Asset Management in the Water/Wastewater Industries:

A Case Study from the Upper Occoquan Service Authority (UOSA) in Centreville, VA

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FTA State of Good Repair Roundtable
Chicago, Illinois
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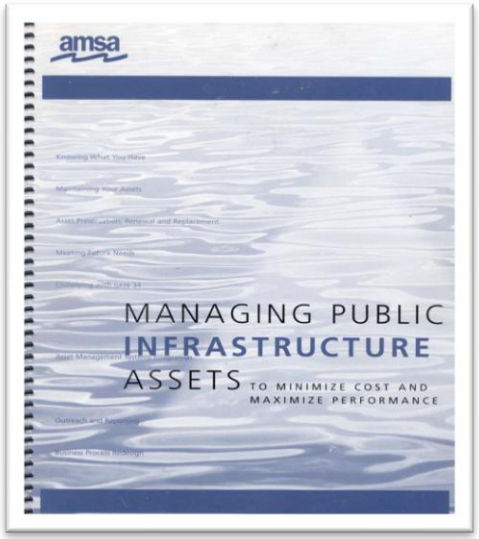
CH2MHILL

Agenda

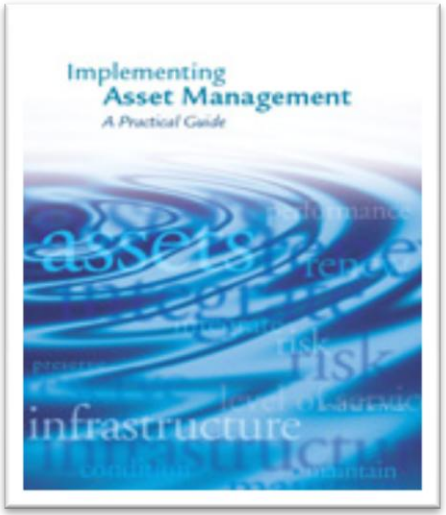
- Overview of approaches to asset management in the water industry
- UOSA Case Study
  - How it was conducted
  - Results
  - How it's been used
- Concluding Thoughts

Water and wastewater industry associations have sponsored a number of studies and guidance documents related to asset management in the past ten years.



Managing Public Infrastructure Assets to Minimize Costs and Maximize Performance

Association of Metropolitan Sewerage Agencies, Association of Metropolitan Water Agencies, American Water Works Assocation, Water Environment Federation, 2002



Implementing Asset Management – A Practical Guide

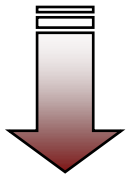
Association of Metropolitan Water Agencies, National Association of Clean Water Agencies, Water Environment Federation, 2007

Asset management is an integrated set of processes to:

- Minimize the life-cycle costs of owning, operating and maintaining infrastructure assets
- Continuously deliver established levels of service…
- At an acceptable level of risk

Risk is quantified using the classic risk equation

Risk = *f* (consequence x likelihood)

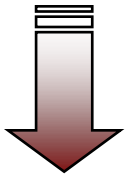


How severe are the consequences of asset failure?

How likely is it for the asset to fail?

Quantify consequence of failure using established levels of service

Risk = (consequence x likelihood)



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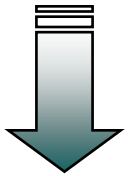


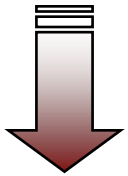
How likely is it for the asset to fail?

Levels of Service

- Health, Safety & Security implications
- Financial impact
- Regulatory/code compliance
- Public confidence/image
- Service delivery

Quantify likelihood of failure

Risk = (consequence x likelihood)



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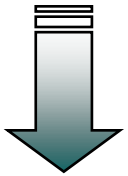
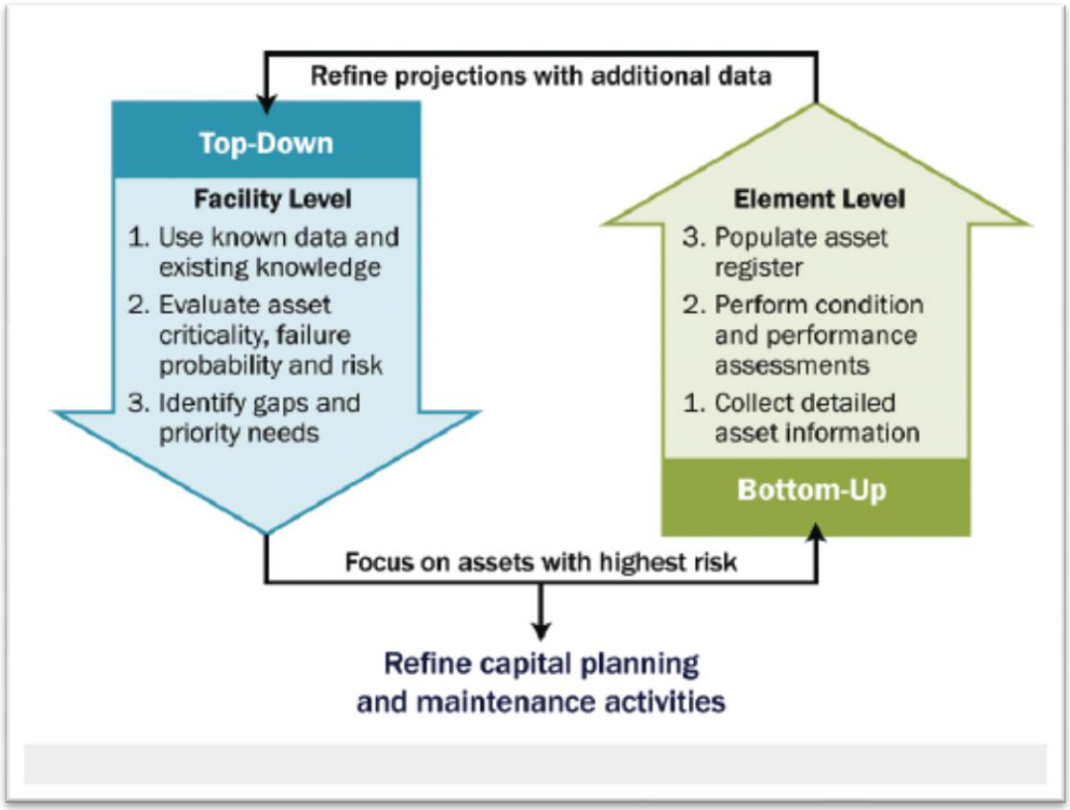


How likely is it for the asset to fail?

- Condition of asset
- Performance of asset
- Effectiveness of O&M protocols
- Maintenance history

Top-down/risk-based approach provides best value for resource investment



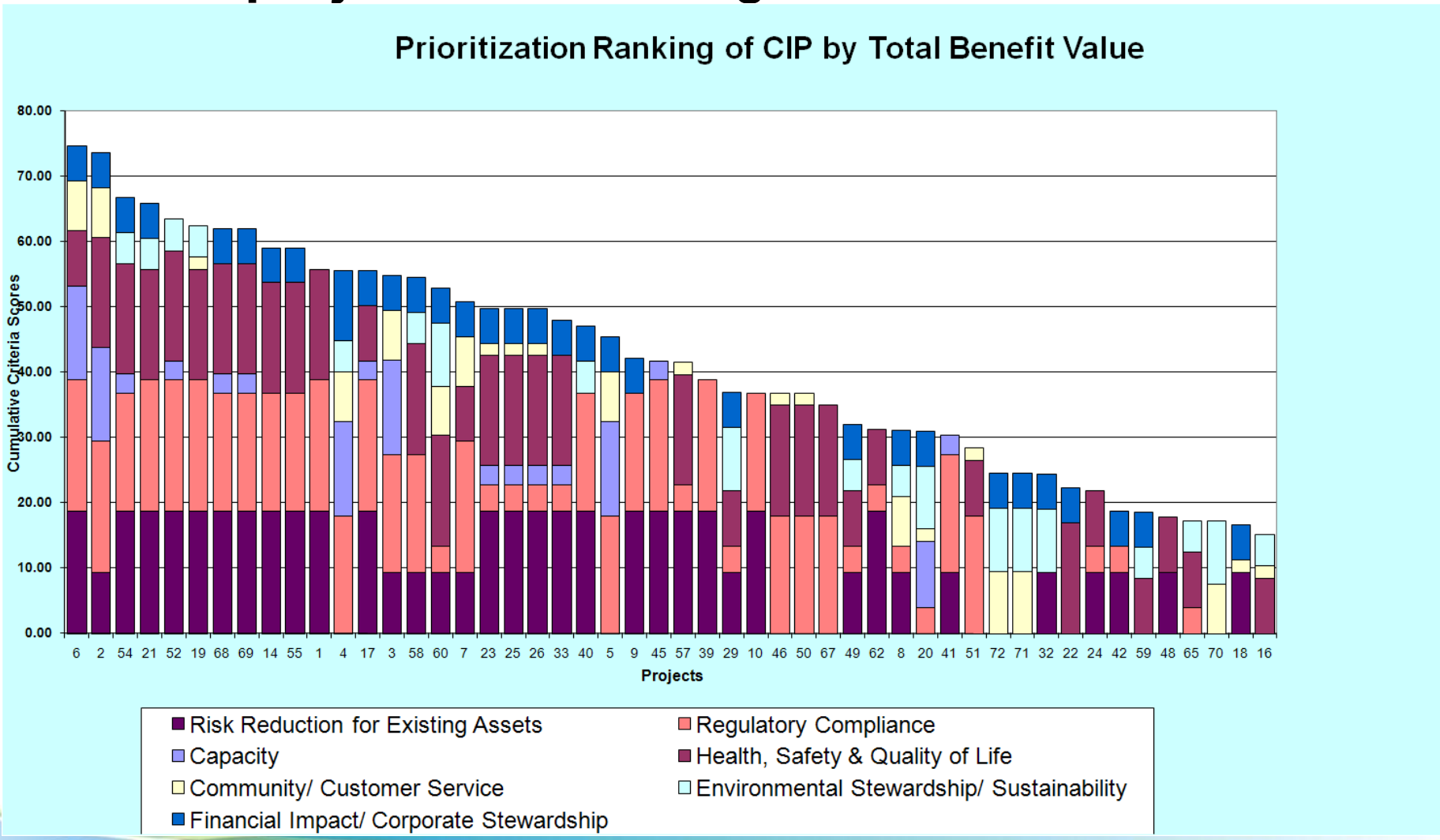
- Develop asset hierarchy
- Conduct Top-Down Risk Assessment
- Prioritize field condition assessments based on initial risk assessment
- Conduct field condition assessments and refine risk scores and rankings
- Develop risk-mitigation measures

Understanding the risk of asset failure provides the basis for

- Objective, informed decision-making
- Optimizing O&M
- Investing in condition assessments
- Prioritizing capital investments for Renewal & Replacement (R&R)




Risk reduction opportunities are often a key factor in overall CIP prioritization where R&R projects compete with other projects for funding



UPPER OCCOQUAN SERVICE AUTHORITY (UOSA) CASE EXAMPLE

Context for UOSA

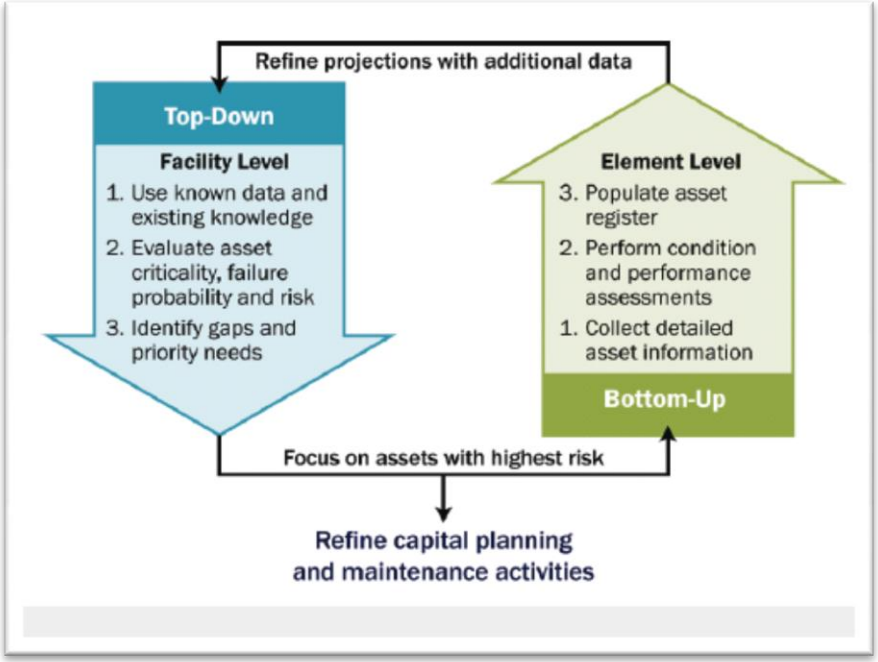
- Major suburban Washington DC area wastewater utility
  - 54 million gallons per day treatment capacity
  - 275,000 service area population

Context for UOSA

- Formed in the 1970s, with major expansions at several intervals, so
  - Facilities of varying age
  - Facilities of varying condition
- Substantial capital needs
  - $437 M capital budget through 2021
  - Need to prioritize investments

The ‘top-down’ approach was used to identify 1,912 assets that merited detailed field assessments

- Existing studies and data
- Staff knowledge of operating history and maintenance
- Preliminary consideration of criticality



Condition assessments were conducted using a step-by-step process that can be sustained

1. Asset data and history were gathered
2. Assessment criteria were developed with UOSA for each type of asset
3. Information was uploaded to CH2M HILL's Asset Condition Evaluation System (ACES) tool
4. Field condition assessments were conducted
5. Risk results were calculated

This example illustrates specific questions by asset type and how answers were documented

UOSA Asset Condition Assessment

Asset	160	Location	Digester Complex Buildings (C1)
Parent Number	0503030000	System	0503020402
Asset Description	PUMP CENT	Inspection Date	6/19/2008 12:00:00 AM
Comments	Picture 60		

Question	Answer		NA	Flag	Answer Comment
Vibration Measurement	2	2 -Good .039 - .15 inches/sec			.1 in / sec
Mounting	2	Good			
All Safety Guards Present	1	yes			
Acceptable Noise	1	yes			
Absence of Pump Cavitations	1	yes			
Absence of Leaks	1	yes			
All Components	1	yes			
Lubrication OK at Inspection	1	yes			
No Mechanical Seal Leakage			X		
Operating at Inspection	1	yes			
Corrosion - Structural Metals	2	Slight staining/small chips			
Infrared	1	Negligible Ambient			
Packing Gland/Seals	2	Normal			
Pipe Alignment	1	Straight			
Belt/Direct Drive/Couplings	2	Minor Wear			
Gauges Operational			X		
Obsolesence	1	Currently supported			

Photo

Condition Score	1.429	Condition Category	Very Good No corrective maintenance needed

Tools and Methods

- Three non-destructive tests were used for the condition assessments
  - Vibration (inches/sec) horizontal, vertical, and axial
  - Thermography
  - Oil analysis
- No invasive techniques were used

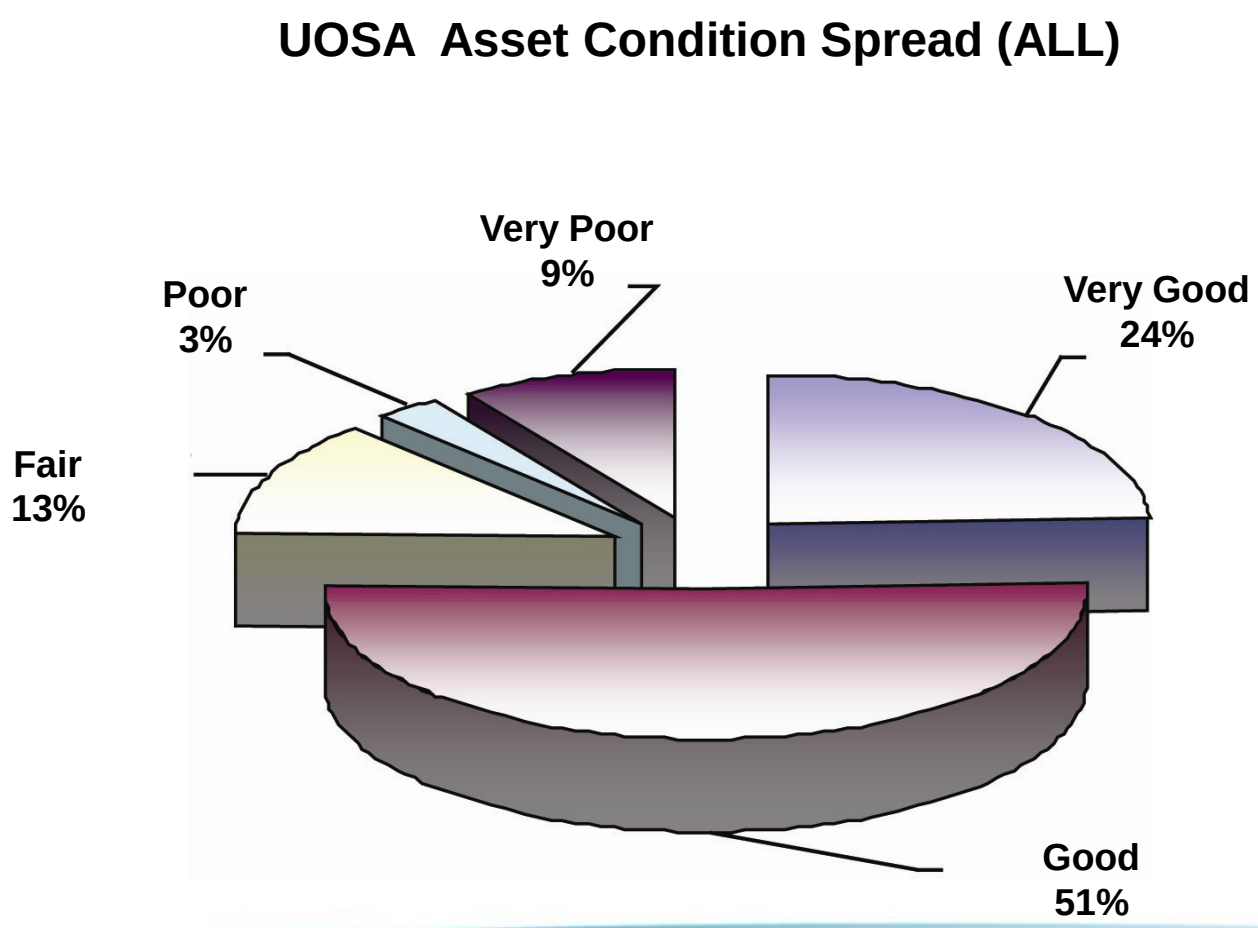
UOSA-specific factors were used to define the elements of the risk equation.

Consequence of Failure						
Factor	**Wt**	**1**	**3**	**5**	**7**	**10**
		Negligible	**Minor**	**Moderate**	**Major**	**Severe**
Permit complaince	23%	Permit conditions met	Above target on an individual day but no impact on monthly standard	Above target on week but no impact on monthly standard	Violated monthly standard	Chronic permit violation; pending enforcement action.
Impact on process	15%	Individual equipment level. Can still meet all flow demands with excess capacity available No impact on process Can be out of service for several months	Multiple equipment level. Can still meet all flow demands with firm capacity still available Routine adjustment on process Can be down more than a month	System level or major equipment. Inability to meet peak flow. Pond available. Significant adjustment in process necessary requiring significant labor effort Cannot be down beyond a week	System level. Inability to meet peak flow. Bypass of unit process Significant adjustment in process necessary with uncertainty as to recovery Cannot be down for more than a couple of days	Plant level. Inability to meet average flow. Bypass/SSO Major process upset with recovery uncertain Cannot be down more than several hours
Financial impact (repair, loss of revenue, claims, etc)	18%	Within budget line item; cost effective	Exceeds O&M budget line item	Requires reserve maintenance funds in excess of expectations	Requires deferal of other reserve expenditures	New money needed. Board action required.
Health and safety	25%	No injuries or adverse health effects		Minor injury with no lost time; no public health effects	Minor injury with lost time; no public health effects	Major injury with lost time; localized public health issue.
Community and publilc image (community/ environmental impact and media coverage)	20%	No complaints. No third-party damage No media coverage.	Small number of complaints. No third-party damage Neutral or no coverage in media	Many complaints. Minor third-party damage Adverse media coverage	Widespread complaints Major third-party damage Minor short-term impact on environment Widespread adverse media coverage	Extensive complaints National adverse media coverage. Political opposition Environmental impact reversible in 6 months or more

UOSA-specific factors were used to define the elements of the risk equation.

Likelihood of Failure						
Description	**Wt**	**1**	**3**	**5**	**7**	**10**
Physical Condition	53%	Very Good No corrective maintenance needed	Good Few minor deficiencies. Some corrective maintenance needed	Fair Several minor deficiencies. Requires corrective maintenance	Poor Major deficiencies. Requires significant repair or rehabilitation	Very Poor Rehabilitation or replacement necessary. May be unserviceable
Performance	32%	Exceeds performance expectations	Meets performance expectations	Barely meets current expectations. Room for performance improvement	Does not meet current performance expectations	Inefficient performance, bottleneck, obsolete
Repair History	16%	Repair history does not suggest problems	Repair history suggests occassional minor problems	Repair history indicates frequent minor problems	Repair history suggests occassional major problems	Repair history indicates frequent major problems

Outputs at UOSA Include an Overall Condition Ranking of the Assets…..



…and a Detailed Risk and Condition Ranking for Each Key Asset

Upper Occoquan Service Authority (UOSA) Asset Ranking				
Level 2	Rank	Number of Assets	Condition Score	Risk Score
OPERATIONS BUILDING G (1402000000)	1	1	1.08	28.19
BALLAST POND PUMP STN #1 (0902000000)	2	13	3.52	24.33
AUXILIARY POWER BLDG Q (1405000000)	3	52	1.73	24.28
CHEM STORAGE,FEED AREA BLDG H (0506000000)	4	35	2.35	17.97
LOAD CENTER #5, BUILDING P (1209000000)	5	20	1.59	17.82
SOLIDS HANDLING BUILDING (0505000000)	6	169	2.11	17.77
DIGESTOR COMPLEX (0503000000)	7	116	1.82	17.33
CHEM SLUDGE DIST STR 18/1-2 (0800000000)	8	10	3.58	16.58
LOAD CENTER #2, BLDG E/1 (1208000000)	9	25	1.72	16.04
HYDROCHLORIC GAS BUILDING W (0408000000)	10	7	2.24	15.32
REGENERATION CHEMICAL BLDG M/1 (1008000000)	11	16	2.23	14.71
ADVANCED TREATMENT BLDG L/1 (0903000000)	12	176	2.03	14.53
CHEMICAL CLARIFIER #1-3 (0604000000)	13	15	2.30	14.06
RECARB SLUDGE PUMPING BLDG N/1 (0704000000)	14	27	3.12	14.03
RAPID MIX BASINS #1-2 (0602000000)	15	27	2.52	13.71
1ST STAGE RECARB BASINS #1 & #2 (0701000000)	16	49	3.26	13.65
PRIMARY CLARIFIERS 4/1-3 (0301000000)	17	18	2.68	13.14
RAS PUMP STATIONS #1-2 (0403000000)	18	79	2.21	12.76
SECONDARY CLARIFIERS #1-6 (0401000000)	19	29	2.46	12.76
RECARBONATION BLDG Y/1 (0706000000)	20	70	2.14	11.64

"The analyses helped us to identify projects that needed to proceed immediately, and projects that could slide back a few years if necessary."
Chuck Boepple, Executive Director at UOSA.

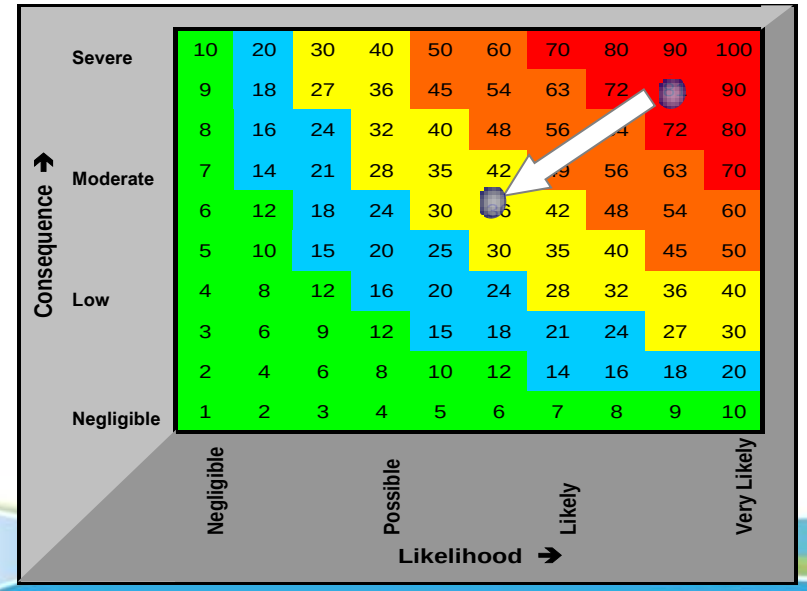
Options for addressing the assets with the greatest risks were identified and evaluated to identify the best strategy.

Rehabilitation
Replacement

Operating procedures
Maintenance procedures

Demand management
Reduce LOS & educate
Improve response & recovery

Assess risk reduction for identified options



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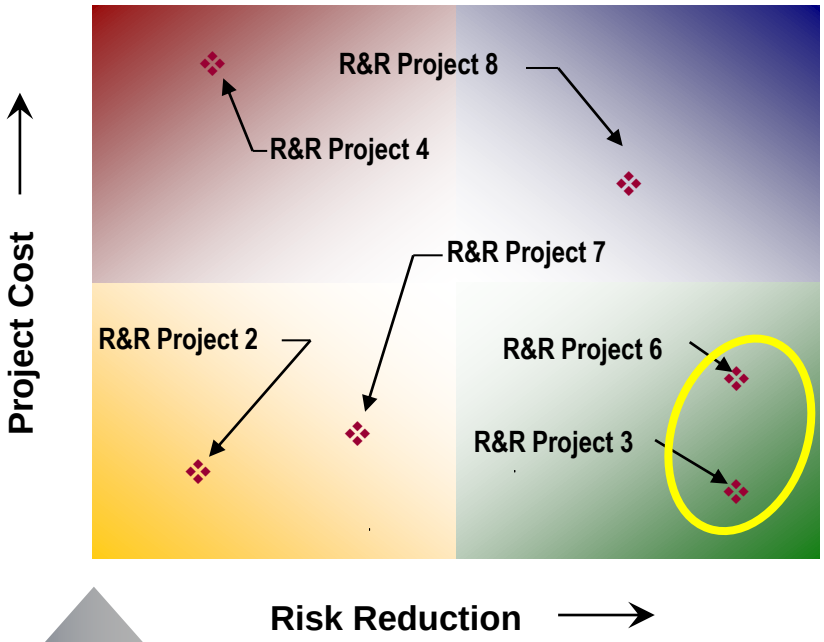
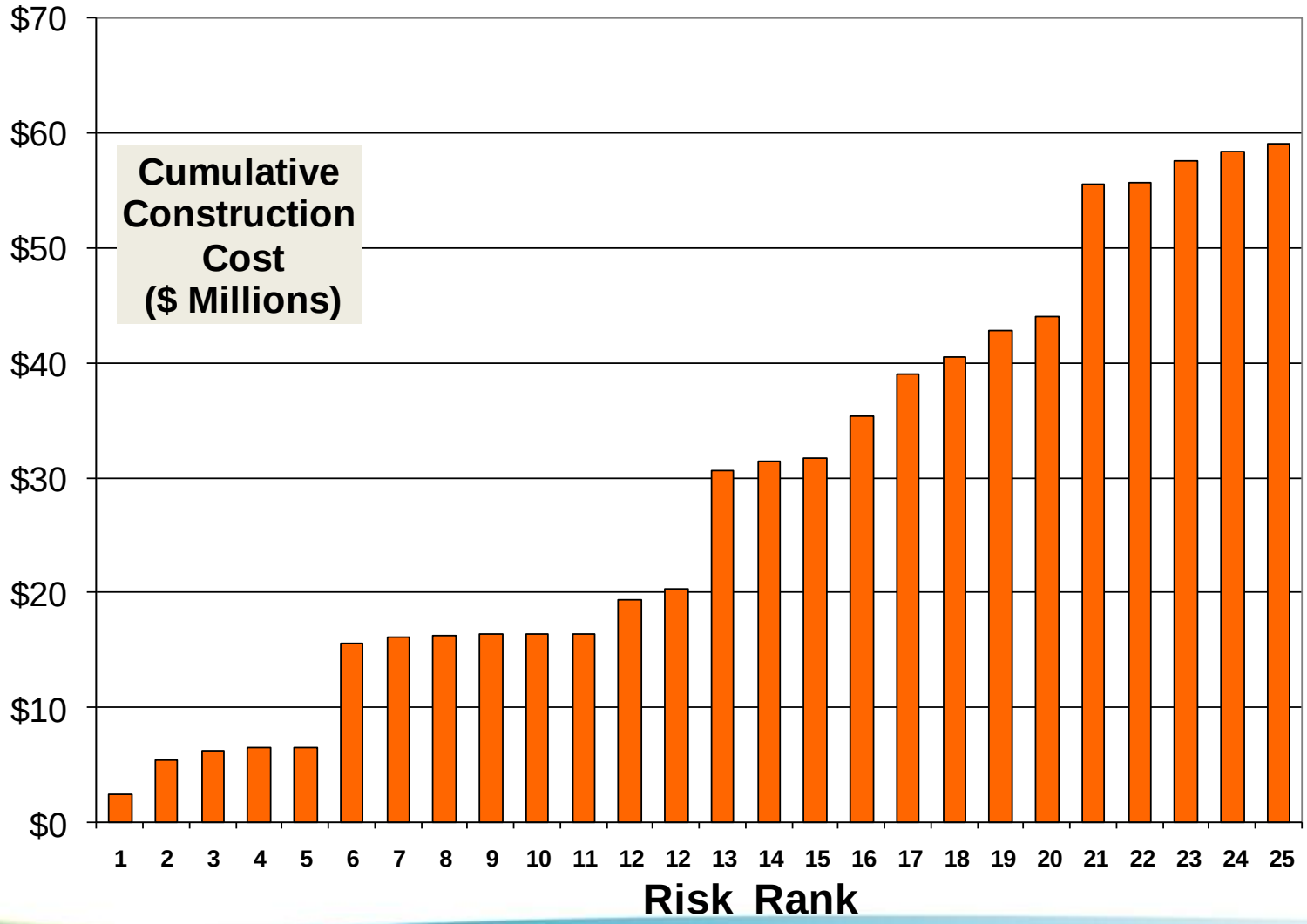


Rank options by:

$$\frac{\text{Risk Reduction}}{\text{Cost}}$$

Linking risk results to estimated construction costs helps prioritize CIP spending

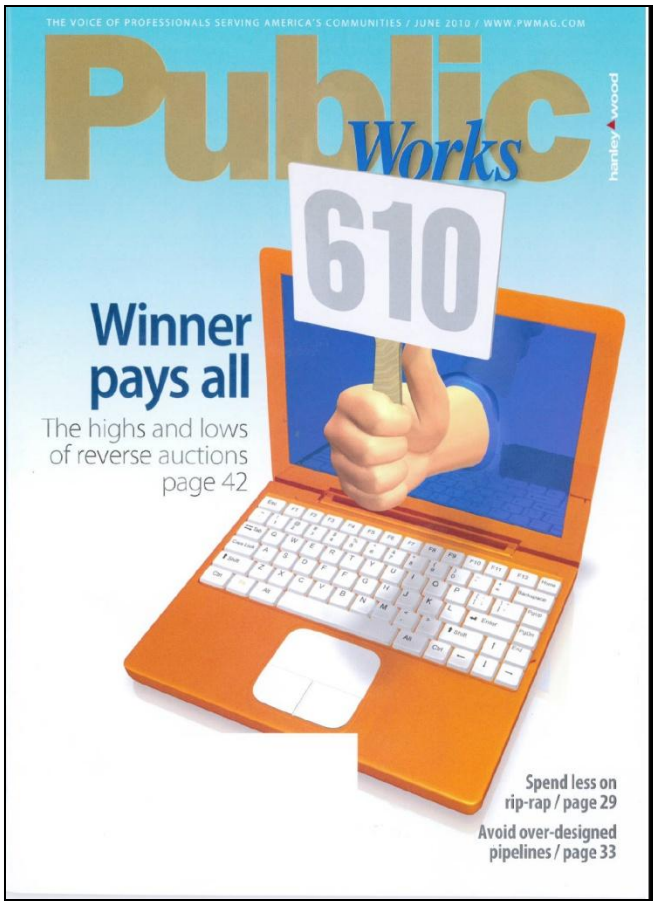


The results of the condition assessments and risk analyses have been used by UOSA to:

- Guide overall development of the capital renewal program
  - Initial phase includes projects that address many assets with high risk scores
  - Follow-on phase addresses remaining priority needs
- Address specific decisions:
  - Modernization of computer platforms for WWTP control systems was accelerated due to considerable risks identified
  - Rehabilitation of tertiary treatment facilities was pushed back a few years

Additional details of the UOSA case study are available in the June 2010 issue of *Public Works*

www.pwmag.com



Concluding thoughts

- Much progress has been made in the past dozen years in developing and applying asset management approaches in the water industry
- Advances in technology have aided this progress
- **BUT**, there is still much work to be done!
- Risk reduction concepts cut across elements of public works
  - Many common elements among water, sewer, transportation, public buildings
  - UOSA's risk reduction efforts parallel the DOT's efforts to "identify 'safety-critical assets' as a means of establishing priority re-investment decisions"

Thanks for listening!

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