

Five Core Components...Five Steps

1. Build an Asset Inventory
2. Select a Level of Service
3. Identify Critical Assets
4. Estimate Life-Cycle Costs
5. Evaluate Long-Term Funding/Financing





Critical Assets

Evaluate Risk of Failure

- Probability of Failure (condition or age)
- Consequence of Failure (major expense, system failure, safety concerns)

Questions to ask

- How can assets fail?
- How do assets fail?
- What is the likelihood (probability) of failure?
- What are the consequences of failure
- What are the cost for repairing/replacing the asset?
- What are other associated costs?



Probability of Failure

Modes of Failure

- Mortality: asset physically fails through collapse, rupture, or otherwise
- Financial Inefficiency: asset costs so much to operate and maintain that it is no longer economical to keep it in operation
- Capacity: asset still operates, but not at the capacity needed
- Level of Service: asset still operates, but doesn't meet the required LOS

Probability of Failure

Factors & Ratings

- Asset Age
- Asset Condition
- Repair History
- O&M History
- Historical Knowledge
- Experience

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Consequence of Failure

Factors & Ratings

- Cost of repair/replacement
- Social impacts or costs
- Environmental impacts or costs
- Costs/impacts related to collateral damage from failure
- Legal costs associated with asset failure
- Public health impacts or costs
- Reduction in Level of Service
- Any other costs or impacts related to the asset failure

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Redundancy Reduces Risk



<https://swefc.unm.edu/home/amkan/Chapter5Videos/CR-9.m4v>

Risk of Failure

Probability of Failure (POF)

- Remaining life
- Structural condition

$$\text{Risk} = \text{POF} \times \text{COF} \times R$$

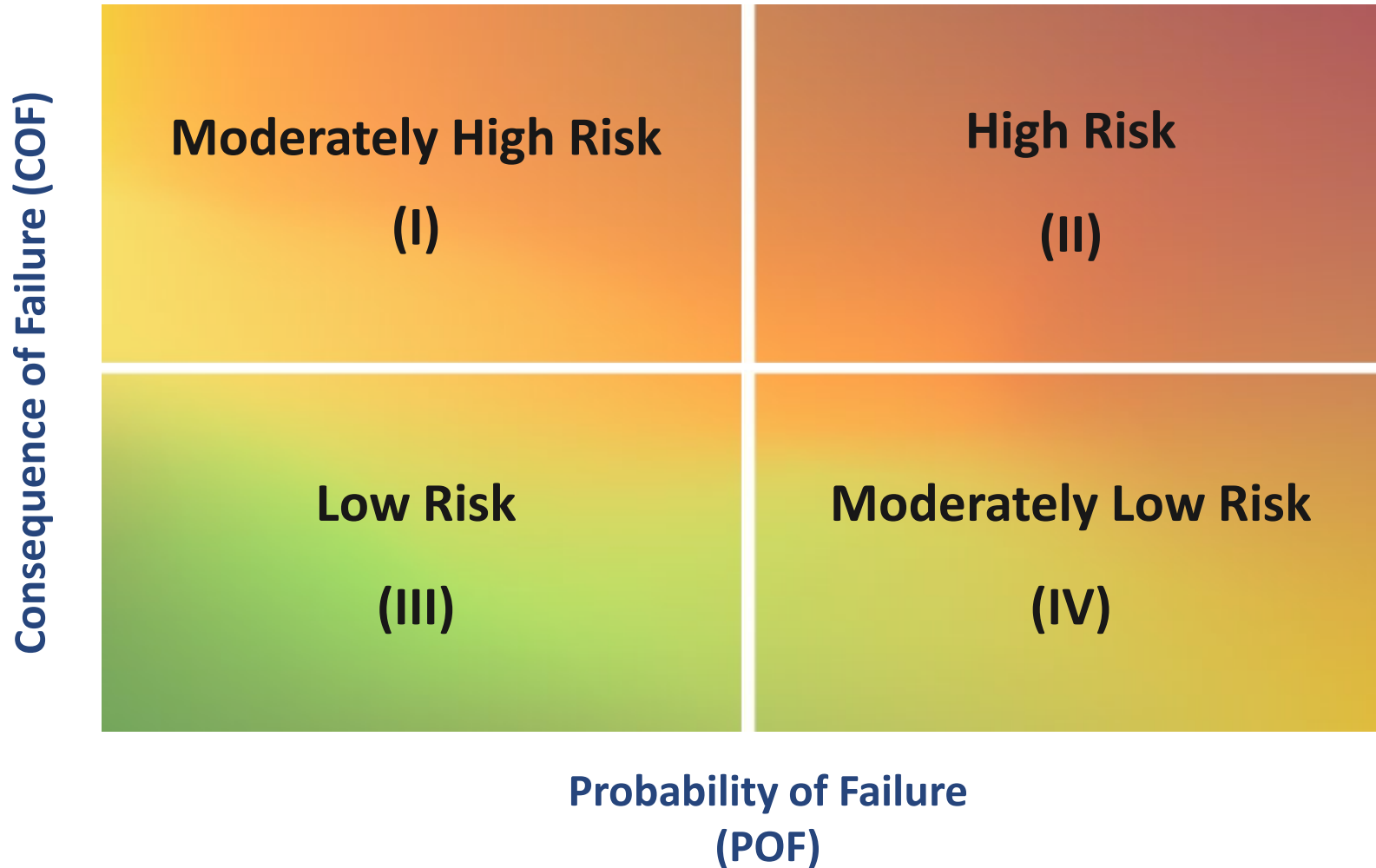
Consequence of Failure (COF)

- General rating (negligible, moderate, high)
- Depth & size of asset (influences cost of replacement)
- Proximity to important community features:
(floodplains, environmental hazards, buildings, roadways)

Redundancy (R)

- Duplicate asset serving as back-up

Identify Critical Assets based on Risk



Criticality and Energy Use

Factors

- Meets Energy Efficiency Goals
- Energy Use
- Renewable Source of Energy
- Potential Alternatives
- Costs
- Availability of Funding/Financing/Rebate
- Operability
- Regulatory Requirements

1	Very Low Energy Use
2	Low Energy Use
3	Moderate Energy Use
4	High Energy Use
5	Very High Energy Use

1	Very Low Feasibility
2	Low Feasibility
3	Moderate Feasibility
4	High Feasibility
5	Very High Feasibility

Prioritizing Based on Failure Risk

- Probability of Failure (POF): likelihood of an asset failing
- Consequence of Failure (COF): effects of an asset failing



Asset 1: Pumps in station



Asset 2: Concrete pipe



Asset 3: Recycled water pump

Asset	Effective Life	Structural Condition	POF	COF	Rank
Pumps in station	30 years	Excellent	Low	High	Medium
Concrete water pipe	100 years	Poor	High	Medium	High
Recycled water pump	20 years	Good	Medium	Low	Low

Collecting Data

Example of an **Asset Inventory** for a Water Treatment Plant

Process Unit	Number of Units	Approximate Date of Installation	Typical Lifespan (Years)	Remaining Life Span (as of 2011)	Approximate Replacement Cost or Original Cost (Unit Cost)	Total Cost	Current Replacement Cost/Remaining Life in Years
RAW WATER PUMPSTATION							
450gpm/25 hp Raw Water Intake Pump/Motor	2	1992	10 - 15	10	14,000	28,000	2,800
Raw Water Vacuum Pump	1	2000	3	1	1,500	1,500	1,500
Intake and Raw Water Line (600 feet of 10" PVC Pipe with concrete casing)	1	1992	35 - 45	15	45,000	45,000	3,000
Transmission Line from Pump Station to SWTP (~3,100 feet of 8" PVC C900 Pipe)	1	1992	35 - 40	20	22,500	22,500	1,125
SURFACE WATER TREATMENT PLANT							
Ozone System:							
Ozone Contactor Tower	1	1992	30 - 60	10	320,000	320,000	32,000
Ozone Generator (25 lbs/day)	2	1992	10 - 15	1	125,000	250,000	250,000
Air Compressor	2	1992	10 - 15	1	20,000	40,000	40,000
Air Dryer	2	1992	10 - 15	1	20,000	40,000	40,000
Ozone off-gas Destruction Unit	1	1992	10 - 15	1	35,000	35,000	35,000
Ozone alarm system	1	1992	5 - 10	2	52,000	52,000	26,000
Coagulant Feed System:							
Chemical Feed Pump (14.4 gal/day)	2	2005	5 - 10	3	3,500	7,000	2,333
Chemical Feed Day Tank	1	1992	10 - 15	10	15,000	15,000	1,500
						Needed CIP/yr	\$ 1,259,195
						Needed CIP/(mo*600 conn)	\$ 175
<p>Note: This does not include inflation, pre-treatment addition, intertie to sewer, or additional storage.</p>							

Ranking Assets

Prioritize investments based on criteria

Water Treatment Plant: Reordered List

Process Unit	Number of Units	Approximate Date of Installation	Typical Lifespan (Years)	Remaining Life Span (as of 2011)	Approximate Replacement Cost or Original Cost (Unit Cost)	Total Cost	Current Replacement Cost/Remaining Life in Years	POF	COF	Rank
RAW WATER PUMPSTATION										
Transmission Line from Pump Station to SWTP (~3,100 feet of 8" PVC C900 Pipe)	1	1992	35 - 40	20	22,500	22,500	1,125	8	9	9
Raw Water Vacuum Pump	1	2000	3	1	1,500	1,500	1,500	9	5	7
Intake and Raw Water Line (600 feet of 10" PVC Pipe with concrete casing)	1	1992	35 - 45	15	45,000	45,000	3,000	4	9	7
450gpm/25 hp Raw Water Intake Pump/Motor	2	1992	10 - 15	10	14,000	28,000	2,800	3	9	6

Invest in This Asset First





Questions?

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Cost Types

- Initial cost of installation
- O&M
- Repairs
- Rehabilitation
- Disposal
- Legal, environmental, or social costs
- Debt



O&M Costs: Degrees of O&M

Reactive:

Meet maintenance and repair needs as they arise

Preventive:

Proactively undertake system maintenance and renewal activities prior to failures

Mixed:

Assign some assets reactive maintenance & others preventive

O&M Costs: O vs M

Operations

Standard procedures

performed on a routine basis

Alternate procedures

performed in response to planned maintenance/repair

Emergency procedures

performed in response to failure or natural disaster

Documented in an O&M Manual

O&M Costs: Operations vs. Maintenance

Maintenance

- Routine: *performed on a regular basis*
- Planned: *planned, in lieu of responding to failure/crisis*
- Preventative: *performed to prevent failure*
- Warranty-Related: *required by manufacturer*
- Corrective: *performed in response to failure*
- Monitoring
- Documented in some way: *written, software, CMMS*



O&M Costs: Questions

What am I currently doing that I need to continue?

What am I currently doing that I need to discontinue?

What am I not doing that I need to start doing?

What am I not doing that should stay that way?

O&M Costs: Based on Risk

Consequence of Failure (COF)	Moderately High Risk Preventative or Mixed O&M	High Risk Preventative O&M
	Low Risk Reactive or Mixed O&M	Moderately Low Risk Preventative or Mixed O&M
	Probability of Failure (POF)	



Asset Repair, Rehabilitation, or Replacement

Consider:

- Condition
- Capital costs
- O&M costs
- Remaining useful life
- Decay pattern
- Criticality
- Energy Use
- Impact on LOS

Asset Repair, Rehab, or Replacement



<https://swefc.unm.edu/home/amkan/Chapter6Videos/LC-12.m4v>



Capital Improvement Planning

Reasons for investing in new assets

- Replacement/Rehab
- Future regulations
- Growth
- Consolidation/ regionalization
- Improve technology



Capital Improvement Planning

Contents

- Project descriptions
- Project needs & benefits
- Project cost
- O&M costs
- Funding sources
- Impact on LOS

A blue-tinted background image showing industrial machinery, possibly a printing press or manufacturing equipment, with various rollers and mechanical parts.

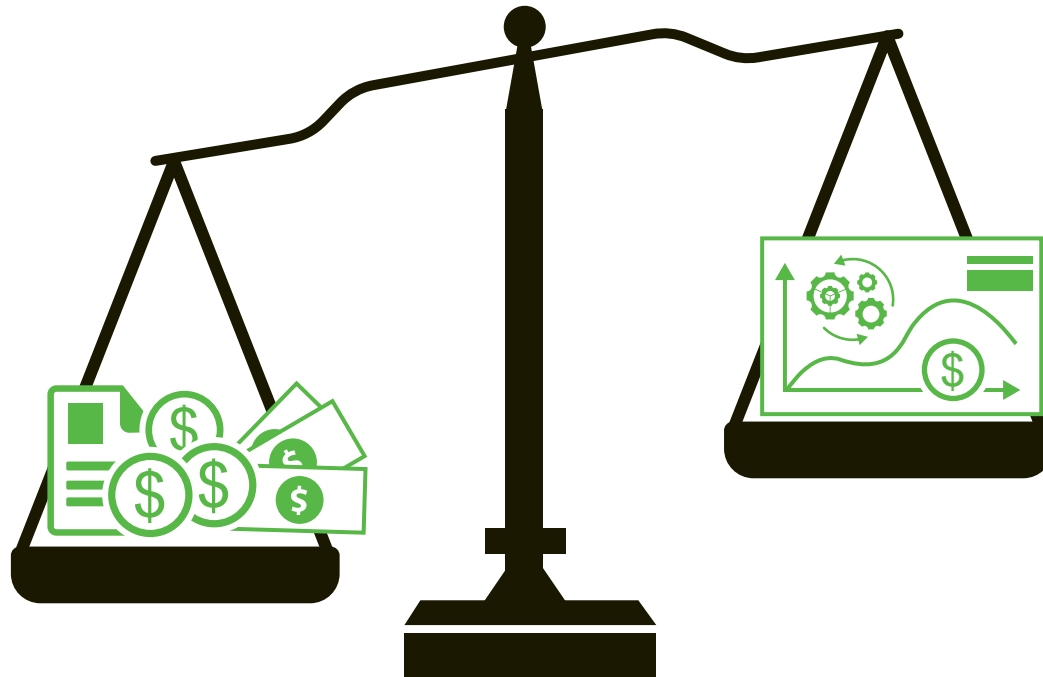
Questions?

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Compare Revenue to Life Cycle Costs



USEPA, undated

Costs

Asset inventory

Collect data on system assets



Identify desired maintenance regime

Regulatory costs + Level of services: existing system + Future buildout cost estimates



Total cost

Revenue



Average water costs



Land use characteristics



Household characteristics



Rate structure analysis



Utility rate structure and funding gap

Expenses and Revenue

- Water systems have many types of expenses and potential sources of revenue

Types of Expenses:

Operations and maintenance (O&M)
Capital improvements
Staff and labor
Debt payments

Sources of Revenue:

Rates, fees, and other customer charges
Bonds and loans
Grants
Other government allocations

- What time frame do we use?
 - Month, year, and 5-year, 10-year, 20-year...

Types of Expenses

- **Operations and Maintenance (O&M)**
O&M of the existing system to keep it running
- **Capital Improvements**
Replacement and upgrades of existing and new system components
- **Staff and Labor**
Salaries and benefits for staff
- **Debt Service**
Amount owed



Sources of Revenue

- **Rates, Fees, and Other Charges**
The operating income generated from charges to customers, including water sales, one-time charges, fees, fines, and others.
- **Bonds and Loans (Debt Income)**
Borrowed funds, to be payed back over time unless forgiven
- **Grants**
Awards to a water system, often for particular projects
- **Other Government Allocations**
In some cases, water systems may receive funding from a local jurisdiction for some purpose



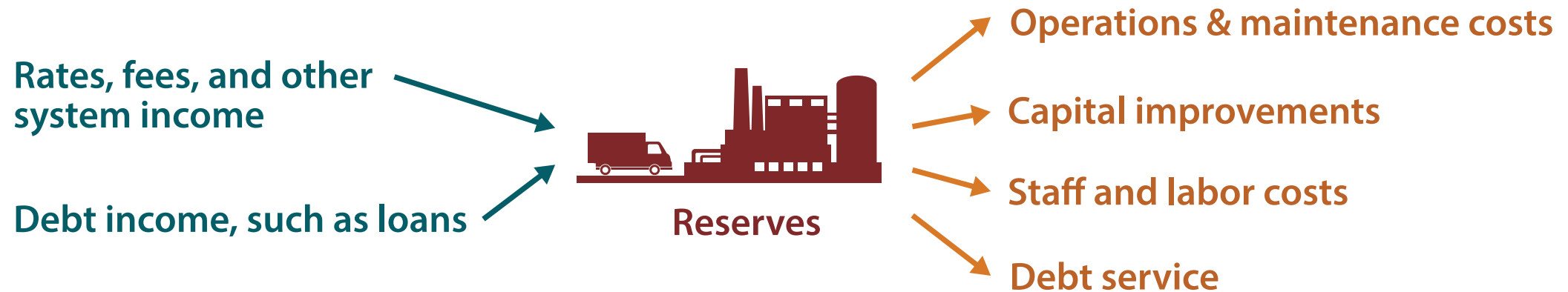
How Is Revenue Stored or Tracked?

- **Capital Reserve Fund**
A fund dedicated for infrastructure renewal and replacement.
- **Repair and Service Fund**
A fund for on-going maintenance needs
- **Emergency or Reserve Funds**
A fund to have “on-hand” for unexpected costs such as severe revenue shortfalls, billing system errors, or very large and sudden system expenses



Matching Revenue, Funding, and Expenses

How can a water system match revenue sources with types of expenses?



How Much Revenue Does a System Need?

It depends, but a system should have enough revenue to cover:

- Regular system operating expenses
- Regular system maintenance
- Staff salaries, benefits, and retirement
- Debt payments
- Other capital costs (depreciation)

Questions For Your Water System:

Can I pay to replace- tomorrow- anything in my system that would break?

Can I pay for my staff's retirement and benefits?

Could I cover costs if my billing system went down for several months?

Can I fund what upgrades the system will need in the next 10 years?

What is the breakdown of fixed and variable costs in my system?

Budgeting and Revenue

Annual budgets documents include all sources of revenue and all expenses

- Annual reports
- Financial statements
- Accounting records

Summary and line item values

Statement of Revenues and Expenses		
	<u>2017</u>	<u>2016</u>
Revenues		
Operating revenues	\$ 44,162	\$ 41,083
Rental	\$ 258	\$ 261
Interest and investments	\$ 495	\$ 558
Grants	\$ 407	\$ 764
Other	\$ 197	\$ 18
Total revenues	\$ 45,519	\$ 42,684
Expenses		
Operating expenses	\$ 20,870	\$ 19,846
depreciation and amortization	\$ 12,182	\$ 11,808
Interest	\$ 3,450	\$ 3,561
sub-recipient grant payments	\$ 407	\$ 764
other	\$ 3	\$ 16
Total expenses	\$ 36,912	\$ 35,995

Examples of summary annual budget documents with revenue and expenses

External Funding: Capital Improvements

Asset Management helps in grant/loan applications



<https://swefc.unm.edu/home/amkan/Chapter7Videos/FS-2.m4v>



Internal Funding: Rate/Fee Structures

- Account for:
 - O&M costs
 - Debt service
 - Emergency operations
 - (Some) capital improvements
- Build reserves
- Be affordable to customers
- Include incremental increases
- Build (rate) capacity

Rate Studies: A Quick Overview

1) Prioritize **objectives** for rate structures

Work with Board & community

2) Estimate **full system costs**

3) Evaluate future system **needs**

4) Explore **revenue** options and **rate structures**

Base, consumptive, and other charges

5) **Project** rates and revenue in future years

6) **Communicate** plan and adopt

Volumetric Rates**	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22
	<i>Existing</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>
Proposed Structure						
All Demand (per		\$3.36	\$3.57	\$3.75	\$3.90	\$4.06
Existing Structure						
Tier 1 (0-30 CCF)	\$2.99					
Tier 2 (31-35 CCF)	\$3.29					
Tier 3 (36+ CCF)	\$3.84					
Fixed Rates						
Meter Size	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22
	<i>Existing</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>	<i>Proposed</i>
Proposed Structure						
1" or below		\$13.06	\$14.12	\$15.16	\$15.77	\$16.41
1 1/2"		16.86	21.72	26.57	27.64	28.75
2"		21.42	30.84	40.24	41.85	43.53
3"		33.59	55.18	76.75	79.82	83.02
4"		47.27	82.54	117.81	122.53	127.44
6"		\$85.29	\$158.58	\$231.87	\$241.15	\$250.80
Existing Structure						
All Meters	\$12.00					

Photo Credit: City of Imperial

Rates Should...

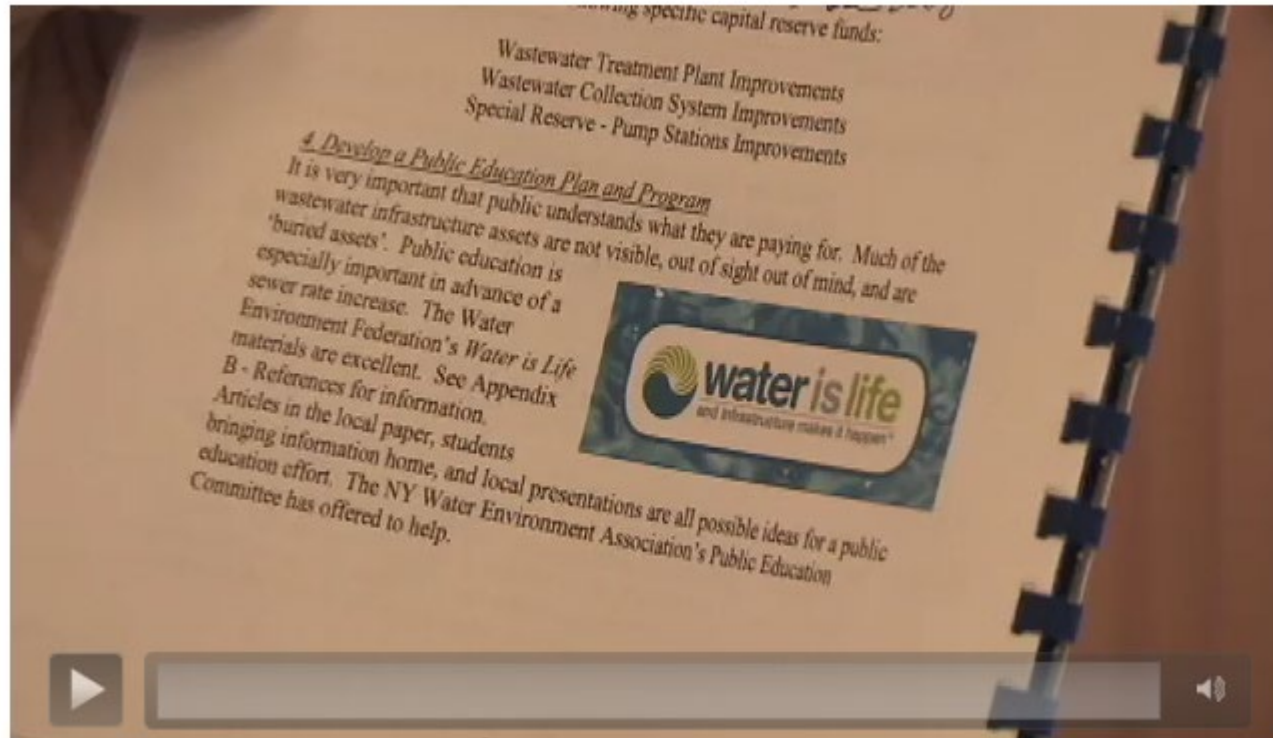
- Cover costs for O&M, capital projects, and debt



<https://swefc.unm.edu/home/amkan/Chapter7Videos/FS-5.m4v>

Rates Should...

- Build reserves



<https://swefc.unm.edu/home/amkan/Chapter7Videos/FS-8.m4v>

Building Rate Capacity



<https://swefc.unm.edu/home/amkan/Chapter7Videos/FS-9.m4v>



Comprehensive Funding Strategies

- Demonstrate O&M revenue source & adequacy
- Specify CIP funding sources
- Include debt repayment
- Define revenue source for increased O&M
- Account for inflation
- Anticipate rising energy costs & identify funding
- Balance L&M costs with CIP costs
- Support community sustainability

Prioritization Exercise

- Rank the following characteristics for prioritizing assess:
 - 2 ○ Potential public health, safety or environmental concern
 - 4 ○ Improved system O&M
 - 5 ○ Nice to have ...
 - 1 ○ Existing threats to public health, safety or environment
 - 3 ○ Internal safety concern or public nuisance

Life Cycle Costing Exercise

- What types of costs should be accounted for in Asset Management?
 - Initial cost of installation
 - O&M
 - Repairs
 - Rehabilitation
 - Disposal
 - Legal, environmental, or social costs
 - Debt

Long Term Funding Exercise

- What two things are compared when developing a long term funding plan?
 - Life cycle costs
 - Revenue
- What are some examples of revenue?
 - Rates, fees, and other customer charges
 - Bonds and loans
 - Grants
 - Other government allocations



Questions?



“Taking a break can lead to breakthroughs.”

-Russell Eric Dobda



Asset Management: How Do I Get Started?

Start Simple

What is a very simple Asset Management Plan?

Contents

- Inventory of critical assets
- A plan for maintaining, repairing, and replacing the treatment works
- A plan for funding the activities
- An evaluation and implementation of water and energy conservation efforts

The top portion of the image features a blue-tinted, out-of-focus photograph of industrial machinery, possibly a printing press or manufacturing equipment, with various metal components and rollers visible. Below this image is a large white rectangular area.

Group Activity

Simple Asset Management for Small Systems

- In groups of 5-6, fill out the asset management worksheets provided by the EPA for an small examples system
- Walk through each step and check in briefly after



Asset Management: A Handbook for Small Water Systems

One of the Simple Tools for Effective Performance (STEP) Guide Series



Step 1: Create an Asset Inventory

- Fill out the System Inventory Worksheet based on the example water system
- Pay special attention to the notes about maintenance/adjustments to useful life
- Refer to the following table for component's expected useful life

Asset	Expected Useful Life
Wells	30 years
Chlorinators	10 years
Storage tanks	40 years
Pumps	15 years
Buildings	50 years
Electrical Systems	10 years
Distribution pipes	40 years
Valves	40 years
Hydrants	50 years

Step 2: Define a Level of Service

- Identify three Technical LOS goals and three Customer LOS goals
- Describe how you will measure goals and determine if your water system is meeting identified goals
- Look at system description for help identifying goals

Categories of Technical LOS

- Operations and maintenance
- Asset Replacements, Rehabilitation, or Repair
- Utility Management
- Hazard and Risk Management Response
- Water Loss Control
- Drought and/or Demand
- Water System Partnerships
- Staff and Workforce Efficiency/Capacity

Categories of Customer LOS

- Accessibility
- Reliability
- Quality
- Efficiency and Capacity Customer Service
- Public Health and Safety
- Legislative Sustainability
- Affordability
- Environmental Impacts
- Stakeholder and Public Engagement



Group Discussion

- What Technical Level of Service goals did you include?
- What Customer Level of Service goals did you include?

Step 3: Prioritizing Assets

- Fill out the **Prioritization Worksheet** provided
- Assign assets a priority 1 – 5, where 1 is the highest priority (needs replacement within the next year) and 5 is the lowest priority
- When ranking assets consider:
 - Remaining useful life
 - Redundancy
 - Importance to operation of water system
 - Needed for service?
 - Needed for redundancy?
 - Needed for fire flow requirements?



Group Discussion

- What assets did you classify as high priority and why?
- What assets did you classify as low priority and why?

Step 4: Planning for the Future

- Fill out the **Required Reserve Worksheet** provided
- List assets from highest to lowest priority
- Use the replacement/rehabilitation cost estimates provided in your example small water system
- For this example we'll assume you are NOT selling any assets

Well Pump 1

The pump for well 1 is in good condition. It was installed in 2012 and rehabilitated in 2017. It's predicted this maintenance added an additional 5 years to its life expectancy. **The cost to replace Well Pump 1 is \$5000.**



Group Discussion

What did you calculate as your annual required reserve?

- This might vary by group depending on how you prioritized your assets.

Step 5: Carrying Out the Plan

- Fill out the **Budgeting Worksheet** provided using information from your systems description and the **Required Reserves Worksheet**
- Calculate your annual revenue, your annual expenses, and your net income
- Compare this number to your annual required reserves
- Brainstorm ways to meet reserve requirements you've predicted



Group Discussion

- What was the difference between your annual net income and required reserves?
- What are some of the ways you discussed to close this gap?



Questions?



15 Minute Break