annual Maintenance Work Plans or the current FY17-21 Five-Year Maintenance Work Plan are listed below. The total cost of these projects is $548.3 Million. The RWTP Reliability Improvement Project makes up almost half this amount, with an estimated cost of $252 Million.

- Coyote Pumping Plant ASD Replacement
- Small Capital Improvements, San Felipe Reach 1-3
- Five-Year Pipeline Rehabilitation
- Ten-Year Pipeline Rehabilitation
- Small Capital Improvements, Raw Water Transmission
- Small Capital Improvements, Treated Water Transmission
- Vasona Pumping Plant Upgrade
- PWTP Clearwell Recoating & Repair
- PWTP Residuals Management
- RWTP FRP Residuals Management Modifications
- RWTP Reliability Improvement Project
- Small Capital Improvements, Water Treatment

2. Water Utility Maintenance Program

The Water Utility maintenance program consists of 16 operating projects with an overall operating budget of $19.8M in FY17. These projects are responsible for executing preventive, planned, and corrective maintenance work orders scheduled or generated in the fiscal year. PM completion is a high priority for maintenance staff because the work keeps assets in good working order and prevents premature failure. PM work orders account for almost 90% of all work orders generated each year. The overall PM completion target is set at 90% (i.e., 90% of the PM work orders scheduled for completion during a month, quarter, or year are targeted for completion in that month, quarter or year) which is based on achieving what the maintenance industry considers the hallmark of an effective PM program.

When an asset operates outside of its intended range or fails unexpectedly, a Corrective Maintenance (CM) work order is generated. CM work orders are also generated for modifications requested by operations or engineering that would improve upon current installations. CM work orders account for approximately 9% of all work orders generated each year. The overall CM completion target is set at 80% (i.e., 80% of the CM work orders scheduled for completion during a

fiscal year are targeted for completion in that fiscal year). Since CM work orders vary in priority and complexity, staff places emphasis on completing all higher priority repairs quickly by rearranging daily work schedules and completing lower priority repairs when time and resources permit. As an example, if a pipeline leak were to occur, a high priority corrective maintenance work order would be generated. Staff would conduct repairs immediately and PM work orders that would normally be completed during that time would be rescheduled. Whereas if a pump were to fail in a system where there are three other pumps available for operation, staff would classify the corrective work order to be lower in priority and schedule repairs when time, resources, and operational conditions are more optimal. In some cases, the best and safest opportunity to conduct repairs is when a plant is offline, so these repairs are queued and executed during a plant shutdown.

PW work orders, which are identified in the Five-Year Maintenance Work Plan, account for approximately 1% of all work orders generated each year. The PW completion target is set at 80% for the scheduled year (i.e., 80% of the asset rehabilitations and replacements scheduled for FY17 are targeted for completion in FY17). PW not completed in the scheduled year is carried forward to the following year until the work is completed. Eventually, 100% of PW is completed though it may occur over multiple years.

There are two maintenance planners in the Treatment Plant Maintenance Unit and two maintenance planners in the Raw Water Field Operations & Pipeline Maintenance Unit that are primarily responsible for planning and executing PW work orders under the Five-Year Maintenance Work Plan. The maintenance planners purchase parts, coordinate with engineering and environmental staff to develop drawings and obtain permits, and procure and manage contractor services to perform the work.

Maintenance Prioritization
Work orders are prioritized as shown below:.

Priority 1 - Emergencies
Priority 2 - High priority CM
Priority 3 - Most PM, CM, and PW
Priority 4 - Lower priority PM, CM, and PW
Priority 5 - Very low priority CM or limited added value

Once the appropriate priority is determined, maintenance staff rebalances their work and first work to completes the priority 1 and 2 work orders. To accomplish emergency, high, and medium priority CM work orders which are unplanned by nature, some PM work orders are postponed until the next PM cycle. A PM cycle is the frequency at which a PM is scheduled: weekly, monthly, quarterly, etc. The PMs that are postponed are usually higher frequency (weekly or monthly) routine inspections.

Another critical responsibility of maintenance staff is to provide support services to capital projects. By interacting with each asset on a regular basis, maintenance staff provides detailed field based perspective on asset performance and application that are captured and incorporated into the design phase of each capital project. Once construction is underway, maintenance staff provides support services in the field. An example is the current Rinconada Reliability Improvements Project where

two five-year term positions were created and filled by seasoned maintenance personnel to provide maintenance support to the project. These two positions act as liaisons between the project and the plant maintenance team to coordinate daily project work with routine plant maintenance work, review submittals and drawings, and manage all change orders requested by maintenance.

In summary, maintenance staff complete their work according to the following priorities:

1. Priority 1 and 2 CM work
2. Work in support of capital projects under construction
3. PM work
4. Priority 3 CM work and PW
5. Lower priority PM and CM work

Emergency Response

The District's water treatment and conveyance system is a 24/7 operation. To ensure continuous operation and proper emergency response, maintenance staff are on-call on a rotational basis to be able to respond after hours, on weekends and holidays. As is the case with all infrastructure, there are times a pipeline can leak or break or a critical system at a treatment plant can stop functioning requiring emergency response by water utility staff. At times like these, water utility staff have a history of coming together quickly and working tirelessly until the pipeline or system is restored, a reflection of staff dedication and resiliency.

The Water Utility Department Operations Center (DOC) activates in emergency events that are complex in nature and extend over multiple days. When the Santa Clara Conduit failed on Saturday morning at 5:30 am in August 2015 staff began making notifications by email and phone calls at 6:00 a.m., and the first responder, the pipeline maintenance supervisor, arrived on-site by 6:30 a.m. meeting with the property owner. The Water Utility DOC activated that morning to organize response efforts. Water utility and watersheds staff mobilized to respond to the pipeline break. District staff from many different functions supported the recovery effort which lasted a month.

Although the Santa Clara Conduit recovery effort was one of the more visible efforts, throughout a normal year, smaller scale response efforts occur from time to time, with operations, maintenance and engineering staff responding outside of business hours because of the continuous operation of many water utility facilities.

3. Performance Monitoring and Improvement

Maintenance Tracking and Reporting

As stated above, each maintenance work type, PM, CM and PW has completion targets. Key Performance Indicators (KPI) measure how well the targets are met. Current KPIs report basic work order completion rates by work type. The current PM completion rate is in the 80% range which is considered 'average' by industry standards. The KPI data and trends are reported quarterly to senior management and shared with the maintenance staff.

Because these basic KPI reports are not currently automated, and can take several days to compile the data, staff recently developed 27 automated KPIs for the water treatment plant assets within

Maximo. The KPIs track PM, CM, and PW completion and the ratio of PM work to CM work by craft (Electricians, Control Technicians, and Mechanics) and by water treatment plant. These KPIs will be implemented for pipeline and pump station assets in FY18 after Maximo is upgraded to the latest version. Additional data points and KPI reporting to spotlight asset reliability are also due to be implemented after Maximo is upgraded. The expanded KPIs will help quantify and better report overall asset performance, and provide information for optimizing maintenance strategies.

In addition, asset management staff annually tracks PW completion in an Annual Maintenance Work Plan Review Report. PW that was not completed in the last fiscal year is carried over to the following fiscal year. The Water utility typically completes 60 - 70% of PW work projects identified for a single fiscal year, with the remainder typically being completed in the following year, eventually achieving 100% completion over two to three fiscal years.

Continuous Improvement

Maintenance and asset management staff track asset maintenance costs and failure data to optimize maintenance strategies and costs, mitigate risk, and better plan and budget for future maintenance activities. For an asset that fails frequently, staff may adjust the asset's planned renewal and PM schedule to reduce the number of failures. One example is treated water meters, which have a high financial consequence of failure because if one fails, revenue is not collected. After a recent failure of a treated water meter, staff reduced the replacement frequency from 20 years to 10 years, and increased the PM frequency from annual to every 6 months.

If staff finds an asset to be in good condition longer than anticipated, its renewal activities or PMs may be changed to optimize lifecycle costs. One example is sample pumps at water treatment plants. Sample pumps are low cost assets at $650 per pump and were previously on a monthly PM schedule, and replaced as needed. Over the life of the pump, the cost of monthly PMs was exceeding $650. Staff eliminated the monthly PMs and now keeps spare pumps in stock so one can be replaced immediately if it fails. As assets are replaced, actual costs are updated in the asset management databases to improve the accuracy of financial projections and asset valuations.

Alignment with Asset Management Standards

The District has employed consultant support in the past to assist with standardizing and improving its asset management programs. The foundation of the District's asset management program is the Environmental Protection Agency's (EPA) ten step asset management planning model, shown in Attachment 3. This ten-step model adheres to guidelines set forth in the International Infrastructure Management Manual (IIMM); the British Standards Institution's Publicly Available Specification for asset management (PAS 55); and, the International Organization for Standardization's guidelines for asset management (ISO 55000). District asset management staff monitors changes in asset management standards to ensure that the District's asset management programs continue to be aligned with internationally recognized standards.

New Technology

The Water Utility participates in two water technology forums, Imagine H2O, a non-profit organization, and the Norcal Technology Approval Group led by Isle, Inc. These groups act as technology accelerators by introducing new water technologies to water agencies. Staff participates

in these groups to monitor new technologies that may help optimize operations and maintenance activities and thereby decrease asset lifecycle costs or reduce risk of failure. In addition, maintenance and engineering staff are continuously reviewing and testing new technologies, often times as part of a new capital project or asset replacement. Some examples of new technologies that have been tested are pipeline condition monitoring technologies, pipeline pressure surge monitoring devices, instrumentation (better resolution and data gathering devices), new SCADA hardware, and corrosion control products.

4. Additional Water Utility Asset Management Activities

The water utility continues to be successful in implementing the initial steps of the ten-step asset management model provided in Attachment 3 as it has established an asset inventory, continuously monitors asset condition and remaining life, and has documented replacement costs. Staff is working on improving steps five through ten of the process, which include developing level of service goals, understanding risk profiles, and optimizing management strategies. An asset's 'management strategy' describes the activities performed over its life, including PM and PW activities described above. Ideally, these activities are optimized based on the level of service the asset is required to provide, and on the risk associated with the asset.

Rather than analyzing all assets at once, staff is taking an in-depth look at one or two major facilities or asset classes per year. Focusing on one specific group of assets at a time allows staff to thoroughly analyze each asset and optimize management strategies. In FY 16, the San Felipe Division Reach 1 facilities were analyzed. In FYs 17 and 18, the program will analyze all pipe infrastructure, followed by water treatment plants and pump stations. Staff estimates it will take five to seven years to work through all the water utility facilities in detail. As facilities are reviewed and maintenance strategies and future costs are refined, the 100 year financial projection will become a more accurate representation of future investments needed in water utility infrastructure.

The asset management program is staffed by several engineers that develop the Five-Year Maintenance Work Plan, develop facility asset management plans, and analyze asset maintenance data to make improvements to asset strategies. The unit also has a program administrator who ensures Maximo user requests and recommendations for system improvements are addressed; and a field operations administrator that oversees the asset condition assessment program and maintains asset databases. The group oversees not only the water utility asset management program, but also the administration and watershed asset management programs.

Next Steps

The Water Utility will continue its maintenance work planning and execution processes and will provide the FY18-22 Five-Year Maintenance Work Plan to the Board for information in August 2017. The water utility asset management and maintenance programs will continue to work together to optimize facility specific asset strategies. The asset management program is beginning work on a pipeline infrastructure asset management plan that will be complete by the end of 2018.

Future Board updates will provide information on asset risk, operations priorities, security, and watershed and administration asset management programs.

FINANCIAL IMPACT:
There is no financial impact associated with this item.

The approved FY17 budget for the water utility asset management program is $936,270.

The total approved FY17 budget for the water utility maintenance units and their budgeted projects is $26,267,168. This includes $19,827,629 in operations costs, and $6,439,939 in capital costs and includes the following budgeted amounts:

- Treatment Plant Maintenance Unit - $8,791,650
- Raw Water and Pipeline Maintenance Unit - $9,696,227
- Silicon Valley Advanced Water Purification Center Maintenance - $1,339,452
- San Felipe Reach 1-3 Small Capital Improvements - $3,608,922
- Water Treatment Small Capital Improvements - $2,831,017

CEQA:
The recommended action does not constitute a project under CEQA because it does not have a potential for resulting in direct or reasonably foreseeable indirect physical change in the environment.

ATTACHMENTS:
Attachment 1: Asset Risk Assessment
Attachment 2: FY17-21 Water Utility Maintenance Work Plan
Attachment 3: EPA 10-Step Asset Management Model
Attachment 4: PowerPoint

UNCLASSIFIED MANAGER:
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