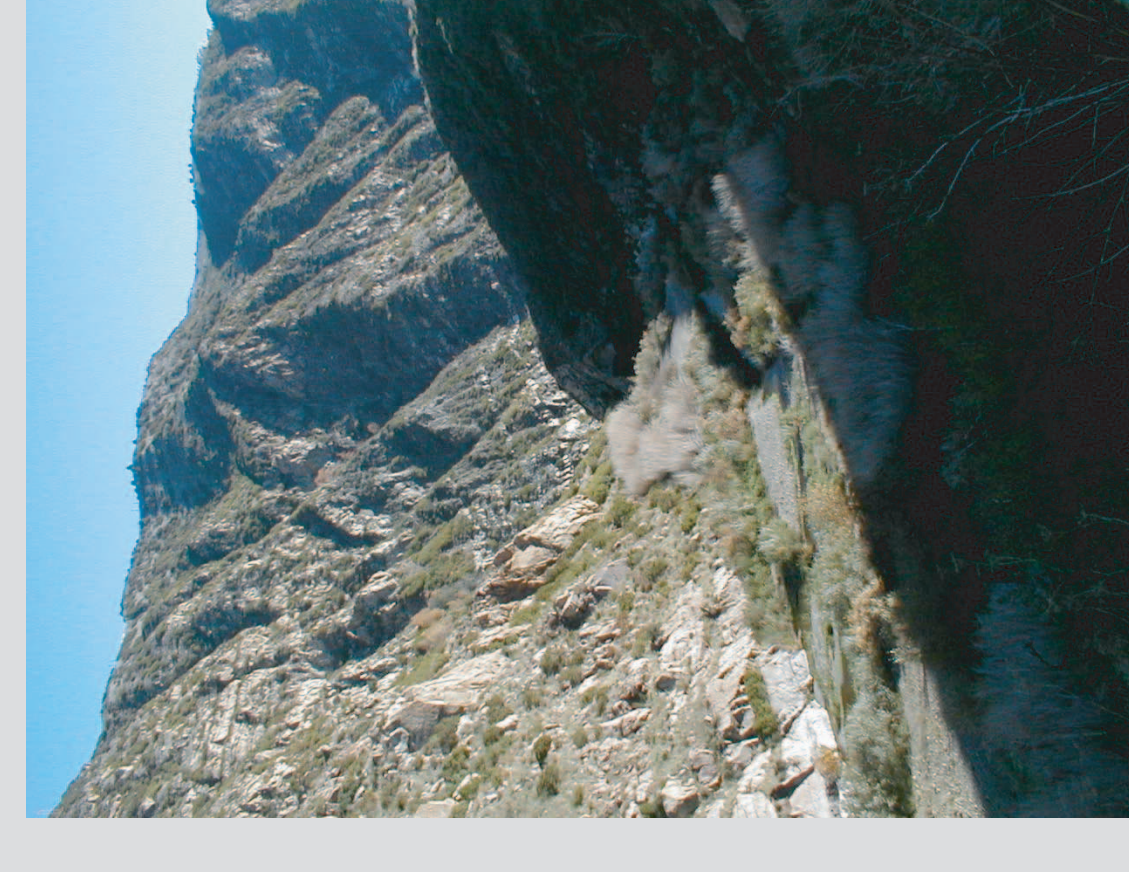
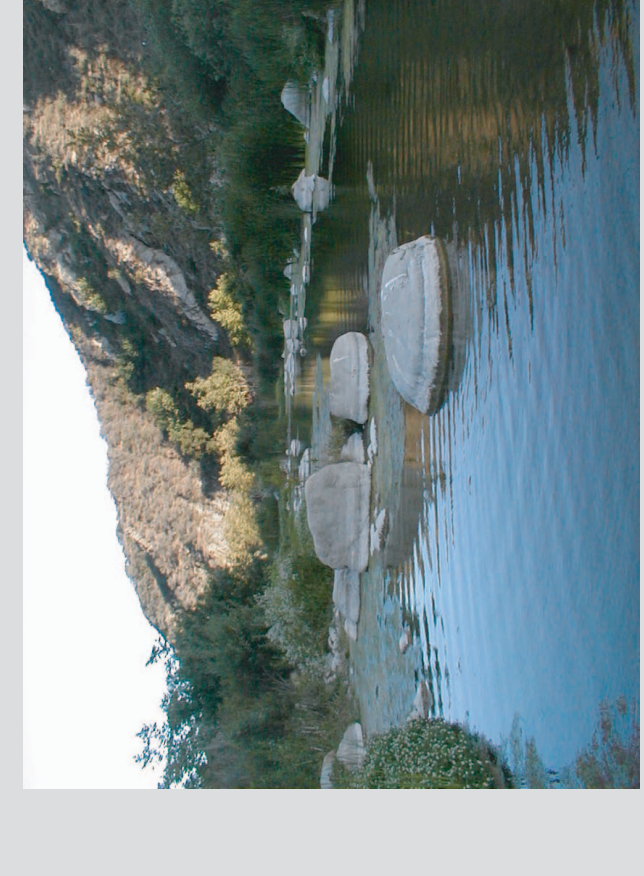
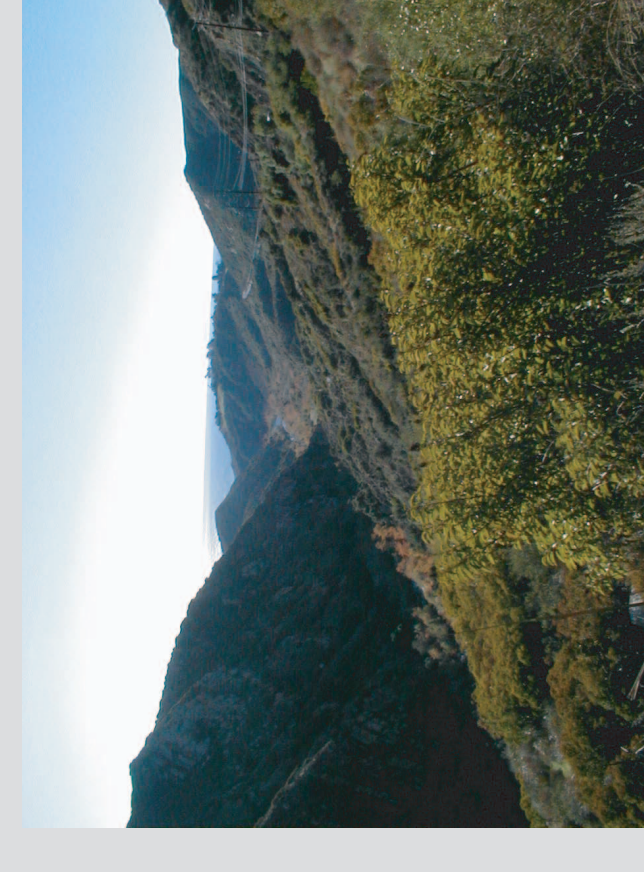
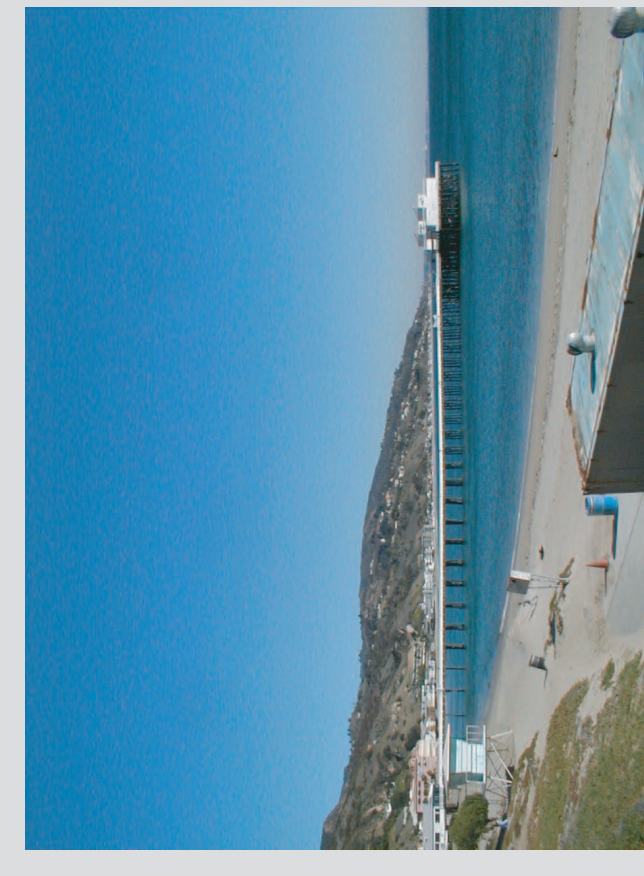


Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas of the City of Malibu, California



The City of Malibu, California is committed to protecting its valuable water resources over the long term. Before implementing a decentralized wastewater management program to provide management for onsite wastewater treatment systems (OWTS), the City wanted science to back up the basis for increased management. This multi-year study included a team of City staff and consultants led by Stone Environmental, Inc. of Montpelier, Vermont, and Questa Engineering Corporation of Santa Barbara, California. It began in spring of 2001, and was designed to provide the answers.

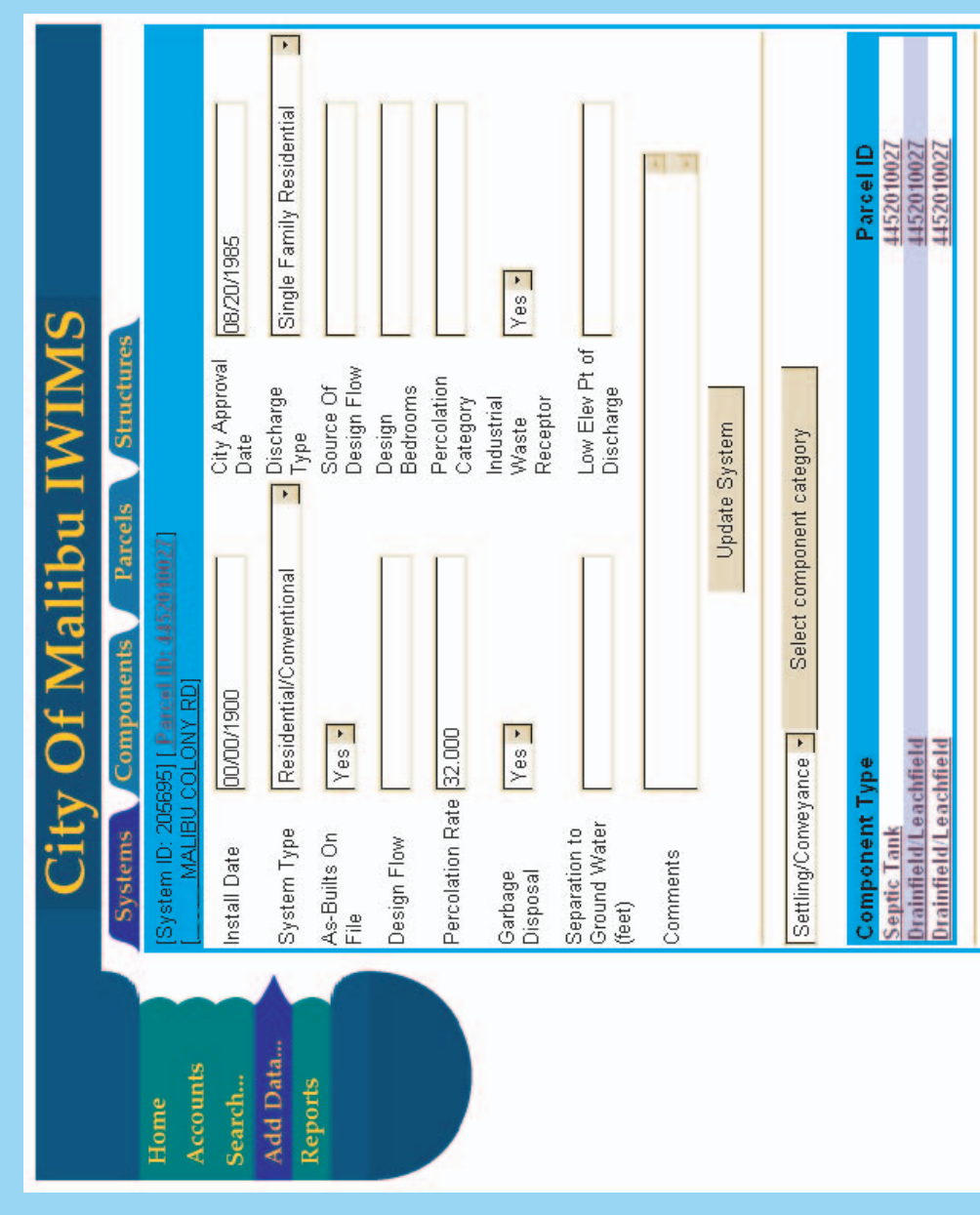
Which Way is the Water Flowing?

- Study focused on a high priority area:
- Residential, commercial, and government properties near Malibu Creek/Lagoon
- Beaches including famous surfing beach at Malibu Pier
- Creek and Lagoon showed indications of pathogen and nutrient (nitrogen) contamination
- Surfzone along the Pacific Ocean (Ocean) experienced pathogen contamination
- What land areas are impacting each resource? What is the contribution of OWTS to groundwater entering the Creek, Lagoon, and Ocean?



Start with the People - Stakeholder Outreach

- Stakeholder involvement built understanding and support for project
- Local outreach crucial for use of existing wells for sampling and water level measurements
- Wider outreach effort included governmental agencies and environmental organizations



Data Collection and Database Development

- Most information was in paper files and reports
- Web-based database used to store and manage complex data including soil borings, monitoring wells, OWTS designs, and permits
- Database links to GIS for spatial information like contours, parcels, roads, and surface water



Monitoring Well Development and Water Quality Sampling

- Initial effort gathered information on existing OWTS and groundwater monitoring wells
- Contacted well owners to obtain access
- Permission granted at 28 existing wells for water levels and/or water quality sampling
- "Gaps" between existing wells were identified
- 16 new groundwater monitoring wells were located, permitted, installed, and used in the study
- Monthly water quality sampling completed at 20 wells over 12 months
- Water sampled for several characteristics including bacteria and nitrogen

Computer Modeling

- 3-D groundwater model developed using MODFLOW and other programs
- Used to determine groundwater flow directions, evaluate OWTS impacts on groundwater quality, determine assimilative capacity of unsaturated soils and groundwater, and delineate specific areas posing risks to receiving waters from nitrogen and pathogens

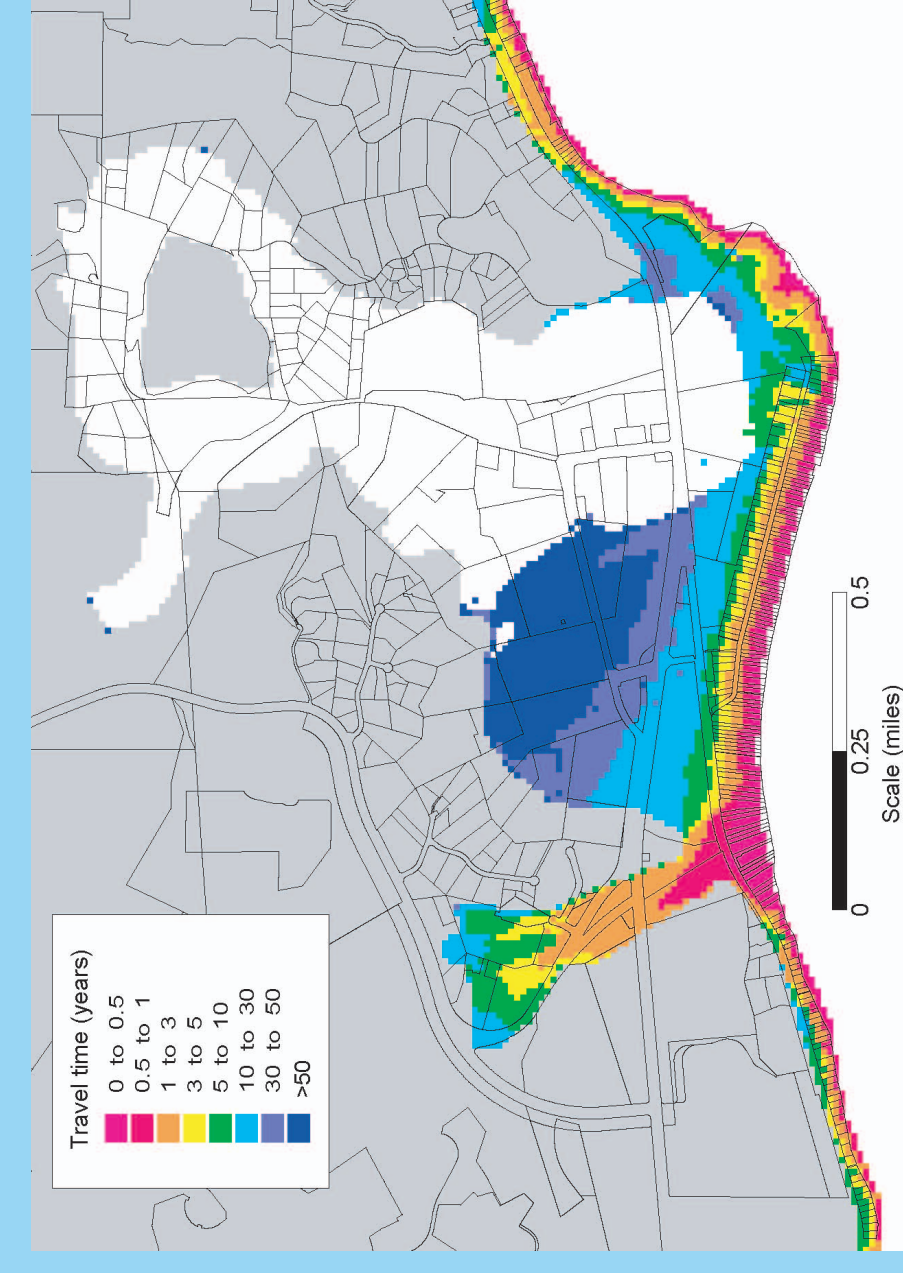


Figure A: Flooded Lagoon

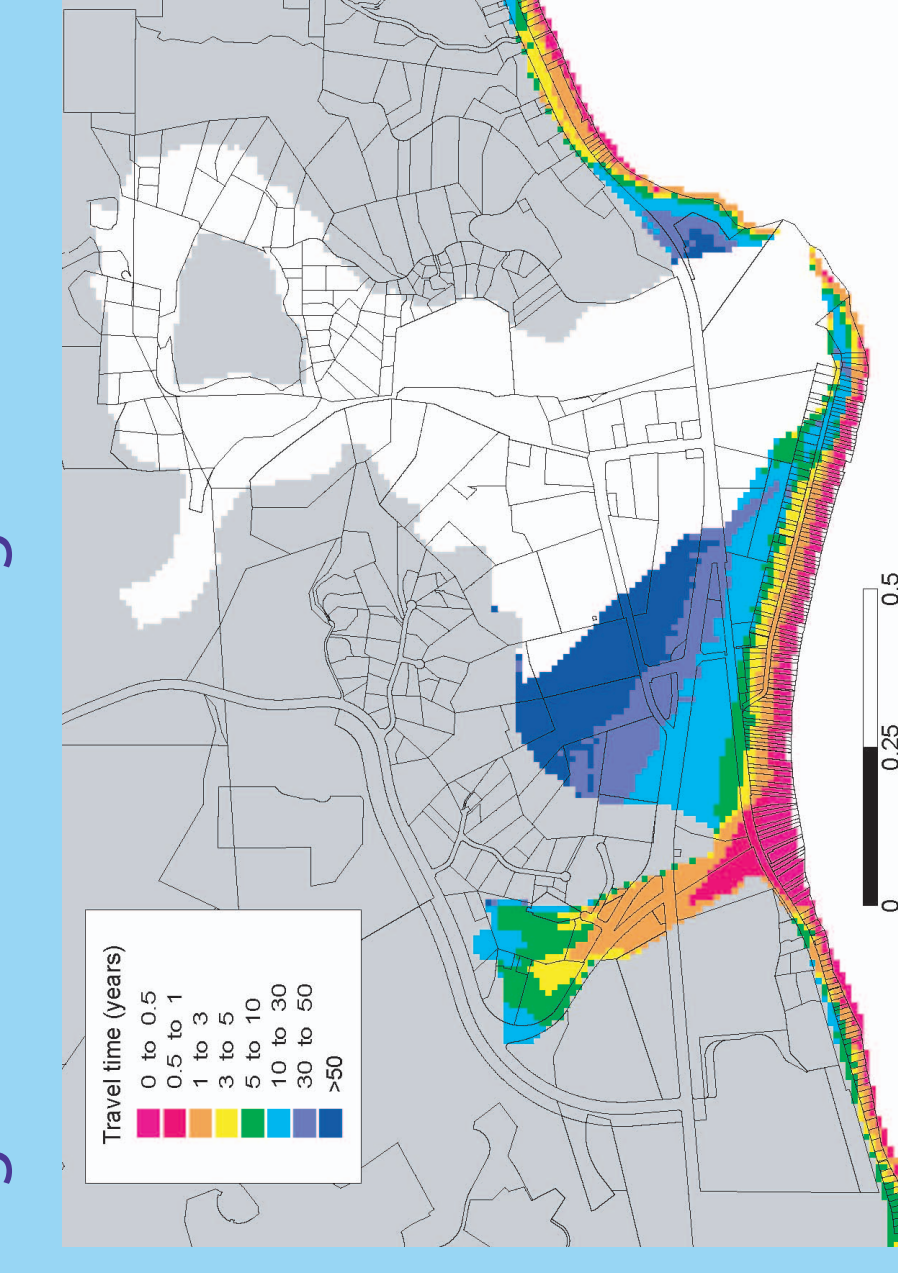


Figure B: Breached Lagoon Groundwater Flow Direction

Which way is the groundwater flowing: towards the Creek/Lagoon, or towards the Ocean? The answer is, "It depends"!

- Lagoon outflow is blocked every year by sand build-up along the Ocean. During this time, groundwater depth is raised for several hundred feet inland (Figure A)
- Once increased streamflow breaks through the sand barrier, the local water table drops (Figure B)
- In part of the study area, groundwater flows toward the Lagoon under breached conditions and towards the Ocean under flooded conditions

Groundwater Flow Rates - Times of Travel

- Model used to estimate the groundwater time of travel towards receiving waters
- Due to the deep aquifer and other factors, travel times ranged from six months to >50 years

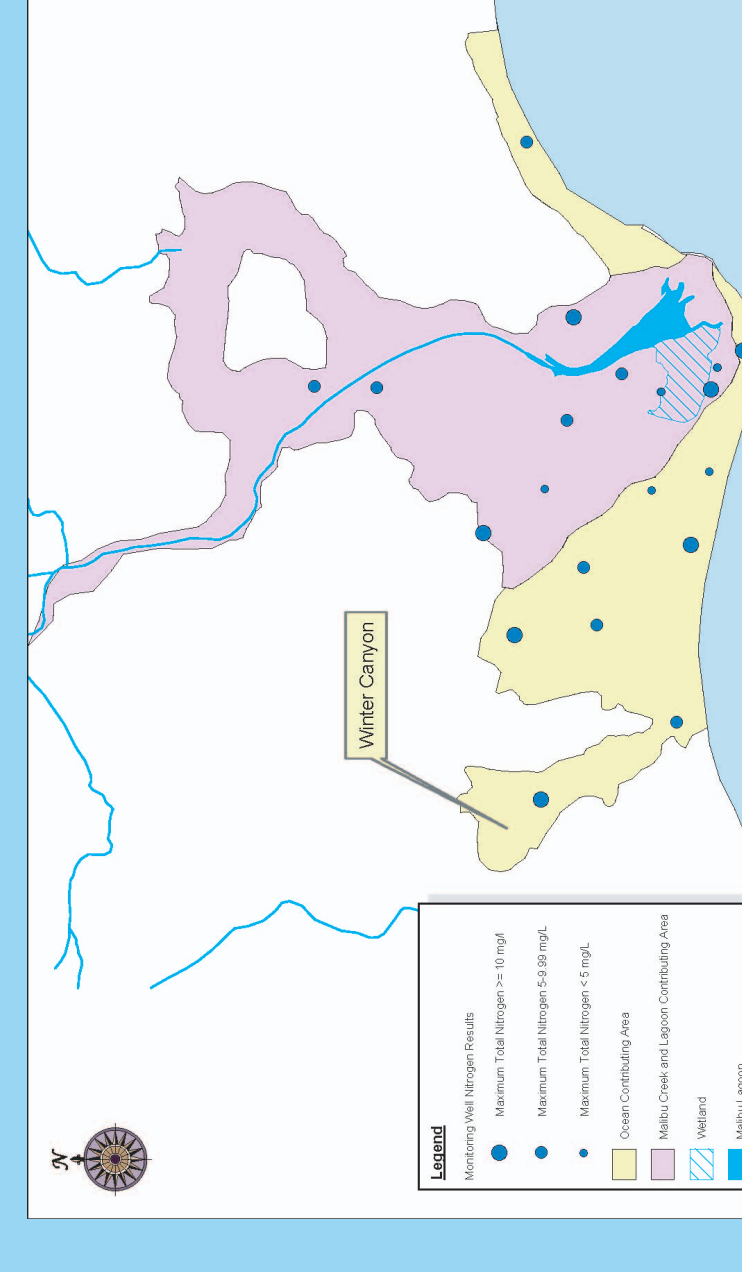


Figure C: Nitrogen Sampling Program Results

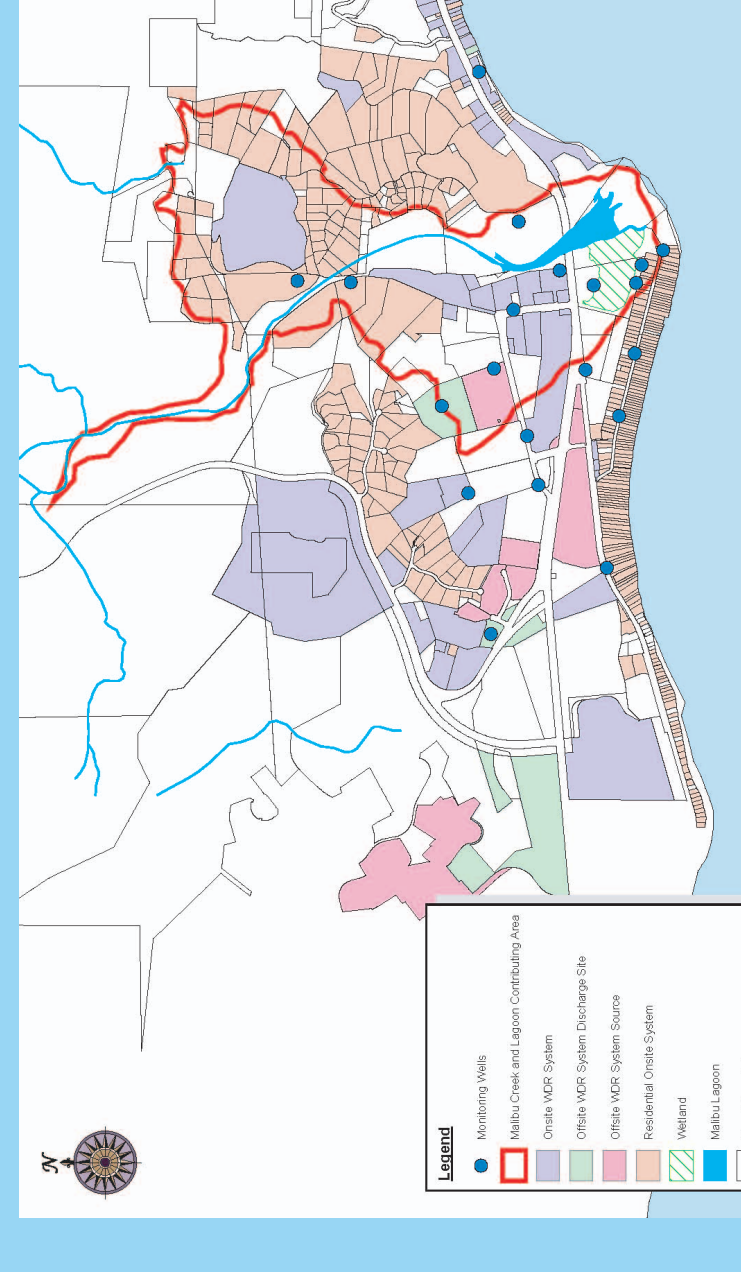


Figure D: Nitrogen Risk Assessment

Nitrogen Risks: Malibu Creek and Lagoon

- Some nitrogen contamination expected from OWTS
- Nitrification/denitrification processes can occur in groundwater
- Nitrogen loadings from OWTS estimated based on data including design flows, water use records, and sampling results (Figure C)
- At-risk area for nitrogen included all of the area contributing groundwater to Malibu Creek/Lagoon (Figure D)

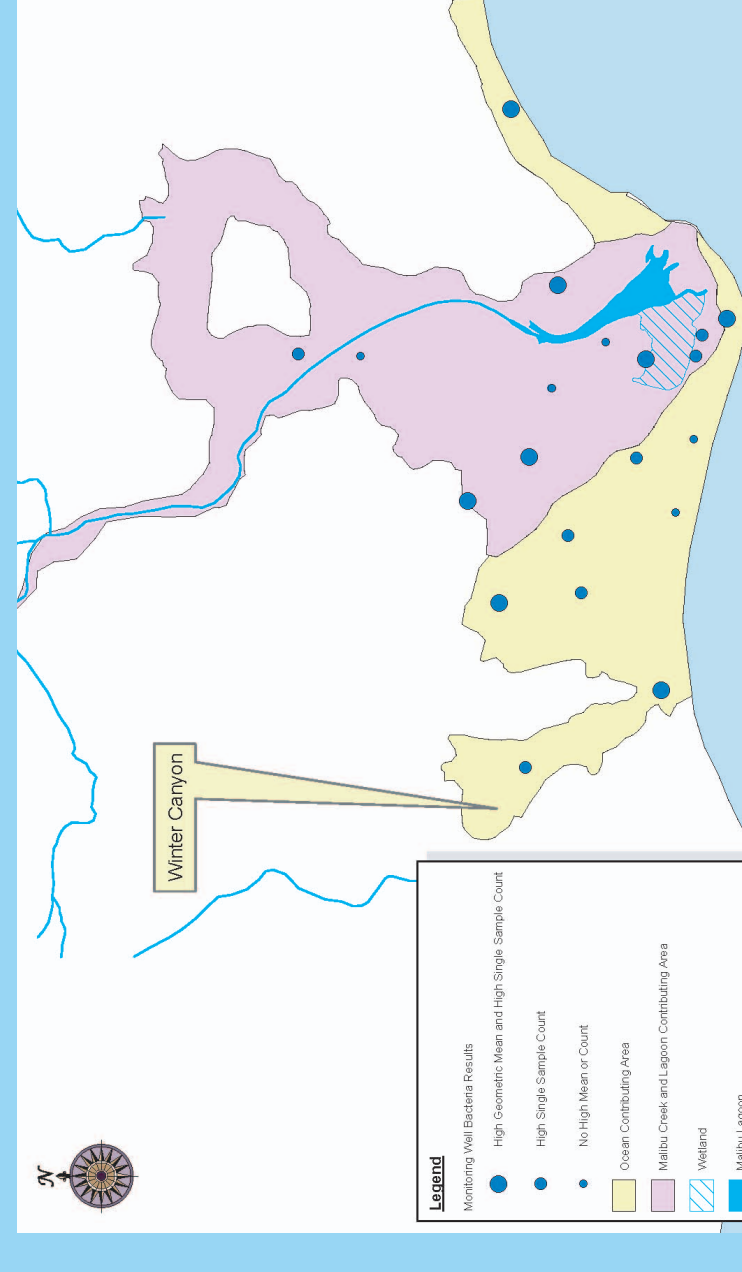


Figure E: Pathogen Sampling Program Results

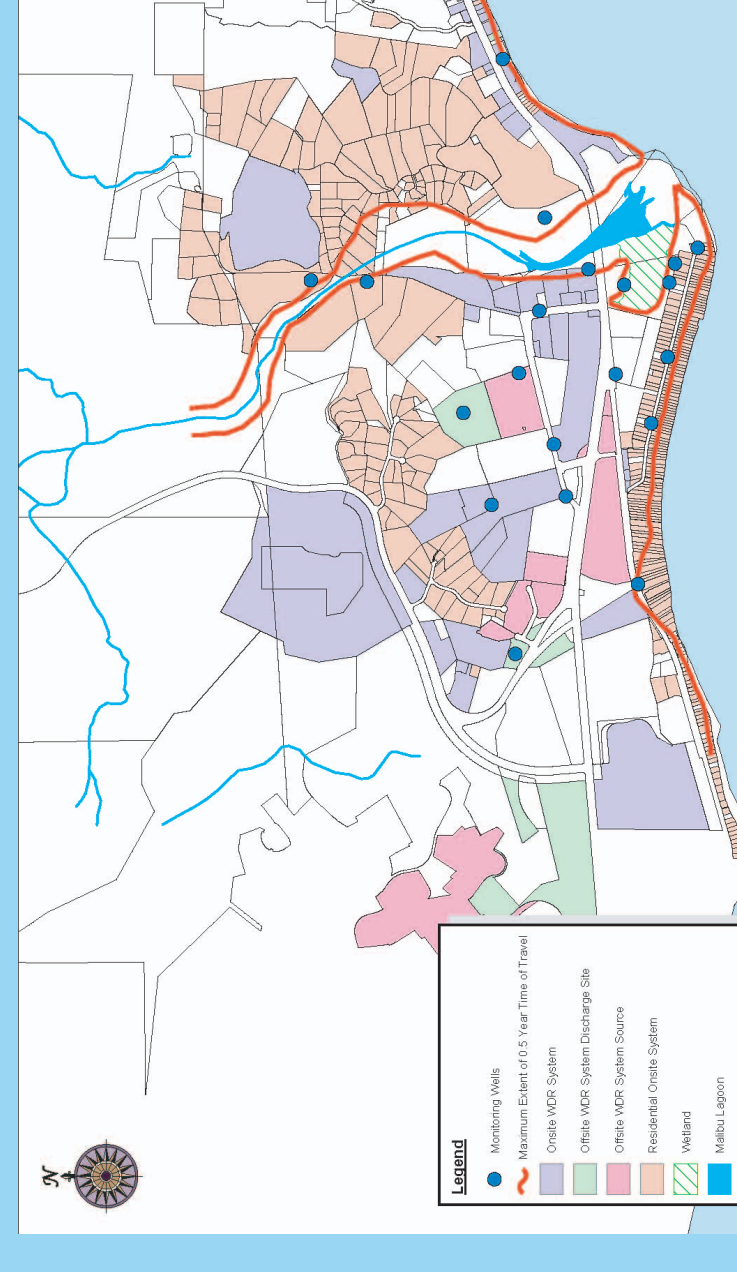
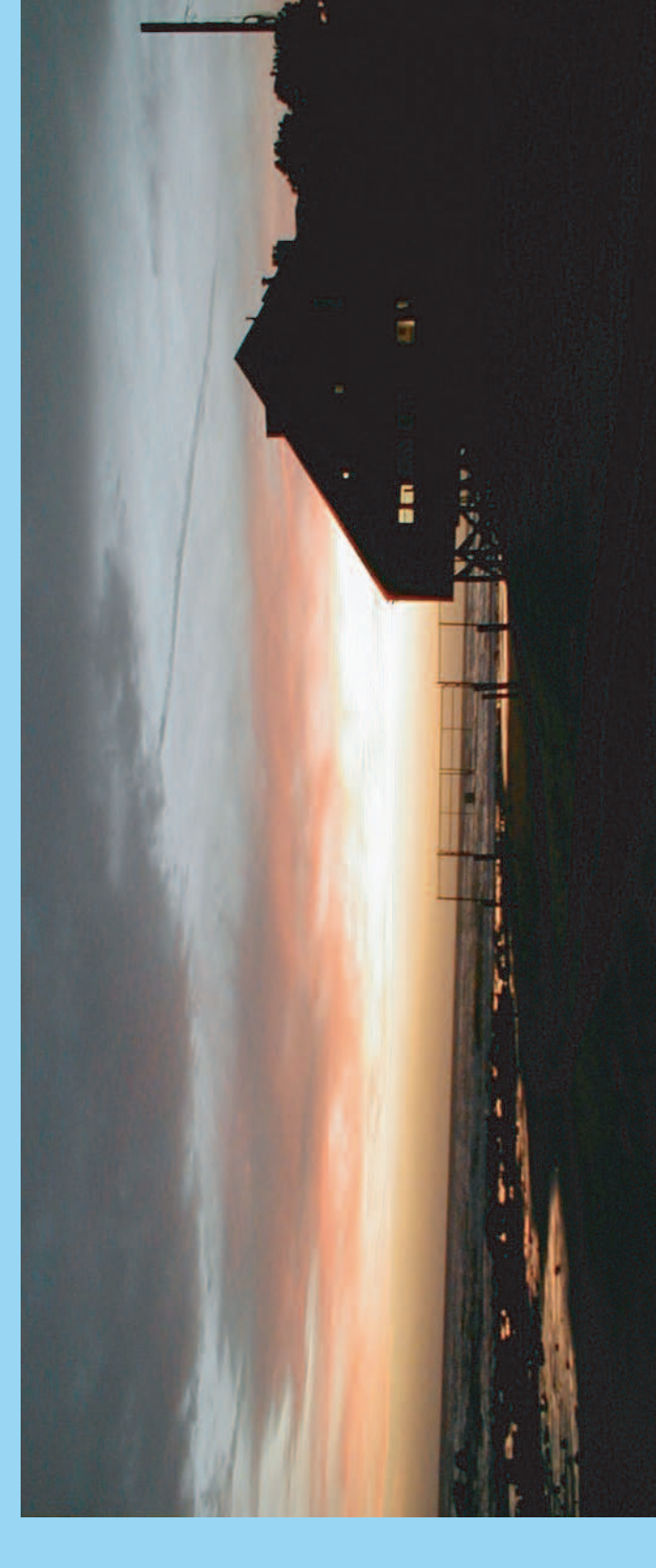


Figure F: Pathogen Risk Assessment

Pathogen Risks: Creek, Lagoon, and Ocean

- Sampling program results indicated OWTS not only source of pathogens affecting groundwater (Figure E)
- Highest risks posed by onsite systems without adequate unsaturated soil and groundwater travel time for pathogen die-off before reaching the Malibu Creek/Lagoon or surfzone.
- At-risk area included one-half year time of travel zone around Creek/Lagoon and surfzone (Figure F).



Nitrogen Wastewater Management Items in the Creek/Lagoon Area

- Point of sale inspections and upgrades as needed
- Inspections of all systems
- Nitrogen removal through pretreatment technologies
- Offsite cluster wastewater treatment system

Pathogen Wastewater Management Items in the Creek/Lagoon and Ocean Areas

- Point of sale inspections and upgrades as needed
- Inspections of all systems
- Pathogen removal (disinfection) through pretreatment technologies
- Offsite cluster wastewater treatment system

Next Steps

- Train City staff to use and implement web-based database for OWTS management
- Conduct analysis of wastewater disposal needs for developed parcels in the study area

Acknowledgements and Contact Information

This project was funded wholly or in part by the Santa Monica Bay Restoration Commission (SMBRC) and the California State Coastal Conservancy using state bond funds from the Safe Neighborhood Parks, Clean Water, Clean Air, and Coastal Protection Act of 2000. For more information, please contact the following study team representatives:
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