



Asset Management & GIS: **Tools for Success**

Types of Geographic Information Systems (GIS)

Many options, from free to expensive:

- ArcGIS Pro and ArcGIS Online
 - ESRI has a water utility management package
ArcGIS Solutions >> Water Distribution Utility Network Foundation
- QGIS
 - Free, open-source version of GIS
- Google Earth
 - Good for basic mapping and drawing
- Commercial software to simulate operations, such as InfoWorks
 - Fancy and expensive

Comparing GIS Software

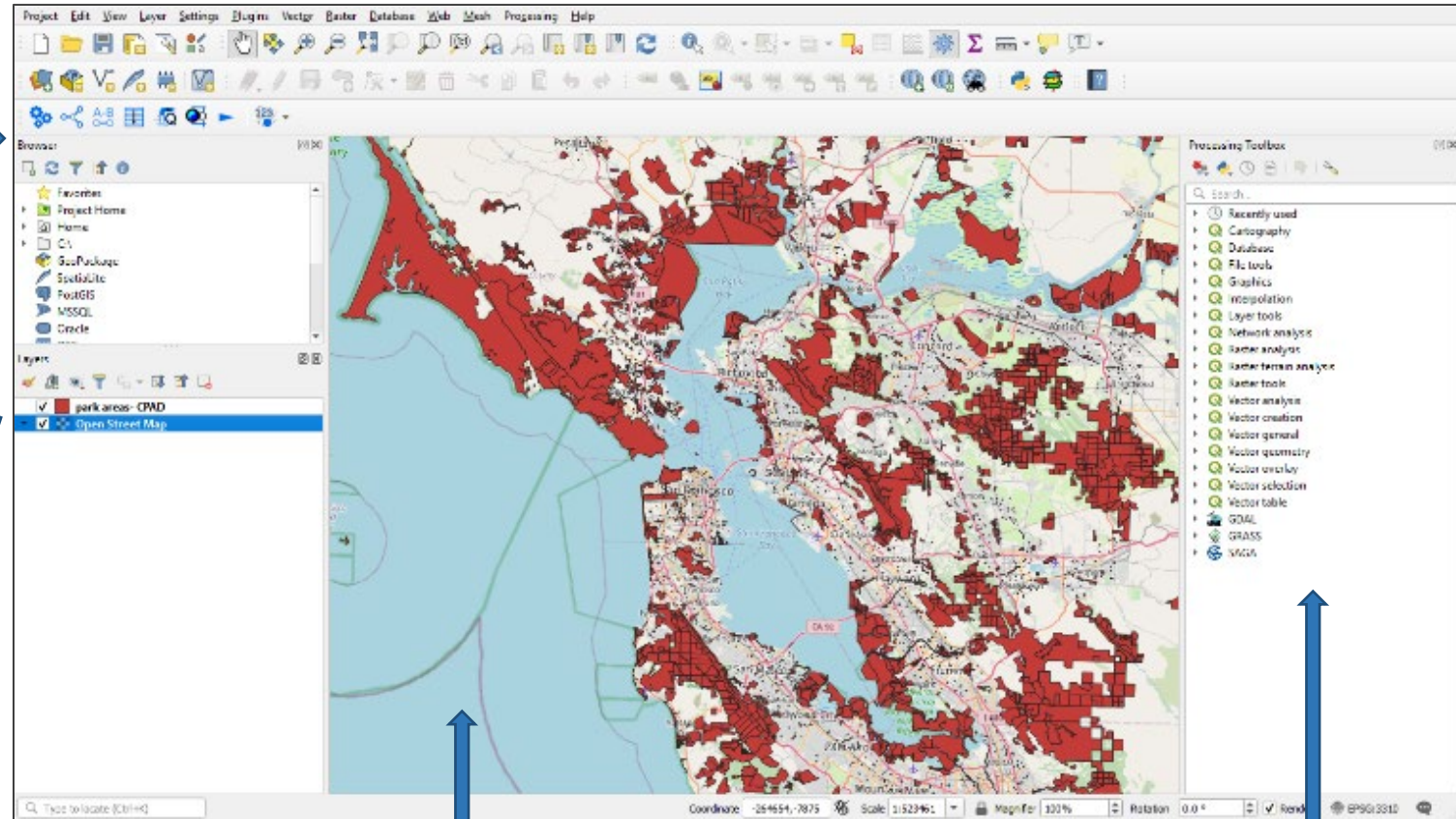
Capability	Software		
	Google Earth	Esri ArcGIS	QGIS
Mapping	Yes	Yes	Yes
Spatial Analysis	Limited	Yes, integrated	Yes, integrated or plug-ins
Cost	Free/Paid	Paid	Free
File and Database Support	Limited	Broad, easy to upload, can be hard to manipulate; ESRI Geodatabases	Broad (except for ESRI geodatabases), harder to upload, can be simpler to manipulate; PostgreSQL
Online mapping*	Support through Google Maps or 3 rd party apps	Support through ArcGIS Online	Support through QGIS Cloud
Integrated water utility analysis packages	No	Available packages (field operations, water utility data management)	Not directly designed or integrated

QGIS Home Screen

How to Add Files: "Layer" Drop-Down Menu

File Browser

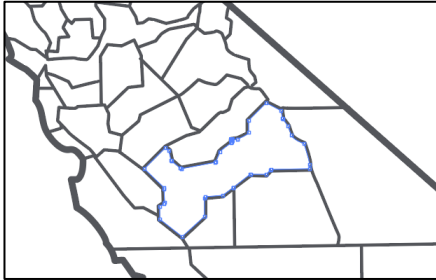
Layers



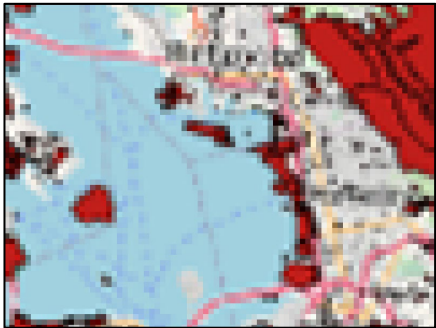
Map Window

Toolbox

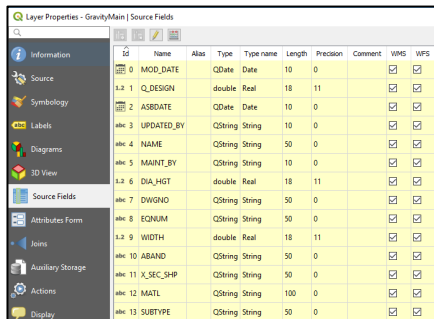
Basic File Types



- **Vector files:** points, lines, polygons databases
 - Assets, agency boundaries, streams or watersheds



- **Raster files:** pictures
 - Digital elevation models, climate data, land cover



Field	Name	Alias	Type	Type name	Length	Precision	Comment	WMS	WFS
0	MOD_DATE		QDate	Date	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2	Q_DESIGN		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	ASBDATE		QDate	Date	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	UPDATED_BY		QString	String	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	NAME		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	MAINT_BY		QString	String	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2	DIA_HGT		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	DWIGNO		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	EQNUM		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2	WIDTH		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	ABAND		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	X_SEC_SHP		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	MATL		QString	String	100	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
13	SUBTYPE		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

- **Table files:** data with spatial information

Coordinate Reference Systems

A Coordinate Reference System (CRS) defines how to project a flat map to the earth

Represents a 3D “real” map on a 2D “flat” map
Hundreds of systems

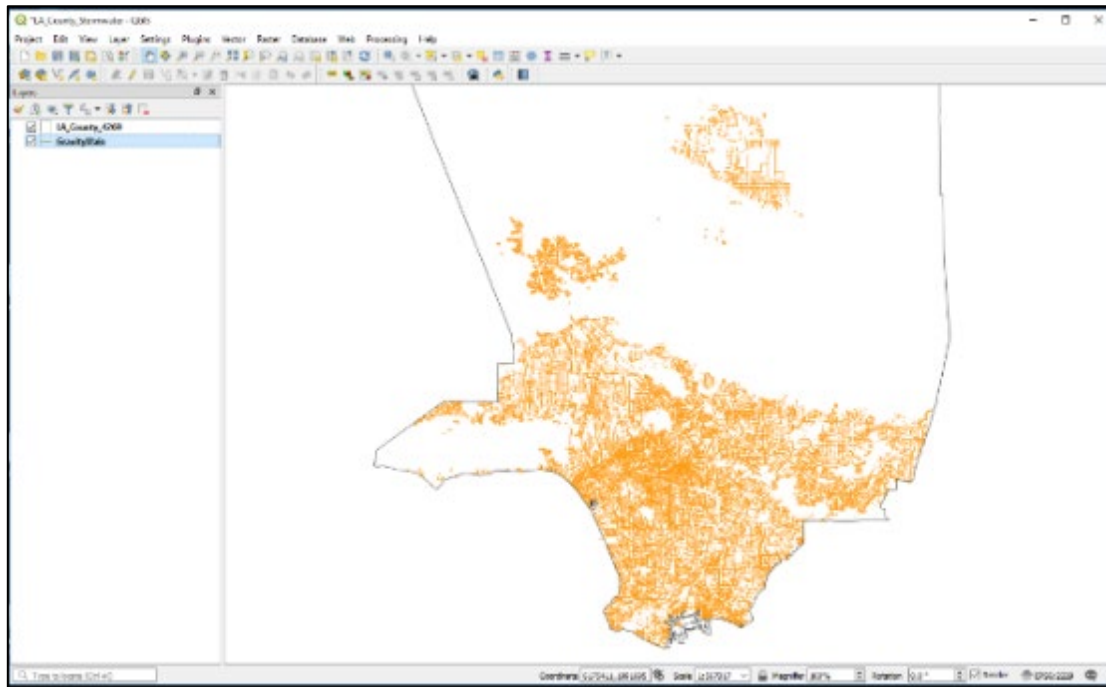
GIS software needs to interpret the input from a file to map it

Mis-identified CRSs are a common source of error when mapping and processing data in GIS



Nasa.gov

QGIS Views: Map and Data Table



Mapping Storm Sewer Gravity Mains in LA County

GIS Files Store Data in an
“Attribute Table”

Database Fields

Layer Properties - GravityMain | Source Fields

Id	Name	Alias	Type	Type name	Length	Precision	Comment	WMS	WFS
0	MOD_DATE		QDate	Date	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 1	Q_DESIGN		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	ASBDATE		QDate	Date	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 3	UPDATED_BY		QString	String	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 4	NAME		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 5	MAINT_BY		QString	String	10	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 6	DIA_HGT		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 7	DWGNO		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 8	EQNUM		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 9	WIDTH		double	Real	18	11		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 10	ABAND		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 11	X_SEC_SHP		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 12	MATL		QString	String	100	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 13	SUBTYPE		QString	String	50	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Data Tables

Record: A row in a table of data

MOD_DATE	Q_DESIGN	ASBDATE	UPDATED_BY	NAME	MAINT_BY	DIA_HGT	DWGNO	EQNUM	WIDTH	ABAND	X_SEC_SHP	MATL	SUBTYPE
2009-12-14	9999.000000000000	1971-02-01	HM	SYCAMORE CA...	LACFCD	168.000000000000	40-D24	F01000308	192.000000000000	No	Square or Recta...	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	87.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2010-02-25	0.000000000000	1969-11-12	MLO	PD 0896	LACFCD	24.000000000000	355-F13	F01000582	0.000000000000	No	Round	Reinforced Con...	Standard
2010-02-25	999.000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	66.000000000000	272-F1	F01003049	0.000000000000	No	Round	Reinforced Con...	Standard
2010-02-25	0.000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	102.000000000000	272-F1	F01003049	0.000000000000	No	Double Box	Reinforced Ce...	Standard
2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	87.000000000000	275-433-D5	F01000169	0.000000000000	No	Round	Reinforced Con...	Standard
2010-02-25	999.000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	66.000000000000	272-F1	F01003049	0.000000000000	No	Round	Reinforced Con...	Standard
2010-02-25	0.000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	102.000000000000	272-F1	F01003049	0.000000000000	No	Double Box	Reinforced Ce...	Standard
2010-03-01	72.300000000000	1961-01-01	KS	PD 0263	LACFCD	33.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard
2010-03-01	94.900000000000	1961-01-01	KS	PD 0263	LACFCD	42.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard
2010-03-01	72.300000000000	1961-01-01	KS	PD 0263	LACFCD	42.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard
2010-03-01	94.900000000000	1961-01-01	KS	PD 0263	LACFCD	42.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard
2010-03-01	150.400000000000	1961-01-01	KS	PD 0263	LACFCD	42.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard
2010-03-01	150.400000000000	1961-01-01	KS	PD 0263	LACFCD	42.000000000000	6-F679	F01001424	0.000000000000	No	Round	Reinforced Con...	Standard

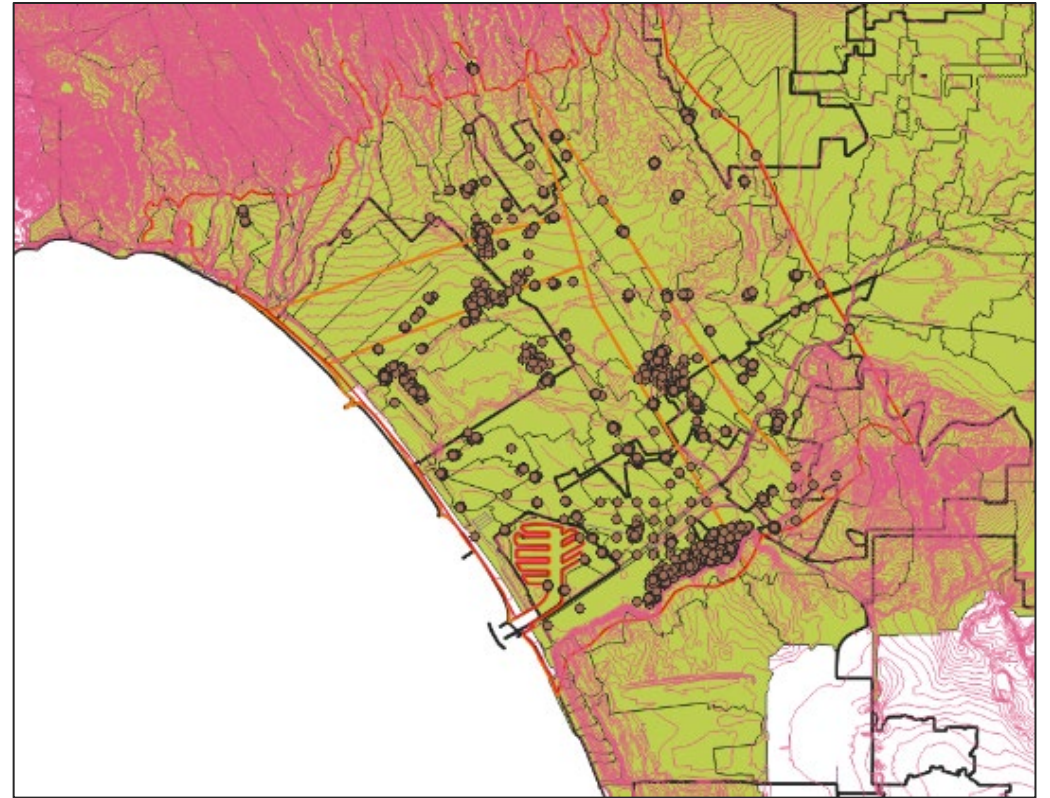
Field: A column in a table that stores the value of a single attribute

Water Utility Management Using GIS

QGIS can support:

- Utility system mapping
- Asset management
- Watershed analysis
- Rate studies

Not “plug-and-play”



Add-Ons

QGIS allows its community of developers to build add-on packages for specific needs
Can become part of the regular functions

Some recent packages are designed to assist with utility management needs

Qwater: integration with EPANet, drainage planning

SAGA Terrain Analysis – Hydrology: watersheds

Qfield: Field data collection

Web searches of “QGIS” and keywords for a task can find blogs and posts with solutions from the QGIS community

Example Asset Management

Storing utility assets in GIS databases

Ways to classify assets

- Location
- Size, length, depth, material
- Condition

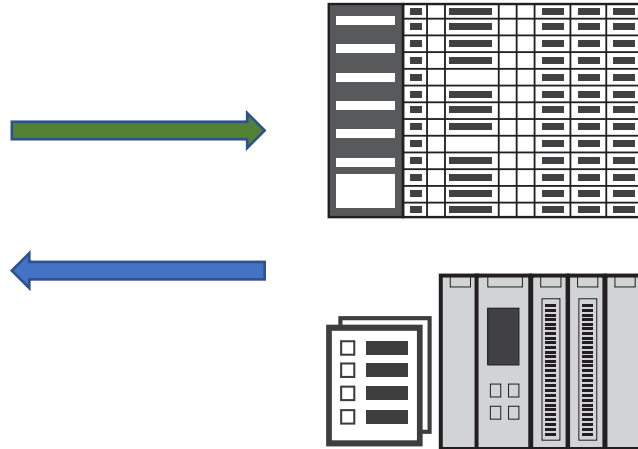
Features	Possible attributes (fields) for each asset
Asset #	Age
1	Length, depth, size
2	Location (GPS coordinates, latitude/longitude)
3	Material
...	Condition
	Cost or value
	Ownership
	Type

Application: Collecting Field Data for Asset Management

Field Data



Data Files or Database



Applications

Operations Planning

Capital Planning

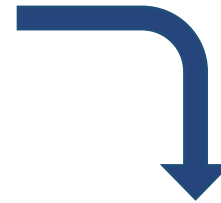
Online and Desktop Maps

Application: Uploading Data for Asset Management

Field Data



Collected via field surveys or a mobile app



Database

CUPSS DataExport.csv - Excel

File Home Insert Draw Page Layout Formulas Data Review View Help Acrobat Tell me what you want to do

Clipboard Font Alignment Number Styles Cells Editing

A1 AssetName*

AssetName	Location*	AssetCate	OtherAss	AssetType	OtherAss	AssetID	AssetSize	AssetMat	Longitude	Latitude	Notes	StorageCa	LinearFee	AcresOfLa	Condition	Redundar	AssetStat	Capacity*	CoF*	Ca
Lot 10 BR	Lot 10	Treatment		Other	LID	L10BR2	3750	Weeds/D	-121.422	38.55403				1	Poor	0%	Active	Fullsized	Minor	Y
Lot 10 BR	Lot 10	Treatment		Other	LID	L10BR2	3750	Weeds/D	-121.422	38.55403				1	Poor	0%	Active	Fullsized	Minor	Y
CTD-RG-4	College T	Treatment		Other	LID	CTD-RG-4	375	Vegetatio	-121.423	38.5556		20	40	1	Fair (Aver	0%	Active	Fullsized	Insignifica	Y
CTD-RG-3	College T	Treatment		Other	LID	CTD-RG-3	375	Vegetatio	-121.424	38.55594		20	40	1	Fair (Aver	0%	Active	Fullsized	Insignifica	Y
LG-RG-2	Library Gri	Treatment		Other	LID	LG-RG-2	375	Vegetatio	-121.424	38.56065		20	40	1	Fair (Aver	0%	Active	Fullsized	Insignifica	Y
Lot 7-BR-1	Lot 7	Treatment		Other	LID	L7-BS-1	3750	Weeds/D	-121.42	38.55448				1	Poor	0%	Active	Fullsized	Minor	Y

CUPSS DataExport

Ready

Where Can I Find Data?

Local and state GIS repositories

Administrative boundaries (e.g. cities, counties, districts, sectors etc...)

Infrastructure information (e.g. dams, levees, water/wastewater treatment plants)

US Census Tiger datasets

Census Blocks National Geodatabase

U.S. federal agencies, such as U.S. Geological Survey

Public-Supply Well Water Quality Results

Flood inundation maps

ArcGIS Data Hub



More Information

- **Environmental Finance Center Network**

SWEFC: “Asset Management 101”:

<https://swefcamswitchboard.unm.edu/am/product/asset-management-101-2/>

EFC-Network provides technical assistance

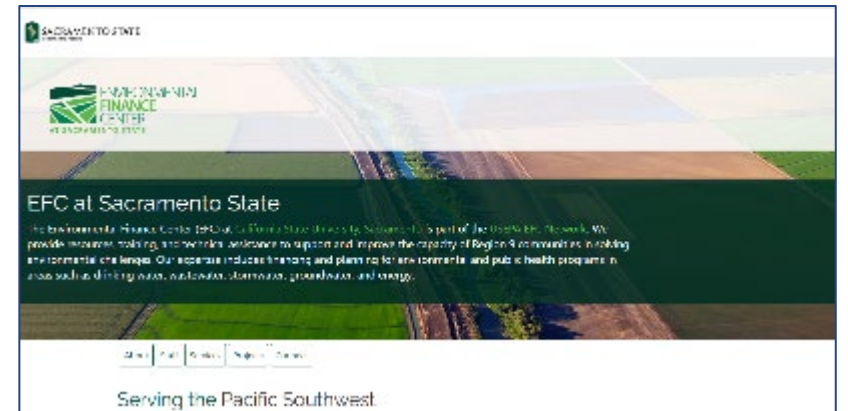
<https://efcnetwork.org/get-help/>

- **Rural Community Assistance Corporation (RCAC)**

<https://www.rcac.org>

- **American Water Works Association (AWWA)**

<https://www.awwa.org/Resources-Tools/Resource-Topics/Asset-Management>



<https://www.efc.csus.edu/>

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Asset Management: Some Terms

- Asset Inventory: Detailed data on components of a system and condition



- Level of Service: Maintenance and replacement targets to provide a reliable system for residents

An asset inventory is key to sustainable management and financial planning

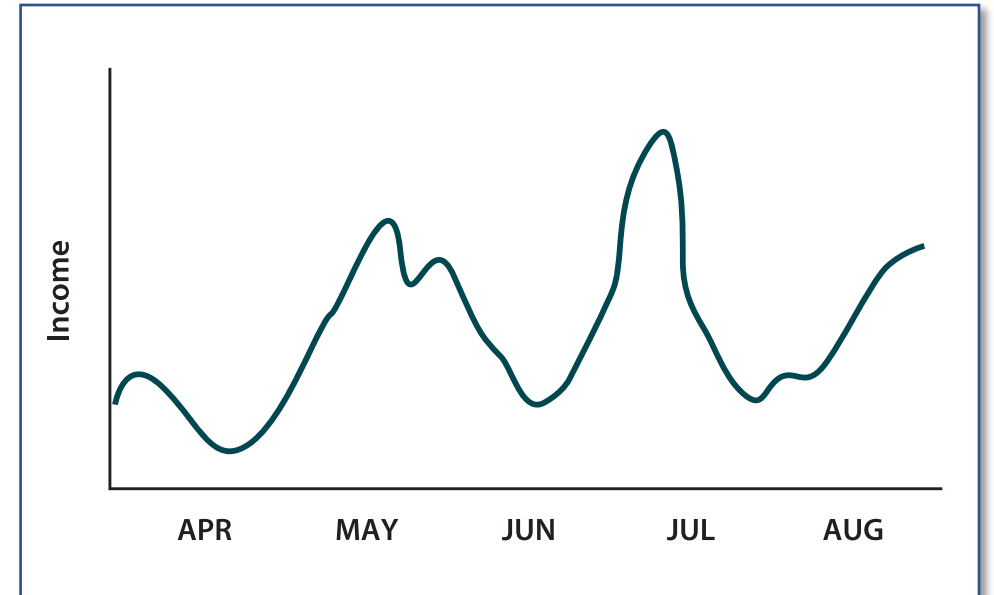
An Example Asset Inventory

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

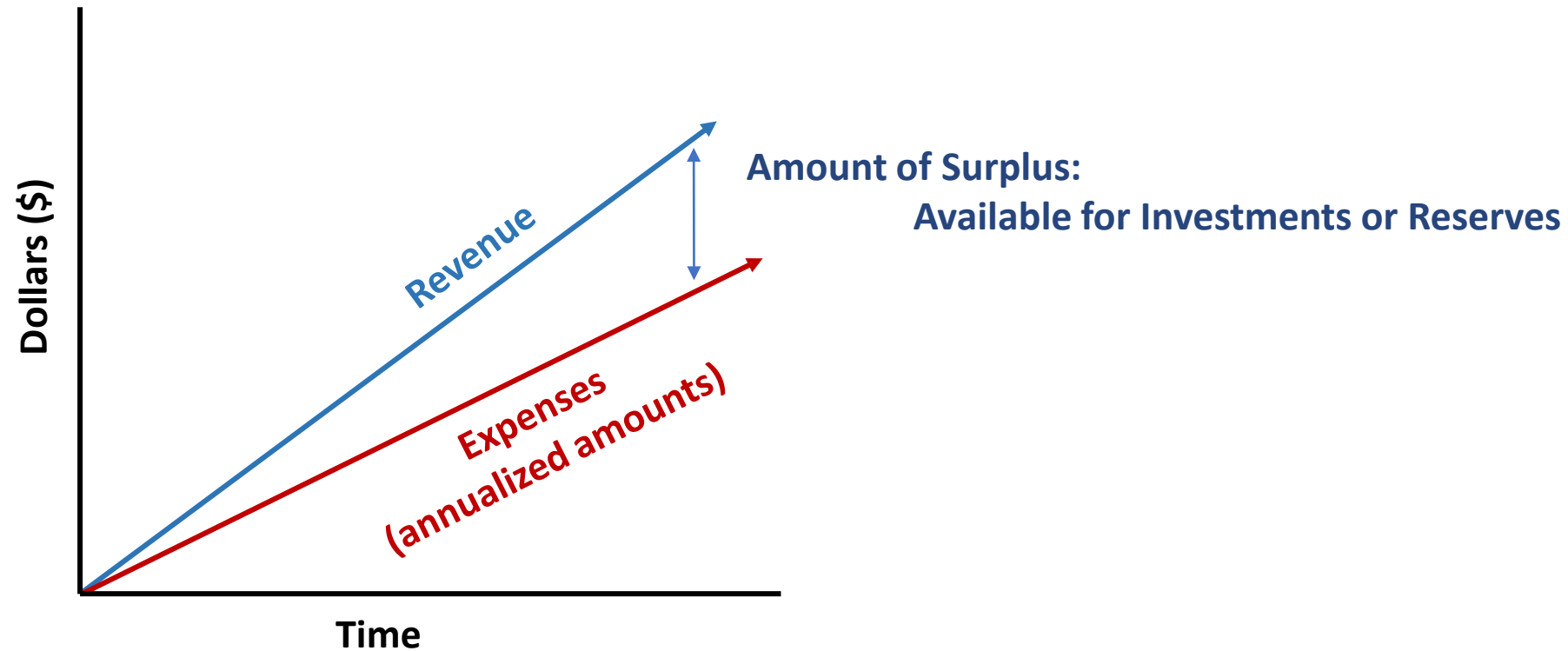
Rate Structures & Funding

- Rate structures influence funding
 - **“Lumpy” budgets**
 - In dry climates, drought and seasonal fluctuations can affect revenue
 - Wintertime monthly flow estimates can provide a reasonable approximation of indoor use



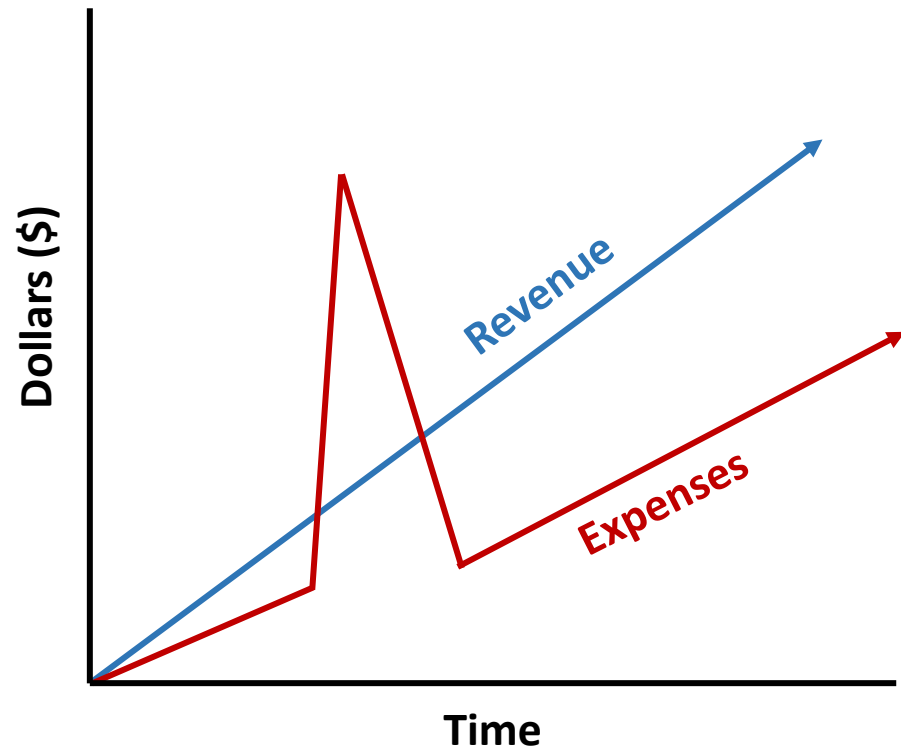
Why is Prioritization Important?

- Prioritizing assets helps mitigate failure risks



Why is Prioritizing Important?

- Prioritizing assets helps mitigate failure risks



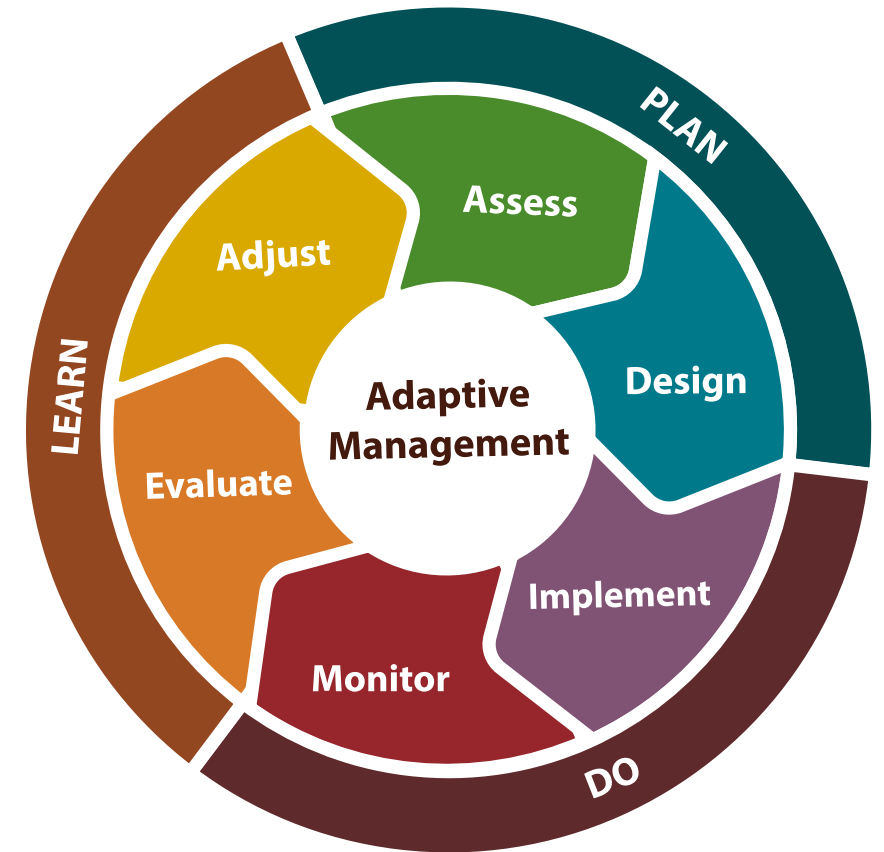
Big Equipment Failure

Need Reserves!

Tracking Progress & Adaptive Management

Review and Update

- Assets
- Asset Characteristics
- LOS goals
- Life Cycle Costs
- Funding/Financing Plan

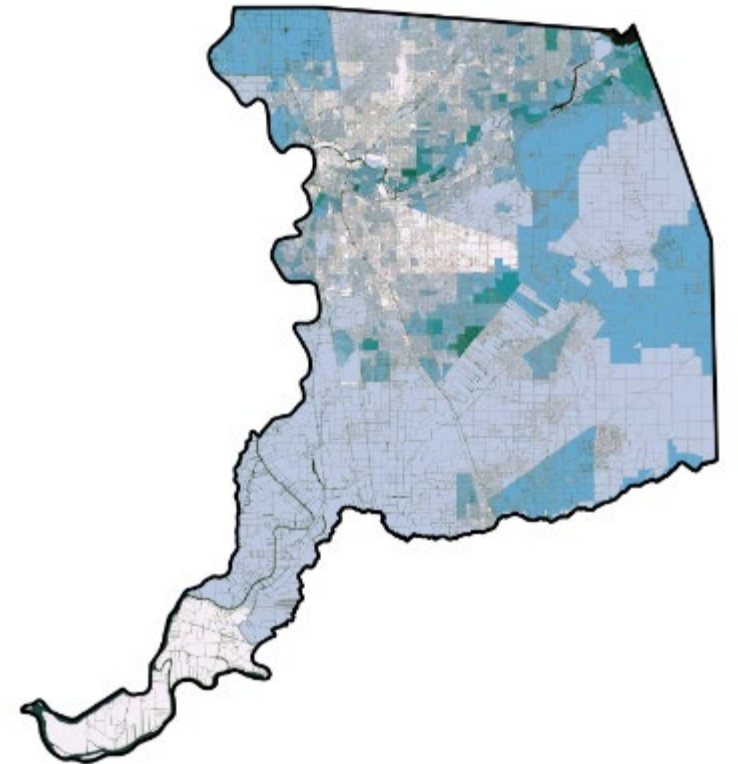


QGIS

A free and open-source version of GIS software

Created over many years by a community of developers

Under continual improvements





Asset Management for Small Systems: **Tools Available**



Additional Resources for Asset Management

Many options available online to help you...

- Continue learning about asset management
- Assessing assets
- Developing a strategy and writing an AM plan
- Financial planning
- Program review



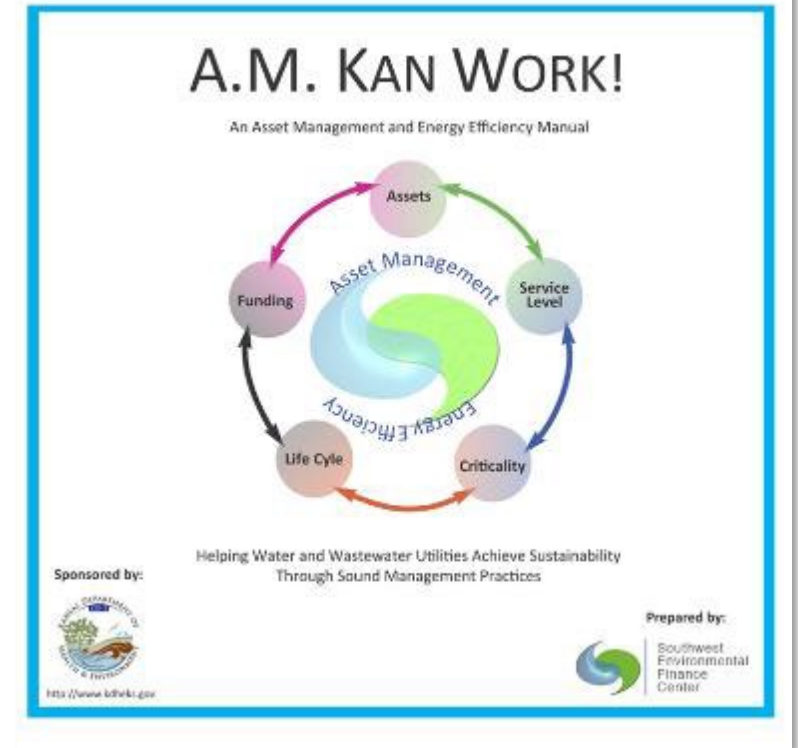
Learning Resources and Additional Trainings

AM Kan Work!

- Online guidebook to help water and wastewater utilities assess the status of their operations and develop strategic plans for sustainable service

Resources available:

- Training videos
- Example forms for LOS, criticality assessments, maps, etc.



SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

AM Kan Work!

- Asset Management IQ
 - self evaluation tool to help assess progress in Asset Management activities

EPA Handbook: Asset Management for Small Systems

- Presents the basic concepts of asset management and provides the tools to develop an asset management plan.

Resources available:

- Step by step guide
- Worksheets for LOS, asset inventory, criticality assessments, maps, etc.



Asset Management: A Handbook for Small Water Systems

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



EPA Handbook: Asset Management Best Practices

- Not specifically for small systems but a good overview of questions systems should ask when developing an AM plan



Asset Management: A Best Practices Guide

Introduction	
<i>Purpose</i>	<p>This guide will help you understand:</p> <ul style="list-style-type: none">• What asset management means.• The benefits of asset management.• Best practices in asset management.• How to implement an asset management program.
<i>Target Audience</i>	<p>This guide is intended for owners, managers, and operators of water systems, local officials, technical assistance providers, and state personnel.</p>

Past EFCN Webinars on Asset Management

- **Intermediate Asset Management Series**
 - Asset Inventory and Mapping
 - Level of Service
 - Criticality
 - Life Cycle Costing
- **Ask the Expert Asset Management**



Upcoming EFCN Webinars

- **Intermediate Asset Management Series**
 - Asset Inventory and Mapping
 - Level of Service
 - Criticality
 - Life Cycle Costing
- **Ask the Expert Asset Management**





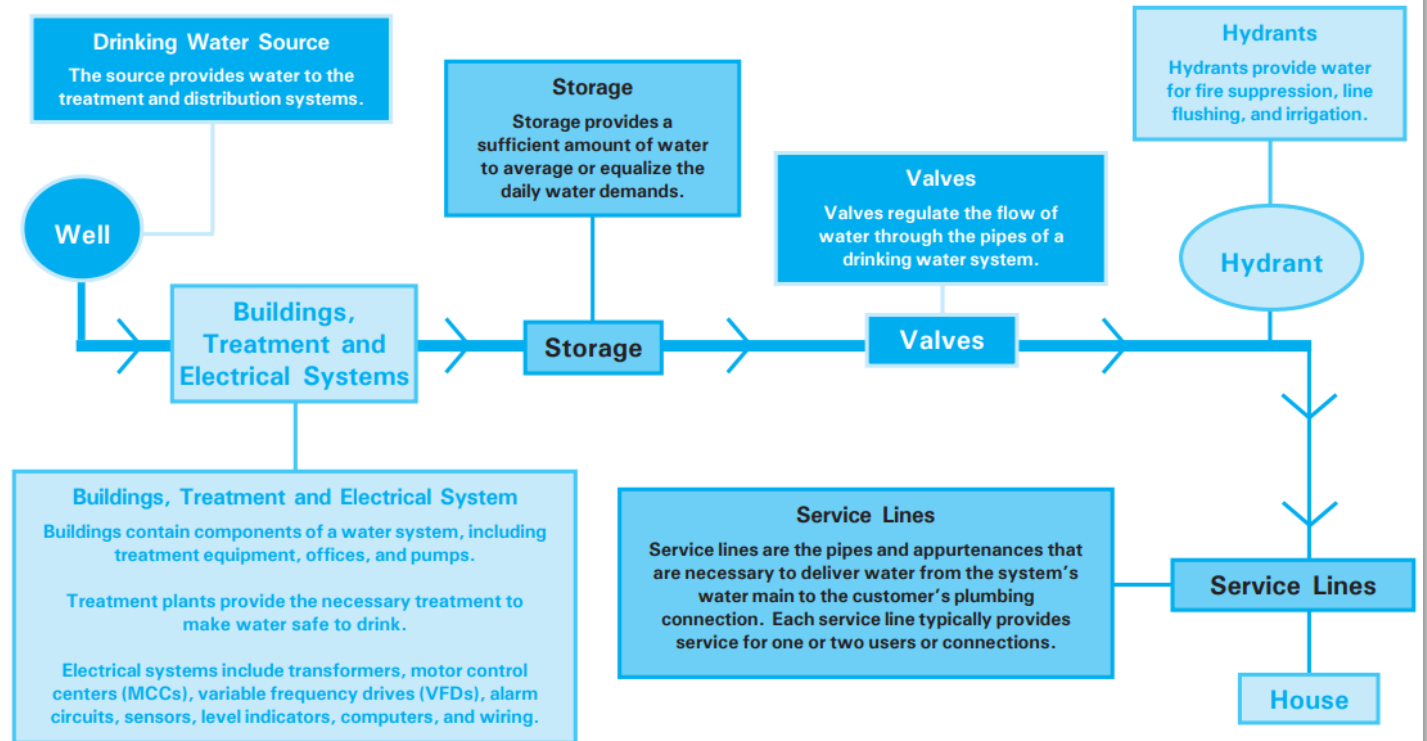
Developing an Asset Management Plan

EPA's Taking Stock of Your Water System

- Guidebook walks through the developing a simple asset inventory
- Different elements of water systems, typical life expectancies, and criticality assessments

Elements of a Simple Asset Inventory

A note to the users of this brochure: It's quite likely that all of the details of the asset management plan presented in this brochure will not apply to every small drinking water system. You should feel free to modify the worksheets and plan so they conform to the particular needs of your system. Help in using this document, conducting asset inventories, and preparing future plans is available from your State or Tribal Drinking Water Primary Agency.



EPA's Taking Stock of Your Water System

- Includes completed examples of asset inventory

Distribution System: Completed Example			
<p>You may want to note the location of shut-off valves to isolate particular sections of the system in case of an emergency.</p> <p>You may also want to note the location of "as-built" drawings showing the layout of the distribution system.</p> <p>If your system has many types of pipe (e.g., different size, different material), reproduce this worksheet and list the information for each type.</p>		<p>Remember that the typical useful life of pipes is 35 years. In this example, the system has estimated that the adjusted useful life will be the same as the typical useful life because in the past its distribution system pipes have lasted for the typical number of years.</p>	
<p>Look at receipts or records from the time of installation for the following information:</p>			
Type of Pipe	Size	Length (feet)	
PVC	3-inch	2,200 feet	
Where Used or Located			
Main St. Line			
<p>Remember that maintenance, water quality, use, and soil conditions can affect useful life. Subtract estimated age from adjusted useful life to determine remaining useful life.</p>			
Adjusted Useful Life	-	Estimated Age	= Remaining Useful Life
35 years	-	21 years old	= 14 years
Whom would you call to service your pipes?			
Company/Agency	Contact	Telephone Number	
Chris' Contracting	Chris Carpenter	(555) 123-4567	
Date Worksheet Completed or Revised			
8/1/04			



Preparations for Pipe Installation in a Distribution System

West Virginia's Asset Management for your Water System

guidance to aid water systems to complete an Asset Management plan broken into three separate parts: Basic, CUPSS, and Advanced

Resources available:

- utility self-assessments, tables, worksheets, and templates
- Excel-based templates are routinely updated



EPA Handbook: Asset Management for Small Systems

Presents the basic concepts of asset management and provides the tools to develop an asset management plan.

Resources available:

- Step by step guide
- Worksheets for LOS, asset inventory, criticality assessments, maps, etc.



Asset Management: A Handbook for Small Water Systems

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



The background of the slide features a blue-tinted image of industrial machinery, possibly a printing press or a manufacturing line, with various rollers and mechanical components visible. The image is slightly blurred and occupies the top portion of the slide.

Fiscal Sustainability Plan Tool

Thank you for attending!

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Slides will be available online at:
<https://www.efc.csus.edu/>

Environmental Finance Center “Get Help” Link:
<https://efcnetwork.org/get-help/>

- Follow link to request additional free services

Environmental Finance Center Upcoming Webinars Link:
<https://efcnetwork.org/training-events/>



References

- Southwest Environmental Finance Center (SW EFC 2022).
[A.M. KAN Work An Asset Management and Energy Efficiency Manual](#). Accessed 2022.
- U.S. Environmental Protection Agency (USEPA 2020).
[Sustainable Water Infrastructure: Asset Management for Water and Wastewater Utilities](#). Accessed March 2020.
- US. Environmental Protection Agency (USEPA undated). Asset Management 101. undated.