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Southwest Metropolitan
Water and Sanitation District

Risk and Resilience Summary for Southwest Metropolitan Water and Sanitation District

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Hazen Project No. 70058-000

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Key to Table Headers

Table 1:

Countermeasure refers to activities or infrastructure that can help reduce risk

Potential Order of Magnitude Costs refer to approximate values of potential countermeasures and were used only for relative comparison and not for budgeting purposes

Annual Risk Reduction refers to the change in risk once a countermeasure has been put in place. Typically, countermeasures reduce vulnerability and sometimes they reduce magnitude of impact

Benefit:Cost Ratio is the “Annual Risk Reduction” multiplied over a 20 year horizon (5 year for cybersecurity) divided by the “Potential Order of Magnitude Cost”

Table 2:

Threat-Asset Index is simply the number used to identify a given “Threat-Asset Pair”

Asset refers to the specific asset or group of assets where the risk may occur

Threat refers to the specific act or event that could negatively impact the asset and the utility's mission to deliver water

Consequence (C) is the value, in dollars, of the impact of a given threat should it occur. This includes loss of life, injury, lost revenue, legal fees, repair costs, staff overtime, etc.

Vulnerability (V) refers to how prepared the utility is to handle a given emergency situation, with “1” being not at all prepared and “0” indicating fully prepared with no known vulnerability

Threat Likelihood (T) is the probability (from 0 to 1, similar to 0% to 100%) that an event may occur in the utility's service area

Annualized Risk is the product of consequence times vulnerability times threat likelihood ($Risk = C \times V \times T$). In other words, this is the monetary value of any given risk for any given year

Table 1: List of Identified Risk Reduction Activities

Countermeasure Title	Countermeasure Description	Potential Order of Magnitude Cost	Annual Risk Reduction	Benefit: Cost Ratio
1. Physical Security Enhancements at Hogback Pump Station	Install cameras and exterior motion sensors at Hogback Pump Station to detect and respond more quickly to potential intruders.	\$10,000	\$28,000	55.3
2. Fire Mitigation Landscaping at the Hogback Pump Station	Implement landscaping to mitigate fire impacts at the Hogback Pump Station.	\$10,000	\$63,000	41.8
3. Installation of Manhole Smart Covers	Install manhole smart covers throughout system to detect and respond more quickly to sewer system backups.	\$250,000	\$250,000	20.1
4. Contractor Generator Fuel Supply Redundancy	Find a backup fuel vendor or consider installing additional storage tank on-site.	\$100,000	\$97,000	19.4
5. Condition Assessments on Critical System Assets	Conduct a condition assessment on critical mains and critical valves to identify areas of the distribution system for work order or CIP planning prioritization.	\$250,000	\$180,000	14.8
6. Cybersecurity Enhancements	Consult with Special District Association - offers cyber protection services. Continue training employees on cyber security risks and best practices. During a cyber-attack, disconnect from network connectivity to mitigate system intrusion. Perform cloud backups (makes recovery quicker). [Additional Priority 1 Controls identified in the Cybersecurity Assessment Tool should be implemented as soon as possible].	\$10,000	\$5,200	10.4
7. Maintenance of Utility Financial Health	Continue to increase to annual fee. Investigate other revenue sources. Annual evaluation of customer base to ensure service population remains stable.	\$10,000	\$3,000	6.0
8. Physical Security Enhancements at District Office Building	Install cameras, implement key cards, always lock front door (buzz people in after identification) at District Office Building. Store employee files in cloud-based system.	\$10,000	\$3,000	6.0
9. Cloud-Based SCADA Data Implementation	Load all SCADA data into cloud-based system to prevent the permanent loss of data due to physical damage of the system.	\$100,000	\$29,000	5.7
10. Backflow Prevention Program	Implement backflow prevention for single-family residences (Denver Water's responsibility).	\$100,000	\$27,000	5.4
11. Maintenance of Critical Knowledge	Implement an annual exercise of existing cross-training procedures to prevent the loss of critical knowledge among employees.	\$1,000	\$190	3.8
12. Potential Installation of Backup Water Feed	Conduct hydraulic analysis and fireflow testing. Consider the installation a backup feed at the Hogback Pump Station and/or collaborate on mitigation efforts with Denver	\$1,000,000	\$56,000	1.1

Southwest Metropolitan Water and Sanitation District, Top Risk Reduction Projects
 America's Water Infrastructure Act, Not Subject to FOIA or Other Open Records Requests

Countermeasure Title	Countermeasure Description	Potential Order of Magnitude Cost	Annual Risk Reduction	Benefit: Cost Ratio
Line at the Hogback Pump Station	Water to prevent a failure to provide adequate fire flow in the distribution system.			
13. Floodplain Analysis on Critical System Assets	Conduct a floodplain analysis on critical system assets to determine inundation areas and to improve planning and preparation of resources for a flood event.	\$100,000	\$4,900	1.0
14. Physical Security Improvements at Fire Hydrants	Apply locks to fire hydrants to prevent the theft of water.	\$100,000	\$4,500	<1
15. Increase Backup Power for SCADA System	Install more batteries or batteries with increased storage capacity. Install a generator on-site at District Office building for backup power during a power outage.	\$100,000	\$3,500	<1
16. Water Main Flood Erosion Analysis	Conduct a full-scale water main flood erosion analysis of each crossing to determine risk.	\$100,000	\$1,170	<1
17. Hydraulic Model Evaluations in Sedaru*	Increase the number of evaluations in Sedaru (work order tracking and CIPP planning) package to prevent a failure to replace pipelines at the mandated replacement rate per contractual obligation.	\$10,000	\$3	<1
18. Distribution System Maintenance	Continue conducting training and having contractors follow Denver Water protocols for distribution system maintenance.	\$10,000	NA	NA
19. Employee Safety Program Training	Continually review and communicate safety program with staff (e.g., field safety, following pandemic illness guidelines) to aid in the prevention of serious injuries and/or fatalities.	\$10,000	NA	NA
20. CMOM Program	Continue routine cleaning and inspection program to prevent sewer system backups.	\$100,000	NA	NA
21. Physical Security at Manholes	Continue to keep manhole covers locked to prevent malevolent acts such as intentional blockage of sewer mains.	\$0	NA	NA

*17. Note that a specific cybersecurity risk was identified with the use of the Silverlight add-in used to view the hydraulic model in Sedaru. The District may wish to evaluate the option of upgrades or alternative packages that do not rely on Silverlight due to know security risks with that add-in and the upcoming end of support from Microsoft on October 12, 2021.

Table 2: List of Top Threat-Asset Pairs and Risk Calculations

Threat-Asset Index	Asset	Threat	C	V	T	Annualized Risk
40	Sewer mains	Other district backup creates spill conditions or backup in SMWSD system.	\$2.8M	0.53	0.3	\$440,000
14	Hogback Pump Station	Contractor unable to meet generator diesel fuel requirement during an emergency. Critical concern. Could result in widespread impacts.	\$870k	1.00	0.3	\$260,000
3	Finished water pipelines	Main break due to aging infrastructure which results in the inability to deliver water to critical facilities and portions of the distribution system.	\$490k	0.43	0.9	\$190,000
26	Fire hydrants	Failure to provide adequate fire flow. Critical concern. Could result in widespread impacts.	\$490k	0.81	0.3	\$120,000
9	Hogback Pump Station	"T2 - Tornado - Fujita 2 – Tornado with estimated winds 111 to 135 mph". High winds damage pump station and impact the delivery of water to critical facilities and portions of the distribution system.	\$870k	0.81	0.1	\$70,000
10	Hogback Pump Station	Wildfire prevents access to and/or damages pump station and impacts the delivery of water to critical facilities and portions of the distribution system.	\$550k	0.81	0.1	\$45,000
16	SCADA system	Fire occurs in SCADA room (e.g., faulty battery) which results in a permanent loss of data.	\$570k	0.53	0.1	\$30,000
13	Hogback Pump Station	Intentional damage to pump station by malevolent actor, which results in a disruption of service to critical portions of the distribution system.	\$870k	0.30	0.1	\$26,000
1	Finished water pipelines	Backflow contamination of home irrigation systems in distribution system which results in health advisories or illness.	\$490k	0.50	0.1	\$24,000
36	Utility financial health	Reliance on earned interest from reserves causes cashflow shortfall when interest rates drop to historic low. Existing fees insufficient to cover costs, so utility dips into reserve funds.	\$100k	0.72	0.3	\$22,000
5	All valves	Critical valve break due to aging infrastructure which results in the inability to deliver water to critical facilities and portions of the distribution system.	\$470k	0.43	0.1	\$20,000
44	Finished water pipelines	Improper water main repair leads to contamination of finished water.	\$600k	0.50	0.05	\$15,000

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Threat-Asset Index	Asset	Threat	C	V	T	Annualized Risk
39	Sewer mains	Sewer main backup results in environmental damage.	\$110k	0.43	0.3	\$14,000
30	District staff	Employee is injured or killed while working in the field (e.g., vehicular accident, heat stroke).	\$520k	0.43	0.05	\$11,000
12	Hogback Pump Station	Extended loss of power grid (<1 days) results in a disruption of service to critical infrastructure or portions of the distribution system.	\$40k	0.43	0.5	\$8,600
43	Water mains at culvert crossings	Potential loss of water mains due to erosion during flood events at one of the 40 - 45 culvert crossings.	\$130k	0.62	0.1	\$8,100
7	Hogback Pump Station	100-year and 500-year floods result in staff being unable to access pump station and/or manually operate system.	\$870k	0.81	0.01	\$7,000
8	Hogback Pump Station	100-year and 500-year floods result in damage to pump station and/or inability to convey water.	\$870k	0.81	0.01	\$7,000
6	Business enterprise system	Ransomware attack on business enterprise systems results in shutdown of critical systems and/or required payment of ransom.	\$130k	0.12	0.3	\$4,700
25	Fire hydrants	Intentional or unintentional damage to fire hydrant, or theft of water.	\$10k	0.50	0.9	\$4,500
32	SCADA system	Loss of power to SCADA system, which results in a disruption of service to critical portions of the distribution system.	\$18k	0.43	0.5	\$3,800
42	Financial records	Financial or employee records stolen, resulting in release of sensitive information.	\$50k	0.30	0.2	\$3,000
27	District staff	Public Health Emergencies - Pandemic illness, resulting in loss of staff or minimal staff to operate system.	\$470k	0.62	0.01	\$2,900
2	Finished water pipelines	Backflow of dangerous chemical or biological contamination in distribution system which results in health advisories or illness.	\$520M	0.50	0.00001	\$2,600
15	Hogback Pump Station	Malevolent actor (could be internal or external) intentionally contaminates water system with biological or chemical agents.	\$520M	0.30	0.00001	\$1,600