



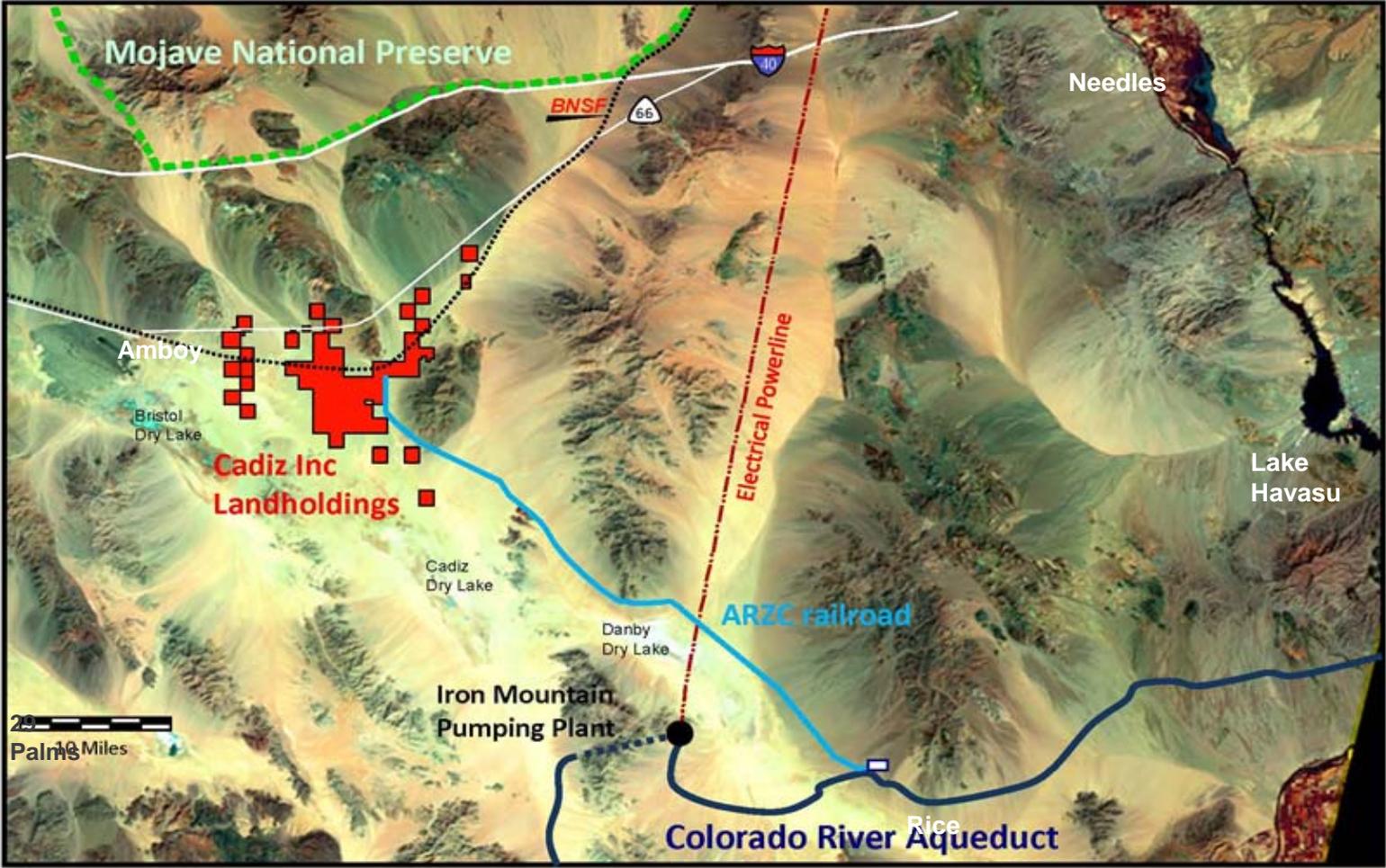
Cadiz Valley Water Conservation,  
Recovery and Storage Project

**PROJECT OVERVIEW AND UPDATE**  
**May 2012**



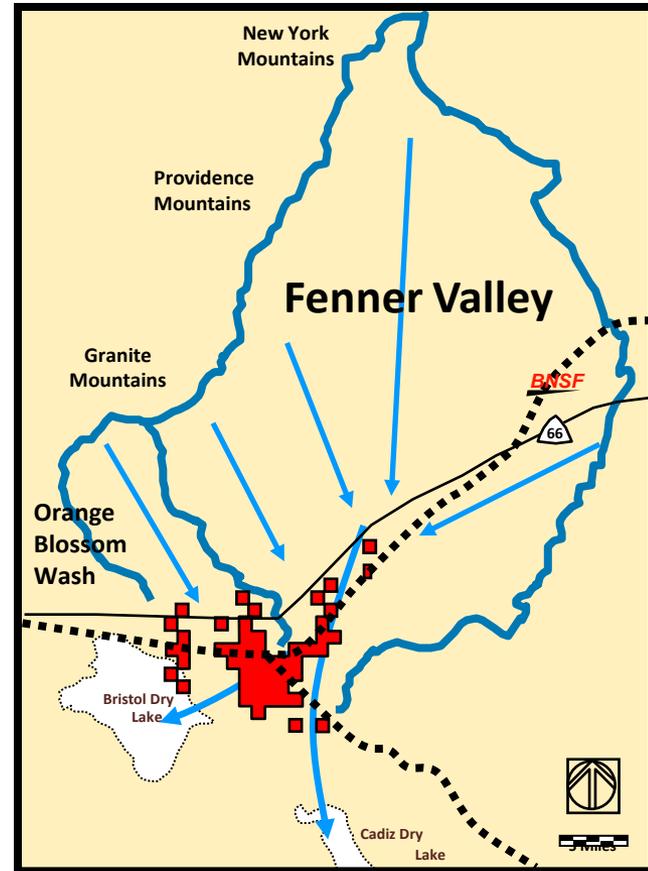
Always There™

# Project Area



## The Cadiz Valley Water Resource

- 1,300 sq. mile watershed.
- Approximately 20 million acre-feet (AF) of water in storage in the alluvial aquifers.
- Estimated average natural recharge is 32,500 AF per year (AF/Y).
- Millions of AF will naturally flow to the dry lakes and be lost to evaporation over the next 100 years.



## Dry Lakes at Base of Watershed



**Dry Lake Crust**

## Dry Lakes at Base of Watershed



**Beneath the Dry Lake Surface**

## Project Description

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### PHASE I - Conservation & Recovery Component

- Construct expanded wellfield on Cadiz Inc. property.
- Construct 43-mile pipeline within existing active railroad ROW.
- Annual average of 50,000 AF/Y conveyed to CRA over 50-year project term. (CEQA Review)

### PHASE II – Imported Water Storage Component

- Construct recharge basins on Cadiz Inc. property.
- Convey imported water to recharge basins for storage.
- Return up to 105,000 AF/Y of previously recharged water.  
to CRA when needed by agencies. (Additional CEQA Review)

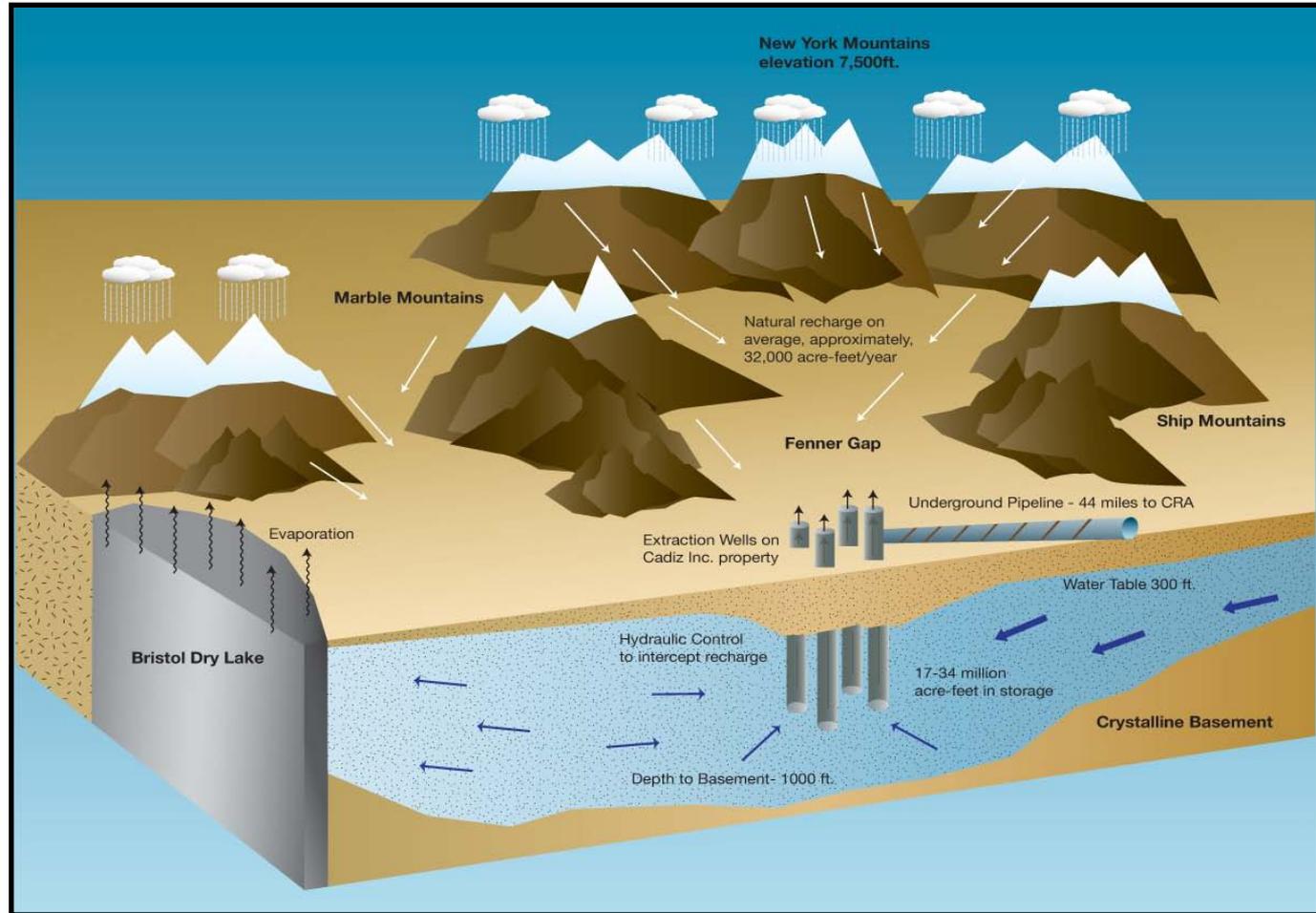
## Project Relationships

- Project Participants: Santa Margarita Water District; Three Valleys Municipal Water District; Jurupa Community Services District; Golden State Water Company; Suburban Water Systems and California Water Service Company.
- Participants have signed option agreements and environmental cost sharing agreements with Cadiz Inc.
- SMWD is Lead Agency for the CEQA environmental review process.
- San Bernardino County, and other public agencies including Project participants, are Responsible Agencies in CEQA process.
- Arizona & California Railroad would use Project water for fire suppression and other railroad uses, obtain power and access rights.



## How It Works – Capture Water Before It Evaporates

- Change water levels in Cadiz wellfield to establish hydraulic barrier to outflow.
- Wells will intercept natural recharge and retrieve groundwater already in storage before it can evaporate.
- Conserved water pumped through underground pipeline to CRA.
- MWD exchange for delivery to retail agencies.



## What's Different - 2001 v. 2012?

FEATURE	2001	2012
Pipeline Capacity	150,000 AFY	75,000 AFY
Cap on Production of Native Groundwater	None	50,000 AFY Average
Storage of Imported Water	Up to 1,000,000 AFY	Deferred to Phase II
Pipeline Route	Open Federal Land to CRA	Disturbed Land, Active Railroad Right-of-Way to CRA
Alternative Pipeline and Source of Supply for Storage	None	Connection to SWP Deferred to Phase II Evaluation
Participants	MWD	Public Water systems and ARZC Railroad
Operator	MWD	Non-Profit Mutual Water Company
Potential Intentionally Created Surplus Credits	None	2,500,000 AF

## Groundwater Stewardship Committee

- In March 2011, a Groundwater Stewardship Committee (GSC) was formed to guide the design of the groundwater monitoring, mitigation and management plan and peer review technical work;
- GSC comprised of highly-respected members from diverse fields, including industry professionals, regulatory officials, academics, and non-governmental organizations.
- Prior to issuance of the DEIR, the GSC reviewed the scientific and technical reports for the Project.
- This review indicates the Project offers a new reliable water supply to the Southern California region and avoids environmental harm.
- Recommendations for specific monitoring and mitigation measures were incorporated into the Project's state-of-the-art groundwater protection plan.

*GSC site visit March 2011*

## Why Private Sector Involvement in Water?

- The Cadiz Project presents a model public-private partnership opportunity in a highly regulated environment:
  - Cadiz land ownership and resource development with public water system owners and operators.
- Private investment risked millions in acquiring 50 square miles of land, capital expenditures on the evaluation and testing of the resource *in advance* of any formal public, rate-payer commitments.

## Legal Framework

- Article X, Section 2 of the California Constitution
- Conjunctive Use: “it is the policy of this state to encourage conjunctive use of surface water and groundwater supplies...” (Water Code, § 1011.5.)
- The safe yield of an aquifer as the amount of water that can be withdrawn *without an undesirable result*. (*City of Los Angeles v. City of San Fernando*.)
- Colorado River Intentionally Created Surplus Credits
- San Bernardino County Groundwater Management Ordinance

## **Science: Cadiz Inc. has invested more than \$7 million since 2009**

**Comprehensive studies measuring the vast scale and productivity of the aquifer system at the Project area by CH2M HILL in July 2010.**

- 32,500 AFY Recharge
- 2008 USGS INFIL 3.0 Watershed Soil Moisture Budget Model.

### **Peer reviews of CH2M HILL work by experts:**

- Dr. Jack Sharp - PhD in Geology, expert in limestone carbonates.
- Dr. Dennis Williams - PhD in Hydrology, expert in groundwater modeling.

### **Additional Hydrology Reports**

- Cadiz Groundwater Modeling and Impact Analysis (Geoscience)
- Supplemental Assessment of Pumping Required (CH2M HILL)
- Assessment of Effects of the Cadiz Groundwater Conservation Recovery and Storage Project Operations on Springs (CH2M HILL)

## Science: Extensive test well drilling

- **10 new wells at the Project site drilled to depths of up to 2,000 ft. bgs**
  - 10" test well produces 1,200 gpm with no drawdown during 72-hour pump test.
  - Wells reveal cavernous limestone carbonate strata deep below ground.
  - Geological characteristics corroborate recharge and project sustainability.



## Recharge and Impacts Thoroughly Examined and Tested

- Several recharge rates modeled in consideration of the range of historical recharge estimates and the impact of climate change.
- Impact evaluation done for recharge at 5,000, 16,000 & 32,000 (AFY).
- Even assuming recharge at only 15% of the estimated amount – modeling predicts no significant impacts to the desert environment.



## Groundwater Management, Monitoring, Mitigation Plan

- Establishes a monitoring protocol and **oversight authority** to avoid adverse impacts for the life of the Project.
- **Monitors:** (a) Groundwater aquifer system (groundwater quality, subsidence, and existing users); (b) Natural springs in the watershed; (c) Brine resources; (d) Air Quality; and (e) Adjacent watersheds.
- Integrates the use of **monitoring equipment** in the field, routine visual inspection, and the ongoing use of the groundwater model to track operations.
- For each critical resource, the GMMMP establishes **specific action criteria** (trigger levels) and corrective measures, to be implemented if necessary, to address potential adverse impacts resulting from the Project.
- Establishes a **defined protocol** for scientific review and decision-making processes.
- A **Technical Review Panel** (TRP) would be established to review data reports and propose management refinements to the Lead Agency over the life of the Project.

## CEQA Environmental Review Underway

- SMWD issued a Notice of Preparation (NOP) of a Draft Environmental Impact Report (DEIR) in February 2011 formally commencing the CEQA process.
- The environmental review consultant is ESA ([www.esaassoc.com](http://www.esaassoc.com)).
- DEIR released December 5, 2011.
- One public workshop and two public comment meetings were held.
- Initial 70-day public review period ended February 13, 2012.
- SMWD extended review period to a total 100 days that ended on March 14, 2012.
- SMWD is preparing responses to comments/FEIR.



*Near Cadiz, CA*

## DEIR Evaluation of Historical Concerns

The Draft Environmental Impact Report (DEIR) studies and evaluates the potential for Project impacts, including four key areas of historic concerns within the desert ecosystem:

Water Quality

Springs

Subsidence

Dust



*Creosote Bush*

Additional chapters of the DEIR evaluate the potential for other impacts including aesthetics, noise, growth, minerals, transportation and traffic, recreation, and greenhouse gas emissions.

## Water Quality - DEIR Conclusion: Water Quality Impacts Less Than Significant

- The risk of water quality degradation is confined to the area between the dry lakes and the wellfield.
- Projections for water quality degradation limit the impact zone to a maximum of 12,000 feet from its current limit and without impact on any user of water.
- Unforeseen impacts can be addressed by water quality monitoring and mitigation measures that will confine the migration; e.g. injection wells and pumping configuration.

## **Springs: DEIR Conclusion: Not Significant.**

- The nearest springs within the Watershed are at least 11 miles away and at substantially higher elevations.
- Mountain springs are fed by rainwater that seeps through cracks in the bedrock, far above the groundwater level.
- No connection (hydraulic continuity) between the groundwater aquifers that will be pumped by the Project and the rainfall fed springs.
- Several springs will be monitored.

## Land Subsidence: DEIR Conclusion: Not Significant

- There are no high concentrations of clays and silts that compress with dewatering.
- Any subsidence would be slowly sloping and would not cause a risk to surface structures.
- Significant monitoring will be implemented
- to ensure against unexpected impacts.



## **Air Quality: DEIR Conclusion: Not Significant**

- Extensive study of the chemical composition of the dry lakes confirms that unlike surface water fed playas, the crusts of Bristol and Cadiz Dry Lakes are not susceptible to increased dust emissions from dewatering.
- The high concentrations of sodium chloride and calcium chloride form a crust that seals the surface and resists dust generation.
- Despite the modeling's projections of no significant impacts, monitoring will be implemented to avoid any potential unexpected adverse impacts.

## Next Steps

- **Continued Engagement with Metropolitan Water District**
  - CRA Tie-In
  - Exchange Arrangements
  - Determination of MWD Benefits
- **Finalize Purchase and Sale Agreements**
- **Complete Project Financing**
- **Permitting and Final Design**
- **Construction**
  - Approximately 18 months

For more information, visit:



*Santa Margarita  
Water District*

<http://www.smwd.com>



<http://www.cadizinc.com>



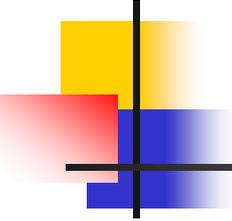
# Conjunctive Administration of Surface and Ground Water is Coming Your Way – What Can You Do About It?



Dave Tuthill, PhD, PE

May 4, 2012





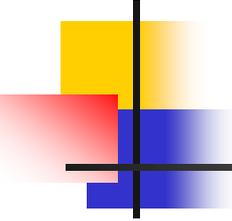
# Prediction...

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Relative to water delivery in many basins in  
the Pacific Northwest...

# *Change*

is coming  
between now and 2020

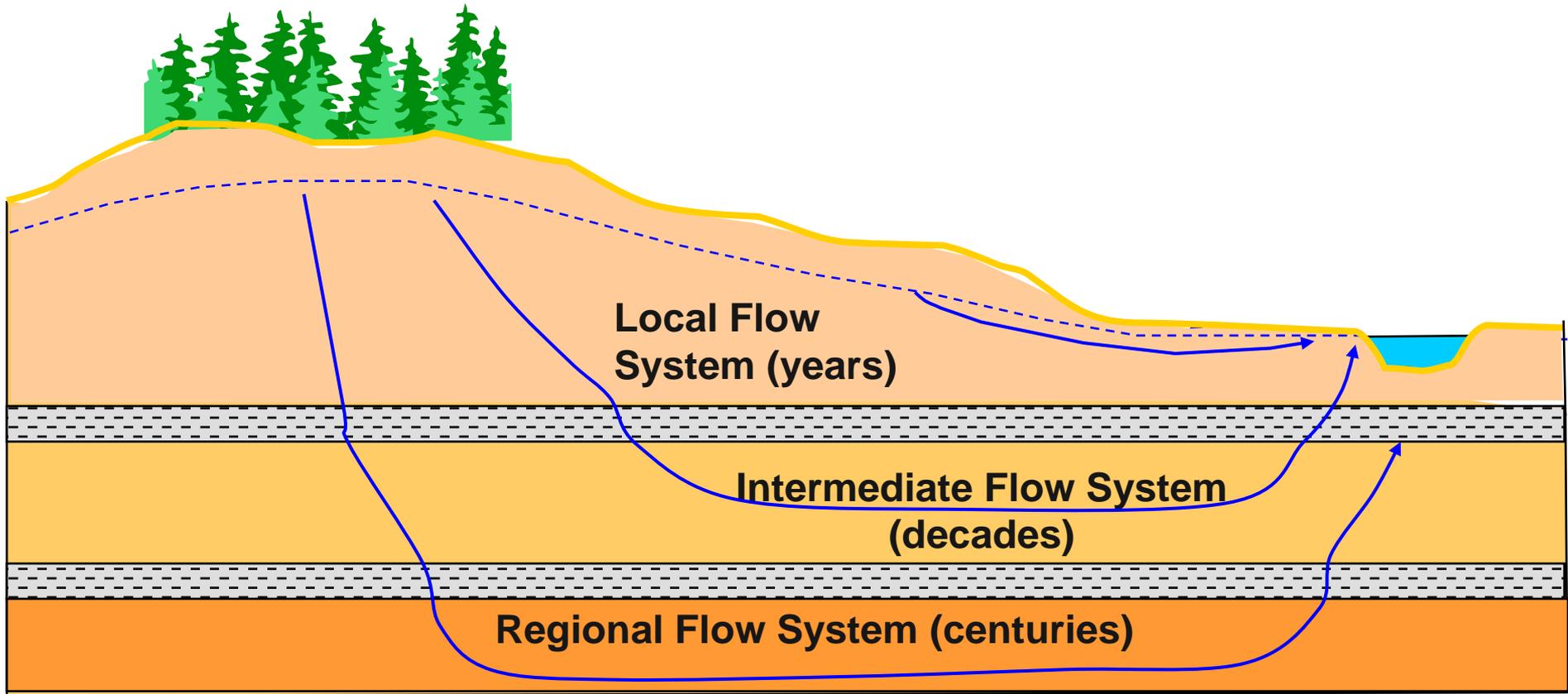


# Outline

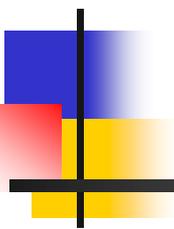
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- Water administration basics
- Implementation of conjunctive administration
- Emerging frontiers in water management

# Ground Water Flow Systems



Why consider conjunctive relationships between ground water and surface water?



In ID, WA and OR the *appropriation doctrine* is used for the delivery both surface water rights and ground water rights—

---

“first in time is first in right”

Administered by a  
*Water District*  
which hires a *Watermaster*



Well

Mrs. Clark  
Irrigation of  
500 acres  
10.0 cfs  
6/16/1982



Mr. Black  
Irrigation of  
60 acres  
1.2 cfs  
6/17/1887

Mrs. Adams  
Irrigation of  
50 acres  
1.0 cfs  
6/16/1887

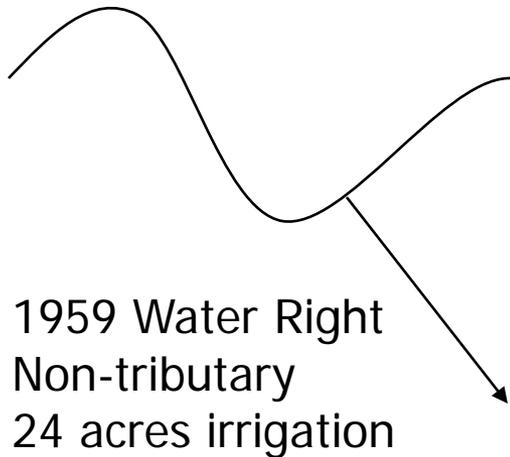


# Example – Which right is most likely to be curtailed?

Scenario 1 – during 2010

Scenario 2 – during 2014

Scenario 3 – during 2020



1959 Water Right  
Non-tributary  
24 acres irrigation



1954 Water Right  
Ground Water  
City of Ketchum, Municipal

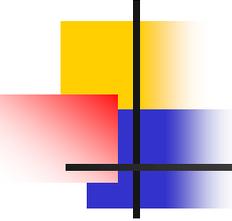


1956 Water Right  
Ground Water  
½ acre lawn irrigation

*Plus, if a water right is not used  
for five consecutive years it can  
be lost due to forfeiture*



1886 Water Right  
Big Wood River  
32 acres Irrigation

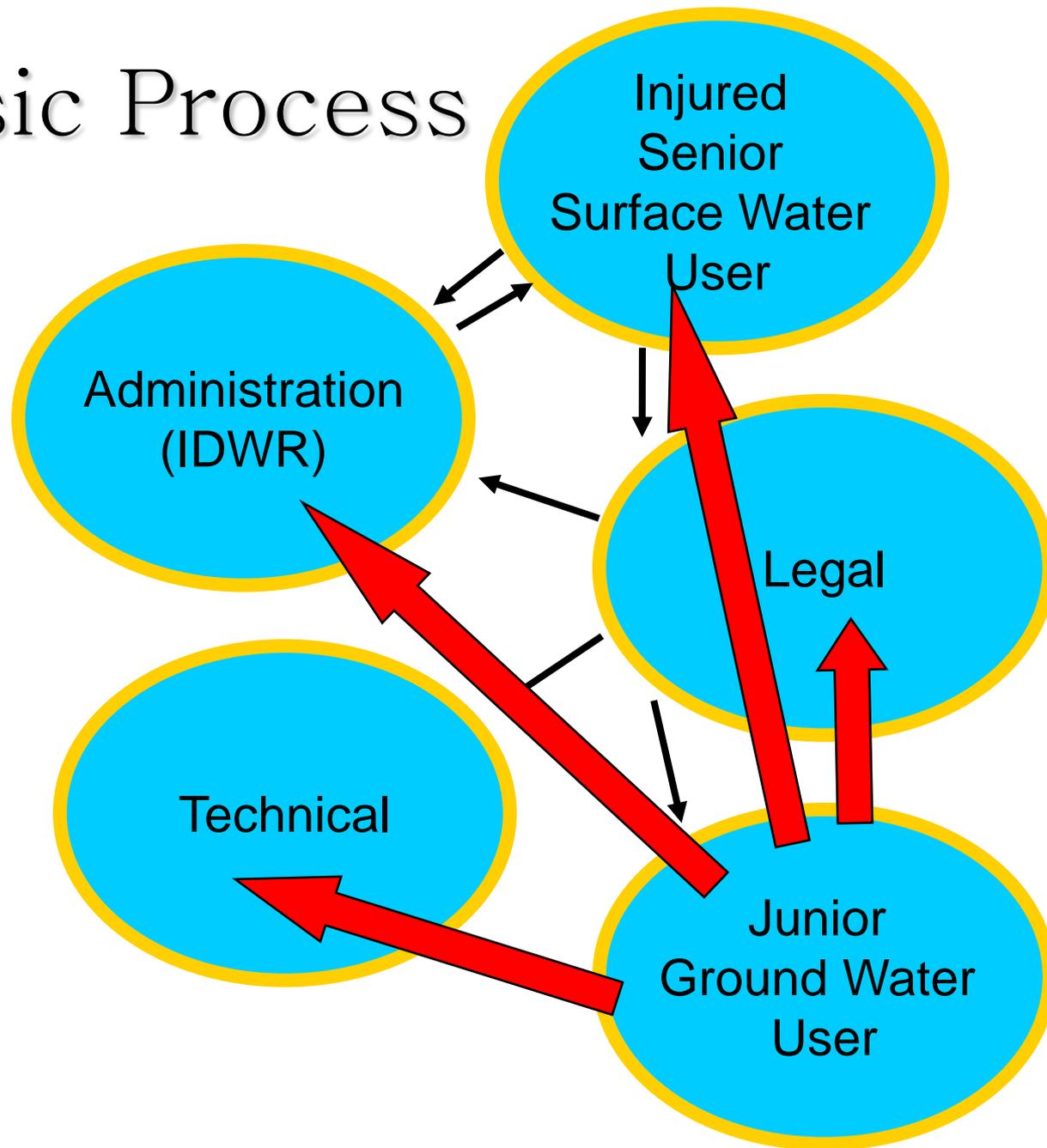


# Hold on – Aren't Municipal Water Rights Special??

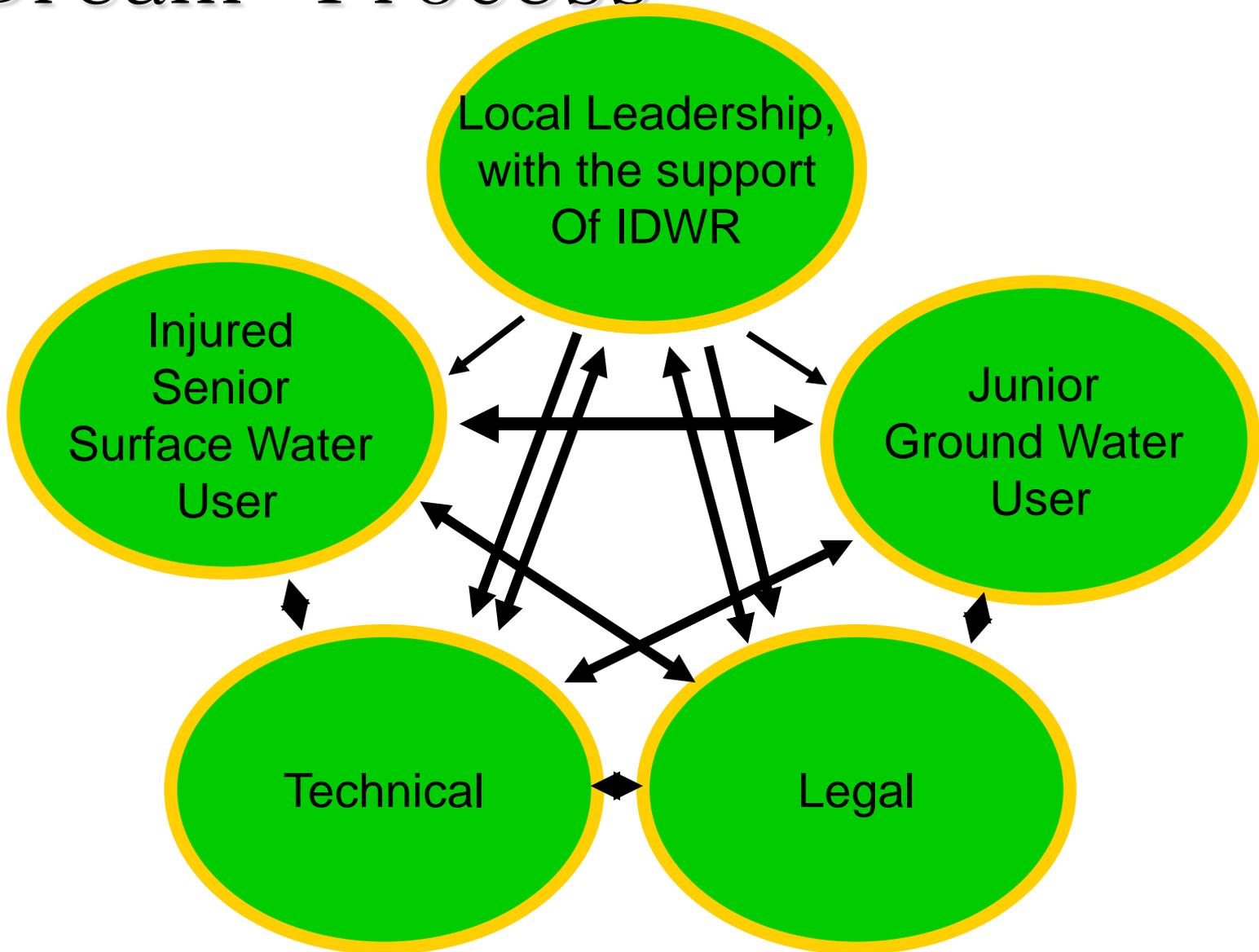
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- Yes
  - Not limited in volume – just rate
  - In-house (non-consumptive portion) not subject to a call
  - “Domestic” water is highest in constitutional hierarchy
- No
  - Consumptive portion subject to delivery based on priority date
  - Any condemnation must be compensated

# Classic Process



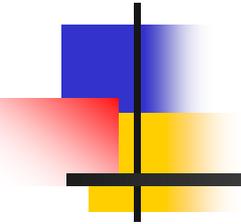
# “Dream” Process

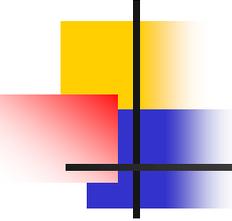




With the CA train coming down the track, what is an Idaho municipal water provider to do?

1. Recognize that conjunctive administration is coming





# Inhibitors to Discussing Water Rights in Property Transactions

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## Historic

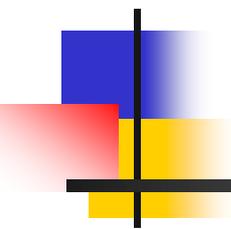
- Lack of buyer awareness
- Lack of determination of water rights
- Lack of regulation
- Lack of measurement
- Lack of enforcement
- Lack of economic incentive

## Emerging

- Increasing awareness
- Snake River Basin Adj.
- Northern Idaho Adj.
- Adjudication enables
- Increased gaging
- Remote sensing
- Increasing water value

## 2. Know very clearly what you have

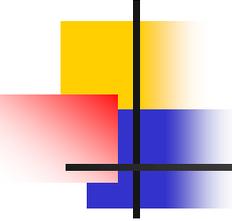
- Water Rights
- Flow rates
  - Diversions
  - Return Flow
- Other water rights from your source
- Consumptive uses



### 3. Know very clearly what you will need in the future

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- Conduct a future needs study
- Include climate change possibilities



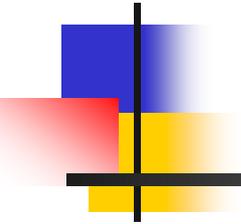
## 4. Conduct a SWOT Analysis

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- Strengths
- Weaknesses
  - Include priority date considerations
- Opportunities
  - Include conservation
  - Include teaming with the irrigation community
- Threats
  - Include implementation of CA

5. Ensure that Staff Stay Abreast of Advances in Technology

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# Opportunities for a Watershed Approach in a River Basin

Automation of  
Irrigation Delivery  
Systems

Reuse of Ag  
and  
Municipal Water

Precision  
Agriculture

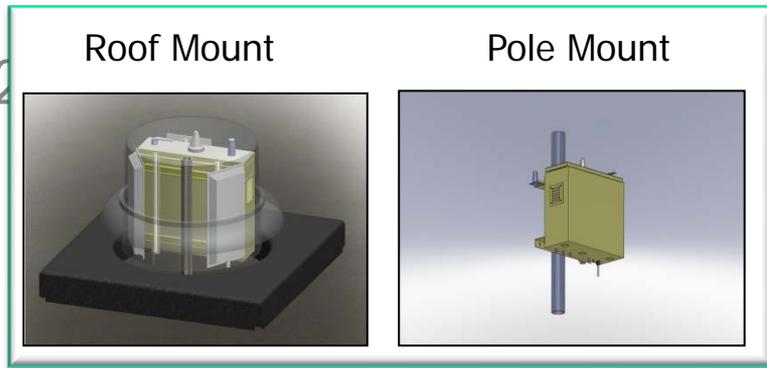
Riparian  
Activities



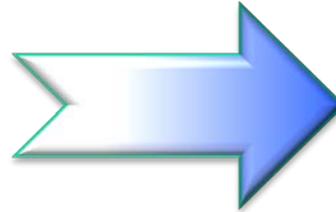
# Automation

Objective: Take only what you need –  
leave the rest in the river

# RECON Dynamics



Receivers



Web Site



Tags

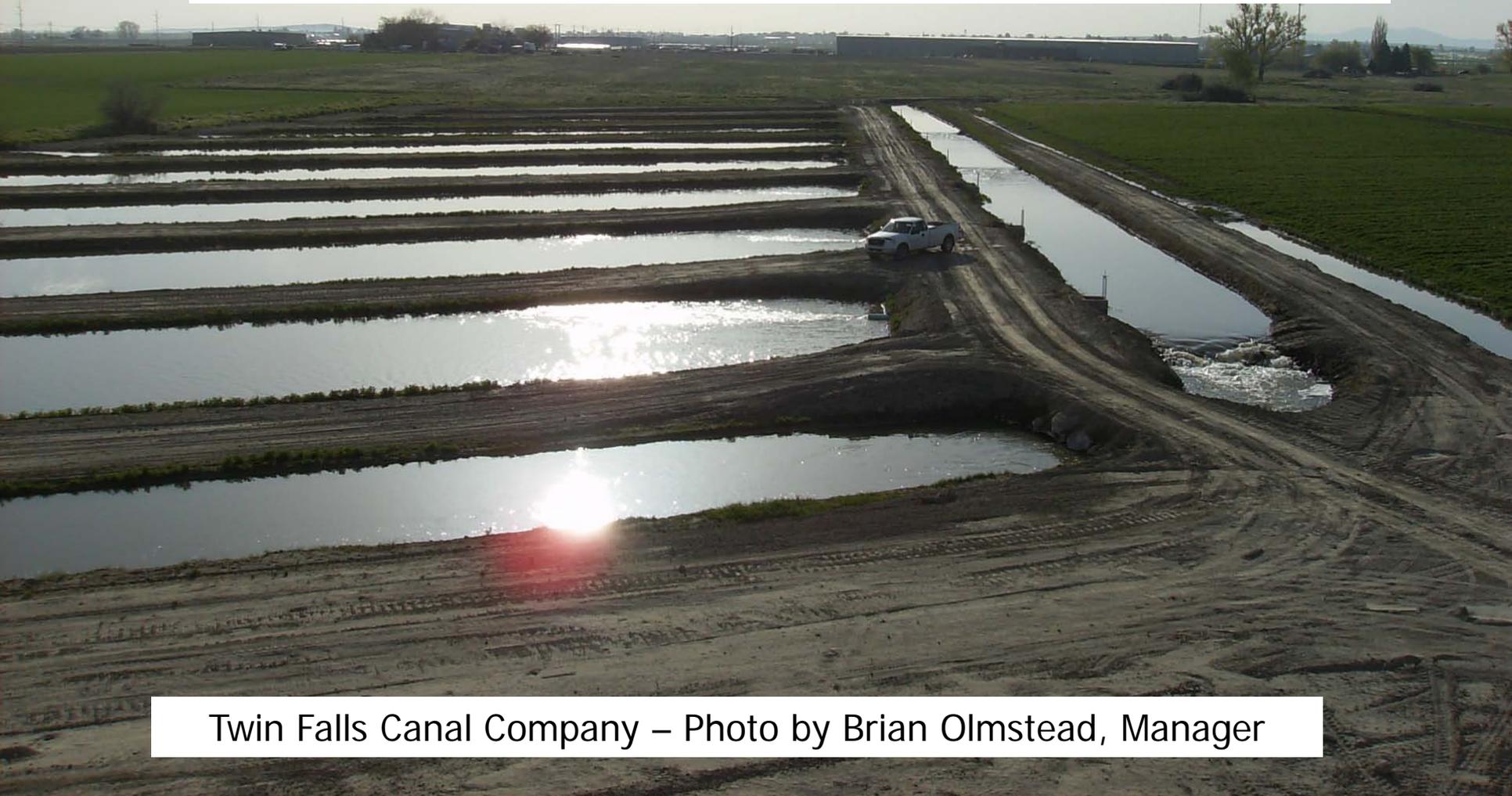


- Low Cost Devices
- Simple Integration & Interface
- Deep Indoor Radio Coverage
- Long Battery Life

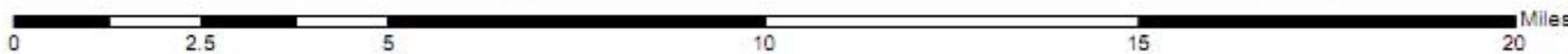
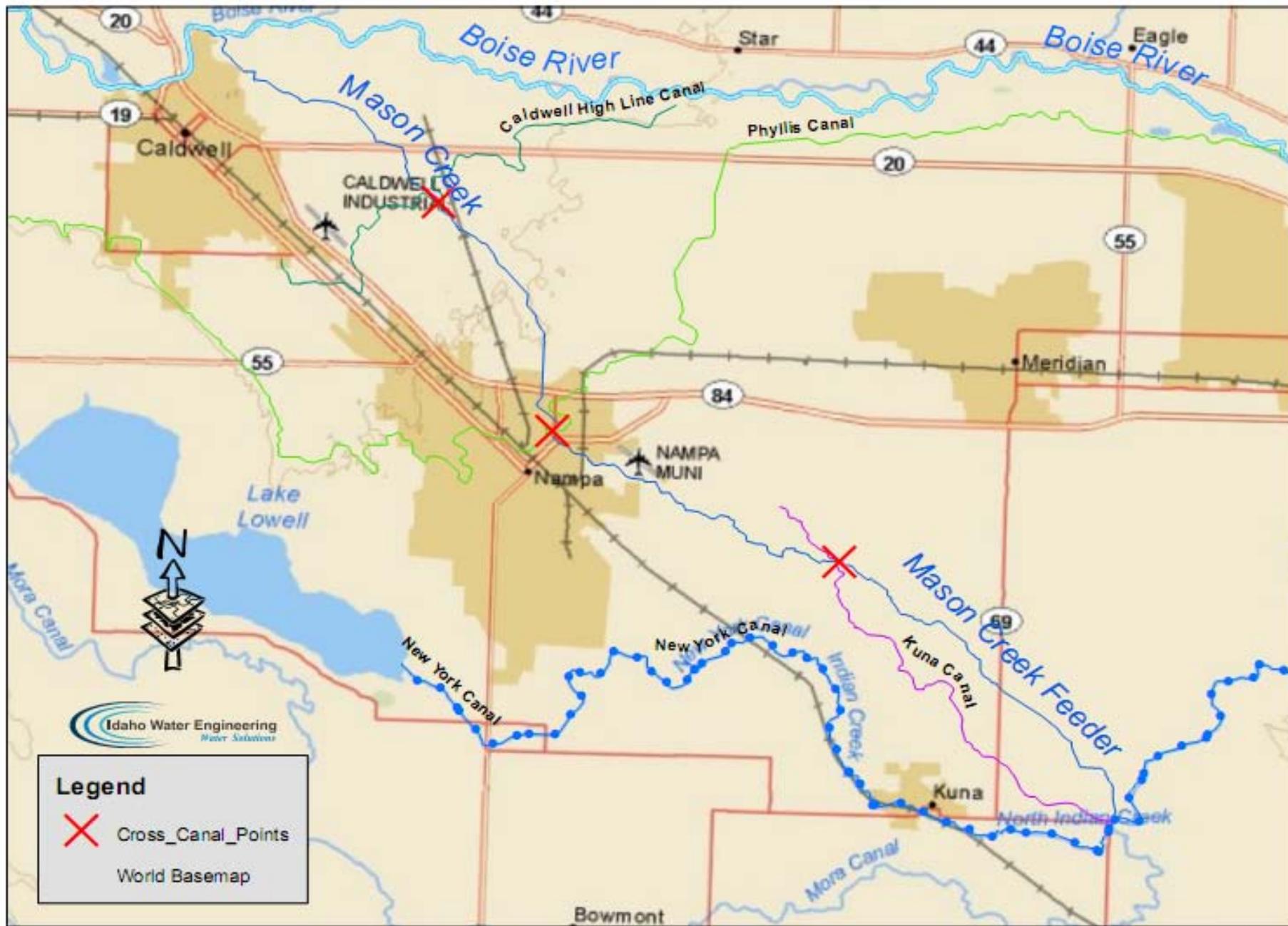
Confidential & Proprietary

# Reuse

Objective: Use nutrient laden water for Irrigation *before* it returns to the river



Twin Falls Canal Company – Photo by Brian Olmstead, Manager



# Precision Agriculture



Objective: Apply the correct amounts and types of nutrients in the right places

# Riparian Activities



Objective: Create wetlands to remove nutrients and lower temperatures

Photo by Dr. Rob Tiedemann

# Will EPA Accept a Watershed Approach?

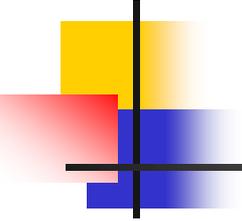
“A watershed approach must be measured and verified, but if this can be done we are supportive.”

Mike Bussell, Director

EPA Region 10

Office of Water and Watersheds

(Meeting in Boise, December 15, 2011)



# Summary

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- Gone are the days of:
  - easy water rights
  - wells pumping merrily away without anyone taking notice
  - municipalities focusing exclusively on water quality issues
- Hello to the 21<sup>st</sup> Century – it should be interesting, and successful for the collaborators!



**Idaho Water Engineering**  
*Water Solutions*



208-378-1513

Website:

[Idahowaterengineering.com](http://Idahowaterengineering.com)

Email:

[info@idahowaterengineering.com](mailto:info@idahowaterengineering.com)

# Integrated Water Management: Enhancing Water Availability through Integration of Storage Operations

Pacific Northwest Section  
AWWA Annual Conference  
May 4, 2012

*Presented By  
Derek Sandison*





Sullivan Lake  
Water Supply

Lake Roosevelt  
Releases

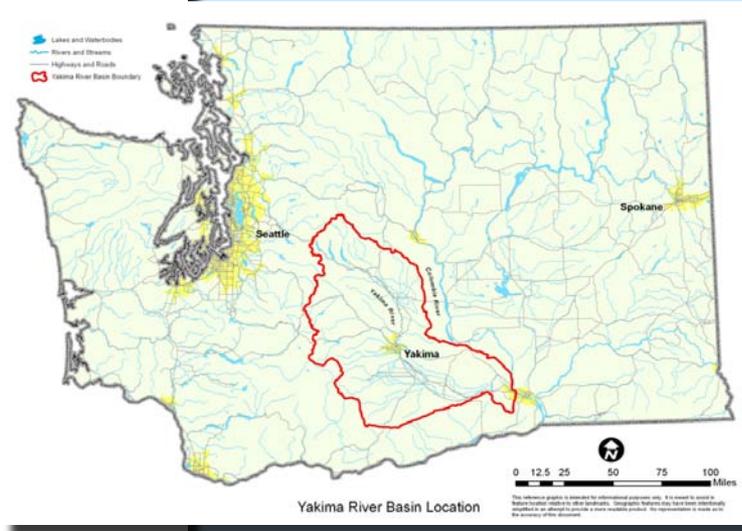
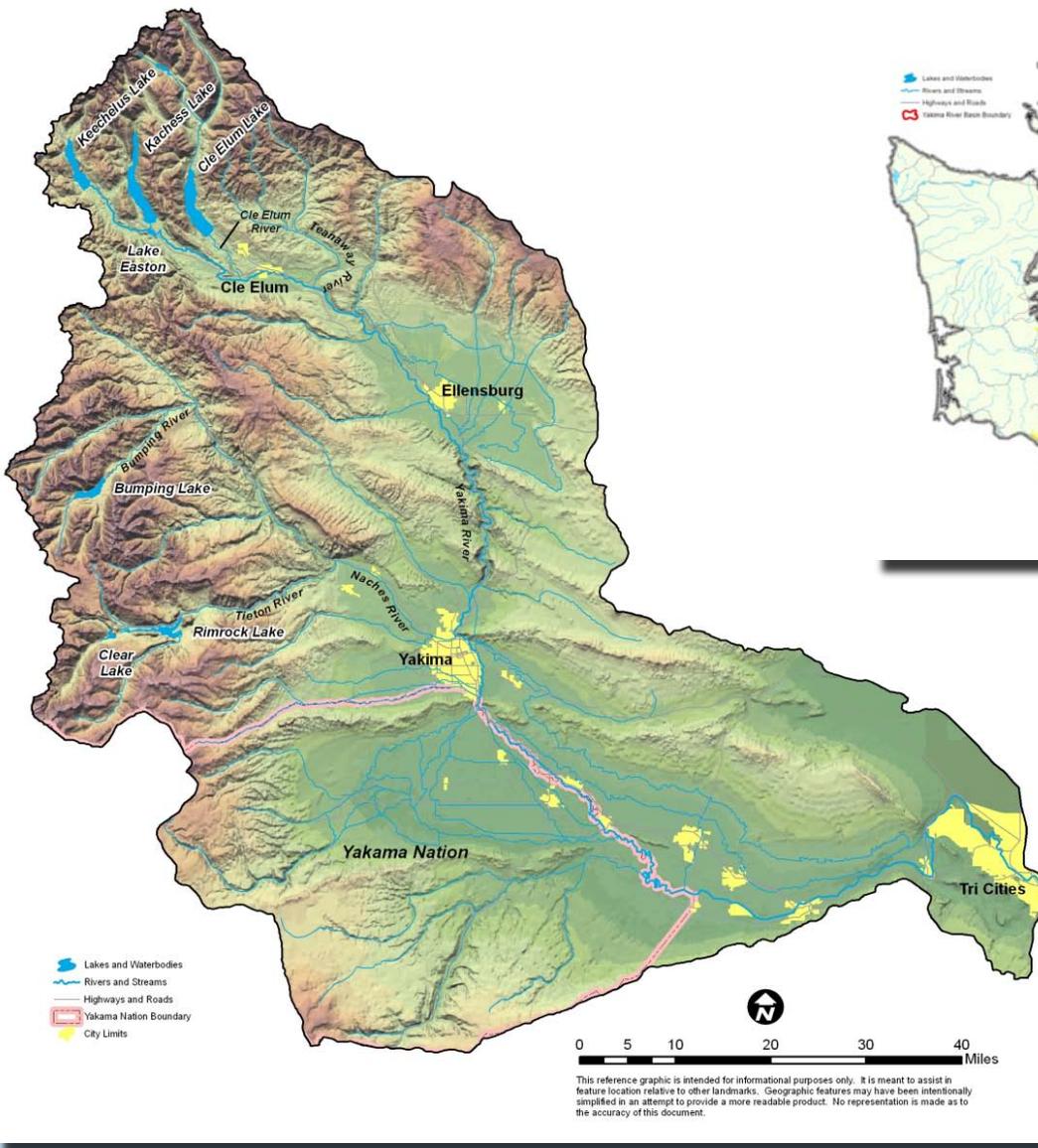
Odessa Special Study

Yakima Basin  
IWMP (Basin-Wide)

Quad Cities/Ecology  
Cooperative Agreement

Red Mountain AVA  
Pump Project

Walla Walla  
Pump Exchange



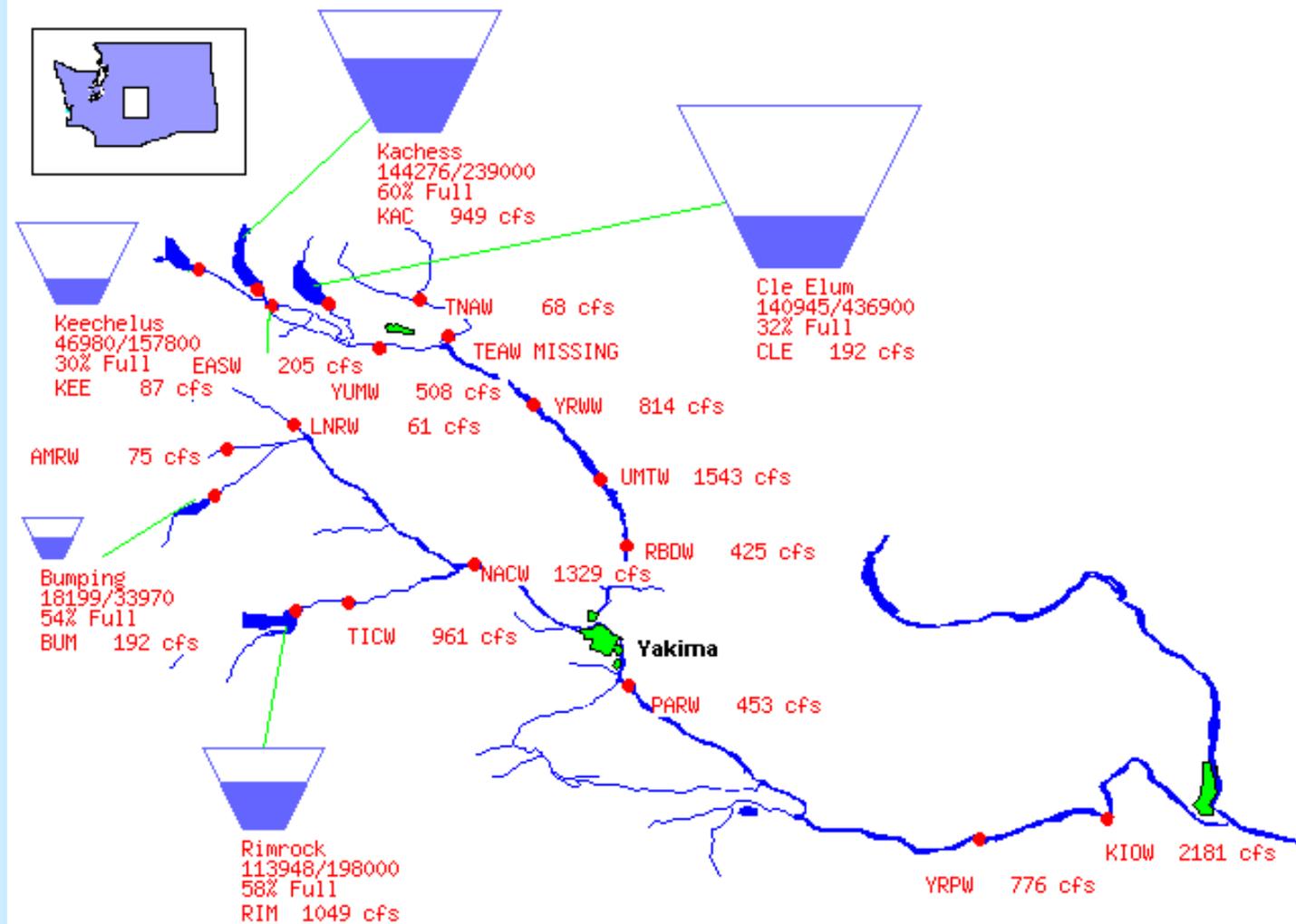
- Basin size = 6,155 sq. miles
- Irrigated cropland = 500,000 acres
- \$2.3 B food processing industry
- \$1.8 B agricultural production

# **Yakima Basin Background**

- Managed by Bureau Reclamation**
- Operates five reservoirs with 1M acre-foot of capacity (average annual runoff 3.3 M acre-feet)**
- Irrigation deliveries = 1.7 M acre-feet**
- Snowpack “sixth reservoir”**

# Yakima Basin Storage Reservoirs

09/27/2010



# **Yakima Basin Background**

- **Historic salmon and steelhead run size about 800,000 fish**
- **Average run size last 10-15 years about 15,000 – 20,000 fish**
- **Native sockeye and summer Chinook extirpated**
- **Native coho once extirpated, now reestablished**
- **Spring and fall Chinook seriously reduced**
- **Steelhead and bull trout ESA Threatened species**

# **Yakima Basin Background**

- Surface water over-appropriated**
- Droughts in 1992, 1993, 1994, 2001, and 2005**
- Proratable irrigation districts reduced to as little as 37% of allotments**
- Instream flows greatly reduced by out-of-stream diversions**

# Water Problems in the Yakima River Basin

## Surface Water Users in the Yakima Basin



**Senior Water Rights**

Pre-1905 priority date:  
receives full water right



**Proratable Water Rights**

1905 priority date:  
receives ~1/3 to full water  
right depending on supply



**Junior Water Rights**

Post-1905 priority date:  
receives no water once  
rationing occurs

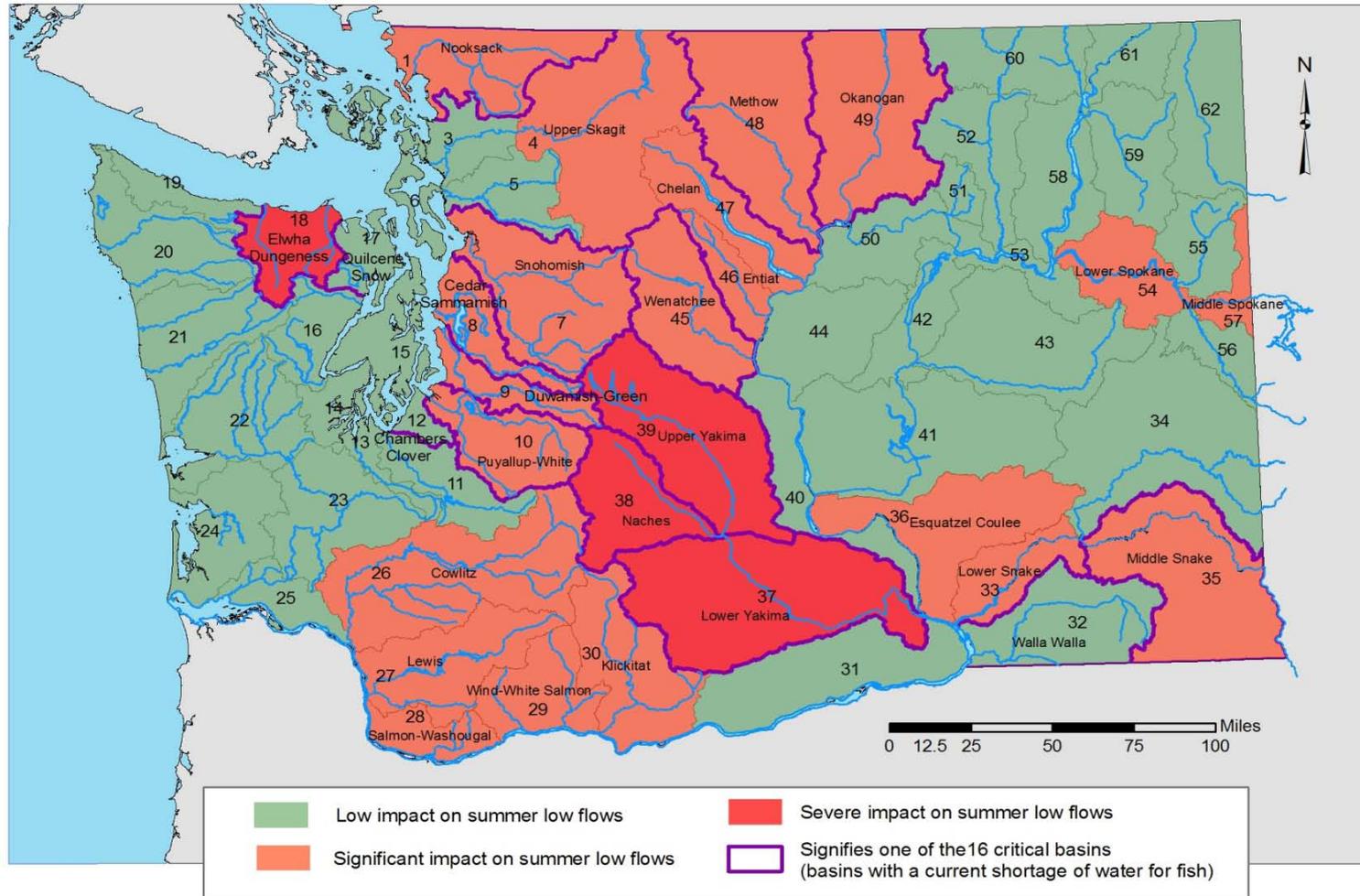


**No Water Rights**

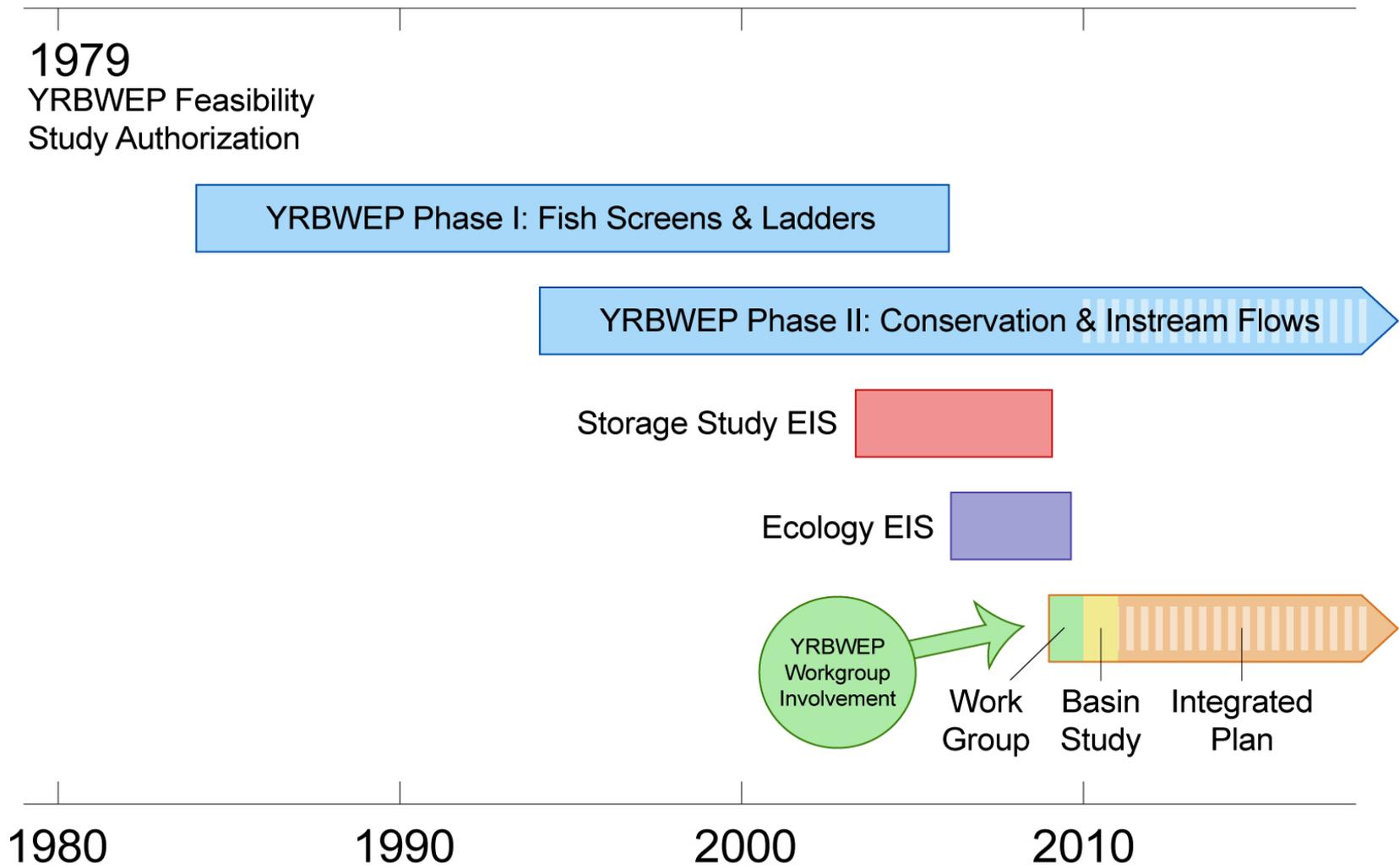
Surface water use  
without a water  
right is unlawful

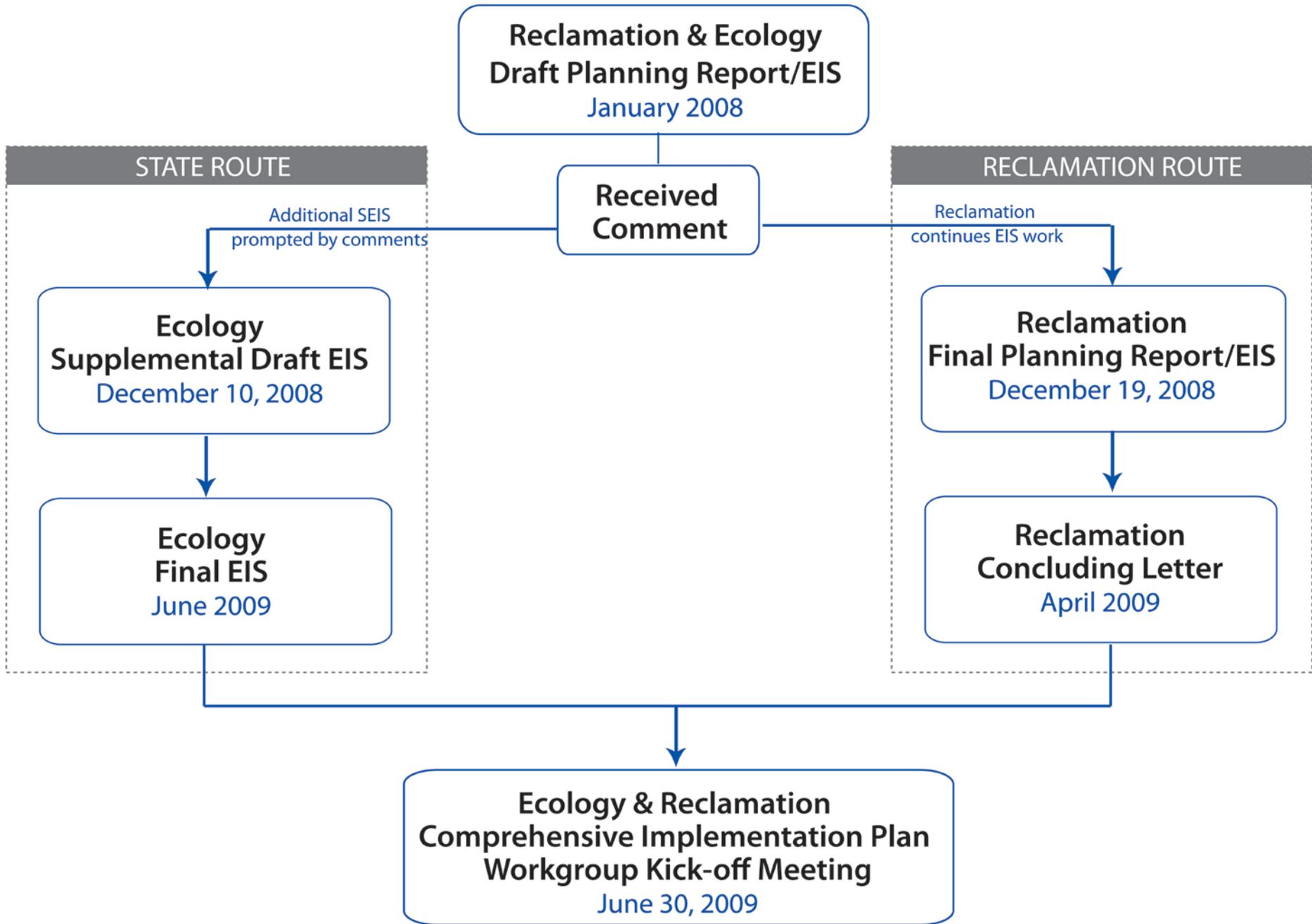
# Climate Change Forecast

2040 Projected Climate Change Impact on Summer Flows by WRIA



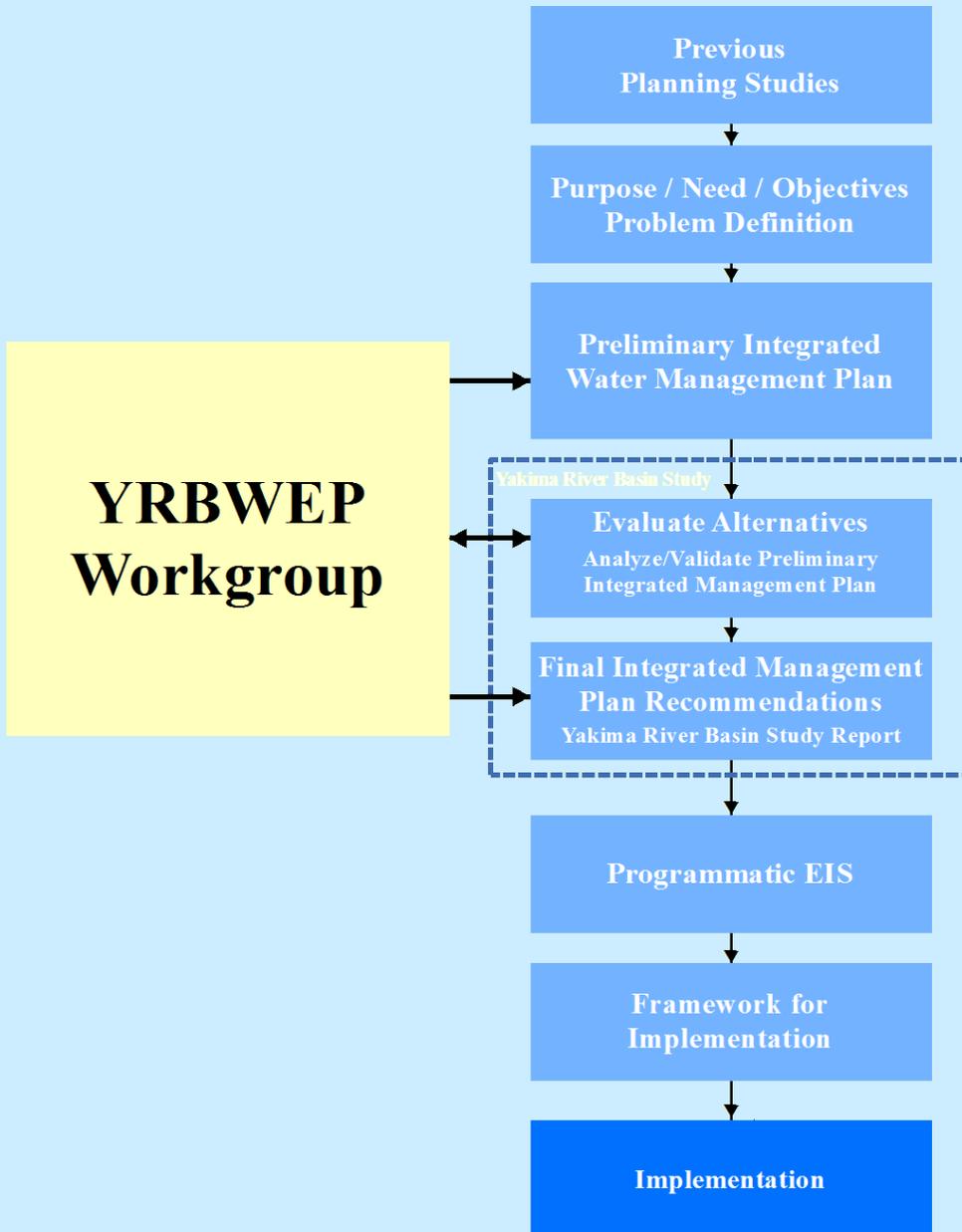
# Yakima River Basin Water Supply Efforts





# YRBWEP Workgroup Members

- **Washington Department of Agriculture**
- **NOAA, National Marine Fisheries Service**
- **Benton County**
- **Yakima Basin Fish & Wildlife Recovery Board**
- **Yakima – Tieton Irrigation District**
- **Yakama Nation – Yakima/Klickitat Fisheries Project**
- **American Rivers**
- **Kittitas Reclamation District**
- **Yakima County**
- **City of Yakima**
- **Kittitas County**
- **Yakima Basin Storage Alliance**
- **Kennewick Irrigation District**
- **Yakama Nation – Natural Resources**
- **Washington Department of Ecology**
- **Washington Department of Fish and Wildlife**
- **US Fish and Wildlife Service**
- **Sunnyside Valley Irrigation District**
- **Roza Irrigation District**
- **Bureau of Reclamation**



# **Yakima River Basin Integrated Water Resource Management Plan Goals**

- Provide opportunities for ecological restoration and enhancement**
- Improve water supply during drought years (70% proratable supply)**
- Provide for efficient and adaptable water supply management**
- Contribute to sustainable economy and environment**

# Yakima Basin Integrated Plan Elements

- **Water supply**
  - **Market driven reallocation of water**
  - **Enhanced conservation**
  - **Surface storage**
  - **Aquifer storage (passive and active recovery)**
- **System operation modifications**
- **Watershed/fish habitat improvements**
- **Fish passage**



# *Yakima River Basin Integrated Water Resource Management Plan*

## **Market Reallocation Element**

### **Near-term effort**

- **Build on existing water market programs**
- **Take steps to reduce barriers**

### **Longer-term effort**

- **Focus on water transfers between districts**
- **Allow fallowing within district; leases to outside district**
- **Requires substantial changes to existing laws/policies.**





# *Yakima River Basin Integrated Water Resource Management Plan*

## Surface Water Storage

### Wymer Dam and Pump Station

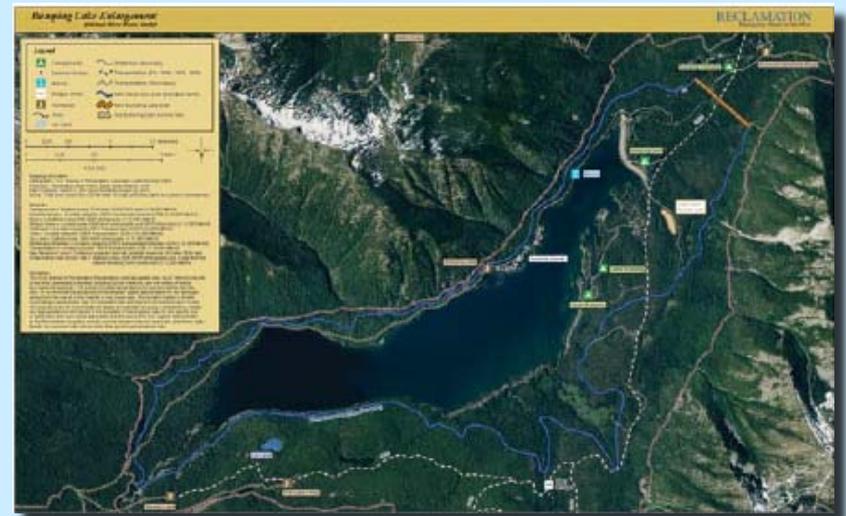
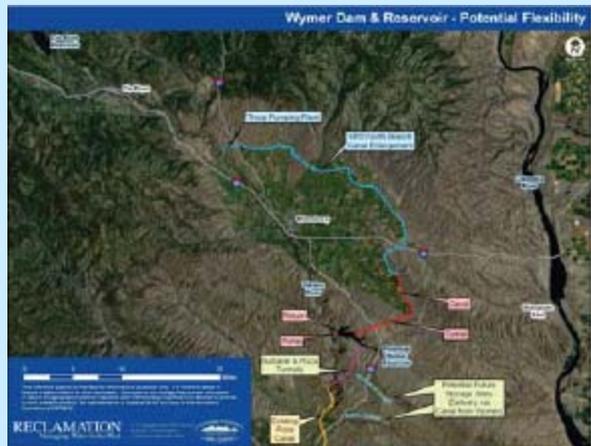
- 162,500-acre-foot-capacity reservoir
- Options for pump station at Thorp or upstream of Lmuma Creek

### Lake Kachess Inactive Storage

- Access 200,000 acre-feet from inactive storage in drought years

### Bumping Lake Enlargement

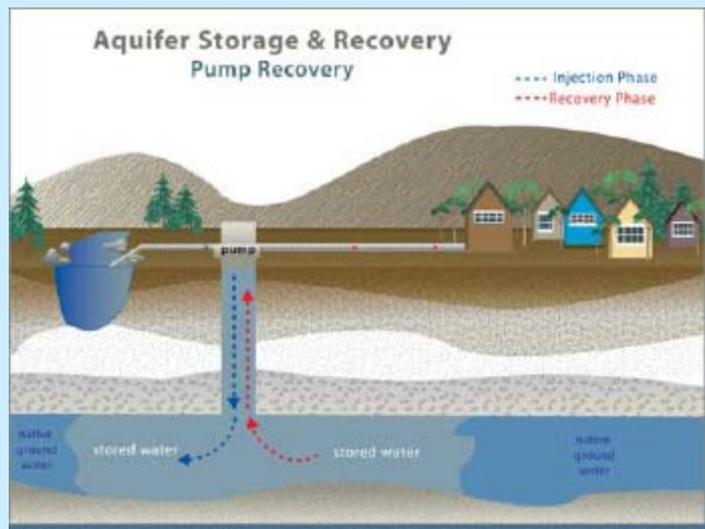
- Construct new dam for additional 164,500 acre-feet storage
- Provide carryover storage



## Groundwater Storage Element

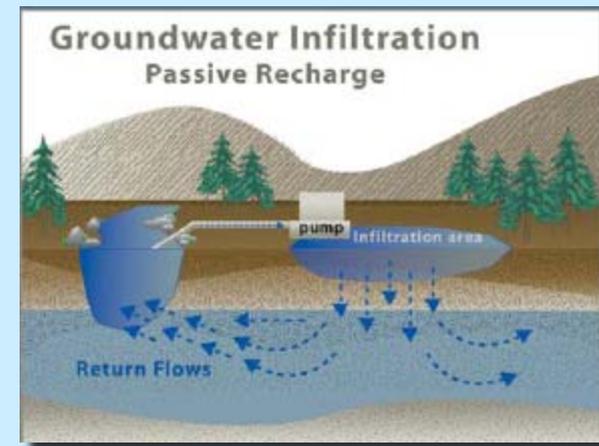
Groundwater storage actions would use surface water to recharge aquifers and store water for later withdrawal and use:

### Aquifer Storage and Recovery



### Shallow Aquifer Recharge

Divert water into designed ground infiltration systems (ponds, canals) during periods of excess runoff



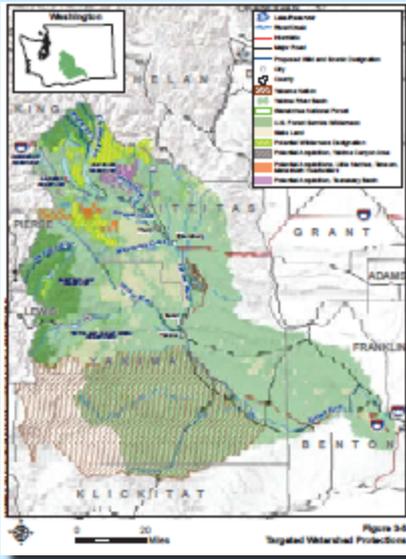


# Yakima River Basin Integrated Water Resource Management Plan

## Habitat/Watershed Protection And Enhancement Element

### Targeted Watershed Protections and Enhancements

- **Three key areas proposed for land acquisition actions**
  - 46,000 acres in Teanaway River Basin
  - 15,000 acres in Yakima River Canyon
  - 10,000 acres at Little Naches River headwaters
- **Consider potential Wilderness, Wild and Scenic River, and national recreation area designations**



# *Yakima River Basin Integrated Water Resource Management Plan*

## **Reservoir Fish Passage Element**

**Cle Elum**



**Provide upstream and downstream fish passage**

**Benefits:**

- Increase anadromous species abundance
- Allow reintroduction of sockeye runs
- Provide greater genetic interchange for bull trout
- Providing access to high quality habitat at higher elevations

**Kachess**



**Bumping**



**Keechelus**



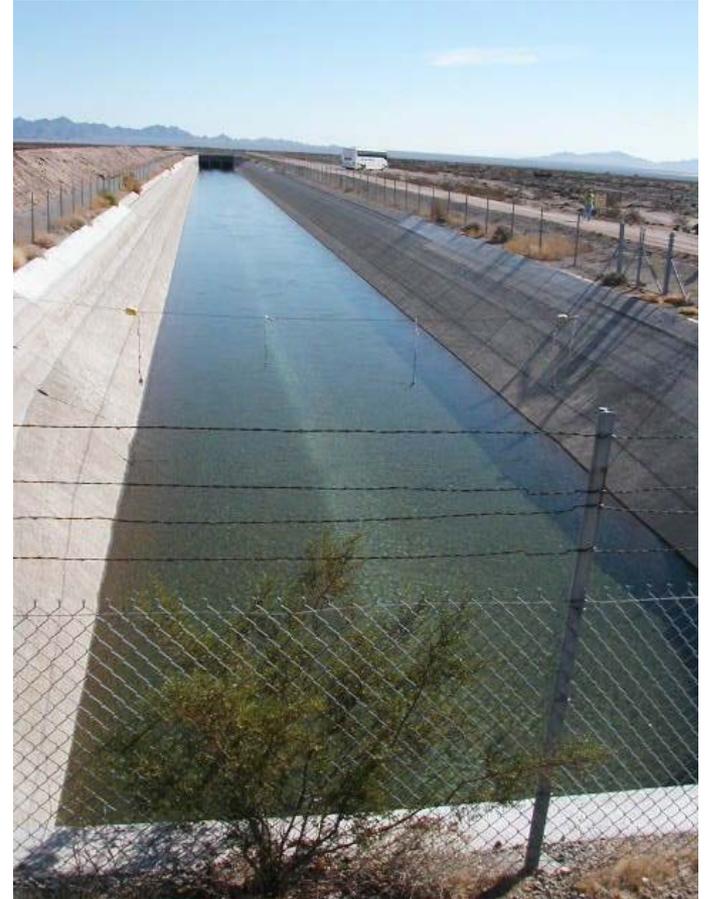
**Rimrock (Tieton Dam)**



# Next Steps

- **Final Programmatic Environmental Impact Statement released March 2012**
- **Complete Integrated Plan “Framework” document – August 2012**
- **Seek state legislative authorization and funding – 2013 session**
- **Seek Congressional authorization and funding – starting in 2012**
- **Conduct extensive outreach inside and outside of the Yakima Basin - ongoing**

# Questions



Utilizing Public Private Partnerships To Enhance Water Supply Reliability

Renewable Resources Group

# Renewable Resources Group

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## Investors and Developers:

- ✧ Managing more than 100,00 acres of agricultural land
  - permanent crops, row crops and rangeland
- ✧ Developing two million acre-feet of water projects
  - supply, storage, conveyance, transfers and conservation
- ✧ Marketing hundreds of water rights in nine states
- ✧ Developing over 1.5 GW of solar energy
- ✧ Developing 840 MW of wind energy
- ✧ Developing environmental attributes such as habitat and carbon

Several projects are structured with public sector partners

# PPPs – A Sign of the Times

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- ✓ Shrinking and overburdened Public Sector Budgets
- ✓ Growing Population
- ✓ Increasing Infrastructure Needs
- ✓ Trillions in Private Capital

# What is a PPP?

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## PPPs Defined:

*Legal arrangement between public and private sector entities in which risks are allocated to further the public good while providing an opportunity for reasonable return on private sector risk capital.*

## Commonly Used Throughout the World:

- ❖ Primarily in other countries
- ❖ Some of the first in the US were in Transportation and Water

# Why a PPP?

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Combines Core Strengths of Both Sectors:

Private Sector
Risk Tolerance
Access to Capital
Experience, Efficiencies, Flexibility
Time and Resources to develop and move innovative ideas in partnership with Public Sector

Public Sector
Legal Authorities
Mission Driven
Political Mandate
Expertise, know-how to maneuver regulatory/bureaucratic systems

Common Concerns:

- Privatization/Loss of Control
- Private Gain from Public Resource
- Potentially Contradictory Missions/Goals
- Loss of Jobs

# Essential Elements to Any PPP

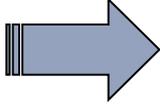
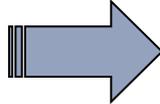
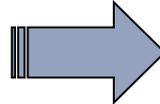
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- ❑ Legal Authority
- ❑ Political Support/Leadership
- ❑ Realistic Business Plan
- ❑ Thorough and Robust Contract
- ❑ Right Partners – Near and Long Term

# Case Study #1

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## Groundwater Storage and Conveyance

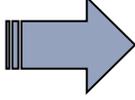
- 2000-2003  RRG performed extensive research to identify ideal site for a water storage facility:
- Percolation rates, water quality
  - Proximity to existing conveyance infrastructure
  - Market demand/Political support
- 2003-2007  Optioned and then purchased 1,800-acre site
- 2006-2010  Entitled and constructed storage facility; Signed up first two public sector customers

# Case Study #1

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## Groundwater Storage and Conveyance

2007  Partnered with two public agencies to expand bank's operational footprint



### Lessons Learned:

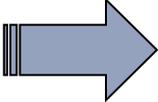
- Local politics
- Legal vehicles
- Market demand
- Aligning interests
- Water transfer limitations



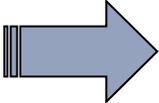
# Case Study #2

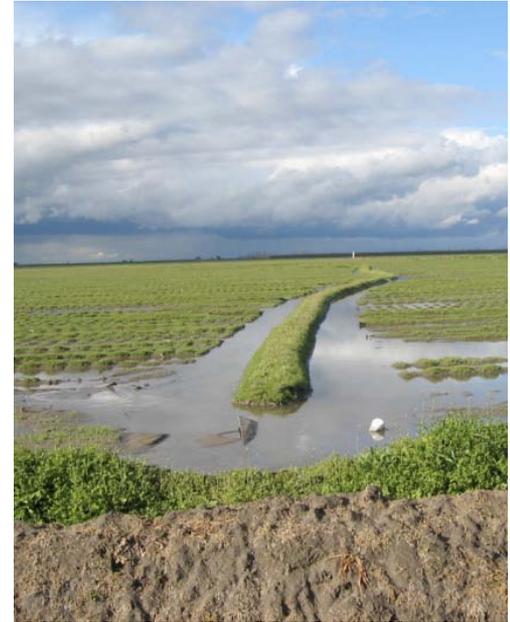
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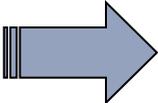
## Groundwater Storage and Water Marketing

2002  RRG purchased 14,000  
acre undeveloped ranch



2002-2005  Entitled water bank and  
sold to an Irrigation District



2005-2010  Irrigation District continued  
development of bank

# Case Study #2

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## Groundwater Storage and Water Marketing

### RRG and District negotiate terms of PPP:

- Division of Construction Costs
- Use of Bank's Capacity
- Available Surface Water
- Market Division

### Contracting Challenges

- Alignment of Interests
- Enforceability
- Complexity
- Risk Mitigation

### Lessons Learned

- Need for strong public leadership
- Right partners
- Permitting challenges and costs

# Conclusions

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- ✧ No two are alike – creativity is key
- ✧ Interests and risks must be thoroughly understood
- ✧ Agreements and outcomes must be fair
- ✧ Key characteristics of a strong PPP:
  - Desire/Commitment
  - Strong Leadership
  - Collaboration/Cooperation
  - Clear Expectations and Enforceable Agreement
  - Trust

# Further Questions?

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**RENEWABLE RESOURCES GROUP**

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323-936-9303

# Keeping Water Close to Home: Effective Water Resource Management in the Quincy Basin

Emil Voges

May | 2012



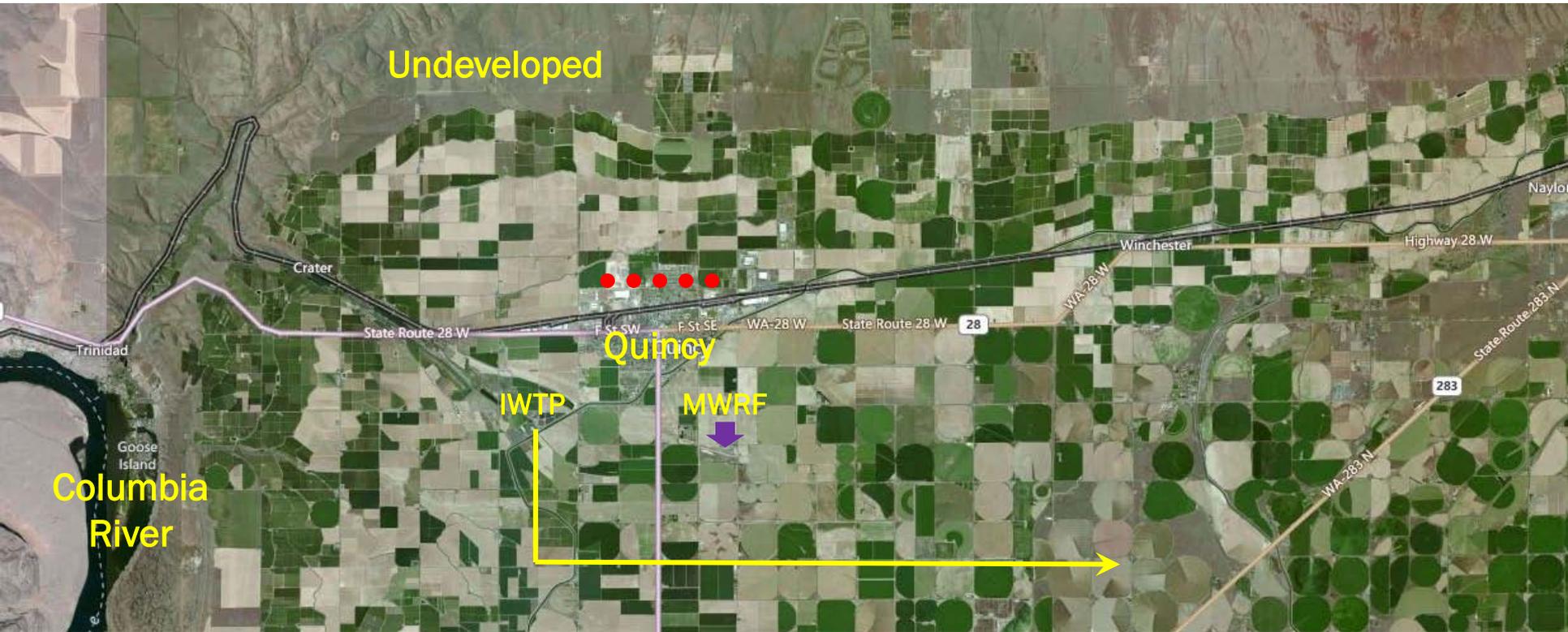
# Presentation Flow

- Overview of Quincy Area
- Project Drivers
- Interim Solutions
- Flexible Progression
- Future Plans



- Breadth
- Data
- Chronology

# Quincy Basin: Quincy - Columbia Basin Irrigation District of Columbia Basin Project



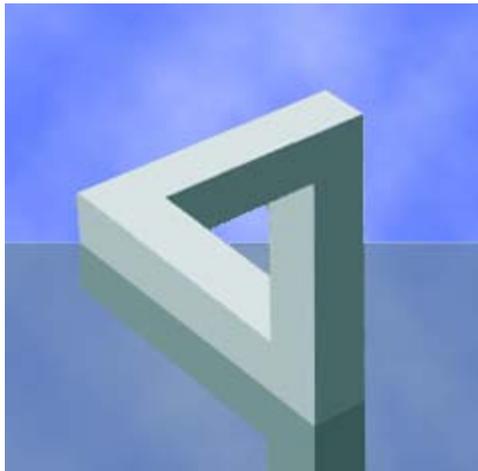
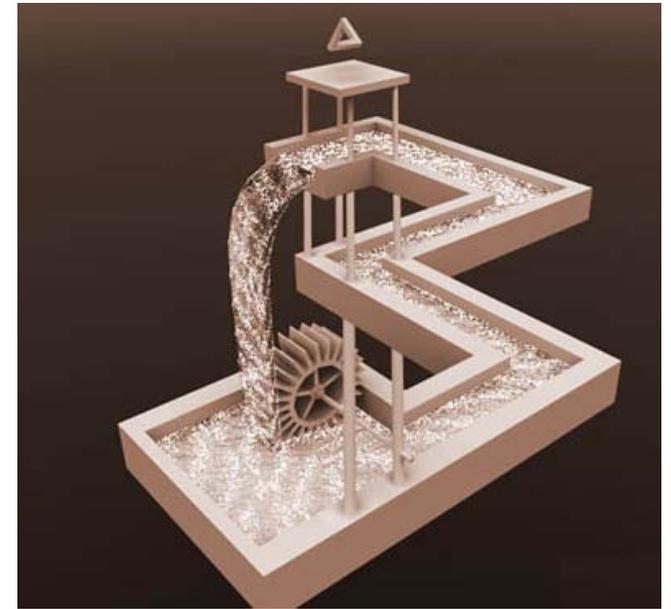
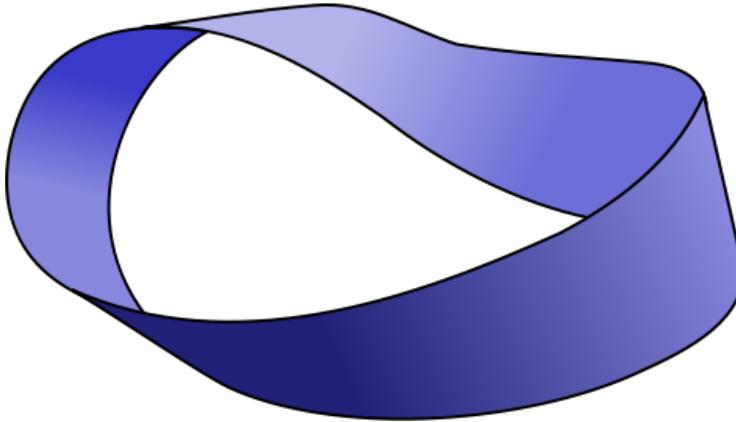
- Groundwater supply – 5 wells
- Sanitary to Municipal Water Reclamation Facility to percolation
- Industrial Wastewater Treatment Plant to wasteway

- 6 miles to Columbia River
- Limited land application area
- Control of TDS required for aquifer recharge
- U.S. Bureau of Reclamation (USBR)



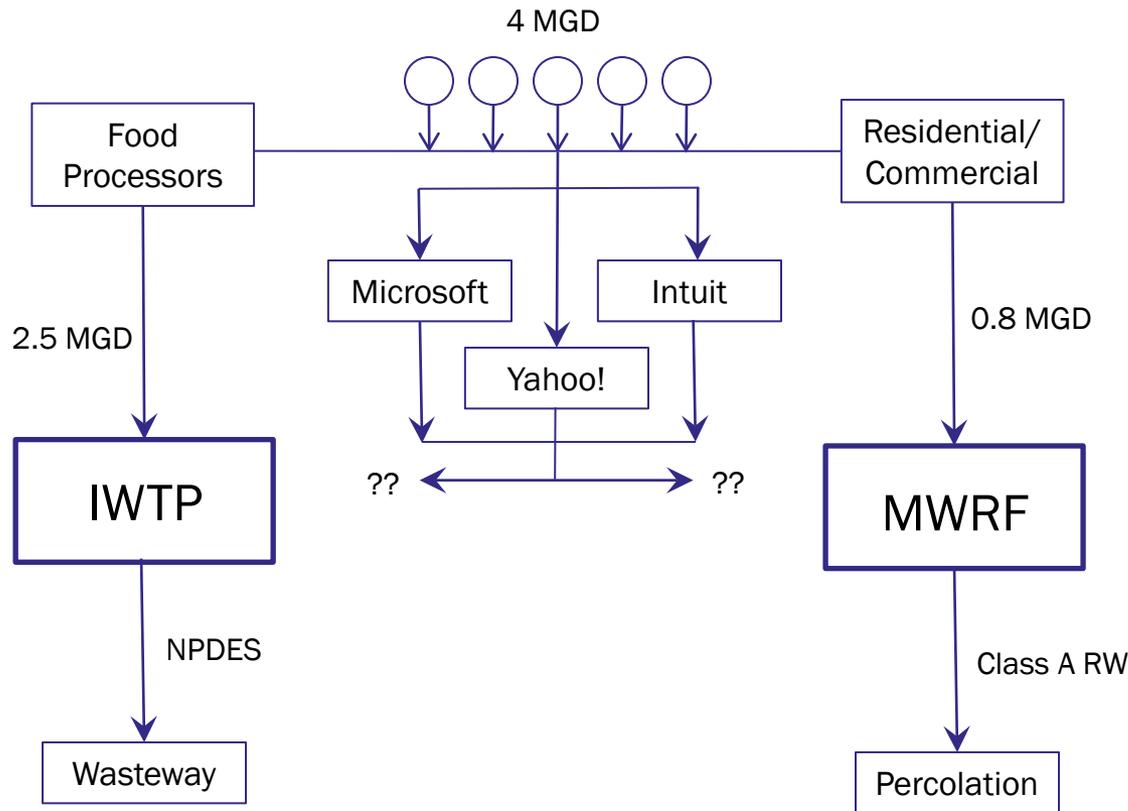
# Can we close the loop?

Why did the chicken cross the mobius strip?



To get to the same side!

# 2007 – The Issues Revealed



- 10's of MW of servers
- 20,000 Tons initial evaporative cooling loads (400,000 gpd)
- High salinity discharge (200,000 gpd)

- Quincy Water System Plan indicated that data center water demands were not sustainable beginning in 2012
- MWRf capacity is limited and high-salinity cooling tower blow down could affect aquifer
- Ecology allowed temporary permits to MWRf through 2013.
- IWTP peak capacity would be exceeded during peak industrial discharges (3.2 mgd limit)
- Use of IWTP and wasteway requires agricultural exemption
- IWTP discharge agreement with USBR expires in September 2015

# Quincy Regional Water Resources Mission Statement

*Develop a comprehensive water resources management plan that starts with a conveniently located industrial water treatment system and provides end-of-pipe solutions for our new industrial residents.*

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*Implement the system in a manner that maximizes the opportunity for customer growth, provides public benefit, maximizes funding availability and protects and improves the regions natural resources.*

# Quincy Regional Water Resources Mission Substatement

*What do you do with the brine!!!*

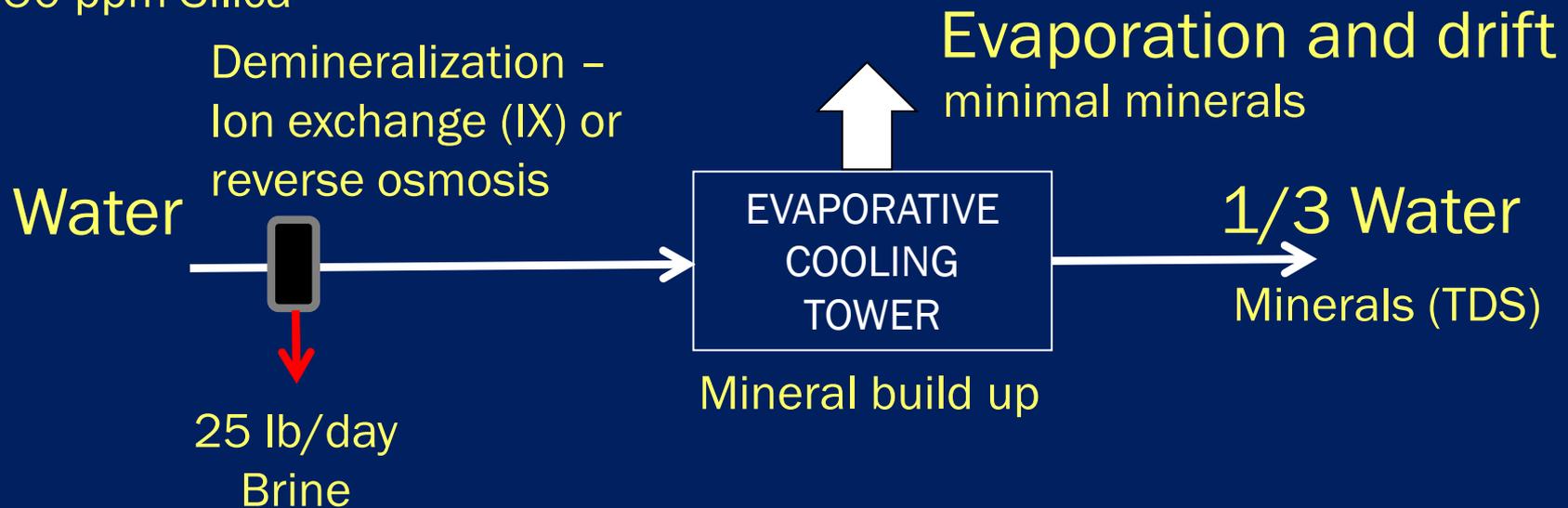
*- Or -*

*When you evaporate a lot of water, you might as well go all  
the way!!*

# Cooling Tower Cycles of Concentration

Groundwater Quality:

- 250 ppm total hardness
- 50 ppm Silica

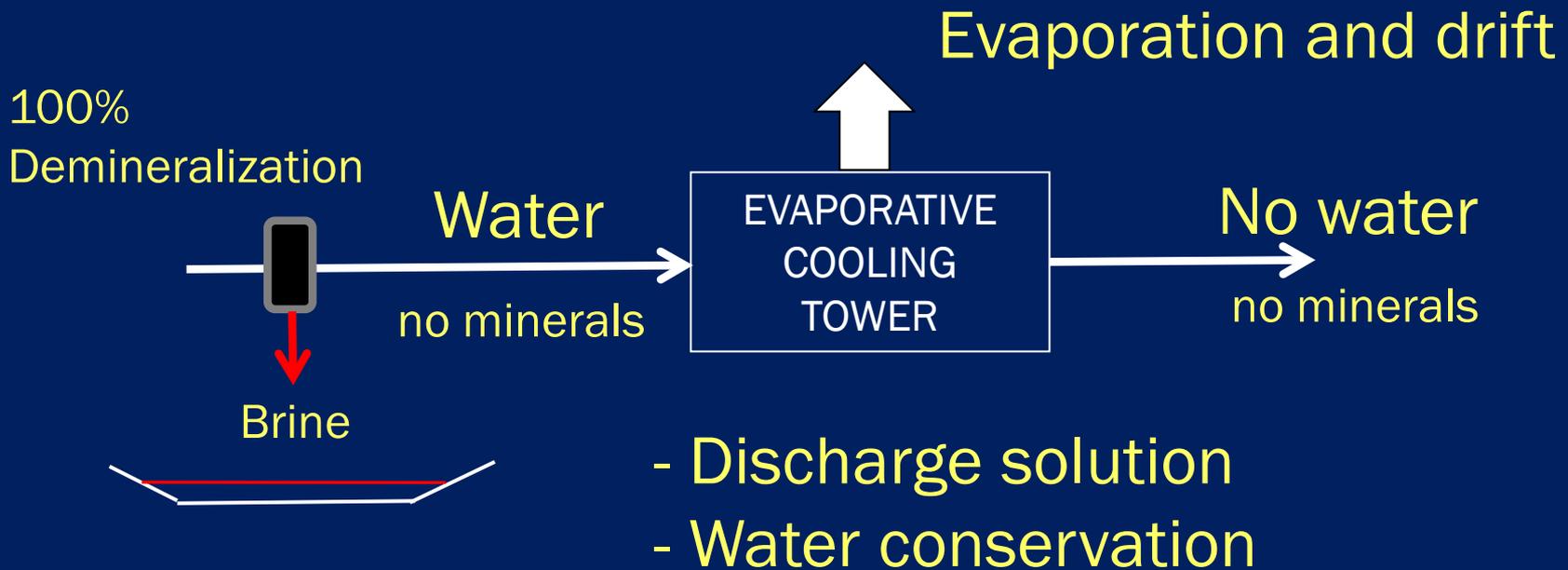


1/3 discharge = 3 cycles = 50 lb/day

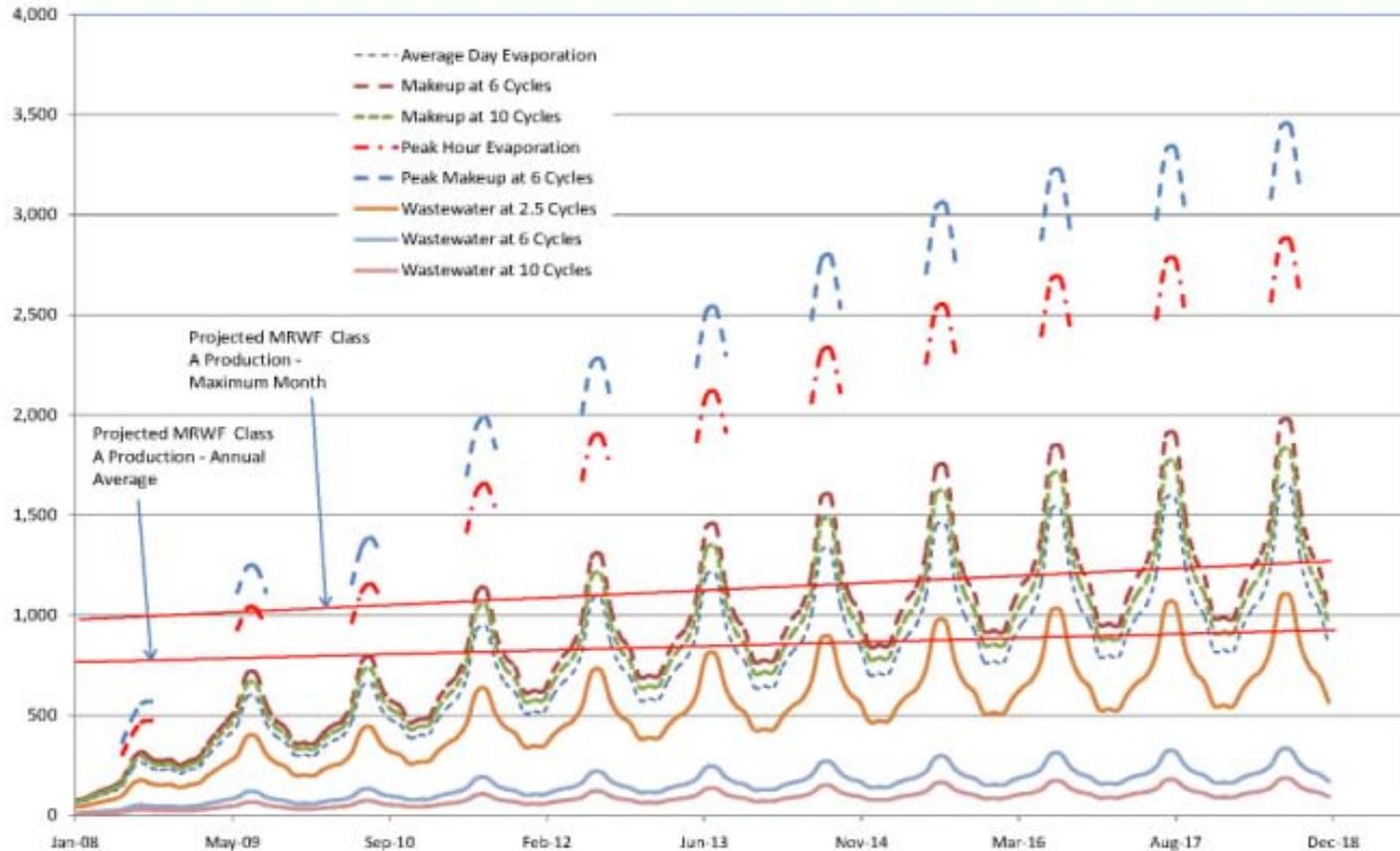
1/6 discharge = 6 cycles = 25 lb/day



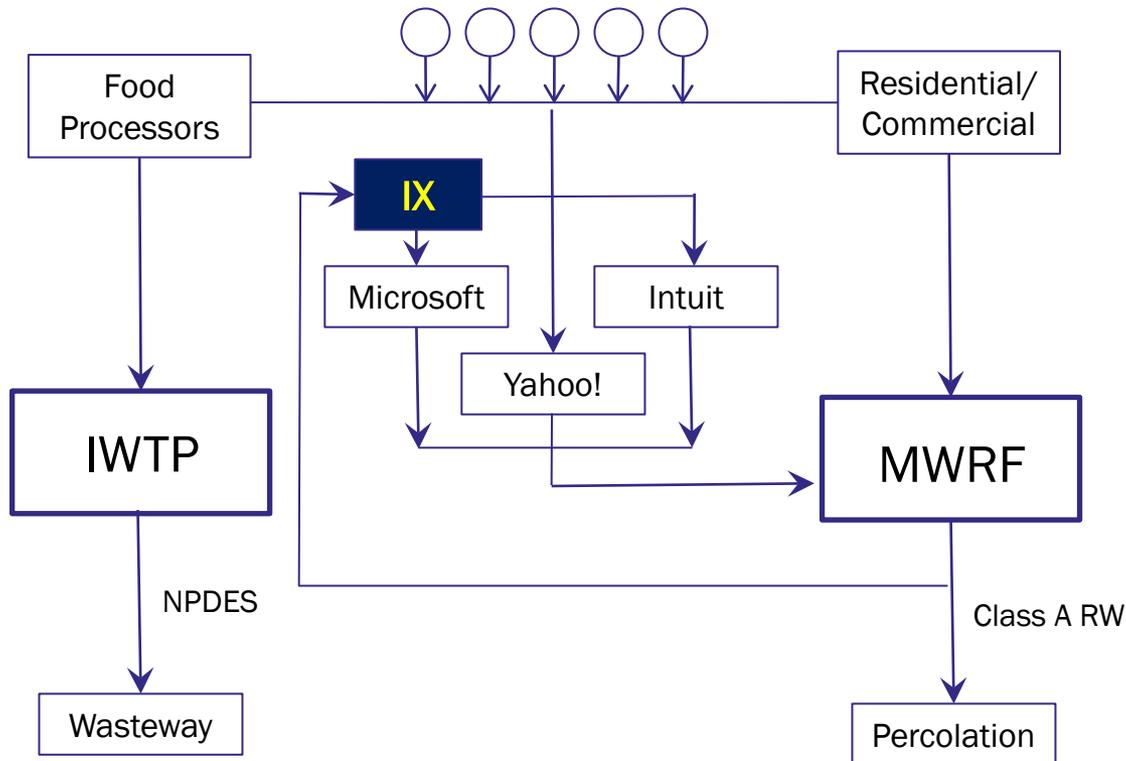
# Cooling Tower Cycles of Concentration



# Annual Variations and Cycles: Very High Projected Consumption and Peak Days

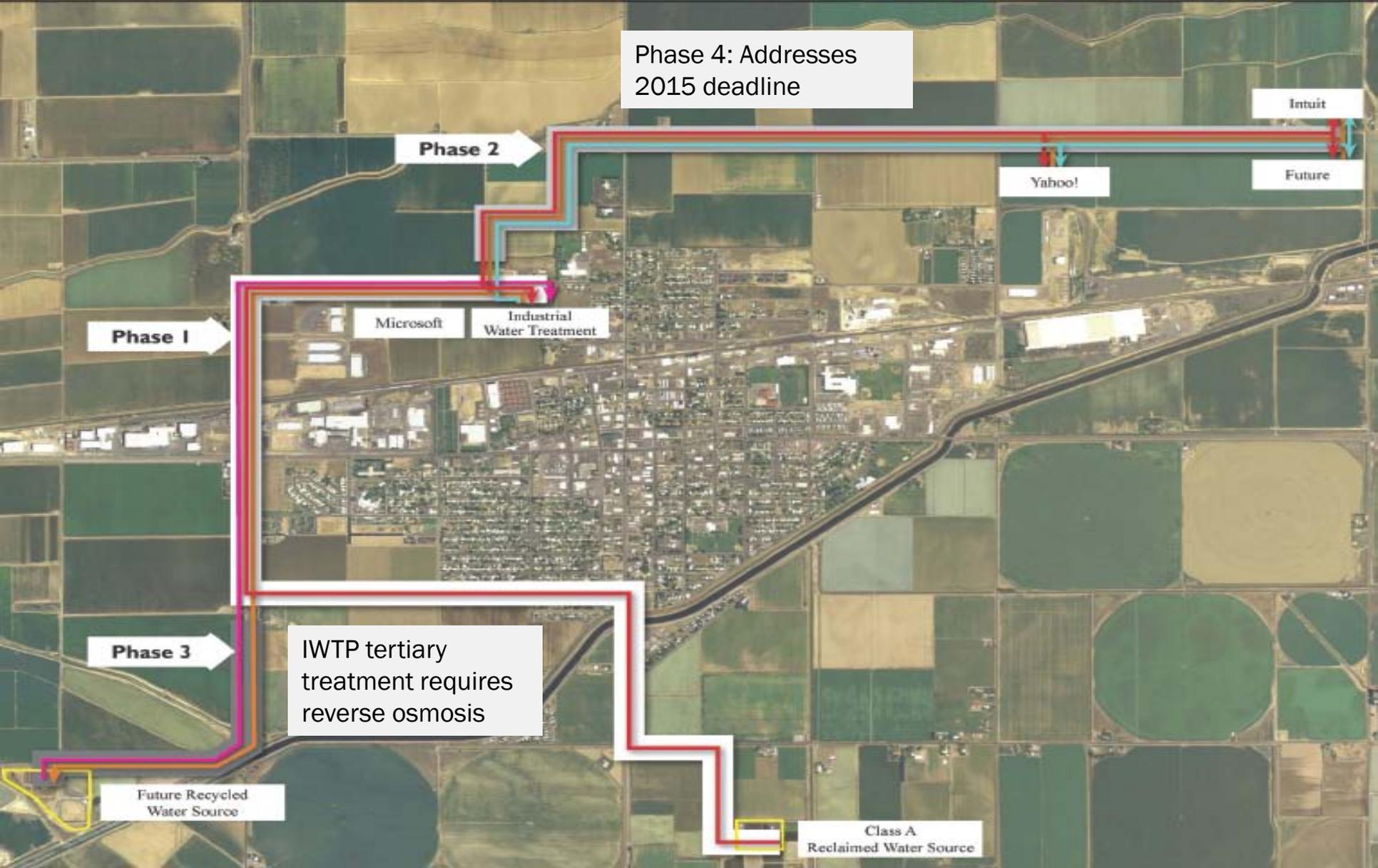


# 2007 – Back at Microsoft

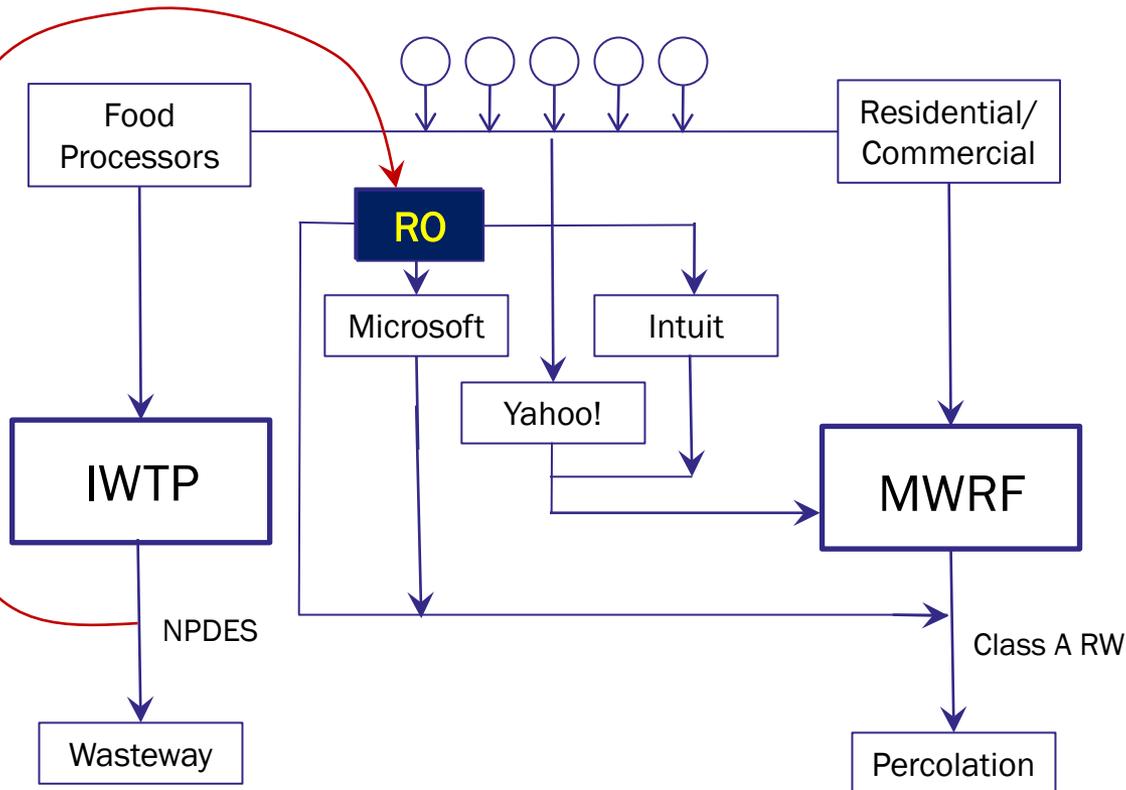


- Rapid response technology
- 200 gpm system, designed with room to expand to 500 gpm
- Compatible with reclaimed water
- Incorporated into Quincy feasibility study
- Use Class A Reclaimed Water as new source to data centers.
- Microsoft achieve near zero discharge to support other growth
- Develop brine management systems

# Phased Infrastructure Development



# 2010 – Reverse the Approach



———— Industrial Reuse Water

- Economic slowdown
- Server technologies advanced
- Cooling technologies advanced. Swamp coolers use 10% of what a chiller plant/cooling tower uses.
- No effects on MWRF operation except for TDS in aquifer
- Summary:
  - Less water strain
  - Less wastewater strain
- Advance the 2015 solution

# Industrial Reuse Water and Reverse Osmosis

- Definitions
  - Reclaimed water – sanitary wastewater source
  - Industrial recycling – no permitting
  - Industrial reuse water
- Industrial effluent as a source for municipal (POTW) use
  - Assuming application of Class A RW quality standards
  - Groundwater TDS anti-degradation rules apply
  - End user water quality requirements may be different from anti-degradation requirements
- RO required regardless of groundwater recharge method

# Industrial Reuse Water and Reverse Osmosis

- High TDS effluent from food processing
  - 1,300 to 1,500 ppm TDS (450 ppm groundwater)
  - 250 ppm hardness
  - 550 ppm bicarbonate alkalinity
  - 50 ppm Silica
  - 900 ppm as *KCl* and  $Na_2SO_4$
- Estimated blend
  - 100% to multimedia filtration
  - 70% to RO
  - Values above reduced by 2/3
  - Better than groundwater for industry

# Industrial Reuse Water and Reverse Osmosis

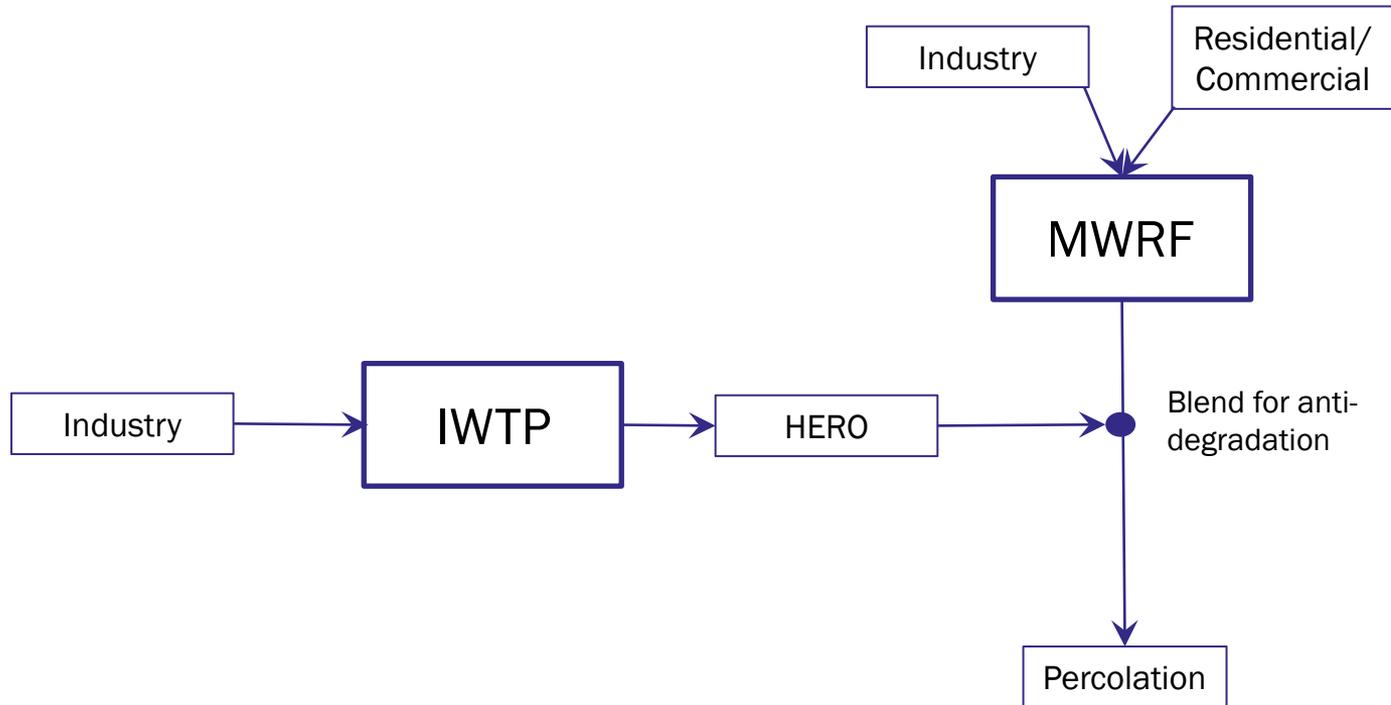
- High Efficiency Reverse Osmosis (HERO<sup>®</sup>)
  - 90% to 95% recovery (low reject volume ). ~65% with no pretreatment
  - Pretreatment Fundamentals
    - Soften to < 0.1 ppm hardness
    - Decarbonate – drop pH, gas strip
    - Raise pH to 10.5 – 11.0 and feed RO
      - Keeps silica soluble in absence of hardness
      - Keeps organics highly emulsified and improves flux
- Compatible with activated sludge system secondary effluent

# The loop is closing in Quincy...

- November 2010: Industry presentation
- October 2011: Water services and lease agreement in place with Microsoft
- Convert their IX system (6 columns) to water softeners for HERO system
- Facility also has evaporation ponds, floor space, water well and stand pipe
- Economy of scale benefits
- End of 2012: Master Plan due to Ecology (lead agency)



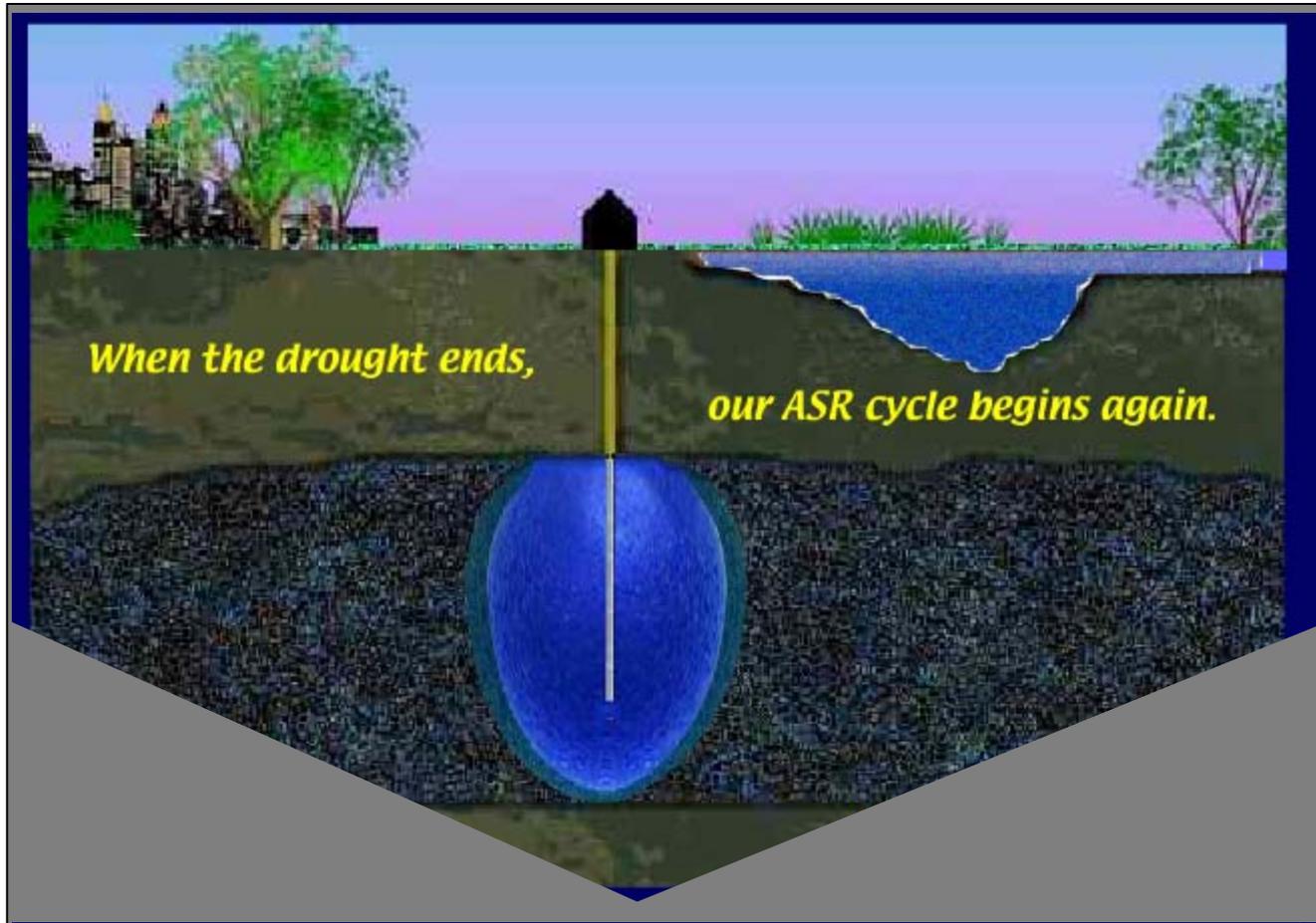
# 2012- The Simple View



# The loop is closing in Quincy...

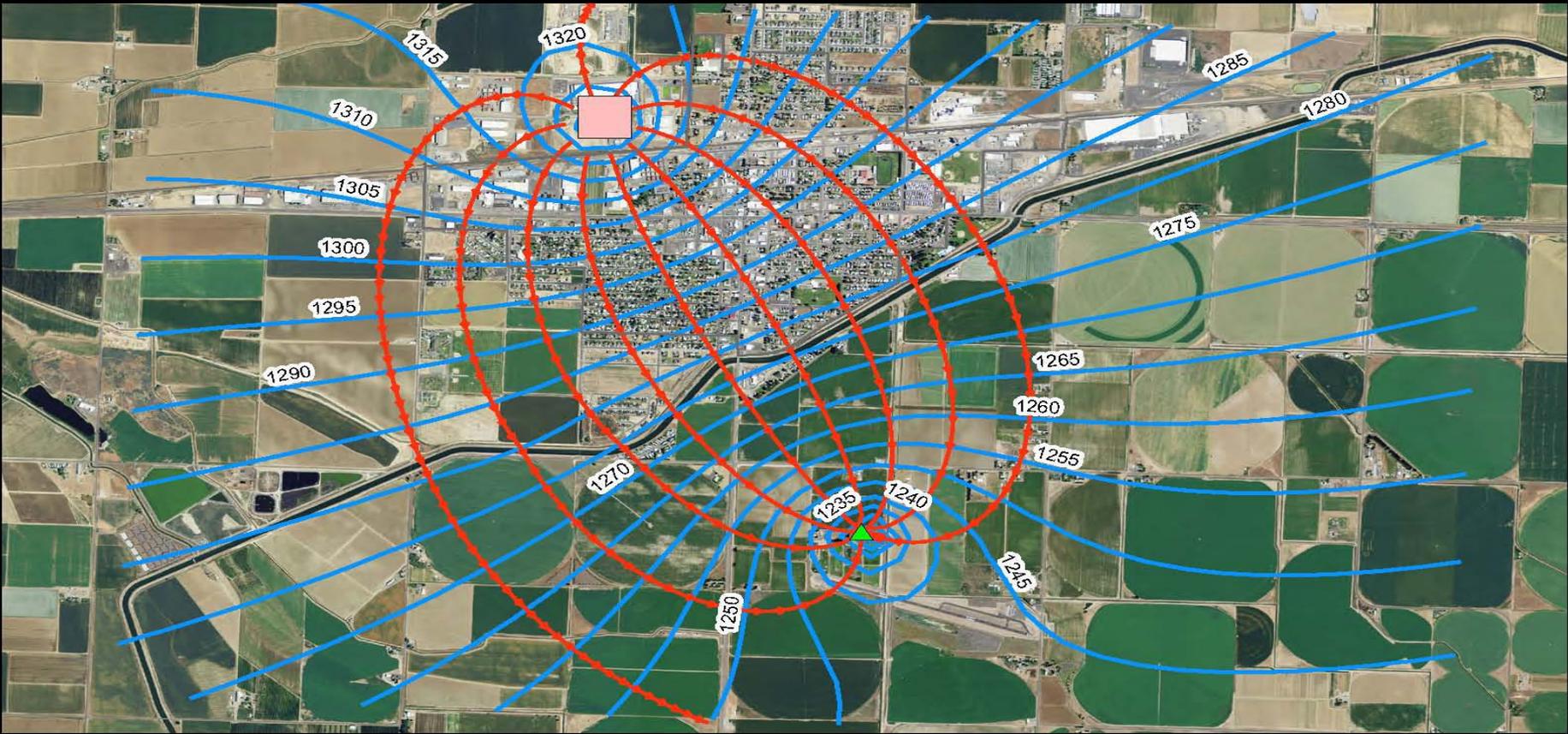
- Reverse osmosis ‘by default’
- Explore resource recovery in addition to piped distribution
- Aquifer storage and recover of wastewater
- Screening level analysis of shallow and deep aquifer management zones
  - Percolation (blended)
  - Direct injection of RO-treated water
- Keep track of where it’s stored
  - Travel time and distance

# Aquifer Storage and Recovery



Adapted from the ASR Forum website  
([www.asrforum.com](http://www.asrforum.com))

# Percolation and Down-gradient Withdraw



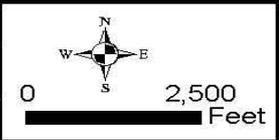
**Explanation**

- Infiltration Basin Cluster
- Groundwater Elevation Contours (ft amsl)
- Recovery Well
- Groundwater Particle Traces (one arrow = 1 yr ToT)

Notes:  
 1. Projection: UTM Zone 11, 1983 North American Datum  
 2. Aerial Photo Taken September 29, 2011 by USDA



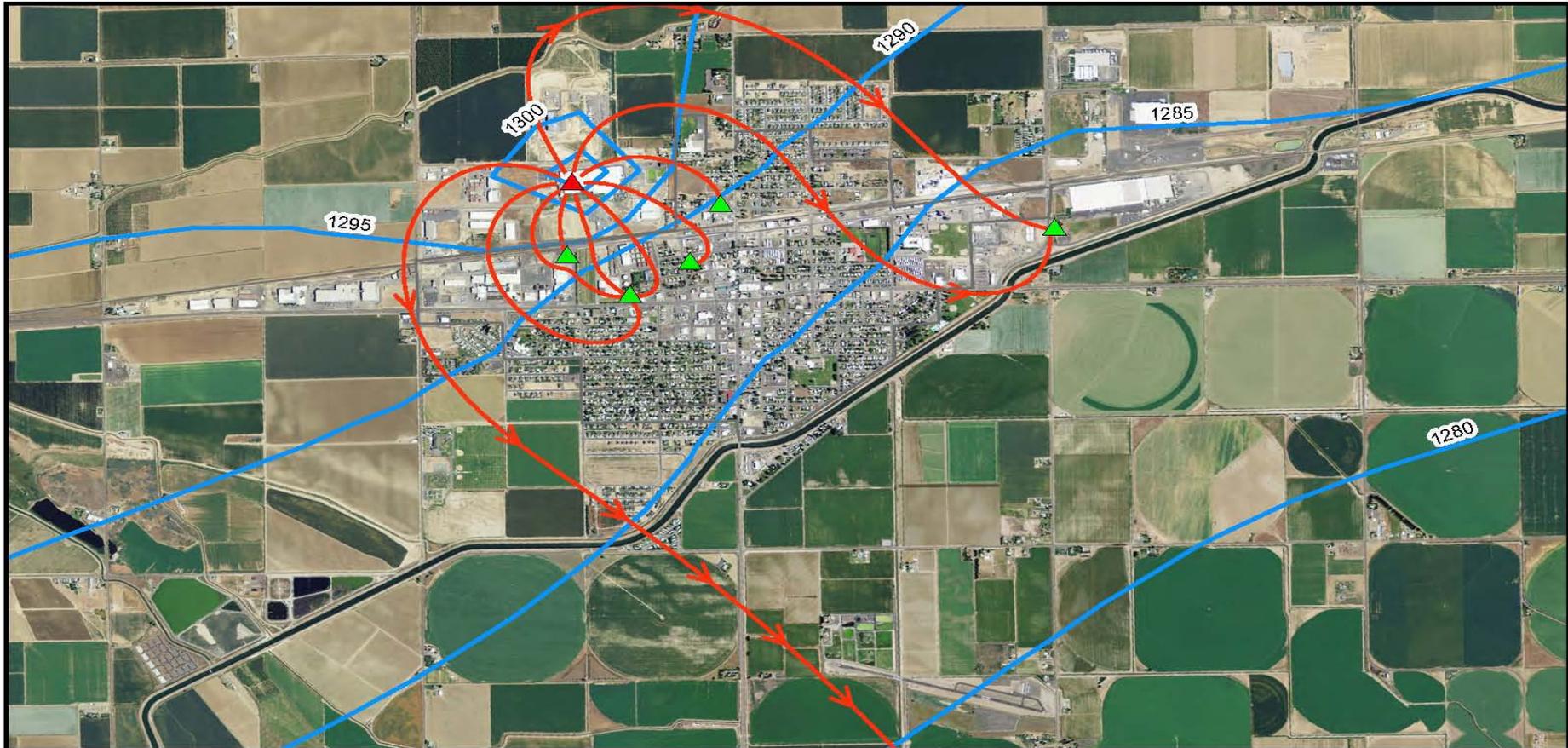
Date: November 2011  
 City of Quincy  
 Project: 141200



Quincy,  
 Grant County,  
 Washington

Scenario 2B. Overburden infiltration northwest of the with recovery well at the MWRF including the effects of West Canal

# Direction injection to deep aquifer



## Explanation

- ▲ ASR Well
- Groundwater Elevation Contours (ft amsl)
- ▲ City of Quincy Wells
- Groundwater Particle Traces (one arrow = 1 yr ToT)

## Notes:

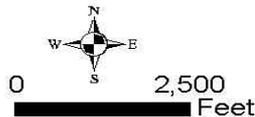
1. Projection: UTM Zone 11, 1983 North American Datum
2. Aerial Photo Taken September 29, 2011 by USDA

**Brown AND Caldwell**

Date: November 2011

City of Quincy

Project: 141200



Quincy,  
Grant County,  
Washington

Scenario 5A. Injection into the Frenchman Springs aquifer northwest of the city with city wells pumping 4 MGD

# Summary

In Quincy, 'land locked' and with a small-population, where municipal infrastructure demands by industry are significantly larger than those of the residents, the infrastructure takes on traits that advance the ability of Quincy to close the loop.