This presentation premiered at WaterSmart Innovations

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Deficit Irrigation Strategies for Drought Response in Landscapes and Profit Maximization in Agriculture

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Presentation / discussion:

- What is deficit irrigation?
- Deficit irrigation in landscapes.
- Deficit irrigation in agriculture.
- Strategies.
- Discussion / questions.

Deficit irrigation …

Irrigation that allows stress in a significant fraction of the (field) at times during the season. – Marshall English, Univ. of Oregon

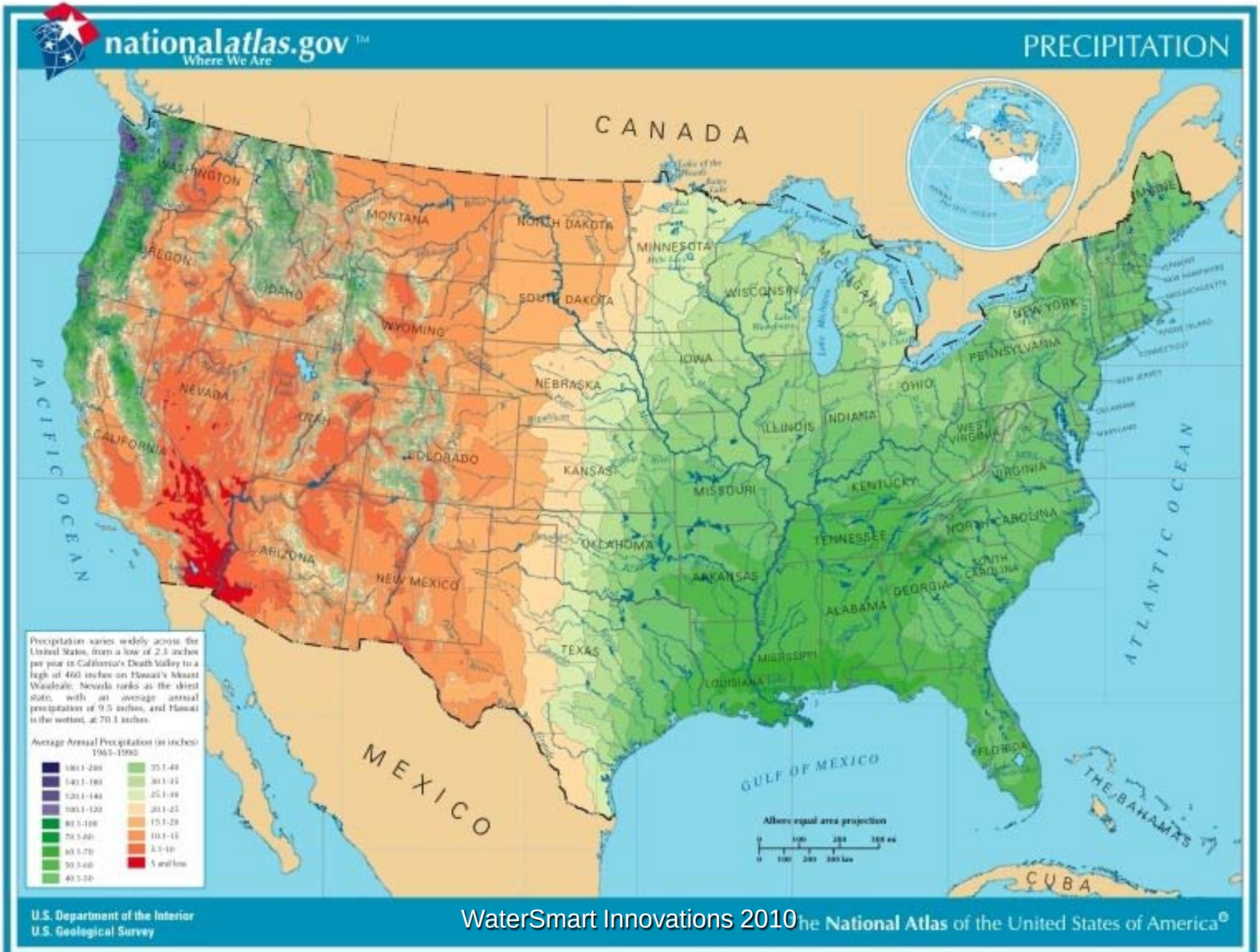
Irrigation at a level under the expectation of reduced crop yield with economics justifying the deficit. -- Freddie Lamb, Kansas State Univ.

Deliberately tolerating stress for maximizing the productivity of water. -- Sam Geerts, Univ. of Leuven, Belgium

Landscapes

The premise is ...

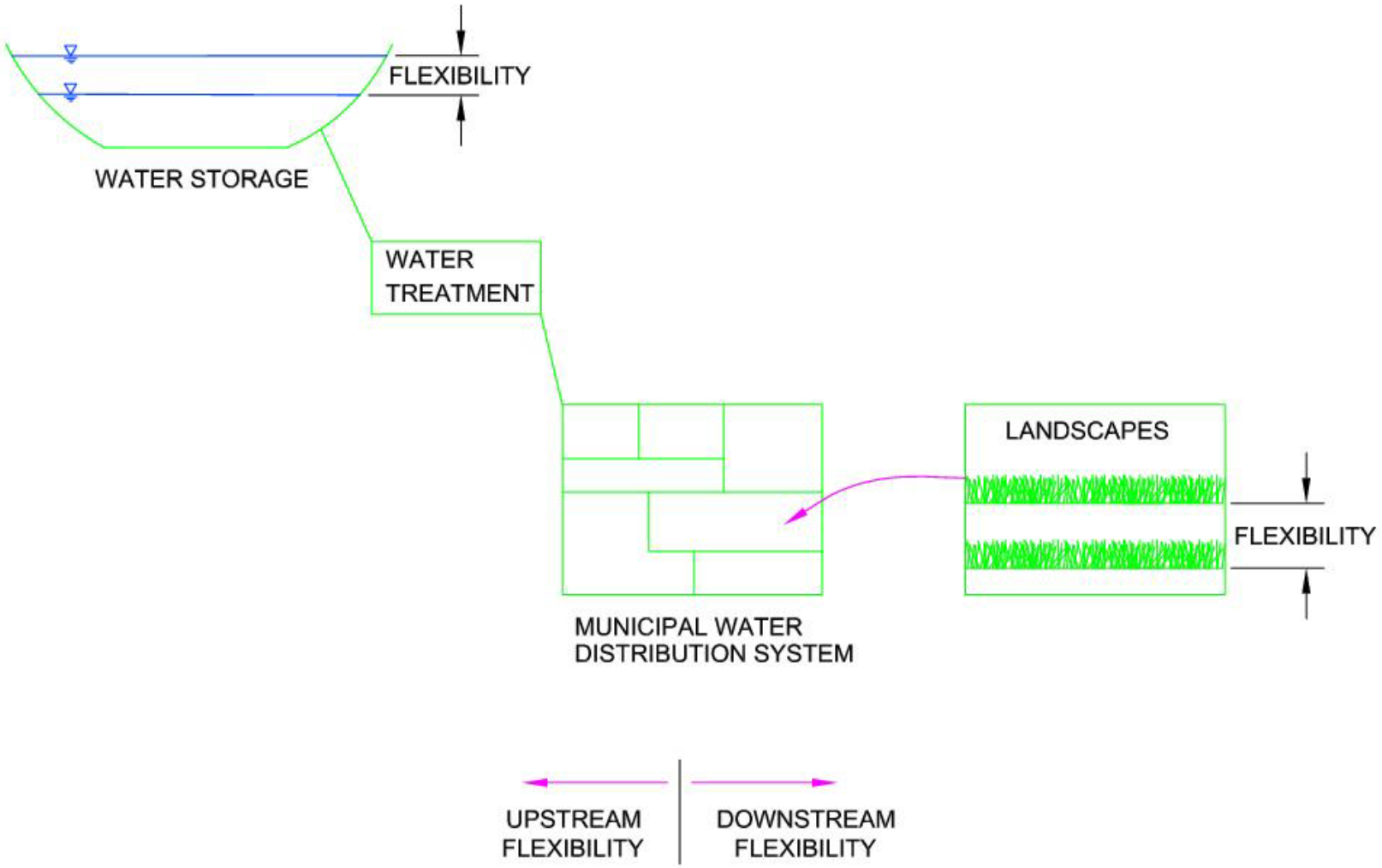
landscapes can provide highly desirable flexibility in dealing with drought, or other water shortage, and the magnitude of the response can be directly related to the magnitude of the event.



WaterSmart Innovations 2010

Municipalities and water districts evaluate water supplies on the basis of “safe yield” … safe yield is the amount of water that can likely be delivered considering analysis of a suitable hydrologic period – generally 50 years.

The answer to the safe yield question includes potable water for landscape irrigation. Should it?


FLEXIBILITY
WATER STORAGE
WATER
TREATMENT
LANDSCAPES
FLEXIBILITY
MUNICIPAL WATER
DISTRIBUTION SYSTEM
UPSTREAM
FLEXIBILITY
DOWNSTREAM
FLEXIBILITY

Characterization of flexible and adaptable landscapes ...

Can this flexibility be used on the output / delivery (demand) end of the system much like reservoirs are used on the inflow / storage side of the system?


sprinkler irrigated cool season grass
drip irrigated wind break
supplementally irrigated native grasses
sprinkler and drip irrigated home garden
unirrigated native grasses

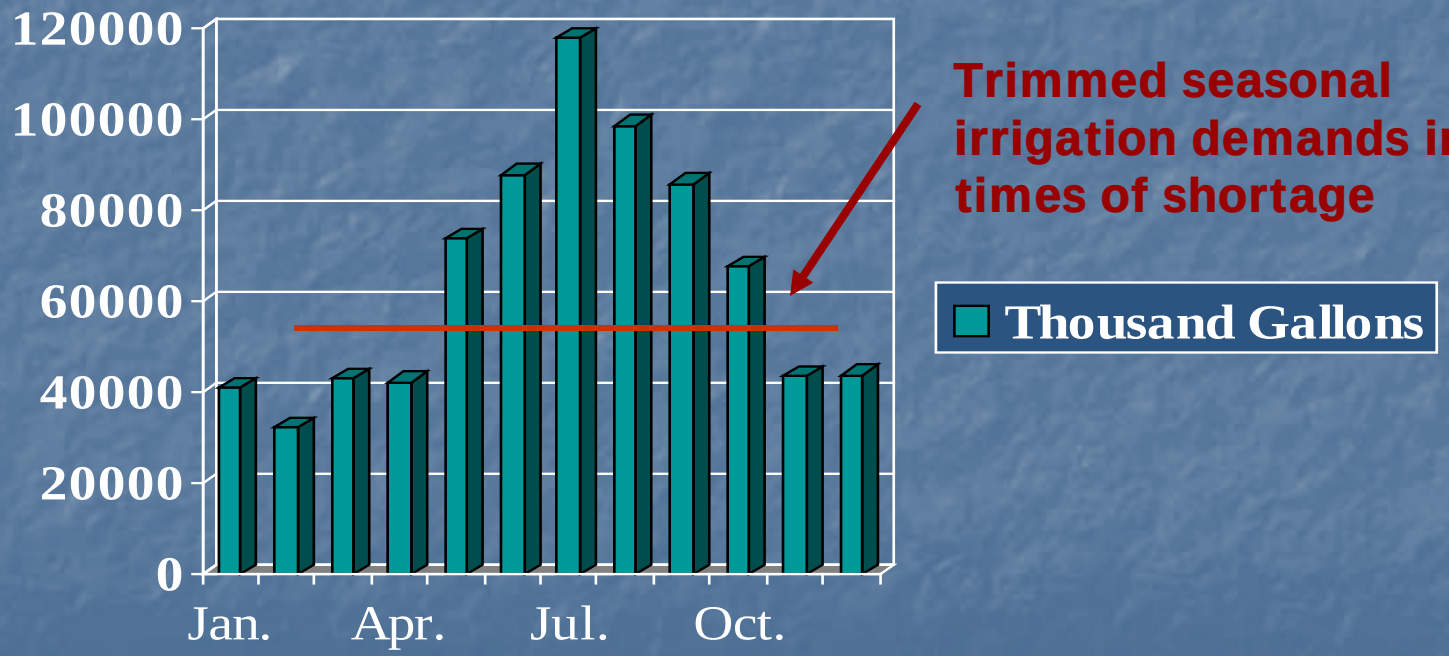
Considerations are logically:

- Combination of efficient methods.
- Suitable control scheme.
- Management / scheduling scheme.
- Plan for shortage – drought response plan.

Drought Triggers and Response by Threshold

Storage at July 1st	Drought Stage	Water Savings Target	Restriction	Probable Restriction	Notes / Staff Action
100%	0	Unrestricted, normal use	No restriction	none	Customer mailings advise of policy matters and service area happenings.
90%	1	5% reduction from normal use	Voluntary restrictions	Customers asked to conserve.	Drought education mailings are initiated. Staff contacts blatant policy violators.
80%	2	10% reduction from normal use	Voluntary restrictions	Customers asked to carefully monitor irrigation and avoid waste.	Educational mailings concerning irrigation scheduling and sprinkler application rates.
70%	3	20% reduction from normal use	Mandatory restrictions	Residential customers limited to 3 days per week by house number. Parks irrigation decreased on low public use areas. Golf course roughs are not irrigated.	Additional staff assigned to monitor and contact violators.
60%	4	30% reduction from normal use	Mandatory restrictions	Residential irrigation limited to 2 days per week by house number. Parks irrigation limited to high use areas and sports fields. Golf course fairways are deficit irrigated.	Fines imposed for water wastage or irrigation outside of imposed restrictions.

Great products, great control systems, great designs … technology at its finest …. So let's use it!



Agriculture

Water rights:

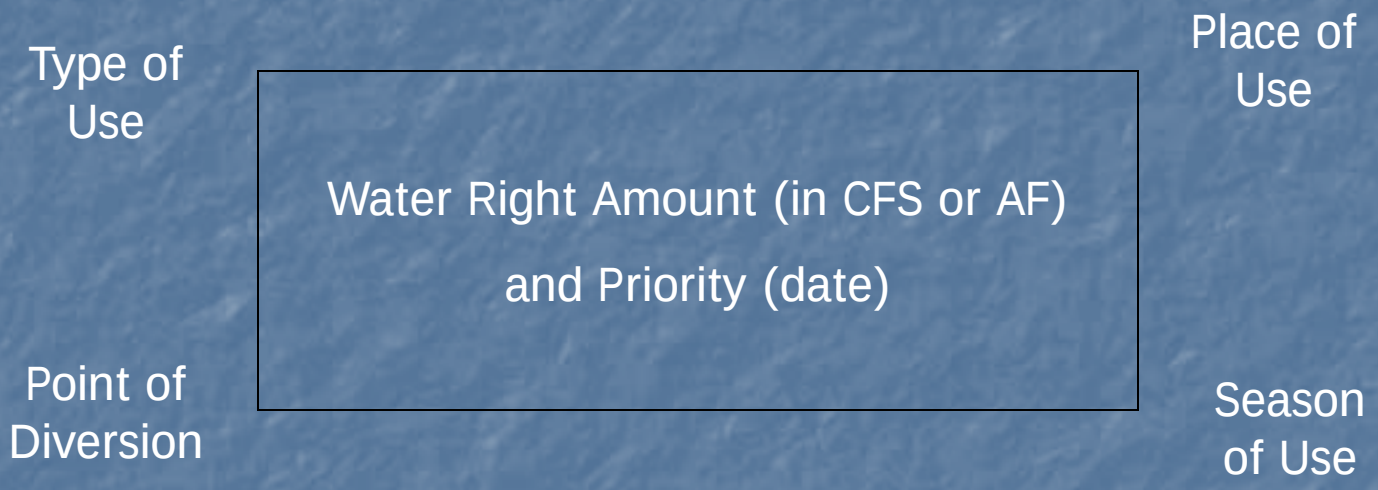
- 19 western states operate under prior appropriation as the legal doctrine.
- The real water right is based on the quantified historic consumptive use (particularly true in CO and becoming recognized in other states).

Ag to urban water transfers:

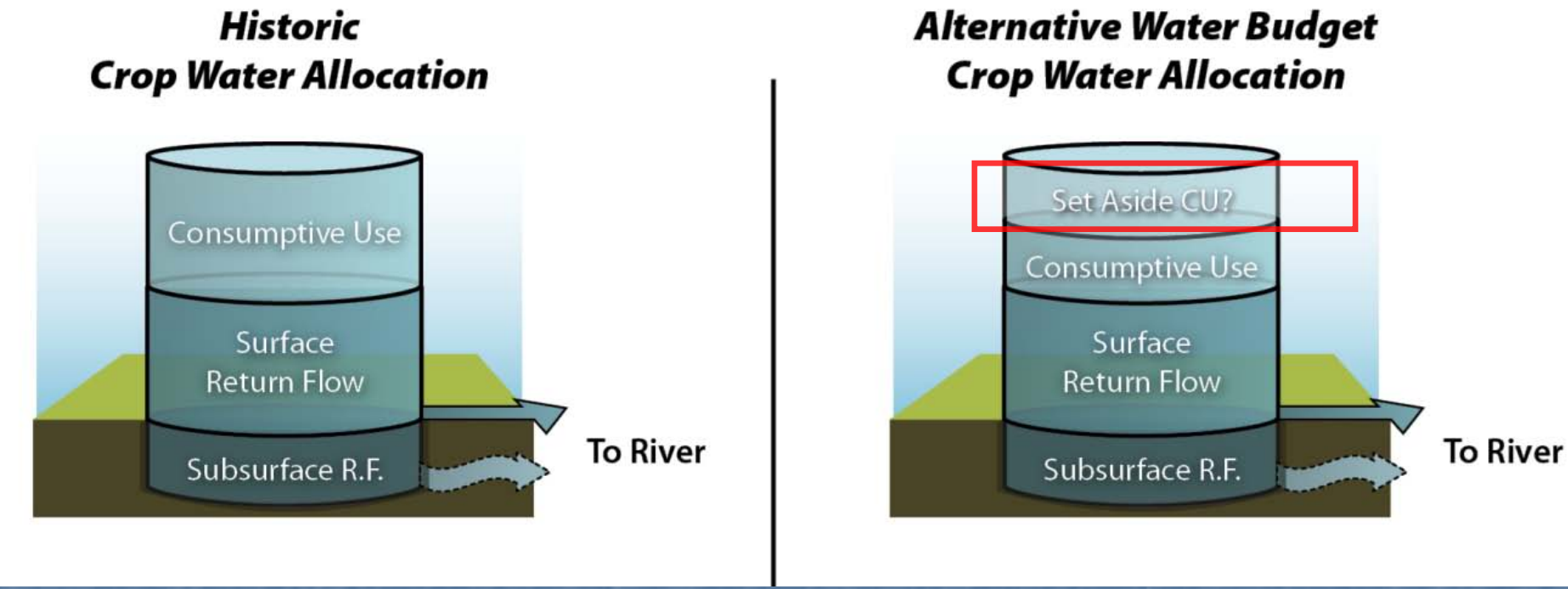
- Driven by population growth and municipal interests in developing a safe yield with their water supplies.
- Often accomplished with “buy and dry” strategies.
- Can we avoid “buy and dry”, allow a farmer to part off a portion of their CU, encourage sustainable farming, etc.?
- Some farmers will evaluate their future practices as a CU water budget and ask themselves if they wish to adopt a package of changed practices in order to see a new and relatively low risk revenue stream added into their existing operations.

Is a change of water right necessary?

Direct Flow or Storage Water Right

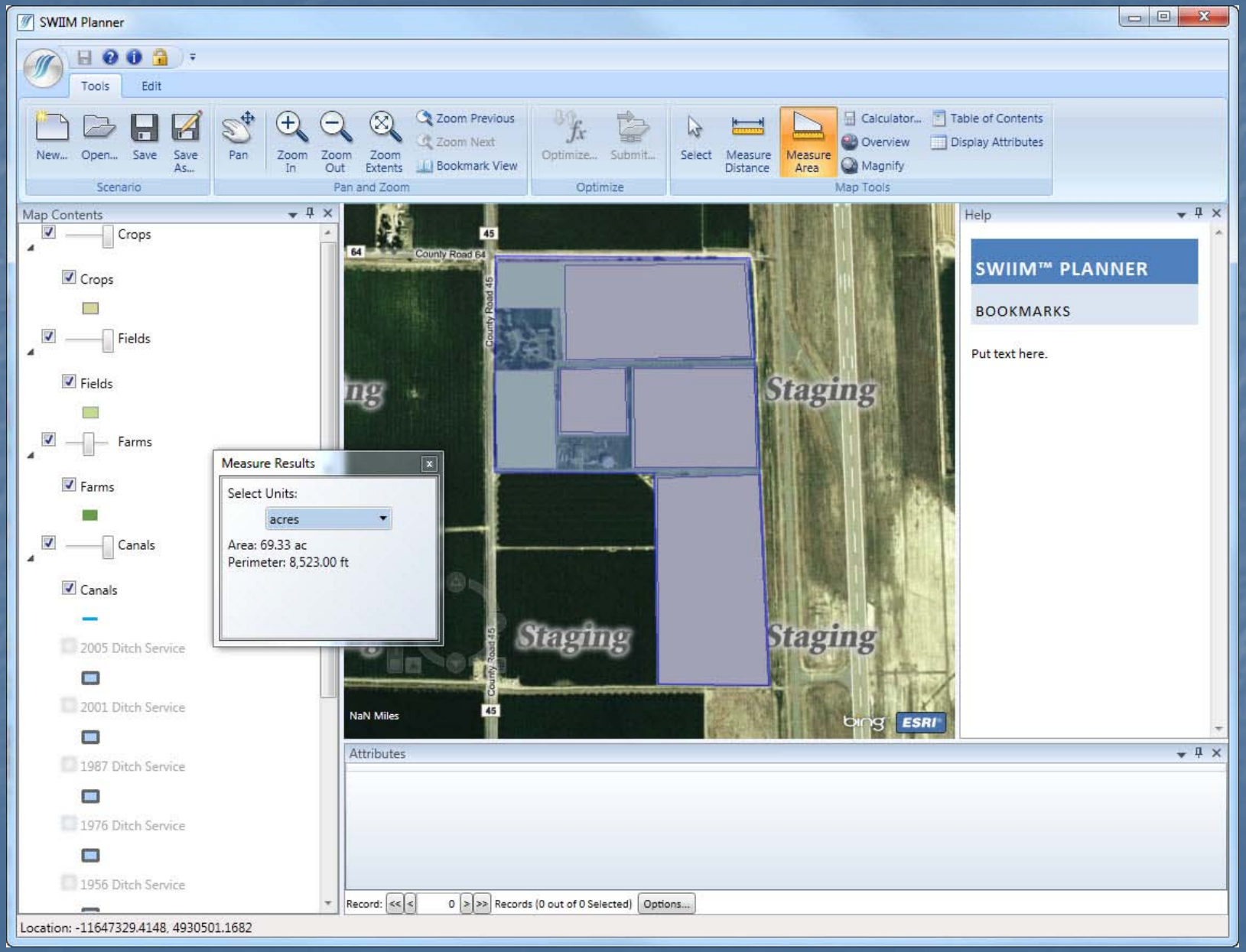


No change is necessary within the boundaries of the water right: same point of diversion, type, place and season of use.

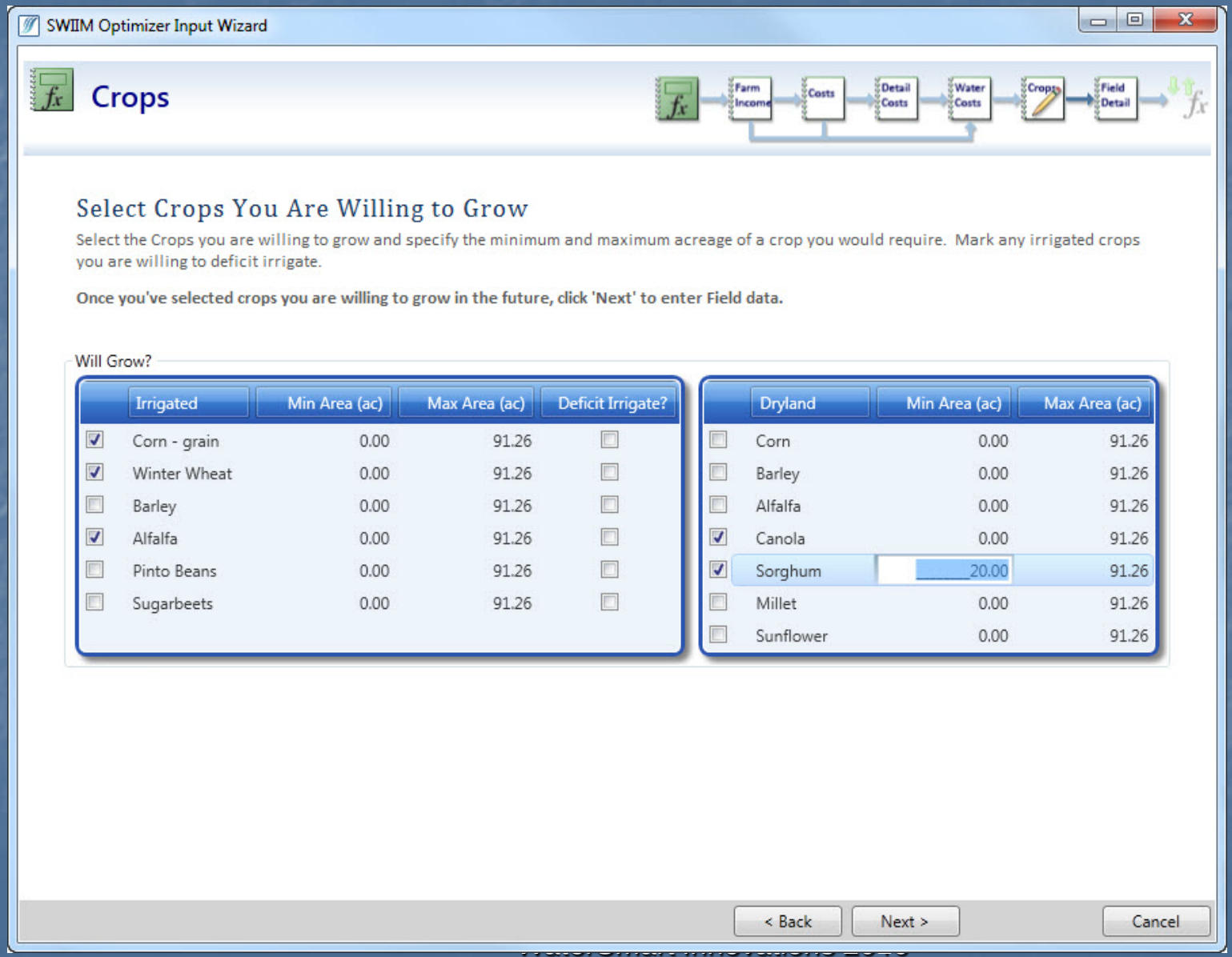


As a farmer, do you want to consider selling or leasing a portion of your decreed consumptive use water to a higher economic demand?

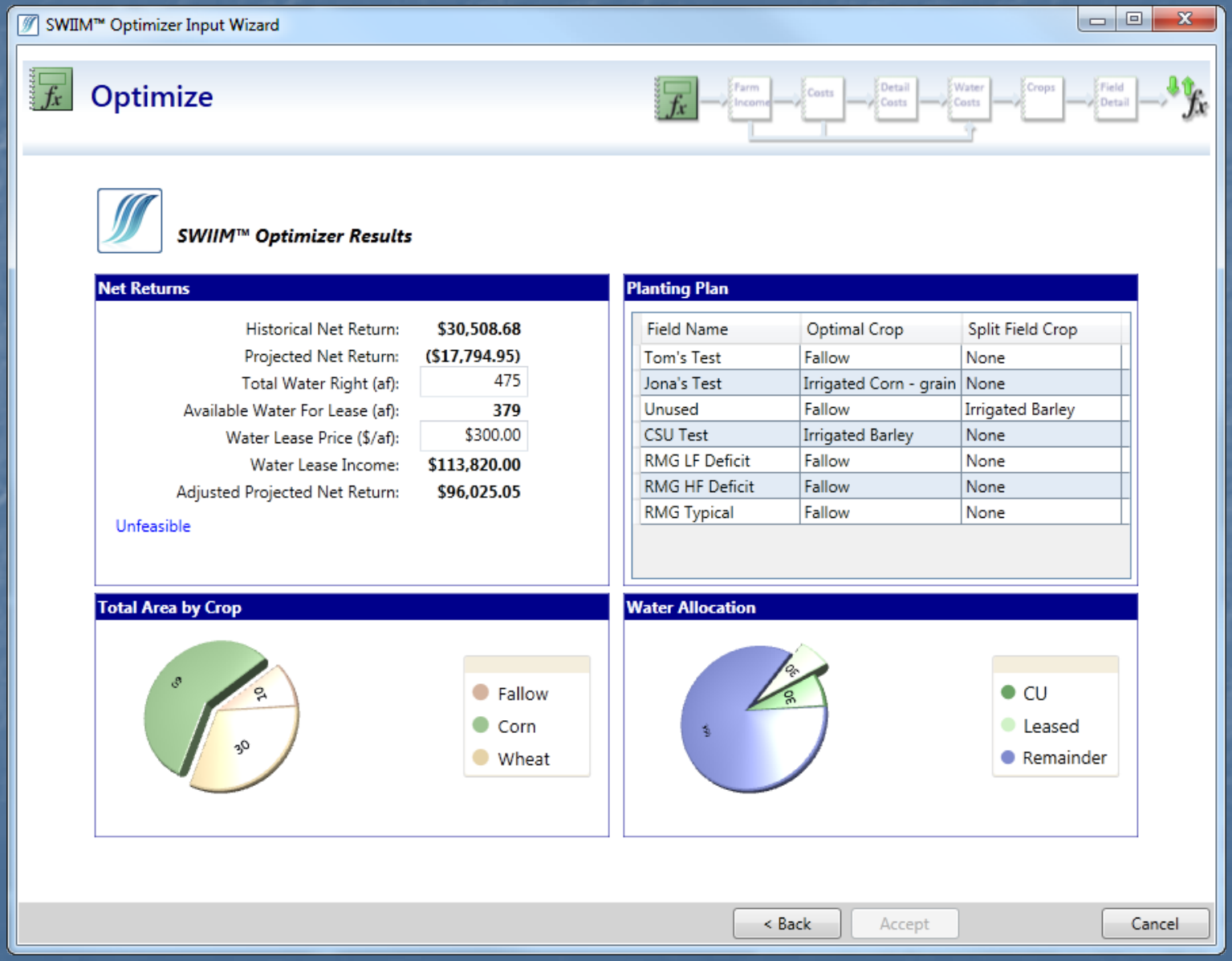
Planning and optimizing – GIS date input:



Planning and optimizing – strategy input:



Planning and optimizing – output reports:

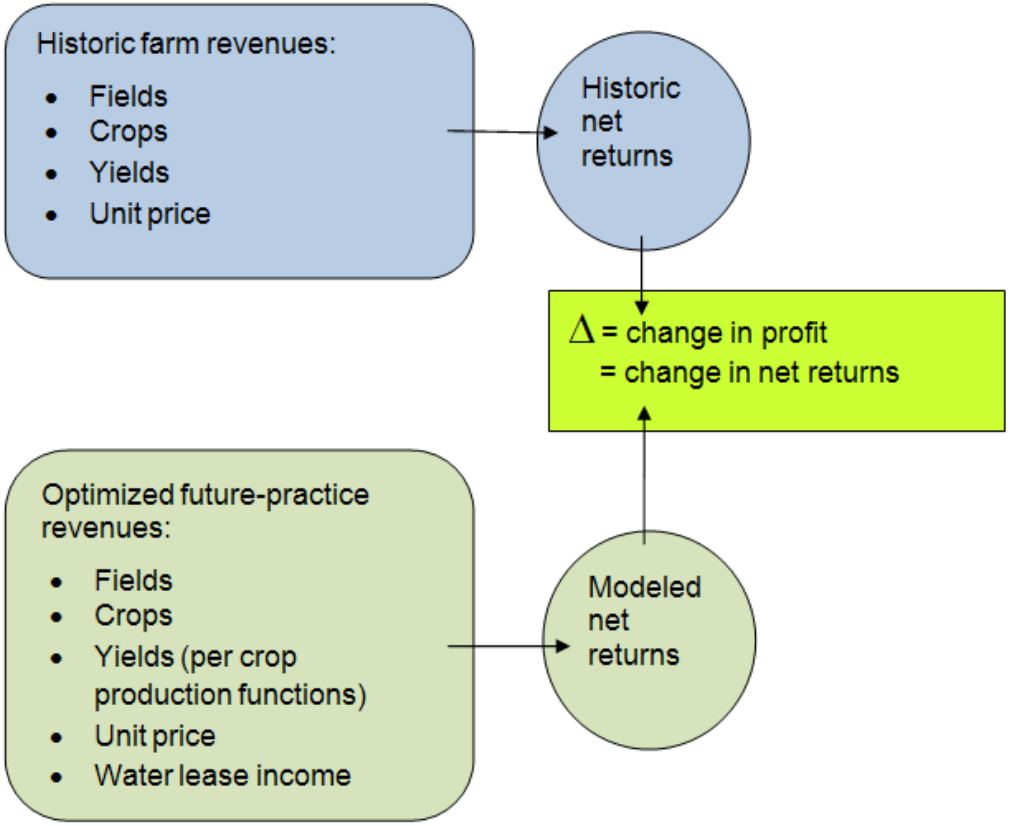


Planning and Optimizing:

- Optimization (linear programming) based on farmer inputs.
- Report / output on optimization results.
- Evaluation and comparison of alternatives based on evaluating historic and future net returns.

Net Returns = Revenue – Operating Costs

Planning and optimizing:



Net Returns = Revenue – Operating Costs

Notes:
1) Operating costs are those costs that will change with a change in practices.
2) Fixed costs that do not change with changed practices are not considered in the analysis.

Changed practices for consideration:

- Deficit irrigation of selected crops.
- Crop rotations.
- Introduction of new crops including perennial crops.
- Permanent fallowing or rotational fallowing.
- Introduction of dryland crops.
- Continued full irrigation of selected crops.
- Combinations of the above.


Full Irrigation
Low Frequency Deficit Irrigation
Research is establishing the yield difference and the crop production functions for key crops.

Sustainable Water and Innovative Irrigation Management™ (SWIIM™) Field Research Project

Corn samples from the research site - August 2010

Sample # 1 **#2** **#3**

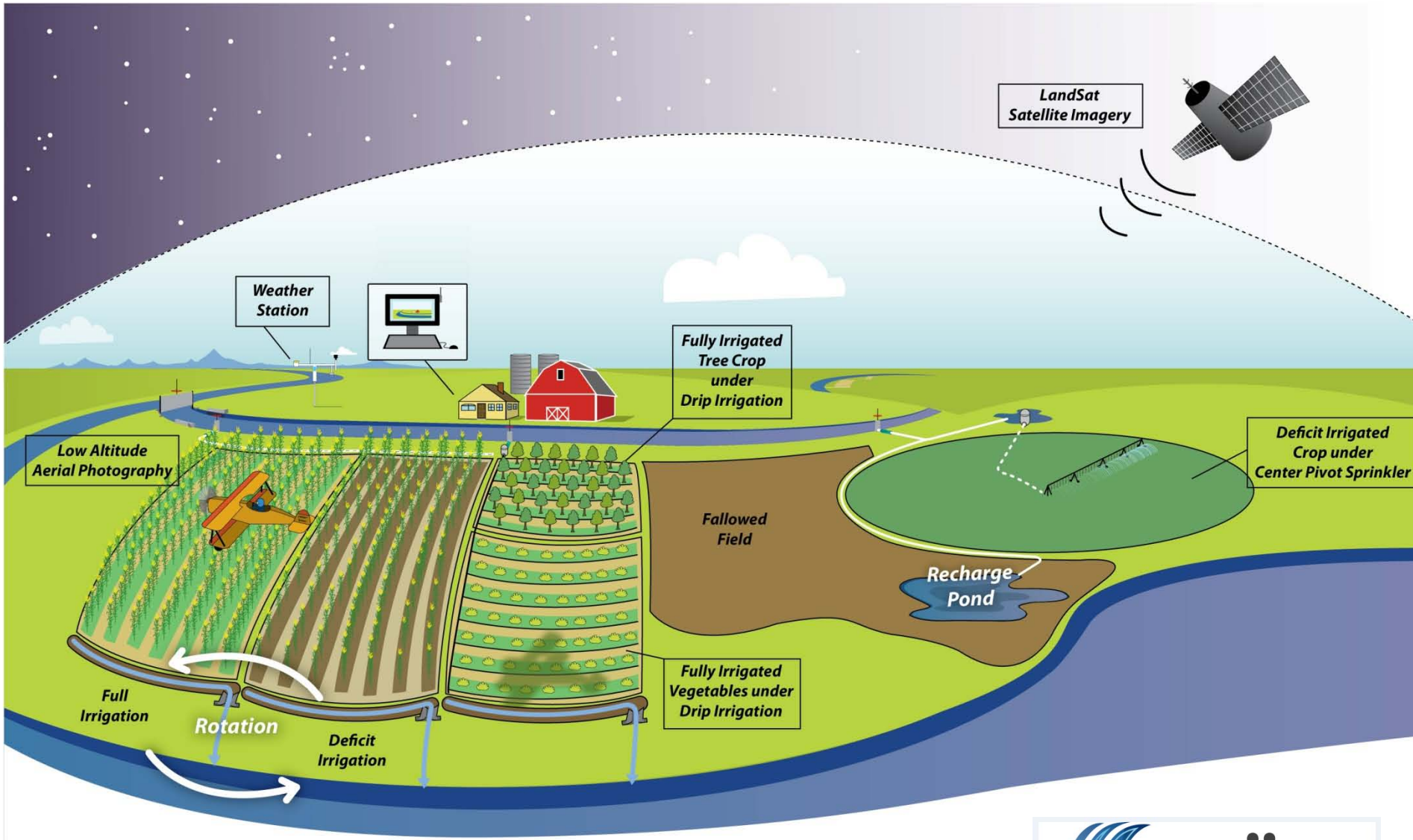
Corn ear sample #1 was taken from Treatment #1 (the fully-irrigated section of the site). Samples #2 and #3 were taken from the middle of Treatment #2 (deficit irrigation), and represents a significant reduction in application of water to the corn.

Based upon the approximate number of kernels in a row, the yield reduction between the fully-irrigated plots and the stressed plots are tentatively estimated at 10 to 15 percent.

USDA Agricultural Research Service | Colorado State University | Regenesis Management Group | swiim

Implementation:

- Internet delivery, server based.
- Comprehensive database.
- Planning for the coming year (perspective of ditch company or new farmer cooperative).
- Real time monitoring (delivery flows, return flows, soil moisture levels, stress verifications).
- Ground truth and record of plant stress.
- Projections and irrigation scheduling during the season.
- Reports to farm management.
- Reports to SEO.



swiim™
SUSTAINABLE WATER & INNOVATIVE IRRIGATION MANAGEMENT ™

Instrumentation:

- Weather stations.
- Soil moisture monitoring.
- Ground truth for stress conditions.
- Comprehensive flow measurements (deliveries and tailwater returns).

Unknowns:

- Can municipal interests see a long term lease as a viable part of their water portfolio and their safe yield?
- Can the science underpin the strategy sufficiently to satisfy objectors and the Water Court?
- Can farmers accept the perceived dramatic changes to their operations?

"I don't know if I can deficit irrigate a crop. I just wasn't taught that way …"

2011 proof of concept strategy:

- Partner with a water right holder.
- Partner with a municipality or environmental interest.
- Procure and install instrumentation at project expense.
- Build a transferable CU block for 2011.
- Transfer water in 2011 as validation and water transfer proof of concept and hopefully set the stage for future transfers.

Summary:

- Landscapes offer water supply flexibility that we don’t fully appreciate.
- We desire sustainable agriculture considering the food supply (buy local) and sustaining the rural economy.

Summary:

- Opportunity varies around the U.S. – many circumstances – generally there is no one size fits all circumstance.
  - Water rights administration.
  - Water costs.
  - Public perceptions.
- Let's assume we desire maximum beneficial use of our water supply.
- We want, need, and appreciate our irrigated landscapes (ag and urban) – especially true in the arid west.

Questions / discussion ….

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