ATTACHMENT 7

LONG-TERM WEST BASIN WATER LEVEL ANALYSIS FOR ASSESSING THRESHOLD IMPINGEMENT EFFECTS OF REDUCED INTAKE FLOWS AT AGUA HEDIONDA LAGOON

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Long-Term West Basin Water Level Analysis for Assessing Threshold Impingement Effects of Reduced Intake Flows at Agua Hedionda Lagoon

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1) Introduction:

This study evaluates the long term water level variation in the West Basin of Agua Hedionda Lagoon. The objective of this analysis is to determine the persistence of water levels occurring higher than the threshold elevation for impingement losses during reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. There are two threshold water levels of interest for reduced flow operations ranging from 149.8 mgd to 304 mgd. These thresholds are -0.687 ft MSL and + 4.83 ft MSL. The persistence analysis of these thresholds is performed by hydrodynamic model simulation of the water elevation history in the West Basin due to tidal forcing at the ocean inlet by historic ocean water levels measured at the nearby Scripps Pier tide gage (NOAA # 931-0230) during the period of record 1980-2000. This time period was chosen because it coincides with the period of record used in the hydrodynamic studies in

Appendix E of the certified EIR (Jenkins and Wasyl, 2005). The verified ocean water level data on which this analysis is based was obtained from NOAA (2006).

Because of tidal muting by frictional losses through the ocean inlet of Agua Hedionda, it is not possible to use the Scripps Pier tide gage measurements directly to determine persistence analysis of. Such a simple approach would err on the side of over-estimating the percentage of time the water elevation in the West Basin of the lagoon met or exceeded the two threshold elevations of interest. Instead the tidal muting of the measured ocean water levels was determined through computer simulation of the lagoon tidal hydraulics. The TIDE_FEM tidal hydraulics model presented in Jenkins and Inman (1999) was gridded for a computational mesh of Agua Hedionda Lagoon as shown in Figure 1, using pre- and post dredging bathymetry from the 2002 dredge event from Jenkins and Wasyl (2003). The pre-dredging bathymetry featured the inlet bar in the west basin that was mapped during the October 2002 sounding shown in Figure 2. The post-dredging survey performed in April 2003 indicated uniform deep water throughout the west basin with depths ranging from -20 ft NGVD to – 30ft NGVD, similar to that found in Figure 2-2 of Elwany, et al (2005). The lagoon model was excited at the ocean inlet by the ocean water level elevation time series measured by the Scripps Pier tide gage for the period 1980-2000. The simulated lagoon water levels in the west basin of Agua Hedionda were then sampled at 1 hour intervals, resulting in 183,432 separate outcomes of water elevation that could be subject to statistical analysis of persistence at or above the threshold elevations of interest.

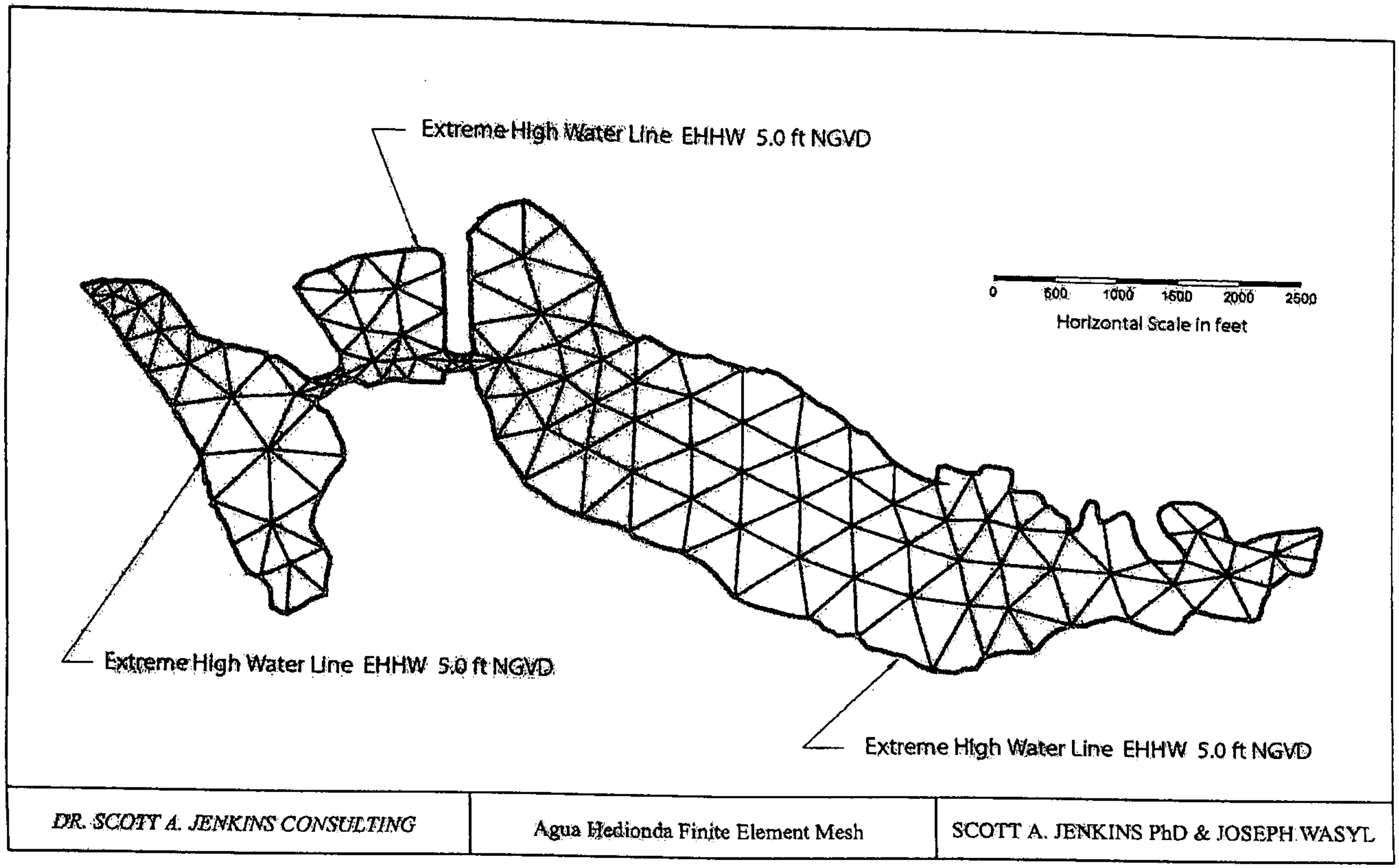

Figure 1. Computational mesh for TIDE_FEM tidal hydraulics model of Agua Hedionda Lagoon.

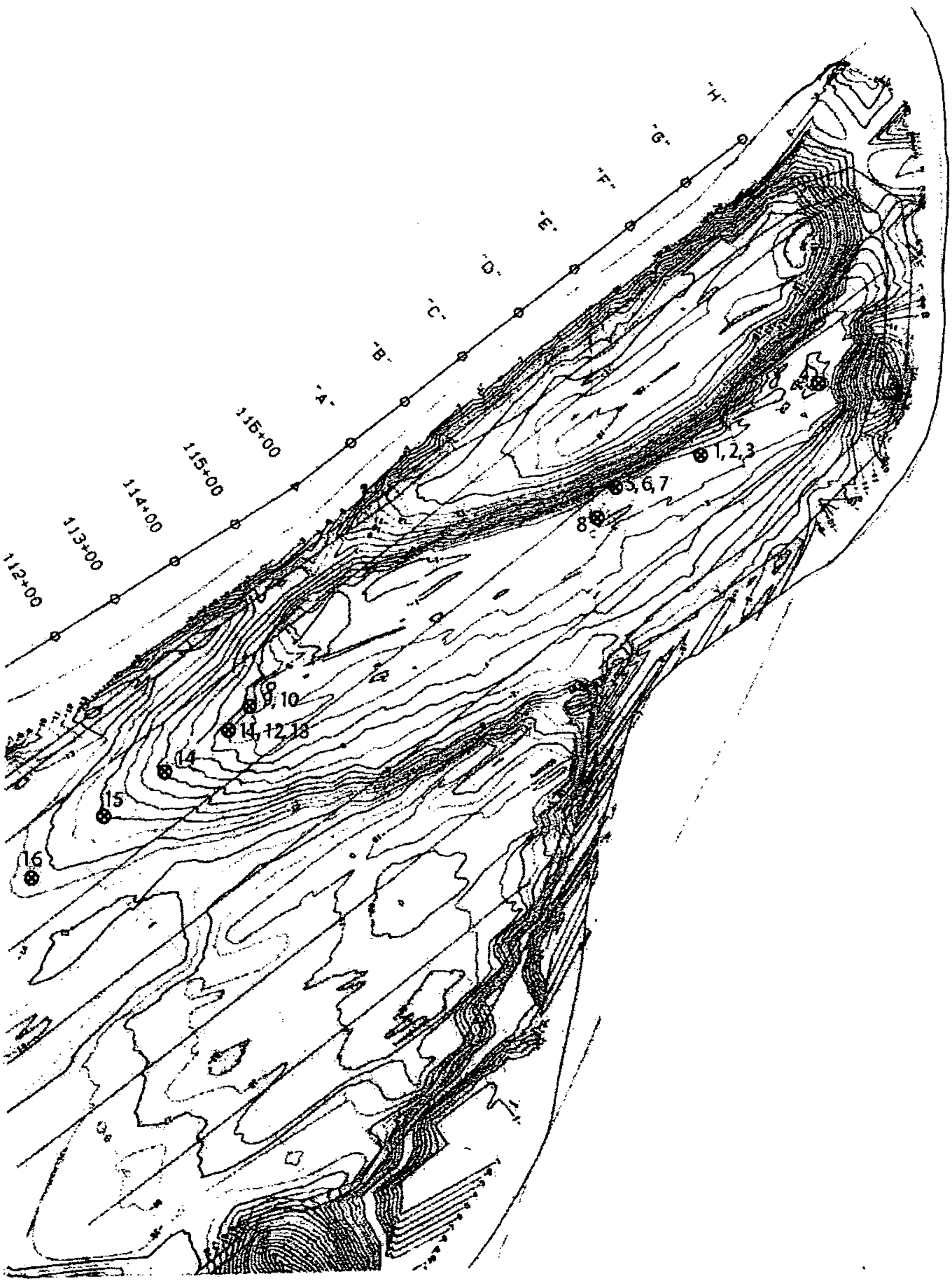

Figure 2. Location key for 12 October 2002 bottom sediment sampling.

2) Results:

Time series of the simulated West Basin water levels for each from 1980 through 2000 are given in the upper panel of Figures A-1 through A-21 in Appendix-A. The lower panel of these Figures gives the west basin water level variation for the month containing the highest water level occurring that particular year. Figure 3 presents the probability density function (defined by red histogram bars) resulting from the 183,432 hourly realizations of West Basin water level. The blue curve in Figure 3 is the cumulative probability that the water level will be greater than or equal to a particular water level. The vertical dashed green line in Figure 3 defines the water elevation at -0.687 ft MSL, above which intake flow velocities at the Unit 1 intakes are below the impingement threshold. From the cumulative probability curve, we find that water elevations equal or exceed the -0.687 ft MSL threshold 67% of the time during this 21 year period of record. Thus it is more probable that impingement would not occur at the Unit 1 intakes. On the other hand, there was only one hourly outcome in the 21 year period of record when water elevations exceeded the Unit 5 threshold elevation at +4.83 (light blue dashed vertical line); and hence impingement would remain a definite possibility for nearly any tidal regime around the Unit 5 intake.

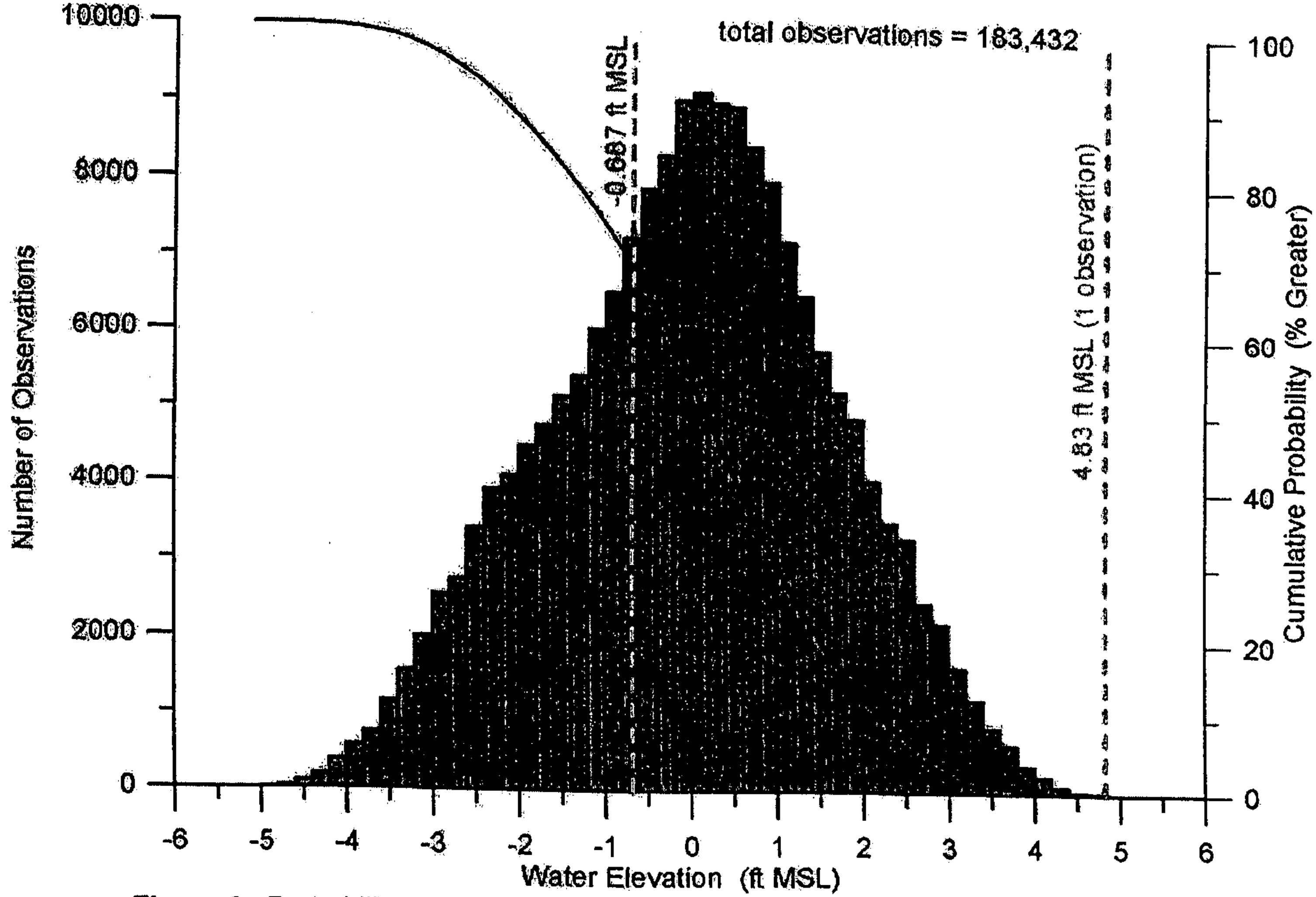

Figure 3. Probability density function and cumulative probability of the water level in the West Basin of Agua Hedionda Lagoon for the period of record 1980-2000.

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APPENDIX-A: Time Series of West Basin Water Levels

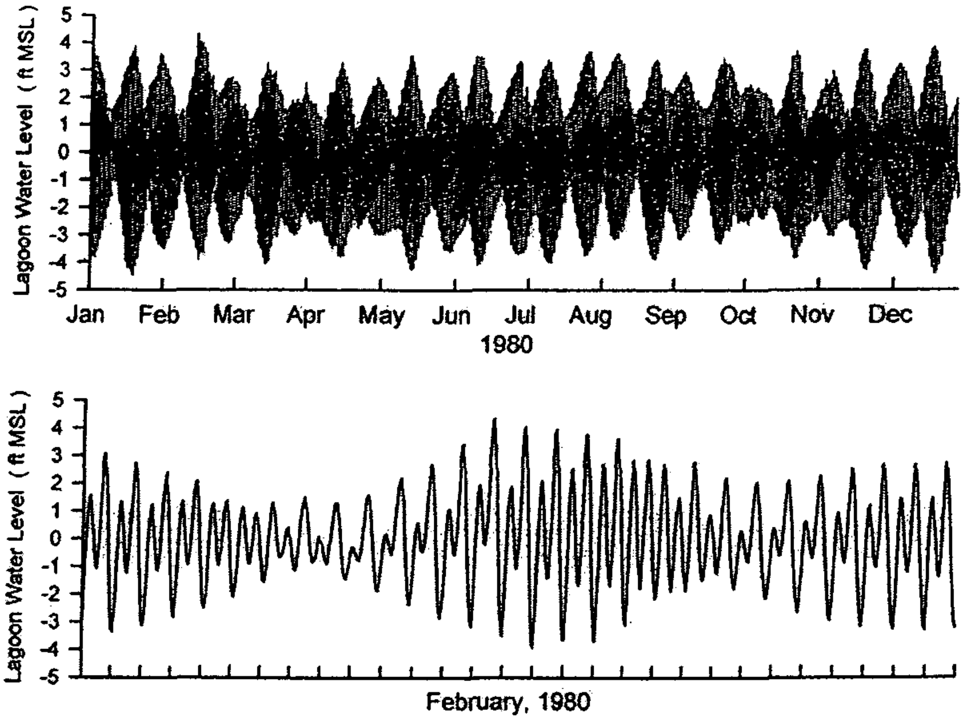

Figure A-1. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1980 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

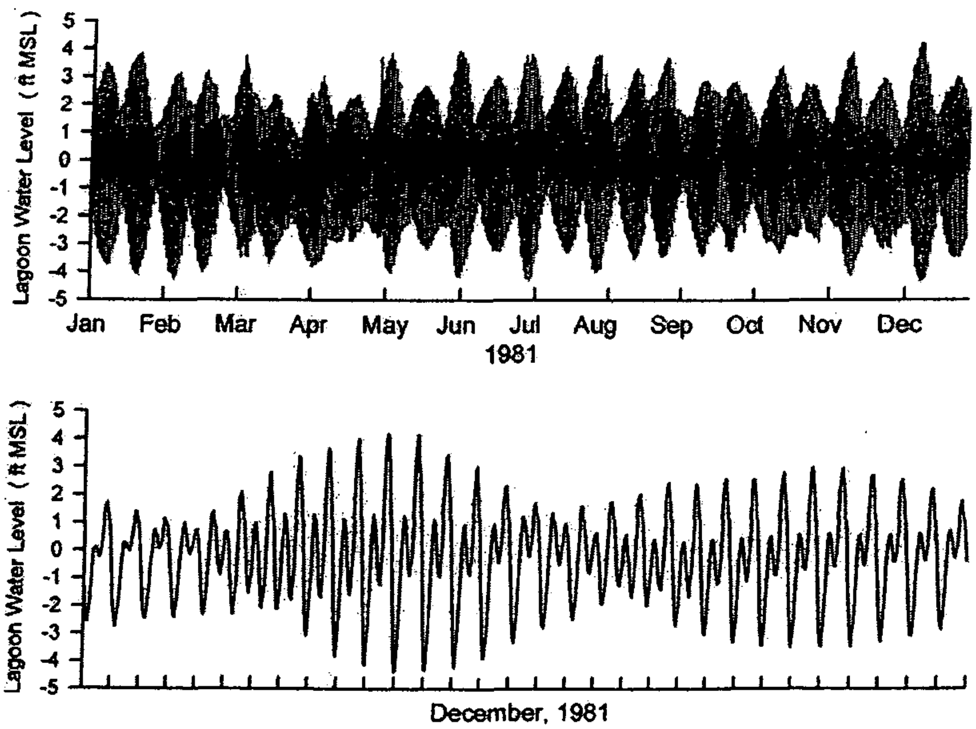

Figure A-2. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1981 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

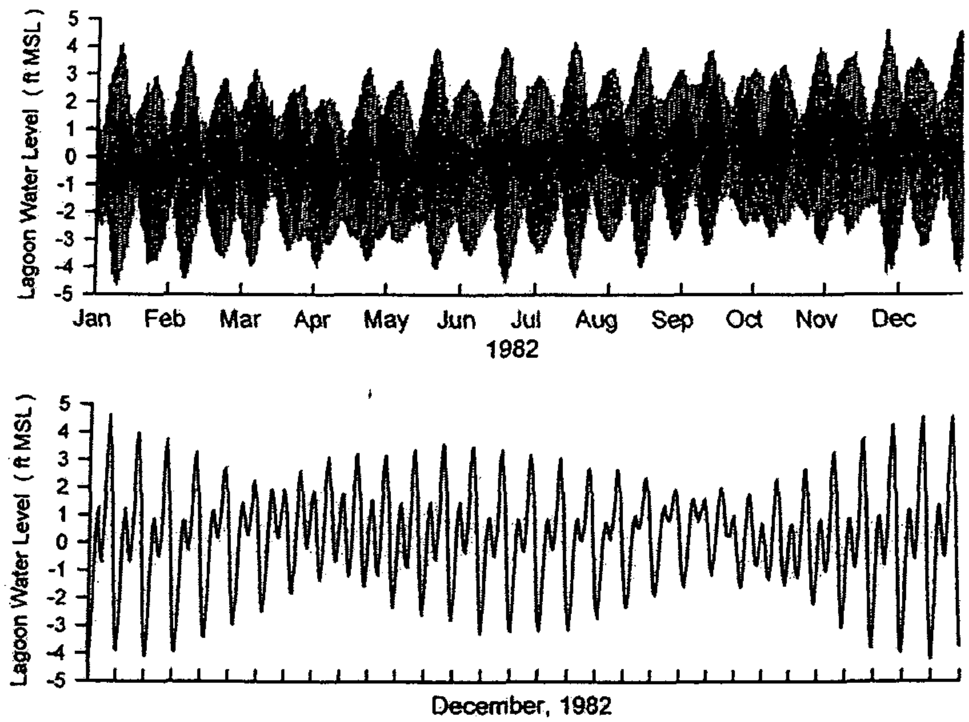

Figure A-3. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1982 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

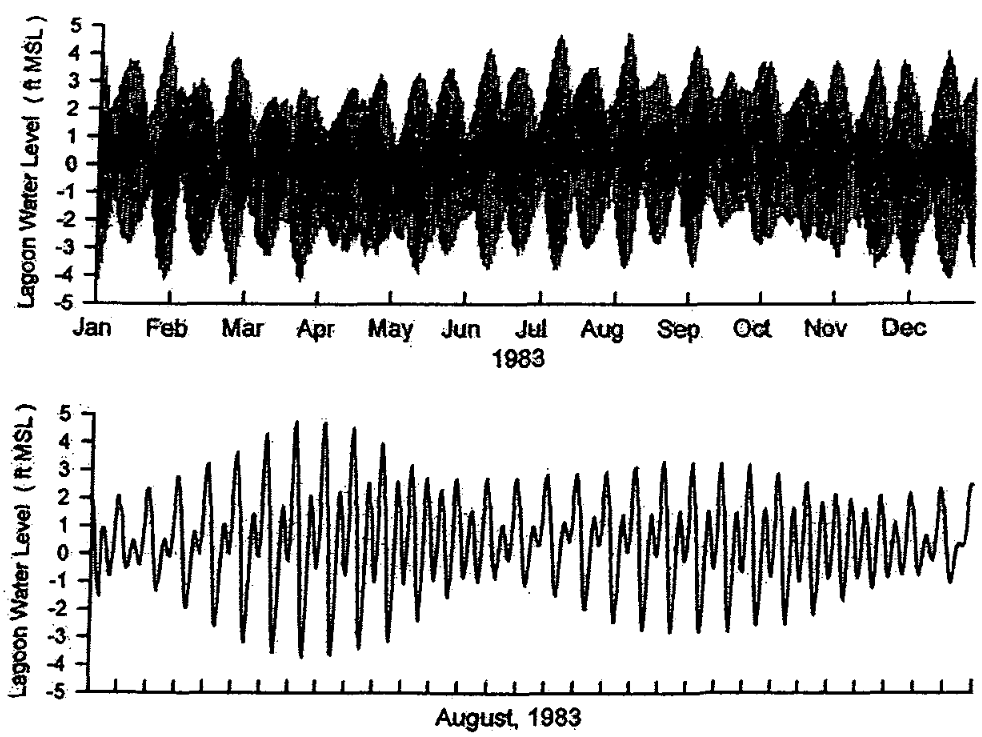

Figure A-4. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1983 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

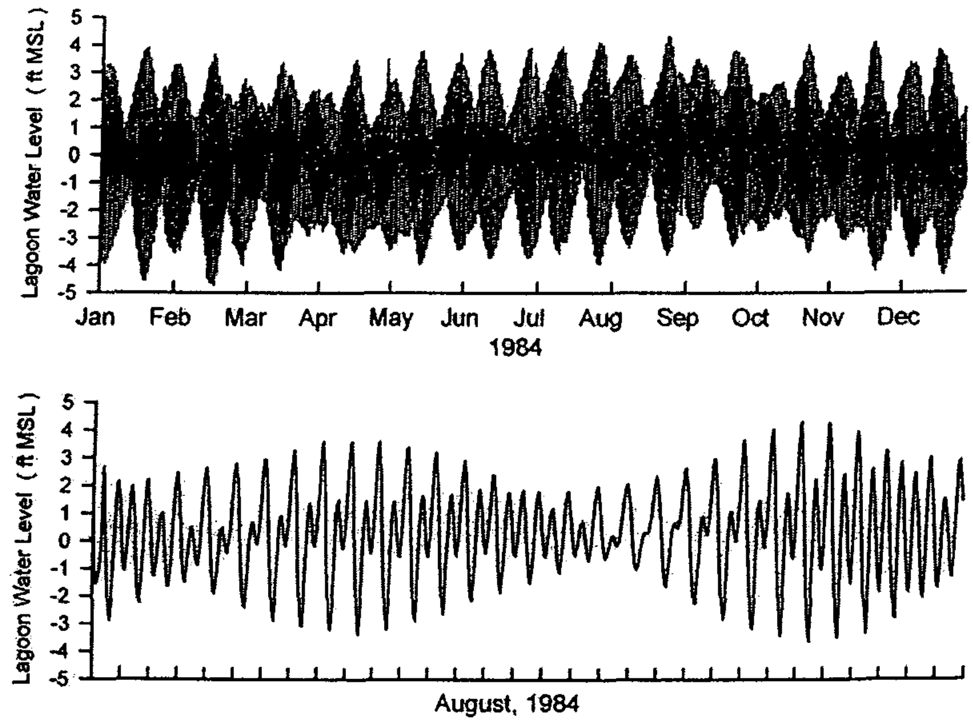

Figure A-5. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1984 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

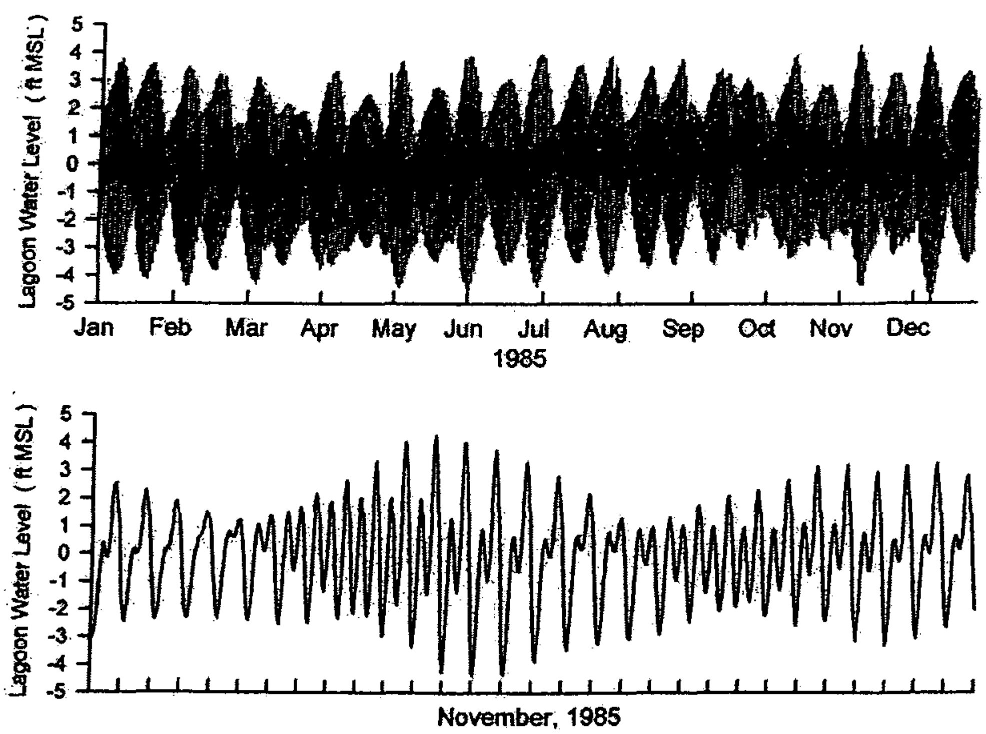

Figure A-6. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1985 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

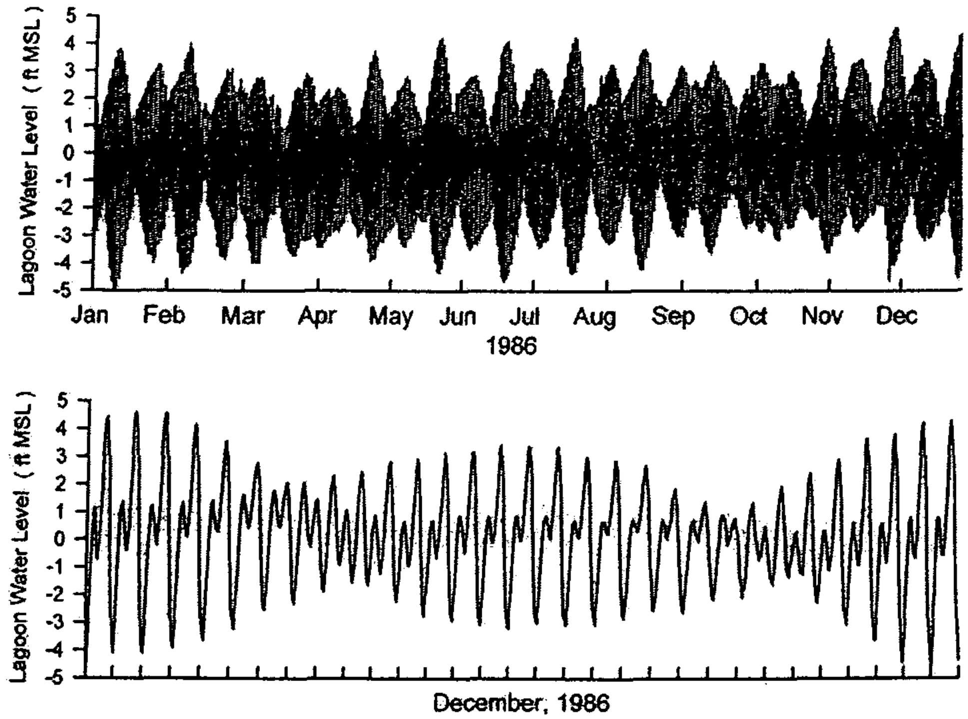

Figure A-7. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1986 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

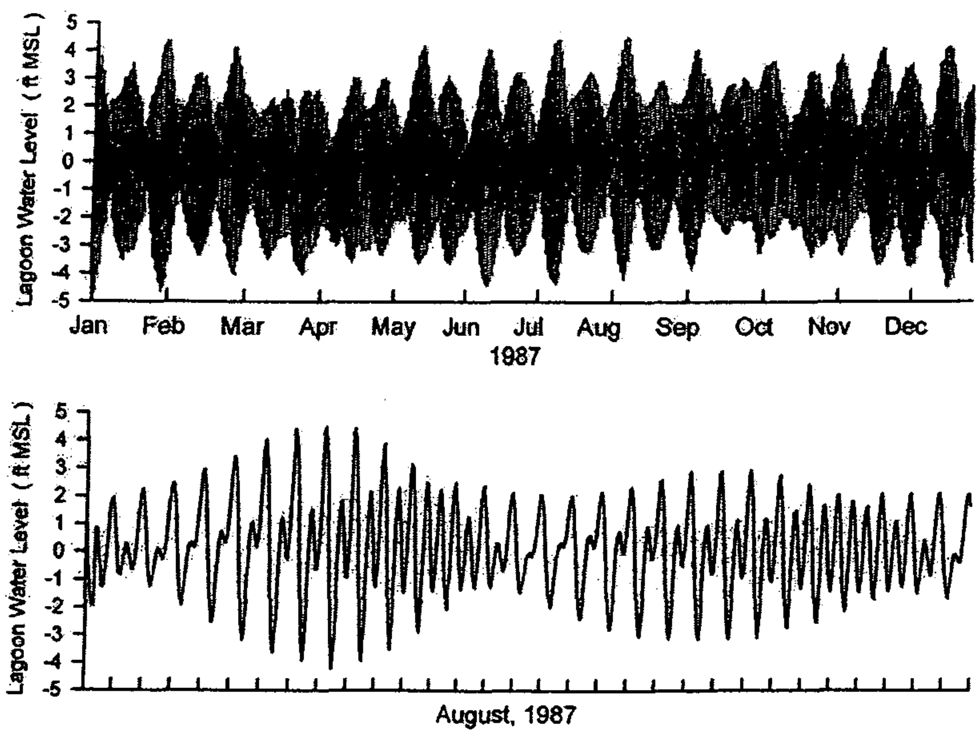

Figure A-8. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1987 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

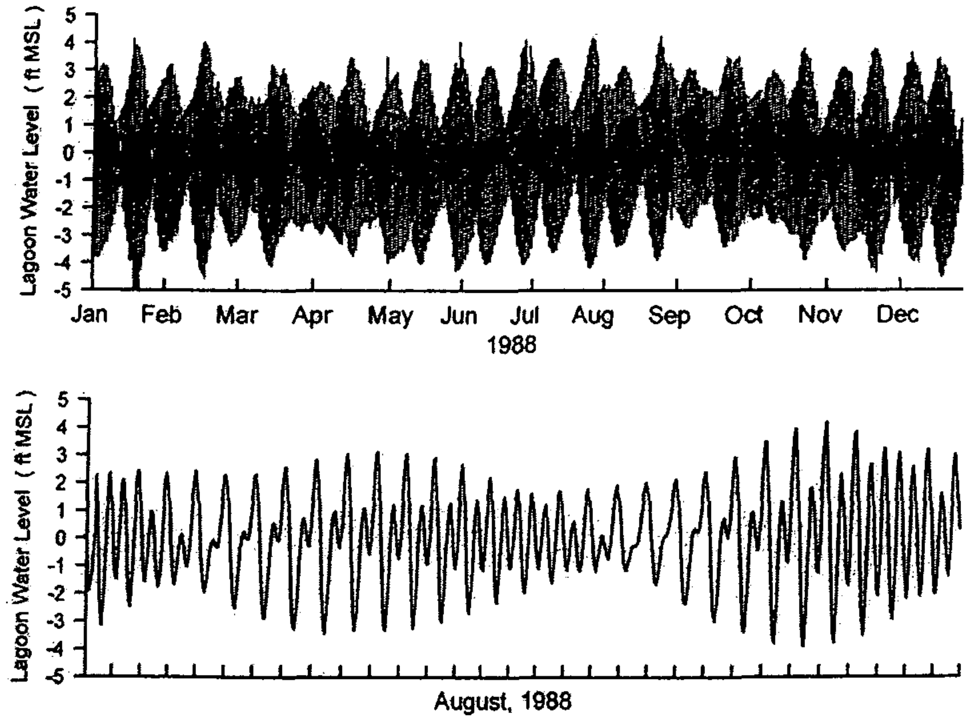

Figure A-9. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1988 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

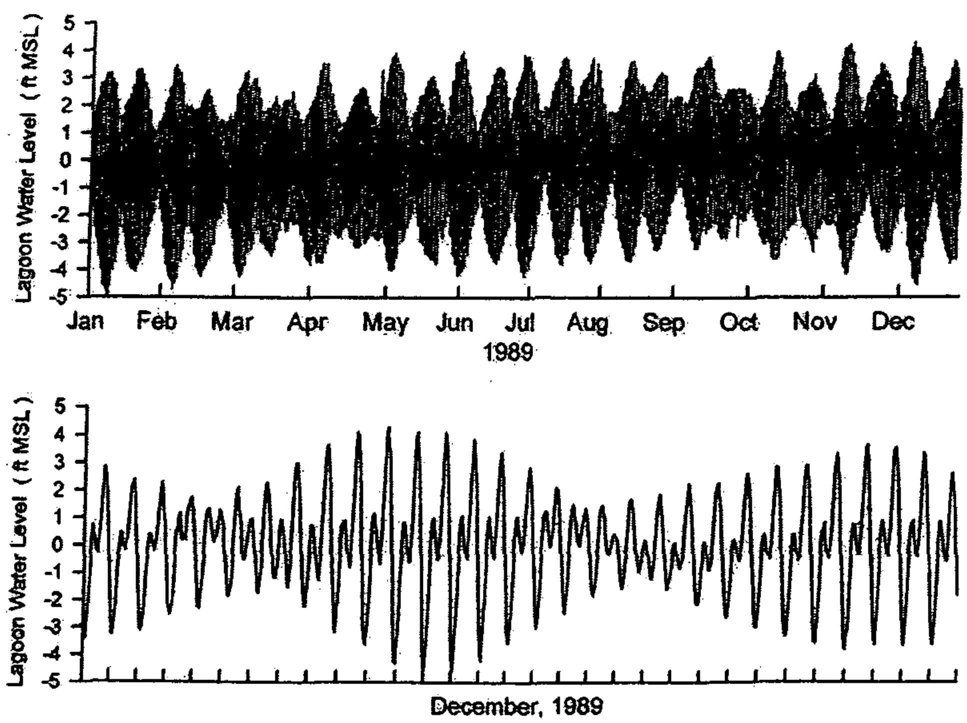

Figure A-10. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1989 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

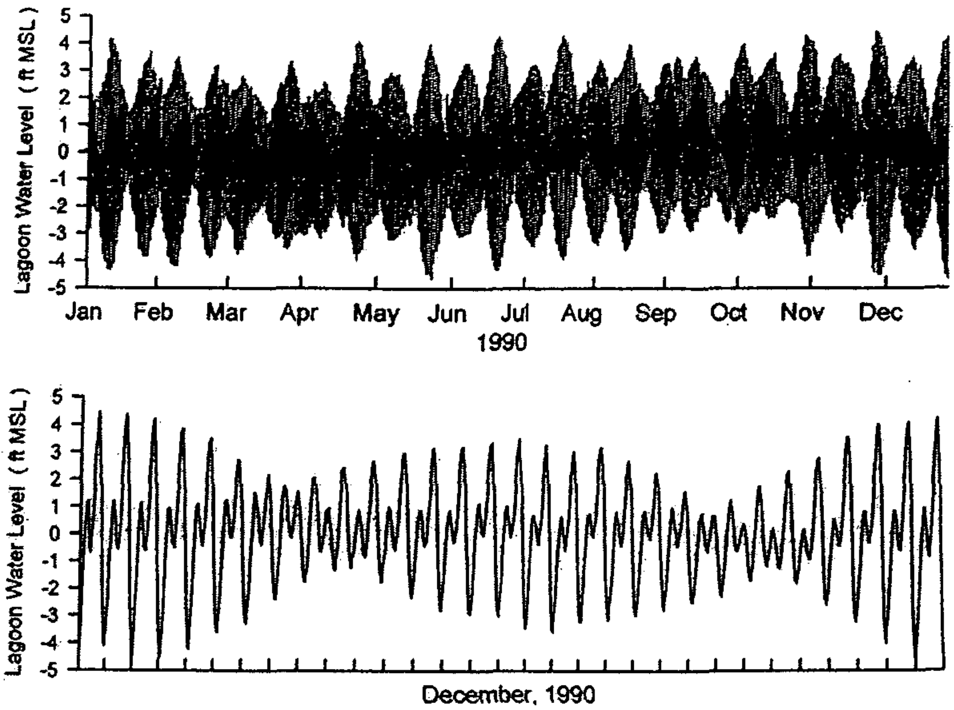

Figure A-11. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1990 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

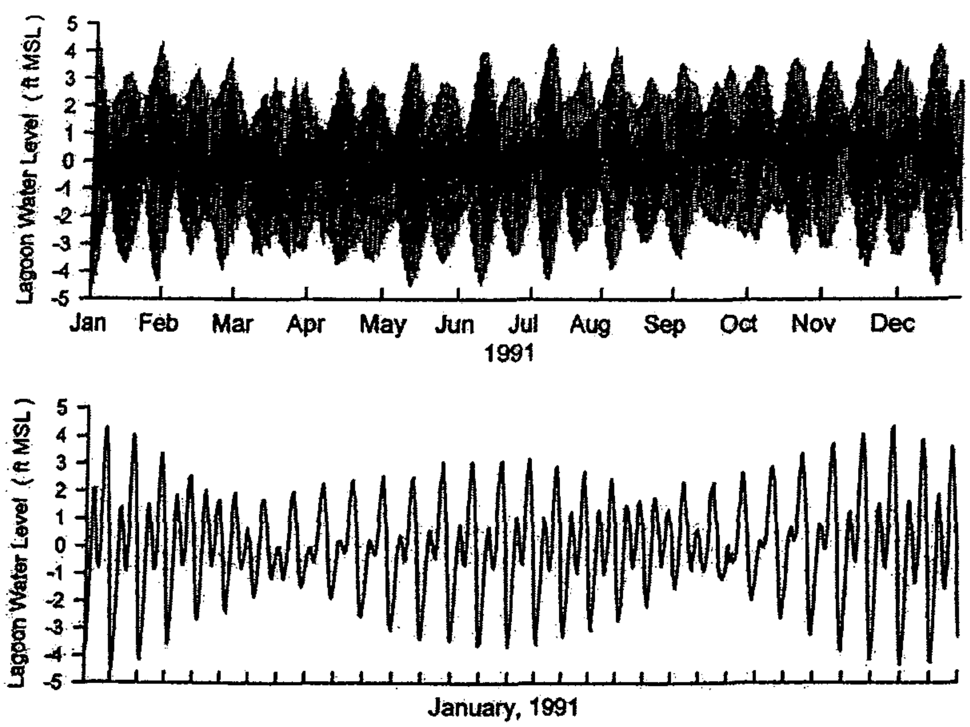

Figure A-12. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1991 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

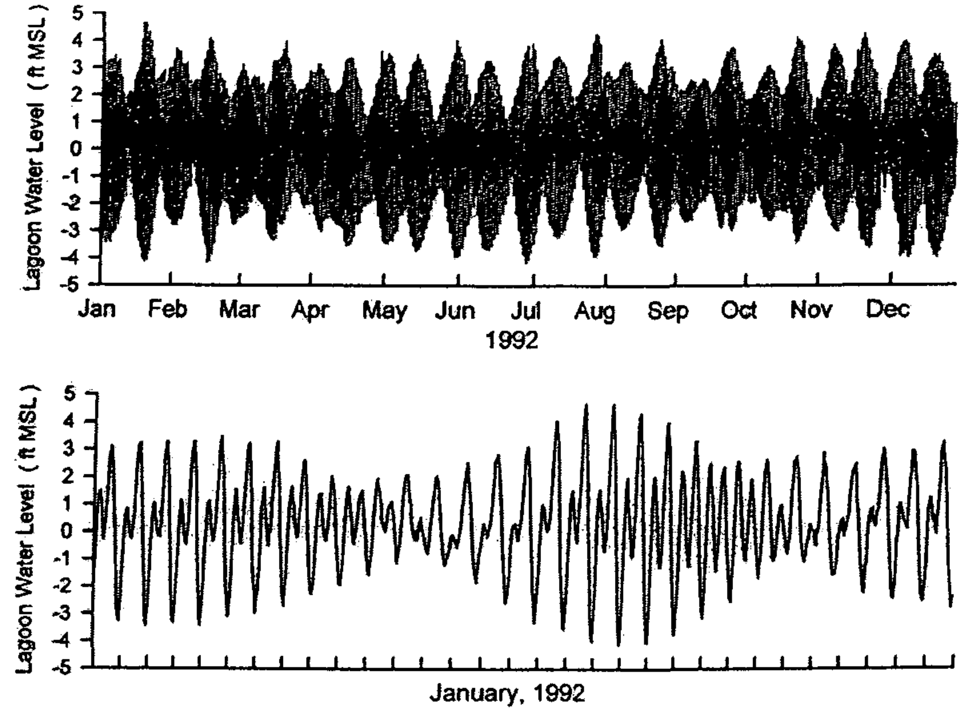

Figure A-13. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1992 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

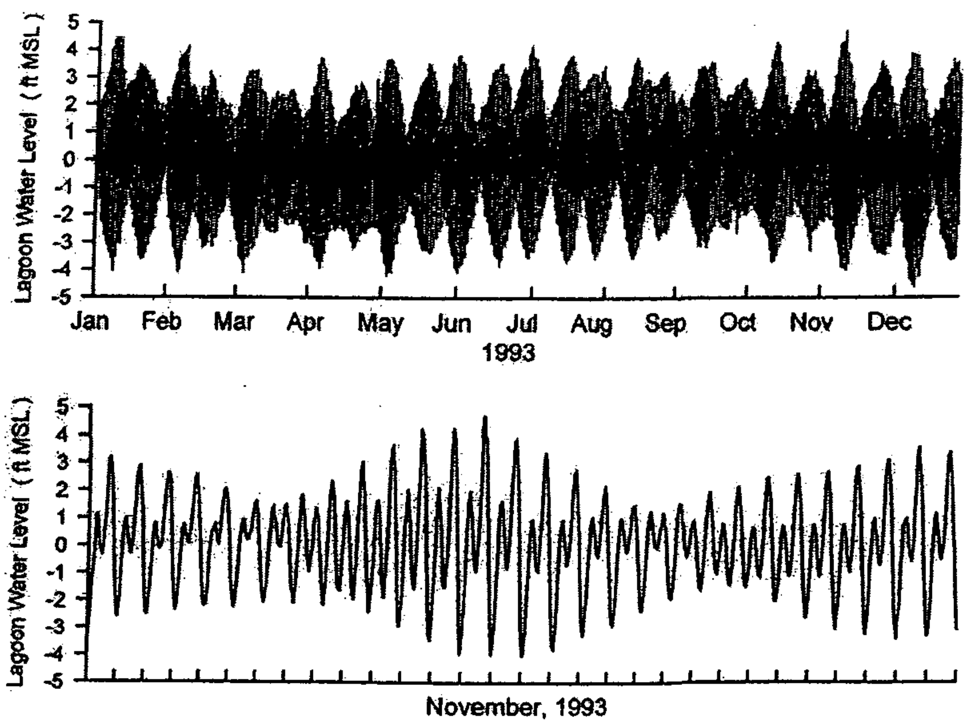

Figure A-14. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1993 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

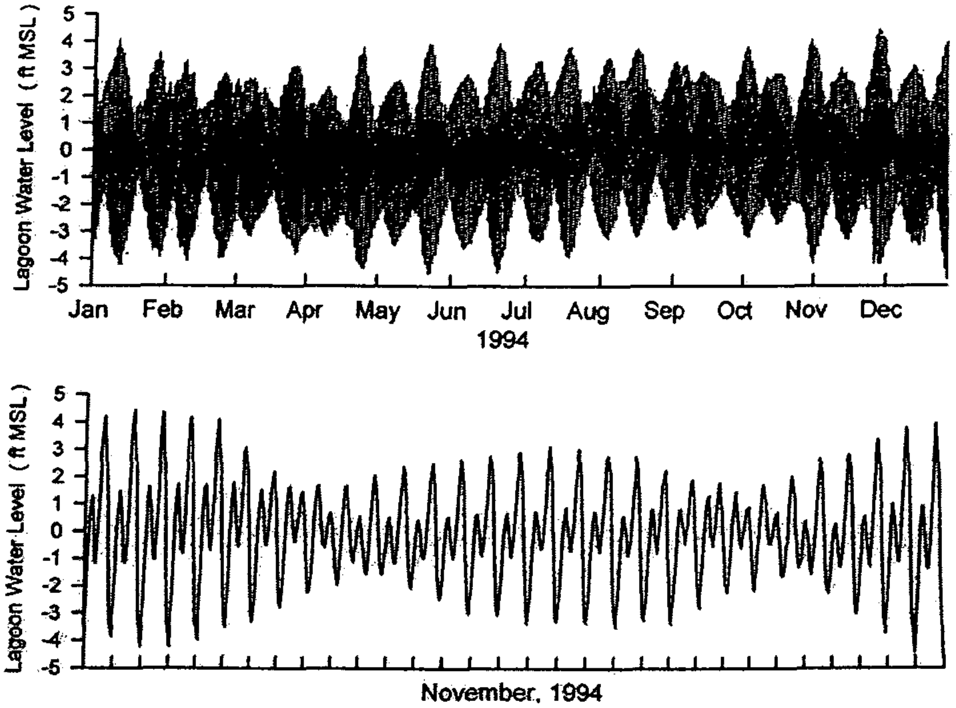

Figure A-15. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1994 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

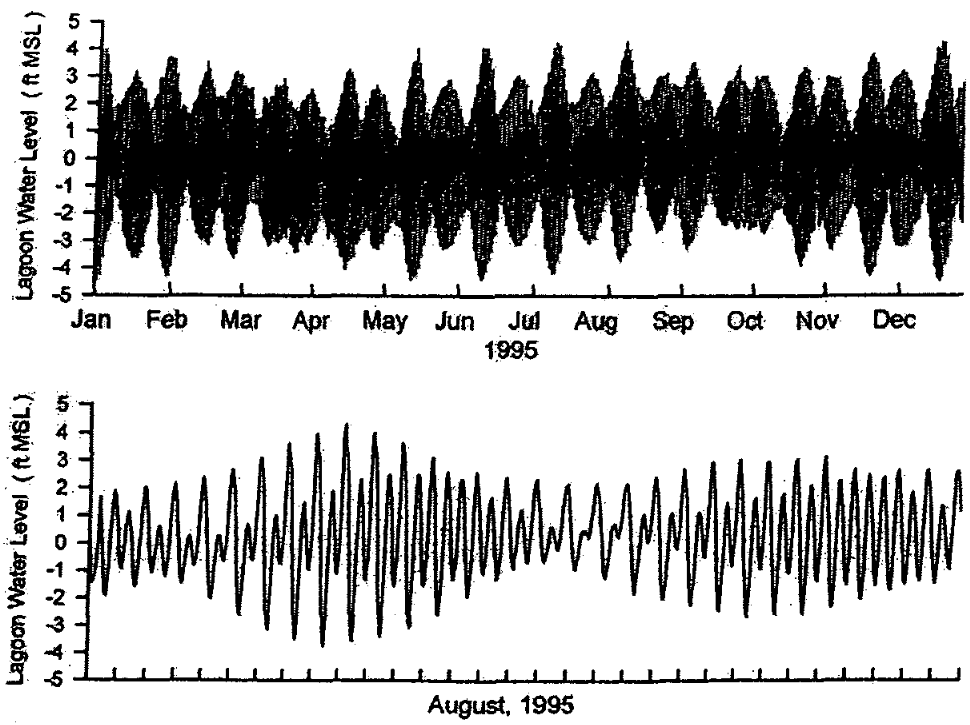

Figure A-16. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1995 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

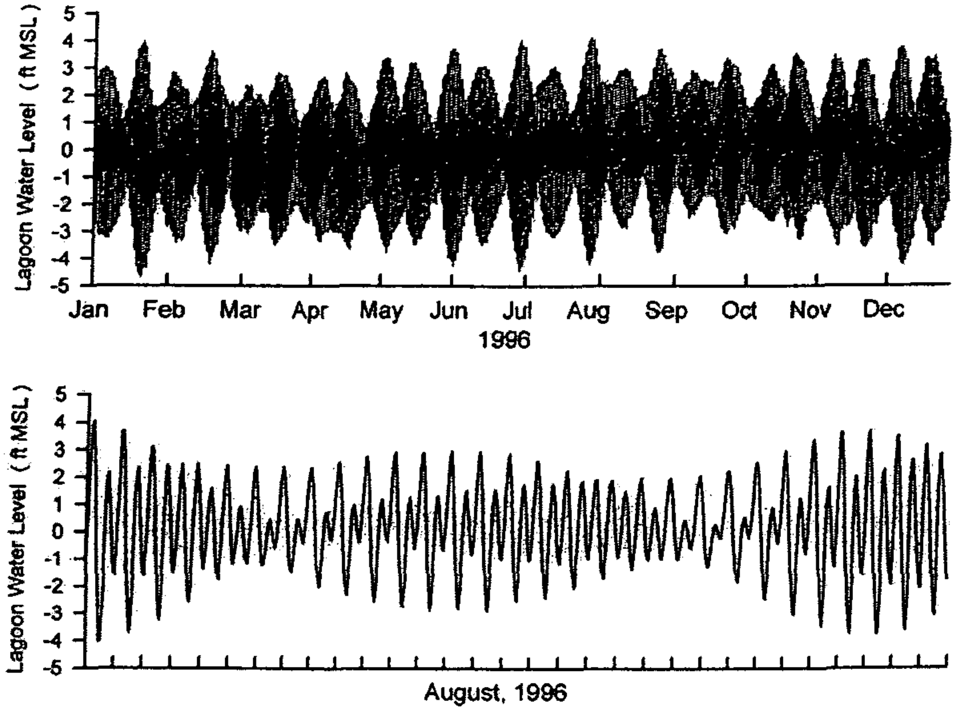

Figure A-17. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1996 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

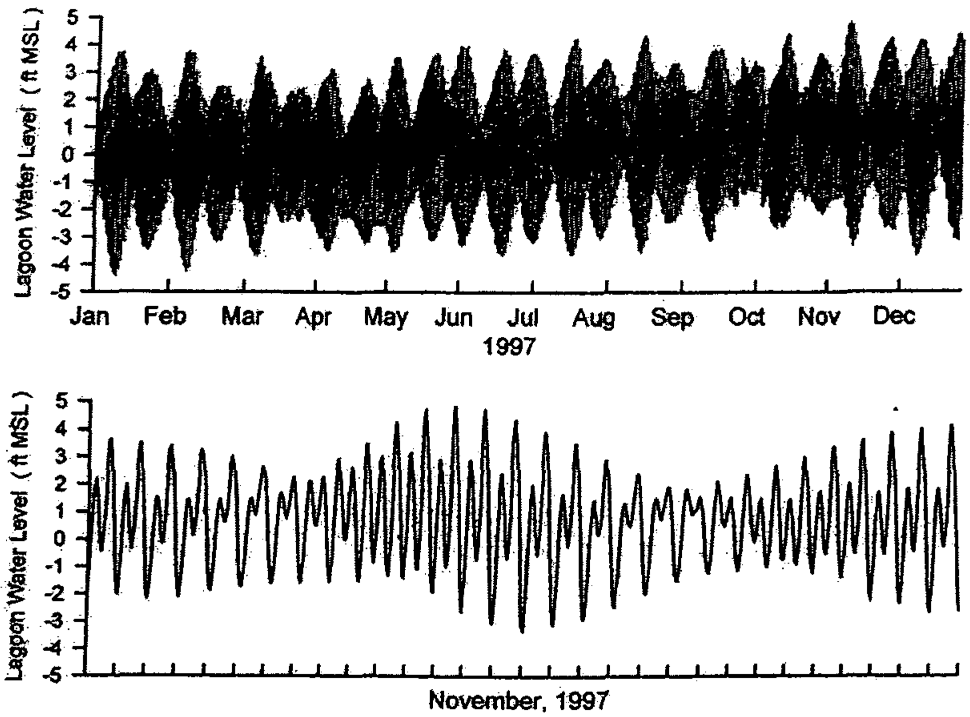

Figure A-18. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1997 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

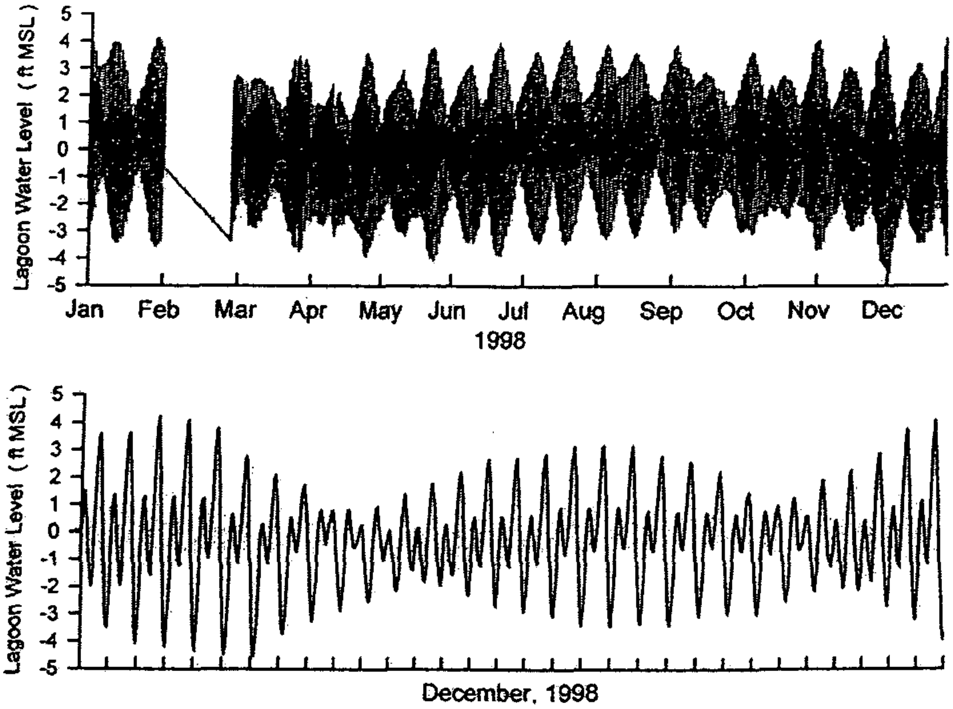

Figure A-19. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1998 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

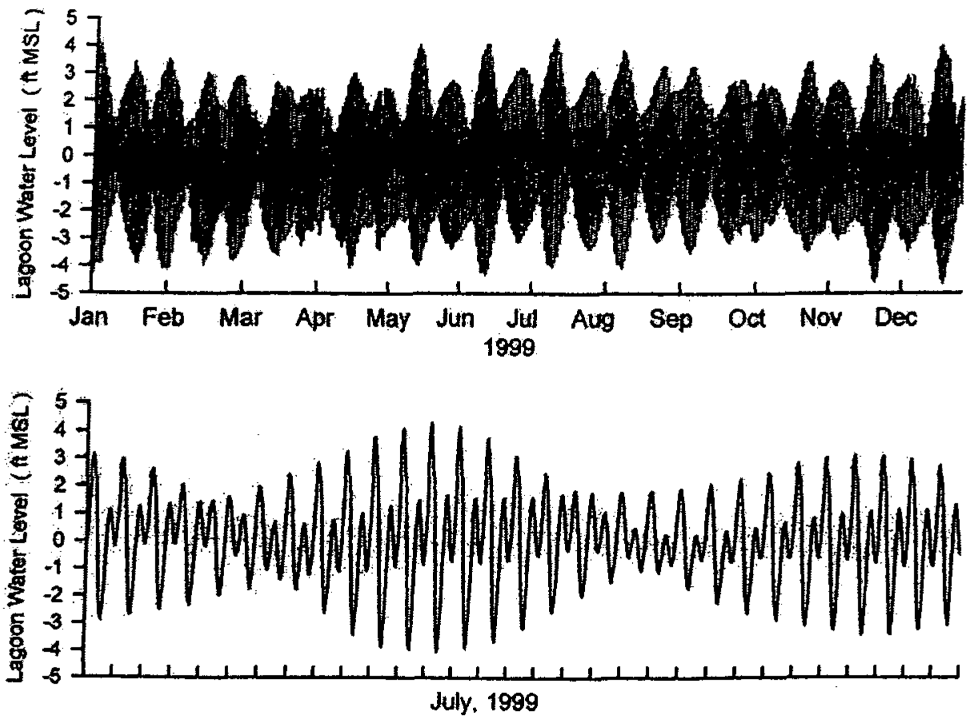

Figure A-20. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1999 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

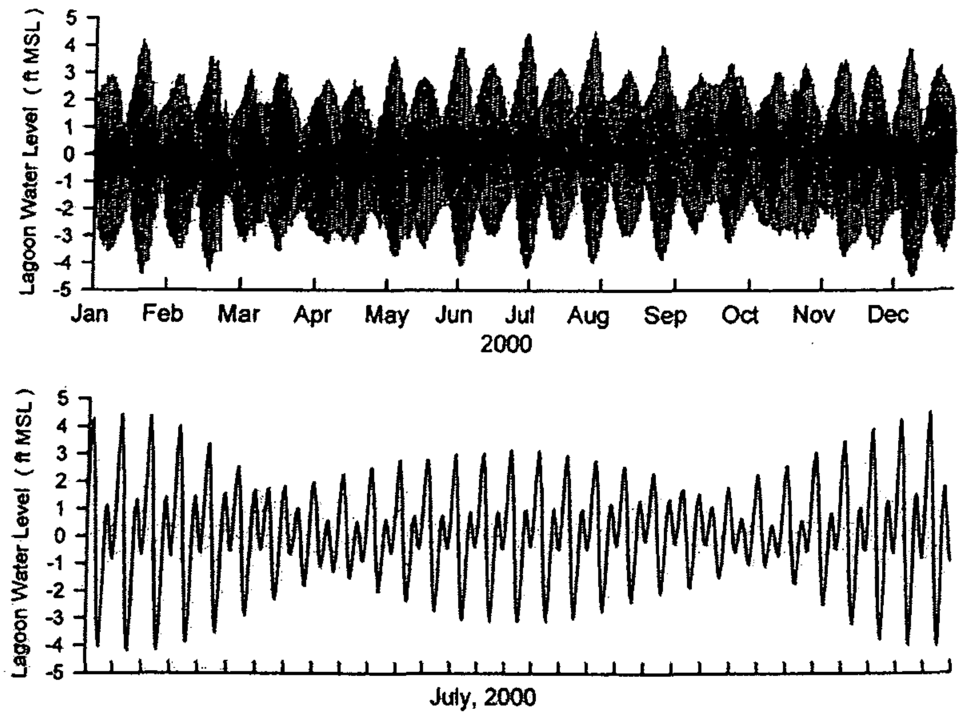

Figure A-21. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 2000 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).