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1.133 M.Eng. Concepts of Engineering Practice

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Sustainability Assessment, Southern California's Water Needs and the “7 Questions” Method

Susan Murcott

MIT Course 1.133 – “Concepts”

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Mulholland's Dream in historical context...

- In the 19th and early 20th century, engineers implemented the promises of the Industrial Revolution.
- Engineers brought progress and economic development, with wide public support to carry out bold projects.
- Archetype of “Engineer as Hero,” “enemy of error.”

William Mulholland's massive water projects occurred in this "Golden Age" of engineering.

Some consider his work and legacy exemplary and even heroic.

Others, such as Marc Reisner, the author of Cadillac Desert, are more critical:

*“This is a desert! ...
Why bring more water
in, that brings in more
growth, that forces us to
bring in more water. It’s
a death vortex, the Red
Queen [in Alice in
Wonderland] running
faster and faster just to
stay in place.”*



Were Mullholland's projects "right" or "wrong?"
And, how does one decide?

Evaluation, Decision-Making, Values

- “EVALUATION is “the process of analyzing a # of plans or projects with a view to searching out comparative advantages and disadvantages and the act of setting down the findings in a logical framework.”
- “EVALUATION is not DECISION-MAKING.” Decision-making is done by institutional players – government, and the political process, engineering and scientific experts, monied interests.
- “Evaluation is based on VALUES.”

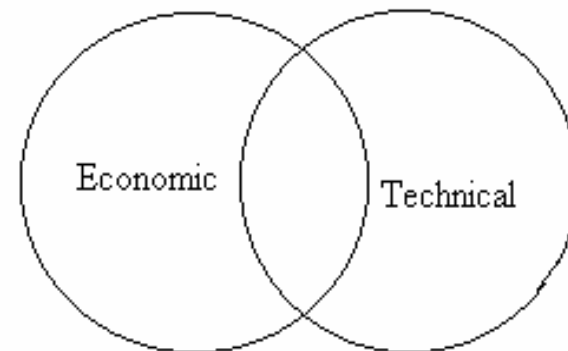
(Ortolano, 1997)

- Different values are reflected in different assessment methodologies

Back then, engineering project assessment was comparatively simple

- Technical /Engineering Components
- Economic Cost Component

Simple 2-Component System for Appraisal of Project Success



Cost-Benefit Analysis

- In 1936, during the worst years of the “Great Depression” and at the beginning of enormous U.S. federal public works programs, Congress, worried about fiscal responsibility and whether federal agencies would spend funds wisely, passed the Flood Control Act.
- It required that federal projects be undertaken only “if the benefits to whomsoever they may accrue are in excess of the estimated costs.”
- Procedures for calculating monetary benefits and costs were developed = CBA.

Strengths of Cost-Benefit Analysis

- Cost-benefit Analysis is, to an engineer, an essential methodology. Like balancing a checkbook for a consumer, it is a fundamental capability.
- The general public is willing to pay to build projects benefiting society. But projects will not gain public support if the costs are too high.
- Cost-benefit analysis gives us the price-tag.

Limitations of Cost-Benefit Analysis

- CBA assumes that “externalities:” environmental preservation or social well-being, can, in all instances, be monetized and that as long as higher capital wealth is generated, natural and human capital will also be generated.
- Use of discounting systematically and improperly down-grades the importance of the environment and future generations
- CBA ignores questions of equity and reinforces existing patterns of economic and social inequity

(Heinzerling, L. and Ackerman, F. 2002)

Environmental Values

- Critics of CBA argued that environmental impacts of public works were not being accounted for in evaluation and decision-making, but rather, only economic efficiency (e.g. utilitarian values) was the dominant value.
- In the U.S., systematic efforts to protect environment began in the 1960s.

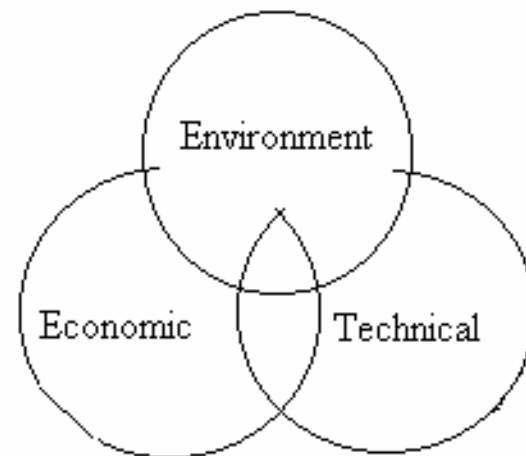
1969 National Environmental Policy Act

- During the 1960s, many people in the US felt that public works, such as drained wetlands or dammed rivers, were degrading the quality of the environment.
- NEPA required all U.S. federal agencies to integrate environmental concerns into its decision-making.
- NEPA indicates that each generation has a responsibility “as trustee of the environment for succeeding generations.”
- NEPA required the preparation of an environmental impact statement (EIS) for all federal projects, such as dam-building by the Army Corps of Engineers.

Engineers' task got a little more complicated...

- Technical /Engineering Assessment
- Cost-benefit Analysis
- Environmental Impact Assessment

3-Component System
for Project Appraisal



Sustainability Values

- Limits to Growth (1972)
- Our Common Future (1987)
- Globalization of environmental crisis: e.g. global warming, ozone depletion and biodiversity, etc.
- U.N. Summits on Environment and Development (Stockholm, 1972, Rio “Earth Summit” 1992, Johannesburg Summit 2002)

Meadows, Donella. *Limits to Growth*. New York,
NY: Signet Publishing, 1972. ISBN: 9780451057679.

Research at
MIT led to this
widely known
1972 book
that helped
shape
sustainable
development
ideas

Global Environmental Crises

- Ozone Depletion
- Global Warming
- Biodiversity
- Etc.

The landmark study of “sustainable development”

1987

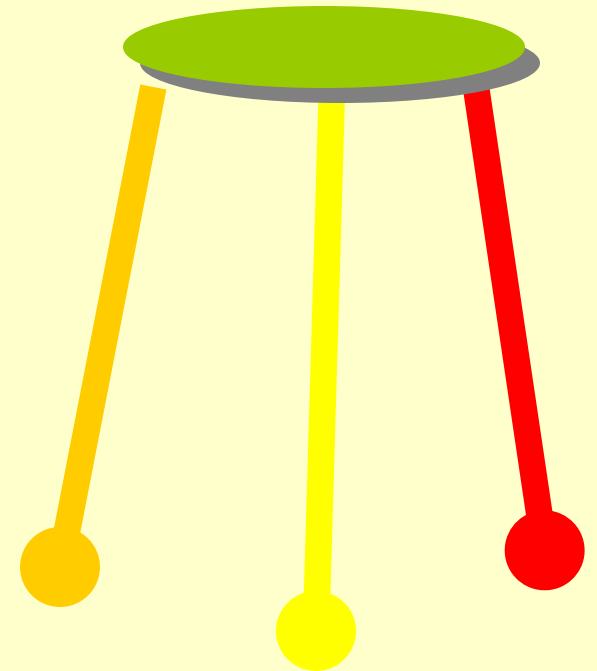
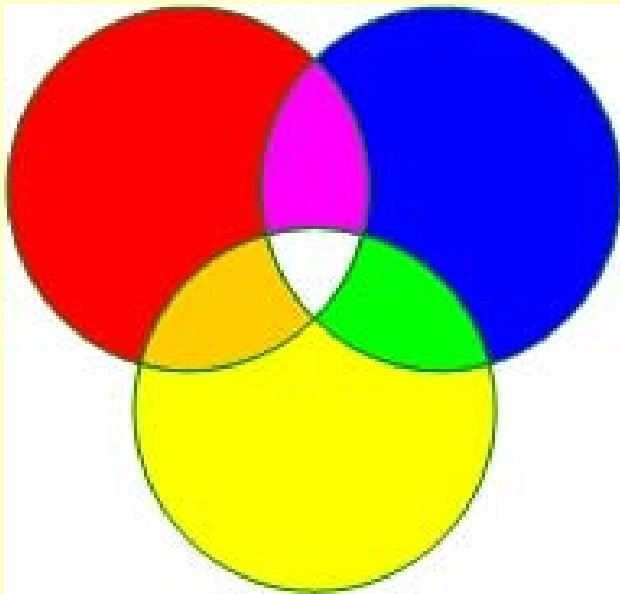
- Brundtland Report
- “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Our Common Future. Oxford, NY: Oxford University Press, 1987.
ISBN: 9780192820808.

1992 U.N. Rio “Earth” and 2002 Johannesburg Summits

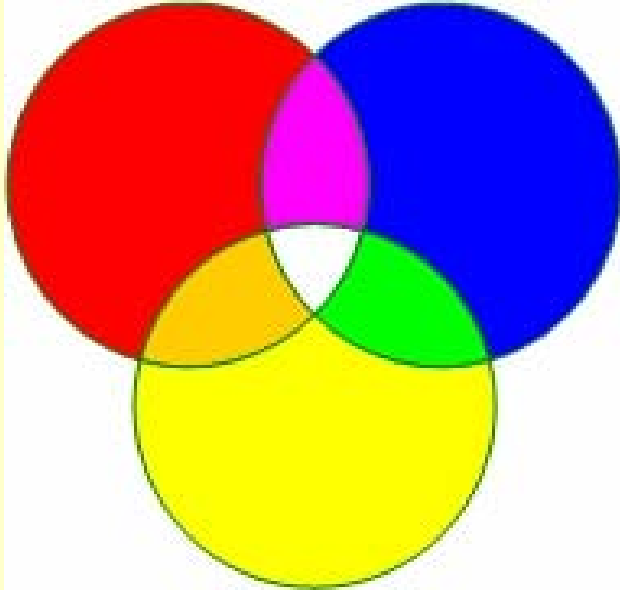
**Sustainable development” has 2 widely agreed upon
ideals expressed in its Principles:**

Brundtland:”...meeting the needs of the present without
compromising the ability of future generations to meet their own
needs.”
Our Common Future, 1987



Balance: economic, social,
environmental

Sustainable development” balance framework



Financial /Economic

- * Low cost
- * Profitable
- * Creates jobs

Technical

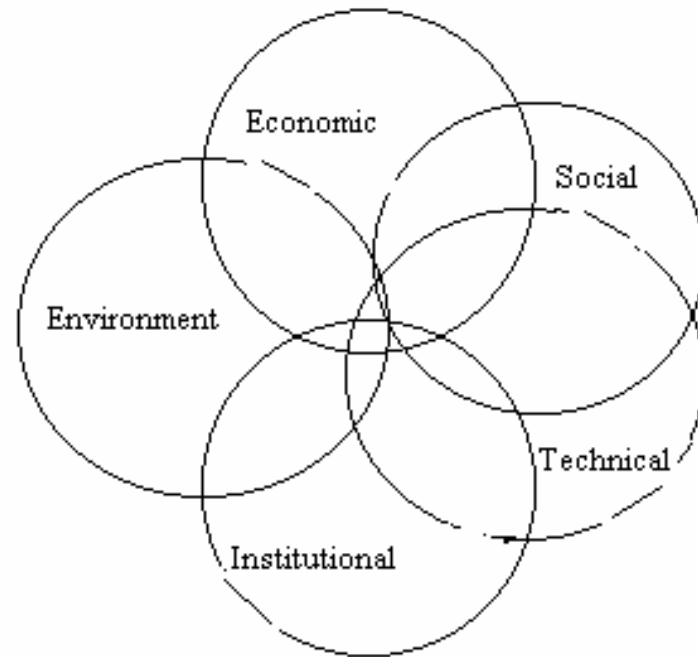
- Performance
- Safety
- Non-toxic materials
- Meets national standards

Social

- User friendly
- Customer satisfaction
- Durable
- Good Service

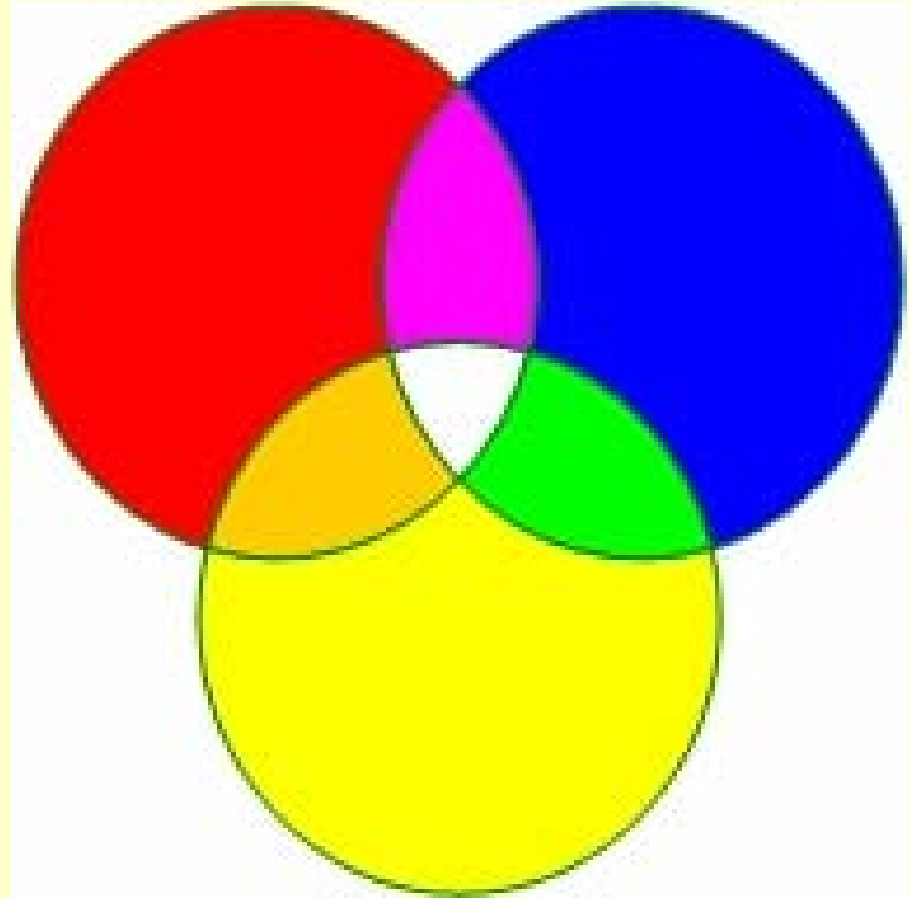
Engineering project today are increasingly complex projects

- Economic
- Technical/engineering
- Environment
- Social/Cultural
- Institutional/Political
- Other...



One New Trend – “Integrated” Sustainability Assessments

- A very recent trend has shifted away from discipline specific assessments (economic, environment, social) to “integrated” sustainability assessments. These hold some promise, but need to be looked at just as critically as all the other methodologies.



There are many Assessment Methodologies for evaluating projects:

- **Cost Benefit Analysis**
- Environmental Impact Assessment
- Social Impact Assessment
- Technology Assessment
- Risk Assessment
- Life Cycle Analysis
- Systems Analysis
- Factor 10/Factor X
- Ecological Footprint
- Climate Impact Assessment
- Public Health Assessment
- Environmental Justice Analysis
- Multi-objective/Multi-criteria Analysis
- **“Integrated” or Sustainability Assessment**
- Expert Opinion (e.g. Royal Society studies, e.g. Delphi Method)

Mining, Minerals & Sustainable Development
North America

www.iisd.org/mmsd

*World Business Council for Sustainable
Development*

*Regional Partner: International Institute for
Sustainable Development*

Chair of Task Group 2, R. Anthony Hodge, PEng

Task

To develop a set of practical principles, criteria, and/or indicators that could be used to guide or test individual mining operations, existing or proposed, in terms of their compatibility with concepts of sustainability; and to suggest approaches or strategies for effectively implementing such a test/guideline

* * *

This process led to the design of an assessment framework:
"Seven Questions to Sustainability"

7 Questions to Sustainability



Sustainable Development Assessment Methodology

“7 Questions”

- For each of 7 key themes, a question is posed.
- An “ideal” answer is offered
- Then a hierarchy of objectives, indicators and specific measurements are suggested
- The initial motivating question leads to progressively more detailed elements.
- This methodology can be tailored to specific infrastructure sector project(s) and/or site specific conditions.

QUESTION 1: ENGAGEMENT

- Are engagement processes in place and working effectively?”
 - Stakeholders?
 - Informed voluntary consent?
 - Reporting and verification mechanisms?
 - Dispute resolution mechanisms?

Stakeholders (“Communities of Interest”) in Mining Infrastructure Projects

- Residents
- Governments
- Indigenous Communities
- Organized Labor
- Non Gov’t Organizations
- Mining Industry Companies
- Consumers
- Subcontractors & Suppliers
- Other Industries
- Academic Institutions
- Industry & Prof. Assoc.
- Future Generations

QUESTION 2: PEOPLE

- Will people's well-being be maintained or improved?
 - This question addresses the effects of the infrastructure project construction or operation on people's well-being and on their communities.
 - Required data builds on traditional socio-economic impact assessment work as well as worker health and community population and health studies.

QUESTION 3: ENVIRONMENT

- Is the integrity of the environment assured over the long term?
 - This question addresses the infrastructure project's effect on ecosystem well-being

QUESTION 4: ECONOMY

- Is the economic viability of the infrastructure project or operation assured and will the community and broader economy be better off as a result?
 - This question addresses the economic condition of the proponents/owners/funders of the project and their relationship to adjacent communities and the larger economy.

QUESTION 5: TRADITIONAL AND NON-MARKET ACTIVITIES

- Are traditional and non-market activities in the community and surrounding area accounted for in a way that is acceptable to local people?
 - This question addresses the viability and success of non-market activities such as cultural, recreational, indigenous, bartering and volunteer activities that are typically omitted from economic studies.

QUESTION 6: INSTITUTIONAL ARRANGEMENTS AND GOVERNANCE

- Are laws, regulations, programs, capacities in place to address infrastructure project construction or operational consequences?
 - Capacity to address construction and operational consequences?
 - Efficiency and effectiveness of laws, voluntary programs, market incentives and cultural norms

QUESTION 7: OVERALL INTEGRATED ASSESSMENT AND CONTINUOUS LEARNING

- Considering the whole, will the net result be positive or negative?
- In the short and long term?
- Will there be periodic assessment?
- Are there mechanisms for continuous learning and improvement?

Applying “7 Questions” Methodology to the Groundwater Replenishment System

**A Project of Orange County Water District
& Orange County Sanitation District
Orange County, California**

Where is it?

Groundwater Replenishment System Map



Image by MIT OpenCourseWare.

Construction Required

- **High-tech, water purification system at existing site.**
- **13 mile pipeline from Fountain Valley to Anaheim**
- **New injection wells**

Advanced Water Treatment Plant

- High-tech, 3-stage purification system producing “ultra-pure” water
 1. Microfiltration – food, medicines
 2. Reverse Osmosis – bottled water
 3. Ultraviolet disinfection – for medical instruments
- Similar projects in VA, TX, AZ, FL, HI, Europe and elsewhere.

First Purification Step

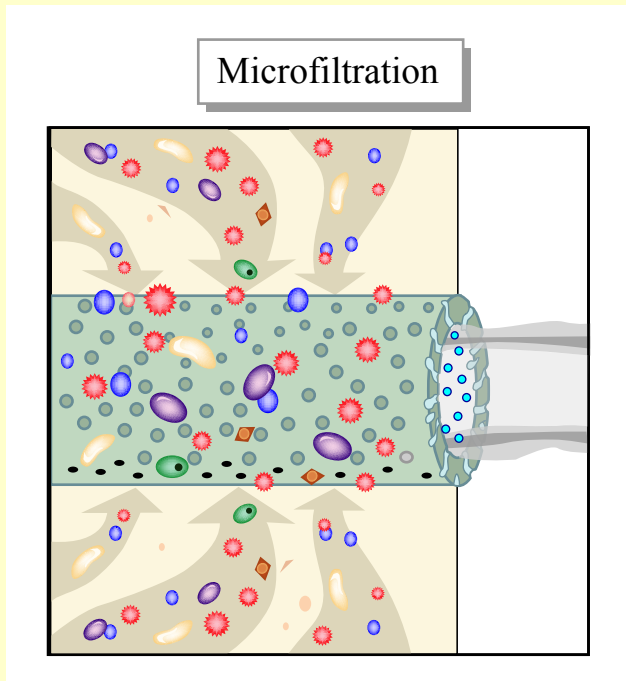
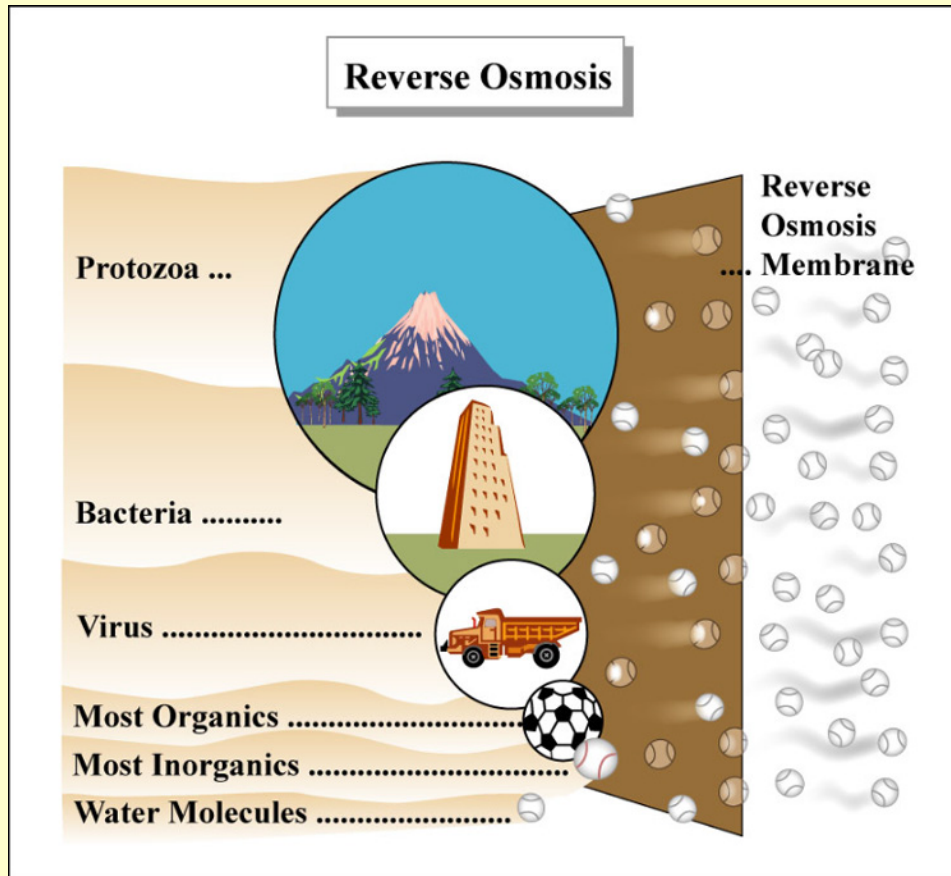


Image by MIT OpenCourseWare.

- **Microfiltration used since WW II, in blood dialysis**
- **Used in computer chip, food and pharmaceutical manufacturing**
- **Used to purify fruit juices & baby food**
- **Used to sterilize medicines that can't be heated**
- **First used to treat water by Disneyworld in Orlando**
- **Excellent pre-treatment before reverse osmosis**

Second Purification Step



- Technology used by bottled water companies
- Used in homes, boats, & by OCWD at Water Factory 21 since 1975
- Forces water under very high pressure thru many plastic sheets of membranes
- Demineralizes and purifies water

Image by MIT OpenCourseWare.

Third Purification Step

Ultraviolet (UV)
Disinfection plus
H₂O₂

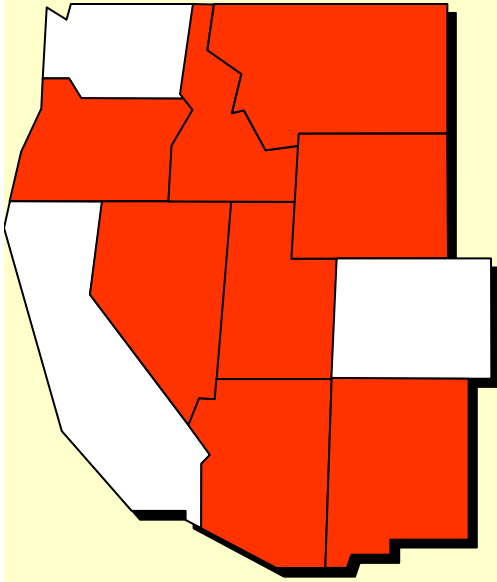
- Proven technology – used to sterilize medical instruments
- Concentrated light & H₂O₂ creates an advanced oxidation reaction
- Appears to be effective against new, emerging contaminants (e.g. pharmaceuticals)
- Finally, recharge step is an additional natural barrier of filtration through the ground.
- “Multiple barrier” approach

GWR Project Schedule

1994	GWR research begins
1999	Environmental Impact Assessment (EIA) certified
2001	Design phase completion and approval by OCWD/OCSD
2002	Phase I construction begins
2007	Phase I operational. 70,000 af/yr
2010	Phase II operational. 95,000 af/yr
2020	Phase III operational. 120,000 af/yr

**Why Groundwater Recharge?
What's the Need and Where does
Orange County Water Come From?**

Population Growth & Water Shortages



ID, MT, OR,
WY, AZ, NV,
NM & UT

Orange County's current population of 2.3 M is predicted to increase to 2.8 M by 2020.

- Southern California: will add 7 million by 2020
- California: will add 15 million by 2020
 - CA will add current populations of 8 western states!!!

Unless solutions are found, there will be water shortages by 2020

- Orange County predicts shortages of 180,000 acre-feet per year
- CA Department of Water Resources predicts shortages of 2-4 million acre-feet per year

One Acre-Foot (AF) of Water

- Enough water to cover an American football field to a depth of one foot
- 1,200 m³
(326,000 gallons)
- Approximately enough water for two US families for one year

How much water does Orange Cty use and where does it come from?

- **Current water demand = 500,000 af/yr (2002)**
- **Projected water demand by 2020 = 680,000 af/yr**
- **IMPORTED/STATE (40%)**
 - “State Water” from Sierra Nevada Mountains = from Owens River and Mono Lake
 - “State Water” from Northern California
 - Colorado River Water
- **LOCAL (60%)**
 - Santa Ana River
 - Groundwater

Colorado River - shared with 7 Western states and Mexico

- Hoover Dam and
Lake Mead

Colorado River is Divided Up

- 16.4 M af/yr = original calculation when the Colorado Water Compact was negotiated.
- 14 M af/yr = more accurate measurement
- 12 M af/yr = drought years (e.g. 1930s)
- Total Allocation = 16.5 M acre-feet/year!!!
 - 7.5 M af/yr to upper basin states
 - 5.5 M af/yr to California,
 - 2.0 M af/yr to Nevada, and Arizona.
 - 1.5 M acre-feet to Mexico
- Bottom Line – all parties must use less Colorado River water in the future!

Orange County's Mix of Groundwater and Imported Water

- **North Orange County uses mostly Groundwater provided by Orange County Water District**
 - Basin under North-Central OC
 - Groundwater basin is a natural storage, filter and piping system
 - Useable: 1 million acre-feet of water
 - Filled by Santa Ana River & imported water
- **South Orange County uses 98% “State Water” (Metropolitan Water District of SoCal (MET) & Municipal Water District OC)**
 - Mono Lake/Owens River, Northern California & Colorado River

Imported Water Cutbacks are coming!!!

- **State Water Reductions of Northern California Water**
 - **Expect loss of 25% or more of supply due to \$8 Billion restoration SF-San Joaquin Bay Delta**
- **Colorado River Reductions**
 - **CA must cut from 5.5M to 4.4M af/yr by 2016 due to over-allocation demands**
 - **Colorado River has many threats from growth, environmental, Native American, salinity, international & pollution fronts**
- **LA/Orange County must leave 10% more water in Mono Lake/Owens River to prevent dust particulate problem**

Orange County's Future Water Options

Option	Cost (\$/af)	Comment
Conservation		Trying, not enough
Buy "State Water"	\$500-\$550*	May not be there
GWR System	\$450- \$500*	Yes!
Rehab Existing H2O Plant	\$600	
Desalination	\$800 - \$2,000	Sister agencies choice
Satellite WW Reclamation Plants	\$3,000	Requires special costly piping
* Cost in 2007		

Benefits of GWR Plan

- **More reliable water**
 - Supports existing & new business & jobs
 - Provides water for recreation like golfing, horseback riding
 - Allows Orange County to maintain enviable lifestyle
- **Higher water quality**
 - Softer water
 - Longer appliance life
 - As good as bottled water
- **Reuses scarce asset**
 - Helps the environment
 - Saves energy
- **Protects groundwater from seawater intrusion**
- **Ensures locally-controlled, low cost water**
- **Provides water diversity, like financial diversity**

Limitations of Environmental Impact Report

Does not address the fundamental non-sustainability of groundwater withdrawal rates:

- **Safe yield (without GWR)* = 274,000 af/yr**
- **Groundwater use (2002) = 300,000 af/yr**
- **Phase III recharge (2020) = 120,000 af/yr**
- **Projected g.water demand (2025) = 450,000 af/yr**

- *** Note 1: This number is the GWR EIR estimate (p.1-16). Safe yield is defined as “annual amount of water that is naturally and artificially recharged into the groundwater, minus any purchases of imported water for direct replenishment.” J.Kennedy of OCWD gives 265,000 af/yr as the safe yield (9/03)**
- *** Note 2: If 100% of average annual rainfall (13” over 800 sq. km.) makes its way to the aquifer, it would come to only 55,000 af/yr.**

One principle of sustainable development of water resources

- **Rate of extraction of groundwater should not exceed the rate at which the resource is renewed and its extraction must not jeopardize the bio-diversity of the ecosystem.**

Overdraft

- **Currently, supply and demand have been balanced in Orange County (and throughout S. Ca. and the American Southwest) through excessive pumping of groundwater and through importing “State Water.”**
- **Excessive pumping is called overdraft.**
- **This cannot continue indefinitely.**
- **Overdraft leads to land subsidence, lower well yields, water quality degradation and the drying up of rivers.**

More Limitations of GWR Environmental Impact Report

- **Does not consider low discount rates (valuing the future) or attempt whole life costing/total cost accounting, even though it does provide a range of water pricing options**
- **“Core” sustainability values of limiting population, consumption, fossil aquifer protection, effects on future generations are absent from the conventional assessment.**

**Question: Would a
Sustainability Assessment
contribute to wiser water planning
and decision-making in Orange
County?**

Q1: ENGAGEMENT?

Broad-based Community Support

Environmental Groups:

Blue Planet Foundation
Groundwater Foundation
Mono Lake Committee
OC Audubon Society
Orange Coast Watch
Orange County CoastKeeper
Sierra Club of OC
Sisters of St. Joseph Honoring Women & Creation
Surfrider Foundation of Huntington Beach/LB Chapter

Health/Science and Education:

Anaheim Memorial Medical Center
Anaheim Union High School District
Chapman University, Dept. of Phys Sciences
Discovery Science Center
Fountain Valley Historical Society
Fountain Valley School District
Garden Grove Historical Society
Hoag Memorial Hospital Presbyterian
Huntington Beach City School District
National Water Research Institute
Newport Bay Hospital
North Orange County United Teachers
Orange County City Engineer's Association
Santa Ana Unified School District
Savanna School District
Sandra Smoley, R.N., Former Agency Secretary, California Health and Welfare Agency
Society of Women Engineers

Community Clubs

Anaheim Evening Lions
Anaheim Hi-12
Anaheim Host Lions
Anaheim Optimists
Brea Noon Lions
Brea Republican Women Federated
Costa Mesa-Orange Coast Breakfast
Lions
Fountain Valley Woman's Club
Fullerton Host Lions Club
Garden Grove Evening Kiwanis
Garden Grove Host Lions Club
Garden Grove Republican Women
Federated
Hispanic Business Women Assoc.
Huntington View Garden Club
Izaak Walton League
Kansas Club of Seal Beach/Leisure
World

Kiwanis of Cypress
Kiwanis of Tustin
League of Women Voters of OC
Lido Isle Community Assoc.
Los Amigos of OC
Newport Harbor Exchange Club
North County Sertoma Club
Orange County Chapter of AARP
Orange Empire Sertoma
Retired Oil Men's Club
Rotary Clubs of Fullerton and Santa
Ana North
Sertoma Club of Anaheim
Soroptimist International of Buena Park
Stanton Lions
Sunrise Exchange Club
Tustin Area Republican Women

Business Supporters

- Baywood Development Group
- Business Industry Assoc., OC
- Centex Homes
- Downtown Santa Ana Business Assoc.
- Hall & Foreman, Inc.
- Hearthside Homes
- John Laing Homes
- Orange County Business Council
- Orange County Taxpayers Assoc.
- Parsons Infrastructure & Tech. Group
- Rainbow Disposal
- Ramirez International
- R.J. Medrano & Associates
- The Robert Mayer Corporation
- Trammell Crow Company
- William Lyon Homes, Inc.
- WNC & Associates

Chambers of Commerce:

Greater Anaheim

Brea

Costa Mesa

Filipino

Fullerton

Garden Grove

Hispanic

Irvine

Los Alamitos

Newport Harbor

Orange

Placentia

Santa Ana

Stanton

Tustin

Vietnamese

West O.C. Legislative

Yorba Linda

Cities, Government, & Water Agencies

Cities:

Anaheim	Cypress	La Palma	Santa Monica	Westminster
Beverly Hills	Fountain Valley	Los Alamitos	Seal Beach	
Brea	Fullerton	Newport Beach	Stanton	
Buena Park	Huntington Beach	Placentia	Torrance	
Burbank	Irvine	San Fernando	Tustin	
Costa Mesa	La Habra	Santa Ana	Villa Park	

Government:

Senator Dianne Feinstein	Former Illinois Senator Paul Simon
Congressman Christopher Cox	Assemblyman John Campbell
Congressman Edward Royce	Assemblyman Lou Correa
Congresswoman Loretta Sanchez	Assemblyman Tom Harman
Former Congressman Ron Packard	Orange County Board of Supervisors
State Senator Dick Ackerman	Orange County Farm Bureau
State Senator Ross Johnson	

Supporters

- **Dr. Harvey Collins**, former Chief, California Department of Health Services, Drinking Water Branch
- **Dianne Feinstein**, U.S. Senator
- **Loretta Sanchez**, U.S. Congresswoman
- **Lou Correa**, California Assemblyman
- **Dr. Jack Skinner**, M.D. and Environmentalist
- **Reed Royalty**, President, Orange County Taxpayers Association
- **Dr. Henry Vaux**, Professor, Environmental Science, University of California
- **Susan Seacrest**, President, The Groundwater Foundation
- **Stephanie Pacheco**, Sierra Club
- **Van Thai Tran**, Mayor Pro Tempore, City of Garden Grove
- **Bobby McDonald**, President, Black Chamber of Commerce
- **Theresa Arzate**, President, Hispanic Business Women Association
- **Sister Sharon Fritsch**, Sisters of St. Joseph of Orange
- **Ross Johnson**, California Senator
- **John Campbell**, California Assemblyman
- **Don Schultz**, Surfriders Foundation
- **Bob Seat**, President, Orange County Farm Bureau
- **Michael Stephens**, Hoag Memorial Hospital
- **Chip Prather**, President, Orange County Fire Chiefs Association
- **Manuel J. Ramirez**, President/CEO, Ramirez International
- **Joan Irvine Smith**

Q2: People?

Does GWR benefit the people of Orange County?

- **Population growth in Orange County means more water is needed. GWR provides this.**
- **GWR enhances local control of water by reducing dependence on imported water**
- **But... will GWR mitigate against future water shortages or simply fend off the day of reckoning?**

Public Opinion regarding the GWR System

Voter Input in 1997

69% believe don't have enough water for future

60% say reclaiming is a good way to go

Voter Input in 2002

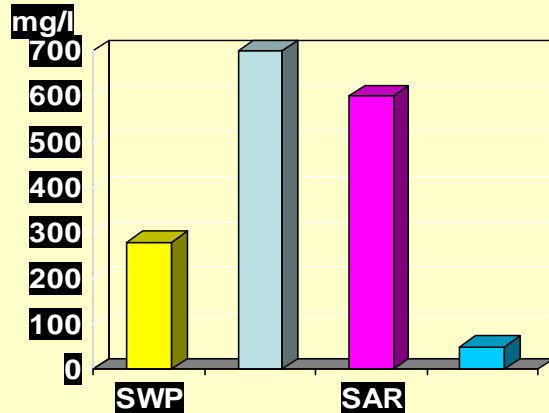
73% believe future water will be a serious problem

87% support water reclamation

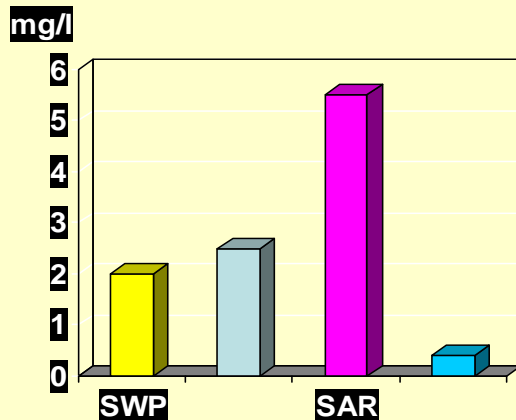
BUT...many people, locally, State-wide and regionally, oppose more growth in Orange County and Southern California

Water Quality and Public Health

Total Dissolved Solids



Total Organic Compounds



- 6 years of full-scale system testing showed no viruses, bacteria, protozoa or other significant contaminants made it through the design system.
- Water Quality Study by several outside PhDs & water experts including a review by health agencies confirmed that water is safe.
- Water quality continually monitored by people and computers at multiple sites
- Project will have oversight by Dept. of Health Services, Environmental Protection Agency, Regional Water Quality Control Board.
- BUT... some people are worried about endocrine disruptors, pharmaceuticals and other unknowns

Q3: Environment?

Does GWR benefit the environment?

- **Reverse hardness/salinity levels in groundwater basin?**
- **Prevent seawater intrusion into aquifer?**
- **Use less energy than pumping imported water?**

Groundwater Increasing in Hardness and Salinity

- **Santa Ana & Colorado Rivers bring minerals into groundwater basin— creates hard, saline water.**
- **Each year, more minerals go into the basin than come out—about 62,000 tons every year**
 - **Aiming for a drinking water goal of 500 mg/L for minerals**
- **Groundwater Replenishment System will produce “ultra-pure” water that will start to reverse salinity and mineral buildup in appliances and plumbing fixtures**

Prevent Seawater Intrusion

- **Groundwater basin is connected to ocean**
- **Since 1975, OCWD has been purifying small amounts of wastewater to drinking water quality & injecting it along coast**
- **Each year, Orange County uses more groundwater. Therefore, even if they didn't do the GWR system, they MUST increase amount of water injected from 17,000 af/yr to 45,000 af/yr in order to prevent seawater intrusion.**

Reduced Energy Use from Reduced Pumping

- **By offsetting a portion of the State Water pumping costs, GWR project saves energy.**
- **50% less energy (140 M kWh/yr savings)**

Q4: Economy?

GWR -- Capital Cost

	October 2002
Advanced Water Treatment Facility	\$ 228.3 M
Conveyance Pipelines	75.2 M
Barrier Well & Pipeline	17.7 M
Administrative Costs	54.7 M
TOTAL	\$ 453.9 M

2007 Construction contracts total **\$410 M** and total program budget totals **\$481 M**

Infrastructure Needs

The OCSD must either build a new, expensive ocean outfall to discharge treated wastewater to the ocean or treat the wastewater to an even higher level and reuse it for groundwater recharge

GWR Reduces Water to Ocean and Saves Money

- **By highly purifying the wastewater, GWR reduces discharge to ocean & saves \$170 million that would have been spent on new outfall pipe.**
- **Instead, that money will be invested in GWR**

EIA Alternatives to GWR

- Seawater barrier only project
 - 35,000 af /yr (seawater barrier) vs. 72,000 af /yr
 - \$164 M vs. \$450 M (GWR)
 - Federal and State grants at risk
- New outfall
 - \$170 M (outfall) vs. \$450 M (GWR)
 - Longer implementation schedule
- Do nothing (not an option because seawater intrusion from over-pumping cannot be ignored)

Q5: Traditional and Non-Market Activities?

Traditional and Non-Market Activities

- **Recreational activities on OCWD/OCSD river trails for walking, jogging, biking, horseback riding**
- **Sport fishing of stocked fish in several recharge basins (artificial lakes created from sand/gravel pits after mine closures).**
- **100 species of wildlife found on OCWD/OCSD land.**

**Q6: Institutional
Arrangements and
Governance?**

Basic Terms

- **35-year term**
- **Phase I facilities only**
- **OCWD gets 72,000 af/yr water supply**
- **OCSD gets 100 mgd of Peak Flow Relief**
 - **Wet weather events**
 - **Emergency treatment and maintenance**

Governance of Planning, Design & Construction

- **Joint Coordination Committee (JCC) oversees construction.**
 - Acquisition of land and permits
 - Preparation of plans and specs, contract documents
- **OCWD Board approves budget and most contracts**
- **OCSD Board approves budget and largest contracts**
- **OCWD Board governs O&M of system facilities**
- **JCC meets annually to review and assess system operations**

Q7: Synthesis and Continuous Learning?

What Critics Have Said About Cost (of the Owens River Aqueduct)

“ It is a piece of gigantic folly that will cost taxpayers fifty million dollars, or more, increasing their taxes three times the present rate.”

— *Evening News*, June 8, 1907

What Critics Have Said About Quality (of the Owens River Aquaduct)

“ Government itself deliberately poisoning the entire water supply of the whole population.”

— *Herald*, August 20, 1914

What Critics Have Said About Need (for the Colorado River Aqueduct)

“No one I talked to in Orange County ever thought they’d live to see the need for water...”

-Lee Martin, MWD

***What Critics Have Said About Governance
& Management Responsibility
(for the State Water Project)***

“If voters go ahead, they are taking a desperate plunge into the unknown and authorizing a blank check to irresponsibility.”

— ***San Francisco Chronicle,***
October 29, 1960

“Perhaps the best way to understand this project is to look at it from the perspective of the future – not the present. Think of how future generations will look back on this moment of time. When we look back at the LA aqueduct and the Colorado River Aqueduct, we describe them as visionary and extraordinary. I’m certain this project will be viewed in that same way.”

-OCWD Director, Jan Flory

October 16, 2002

Summary of “7 Questions” Applied to GWR Case Study

- “7 Questions” enables us to identify and support many dimensions of sustainability.
 - Public participation
 - Increased well-being in terms of provision of a certain quality and quantity of water
 - Recognizing the limits of imported water, takes a first step towards local sufficiency by trying to work from within constraints of local groundwater resources.
 - In terms of the alternatives presented, makes logical choices towards protecting the environment, meeting human needs, energy conservation, economically sensible choices.

Strengths of “7 Questions” Sustainable Assessment Methodology

- Puts the “triple bottom line” at the center.
- Takes a “soft systems” as opposed to a “hard systems” approach recognizing that sustainability issues cannot be resolved in a rational, linear, piecemeal way.
- Is specifically intended NOT to rank different elements and sum up the bottom line, hence an “open” approach.

Limitations of “7 Questions” Sustainability Assessment Methodology

- Complexity of issues might overwhelm the stakeholders and simple answers might become the default decision.
- Can miss the forest for the trees. (e.g. target many “small” sustainabilities at the expense of “big picture” sustainability)

References

environment

- Burdge, R.J. "Benefiting from the Practice of Social Impact Assessment" *Impact Assessment and Project Appraisal*. Vol 21, No. 3. Sept. 2003.
- Heinzerling, L. and Ackerman, F. Pricing the Priceless: Cost Benefit Analysis and Environmental Protection, 2002
- Interorganizational Committee on Principles and Guidelines for SIA. "Principles and Guidelines for SIA in the USA." *Impact Assessment and Project Appraisal*. Vol 21, No. 3. Sept. 2003.
- Reisner, Marc. Cadillac Desert. Pubnam/Penguin. New York and London.

society

economy

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society

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Web Resources

- <http://www.ocwd.org/html/recharge.htm>
- <http://www.gwrsystem.com/>
- <http://www.socialimpactassessment.net>
- http://www.nmfs.noaa.gov/sfa/social_impact_guide.htm (1994/95 version of the Guidelines and Principles for Social Impact Assessment)
- <http://ceq.hss.doe.gov/nepa/nepanet.htm> (EIA and NEPA)

How Much Water Does Orange County Use?

- **Current water demand
= 500,000 af/yr (2002)**
- **Projected water
demand by 2020
= 680,000 af/yr**
- **40% = “State Water” +
Colorado River Water**
- **60% = Groundwater**