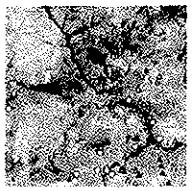
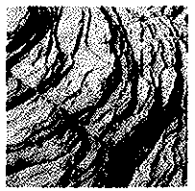
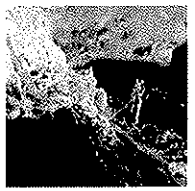
O-3



Civic Center Hydrology Study

Consulting Team: Stone Environmental, Inc.
McDonald Morrissey Associates, Inc.
Earth Consultants International, Inc.

Presented by: Bruce F. Douglas
Stone Environmental, Inc.

City of Malibu

Malibu, California
May 25, 2010

STONE ENVIRONMENTAL INC

Study Objectives

- Evaluate the cumulative impact of subsurface waste water dispersal on ground water levels in the Civic Center area
- Refine existing numerical ground-water flow model with additional data
- Use the numerical model to evaluate hydrologic effects of waste water dispersal

Past Modeling of Study Area

- Stone (2004) Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas in the City of Malibu, California.
- Questa (2005). Malibu Civic Center Integrated Water Quality Management Feasibility Study.

MAP 2: STUDY AREA BASE MAP WITH 1-METER SATELLITE IMAGERY AND PARCEL BOUNDARIES
Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas
in the City of Malibu, California

0 0.25 0.5 Miles

Source: Satellite Imagery Data, AirPhoto USA, November 2000;
Parcel Boundaries, City of Malibu, CA; Study Area Boundary, SEI.

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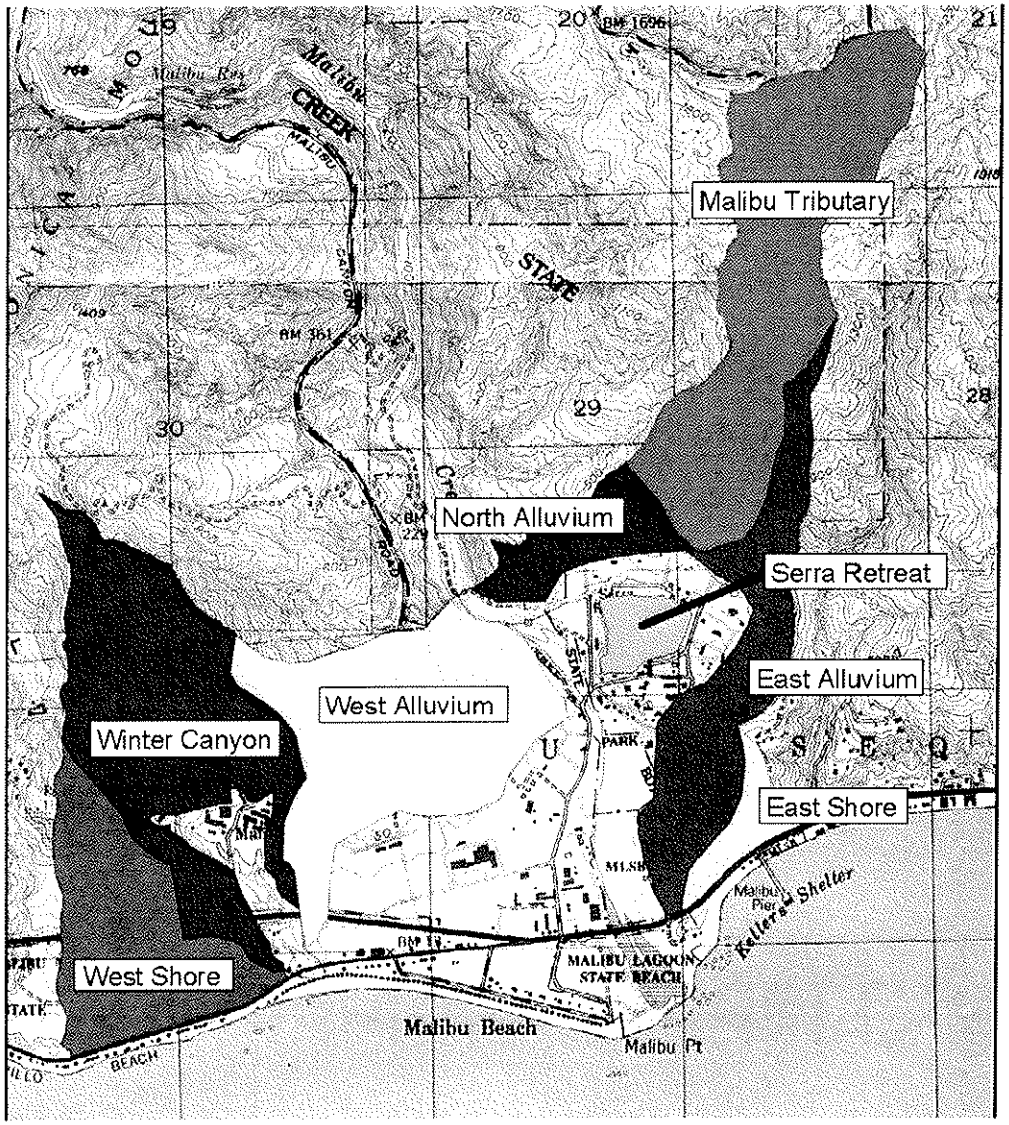
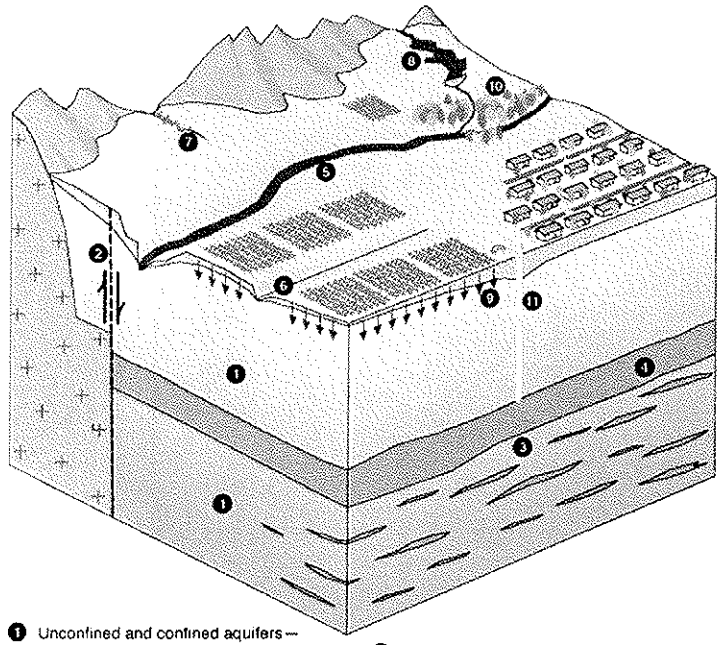
Upland Recharge Areas



(Source: Stone Environmental, Inc., 2004)

Hydrogeologic Model Development



1. Unconfined and confined aquifers—Ground-water flow and storage changes
2. Faults and other barriers—Resistance to horizontal ground-water flow
3. Fine-grained confining units and interbeds
4. Confining units—Ground-water flow and storage changes
5. Rivers—Exchange of water with aquifers
6. Drains and springs—Discharge of water from aquifers
7. Ephemeral streams—Exchange of water with aquifers
8. Reservoirs—Exchange of water with aquifers
9. Recharge from precipitation and irrigation
10. Evapotranspiration
11. Wells—Withdrawal or recharge at specified rates

Figure 1. Features of an aquifer system that can be simulated by MODFLOW.

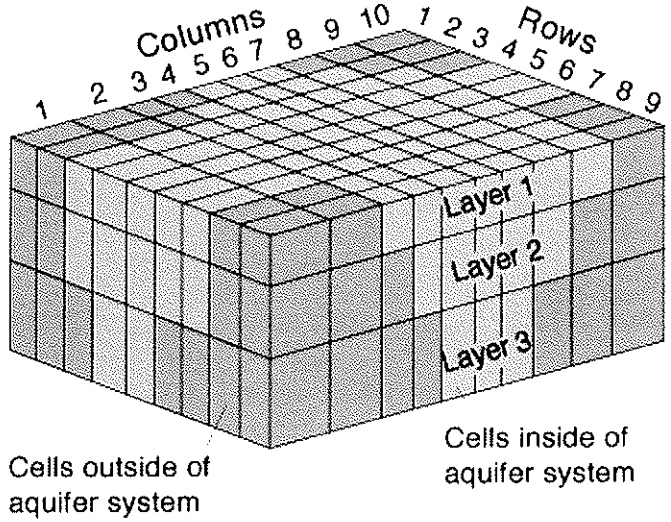
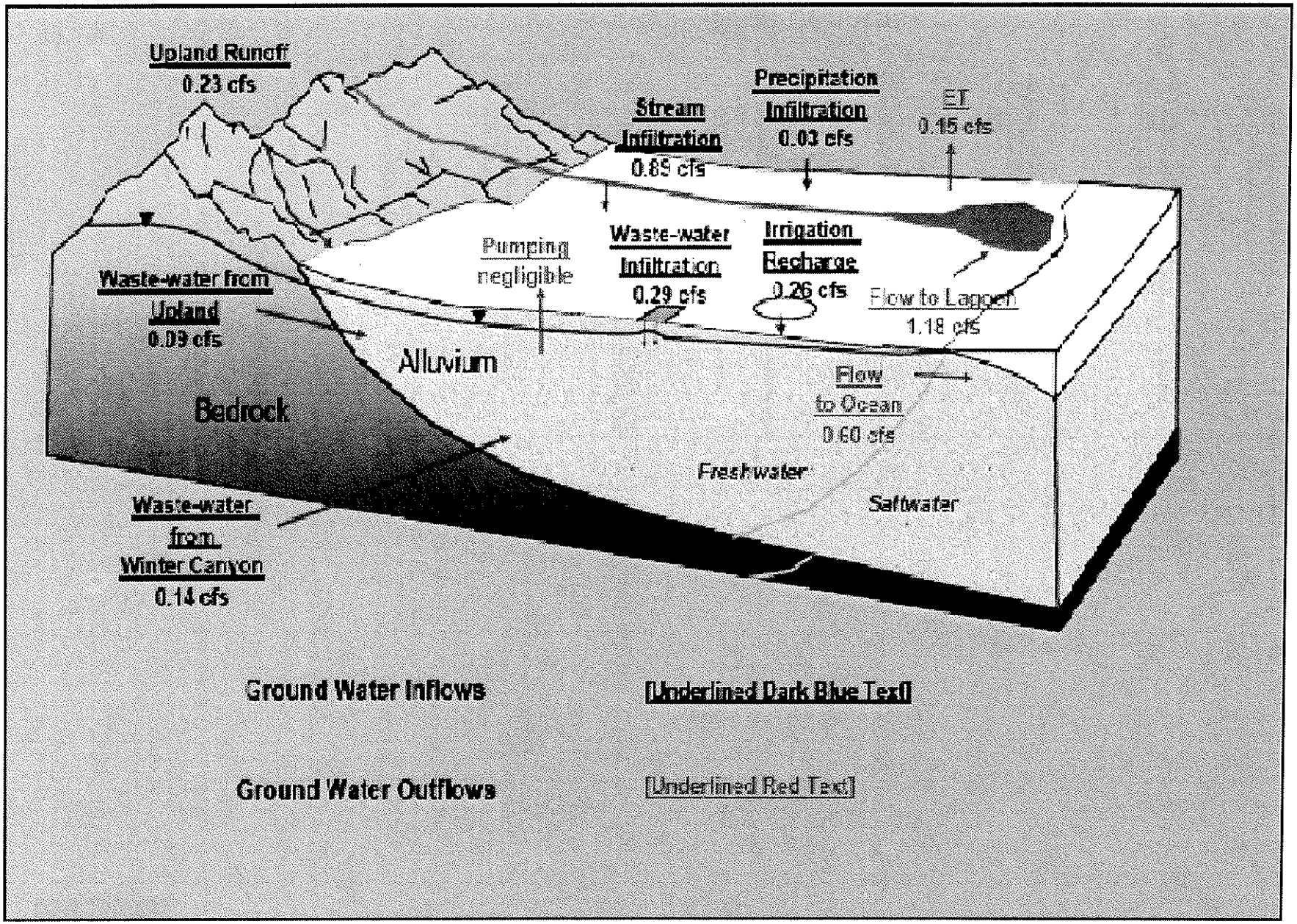


Figure 2. Example of model grid for simulating three-dimensional ground-water flow.

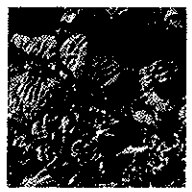
Published Geology

Map showing extent of alluvial deposits in the Civic Center area (Stone, 2004)

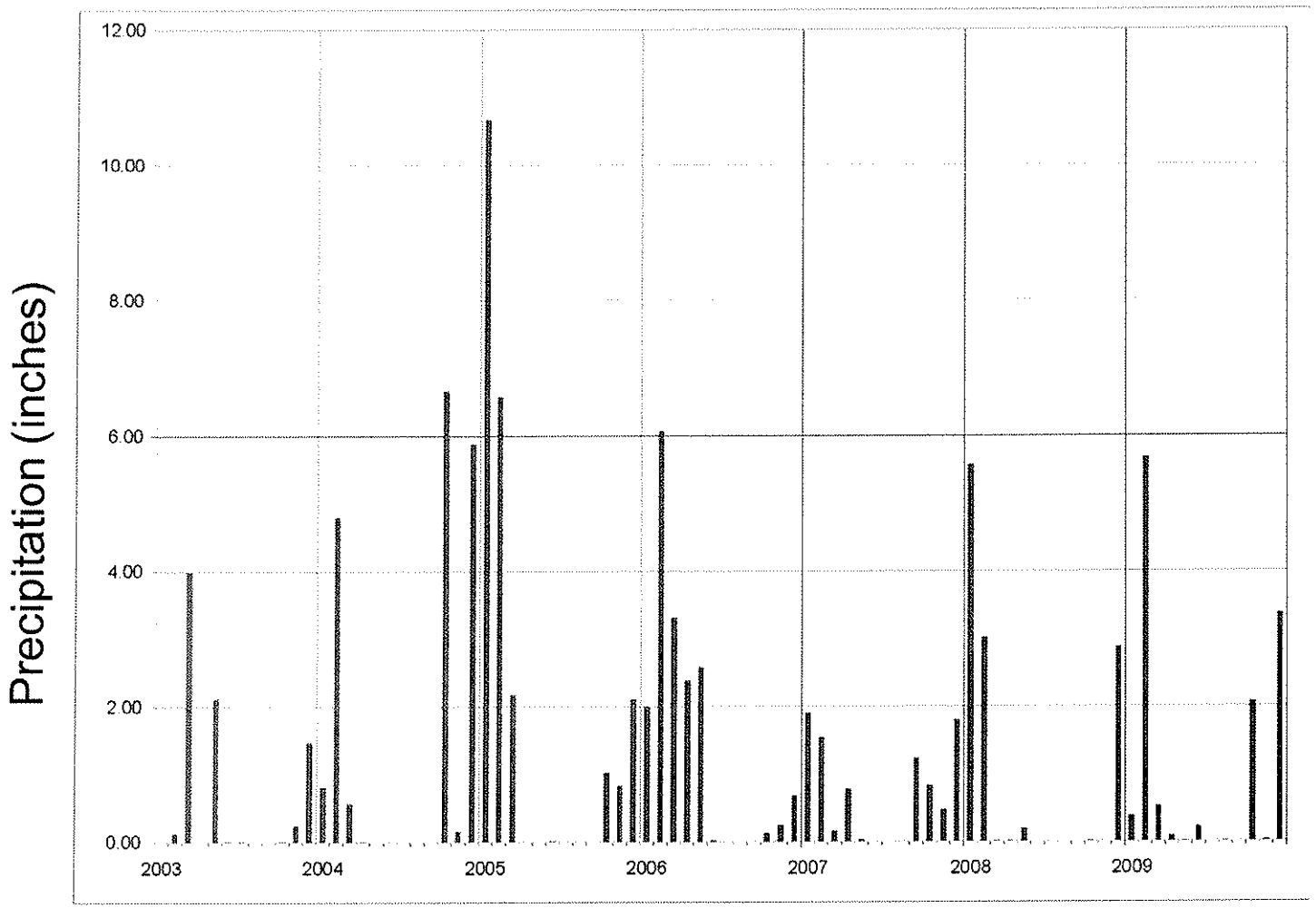
Recharge from irrigated areas and precipitation



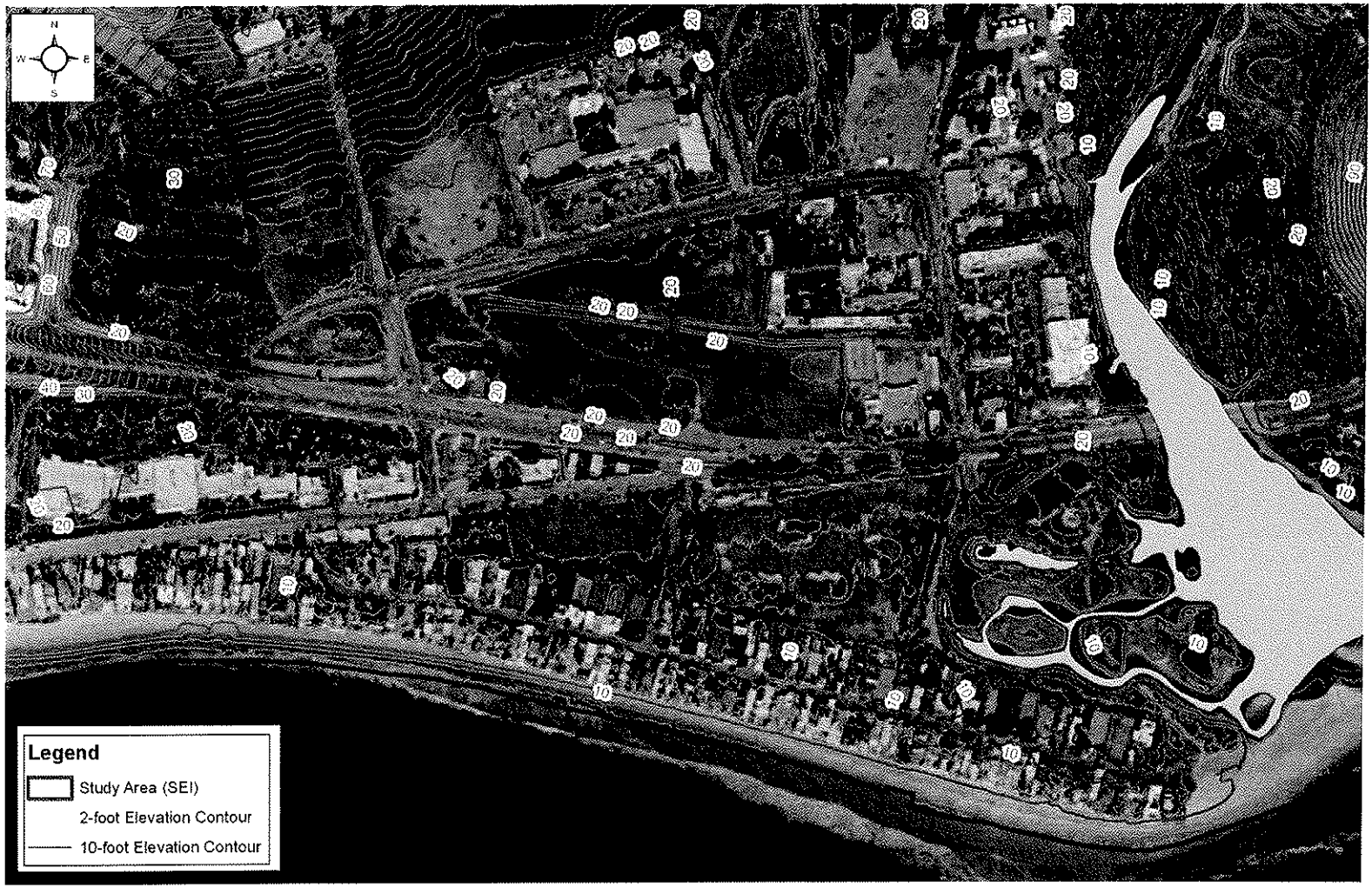
Sources and sinks for the Malibu alluvial ground-water flow system.



Rainfall
Measured at Pepperdine University

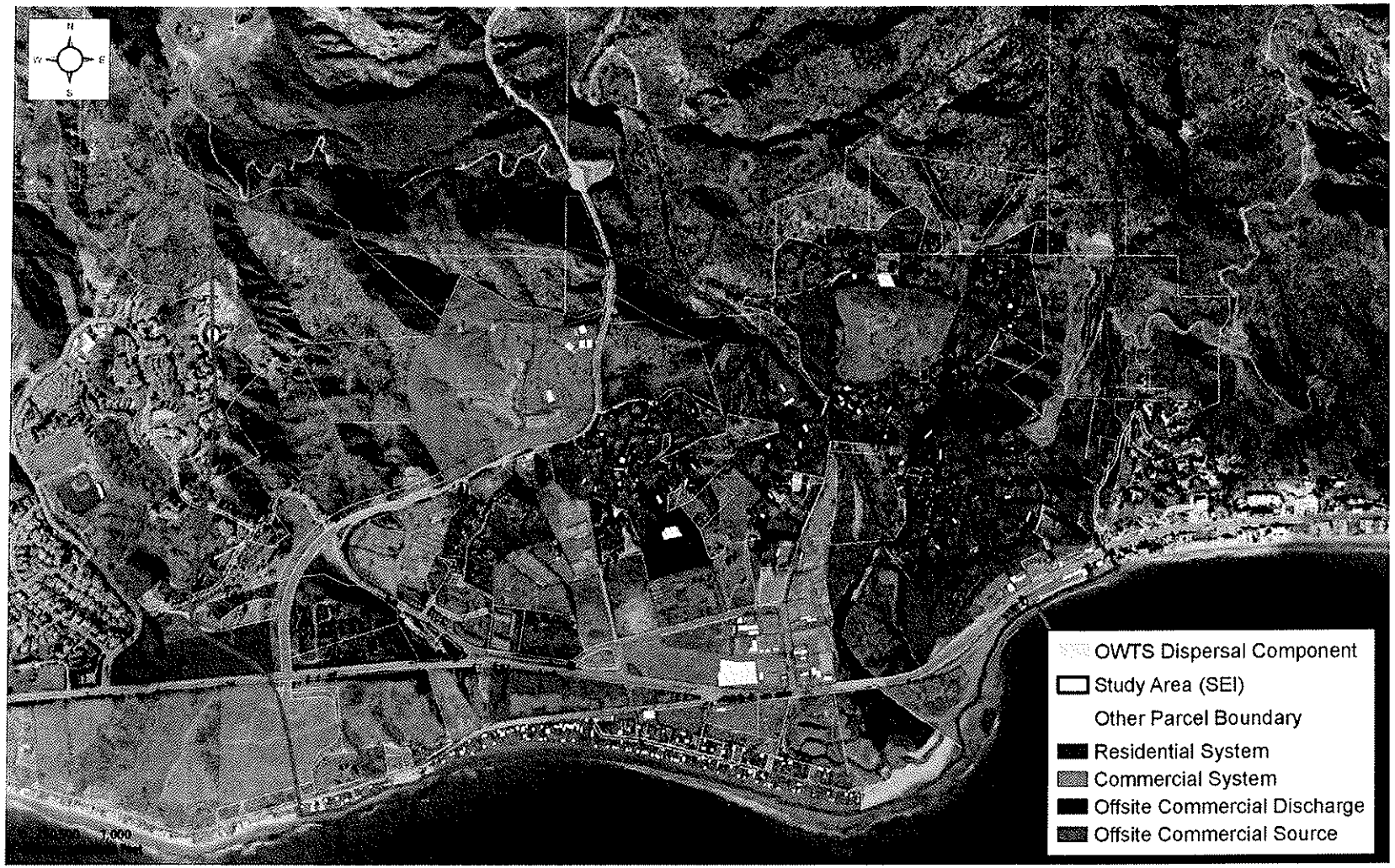


Ground Surface in Study Area



Sources: Topographic contours generated from LAR-IAC 2006-2007 digital elevation model, 2009; Hydrography digitized by Stone using LAR-IAC 2006-2007 digital elevation model, 2009; Study area, Stone, 2004; Imagery, ESRI.

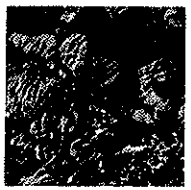
Onsite Wastewater Treatment Systems in the Study Area



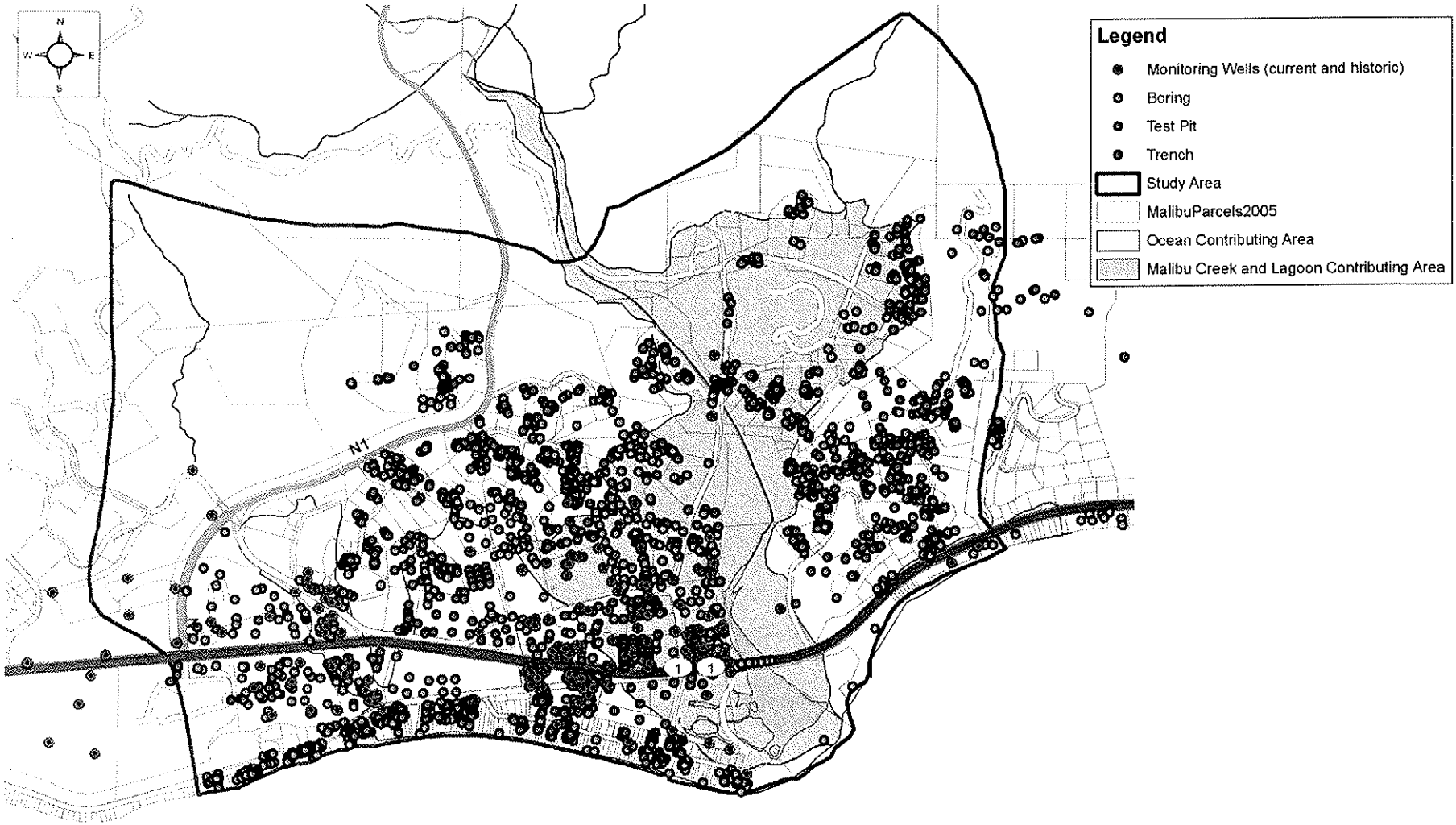
Sources: Dispersal components digitized by Stone, 2009; Study Area and Groundwater Recharge Areas, Stone, 2004; Parcel boundaries, LA County Assessor; Imagery, ESRI.

Onsite Wastewater Treatment Systems in the Study Area – Close Up

Sources: Dispersal components digitized by Stone, 2009; Study Area and Groundwater Recharge Areas, Stone, 2004; Parcel boundaries, LA County Assessor; Imagery, ESRI.

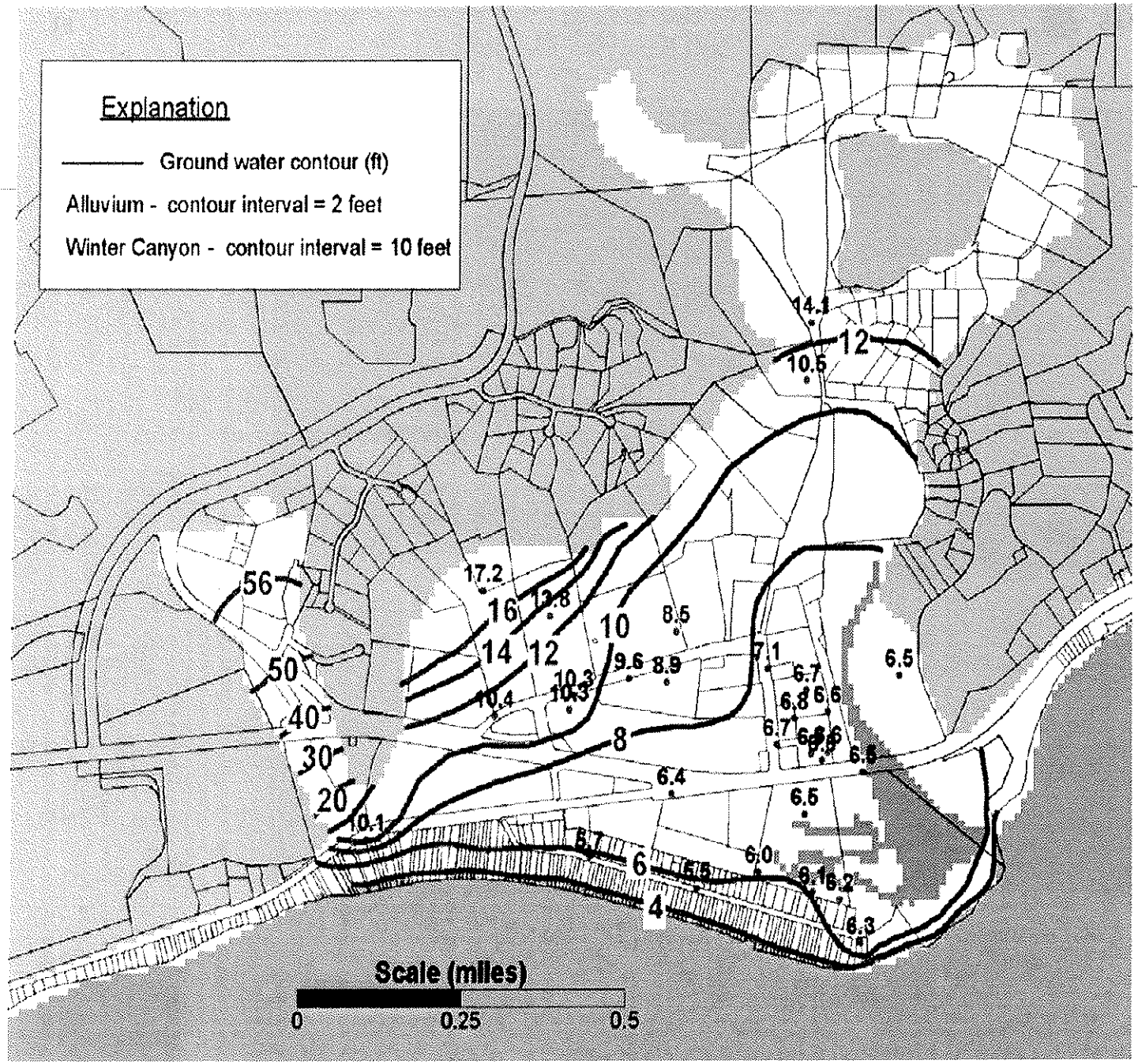


Monitoring Wells, Borings, and Test Pits in the Study Area

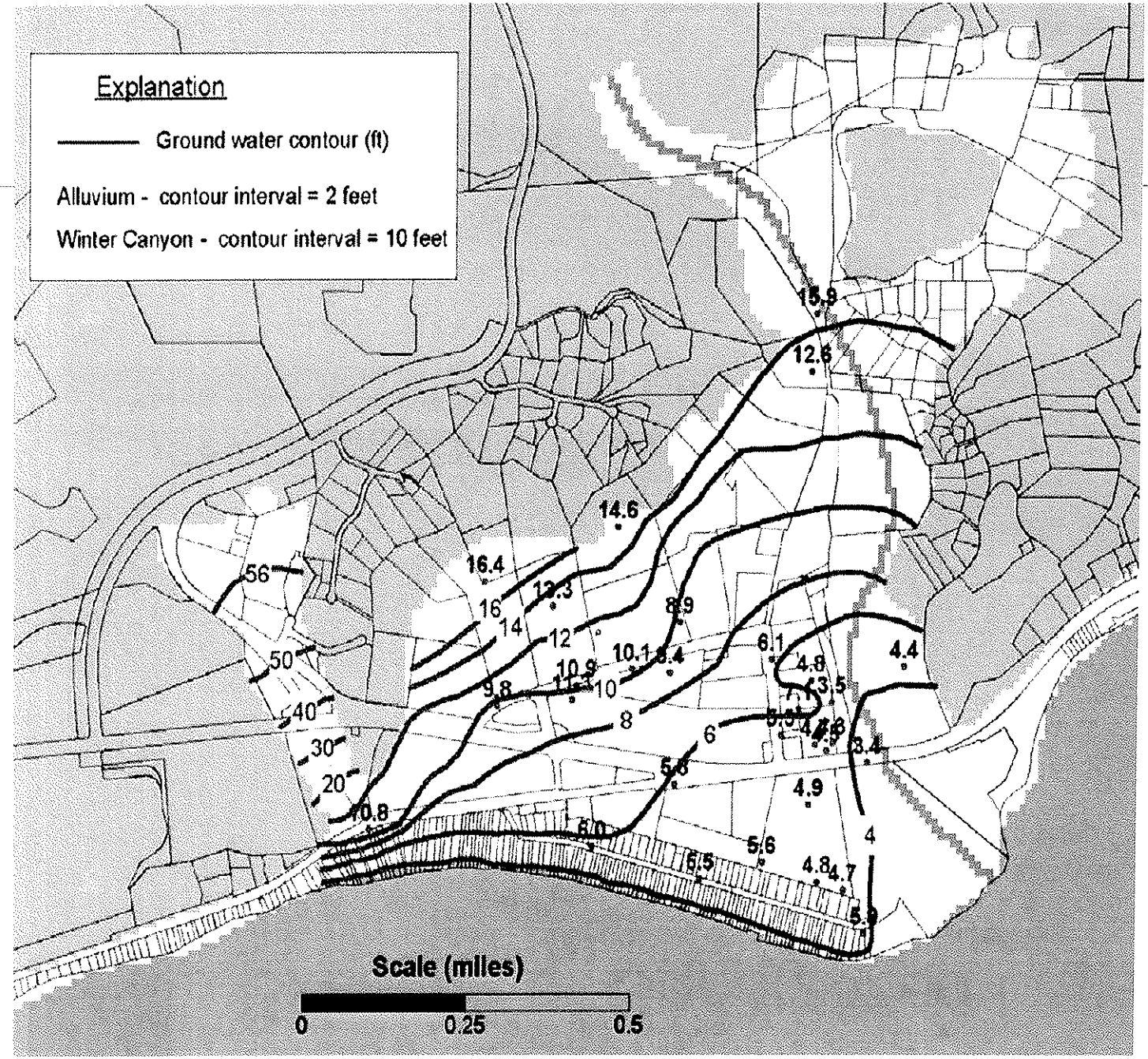


Sources: Groundwater well locations and soil boring locations digitized by Stone, 2002-2009; Hydrography digitized by Stone using LAR-IAC 2006-2007 topography, 2009; Study Area and Groundwater Recharge Areas, Stone and McDonald Morrissey Assoc., 2004.

Effect of Lagoon on Groundwater Elevation

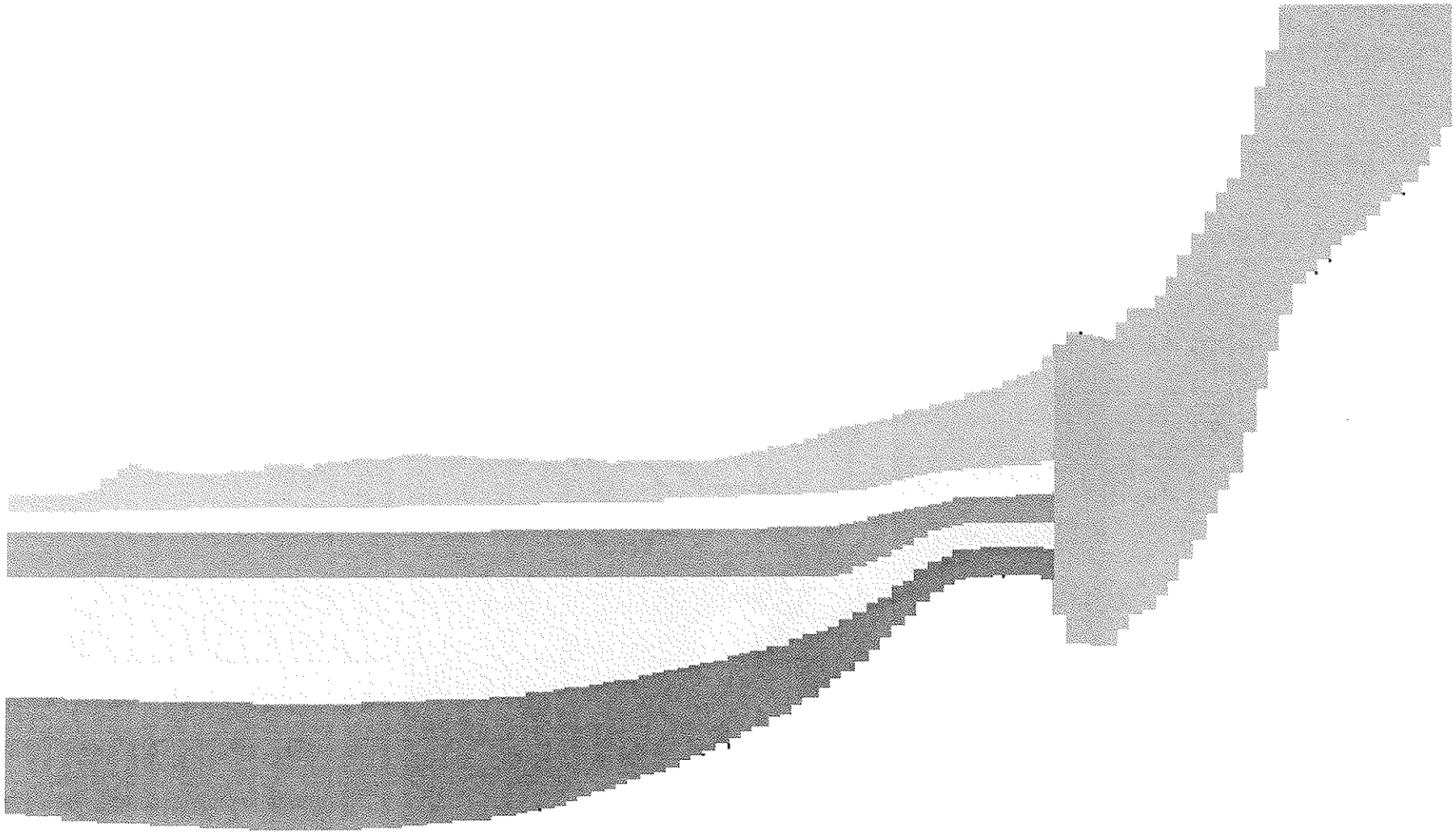


•Flooded Condition



•Breached Condition

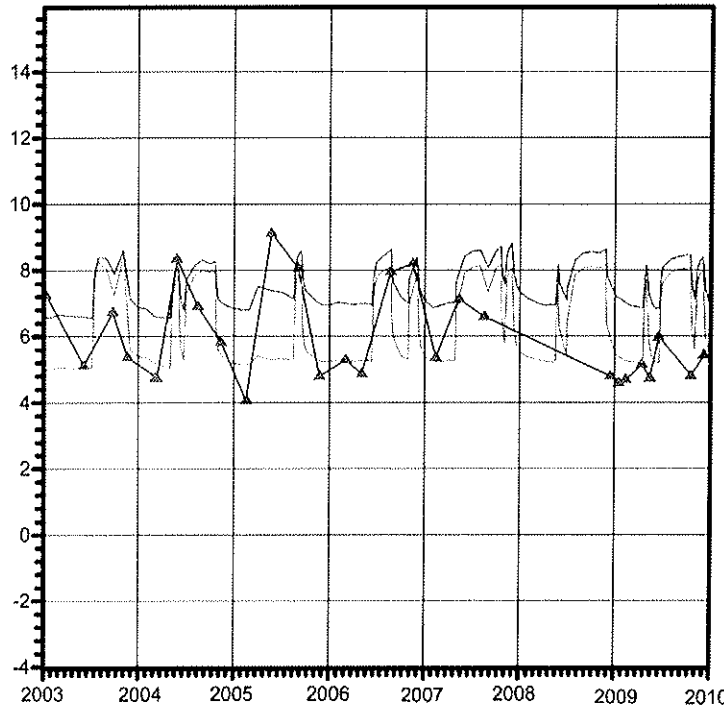
Cross Section - Example of Generalized Layering



Preliminary Calibration Result Near Lagoon

Malibu Hydrograph

Water Level Elevation (ft msl NAVD88)

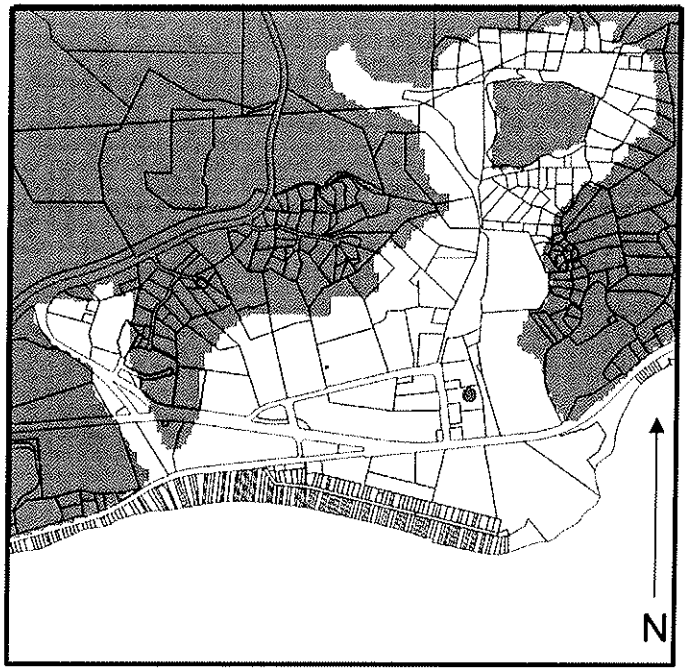


Number of Measurements	28
Range of Elevation	4.06 to 9.13
Average Elevation	5.95

CCPNE_4452011042

Model Layer **2**

Screen Info: **Depth Only**



0 1000 2000
feet

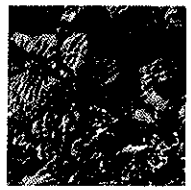
Run 10_Tran_PEST — 10_Tran_PEST Transient model, pilot points and zones.Upland Exponential Zonation only in lower layers, drain.

Run 11_Tran_PEST — 11_Tran_PEST Transient model, pilot points and zones.Upland Exponential drain, new bottom and layering.

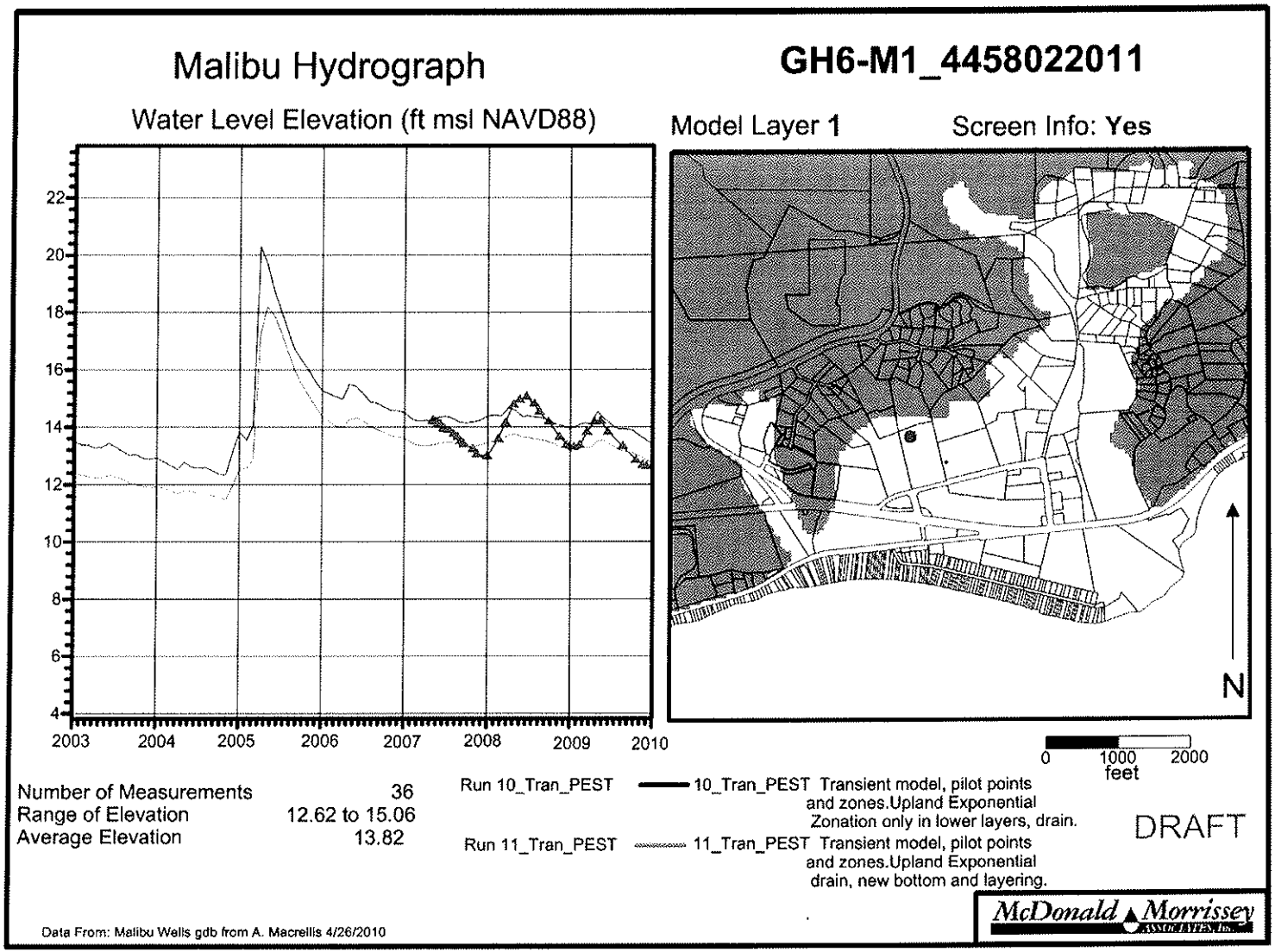
DRAFT

Data From: Malibu Wells gdb from A. Macrellis 4/26/2010

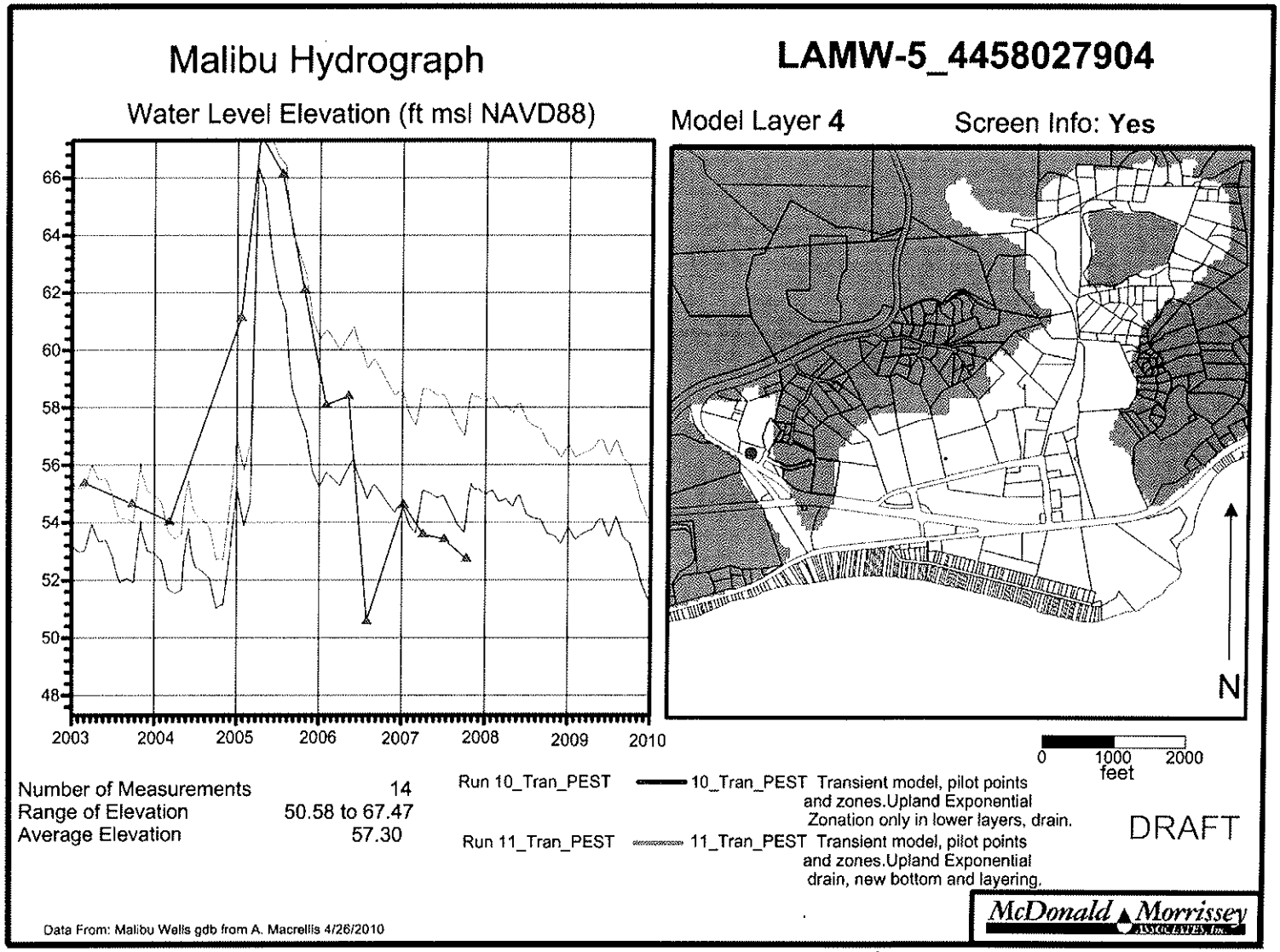
McDonald Morrissey Associates Inc



Preliminary Calibration Result - Near Stuart Ranch Road



Preliminary Calibration Result
Winter Canyon



Major Elements of Groundwater Flow Model

- Using
  - New Surface Topography
  - New Geologic Data
  - New Surface Geophysics
  - Closer Grid Spacing & Transient Approach
- Incorporating
  - Stormwater Drainage System
  - 2003-2009 Recharge Data
  - Water Level Elevations

Project Schedule

ID	Task Name
1	**Task 1: Project Startup; Collect and Inventory Existing Data**
2	Team startup meeting
3	Project startup meeting in Malibu
4	Task 1a: Climate
5	Task 1b: Topography
6	Task 1c: Geology (location and elevation of all borings)
7	Task 1d: Groundwater (location / elevation of all monitoring wells)
8	Task 1e: Surface Water
9	Task 1f: Water Use
10	Task 1g: Wastewater Disposal Systems – Existing and Proposed
11	Task 1h: Stormwater Systems
12	Task 2: Develop Conceptual Model of Study Area
13	Task 3: Define Alternative Development Scenarios
14	Team Meeting – Present conceptual model, discuss needs and scenarios
15	Task 4: Define Additional Data Needs
16	Task 5: Collect New Data
17	Team meeting in Malibu and synoptic water level collection
18	Task 6: Develop Model for Existing Conditions
19	Task 7: Calibrate Model
20	Task 8: Conduct Sensitivity Analysis for Pertinent Parameters
21	Task 9: Predict Impacts of Alternative Development Scenarios
22	**Task 10: Draft and Final Reports**
23	Write draft report
24	Draft report delivery
25	Respond to comments and finalize report
26	Final report delivery
27	Task 11: Final Presentation