

QGIS for Water Utility Management: Getting Started with QGIS for Free

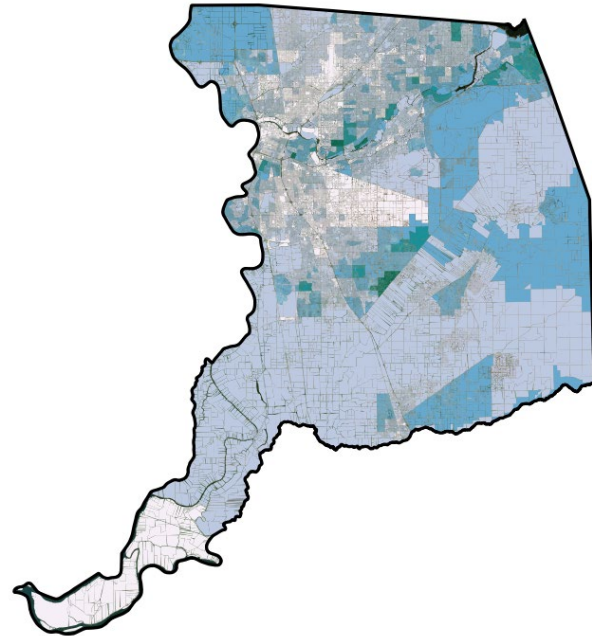
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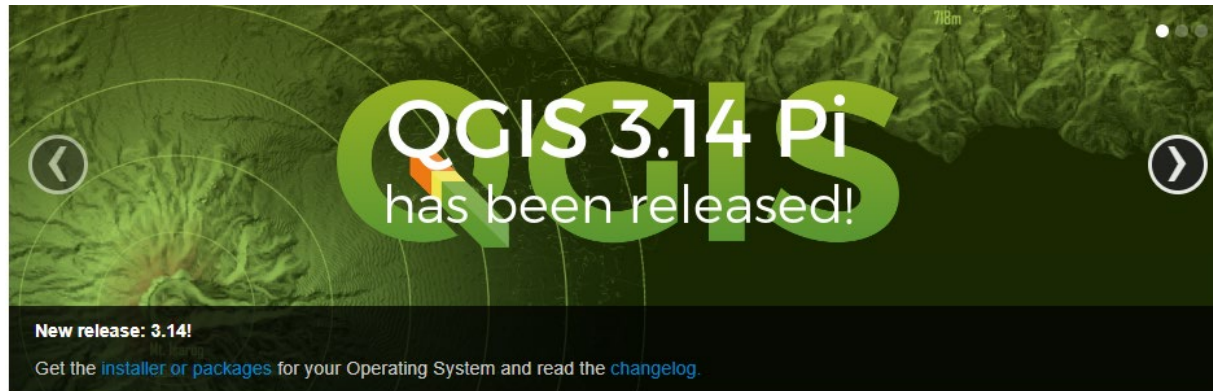
Geographic Information Systems (GIS)

- Geographic Information Systems
 - Software systems for storing and analyzing data with spatial information
- Many types of GIS
 - Esri's ArcGIS is most popular
- Bringing maps to life



QGIS

- A free and open-source version of GIS software
 - Created over many years by a community of developers
 - Under continual improvements



<http://qgis.org>

How does QGIS Compare?

Capability	Software		
	<i>Google Earth</i>	<i>Esri ArcGIS</i>	<i>QGIS</i>
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 Esri Online	Support through QGIS Cloud
Integrated water utility analysis packages	No	Available packages (field operations, data management)	Not directly designed or integrated

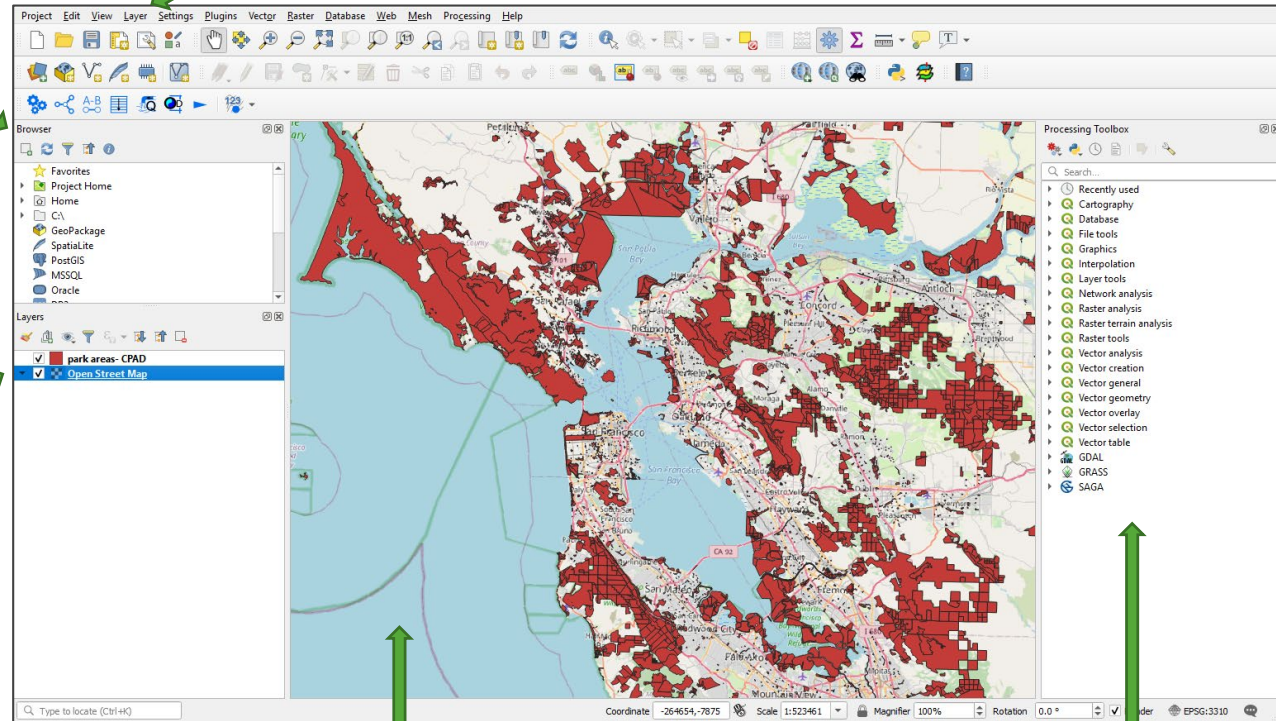
QGIS supports analysis and mapping similar to ArcGIS, but does not currently have integrated solutions for utility enterprise management and advanced utility operations

QGIS: Home Screen

How to Add Files: “Layer” Drop-Down Menu

**File
Browser**

Layers

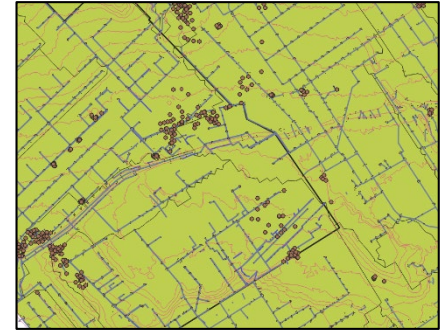


Map Window

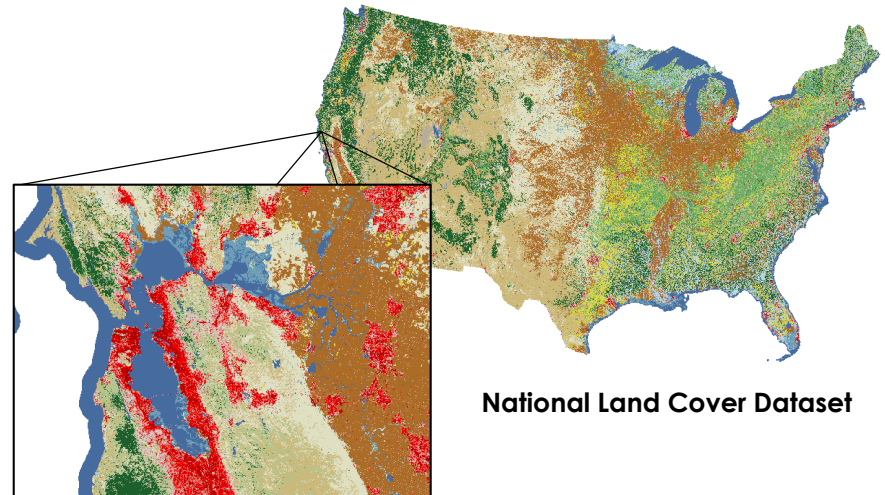
Toolbox

Some 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
- Table files: data with spatial information



Urban stormwater infrastructure
(compiled from multiple sources)



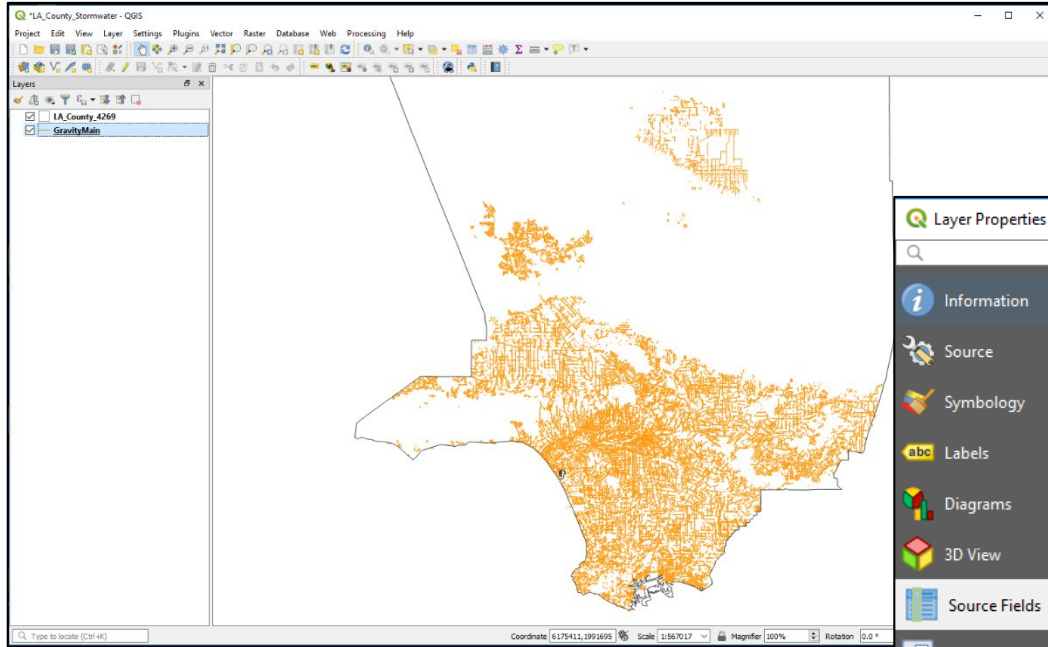
National Land Cover Dataset

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 errors when mapping and processing data in QGIS



QGIS Views: Map and Data Table



Mapping Storm Sewer Gravity Mains in LA County

GIS Files Store Data in an “Attribute Table”

Database Fields

Q 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

Q GravityMain :: Features Total: 185065, Filtered: 185065, Selected: 0

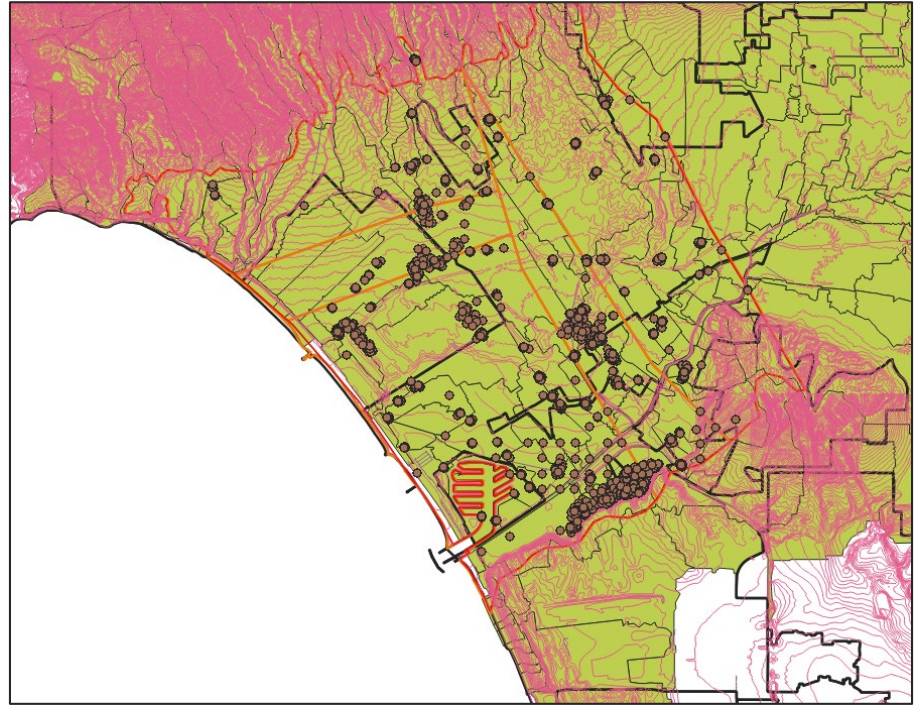
	MOD_DATE	Q_DESIGN	ASBDATE	UPDATED_BY	NAME	MAINT_BY	DIA_HGT	DWGNO	EQNUM	WIDTH	ABAND	X_SEC_SHP	MATL	SUBTYPE
1	2009-12-14	9999.000000000000	1971-02-01	HM	SYCAMORE CA...	LACFCD	168.000000000000	40-D24	F01000308	192.000000000000	No	Square or Recta...	Reinforced Con...	Standard
2	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
3	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
4	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
5	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
6	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
7	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	87.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
8	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
9	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	72.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
10	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
11	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
12	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	36.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
13	2010-02-25	0.00000000000000	1969-11-12	MLO	PD 0896	LACFCD	24.0000000000000	355-F13	F01000582	0.0000000000000	No	Round	Reinforced Con...	Standard
14	2010-02-25	999.0000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	66.0000000000000	272-F1	F01003049	0.0000000000000	No	Round	Reinforced Con...	Standard
15	2010-02-25	0.00000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	102.0000000000000	272-F1	F01003049	0.0000000000000	No	Double Box	Reinforced Ce...	Standard
16	2009-12-28	9999.000000000000	1969-06-20	HM	BI 0433 U2	LACFCD	87.0000000000000	275-433-D5	F01000169	0.0000000000000	No	Round	Reinforced Con...	Standard
17	2010-02-25	999.0000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	66.0000000000000	272-F1	F01003049	0.0000000000000	No	Round	Reinforced Con...	Standard
18	2010-02-25	0.00000000000000	1958-01-01	ST	MCKINLEY DRA...	LACFCD	102.0000000000000	272-F1	F01003049	0.0000000000000	No	Double Box	Reinforced Ce...	Standard
19	2010-03-01	72.3000000000000	1961-01-01	KS	PD 0263	LACFCD	33.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard
20	2010-03-01	94.9000000000000	1961-01-01	KS	PD 0263	LACFCD	42.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard
21	2010-03-01	72.3000000000000	1961-01-01	KS	PD 0263	LACFCD	42.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard
22	2010-03-01	94.9000000000000	1961-01-01	KS	PD 0263	LACFCD	42.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard
23	2010-03-01	150.4000000000000	1961-01-01	KS	PD 0263	LACFCD	42.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard
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25	2010-03-01	150.4000000000000	1961-01-01	KS	PD 0263	LACFCD	42.0000000000000	6-F679	F01001424	0.0000000000000	No	Round	Reinforced Con...	Standard

Show All Features

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

Water Utility Management Using QGIS

- 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

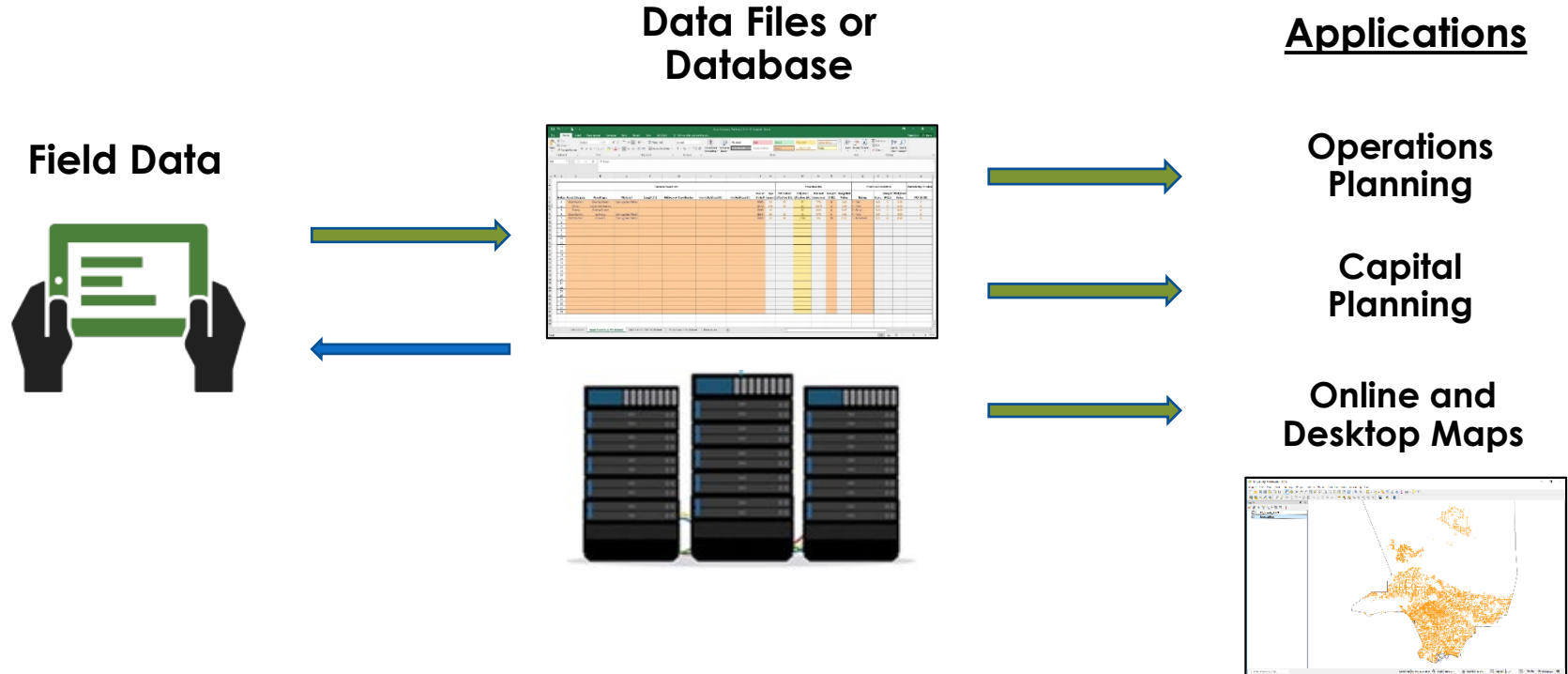
Web searches of “QGIS” and keywords for a task can find blogs and posts with solutions from the QGIS community

Example: Asset Management

- Storing utility assets in GIS databases
- Ways to classify assets
 - Location
 - Size, length, depth, material
 - Condition

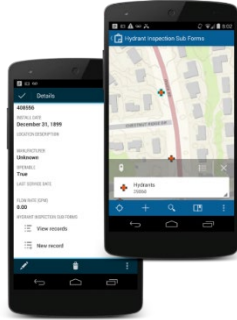
Features	Possible attributes (fields) for each asset
Asset #	Age
1	Length, depth, size
2	Location (GPS coordinates, latitude/longitude)
3	Material
...	Condition
	Cost or value
	Ownership
	Type

Example: Collecting Field Data for Asset Management

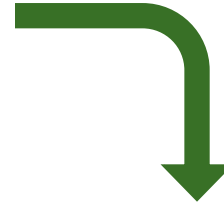


Example: Uploading Data for Asset Management

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

AssetName*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
AssetName	Location*	AssetCate	OtherAss	AssetType	OtherAss	AssetID	AssetSize	AssetMat	Longitude	Latitude	Notes	StorageCa	LinearFee	AcresOfLa	Condition	Redundan	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-BR-1	3750	Weeds/D	-121.42	38.55448				1	Poor	0%	Active	Fullsized	Minor	Y

CUPSS DataExport

Ready

Let's See an Example

Where Can I Find Data?

- Local and state GIS repositories
 - Administrative boundaries (e.g. cities, counties, field divisions, districts, sectors etc...)
 - Infrastructure information (e.g. dams, levees, water and 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
- Esri Open Data Hub



Links

EPA Region 9 Environmental Finance Center:

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

Contact:

erik.porse@owp.csus.edu

QGIS:

<http://qgis.org>

<https://www.qgistutorials.com/>

