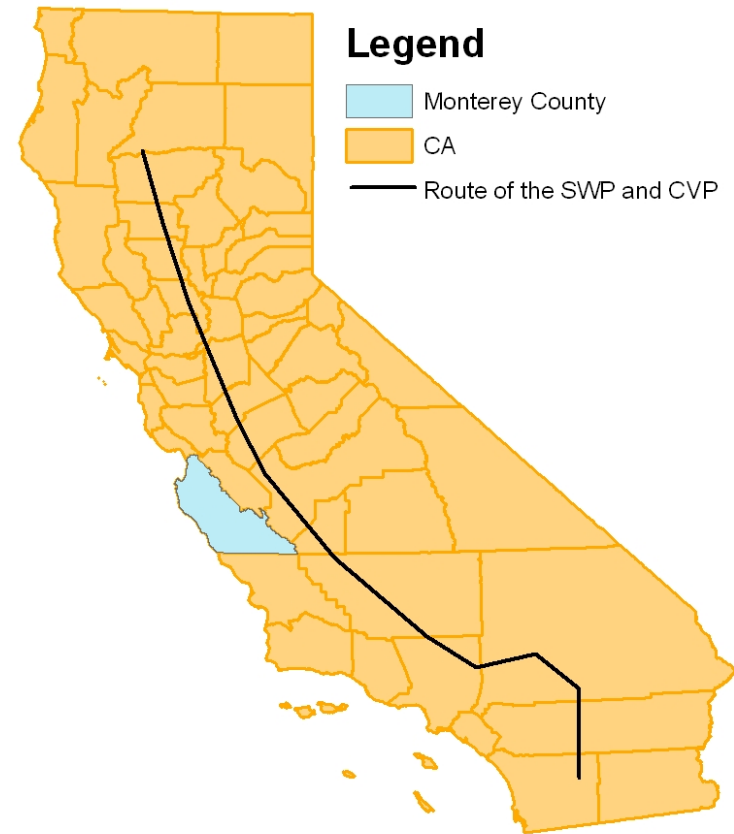

Harvesting Rain: Addressing Water Needs of the Monterey Peninsula

A Capstone Project in the College of Science, Media
Arts, and Technology at California State University,
Monterey Bay

By: Bryce Kantz
Completed Spring of 2009

California Water Supply Context

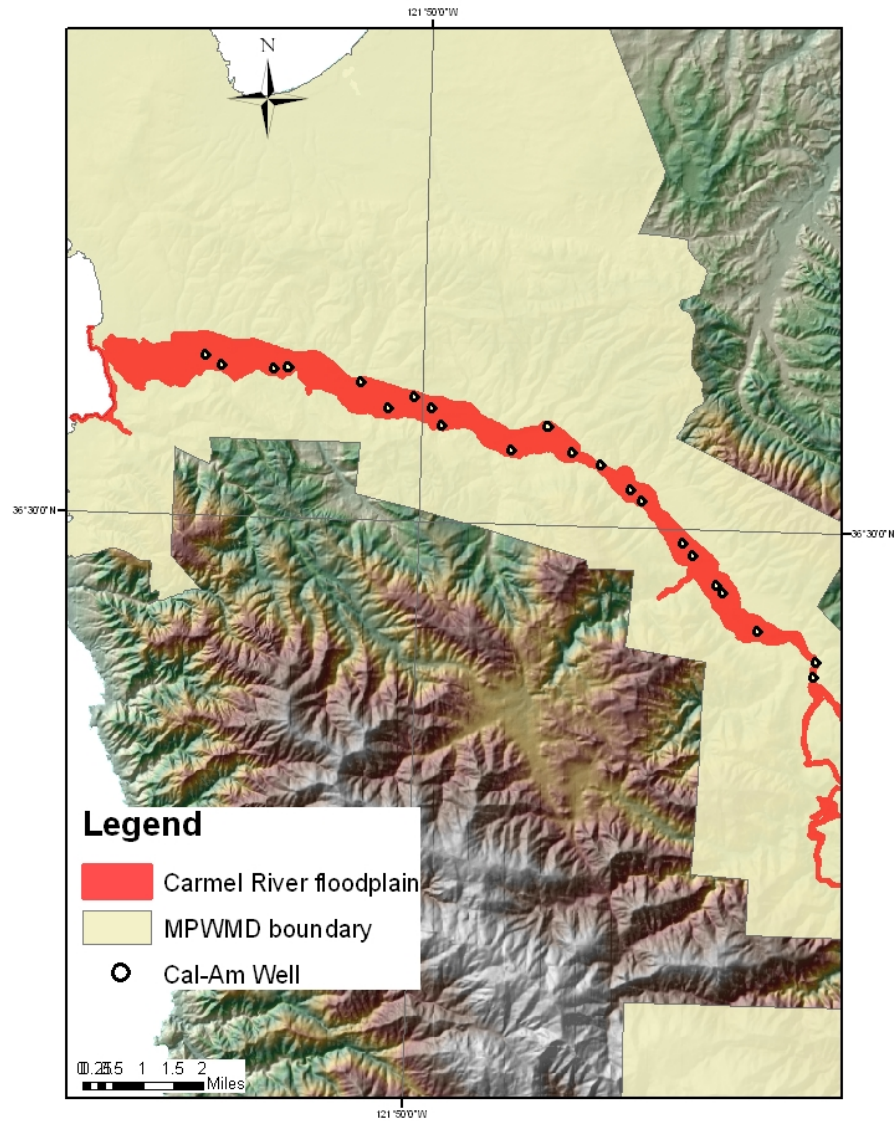
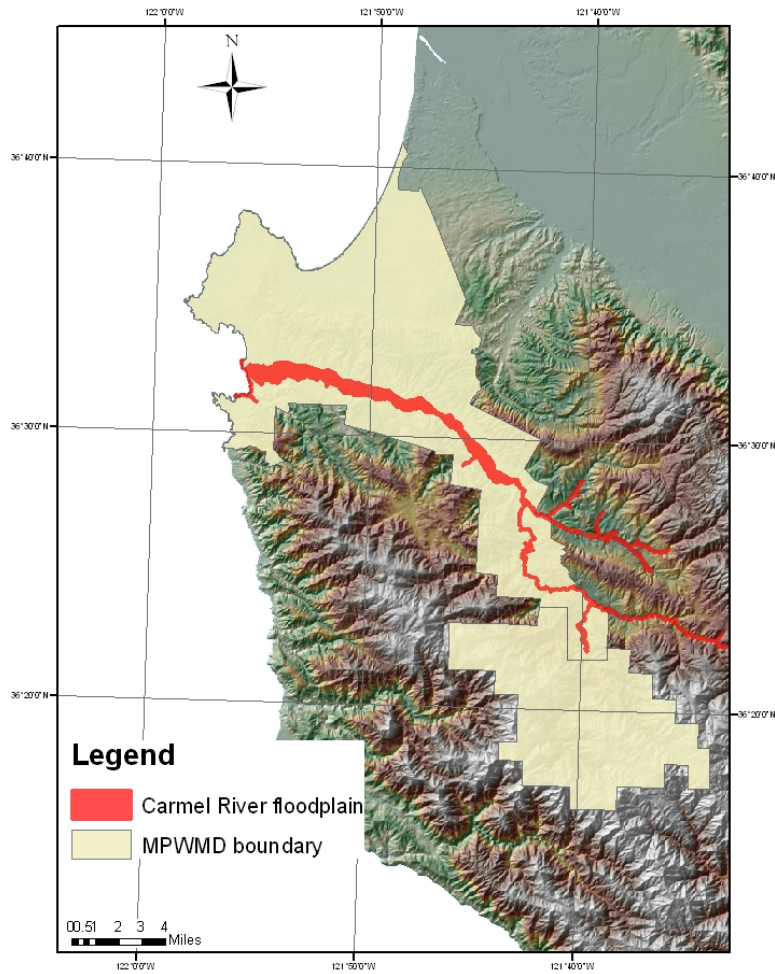
- California: two water delivery public works projects
 - Central Valley Project
 - Federal
 - State Water Project
 - State
- Monterey Peninsula = closed water system.



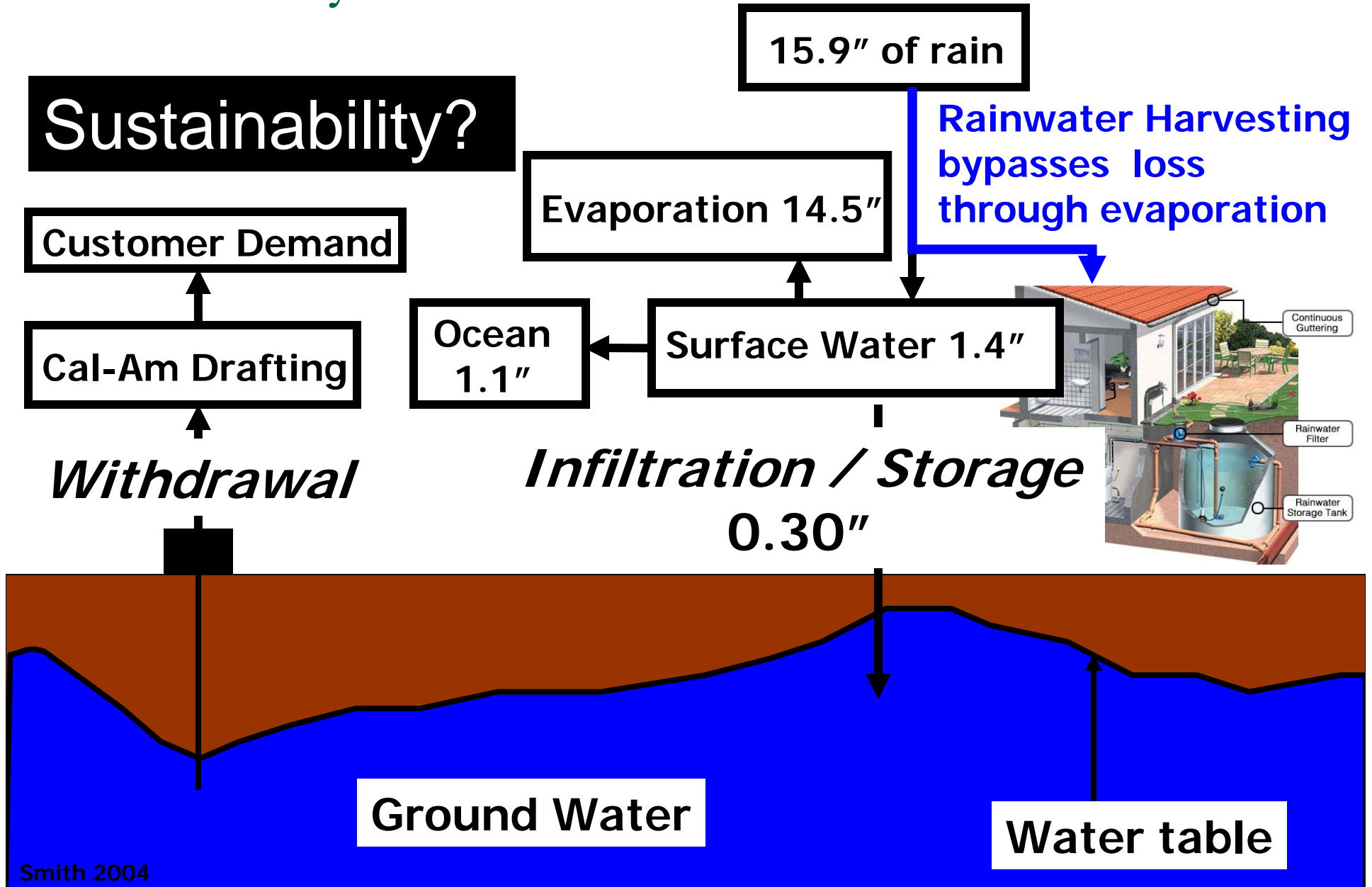
Monterey's Groundwater History

- Providing fresh water to the Monterey Peninsula, a difficult issue of resource management.
 - San Clemente Reservoir
 - When constructed held 2,140 acre-feet of water
 - Post 1940 Cal-Am drills wells in Carmel River and Seaside aquifers to augment supply
-

Twenty One Wells Tapping Carmel Aquifer



Monterey Ground Water Resource Model



State Water Board Decision WR 95-10

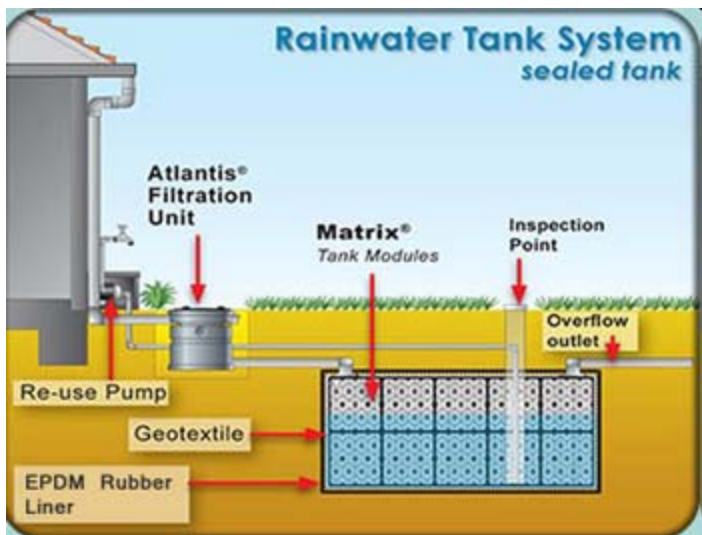
- 1995 WR 95-10 finds that Cal-Am has no legal right to 10,730 acre-feet of the 14,000 drafted annually.
 - Mitigation plan:
 - Appropriation of legal rights to the water in overdraft,
 - Reliance on the nearby Seaside aquifer,
 - Building of a new dam,
 - Exploration of alternative and renewable sources of fresh water.
 - Pursuing Mitigation
 - 1995 the New Los Padres Dam project turned down by voters.
 - Desalination study determines cost to yield not favorable, MPWMD board votes down the full scale Sand City plant.
 - Shifting reliance causes Seaside aquifer to go into over draft.
-

2008 Cease and Desist Litigation

- Cal-Am has not met the water diversion reduction schedule set forth in WR 95-10.
 - 2008 a Draft Cease and Desist Order was filed by the SWRCB requiring that Cal-Am reduce water diversions to 1995 levels by 2010, otherwise:
 - legal action on the part of the State Attorney General
 - Six digit fines
 - Tiered seven level water rationing schedule (increasing water rates) for the entirety of the MPWMD district
 - Still under litigation
-

Development of a Rainwater Harvesting Capstone

- Spring 2008, open house installation of a 4,000 gallon underground cistern in Seaside.
- Manifestation of the green movement
 - Citizen involvement
 - Local business participation (Rain Source Water)



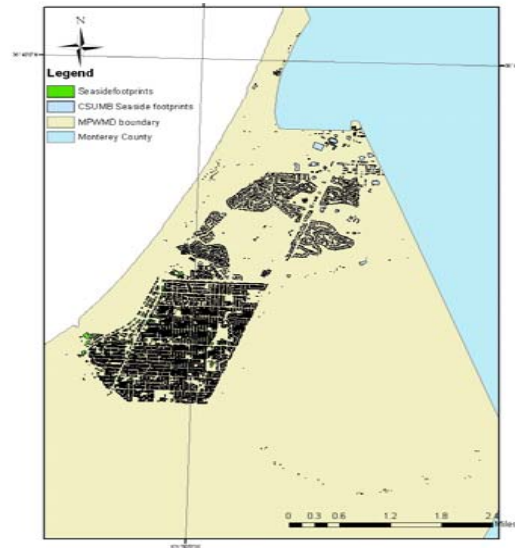
Quantification of the Monterey Peninsula Rainwater Resource

- Monterey needs a sustainable source of freshwater to replace the Carmel River Aquifer.
 - Internationally rainwater harvesting has become a successful method to augment the supply of water limited communities.
 - “How much water could the citizenry of Monterey harvest if every building captured the water that falls on it’s roof?”
 - Roof top square footage
 - Analyzed within ArcGIS geo-spatial processing software by ESRI
 - Monterey Peninsula hydrology
 - Average, wet, and dry annual rainfall predictions
-

Peninsula Roof Square Footage Data

- Association of Monterey Bay Area Governments
 - Hand digitized polygons based on aerial photos shot in 2007. Only covers 10% of study area
- Monterey County Assessors Office
 - Parcel data for entirety of study area. Building square footage and number of stories stored in data tables.

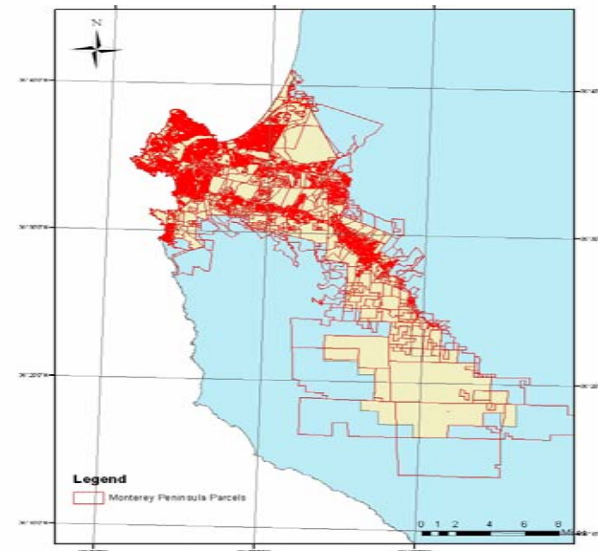
AMBAG data



AMBAG data Close-up



Parcel Data



Results of the Study

- 1.84 sq. miles, 1179 acres, or 51,391,667 sq. feet of roof in the MPWMD district
 - Annual rain fall within the study area is 15.9", 95% confident that any year will fall between 14.6" and 17.3".
 - Between 1434 acre-feet and 1700 acre-feet of water fall on Monterey Peninsula rooftops annually.
 - 15% of the Carmel River overdraft could be offset via rainwater harvesting in a dry year.
-

Introduction to Cost-Benefit Analysis

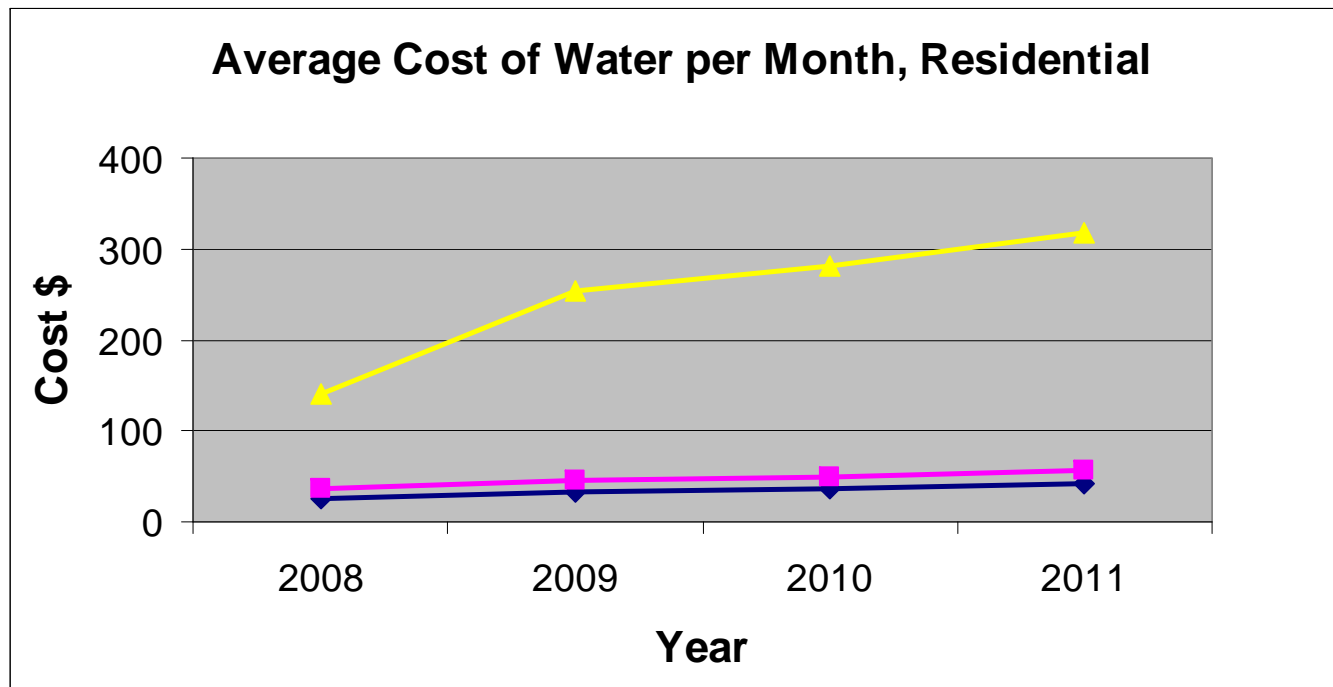
- What is the value of harvestable rainwater?
 - Cost-Benefit Analysis
 - Valuation tool used in the decision making process within the United States to “Promote the efficient resource allocation through well-informed decision making”
 - Tabulate economic costs and benefits.
 - Externalities valuation?
-

Valuing externalities resulting from Rainwater Harvesting

- Valuation of an externality is subjective. How much are these worth?
 - Benefits to Carmel River ecosystem?
 - Negative effect on natural aquifer recharge rates?
 - Downstream user impact?
 - Preservation of an endangered species?
 - Issues not considered in the Value analysis:
 - No externalities “good” or “bad” have been valued,
 - Cost of maintenance,
 - Rebates from local municipalities,
 - Initial cost of system.
-

Current Water Rates

- Cal-Am's water rates are set according to a 3 tiered system; more consumption = higher rates.
- The following graph summarizes Cal-Am rate increases approved by the Public Utilities Commission through 2011.



High use –
0.34 acre-feet

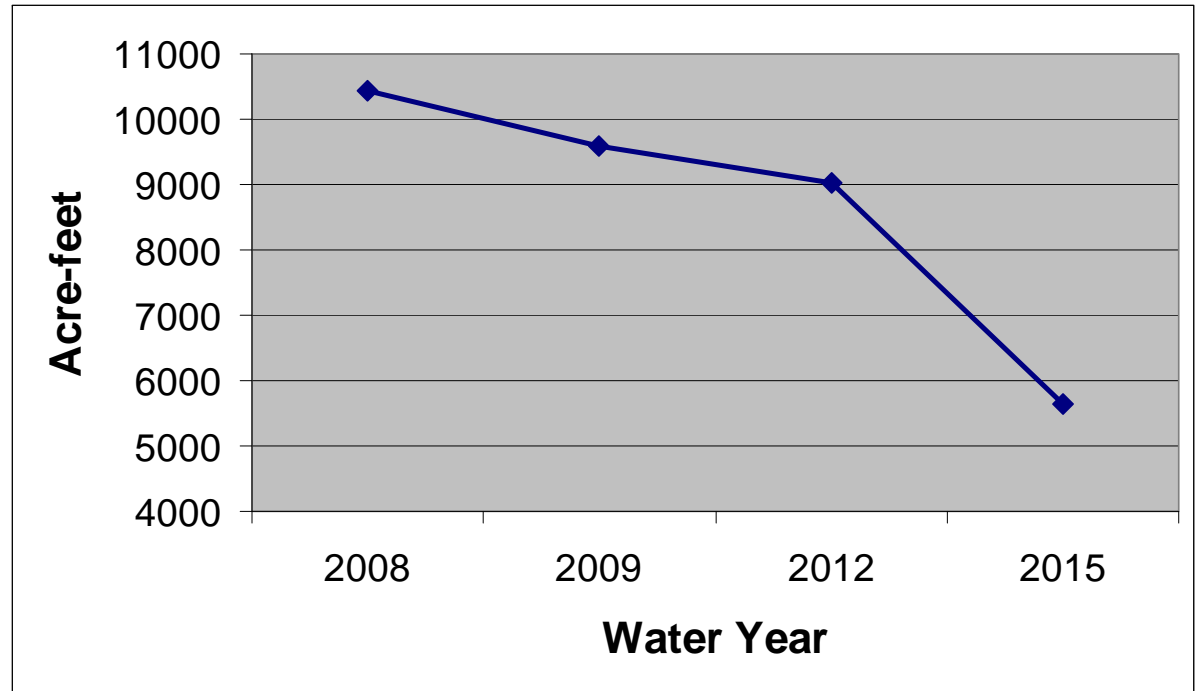
Average use –
0.12 acre-feet

Low use –
0.09 acre-feet

- Totally restructured when the Cease and Desist Order goes into effect

CDO Effect on Cal-Am Water Rates

- New, aggressive pumping reduction schedule:
- Proposed modifications of the current Cal-Am water rate structure.
 - 3 tier increases to 7 tiers
 - Spectrum remains the same 0 to 0.34 acre-feet use per month.



- Current CDO proposed requires 4,000 acre-feet within 4 years
 - Inability to meet pumping reductions will result in fines levied at Cal-Am. Customer water rates could double.
 - Benefit of doubled rates, pay back on investment on a cistern cuts in half

Value of a Hypothetical Capture System

- 4,000 gallon cistern costing \$2,000 (low end of the price spectrum)
 - Capable of containing \$50 worth of water at the PUC approved 2011 rate.
 - Assuming a once per year fill rate, the cistern would pay back in 40 years
 - Underestimate, 2,000 square feet of roof could capture 17,800 gallons – 4.1 fill rate
 - If all 17,800 gallons could be utilized, time to pay back would reduce to 10 years.
 - Once CDO goes into effect doubled water rates reduce the time to pay back in half again – between 5 and 20 years depending on fill and utilization rates.
-

Harvesting Rainwater on the Monterey Peninsula

- Rainwater harvesting is currently capable of supplanting 15% of the reductions required by WR 95-10 in a dry year.
 - Recommendations
 - Monterey County Building Codes should be updated to require the installation of passive rainwater harvesting and storage systems on all new construction projects.
 - To the citizens: investigate installation of harvesting systems! It's a "green" way for citizens to augment the water supply of their communities!
-

Community Member Acknowledgements

- David Johnston – AMBAG
 - Amy White – Installation open house hostess
 - Bob Holdon – MRWPCA, Principal Engineer
 - Heidi Niggemeyer – MRWPCA, Regional Stormwater expert.
 - Regina Doyle – Pacific Grove Water Board
 - Bruce Arthur – Rain Source Water
 - Monterey County Assessors Office
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