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OPPORTUNITIES AND CHALLENGES IN
Agricultural Water Reuse

SPECIALTY CONFERENCE

October 29-31, 2006
Hyatt Vineyard Creek
Santa Rosa, California

Sponsored by the WaterReuse Association,
the U.S. Department of Agriculture,
and Washington State University



Onsite Program



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Photos courtesy of USDA NRCS

Welcome to Santa Rosa!

On behalf of the WateReuse Association, the U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service (CSREES) and Agricultural Research Service (ARS), and Washington State University, we are pleased that you have joined us for this specialty conference on **Opportunities and Challenges in Agricultural Water Reuse**, October 29–31, 2006 in beautiful Santa Rosa, California!

This conference will cover success stories in agricultural reuse, the USDA's role in water management, regulations and health aspects of the use of recycled water on edible and nonedible crops, economics, technology, and public perception. On Tuesday, attendees will divide into breakout groups to identify information gaps, opportunities for collaboration, and research needs. The conference will conclude with a "listening session" in which the audience will provide input on the actions USDA should take to expand its efforts in water reuse.

Dr. Merle Pierson, U.S. Deputy Under Secretary of Agricultural Research, Education and Economics, will deliver the keynote address. Mayor Jane Bender of Santa Rosa will welcome conference participants to the city. A number of prominent experts from the fields of agriculture and water reuse also will address conference attendees, including Dr. George Tchobanoglous (UC-Davis), Dr. Robert Raucher (Stratus Consulting), Mr. Dale Huss (SeaMist/OceanMist Farms), Mr. Robert Hultquist (California Department of Health Services), Dr. Jeannette Thurston-Enriquez (USDA), and Ms. Laura Kennedy (Kennedy/Jenks Consultants).

Santa Rosa, the largest city in Sonoma County, is nestled in the center of famous Sonoma Wine Country. The downtown area is home to world class restaurants and museums. The Hyatt Vineyard Creek, which is located in Historic Railroad Square, is located just a short drive from the Napa Valley Wine Country, the Russian River, and San Francisco Bay Area in the center of the growing Santa Rosa Sonoma County business community.

On behalf of the Conference Planning Committee and the Northern California Chapter of the WateReuse Association, thank you for joining us for this fantastic event. We believe that numerous opportunities exist for USDA and WateReuse to collaborate on research, education and outreach, and other efforts related to water reuse. The conference will provide a forum for learning, sharing information and data, identifying opportunities, networking with new and old friends, and enjoying the ambience and local color of the California wine country. We hope you enjoy this conference!

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Executive Director
WateReuse Association

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National Program Leader,
Water Resources
CSREES-USDA

Jim Dobrowolski

National Program Leader,
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Kennedy/Jenks Consultants
Engineers & Scientists



The WateReuse Association, the U.S. Department of Agriculture, and Washington State University thank Kennedy/Jenks Consultants and the City of Santa Rosa for sponsorship of the Agricultural Water Reuse Tour on Sunday, October 29.

CONFERENCE SCHEDULE

*All plenary sessions and lunches will be held in the Alexander Valley Ballroom II, III, and IV. Registration, continental breakfasts, and breaks are in the Alexander Valley Foyer.

Sunday, October 29, 2006

- 10:30 a.m.–5:00 p.m. Registration
1:00 p.m.–5:00 p.m. Agricultural Water Reuse Tour

Monday, October 30, 2006

- 8:00 a.m. Registration and Continental Breakfast
8:30 a.m. Opening Remarks
Mr. Wade Miller, WaterReuse Association
8:40 a.m. Welcome to Santa Rosa
Ms. Jane Bender, Mayor of Santa Rosa
8:55 a.m. Keynote Addresses
Dr. Merle Pierson, Deputy Under Secretary for Research, Education, and Economics, USDA
9:25 a.m. The Current and Potential Future Roles of the U.S. Department of Agriculture in Water Reuse
Dr. Michael O'Neill, Dr. James Dobrowolski, and Dr. Mark Weltz, USDA
10:15 a.m. Break

10:30 a.m.–12:00 p.m.
Proof of Performance: Technologies and Public Acceptance Efforts that Work
—Moderator: Mr. Craig Lichty, Kennedy/Jenks Consultants

- 10:30 a.m. Santa Rosa's Agricultural Reuse System
Mr. Daniel Carlson, City of Santa Rosa
10:55 a.m. Use of Recycled Water to Irrigate Edible Crops in Monterey County
Mr. Robert Holden, Monterey County Water Pollution Control Agency
11:20 a.m. Reclaimed Water Use on Citrus and Other Crops in Florida
Mr. Phil Cross, Woodard & Curran
11:45 p.m. Solving Agricultural Irrigation Issues with Reclaimed Water—the Hawaii Experience
Dr. Chauncey Ching, University of Hawaii at Manoa
12:15 p.m. Luncheon Address: Gallo's Commitment to Sustainability and the Role of Water Recycling
Mr. Jim Collins, Director of Winegrowing, Gallo Vineyards

1:45–3:30 p.m.
Emerging Issues for Water Reuse in Agriculture
—Moderator: Dr. Mark A. Weltz, USDA

- 1:45 p.m. Emerging Issues from the Grower's Perspective
Mr. Dale Huss, Sea Mist/Ocean Mist Farms
2:10 p.m. Are Pathogens a Concern for Recycled Water?
Dr. Jeannette Thurston-Enriquez, USDA
2:35 p.m. Health Issues Related to the Use of Recycled Water on Crops
Ms. Laura Kennedy, Kennedy/Jenks Consultants
3:00 p.m. California's Water Recycling Regulations as They Pertain to Agricultural Reuse
Mr. Robert Hultquist, California Department of Health Services
3:30 p.m. Networking Break

3:45–5:30 p.m.
Critical Issues in the Development of a Water Reuse Project
—Moderator: Mr. Dan Carlson, City of Santa Rosa—Utilities Department

- 3:45 p.m. The Adequacy of Technology to Achieve Water Quality Goals
Dr. George Tchobanoglous, University of California—Davis
4:05 p.m. Management of Public Perception
Mr. Mark Millan, Data Instincts, Public Outreach
4:25 p.m. An Overview of the Economics of Water Reuse
Dr. Robert Raucher, Stratus Consulting, Inc.
4:45 p.m. The Implications of Recycled Water Use for Organic Certification
Kevin McEnnis, Quetzal Farm
5:05 p.m. Soil Salinity and Farming Sustainability Related to Crop Yield and Quality
Dr. Donald L. Suarez, USDA
5:30 p.m. Adjourn
6:00–7:30 p.m. Reception in Alexander Valley Ballroom I

Tuesday, October 31, 2006

- 8:00 a.m. Registration and Continental Breakfast

8:30–8:40 a.m.
Research, Education and Outreach: Identifying Challenges and Opportunities
—Instructions and charge to the group, Alchemy Facilitators led by Ms. Patti Dobrowolski

Breakout sessions will be held in Alexander Valley Ballroom II, III and IV; Dry Creek Valley Ballroom I; Dry Creek Valley Ballroom II; and Sonoma Mountain.

- Which Crop for Which Place with What Water?
- Reducing Human Exposure During Production and Understanding Exposure Risks For Consumption
- Improving Public Perception and Acceptance
- Management Actions to Improve Irrigation with Recycled Water

- 10:15 a.m. Networking Break

10:30 a.m.–12:00 p.m.
Plenary Session: Reports from the Breakout Groups
—Moderators: Ms. Patti Dobrowolski, Alchemy Facilitator and Dr. Michael O'Neill and Dr. James Dobrowolski, USDA

- 12:15 p.m. Luncheon with Speaker
Mr. Richard Katz, former member of the California State Water Resources Control Board and Chair, Governor's Recycled Water Task Force

1:30 p.m.–3:00 p.m.
Panel Discussion: What Actions Should USDA Take to Expand its Efforts in Water Reuse?
—Moderators: Dr. Michael O'Neill and Dr. James Dobrowolski, USDA

- Panel: Mr. Dan Carlson, City of Santa Rosa—Utilities Department; Mr. Keith Israel, Monterey Regional Water Pollution Control Agency; Mr. Mark Millan, Data Instincts, Public Outreach; Dr. Trevor Suslow, University of California—Davis.
3:00 p.m. Closing Remarks and Conference Evaluation
Mr. Wade Miller, WaterReuse Association

Opportunities and Challenges in Agricultural Water Reuse



Upcoming Events

2007 California Section Annual Conference

*Drought Proofing the Golden State—
Sustainability in the Era of Climate Change*

Wyndham Palm Springs

Palm Springs, California

March 4-6, 2007

www.watereuse.org/events.htm

The California Section of the WateReuse Association invites you to attend and participate in our 2007 Annual Conference. The conference will focus on diverse topics of interest to California's water recycling community.

22nd Annual WateReuse Symposium

*Water Reuse & Desalination: Bright as
the Florida Sun*

Tampa Marriott Waterside Hotel and Marina

Tampa, Florida

September 9-12, 2007

www.watereuse.org/events.htm

The WateReuse Association, the American Water Works Association, and the Water Environment Federation invite you to attend and participate in the 22nd Annual WateReuse Symposium—the world's preeminent conference devoted to water reuse and desalination.

USDA-WATER REUSE ASSOCIATION GROUP DISCUSSIONS ON AGRICULTURAL WATER REUSE

SANTA ROSA, CA, OCTOBER 30-NOVEMBER 1, 2006

Key Considerations for Group Discussion Leaders

Thank you for participating in the USDA-WaterReuse Association's Conference on Agricultural Water Reuse.

The intent of these sessions is to give participants an opportunity to identify challenges and opportunities in four topic areas to expand research, education and outreach by the USDA and others to consider in working on water reuse solutions.

The four group discussions are:

- Which Crop for Which Place with What Water?
- Reducing Human Exposure During Production and Understanding Exposure Risks For Consumption
- Improving Public Perception and Acceptance
- Designing Novel Technologies While Optimizing Investment and Operational Costs

Your role as a participant in your topic area group discussion is to:

- 1) Set the context for group participants with an initially brief (5-10) minute overview/discussion of the topic area.
- 2) Make sure you understand the topic area and group objectives. Help provide content information when participants need or ask for it.
- 3) The facilitator of your session will keep your group on task in discussing the topic areas and capturing the responses on the focus area maps.
- 4) Help keep the conversation flowing by asking/answering open ended questions.
- 5) As a group, help the facilitator prepare and provide a concise debrief that allows for all viewpoints and ideas to be heard by the larger group during the debrief session in the afternoon of the second day.
- 6) Your group needs to speak as one—it's your job to accurately represent the issues raised and decisions made by your group.

Things to avoid:

Too much set up (group discussions are limited in time)

A few group participants hogging the air time

Pushing your agenda

Ground rules:

1. We will listen respectfully and thoughtfully.
2. We will maintain our sense of humor.
3. We will challenge ourselves, stretch and be willing to adapt.
4. We will take ownership of creating a successful meeting outcome.
5. We will stay actively engaged in what is going on during the meeting.
6. We will avoid interruptions, side conversations, phone calls, or other disruptions.
7. We will be responsible for our own comfort.

Supporting Information Kit for Water Reuse Facilitators

Emerging issues: Adverse effects on plants, groundwater, environment, and public health

Uncharted areas: Economic, institutional, and liability issues educating the public, water users, and distributors about the risk involved

Water reuse projects are complex, require multidisciplinary knowledge, and prudent decision-making regarding public health, environmental impact, economic and financial concerns, social and legal aspects and design and planning.

Principal water quality factors that determine the suitability of recycled water for irrigation are pathogen content, salinity, sodicity (sodium levels that could alter soil infiltration rates), specific ion toxicity, trace elements, and nutrients.

Two separate initiatives focus on maintaining public health:

- Set up a legislative framework through the adoption of stringent standards and regulations adapted to the characteristics of different crops
- Combining the wastewater treatment process, the irrigation system (e.g., drip versus sprinkler), the exposed group, and the crops to be irrigated (edible versus non-edible).

Key constraints: Economic viability (profitable?), availability of project funding, sensitive health and environmental issues, public acceptance

Successful project components: Technical know-how, good engineering design, rigorous market analysis—a balance between economic, social and environmental benefits against project costs and risks

Israel is the world's leader in water reuse with over 70% of wastewater reused for agriculture. In some arid and semiarid countries recycled water is considered the only significant low-cost alternative water resource for irrigation.

What's driving water reuse in the U.S.?

- Chronic and temporary water shortages
- Fast-growing water demand in urbanized and urbanizing areas
- More stringent standards for wastewater discharge
- Increased cost for mobilization of new water and environmental constraint (e.g., dam or canal construction)

Irrigation is the largest *consumer* of freshwater in the U.S. (42%)—lost due to evaporation, etc. Thermoelectric power generation removes a large proportion of freshwater (52%) but much of that water is returned to water bodies. Four states

include water reuse in their official water policies: California (calls it “recycled water”), Florida, Hawaii, and Washington.

Unrestricted landscape irrigation and irrigation of food crops eaten raw require extensive disinfection—commonly achieved through pretreatment, primary settling, activated sludge, clarification, coagulation/flocculation, filtration, and disinfection. In some cases additional advanced treatment is used such as storage and reverse osmosis (forcing water through a membrane) to remove salts and other ions.

Remember that water quality considerations determine the acceptability and safety of the use of recycled water for a given application. Health-related concerns (e.g., endocrine disruption, antibiotic resistance of pathogens) related to endocrine disruptors, pharmaceuticals, and personal care products in raw wastewater, recycled and other waters *are fertile fields for research*.

Pathogenic risks in wastewater or on crops:

- Pathogens must reach the plant or be able to multiply to the number required for an infective dose
- A human host must come into contact with the infective dose
- The host must become infected
- Disease results from the infection or leads to further transmission.

Salinity and toxicity risks when wastewater is applied to crops:

- The most important factor for crop selection is the salinity of irrigation water—plants use more and more energy to extract water from a saline solution at the expense of growth
- Not all plants respond in a similar manner; some crops can produce acceptable yields at much higher soil salinities
- The relative salt tolerance of most agricultural crops is known well enough to provide salt-tolerant guidelines
- Salt tolerance beyond crop selection depends on the type, method and frequency of irrigation
- Toxicity problems produce damage to plant parts, rather than from restrictions to water uptake.

California is a leader in the development of comprehensive water recycling regulation—they know their stuff!

Issues affecting crop irrigation with recycled water:

- Begins with a decision tree—edible or not? Eaten cooked or raw? Will handling cause contamination? Some states prohibit selling or distributing crops before processing. If non-edible, are irrigated areas restricted to trained personnel?

Irrigation type and location are key to disease transmission from dust or windblown spray.

- Matching the right crop to the soil and water—particularly if the soil/water is saline and/or sodic

Issues affecting landscape irrigation with recycled water:

- Absence of direct consumption, but...
- Public exposure due to inhalation, contact or accidental ingestion
- Chemical content is usually not limiting

Groups of practices for recycled water use for irrigation:

- Wastewater treatment (reliability of operations,) and storage (closed reservoirs)
- Control of wastewater application by irrigation (backflow prevention, flood, furrow, sprinkler, subsurface and drip) and/or cultivation methods
- Crop restriction for agricultural irrigation (if you have a strong law enforcement, institutional control of water allocation, irrigation project with strong central management, market demand for product watered with reuse water, match crop to water and soil properties) and access restriction for landscape irrigation (distance, manual versus automatic irrigation).
- Human exposure control, harvesting measures, education, promotion of hygienic practices (agricultural workers and families direct contact exposure, crop handlers through direct contact, consumers of crops, people living in close proximity, and players on sports field irrigated with reuse water)
- Blending or alternating recycled water with other supplies (conventional sources, groundwater)

Water Reuse in Agriculture Group Discussion Guidance

Tuesday Morning Group Discussions:

Research, Education and Outreach: Identifying Challenges, Opportunities, Policies and Actions

Breakout sessions will be held in Alexander Valley Ballroom II, III and IV; Dry Creek Valley Ballroom I; Dry Creek Valley Ballroom II; and Sonoma Mountain.

Be prepared to be an active participant in the following discussion groups:

- **Which Crop for Which Place with What Water?**

In order to be successful with recycled (reuse) water, which crop better suited in what location and what water should be used?
What are the challenges? What are the opportunities?
What policies/actions might USDA make/take?

- **Reducing Human Exposure During Production and Understanding Exposure Risks For Consumption**

When and where in the food production and consumption process are the points of risk?
What are the challenges? What are the opportunities?
What policies/actions might USDA make/take?

- **Improving Public Perception and Acceptance**

How do we better understand what the public fears?
What are the challenges? What are the opportunities?
What policies/actions might USDA make/take?

- **Management Actions to Improve Irrigation with Recycled Water**

How do we manage the delivery, storage and use of reuse water across growing seasons and year 'round?
What are the challenges? What are the opportunities?
What policies/actions might USDA make/take?

You'll be part of the World Café!

Mix yourselves and find a seat in a circle of chairs within the room, your “mini-group.” Mini-groups will designate a host, a scribe, and answer the main question (i.e., in order to be successful with recycled (reuse) water, which crop is better suited in what location and what water should be used?) Each mini-group scribe will capture all discussion on a flip-chart. Then host of this mini-group will help the group choose the top 3 key take-aways from their discussion. Hosts will be instructed to remain at the flip-chart.

Then...you will be asked to rotate to another mini-group. Hosts from Q1 will debrief to the new mini-group what was discussed by the previous group
Then the group will answer the second set of questions: What are the challenges and opportunities, and suggested policies in this area? Your new group will choose their top 3 challenges/opportunities/policies to debrief to the larger group.

Hosts from each mini-group will debrief questions 1-4 to the entire break-out group. You will be asked to come up with your one big suggestion for the USDA in this topic area and among those write it on a large post-it note. In the small mini group, you will put their post-it on the flipchart and the small group will choose their top 1-2 recommendations.

All mini groups will debrief their top two recommendations. (captured on map) If there is not enough time, the host will bring the top two to the facilitator who will transfer them onto the map.

USDA's Road:

- Study the additional costs to farmers, financial or real (e.g., salination), in transition to irrigation with effluent.
- Study the elements that comprise approaches to effluent pricing for use in irrigation (e.g., conveyance, treatment).
- Do social benefits exceed the social cost (The Compensation (Kaldor-Hicks) Principle).
- Identify what the effluent volume contains--concentrations of chemicals, which may be hazardous to agricultural yields and to conservation of soils. It may cause groundwater contamination, in terms of chlorides, nitrates, sodium, boron, and, other contaminants.
- The only existing regulations with respect of effluent quality are public health oriented, and even these are not properly observed. What about for agriculture?
- Rigorously organized follow up and control of water with proper quality sampling is required, regarding the chain commencing with fresh water supply to households and industrial plants, as ending with the use of effluent in irrigation.
- Programs and projects that focus on two principal methods for reducing drainage salinization problems. They are 1) reducing the amount of irrigation water applied to crops and 2) reusing the applied water on subsequent, more salt-tolerant crops.

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