Walker Water

January 26, 2022

Our Mission

Our mission is to help you design and build your own state-of-the-art water administration control system that will enable you to deliver water resources accurately and on time and protect and preserve them for years to come.

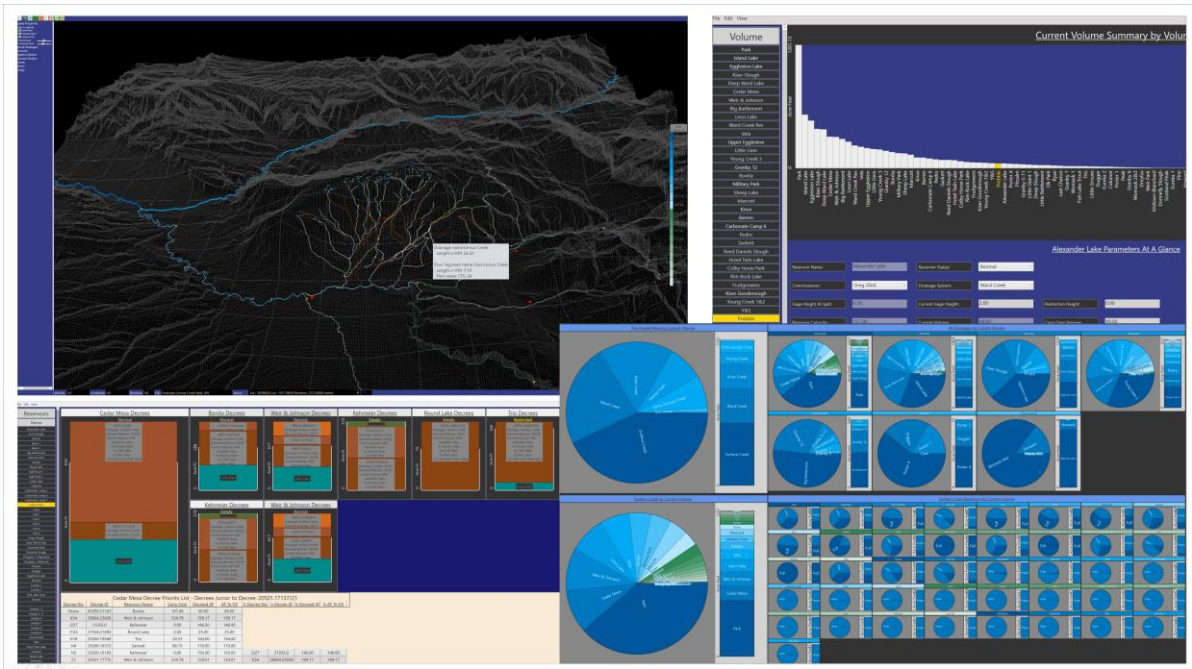
Who We Are

Walker Water is a technology services company founded in 2021 by John Walker, and built upon his strong passion for conservation, and a budding knowledge of how the complex irrigation system in the Surface Creek Valley of Western Colorado works. The development of our technologies is based upon what we learned as irrigators and water users ourselves within this valley.

We are a software development and irrigation system consultation services company whose charge is to build administrative tools that help the district administrator to ensure the accurate and timely delivery of their water to the rightful user, that allow ditch companies or even individual users to know what

Walker Water LLC
24750 Tannin Rd
Cedaredge, CO 81413

water is flowing in their ditch, and stakeholders in the city's golf course water supply to know that their golf greens will remain that way.



Interactive tools collect and display water distribution data in easy-to-understand maps and dashboards.

We are also specialists in assisting our customers to successfully secure grant monies to help fund their water-related projects.

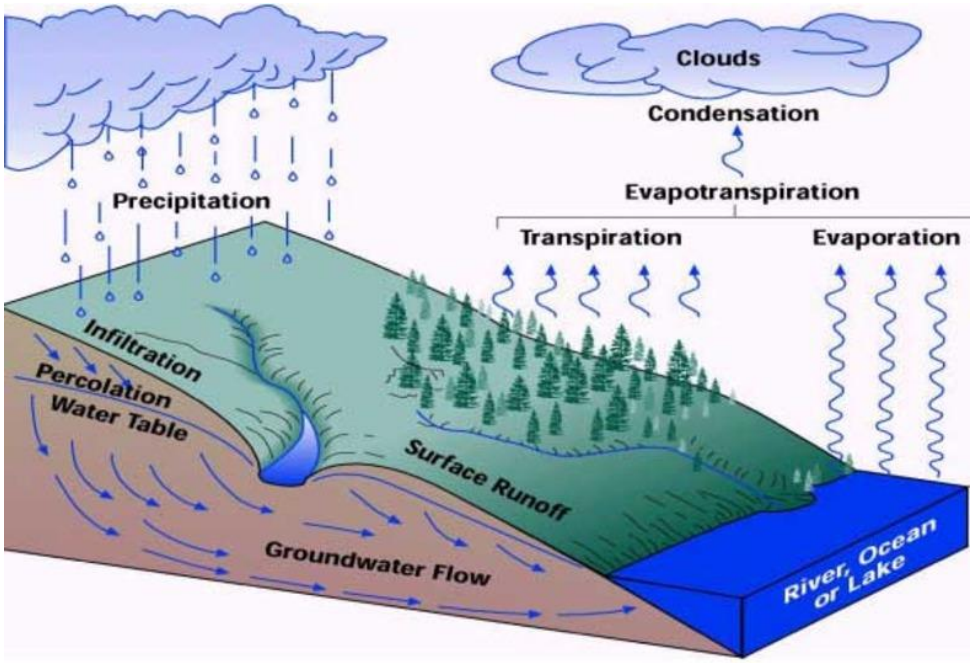
The Irrigation System Where We Live

Arguably the most complicated irrigation system in the State, if not the World, the Grand Mesa Surface Creek Valley water distribution and delivery system is an absolute marvel of man in harmony with nature. Over 120 man-made and natural reservoirs and lakes deliver water through a centuries-old spider-web like network of streams and ditches to farms, orchards, ranches, and municipalities within the valley. If it's water you are touching, drinking, flushing, or using to irrigate in our valley, look over your shoulder because it *all* comes from the mountains to our north. This is a precious and finite resource, enduring increasing pressure from diminishing supply and what could one day be over-demand.

A headgate from which to turn water out of a reservoir on the Grand Mesa

Why do we need software modeling tools?

The Earth's water cycle is complex, albeit closed.



The various water systems in the global cycle.

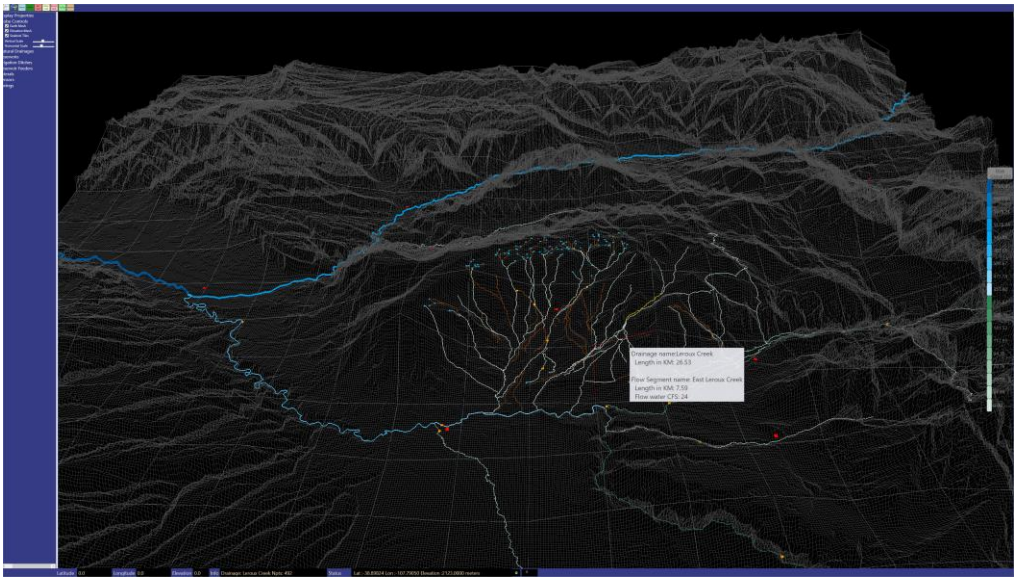
Knowing where our irrigation and water distribution networks gain and lose water helps us do a better job of quantifying and delivering our water in priority and on time. Lakes and reservoirs, streams and ditches, aquifers and springs, and other systems, are coupled and intricately woven together in the fabric of water on our planet. It is incumbent on we humans to better model and interpret these systems so we can better protect and preserve them. That means we must model and understand precipitation, percolation, evaporation, and transpiration throughout the system. Where do we gain water? Where do we lose water? And in what quantities?

Walker Water has developed *Topoflows™,* a suite of software tools coupled with SCADA sensor devices that make up a control system for irrigation water management and distribution.

An [overly complex] control system for the management and distribution of water.

Walker Water's Irrigation Management Tools

Our technological strengths lie in the domain of modeling and visualizing stream flows and comparing them in real time to in-stream sensor flows, and in ensuring their delivery to decreed and in priority users on time. These tools provide the water administrator instantaneous knowledge of the state and ownership of water flows in streams and ditches within their system.



3D map showing the amount (CFS) of water modeled as run-off or flow. Both color and line thickness indicate the flow rate.

Many [of our streams] and ditches are open, and transport several *"colors"* of water, from large volumes, or rates, to small. In the early season during snow melt the water carried in these systems is termed *flow water and* is administered and delivered by decree seniority to in-priority rights users. Flow water is also made up of water from springs and rainfall, etc. This decree water has a color and must be delivered in priority throughout the irrigation season so long as it's available.

A natural spring adding flow to the system.

Meanwhile, water users who own *private reservoir* water may order that water and have it delivered via this same system. This water is termed *call water* and has its own color. It can be in the same ditch at the same time as flow water. These two colors of water must be accounted for with accuracy and delivered to the rightful users on time.

"The way it's always been done!"

Sounds simple, right! Well, yes and no. On paper, yes, but no if the number of delivery ditches in the system is in the hundreds and receiving water from over a hundred reservoirs on call. How is a system that complicated kept running efficiently and accurately? With very careful attention to detail in the front office and diligent operation in the field. The way water has been administered in this valley, and certainly many others, was the way it's always been done, and if anyone dares to ask why or how it could be done differently, the typical response is "we've been operating this way for over a hundred years, why change?". The answer to that somewhat rhetorical question is complicated, and usually invokes an emotional response from the petitioner. Our answer here at Walker Water is that we can now leverage modern advances in technologies that permit us to collect data in real time, communicate

that to field personnel more quickly and accurately than before, and satisfy the curiosity of the all the users who always call or drop in the front office to inquire how much water they have, or why their neighbor's ditch has so much water, or how much is left in their reservoir, and on and on.

Sensor communication equipment at a reservoir on the Grand Mesa.

Most importantly, in our point of view, is the ability to retrieve accurate live sensor data of reservoir and stream flow conditions in real time, account for and display those conditions in modern looking dashboards and visualization tools, and record and store that information for future use.

The best way to preserve our water is to understand how we are using it so that perhaps we can prepare to modify our behaviors and avoid future crises.

Software Development Services

Walker Water has designed and built a modern control-center-oriented dashboard-based SCADA modeling system that aids in the accurate administration and timely distribution of Colorado's (and any other place in the world's) water resources to its lawful and rightful users.

The system is comprised of several key apps each of which is described in the **Products** section.

- *TopoFlows™* – Reservoir and stream flow analytics including live sensor feeds and dashboards
- *TopoFlows 3D™* – A full 3D visualization studio of *TopoFlows*
- *DecreeCall™* – Assuring delivery of senior priority water in priority and on time
- *SeepMon™* – An alarm-based reservoir seep monitoring system
- *UOrderH_2O™* – User water ordering and account management system

Let us help you design and build your own system that will enable you to deliver your water resources in priority and on time and protect and preserve them for years to come.

Irrigation System Management Consultation Services

- Irrigation system management design and consultation
- Grant writing and consultation

- Sensor installation and support
- Stream flow analysis
- Watershed analysis
- Ground water flow analysis

Let us help you find grant money for your project, or design and install a network of sensors to collect real-time data from the field.

Products

These products were developed in collaboration with lifelong water administrators from the Surface Creek Valley, lead water commissioners, ditch riders, and operations managers. They are derived from many years of experience in "doing things the old-fashioned way", and a passion and desire to see modern improvements that will result in fewer errors, more accurate and quicker analysis of decree call situations, and on time delivery of the proper amount of water to the lawful user.

Measuring the water column or gage height.

Measuring the flow through a "V-Notch" device.

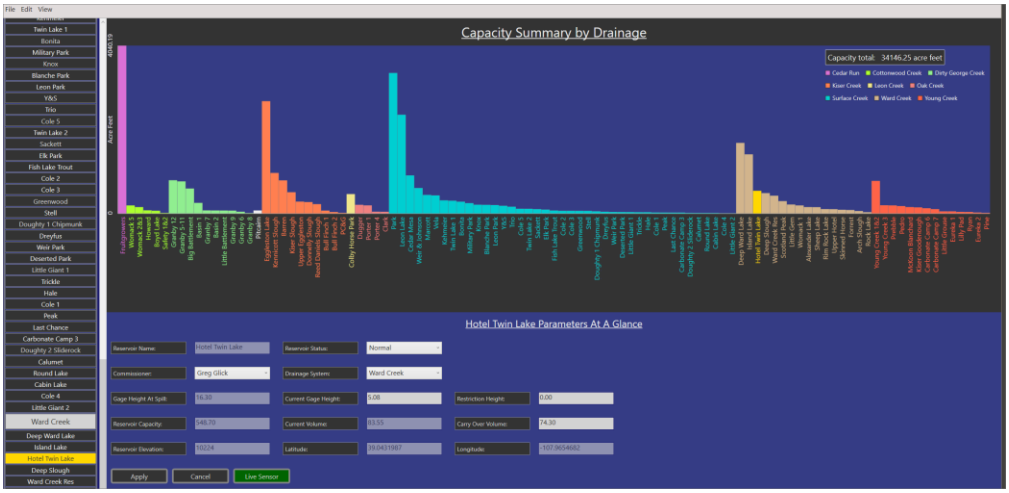
While we believe this valley may have the most complicated water delivery system in the world, each system has its unique characteristics and special "one-off" situations. We are prepared to tailor the system that you need to deliver your water properly and accurately to your users.

***TopoFlows™* – Reservoir and stream flow analytics including live sensor feeds and dashboards**

Several apps allow the administrator to maintain and visualize a database of reservoir, ditch, and headgate structures.

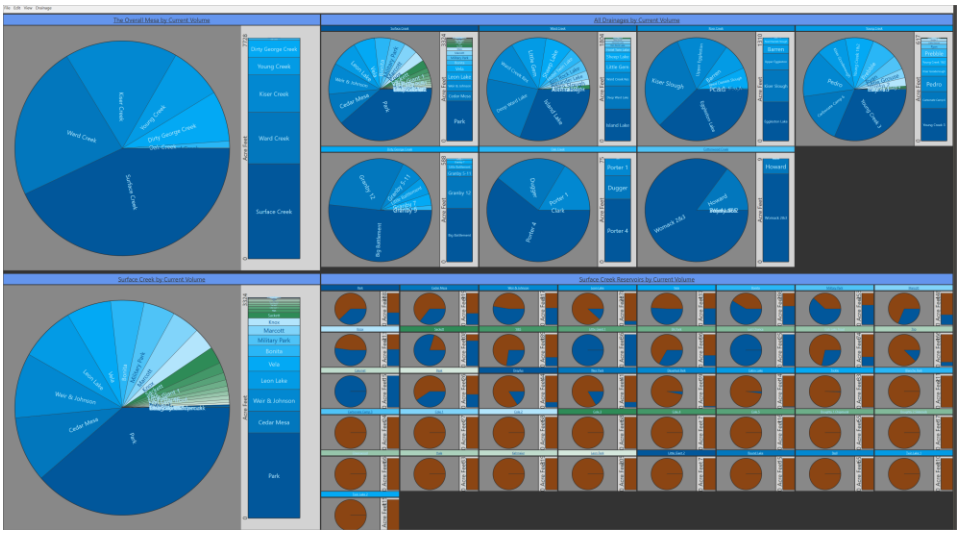
- *Drainage Statistics* is an app for entering, modifying, and maintaining the system information.
    - Retrieves live stream flow data at scheduled intervals.
    - Graphs of reservoir and system statistics such as capacities, current volumes, and carry over volumes.

- Sort and view system information by drainage, commissioner, volume, or operational status.
- Historical usage graphs



Data entry and graphs of storage, usage, and status.

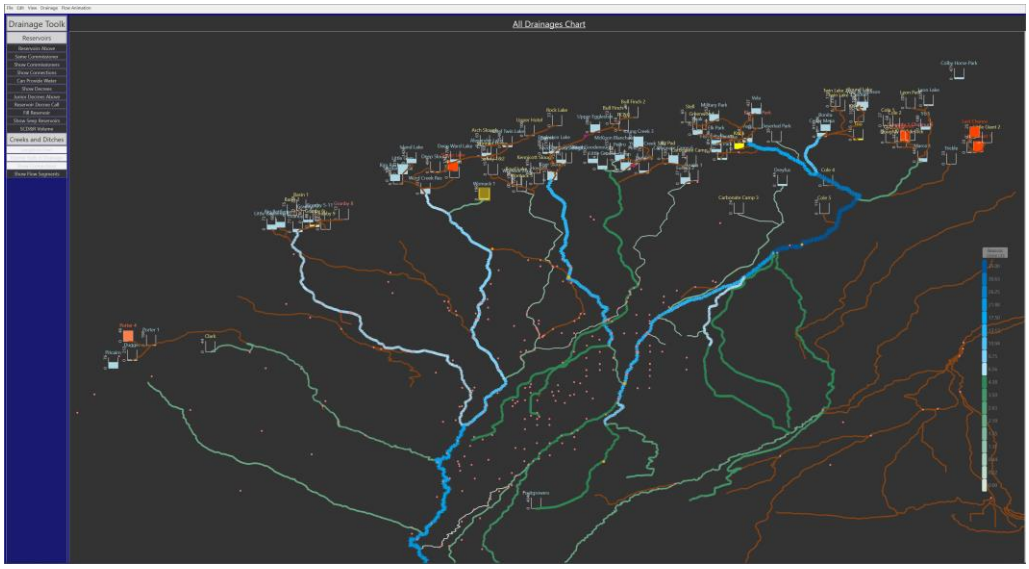
- *Dashboard* presents various views of reservoir and stream flow status such as current capacity, current volume, carryover volume
  - Graphs and plots of reservoir and system statistics such as capacities, current volumes, and carry over volumes.
  - Sort and view system information by drainage, commissioner, volume, or operational status.
  - Updates in real time from sensors.



Pie charts of reservoir volumes by overall system, by drainage and by reservoir.

- *TopoFlows 2D* is a map of the system that illustrates reservoir content and status and modeled and sensor-based stream and ditch flow rates and status.
  - Show reservoir and stream and ditch status.
  - Show modeled flow and call water flow rates in streams and ditches.
  - Show sensor flow rates in streams and ditches.

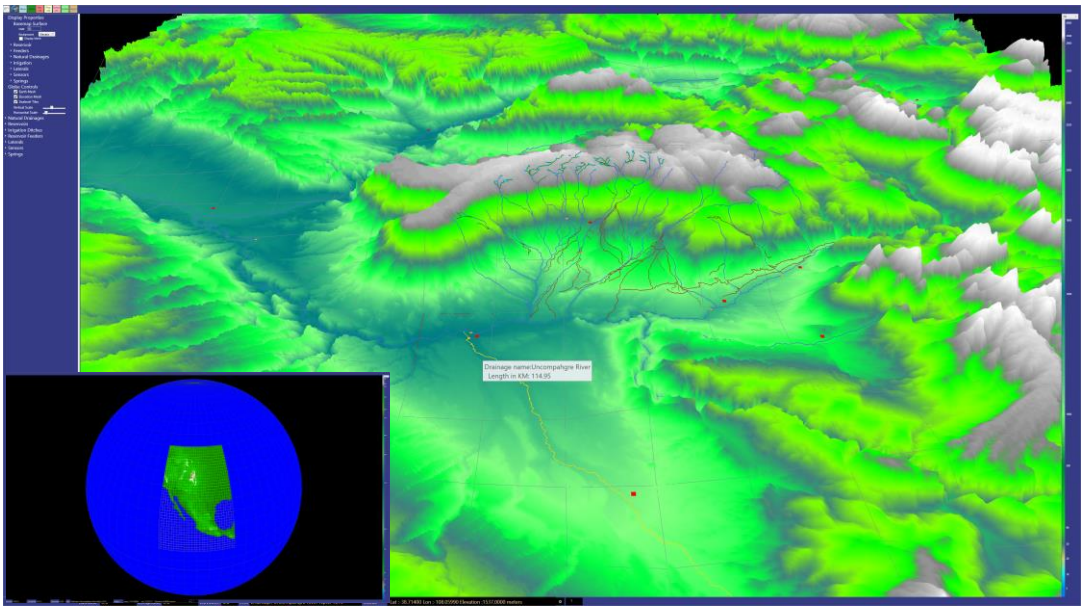
- Plots of graphs comparing those rates, and optional warning alerts when they deviate beyond defined thresholds (rain event or sudden change in conditions).
- When coupled with the ***DecreeCall™*** app will show headgates to close when a call is made on the creek, or reservoirs from which to draw water (on paper) when a senior decree is short of full.



2D map of reservoir call water in CFS.

TopoFlows 3D™* – A full 3D visualization studio of *TopoFlows

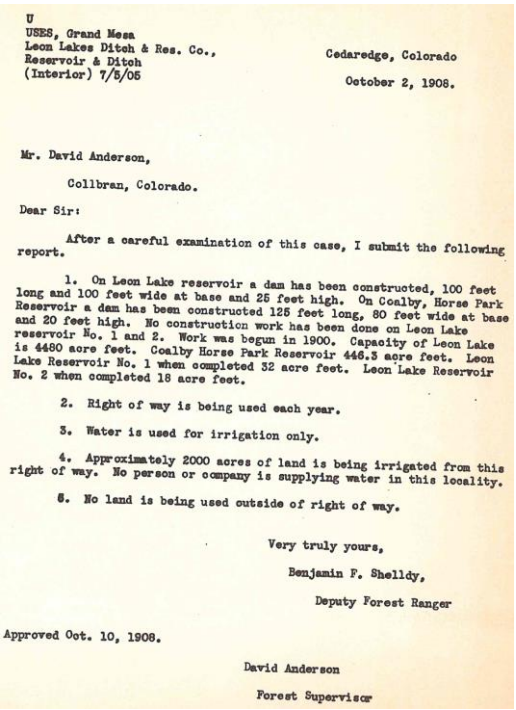
A full mesh-based 3D visualization system of the reservoir and stream and ditch conditions. This view can be zoomed out to a global perspective and is designed to support all the waters of the world. *TopoFlows 3D* offers the same functionality as *TopoFlows 2D*. Streams and ditches are colored by and their thickness varied by water flow rate. The user can instantaneously compare modeled flow rates to sensor flow rates and look for anomalies in the creek. Anomalies could caused By a recent precipitation event adding water to the system, or by an upstream pump or illegal operation removing water.


3D map of a portion of Colorado showing streams and ditches and sensor locations.

Sensor data is collected from the field and posted to the maps and dashboards in real time. Visualization in the 3D space allows the administrator to see regional weather effects and their impact on localized anomalies. Changes in stream conditions can be better understood and acted upon appropriately.

***DecreeCall™* – Assuring delivery of senior priority water in priority and on time**

Water in Colorado and other Western States is administered and delivered based upon a “first in time, first in right” appropriation system. When the State of Colorado was founded in the late 1800’s, early settlers built reservoirs to capture and store snow melt, and dug ditches to deliver runoff waters to their fields, farms and orchards.



U
USES, Grand Mesa
Leon Lakes Ditch & Res. Co.,
Reservoir & Ditch
(Interior) 7/5/05

Cedaredge, Colorado

October 2, 1908.

Mr. David Anderson,

Collbran, Colorado.

Dear Sir:

After a careful examination of this case, I submit the following report.

1. On Leon Lake reservoir a dam has been constructed, 100 feet long and 100 feet wide at base and 25 feet high. On Coalby, Horse Park Reservoir a dam has been constructed 125 feet long, 80 feet wide at base and 20 feet high. No construction work has been done on Leon Lake reservoir No. 1 and 2. Work was begun in 1900. Capacity of Leon Lake is 4480 acre feet. Coalby Horse Park Reservoir 446.3 acre feet. Leon Lake Reservoir No. 1 when completed 32 acre feet. Leon Lake Reservoir No. 2 when completed 18 acre feet.

2. Right of way is being used each year.

3. Water is used for irrigation only.

4. Approximately 2000 acres of land is being irrigated from this right of way. No person or company is supplying water in this locality.

5. No land is being used outside of right of way.

Very truly yours,

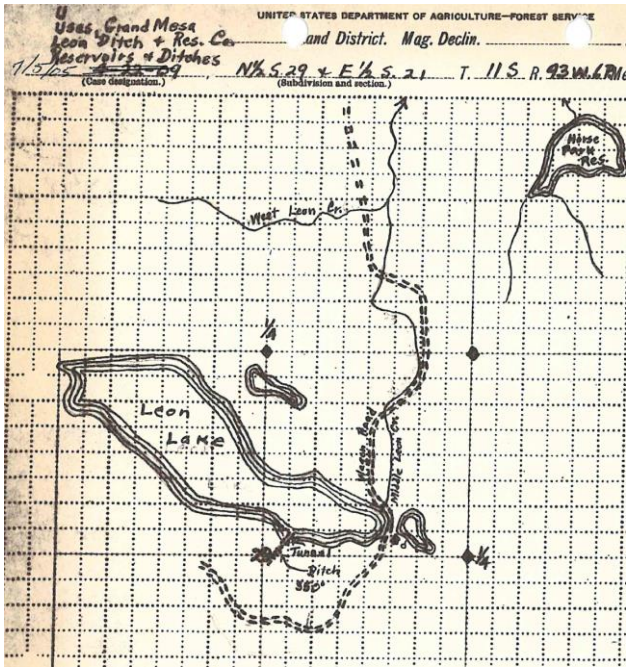
Benjamin F. Shelldy,

Deputy Forest Ranger

Approved Oct. 10, 1908.

David Anderson

Forest Supervisor



These same folk then went to the State Water Court and asked for the court to decree rights to transport water through their ditches for their use. These first applicants were adjudicated rights for specific amounts of water to be allowed to be appropriated and delivered via specific ditches to irrigate specific lands, and these rights are still valid and in play today. The first to file was granted the #1 decree, the second to file the #2 decree and so on. The #1 decree is senior to the #2 decree and what this means is that if the supply of water on the creek falls below the level of the decreed amount to the #1 decree, let’s say, the #1 decree holder can make a “call” on the creek and demand that all junior users on the creek above his headgate must have their headgates shut off so that all the water in the creek is delivered to the #1 decree holder.

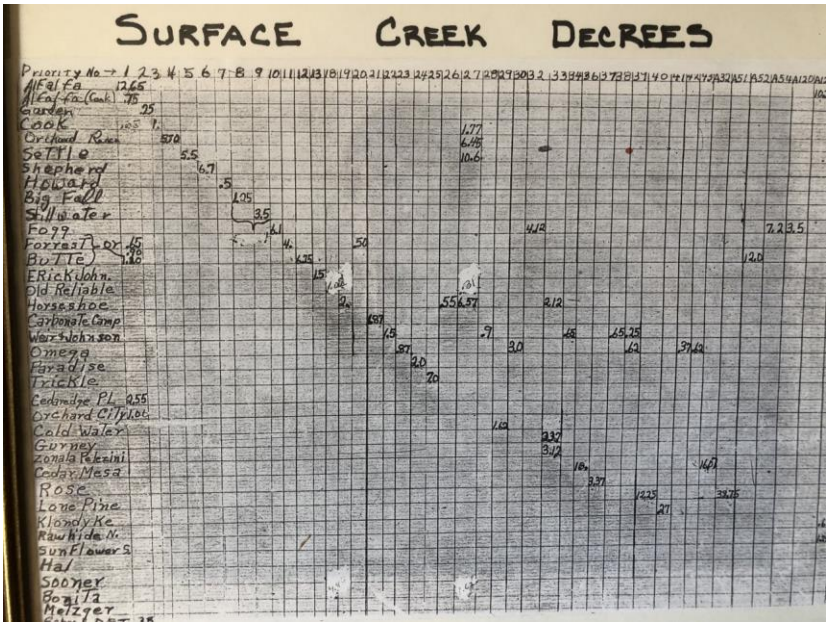
IMG_4407.MOV

A movie showing water flowing through a Parshall flume used to calculate flow rates.

As one can imagine the amount of water flowing in the streams and creeks fluctuates by season, by rainfall or precipitation, and even daily since warm sun will melt additional flows in the daytime and

then at nightfall these flows reduce as the mountain refreezes overnight. These daily changes are called diurnals and by law must be accounted for and delivered to the appropriate decree. Sounds complicated, right? It is, very, and what's more, water must be delivered to the lawful "in-priority" user and on time!

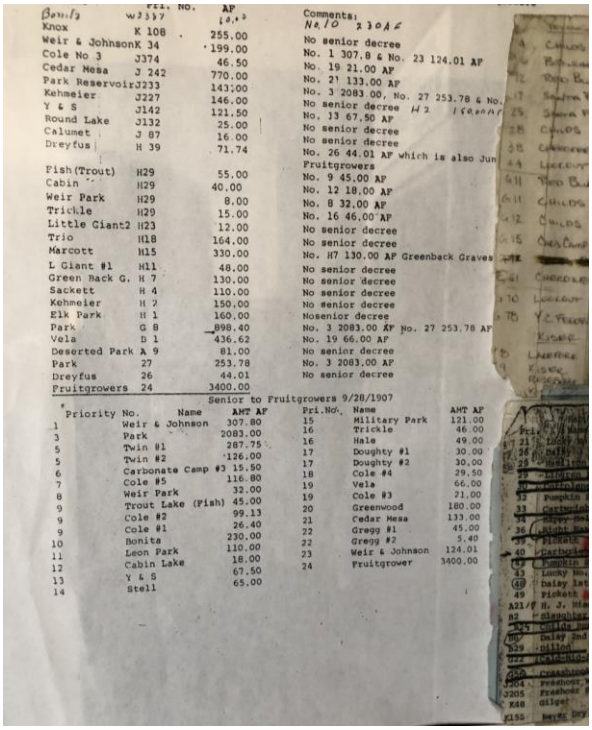
How is this *Decree Priority* process currently managed? Well, one could imagine that each irrigation company or district might do things their own way. In Colorado, the State is responsible for turning flow water into the headgates of the decreed entity and employs Water Commissioners to fulfill that responsibility. But how does the Commissioner know exactly what headgates to close or open? Here is how this is done in the Surface Creek Valley where we live. The Commissioner uses a hand-written sheet to lookup what ditch receives water and how much under current stream flow conditions. In other words, who is Junior to who, and therefore who gets shut off?



An old-fashioned decree priority chart showing ditches by priority and their decreed flow rates.

Reservoirs also have assigned priorities. They are essentially just very long ditches (as far as the way the Courts view them), and therefore they too have senior rights over other reservoirs based upon their date of adjudication. So, reservoirs with senior rights over junior reservoirs that are both connected and above them can make a call on that junior reservoir if their senior right was not filled during the fill season and fill their senior by the other reservoir's junior water. These fills happen essentially on paper as the water does not have to be physically moved until it is ordered and used. Once again, in our valley,

this is administered by the Commissioner using an old list on the office wall as reference to the priorities.



		AF	Comments:
Knox	K 108	255.00	No senior decree
Weir & Johnson	K 34	199.00	No. 1 307.8 & No. 23 124.01 AF
Cole No 3	J374	46.50	No. 19 21.00 AF
Cedar Mesa	J 242	770.00	No. 21 133.00 AF
Park Reservoir	J233	143.00	No. 3 2083.00, No. 27 253.78 & No.
Kehmeier	J227	146.00	No senior decree H2
Y & S	J142	121.50	No. 13 67.50 AF
Round Lake	J132	25.00	No senior decree
Calumet	J 87	16.00	No senior decree
Dreyfus	H 39	71.74	No. 26 44.01 AF which is also Jun
			Fruitgrowers
Fish (Trout)	H29	55.00	No. 9 45.00 AF
Cabin	H29	40.00	No. 12 18.00 AF
Weir Park	H29	8.00	No. 8 32.00 AF
Trickle	H29	15.00	No. 16 46.00 AF
Little Giant 2	H23	12.00	No senior decree
Trio	H18	164.00	No senior decree
Marcott	H15	330.00	No. H7 130.00 AF Greenback Graves
L Giant #1	H11	48.00	No senior decree
Green Back G.	H 7	130.00	No senior decree
Sackett	H 4	110.00	No senior decree
Kehmeier	H 2	150.00	No senior decree
Elk Park	H 1	160.00	Nosenior decree
Park	G 8	898.40	No. 3 2083.00 AF No. 27 253.78 AF
Vela	D 1	436.62	No. 19 66.00 AF
Deserted Park	A 9	81.00	No senior decree
Park	27	253.78	No. 3 2083.00 AF
Dreyfus	26	44.01	No senior decree
Fruitgrowers	24	3400.00	

Senior to Fruitgrowers 9/20/1907

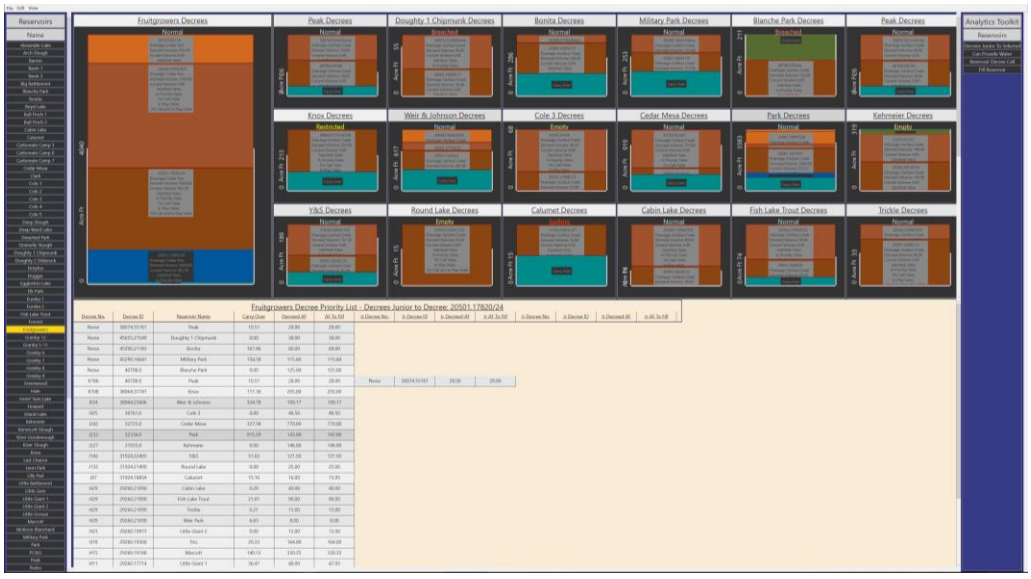
Priority No.	Name	AMT AF
1	Weir & Johnson	307.80
3	Park	2083.00
5	Twin #1	287.75
5	Twin #2	126.00
6	Carbonate Camp #3	15.50
7	Cole #5	116.80
8	Weir Park	32.00
9	Trout Lake (Fish)	45.00
9	Cole #2	99.13
9	Cole #1	26.40
10	Bonita	230.00
11	Leon Park	110.00
12	Cabin Lake	18.00
13	Y & S	67.50
14	Stell	65.00

Pri.No.	Name	AMT AF
15	Military Park	121.00
16	Trickle	46.00
16	Hale	49.00
17	Doughty #1	30.00
17	Doughty #2	30.00
18	Cole #4	29.50
19	Vela	66.00
19	Cole #3	21.00
20	Greenwood	180.00
21	Cedar Mesa	133.00
22	Gregg #1	45.00
22	Gregg #2	5.40
23	Weir & Johnson	124.01
24	Fruitgrower	3400.00

The decree priority list for the reservoirs on the Grand Mesa

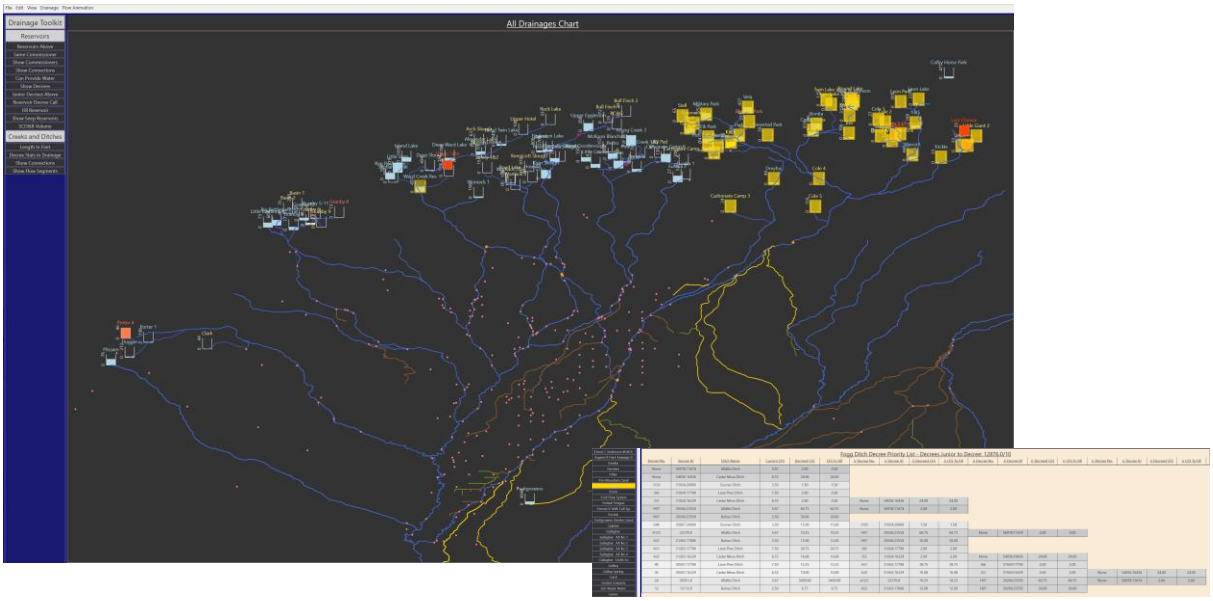
These “old school” methods worked fine in the past, but they are no longer working so well. Many more users have moved into the valley, ditches and ownership of decrees get sub-divided and new users have far less knowledge of how the system works.

Walker Water has developed an interactive decree priority administration tool to make this process simpler to administer resulting in fewer mistakes and improved deliveries and customer satisfaction.



DecreeCall showing reservoir decrees and a list of juniors to the selected reservoir.

The decree analytics tool produces a call map showing the reservoirs and ditches that are put “in play” by the calling structure.



Reservoirs and ditches put in play by a call from the #10 priority ditch on the system.

The call map is used by the administrator to know what headgates to close above the calling structure.

Let the *DecreeCall* app help you plan optimal end-of-year water storage in each of your reservoirs to ensure senior decrees are prioritized for the next season.

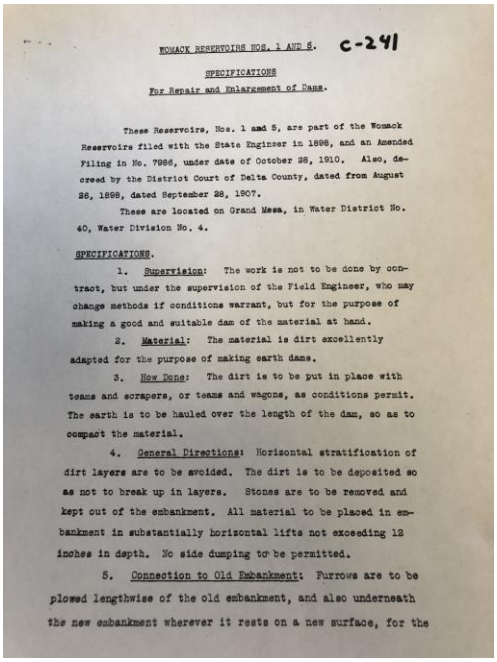
***SeepMon™* – An alarm-based reservoir seep monitoring system**

Many older reservoirs seep some amount of water, particularly in the vicinity of the groin of the dam, where the dam couples to the earth. These seeps may be small a few gallons per day, or large many hundreds of gallons per day.

A seep collected through a pvc pipe for ease of measuring.

In-field seep monitoring.

Obviously large seeps should be repaired as quickly as possible by the reservoir owner since that loss of water is irrecoverable. However, many of these seeps are to be expected given the construction methods of these dams at the time they were assembled, and these seeps would not be repaired unless their state were to change to something serious.



WOMACK RESERVOIRS NOS. 1 AND 5. C-291

SPECIFICATIONS

For Repair and Enlargement of Dams.

These Reservoirs, Nos. 1 and 5, are part of the Womack Reservoirs filed with the State Engineer in 1898, and an Amended Filing in No. 7986, under date of October 28, 1910. Also, decreed by the District Court of Delta County, dated from August 28, 1898, dated September 28, 1907.

These are located on Grand Mesa, in Water District No. 40, Water Division No. 4.

SPECIFICATIONS.

1. Supervision: The work is not to be done by contract, but under the supervision of the Field Engineer, who may change methods if conditions warrant, but for the purpose of making a good and suitable dam of the material at hand.

2. Material: The material is dirt excellently adapted for the purpose of making earth dams.

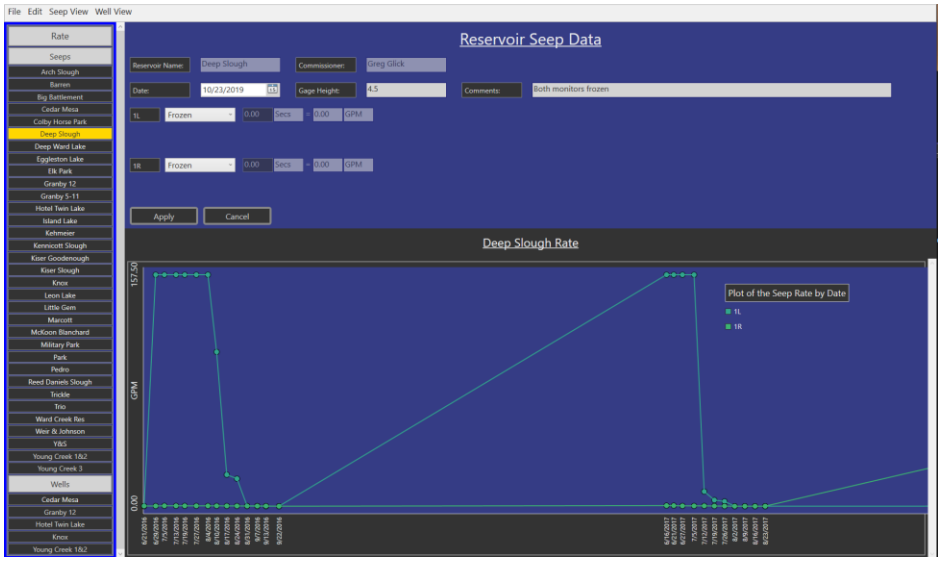
3. How Done: The dirt is to be put in place with teams and scrapers, or teams and wagons, as conditions permit. The earth is to be hauled over the length of the dam, so as to compact the material.

4. General Directions: Horizontal stratification of dirt layers are to be avoided. The dirt is to be deposited so as not to break up in layers. Stones are to be removed and kept out of the embankment. All material to be placed in embankment in substantially horizontal lifts not exceeding 12 inches in depth. No side dumping to be permitted.

5. Connection to Old Embankment: Furrows are to be plowed lengthwise of the old embankment, and also underneath the new embankment wherever it rests on a new surface, for the

Example of old construction requirements.

Our software is designed to monitor these seeps. Rapid or sudden changes in rates are cause for alarm.



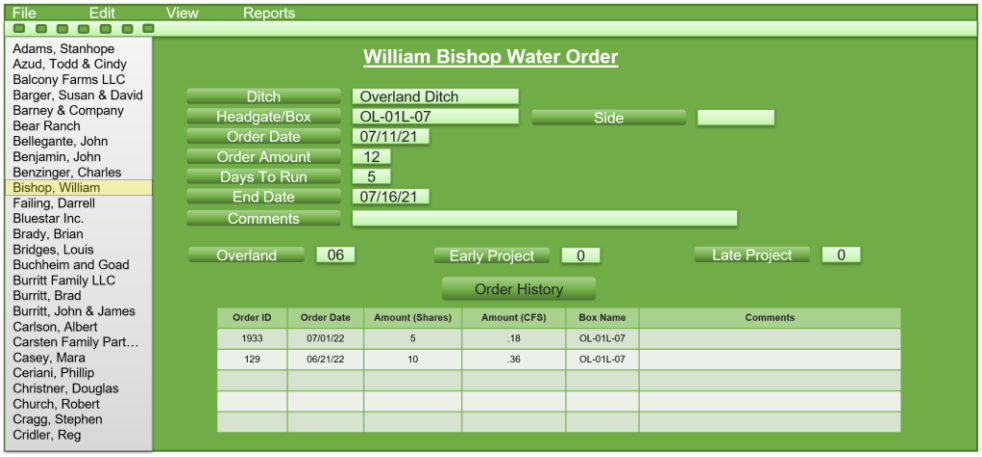
Seep data is collected in the SeepMon system. Sudden changes in seep conditions will trigger alarms.

This means the state of conditions within the dam itself are changing. If a seep suddenly dries, then where is that water going now? If it suddenly increases, then is the dam subject to rapid erosion? Alarms can be set so that if these changes occur a message would be sent to the administrator.

Seep monitoring is similar to stream monitoring in that sudden changes in stream levels trigger notification events to inform administrators. Sensors can be installed at seeps or in ditches to collect these data.

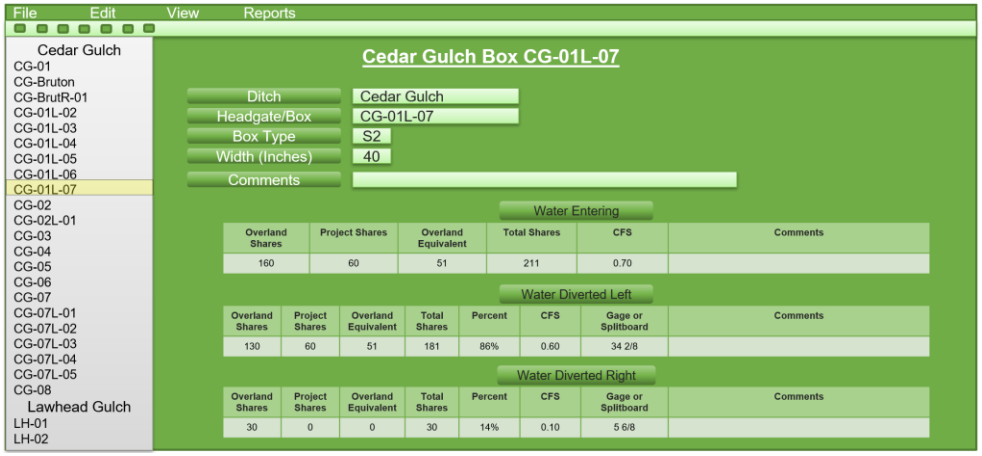
***UOrderH$_2$O™* – User water ordering and account management system**

How do you order your water? Do you use a web-based browser or do users call in their orders to a water office? We are currently constructing this app. It is an interactive irrigation water ordering interface that will empower individual users to place their water orders with built in flexibility and water account metrics.



User interface for ordering water by ditch and headgate.

Water orders will require administrator final authorization and approval and order tickets will be printed for the commissioner in the field.



User interface for the administrator to manage the distribution system.

Let us design and build the user interface and water ordering system for your network of ditches and headgates.

SCADA and Sensor Data

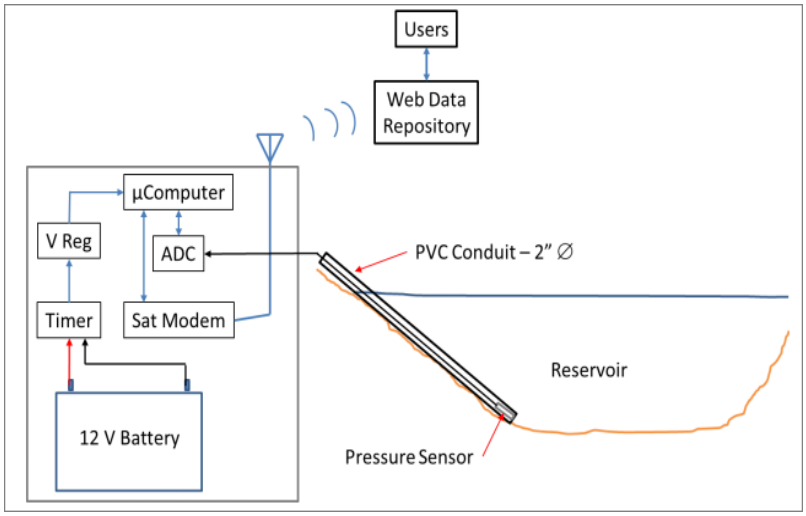
Oftentimes, *call water* is ordered through the same headgate as *flow water* and therefore knowing how much water is flowing through the headgate becomes complicated. Let's say 0.75 CFS (cubic feet per second) of two colors of water is flowing in a ditch, how do the users of the ditch know if the right amount of each color is in the ditch and flowing into their headgate? Or how about the simple question

of how much water is in the reservoir currently? Or even better, how can we automatically compute flow coming into a reservoir so that it can be assigned to the rightful users downstream since it can't be stored in the reservoir for more than 72 hours?

Measuring the water column or gage height.

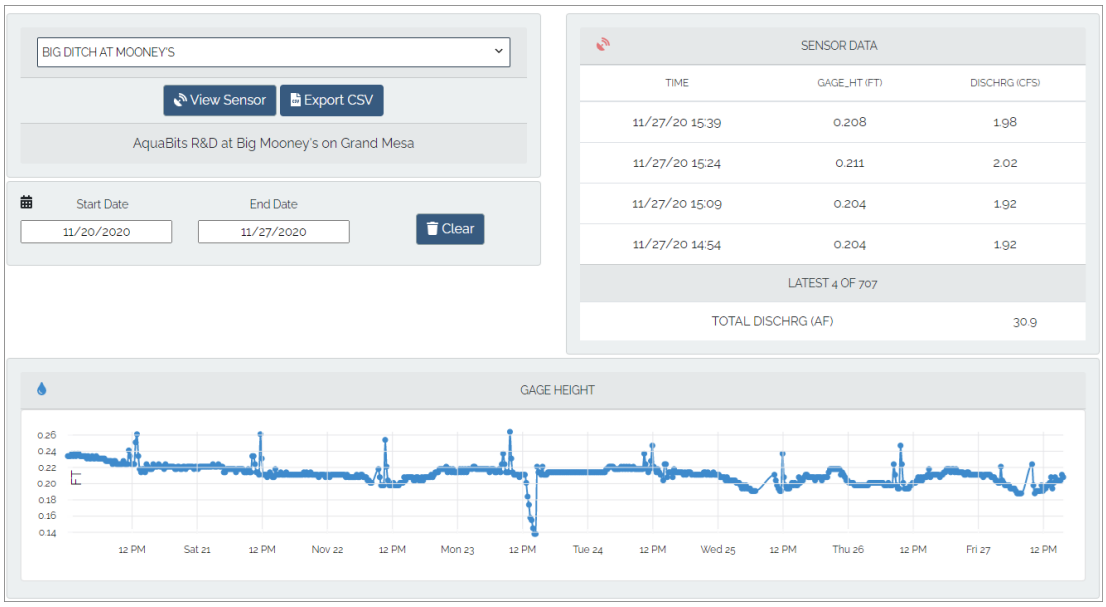
Measuring the flow through a "V-Notch" device.

The images above show how these measurements are currently collected in the field. A gage rod is read to compute current volume, and a staff gage is read to convert to flow rate in cubic feet per second. Manual measurements have a substantial margin of error and are only available when the field engineer collects them, perhaps once a week or so. In other words, real time data is not available using these older methods. For example, if a rainfall event occurs between the time these measurements are taken it would be missed entirely, and the flow uncertain, or guessed at. Thus, the need for installation of electronic sensors to collect and transmit this data in real-time or on demand at scheduled time intervals.



Schematic of electronic sensor installation in a reservoir to transmit the gage height to a web repository.

Walker Water works with 3rd party vendors of drone mapping and sensor installation services. Our software is compatible with their database for retrieval of sensor data in real-time.



Real-time data sensor data showing the flow rate of water through a headgate transmitted on 15-minute intervals.

Let us assist you in designing a sensor installation that efficiently captures key data points within your network of ditches and headgates. Our expertise in placing sensors optimizes their use in capturing data key to modeling natural run-off flow rates, evaporation and perhaps better understand transpiration and percolation within the system and even perhaps with select ditches.

Our Clients

If you're still reading, then you are very likely a potential customer of Walker Water.

Our *software* is for anyone who wants to know the status of the waters in their streams and ditches.

- The individual who wants to place their orders through our ordering system, and then monitor the delivery of water to their property when and how much they expect.
- Water administrators of ditch and reservoir companies or users associations.
- Water regulators, be they governmental, environmental, or social.
- Universities and schoolrooms to facilitate educating all young stakeholders in the ways of our water.

Our *services* are for anyone who has a water related project that needs outside funding in the form of grant monies.

- Reservoir and ditch companies that need funding to resuscitate aging infrastructure.
- Farmers and irrigators who want to convert to drip or more efficient irrigation systems.

Publications

Our People

John Walker

- CSM ’84 Geophysical engineering
- Oil & gas for 35 years
- C# developer
- 3 years developing current system
- Water owner/irrigator and farmer
- Wildlife conservationist

Leron Wells

- Oil & gas software design and construction for 30 years
- Entrepreneur and adventurer
- Any darn language you want me to program in developer
- Farmer

Contact us

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