WaterSavr™

COVER & CONSERVE

Water Conservation Via Evaporation Control

Lake Elsinore and Canyon Lake Stakeholders Committee

October 2015

Flexible Solutions

cover and conserve

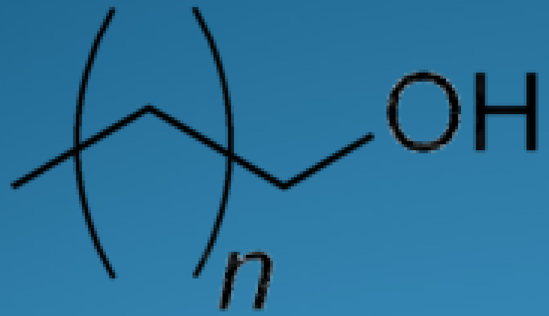
Company Background

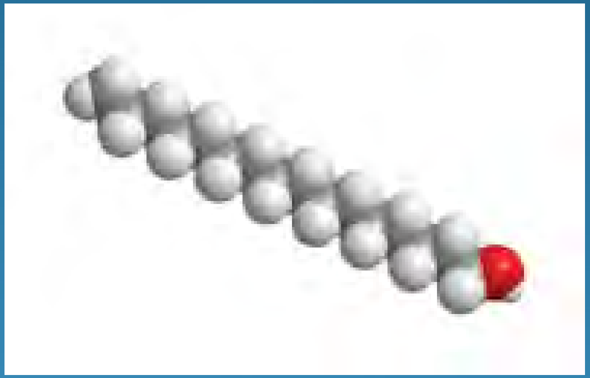
- Flexible Solution International - US Based Company in Bedford Park, Illinois and satellite office in Victoria, Canada
- Established 14 years ago and publicly listed on NYSE for 12 years.
- Three main divisions – Nanochems™, HeatSavr™, WaterSavr™
- Watersavr™ product made in the USA and warehoused in Illinois and Louisiana

What is WaterSavr™ ?

- Developed and Manufactured by Flexible Solutions under U.S. Pat 6,303,133 (global patents filed).
- The only commercially available method proven safe and economically viable for reducing evaporation on large potable reservoirs .
- Formula:
  - 10% Cetyl + Steryl Alcohols (Hexadecanol and Octadecanol) – Extract of Palm Oil.
  - 90 % Calcium Hydroxide (food grade hydrated lime)

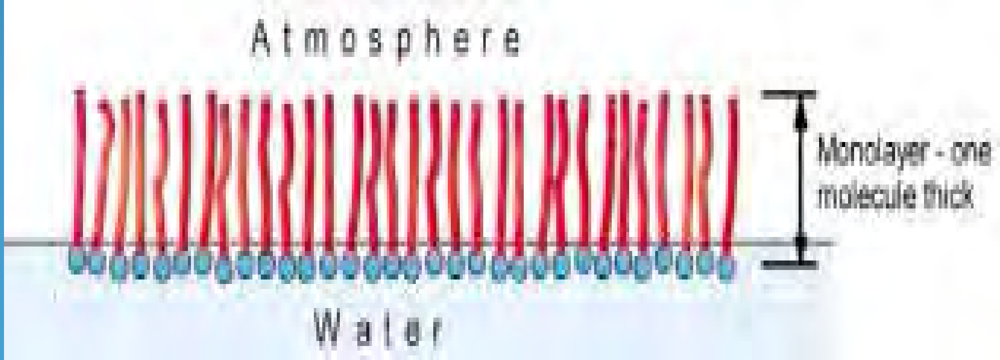
New monolayers required





Hexadecanol and Octadecanol $–CH_3(CH_2)_{15(17)}OH$

Insoluble Fatty Alcohols - Natural Coconut / Palm Sources



Demonstration of self spreading action 30 seconds later

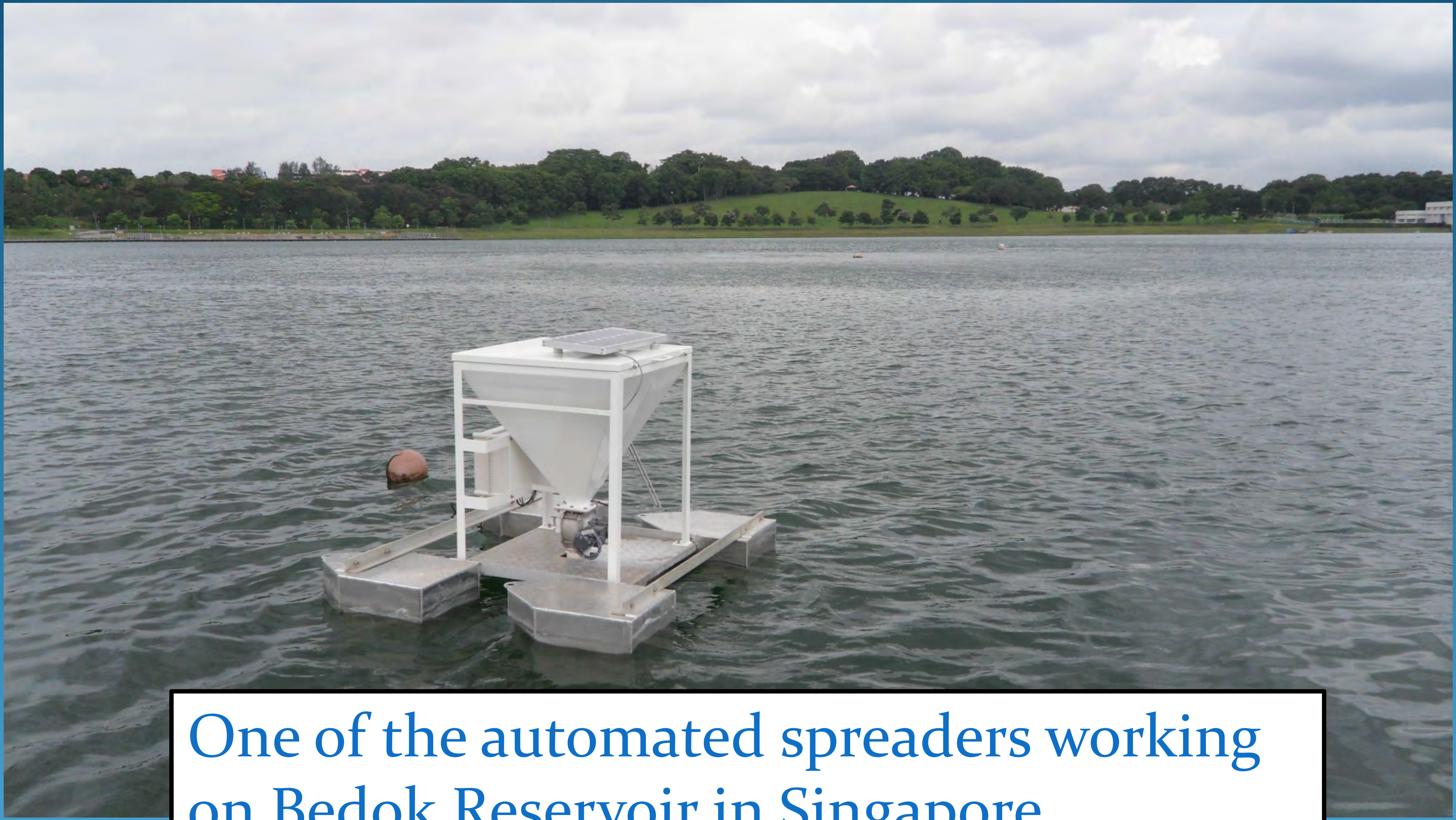
Photos courtesy of Coliban Water Australia

60 Seconds Later

Photos courtesy of Coliban Water Australia

How was WaterSavr™ spread?

Solar Powered anchored spreaders



One of the automated spreaders working on Bedok Reservoir in Singapore

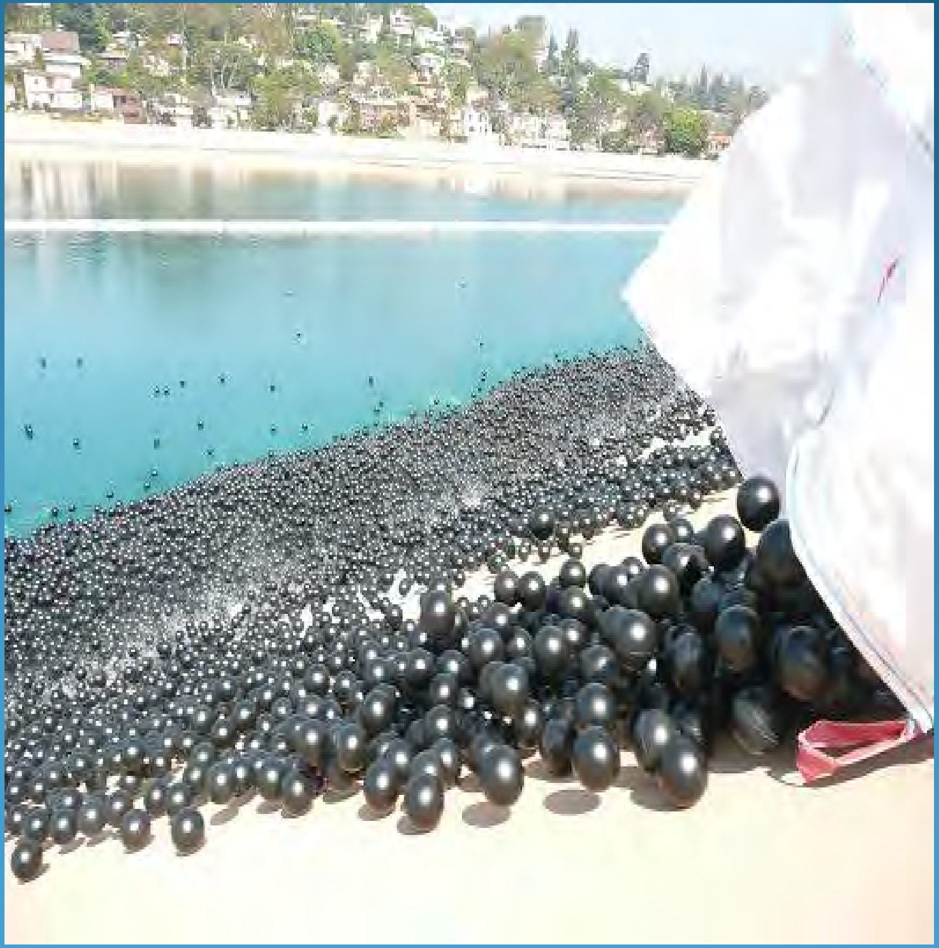
Spreading by boat – now doing 1000 acres per hour with new boat system

Is *WaterSavr* Safe?

- 90% of ingredients in formula is lime - used in Texas / California Water (ie: liming to balance PH levels)
- 10% of ingredients in formula is ceryl and steryl alcohol (ie: used in first aid cream, rubbing alcohol to disinfect human wounds, etc..)
- WaterSavr™ is NSF ANSI 60 Approved for potable water and drinking water treatment systems.
- Awarded for the United Nations Environment Program

  Fully biodegrades in 48 -72 hours
- EPA Gold Seal registered for application to reservoirs since 2005
- Approved for use by TCEQ in Texas – data available upon request

Other Evaporation Solutions-Physical Barriers



Various showcases done with WaterSavr™ around the world by various water authorities

- ✓2004 – Owens Lake, California (MWD)
- ✓2009 - Australia, Coliban Water (near Melbourne)
- ✓2010 - Singapore, Public Utility Board (rated as one of top water authorities in the world)
- ✓2011 - Turkey DSI (Federal agency for Turkey Water)
- ✓2012 / 13 – USA – South Nevada Water Authority (Las Vegas)
- ✓2014 – USA, TEXAS showcase by TWDB on 5600 acres drinking water

Results of trial by SNWA in Nevada

- Results were published in AWWA Journal March 2014 edition
- Overall conclusion show no changes in water quality
- Average savings of 30% of water evaporation based on trial

"Given our current price of water, our return on investment using WaterSavr™ has exceeded 500% prior to any rebate program. We are very satisfied with this expenditure and our board has just voted to use WaterSavr™ for 9 months in 2014, instead of the 6 months in 2013." Greg Toussaint, Chairman Lake Sahara

Approved by Nevada Fish and Wildlife and TWDB

- Lake Sahara contains endangered species protected by the Harbour Protection (ie: Razorback sucker fish)
- Lake Sahara is constantly monitored by various authorities while WaterSavr™ is being used and spread daily and showed no changes in water quality <u>over 4 years</u>
- Reviewed and approved by California Fish and Wildlife permit process started by and State Water Board

Expected savings at Lake Elsinore and Canyon Lake

- Current evaporation rates is 5 to 5.5 feet
- On 4100 acre (combined area of both lakes), that is 20,500 to 22,500 acre feet of evaporation loss per year
- **<u>This is 14,000 gallons per minute evaporating every day of the year (about 230 gallons per second!)</u>**
- WaterSavr™ can save at least 20% of that water

Expected cost of WaterSavr™ in Lake Elsinore and Canyon Lake

- Cost per acre foot of WaterSavr™, including spreading done by our team, will be less than $150 per acre foot
- Combined cost for both reservoirs for 4 months of application is less than $500,000
- Comparative cost of recycled water for non ag treated $407 per acre foot

Cost Benefits of WaterSavr™

- Including cost of product and spreading, the average water saving (using 20% saving) is less than $150 per acre foot.
- No major upfront costs and savings are immediate
- No long term contract if reservoir is full
- The cost of water using reuse water technology is over $400 per acre foot
- Savings of about $1 million between using WaterSavr™ vs recycled water (based on 3600 acre foot saved)

Status of WaterSavr™ in California

- Beginning General Permit process now
- Expecting Permit completion by March 2016
- Product available for Summer 2016

Q&A

- Flexible Solutions would be pleased to provide you with a complementary detailed cost analysis – including spreading costs - and how much water could be saved

Thank you

Flexible Solutions

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Long-Term Water Quality Simulations for Lake Elsinore: Effects of Supplementation with Recycled Water (v.2)

Michael Anderson

UC Riverside

Objectives

- Evaluate impacts of recycled water inputs on key water quality measures (chlorophyll a, DO, total N and total P concentrations) relative to no recycled water supplementation

Approach

- Extend previously developed DYRESM (Dynamic Reservoir Simulation Model) that quantified water budget and provides 1-D hydrodynamic/thermodynamic/salinity predictions
- CAEDYM (Computational Aquatic Ecosystem Dynamics Model) was linked to DYRESM model to predict water quality and ecological properties of lake
- Period from 1916-2014 simulated using LEMP basin and meteorological and runoff data for this interval as described in Tech Memo 1.1

Water quality model was calibrated against available 2000-2014 data

Influent concentration data were taken from a range of sources

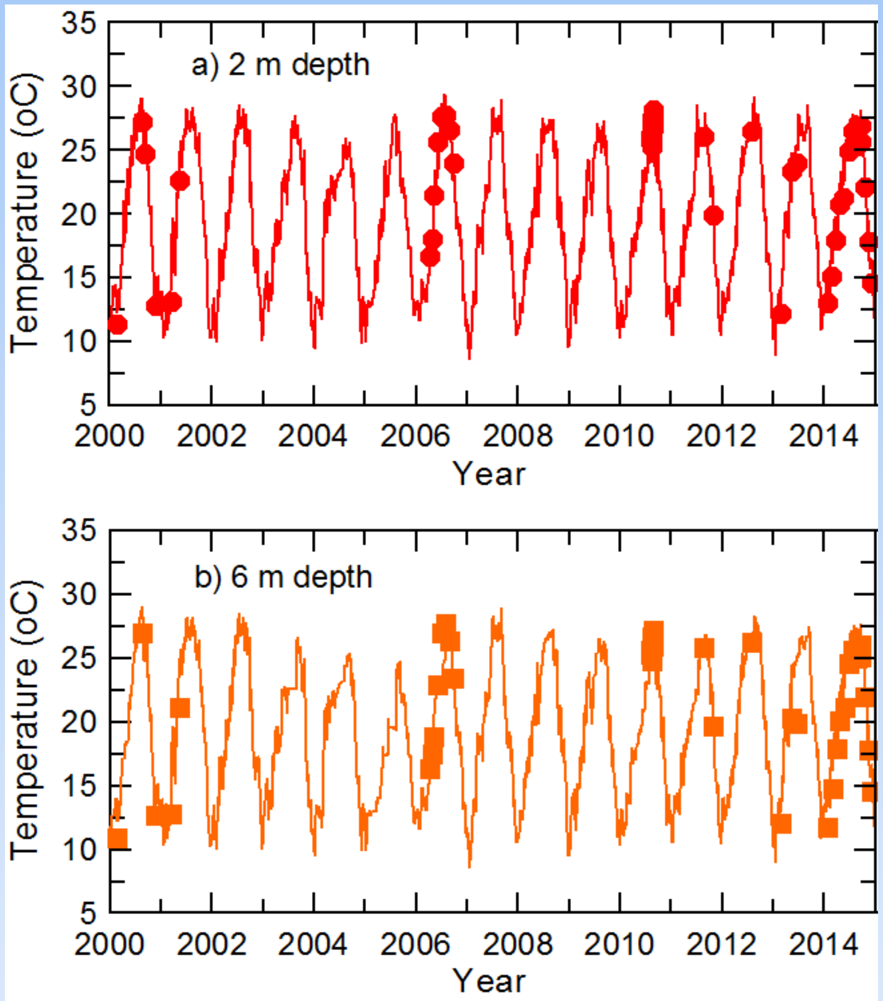
Source	TDS (mg/L)	PO4-P (mg/L)	Total P (mg/L)	NH4-N (mg/L)	NO3-N (mg/L)	Total N (mg/L)
San Jacinto R	310	0.28	0.50	0.22	0.57	1.62
Local Runoff	150	0.20	0.48	0.22	0.80	1.82
Recycled H_2O	705	0.32	0.41	0.36	1.62	2.87

Default values were used for nearly all model parameters; a few parameters were adjusted to reflect observed conditions in lake

Model Calibration

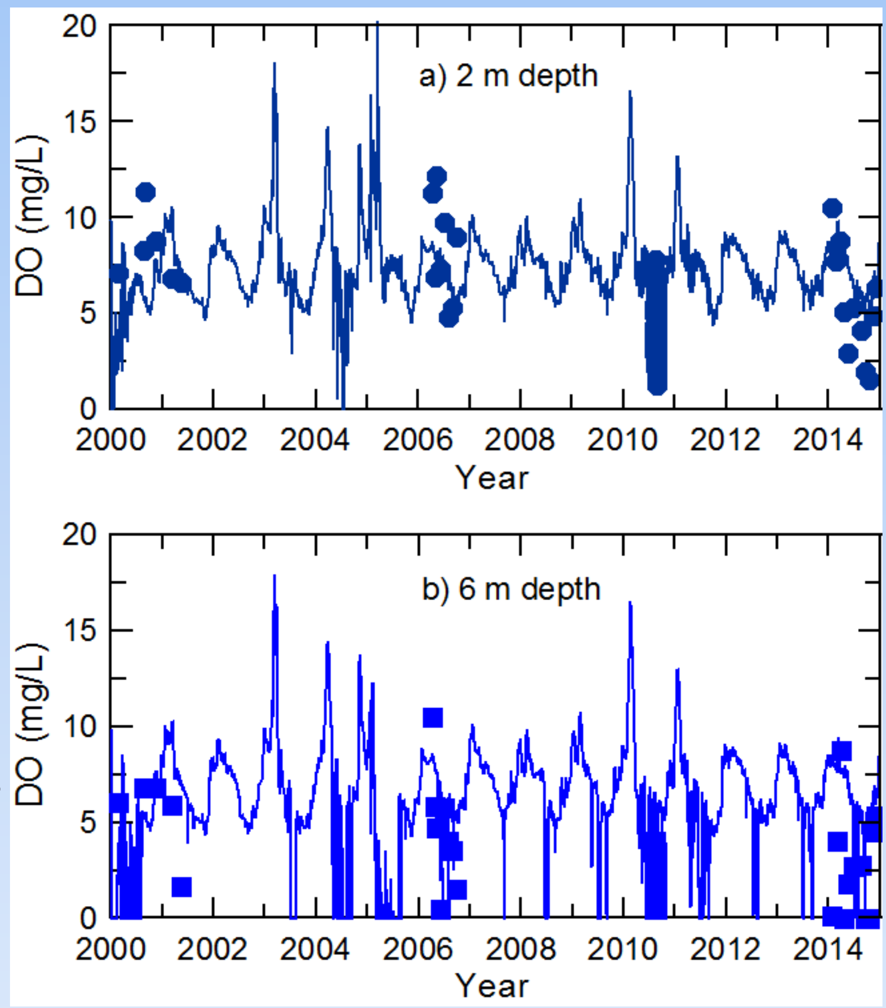
Temperature

- Model reasonably reproduced representative measured temperature values at 2 m and 6 m depth
- Strong seasonal trends evident, with summer temperatures 26-28°C and winter values typically near 11-12°C
- Strong stratification was not predicted within water column, consistent with generally well-mixed conditions in lake



Dissolved Oxygen

- The model also predicted some seasonal trends in DO, with higher values during the winter cooler months when O_2 solubility is greater
- Evidence of both supersaturation and undersaturation was present
- Model did predict some low surface DO episodes (e.g., in 2000, 2003 and 2010), but over-predicted concentrations in 2014
- Correctly timing such episodes can be challenging



Nutrients

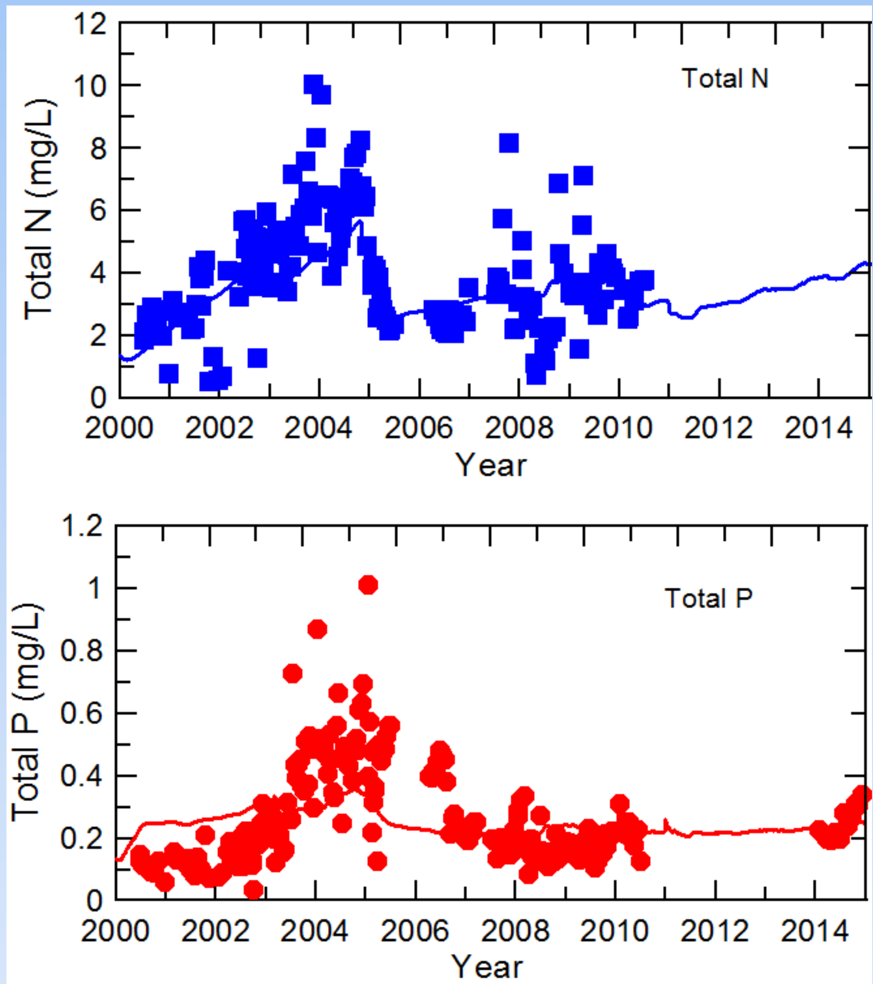
The model predicted general observed trends in total N concentrations

- Increased concentration from 2000-2004
- Marked reduction in 2005
- Subsequent increase in 2008-2010

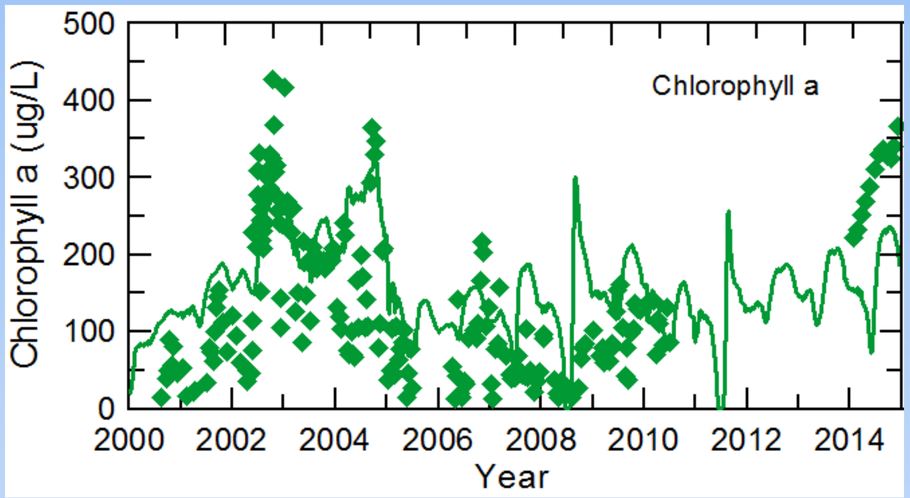
Model underpredicted total N concentrations in 2003-04

Total P baseline values reasonably described, but missed marked increase in 2003-04

- some of this increase attributed to sediment resuspension that was not adequately represented by model
- model not able to quantify resuspension due to benthivorous fish



- Chlorophyll a concentrations exhibited strong annual periodicity in both measured and predicted values
- Model reproduced high values in 2002-04 but overpredicted levels in late 2008



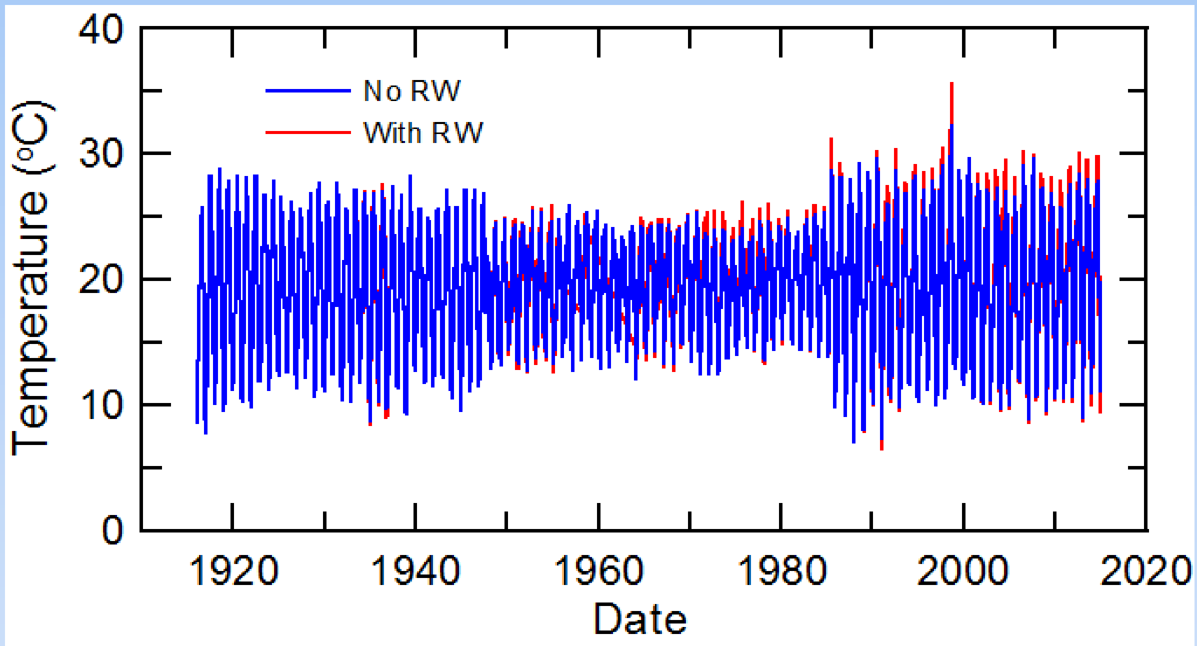
- It proved to be very difficult to capture the unique characteristics of *Oscillatoria*, which dominates the lake in especially in extreme algal events
- A simple comparison was conducted using the 2000-2010 period (when regular monitoring data available)

Mean predicted and observed values: 2000-2010				
	Observed	Predicted	% Error	*Prior Calibr*
Total N	3.98	3.39	-14.8	*-18.1*
Total P	0.265	0.246	-7.2	*49.1*
Chlorophyll a	130	157	20.8	*-34.0*

- Overall, model calibration for this dynamic period of time was improved relative to earlier calibration
- Model calibration included:
  - use improved data for recycled water
  - daytime diffused aeration operation
  - food web effects through incorporation of:
    - 2 zooplankton groups (Cladocerans, copepods)
    - 2 fish groups (shad, piscivores)
- Model is most useful for *relative (semi-quantitative)* comparison of water quality with/without recycled water inputs, food web alterations, etc. rather than rigorous quantitation

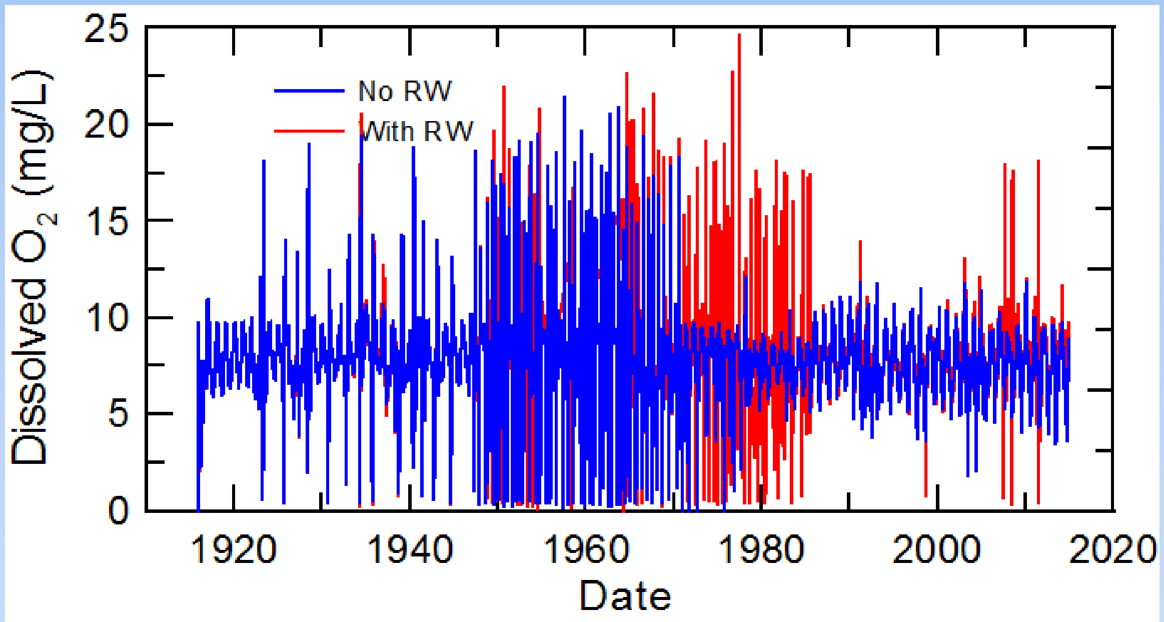
Results

Daily Average Water Column Temperature



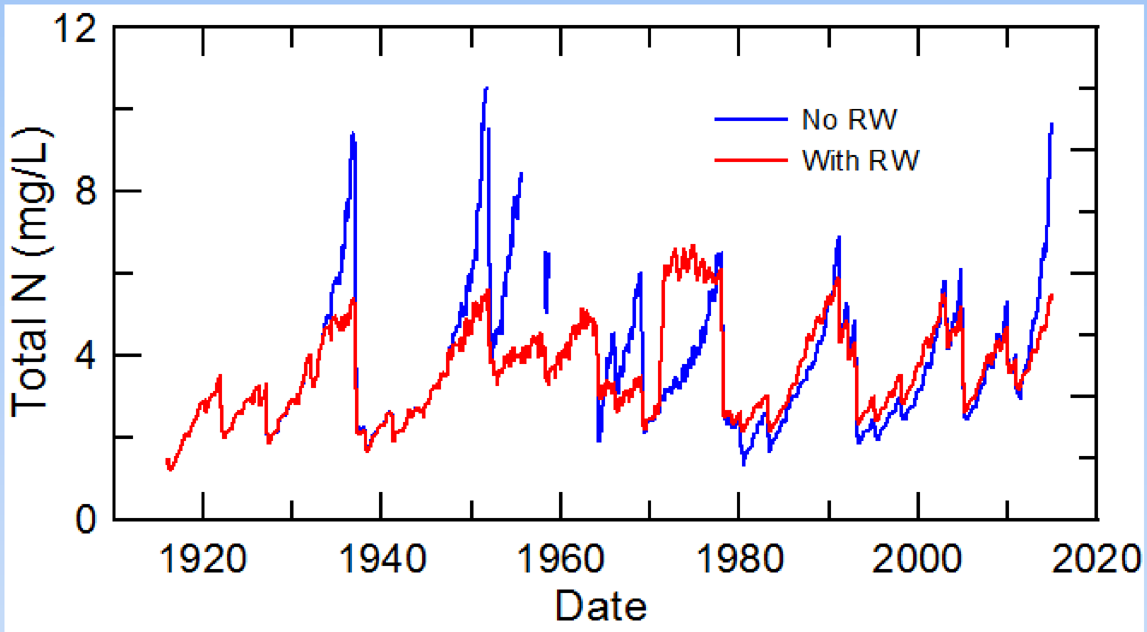
- Model predicted strong seasonal variation in average water column temperature
- Greater interannual temperature ranges in 1916-1945 and 1995-2014
- Recycled water inputs were not predicted to alter the heat budget or temperature of the lake

Daily Average Water Column DO



- Predicted daily average water column DO levels varied modestly from 1920-1950 without RW
- Extreme oscillations predicted during low lake levels 1950-1970
- Periodic inputs of RW yielded even greater variance, often with DO supersaturation and anoxia

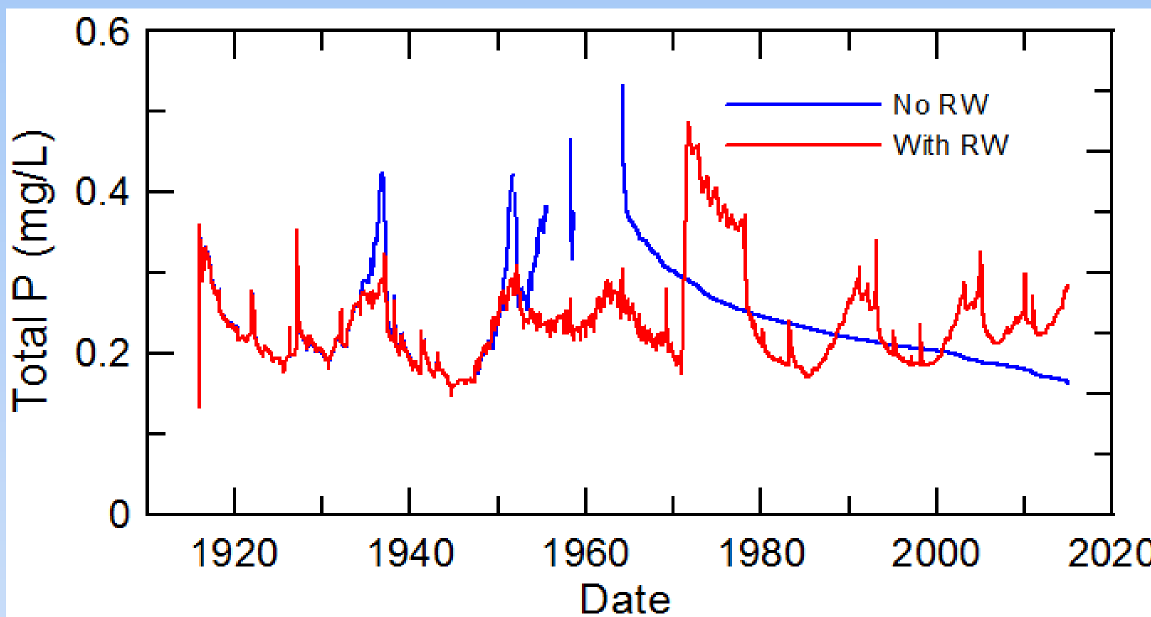
Daily Average Water Column Total N



Total N concentrations without RW inputs varied in response to watershed inputs and evapoconcentration

Inputs of RW predicted to markedly increase total N concentration in the lake, beyond that due to evapoconcentration

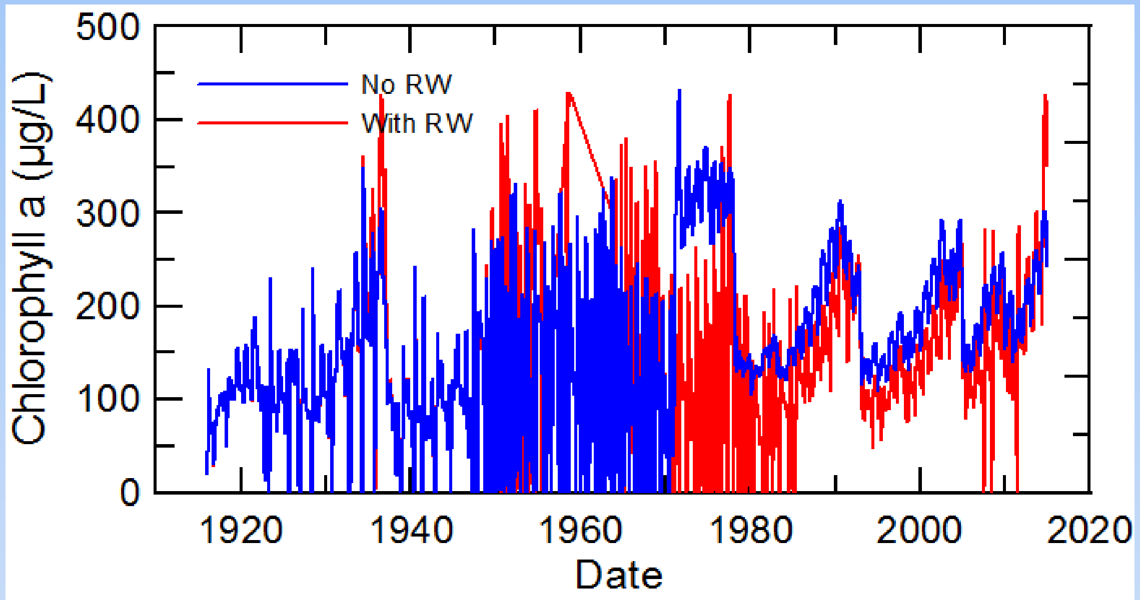
Daily Average Water Column Total P



Recycled water supplementation was predicted to actually *decrease* P concentrations relative to no RW inputs, due to:

- Dilution during periods of strong evapoconcentration
- Evidence for incorporation into food web and subsequent settling
- System predicted to return to values of 0.2-0.25 mg/L

Daily Average Water Column Chlorophyll a



- Recycled water inputs tended to exacerbate extreme swings in chlorophyll a values
- Initial inputs in late 1930's triggered a slight increase in predicted chlorophyll a
- Inputs during drought in 1970's predicted to have a positive impact on chlorophyll a

Mean Predicted Values: 1916-2014					
	Temp	DO	Total N	Total P	Chl a
No RW	19.58	7.92	3.65	0.23	138
With RW	19.51	7.82	3.64	0.24	161
Rel Change	-0.36%	-1.26%	0.02%	4.3%	16.7%

- Addition of recycled water had no effect on mean temperature
- Recycled water inputs also had little effect on mean DO concentration although did increase variability in DO
- Supplementation with recycled water *increased* mean total N content by 57.9% and *increased*, with this model parameterization, mean total P concentration by 4.3%
- Mean chlorophyll a concentration was increased by 16.7% as a result of recycled water addition in this model parameterization

Conclusions

- Simulations provide improved insights into response of lake to long-term recycled water inputs
- Supplementation with recycled water was predicted to:
  - No affect temperature and heat budget of lake
  - Had negligible effect on mean DO concentration in lake, but increased range of average water column DO concentrations, with both increased supersaturation and greater episodes of anoxia
  - Had negligible effects on average total N and total P concentrations
  - Did increase chlorophyll a concentrations slightly
- Overall, model predictions do not indicate marked effects on water quality resulting from periodic inputs of recycled water to help maintain lake level

Questions Previously Outlined

) How do nutrient concentrations, salinity concentrations, dissolved oxygen
DO) concentrations and algae concentrations vary with lake level under pre-
levelopment and modern land use conditions?

) How does the addition of recycled water change the natural variations in lake
evel that would otherwise occur and what is the net effect on nutrient, salinity
nd algae concentrations over time?

) What is the estimated effect on water quality (nutrients, algae, DO) of limiting
he carp population? (Note: similar to the question previously addressed in Dr.
nderson's 2006 sensitivity study).

) What is the estimated effect on water quality (nutrients, algae, DO) of stocking
ybrid game fish to reduce the shad population and protect the zooplankton
opulation?

) What is the net effect of using recycled water to stabilize water levels in Lake lsinore over a long period of time? Specifically, how do all of the following hange with and without the presence of recycled water? And, what is the net ffect on each of adding more/less recycled water?

a) Acre-feet of aquatic habitat; surface acres of recreational reservoir

b) Algae and DO concentrations

c) Nutrient and salinity concentrations

) What is the estimated effect on water quality in Lake Elsinore if additional neasures are implemented to further reduce the average phosphorus oncentration in recycled water (e.g. from the current 0.5 mg/L down to as low as .1 mg/L in 0.1 mg/L increments)?

) To what extent, if any, will reducing algae populations in Lake Elsinore affect mmonia concentrations in the lake?

) Based on our best understanding of dynamic lake levels, asymmetric recipitation/runoff/loading patterns and nutrient cycling in Lake Elsinore, how nuch reduction in new external nutrient loads and/or existing sediment loads vould be required to achieve compliance with the TMDL response targets for hlorophyll-a and DO?