

Use Your Tech for the Environment

Environmental Leadership Conference

Fossil Ridge High School

April 7, 2017



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Open Water Foundation

Social enterprise 501(c)3 nonprofit focusing on developing open source software tools to help make better decisions about water resources. Water is a public resource, and water data and software tools should also be public.



open data | **open software** | **open decisions**

openwaterfoundation.org

The Unexamined Life

“The unexamined life is not worth living” – Socrates

According to Wikipedia: “...uttered by Socrates at his trial for impiety and corrupting youth, for which he was subsequently sentenced to death”

https://en.wikipedia.org/wiki/The_unexamined_life_is_not_worth_living

Water as a Human Right

On 28 July 2010, through [Resolution 64/292](#), the United Nations General Assembly explicitly [recognized the human right to water and sanitation](#) and acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights. The Resolution calls upon States and international organisations to provide financial resources, help capacity-building and technology transfer to help countries, in particular developing countries, to provide safe, clean, accessible and affordable drinking water and sanitation for all.

http://www.un.org/waterforlifedecade/human_right_to_water.shtml

Water as a Public Resource

Article 16

Mining and Irrigation

IRRIGATION

Section 5. Water of streams public property. The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the **property of the public**, and the same is dedicated to the use of the people of the state, **subject to appropriation** as hereinafter provided.

<http://law.justia.com/constitution/colorado/cnart16.html>

Water as a Public Resource

Section 6. Diverting unappropriated water  **priority preferred uses.** The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using the water for the same purpose; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.

<http://law.justia.com/constitution/colorado/cnart16.html>

Some Recent Events: Flint Michigan

After Water Fiasco, Trust of Officials Is in Short Supply in Flint

<https://www.nytimes.com/2016/10/09/us/after-water-fiasco-trust-of-officials-is-in-short-supply-in-flint.html>



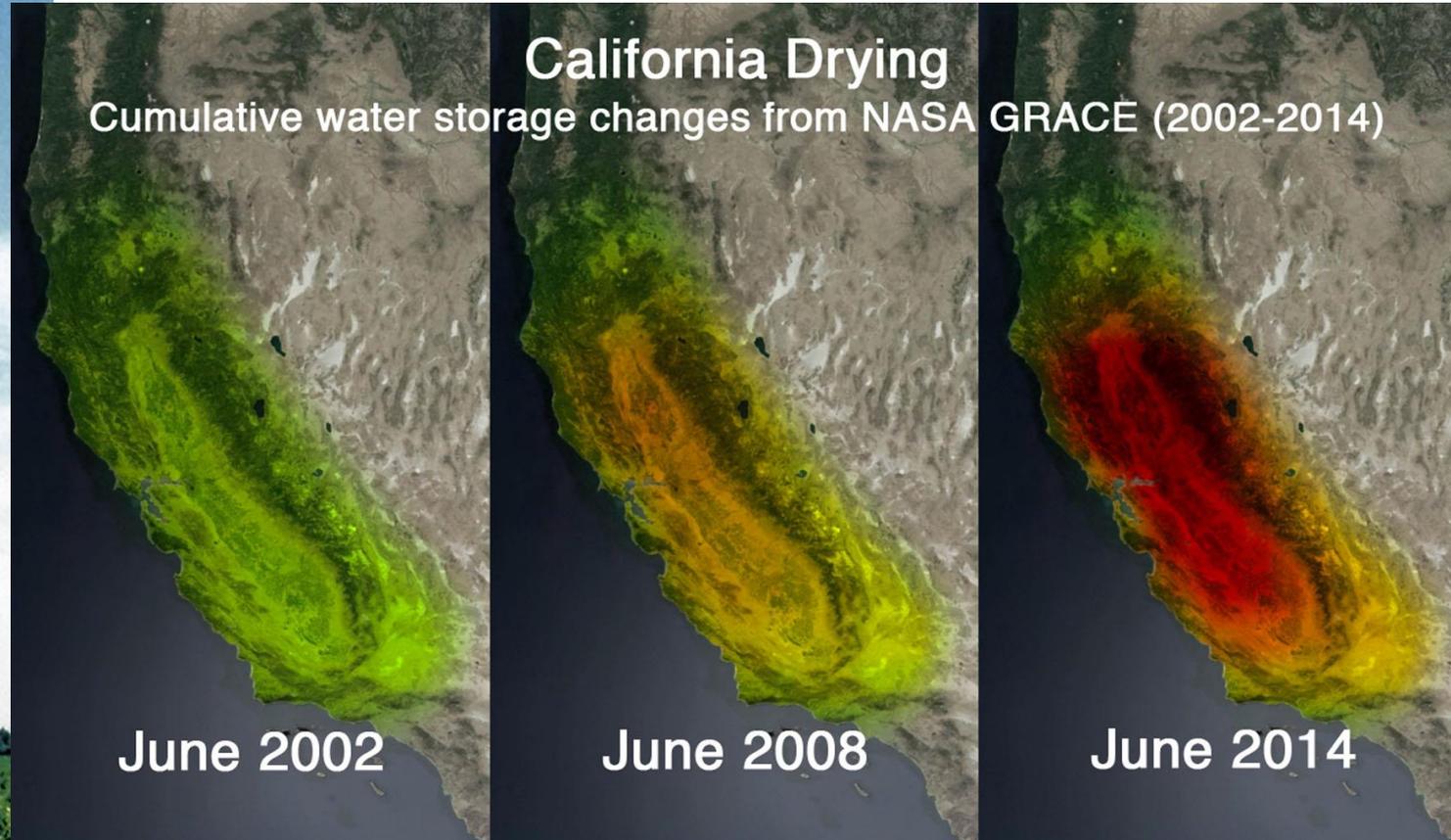
Chemical testing could have predicted Flint's water crisis

<http://www.freep.com/story/news/local/michigan/2015/10/10/misused-opportunities-flint-water-crisis/73688428/>



<http://edgeeffects.net/flint-water-crisis/>

California Groundwater Pumping



<https://www.jpl.nasa.gov/spaceimages/details.php?id=pia18816>
Gravity Recovery and Climate Experiment

<https://water.usgs.gov/edu/earthgwlandsubside.html>

Fluoridation

Drinking Water Fluoridation



Fort Collins Utilities and Water Fluoridation

Fort Collins Utilities adds fluoride to its drinking water, based on the recommendations of the Centers for Disease Control and Prevention (CDC), the U.S. Department of Health and Human Services (USPHS), the Colorado Department of Public Health and Environment (CDPHE), and the American Dental Association (ADA).

For more than half a century, the USPHS and CDPHE have recommended adding fluoride to drinking water to help prevent tooth decay. The CDC recognizes the widespread adoption of community fluoridation as one of the 10 greatest public health achievements of the 20th century.

According to the CDC website, "For 70 years, people in the United States have benefited from drinking water with fluoride, leading to better dental health. Drinking fluoridated water keeps the teeth strong and reduced tooth decay by approximately 25 percent in children and adults. By preventing tooth decay, community water fluoridation has been shown to save money, both for families and the health care system."

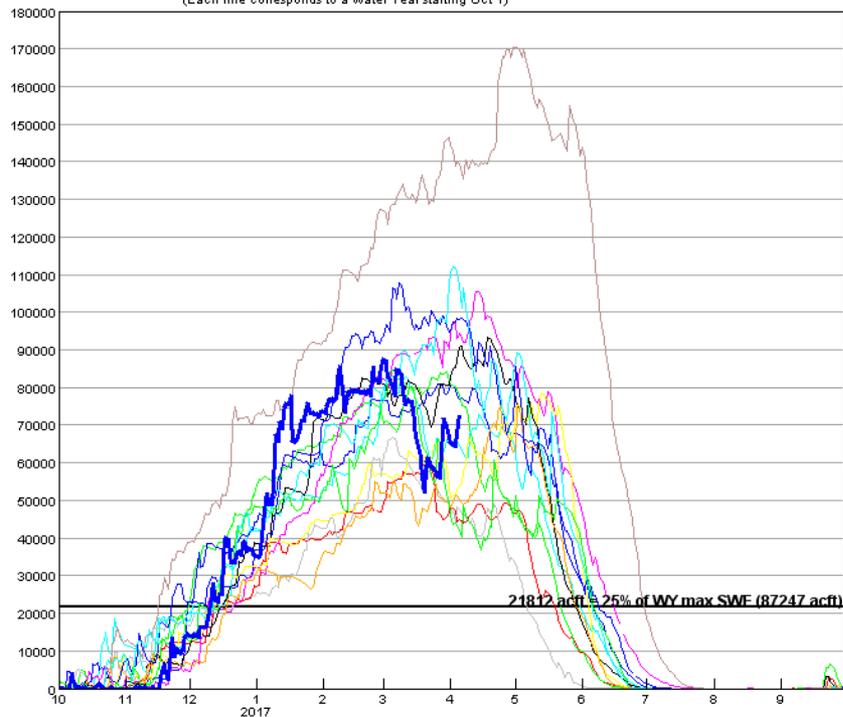
Read more: State of the Science: [Community Water Fluoridation](#)

<http://www.fcgov.com/utilities/what-we-do/water/water-treatment/treated-drinking-water/drinking-water-fluoridation>

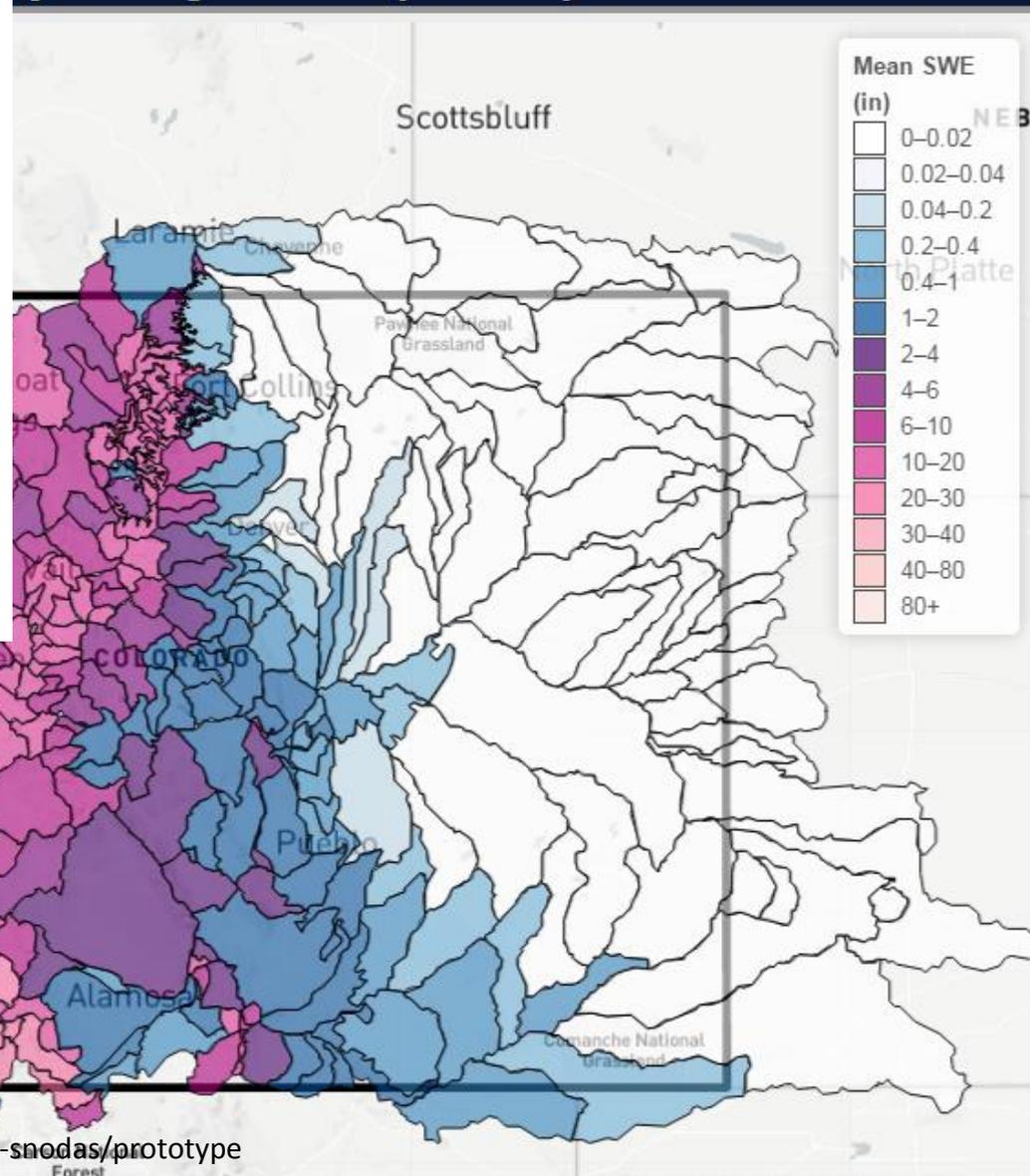
Climate Change Impacts

MICHIGAN RIVER NR WALDEN, CO (3176) SNODAS SWE Volume

(Each line corresponds to a Water Year starting Oct 1)



Support Systems (CDSS) SNODAS Tools



Algal Blooms



NEWS

TRAFFIC

ON FOX31

ON CHANNEL 2

CO BEST

CONTESTS

COMMUNITY

SPORTS

WEATHER 51°

Loveland water supply affected by algae bloom

POSTED 10:45 PM, SEPTEMBER 28, 2016, BY [DREW ENGELBART](#), UPDATED AT 06:05AM, SEPTEMBER 29, 2016

FACEBOOK 1K+

TWITTER

G+ GOOGLE

LINKEDIN 33

PINTEREST

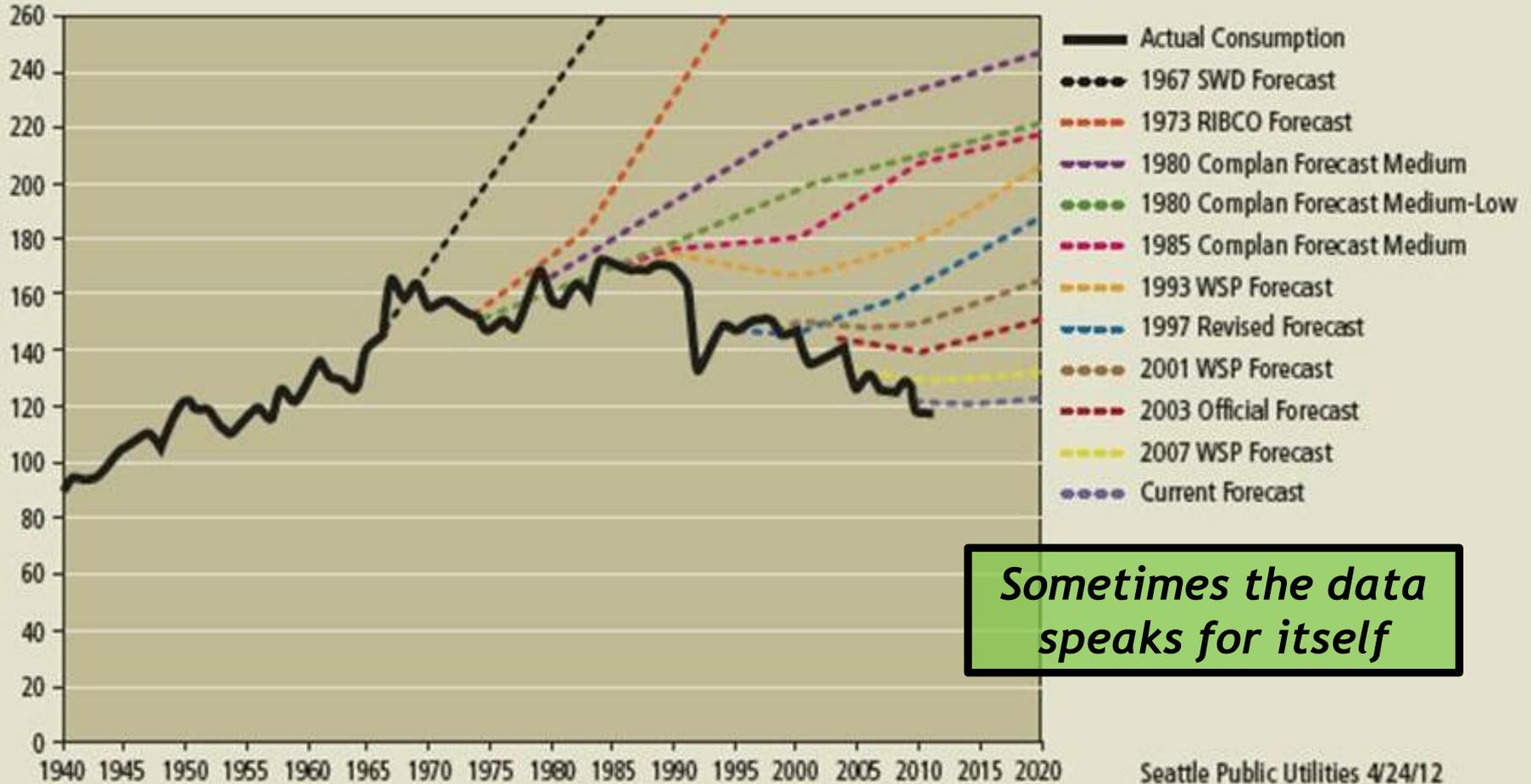


<http://kdvr.com/2016/09/28/loveland-water-supply-affected-by-algae-bloom/>

LOVELAND, Colo. -- There's something in the water in Loveland that has made it unbearable for some residents to drink and even smell.

Planning Example

Annual MGD



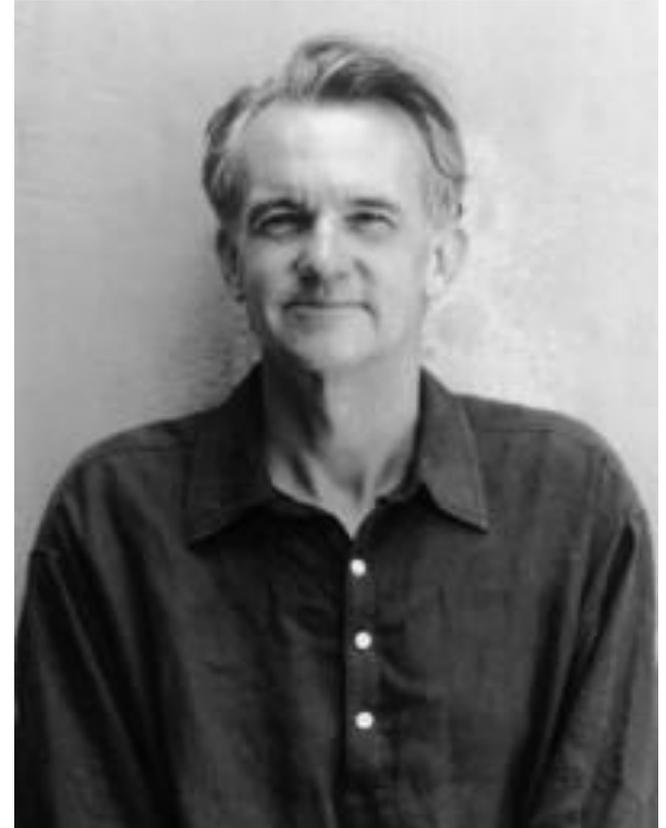
Sometimes the data speaks for itself

Seattle Public Utilities 4/24/12

Telling Your Story with Data

“There are two goals when presenting data: convey your story and establish credibility.”

-Edward Tufte



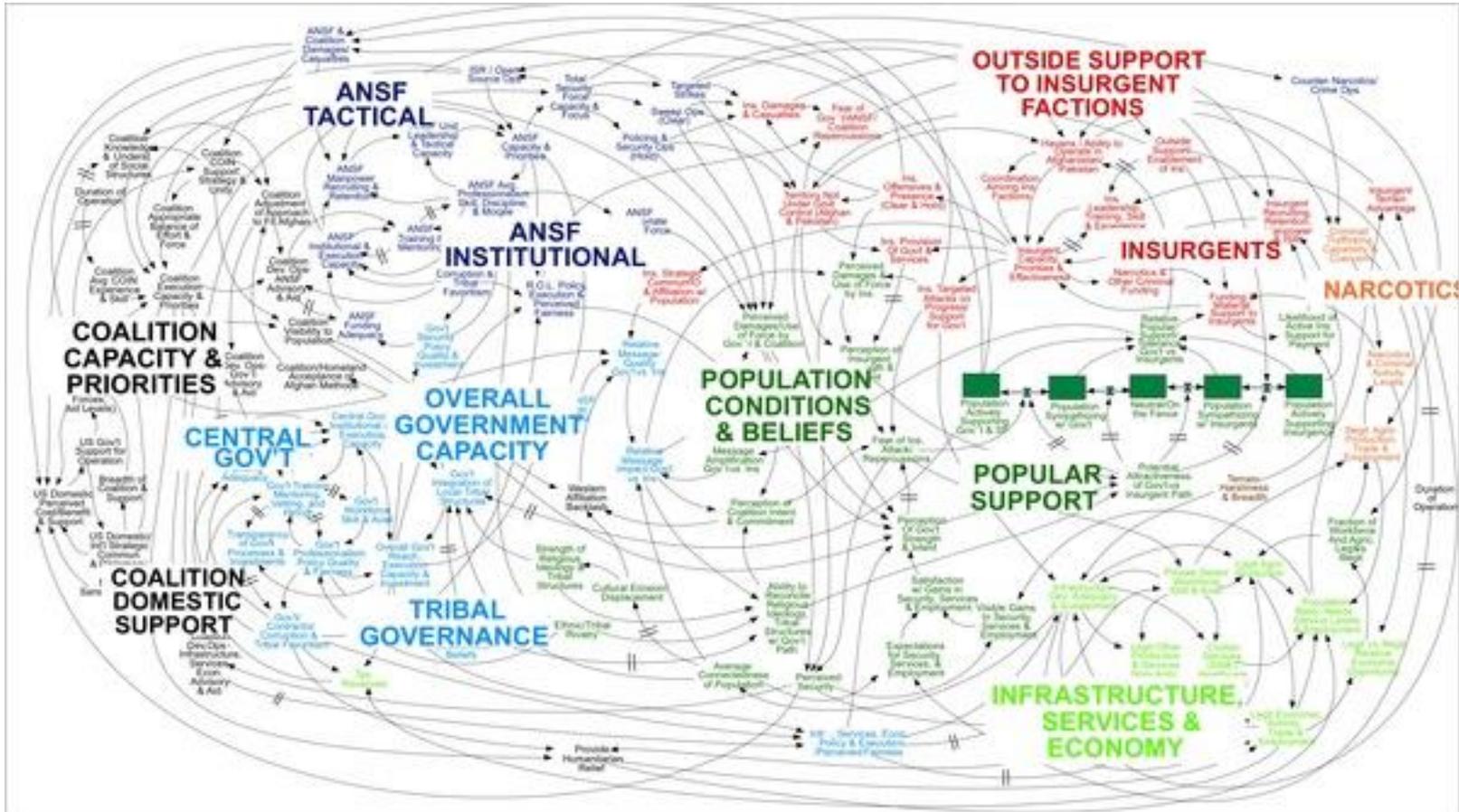
https://en.wikipedia.org/wiki/Edward_Tufte

Shared Experience



We Have Met the Enemy and He is PowerPoint

PowerPoint diagram to display the complexity of the American strategy in Afghanistan



<http://www.nytimes.com/2010/04/27/world/27powerpoint.html>

Make the Complicated...Simple

“Making the simple complicated is commonplace.

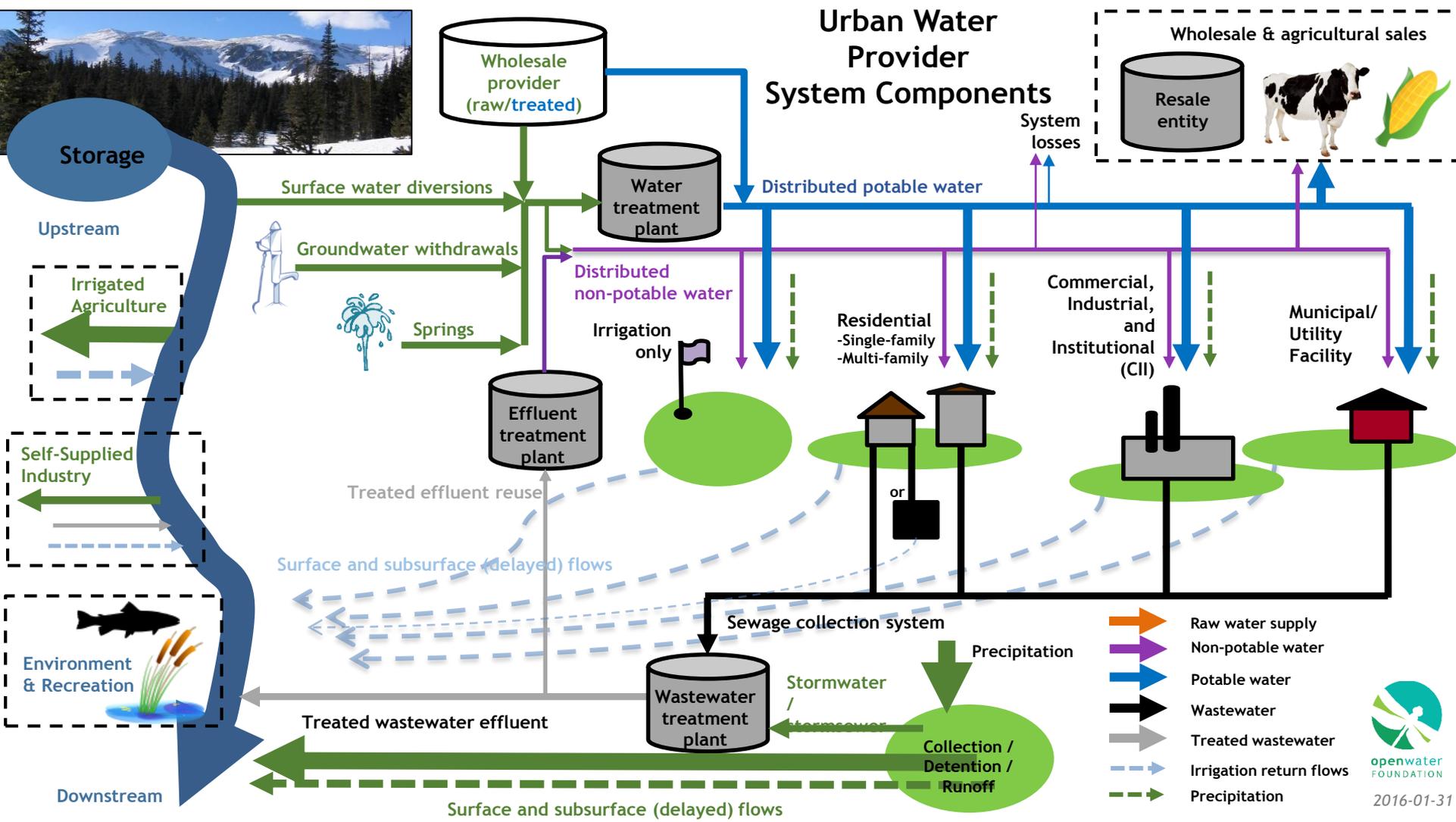
Making the complicated simple, awesomely simple, that’s creativity”

-Charles Mingus



https://en.wikiquote.org/wiki/Charles_Mingus

“What is urban water use efficiency?”

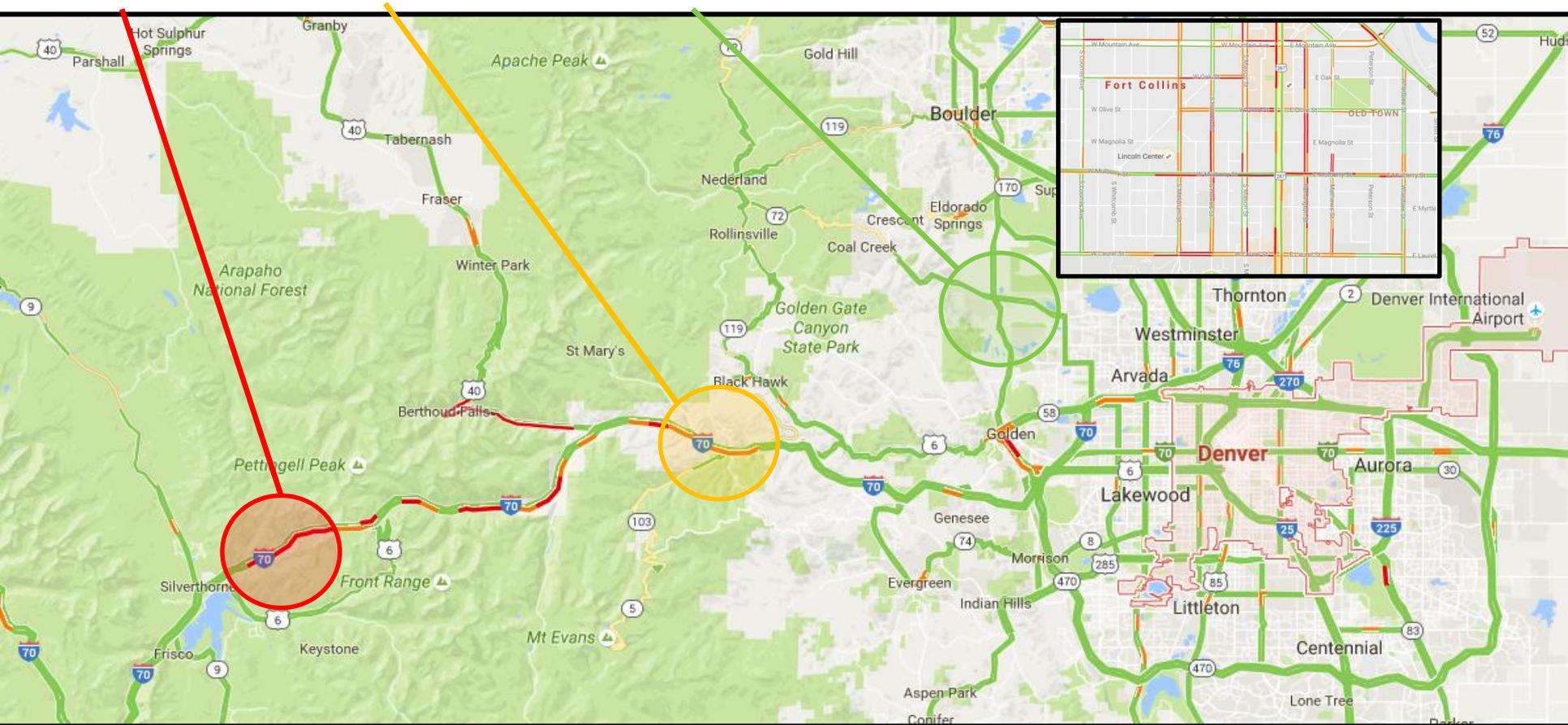


Open Data Definition

- **Accessible to all** - the data becomes accessible outside of the organization that generated or collected it
- **Machine-readable** - data must be usable, which means it must be made available in formats that are easily used by third-party applications
- **Free - zero or low costs** for data access and openness
- **Unrestricted rights to use** - data that is unencumbered by contractual or other restrictions leads to the maximum potential of innovation
 - “Generating Economic Value through Open Data” in “Beyond Transparency”

Democratization of Data: Google Traffic Map

Red=bad, orange=a little bad, green=OK, but need to understand context of “bad”



So how does Google do it? Smart phone crowdsourced data. Resolution to ~300 feet?.

People are now familiar with these types of products.

Can stream conditions be similarly visualized?

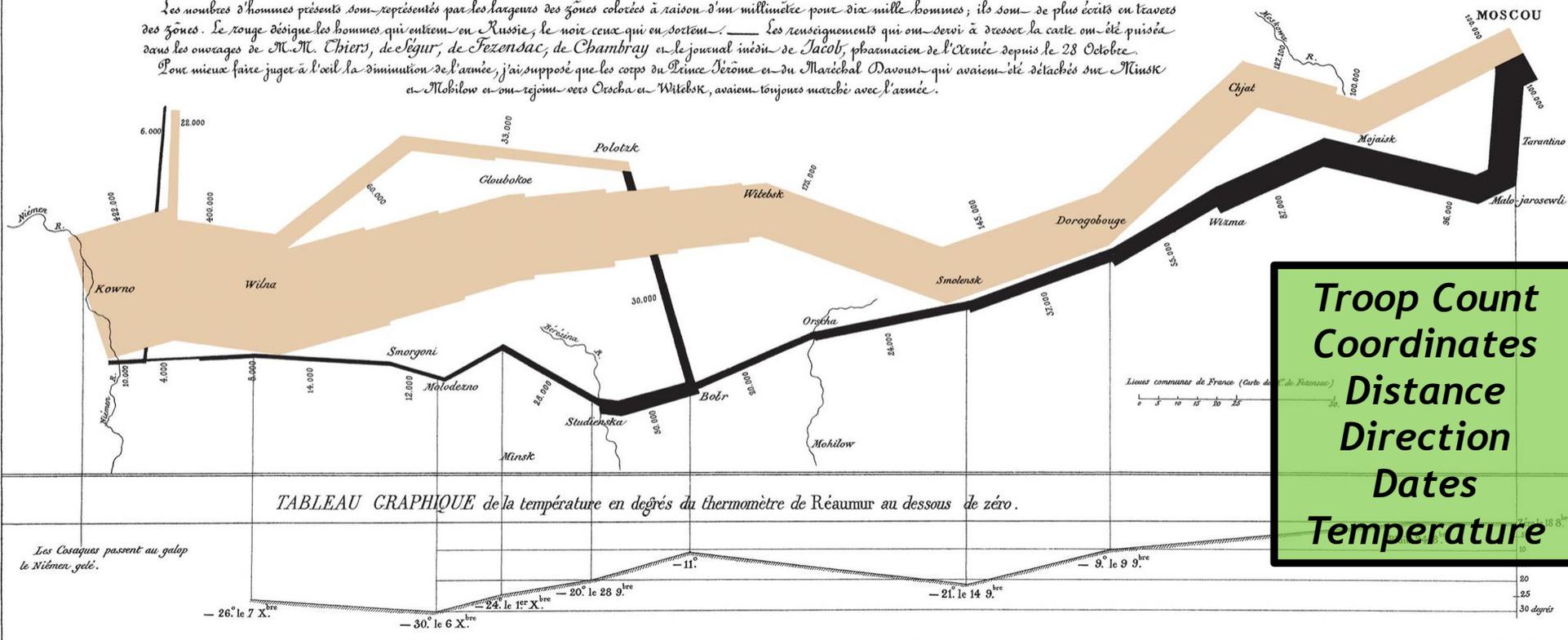
A Classic Data Visualization

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en traits de zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Légar, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mohilow et qui rejoignent vers Orscha et Witebsk, avaient toujours marché avec l'armée.



Troop Count
Coordinates
Distance
Direction
Dates
Temperature

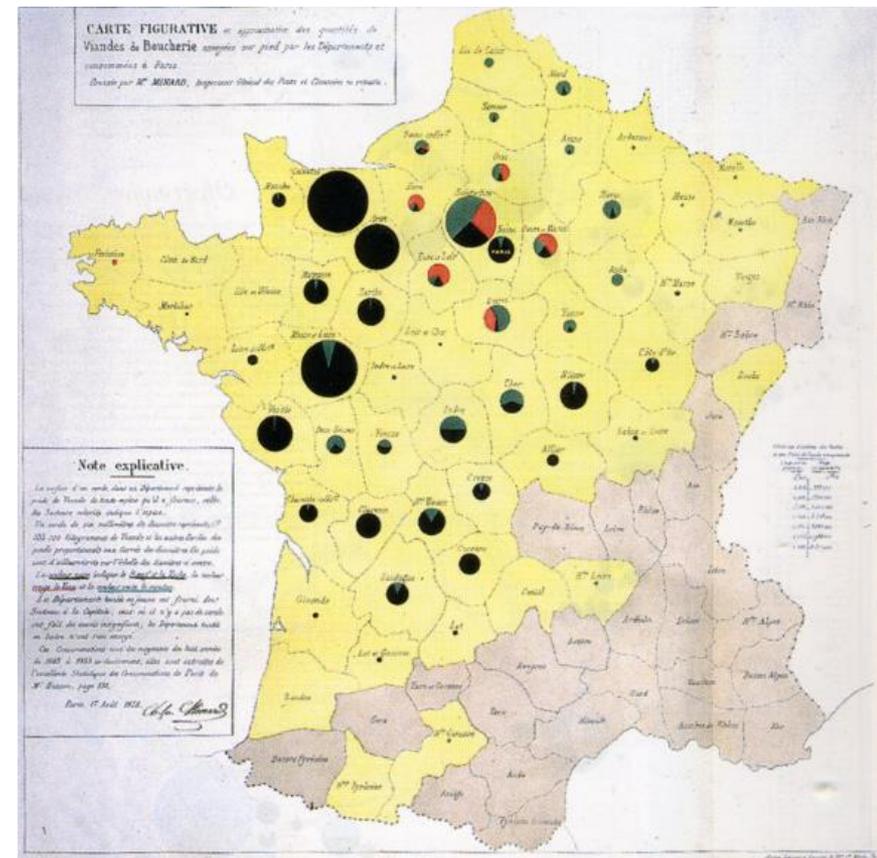
https://en.wikipedia.org/wiki/Charles_Joseph_Minard

Data Visualization



(1854) London Cholera outbreak

open water



(1858) Where does Paris get its beef?



Search

Clear All Options

View Types

- Data Lens pages What's this?
- Datasets
- Charts
- Maps
- Calendars
- Filtered Views
- External Datasets
- Files and Documents
- Forms
- APIs

Categories

- (All)
- Agriculture
- Business
- Demographics
- Economic Growth
- Education
- Water

Topics

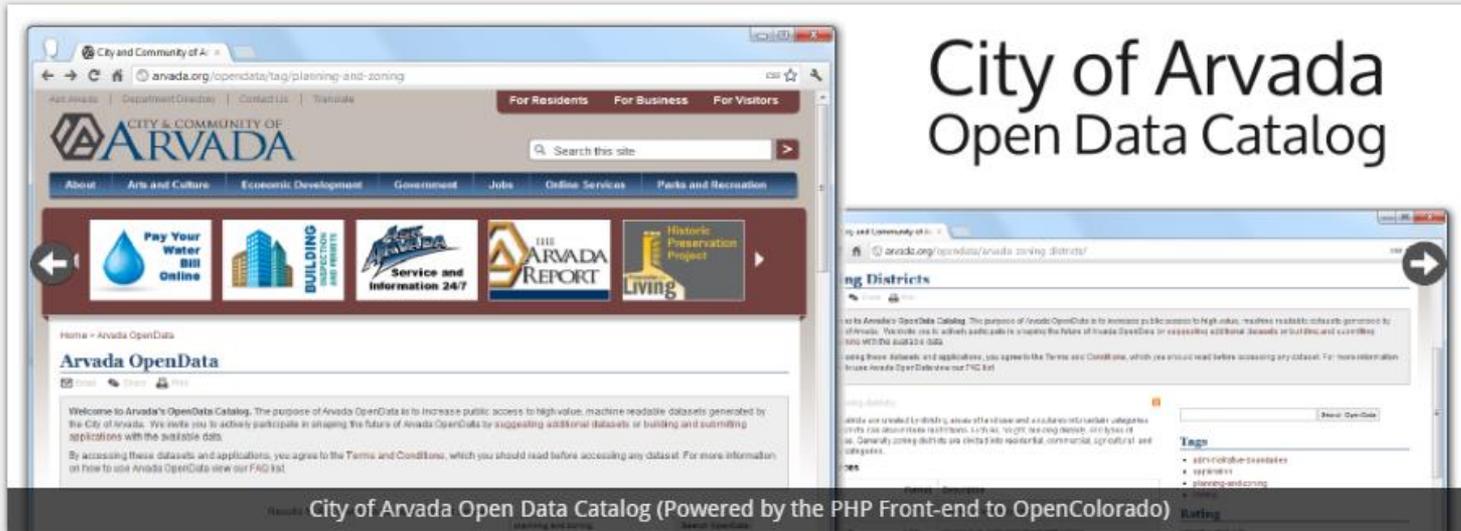
- 2013
- bic
- colorado
- gocode
- pueblo

Results matching category of Water

Most Relevant

	Name	Popularity	Type
1.	DWR Water Right Net Amounts Water water right, gocode A Water Right is a property right that is either conditional or	3,164 views	
2.	DWR Well Application Permit Water well, application, permit, gocode All well applications and permits issued.	2,406 views	
3.	DWR Water Right Transactions Water water right, gocode A Water Right is a property right that is either conditional or	1,575 views	
4.	DWR Administrative Structures Water ditch, headgate, reservoir, well, gocode Contains physical, manmade structures used for diverting, storing, releasing, or measuring water; struct	1,520 views	
5.	DWR Current Surface Water Conditions Map (Statewide) Water Current streamflow conditions	1,456 views	
6.	DWR Active Calls Water river administration, river call, gocode Division of Water Resources (DWR) Active Calls. The Call is a term used by the state engineer to effectivel	1,358 views	
7.	DWR Current Surface Water Conditions Water streamflows, current conditions, gocode Division of Water Resources (DWR) Current Surface Water Conditions. This is a list of all remote monitore	1,268 views	
8.	DWR Calls History Water administrative call, gocode Division of Water Resources (DWR) Call History. The Call is a term used by the state engineer to effectivel	1,316 views	
9.	DWR Well Water Level Water well, water level, level, gocode Water Level wells with the State of Colorado along with their last known water level.	1,295 views	

“dataset” = often a table or map layer



i About OpenColorado

Our vision is to support a transformation that will lead to a simple, beautiful, and easy-to-use government. We founded OpenColorado to achieve this new, more effective, and open government.

This site provides access to a [wealth of government data](#) becoming available from participating jurisdictions.

[Learn more →](#)

u About Us

Who are we? We are people like you - government employees, concerned citizens, journalists, programmers, elected officials, vendors, and techies - that are interested in transforming Colorado government. We encourage you to join the community.

[Learn more →](#)

g Data Publishing Guide

OpenColorado provides a data sharing platform that allows Colorado government organizations to make public data available and accessible to all Colorado constituents.

To begin publishing data, consult our [data publishing guide](#).

[Learn more →](#)

Use Annotations for Context

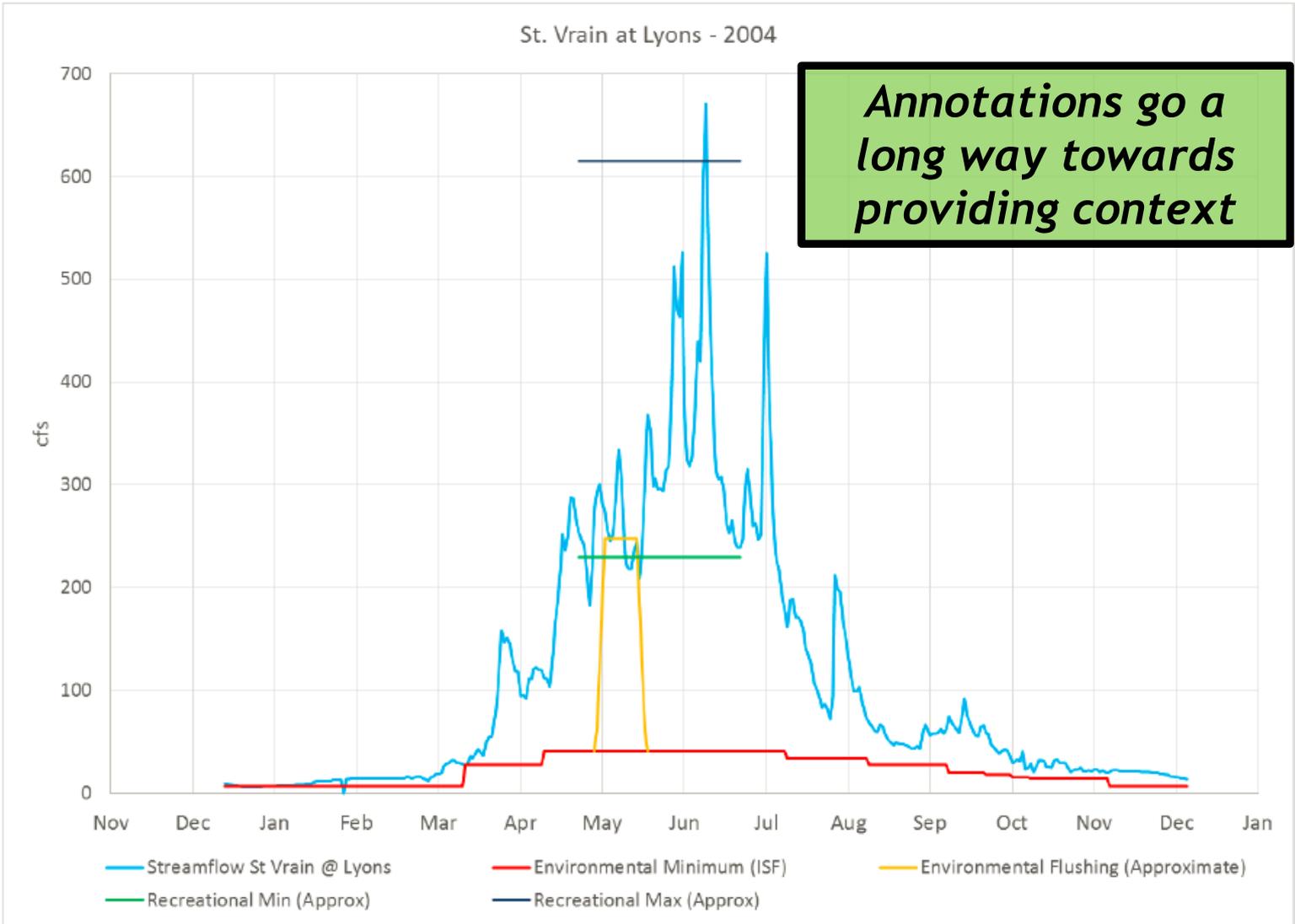
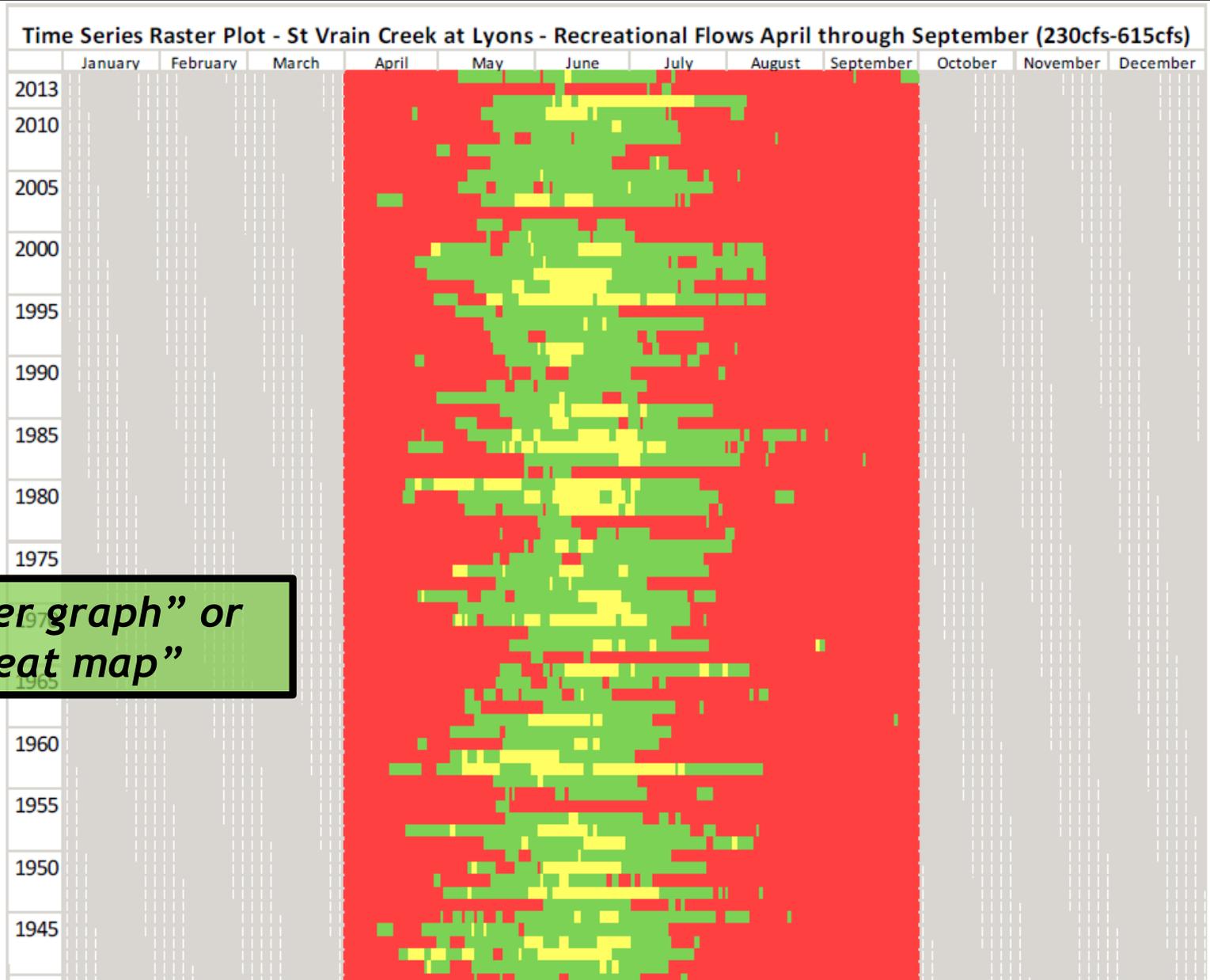


Figure 4-9 - Hydrograph comparison to available environmental and recreational flow information - 2004

Analytics Example

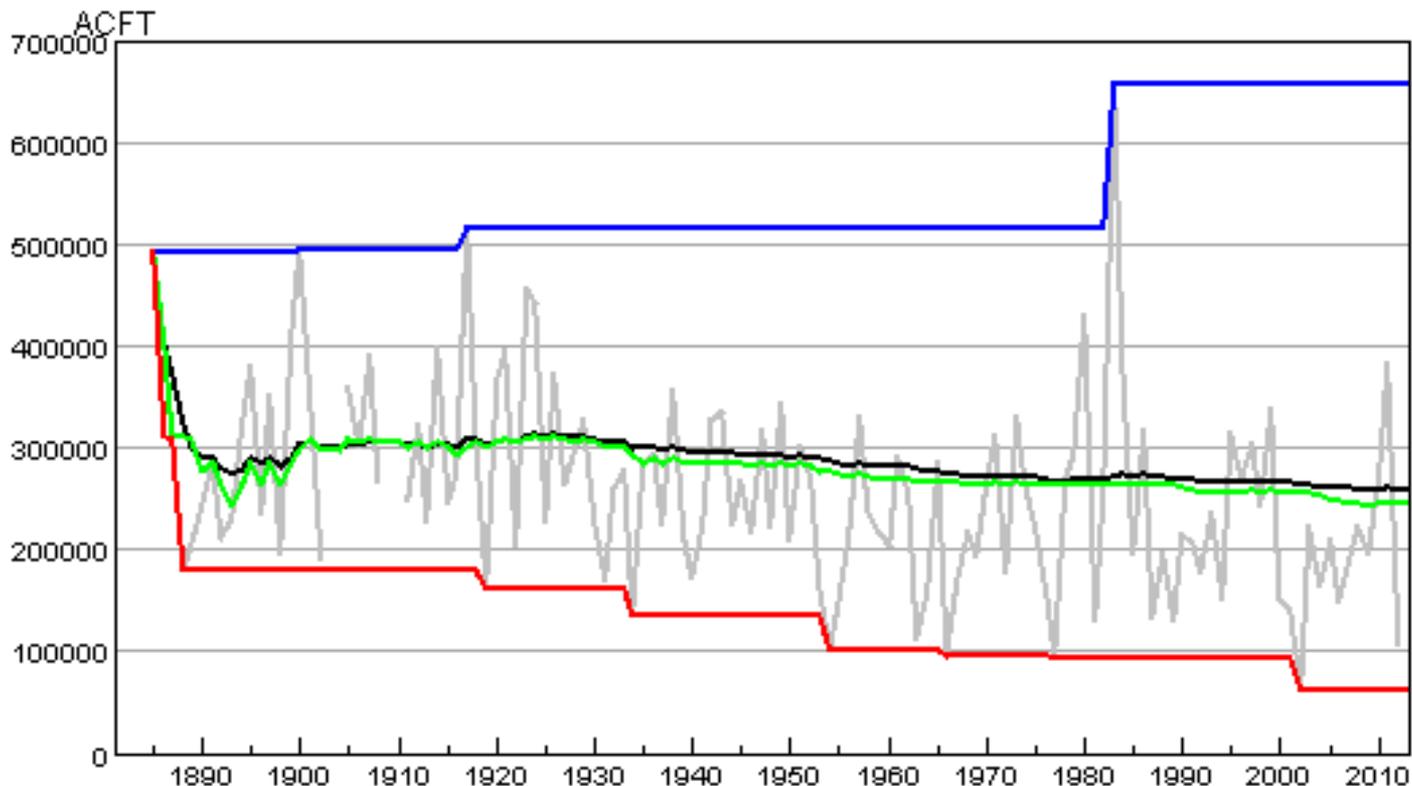


*“raster graph” or
“heat map”*

Analytics Example

Cache La Poudre River at Mouth of Canyon

Running Statistics (use all previous values)

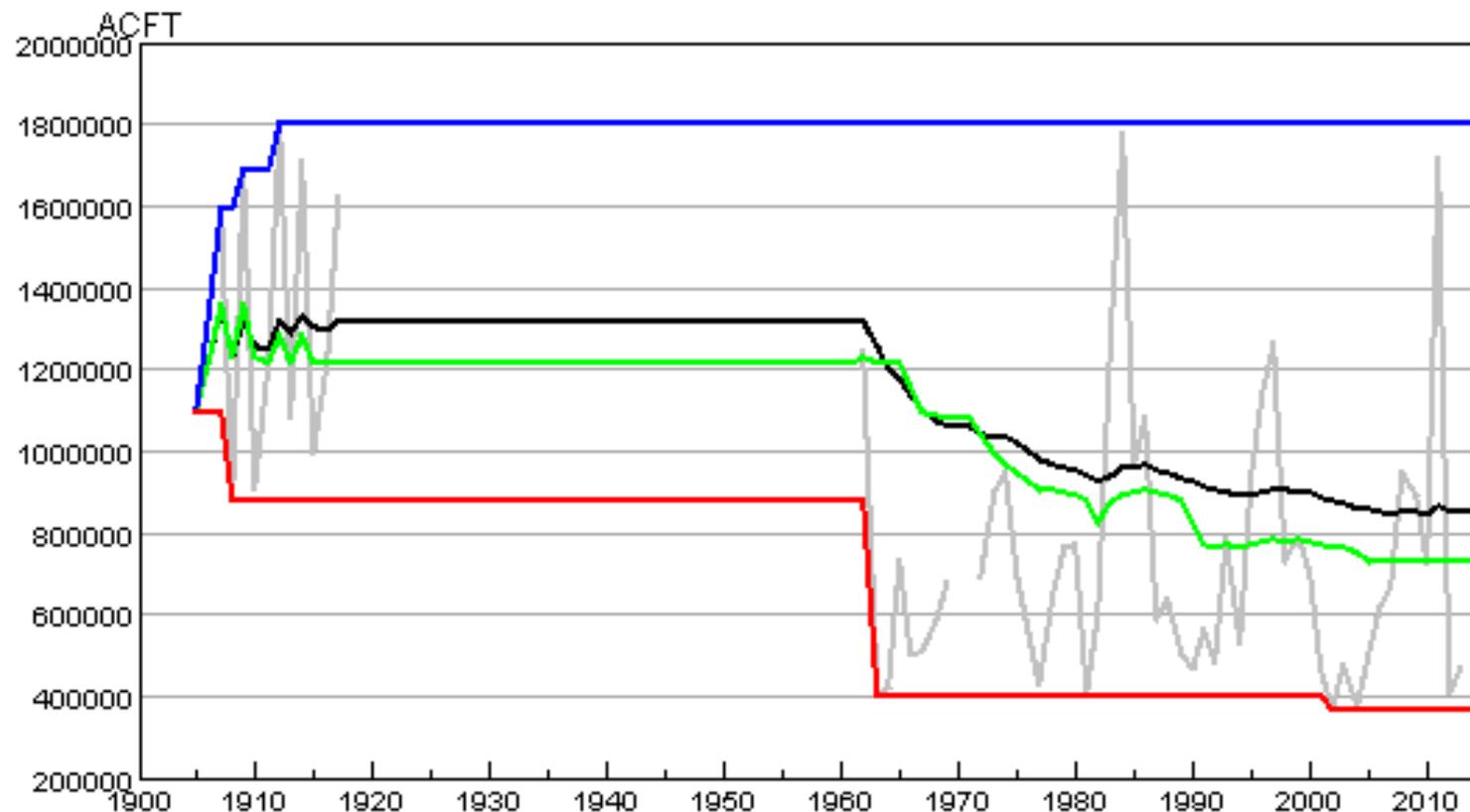


- 06752000-Streamflow-Year - CACHE LA POUFRE RIV AT MO OF CN, NR FT COLLINS, CO, 06752000.DWR.Streamflow.
- 06752000-Streamflow-Year-Mean - CACHE LA POUFRE RIV AT MO OF CN, NR FT COLLINS, CO, NAll-year run stat, 067
- 06752000-Streamflow-Year-Median - CACHE LA POUFRE RIV AT MO OF CN, NR FT COLLINS, CO, NAll-year run stat, 01
- 06752000-Streamflow-Year-Max - CACHE LA POUFRE RIV AT MO OF CN, NR FT COLLINS, CO, NAll-year run stat, 0675
- 06752000-Streamflow-Year-Min - CACHE LA POUFRE RIV AT MO OF CN, NR FT COLLINS, CO, NAll-year run stat, 0675:

Analytics Example

Colorado River Near Kremmling

Running Statistics (use all previous annual values)



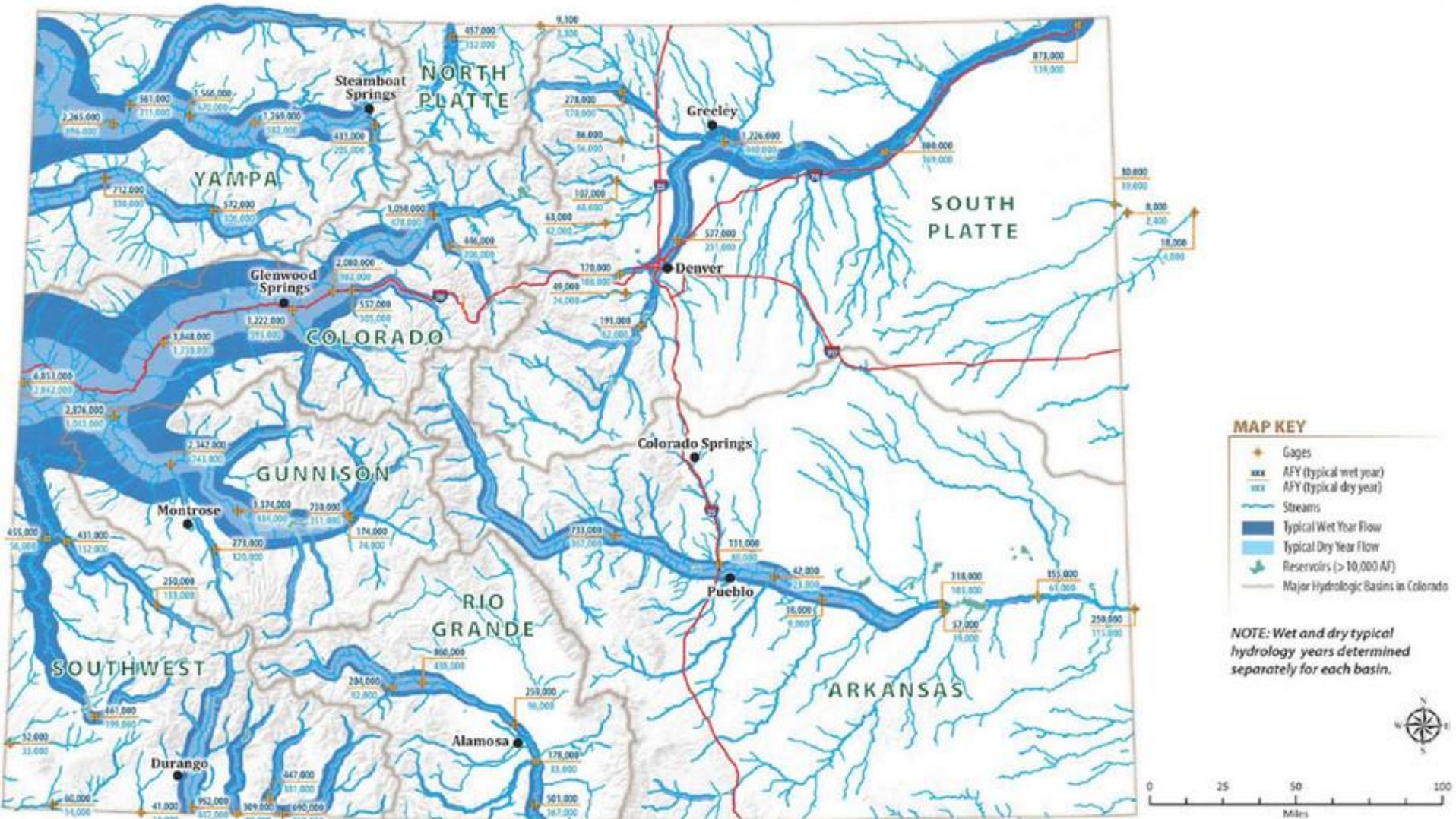
- 09058000-Streamflow+Year - COLORADO RIVER NEAR KREMMLING, CO, 09058000.USGS.00060-00003.Year (1900 to
- 09058000-Streamflow+Year-Mean - COLORADO RIVER NEAR KREMMLING, CO, NAll-year run stat, 09058000.USGS.000
- 09058000-Streamflow+Year-Median - COLORADO RIVER NEAR KREMMLING, CO, NAll-year run stat, 09058000.USGS.0
- 09058000-Streamflow+Year-Max - COLORADO RIVER NEAR KREMMLING, CO, NAll-year run stat, 09058000.USGS.000E
- 09058000-Streamflow+Year-Min - COLORADO RIVER NEAR KREMMLING, CO, NAll-year run stat, 09058000.USGS.000B

Water is on the West, People on the East

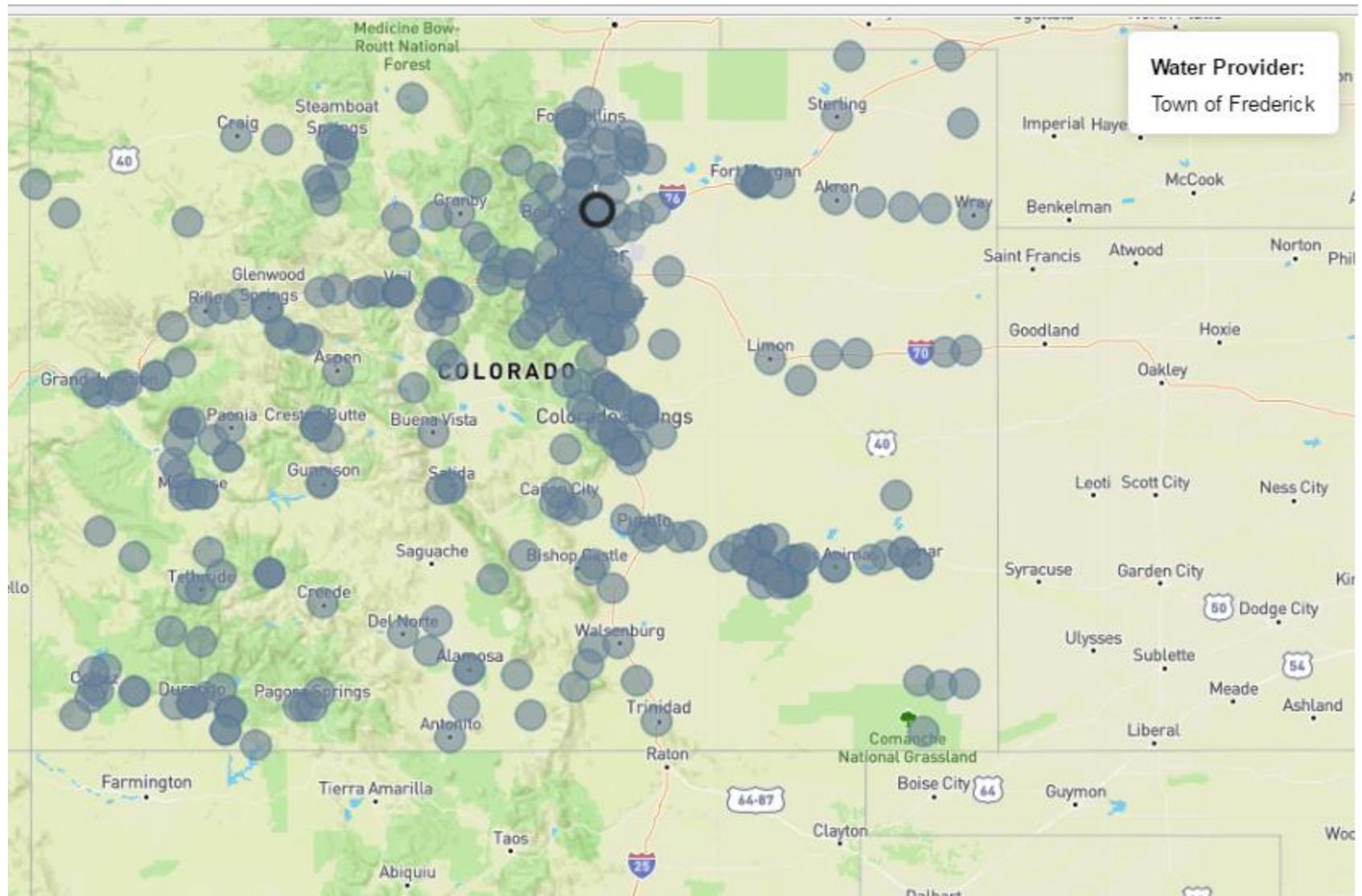
DRAFT

STATEWIDE

Summary of Observed Wet & Dry Surface Water Hydrology

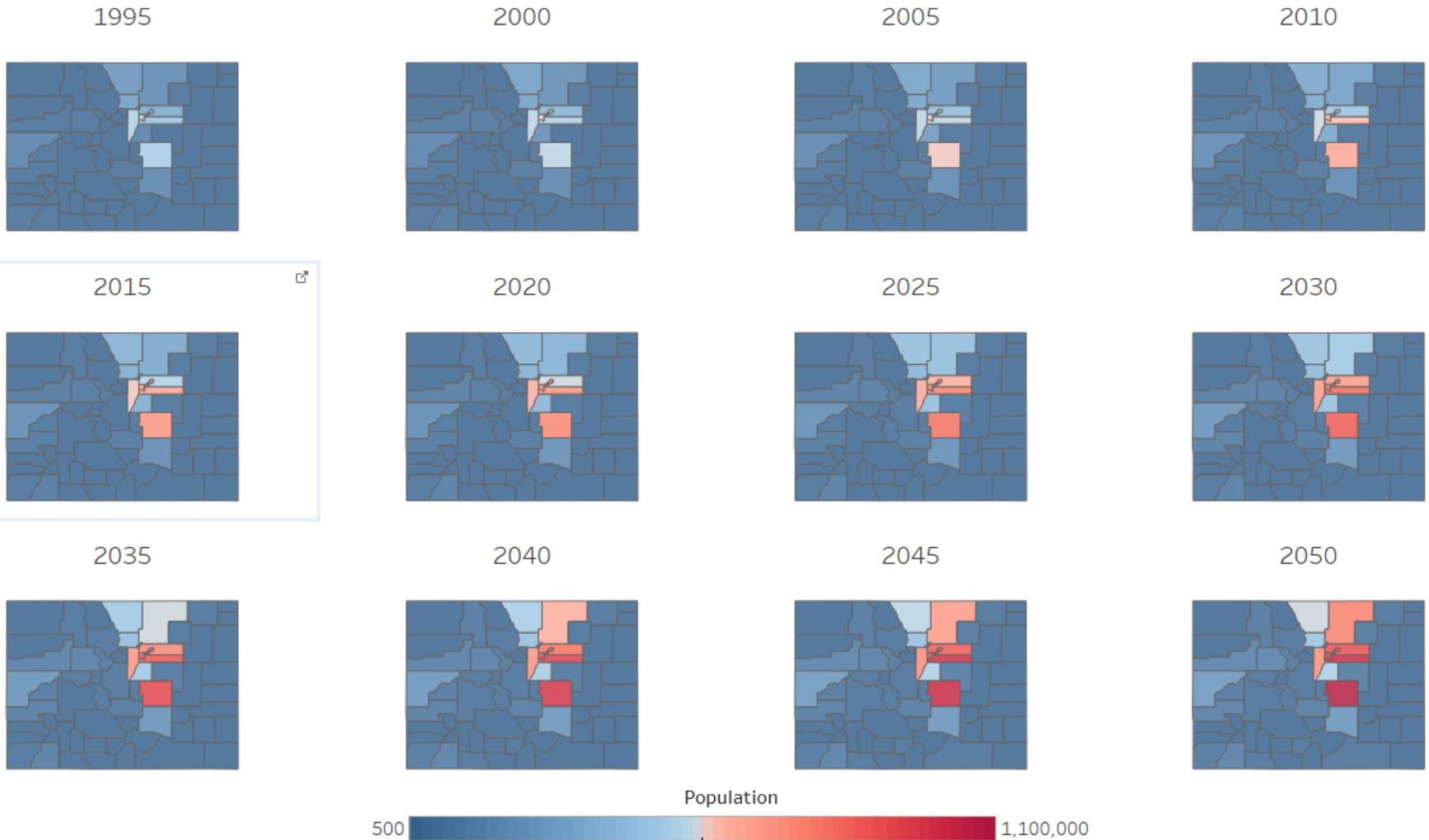


Water Use: Municipal Providers

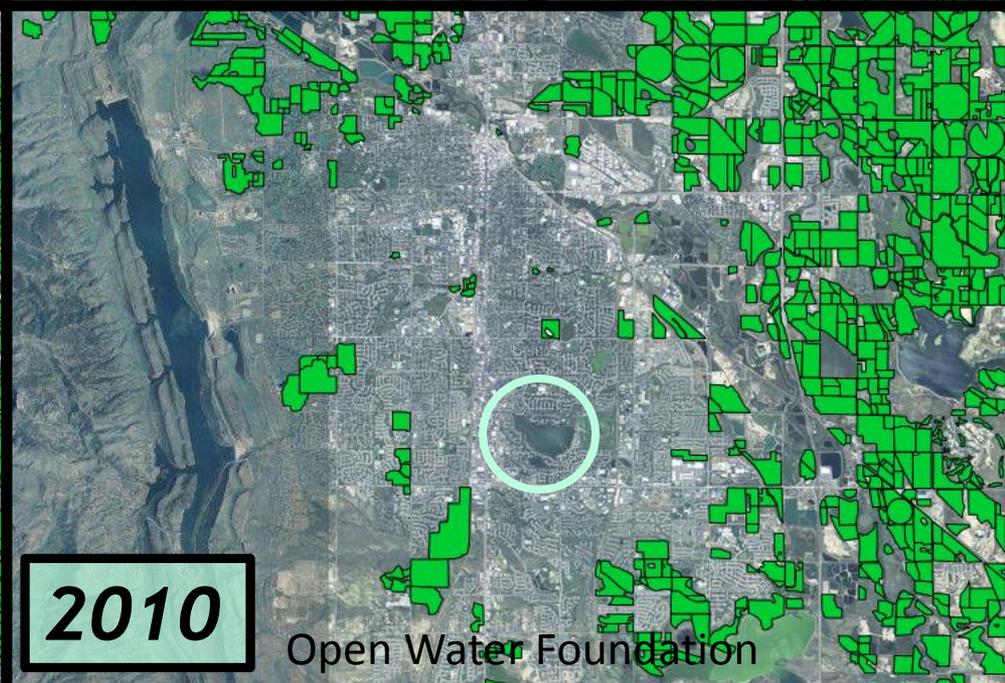
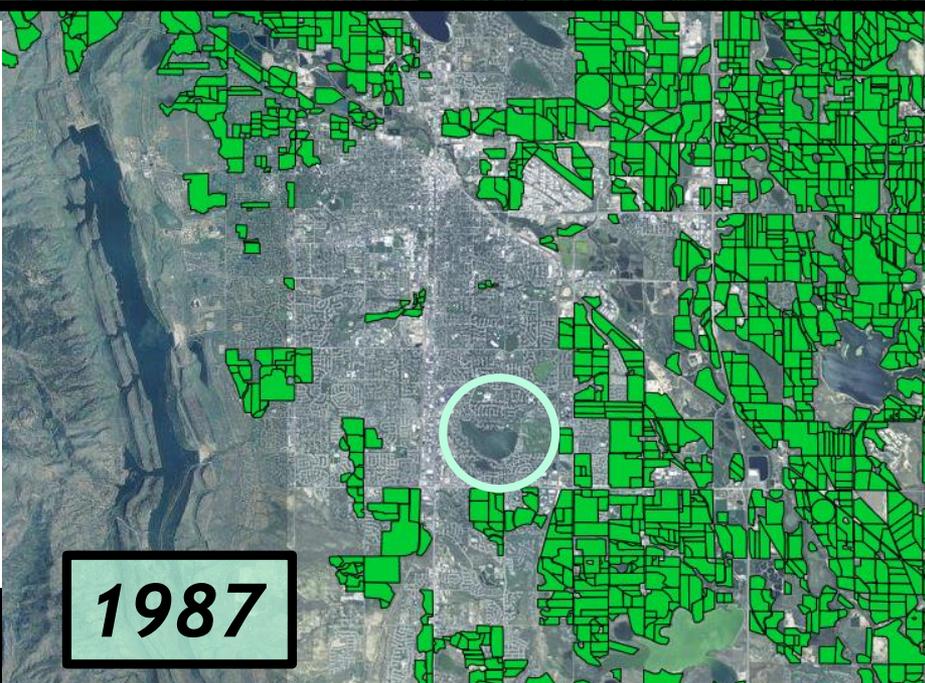
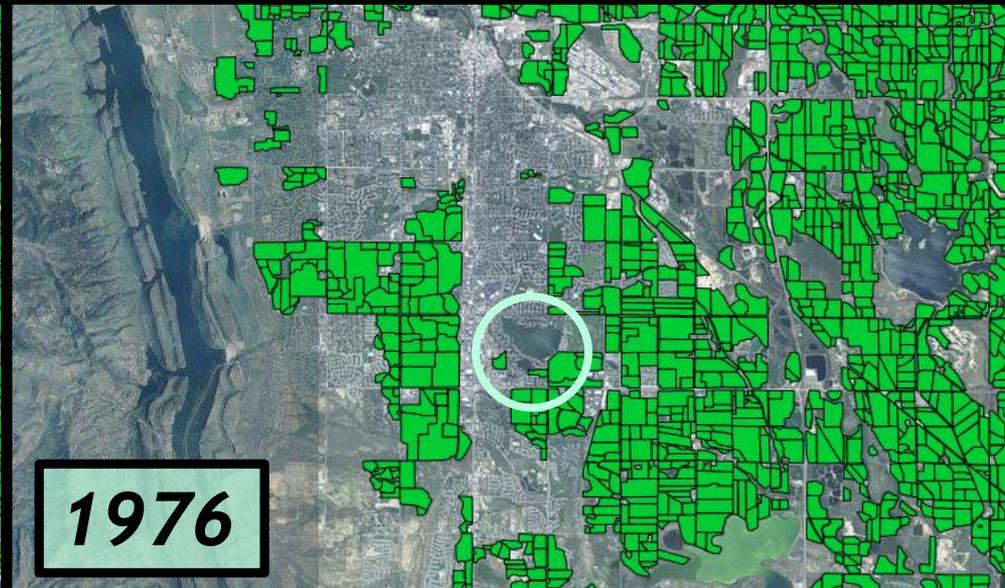
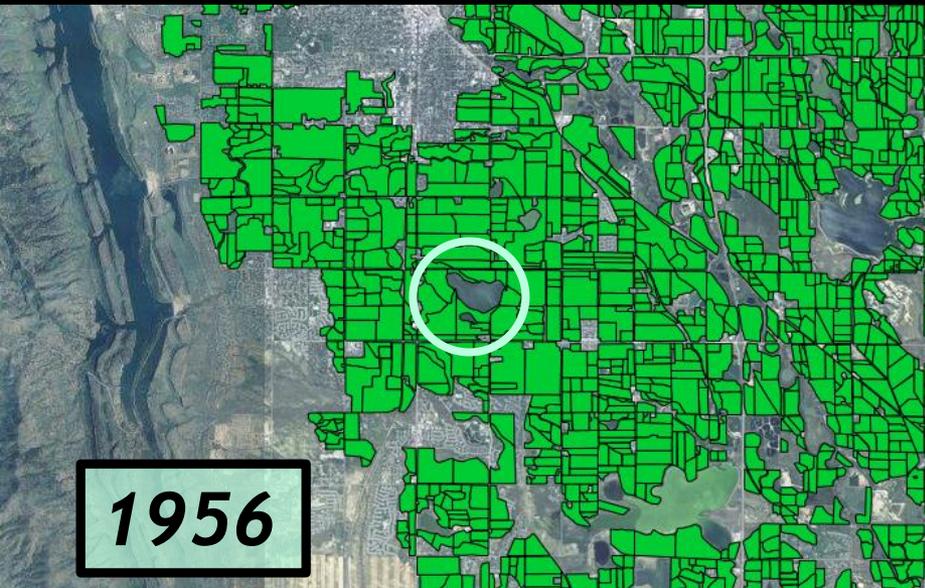


County Population Change

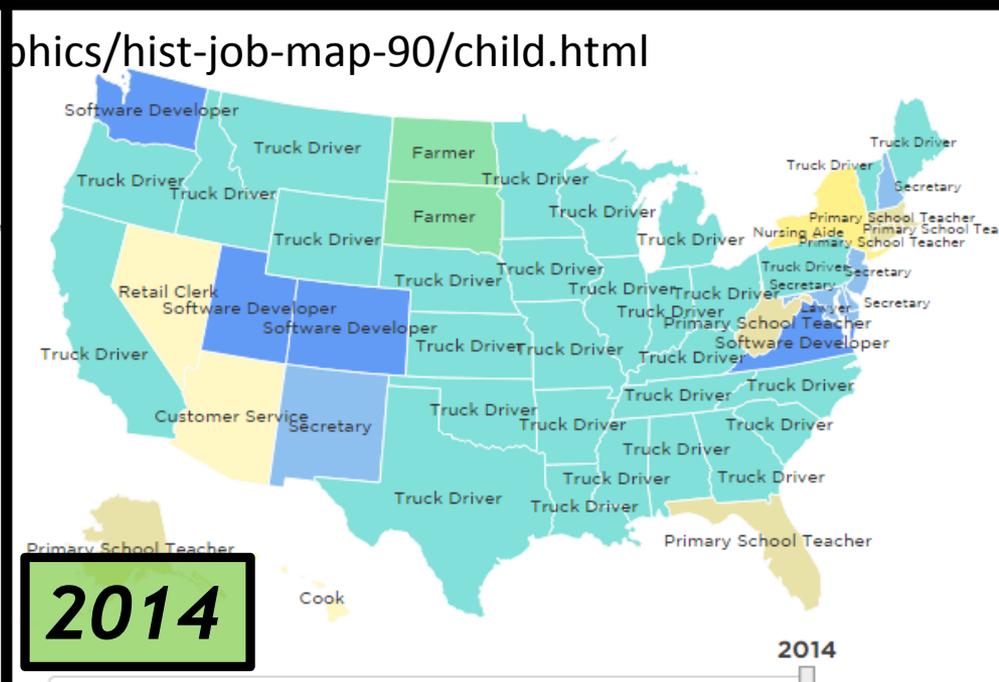
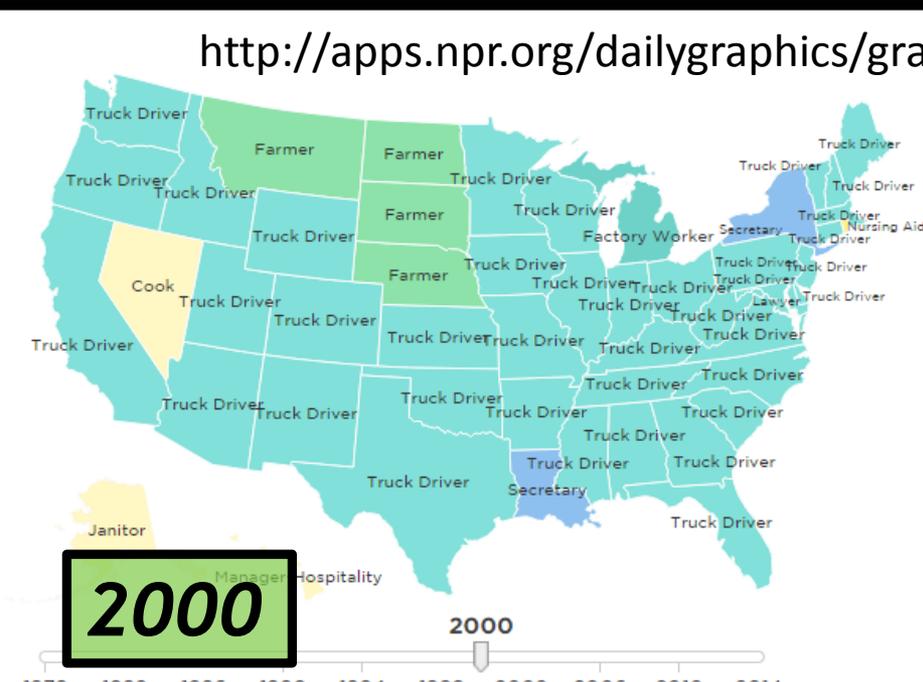
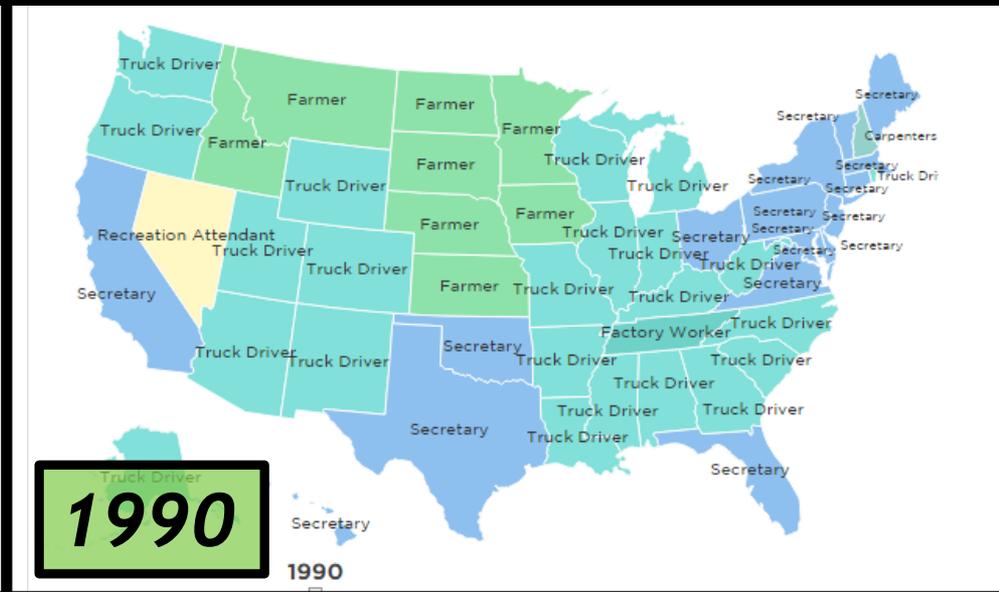
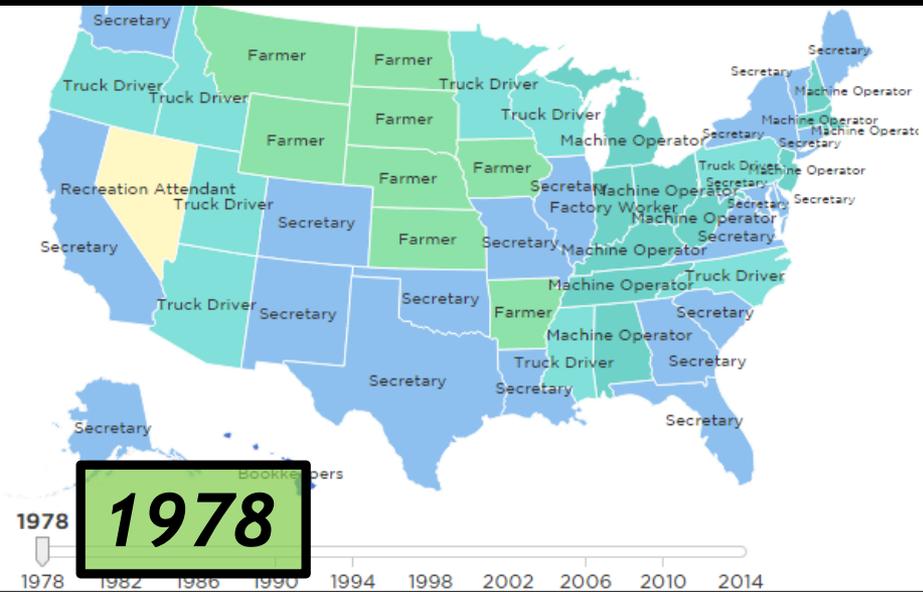
County Population



Irrigated Agriculture Dry Up



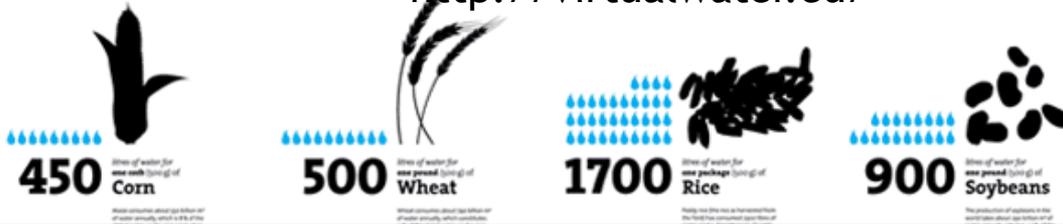
The Most Common Jobs in Each State



<http://apps.npr.org/dailygraphics/graphics/hist-job-map-90/child.html>

Virtual Water / Water Footprint

<http://virtualwater.eu/>

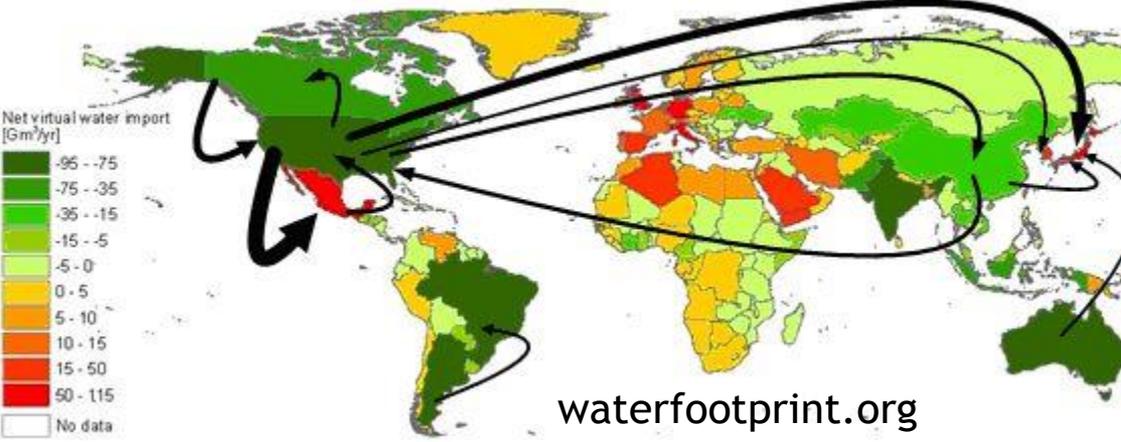


http://pacinst.org/wp-content/uploads/2013/02/ca_ftprint_full_report3.pdf



Why beef is the new SUV

<http://www.cnn.com/2015/09/29/opinions/sutter-beef-suv-climate-two-degrees/>



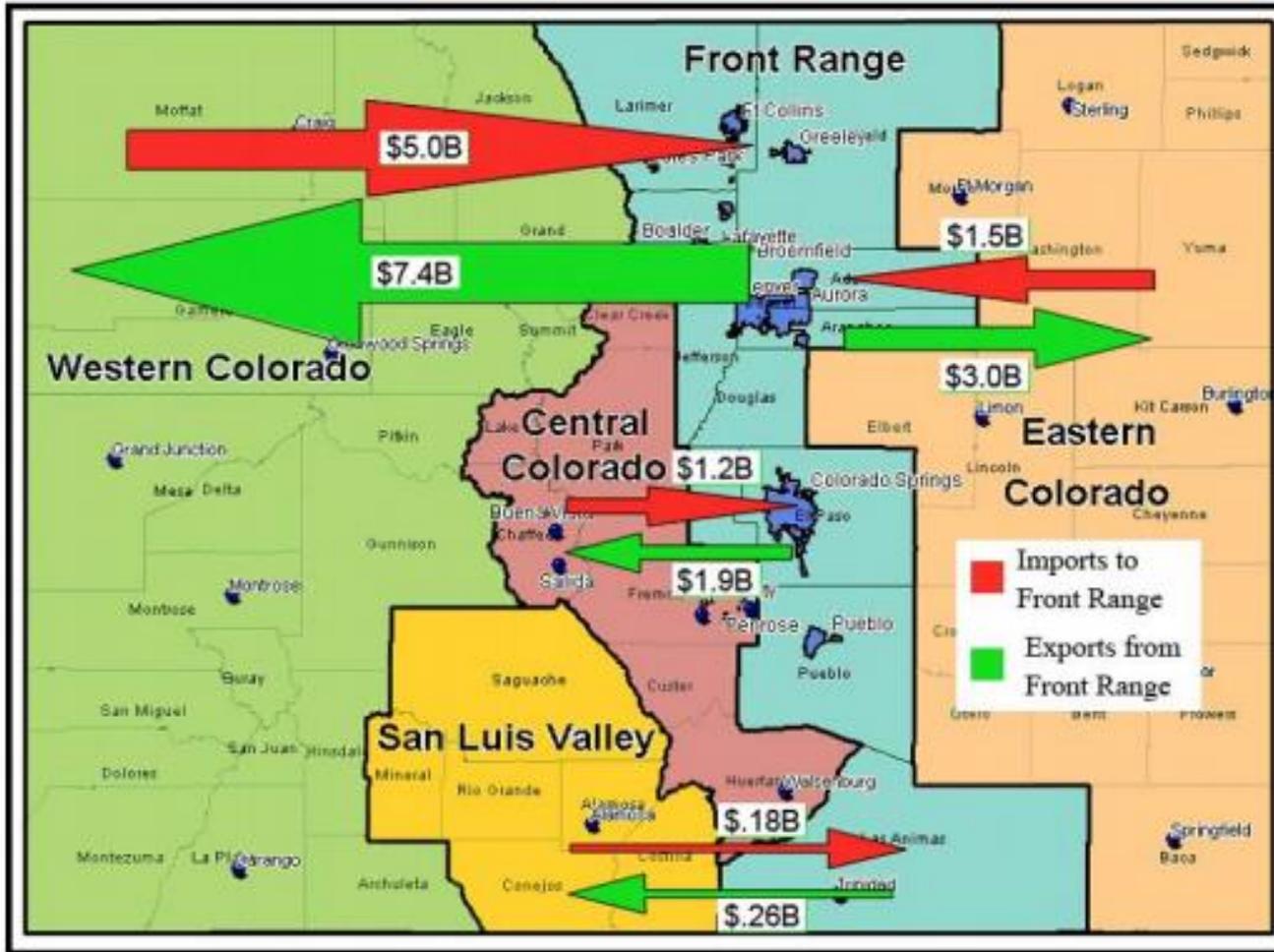
California's Water Footprint

Julian Fulton, Heather Cooley, and Peter H. Gleick

December 2012

Colorado Water Economy

Front Range Trade Flows



“Water and the Colorado Economy”, Front Range Water Council, 2009

Source: MIG, Summit/Adams

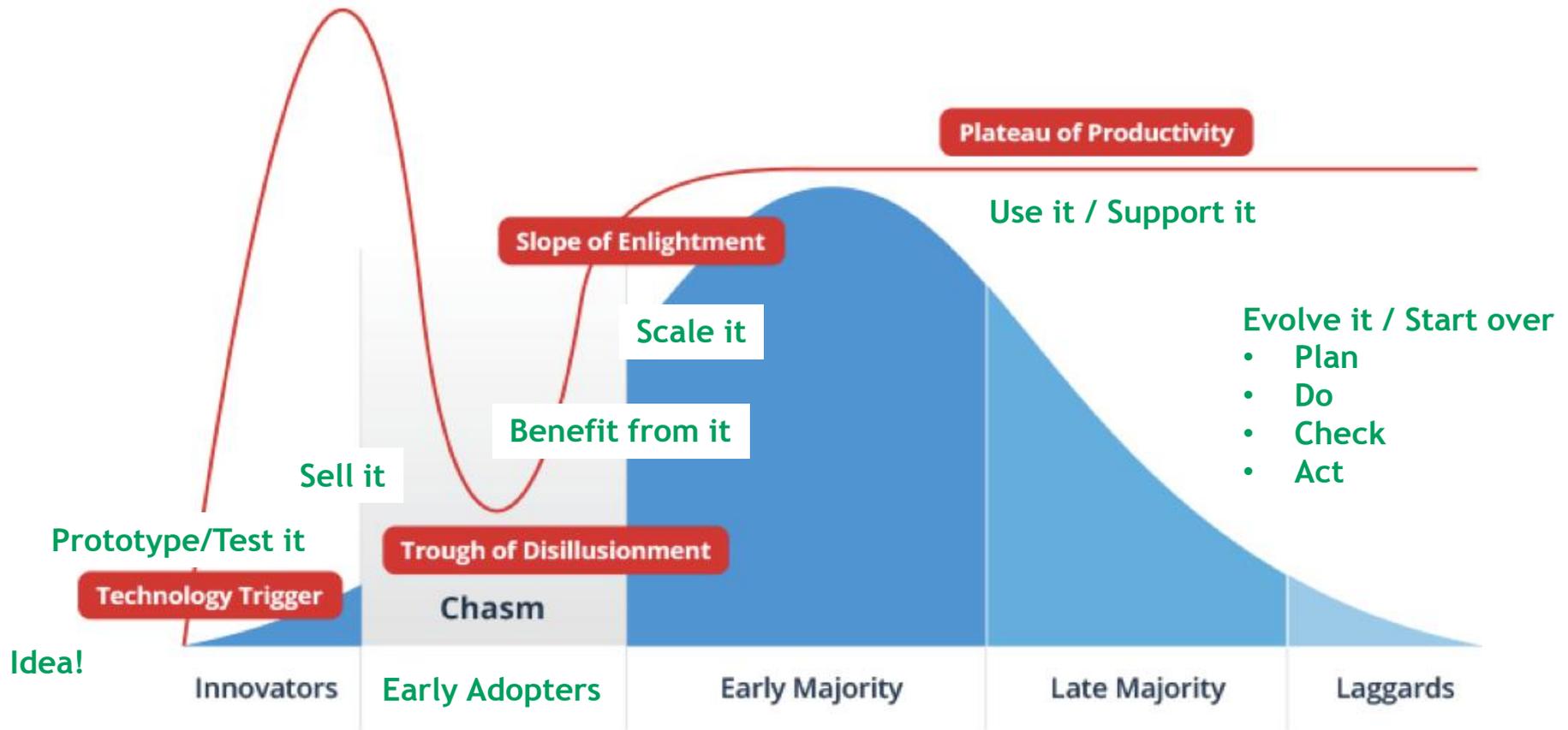
http://www.denverwater.org/docs/assets/4bea7503-0237-e833-64a3f4c3447f588c/frwc_econ_report.pdf

What We Need (IMHO)

- Systems thinkers
- Hackers (not crackers) that can do more than write code
- Communicators
- People and organizations that deal with the difficult problems
- Risk takers with a vision of positive impact
- Leaders that do the right things and do things right

Diffusion of Innovation

Crossing the Chasm (Geoffrey Moore)



<http://www.datameer.com/blog/big-data-analytics-perspectives/big-data-crossing-the-chasm-in-2013.html>

http://en.wikipedia.org/wiki/Crossing_the_Chasm

Questions

How important is transparency?

What limits should there be to transparency?

Questions

With the prevalence of technologies in our lives...

Should we be less knowledgeable about tech/STEM because our work is done for us?

Should we more knowledgeable about tech/STEM because technologies and science are the tools for the work we do?

Questions

What is the role of ethics in science? politics?

Should our elected officials let scientists do their work independently or influence science through politics?

What should scientists do to ensure that science is valued and utilized? Should they advocate more?

What role do technologies and technologists play?

Questions

As students, what impact can you have?

What is holding you back?

What questions do you have about your future options?

Share It

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open data | open software | open decisions

openwaterfoundation.org