SERWTP Digital Twin Problem Statement
Jordan Valley Water Conservancy District

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The Southeast Regional Water Treatment Plant (SERWTP), a vital component of Jordan Valley Water Conservancy District's (JVWCD) infrastructure serving over 750,000 people, faces a significant challenge in maximizing the utilization of its available source water. The plant, with a capacity of 20 million gallons per day, is a conventional surface water treatment process that includes high-rate clarification, filtration, and disinfection. SERWTP treats water from two sources: canyon water and water from the Deer Creek Reservoir. While the canyon water is essentially free, its availability and quality exhibit substantial fluctuations, both seasonally and daily. Conversely, the reservoir water provides a reliable supply but comes at a cost of approximately $160/acre-ft. Given the complex chemical reactions required for effective clarification of the water, the fluctuating nature of canyon water chemistry poses a challenge to the current treatment process.

Operators are regularly forced to turn away canyon water due to sudden changes in water chemistry that disrupt the treatment process to the point of jeopardizing finished water quality. It is important to maximize the use of the canyon source water because:

1. It provides significant cost savings compared to paying for an equivalent volume of water from the Deer Creek Reservoir.
2. The average volume of water that operators had to turn away over the last five years was 656 acre-ft per year. As growth in demand continues to approach the availability of supply, it becomes more critical to put this water to use. Doing so will delay or eliminate the need for one new well.

Thus far, the complexities of treating the canyon water have not been able to be fully addressed with operator expertise and available modeling tools. **JVWCD believes that implementing an online digital twin of the SERWTP treatment process, leveraging advanced machine learning techniques, will provide the tools needed for operators to fully utilize the canyon water.** As such, JVWCD is making SERWTP data available to companies with an interest in developing machine learning solutions to water treatment problems, with the intent to procure digital twin services/software from them.

The data will be made available to companies for them to develop a prototype of the digital twin that will be used in JVWCD's selection process. Companies wishing to develop a prototype will be required to sign a nondisclosure agreement (NDA) defining the allowable uses and required handling of the data. The Request for Information (RFI) to which this problem statement is attached provides more details about the procurement process. This document summarizes the desired functionality of the SERWTP Digital Twin, desired outcomes, and data that will be made available.

Desired Functionality

The digital twin should serve as a real-time simulation and decision-support system, enabling operators to optimize treatment processes in response to the dynamic nature of canyon water quality and availability. The digital twin should encompass the following functionalities:

- **Predictive Modeling:** Develop a hybrid physics and machine-learning model capable of accurately predicting treatment process performance under variable canyon water quality conditions. The model should predict critical parameters such as treated water turbidity, unit filter runtime volume (UFRV), and chemical dosages.
- **Optimization Engine:** Incorporate an optimization engine that determines the optimal setpoints for up to 15 key decision parameters, including chemical dosages, canyon water usage, and reservoir water blending.
- **Scenario Analysis:** Enable the evaluation of various optimization strategies, such as maximizing canyon water usage while maintaining target treated water quality and UFRV and minimizing chemical costs.
- **Cost Analysis:** Provide a comprehensive cost analysis module that quantifies the potential savings associated with each optimization strategy, accounting for the variable costs of canyon and reservoir water, chemical consumption, and filter run times.
- **What-If Analysis:** Allow operators to perform what-if analyses by adjusting input parameters for the two water sources and treatment set points and then evaluating the impact on optimization outcomes.

Desired Outcomes

The implementation of a digital twin at SERWTP is expected to yield several significant benefits, including:

- **Increased Canyon Water Utilization:** By enabling real-time optimization based on canyon water quality, the digital twin will facilitate increased usage of this essentially free water source. Initial estimates indicate expected average annual operational cost savings of $100,000 with significant variation from year-to-year based on canyon water availability. It is also believed that better utilization of the canyon water will defer or eliminate the need for a new supply well in the JVWCD system, which would save $5M-$10M.

- **Enhanced Treatment Efficiency:** The digital twin's ability to predict optimal setpoints for critical process parameters will significantly improve treatment efficiency by reducing chemical consumption, extending filter run times, and minimizing the need for manual adjustments.
- **Reliable Plant Operation:** By incorporating UFRV as a key optimization parameter, the digital twin will ensure sustainable plant operation even with increased canyon water usage, preventing the occurrence of low UFRV conditions that could render the water untreatable.
- **Improved Decision-Making:** The digital twin will empower operators with real-time insights into the trade-offs between different operational strategies, enabling more informed and data-driven decisions that balance cost savings, water quality, and operational stability.

Data Index

The following data points will be provided to companies that sign the required nondisclosure agreement, along with a schematic showing the location of the source instrumentation for each data point.

Schematic Location	Description	Tag Name
1	Total Flow Bell Canyon	SERWTP.SE_INT_BC_FIT00104_F_PV.F_CV
2	West Flow Bell Canyon	SERWTP.SE_INT_BC_FIT00103_F_PV.F_CV
3	Draper Diversion Turbidity	SERWTP.SE_INT_BC_AIT03403_TB_PV.F_CV
4	Draper Diversion Weir Level	SERWTP.SE_INT_BC_LIT03402_LEV_PV.F_CV
5	Draper Diversion Gate Position	SERWTP.SE_INT_BC_VLV03400_V_PV.F_CV
6	SLC Aqueduct Flow	SERWTP.SE_INT_RWV_FIT2019_F_PV.F_CV
7	SLC Aqueduct Turbidity	SERWTP.SE_INT_RWV_AIT1707_TB_PV.F_CV
8	SLC Valve Position	SERWTP.SE_INT_RWV_VLV1101_V_PV.F_CV
9	Canyon Flow	SERWTP.SE_INT_RWV_FIT2006_F_PV.F_CV
10	Canyon Influent Turbidity	SERWTP.SE_INT_RWV_AIT1706_TB_PV.F_CV
11	Canyon Valve Position	SERWTP.SE_INT_RWV_VLV1102_V_PV.F_CV
12	Total Influent Flow	SERWTP.SE_INT_IS_FIT1731_F_CALC.F_CV
13	Combined Influent Temperature	SERWTP.SE_INT_IS_TIT1106_T_PV.F_CV
14	Combined Influent Turbidity	SERWTP.SE_INT_IS_AIT1107_TB_PV.F_CV
15	Reclaim Flow	SERWTP.SE_RC_FIT4114_F_PV.F_CV
16	Bpoly Train 1 Pump Dose Setpoint	SERWTP.SE_CG_BPF_FIC2991_DOSE_SP.F_CV
17	Bpoly Train 2 Pump Dose Setpoint	SERWTP.SE_CG_BPF_FIC2992_DOSE_SP.F_CV
18	Sludge Flow In MGD	SERWTP.SE_RC_FIT2008A_F_PV.F_CV

Schematic Location	Description	Tag Name
19	Intended PACL Dose to Flash Mix	SERWTP.SE_CG_PACL_FIC6213_DOSE_SP.F_CV
20	Intended PACL Dose to Filters	SERWTP.SE_CG_PACL_FIC6211_DOSE_SP.F_CV
21	PEC Intended Dosage	SERWTP.SE_CG_PEC_FIT5010_DOSE_CALC.F_CV
22	Total Intended PRE CL2 Doseage	SERWTP.SE_TC_CL2_FIC6360_DOSE_CALC.F_CV
23	Actiflo Influent Particle Counts	SERWTP.SE_ACT_FM_AIT2781_PC_PV.F_CV
24	Influent Actiflo Turbdity	SERWTP.SE_ACT_FM_AIT2002_TB_PV.F_CV
25	Actiflo Train 1 Turbidity	SERWTP.SE_ACT_T1_AIT2014_TB_PV.F_CV
26	Actiflo Train 2 Turbidity	SERWTP.SE_ACT_T2_AIT2016_TB_PV.F_CV
27	Train 1 Sand Conc Target (Manual Enter)	SERWTP.SE_ACT_T1_CONC2471_SP.F_CV
28	Train 1 Sand Actual Concentration (g/L)	SERWTP.SE_ACT_T1_CONC2471_CONC_CALC.F_CV
29	Train 2 Sand Conc Target (Manual Enter)	SERWTP.SE_ACT_T2_CONC2472_SP.F_CV
30	Train 2 Sand Actual Concentration (g/L)	SERWTP.SE_ACT_T2_CONC2472_CONC_CALC.F_CV
31	Total Filter Influent Flow	SERWTP.SE_FL_FC3773_F_CALC.F_CV
32	Filter Influent CL2	SERWTP.SE_FL_AIT3136_CL2_PV.F_CV
33	Filter Influent Turbidity	SERWTP.SE_FL_AIT6581_TB_PV.F_CV
34	Filtration Rate	SERWTP.SE_FL_FC3772_RATE_CALC.F_CV
35	Surface Wash Flow	SERWTP.SE_FL_FIT3037A_F_PV.F_CV
36	Filter 1 Level	SERWTP.SE_FL_FL1_LIT3014_LEV_PV.F_CV
37	Filter 2 Level	SERWTP.SE_FL_FL2_LIT3024_LEV_PV.F_CV
38	Filter 3 Level	SERWTP.SE_FL_FL3_LIT3034_LEV_PV.F_CV
39	Filter 4 Level	SERWTP.SE_FL_FL4_LIT3044_LEV_PV.F_CV
40	Filter 5 Level	SERWTP.SE_FL_FL5_LIT3054_LEV_PV.F_CV
41	Filter 6 Level	SERWTP.SE_FL_FL6_LIT3064_LEV_PV.F_CV
42	Filter 1 Turbidity	SERWTP.SE_FL_FL1_AIT3016_TB_PV.F_CV
43	Filter 2 Turbidity	SERWTP.SE_FL_FL2_AIT3026_TB_PV.F_CV
44	Filter 3 Turbidity	SERWTP.SE_FL_FL3_AIT3036_TB_PV.F_CV
45	Filter 4 Turbidity	SERWTP.SE_FL_FL4_AIT3046_TB_PV.F_CV
46	Filter 5 Turbidity	SERWTP.SE_FL_FL5_AIT3056_TB_PV.F_CV
47	Filter 6 Turbidity	SERWTP.SE_FL_FL6_AIT3066_TB_PV.F_CV
48	Filter 1 Particle Counts	SERWTP.SE_FL_FL1_AIT3017_PC_PV.F_CV
49	Filter 2 Particle Counts	SERWTP.SE_FL_FL2_AIT3027_PC_PV.F_CV
50	Filter 3 Particle Counts	SERWTP.SE_FL_FL3_AIT3037_PC_PV.F_CV
51	Filter 4 Particle Counts	SERWTP.SE_FL_FL4_AIT3047_PC_PV.F_CV
52	Filter 5 Particle Counts	SERWTP.SE_FL_FL5_AIT3057_PC_PV.F_CV
53	Filter 6 Particle Counts	SERWTP.SE_FL_FL6_AIT3067_PC_PV.F_CV
54	Filter Effluent CL2 Residual	SERWTP.SE_FW_AIT5002_CL2_PV.F_CV
55	Total POST CL2 Dose	SERWTP.SE_TC_CL2_FIC6310_DOSE_CALC.F_CV

Schematic Location	Description	Tag Name
56	Combined Filter Effluent Turbidity	SERWTP.SE_FW_AIT5001_TB_PV.F_CV
57	Backwash Water Flow In Gpm	SERWTP.SE_FL_FIT3131A_F_PV.F_CV
58	Backwash Water Turbidity	SERWTP.SE_FL_AIT4102_TB_PV.F_CV
59	Reclaim Basin Being Used Level	SERWTP.SE_RC_LIT4100_LEV_PV.F_CV
60	Plant Effluent Flow	SERWTP.SE_FW_FIT6405_F_PV.F_CV
61	Reclaim Turbidity	SERWTP.SE_RC_AIT4105_TB_PV.F_CV
62	Influent pH	SERWTP.SE_INT_IS_AIT1103_PH_PV.F_CV
63	Influent Alkalinity	SERWTP.SE_FW_LAB_AC1747_CALC.F_CV
64	Influent Hardness	SERWTP.SE_FW_LAB_AC1744_CALC.F_CV
65	Influent Temperature	SERWTP.SE_ACT_FM_TIT2005_T_PV.F_CV

Summary

This problem statement and data provided with it is intended to guide the development of digital twin prototypes that JVWCD will evaluate to select a company to provide a digital twin of the SERWTP treatment process. Additional details about the procurement process are provided in the RFI. The successful implementation of the digital twin will transform the operation of SERWTP, enabling JVWCD to effectively address the challenges posed by the variable nature of canyon water. The expected result is substantial cost savings while ensuring the reliable delivery of high-quality treated water to its customers.