TECHNICAL PUBLICATIONS
WRE-326

July 1995

A THREE-DIMENSIONAL FINITE-DIFFERENCE GROUND WATER FLOW MODEL OF THE SURFICIAL AQUIFER SYSTEM IN ST. LUCIE COUNTY, FLORIDA

TECHNICAL PUBLICATION 95-01

(INVENTORY #326)

A THREE-DIMENSIONAL FINITE-DIFFERENCE GROUND WATER FLOW MODEL OF THE SURFICIAL AQUIFER SYSTEM IN ST. LUCIE COUNTY, FLORIDA

by

David E. Butler, P.G.

And

Don G. J. Padgett, P. G.

July 1995

Hydrogeology Division
Water Resources Evaluation Department
South Florida Water Management District
West Palm Beach, Florida

EXECUTIVE SUMMARY

This study was undertaken as part of the South Florida Water Management District's (SFWMD) Water Supply Planning initiative. One of the directives in the water supply planning initiative is to "develop and maintain resource monitoring networks and applied research programs (such as forecasting models) required to predict the quantity and quality of water available for reasonable-beneficial uses" (SFWMD, 1991). The St. Lucie County model will be used within the SFWMD by the Planning Department to support the development of the Upper East Coast Water Supply Plan and by the Regulation Department to assist in the implementation of the water use criteria and policies of the District. The Water Supply Plan includes a projection of future water demand, identification of water sources, methods to meet the water demand on a regional scale, and an analysis of impacts associated with these alternate methods. The St. Lucie model will also be used for impact analysis in the District's water use regulatory function and on the local scale by governments and consultants.

This model is not considered to be an unchanging final product. As new data and technologies become available, it will be upgraded and improved. Future plans include the integration of surface water and water quality elements, Geographic Information Systems (GIS) applications, and the ability to "zoom" in on specific areas for more detailed local modeling.

St. Lucie County is underlain by two aquifer systems: the surficial aquifer system and the deeper Floridan aquifer system. Data from a ground water assessment completed by the South Florida Water Management District in 1990 were used to develop the regional three-dimensional finite-difference ground water flow model for St. Lucie County. This report focuses on the ground water flow model for the surficial aquifer system. A separate model with documentation (Lukasiewicz 1992) was developed for the Floridan aquifer system.

For modeling purposes, the surficial aquifer system in St. Lucie County was divided into three layers based on lithology and hydraulic characteristics. Layer 1 is the least productive and contains the surface water bodies. Layers 2 and 3 are the major supply sources for ground water use from the surficial aquifer system in St. Lucie County.

THE GROUND WATER FLOW MODEL

The St. Lucie County surficial aquifer system model was developed using the U.S. Geological Survey modular three-dimensional finite-difference ground water flow model code, commonly known as MODFLOW. This code was used because it allows a detailed evaluation of ground water flow, is available in the public domain, is compatible with most computer systems, and contains many features which make it easy to use and modify. MODFLOW simulates ground water heads and flows. Stress on the aquifers and interactions with surface water bodies can also be simulated with the model.

The horizontal model grid is composed of 71 rows and 109 columns. A uniform cell size of 2,000 feet by 2,000 feet was used throughout the model.

RECHARGE,DISCHARGE, AND WATER USE

Rainfall provides nearly all of the total inflow to the surficial aquifer system in the study area under present conditions. Analysis of the rainfall data for the study area indicates that the rainfall during the calibration period approximates 1-in-10 year drought conditions.

Evapotranspiration accounts for approximately 55% of the outflow from the model area under present conditions. Leakage to drains and rivers in the study area accounts for an additional 36% of the losses. Well withdrawals account for an additional 4%. The remaining outflows are due to ground water flows across model boundaries.

Well withdrawals for agriculture, public supply, and domestic self-supply were determined by various means. Agricultural ground water withdrawal information for the study period was estimated primarily from water use permits issued by the District. The permits supplied information on crop types, acreage, irrigation practices, and wells. Additional information, when necessary, was obtained directly from the agricultural operators. Actual pumpage records were used when available. Public supply water use was derived from the monthly reports the utilities submit to the District. Domestic self-supply was estimated based on land use types and irrigation use assumptions.

CALIBRATION/SENSITIVITY TESTING

The model was calibrated by adjusting aquifer parameters within prescribed limits in order to obtain the best match between the computed water levels and the observed water levels. The calibration period was from July 1989 through June 1990. The model was calibrated to steady-state and transient conditions.

The steady-state calibration was based on the hypothesis that during the calibration period the ground water levels fluctuated around a mean water level that could approximate steady-state conditions. The fluctuations in water levels were caused by seasonal variations in rainfall, pumpage, evapotranspiration and canal levels. Furthermore, the average recharge rate during the calibration period was presumed to approximate the steady-state recharge rate under 1-in-10 year drought conditions.

Two criteria were used to evaluate steady-state calibration: 1) the simulated steady-state water level must be between the minimum and maximum observed head values for the associated monitoring well; and 2) the simulated steady-state water level was within ± one foot of the average water level for the associated monitoring well. At least 50% of the observation wells must meet each criterion for the model to be considered successfully calibrated. Results from the model indicate that 71% of the observation wells meet the first criterion, and 73% of the observation wells meet the second criterion.

For the transient scenario, the calibration criterion required that simulated water levels to be within one foot of the observed water levels for at least nine of the twelve months. This criterion was met by 61% of the observation nodes.

Residual maps were generated, for both steady-state and transient conditions, in order to view the spacial distribution of error. Analyses of the residual maps infer that the Level 1 calibration criterion (Anderson and Woessner, 1992) was met for most of the study area. However, there were a few areas, mostly near large withdrawal sources or the tidal portion of the North Fork of the St. Lucie River, that did not meet the Level 1 calibration criterion.

To ensure the best possible accuracy for evaluative or predictive purposes, it was important to test the sensitivity of the model to the estimated parameters. With the exceptions of river bed conductance and drain bed conductance, the model was fairly insensitive to changes in hydraulic parameters. However, changes in the recharge and evapotranspiration parameters significantly affected the simulated water levels in all three layers of the model.

RECOMMENDATIONS

The most important recharge and discharge sources in the model are rainfall and evapotranspiration, respectively. The accuracy of the model depends on the accuracy of the input data for these two sources. As currently designed, the model provides a simplification of the actual complex processes involved in determining how much rainfall actually reaches the aquifer and how much water is removed from the aquifer by evapotranspiration. Work in these areas is needed to improve model accuracy.

Domestic self supply water use and irrigation water use are large water uses in St. Lucie County. In order to enhance the accuracy and reliability of the model for resource availability determinations, improvements in the estimation of domestic self-supply use and irrigation use should be made. Some possible improvements are as follows:

a) The PWS utilities should provide the District with exact locations for the service area boundaries.

b) The local governments in the study area should provide the District with a listing of residences which utilize privately supplied water for landscape irrigation or domestic uses.

c) The District should require agricultural permittees to submit pumpage records to the District monthly.

Public water supply utilities that utilize multiple wells need to record the raw water pumpage individually for each well. Because of differences in pump capacity and the operating schedule of each well, total wellfield pumpage is of limited value for generating the model input necessary for determining wellfield impacts. Individualized withdrawals for each well is especially important when "zooming in" on an area.

Based on the water budget calculated from the model, discharge to surface water bodies represents a significant loss from the aquifer. Input data, including canal construction details and stage levels, are limited and estimation errors could result in inaccurate seepage amounts into or out of the canals. Efforts should be made in the permitting process to obtain and include these data in future surface water management permits. Stage recorders in major grove canals would provide information on water levels for setting river stages and drain elevations in future modeling efforts.

The model can be used in the evaluation of water use permit applications, when examining impacts on a large scale basis is desirable. Where a finer scale or site-specific model is required, the regional model could be used to provide the boundary conditions and general information for the localized model.

AVAILABILITY OF MODEL FOR USE

Electronic copies of model data sets are available upon request from the Hydrogeology Division. If, in using the model, users include new or more detailed data that results in a better calibration, they are encouraged to share that data with the District. Refinement of the model is a continuous and ongoing process.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF TABLES

ACKNOWLEDGEMENTS

This project was carried out under the direction of Scott Burns, formerly the Director of the Hydrogeology Division and currently Director of the Water Use Division, and Keith Smith, currently the Director of the Hydrogeology Division. The authors would like to thank these individuals for the opportunity to undertake this effort.

The authors wish to acknowledge the peer review committee, whose comments greatly improved the quality of this report:

Hector Arias, City of Fort Pierce
Gary Basham, City of Port St. Lucie
Richard Bouchard, St. Lucie County
Kate Donoghue, Upper District Planning, SFWMD
Emily Hopkins, Upper District Planning, SFWMD
Bruce Lafrenz, Hartman & Associates, Inc.
Linda Lindstrom, Hydrogeology Division, SFWMD
John Lockwood, Geraghty & Miller, Inc.
Michael Merritt, USGS
Richard Nevulis, CH2M Hill
Karin Smith, Water Use Division, SFWMD
Keith Smith, Hydrogeology Division, SFWMD
Richard Stenberg, Fort Pierce Utility Authority
Leslie Wedderburn, Dept. of Water Resources Evaluation, SFWMD
Jason Yan, Hydrogeology Division,SFWMD

Jorge Restrepo provided numerous insights into the model as well as several very useful pre- and post-processing programs for which we are very grateful. Jeff Needle (SFWMD), Mark Daron (SFWMD) and Martin Sanders (Lindahl Browning Ferrari and Hellstrom) provided valuable information with regards to the operation of surface water management systems in the county. We also appreciate the suggestions and solutions we received from fellow hydrogeologists on the problems we encountered.

Gratitude is expressed to Barbara Dickey for her immediate attention and assistance to all problems involving the computer, especially in writing programs to make our job easier. Diane Bello, Janet Wise and Dave Demonstranti generated the graphics for this report. Martin Braun, Tony Lubrano, Paul Benton, James McDermott, Arthur Tassinari, Pete Dauenhauer, and Dave Demonstranti provided assistance with well drilling, geophysical logging, and data collection. Finally, Hedy Marshall assisted with the compilation of this report.

ABSTRACT

The surficial aquifer system is an important ground water supply source in St. Lucie County. The surficial aquifer system is comprised of moderately productive zones of sand, shell, limestone and sandstone. The intermediate confining unit underlies the surficial aquifer system and separates it from the Floridan aquifer system. A three-dimensional ground water flow model of the surficial aquifer system was developed using the U.S. Geological Survey modular finite-difference ground water flow model code (MODFLOW). The model consists of three layers representing three lithologic zones. Horizontal discretization was accomplished using a grid comprised of 71 rows and 109 columns. Initial aquifer parameters were obtained from previous studies and the associated ground water reconnaissance study. A transient calibration was performed for a one-year period, July 1989 through June 1990, by comparing simulated water levels with observed water levels from an extensive monitoring network. A steady-state calibration was performed by comparing the steady-state calculated values with the average observed values from the monitoring network. A good correlation was achieved between the estimated values and the observed values for both the steady-state and transient conditions. Sensitivity analyses showed that water levels in all layers of the surficial aquifer system are sensitive to changes in the recharge and evapotranspiration parameters.

INTRODUCTION

PURPOSE AND SCOPE

This report describes the development and calibration of a three-dimensional ground water flow model of the surficial aquifer system in St. Lucie County. The first part of this report is a description of the data and justification of the assumptions used in constructing the model. The second part presents the results of the steady-state and transient calibrations, and a discussion of the model sensitivity analyses.

The model was developed as a tool for assessing regional mass balance relationships between recharge and discharge to the aquifer system. The major tasks associated with this development are described below:

1) Compile and evaluate existing hydrogeologic and hydrologic data.

2) Conduct field investigations to collect additional information in data deficient areas.

3) Define the hydrogeologic framework of the surficial aquifer system.

4) Develop and calibrate a three-dimensional ground water flow model of the system.

5) Conduct model sensitivity analyses to determine the relative influence of different components of the hydrologic and hydrogeologic regimes.

6) Develop a detailed documentation of the model development process to support model use in water management and regulatory applications.

Only the results of tasks 1, 2, and 3 that relate to the process of generating the input files for model development are described in this report. A resource assessment report describing these tasks in detail will be presented at a later date (Lukasiewicz and Switanek, in press). Tasks 4, 5, and 6 are fully described in this report.

LOCATION OF STUDY AREA

St. Lucie County is located in southeastern Florida, northeast of Lake Okeechobee (Figure 1). It is bounded to the north by Indian River County, to the east by the Atlantic Ocean, to the south by Martin County, and to the west by Okeechobee County. The county is roughly square with an average east to west width of 26miles and a north to south length of 25 miles.

Figure 2 depicts the study area. The study area encompasses all of St. Lucie County, and portions of Martin, Okeechobee, and Indian River counties which are part of the regional ground water flow regime. The study area is bounded to the east by the Indian River Lagoon, to the south by Canal C-23, to the west by a topographic ridge, and to the north by the southernmost drainage and water control districts in Indian River County.

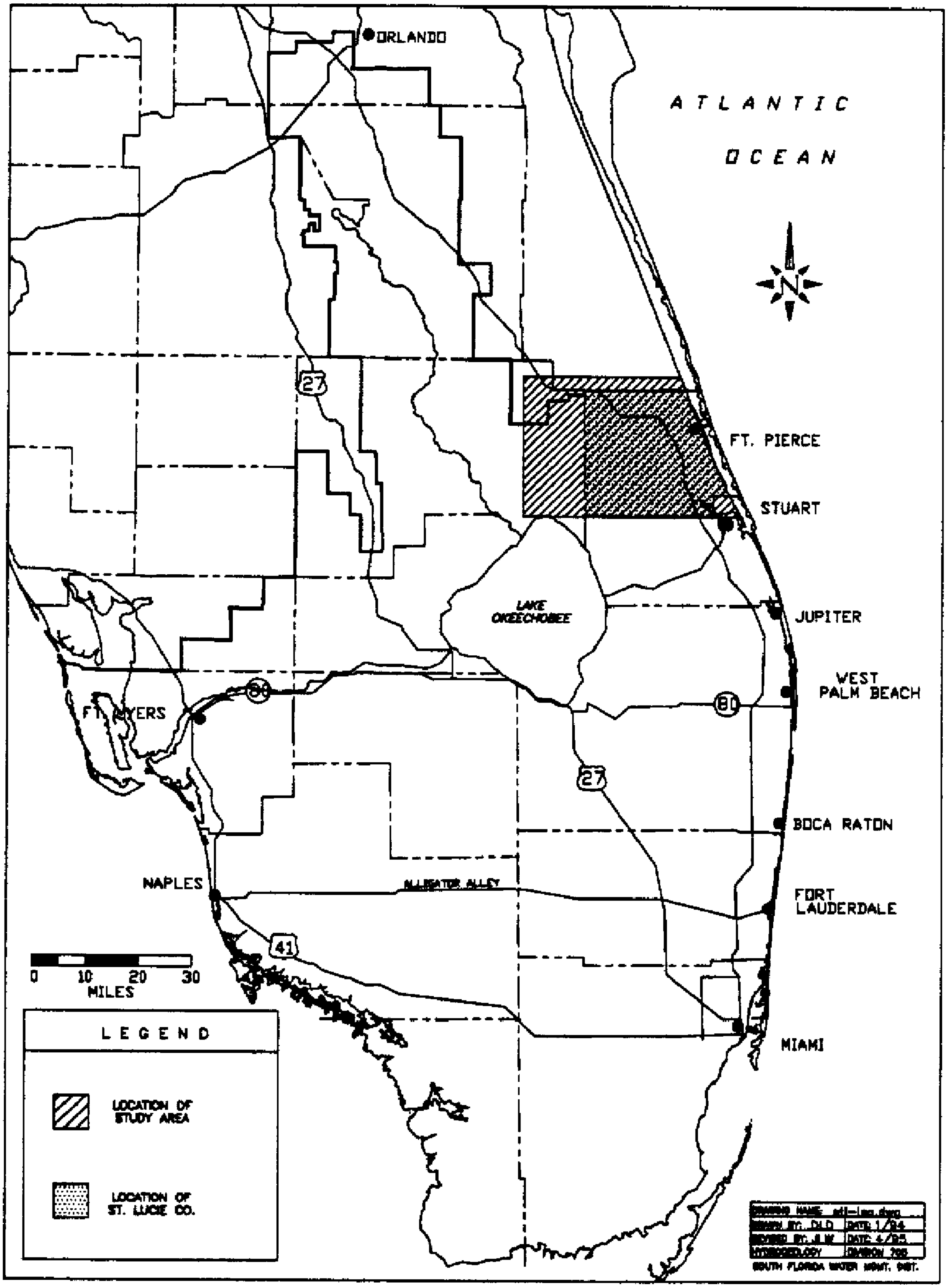


FIGURE 1. Location of Study Area

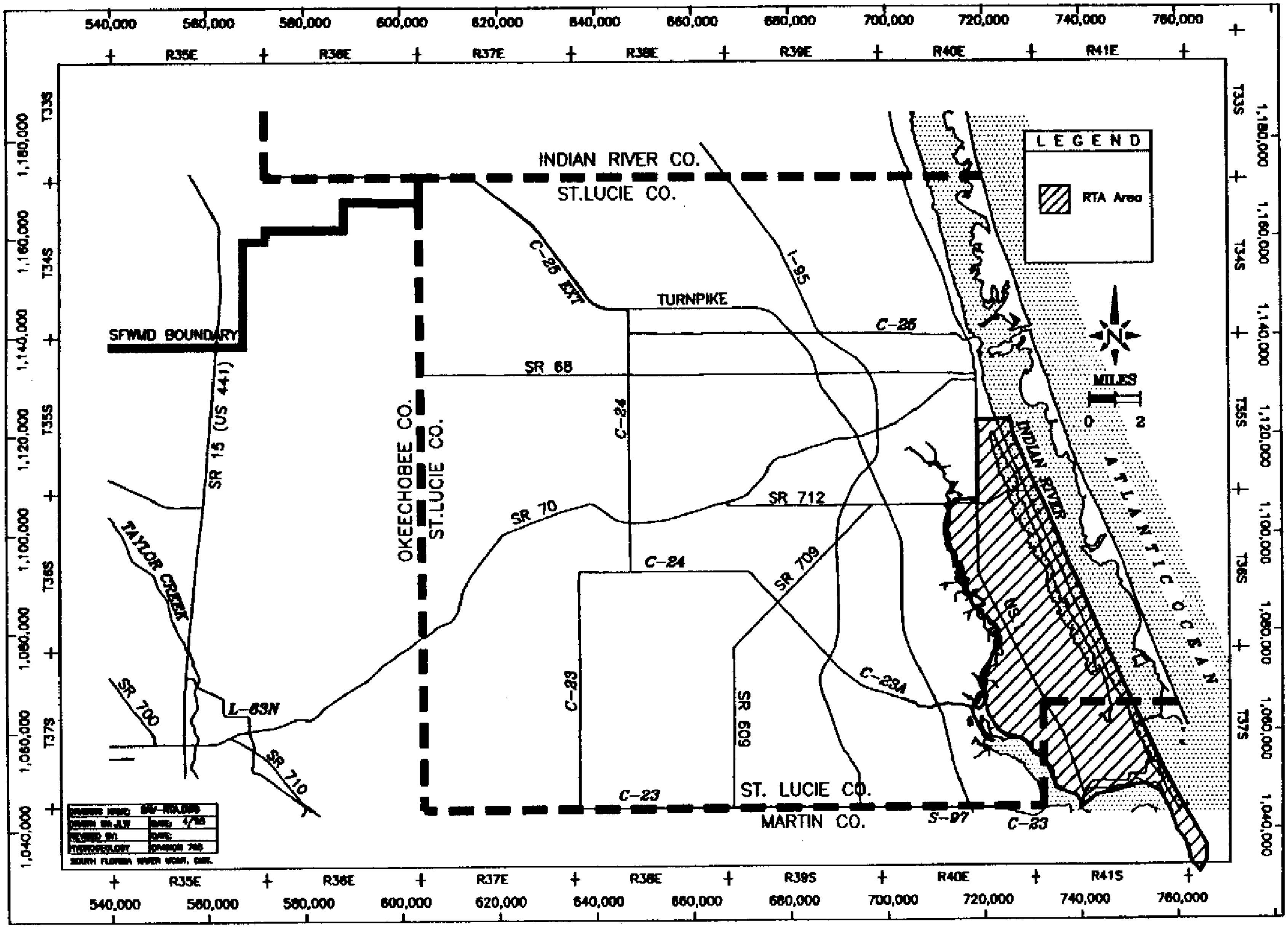


FIGURE 2. Study Area

DATA COLLECTION AND ANALYSIS

The extent and characteristics of the surficial aquifer system in St. Lucie County were determined based on extensive review and evaluation of the available hydrogeologic data. Data from the following reports were used to conceptualize the hydrogeology of the study area: Ardaman & Associates, Inc. (1990); C.F.S. and Associates, Inc. (1981); CH2M Hill (1988); Geraghty and Miller (1981), (1982), and (1984); Hydrodesigns, Inc. (1988); Layne Atlantic Company (1970); Miller (1979); James M. Montgomery, Inc. (1989); Parker et al. (1955); Post Buckley Schuh and Jernigan, Inc. (1985); Schiner, Laughlin and Toth (1988); and Universal Engineering and Testing Company (1986).

The report data were supplemented by field investigations conducted as part of this study at 24 sites in the study area. Data collection at these sites consisted of collection of aquifer material from drill cuttings, conventional cores, or split spoon samples. Additional hydrogeologic data were collected at three of these sites during aquifer performance tests (APT) utilizing multi-level observation wells.

Field data from the sites described above were supplemented by lithologic descriptions, well cuttings or geophysical logs from over 100 other wells located throughout the study area. Additional data on the hydraulic characteristics of the aquifer were derived from review and re-analysis of aquifer performance tests conducted in the study area by the U. S. Geological Survey, Florida Bureau of Geology, or private consultants. Additional APT data was reviewed but was not used because of poor data quality or insufficient documentation. Data from specific capacity tests from production wells were also used to estimate aquifer characteristics.

AQUIFERS IN THE STUDY AREA

There are two aquifer systems within the study area: the surficial aquifer system and the Floridan aquifer system. Both are laterally continuous throughout the study area, but are vertically separated by the thick sequence of low permeability sediments of the intermediate confining unit (Florida Geological Survey, 1986). Figure 3 provides a generalized hydrogeologic column of the study area.

Due to the low permeability of the sediments that compose the intermediate confining unit, the effects of the Floridan aquifer system on the surficial aquifer system are minimal. For more detailed information on the lithologic and hydrogeologic nature of the Floridan aquifer system in the study area, the reader is referred to Brown and Reece (1979), Brown (1980), Wedderburn and Knapp (1983), and Lukasiewicz (1992).

The intermediate confining unit is a thick sequence of fine clastic and carbonate sediments which acts as an aquitard and restricts the upward migration of poor quality Floridan aquifer system water into the overlying surficial aquifer system. In this report, the top of the intermediate confining unit corresponds with the top of the Hawthorn Group. In the study area, the top of the Hawthorn Group is identified by an increase in content of green clay. The intermediate confining unit was represented as a no-flow boundary at the base of the model. Lithologic characteristics of this unit are described by Scott (1988).

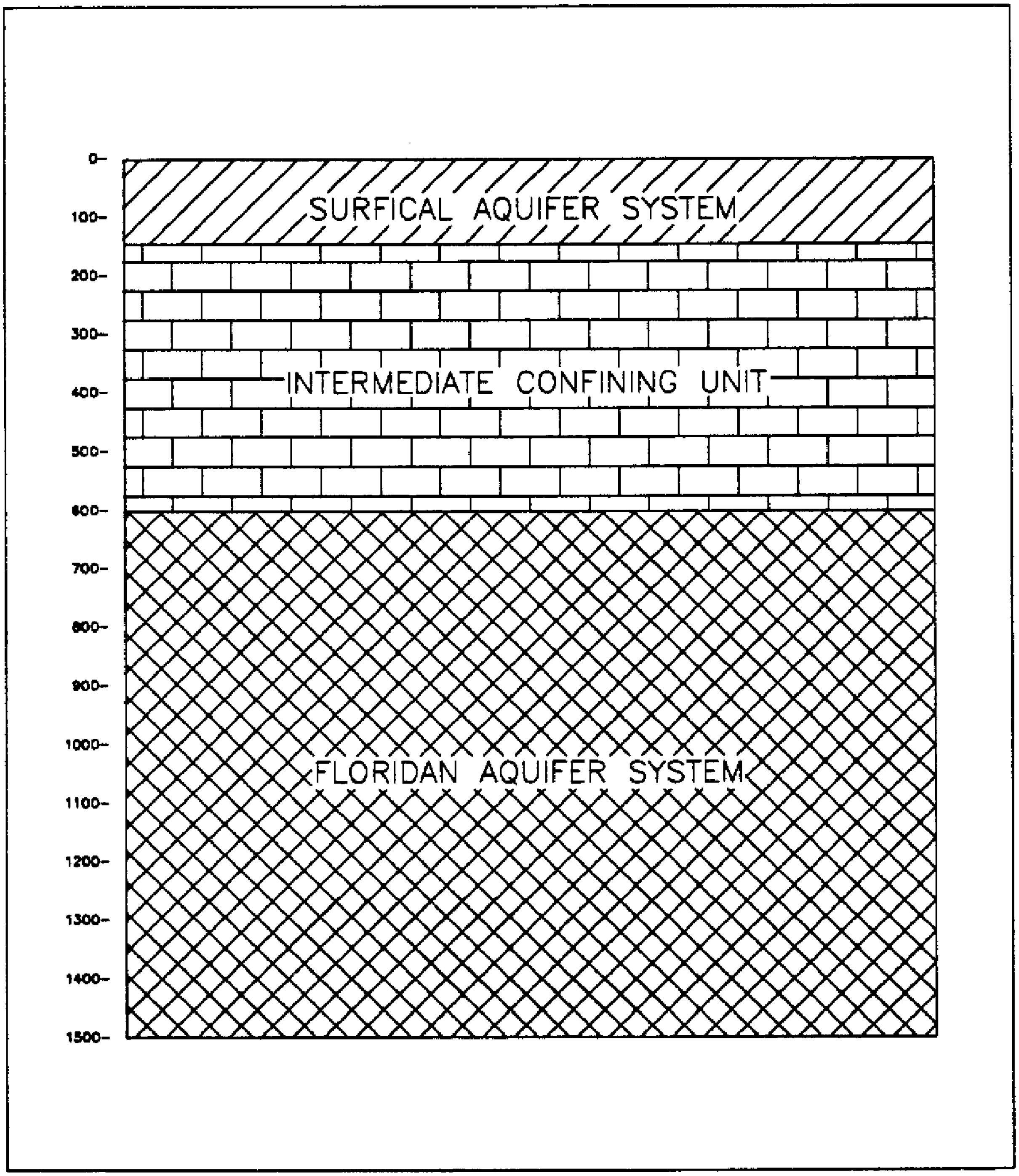


FIGURE 3. Generalized Hydrogeologic Cross Section

The surficial aquifer system is an important source of potable water in the study area. It is composed of low to moderately permeable clastic and carbonate sediments. Ground water in the aquifer exists under unconfined conditions in some areas and semi-confined conditions in others.

Based on the data described above, the system was conceptualized into two hydrogeologic zones: a shallow unconfined soil/sand zone which extends from the surface down to as deep as 50 feet, and an underlying unconfined to semi-confined production zone which extends from the base of the overlying soil/sand zone down to the base of the surficial aquifer system. This conceptualization is shown in Figure 4.

The upper sand/soil zone is seldom used as a water source. The underlying production zone is the primary source of potable water in the surficial aquifer system. The production zone is composed of a interbedded mixture of sand, silt, clay, shells, and limestone. The heterogeneous nature of this zone makes ground water exploration difficult. The regional hydrogeologic variations within this zone were defined by interpolating between the data at discrete well sites.

A more detailed discussion of the geology of the surficial aquifer system is provided in the report by Lukasiewicz and Switanek (in press).

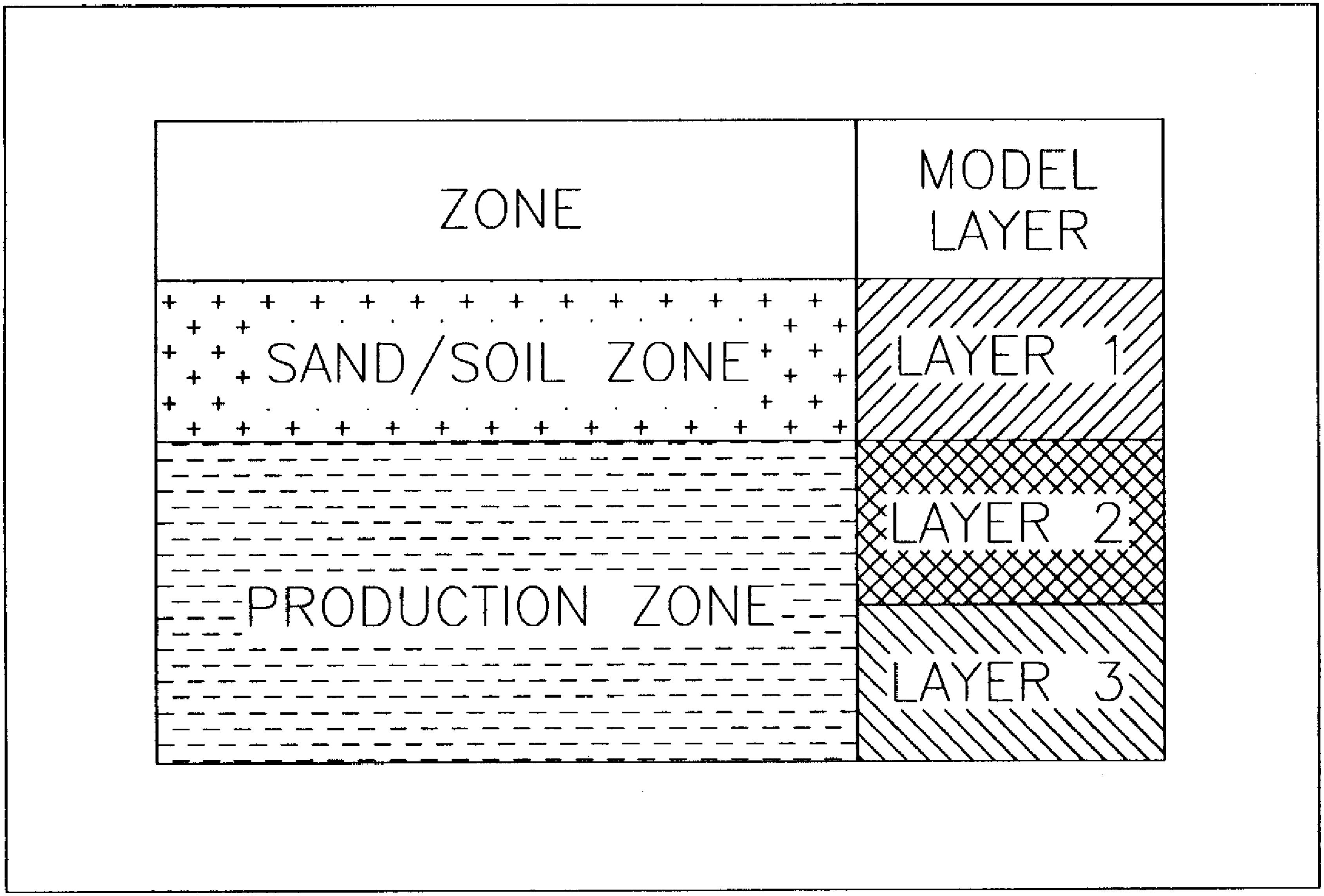


FIGURE 4. **Generalized Hydrogeologic Column Showing Model Layers.**

MODEL FORMULATION AND APPLICATION

OVERVIEW

The code used in this study to simulate the ground water flow and the interaction of the ground water and surface water systems is the U. S. Geological Survey modular three-dimensional finite-difference ground water flow code MODFLOW (McDonald and Harbaugh, 1988). MODFLOW is capable of simulating ground water flow in an anisotropic, heterogeneous, multi-layered aquifer systems. The finite-difference approach is block-centered, which means that the head values are calculated at the center of the cells. Layers may be simulated as confined, unconfined or convertible (confined/unconfined). This code was selected for the following reasons:

1. It is available in the public domain.

2. It is compatible with most computers with only minor modification.

3. The modular structure of the code and its excellent documentation allow easy modification of the code and the addition of new modules for specialty applications.

4. It allows great flexibility of data file structure and management, which facilitates the employment of and interaction with other software for data manipulation.

5. The cell-by-cell flow feature of the code can be used to:

   A. evaluate in detail flow and head changes associated with various withdrawal scenarios; and

   B. generate boundary conditions for higher-resolution models within the regional flow model.

6. It can be coupled with currently available non-density dependent solute transport models.

7. A stream package is also available for MODFLOW.

The MODFLOW code is written in modular form. It consists of a main routine and a series of highly independent subroutines called modules. These modules are grouped into packages which address the general use of the model, specific features of the hydrologic system, or particular numerical solution techniques. The hydrologic system packages simulate recharge, evapotranspiration from the saturated aquifer zone, rivers, drains, wells, and other sources and sinks of water external to the model(boundary conditions). Three solution technique packages are available for simulating flow problems: 1) slice successive over relaxation (SOR), 2) strongly implicit procedure (SIP), and 3) the preconditioned conjugate gradient (PCG) method. The SOR method was used in this study. Table 1 lists the packages used in this study.

TABLE 1. MODFLOW Packages Used in the St. Lucie County Model

MODFLOW PACKAGE	FUNCTION	USE IN MODEL
BASIC	Oversees model.	Used to activate packages.
BLOCK CENTERED FLOW	Computes hydraulic parameters.	Used to assign hydraulic parameters.
WELL	Simulates a source or sink to the aquifer that is not affected by heads in the aquifer.	Used to represent public water supply, agricultural, and domestic supply withdrawals and recharge from the Upper Floridan.
DRAIN	Simulates discharge from the aquifer to the drain.	Used to represent all water bodies that remove water from the aquifer.
RIVER	Simulates exchange between a river and an aquifer	Used to represent water bodies that may contribute or remove water from the aquifer.
ET	Simulates ET where the source of water is the saturated porous medium.	Used modified Blaney-Criddle calculation. Coefficients are estimated by land use type.
GENERAL HEAD BOUNDARY	Simulates a source/sink of water to the aquifer that is dependent on the head difference between the source/sink and the aquifer.	Used along the model boundaries to control inflow and outflow for the model.
RECHARGE	Simulates the effects of rainfall to the aquifer.	Used with measured precipitation. A pre-processor calculates actual recharge value.
SLICE-SUCCESSIVE OVERRELAXATION	Solves the finite difference equations for the model using the Slice-Successive Overrelaxation method.	Used to solve flow equations.
OUTPUT CONTROL	Saves the model output in the requested format.	Used to save model output.
OBSERVATION NODES	Generates a file of simulated water levels for selected cells.	Used to generate comparative hydrographs and calibration data.

Three types of boundary conditions are available for the model formulation: prescribed head, prescribed flux and head-dependent flux. A prescribed head boundary is defined when the head is specified as a known function of position and time at the boundaries. Similarly, prescribed flux is defined when the flux is specified as a known function of time at the outer edges of boundaries. The head-dependent flux boundary is defined when the ratio between the head gradient and flux is known. Constant head boundaries, which are a particular case of prescribed head boundaries, maintain the same user-specified head levels throughout the simulation.

Prescribed flux boundaries can be simulated in MODFLOW through the use of external source terms in the model. No-flow boundaries are a type of prescribed flux boundary for which no flow is simulated between the inactive cell and any adjacent active cell. Head-dependent flux boundaries generate a flux dependent on the head in the cell and a user-prescribed head assigned to the external source. Head-dependent flux boundaries can be simulated in MODFLOW through the use of general head boundaries as well as the river, drain and ET packages. Prescribed head can be represented in MODFLOW as a particular case of head-dependent flux, where the flux is set as large as needed. All types of boundary conditions can be set anywhere within a model grid. A no-flow boundary is implicit along the outer edges and bottom layer of a model grid.

DISCRETIZATION

Horizontal Discretization

Grid cell dimensions were determined by balancing the need for resolution of surface water features against the integrity of data regionalization, and the ease of relating cell coordinates to established geographic references. Canal density was very influential in determining the grid spacing. This is especially true in the eastern portion of the study area where surface water management systems strongly influence water levels in the surficial aquifer system. Two of the largest water control districts in the county operate systems with canal densities of about one canal per half mile.

The horizontal model grid comprises 71 rows and 109 columns. Row lengths and column widths are a uniform 2000 feet throughout the model area.

This cell size provides the resolution necessary to differentiate major drainage basins in the larger drainage districts in St. Lucie County. Figure 5 provides the model grid for the St. Lucie County model.

The model cells in row 71 overlap the model cells of row 1 for the Martin County model (Adams 1992). This facilitates the merging of the two models in cases where predictive simulations may require a more regional perspective.

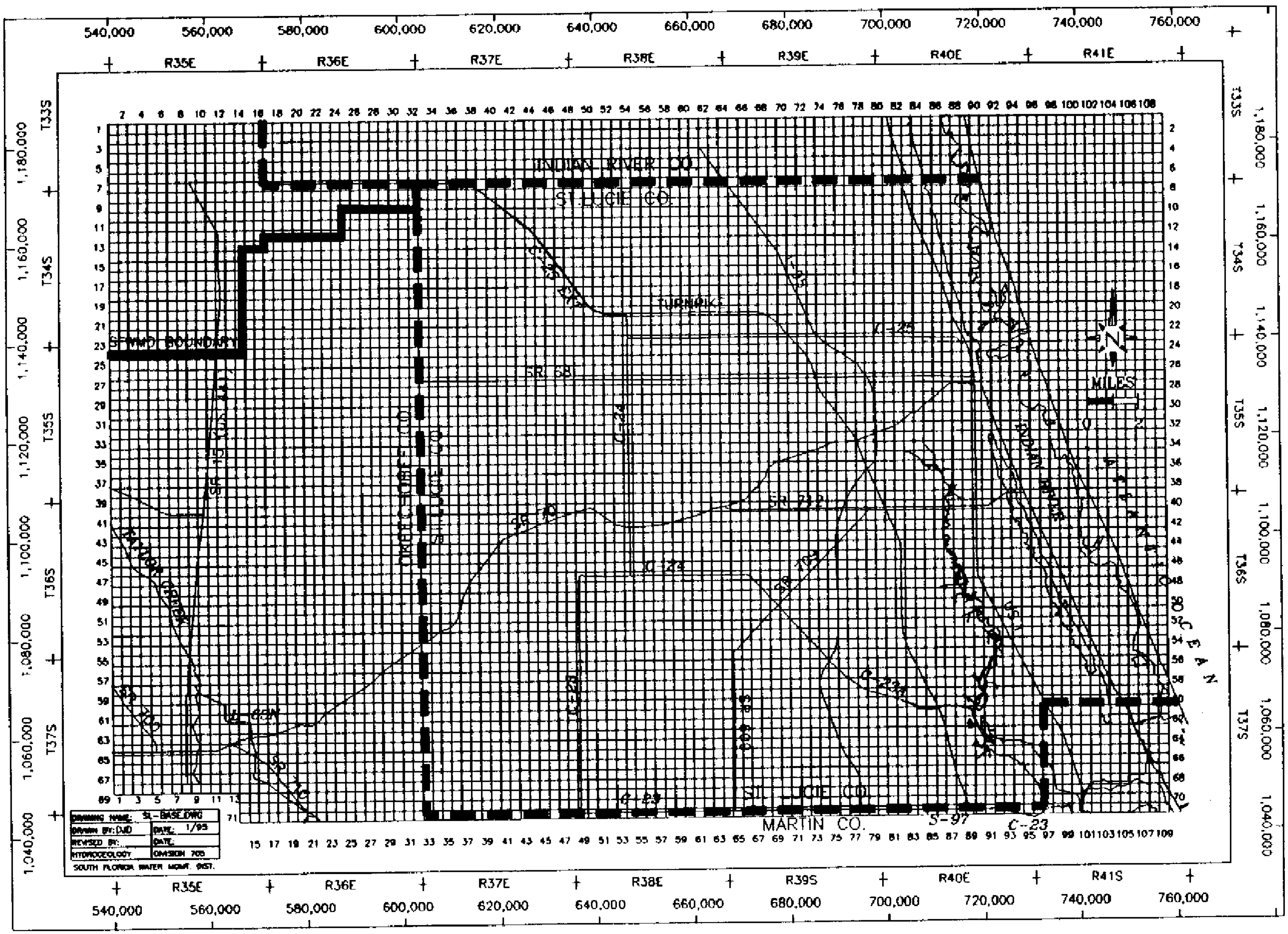


FIGURE 5. Model Grid for St. Lucie County

Vertical Discretization

The surficial aquifer system was modeled as a multi-layered system to simulate its semi-confined nature and to better represent the influences of surface water features on ground water levels. Three layers were chosen to simulate the hydraulic heterogeneity of the aquifer system. The upper layer, layer 1, contains all of the surface water features. Layers 2 and 3 represent the producing intervals of the aquifer from which most of the ground water withdrawals are made. A generalized hydrogeologic cross section of the county showing the relationship between the producing zone and model layering is shown in Figure 4.

Figure A-1, in Appendix A, illustrates the location of the wells in the study area with lithologic or geophysical information. Table A-1 in Appendix A lists the location and layering data for wells with available information. Model arrays of land surface elevation, layer thickness, and layer bottom elevations were generated from discrete data points using the kriging interpolation technique provided in the SURFER software (Golden Software Inc., 1989). Since cells in row 1 of the Martin County model (Adams 1992) are coincident with cells in row 71 of the model documented in this report, most of the data from these cells were incorporated directly into the kriging process.

Layer 1 corresponds to the sandy Pleistocene terrace deposits and the overlying soils. Although the base of layer 1 was initially chosen to correspond to the abrupt transition between the shallow sands and soils, and the underlying shell and sand sequences, the layer 1 base array was modified to prevent model cells from going dry during the iterations of the solver.

Figure A-2 is an isopach map of layer 1. The layer is thickest in the western and southeastern portions of the study area.

Figure A-3 is a structure contour map of the base of layer 1. According to Figure A-3, layer 1 is deepest in the southeastern portion of the study area.

The primary producing interval in the modeled aquifer system was divided into two layers, layers 2 and 3, based primarily on regional lithologic and hydraulic characteristics. Measured aquifer head elevations were also used to discern layer boundaries. Variations in aquifer heads with depth were correlated to lithologic changes in the production zone as observed at sites with both deep and shallow monitor wells. These same lithologic changes were interpreted to represent layer boundaries in other deep wells where water level data was not available. Table A-1 in Appendix A provides the elevations of layers 2 and 3 based on the lithologic or geophysical logs available in the study area.

As a general rule, layer 2 is primarily composed of shelly sands with limited occurrences of shelly or sandy limestone. Silt and clay content in layer 2 generally decreases from west to east. Deviations from this trend occur primarily in the south-central part of St. Lucie County where layer two is composed of sandy, granular limestone. Figures A-4 and A-5, in Appendix A, present an isopach map of layer 2 and structure contour map of the base of layer 2, respectively.

Layer 3 is a sequence of interbedded sands and shell material in a carbonate dominated matrix. The lithologic character of layer 3 varies across the study area. In the eastern part of the county, layer 3 correlates to a calcareous and poorly- to well-indurated sandstone or biogenic limestone. In the central and western part of the county layer 3 is characterized by sparse shell material occurring in silty, calcareous mud or poorly indurated mudstone/siltstone. Figure A-6 is an isopach map of layer 3.

The bottom of the producing zone, and the base of the model, correlates to the shallowest occurrence of the low permeability clays, silts and sandy calcareous mud of the Hawthorn Group.

Table A-1 in Appendix A provides the elevations of the base of the surficial aquifer system based on the lithologic and geophysical logs. Figure A-7 is a structure contour map of the base of the surficial aquifer system.

Time Discretization

The transient calibration was discretized into 12 one-month stress periods to correspond with the availability of pumpage reports from the public water supply utilities within the study area and the collection frequency of the water level monitoring network. The calibration period extends from July 1, 1989 through June 30, 1990.

BOUNDARY CONDITIONS

The St. Lucie County ground water flow regime has two natural boundaries: the Indian River on the east, and the Indiantown Spit on the west. The southern boundary is a man-made feature, the C-23 Canal. A constant-head boundary was set along the northern boundary of the model.

Eastern Boundary

The Indian River Lagoon is a nearly linear northwest to southeast trending water sink relative to regional flow. Water levels in most of the inland portion of the Indian River Lagoon are heavily influenced by wind and vary within a range of one foot seasonally. During the transient calibration period, the average stage elevation of the river at a monitoring station located at Fort Pierce was 0.4 feet NGVD. The river was made a constant head boundary at 0.4 feet NGVD in all layers. The coarseness of the model grid makes it unrealistic to simulate the shape of the saltwater/freshwater interface in the vicinity of the shoreline. This boundary will remain valid for all predictive modeling purposes assuming the horizontal discretization of the model grid is not changed. Figure 6 illustrates the location of the cells along the Indian River Lagoon that were held at a constant head of 0.4 feet NGVD.

Western Boundary

The Indiantown Spit is a topographic ridge which extends into Okeechobee County and acts as a northwest/southeast trending ground water divide. The apex of this ridge was made a constant head boundary in all layers. Figure 6 shows the location of the cells that were assigned a constant head elevation. Currently, there are no significant ground water stresses in the vicinity of the western boundary. However, the hydrogeologic characteristics of the western boundary should be examined further to determine the validity of this boundary before planning or regulatory potential impact assessments of water use in the area are simulated. Additional evaluation of this boundary will be accomplished as part of the Okeechobee County Ground Water Resource Assessment.

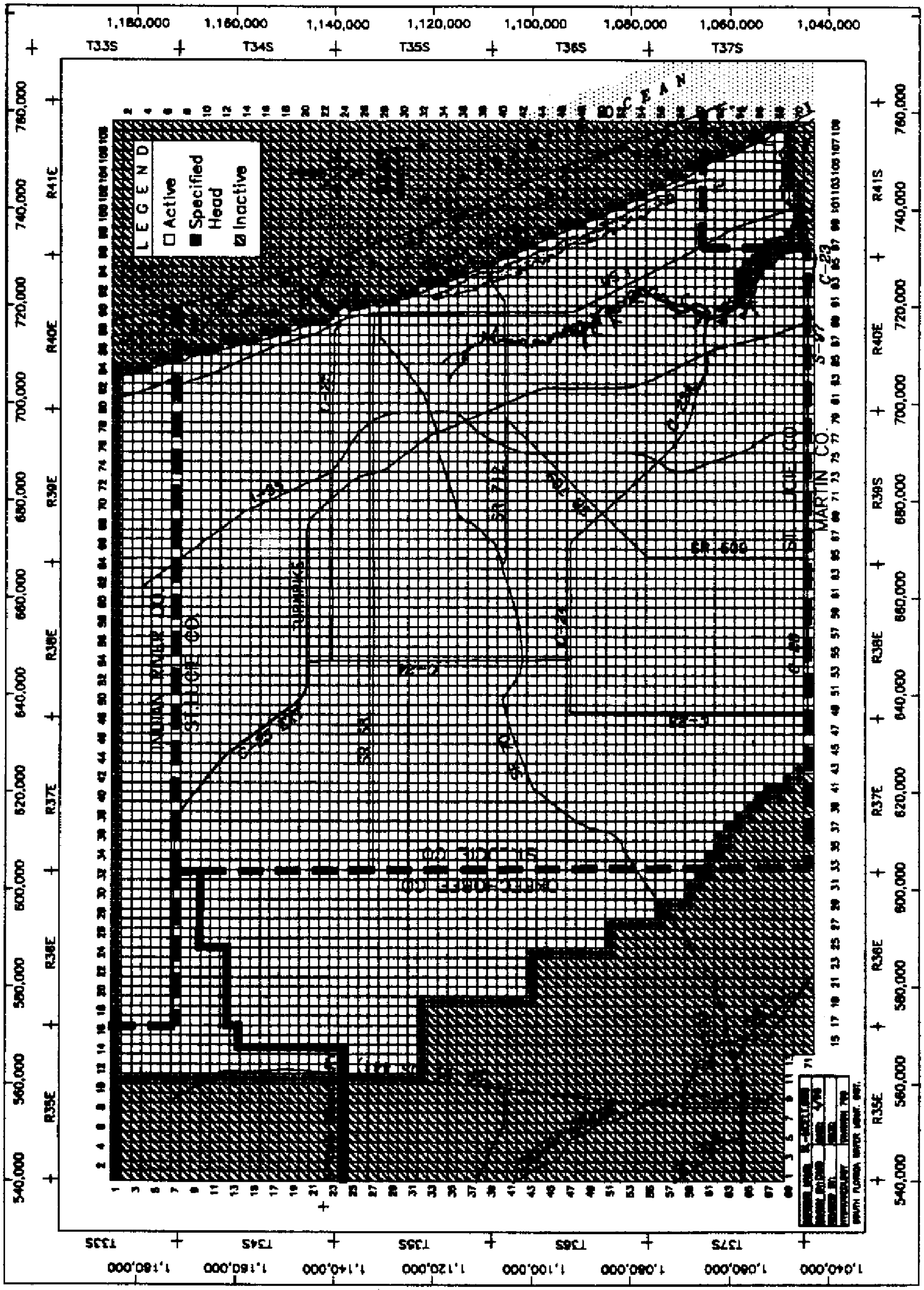


FIGURE 6. Cells with Specified Heads

Southern Boundary

The southern model boundary is associated with the C-23 Canal. The C-23 Canal is a very large canal and acts as a regional ground water sink to the flow systems in both northern Martin County and southern St. Lucie County. The stages in the canal vary and form the baseline for local flow. The cells in which the C-23 reaches are present are active river cells having no flow boundaries at their southernmost edges, while the underlying cells in layers two and three are general head. The cells west of the canal up to the western boundary are general head in all layers. Figure 7 shows the location of the cells with general head boundaries in layer 1 and Figure 8 shows the location of the general head cells in layers 2 and 3. The cells in layer 1 which act as river cells are discussed in more detail in the section on Surface Water Interactions.

The data available from monitor wells and the C-23 Canal stages make it possible to assess the validity of calibrated general head boundary conditions in this area for both planning and regulatory purposes. Reactions of general head cells to simulations of new water uses in the area will determine the validity of the model boundary in specific predictive scenarios.

Northern Boundary

There are no surficial aquifer system monitor wells in the southern area of Indian River County. Therefore, the northern boundary conditions of the model are based on the limited information available about the surface water management systems in both northern St. Lucie County and southern Indian River County. The historical methods of operation for these systems are speculative. Therefore, the northern boundary was placed 10,000 feet north of the St. Lucie County line in order to minimize effects of erroneous boundary assumptions on the cells within the county. The northern boundary of the model is constant head in all three layers with the elevations set to approximate the surface water system maintenance elevations as described by system operators. Figure 6 shows the location of the cells that were assigned constant heads along the northern boundary.

The information on ground water and surface water uses in southern Indian River County is limited. Ground water uses other than for agricultural purposes have not been permitted by the St. Johns River Water Management District. However, managers for Indian River County regional water supply systems indicate there are several developments with private water supply facilities that exist within the modeled area. These users will have to be inventoried to determine their size and facility locations before their possible impacts on the validity of the boundary in the northeast area of the model can be assessed in a reliable manner.

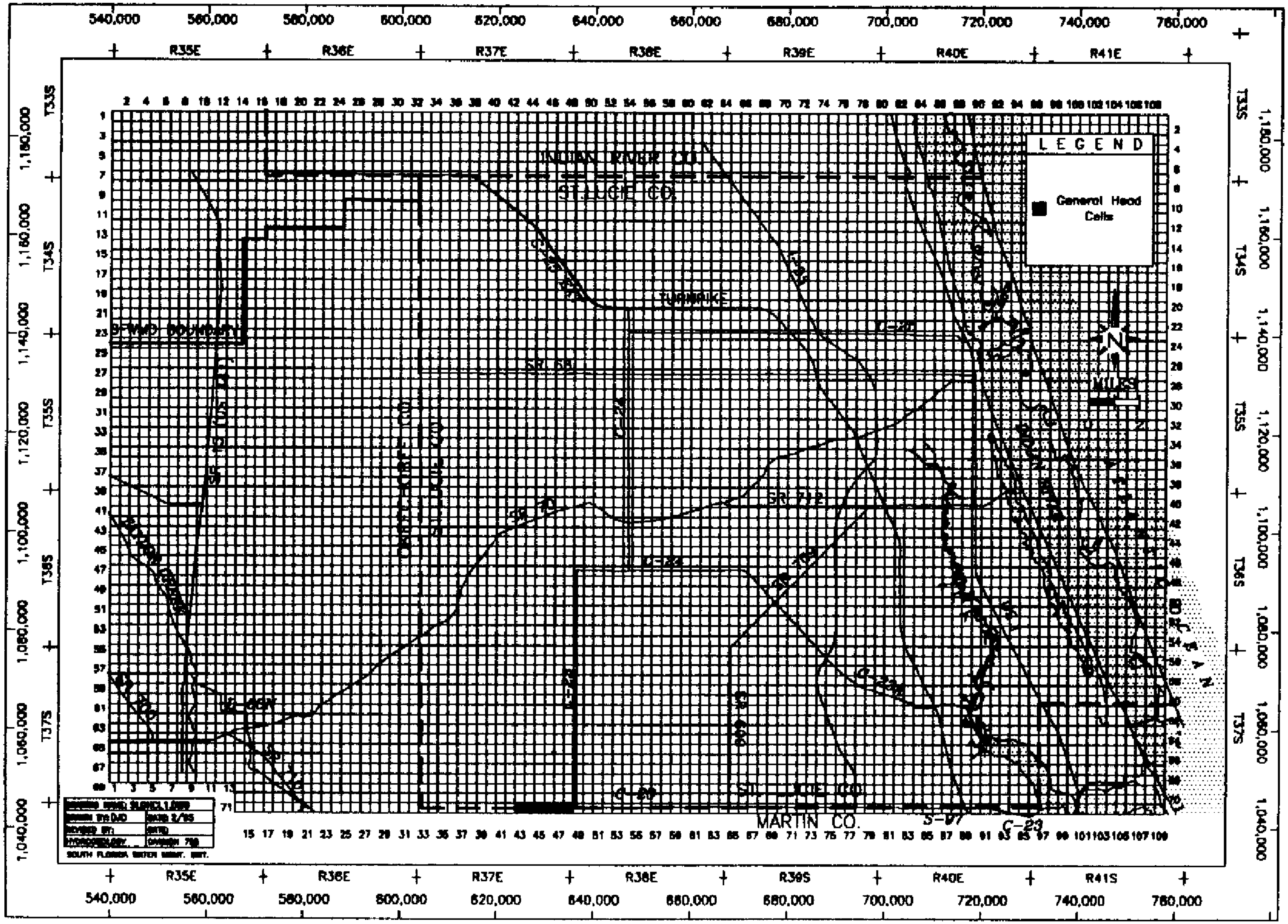


FIGURE 7. General Head Cells in Layer 1

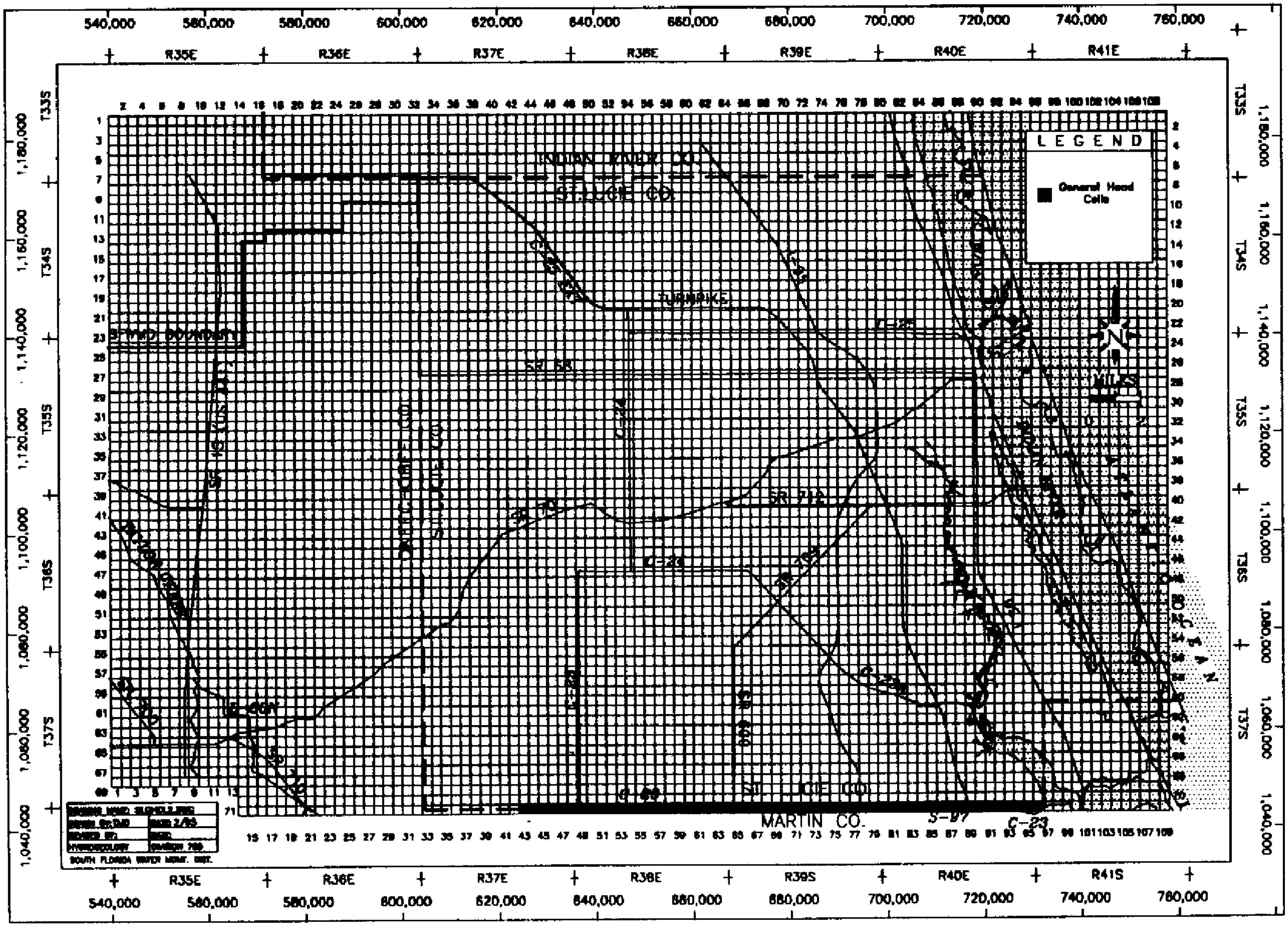


FIGURE 8. General Head Cells in Layers 2 and 3

HYDRAULIC CHARACTERISTICS

Horizontal Hydraulic Conductivity/Transmissivity

Horizontal hydraulic conductivity was modeled as being isotropic in each cell. Regional variations in horizontal hydraulic conductivity within each layer were simulated by varying conductivity or transmissivity values between cells.

Model arrays of horizontal hydraulic characteristics were generated from discrete data points using the kriging interpolation technique provided in SURFER software (Golden Software Inc., 1989). In most cases, data was taken directly from row 1 in the model created by Adams (1992) and incorporated in the kriging process. This procedure assured consistency between the Martin and St. Lucie models.

Pre-calibration estimates of the hydraulic characteristics of layer 1 were derived from data presented in the Soil Conservation Service soil surveys for St. Lucie County (Watts and Starky 1980), Okeechobee County (McCollum and Pendleton 1971), Martin County (McCollum and Cruz 1981) and Indian River County (Wettstein, Noble, and Slabaugh 1987). The data presented in these surveys were related to the Soil Conservation Service STATSGO coverage to generate horizontal hydraulic conductivities for each cell in layer 1. Figure A-8, in Appendix A, illustrates the STATSGO coverage for the study area and Table A-2 lists the soil classification with the estimated hydraulic conductivity. Conductivity values calculated in this manner ranged from 11.5 feet/day to 44.2 feet/day.

The hydraulic conductivity values described above were later adjusted during the calibration process in the following manner:

1) The minimum horizontal hydraulic conductivity value in the layer 1 array was raised to 18 feet/day.

2) All values were increased by 10%.

The calibrated hydraulic conductivity values used in layer 1 range from 19.8 feet/day to 51.7 feet/day. These values are consistent with hydraulic conductivity ranges for the soils in the modeled area as shown in Table A-2. Figure A-9, in Appendix A, presents a contour map of the calibrated hydraulic conductivities for layer 1.

Hydraulic characteristics of production zone sediments were determined from the APT's presented in Table A-3, in Appendix A. Figure A-10 shows the location of the aquifer performance test sites in St. Lucie County. For each aquifer performance test, the layer in which the production well was screened was assumed to produce 100 percent of the water. The transmissivity value derived from the test was then divided by the thickness of the screened layer to determine a horizontal hydraulic conductivity for that layer at that site. Layers at sites where hydraulic conductivity data were unavailable were assigned hydraulic conductivities relative to their lithologic similarities with layers at APT sites. Assigned hydraulic conductivity values for layers at untested sites were biased upward relative to the amount of clean shell, calcareous sandstone and coquina limestone present; and downward in an inverse relationship to silt, clay and carbonate mud content. Estimations of hydraulic conductivities from both aquifer performance tests and lithologic data collection wells are presented in Table A-3 in Appendix A. Lukasiewicz and Switanek(in press) discuss the results of the aquifer performance tests in more detail.

Because historical water levels in the surficial aquifer system were always above the top of layer 3, the transmissivity of this layer remains constant throughout steady-state and transient simulations. The input array for horizontal hydraulic character of this layer represents the transmissivity of layer 3 in units of feet^2/day. Transmissivity values for this layer were calculated by subtracting the kriged surficial aquifer system bottom elevations from the kriged base elevations for layer 2 and multiplying the difference array by the layer 3 kriged horizontal hydraulic conductivity array.

Model calibration was achieved by adjusting the hydraulic conductivity array of layer 2 and the transmissivity array of layer 3 by the following methods:

1) The minimum hydraulic conductivity of layer 2 was increased to 25 feet/day.

2) All layer 2 array values were increased by 10%.

3) Discrete values in the array were adjusted manually in response to the calibration runs.

4) The minimum transmissivity of layer 3 was increased to 600 feet^2/day.

5) All layer 3 array values were increased by 20%.

6) Discrete values in the array were adjusted manually in response to the calibration runs.

The resulting modeled minimum and maximum hydraulic conductivity values for layer 2 were 27.5 ft/day and 144.1 ft/day, respectfully. Figure A-11 provides a map of the calibrated hydraulic conductivity values for layer 2.

The resulting modeled minimum and maximum transmissivity values for layer 3 were 720 feet^2/day and 12,380 feet^2/day, respectively. Figure A-12 provides a map of the calibrated transmissivity values for layer 3. Figure A-13 provides a composite transmissivity map for the surficial aquifer system.

Calibrated ranges of layer 2 hydraulic conductivities and layer 3 transmissivities are very reasonable when compared to the APT derived values presented in Table A-3.

Vertical Hydraulic Conductivity

Vertical flow in the model is a function of the vertical leakance (Vcont), area of the cell, and the head difference between the layers. MODFLOW requires that the user calculate the Vcont values between nodes and enter the values into the model as input data. The following formula, from McDonald and Harbaugh (1988), was used to calculate the initial Vcont values:

$$Vcont = \frac{2}{\frac{b1}{vc1} + \frac{b2}{vc2}} \qquad (1)$$

where,

b1 = thickness of upper layer,

b2 = thickness of lower layer,

vc1 = vertical conductivity of upper layer, and

vc2 = vertical conductivity of lower layer.

Discrete values in the arrays were adjusted in response to calibration runs. Figures A-14 and A-15 are contour maps of the calibrated Vcont values between layers 1 and 2, and between layer 2 and 3, respectively.

Storativity

Layer 1 cells were all treated as unconfined and were assigned a specific yield of 0.2. This value is within the range of specific yield measurements for unconsolidated sediments as indicated by Fetter (1980).

Layer 2 cells were allowed to vary between unconfined and confined conditions, depending on the water level. For this scenario, MODFLOW requires both a specific yield value and a confined storativity value. Again, the primarily unconsolidated nature of the sediments of layer 2 made it reasonable to assume a specific yield of 0.2 for these cells. A storativity of 0.0009 was used to represent confined storage in all active layer 2 cells. This value is an average storativity value derived from the pump tests in Table A3 that were conducted in layer 2.

All cells in layer 3 were modeled as a confined aquifer with a storativity of 0.0003. This storativity value is an average of the storativity values derived from the pump tests in Table A3 that were performed in the producing zones represented by layer 3.

SURFACE WATER INTERACTIONS

Physical System

There are several surface water features within the study area which affect the water levels within the surficial aquifer system. Understanding the surface water systems is essential to the development of a ground water model for the study area. According to Restrepo et al. (1992), canal-aquifer interaction is dependent on several factors:

1) the hydraulic connection between the canal and the aquifer,

2) the head gradient between the canal and the aquifer,

3) the shape of the flow lines in the aquifer surrounding the canal reach, and

4) the geometric characteristics of the cross-section of the canal reach.

Figure 9 is a hydrograph which compares the water level monitoring well SLMW5S with the average monthly and daily stages in the C-24 Canal at Structure G-81. The daily stage readings were taken on the same day as the monthly water

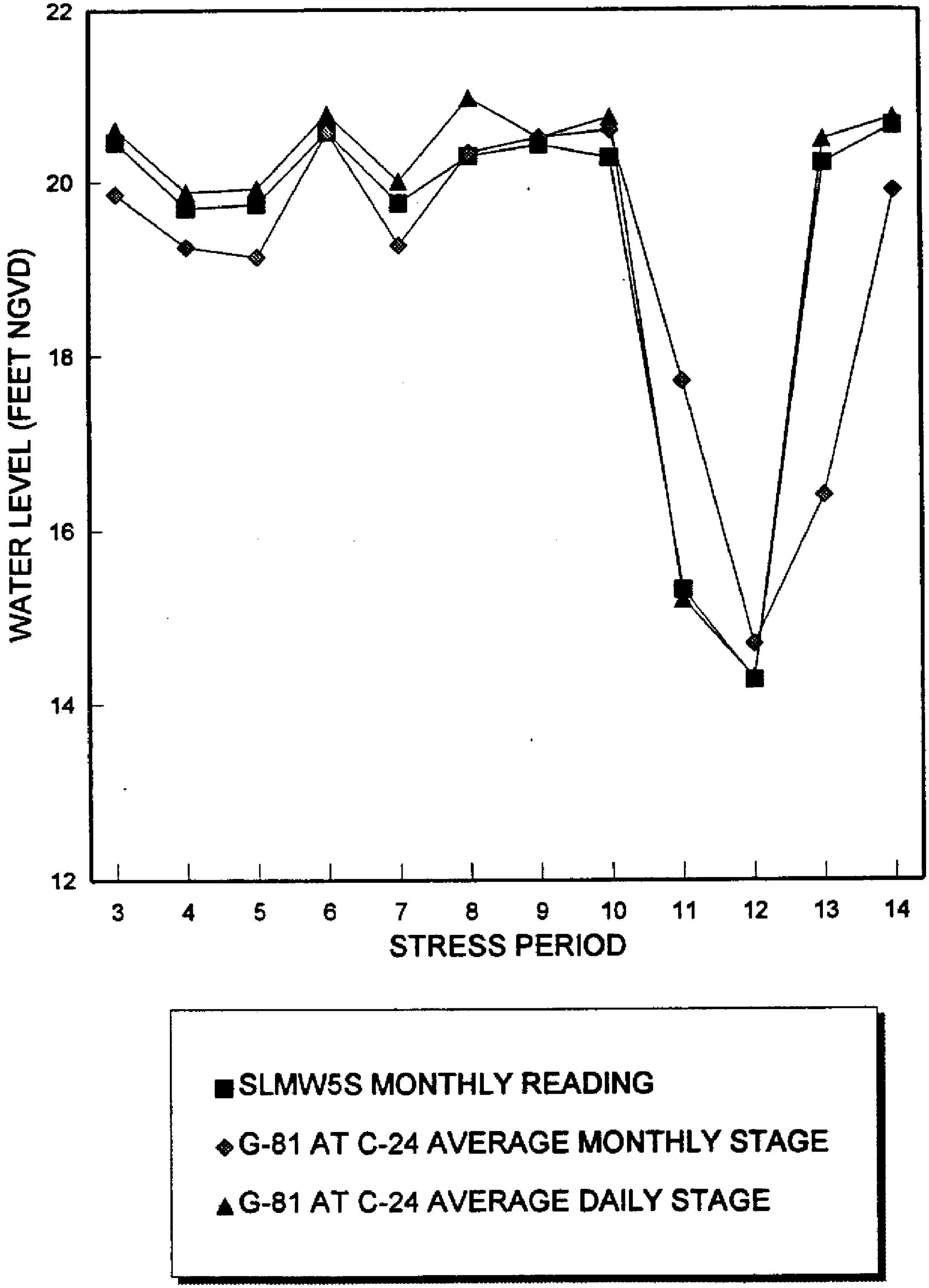


FIGURE 9. Hydrograph of Well SLMW5S and Stage at G-81

level from well SLMW5S. An examination of the hydrograph indicates that there is a good correlation between the daily stage reading and the ground water level. Figure 9 indicates that the surficial aquifer system responds quickly to changes in canal stages. As shown in Figure 9, there may be a significant difference between the average monthly stage and the ground water level on a specific day.

Cooper and Ortel (1988) divided the surface water bodies in St. Lucie and eastern Okeechobee Counties into five surface water management basins: the C-23 Basin, the C-24 Basin, the C-25 Basin, the C-59 Basin, and the North Fork of the St. Lucie River Basin. The basins were delineated based on surface water flow patterns. Figure 10 depicts the locations of the basins. Figures B-1 through B-5, in Appendix B, depict the major surface water bodies within each basin. Tables B-1 through B-4 describe the design criteria for the control structures within the basins. There are no SFWMD structures within the North Fork of the St. Lucie River Basin.

In addition, there are two other entities that are responsible for large surface water management systems within St. Lucie County: the Fort Pierce Farms Drainage District (FPFDD) and the North St. Lucie River Water Control District (NSLRWCD). Figure 10 illustrates the location of the FPFDD. Figure B-6, in Appendix B, depicts the location of the NSLRWCD in relation to the C-24 and North Fork of the St. Lucie River Basins.

There are no District structures in either the FPFDD or the NSLRWCD. The canals within the FPFDD and NSLRWCD are controlled by the structures which belong to the individual districts. Most of these structures are either culverts or risers with removable flashboards. The control elevation for these structures were surveyed by District staff.

Most of the canals within the NSLRWCD are structure controlled. However, the NSLRWCD maintains the stages in several canals by back-pumping water from Ten Mile Creek (NSLRWCD 1991). Also, the NSLRWCD has a permit from the SFWMD to withdraw water from the C-25 Canal. Figure B-7, in Appendix B, illustrates the location of the pump stations within the NSLRWCD.

A review of aerial photos indicates that there is a myriad of canals throughout the study area. The canals range in size from major waterways to minor irrigation ditches. This modeling study includes only the canals that were deemed to significantly affect the regional flow system. This classification includes the District's canals; and major canals within water control districts, developments, and agricultural areas. Minor canals were only included if they were deemed to significantly affect the regional flow system.

Rivers

The surface water bodies that were incorporated into the model were classified as either rivers or drains based on their storage capacity and ability to maintain a desired water level elevation. Large water bodies that are maintained at a certain control elevation were modeled as rivers in this report. The maintenance can be accomplished via control structures, back-pumping, withdrawal restrictions, or tidal influence. Figure 11 depicts the location of the cells with river reaches. The remaining surface water bodies were classified as drains.

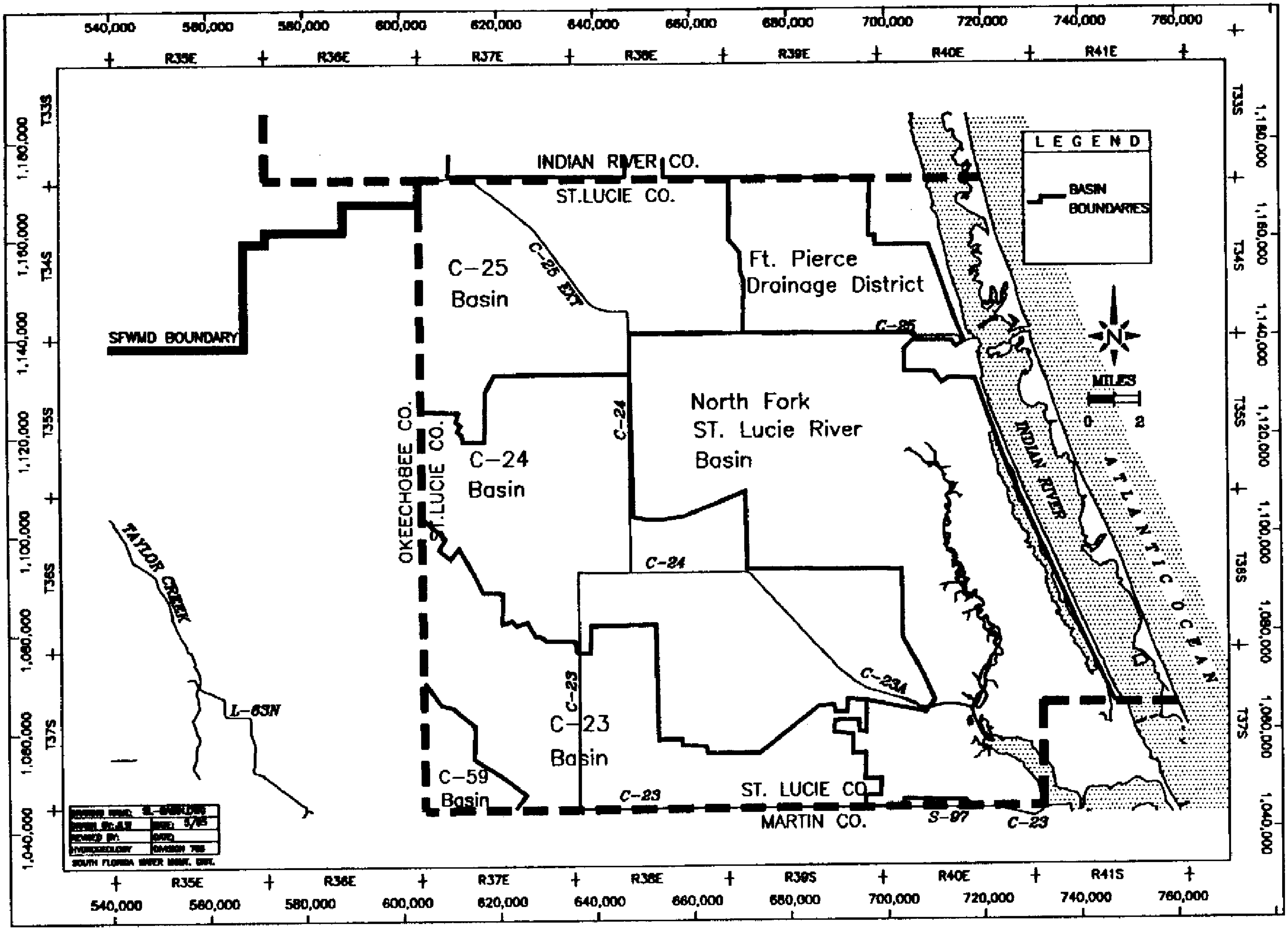


FIGURE 10. Location Map of Surface Water Basins within St. Lucie and Eastern Okeechobee Counties (from Cooper and Ortel 1988)

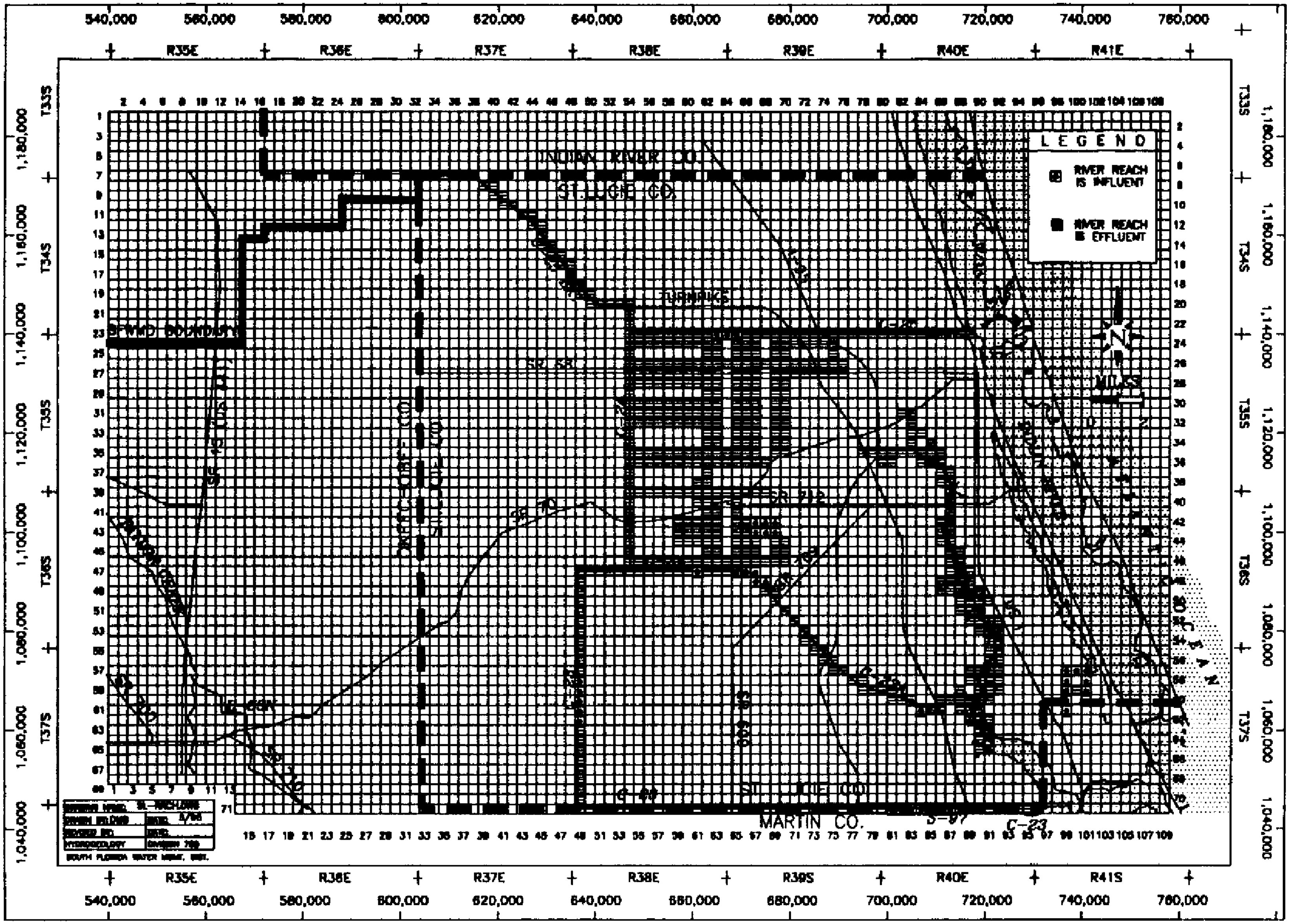


FIGURE 11. Cells with River Reaches

MODFLOW allows for two-way flow between rivers and the aquifer system. The amount of flow is determined by the following: 1) the hydraulic characteristics of the river bed; and 2) the head difference between the aquifer system and the river. MODFLOW assumes that the river stage is constant through a stress period. McDonald and Harbaugh (1988) provide the following equation for flow between the river and aquifer:

$$Q_{RIV} = KLW(H-R)/M \qquad (2)$$

where,

Q_{RIV}	=	the leakage through the reach of the river bed;
K	=	the hydraulic conductivity of the river bed;
L	=	the length of the river reach;
W	=	the width of the river;
M	=	the thickness of the river bed;
H	=	the head in the aquifer; and
R	=	the head in the river.

River bed conductivity values of 1/100 multiplied by the hydraulic conductivity of the soil were used to estimate the conductivity of the river bed. These values were derived by conducting a series of sensitivity analyses on the river bed conductivity values. A product of 1/100 multiplied by the hydraulic conductivity of the soil produced the best results. For all river reaches, a thickness of one foot was assigned to the river bed.

SFWMD Canals C-23, C-24, C-25, C-23 Extension, and C-25 Extension were treated as rivers in the model. These canals were classified as rivers for the following reasons: 1) the canal reaches are fairly extensive; and 2) ground water seepage combined with restrictions on water withdrawals (SFWMD 1974 and SFWMD 1985) should prevent these canals from drying up completely. Canal reaches and widths were estimated from USGS quadrangle maps. Canal bottom elevations were determined from the US ARMY Corps of Engineers "as-built" drawings. These drawings do not account for later infilling of sediments which would result in canal bottom elevations being higher than originally constructed. Canal stages were taken from data collected by the SFWMD.

The tidal portion of the North Fork of the St. Lucie River was treated as river reaches in the model. The northern limits of the river cells extend up to the control structure of the North St. Lucie River Water Control District. The wetted perimeter of the river was set equal to the area of the water surface. Initially, the hydraulic conductivity of the river bottom in each cell was set equal to 1/100 of the soil hydraulic conductivity in corresponding cells. River stage data was based on data measured at the intersection of SR 70 and the North Fork of the St. Lucie River. Monthly average stage data was used for each transient time step. River bottom elevations were estimated to grade from -5 ft NGVD at the extreme northern reaches to -13 feet NGVD (per C-23 extension as-built) at the extreme southern end.

Water levels in several canals in the North St. Lucie River Water Control District are artificially maintained by backpumping (NSLRWCD 1991). These canals have wet season (May through October) and dry season (November through April) maintenance schedules. These maintained canals were represented as rivers in the model. The remaining canals in the system were represented using the drains package.

Reaches were determined from digitized maps and widths were determined from field observations and conversations with engineers from a local engineering company. Canal bottom elevation data are not available. However, the consulting engineers indicated that canal bottom elevations range from 9 to 15 feet below land surface. Initially, the river bottom hydraulic conductivity was assigned a value of 1/100 of the soil conductivity. Table B-6, in Appendix B, provides the hydraulic parameters for the river cells within the North St. Lucie River Water Control District.

The Gateway and Buttonwood Waterways are also classified as rivers in this study. These canals are located in East Port St. Lucie which is situated in the southeastern portion of the study area. Talks with city employees indicate that these canals are maintained at an elevation of 11.8 feet NGVD. The City of Port St. Lucie maintains canals stages by routing storm water from adjacent areas into these canals and installing structures to control the off-site discharge. The length, width and river bottom for the canals were obtained from the permit file.

According to Figure 11, most of the river reaches are effluent. The water flows from the aquifer into the rivers. However, in certain areas, usually corresponding with the location of a control structure, some of the District's river reaches become influent. In addition, the river reaches for the Gateway and Buttonwood Waterways are influent. This is consistent with the permit which indicates that these waterways help maintain the water levels in the development.

Drains

MODFLOW only allows flow from the aquifer to drains. The amount of flow is determined by the following factors: 1) the hydraulic characteristics of the drain, and 2) the head difference between the aquifer system and the drain. McDonald and Harbaugh (1988) provide the following equation for flow between the aquifer and the drain:

$$Q = C(H-D) \qquad (3)$$

where,

Q = the flow from the aquifer to the drain;

C = the conductance of the interface between the aquifer and the drain;

H = the head in the aquifer; and

D = the head in the drain.

Similar to the calculation for river bed conductivity, the drain bed conductivity was estimated to be 1/100 of the soil conductivity. Also, the drain beds were assigned a thickness of one foot.

All of the canals within the FPFDD are considered to be drains in this report. The surveyed control elevations for the canals were used for the drain stage elevation. Canal reaches were derived by overlying the model grid on a digitized map of the system. Drain widths were determined by random field inspection.

The canals of the NSLRWCD control the surface water levels in the east central portion of the county (NSLRWCD 1991). The surveyed control elevations were used as drain stages for the model. The elevations should reflect the maximum potential stages in the canals during the transient calibration period since drought conditions during the calibration period made water storage a prime objective of the NSLRWCD.

Some canals do not have structures that restrict discharges to North Fork of the St. Lucie River. In these cases, the effective drain elevation control was the canal bottom.

The remaining hydraulic parameters were derived as follows. Canal widths were based on information provided by system operators and confirmed by field observations made at random locations. Canal reaches were determined by overlaying the model grid on a digitized base map of the NSLRWCD system.

Two other water control districts affect the study area, the St. Johns Water Control District (SJWCD) and the Indian River Farms Drainage District (IRFDD). Both of these districts are located within the St. Johns River Water Management District.

The St. Johns Water Control District is a surface water management system designed to provide irrigation and drainage to the citrus groves in the north central portion of the study area (SJWCD 1991). The Floodway is an east to west running aqueduct which forms the backbone of the system. For calibration purposes, the drain elevations vary between 17 feet to 20 feet NGVD.

The northeastern portion of the model is hydraulically dominated by the IRFDD. This surface water system provides drainage to the suburban and incorporated areas of Vero Beach. Discharges from the system are to the Indian River Lagoon.

Conversations with system operators yielded information on the general operating procedure and canal construction. The entire system functions as a drain with primary control structures located outside of the modeled area (IRFDD 1993). Drainage district operators confirmed that these drains effectively reduced local ground water levels to approximately 4 feet below land surface. Actual drain widths and reaches were approximated from quadrangle maps.

There are several other drains within the study area. Figure 12 depicts the location of the cells in layer 1 which have active drains. Where available, the permit information was used to determine drain extinction depths and routing scenarios. Widths and reaches of the canals and lakes were determined from areal photos and USGS quadrangle maps. Initially, the drain conductance was presumed to be 1/100 of the soil conductivity.

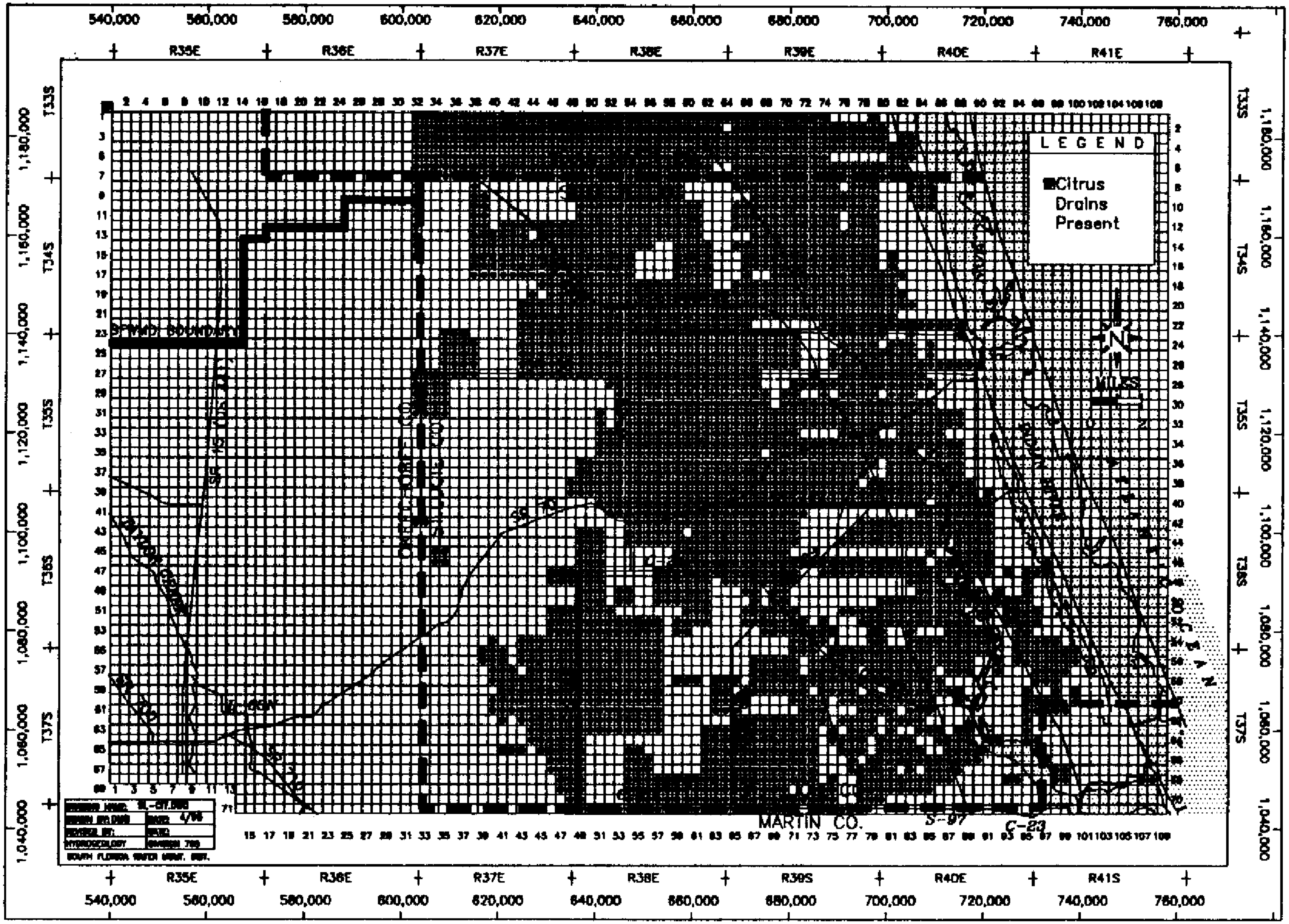


FIGURE 12. Cells with Drain Reaches

RECHARGE

Background

Figure C-1, in Appendix C, depicts the location of the rainfall stations in the study area. Table C-1 lists the locations of the rainfall stations.

SFWMD (1994) estimated the average rainfall for St. Lucie County from 1936 to 1992. Table C-1 specifies the stations used in the analysis and Table C-2 (SFWMD 1994) presents the results of the analysis. Only the rainfall stations with a extensive historical record were used for this analysis.

According to Table C-2, the yearly average rainfall in the study area from 1936 through 1992 was 51.37 inches per year. However, during the calibration period the estimated rainfall for the study area was 42.25 inches per year. Table C-3 lists the rank and cumulative percentile for the annual rainfall data from 1936 through 1992, and Figure C-2 is a normal probability plot of the annual rainfall for this period (Statgraphics 1992).

Triola (1993) provides the following formula to analyze normal probability distributions:

$$z = (x - u)/o \qquad (4)$$

where,

z = the standard score,
x = the x value of the desired percentile,
u = the mean value of the sample, and
o = the standard deviation of the sample.

According to Equation 4, the rainfall during the calibration period would fall in between the 14th and 15th percentiles. This is fairly close to a 1-in-10 year drought event (40.39 inches/year).

Figure C-3 is a graph of the average monthly rainfall during the period from 1936 through 1992. According to Figure C-3, 71% of the precipitation occurs during the wet season (May through October).

Daily rainfall data from all 65 stations were used to develop the recharge arrays for the calibration period. The average recharge in a model cell resulting from precipitation, Rp, can be computed using the mass balance equation:

$$R_p = P_n - Q_d - ET_u \qquad (5)$$

where,

P_n is the average net precipitation over the cell not lost to interception or depressional storage,

Q_d is the average discharge of water lost to surface drainage (not otherwise simulated using a MODFLOW package), and

ET_u is the average evapotranspiration from the unsaturated zone (not calculated by the evapotranspiration package in MODFLOW).

The ET package was not updated in time to incorporate ET_u in the development of this model. In areas where there is a significant unsaturated zone above the water table, the recharge calculations may become inaccurate without considering ET_u. However, this model was calibrated without incorporating this parameter.

Net Precipitation

The average monthly net precipitation, Pn, for a cell can be approximated from the total monthly precipitation over the cell, Pt, as:

$$P_n = MAX\{K_i P_t - (\sum_{n=1}^{N} K_d(n), 0\} \quad (6)$$

where,

K_i in the interception coefficient,

$K_d(n)$ is the daily depression storage loss due to evaporation, and

n is the number of days in the month.

Interception is that portion of gross precipitation which wets and adheres to above ground objects until it returns to the atmosphere through evaporation (Bower et al., 1990). The quantity of water intercepted depends upon the storm character, the season of the year, and the species, age, and density of the prevailing plants and trees. The total interception by an individual plant is directly related to the amount of foliage. For non-urban land uses, extreme values of K_i can be defined as (Viessman, et al., 1977):

$$K_i = \begin{cases} 1.00 & \text{for clear bare ground surface (0\% interception)} \\ 0.75 & \text{for dense closed forest (25\% interception).} \end{cases}$$

Values for K_i in urban areas ranged from 1.00 to 0.50, depending upon the land use type. The value of K_i assigned to a model cell represented the weighted average of the K_i values for all land use types within the cell. Figure C-4, in Appendix C, is a general land use map for the study area. Table C-4 provides the land use cover codes and Table C-5 lists land use types and corresponding values for K_i.

Precipitation that reaches the ground surface may infiltrate, flow over the surface, or become trapped in numerous small depressions. The depression-storage loss for impervious drainage areas varies from 0.05 inches, on a slope of 2.5%, up to 0.11 inches, on a slope of 1% (Bower, et al., 1990). The upper limit of 0.11 inches was assumed for each precipitation event. The model depression storage loss, K_d, was calculated as:

$$K_d = K_d^{max}\{MAX\{[1 - (K/K_m)^{0.5}], 0\}\} \quad (7)$$

where,

K_d^{max} is the sum of maximum depression storage losses for the stress period computed on a daily basis (an upper limit of 0.11 inches was assumed for each day), K is the hydraulic conductivity of the soil layer, and

K_m is a calibration factor. It is defined as the value of hydraulic conductivity at which infiltration is assumed to be nearly instantaneously related to the potential evaporation rate.

A value of $(K/K_m) = 0$, signifying an impervious drainage area, implies a value of $K_d = 0.11$ inches per single precipitation event, and a value of $(K/K_m) = 1$, a highly pervious area, implies a $K_d = 0$. Rainfall of less than the critical daily precipitation evaporates and creates neither infiltration nor runoff drainage.

Only one precipitation event per rainy day of at least 0.11inches was assumed. Storage capacity due to interception is usually reached early in a storm event. This implies that a larger fraction of rainfall is intercepted in depressions during numerous small storms than during infrequent severe storms (Bower et al., 1990).

The value of soil hydraulic conductivity, K, in a model cell was estimated by examining the tables of saturated vertical permeability for applicable soil types found in Soil Conservation Service soil survey books (Watts and Starky 1980; McCollum and Pendleton 1971; McCollum and Cruz 1981; and Wettstein et al., 1987). Soil permeability values ranged from 19.8 feet/day to 51.7 feet/day throughout the modeled area. The instantaneous hydraulic conductivity, K_m, was set to 51.7 ft/day.

Surface Drainage

The surface drainage is defined as the difference between the net precipitation, P_n, and the net infiltration (Bower, et al., 1990). The net average surface drainage, Q_d, can be estimated by:

$$Q_d = (K_s)(K_a)(P_n) \quad (8)$$

where,

K_s is a coefficient relating the potential for runoff to surface drainage, and

K_a is a coefficient relating the potential for aquifer recharge from surface drainage.

K_s varies between 0 and 1, depending on the potential of the land use type to have surface drainage into a canal or into a surface water body. Factor K_a takes into account the effects of drainage systems which may recharge the unsaturated zone of the aquifer. The value of K_a is a function of the average hydraulic conductivity and the average slope of the land surface. It has a value of 1 if there is no drainage into the unsaturated zone, and has a value of 0 when rainfall completely recharges the unsaturated zone. Model values for K_s varied between 0.1 and 0.3. Table C-5 lists land use codes and the K_s value assigned for each code. The value for K_a was uniformly set to 0.1 and was defined as:

$$K_a = K_a^{max}(1-K/K_{max}) \quad (9)$$

where,

K_a^{max} is the maximum value that K_a may take (less than or equal to 1), and

K_{max} is the maximum soil hydraulic conductivity in the study area.

Recharge vs Rainfall

Figure C-5 is a map of the average monthly rainfall for the study period based on the rainfall stations in Table C-1. During the calibration period, rainfall was heaviest in the southwestern and northeastern portion of the study area. Rainfall was lightest in the southeastern portion of the study area.

The recharge term used in MODFLOW represents water that actually reaches the aquifer. Figure C-6 is a map of the net recharge under steady-state conditions. Generally, the recharge map reflects the same major patterns as the average rainfall map.

Figure C-7 is a map which illustrates the ratio of recharge to rainfall throughout the study area. The ratio varies throughout the study area due to the number of variables used to estimate the recharge over the study area.

EVAPOTRANSPIRATION

Water loss from the saturated zone through direct evaporation or through transpiration by plants is simulated in the model by the Evapotranspiration (ET) Package of MODFLOW. The following equations express the ET rate (McDonald and Harbaugh, 1988):

$$Q = 0 \text{ when } H < SU - DP \qquad (10a)$$

$$Q = ER*(H - (SU - DP))/DP \text{ when } SU \geq H \geq SU - DP \qquad (10b)$$

$$Q = ER \text{ when } H > SU \qquad (10c)$$

where,

Q = the ET discharge rate (L^3t^{-1});

H = the head in the aquifer (L);

SU = the ET surface elevation (L);

DP = the extinction depth (L); and

ER = the maximum ET rate (L^3t^{-1}).

ET Surface

The ET surface elevation is represented in the model by the average land surface elevation in each cell minus the capillary fringe height for that cell (see Figure 13 for conceptualization). Fetter (1980) indicates that the capillary rise is inversely proportional to the pore radius. According to Fetter (1980) the capillary rise varies between 0.026 feet for gravel to 9.84 feet for clay.

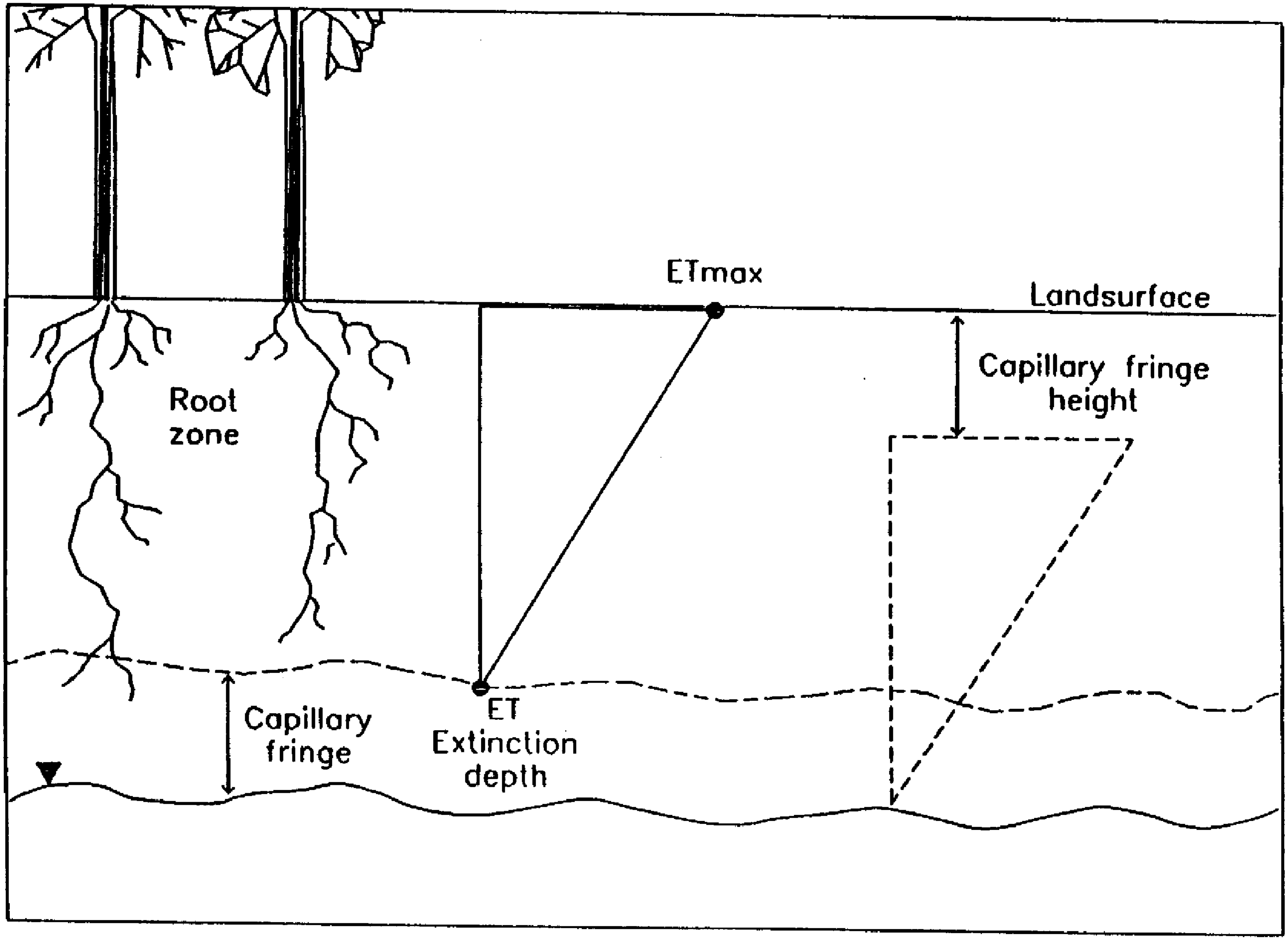


FIGURE 13. **Conceptualization of Capillary Fringe and ET Extinction Depth Determination**

In order to derive the ET surface elevations, initial values were taken from USGS 7.5 minute topographic quadrangle maps. The values were smoothed by utilizing the SURFER Program to remove extreme values such as benchmarked features not representative of average land surface elevation in the model cell. Finally the capillary fringe height was subtracted from the average topographic values to estimate the ET surface.

Figure C-8, in Appendix C, is a map of the ET surface elevations. In most cases, the ET surface is fairly close to the land surface.

Maximum ET Rate

The maximum ET rate was estimated using the Blaney-Criddle equation (USDA 1970). The basic form of the equation is as follows:

$$U = (KK_t P_m T_m)/100 \qquad (11)$$

where,

U is the crop ET for the time period, in inches per day;

K is a consumptive use coefficient which varies according to the crop;

$K_t = 0.0173T$, where T is the temperature in degrees Fahrenheit;

P_m is the percent of daytime hours of the year which occurred during the month; and

T_m is the mean temperature for the month in degrees Fahrenheit.

The consumptive use coefficient is defined as follows:

$$K = K_c * K_f \qquad (12)$$

where,

K_c is a coefficient reflecting the growth state of the crop (Table C-6, Appendix C); and

K_f is a coefficient reflecting the fraction of land surface which is covered with vegetation (also Table C-6). K_f is 1.0 for non-urban land uses, and varies between 0.1 and 1.0 for urban land uses.

The monthly percentage daytime hours and mean temperature data from both Indiantown and Fort Pierce rainfall stations were taken directly from SFWMD (1985) Permit Information Manual Volume III and averaged to get monthly values for the modeled area. Crop coefficients (K_c) were either taken directly from or inferred from values presented in SFWMD (1985) Permit Information Manual Volume III. Values of K_f for urban land uses were determined by examination of surface water permit data for ratios of pervious to impervious area.

Extinction Depth

Extinction depth was a very sensitive parameter in the model calibration. Evapotranspiration will cease if the simulated head in the aquifer drops below the extinction depth for the cell. Extinction depths in the model are related to land use and are based upon estimated root depths for various kinds of vegetation (memorandum dated April 26, 1990 from Thomas Teets to Michael Bennett). Table C-7, in Appendix C, provides the land use codes with their assigned extinction depths.

Even with relatively deep water tables, ET may still occur due to upward transport via capillary forces. In this model, best calibration results were achieved by lowering the extinction depths by one foot in all layer 1 cells.

Evapotranspiration vs Recharge

For several cells the ET discharge exceeds recharge under steady-state conditions. Some possible reasons are as follows:

Drought Conditions. As previously indicated, the rainfall frequency during the calibration period approximates a 1-in-10-year drought conditions. Therefore, it is possible for the evapotranspiration to exceed recharge for certain cells during a drought period.

Missing Canals. Many of the cells where the evapotranspiration exceeds recharge occur in the agricultural areas. As previously indicated, many minor drainage canals were not included because they do not significantly affect the regional flow system. However, the canals may affect the discharges for the individual cells.

Equations 10a, 10b, and 10c indicate that the ET discharge is dependent on the head in the aquifer. While the absence of these minor irrigation ditches does not significantly affect the water level, the simulated water level in the cell may be slightly higher than in actuality due to the absence of these canals. The higher simulated water level increase the simulated ET discharge.

Additional Inflows. A cell may receive inflows from rivers or alternative sources. These inflows will raise the simulated water levels, and consequently the ET discharge.

GROUND WATER USE

The SFWMD requires all water users to obtain a water use permit with the exception of the following: 1) single family homes, 2) duplexes, and 3) fire-fighting uses. The SFWMD (1985) divides water use permits into two categories: 1) individual permits where the water use demand is greater than 100,000 GPD, and 2) general permits where the water use is less than 100,000 GPD. The SFWMD also requires individual permits from users whose average daily withdrawals exceed 10,000 GPD or maximum daily withdrawals exceed 20,000 GPD in a reduced threshold area (RTA). Figure 2 shows the location of the Savanna's and Jensen Beach Peninsula RTA which is located within the study area.

The permit records were a major source of data utilized in determining input data for the well packages. Table D-1,in Appendix D, provides information on the individual permits located within the modeled area.

Calibration for the transient runs were generated by using monthly data. Each month represents a stress period. Calibration for the steady-state run was attained by averaging the last 12 transient stress periods of pumpage data for each well.

Public Water Supply Use

Permitted public water supply pumpages for July 1989 through June 1990 were take from the water use pumpage files. Only public water supply systems permitted by the SFWMD were included in this study. Pumpages from individual wells were determined from utility pumpage records using either actual metered volumes or the pumping time multiplied by the well capacity.

The exceptions to this procedure were the permitted pumpages on the Jensen Beach Peninsula. In this area, well pumpages were based on the total reported wellfield pumpage divided by the number of wells. This methodology is similar to the procedure used by Hopkins (1991) in the development of the North Martin County model.

Pumpages for Harbor Ridge (permit 56-00449-W) were also included in the public water supply package; even though this permit is for irrigation. Harbor Ridge has a permit for public water supply (permit 56-00500-W). However, Harbor Ridge did not use its allocation since the facilities were not in place during the calibration period.

Cell locations were determined by converting the planar coordinates for the wells to a row and column location, and assigning the pumpage to the layer at that location which has the highest transmissivity. Figures D-1 and D-2, in Appendix D, depict the locations of cells containing public water supply withdrawals in layers 2 and 3, respectively.

Agricultural Water Use

Agricultural water use was estimated by using the modified Blaney-Criddle equation used by the SFWMD to calculate the annual and monthly allocations. Soil types, system efficiencies, and crop types were taken directly from the water use permits.

Next, the data were inputted into a program which takes well casing and total depth information and assigns the pumpage to the proper layer. The program takes into consideration that a well screen may penetrate more than one interval. In this case, the pumpage from the well is broken into one or more records and is assigned a relative pumpage per layer based on the amount of screen present in each layer and the hydraulic conductivity of that layer.

Exhibits D-3 and D-4, in Appendix D, illustrate the location of cells with agricultural ground withdrawals in layers 2 and 3, respectively. Withdrawals from surface water sources were not included in the model.

Domestic Self Supply

Domestic self supply withdrawals were estimated using land use data. Five land use types were considered: urban single family low density (URSL); urban single family medium density (URSM); urban single family high density (URSH); urban multifamily (URMF); and urban mobil home (URMH). The area of land use types within each model cell were calculated using GIS polygons. Domestic self supply water use for each cell was calculated using the areas of land use types described above multiplied by the associated rate-per-area values given in Table 2. Population density figures were checked against the land use areas and the 1990 census and were within reasonable limits for the area within the county boundaries.

The transient file for domestic water supply is a single month water use estimation repeated for each month of the calibration period. There is no seasonal differentiation in water use in this simulation.

Agricultural Recharge

According to Lukasiewicz (1992), the Upper Floridan aquifer accounts for a large amount of the agricultural water use within the study area. Since the plants will not use all of the water in the irrigation process, there is a potential for some of this water to recharge the surficial aquifer system. In order to approximate the amount of recharge, the following steps were taken:

1) Lukasiewicz (1992) estimated the pumpage for each Floridan agricultural well in the study area. The wells were separated into two groups: wells with reported data and wells with estimated data.

2) Basically there are three major types of irrigation systems: flood - 50% irrigation efficiency; sprinkler - 75% irrigation efficiency; and drip - 85% irrigation efficiency. Using an intermediate value of 75% efficiency, it can be concluded that 25% of the water withdrawn from the Floridan aquifer is available to recharge the surficial aquifer system. Therefore, the pumpage from each Floridan well was multiplied by a factor of 0.25 to obtain an estimated recharge value.

3) The calculated recharge data from the wells with reported pumpages were added to the public water supply package. The recharge data for the remaining wells were added to the agricultural package.

TABLE 2. DOMESTIC SUPPLY ESTIMATED PARAMETERS

LAND USE	GPD/ACRE	IRRIGATION PERCENT
URSL	615.75	0.50
URSM	1435	0.50
URSH	2870	0.50
URMF	1456	0.25
URMH	3500	0.20

Methodology for table development:

1) The 1990 population is 150,171.

2) A per capita usage of 149 GPD/person was used to estimate the withdrawals.

3) The per capita usage was combined with the land use based population density data to derive the table.

CALIBRATION

Calibration is the process of adjusting the parameters of the numerical model so that the model responds similarly to the physical system. The St. Lucie County model was calibrated to both steady-state and transient conditions.

First, the model is initialized with reasonable parameters based on the results from hydrologic studies. Steady-state runs were used to make the primary adjustments to the model. Next, transient runs were used to refine the model. Finally, adjustments were made to the data sets to help the model meet the calibration criteria for steady-state and transient conditions.

In order to measure the success of the calibration, the model results were compared to the actual water levels obtained from the monitoring well network. The monitoring network consisted of 127 wells which were distributed throughout the study area. Figures 14, 15, and 16 depict the location of the monitoring wells for each layer. Water levels from the wells were obtained on a monthly basis.

STEADY-STATE CALIBRATION

Methodology

"Steady-state" can be viewed as an average condition achieved over a long period of time. It presumes that no major changes in stress rates occur during that time. When the stresses that drive ground water flow change very slowly in time relative to the rate of change within the aquifer system, steady-state assumptions are justified. Table E-1, in Appendix E, provides the maximum, average, and minimum water level values for the monitor wells during the calibration period. Table E-1 also provides the standard deviation and variance for the sampled data. In most cases the standard deviation and variance are relatively small. This infers that there is little deviation from the mean water level. Based on the following it can be concluded that "quasi steady-state" conditions existed during the calibration period.

Average values of recharge, evapotranspiration, pumpage, and surface water stage elevations were used to approximate steady-state conditions. These values were calculated from the monthly data collected during the calibration period.

August 1989 water level data from observation wells and surface water stages were kriged to develop the initial starting heads. Figures 17, 18, and 19 present the starting heads used in the calibration process for layers 1, 2, and 3 respectively.

Figures 20, 21, and 22 depict the steady-state water levels for layers 1, 2, and 3, respectively. These figures represent average conditions during the calibration period. Restrepo et al. (1989) indicate that steady-state runs can be used for sensitivity analyses or for predictive scenarios.

Results

The steady-state calibrations were based on comparison of simulated water levels under averaged recharge/discharge conditions versus the measured water levels in surveyed wells during the calibration period. Two criteria were used to measure the steady-state calibration:

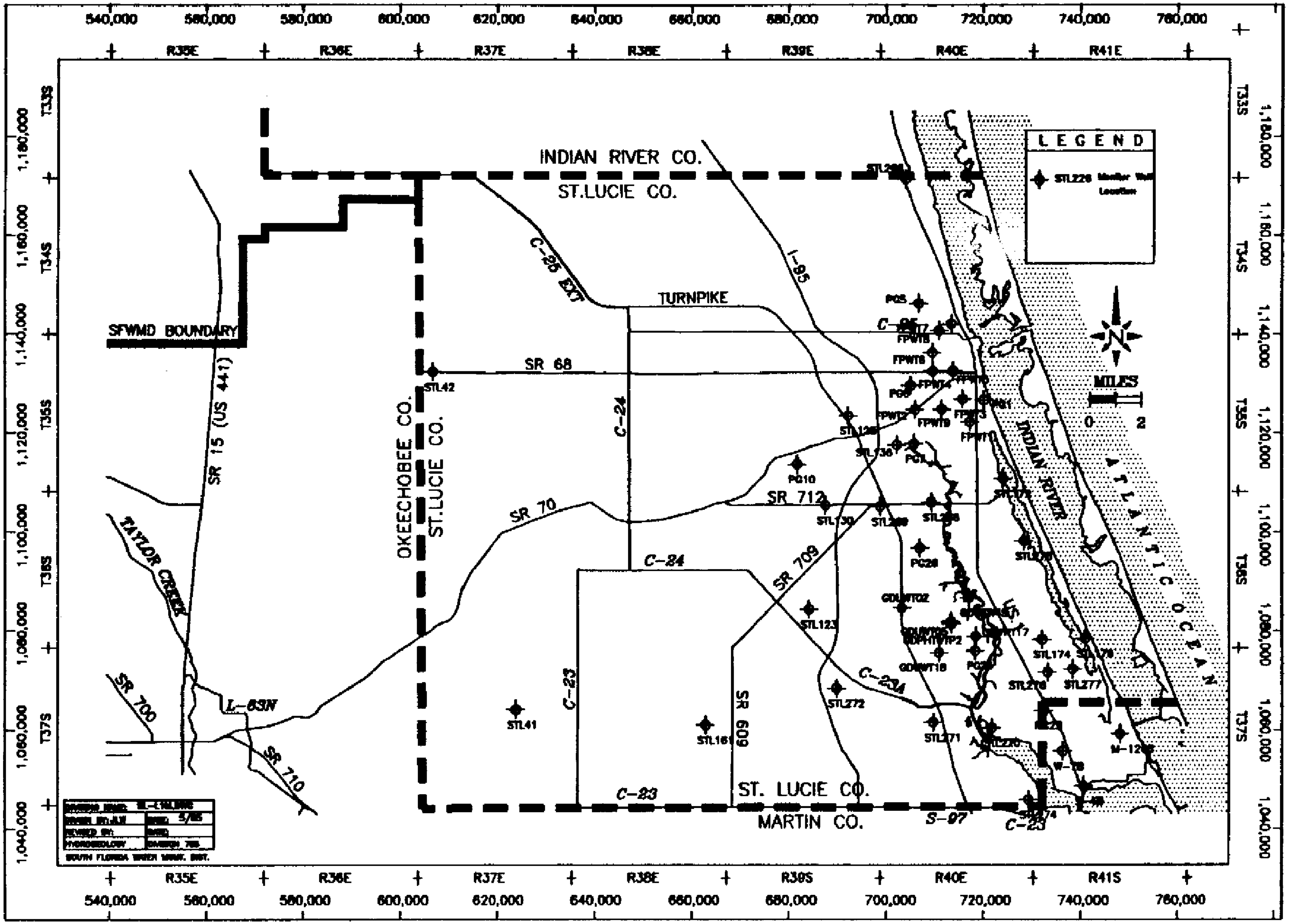


FIGURE 14. Location of the Monitoring Wells in Layer 1.

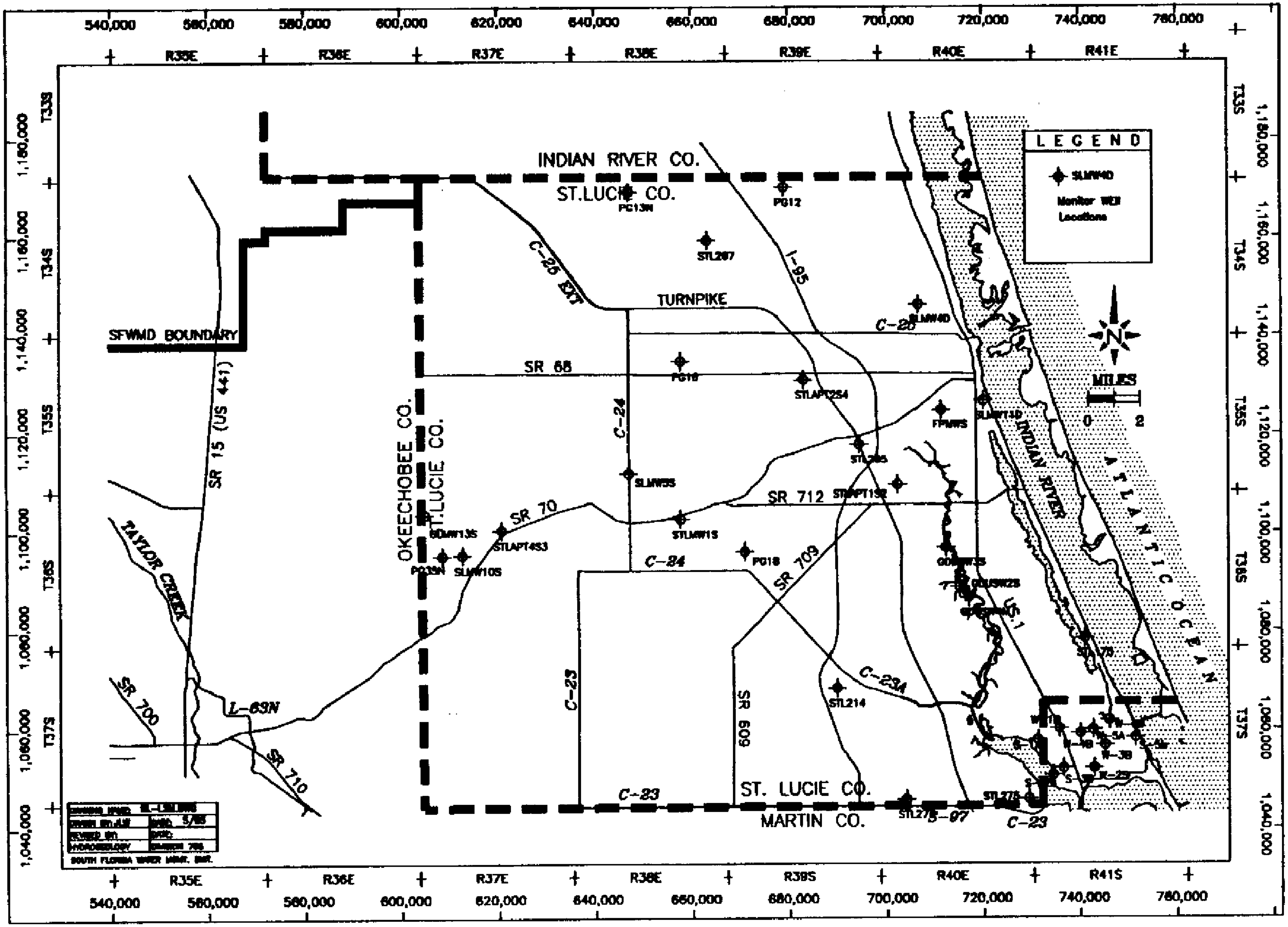


FIGURE 15. Location of the Monitoring Wells in Layer 2.

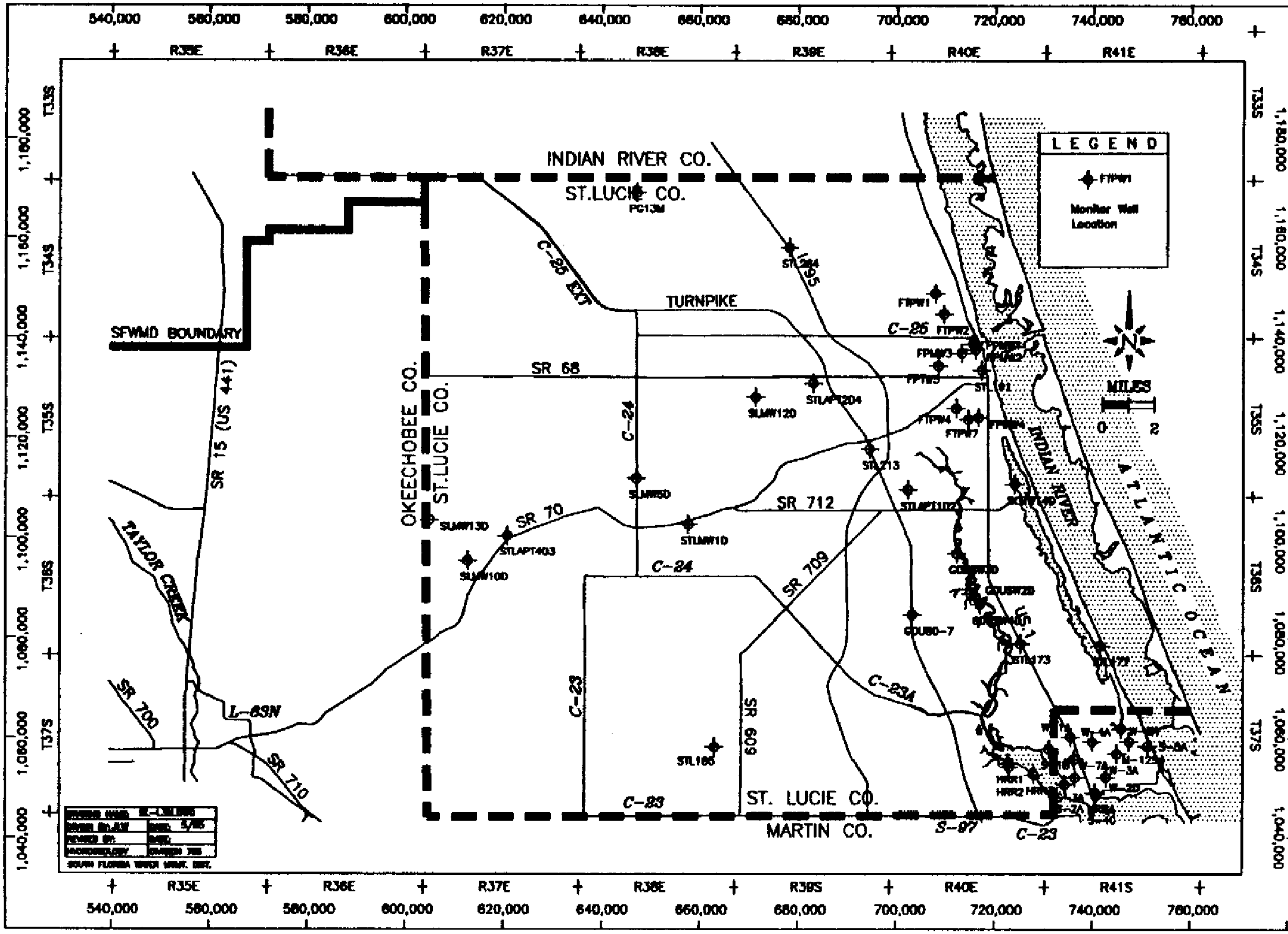


FIGURE 16. Location of the Monitoring Wells in Layer 3.

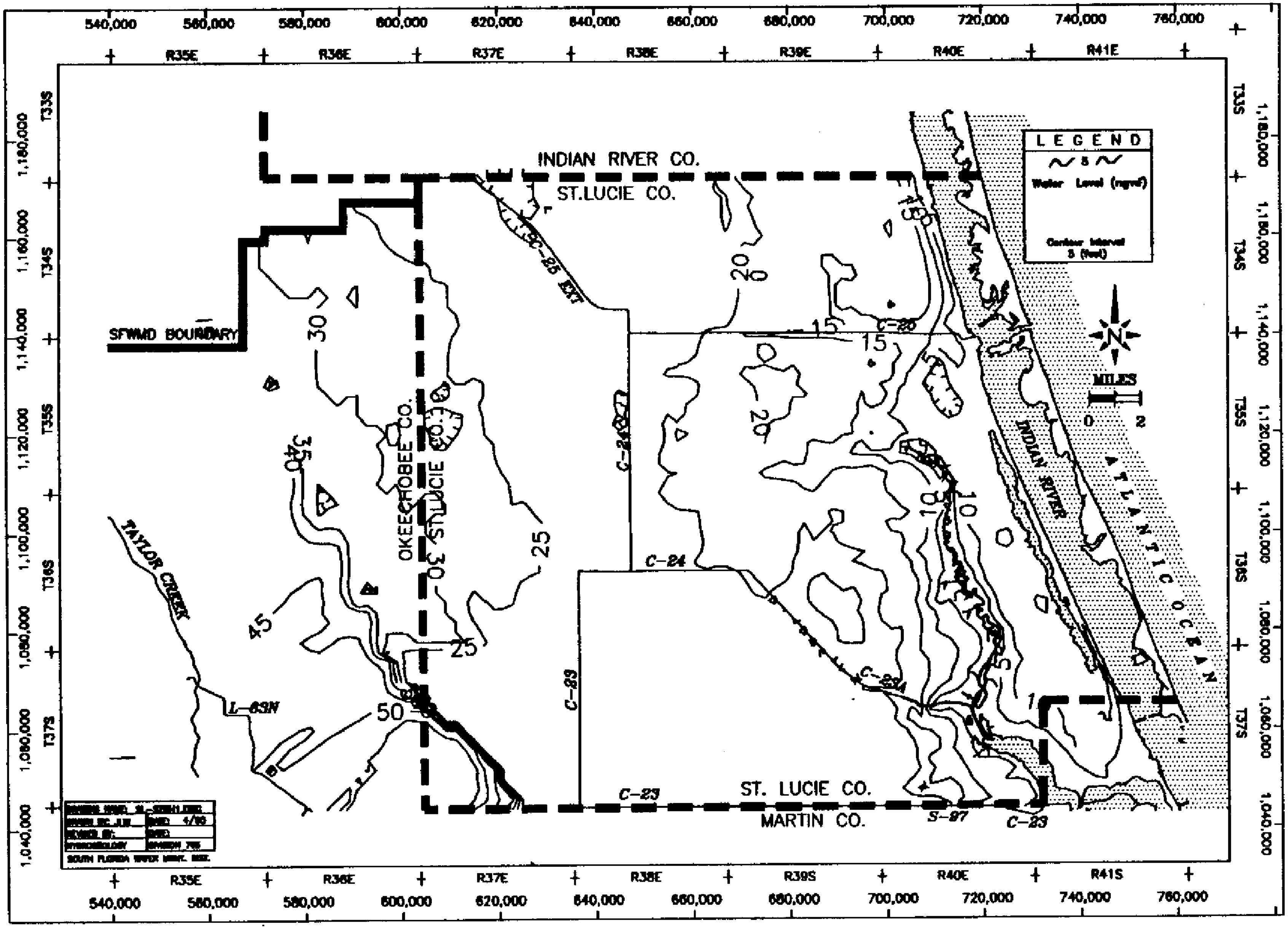


FIGURE 17. Starting Heads for Layer 1.

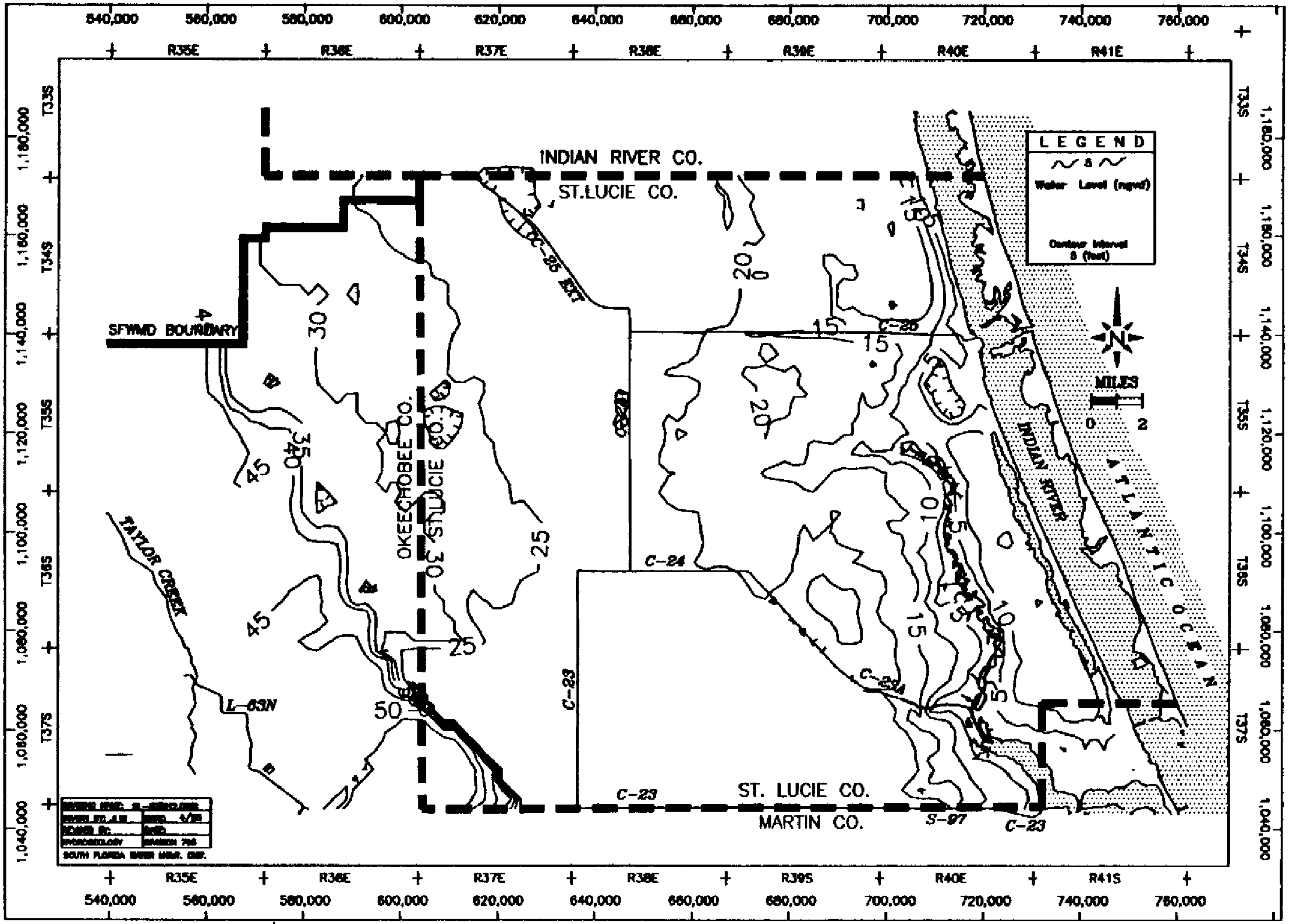


FIGURE 18. Starting Heads for Layer 2.

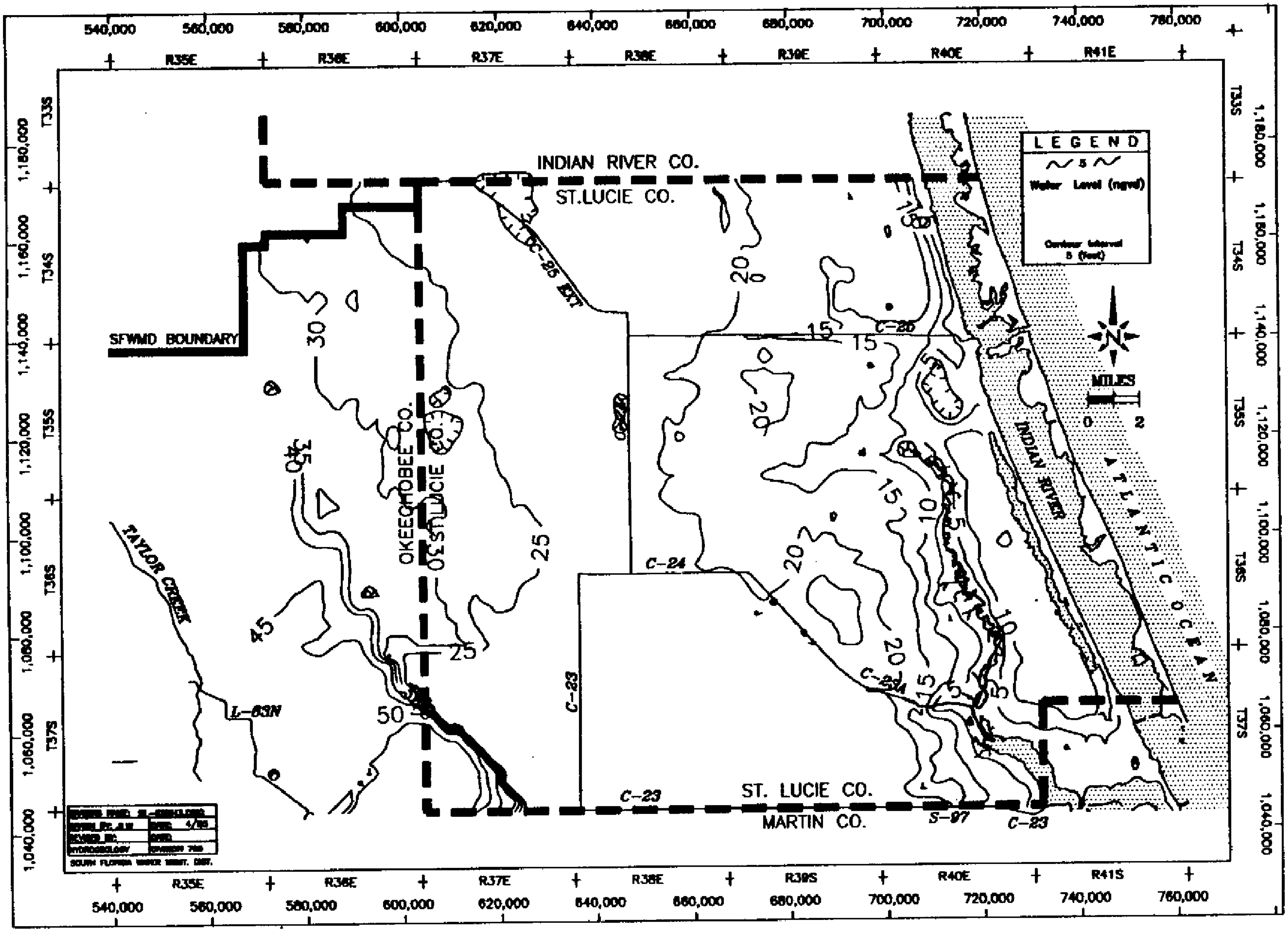


FIGURE 19. Starting Heads for Layer 3.

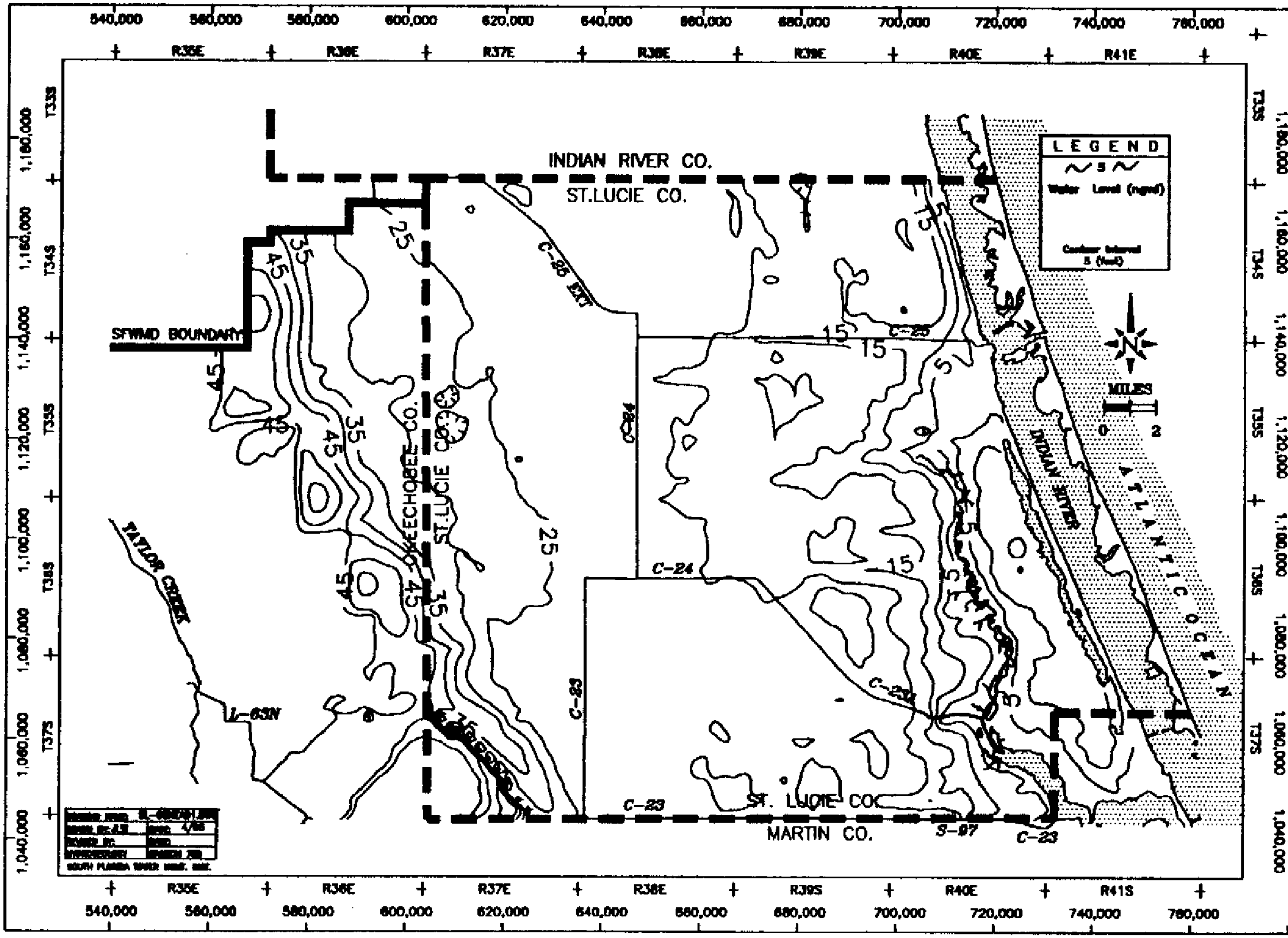


FIGURE 20. Steady-State Heads for Layer 1.

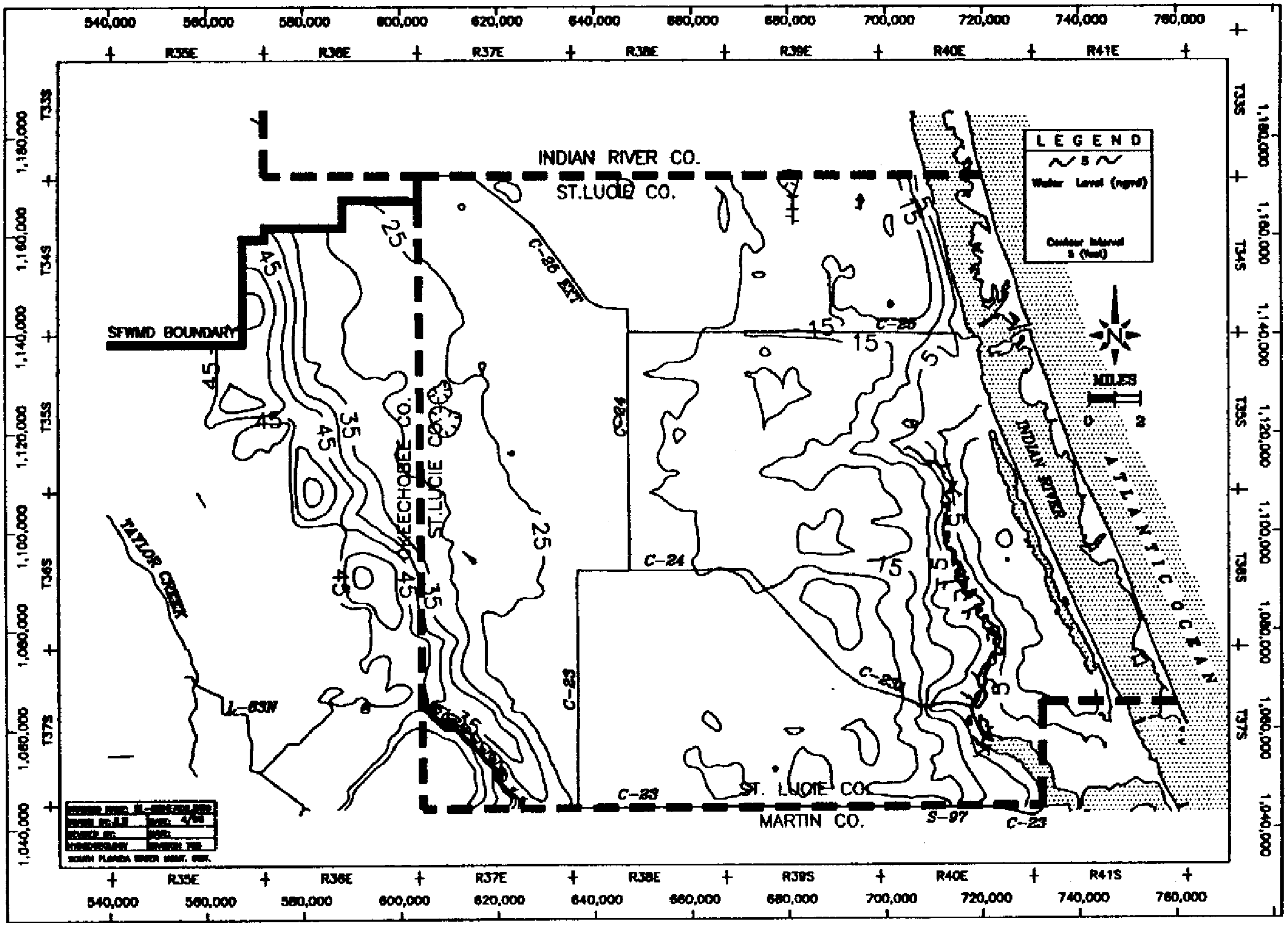


FIGURE 21. Steady-State Heads for Layer 2.

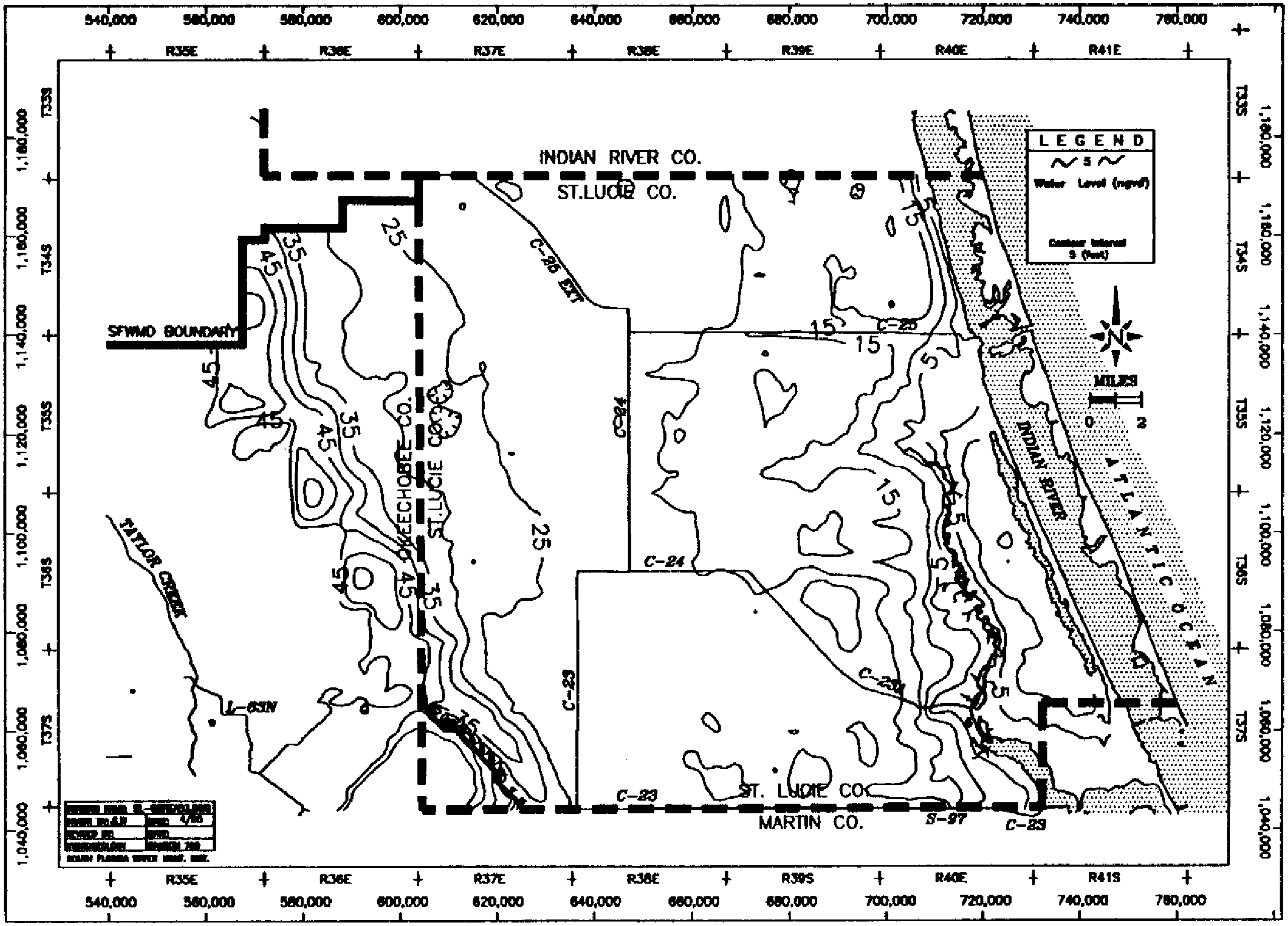


FIGURE 22. Steady-State Heads for Layer 3.

1) The simulated steady-state water level for the observation node was within the range of the maximum and minimum observed water levels for the corresponding well. At least 50% of the observation nodes must meet this criteria for the model to be considered calibrated. This criteria was used by Adams (1992) for the Martin County model.

2) The modeled water level for the observation node was within ± one foot of the averaged water level of the corresponding well. At least 50% of the observation nodes must meet this criteria for the model to be considered calibrated.

Table 3 presents the results of the steady-state simulation. According to Table 3, 90 observation nodes (71%) meet the first calibration criteria, 93 observation nodes (73%) meet the second criteria, and 87 observation nodes(68%) meet both criteria. Therefore, the steady-state model successfully meets both calibration criteria.

The remaining wells were classified as either uncalibrated or explainable. An observation node was considered uncalibrated if there was no apparent reason for its failure to meet the calibration criteria. Reasonable adjustments were made to the aquifer parameters affiliated with these nodes. However, these nodes did not calibrate.

An observation node was considered explainable if it met both of the following conditions:

1) There is an apparent reason for a node to fail the calibration criteria.

2) A review of the monitoring well data and adjacent water levels indicates that the simulated data reasonably fits the local trend.

Appendix F describes possible causes for each of the explainable wells.

Anderson and Woessner (1992) recommend that a quantitative analysis of the distribution error be conducted as part of the calibration assessment. In addition, they provided levels for the calibration assessment. For Level 1, the simulated values fall within the calibration target. For this study, if the simulated steady-state water level is within ± 1-foot of the average value, it is defined as meeting the Level 1 calibration criteria for steady-state conditions.

Figures 23, 24, and 25 are the steady-state residual maps for layers 1, 2, and 3, respectively. The residuals were determined by subtracting the mean observed water level for a well from the estimated steady-state water level for the corresponding node.

Figure 23 indicates that most of the study area within layer 1 lies between the ±1-foot contour interval (Level 1). There are a few areas where the residuals are relatively high (greater than 1.00 foot) or relatively low (less than -1.00 feet). The area located west of the North Fork of the St. Lucie River and northeast of the C-24 Canal does not fit Level 1 calibration criteria. In addition, the area located in the southeast corner of the study area also does not fit Level 1 calibration criteria. These areas are located in the vicinity of the GDU Wellfield and the North Martin County Wellfield, respectively.

TABLE 3. Steady-State Calibration Results

Layer	Row	Column	Well	SS Value	Average	Minimum	Maximum	Status
1	7	83	STL266	9.55	8.77	8.24	9.68	both
1	20	84	PG5	16.90	16.68	15.73	17.41	both
1	22	87	FPWT8	5.07	4.62	3.66	5.46	both
1	23	86	FPWT7	6.96	5.22	2.96	7.46	within range
1	25	85	FPWT6	6.81	5.42	4.41	6.61	uncalibrated
1	27	34	STL42	25.94	25.88	25.12	27.11	both
1	27	85	FPWT4	0.11	0.06	-0.62	0.58	both
1	27	87	FPWT5	1.08	2.40	1.43	3.13	uncalibrated
1	28	83	PG6	10.02	9.18	8.97	9.44	less than one
1	30	88	FPWT3	-3.85	1.48	0.41	2.61	uncalibrated
1	30	91	PG1	3.95	4.87	3.57	5.71	both
1	31	77	STL125	16.77	16.89	13.85	17.74	both
1	31	83	FPWT2	6.21	6.69	6.03	7.03	both
1	31	86	FPWT9	-0.07	-2.19	-3.22	-0.52	uncalibrated
1	32	89	FPWT1	6.59	8.00	6.49	9.49	within range
1	34	82	STL136	4.16	4.80	3.22	5.99	both
1	34	83	PG7	3.53	3.61	2.77	4.61	both
1	36	71	PG10	13.07	12.21	10.66	14.76	both
1	38	93	STL172	11.09	11.17	10.47	11.94	both
1	40	74	STL130	19.06	19.19	17.97	20.21	both
1	40	80	STL269	17.09	17.13	15.76	18.16	both
1	40	85	STL268	8.47	8.37	7.18	9.44	both
1	44	95	STL278	13.15	12.68	11.03	13.91	both
1	45	84	PG26	12.69	12.16	11.34	13.09	both
1	50	89	GDUSW4S	0.61	0.05	-1.34	0.85	both
1	51	55	STL123	20.26	19.79	18.32	20.64	both
1	51	82	GDUWT02	15.72	11.38	5.88	15.30	uncalibrated
1	52	87	GDPHTWT	3.18	7.77	6.94	12.09	uncalibrated
1	52	87	GDUWT05	3.18	0.39	-1.45	2.30	uncalibrated
1	54	90	GDUWT17	5.55	7.29	6.35	8.35	uncalibrated
1	54	97	STL174	11.05	11.61	10.85	12.21	both
1	54	101	STL176	6.02	11.93	10.67	12.33	uncalibrated
1	55	86	GDUWT18	10.35	10.18	8.71	11.54	both
1	55	90	PG25	5.66	8.52	7.31	9.59	uncalibrated
1	57	97	STL276	11.18	10.96	9.87	11.84	both
1	57	100	STL277	11.83	12.67	11.72	13.33	both
1	59	75	STL272	19.66	19.73	18.39	21.54	both
1	61	42	STL41	24.48	24.52	22.88	26.41	both
1	61	97	PG23	5.06	5.39	4.37	5.84	both
1	62	85	STL271	10.78	10.12	9.15	10.86	both
1	63	62	STL161	24.54	24.84	23.39	25.61	both
1	63	92	STL270	2.23	3.31	2.61	3.76	uncalibrated
1	63	105	M-1268	3.97	4.92	4.15	5.73	less than one
1	65	99	W-7B	6.29	2.86	2.28	3.86	uncalibrated
1	69	101	S-4B	1.38	1.16	0.63	1.45	both
1	70	95	STL274	9.41	9.04	8.44	9.72	both
2	8	54	PG13N	19.90	19.49	19.03	20.50	both
2	8	70	PG12	14.93	14.82	14.28	16.27	both
2	13	62	STL267	22.05	21.57	20.89	22.59	both
2	20	84	SLMW4D	16.83	16.52	15.55	17.26	both
2	26	59	PG16	19.83	19.44	18.50	20.26	both
2	28	72	STLAPT2	19.24	19.98	18.84	20.93	both
2	30	91	SLMW11D	3.78	4.39	2.49	5.32	both
2	31	86	FPMW5	-0.17	-3.20	-4.30	-1.30	uncalibrated
2	34	78	STL265	9.81	10.16	8.91	12.24	both

TABLE 3. Steady-State Calibration Results (Continued)

Layer	Row	Column	Well	SS Value	Average	Minimum	Maximum	Status
2	37	54	SLMW5S	20.24	19.30	14.28	20.65	both
2	38	82	STLAPT1	13.83	13.35	12.02	14.78	both
2	41	33	SLMW13S	31.39	30.87	28.85	32.03	both
2	42	59	STLMW1S	20.78	20.08	19.04	20.85	both
2	43	41	STLAPT4	26.56	26.18	24.79	27.17	both
2	45	35	PG35N	30.34	30.03	28.29	30.93	both
2	45	37	SLMW10S	30.01	30.12	28.24	30.79	both
2	45	65	PG18	18.83	18.94	18.32	19.20	both
2	45	87	GDUSW3S	1.11	0.79	0.42	1.26	both
2	49	88	GDUSW2S	0.52	1.42	0.20	2.28	both
2	50	89	GDUSW4M	0.62	0.73	-1.64	1.44	both
2	54	101	STL175	5.92	7.23	6.54	7.66	uncalibrated
2	59	75	STL214	19.99	19.75	18.41	21.56	both
2	62	103	W-6B	8.61	9.09	8.28	9.61	both
2	63	98	W-1B	3.84	6.50	5.75	7.41	uncalibrated
2	63	100	W-4B	6.48	4.63	2.71	5.88	uncalibrated
2	63	102	W-5A	7.25	4.85	3.98	6.46	uncalibrated
2	64	96	S-1A	1.39	0.93	0.42	1.92	both
2	64	106	S-5b	2.38	2.85	2.09	3.98	both
2	65	103	W-3B	5.00	4.29	3.47	5.17	both
2	67	99	S-3B	1.04	1.39	0.16	4.50	both
2	67	102	W-2S	3.72	3.53	-0.76	7.06	both
2	68	98	S-2B	0.33	0.27	-0.41	0.75	both
2	70	82	STL273	20.39	20.48	18.69	21.40	both
2	70	95	STL275	5.36	4.26	4.00	4.89	uncalibrated
3	8	54	PG13M	19.91	19.91	19.40	20.61	both
3	14	69	STL264	19.11	19.54	19.16	20.37	less than one
3	19	84	FPTW1	17.58	14.63	13.73	15.93	uncalibrated
3	21	85	FPTW2	14.38	15.07	14.22	16.42	both
3	24	88	FPMW1	4.66	3.93	2.90	5.10	both
3	24	89	FPMW2	3.25	4.84	3.82	5.82	uncalibrated
3	25	87	FPMW3	5.14	6.59	5.99	7.29	uncalibrated
3	26	85	FPTW5	3.62	7.11	6.45	8.45	uncalibrated
3	26	89	STL191	4.07	4.91	4.43	5.37	less than one
3	28	72	STLAPT2	19.34	19.70	18.33	20.63	both
3	29	66	SLMW12D	19.02	18.93	17.97	19.53	both
3	30	87	FPTW4	-9.61	-6.19	-8.61	-2.11	explainable
3	31	88	FPTW7	-2.48	-6.11	-8.23	-3.13	explainable
3	31	89	FPMW4	3.20	4.32	3.10	5.00	within range
3	34	78	STL213	10.11	10.17	9.13	11.52	both
3	37	54	SLMW5D	20.26	19.28	14.40	20.65	both
3	38	82	STLAPT1	12.62	8.84	7.74	9.78	uncalibrated
3	38	93	SLMW14D	10.99	11.16	10.42	11.91	both
3	41	33	SLMW13D	31.39	31.20	29.15	32.23	both
3	42	59	STLMW1D	20.77	20.18	19.44	20.54	less than one
3	43	41	STLAPT4	26.62	26.13	24.79	27.04	both
3	45	37	SLMW10D	29.99	29.94	27.99	30.44	both
3	45	87	GDUSW3D	1.20	2.68	2.17	3.09	uncalibrated
3	49	88	GDUSW2D	0.65	-0.27	-2.05	0.62	less than one
3	50	89	GDUSW4D	0.77	-0.01	-2.00	2.42	both
3	51	82	GDU80-7	15.43	14.70	11.89	16.48	both
3	54	93	STL173	6.29	7.29	6.04	8.22	both
3	54	101	STL177	5.81	4.24	3.60	5.25	uncalibrated
3	62	103	W-6A	8.33	7.83	3.40	9.27	both

TABLE 3. Steady-State Calibration Results (Continued)

Layer	Row	Column	Well	SS Value	Average	Minimum	Maximum	Status
3	63	98	W-1A	3.58	6.54	5.93	7.34	uncalibrated
3	63	100	W-4A	6.40	2.49	1.20	3.88	uncalibrated
3	63	104	M-1254	5.78	4.53	3.75	5.40	uncalibrated
3	64	62	STL185	24.21	24.71	23.35	25.30	both
3	64	96	S-1B	1.43	0.76	0.05	1.55	both
3	64	96	S-1C	1.43	0.82	0.31	1.89	both
3	64	106	S-5A	2.25	2.72	-1.56	4.64	both
3	65	99	W-7A	-0.81	1.30	-0.26	3.66	uncalibrated
3	65	103	W-3A	4.81	4.39	3.59	5.82	both
3	66	92	HRR1	3.87	3.38	2.51	4.61	both
3	66	92	HRR2	3.87	3.46	1.76	4.73	both
3	67	94	HRR3	3.16	2.41	1.48	3.49	both
3	67	99	S-3A	1.00	1.76	0.51	2.76	both
3	67	102	W-2D	3.60	3.89	0.09	7.03	both
3	68	98	S-2A	0.29	0.27	-0.99	0.92	both
3	69	96	HRR4	2.26	2.01	1.03	2.76	both
3	69	101	S-4A	1.51	1.13	0.93	1.52	both
3	69	101	S-4C	1.51	1.26	0.45	2.03	both

90 wells (71%) meet the first calibration criterion where the estimated steady-state head value for the node falls between the maximum and minimum water level for the corresponding observation well.

93 wells (73%) meet the second calibration criterion where the difference between the average head value for the observation well and the estimated steady-state head value for the corresponding node is less than or equal to 1.00 feet.

87 wells (68%) meet both criteria.

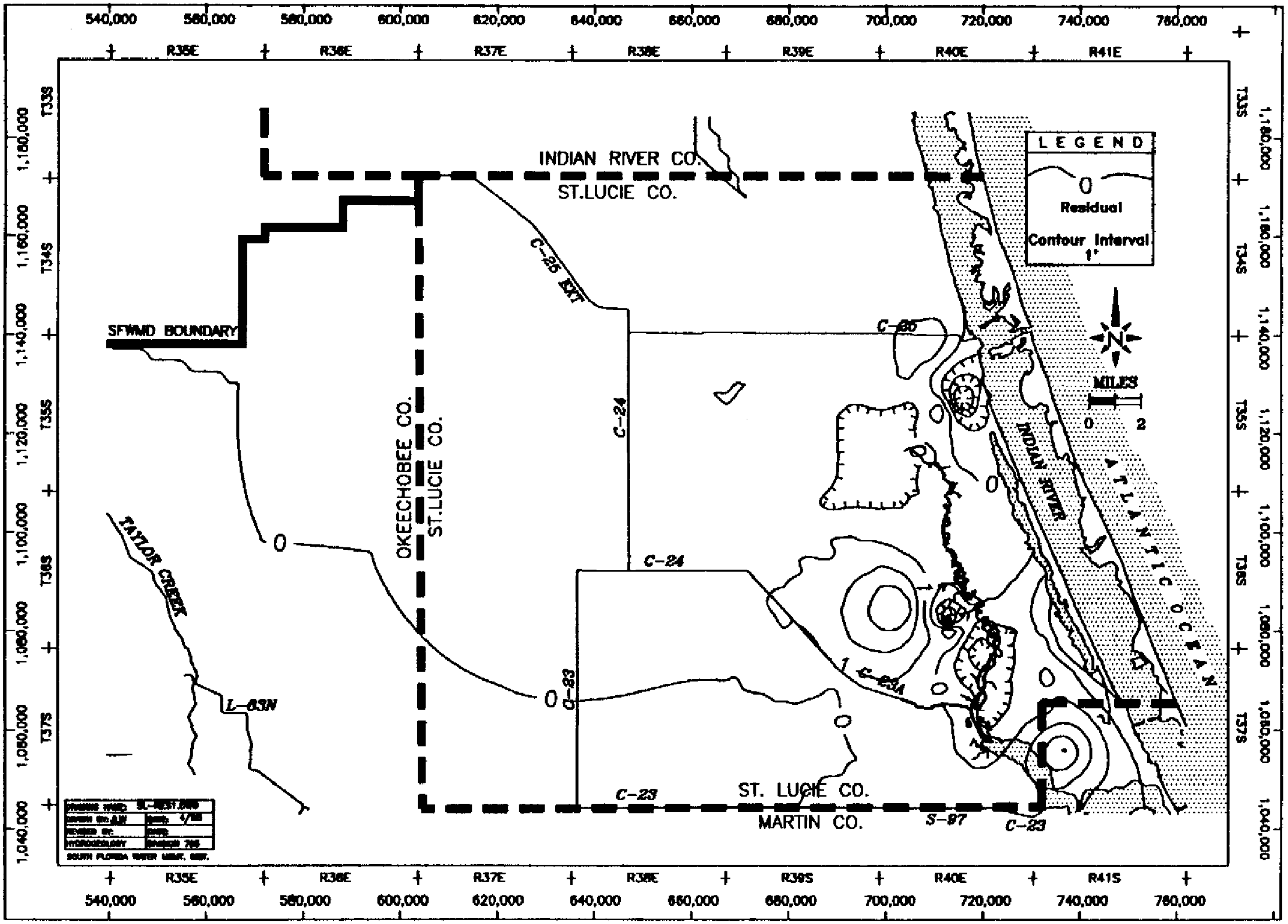


FIGURE 23. Steady-State Residuals for Layer 1

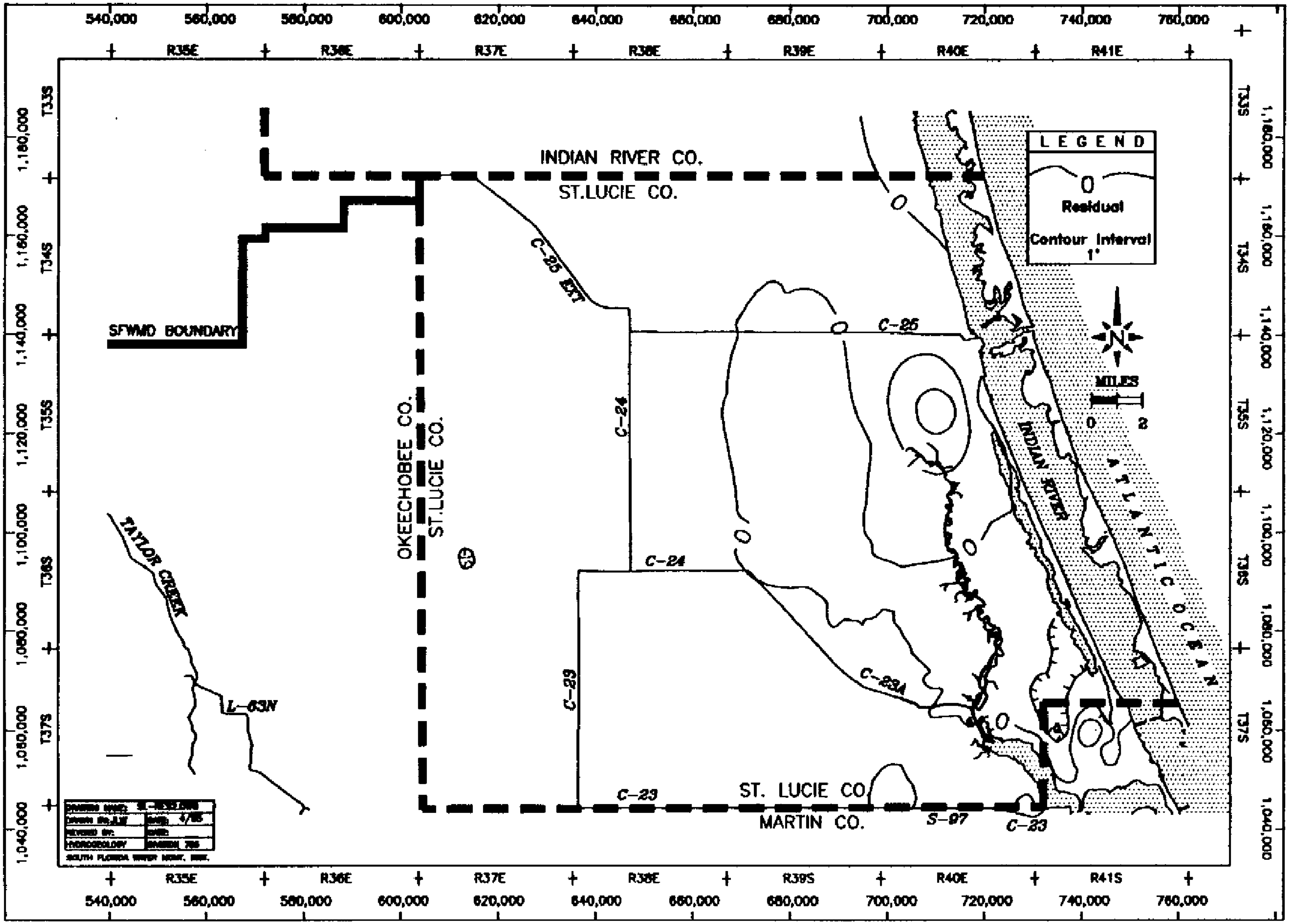


FIGURE 24. Steady-State Residuals for Layer 2

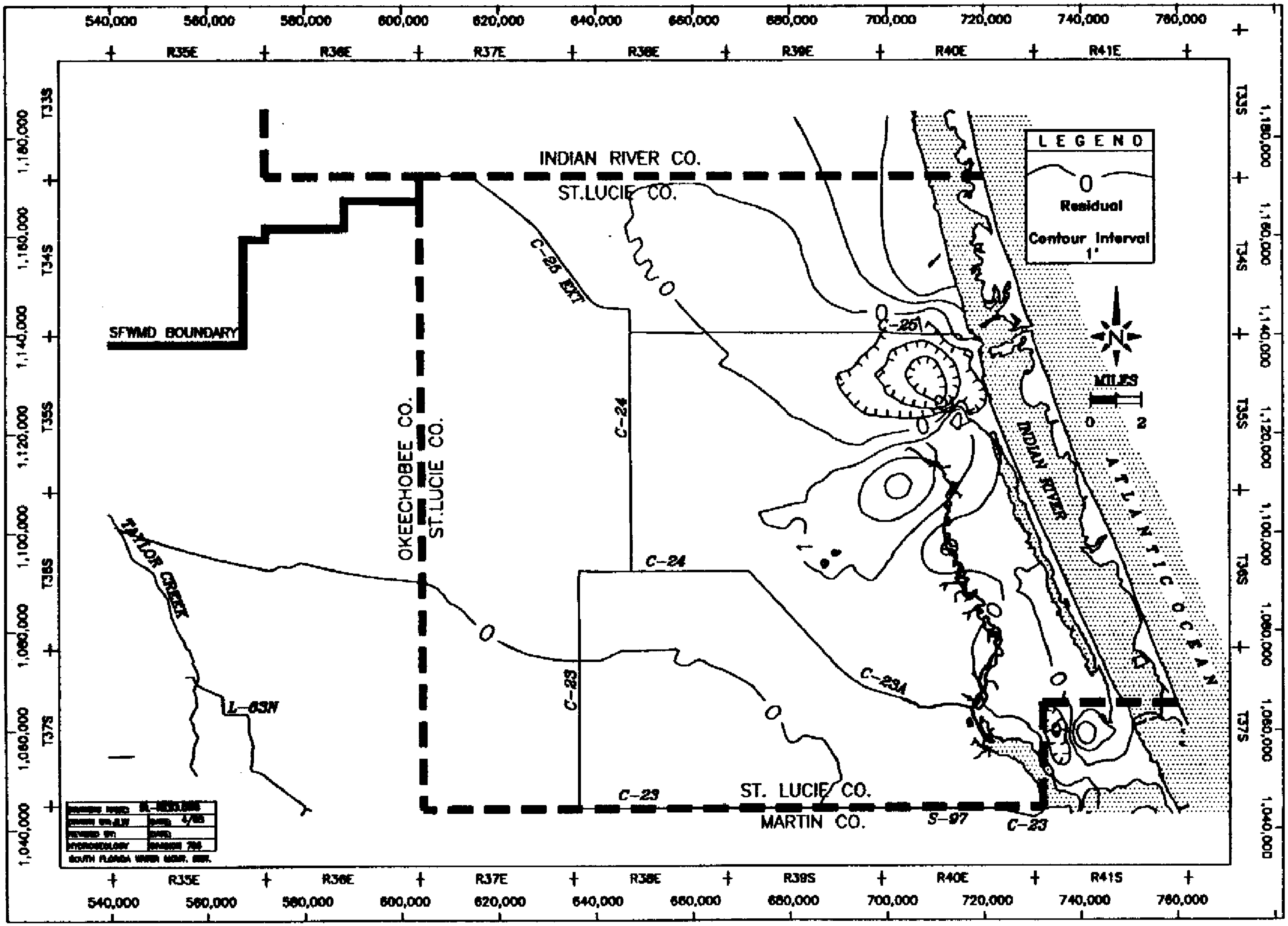


FIGURE 25. Steady-State Residuals for Layer 3

Figure 24 shows that most of the study area within layer 2 meets the Level 1 calibration criteria. However, there is an area of relatively high residuals near the northern end of the North Fork of the St. Lucie River. This area lies within or adjacent to the Fort Pierce Wellfield.

Figure 25 indicates that most of the study area in layer 3 meets the Level 1 calibration criteria. However, there is an area of high residuals near the northwestern end of the North Fork of the St. Lucie River. This area corresponds to an area of high domestic withdrawals in layer 3 (see Figure D-6). In addition, there is an area of relatively low residuals located between the C-25 Canal and the northern end of the North Fork of the New River.

Basically, Figures 23 through 25 indicate that the error distribution is relatively low throughout most of the study area. Most of the areas that lie outside the calibration limits are associated with concentrated withdrawal areas. The grid spacing may not be fine enough to adequately simulate the distance between the withdrawal sources and the monitor wells.

Budget and Flows

Layer One. Figure 26 illustrates the magnitude and direction of the horizontal flows in layer 1 under steady-state conditions. An examination of Figures 20 and 26 indicates that the regional flow direction is towards the east. Most of the flow vectors are fairly small. This indicates modest horizontal flows throughout most of the layer. However, there are significant flows along the active cells adjacent to the western boundary. The magnitude of the ground water flow is due to the steep ground water gradient in the area. Another significant area of horizontal flow is associated with the ground water divide in the southeastern portion of the study area. In the northeastern portion of the study area, the converging vectors are associated with the Fort Pierce wellfield.

In addition to the head distribution, MODFLOW also provides a volumetric budget as a check on the numerical accuracy of the simulation (McDonald and Harbaugh, 1988). The following volumetric analyses were performed on the steady-state flow rates on a layer by layer basis.

The volumetric budget for layer 1 is approximately $134*10^6$ ft^3/day. Figure 27 provides a breakdown of the volumetric flows for layer 1 under steady-state conditions. According to Figure 27, recharge accounts for 90% of the inflow for layer 1; upward leakage from layer 2 accounts for 8% of the inflow; and river leakage, model boundaries, and recharge wells account for the remaining 2% of the inflow. Figure 27 indicates that the outflow from layer 1 can be broken down as follows: 51% goes to ET; 25% goes to drains; 15% goes to downward leakage; 9% goes to rivers and to the model boundaries.

Layer Two. Figure 28 illustrates the magnitude and direction of the horizontal flows in layer 2 under steady-state conditions. A comparison with Figure 26, indicates that the regional flow pattern in layer 2 is similar to the regional flow pattern in layer 1. However, the effects of the large public water supply wellfields are more apparent in layer 2.

Figure 29 depicts the magnitude and direction of vertical flow between layers 1 and 2. Generally, the vertical gradient between layers 1 and 2 is relatively small. For most cells, the flow direction is downward. The largest vertical flows are associated with the Ft. Pierce Wellfield.

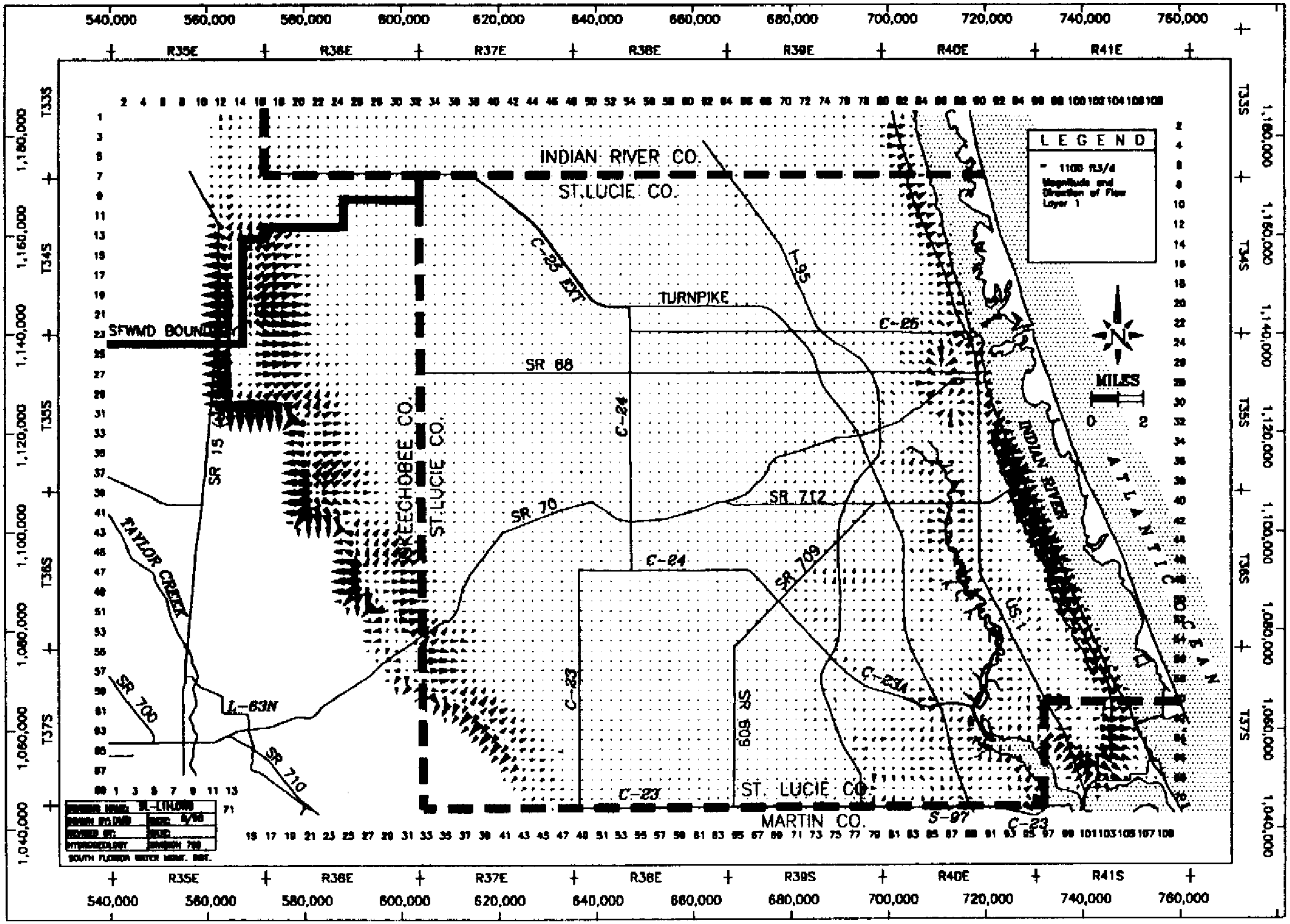


FIGURE 26. Magnitude and Direction of Horizontal Flow in Layer 1

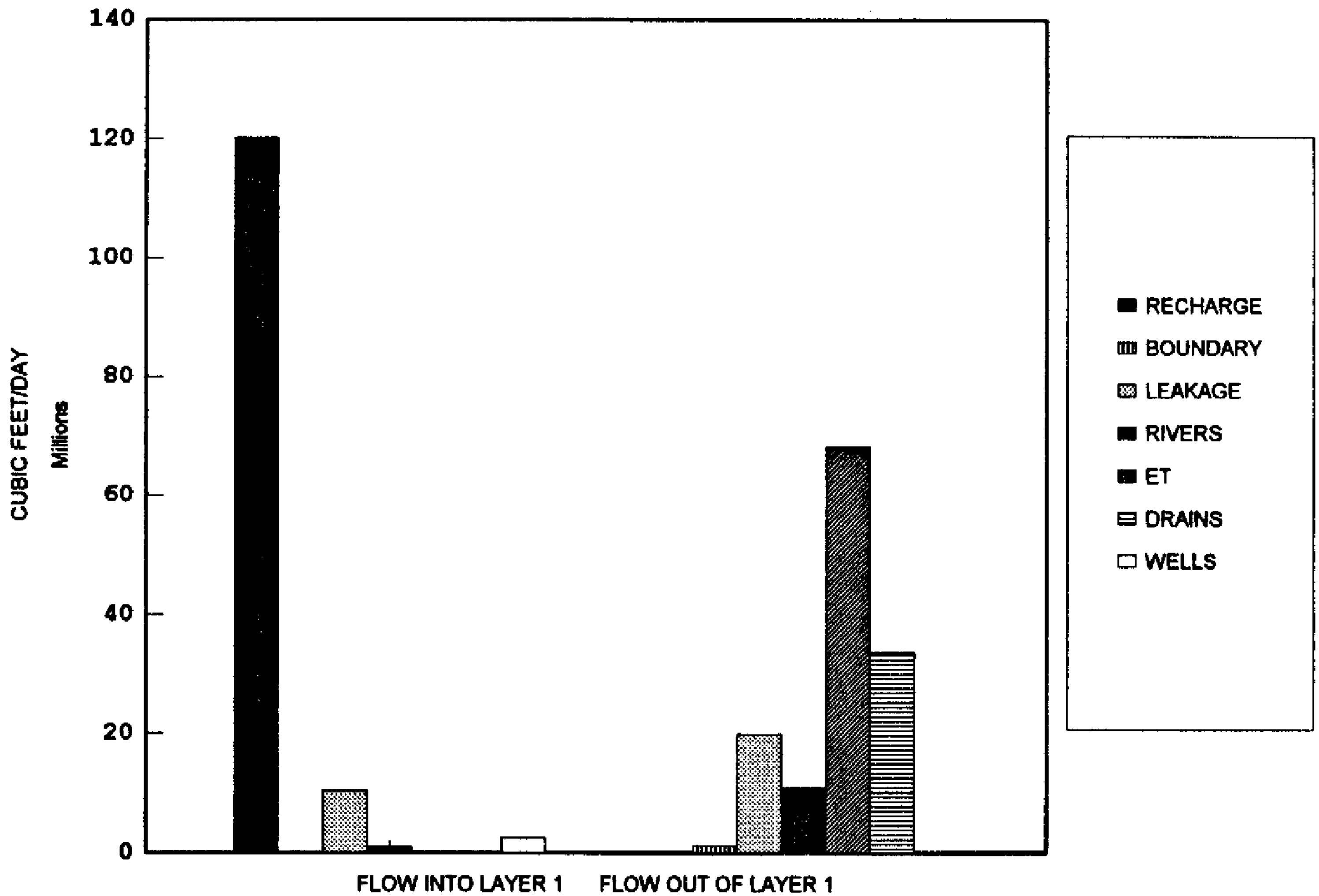


FIGURE 27. Volumetric Budget for Layer 1

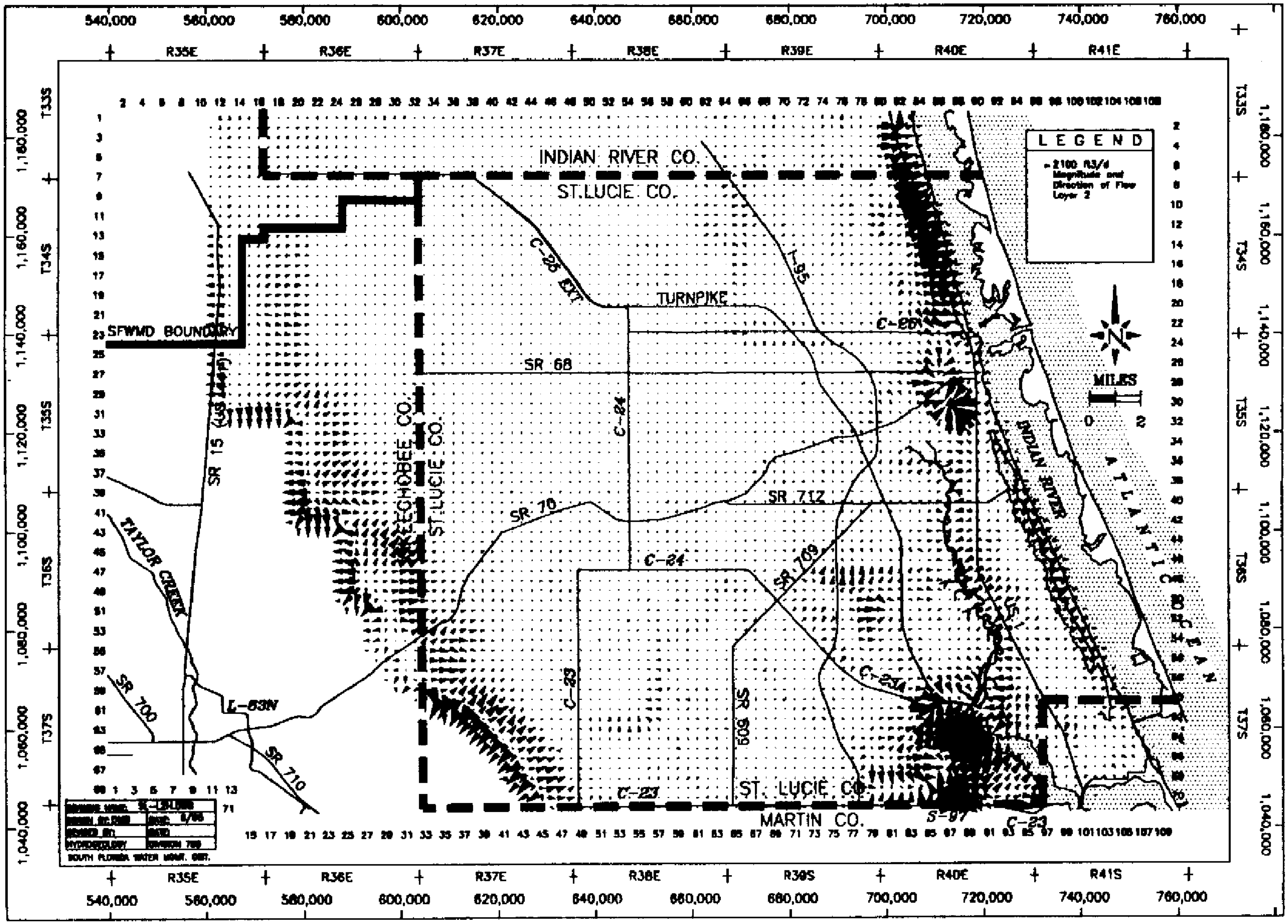


FIGURE 28. Magnitude and Direction of Horizontal Flow in Layer 2

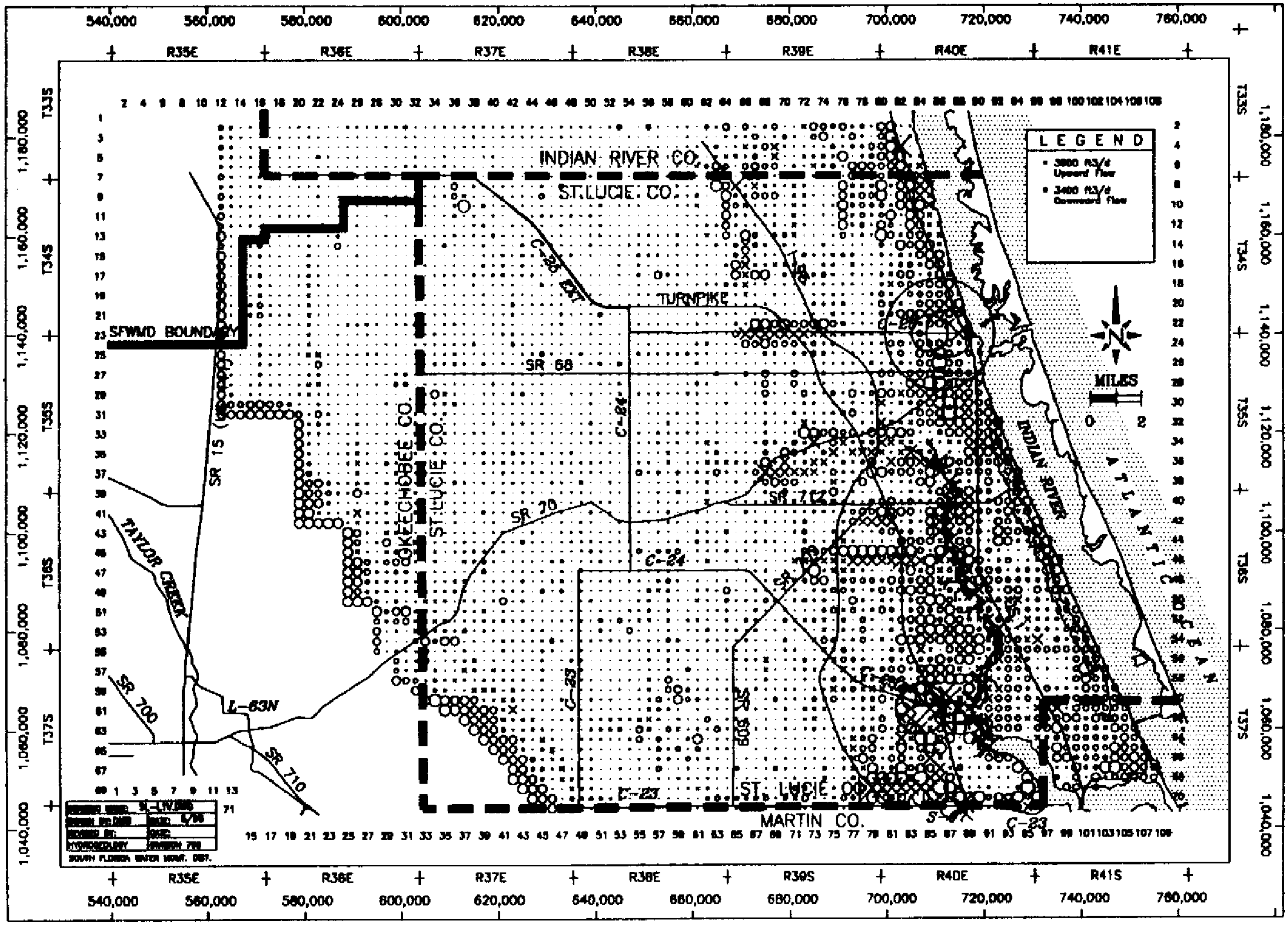


FIGURE 29. **Magnitude and Direction of Vertical Flow between Layers 1 and 2**

The steady-state volumetric budget for layer 2, 25 $*10^6$ ft^3/day, is smaller than the volumetric budget for layer 1. Figure 30 provides the volumetric flows for layer 2. According to Figure 30, the inflow for layer 2 can be broken down as follows: 79% is from downward leakage and 21% is from upward leakage and the model boundaries. The outflow is broken down as follows: 45% goes to upward leakage, 41% goes to downward leakage, and 14% goes to well withdrawals and to model boundaries.

Layer Three. Figure 31 illustrates the magnitude and direction of the horizontal flows in layer 3 under steady-state conditions. An examination of Figures 22 and 31 indicates that the regional flow direction is towards the east. The regional flow pattern in layer 3 is similar to the regional flow patterns in layers 1 and 2.

A comparison of Figures 26, 28, and 31 indicates that the horizontal flow increases with depth in the vicinity of the North Fork of the St. Lucie River. This phenomenon is caused by the increased withdrawals in layer 3 in the vicinity of the North Fork of the St. Lucie River. An examination of Figures D-1, D-2, D-5 and D-6 indicates that there are more public water supply wells and domestic wells in layer 3 than in layer 2. As previously stated, there are no withdrawals in layer 1. The examination also reveals that most of the public water supply wells and domestic wells are located in the vicinity of the North Fork of the St. Lucie River.

Figure 32 depicts the magnitude and direction of vertical flows between layers 2 and 3. Generally, the vertical gradient between layers 2 and 3 is small. In most cases the direction of vertical flow is downward. The largest vertical flows are associated with the Fort Pierce Wellfield.

The steady-state volumetric budget for layer 3 is 11.1 $*10^6$ ft^3/day. Therefore, the volumetric flow for a layer decreases with depth. Figure 33 provides the breakdown of the volumetric budget for layer 3. According to Figure 33, the predominant inflow source of for layer 3 is downward leakage from layer 2. Boundary effects are insignificant. The outflow from layer 3 can be broken down as follows: 47% goes to upward leakage to layer 2, 36% goes to wells withdrawals, and 17% goes to the model boundaries.

Table 4 provides the total volumetric budget for the entire model area. According to Table 4, rainfall accounts for nearly all of the inflow for the model area. ET is the largest source of outflow (55%) followed by drains (27%). Ground water withdrawals account for 4% of the discharge from the model

TRANSIENT CALIBRATION

Methodology

A series of transient runs were made to calibrate the model to observed water levels. The calibration period for the model was July 1989 through June 1990. This period was chosen because it is the most recent period with sufficient water level observations. The transient simulation includes 14 stress periods. The first month, July 1989, was run three times in order to help equilibrate the starting heads. Table 5 provides a listing of the stress periods with the corresponding month.

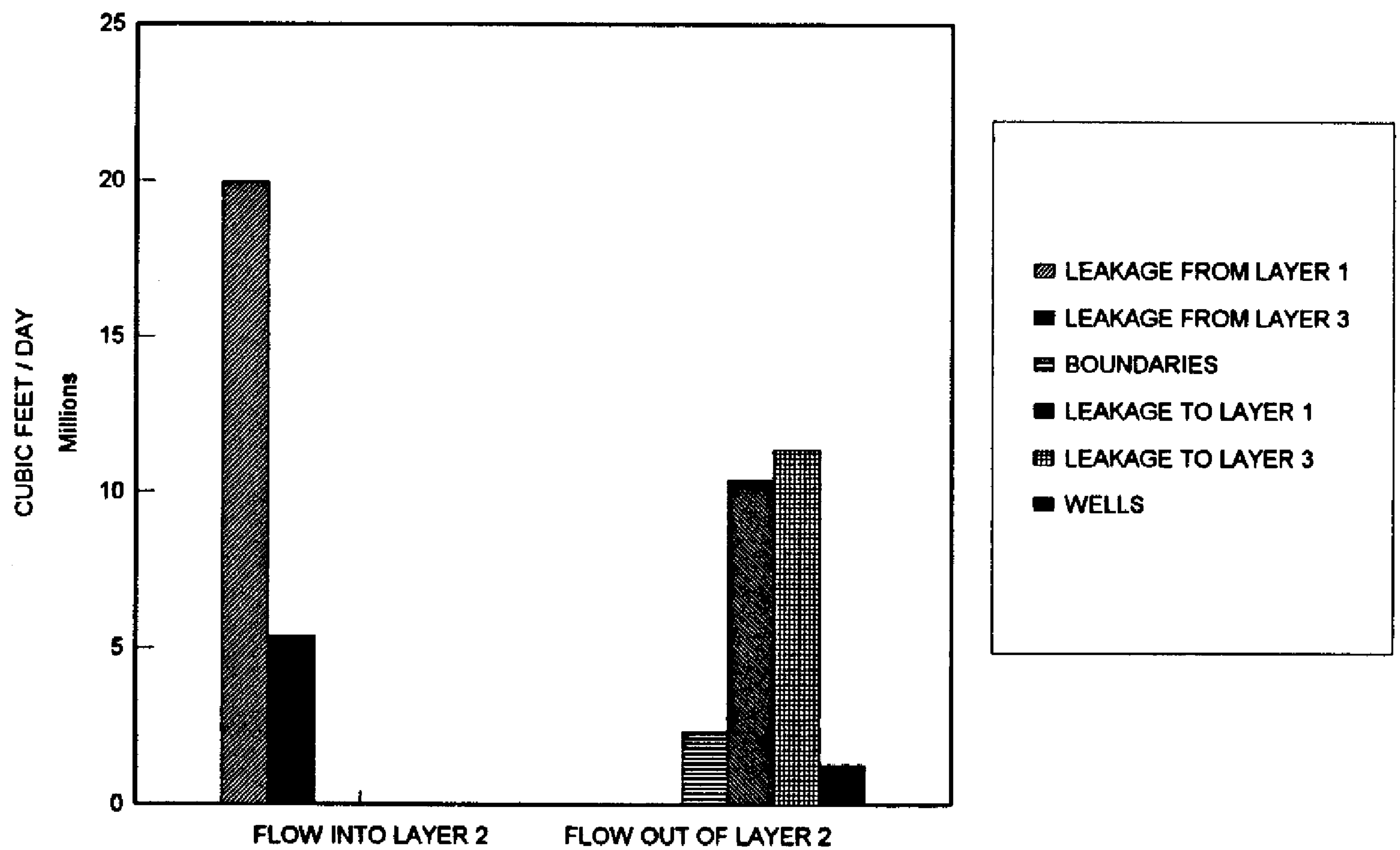


FIGURE 30. Volumetric Budget for Layer 2

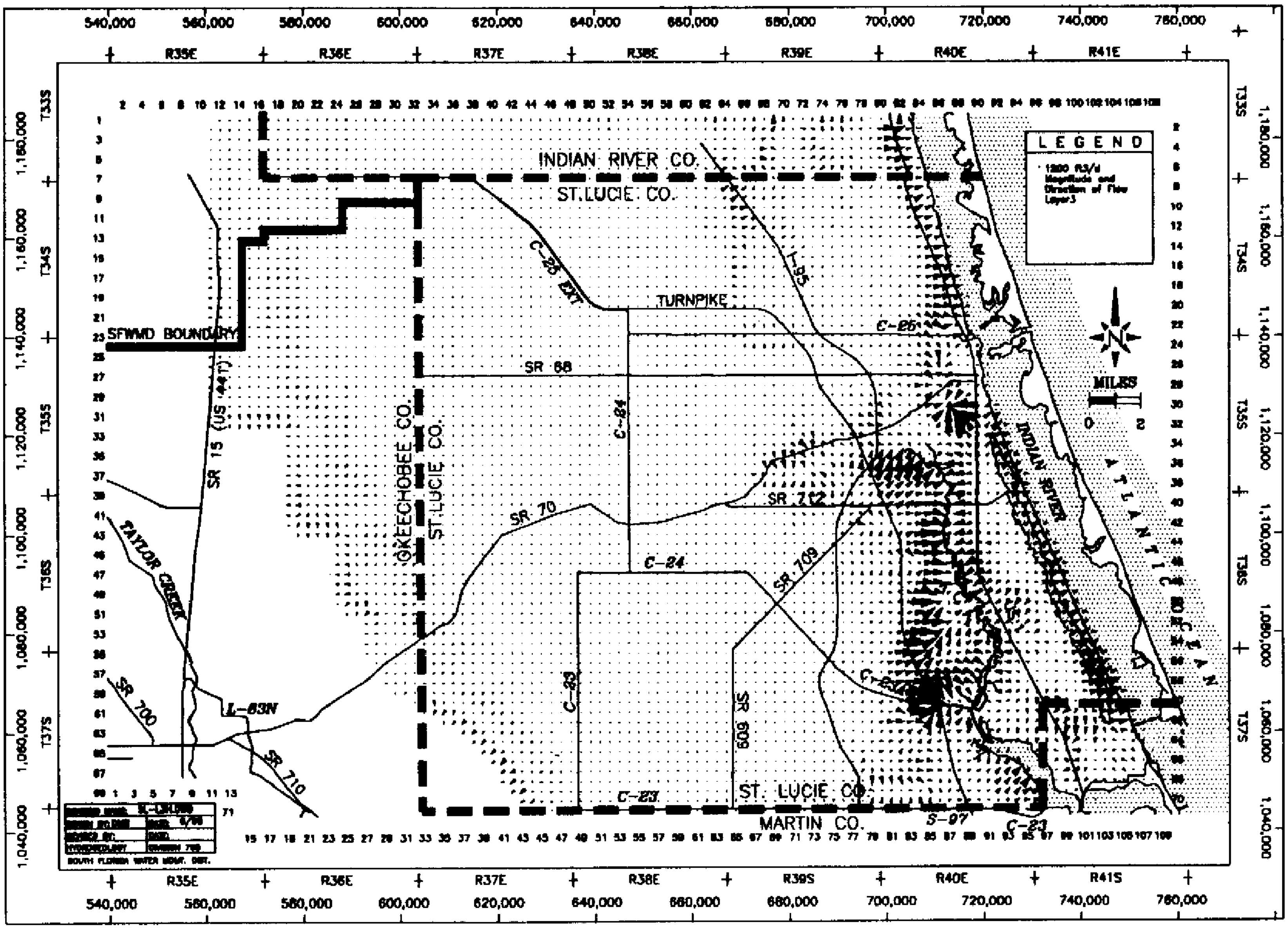


FIGURE 31. Magnitude and Direction of Horizontal Flow in Layer 3

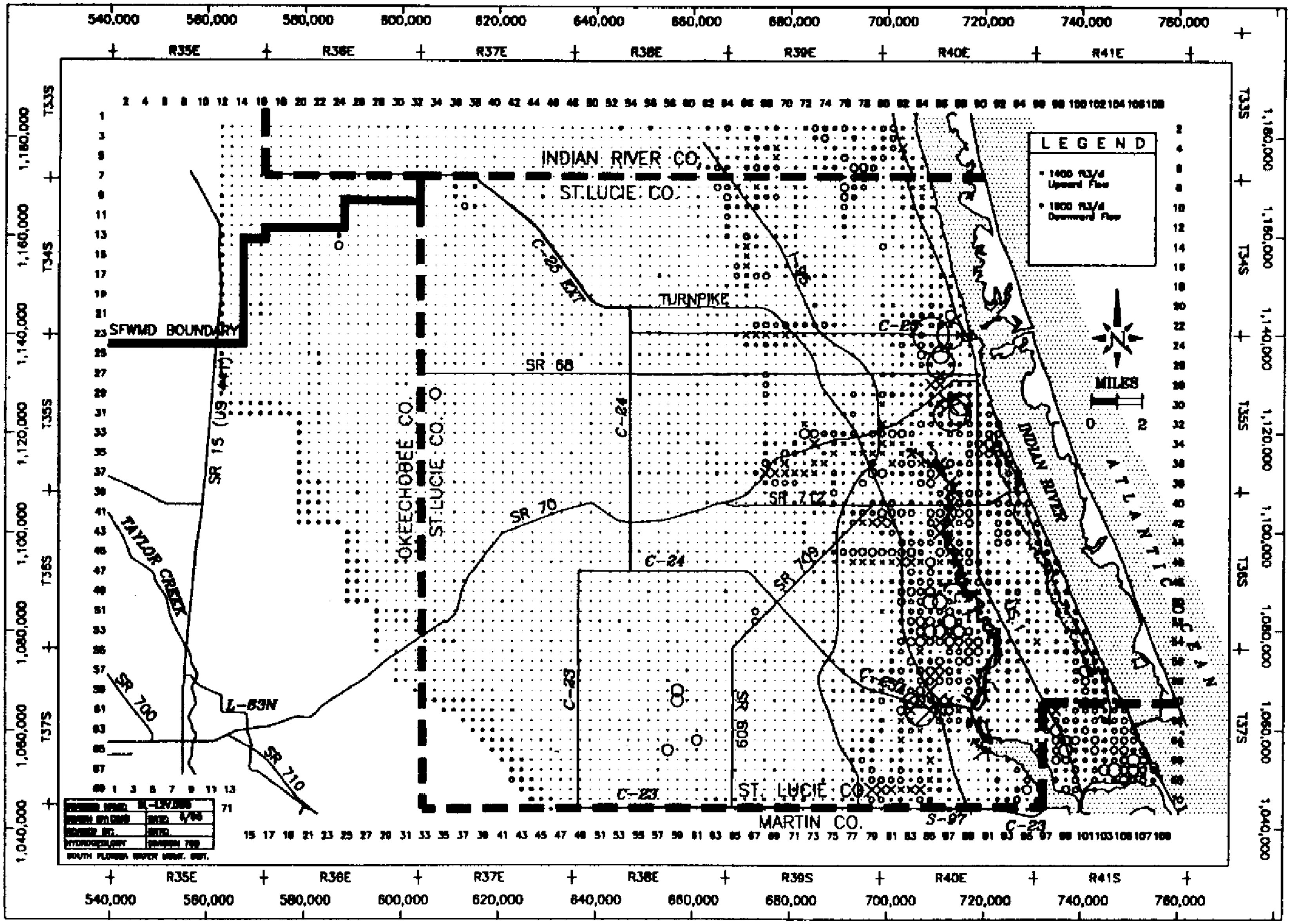


FIGURE 32. **Magnitude and Direction of Vertical Flow between Layers 2 and 3**

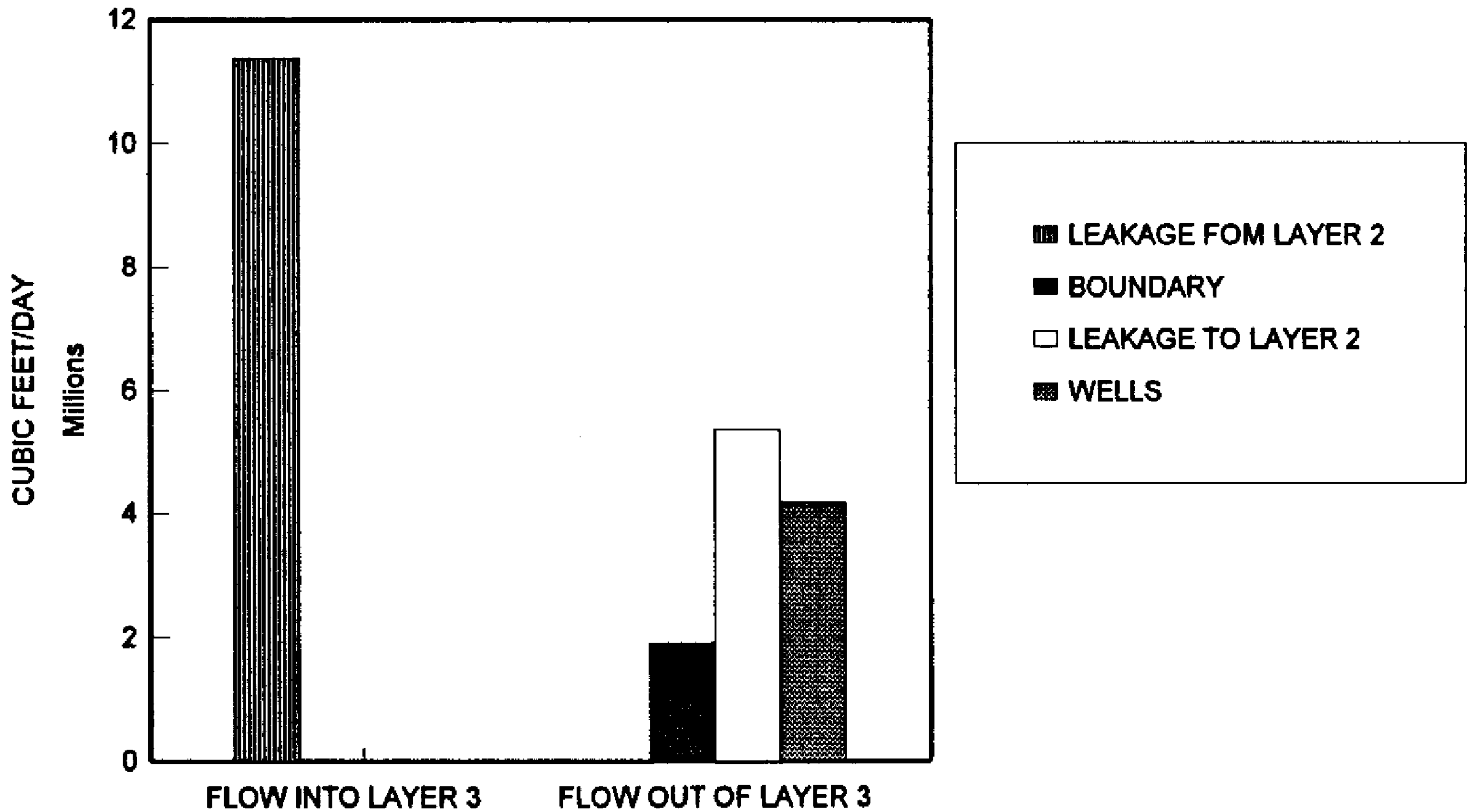


FIGURE 33. Volumetric Budget for Layer 3

TABLE 4. Volumetric Budget for Steady-State Simulation

INFLOW	RATE (10^6 ft^3/day)
Boundaries	0.096
Wells	2.441
Recharge	120.190
River Leakage	1.552
TOTAL IN	124.279

OUTFLOW	RATE (10^6 ft^3/day)
Boundaries	5.457
Wells	5.453
Drains	33.645
ET	68.221
River Leakage	11.512
TOTAL OUT	124.288

INFLOW - OUTFLOW = 0.009 *(10^6 ft^3/day)

TABLE 5. Stress Period, Month and Season Correlation

Stress Period	Month	Season Type
1	July 1989	Wet Season
2	July 1989	Wet Season
3	July 1989	Wet Season
4	August 1989	Wet Season
5	September 1989	Wet Season
6	October 1989	Wet Season
7	November 1989	Dry Season
8	December 1989	Dry Season
9	January 1990	Dry Season
10	February 1990	Dry Season
11	March 1990	Dry Season
12	April 1990	Dry Season
13	May 1990	Wet Season
14	June 1990	Wet Season

Several factors affect the agreement between observed water levels and the simulated water levels:

1. MODFLOW simulates well withdrawals at the center of a cell. This process induces errors because in reality pumping wells are located throughout the cell. The amplitude of the error depends on the magnitude of the withdrawal and the distance between the center of the cell and the well location.

2. Anderson and Woessner (1992) state that finite-difference methods compute a value for head at the node which is also the average head for the cell that surrounds the node. In areas of high ground water gradients, water levels throughout a cell can vary significantly.

   Figure 34 is a water level map of the surficial aquifer system in St. Lucie County (Kane 1992). According to Figure 34, there are several areas in St. Lucie County where the ground water gradient is relatively steep.

3. The model was developed using one month stress periods. Consequently, the simulated water levels reflect the cumulation of all stresses that occurred within a month. However, the measured water levels reflect the events from the most recent time of measurement. The measured water level may be more sensitive to these recent stresses than to the cumulative stresses in the vicinity of the well.

4. A local rainstorm during or immediately prior to a measuring period, could produce water level increases in selected wells. Also, the distance between rainfall stations and monitoring wells is important. A rainfall event may cause water fluctuations at a given well, but the rainfall event may not be detected by the nearest rainfall station.

In order to achieve calibration, changes were made to the initialized model. Most of the successful changes were made to the following parameters: evapotranspiration surface, extinction depth, starting water levels, drain elevation, river stage (refined to correlate more accurately with the operation of the surface water management system), and river/drain conductance. Changes to any of these parameters affected the simulated water levels for all layers. The decision on which parameters to alter in order to calibrate an observation node were based on analyses of the hydrographs, water level maps, and information on the surface water systems.

Anytime a change was made for the transient scenario, a corresponding change was made for the steady-state scenario, and vice versa. This procedure maintained consistency between the steady-state and transient cases.

Most of the successful corrections involved alteration of the ET surface or the extinction depth. The simulated water level could be increased by either raising the ET surface or the extinction depth. The opposite situation can be affected by lowering the ET surface or extinction depth.

The development of the ET surface was based on USGS topographic quadrangles which have a contour interval of 5 feet. According to Adams (1992), this leaves a range of ± 2.5 feet for adjustment of the ET surface. Adjustments to the ET surface were kept within this range.

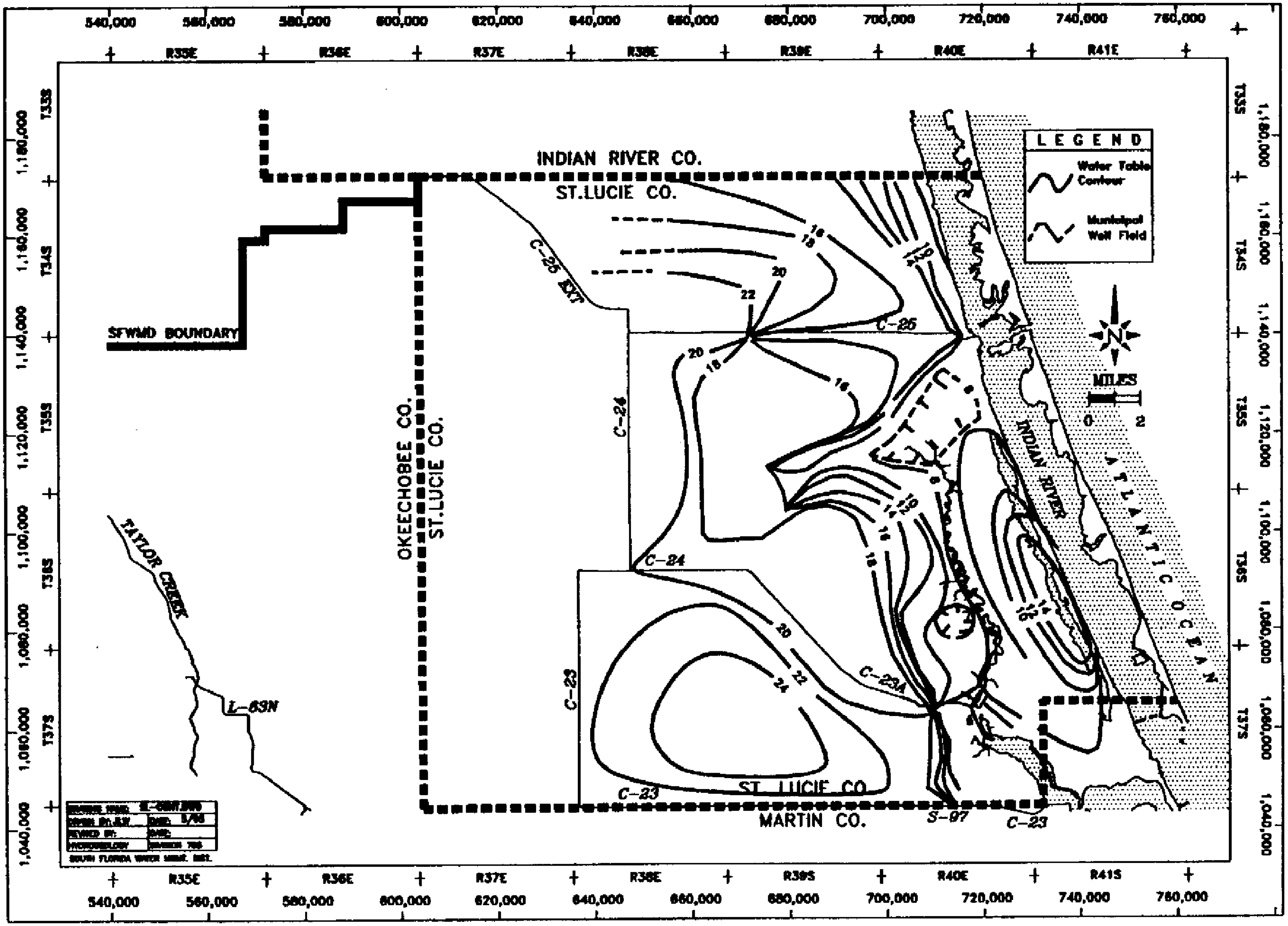


FIGURE 34. **Water Level Map of the Surficial Aquifer System in St. Lucie County, May 1988 (modified from Kane, 1992)**

In some instances, nodes were assigned inaccurate starting heads as a result of kriging errors. This situation occurred mostly in the western portion of the model where data from monitoring wells are scarce. Consequently, the simulated water level for an observation node was not able to approach the observed water level. This situation was corrected by assigning a more realistic starting head to the affected nodes. In order to derive more realistic water levels, the surface water system was reviewed. It was presumed that the surface water levels approximate the ground water levels.

There are several observation nodes that are affected by surface water sources. The model was run several times using different conductance for the rivers and drains. The values that yielded the best results were used in the final calibration.

Results

The transient simulation was considered successfully calibrated if the modeled water level for a node was within one foot of the observed water level for 75% of the stress periods. This was the same criterion used by Adams (1992) for the Martin County model. Since stress periods 1, 2, and 3 are repetitious, stress period 3 through 14 were used for analysis of the calibration criteria.

Appendix G contains the hydrographs for the calibrated transient model. The hydrographs are useful for comparing the observed water levels versus the calculated results, and for examining the change in the water levels over time in response to varying stresses.

Table 6 presents the results of the transient simulation. According to Table 6, 78 observation nodes (61%) met the calibration criterion. The remaining observation nodes were classified as either explainable or uncalibrated.

An observation node was considered explainable if it met these conditions:

1) There was an apparent reason for a node to fail the calibration criterion.

2) A review of the monitoring well data and adjacent water levels indicates that the simulated water levels reasonably fit the local trend.

The explanation for the explainable wells are discussed in Appendix F.

Table 5 lists the stress periods with its season type. Table 7 presents the residuals from the transient calibration. The transient residuals were divided into dry-season residuals and wet-season residuals. The dry-season residuals were determined by averaging the residuals for the dry-season stress periods for each well. Likewise, the wet-season residuals were determined by averaging the wet-season residuals for each well. Since stress periods 1 and 2 are repetitive, they were not used to determine the wet season residuals. As indicated by Table 7, in most cases the differences between the wet season residual and the dry season residual are small. If the simulated water level for a given stress period is within the range of ± 1-foot of the observed water level, it is defined as meeting Level 1 calibration criteria under transient conditions.

Figures 35 and 36 are maps of the dry-season residuals and wet-season residuals for layer 1, respectively. Overall, both figures exhibit similar trends to the steady-state residual map for layer 1 (Figure 23). The majority of the study area lies

TABLE 6. Transient Calibration Results

Layer	Row	Column	Well Name	% of Calibrated Stress Periods	Results
1	7	83	STL266	91.67	calibrated
1	20	84	PG5	100.00	calibrated
1	22	87	FPWT8	91.67	calibrated
1	23	86	FPWT7	25.00	uncalibrated
1	25	85	FPWT6	8.33	uncalibrated
1	27	34	STL42	100.00	calibrated
1	27	85	FPWT4	83.33	calibrated
1	27	87	FPWT5	16.67	uncalibrated
1	28	83	PG6	75.00	calibrated
1	30	88	FPWT3	0.00	uncalibrated
1	30	91	PG1	66.67	explainable
1	31	77	STL125	66.67	uncalibrated
1	31	83	FPWT2	83.33	calibrated
1	31	86	FPWT9	0.00	uncalibrated
1	32	89	FPWT1	83.33	calibrated
1	34	82	STL136	91.67	calibrated
1	34	83	PG7	83.33	calibrated
1	36	71	PG10	41.67	explainable
1	38	93	STL172	100.00	calibrated
1	40	74	STL130	75.00	calibrated
1	40	80	STL269	83.33	calibrated
1	40	85	STL268	91.67	calibrated
1	44	95	STL278	75.00	calibrated
1	45	84	PG26	100.00	calibrated
1	50	89	GDUSW4S	66.67	uncalibrated
1	51	55	STL123	83.33	calibrated
1	51	82	GDUWT02	8.33	uncalibrated
1	52	87	GDPHTWTP2	0.00	uncalibrated
1	52	87	GDUWT05	0.00	uncalibrated
1	54	90	GDUWT17	16.67	uncalibrated
1	54	97	STL174	83.33	calibrated
1	54	101	STL176	0.00	uncalibrated
1	55	86	GDUWT18	75.00	calibrated
1	55	90	PG25	0.00	uncalibrated
1	57	97	STL276	91.67	calibrated
1	57	100	STL277	75.00	calibrated
1	59	75	STL272	91.67	calibrated
1	61	42	STL41	66.67	uncalibrated
1	61	97	PG23	100.00	calibrated
1	62	85	STL271	75.00	calibrated
1	63	62	STL161	91.67	calibrated
1	63	92	STL270	75.00	calibrated
1	63	105	M-1268	83.33	calibrated
1	65	99	W-7B	0.00	uncalibrated
1	69	101	S-4B	100.00	calibrated
1	70	95	STL274	83.33	calibrated

TABLE 6. Transient Calibration Results (Continued)

Layer	Row	Column	Well Name	% of Calibrated Stress Periods	Results
2	8	54	PG13N	75.00	calibrated
2	8	70	PG12	83.33	calibrated
2	13	62	STL267	91.67	calibrated
2	20	84	SLMW4D	100.00	calibrated
2	26	59	PG16	83.33	calibrated
2	28	72	STLAPT2S4	58.33	uncalibrated
2	30	91	SLMW11D	66.67	uncalibrated
2	31	86	FPMW5	0.00	uncalibrated
2	34	78	STL265	75.00	calibrated
2	37	54	SLMW5S	66.67	explainable
2	38	82	STLAPT1S2	75.00	calibrated
2	41	33	SLMW13S	83.33	calibrated
2	42	59	STLMW1S	83.33	calibrated
2	43	41	STLAPT4S3	83.33	calibrated
2	45	35	PG35N	83.33	calibrated
2	45	37	SLMW10S	91.67	calibrated
2	45	65	PG18	91.67	calibrated
2	45	87	GDUSW3S	83.33	calibrated
2	49	88	GDUSW2S	66.67	uncalibrated
2	50	89	GDUSW4M	91.67	calibrated
2	54	101	STL175	25.00	uncalibrated
2	59	75	STL214	83.33	calibrated
2	62	103	W-6B	100.00	calibrated
2	63	98	W-1B	8.33	uncalibrated
2	63	100	W-4B	16.67	uncalibrated
2	63	102	W-5A	0.00	uncalibrated
2	64	96	S-1A	91.67	calibrated
2	64	106	S-5b	100.00	calibrated
2	65	103	W-3B	50.00	uncalibrated
2	67	99	S-3B	91.67	calibrated
2	67	102	W-2S	50.00	uncalibrated
2	68	98	S-2B	100.00	calibrated
2	70	82	STL273	100.00	calibrated
2	70	95	STL275	25.00	uncalibrated
3	8	54	PG13M	100.00	calibrated
3	14	69	STL264	75.00	calibrated
3	19	84	FPTW1	0.00	uncalibrated
3	21	85	FPTW2	66.67	explainable
3	24	88	FPMW1	75.00	calibrated
3	24	89	FPMW2	8.33	uncalibrated
3	25	87	FPMW3	33.33	uncalibrated
3	26	85	FPTW5	0.00	uncalibrated
3	26	89	STL191	91.67	calibrated
3	28	72	STLAPT2D4	91.67	calibrated
3	29	66	SLMW12D	100.00	calibrated
3	30	87	FPTW4	16.67	explainable

TABLE 6. Transient Calibration Results (Continued)

Layer	Row	Column	Well Name	% of Calibrated Stress Periods	Results
3	31	88	FPTW7	0.00	explainable
3	31	89	FPMW4	75.00	calibrated
3	34	78	STL213	75.00	calibrated
3	37	54	SLMW5D	66.67	explainable
3	38	82	STLAPT1D2	0.00	uncalibrated
3	38	93	SLMW14D	91.67	calibrated
3	41	33	SLMW13D	83.33	calibrated
3	42	59	STLMW1D	91.67	calibrated
3	43	41	STLAPT4D3	83.33	calibrated
3	45	37	SLMW10D	91.67	calibrated
3	45	87	GDUSW3D	25.00	uncalibrated
3	49	88	GDUSW2D	41.67	uncalibrated
3	50	89	GDUSW4D	50.00	uncalibrated
3	51	82	GDU80-7	50.00	uncalibrated
3	54	93	STL173	66.67	uncalibrated
3	54	101	STL177	8.33	uncalibrated
3	62	103	W-6A	75.00	calibrated
3	63	98	W-1A	0.00	uncalibrated
3	63	100	W-4A	0.00	uncalibrated
3	63	104	M-1254	8.33	uncalibrated
3	64	62	STL185	91.67	calibrated
3	64	96	S-1B	91.67	calibrated
3	64	96	S-1C	75.00	calibrated
3	64	106	S-5A	75.00	calibrated
3	65	99	W-7A	16.67	uncalibrated
3	65	103	W-3A	58.33	uncalibrated
3	66	92	HRR1	91.67	calibrated
3	66	92	HRR2	83.33	calibrated
3	67	94	HRR3	75.00	calibrated
3	67	99	S-3A	83.33	calibrated
3	67	102	W-2D	75.00	calibrated
3	68	98	S-2A	91.67	calibrated
3	69	96	HRR4	91.67	calibrated
3	69	101	S-4A	100.00	calibrated
3	69	101	S-4C	100.00	calibrated

78 observation wells (61%) meet the calibration criterion.

TABLE 7. Dry Season and Wet Season Residuals

Layer	Row	Column	Well Name	Dry Season Residuals	Wet Season Residuals
1	7	83	STL266	0.69	0.58
1	20	84	PG5	0.05	0.01
1	22	87	FPWT8	0.55	0.30
1	23	86	FPWT7	2.22	1.47
1	25	85	FPWT6	2.17	1.31
1	27	34	STL42	0.11	-0.14
1	27	85	FPWT4	0.31	-0.44
1	27	87	FPWT5	-1.31	-1.48
1	28	83	PG6	0.68	0.52
1	30	88	FPWT3	-4.97	-5.32
1	30	91	PG1	-0.88	-0.89
1	31	77	STL125	-0.30	-0.27
1	31	83	FPWT2	-0.38	0.24
1	31	86	FPWT9	2.58	3.08
1	32	89	FPWT1	-0.57	-0.78
1	34	82	STL136	-0.20	-0.11
1	34	83	PG7	-0.12	0.64
1	36	71	PG10	0.70	0.93
1	38	93	STL172	-0.19	0.13
1	40	74	STL130	-0.28	-0.03
1	40	80	STL269	-0.30	0.18
1	40	85	STL268	-0.39	0.77
1	44	95	STL278	0.43	0.64
1	45	84	PG26	0.33	0.51
1	50	89	GDUSW4S	1.11	0.47
1	51	55	STL123	0.79	0.37
1	51	82	GDUWT02	3.14	5.77
1	52	87	GDPHTWTP2	-5.03	-2.86
1	52	87	GDUWT05	3.46	3.42
1	54	90	GDUWT17	-1.98	-1.40
1	54	97	STL174	-0.66	-0.05
1	54	101	STL176	-5.87	-5.70
1	55	86	GDUWT18	-0.14	0.75
1	55	90	PG25	-2.69	-2.50
1	57	97	STL276	0.07	0.44
1	57	100	STL277	-0.96	-0.70
1	59	75	STL272	0.15	-0.34
1	61	42	STL41	0.24	-0.41
1	61	97	PG23	-0.41	-0.08
1	62	85	STL271	0.45	1.03
1	63	62	STL161	-0.04	-0.49
1	63	91	STL270	-0.88	-0.79
1	63	105	M-1268	-0.74	-0.56
1	65	99	W-7B	4.45	3.96
1	69	101	S-4B	0.32	0.40
1	70	95	STL274	-0.12	0.71
2	8	54	PG13N	0.01	0.63
2	8	70	PG12	-0.01	0.112

TABLE 7. Dry Season and Wet Season Residuals (Continued)

Layer	Row	Column	Well Name	Dry Season Residuals	Wet Season Residuals
2	13	62	STL267	0.70	0.09
2	20	84	SLMW4D	0.11	0.14
2	26	59	PG16	0.47	0.63
2	28	72	STLAPT2S4	-0.73	-0.93
2	30	91	SLMW11D	-0.49	-0.65
2	31	86	FPMW5	3.45	3.99
2	34	78	STL265	-0.29	-0.08
2	37	54	SLMW5S	1.18	-0.30
2	38	82	STLAPT1S2	-0.28	0.94
2	41	33	SLMW13S	0.76	0.24
2	42	59	STLMW1S	0.76	0.70
2	43	41	STLAPT4S3	0.47	0.30
2	45	35	PG35N	-0.08	0.75
2	45	37	SLMW10S	-0.28	0.05
2	45	65	PG18	-0.14	0.28
2	45	87	GDUSW3S	0.59	0.49
2	49	88	GDUSW2S	-0.60	-0.69
2	50	89	GDUSW4M	-0.11	0.34
2	54	101	STL175	-1.31	-1.07
2	59	75	STL214	0.40	0.00
2	62	103	W-6B	0.01	-0.42
2	63	98	W-1B	-1.90	-2.13
2	63	100	W-4B	2.27	2.16
2	63	102	W-5A	2.73	2.60
2	64	96	S-1A	0.46	0.56
2	64	103	S-5b	-0.24	-0.01
2	64	106	W-3B	1.23	1.18
2	67	99	S-3B	-0.34	-0.15
2	67	102	W-2S	-0.50	1.75
2	68	98	S-2B	0.03	0.09
2	70	82	STL273	-0.45	-0.07
2	70	95	STL275	1.07	1.33
3	8	54	PG13M	-0.03	-0.17
3	14	69	STL264	-0.68	-0.48
3	19	84	FPTW1	2.85	2.73
3	21	85	FPTW2	-0.72	-1.06
3	24	88	FPMW1	1.09	0.64
3	24	89	FPMW2	-1.26	-1.68
3	25	87	FPMW3	-0.78	-1.58
3	26	85	FPTW5	-2.98	-3.60
3	26	89	STL191	-0.97	-0.76
3	28	72	STLAPT2D4	0.04	-0.61
3	29	66	SLMW12D	0.32	0.21
3	30	87	FPTW4	-2.26	-4.18
3	31	88	FPTW7	3.79	4.40
3	31	89	FPMW4	-0.57	-0.83
3	34	78	STL213	-0.02	0.33

TABLE 7. Dry Season and Wet Season Residuals (Continued)

Layer	Row	Column	Well Name	Dry Season Residuals	Wet Season Residuals
3	37	54	SLMW5D	1.20	-0.21
3	38	82	STLAPT1D2	3.33	4.13
3	38	93	SLMW14D	-0.53	0.29
3	41	33	SLMW13D	0.27	0.08
3	42	59	STLMW1D	0.51	0.73
3	43	41	STLAPT4D3	0.58	0.41
3	45	37	SLMW10D	-0.23	0.33
3	45	87	GDUSW3D	-1.38	-1.16
3	49	88	GDUSW2D	1.18	1.19
3	50	89	GDUSW4D	1.12	0.92
3	51	82	GDU80-7	0.14	1.53
3	54	93	STL173	-0.73	-0.69
3	54	101	STL177	1.49	1.87
3	62	103	W-6A	0.52	1.03
3	63	98	W-1A	-2.29	-2.37
3	63	100	W-4A	4.43	4.13
3	63	104	M-1254	1.54	1.60
3	64	62	STL185	-0.39	-0.61
3	64	96	S-1B	0.63	0.82
3	64	96	S-1C	0.61	0.73
3	64	106	S-5A	-0.61	0.35
3	65	99	W-7A	-1.95	-1.50
3	65	103	W-3A	1.03	0.80
3	66	92	HRR1	0.45	0.54
3	66	92	HRR2	0.43	0.41
3	67	94	HRR3	0.54	1.04
3	67	99	S-3A	-0.56	-0.75
3	67	102	W-2D	0.14	0.13
3	68	98	S-2A	-0.19	0.22
3	69	96	HRR4	0.19	0.39
3	69	101	S-4A	0.60	0.44
3	69	101	S-4C	0.51	0.28

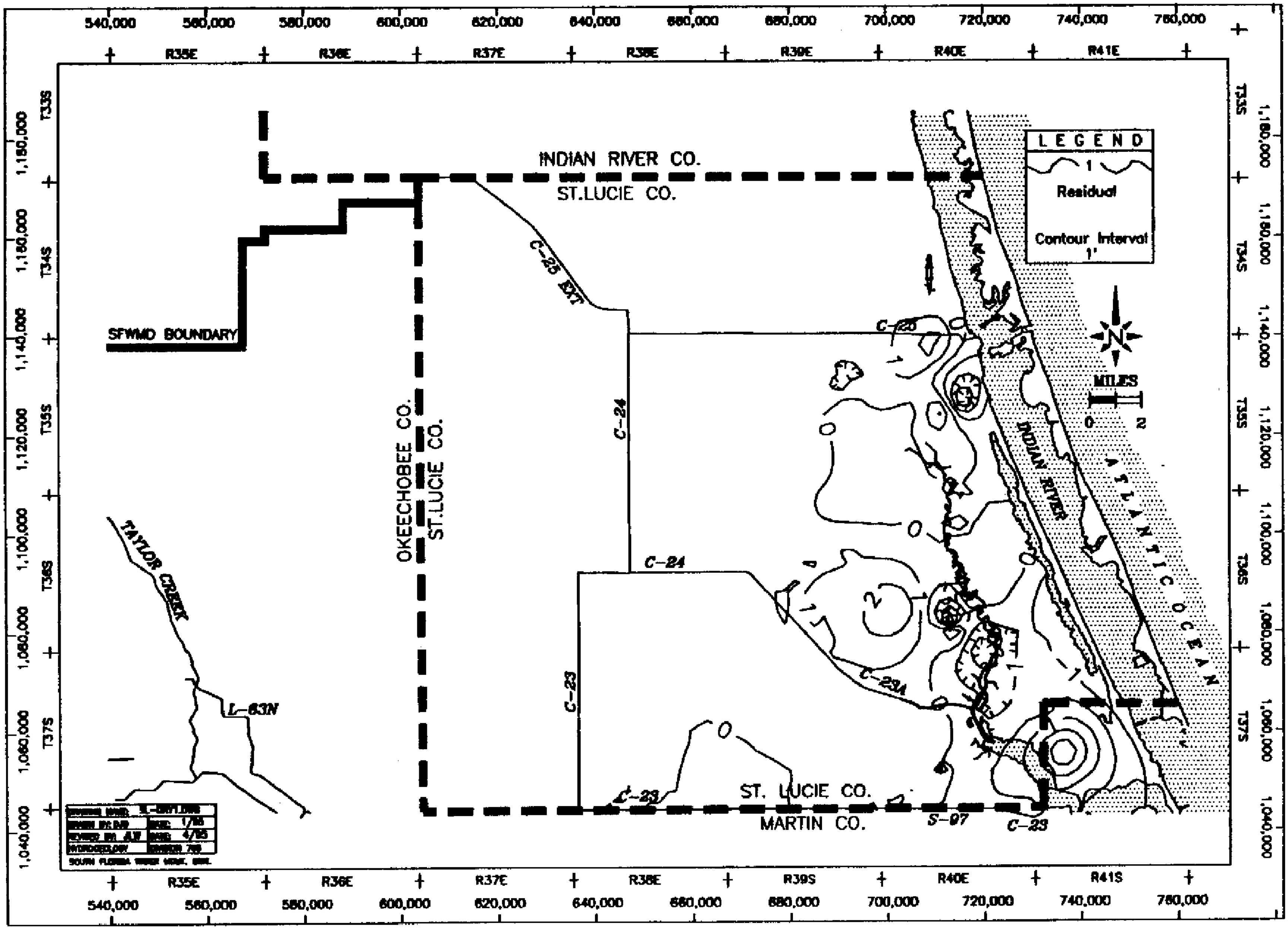


FIGURE 35. Dry Season Residual Map for Layer 1

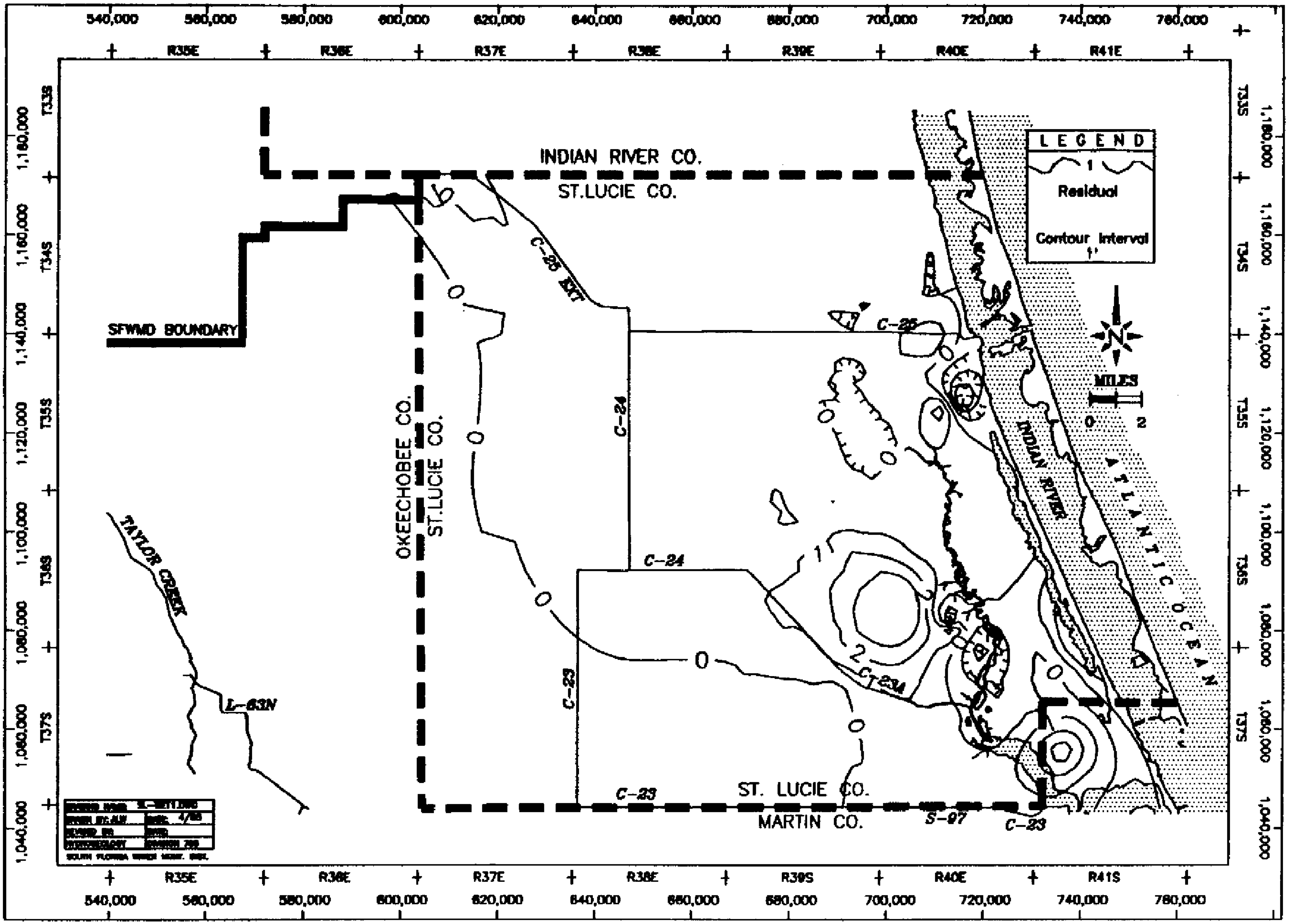


FIGURE 36. Wet Season Residual Map for Layer 1

within the region bounded by the ±1-foot contours. Therefore, the majority of the area meets the Level 1 calibration requirement. Most of the areas that do no meet the calibration criteria are associated with large withdrawal areas.

Figures 37 and 38 are maps of the dry-season residuals and wet-season residuals for layer 2, respectively. Overall, both figures exhibit similar trends to the steady-state residual map for layer 2 (Figure 24). Most of the study area lies between the ± 1-foot contours. However, there is an area near the C-24 Canal with high residuals on Figure 37 that does not appear on Figure 24.

Figure 39 and 40 are maps of the dry-season residuals and wet-season residuals for layer 3, respectively. Overall, both figures exhibit similar trends to the steady-state residual map for layer 3 (Figure 25). However, there is an area near the C-24 Canal with high residuals on Figure 39 that does not appear on Figures 25 and 40. Most of the study area in layer 3 meets the Level 1 calibration criteria.

Basically, Figures 35 through 40 indicate that most of the study area meets Level 1 calibration criteria in all three layers under transient conditions. Most of the areas that do not meet Level 1 conditions are associated large public water supply or domestic withdrawals. However, there is an area near C-24 that does not meet the calibration target. Monitoring wells SLMW5S (layer 2) and SLMW5D (layer 3) are located within this area. The stage of the C-24 was changed significantly during several stress periods. This affected the calibration of the monitoring wells.

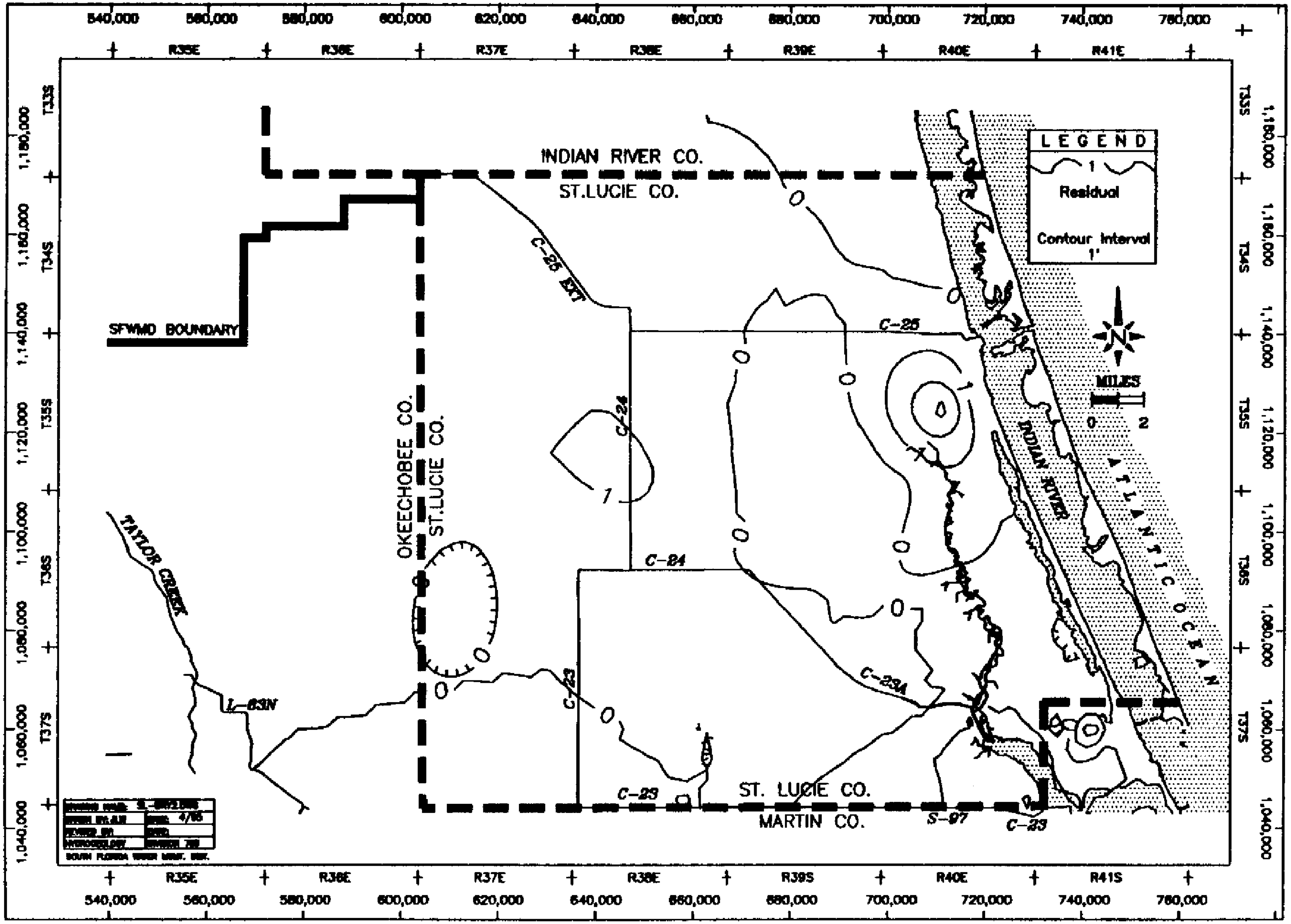


FIGURE 37. Dry Season Residual Map for Layer 2

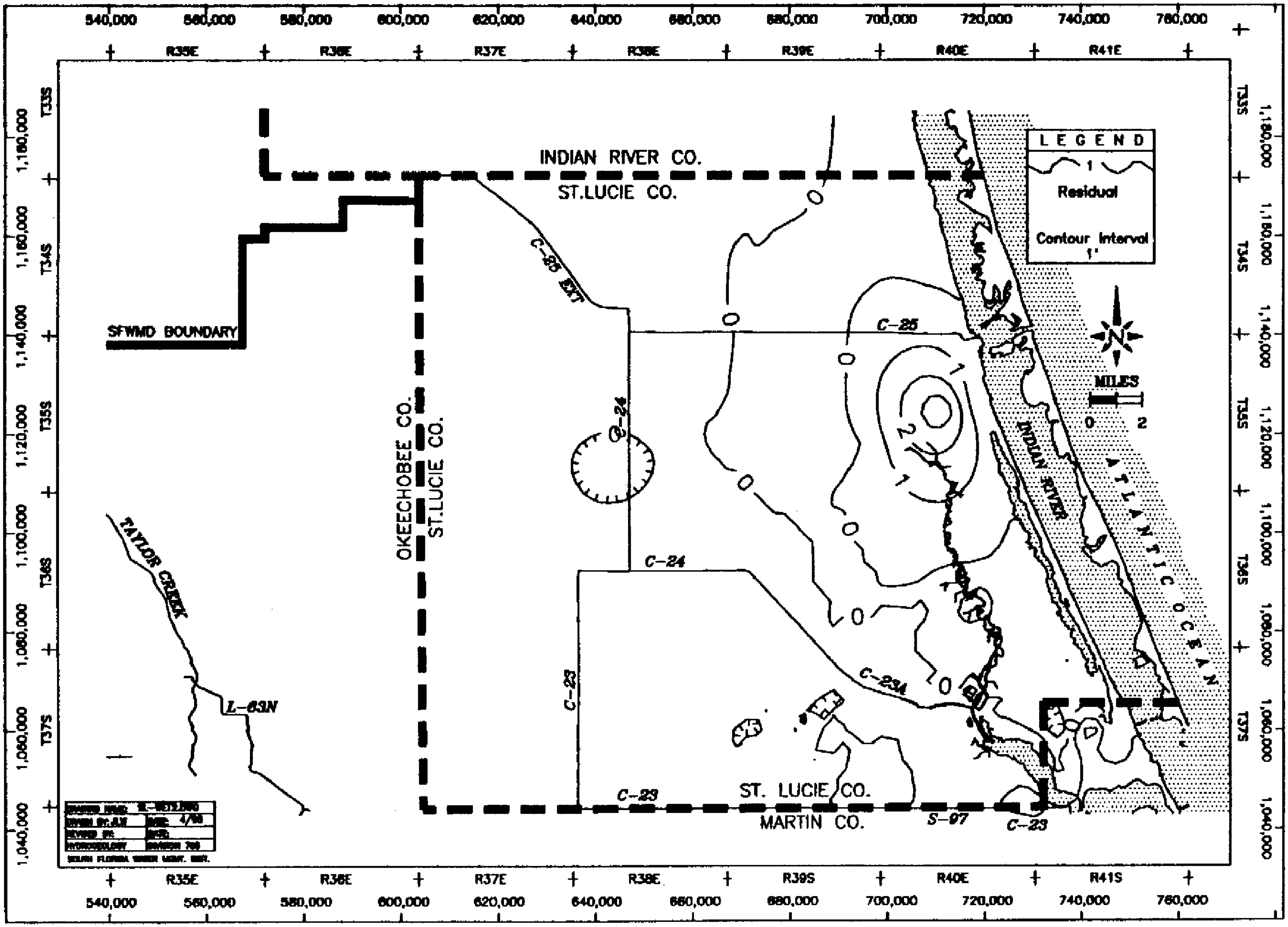


FIGURE 38. Wet Season Residual Map for Layer 2

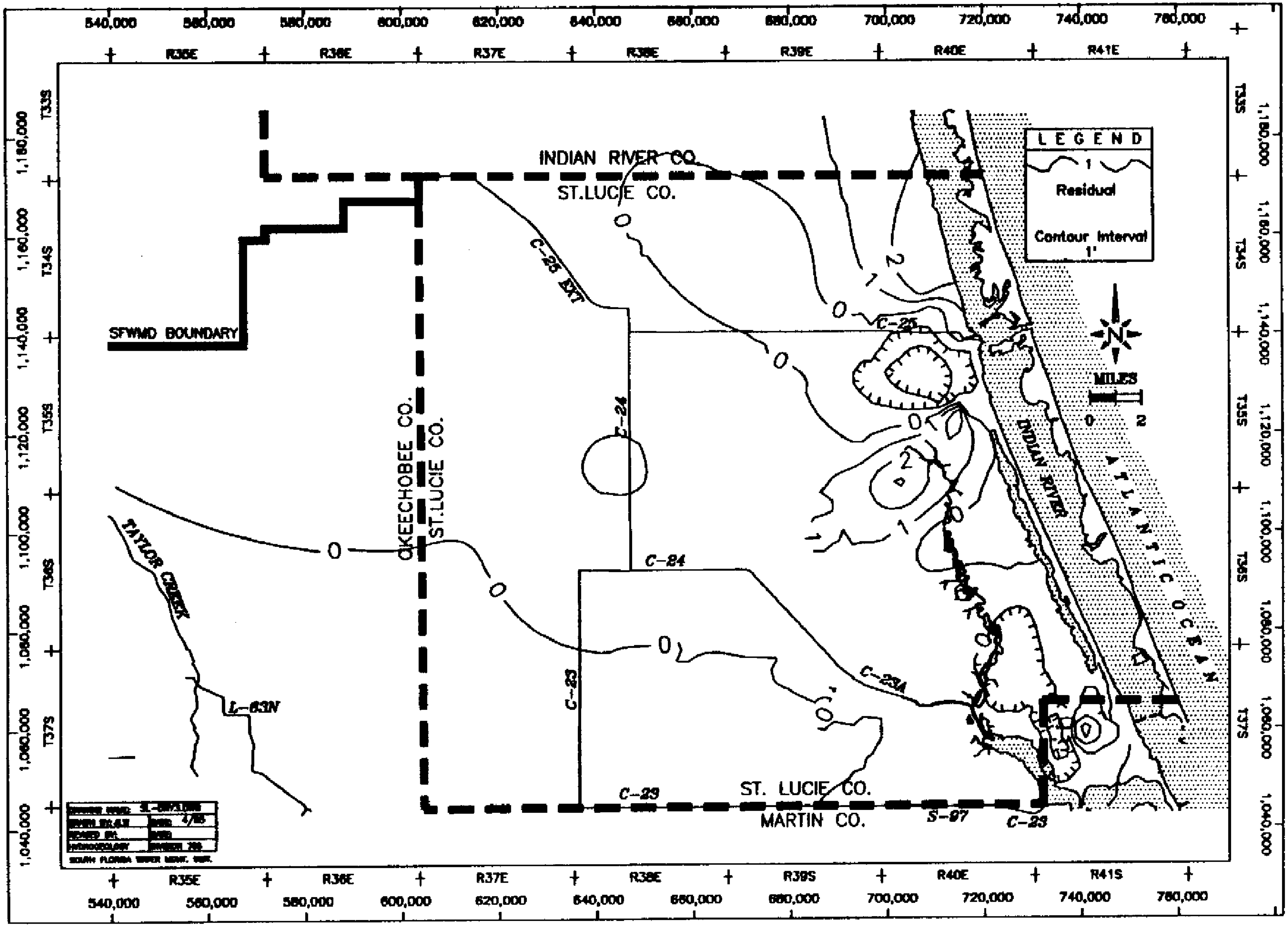


FIGURE 39. Dry Season Residual Map for Layer 3

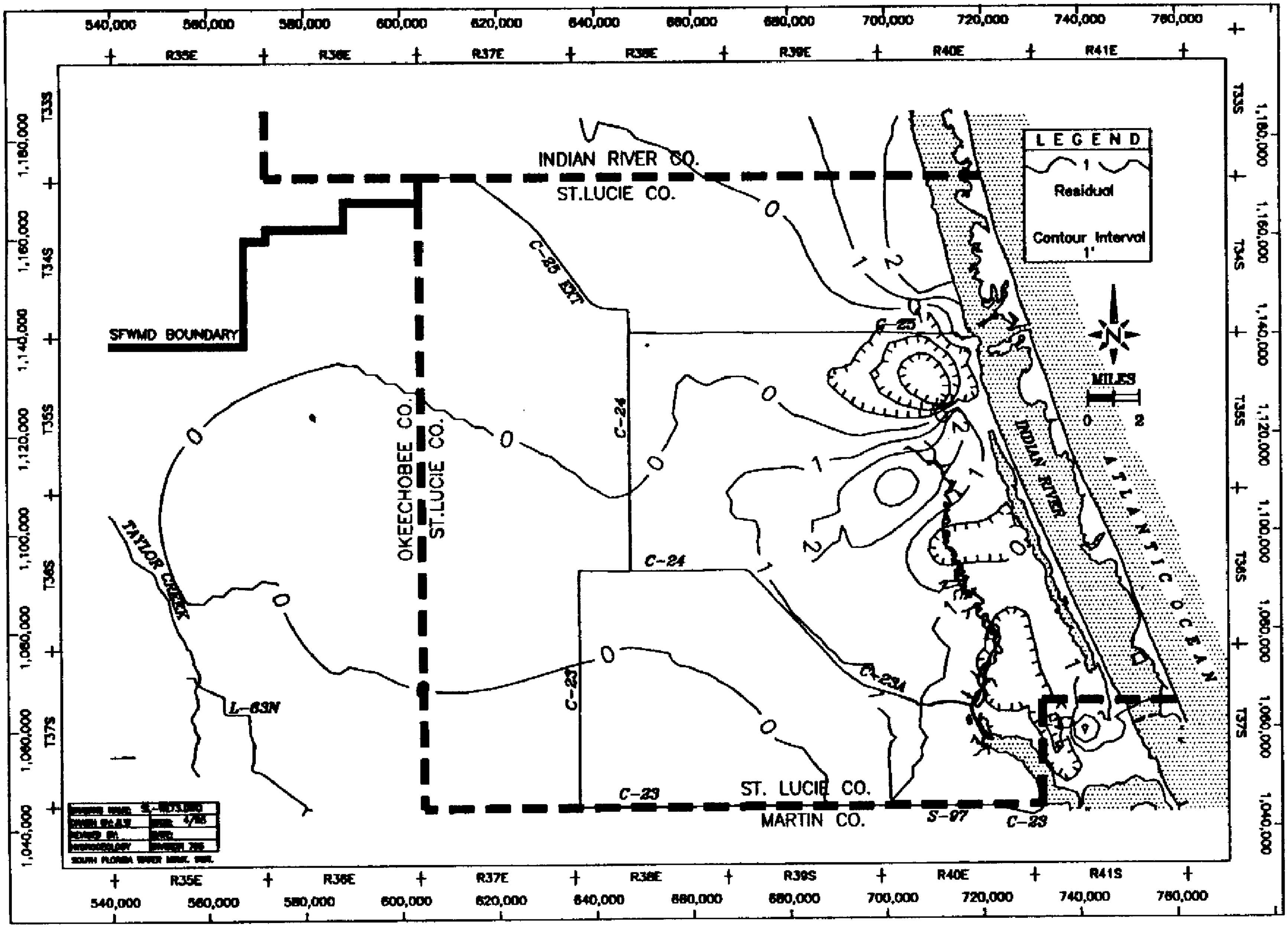


FIGURE 40. Wet Season Residual Map for Layer 3

SENSITIVITY TESTING

The model was tested to check its sensitivity to changes in aquifer parameters, climatic conditions, and stresses. Using the steady-state version, aquifer parameters were tested by altering the following: layer 1 hydraulic conductivity, layer 2 hydraulic conductivity, layer 3 transmissivity, Vcont between layers 1 and 2, Vcont between layers 2 and 3, and river and/or drain bed conductance. The sensitivity of the model to these parameters was tested by doubling, then halving each parameter, one at a time. In addition, the Vcont, and river and drain conductances were also reduced and increased by an order of magnitude. Head changes in each layer were examined to determine the relative sensitivity of the calibrated model. The results of these tests are presented in Table 8.

The model was also tested, using the steady-state version, for its sensitivity to the following climatological and stress factors: recharge, maximum ET rate, and ET surface. Recharge and ET rates were increased and decreased by 20%. The ET surface was analyzed with the climate and stress parameters since this item is part of the ET package. In addition, the recharge from the FAS wells was cancelled and doubled. The results of these tests are presented in Table 9.

AQUIFER PARAMETER CHANGES

Table 8 presents the results from the sensitivity testing of aquifer parameters. The table provides a listing of the altered parameter, maximum decline in water level, maximum increase in water level, mean head change, and standard deviation.

Overall, changes in the river and drain conductance values caused the largest changes in water levels for the individual nodes in all three layers of the model. Water levels for individual nodes increased as much as 10.26 feet and decreased as much as 11.54 feet when the conductance was changed by an order of magnitude. The maximum mean water level change, -1.09 feet, occurred when the conductance was increased an order of magnitude above the calibrated values.

An analysis of Table 8 indicates that altering the other aquifer characteristics had a minimal effect on the water level on a regional basis. This is exemplified by the small values of the average mean difference and standard deviation. However, the changes have an effect locally as illustrated by the extreme water level changes for particular nodes.

CLIMATIC AND STRESS CHANGES

Table 9 presents the results from the sensitivity testing of the climatic and stress changes. The table provides a listing of the altered parameter, maximum decline in water level, maximum increase in water level, mean head change, and standard deviation.

The results from Table 9 indicate that recharge is an important parameter. Increasing the recharge by 20% raised the average water level by 0.31 feet in all three layers. The maximum increase in water levels was 3.45 feet. Decreasing the recharge caused the average water level to drop by 0.37 feet. The maximum decrease was 5.04 feet.

Altering the maximum ET rate did not affect the model results as much as changing the recharge rate. Increasing the ET rate by 20% caused an average water level decline of 0.11 feet throughout the model area. Decreasing the ET rate by 20% caused an average rise in the water level of 0.15 feet throughout the modeled area.

Decreasing the ET surface by one foot caused the average water level to drop 0.63 feet in all three layers. With the exception of river and/or drain conductance, this parameter has the largest effect on all nodes throughout the modeled area.

Neither eliminating or doubling the recharge from the FAS wells significantly affected the water levels throughout the model area. However, several individual nodes were significantly affected by altering the Floridan aquifer recharge.

TABLE 8. Sensitivity Response to Aquifer Parameter Changes

Results for Layer 1 hydraulic conductivity * 2				
Layer 1	maximum decrease = 1.40	maximum increase = 1.85	mean = -0.02	std = 0.14
Layer 2	maximum decrease = 0.95	maximum increase = 1.80	mean = -0.02	std = 0.12
Layer 3	maximum decrease = 0.93	maximum increase = 1.80	mean = -0.02	std = 0.12
Results for Layer 1 hydraulic conductivity * 0.5				
Layer 1	maximum decrease = 1.08	maximum increase = 1.35	mean = 0.01	std = 0.09
Layer 2	maximum decrease = 1.06	maximum increase = 0.61	mean = 0.01	std = 0.07
Layer 3	maximum decrease = 1.06	maximum increase = 0.61	mean = 0.01	std = 0.07
Results for Layer 2 hydraulic conductivity * 2				
Layer 1	maximum decrease = 1.64	maximum increase = 4.44	mean = -0.04	std = 0.27
Layer 2	maximum decrease = 1.65	maximum increase = 4.45	mean = -0.04	std = 0.28
Layer 3	maximum decrease = 1.64	maximum increase = 4.41	mean = -0.04	std = 0.28
Results for layer 2 hydraulic conductivity * 0.5				
Layer 1	maximum decrease = 4.52	maximum increase = 1.30	mean = 0.02	std = 0.22
Layer 2	maximum decrease = 4.52	maximum increase = 1.30	mean = 0.02	std = 0.23
Layer 3	maximum decrease = 4.47	maximum increase = 1.30	mean = 0.02	std = 0.23
Results for layer 3 transmissivity * 2				
Layer 1	maximum decrease = 1.93	maximum increase = 4.78	mean = -0.05	std = 0.30
Layer 2	maximum decrease = 1.92	maximum increase = 4.79	mean = -0.05	std = 0.31
Layer 3	maximum decrease = 1.94	maximum increase = 4.84	mean = -0.05	std = 0.33
Results for layer 3 transmissivity * 0.5				
Layer 1	maximum decrease = 5.09	maximum increase = 1.65	mean = 0.02	std = 0.27
Layer 2	maximum decrease = 5.09	maximum increase = 1.67	mean = 0.02	std = 0.28
Layer 3	maximum decrease = 5.12	maximum increase = 1.67	mean = 0.02	std = 0.29
Results for Vcont between layers 1 & 2 * 2				
Layer 1	maximum decrease = 1.95	maximum increase = 0.24	mean = -0.01	std = 0.08
Layer 2	maximum decrease = 0.47	maximum increase = 1.52	mean = 0.01	std = 0.09
Layer 3	maximum decrease = 0.46	maximum increase = 1.47	mean = 0.01	std = 0.08
Results for Vcont between layers 1 & 2 * 0.5				
Layer 1	maximum decrease = 0.35	maximum increase = 1.72	mean = 0.01	std = 0.07
Layer 2	maximum decrease = 2.02	maximum increase = 0.66	mean = -0.01	std = 0.13
Layer 3	maximum decrease = 1.96	maximum increase = 0.63	mean = -0.01	std = 0.12
Results for Vcont between layers 1 and 2 * 10				
Layer 1	maximum decrease = 4.68	maximum increase = 0.49	mean = -0.02	std = 0.20
Layer 2	maximum decrease = 0.95	maximum increase = 2.33	mean = 0.01	std = 0.14
Layer 3	maximum decrease = 0.92	maximum increase = 2.26	mean = 0.01	std = 0.14
Results for Vcont between layers 1 and 2 * 0.10				
Layer 1	maximum decrease = 1.21	maximum increase = 3.48	mean = 0.07	std = 0.29
Layer 2	maximum decrease = 6.68	maximum increase = 2.82	mean = -0.08	std = 0.57
Layer 3	maximum decrease = 6.52	maximum increase = 2.67	mean = -0.08	std = 0.56
Results for Vcont between layers 2 and 3 * 2				
Layer 1	maximum decrease = 0.47	maximum increase = 0.25	mean = 0.00	std = 0.02
Layer 2	maximum decrease = 0.49	maximum increase = 0.26	mean = 0.00	std = 0.03
Layer 3	maximum decrease = 0.49	maximum increase = 0.51	mean = 0.00	std = 0.04

TABLE 8. Sensitivity Response to Aquifer Parameter Changes (Continued)

Results for Vcont between layers 2 and 3 * 0.5

Layer 1	maximum decrease = 0.32	maximum increase = 0.49	mean = 0.01	std = 0.03
Layer 2	maximum decrease = 0.34	maximum increase = 0.49	mean = 0.01	std = 0.03
Layer 3	maximum decrease = 0.80	maximum increase = 0.65	mean = -0.01	std = 0.06

Results for Vcont between layers 2 and 3 * 10

Layer 1	maximum decrease = 1.58	maximum increase = 0.54	mean = -0.01	std = 0.05
Layer 2	maximum decrease = 1.62	maximum increase = 0.57	mean = -0.01	std = 0.06
Layer 3	maximum decrease = 1.42	maximum increase = 1.06	mean = 0.00	std = 0.08

Results for Vcont between layers 2 and 3 * 0.10

Layer 1	maximum decrease = 0.97	maximum increase = 2.18	mean = 0.03	std = 0.16
Layer 2	maximum decrease = 1.03	maximum increase = 2.20	mean = 0.03	std = 0.17
Layer 3	maximum decrease = 3.32	maximum increase = 2.42	mean = -0.06	std = 0.34

Drain and River Conductance * 2

Layer 1	maximum decrease = 3.35	maximum increase = 2.07	mean = -0.39	std = 0.46
Layer 2	maximum decrease = 3.29	maximum increase = 1.95	mean = -0.39	std = 0.45
Layer 3	maximum decrease = 2.96	maximum increase = 1.92	mean = -0.39	std = 0.44

Drain and River Conductance * 0.5

Layer 1	maximum decrease = 2.87	maximum increase = 3.67	mean = 0.35	std = 0.46
Layer 2	maximum decrease = 2.72	maximum increase = 3.63	mean = 0.35	std = 0.45
Layer 3	maximum decrease = 2.69	maximum increase = 3.43	mean = 0.35	std = 0.45

Drain and River Conductance * 10

Layer 1	maximum decrease = 8.22	maximum increase = 4.27	mean = -1.09	std = 1.14
Layer 2	maximum decrease = 7.94	maximum increase = 4.02	mean = -1.09	std = 1.11
Layer 3	maximum decrease = 6.75	maximum increase = 3.96	mean = -1.09	std = 1.09

Drain and River Conductance * 0.1

Layer 1	maximum decrease = 11.54	maximum increase = 10.26	mean = 0.85	std = 1.21
Layer 2	maximum decrease = 11.01	maximum increase = 10.06	mean = 0.85	std = 1.18
Layer 3	maximum decrease = 10.88	maximum increase = 9.10	mean = 0.85	std = 1.16

TABLE 9. Sensitivity Responses to Climatic or Stress Changes

Recharge increased by 20%

Layer 1	maximum decrease = 0.00	maximum increase = 3.45	mean = 0.31	std = 0.30
Layer 2	maximum decrease = 0.00	maximum increase = 3.43	mean = 0.31	std = 0.29
Layer 3	maximum decrease = 0.00	maximum increase = 3.43	mean = 0.31	std = 0.29

Recharge decreased by 20%

Layer 1	maximum decrease = 5.04	maximum increase = 0.00	mean = -0.37	std = 0.45
Layer 2	maximum decrease = 5.02	maximum increase = 0.00	mean = -0.36	std = 0.44
Layer 3	maximum decrease = 5.01	maximum increase = 0.00	mean = -0.36	std = 0.44

ET rate increased by 20%

Layer 1	maximum decrease = 0.54	maximum increase = 0.00	mean = -0.11	std = 0.09
Layer 2	maximum decrease = 0.54	maximum increase = 0.00	mean = -0.11	std = 0.09
Layer 3	maximum decrease = 0.54	maximum increase = 0.00	mean = -0.11	std = 0.09

ET rate decreased by 20%

Layer 1	maximum decrease = 0.00	maximum increase = 0.98	mean = 0.15	std = 0.14
Layer 2	maximum decrease = 0.00	maximum increase = 0.95	mean = 0.15	std = 0.14
Layer 3	maximum decrease = 0.00	maximum increase = 0.93	mean = 0.15	std = 0.14

ET surface increased 1 foot: failed to converge

ET surface decreased by 1 foot

Layer 1	maximum decrease = 1.01	maximum increase = 0.00	mean = -0.63	std = 0.33
Layer 2	maximum decrease = 1.01	maximum increase = 0.00	mean = -0.63	std = 0.32
Layer 3	maximum decrease = 1.01	maximum increase = 0.00	mean = -0.63	std = 0.32

No recharge from Floridan aquifer wells

Layer 1	maximum decrease = 2.36	maximum increase = 0.00	mean = -0.03	std = 0.09
Layer 2	maximum decrease = 2.30	maximum increase = 0.00	mean = -0.03	std = 0.09
Layer 3	maximum decrease = 2.19	maximum increase = 0.00	mean = -0.03	std = 0.08

Recharge from Floridan aquifer wells * 2

Layer 1	maximum decrease = 0.01	maximum increase = 2.05	mean = 0.03	std = 0.09
Layer 2	maximum decrease = 0.01	maximum increase = 2.00	mean = 0.03	std = 0.08
Layer 3	maximum decrease = 0.01	maximum increase = 1.91	mean = 0.03	std = 0.08

QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

The South Florida Water Management District developed quality assurance/quality control (QA/QC) procedures pertaining to ground water flow models as the models progressed from the development stage in the Water Resources Evaluation Department to utilization by the Regulation and Planning Departments. The process involves a series of iterations between the model developer and the end users. In addition, a peer review team is selected for each model.

Each model is evaluated in terms of: a) acceptability, and b) impacts of deficiencies on application of the model. Acceptability is divided into three categories: 1) meets all standards of completeness and accuracy, 2) meets main standards, but enhancements are necessary to improve the overall accuracy of the model, and 3) does not meet standards and the model is not ready for use. All parameters that did not meet standards were corrected as a first priority. Parameters needing enhancements were prioritized into the items that should be upgraded before the models are used in order to minimize future problems and the items which can be continually enhanced even while the model is in use.

The QA/QC checklist is divided in two parts: a conceptualization section and a data section. The conceptualization section is a narrative discussion of the methodology and assumptions used in creating the data sets. It covers such topics as boundary conditions, time and space discretization, recharge and evapotranspiration calculations, water use data sources and assumptions, aquifer parameters, river and drain parameters, and calibration criteria. This discussion was intended to familiarize the users with all assumptions used in creating the model in order to make them aware of situations which may affect the results. The data set checklist includes all data sets used in the model and verifies that there are no data anomalies. Data were checked both graphically and numerically. Contour plots were compared with data points used to create them to make sure they were accurate. The minimum and maximum values for each plot were determined and checked for reasonableness. Numerical arrays were printed and checked visually, especially at boundaries. River, drain and general head cell values were also printed spatially and checked for reasonableness and consistency between cells. All well locations were verified both in row and column format, and planar coordinate format. The simulated withdrawals were compared to permitted allocations for reasonableness. The volumetric budget was also checked to determine if anything was out of proportion.

Final agreement was reached and the checklists from the peer review panel were approved with no unacceptable sections and several sections identified as acceptable under current conditions with future enhancements necessary.

CONCLUSIONS AND RECOMMENDATIONS

1. According to the model results, surface water discharges accounted for 36% of losses from the ground water system. Currently, the accuracy of this number cannot be verified. However, a surface water model which encompasses the study area is being developed and the outcome from this model may result in modifications to the existing ground water model. One area of potential improvement is defining the "wetted perimeter" of a canal. Data on widths and depths of drainage canals are sparse, especially for the many grove and roadside drainage canals. Also, most of these canals have no records of stage levels and sometimes information on control structure elevations is missing or inaccurate. This makes it difficult, if not impossible, to accurately represent the drainage potential of these surface water bodies. During the regulation process, every effort should be made to include pertinent control elevation and canal construction data in the permits. Information concerning ditches, lakes, canals, wetlands, etc. in future surface water permits as well as one-foot topographic data obtained during permit review would benefit future model calibration efforts. Stage recorders in some of the major grove canals would produce valuable data for use in the ground and surface water models.

2. Currently, the model is not sensitive enough to be used in surface water permitting to determine exact control elevations or to set acceptable wetland elevations. However, ground water levels in the model can be checked against existing permits and new proposed control elevations, and any discrepancies should be reported to the model developer to aid in improved model calibration. Refining the grid size and elevation data would make this model a useful tool for evaluating existing and future impacts on surface water management systems.

3. The model in its present configuration is not effective for assessing ground water withdrawal impacts on a small scale, due to the regional nature of the model grid. As a result, small scale impacts on adjacent users or small wetland areas may be overlooked due to cell-wide averaging. Improved grid resolution and use of one-foot topographic data is needed to better assess these small scale impacts. The SFWMD has developed software which makes it possible to "zoom in" on an area of a regional model and obtain data to create a model with finer grid resolution. This process will improve site-specific evaluations.

4. With 97% of the inflow for the model coming from the recharge package and 55% of the losses removed by the evapotranspiration (ET) package, the overall accuracy of the model is dependent on the accuracy of these two packages. During model calibration, it became obvious that these packages do not allow the user to accurately imitate the intricacies of these processes because they deal only with direct effects on the saturated aquifer. Therefore, pre-processing of inputs to these packages is necessary to meet the assumptions the model makes of the data. Areas needing work include accounting for irrigation water, investigating areas where ground water is significantly below land surface, the effects of canals which lower the water table below the ET extinction depth and the results of each of these situations on recharge and evapotranspiration rates.

5. One portion of the evapotranspiration package is the ET surface elevation. It is usually set close to land surface. Detailed land surface data on a large scale is not available. Changes of even one foot in ET surface affected calibration results. These results illustrate the need for detailed information. In addition, cell size is also an important factor. In areas with rapid elevation changes, smaller cells and more detailed data should result in improved calibration of the model.

6. Although ground water withdrawals account for only 4% of the modeled outflow, the impact of these withdrawals was the stimulus for developing the model. There are three main types of ground water withdrawals: public water supply, agricultural, and domestic.

   Public water supply withdrawals are the best documented of the three types. However, most public water supply purveyors do not record flow from individual wells. Individual flow meters would provide more accurate withdrawal data for model input.

   Accurate withdrawal information for agricultural water use is scarce. Actual water use data would increase confidence in the calibration of the model, particularly in areas of heavy ground water use. In addition, accurate projections of future agricultural water use will be necessary for the development of a water supply plan for the study area.

   Domestic self-supply is a large and widespread type of water use. Therefore, parameters used in reaching this estimate need refining to increase the accuracy and reliability of the model.

7. The model was difficult to calibrate within the specified constraints in several localized areas. A review of the residual maps indicates that the highest residuals are located near large withdrawal sources or near the tidal portions of the North Fork of the St. Lucie River. Probable reasons are cell-wide averaging, uncertainty in aquifer parameters, and missing or incorrect data for the surface water system or stress rates. Future revisions to the model should be concentrated in these areas to improve the confidence level of the model.

8. A review of the data maps indicate that there are several areas where input data is scarce, particularly in the western portion of St. Lucie County. Future studies should include ground water reconnaissance investigations in these areas.

9. Model calibration for this study was based on one year of data collection. The relatively short calibration period was chosen in order to comply with the priorities and time lines of the District. Future studies should include a longer calibration period. A time period of at least two years is recommended. Also, the District should develop ground water level maps in order to obtain a better idea of the ground water movement in the study area. The additional information will allow the District staff to utilize statistical analysis for model calibration as opposed to using an arbitrary criterion of ± one foot.

In addition, the study period coincided with a relatively dry period. Analysis of the rainfall data infers that the study period approximates 1-in-10 year drought conditions. Future studies should include calibration under different climatic conditions.

10. Ground water in the study area primarily flows from west to east. A significant amount of the recharge to the surficial aquifer system takes place in Okeechobee County. The District is conducting a ground water reconnaissance study of Okeechobee at the present time. Data from this study should be included in any future model recalibrations.

11. The District should develop interfaces for the St. Lucie model with the existing Martin County model, the Okeechobee County model (which is being developed), and the regional surface water model (currently being developed). This will result in a truly regional model that will encompass the entire flow regime of the surficial aquifer system for the Upper East Coast Planning Area.

12. Most of the canals within the study area function as drains or as effluent rivers. In both cases, ground water flows from the aquifer into the canals.

13. Refinement of the model is a continuous process. As part of the process, the District will develop GIS coverages for the data used in the calibrated model. One of the more important coverages is the canal coverage. First, the District will generate a GIS coverage for the input data used to develop the river and drain packages. Once this task is completed, the District will incorporate the data for the minor irrigation canals that were not used in the model. Even though these canals are not significant on a regional scale, they may be significant when future users wish to conduct a more site-specific evaluation for regulation or planning purposes.

14. Overall, the total inflows and outflows for the model are balanced and appear reasonable. However, there are several nodes where the ET discharge is absent or significantly higher than the recharge. As previously indicated, most of the rivers reaches in the model are effluent. In several cases, the rivers and drains lower the water levels in the aquifer below the extinction depths. When this situation occurs, the ET discharge will be absent for that particular node. Most of the areas where the ET discharges are missing are located in areas with a relatively high density of canals.

    There are several nodes which have relatively high ET/recharge ratios. Some possible reasons for the high ET/recharge ratios are as follows:

    a) This phenomenon may be due to the moderate drought conditions which occurred during the study period.

    b) Many of the nodes with a high ET/recharge ratio occur in areas where canals are absent from the model. Since these nodes do not have surface water discharges to lower the water levels, these nodes have a relative high ET discharge.

c) Several nodes have other significant sources of inflow besides recharge. This additional water raises the simulated water level in the cell. Consequently, the ET discharge also increases due to the higher simulated water level.

It should be noted that none of the cells where ET exceeds recharge goes dry under either transient or steady-state simulations. Also, random checks of the individual budgets for these nodes indicates that the total inflow for the node matches the total outflow for the node.

REFERENCES

Adams, Karin, M. 1992. A Three-Dimensional Finite-Difference Ground Water Flow Model of the Surficial Aquifer in Martin County, Florida. South Florida Water Management District, Technical Publication 92-02

Anderson, Mary.P., and William W. Woessner. 1992. Applied Ground Water Modeling, Simulation of Flow and Advective Transport. Academic Press, Inc.

Ardaman & Associates, Inc. 1990. Aquifer Performance Test Results for Savanna Dunes Project, St. Lucie County, Florida. Consultant Report in SFWMD Water Use Division Library.

Bearden, H.W.. 1972. Water Availability in Canals and Shallow Sediments in St. Lucie County, Florida. State of Florida Department of Natural Resources Report of Investigation No. 62.

Bower, Richard F., K.M. Adams, and J.I. Restrepo. 1990. A Three-Dimensional Finite-Difference Ground Water Flow Model of Lee County, Florida. South Florida Water Management District, Technical Publication 90-1.

Brown, Michael P. 1980. Aquifer Test Data and Analyses for the Floridan Aquifer System in the Upper East Coast Planning Area. South Florida Water Management District, Technical Publication 80-1.

Brown, Michael P., and D.E. Reece. 1979. Hydrologic Reconnaissance of the Floridan Aquifer System, Upper East Coast Planning Area. South Florida Water Management District, Technical Map Series 79-1 Plates 1-10B

C.F.S. and Associates, Inc. 1981. Supplemental Information for a Water Use Permit for Spanish Lakes Country Club Service Corporation. Consultant Report in SFWMD Water Use Division Library.

CH2M Hill Inc. 1988. Well Completion Report for the Lawnwood Wellfield Expansion and Floridan Aquifer Blending Well. Consultant Report in SFWMD Water Use Division Library.

Cooper, R. M. and T. W. Ortel. 1988. An Atlas of St. Lucie County Surface Water Management Basins. South Florida Water Management District Technical Memorandum.

El-Khazan, Clovis C. 1988. Modeling of Water Exchange Between the Indian River Lagoon and the Surficial Aquifer in Port St. Lucie, Florida, MS Thesis, Florida Institute of Technology, Melbourne, Florida.

Fetter, C.W. 1980. Applied Hydrogeology. Charles E. Merrill Publishing Company.

Florida Geological Survey, 1986. Hydrogeologic Units of Florida. Florida Geological Survey, Special Publication No. 28.

Geraghty and Miller, Inc. 1981. Hydrogeologic Investigations of the Savannah Club, St. Lucie County, Florida. Consultant Report in SFWMD Water Use Division Library.

Geraghty and Miller, Inc. 1982. Hydrogeologic Investigation of Harbor Ridge Limited, St. Lucie County, Florida. Consultant Report in SFWMD Water Use Division Library.

Geraghty and Miller, Inc. 1984. Installation and Testing Production Well 2 and Associated Wells, Harbor Ridge Limited, St. Lucie County, Florida. Consultant Report in SFWMD Water Use Division Library.

Gilbert, Richard O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold.

Golden Software Inc. 1989. Surfer Reference Manual.

Hopkins, Emily. 1991. A Water Resource Analysis of the Jensen Beach Peninsula, Martin County, Florida. South Florida Water Management District, Technical Publication 91-03.

Hunter/Hydrosoft. 1989. Martin and St. Lucie County Ground-Water Modeling Study. Consultant Report in SFWMD Water Use Division Library.

Hydrodesigns, Inc. 1988. Safe Casing Depths for Floridan Aquifer System Wells in Martin, St. Lucie and Okeechobee Counties, Florida. Consultant report in SFWMD Water Use Division Library.

Indian River Farms Drainage District. 1993. Plan of Indian River Farms Drainage District, Indian River County, Florida.

James M. Montgomery, Inc. 1989. North Martin County Wellfield Wetlands Impact Study, Aquifer Performance Test. Consultant Report in SFWMD Water Use Division Library.

Kane, Richard L. 1992. Altitude of the Water Table in the Surficial Aquifer System in Martin and St. Lucie Counties, May 1988. U.S. Geological Survey Open-File Report 92-98.

Layne Atlantic Company. 1970. General Development Utilities, Inc., Report of Analyses of Pumping Test and Determination of Effects of Pumping. Consultant Report in SFWMD Water Use Division Library.

Lukasiewicz, John. 1992. A Three-Dimensional Finite-Difference Ground Water Flow Model of the Floridan Aquifer System in Martin, St. Lucie, and Eastern Okeechobee Counties, Florida, South Florida Water Management District, Technical Publication 92-03.

Lukasiewicz, John and M. P. Switanek. In Press. Ground Water Resource Assessment of Martin and St. Lucie Counties, Florida. South Florida Water Management District, Technical Publication 95-**

McCollum, Samuel H., and O. E. Cruz, Sr. 1981. Soil Survey of Martin County Area, Florida. United States Department of Agriculture, Soil Conservation Service.

McCollum, Samuel H., and Robert F. Pendleton. 1971. Soil Survey of Okeechobee County, Florida. United States Department of Agriculture, Soil Conservation Service.

McDonald, M.G., and A.W. Harbaugh. 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. Techniques of Water-Resources Investigations of the U. S. Geological Survey, Book 6.

Miller, W. L. 1979. Hydrologic and Geologic Data from the Upper East Coast Planning Area, Southeast Florida. U. S. Geological Survey, Open File Report 79-1543.

North St. Lucie River Water Control District. 1991. Information Map.

Parker, G. G., G. E. Ferguson, S. K. Love, et al. 1955. Water Resource of Southeastern Florida. U. S. Geological Survey Water Supply Paper No. 1255.

Post, Buckley, Schuh & Jernigan, Inc. 1985. Hydrological Report, St. Lucie West, St. Lucie County, Florida. Consultant Report in SFWMD Water Use Division Library.

Restrepo, J.I, C. Bevier, and D. Butler. 1992. A Three-Dimensional Finite-difference Ground Water Flow Model of the Surficial Aquifer System, Broward County, Florida. South Florida Water Management District, Technical Publication 92-05.

St. Johns Water Control District. 1991. St. Johns Water Control District Water Conservation Plan.

Schiner, G. R., C. P. Laughlin, and D. J. Toth. 1988. Geohydrology of Indian River County, Florida, U. S. Geological Survey, Water-Resources Investigation Report 88-4073.

Scott, Thomas M.. 1988. The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida. Florida Geological Survey Bulletin No. 59.

South Florida Water Management District. 1974. Memorandum Report on Surface Water Availability in the St. Lucie County Area.

South Florida Water Management District. 1985. Management of Water Use, Permit Information Manual Volume III.

South Florida Water Management District. 1991. Draft Water Supply Policy Document.

South Florida Water Management District, 1994. Upper East Coast Water Supply Plan Background Document.

Statgraphics. 1992. Manugistics, Inc.

Triola, Mario F. 1993. Elementary Statistics (5th edition). Addison-Wesley Publishing Company, Inc.

United States Department of Agriculture, Soil Conservation Service. 1970. Irrigation Water Requirements. Technical Release No. 21.

Universal Engineering and Testing Company. 1986. Task III, Kings Bay Golf and Country Club, Okeechobee, Florida, Aquifer Performance Test. Consultant Report in SFWMD Water Use Division Library.

Viessman, W., J. W. Knapp, G. L. Lewis, and T. E. Harbaugh. 1977. Introduction to Hydrology. A Dun-Donnelley Publisher, New York.

Watts, Frank C., and Daniel L. Starky. 1980. Soil Survey of St. Lucie County Area, Florida, United States Department of Agriculture, Soil Conservation Service.

Wedderburn, Leslie A. and Michael S. Knapp. 1983. Field Investigation into the Feasibility of Storing Fresh Water in Saline Portions of the Floridan Aquifer System, St. Lucie County, Florida, South Florida Water Management District, Technical Publication 83-7.

Wettstein, Carol A., Chris V. Noble, and James D. Slabaugh. 1987. Soil Survey of Indian River County, Florida. United States Department of Agriculture, Soil Conservation Service.

White, William A. 1970. The Geomorphology of the Florida Peninsula. Florida Bureau of Geology, Geological Bulletin No. 51.

APPENDIX A

LITHOLOGIC AND HYDROGEOLOGIC DATA

LIST OF FIGURES - APPENDIX A

LIST OF TABLES - APPENDIX A

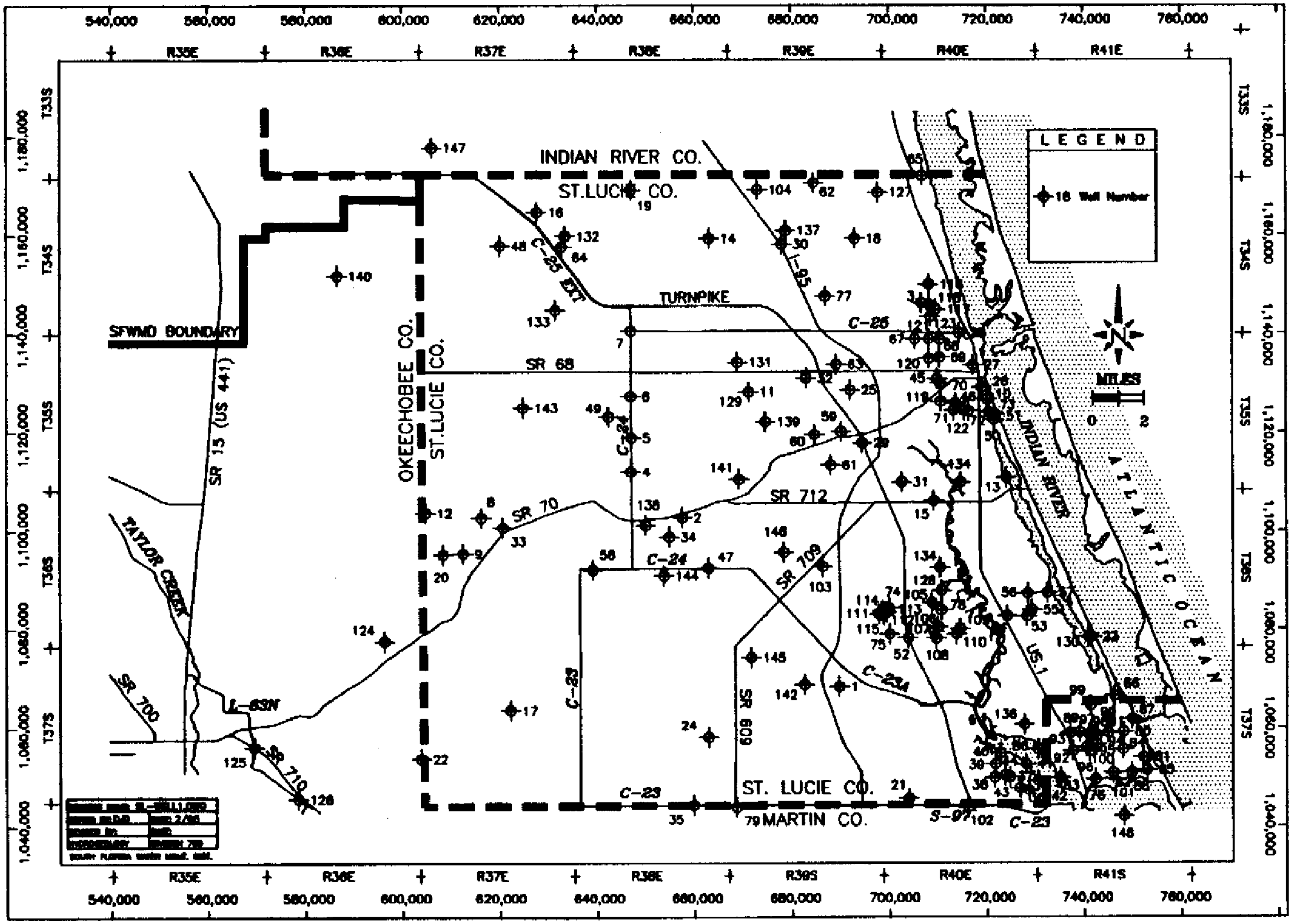


FIGURE A-1. Map of Wells with Lithologic or Geophysical Data

TABLE A-1. Lithologic Well Data

MAP #	WELL NAME	TOTAL DEPTH	GROUND LEVEL (NGVD)	EAST PLANARS	NORTH PLANARS	LAYER 1 THICKNESS	LAYER 1 BASE (NGVD)	LAYER 2 THICKNESS	LAYER 2 BASE (NGVD)	LAYER 3 THICKNESS	BASE OF S.A.S. (NGVD)
1	STL214	134	27.40	689672	1068323	35.00	-7.60	35.00	-42.60	60.00	-102.60
2	STLMW1	132	22.60	657595	1102620	10.00	12.60	48.00	-35.40	70.00	-105.40
3	SLMW4D	120	22.00	706690	1146162	36.00	-14.00	49.00	-63.00	25.00	-88.00
4	SLMW5D	122	26.00	647013	1111870	14.00	12.00	36.00	-24.00	58.00	-82.00
5	SLMW6D	112	26.40	647078	1118737	15.00	11.40	45.00	-33.60	48.00	-81.60
6	SLMW7D	110	26.00	646957	1127218	15.00	11.00	20.00	-9.00	74.00	-83.00
7	SLMW8D	115	24.60	646998	1140447	19.00	5.60	28.00	-22.40	59.00	-81.40
8	SLMW9D	115	30.00	616302	1102581						-74.00
9	SLMW10D	120	30.50	612626	1095300	10.00	20.50	41.00	-20.50	60.00	-80.50
10	SLMW11D	153	30.73	720126	1126642	59.00	-28.27	35.00	-63.27	40.00	-103.27
11	SLMW12D	115	24.40	671191	1128122	24.00	0.40	18.00	-17.60	59.00	-76.60
12	SLMW13D	119	33.30	604850	1103559	8.00	25.30	49.00	-23.70	58.00	-81.70
13	SLMW14D	130	16.70	724089	1110709	37.00	-20.30	37.00	-57.30	48.00	-105.30
14	SLMW20	130	24.20	663136	1159191	14.00	10.20	48.00	-37.80	51.00	-88.80
15	SLMW21	140	14.50	709240	1105984	44.00	-29.50	31.00	-60.50	55.00	-115.50
16	SLMW22D	116	25.00	627736	1164515	18.00	7.00	32.00	-25.00	56.00	-81.00
17	SLMW23D	320	32.00	622280	1063621	20.00	12.00	35.00	-23.00	75.00	-98.00
18	SLMW24D	142	22.00	692937	1159222	25.00	-3.00	50.00	-53.00	40.00	-93.00
19	PG13M	140	23.60	646984	1169024	16.00	7.60	37.00	-29.40	56.00	-85.40
20	PG35S	140	35.00	608478	1095087	20.00	15.00				-77.00
21	PG28S	140	23.00	703953	1045672	17.00	6.00	55.00	-49.00		
22	PG21B	140	55.44	603895	1053776	40.00	15.44	40.00	-24.56		
23	STL177	202	38.30	741590	1078394	57.00	-18.70	43.00	-61.70	67.00	-128.70
24	STL185	118	27.80	662913	1058109	15.00	12.80	48.00	-35.20		
25	SLT188	118	21.00	692003	1128518	25.00	-4.00	31.00	-35.00		
26	STL190	148	15.00	719122	1129061	50.00	-35.00	44.00	-79.00	39.00	-118.00
27	STL191	133	8.20	717296	1133494	44.00	-35.80	51.00	-86.80	18.00	-104.80
28	STL192	118		714468	1140043	47.00			-91.00		
29	STL213	115	17.80	694488	1117725	25.00	-7.20	26.00	-33.20	61.00	-94.20
30	STL26475N	125	22.00	677997	1158042	13.00	9.00	44.00	-35.00	43.00	-78.00
31	STLAPT1PW1	103	18.00	702639	1109788	28.00	-10.00	37.00	-47.00	60.00	-107.00
32	STLAPT2D4	143	23.00	682982	1130900	21.00	2.00	32.00	-30.00	67.00	-97.00
33	STLAPT4PW	122	29.00	620726	1100574	22.00	7.00	21.00	-14.00	74.00	-88.00
34	STLAPT3PW	142	25.00	654905	1098671	22.00	3.00	35.00	-32.00	68.00	-100.00
35	CH5	125	25.00	659808	1044364	15.00	10.00	50.00	-40.00		
36	HRTW-1	125	10.00	728683	1047318	36.00	-26.00	44.00	-70.00		
37	HRTW-2	140	10.00	724786	1050023	48.00	-38.00	32.00	-70.00	60.00	-130.00

TABLE A-1. Lithologic Well Data (Continued)

MAP #	WELL NAME	TOTAL DEPTH	GROUND LEVEL (NGVD)	EAST PLANARS	NORTH PLANARS	LAYER 1 THICKNESS	LAYER 1 BASE (NGVD)	LAYER 2 THICKNESS	LAYER 2 BASE (NGVD)	LAYER 3 THICKNESS	BASE OF S.A.S. (NGVD)
38	HRTW-4	138	10.00	721627	1049905	30.00	-20.00	65.00	-85.00	43.00	-128.00
39	HRTW-6	126	12.00	721793	1052632	42.00	-30.00	53.00	-83.00		
40	HRR-1	150	10.00	722773	1054859	42.00	-32.00	63.00	-95.00		
41	HRR-3	147	10.00	728112	1052566	42.00	-32.00	42.00	-74.00	35.00	-109.00
42	HRR-4	131	10.00	730660	1049248	30.00	-20.00	64.00	-84.00	26.00	-110.00
43	HRPW-2	125	10.00	726875	1047712	45.00	-35.00	35.00	-70.00	48.00	-118.00
44	HRPW-1	110	10.00	723701	1050320	45.00	-35.00	35.00	-70.00		
45	FPBLEND	904	20.00	709923	1130728	45.00	-25.00	35.00	-60.00	30.00	-90.00
46	FPS-18	120	20.00	713732	1125901	45.00	-25.00	35.00	-60.00	35.00	-95.00
47	SLF50	1000	25.00	662956	1092341				25.00	130.00	-105.00
48	PG-31B	150	28.46	620195	1157726	29.00	-0.54	34.00	-34.54	45.00	-79.54
49	SCD	403	22.00	642376	1123062	18.00	4.00	22.00	-18.00	62.00	-80.00
50	FP#3ABD	154	29.70	721591	1122510	45.00	-15.30	45.00	-60.30	60.00	-120.30
51	FP#5ABD	174	24.50	721765	1123622	46.00	-21.50	44.00	-65.50		
52	FTPATW1	170	20.54	703880	1078187	22.00	-1.46	23.00	-24.46	80.00	-104.46
53	SC5D	125	16.56	728305	1082558	35.00	-18.44	35.00	-53.44	50.00	-103.44
54	SC1D	120	17.00	724245	1082637	25.00	-8.00	45.00	-53.00	45.00	-98.00
55	SC14D	125	15.00	729380	1083877	45.00	-30.00	25.00	-55.00		
56	SC25D	135	15.00	728459	1087204	30.00	-15.00	30.00	-45.00		
57	SC29D	135	15.00	732517	1087329	40.00	-25.00	40.00	-65.00		
58	W8361/SLF14	1246	26.00	639149	1091949	20.00	6.00	20.00	-14.00	85.00	-99.00
59	W1052	867	19.00	690151	1120027	20.00	-1.00	40.00	-41.00	40.00	-81.00
60	W1022	930	18.00	684656	1119396	20.00	-2.00	20.00	-22.00	80.00	-102.00
61	W1393	980	17.00	688020	1113252	20.00	-3.00	20.00	-23.00		
62	W3023	691	20.00	684512	1170492	12.00	8.00	46.00	-38.00	84.00	-122.00
63	W7677	576	22.00	689186	1133655	30.00	-8.00	33.00	-41.00	62.00	-103.00
64	W15106	470	25.00	632801	1157463	20.00	5.00	30.00	-25.00	50.00	-75.00
65	W3018	714	2.00	706827	1171914	10.00	-8.00	74.00	-82.00	41.00	-123.00
66	SD0W4	>190	20.00	746354	1066507	45.00	-25.00	40.00	-65.00		
67	FPTW11	130	21.62	705370	1138784	50.00	-28.38	30.00	-58.38	48.00	-106.38
68	FPTW10	138	21.87	710512	1138709	65.00	-43.13	25.00	-68.13	45.00	-113.13
69	FPTW9	130	23.65	710440	1135073	65.00	-41.35	25.00	-66.35	34.00	-100.35
70	FPTW6	174	20.00	710557	1129924	65.00	-45.00	35.00	-80.00	26.00	-106.00
71	FPTW7	130	20.00	713380	1124385	55.00	-35.00	25.00	-60.00	30.00	-90.00
72	FPTW8	130	20.00	716444	1124300	40.00	-20.00	35.00	-55.00	40.00	-95.00
73	FPTW5	175	30.00	720591	1124019						-115.00
74	SLWD2	130	23.00	699971	1084226	24.00	-1.00	45.00	-46.00		

TABLE A-1. Lithologic Well Data (Continued)

MAP #	WELL NAME	TOTAL DEPTH	GROUND LEVEL (NGVD)	EAST PLANARS	NORTH PLANARS	LAYER 1 THICKNESS	LAYER 1 BASE (NGVD)	LAYER 2 THICKNESS	LAYER 2 BASE (NGVD)	LAYER 3 THICKNESS	BASE OF S.A.S. (NGVD)
75	SLWB2	130	26.00	700087	1078976	22.00	4.00	46.00	-42.00		
76	M1023	220	7.00	742394	1049518	40.00	-33.00	40.00	-73.00	110.00	-183.00
77	MCCC		20.00	686869	1147478	10.00	10.00	50.00	-40.00		
78	GDCPW4		13.00	710737	1083830	15.00	-2.00	25.00	-27.00		
79	M1240		30.00	668568	1043894	14.00	16.00	36.00	-20.00		
80	M1254		16.00	748113	1059150	45.00	-29.00	50.00	-79.00		
81	M1043		26.00	752207	1054021	52.00	-26.00	58.00	-84.00	100.00	-184.00
82	M1030		13.00	745997	1050852	40.00	-27.00	50.00	-77.00	50.00	-127.00
83	W5219		7.00	735169	1049880	55.00	-48.00	25.00	-73.00		
84	WGI3078		11.00	748045	1055611				-70.00		
85	W8749		13.00	753036	1051400	40.00	-27.00				
86	80742		5.00	730623	1055609	60.00	-55.00				
87	47005		15.00	749992	1061783				-64.00		
88	SW1		5.00	749789	1050875	40.00	-35.00	40.00	-75.00		
89	NMCPW1		16.00	739087	1059092	40.00	-24.00	32.00	-56.00		
90	NMCPW2		16.00	741615	1059107	39.00	-23.00	29.00	-52.00		
91	NMCPW3		16.00	744955	1059026	62.00	-46.00				
92	NMCPW4		12.00	737756	1055246	48.00	-36.00	32.00	-68.00		
93	NMCPW6		16.00	737193	1058879	40.00	-24.00	40.00	-64.00		
94	NMCPW7		16.00	742612	1058406	55.00	-39.00	28.00	-67.00		
95	NMCPW8		16.00	742622	1056588	57.00	-41.00	26.00	-67.00		
96	75150		17.00	741187	1055166	50.00	-33.00				
97	VP1-A		17.50	741050	1058600	52.00	-34.50	16.00	-50.50		
98	MCB		18.00	741550	1058550	44.00	-26.00	26.00	-52.00		
99	MCA		19.00	741400	1064550	56.00	-37.00	15.00	-52.00		
100	MCC		19.00	740550	1056000	56.00	-37.00	15.00	-52.00		
101	SW1		5.00	749789	1050875	40.00	-35.00	40.00	-75.00		
102	M1246		22.00	716250	1043800	18.00	4.00	44.00	-40.00		
103	RESTW3		23.00	686312	1092664	22.00	1.00	56.00	-55.00		
104	SLFWPW3			672997	1169072						
105	GDPW13			708805	1085280						
106	GDPW14			710093	1080440						
107	GDPW15			709196	1079426						
108	GDPW16			709744	1078116						
109	GDPW17			714606	1080060						
110	GDPW18			713890	1078945						
111	SLW1			697902	1083004						

TABLE A-1. Lithologic Well Data (Continued)

MAP #	WELL NAME	TOTAL DEPTH	GROUND LEVEL (NGVD)	EAST PLANARS	NORTH PLANARS	LAYER 1 THICKNESS	LAYER 1 BASE (NGVD)	LAYER 2 THICKNESS	LAYER 2 BASE (NGVD)	LAYER 3 THICKNESS	BASE OF S.A.S. (NGVD)
112	SLW3			698893	1083211						
113	SLW4			699434	1083416						
114	SLW5			698536	1083603						
115	SLW6			698805	1082807						
116	FPTW1-78	120	20.00	708202	1149906	25.00	-5.00				
117	FPTW2-78	140	20.00	709669	1144764	20.00	0.00		-55.00	55.00	-110.00
118	FPTW3-78	140	20.00	708222	1145867	40.00	-20.00		-55.00	55.00	-110.00
119	FPTW4-78	120	19.00	710667	1126188	35.00	-16.00		-56.00	40.00	-96.00
120	FPTW5-78	140	20.00	708279	1134860	40.00	-20.00		-55.00	45.00	-100.00
121	FPTW6-78	140	20.00	708259	1138798	40.00	-20.00		-60.00	50.00	-110.00
122	FPTW7-78	140	19.00	715452	1124396	35.00	-16.00		-51.00	50.00	-101.00
123	FPTW8-78	140	21.00	708506	1143344	30.00	-9.00		-59.00	45.00	-104.00
124	OKS82	178	55.00	596347	1077587	88.00	-33.00		-73.00	30.00	-103.00
125	ASROW1	1700	31.00	569500	1056126	40.00	-9.00		-69.00	50.00	-119.00
126	UNIV	150	25.00	578546	1045641	39.00	-14.00		-75.00		
127	SLCCPW1		22.00	697753	1168535						
128	NPSLPW12	111		710777	1087816	19.00					
129	PG15E	105	23.80	671191	1128122						-79.20
130	STL175	200	19.10	740959	1078390						-135.90
131	OR COMP	140	24.00	668914	1134070						-96.00
132	SLV15		25.00	633513	1159687						-81.00
133	SLF55	1260	25.00	631492	1144634						-75.00
134	SL45	640	10.00	714719	1109749						-110.00
134	NPSLIW	>3000	15.00	710482	1092459						-125.00
136	SPSLIW	3418	10.00	727796	1060643						-130.00
137	HD3	934	22.00	678795	1160772						-71.00
138	HD6	236	26.00	650027	1101076						-91.00
139	HD2	890	25.00	674641	1122078						-93.00
140	HD16-OK	1000	30.00	586715	1151683						-58.00
141	HD21	585	27.00	669193	1110341						-85.00
142	HD22	695	27.00	682541	1068795						-96.00
143	HD18	638	29.00	624888	1124923						-63.00
144	HD4	1126	28.00	653763	1090790						-99.00
145	HD27	733	26.00	671599	1074301						-93.00
146	HD19	416	23.00	678363	1095536						-99.00
147	IR0319	900	25.00	606187	1177681						-67.00
148	SITE-A		10.00	748200	1042100						-141.00

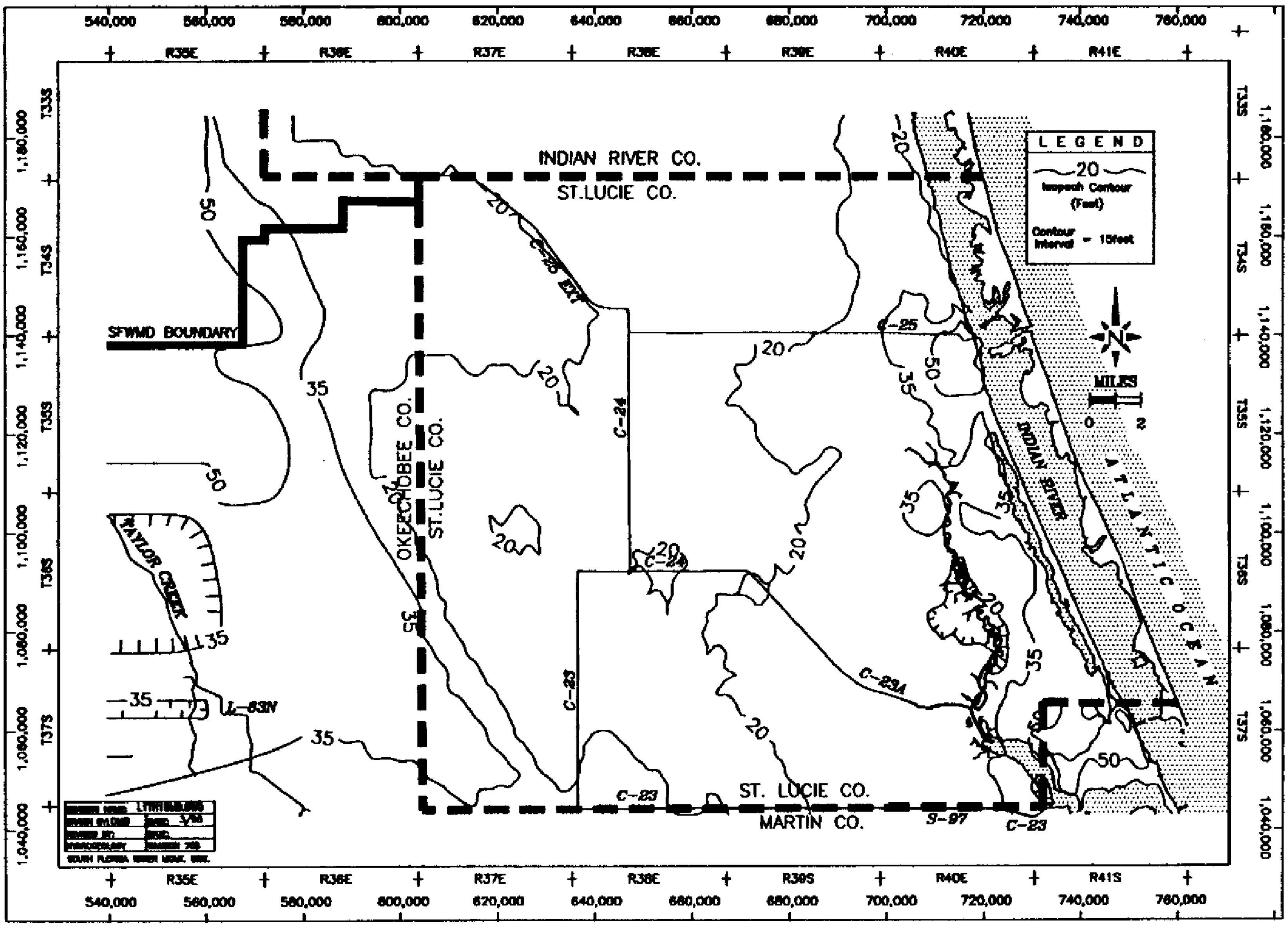


FIGURE A-2. Isopach Map of Layer 1

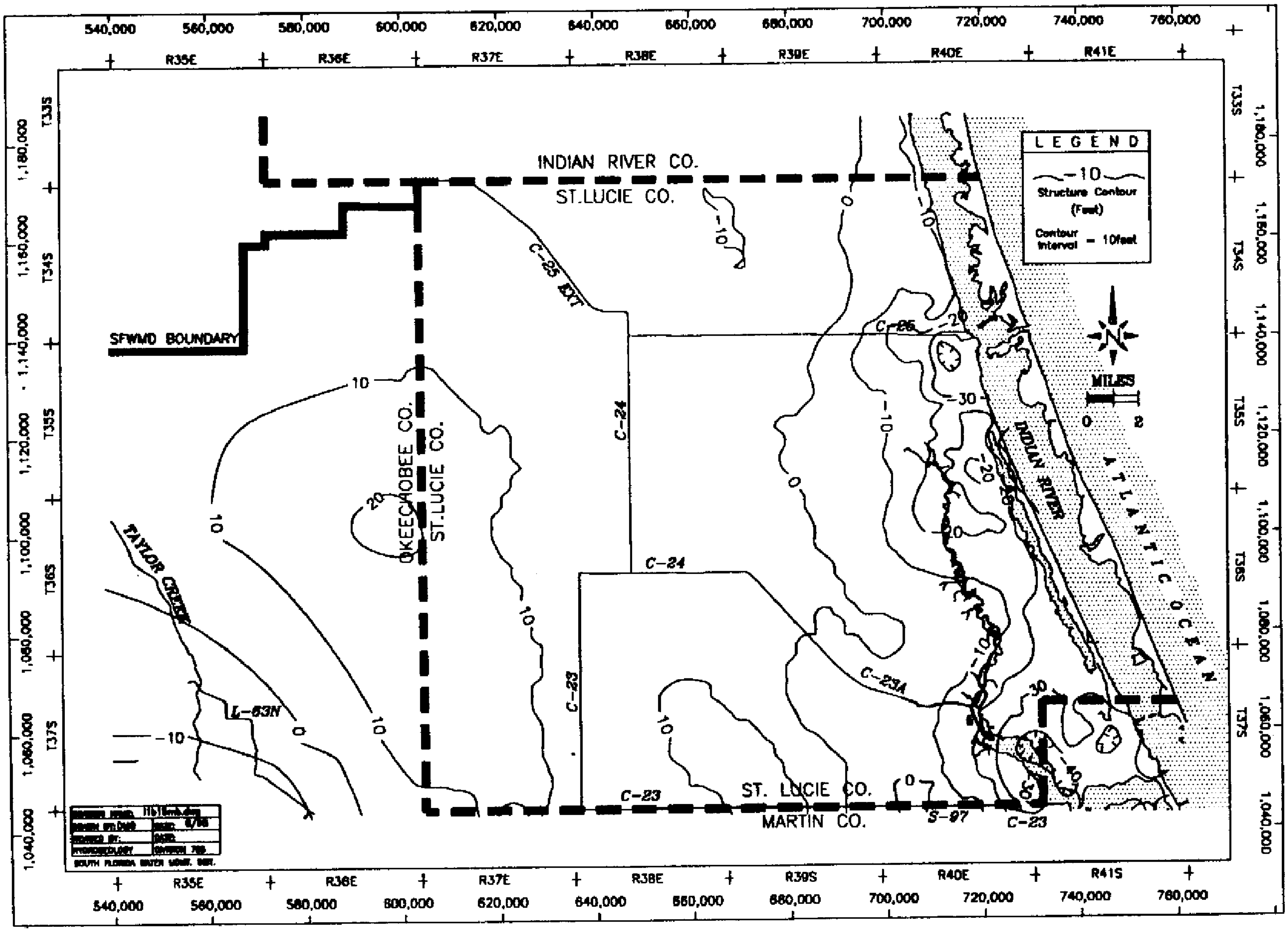


FIGURE A-3. Structure Contour Map of the Base of Layer 1

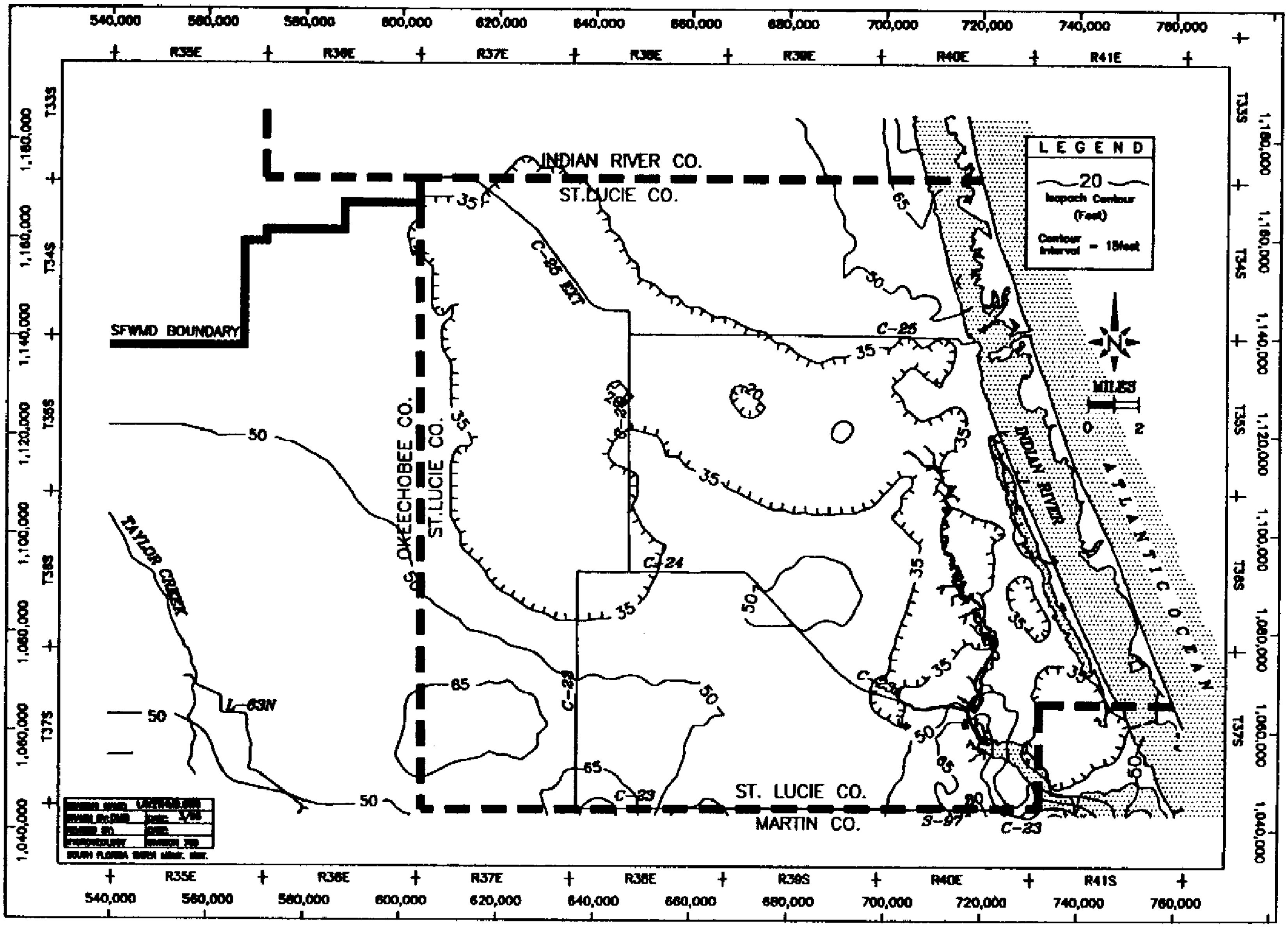


FIGURE A-4. Isopach Map of Layer 2

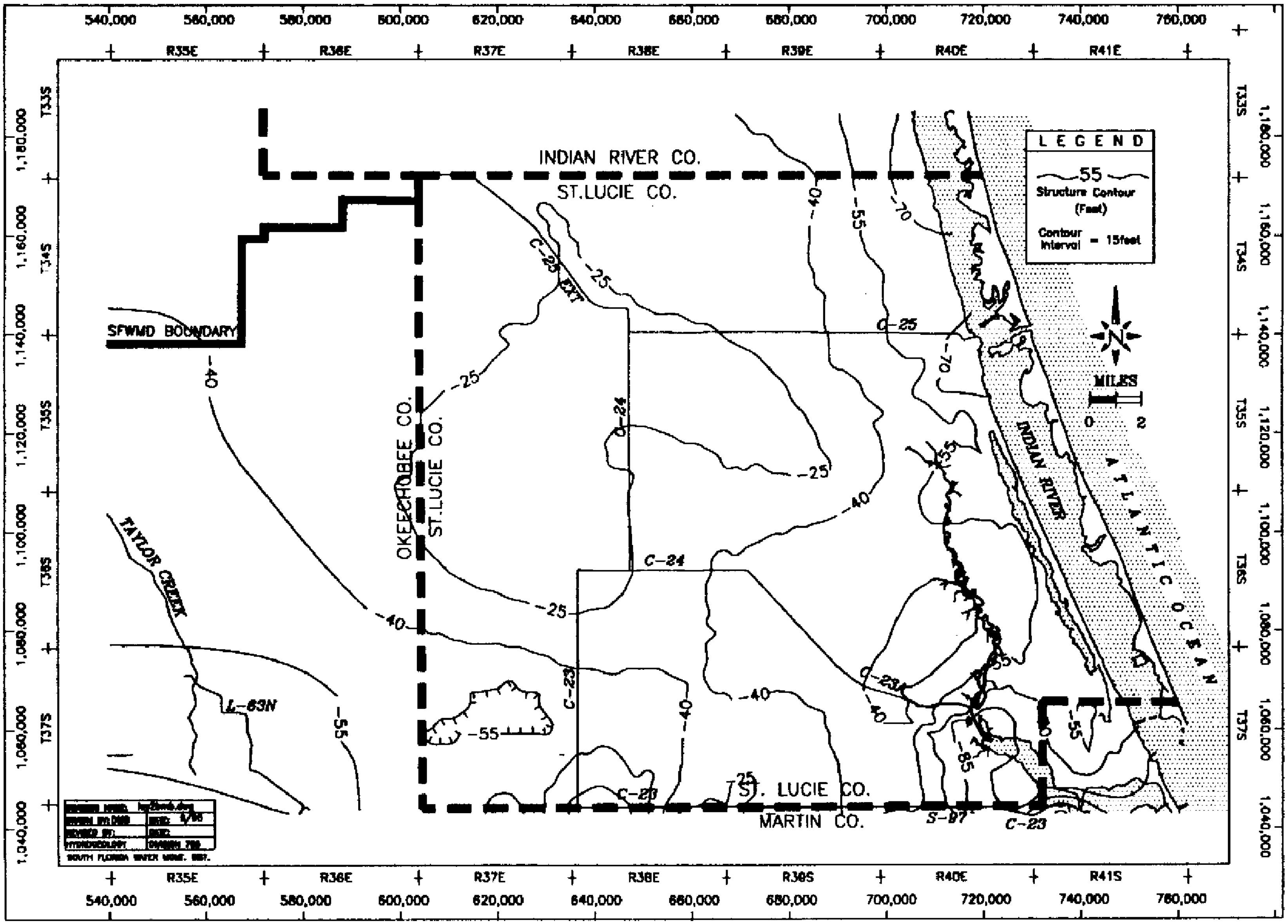


FIGURE A-5. Structure Contour Map of the Base of Layer 2

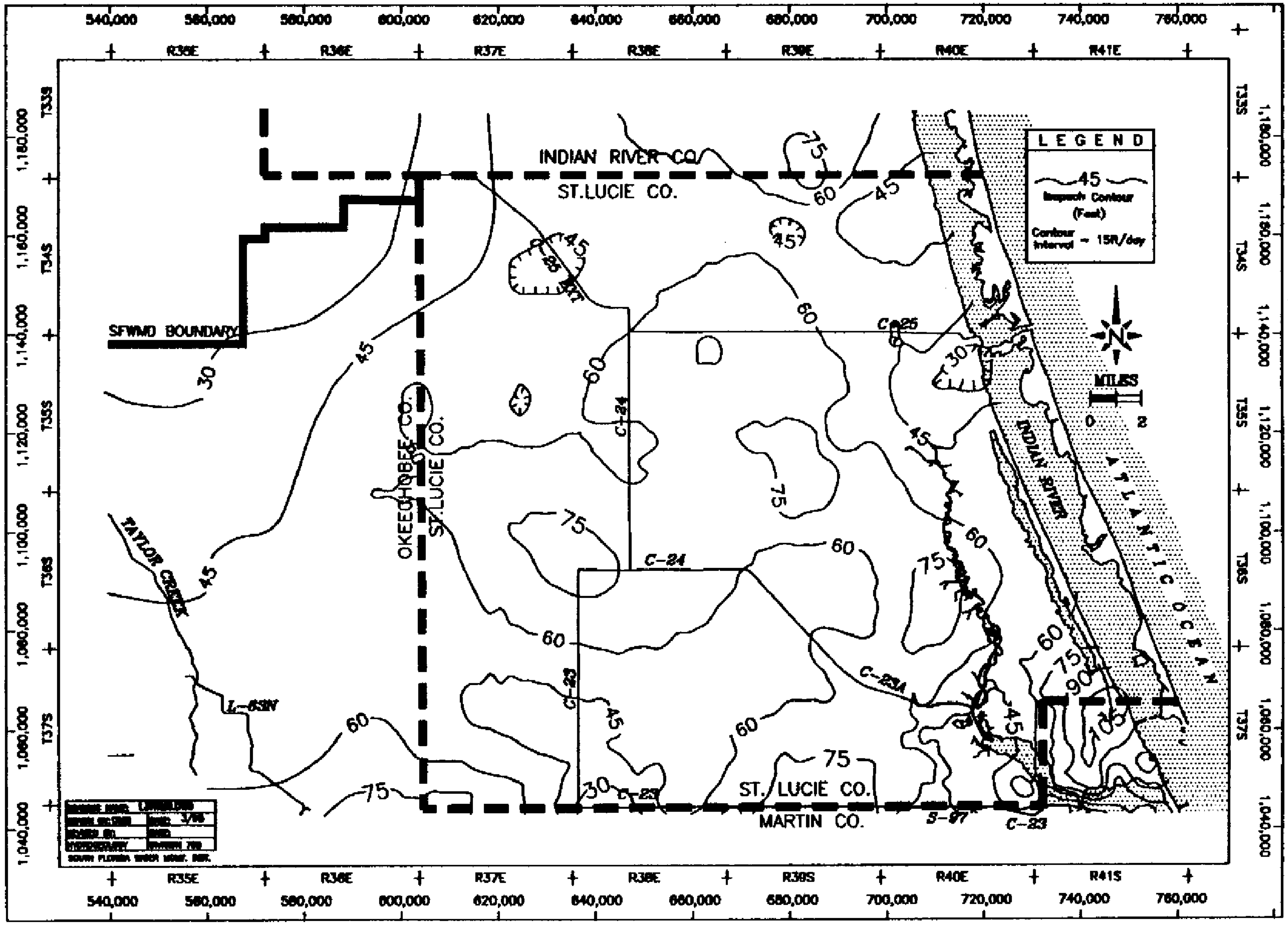


FIGURE A-6. Isopach Map of Layer 3

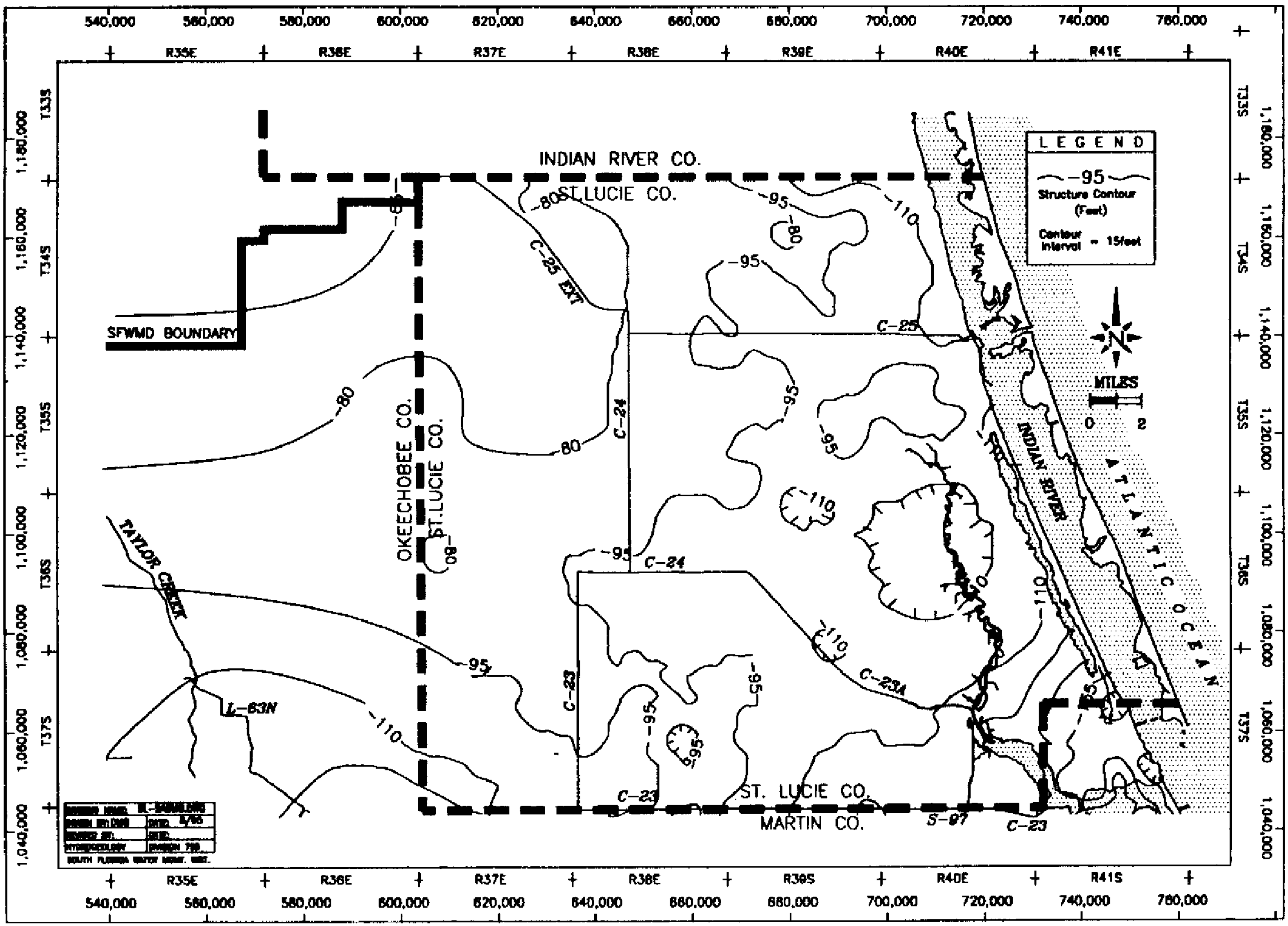


FIGURE A-7. **Structure Contour Map of the Base of the Surficial Aquifer System**

TABLE A-2. Soil Classification

MAP SYMBOL	SOIL CLASSIFICATION (STATSGO)	ESTIMATED HYDRAULIC CONDUCTIVITY (ft/day)
	ARENTS-MATLACHA-HYDRAQUENTS-WATER-NEILHURST	20.0
	BASINGER-URBAN LAND-IMMOKALEE-MYAKKA-OKELANTA	31.5
	FELDA-CHOBEE-KALIGA-FLORIDANA-NITTAW	11.5
	FLORIDANA-RIVIERA-TERRA CEIA-PLACID-POMPANO	25.1
	MYAKKA-POMELLO-IMMOKALEE-WAVELAND-CASSIA	26.6
	PALM BEACH-CANAVERAL-URBAN LAND-ST. AUGUSTINE-BEACHES	44.2
	PAOLA-ORSINO-ASTATULA-POMELLO-MYAKKA	43.2
	POMONA-EAUGALLIE-MALABAR-MYAKKA-BASINGER	28.2
	RIVIERA-PINEDA-FELDA-WINDER	11.7
	SMYRNA-IMMOKALEE-BASINGER-MYAKKA-EAUGALLIE	29.6
	TAVARES-ZOLFO-PAOLA-ASTATULA-MYAKK	41.7
	TERRA CEIA-GATOR-CANOVA	16.0
	TERRA CEIA-SAMSULA-TOMOKA-HONTOON	25.9
	WABASSO-FELDA-PINEDA-WINDER-PAISLEY	15.6
	WATER-FELDA-MALABAR	17.2
	WATER-PECKISH-ESTERO-PELLICER-WULFERT	OUTSIDE MODEL
	WATER-TERRA CEIA-GATOR	18.6
	WATER-TERRA CEIA-URBAN LAND	28.0
	WAVELAND-ZOLFO-MYAKKA-IMMOKALEE-MALABAR	20.4

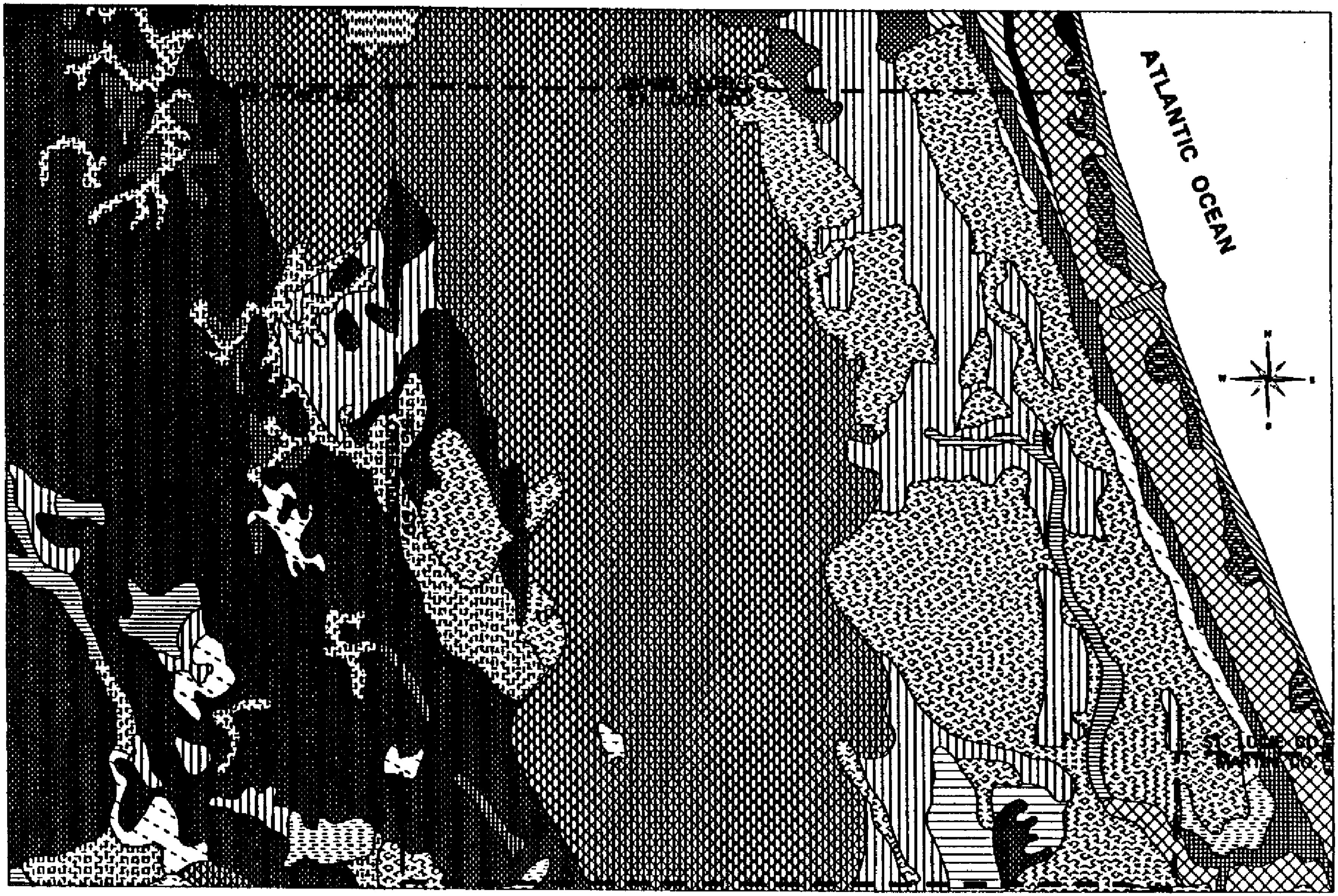


FIGURE A-8. General Soil Type Map for the Study Area from Statsgo

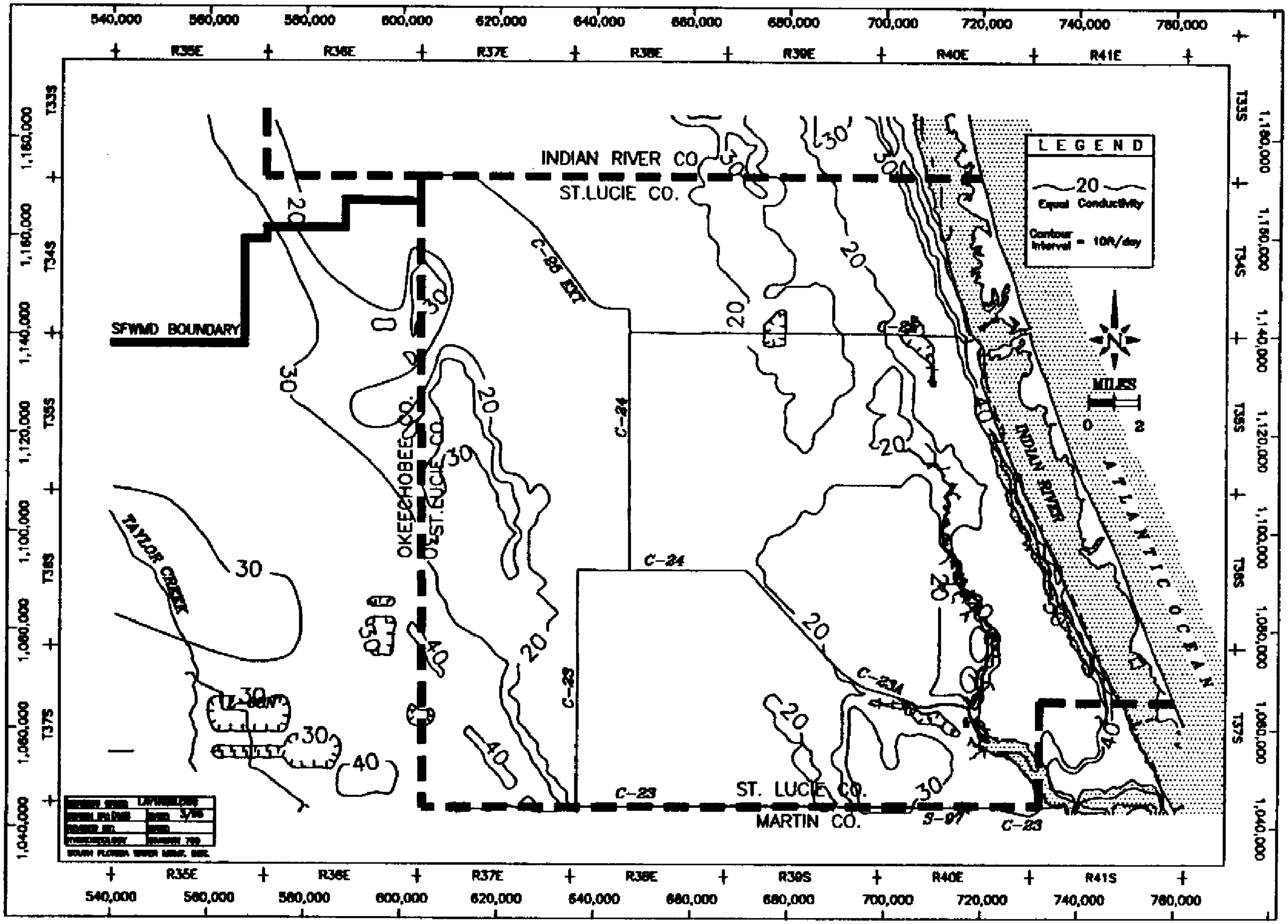


FIGURE A-9. Hydraulic Conductivity Map of Layer 1

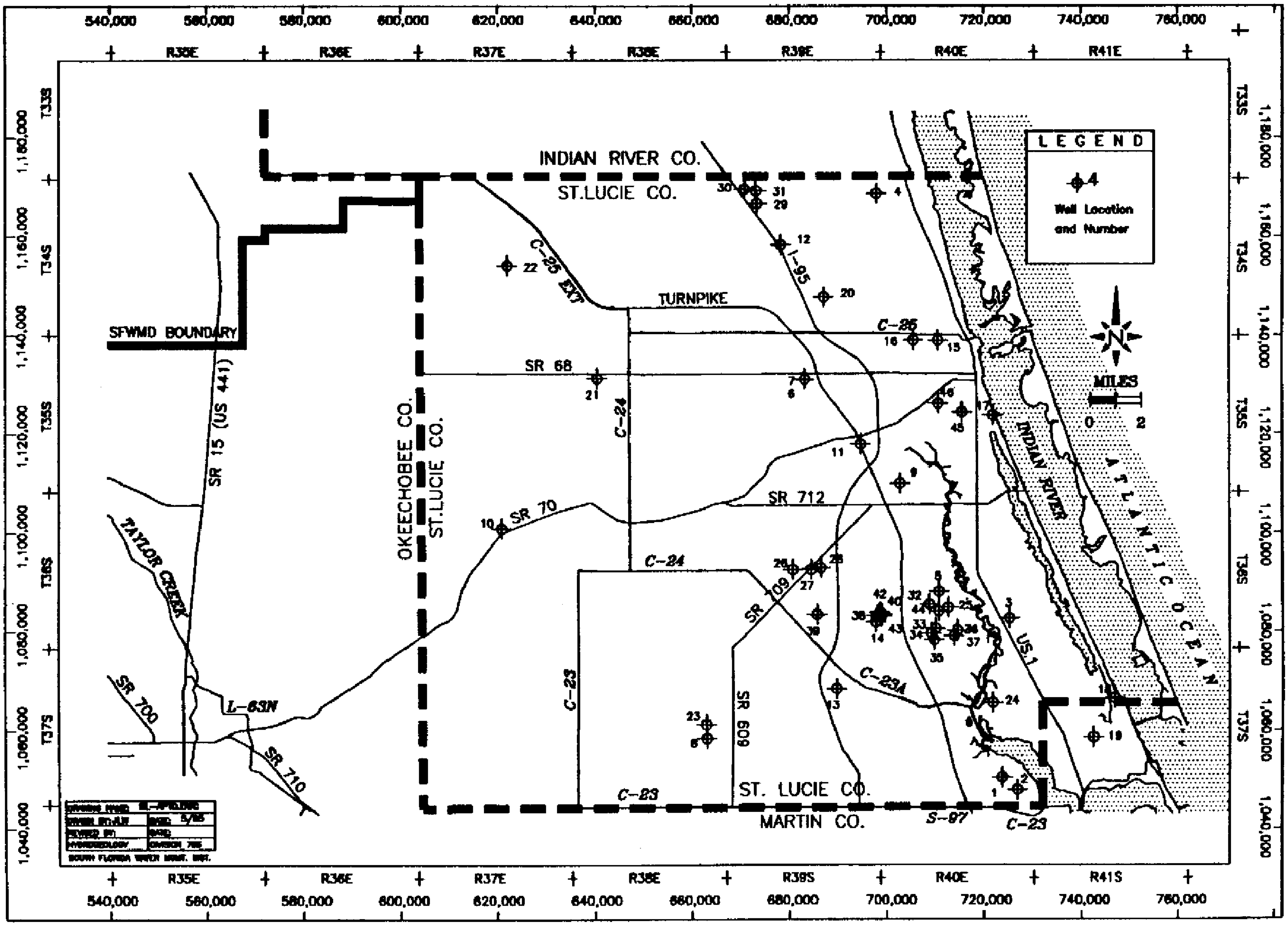


FIGURE A-10. Map Showing the Location of the APT's

TABLE A-3. St. Lucie County Aquifer Performance Tests

* DENOTES THE T VALUES CAME FROM BEARDEN'S BOG REPORT OR FROM HYDROSOFT'S DATA RECON FOR THE ST LUCIE COUNTY WELLFIELD PROTECTION MODEL. THESE VALUES ARE UNVERIFIED.

WELL NAME	MAP #	EAST PLANARS	NORTH PLANARS	TRANSMISSIVITY (FT^2/DAY)	STORATIVITY	LEAKANCE (1/DAY)	SCREEN INTERVAL	HYDRAULIC CONDUCTIVITY LAYER 2 (FEET/DAY)	LAYER 3 (FEET/DAY)
HARBOR RIDGE #1	1	723702	1050219	13368.984	0.00030	0.00020	80-110	125	150
HARBOR RIDGE #2	2	726875	1047712	6684.000			95-120	60	95
SAVANNAH CLUB	3	725328	1082542	1002.674	0.00023	0.00080	70-100	10	22
SP LAKES C CLUB	4	697753	1168535	6684.492	0.00050	0.00400	80-100	80	80
NPT ST LUCIE PW12	5	710777	1087816	1804.813	0.00019	0.00040	71-106	20	25
STL APT2	6	682980	1130900	802.139	0.00010	0.00020	67-117		11
SHALLOW	7	682980	1130900	1336.898	0.00510		31-51	41	
McCARTY RANCH	8	662913	1058109	1336.898	0.00011	0.00045	130-113	70	20
STL APT1	9	702639	1109785	8021.390		VERY LOW	58-108	20	131
STLAPT4	10	620706	1100574	1644.385	0.00040	0.00250	30-40	78	11
FT PIERCE INT	11	694488	1117725	1791.444		VERY LOW	70-110	20	30
INDRIO ROAD	12	677997	1158042	3074.866	0.00006	0.00120	60-90	30	71
SAVAGE ROAD	13	689672	1068323	802.139	0.00020	0.00400	33-63	23	11
ST LUCIE WEST	14	697638	1081690	2272.727	0.00016	0.00170	30-60	49	11
FT.PIERCE,BCE#10	15	710512	1138709	3771.791	0.00130		71-131	54	54
FT.PIERCE,BCE#11	16	705370	1138784	3021.390	0.00022		60-120	39	39
FP#5ABD	17	721765	1123622	5347.594	0.00030		78-168	44	44
SAVANNAH DUNES	18	747020	1066400	6016.043	0.00022	0.00067	180-195		52
N MARTIN CO PW7	19	742612	1058406	2112.299	0.00030	0.01500 71-		20	31
MONTE CARLO CC	20	686869	1147478	1711.230	0.00005	0.00020	65-95	10	28
*BEARDEN 157	21	640276	1131032	5347.594	0.00005				
*BEARDEN 162	22	621827	1153894	1149.733	0.00010		58	34	25
*BEARDEN 160	23	662811	1060936	7085.561	0.00008		21	147	20
*BEARDEN 167	24	721813	1065356	668.449	0.00025		105		
*BEARDEN 165	25	712688	1084595	6818.182	0.00083		100	20	91
*RESERVE TW1	26	680542	1092315	561.497					
*RESERVE TW2	27	684329	1092332	574.866					
*RESERVE TW3	28	686312	1092664	487.968			100-135	12	8
*SP LKS FAIRWYS 1	29	673188	1166402	5347.594			68-95		
*SP LKS FAIRWYS 2	30	670656	1169320	2005.348			75-83		
*SP LKS FAIRWYS 3	31	672997	1169027	868.984			65-80	20	55
*GEN DEV #13	32	708805	1085280	3074.866			71-95	20	47
*GEN DEV #14	33	710093	1080440	3943.850			54-100	20	60
*GEN DEV #15	34	709196	1079426	7312.834			60-100	20	112
*GEN DEV #16	35	709744	1078116	9545.455			64-90	20	147
*GEN DEV #17	36	714606	1080060	4799.465			55-110	20	73

TABLE A-3. St. Lucie County Aquifer Performance Tests (Continued)

* DENOTES THE T VALUES CAME FROM BEARDEN'S BOG REPORT OR FROM HYDROSOFT'S DATA RECON FOR THE ST LUCIE COUNTY WELLFIELD PROTECTION MODEL. THESE VALUES ARE UNVERIFIED.

WELL NAME	MAP #	EAST PLANARS	NORTH PLANARS	TRANSMISSIVITY (FT^2/DAY)	STORATIVITY	LEAKANCE (1/DAY)	SCREEN INTERVAL	HYDRAULIC CONDUCTIVITY LAYER 2 (FEET/DAY)	HYDRAULIC CONDUCTIVITY LAYER 3 (FEET/DAY)
*GEN DEV #18	37	713890	1078945	1497.326			50-95	20	23
*ST LUCIE W 1	38	697902	1083004	3475.936			30-70	75	20
*ST LUCIE W 2	39	685533	1083180	630.214			30-70		20
*ST LUCIE W 3	40	698893	1083211	3208.556			30-70	70	20
*ST LUCIE W 4	41	699434	4083416	2807.487			30-70	61	20
*ST LUCIE W 5	42	698536	1083603	3475.936			30-70	75	20
*ST LUCIE W 6	43	698805	1082807	2406.417			30-70	52	20
GEN DEV PW4	44	710737	1083830	2312.834	0.00020		60-100	20	36
FPPW778	45	715452	1124256	13368.980	0.00020		60-100	157	157
FPPW478	46	710667	1126118	2673.797	0.00300		60-100	36	36

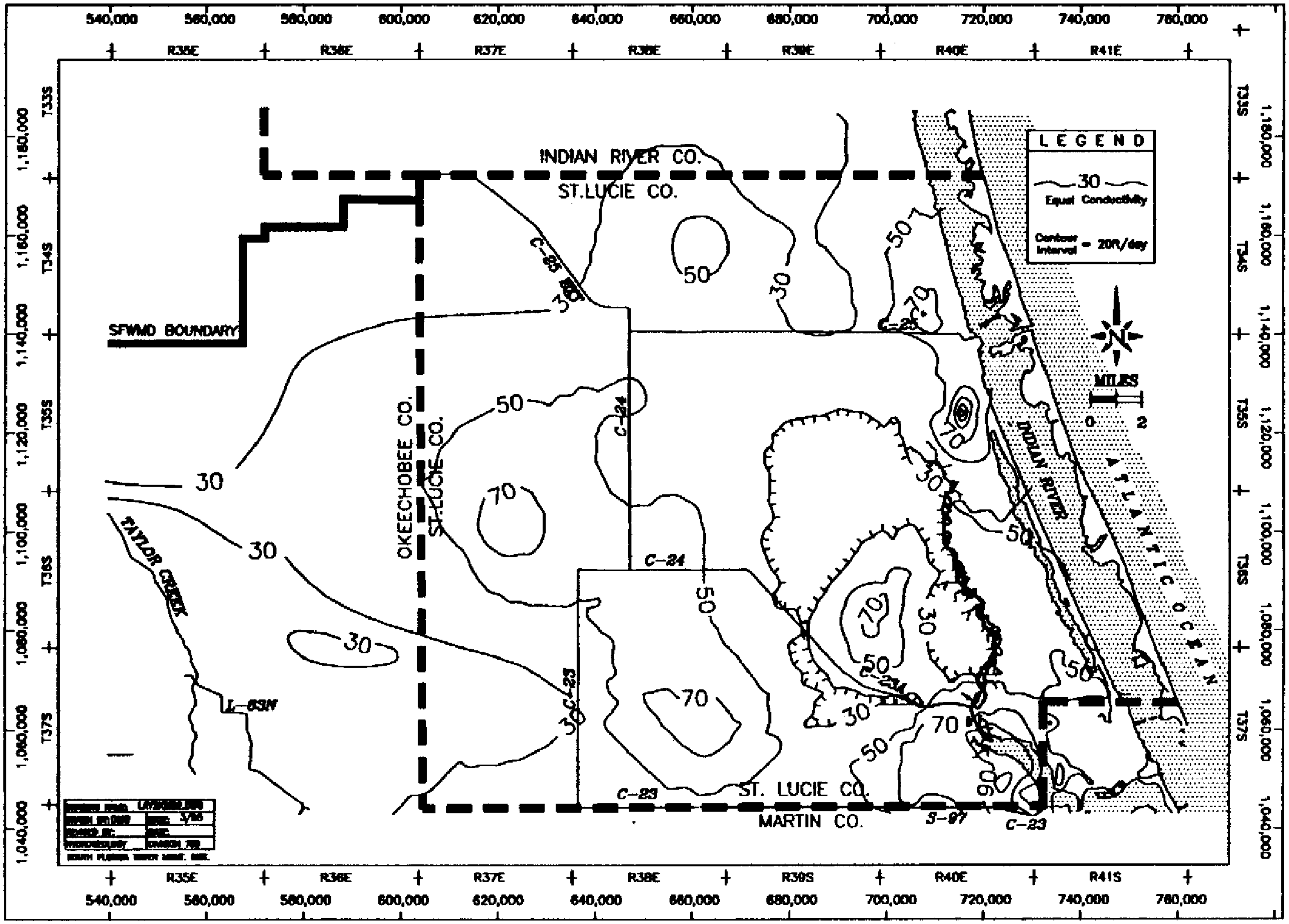


FIGURE A-11. Hydraulic Conductivity of Layer 2

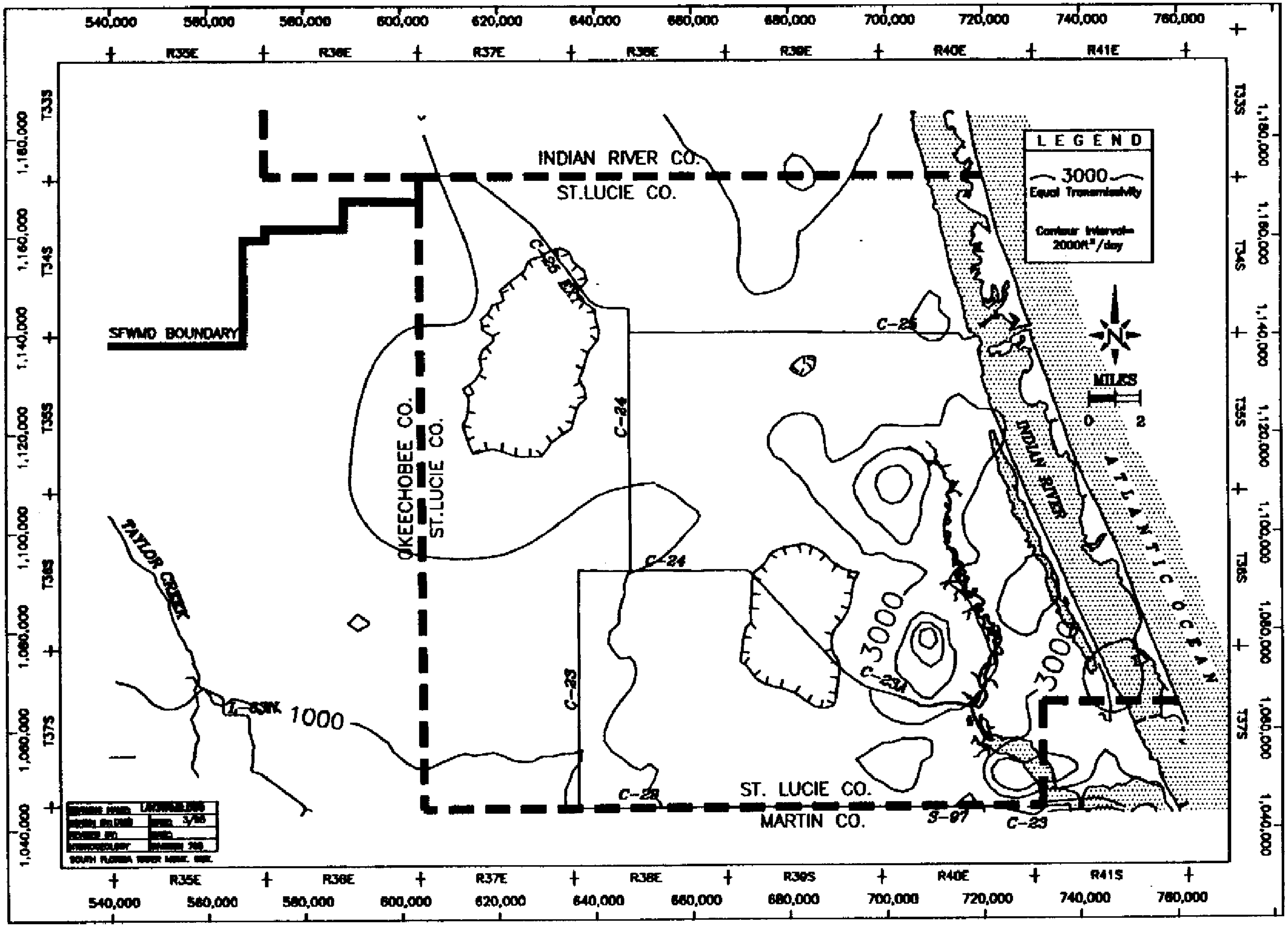


FIGURE A-12. Transmissivity of Layer 3

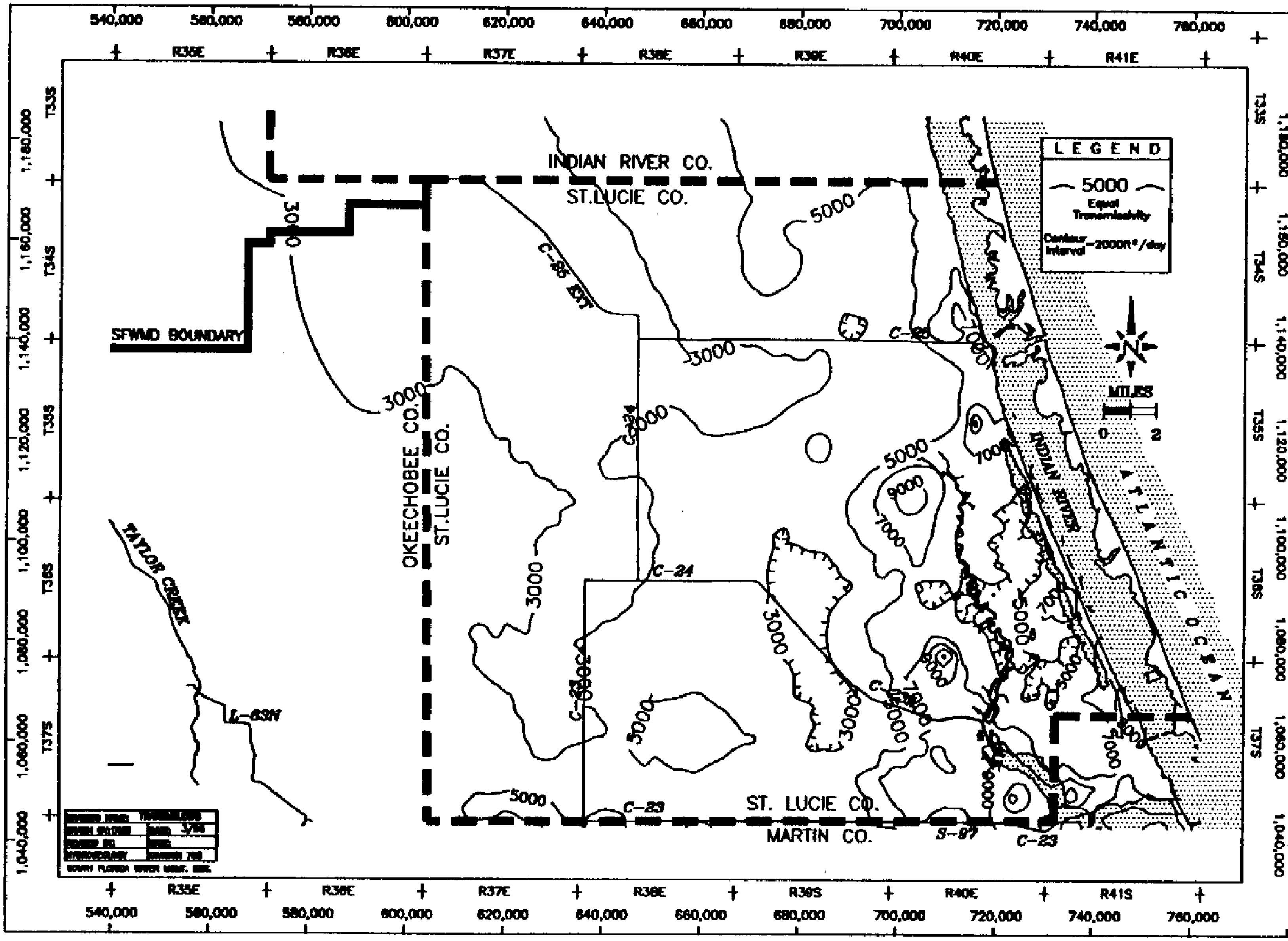


FIGURE A-13. Composite Transmissivity Map of the Surficial Aquifer System

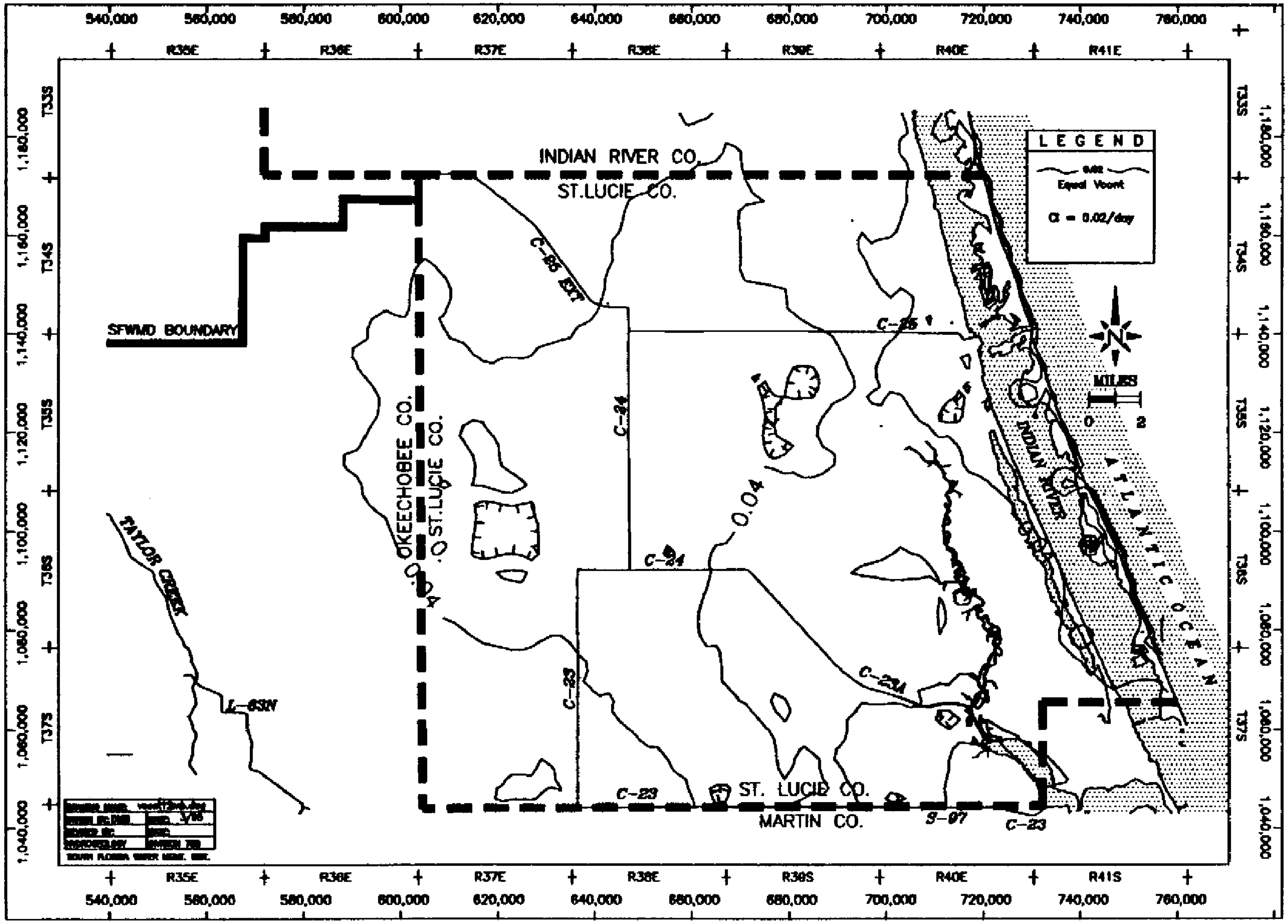


FIGURE A-14. Vcont between layers 1 and 2

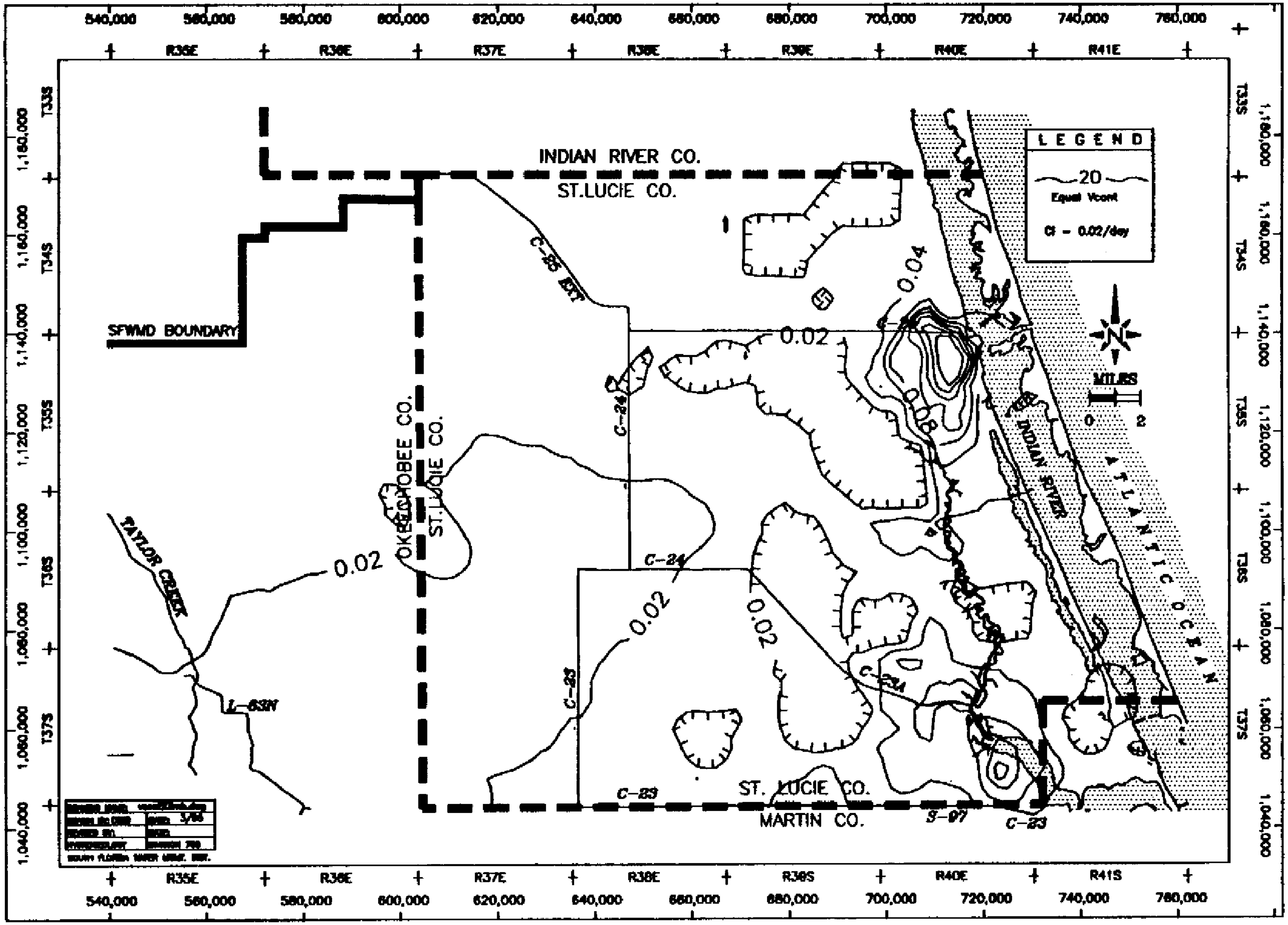


FIGURE A-15. Vcont between layers 2 and 3

APPENDIX B

DATA FOR SURFACE WATER FEATURE

LIST OF FIGURES - APPENDIX B

LIST OF TABLES - APPENDIX B

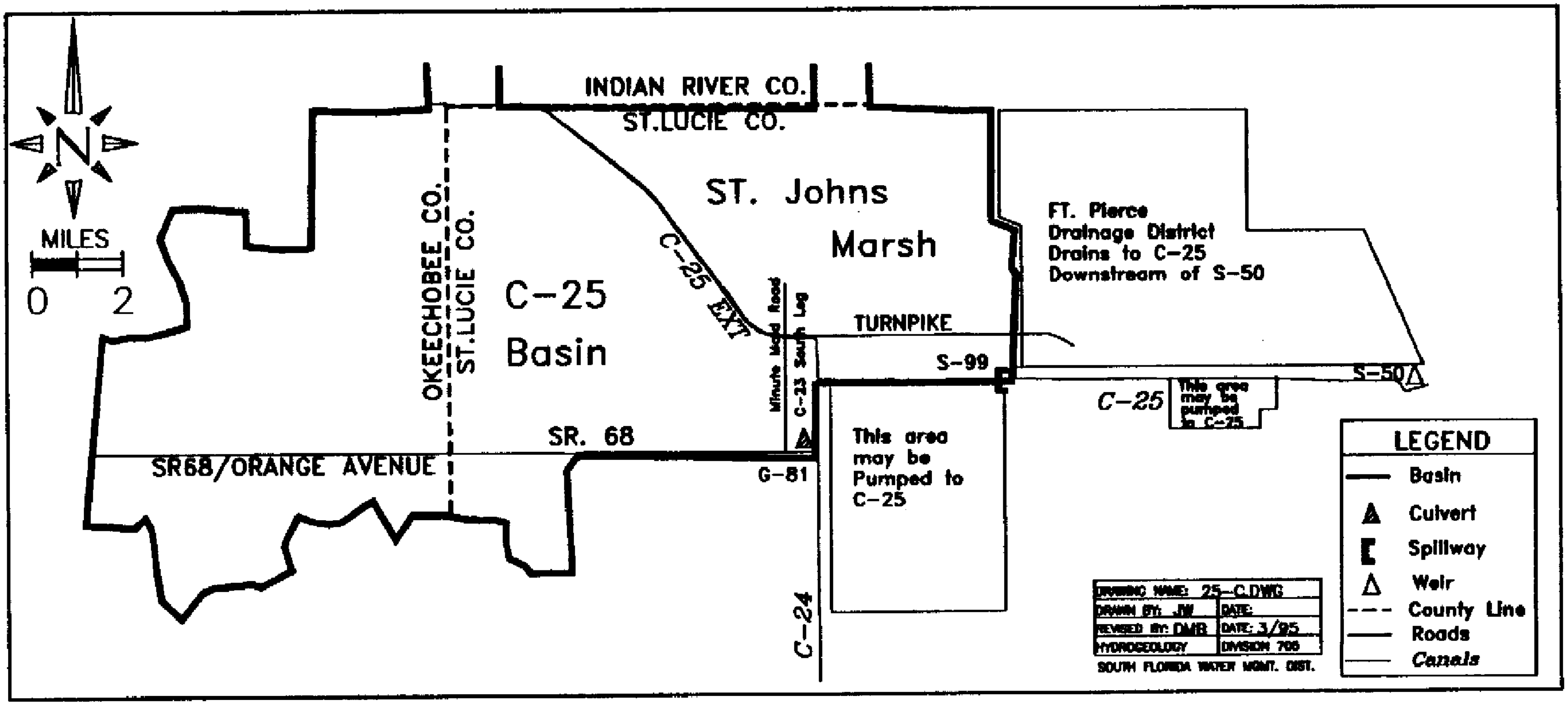


FIGURE B-1. The C-25 Basin (from Cooper and Ortel, 1988)

Table B-1. C-25 Basin Structures - Design Criteria

Structure	Type	Design Stages (ft NGVD)	Optimum Stage (ft NGVD)
S-50 Stage divide	Fixed crest weir; cl = 126 ft ce = 12.0 ft	HW = 16.0 TW = 0.7	Passes flow when HW) 12.0
S-99 Stage divide	Gated spillway, 2 gates 15.4 ft high * 25.8 ft wide, ncl = 50.0 ft ce = 5.6 ft	HW = 20.0 TW = 19.5	May 15 to Oct 15 19.2 ≤ HW ≤ 20.2 Oct 15 to May 15 21.5 ≤ HW ≤ 22.5
G-81 Water supply between C-24 and C-25	Steel sheet-pile dam, 3 timber gates on concrete weir, 9.5 ft high * 5.7 feet wide; ncl = 15.0 ft ce = 13.5 ft		Depends on conditions

ce = crest elevation
HW = head water
cl = crest length
ncl = net crest length

cmp = corrugated metal pipe
ie = invert elevation
TW = tail water

ft = feet
in = inches

Modified from Cooper and Ortel (1988)

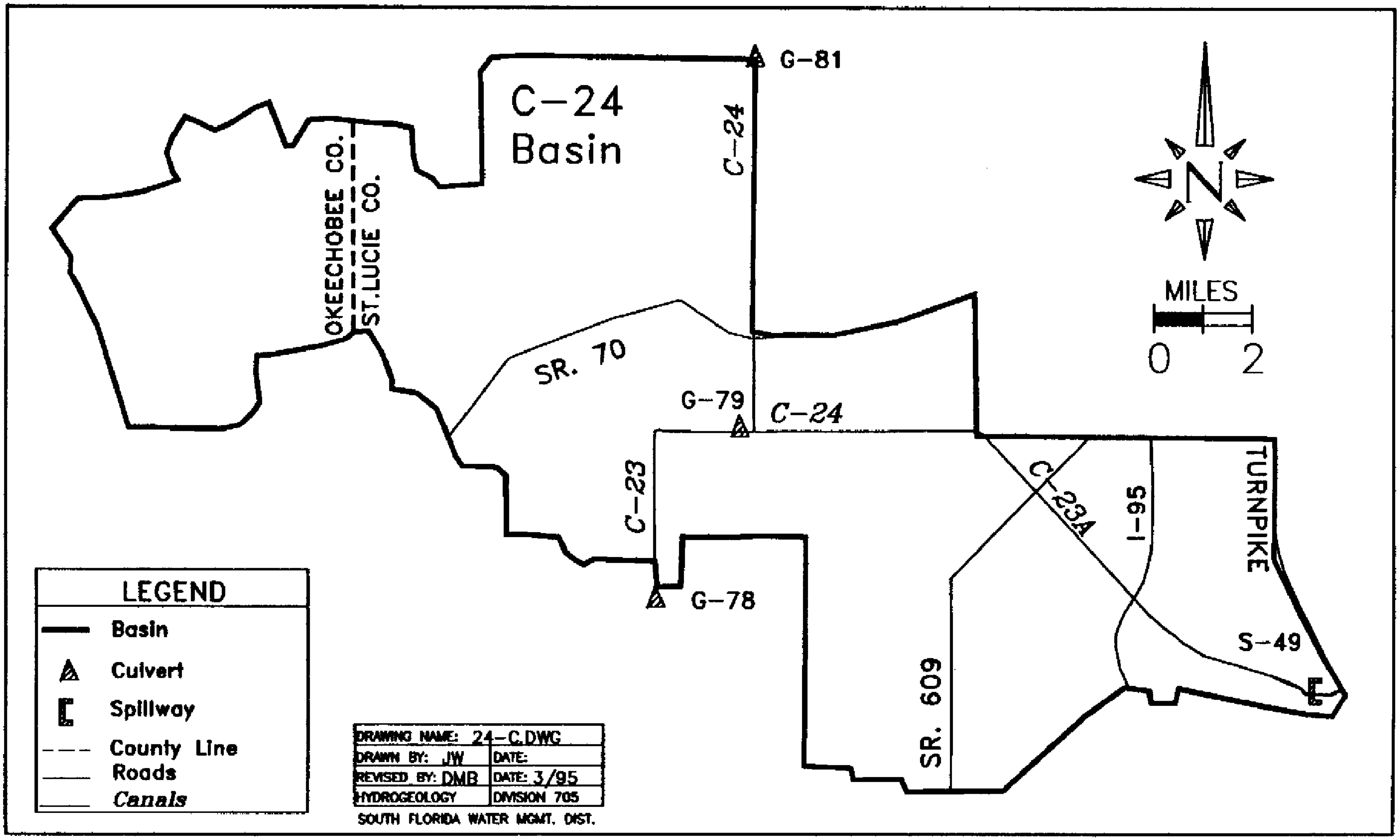


FIGURE B-2. The C-24 Basin (from Cooper and Ortel, 1988)

Table B-2. C-24 Basin Structures - Design Criteria

Structure	Type	Design Stages (ft NGVD)	Optimum Stage (ft NGVD)
S-49 Stage divide	Gated spillway, 2 gates, 15.7 ft high * 17.8 ft wide, ncl = 34.0 ft, ce = 4.4 ft NGVD	HW = 16.3 TW = 2.4	May 15 to Oct 15 18.5 ≤ HW ≤ 20.2 Oct 15 to May 15 19.5 ≤ HW ≤ 21.2
G-78 Divide Structure: C-23 and C-24 basins; Water Supply between C-23 and C-24	Culvert with flashboard riser 1-72 in * 50 ft CMP		Normally closed, opened for water supply or drainage
G-79 Stage divide Water Supply between C-23 and C-24	Culvert with flashboard riser 2-60 in * 62 ft CMP, ie = 16.9 ft (west end) ie = 15.9 ft (east end), 1-84 in * 62 ft CMP ie = 15.1 ft	HW = 22.0 (east side) TW = 22.9 (west side)	HW ⟨ 23.0
G-81 Water supply between C-24 and C-25	Steel sheet-pile dam, 3 timber gates on concrete weir, 9.5 ft high * 5.7 feet wide; ncl = 15.0 ft ce = 13.5 ft		Depends on conditions

ce = crest elevation
HW = head water
ncl = net crest length
cmp = corrugated metal pipe
ie = invert elevation
TW = tail water
ft = feet
in = inches

Modified from Cooper and Ortel (1988)

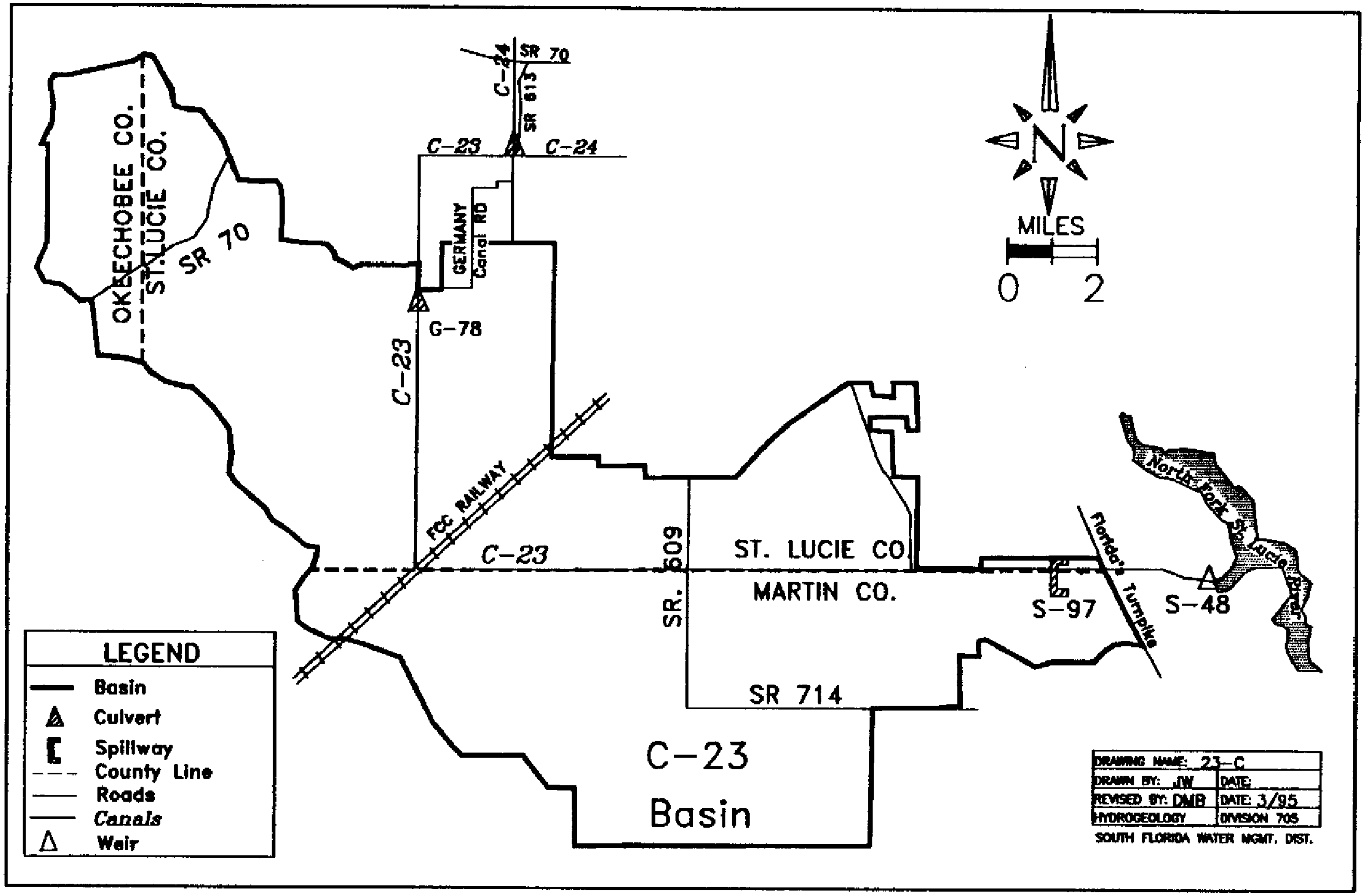


FIGURE B-3. **The C-23 Basin (from Cooper and Ortel, 1988)**

Table B-3. C-23 Basin Structures - Design Criteria

Structure	Type	Design Stages (ft NGVD)	Optimum Stage (ft NGVD)
S-48 Stage divide	Fixed crest weir, cl = 113 ft ce = 8.0 ft	HW = 13.0 TW = 0.7	Passes flow when HW) 8.0
S-97 Stage divide	Gated spillway, 2 gates 14.2 ft high * 22.8 ft wide, ncl = 44.0 ft ce = 7.8 ft	HW = 18.5 TW = 14.0	May 15 to Oct 15 20.5 $\leq$ HW $\leq$ 22.2 Oct 15 to May 15 22.2 $\leq$ HW $\leq$ 23.2
G-78 Divide Structure: C-23 and C-24 basins; Water Supply between C-23 and C-24	Culvert with flashboard riser 1-72 in * 50 ft CMP		Normally closed, opened for water supply or drainage

ce = crest elevation
HW = head water
cl = crest length
ncl = net crest length

cmp = corrugated metal pipe
ie = invert elevation
TW = tail water

ft = feet
in = inches

Modified from Cooper and Ortel (1988)

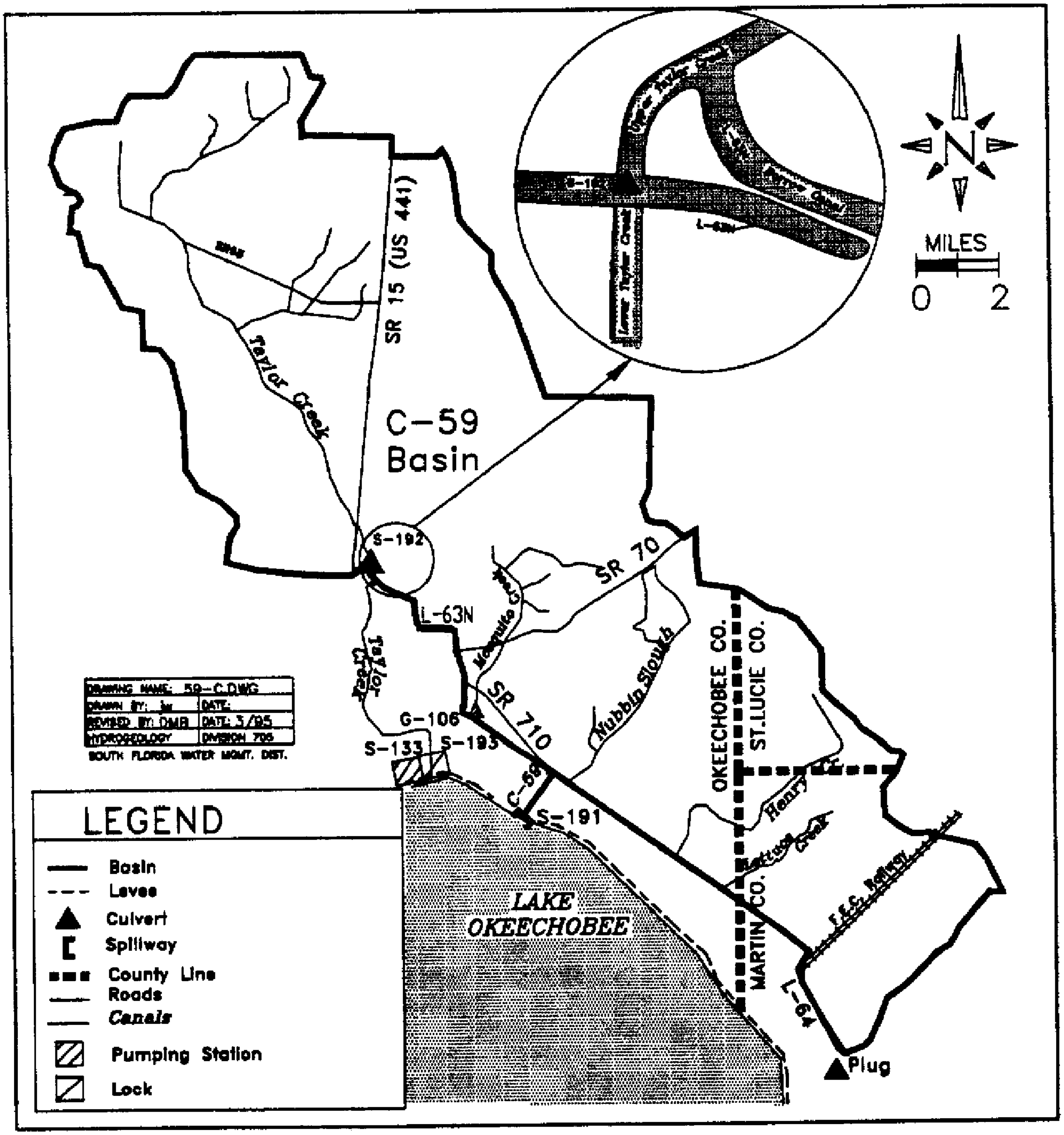


FIGURE B-4. **The C-59 Basin (from Cooper and Ortel, 1988)**

Table B-4. C-59 Basin Structures - Design Criteria

Structure	Type	Design Stages (ft NGVD)	Optimum Stage (ft NGVD)
S-191 Stage divide	Gated spillway, 3 gates 17.6 ft high * 27.8 ft wide, ncl = 81.0 ft ce = 7.4 ft	HW = 19.2 TW = 18.6	19.0 19.2 ≥ HW ≥ 18.8 (Gate closed if TW ⟩ HW)
S-192 Divide structure and pump station, water supply from L-63N Borrow Canal to Taylor Creek	Gated Culvert 4ft * 112ft CMP ie = 8.0 ft; Pump station unit:one 13500 GPM pump	HW = 21.6 TW = 13.0	HW = 19.0 TW = 14.0 (water supply)
G-106 Divide structure and water supply from L-63N Borrow Canal to S-113 Basin	Gated Culvert 3ft * 90ft CMP ie = 15.0		

ce = crest elevation
HW = head water
ncl = net crest length

cmp = corrugated metal pipe
ie = invert elevation
TW = tail water

ft = feet
in = inches

Modified from Cooper and Ortel (1988)

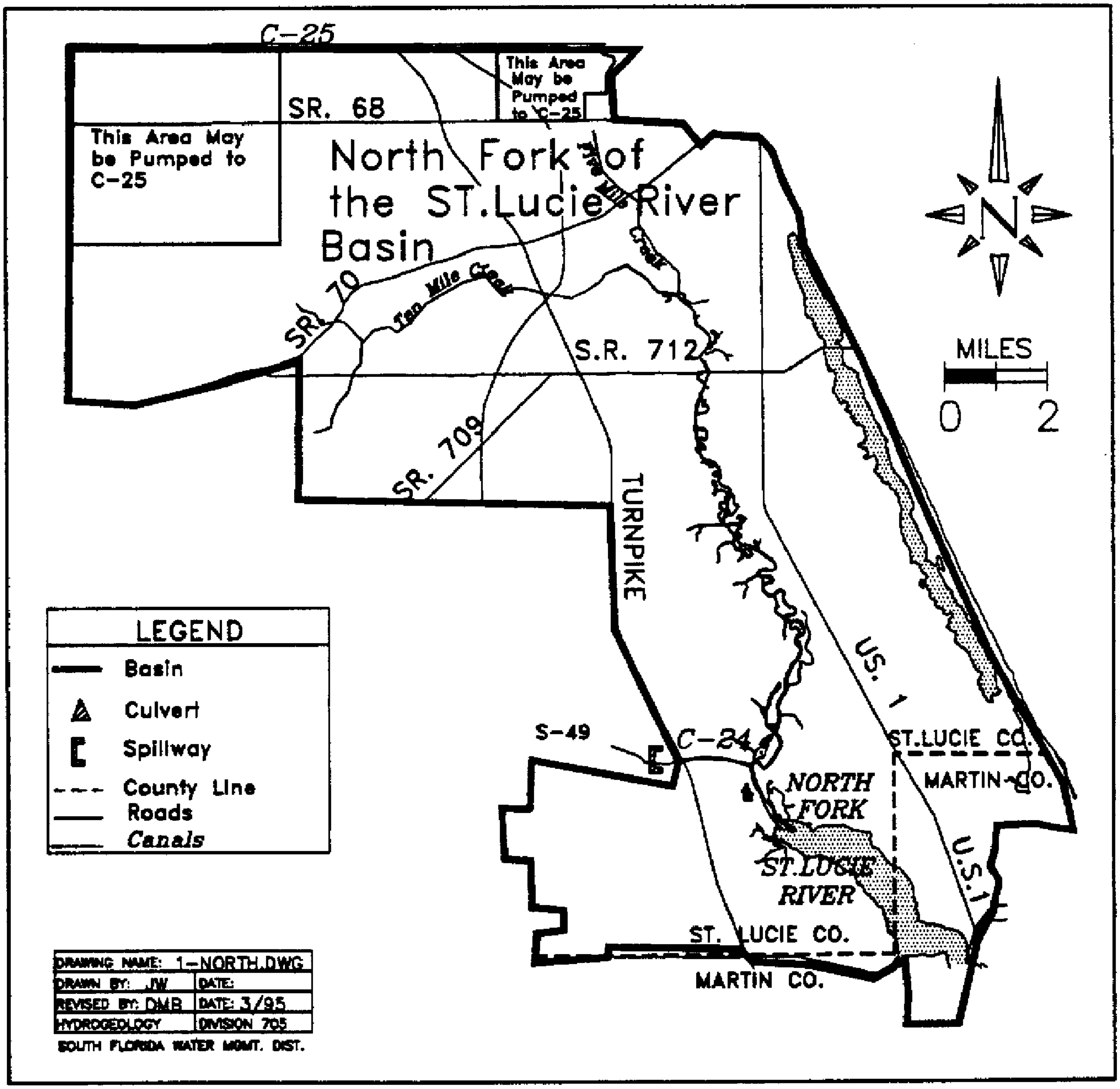


FIGURE B-5. The North Fork of the St. Lucie River Basin (from Cooper and Ortel, 1988)

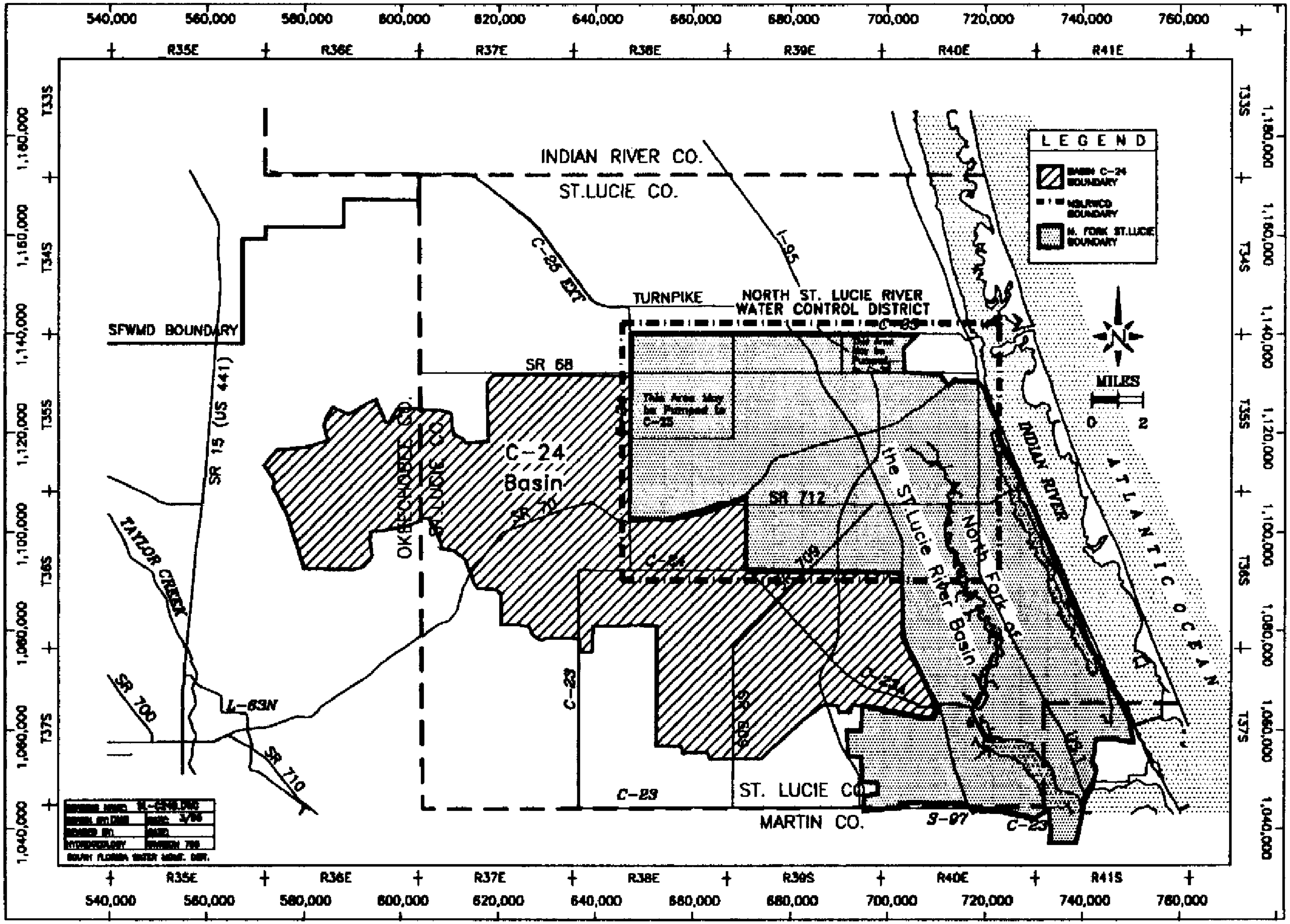


FIGURE B-6. **Location of the NSLRWCD in Relation to the North Fork of the St. Lucie River Basin and the C-24 Basin**

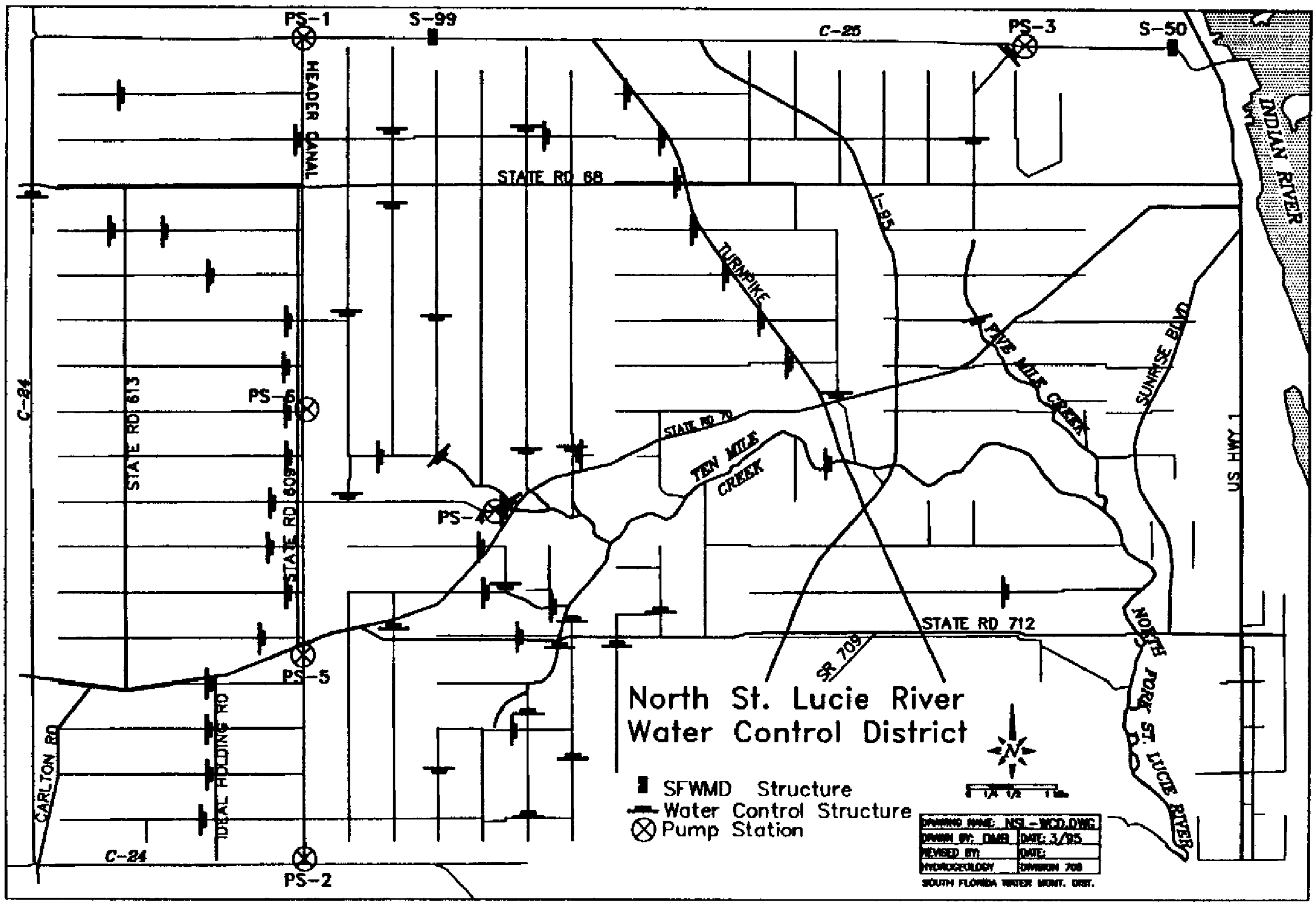


FIGURE B-7. Location of the Pump Stations within the NSLRWCD.

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-25	S-99	23	54	0.6	2408	100	0.117
C-25	S-99	23	55	1.0	2000	100	0.117
C-25	S-99	23	56	1.0	2000	100	0.117
C-25	S-99	23	57	1.0	2000	100	0.117
C-25	S-99	23	58	1.0	2000	100	0.117
C-25	S-99	23	59	1.0	2000	100	0.117
C-25	S-99	23	60	1.0	2000	110	0.117
C-25	S-99	23	61	2.0	2000	110	0.117
C-25	S-99	23	62	2.0	2000	130	0.117
C-25	S-99	23	63	2.0	2000	110	0.117
C-25	S-99	23	64	2.0	2000	100	0.117
C-25	S-99	23	65	2.0	2000	100	0.117
C-25	S-50	23	66	2.0	2000	100	0.119
C-25	S-50	23	67	2.0	2000	100	0.201
C-25	S-50	23	68	2.0	2000	100	0.158
C-25	S-50	23	69	2.0	2000	100	0.156
C-25	S-50	23	70	2.0	2000	100	0.173
C-25	S-50	23	71	2.0	2000	100	0.204
C-25	S-50	23	72	2.0	2000	90	0.204
C-25	S-50	23	73	1.0	2000	80	0.204
C-25	S-50	23	74	1.0	2000	90	0.204
C-25	S-50	23	75	1.0	2000	100	0.191
C-25	S-50	23	76	1.0	2000	100	0.156
C-25	S-50	23	77	1.0	2000	100	0.156
C-25	S-50	23	78	1.0	2000	100	0.156
C-25	S-50	23	79	1.0	2000	100	0.156
C-25	S-50	23	80	1.0	2000	100	0.156
C-25	S-50	23	81	0.0	2000	100	0.186
C-25	S-50	23	82	0.0	2000	110	0.180
C-25	S-50	23	83	0.0	2000	100	0.156
C-25	S-50	23	84	0.0	2000	110	0.157
C-25	S-50	23	85	0.0	2000	110	0.194
C-25	S-50	23	86	0.0	2000	100	0.204

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-25	S-50	23	87	0.0	2000	100	0.204
C-25	S-50	23	88	0.0	455	130	0.348
C-25	TIDAL	23	88	-5.0	2227	180	0.348
C-25	TIDAL	23	89	-10.0	2000	200	0.383
C-25E	S-99	7	33	0.6	2000	60	0.117
C-25E	S-99	7	34	0.6	2000	60	0.117
C-25E	S-99	7	35	0.6	2000	60	0.117
C-25E	S-99	7	36	0.6	2000	50	0.117
C-25E	S-99	7	37	0.6	2455	60	0.117
C-25E	S-99	7	38	0.6	2227	70	0.117
C-25E	S-99	8	39	0.6	2364	70	0.117
C-25E	S-99	8	40	0.6	1410	70	0.117
C-25E	S-99	9	40	0.6	1455	70	0.117
C-25E	S-99	9	41	0.6	1590	80	0.117
C-25E	S-99	10	41	0.6	955	90	0.117
C-25E	S-99	10	42	0.6	2136	90	0.117
C-25E	S-99	11	43	0.6	2545	90	0.117
C-25E	S-99	11	44	0.6	363	90	0.117
C-25E	S-99	12	44	0.6	2455	100	0.117
C-25E	S-99	12	45	0.6	363	100	0.117
C-25E	S-99	13	45	0.6	2363	100	0.117
C-25E	S-99	14	45	0.6	363	100	0.117
C-25E	S-99	14	46	0.6	2090	100	0.117
C-25E	S-99	15	46	0.6	1136	90	0.117
C-25E	S-99	15	47	0.6	1455	90	0.117
C-25E	S-99	16	47	0.6	1955	90	0.117
C-25E	S-99	16	48	0.6	363	90	0.117
C-25E	S-99	17	48	0.6	2500	80	0.117
C-25E	S-99	18	48	0.6	136	120	0.117
C-25E	S-99	18	49	0.6	2136	100	0.117
C-25E	S-99	19	49	0.6	1182	100	0.117
C-25E	S-99	19	50	0.6	1182	110	0.117
C-25E	S-99	20	50	0.6	1227	100	0.117

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-25E	S-99	20	51	0.6	2182	100	0.117
C-25E	S-99	20	52	0.6	2000	90	0.117
C-25E	S-99	20	53	0.6	2000	90	0.117
C-25E	S-99	20	54	0.6	1000	100	0.117
C-25E	S-99	21	54	0.6	2000	100	0.117
C-25E	S-99	22	54	0.6	2000	100	0.117
C-25	S-99	23	54	5.0	455	90	0.117
C-25	S-99	24	54	5.0	2000	90	0.117
C-25	S-99	25	54	5.0	2000	90	0.117
C-25	S-99	26	54	5.0	2000	80	0.117
C-25	S-99	27	54	5.0	1000	80	0.117
C-24	G-81 @ C-24	27	54	5.0	1000	90	0.117
C-24	G-81 @ C-24	28	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	29	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	30	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	31	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	32	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	33	54	5.0	2000	80	0.117
C-24	G-81 @ C-24	34	54	5.0	2000	80	0.117
C-24	G-81 @ C-24	35	54	5.0	2000	90	0.117
C-24	G-81 @ C-24	36	54	5.0	2000	100	0.117
C-24	G-81 @ C-24	37	54	4.0	2000	110	0.117
C-24	G-81 @ C-24	38	54	4.0	2000	110	0.117
C-24	G-81 @ C-24	39	54	4.0	2000	110	0.117
C-24	G-81 @ C-24	40	54	4.0	2000	110	0.117
C-24	G-81 @ C-24	41	54	3.0	2000	100	0.117
C-24	G-81 @ C-24	42	54	0.0	2000	90	0.117
C-24	G-81 @ C-24	43	54	0.0	2000	80	0.117
C-24	G-81 @ C-24	44	54	0.0	2000	80	0.117
C-24	G-81 @ C-24	45	54	0.0	2000	70	0.117
C-24	G-81 @ C-24	46	54	0.0	2000	70	0.117
C-24	G-81 @ C-24	47	54	0.0	1500	100	0.117
C-24	S-49	47	55	0.0	2000	110	0.117

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-24	S-49	47	56	0.0	2000	110	0.117
C-24	S-49	47	57	0.0	2000	110	0.117
C-24	S-49	47	58	0.0	2000	100	0.117
C-24	S-49	47	59	0.0	2000	100	0.117
C-24	S-49	47	60	0.0	2000	100	0.117
C-24	S-49	47	61	0.0	2000	100	0.117
C-24	S-49	47	62	0.0	2000	100	0.117
C-24	S-49	47	63	0.0	2000	100	0.117
C-24	S-49	47	64	0.0	2000	110	0.117
C-24	S-49	47	65	0.0	2000	110	0.117
C-24	S-49	47	66	0.0	1455	120	0.117
C-23	G-79 @ C-23	47	49	14.9	1545	30	0.117
C-23	G-79 @ C-23	47	50	14.9	2000	30	0.117
C-23	G-79 @ C-23	47	51	14.9	2000	30	0.117
C-23	G-79 @ C-23	47	52	14.9	2000	30	0.117
C-23	G-79 @ C-23	47	53	14.9	2000	30	0.117
C-23	G-79 @ C-23	47	54	14.9	1200	30	0.117
C-23	G-79 @ C-23	47	49	14.9	1545	30	0.117
C-23	G-79 @ C-23	48	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	49	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	50	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	51	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	52	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	53	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	54	49	14.9	2000	30	0.117
C-23	G-79 @ C-23	55	49	14.9	400	30	0.117
C-23	G-79 @ C-23	55	49	7.5	1600	80	0.117
C-23	G-79 @ C-23	56	49	7.5	2000	80	0.117
C-23	G-79 @ C-23	57	49	7.3	2000	80	0.117
C-23	S-97	58	49	7.0	2000	80	0.137
C-23	S-97	59	49	6.5	2000	80	0.146
C-23	S-97	60	49	5.0	2000	90	0.125
C-23	S-97	61	49	4.0	2000	90	0.117

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-23	S-97	62	49	4.0	2000	100	0.117
C-23	S-97	63	49	4.0	2000	90	0.117
C-23	S-97	64	49	4.0	2000	90	0.117
C-23	S-97	65	49	4.0	2000	90	0.117
C-23	S-97	66	49	4.0	2000	90	0.117
C-23	S-97	67	49	4.0	2000	90	0.117
C-23	S-97	68	49	4.0	2000	90	0.117
C-23	S-97	69	49	4.0	2000	90	0.117
C-23	S-97	70	49	4.0	2000	90	0.117
C-23	S-97	71	49	3.0	2090	120	0.178
C-23	S-97	71	50	2.0	2000	130	0.114
C-23	S-97	71	51	3.0	2000	120	0.076
C-23	S-97	71	52	3.5	2000	120	0.072
C-23	S-97	71	53	3.5	2000	120	0.070
C-23	S-97	71	54	4.0	2000	120	0.070
C-23	S-97	71	55	3.5	2000	120	0.070
C-23	S-97	71	56	4.0	2000	120	0.070
C-23	S-97	71	57	3.0	2000	120	0.070
C-23	S-97	71	58	4.0	2000	120	0.070
C-23	S-97	71	59	4.0	2000	130	0.070
C-23	S-97	71	60	4.0	2000	150	0.070
C-23	S-97	71	61	4.0	2000	150	0.113
C-23	S-97	71	62	4.0	2000	160	0.120
C-23	S-97	71	63	4.0	2000	170	0.120
C-23	S-97	71	64	4.0	2000	170	0.120
C-23	S-97	71	65	2.5	2000	180	0.120
C-23	S-97	71	66	2.5	2000	180	0.120
C-23	S-97	71	67	4.0	2000	180	0.120
C-23	S-97	71	68	4.0	2000	180	0.120
C-23	S-97	71	69	2.0	2000	180	0.120
C-23	S-97	71	70	3.0	2000	180	0.120

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-23	S-97	71	71	2.0	2000	180	0.120
C-23	S-97	71	72	3.5	2000	180	0.120
C-23	S-97	71	73	3.0	2000	190	0.120
C-23	S-97	71	74	3.0	2000	190	0.120
C-23	S-97	71	75	3.0	2000	190	0.120
C-23	S-97	71	76	3.0	2000	190	0.120
C-23	S-97	71	77	3.0	2000	190	0.129
C-23	S-97	71	78	3.0	2000	190	0.270
C-23	S-97	71	79	3.0	2000	200	0.270
C-23	S-97	71	80	3.0	2000	200	0.270
C-23	S-97	71	81	1.0	2000	200	0.270
C-23	S-97	71	82	0.5	2000	200	0.270
C-23	S-97	71	83	0.0	2000	200	0.270
C-23	S-97	71	84	-4.0	2000	190	0.270
C-23	S-97	71	85	-3.0	2000	180	0.270
C-23	S-97	71	86	-3.0	2000	180	0.270
C-23	S-97	71	87	-3.0	2000	180	0.265
C-23	S-97	71	88	-3.0	200	170	0.110
C-23	S-48	71	88	-6.0	1800	190	0.110
C-23	S-48	71	89	-6.0	2000	160	0.110
C-23	S-48	71	90	-6.0	2000	150	0.224
C-23	S-48	71	91	-6.0	2000	150	0.270
C-23	S-48	71	92	-6.0	2045	160	0.270
C-23	S-48	71	93	-6.0	2136	170	0.253
C-23	S-48	71	94	-6.0	2130	170	0.252
C-23	S-48	71	95	-6.0	800	190	0.258
C-23	TIDAL	71	95	-13.0	1300	190	0.258
C-23	TIDAL	71	96	-13.0	909	200	0.259
C-23	TIDAL	71	97	-13.0	818	180	0.220
C-24	S-49	47	66	0.0	900	120	0.117
C-24	S-49	47	66	0.0	1272	170	0.117
C-24	S-49	47	67	0.0	727	170	0.117

TABLE B-5. Hydraulic Parameters for SFWMD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
C-24	S-49	48	67	0.0	2136	140	0.117
C-24	S-49	48	68	0.0	590	150	0.126
C-24	S-49	49	68	0.0	2000	150	0.117
C-24	S-49	49	69	0.0	363	150	0.146
C-24	S-49	50	69	0.0	2136	140	0.117
C-24	S-49	51	70	0.0	2272	140	0.117
C-24	S-49	52	71	0.0	2410	150	0.121
C-24	S-49	53	72	0.0	2272	150	0.124
C-24	S-49	54	72	0.0	318	150	0.117
C-24	S-49	54	73	0.0	2318	150	0.142
C-24	S-49	55	73	0.0	545	150	0.136
C-24	S-49	55	74	0.0	2410	160	0.159
C-24	S-49	56	74	0.0	636	160	0.156
C-24	S-49	56	75	0.0	2045	160	0.175
C-24	S-49	57	75	0.0	681	170	0.156
C-24	S-49	57	76	0.0	2455	200	0.185
C-24	S-49	58	77	0.0	2590	200	0.181
C-24	S-49	58	78	0.0	910	200	0.204
C-24	S-49	59	78	0.0	1410	200	0.166
C-24	S-49	59	79	0.0	2227	200	0.185
C-24	S-49	59	80	0.0	2227	200	0.200
C-24	S-49	59	81	0.0	910	200	0.204
C-24	S-49	60	81	0.0	1727	200	0.158
C-24	S-49	60	82	0.0	2272	190	0.170
C-24	S-49	60	83	0.0	2181	190	0.182
C-24	S-49	61	84	0.0	2090	190	0.157
C-24	S-49	61	85	0.0	90	190	0.168
C-23A	TIDAL	61	85	-12.5	2000	190	0.168
C-23A	TIDAL	61	86	-12.5	900	190	0.173
C-23A	TIDAL	60	86	-12.5	1200	190	0.191
C-23A	TIDAL	60	87	-12.5	2090	180	0.195
C-23A	TIDAL	60	88	-13.0	1000	180	0.204
C-23A	TIDAL	61	88	-13.0	1100	180	0.204

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 61	NSL 16	24	55	14	1545	25	0.117
NSLDD 61	NSL 16	24	56	14	2000	25	0.117
NSLDD 61	NSL 16	24	57	14	2000	25	0.117
NSLDD 61	NSL 16	24	58	14	2000	25	0.117
NSLDD 61	NSL 16	24	59	14	2000	25	0.117
NSLDD 61	NSL 16	24	60	14	2000	25	0.117
NSLDD 61	NSL 16	24	61	14	2000	25	0.117
NSLDD 61	NSL 16	24	62	12	910	25	0.117
NSLDD 62	NSL 16	26	55	14	1545	25	0.117
NSLDD 62	NSL 16	26	56	14	2000	25	0.117
NSLDD 62	NSL 16	26	57	14	2000	25	0.117
NSLDD 62	NSL 16	26	58	14	2000	25	0.117
NSLDD 62	NSL 16	26	59	14	2000	25	0.117
NSLDD 62	NSL 16	26	60	13	2000	25	0.117
NSLDD 62	NSL 16	26	61	11	2000	25	0.117
NSLDD 62	NSL 16	26	62	12	910	25	0.117
NSLDD 63	NSL 16	27	55	14	1545	45	0.117
NSLDD 63	NSL 16	27	56	14	2000	45	0.117
NSLDD 63	NSL 16	27	57	14	2000	45	0.117
NSLDD 63	NSL 16	27	58	14	2000	45	0.117
NSLDD 63	NSL 16	27	59	14	2000	45	0.117
NSLDD 63	NSL 16	27	60	14	2000	45	0.117
NSLDD 63	NSL 16	27	61	12	2000	45	0.117
NSLDD 63	NSL 16	27	62	12	955	45	0.117
NSLDD 64	NSL 16	28	55	14	1545	22	0.117
NSLDD 64	NSL 16	28	56	14	2000	22	0.117
NSLDD 64	NSL 16	28	57	14	2000	22	0.117
NSLDD 64	NSL 16	28	58	14	2000	22	0.117
NSLDD 64	NSL 16	28	59	14	2000	22	0.117
NSLDD 64	NSL 16	28	60	14	2000	22	0.117
NSLDD 64	NSL 16	28	61	14	2000	22	0.117
NSLDD 64	NSL 16	28	62	12	955	22	0.117
NSLDD 65	NSL 16	30	55	14	1545	22	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 65	NSL 16	30	56	14	2000	22	0.117
NSLDD 65	NSL 16	30	57	14	2000	22	0.117
NSLDD 65	NSL 16	30	58	14	2000	22	0.117
NSLDD 65	NSL 16	30	59	14	2000	22	0.117
NSLDD 65	NSL 16	30	60	13	2000	22	0.117
NSLDD 65	NSL 16	30	61	12	2000	22	0.117
NSLDD 65	NSL 16	30	62	12	955	22	0.117
NSLDD 66	NSL 16	31	55	14	1545	20	0.117
NSLDD 66	NSL 16	31	56	14	2000	20	0.117
NSLDD 66	NSL 16	31	57	14	2000	20	0.117
NSLDD 66	NSL 16	31	58	13	2000	20	0.117
NSLDD 66	NSL 16	31	59	14	2000	20	0.117
NSLDD 66	NSL 16	31	60	13	2000	20	0.117
NSLDD 66	NSL 16	31	61	11	2000	20	0.117
NSLDD 66	NSL 16	31	62	12	955	20	0.117
NSLDD 67	NSL 16	32	55	14	1545	22	0.117
NSLDD 67	NSL 16	32	56	14	2000	22	0.117
NSLDD 67	NSL 16	32	57	14	2000	22	0.117
NSLDD 67	NSL 16	32	58	12	2000	22	0.117
NSLDD 67	NSL 16	32	59	13	2000	22	0.117
NSLDD 67	NSL 16	32	60	13	2000	22	0.117
NSLDD 67	NSL 16	32	61	11	2000	22	0.117
NSLDD 67	NSL 16	32	62	12	955	22	0.117
NSLDD 68	NSL 49	34	62	12	800	22	0.117
NSLDD 69	NSL 29	35	55	14	1545	20	0.117
NSLDD 69	NSL 29	35	56	14	2000	20	0.117
NSLDD 69	NSL 29	35	57	14	2000	20	0.117
NSLDD 69	NSL 29	35	58	12	2000	20	0.117
NSLDD 69	NSL 29	35	59	13	2000	20	0.117
NSLDD 69	NSL 29	35	60	12	2000	20	0.117
NSLDD 69	NSL 29	35	61	12	2000	20	0.117
NSLDD 69	NSL 29	35	62	12	955	20	0.117
NSLDD 70	NSL 49	36	55	14	1545	22	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 70	NSL 49	36	56	14	2000	22	0.117
NSLDD 70	NSL 49	36	57	14	2000	22	0.117
NSLDD 70	NSL 49	36	58	12	2000	22	0.117
NSLDD 70	NSL 49	36	59	13	2000	22	0.117
NSLDD 70	NSL 49	36	60	12	2000	22	0.117
NSLDD 70	NSL 49	36	61	12	2000	22	0.117
NSLDD 70	NSL 49	36	62	12	1045	22	0.117
NSLDD 71	NSL 35A	36	62	12	730	75	0.117
NSLDD 71	NSL 35A	36	63	12	2000	75	0.117
NSLDD 71	NSL 35A	36	64	11	2000	75	0.117
NSLDD 71	NSL 35A	36	65	11	2000	75	0.117
NSLDD 71	NSL 35A	36	66	11	2000	75	0.117
NSLDD 71	NSL 35A	36	67	11	1820	75	0.117
NSLDD 59	NSL 16	23	62	13	1455	60	0.117
NSLDD 59	NSL 16	24	62	12	2000	60	0.117
NSLDD 59	NSL 16	25	62	12	2000	60	0.117
NSLDD 59	NSL 16	26	62	12	2000	60	0.117
NSLDD 59	NSL 16	27	62	12	2000	60	0.117
NSLDD 59	NSL 16	28	62	12	2000	60	0.117
NSLDD 59	NSL 16	29	62	12	2000	60	0.117
NSLDD 59	NSL 16	30	62	12	2000	60	0.117
NSLDD 59	NSL 16	31	62	12	2000	60	0.117
NSLDD 59	NSL 16	32	62	12	2000	60	0.117
NSLDD 59	NSL 16	33	62	12	2000	60	0.117
NSLDD 59	BP#6	34	62	12	2000	60	0.117
NSLDD 59	BP#6	35	62	12	2000	60	0.117
NSLDD 59	BP#6	36	62	12	2000	60	0.117
NSLDD 58	NSL 30	35	64	11	2000	48	0.117
NSLDD 58	NSL 31	35	65	11	2000	48	0.117
NSLDD 58	NSL 31	35	66	11	2591	48	0.117
NSLDD 58	NSL 35	35	67	11	1636	48	0.117
NSLDD 58	NSL 35	36	67	11	1455	48	0.117
NSLDD 58	NSL 35	36	68	11	2090	48	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 57	NSL 36	23	63	12	955	18	0.117
NSLDD 57	NSL 36	24	63	12	2000	18	0.117
NSLDD 57	NSL 36	25	63	12	2000	18	0.117
NSLDD 57	NSL 36	26	63	12	1975	25	0.117
NSLDD 57	NSL 36	27	63	13	2000	25	0.117
NSLDD 57	NSL 36	28	63	12	2000	25	0.117
NSLDD 57	NSL 36	29	63	12	2000	25	0.117
NSLDD 57	NSL 36	30	63	12	2000	25	0.117
NSLDD 57	NSL 36	31	63	11	2000	25	0.117
NSLDD 57	NSL 36	32	63	12	2000	25	0.117
NSLDD 57	NSL 36	33	63	12	2000	25	0.117
NSLDD 57	NSL 36	34	63	12	2000	25	0.117
NSLDD 57	NSL 36	35	63	12	2000	25	0.117
NSLDD 57	NSL 36	36	63	12	1045	25	0.117
NSLDD 56	NSL 19	23	65	13	955	18	0.117
NSLDD 56	NSL 19	24	65	12	2000	18	0.117
NSLDD 56	NSL 19	25	65	12	2000	18	0.117
NSLDD 56	NSL 21	26	65	13	1960	25	0.117
NSLDD 56	NSL 21	27	65	12	2000	25	0.117
NSLDD 56	NSL 31	28	65	11	2000	25	0.117
NSLDD 56	NSL 31	29	65	12	2000	25	0.117
NSLDD 56	NSL 31	30	65	12	2000	25	0.117
NSLDD 56	NSL 31	31	65	11	2000	25	0.117
NSLDD 56	NSL 31	32	65	11	2000	25	0.117
NSLDD 56	NSL 31	33	65	11	2000	30	0.117
NSLDD 56	NSL 31	34	65	11	2000	30	0.117
NSLDD 56	NSL 21	35	65	11	727	30	0.117
NSLDD 55	NSL 26	24	66	13	1545	18	0.117
NSLDD 55	NSL 26	25	66	13	2000	18	0.117
NSLDD 55	NSL 26	26	66	13	1960	25	0.117
NSLDD 55	NSL 26	27	66	13	2000	25	0.117
NSLDD 55	NSL 26	28	66	12	2000	25	0.117
NSLDD 55	NSL 26	29	66	12	2000	25	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 55	NSL 26	30	66	12	2000	25	0.117
NSLDD 55	NSL 26	31	66	11	2000	25	0.117
NSLDD 55	NSL 31	32	66	11	2000	25	0.117
NSLDD 55	NSL 31	33	66	11	2000	25	0.117
NSLDD 55	NSL 31	34	66	11	2000	30	0.117
NSLDD 55	NSL 31	35	66	11	727	30	0.117
NSLDD 54	NSL 35	24	67	14	1545	18	0.197
NSLDD 54	NSL 35	25	67	13	2000	18	0.176
NSLDD 54	NSL 35	26	67	13	1960	25	0.129
NSLDD 54	NSL 35	27	67	13	2000	25	0.117
NSLDD 54	NSL 35	28	67	13	2000	25	0.117
NSLDD 54	NSL 35	29	67	12	2000	25	0.117
NSLDD 54	NSL 35	30	67	12	2000	25	0.117
NSLDD 54	NSL 35	31	67	12	2000	25	0.117
NSLDD 54	NSL 35	32	67	12	2000	25	0.117
NSLDD 54	NSL 35	33	67	12	2000	30	0.117
NSLDD 54	NSL 35	34	67	11	2000	30	0.117
NSLDD 54	NSL 35	35	67	11	2000	30	0.117
NSLDD 54	NSL 35	36	67	11	863	30	0.117
NSLDD 53	NSL 4	23	69	13	1365	18	0.156
NSLDD 53	NSL 4	24	69	13	2000	18	0.157
NSLDD 53	NSL 4	25	69	13	2000	18	0.198
NSLDD 53	NSL 4	26	69	13	1960	25	0.204
NSLDD 53	NSL 4	27	69	14	2000	25	0.164
NSLDD 53	NSL 4	28	69	13	2000	25	0.132
NSLDD 53	NSL 4	29	69	13	2000	25	0.117
NSLDD 53	NSL 4	30	69	13	2000	25	0.117
NSLDD 53	NSL 4	31	69	13	2000	25	0.117
NSLDD 53	NSL 4	32	69	12	2000	25	0.117
NSLDD 53	NSL 4	33	69	12	2000	25	0.117
NSLDD 53	NSL 4	34	69	13	2000	25	0.117
NSLDD 53	NSL 4	35	69	12	1200	25	0.118
NSLDD 52	NSL 33	24	70	13	1545	18	0.182

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 52	NSL 33	25	70	13	2000	18	0.202
NSLDD 52	NSL 33	26	70	13	1960	18	0.204
NSLDD 52	NSL 33	27	70	13	2000	25	0.204
NSLDD 52	NSL 33	28	70	13	2000	25	0.203
NSLDD 52	NSL 33	29	70	13	2000	25	0.129
NSLDD 52	NSL 33	30	70	13	2000	25	0.123
NSLDD 52	NSL 33	31	70	13	2000	25	0.137
NSLDD 52	NSL 33	32	70	13	2000	25	0.135
NSLDD 52	NSL 33	33	70	12	2000	25	0.142
NSLDD 52	NSL 33	34	70	12	2000	25	0.121
NSLDD 52	NSL 33	35	70	12	2000	25	0.131
NSLDD 43	NSL 12	24	71	13	450	20	0.204
NSLDD 43	NSL 12	24	72	13	200	20	0.204
NSLDD 43	NSL 2	24	72	13	1800	10	0.204
NSLDD 43	NSL 2	24	73	12	2000	10	0.204
NSLDD 43	NSL 2	24	74	11	2000	10	0.204
NSLDD 43	NSL 2	24	75	11	1365	10	0.204
NSLDD 44	NSL 20A	26	62	12	820	25	0.117
NSLDD 44	NSL 20A	26	63	12	2000	25	0.117
NSLDD 44	NSL 20A	26	64	12	2000	40	0.117
NSLDD 44	NSL 20A	26	65	13	2000	40	0.117
NSLDD 44	NSL 20A	26	66	13	2000	40	0.117
NSLDD 44	NSL 20A	26	67	13	2000	40	0.129
NSLDD 44	NSL 20A	26	68	13	2000	40	0.197
NSLDD 44	NSL 2	26	69	13	2000	40	0.204
NSLDD 44	NSL 2	26	70	13	2000	40	0.204
NSLDD 44	NSL 2	26	71	13	2000	40	0.204
NSLDD 44	NSL 2	26	72	13	2000	40	0.204
NSLDD 44	NSL 2	26	73	12	500	40	0.204
NSLDD 44	NSL 2	26	73	12	1500	40	0.204
NSLDD 44	NSL 2	26	74	11	2000	40	0.204
NSLDD 44	NSL 2	26	75	11	2000	40	0.204
NSLDD 44	NSL 2	26	76	11	2000	40	0.195

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 45	NSL 2	27	71	13	455	15	0.204
NSLDD 45	NSL 2	27	72	13	2000	15	0.204
NSLDD 45	NSL 2	27	73	11	2000	15	0.204
NSLDD 45	NSL 2	27	74	11	2000	15	0.204
NSLDD 45	NSL 2	27	75	11	2000	15	0.204
NSLDD 45	NSL 2	27	76	11	2000	25	0.204
NSLDD 41	NSL 2	23	75	11	820	18	0.191
NSLDD 41	NSL 2	24	75	11	2000	18	0.204
NSLDD 41	NSL 2	25	75	11	2000	18	0.204
NSLDD 41	NSL 2	26	75	11	1960	18	0.204
NSLDD 41	NSL 2	27	75	11	772	20	0.204
NSLDD 72	NSL 49	38	61	12	550	25	0.117
NSLDD 72	NSL 49	38	62	12	1000	25	0.117
NSLDD 73	NSL 49	39	55	14	1545	20	0.117
NSLDD 73	NSL 49	39	56	14	2000	20	0.117
NSLDD 73	NSL 49	39	57	14	2000	25	0.117
NSLDD 73	NSL 49	39	58	13	2000	25	0.117
NSLDD 73	NSL 49	39	59	12	2000	25	0.117
NSLDD 73	NSL 49	39	60	12	2000	25	0.117
NSLDD 73	NSL 49	39	61	12	2000	25	0.117
NSLDD 73	NSL 49	39	62	12	1000	25	0.117
NSLDD 74	NSL 49	40	61	12	1100	25	0.117
NSLDD 74	NSL 49	40	62	12	1000	25	0.117
NSLDD 75	NSL 57	42	59	14	300	25	0.117
NSLDD 75	NSL 57	42	60	14	2000	25	0.117
NSLDD 75	NSL 57	42	61	13	2000	25	0.117
NSLDD 75	NSL 57	42	62	13	1000	25	0.117
NSLDD 76	NSL 57	43	59	14	300	25	0.117
NSLDD 76	NSL 57	43	60	14	2000	25	0.117
NSLDD 76	NSL 57	43	61	13	2000	25	0.117
NSLDD 76	NSL 57	43	62	13	1000	25	0.117
NSLDD 77	NSL 57	44	59	14	200	25	0.117
NSLDD 77	NSL 57	44	60	14	2000	25	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 77	NSL 57	44	61	13	2000	25	0.117
NSLDD 77	NSL 57	44	62	13	1000	25	0.117
NSLDD 78	NSL 58	46	55	14	1545	25	0.117
NSLDD 78	NSL 58	46	56	15	2000	25	0.117
NSLDD 78	NSL 58	46	57	15	2000	25	0.117
NSLDD 78	NSL 58	46	58	15	2000	25	0.117
NSLDD 78	NSL 57	46	59	14	2000	25	0.117
NSLDD 78	NSL 57	46	60	14	2000	25	0.117
NSLDD 78	NSL 57	46	61	13	2000	25	0.117
NSLDD 78	NSL 57	46	62	13	1000	25	0.117
NSLDD 78A	NSL 58	46	57	15	1320	20	0.117
NSLDD 80	NSL 49	37	62	12	2000	60	0.117
NSLDD 80	NSL 49	38	62	12	2000	60	0.117
NSLDD 80	NSL 49	39	62	12	2000	60	0.117
NSLDD 80	NSL 49	40	62	12	2000	60	0.117
NSLDD 80	NSL 57	41	62	13	500	60	0.117
NSLDD 80	NSL 57	41	62	13	1500	60	0.117
NSLDD 80	NSL 57	42	62	13	2000	60	0.117
NSLDD 80	NSL 57	43	62	13	2000	60	0.117
NSLDD 80	NSL 57	44	62	13	2000	60	0.117
NSLDD 80	NSL 57	45	62	13	2000	60	0.117
NSLDD 80	NSL 57	46	62	13	2000	60	0.117
NSLDD 80	NSL 57	47	62	13	775	48	0.117
NSLDD 83	NSL 57	39	64	11	2000	15	0.117
NSLDD 83	NSL 57	39	65	11	2000	15	0.117
NSLDD 83	NSL 57	39	66	11	2000	15	0.117
NSLDD 83	NSL 57	39	67	11	2000	15	0.117
NSLDD 83	NSL 57	39	68	11	1045	15	0.117
NSLDD 81	NSL 57	39	63	11	1090	15	0.117
NSLDD 81	NSL 57	40	63	11	2000	15	0.117
NSLDD 81	NSL 57	41	63	12	2000	15	0.117
NSLDD 81	NSL 57	42	63	12	2000	15	0.117
NSLDD 81	NSL 57	43	63	12	2000	15	0.117

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 81	NSL 57	44	63	13	2000	15	0.117
NSLDD 81	NSL 57	45	63	13	2000	15	0.117
NSLDD 81	NSL 57	46	63	13	1136	15	0.117
NSLDD 85	NSL 57	39	65	11	1090	20	0.117
NSLDD 85	NSL 57	40	65	11	2000	20	0.117
NSLDD 85	NSL 57	41	65	12	2000	20	0.117
NSLDD 85	NSL 57	42	65	12	2000	20	0.117
NSLDD 85	NSL 57	43	65	12	2000	20	0.117
NSLDD 85	NSL 57	44	65	12	2000	20	0.117
NSLDD 85	NSL 57	45	65	12	2000	20	0.117
NSLDD 85	NSL 57	46	65	12	1136	20	0.117
NSLDD 88X	NSL 55	42	66	11	1045	10	0.117
NSLDD 88X	NSL 55	42	67	10	2000	10	0.117
NSLDD 88X	NSL 55	42	68	9	2000	10	0.117
NSLDD 88X	NSL 55	42	69	10	636	10	0.117
NSLDD 90	NSL 57	44	70	11	1600	25	0.204
NSLDD 90	NSL 57	45	70	11	2000	25	0.204
NLSDD 90	NSL 57	46	70	11	1363	25	0.204
NSLDD 88	NSL 53	43	66	11	772	10	0.117
NSLDD 88	NSL 53	43	67	10	2000	10	0.117
NSLDD 88	NSL 53	43	68	10	2000	10	0.117
NSLDD 88	NSL 53	43	69	10	500	10	0.128
NSLDD 86	NSL 53	43	66	11	1045	15	0.117
NSLDD 86	NSL 53	44	66	11	2000	15	0.117
NSLDD 86	NSL 57	45	66	12	2000	15	0.117
NSLDD 86	NSL 57	46	66	12	1136	15	0.117
NSLDD 87	NSL 57	43	67	10	1045	15	0.117
NSLDD 87	NSL 57	44	67	11	2000	15	0.117
NSLDD 87	NSL 57	45	67	11	2000	15	0.117
NSLDD 87	NSL 57	46	67	11	1136	15	0.117
NSLDD 89	NSL 56	42	69	10	1045	15	0.117
NSLDD 89	NSL 56	43	69	10	2000	15	0.128
NSLDD 89	NSL 56	44	69	11	2000	15	0.198

TABLE B-6. Hydraulic Parameters for the NSLRWCD River Reaches (Continued)

CANAL NAME	CONTROL STRUCTURE	MODEL ROW	MODEL COLUMN	RIVER BOTTOM (NGVD)	RIVER REACH (FEET)	RIVER WIDTH (FEET)	RIVER BED HYDRAULIC CONDUCTIVITY (FEET/DAY)
NSLDD 89	NSL 56	45	69	11	2000	15	0.204
NSLDD 89	NSL 57	46	69	12	1136	15	0.204
NSLDD 107	NSL 57	46	62	13	940	25	0.117
NSLDD 107	NSL 57	46	63	13	1985	25	0.117
NSLDD 107	NSL 57	46	64	13	2000	25	0.117
NSLDD 107	NSL 57	46	65	12	1985	25	0.117
NSLDD 107	NSL 57	46	66	12	1985	30	0.117
NSLDD 107	NSL 57	46	67	11	1985	30	0.117
NSLDD 107	NSL 57	46	68	11	2000	30	0.187
NSLDD 107	NSL 57	46	69	12	1985	30	0.204
NSLDD 107	NSL 57	46	70	11	1090	30	0.204

APPENDIX C

RAINFALL STATION MAP AND TABLE, GENERAL LAND USE MAP, RECHARGE AND ET COEFFICIENTS

LIST OF FIGURES - APPENDIX C

LIST OF TABLES - APPENDIX C

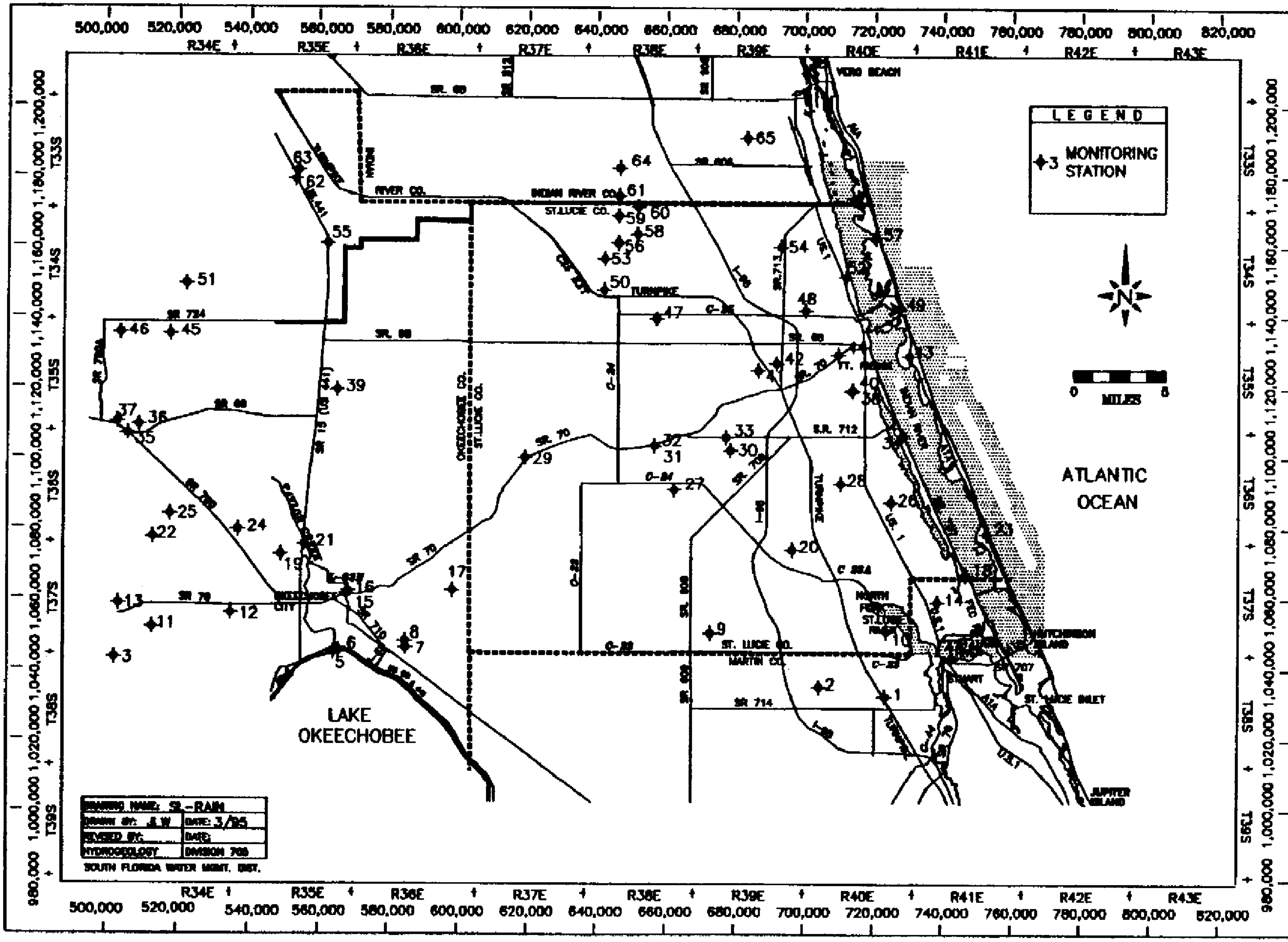


FIGURE C-1. Map of Rainfall Stations

TABLE C-1. Rainfall Stations

MAP #	STATE PLANE COORDINATES		SITE: SOURCE
	EAST	NORTH	
1	724500	1031500	Martin Downs WTP:Operator
2	705456	1034067	Martin County Palm City Landfill:Operator
3	501174	1042435	Brighton 1 Dairy; SFWMD
4*	743790	1042559	Stuart 1;SFWMD
5	564645	1044001	S133 R;SFWMD
6*	566270	1044407	HGS6 R;SFWMD
7	585589	1045352	New Palm Dairy;SFWMD
8	585404	1047169	Red Top Dairy;SFWMD
9*	673871	1049370	Bluegoose (Belfort);SFWMD
10	724900	1049900	Harbor Ridge Country Club; Operator
11	512067	1051029	S65 East Spillway;SFWMD
12	534849	1055005	G80 Culvert;SFWMD
13	502347	1057682	Maple River;SFWMD
14	739724	1058288	N. Martin County WTP;Operator
15*	568500	1060466	Okeechobee Field Station #2;SFWMD
16	569040	1061376	Okeechobee Field Station;SFWMD
17	599092	1061539	Davie Dairy(Belfort);SFWMD
18	747801	1066011	MCD8 Lake Manor;STL MOSQ. Control Dist.
19	549263	1071646	SEZ East Well;SFWMD
20	697590	1073107	MCD16 Beekman;STL MOSQ. Control Dist.
21	556116	1074583	Okeechobee Forest Service HQ;SFWMD
22	512269	1076667	Brightton Dairy #2;SFWMD
23	753954	1077763	MCD7 Island Dunes;STL MOSQ. Control Dist.
24	536805	1078802	Dry Lake Dairy #2;SFWMD
25	517138	1083131	Flying G. Dairy #2;SFWMD
26	726207	1086687	MCD10 Spanish Lakes;STL MOSQ. Control Dist.
27*	663325	1090222	Hayes Property (Belfort);SFWMD
28	711747	1091961	MCD10 White City;STL MOSQ. Control Dist.
29*	620090	1099281	Cow Creek Ranch (Belfort);SFWMD

TABLE C-1. Rainfall Stations (Continued)

MAP #	STATE PLANE COORDINATES		SITE: SOURCE
	EAST	NORTH	
30	679599	1101500	MCD17 Pony Pines; STL MOSQ. Control Dist.
31*	657594	1102721	Ft. Pierce Field Station;SFWMD
32*	657594	1102721	Ft. Pierce Field Station;SFWMD
33*	678230	1105129	Scotto Groves;SFWMD
34	729525	1105892	MCD9 Barnes;STL MOSQ. Control Dist.
35	504958	1106049	GW 160 Rain/Well, US98 at Bassinger;SFWMD
36	508203	1108574	Lamb Island Dairy;SFWMD
37	501983	1109482	Chandler Slough;SFWMD
38	714853	1118434	MCD20 MCDH.Q.;STL MOSQ. Control Dist.
39	565698	1118623	McArthur Dairy Barn #2;SFWMD
40*	715032	1118738	Ft. Pierce Tower;SFWMD
41	687518	1124256	CC740 Coca Cola Groves Blk5; Operator
42	692825	1126200	Ft. Pierce IFAS Center;IFAS
43	731380	1128422	MCD6 Ocean Village;STL MOSQ. Control Dist.
44*	710834	1128714	Ft. Pierce;SFWMD
45	517206	1134427	W.F. Rucks Dairy;SFWMD
46	502793	1134726	Eagle Island Dairy;SFWMD
47	657994	1138873	CC702 Coca Cola Groves;Operator
48	701310	1141389	MCD4 Bill Grace;STL MOSQ. Control Dist.
49	728329	1142028	MCD2 North Beach1STL MOSQ. Control Dist.
50	642832	1146996	CC710 Coca Cola GrovesBlk1; Operator
51	521703	1148768	GW 189 Rain/Well on Rocking K Ranch;SFWMD
52	712969	1150941	MCD3 Walden III;STL MOSQ. Control Dist.
53	642980	1155983	CC715 Coca Cola Grove Blk11;Operator
54	693927	1159428	MCD5 Lakewood Park; STL MOSQ. Control Dist.
55*	562659	1160322	GW 143 Rain/well on Rocking k Ranch;SFWMD
56	646925	1160441	CC717 Coca Cola Groves Blk14; Operator
57	721282	1162195	MCD1 Bryn Mawr;STL MOSQ. Control Dist.
58	652408	1162986	CC732 Coca Cola Groves Blk44; Operator
59	646987	1168216	CC720 Coca Cola Groves Blk20; Operator

TABLE C-1. Rainfall Stations (Continued)

MAP #	STATE PLANE COORDINATES		SITE: SOURCE
	EAST	NORTH	
60	652558	1170762	CC735 Coca Cola Groves Blk50; Operator
61	647146	1173872	CC727 Coca Cola Groves Blk34; Operator
62	553182	1178585	Rocking K Ranch (2A35);SFWMD
63*	553988	1181212	Fort Drum 5NW;SFWMD
64	647207	1181850	CC730 Coca Cola Groves Blk40; Operator
65*	684060	1190485	Vero Beach Tower;SFWMD

* Used to estimate long term average for study area

Table C-2. Monthly Mean Rainfall 1936 through 1992

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1936	1.85	5.34	3.73	2.49	5.76	10.08	4.49	3.26	8.73	7.34	4.64	4.48	62.18
1937	1.62	3.47	7.69	6.38	7.08	3.64	3.58	4.04	8.43	15.03	6.53	0.98	68.47
1938	0.72	1.09	0.83	0.26	2.39	5.87	5.12	1.51	7.12	6.63	3.38	1.06	35.98
1939	0.35	0.25	2.28	5.31	6.51	4.79	5.51	7.55	5.37	8.56	1.30	1.13	48.90
1940	2.88	2.59	5.37	1.12	3.66	5.83	4.04	5.75	12.33	1.87	0.13	4.31	49.87
1941	6.18	4.65	2.66	6.57	2.95	5.35	9.53	3.50	10.06	5.64	4.24	3.26	64.59
1942	2.28	4.08	5.03	1.39	5.69	8.54	2.05	3.40	6.17	2.18	1.13	3.45	45.39
1943	0.27	0.84	5.04	1.28	4.70	4.56	7.24	6.87	5.48	3.80	2.56	0.56	43.21
1944	1.21	0.18	1.99	4.18	2.30	5.29	5.87	4.43	5.03	9.86	0.84	0.49	41.67
1945	1.13	0.65	0.69	2.43	2.43	4.95	4.99	5.24	13.99	6.14	2.86	2.61	48.10
1946	1.61	0.99	1.84	0.19	7.29	5.78	5.79	4.73	5.91	3.12	3.20	2.41	42.86
1947	1.18	3.08	6.46	4.33	4.33	8.43	7.67	5.66	15.20	9.90	4.05	1.05	71.32
1948	4.49	0.53	1.63	4.12	3.18	2.90	5.31	6.97	13.14	3.57	1.02	0.83	47.71
1949	0.61	1.00	0.45	2.72	3.83	8.91	6.12	10.96	8.64	4.49	0.64	5.33	53.71
1950	0.45	0.99	3.80	2.47	2.58	3.77	4.03	8.51	6.37	8.99	1.56	0.65	44.17
1951	0.26	2.21	0.62	7.60	3.79	3.90	4.16	7.15	5.41	10.97	2.40	0.70	49.18
1952	1.70	6.36	3.13	1.79	2.06	2.21	8.84	6.99	5.28	13.32	0.41	0.71	52.79
1953	2.03	1.95	6.30	3.57	1.68	7.60	6.05	8.14	9.32	9.13	2.63	2.15	60.53
1954	1.08	2.15	2.44	7.18	5.58	10.90	6.00	7.07	9.71	5.75	4.51	0.77	63.14
1955	1.99	1.13	2.11	3.66	2.91	7.81	4.88	5.89	4.42	5.35	0.17	3.78	44.10
1956	1.10	2.26	0.55	2.92	3.61	3.61	5.54	5.81	6.35	11.04	0.52	0.74	44.05
1957	1.35	3.15	4.59	5.79	6.04	5.55	9.24	7.29	8.55	5.21	1.41	3.32	61.49
1958	7.78	1.12	4.56	2.33	6.04	5.30	3.13	5.25	3.31	5.87	0.96	3.86	49.51
1959	2.90	1.21	7.16	2.96	4.99	12.18	5.03	6.29	8.84	10.58	3.66	2.17	67.98
1960	0.23	4.83	4.05	4.12	2.88	7.62	7.75	5.45	15.93	3.62	0.76	1.10	58.36
1961	2.95	0.88	3.20	1.27	6.41	4.82	1.84	6.68	2.83	3.77	1.35	0.22	36.21
1962	0.75	0.78	3.21	2.90	2.76	8.67	9.04	10.96	7.28	1.52	3.21	0.35	51.44
1963	1.00	4.77	1.63	0.74	4.52	5.52	4.59	2.71	12.63	5.20	3.80	6.76	53.88
1964	2.21	4.74	1.21	4.08	3.27	2.87	6.75	10.65	7.49	6.26	0.67	1.71	51.91
1965	0.50	5.22	2.80	1.42	0.46	6.03	8.14	4.03	5.83	8.03	1.68	1.50	45.65
1966	4.72	5.22	1.96	3.13	5.86	11.71	6.83	5.23	6.26	6.44	1.44	1.09	59.89
1967	1.21	2.94	1.40	0.33	0.39	8.01	8.42	5.33	4.46	5.30	0.77	1.75	40.32
1968	1.09	2.06	0.84	0.98	5.23	15.40	8.68	4.87	6.84	6.87	2.19	0.13	55.18
1969	2.27	1.26	6.86	1.61	7.93	3.39	5.16	8.58	8.20	10.22	4.06	2.69	62.21

TABLE C-2. Monthly Mean Rainfall 1936 through 1992 (Continued)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1970	4.23	3.09	8.07	0.17	4.79	5.75	4.90	4.21	7.94	6.94	0.76	0.59	51.45
1971	0.37	2.66	1.37	1.42	3.92	8.20	8.93	4.59	5.84	5.66	1.66	2.67	47.30
1972	1.47	3.25	3.20	3.87	5.66	8.90	4.71	6.49	1.87	2.62	3.18	1.52	46.73
1973	3.62	2.75	2.30	2.21	5.67	7.91	9.08	5.72	7.36	5.12	0.86	1.60	54.21
1974	1.73	1.22	0.63	2.72	3.34	9.39	11.43	6.63	5.18	2.67	1.93	1.79	48.65
1975	0.31	3.05	1.37	1.13	8.13	6.19	6.62	5.96	6.54	3.14	1.61	1.08	45.14
1976	0.38	1.33	0.82	2.45	10.63	7.93	4.19	4.90	8.11	1.09	2.66	3.16	47.65
1977	1.92	1.06	0.58	0.87	3.66	6.07	5.27	6.51	7.95	3.11	3.78	4.29	45.08
1978	2.56	2.30	3.07	1.94	4.24	4.24	7.68	5.05	5.71	4.36	2.50	5.49	49.13
1979	5.29	0.64	1.24	2.58	10.15	3.74	6.18	5.04	17.98	1.84	2.09	1.58	58.34
1980	2.97	2.77	2.87	3.41	3.05	4.41	6.12	3.97	4.78	2.17	3.47	1.53	41.51
1981	0.44	2.41	1.03	0.39	3.40	2.98	4.32	12.24	6.82	2.30	1.62	0.41	38.36
1982	0.97	3.67	8.84	5.70	7.42	8.32	7.89	8.36	5.91	2.56	6.12	1.58	67.33
1983	3.86	8.59	4.71	1.82	1.93	6.33	4.71	8.19	6.31	9.21	1.39	3.96	60.99
1984	0.92	3.82	3.42	1.34	5.98	4.59	5.98	6.65	8.36	1.56	7.68	0.92	51.22
1985	0.67	0.28	3.23	4.24	2.24	5.04	8.10	6.75	12.87	2.97	1.94	1.68	50.02
1986	3.03	1.36	5.03	0.22	2.72	10.09	6.48	6.74	4.95	7.54	2.19	3.31	53.66
1987	2.09	1.28	5.68	0.24	3.37	4.84	4.70	2.36	6.30	7.21	6.94	0.31	45.32
1988	2.65	2.45	4.05	1.46	3.96	4.67	8.35	6.27	1.53	1.79	2.86	1.51	41.56
1989	2.06	0.72	3.64	3.42	2.39	4.64	4.98	7.13	5.48	5.79	0.78	2.92	43.95
1990	0.94	2.83	0.89	1.21	3.56	5.76	7.20	7.54	8.57	5.32	1.58	0.36	45.76
1991	4.99	3.82	4.82	6.11	5.22	7.67	9.73	5.99	5.82	4.78	1.18	1.01	61.14
1992	1.02	3.11	1.42	3.10	1.17	17.67	4.04	10.22	5.69	2.13	7.32	1.05	57.94
MEAN	1.97	2.50	3.17	2.73	4.35	6.62	6.19	6.22	7.52	5.67	2.47	1.97	51.37

Modified from SFWMD (1994).

Table C-3. Ranking of the Annual Rainfall (1936 through 1992)

RANK	YEAR	RAINFALL	PERCENTILE
1	1938	35.98	1.09
2	1961	36.21	2.84
3	1981	38.36	4.59
4	1967	40.32	6.33
5	1980	41.51	8.08
6	1988	41.56	9.83
7	1944	41.67	11.57
8	1946	42.86	13.32
9	1943	43.21	15.07
10	1989	43.95	16.81
11	1956	44.05	18.56
12	1955	44.10	20.31
13	1950	44.17	22.05
14	1977	45.08	23.80
15	1975	45.14	25.55
16	1987	45.32	27.29
17	1942	45.39	29.04
18	1965	45.65	30.79
19	1990	45.76	32.53
20	1972	46.73	34.28
21	1971	47.30	36.03
22	1976	47.65	37.77
23	1948	47.71	39.52
24	1945	48.10	41.27
25	1974	48.65	43.01
26	1939	48.90	44.76
27	1978	49.13	46.51
28	1951	49.18	48.25
29	1958	49.51	50.00
30	1940	49.87	51.75
31	1985	50.02	53.49
32	1984	51.22	55.24
33	1962	51.44	56.99
34	1970	51.45	58.73
35	1964	51.91	60.48
36	1952	52.79	62.23
37	1986	53.66	63.97
38	1949	53.71	65.72
39	1963	53.88	67.47
40	1973	54.21	69.21
41	1968	55.18	70.96
42	1992	57.94	72.71
43	1979	58.34	74.45
44	1960	58.36	76.20
45	1966	59.89	77.95
46	1953	60.53	79.69

Table C-3. Ranking of the Annual Rainfall (1936 through 1992) (Continued)

RANK	YEAR	RAINFALL	PERCENTILE
47	1983	60.99	81.44
48	1991	61.14	83.19
49	1957	61.49	84.93
50	1936	62.18	86.68
51	1969	62.21	88.43
52	1954	63.14	90.17
53	1941	64.59	91.92
54	1982	67.33	93.67
55	1959	67.98	95.41
56	1937	68.47	97.16
57	1947	71.32	98.91

Mean = 51.37 in/yr **Median = 49.51 in/yr**
Standard Deviation = 8.57 in/yr

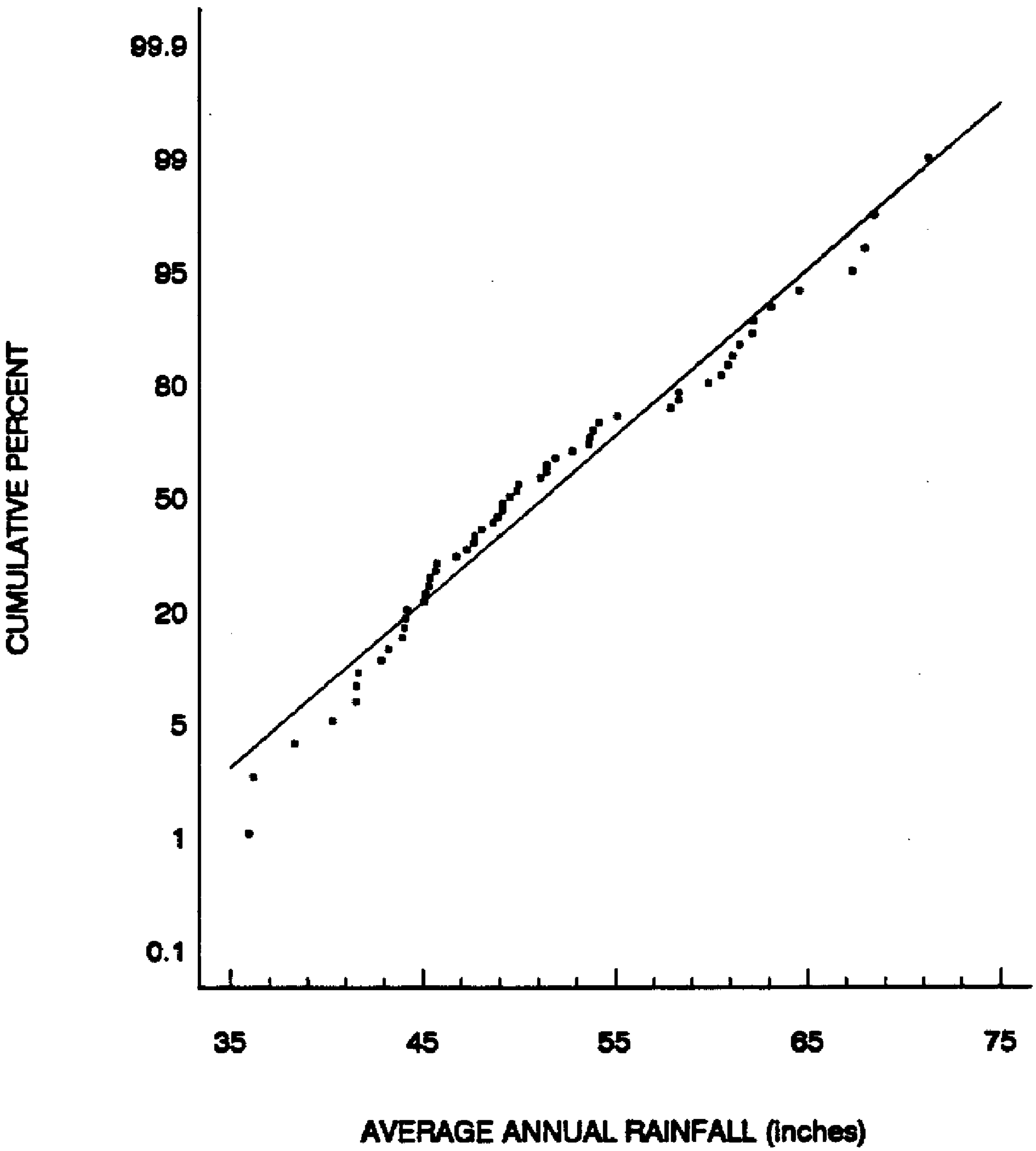


FIGURE C-2. Normal Probability Plot of Average Annual Rainfall

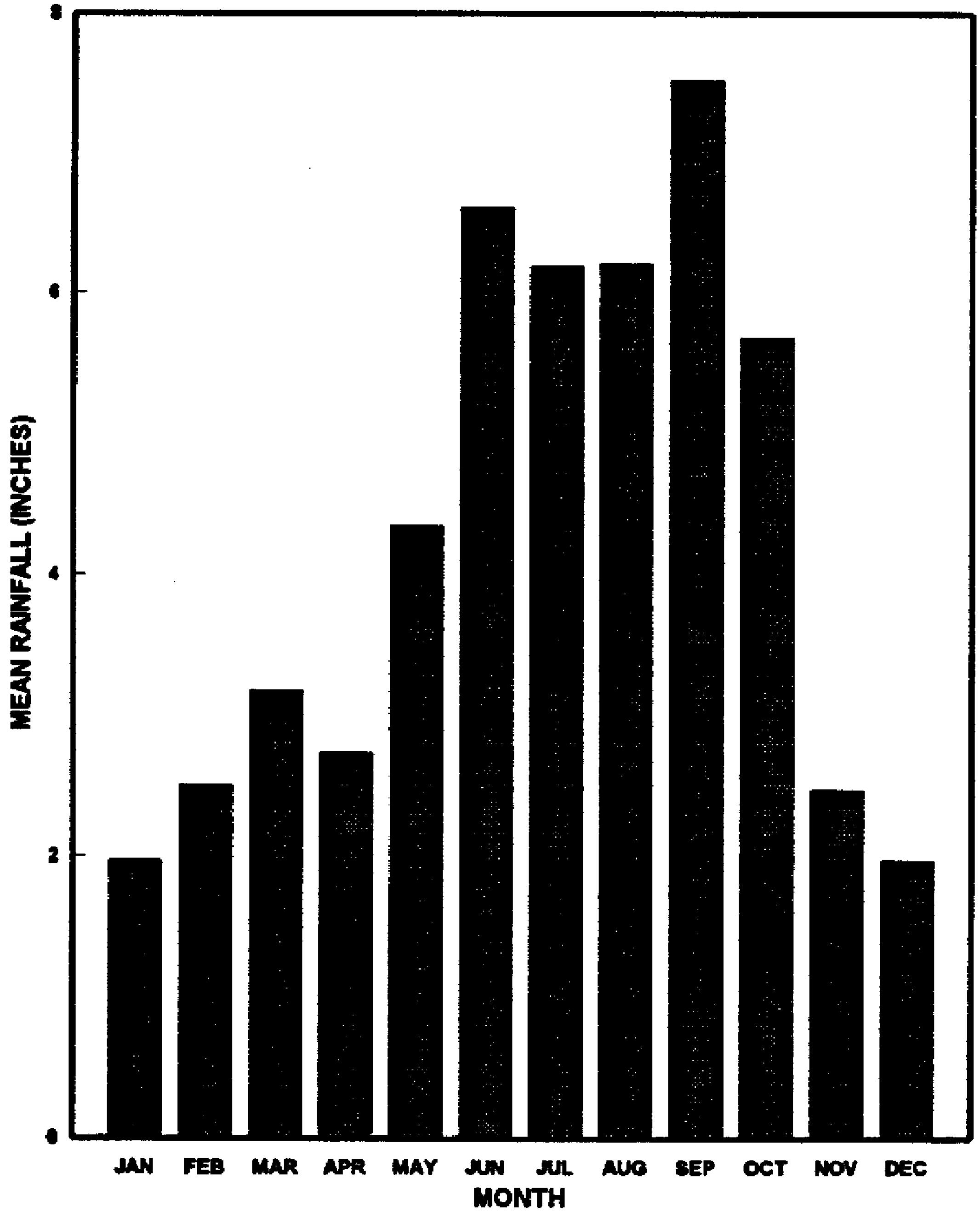
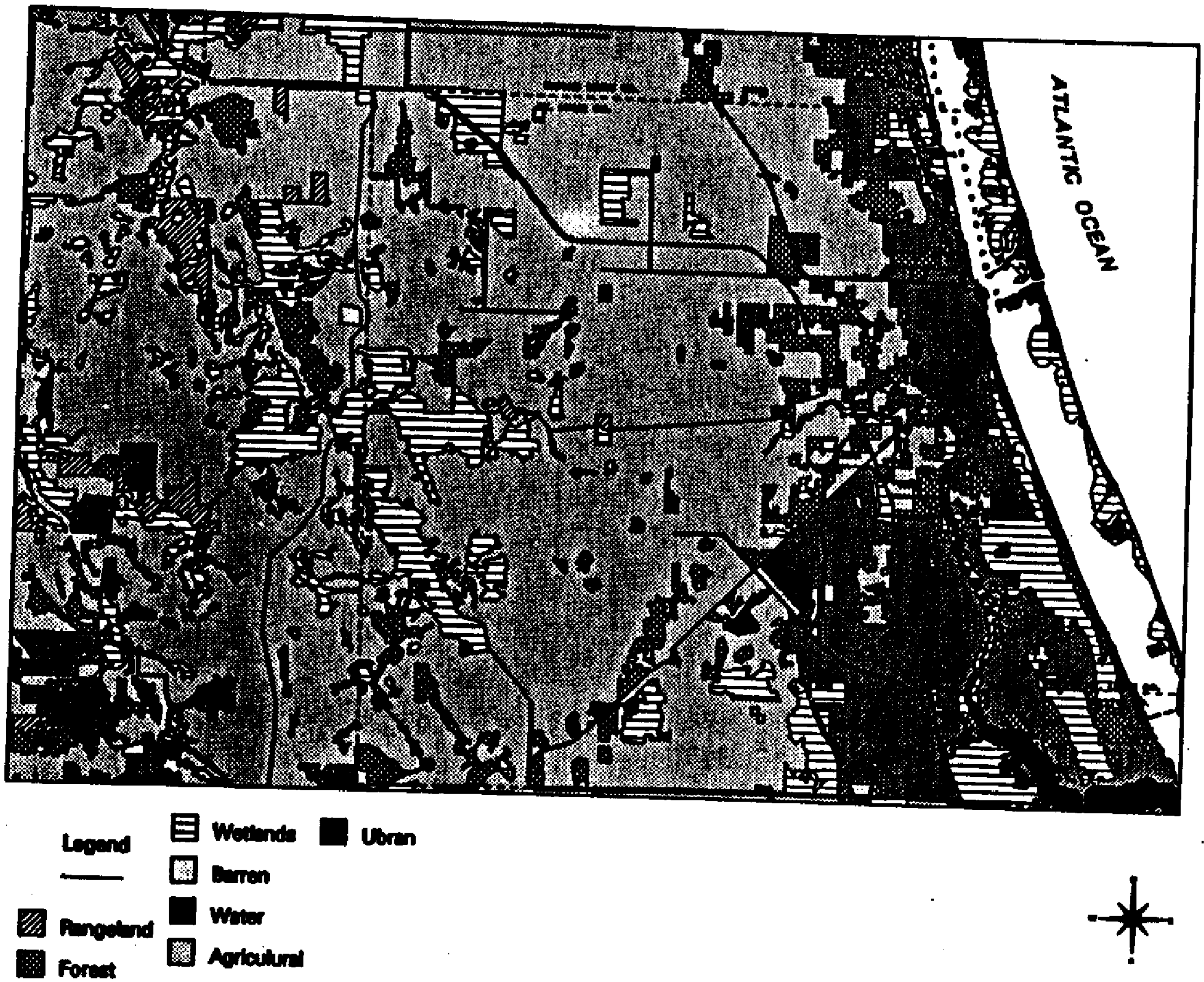


FIGURE C-3. **Average Monthly Rainfall (1936 through 1992)**



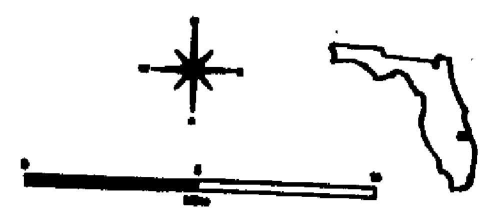


FIGURE C-4. General Land Use Map

TABLE C-4: S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

LEVEL I	LEVEL II	LEVEL III
(U) Urban and built-up land		
	(UR) Residential	
		(URSL) Single-family, Low Density (under 2 D.U./gross acre)
		(URSM) Single-family, Medium Density (2 to 5 D.U./gross acre)
		(URSH) Single-family, High Density (over 5 D.U./gross acre)
		(URMF) Multi-family building
		(URMH) Mobile homes
	(UC) Commercial and Services	
		(UCPL) Parking lot
		(UCSC) Shopping center
		(UCSS) Sales and services
		(UCCE) Cultural and Entertainment
		(UCMC) Marine commercial (Marinas)
		(UCHM) Hotel-Motel
	(UI) Industrial	
		(UIJK) Junkyard
		(UILT) Other light industrial
		(UIHV) Other heavy industrial
	(US) Institutional	
		(USED) Educational
		(USMD) Medical
		(USRL) Religious
		(USMF) Military
		(USCF) Correctional
		(USGF) Governmental (other than military or correctional)
		(USSS) Social services (Elks, Moose, Eagles)
	(UT) Transportation	
		(UTAP) Airports
		(UTAG) Small grass airports
		(UTRR) Railroad yards and terminals
		(UTPF) Port facilities
		(UTEP) Electrical power facilities
		(UTTL) Major transmission lines
		(UTHW) Major highway and rights-of-way
		(UTWS) Water supply plants
		(UTSP) Sewerage treatment plants
		(UTSW) Solid waste disposal

(UTRS) Antenna arrays
(UTOG) Oil and gas storage

(UO) Open and others

(UORC) Recreational facilities
(UOGC) Golf courses
(UOPK) Parks
(UOCM) Cemeteries
(UORV) Recreational vehicle parks
(UOUD) Open under development
(UOUN) Open and undeveloped within urban area

(A) Agriculture

(AC) Cropland

(ACSC) Sugar cane
(ACTC) Truck crops
(ACRF) Rice fields

(AP) Pasture

(APIM) Improved pasture
(APUN) Unimproved pasture

(AM) Groves, Ornamentals, Nurseries, Tropical fruits

(AMCT) Citrus
(AMTF) Tropical fruits
(AMSF) Sod farms
(AMOR) Ornamentals

(AF) Confined feeding operations

(AFFL) Cattle feed lots
(AFDF) Dairy farms
(AFFF) Fish farms
(AFHT) Horse training and stables
(AFPY) Poultry

(R) Rangeland

(RG) Grassland

(RS) Scrub and brushland

(RSPP) Palmetto prairies
(RSSB) Brushland

TABLE C-4: S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE (CON'T.)

(F) Forested uplands

(FE) Coniferous

(FEPF) Pine flatwoods
(FESP) Sand pine scrub
(FECF) Commercial forest (pine)

(FO) Non-coniferous

(FOAP) Australian pine
(FOBP) Brazilian pepper
(FOPA) Palms
(FOSO) Scrub oak
(FOOK) Oak
(FOCF) Commercial forest

(FM) Mixed forested

(FMTW) Temperate hardwoods
(FMCM) Cabbage palms/Melaleuca
(FMCO) Cabbage palms/Oaks
(FMPM) Pine/Melaleuca
(FMPO) Pine/Oak
(FMTH) Tropical hammocks
(FMOF) Old fields forested
(FMCD) Coastal dunes
(FMPC) Pine/Cabbage palms

(W) Wetlands

(WF) Forested fresh

(WFCM) Cypress/Melaleuca
(WFCY) Cypress
(WFWL) Willow
(WFME) Melaleuca
(WFSB) Scrub and brushland
(WFMX) Mixed forested

(WN) Non-forested fresh

(WNSG) Sawgrass
(WNCT) Cattail
(WNBR) Bullrush
(WNWC) Wire cordgrass
(WNAG) Mixed aquatic grass
(WNWL) Sloughs

(WS) Forested salt

(WSRM) Red mangrove
(WSBW) Black and White mangrove

(WM) Non-forested salt

(WX) Mixed forested and non-forested fresh

(WXPP) Pine and wet prairies
(WXCP) Cypress domes and wet prairies
(WXHM) Hardwood marsh

(H) Water

(B) Barren land

(BB) Beaches
(BP) Extractive
(strip mines, quarries, and gravel pits)
(BS) Spoil areas
(BL) Levees

* Documentation of major codes from "LAND USE, COVER AND FORMS CLASSIFICATION SYSTEM, A TECHNICAL MANUAL", Department of Transportation, State Topographic Office Remote Sensing Center, Kuyper, Becker and Shopmyer, February 1981

TABLE C-5. Coefficients Used in Recharge Preprocessing

Land Use	Ki	Ks	Ka
U	.75	.10	.10
UR	.70	.10	.10
URSL	.80	.10	.10
URSM	.75	.10	.10
URSH	.70	.10	.10
URMF	.65	.10	.10
URMH	.60	.10	.10
UC	.50	.30	.10
UCPL	.50	.30	.10
UCSC	.50	.30	.10
UCSS	.50	.30	.10
UCCE	.60	.20	.10
UCMC	.50	.20	.10
UCHM	.50	.20	.10
UI	.50	.30	.10
UIJK	.50	.30	.10
UILT	.50	.20	.10
UIHV	.50	.30	.10
US	.50	.20	.10
USED	.60	.20	.10
USMD	.50	.30	.10
USRL	.50	.20	.10
USMF	.50	.20	.10
USCF	.50	.20	.10
USGF	.50	.20	.10
USSS	.50	.20	.10
UT	.60	.20	.10
UTAP	.60	.20	.10
UTAG	.70	.10	.10
UTRR	.60	.10	.10
UTPF	.60	.20	.10

Land Use	Ki	Ks	Ka
AFDF	.90	.10	.10
AFFF	.90	.10	.10
AFHT	.90	.10	.10
AFPY	.90	.10	.10
R	.75	.10	.10
RG	1.00	.10	.10
RS	.80	.10	.10
RSPP	.75	.10	.10
RSSB	.80	.10	.10
F	.85	.10	.10
FE	.85	.10	.10
FEPF	.85	.10	.10
FESP	.85	.10	.10
FECP	.85	.10	.10
FO	.85	.10	.10
FOAP	.85	.10	.10
FOBP	.85	.10	.10
FOPA	.85	.10	.10
FOSO	.85	.10	.10
FOOK	.85	.10	.10
FOCF	.85	.10	.10
FM	.85	.10	.10
FMTW	.85	.10	.10
FMCM	.85	.10	.10
FMCO	.85	.10	.10
FMPM	.85	.10	.10
FMPO	.85	.10	.10
FMTH	.85	.10	.10
FMOF	.85	.10	.10
FMCD	.85	.10	.10
FMPC	.85	.10	.10

TABLE C-5. Coefficients Used in Recharge Preprocessing (Continued)

Land Use	Ki	Ks	Ka
UTEP	.60	.10	.10
UTTL	.60	.10	.10
UTHW	.60	.10	.10
UTWS	.60	.10	.10
UTSP	.60	.20	.10
UTSW	.60	.10	.10
UTRS	.60	.10	.10
UTOG	.60	.20	.10
UO	.98	.10	.10
UORC	.90	.10	.10
UOGC	.75	.10	.10
UOPK	.90	.10	.10
UOCM	.90	.10	.10
UORV	.80	.20	.10
UOUD	.98	.10	.10
UOUN	.75	.10	.10
A	.80	.10	.10
AC	.95	.10	.10
ACSC	.83	.10	.10
ACTC	.95	.10	.10
ACRF	.86	.10	.10
AP	.83	.10	.10
APIM	.83	.10	.10
APUN	.83	.10	.10
AM	.85	.10	.10
AMCT	.85	.10	.10
AMTF	.85	.10	.10
AMSF	.90	.10	.10
AMOR	.70	.10	.10
AF	.90	.10	.10
AFFL	.90	.10	.10

Land Use	Ki	Ks	Ka
W	.90	.10	.10
WF	.85	.10	.10
WFCM	.85	.10	.10
WFCY	.85	.10	.10
WFWL	.85	.10	.10
WFME	.87	.10	.10
WFSB	.80	.10	.10
WFMX	.80	.10	.10
WN	.90	.10	.10
WNSG	.90	.10	.10
WNCT	.90	.10	.10
WNBR	.90	.10	.10
WNWC	.90	.10	.10
WNAG	.90	.10	.10
WNWL	.90	.10	.10
WS	.85	.10	.10
WSRM	.85	.10	.10
WSBW	.85	.10	.10
WM	.90	.10	.10
WX	.90	.10	.10
WXPP	.90	.10	.10
WXCP	.90	.10	.10
WXHM	.90	.10	.10
H	1.00	.10	.10

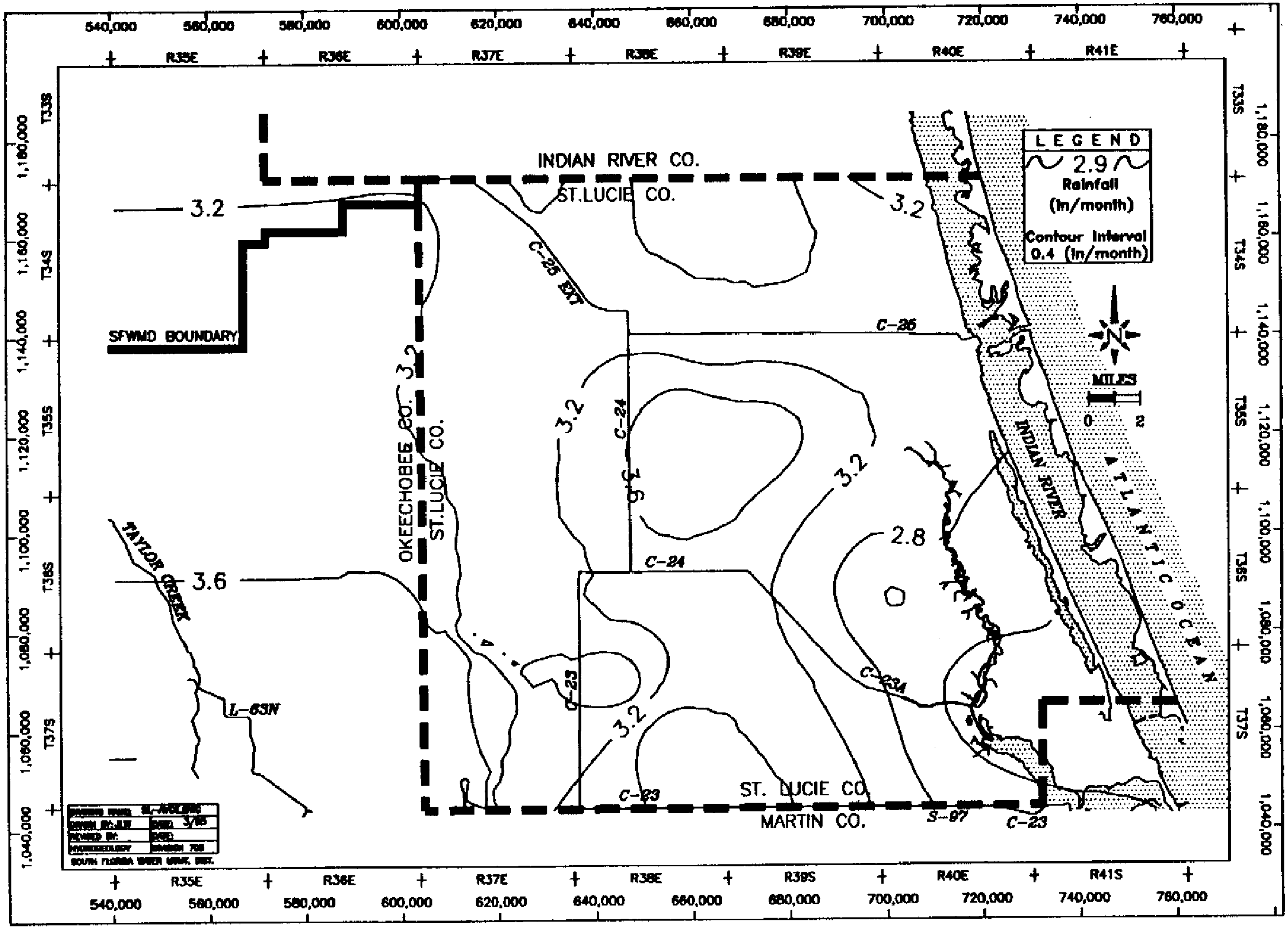


FIGURE C-5. Average Monthly Rainfall

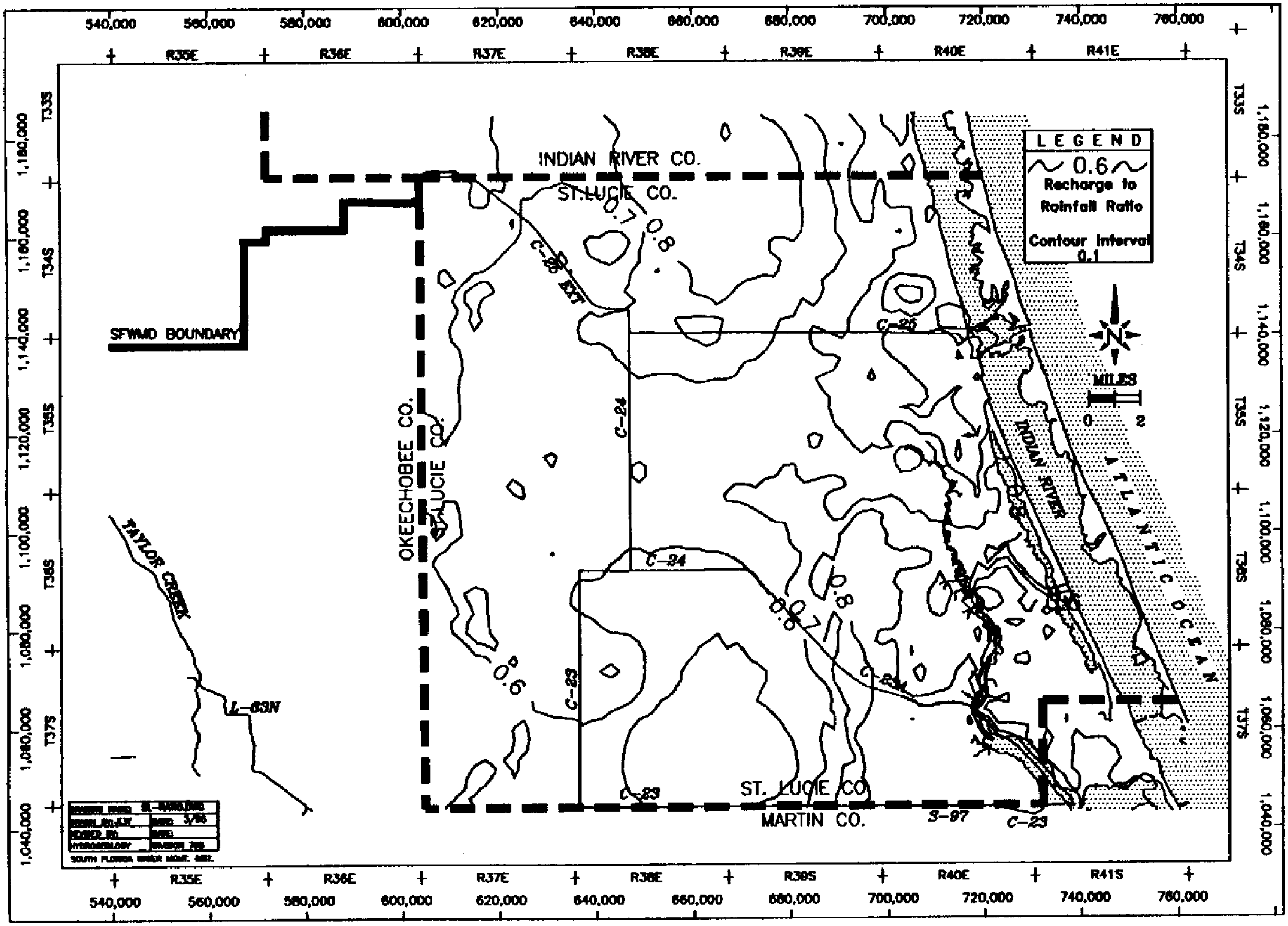


FIGURE C-7. Ratio of Net Recharge to Average Monthly Rainfall

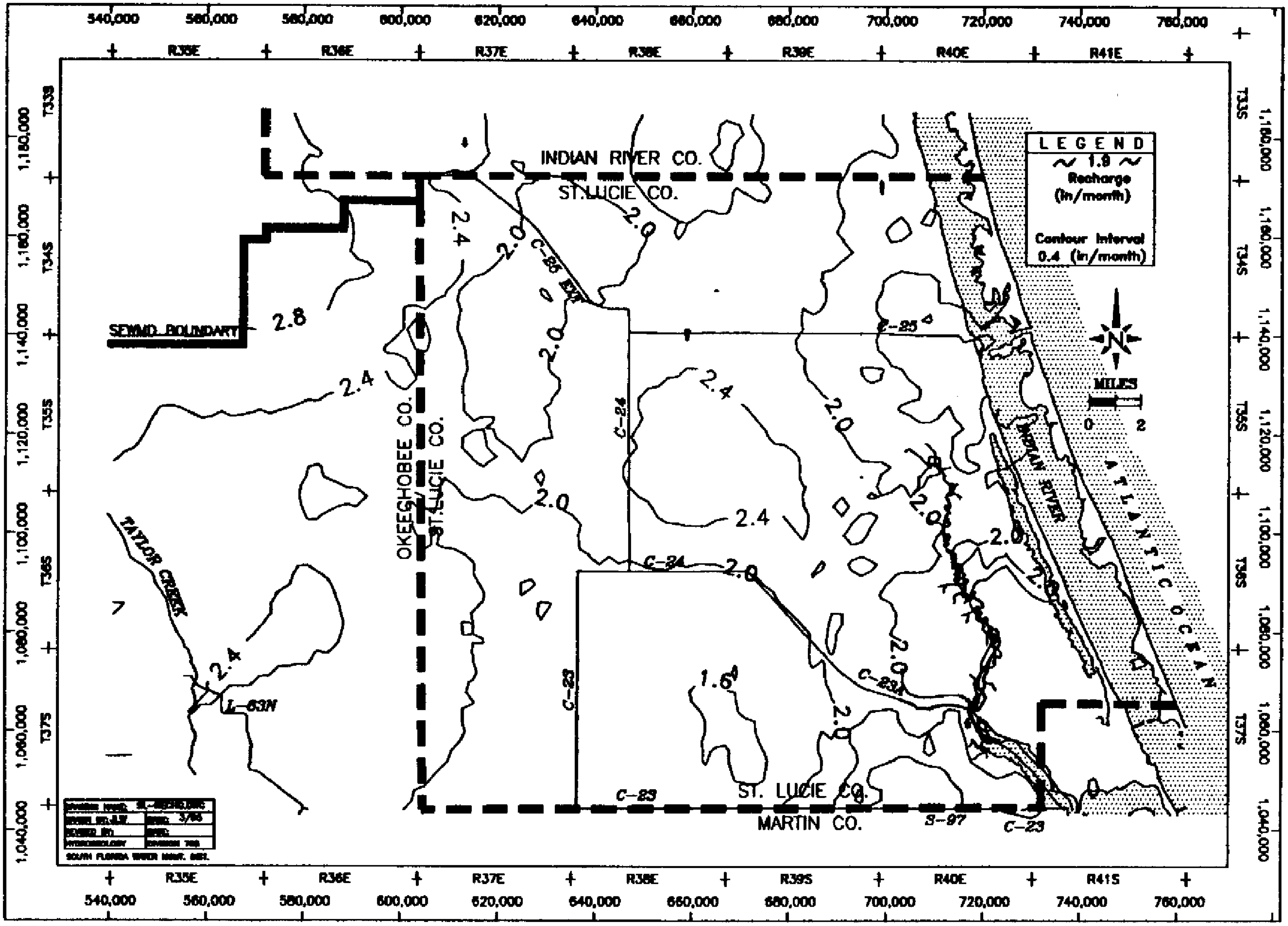


FIGURE C-6. Net Recharge Map

TABLE C-6. Crop Coefficients Used for ET Preprocessing (Continued)

Land Use	Covered	Month											
	%	1	2	3	4	5	6	7	8	9	10	11	12
UTRR	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTPF	.05	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTEP	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTTL	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTHW	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTWS	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTSP	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTSW	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTRS	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTOG	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UO	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UORC	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UOGC	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UOPK	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UOCM	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UORV	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UOUD	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UOUN	.90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
AC	1.0	.41	.44	.63	.67	.64	.69	.72	.71	.72	.86	.74	.64
ACSC	1.0	.39	.30	.53	.61	.70	.79	.79	.84	.73	.88	.72	.69
ACTC	1.0	.44	.71	.82	.78	.53	.49	.57	.44	.71	.82	.78	.53
ACRF	1.0	.39	.30	.53	.61	.70	.79	.79	.84	.73	.88	.72	.69
AP	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
APIM	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
APUN	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AM	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
AMCT	1.0	.63	.66	.68	.7	.71	.71	.71	.71	.7	.68	.67	.64
AMTF	1.0	.27	.42	.58	.7	.78	.81	.77	.71	.63	.54	.43	.3
AMSF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
AMOR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

TABLE C-6. Crop Coefficients Used for ET Preprocessing

Land Use	Covered	Month											
	%	1	2	3	4	5	6	7	8	9	10	11	12
U	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UR	.48	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
URSL	.67	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
URSM	.53	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
URSH	.45	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
URMF	.33	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
URMH	.40	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UC	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCPL	.25	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCSC	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCSS	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCCE	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCMC	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UCHM	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UI	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UIJK	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UILT	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UIHV	.05	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
US	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USED	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USMD	.60	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USRL	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USMF	.60	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USCF	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USGF	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USSS	.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UT	.50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTAP	.10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UTAG	.20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

TABLE C-6. Crop Coefficients Used for ET Preprocessing (Continued)

Land Use	Covered	Month											
	%	1	2	3	4	5	6	7	8	9	10	11	12
FMOF	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMCD	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMPC	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
W	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WF	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFCM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFCY	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFWL	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFME	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFSB	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WFMX	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WN	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNSG	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNCT	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNBR	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNWC	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNAG	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WNWL	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
WS	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WSRM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WSBW	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WX	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WXPP	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WXCP	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
WXHM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
H	1.0	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
B	.50	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55

TABLE C-6. Crop Coefficients Used for ET Preprocessing (Continued)

Land Use	Covered	Month											
	%	1	2	3	4	5	6	7	8	9	10	11	12
AF	.76	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AFFL	.75	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AFDF	.80	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AFFP	.75	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AFHT	.75	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
AFPY	.75	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
R	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
RG	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
RS	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
RSPP	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
RSSB	1.0	.49	.57	.73	.85	.90	.92	.92	.91	.87	.79	.67	.55
F	1.0	.63	.73	.86	.98	1.09	1.13	1.11	1.06	.99	.90	.78	.66
FE	1.0	.63	.73	.86	.98	1.09	1.13	1.11	1.06	.99	.90	.78	.66
FEPF	1.0	.63	.73	.86	.98	1.09	1.13	1.11	1.06	.99	.90	.78	.66
FESP	1.0	.63	.73	.86	.98	1.09	1.13	1.11	1.06	.99	.90	.78	.66
FECF	1.0	.63	.73	.86	.98	1.09	1.13	1.11	1.06	.99	.90	.78	.66
FO	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOAP	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOBP	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOPA	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOSO	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOOK	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FOCF	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMTW	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMCM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMCO	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMPM	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMPO	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75
FMTH	1.0	.73	.84	.99	1.14	1.24	1.30	1.28	1.22	1.14	1.05	.90	.75

TABLE C-7. Extinction Depths Used for ET Preprocessing (Continued)

LAND USE CODE	EXTINCTION DEPTH (FEET)
UT	1.0
UTAP	1.0
UTAG	1.0
UTRR	1.0
UTPF	1.0
UTEP	1.0
UTTL	1.0
UTHW	1.0
UTWS	1.0
UTSP	1.0
UTSW	1.0
UTRS	1.0
UTOG	1.0
UO	1.10
UORC	1.0
UOGC	1.0
UOPK	1.25
UOCM	1.0
UORV	1.25
UOUD	1.0
UOUN	1.25
A	1.4
AC	1.65
ACSC	3.0
ACTC	1.0
ACRF	1.0

LAND USE CODE	EXTINCTION DEPTH (FEET)
FMCM	1.5
FMCO	1.5
FMPM	2.0
FMPO	3.0
FMTH	1.5
FMOF	2.0
FMCD	3.0
FMPC	2.0
W	2.25
WF	3.35
WFCM	5.0
WFCY	8.0
WFWL	1.0
WFME	1.5
WFSB	1.5
WFMX	3.0
WN	1.5
WNSG	2.5
WNCT	2.5
WNBR	1.0
WNWC	1.0
WNAG	1.0
WNWL	1.0
WS	3.0
WSRM	3.0
WSBW	3.0

TABLE C-7. Extinction Depths Used for ET Preprocessing

LAND USE CODE	EXTINCTION DEPTH (FEET)
U	1.0
UR	1.0
URSL	1.0
URSM	1.0
URSH	1.0
URMF	1.0
URMH	1.0
UC	1.0
UCPL	1.0
UCSC	1.0
UCSS	1.0
UCCE	1.0
UCMC	1.0
UCHM	1.0
UI	1.0
UIJK	1.0
UILT	1.0
UIHV	1.0
US	1.0
USED	1.0
USMD	1.0
USRL	1.0
USMF	1.0
USCF	1.0
USGF	1.0
USSS	1.0

LAND USE CODE	EXTINCTION DEPTH (FEET)
AMOR	1.5
AF	1.0
AFFL	1.0
AFDF	1.0
AFFF	1.0
AFHT	1.0
AFPY	1.0
R	1.50
RG	1.25
RS	1.75
RSPP	2.0
RSSB	1.5
F	2.30
FE	2.65
FEPF	2.0
FESP	5.0
FECP	1.0
FO	2.0
FOAP	1.0
FOBP	1.0
FOPA	1.5
FOSO	1.5
FOOK	5.0
FOCF	2.0
FM	2.40
FMTW	5.0

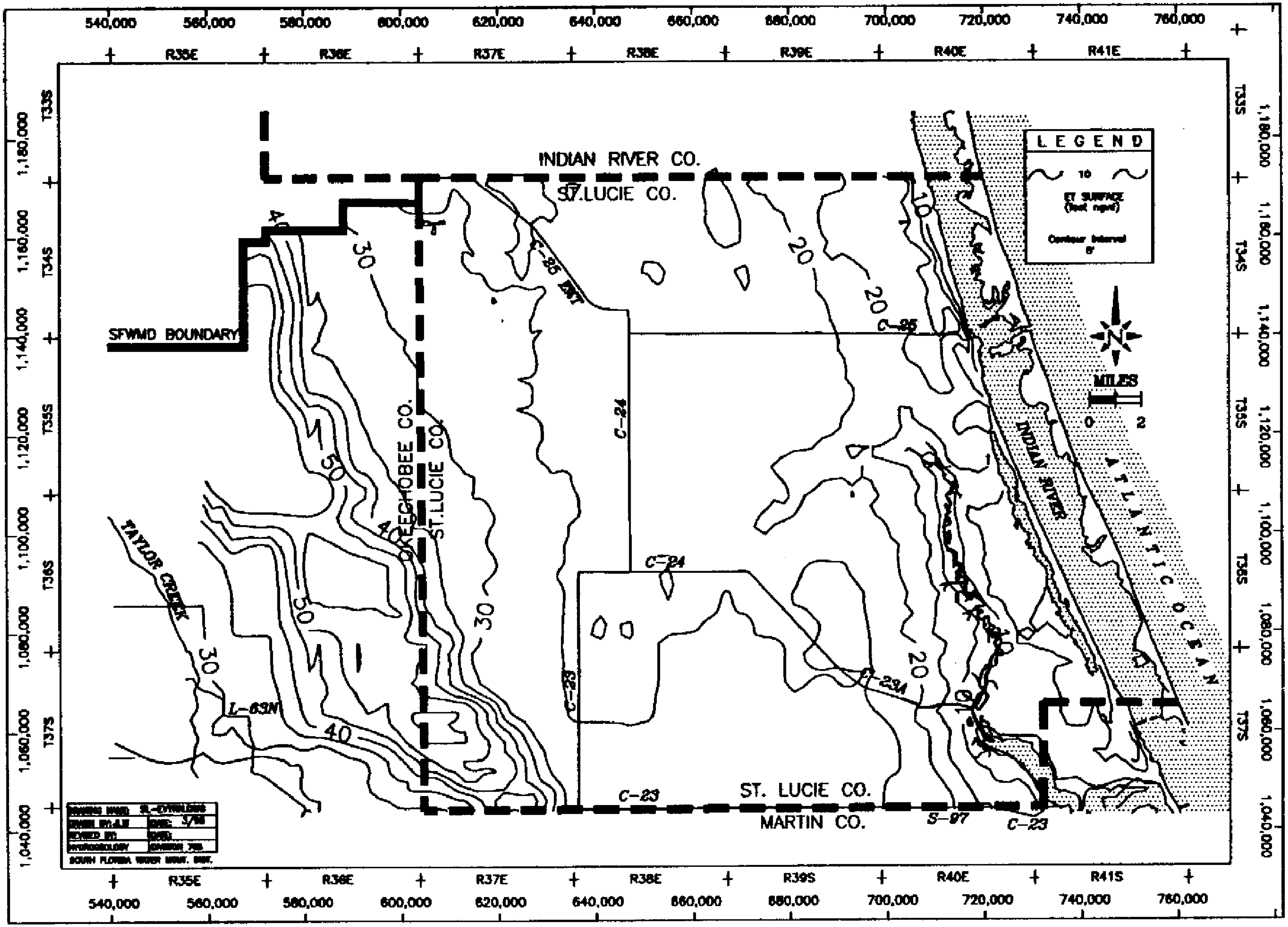


FIGURE C-8. ET Surface

TABLE C-7. Extinction Depths Used for ET Preprocessing (Continued)

LAND USE CODE	EXTINCTION DEPTH (FEET)
AP	2.0
APIM	2.0
APUN	2.0
AM	2.25
AMCT	3.0
AMTF	3.0
AMSF	1.25

LAND USE CODE	EXTINCTION DEPTH (FEET)
WM	1.25
WX	4.3
WXPP	3.0
WXCP	5.0
WXHM	5.0
H	6.0
B	.75

APPENDIX D

WATER USE DATA

LIST OF FIGURES - APPENDIX D

LIST OF TABLES - APPENDIX D

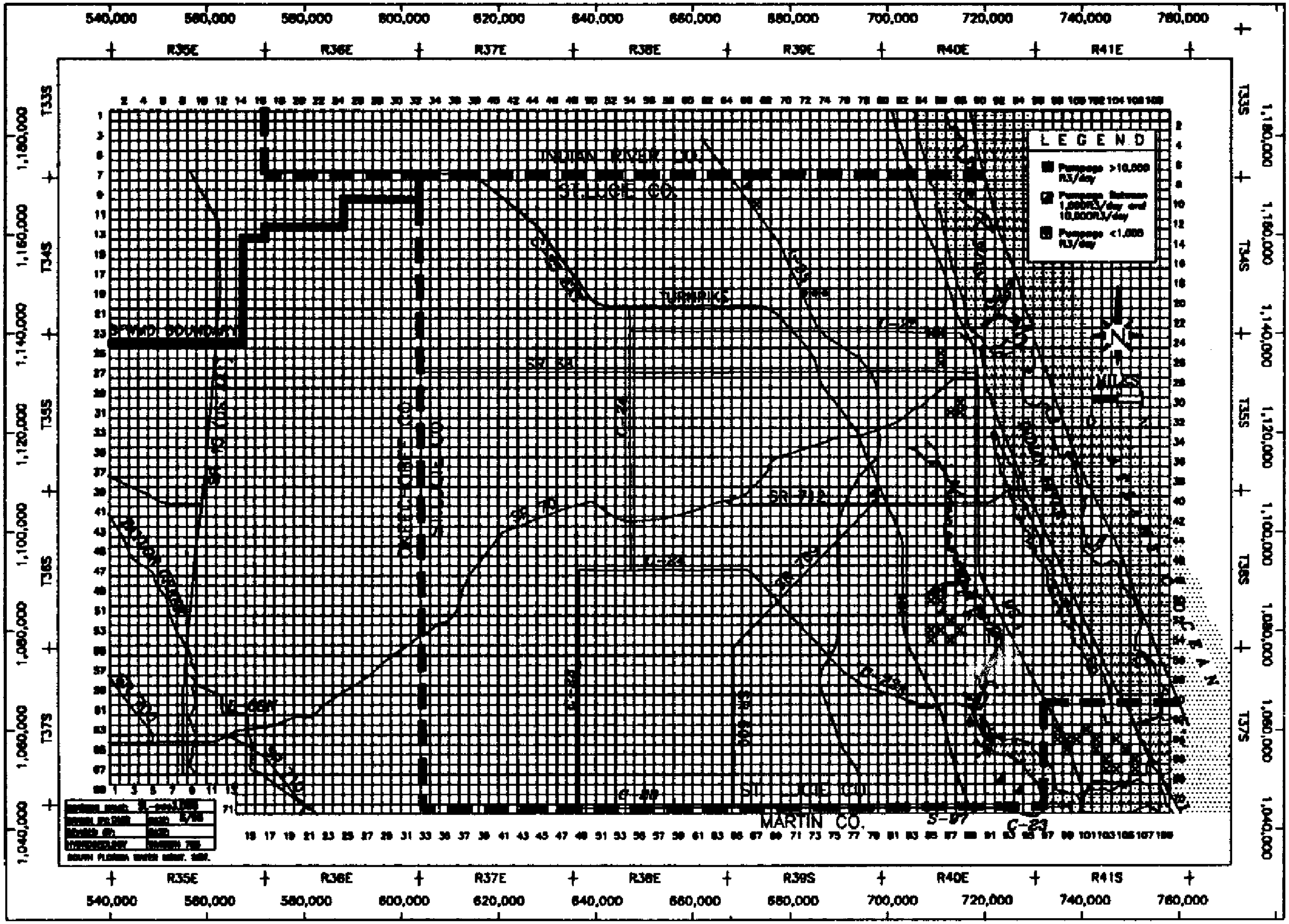


FIGURE D-2. Cells with Public Water Supply Withdrawals in Layer 3

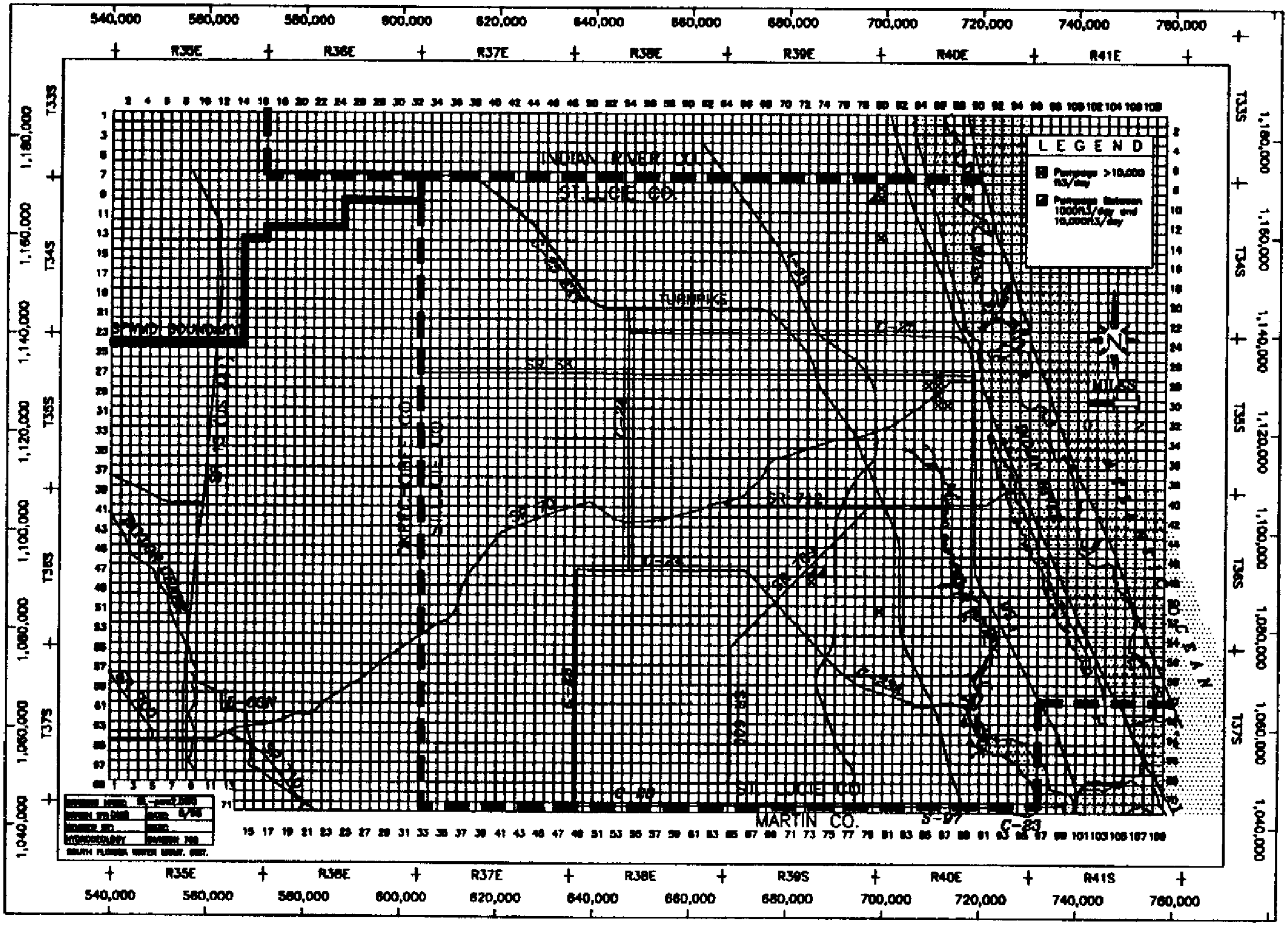


FIGURE D-1. Cells with Public Water Supply Withdrawals in Layer 2

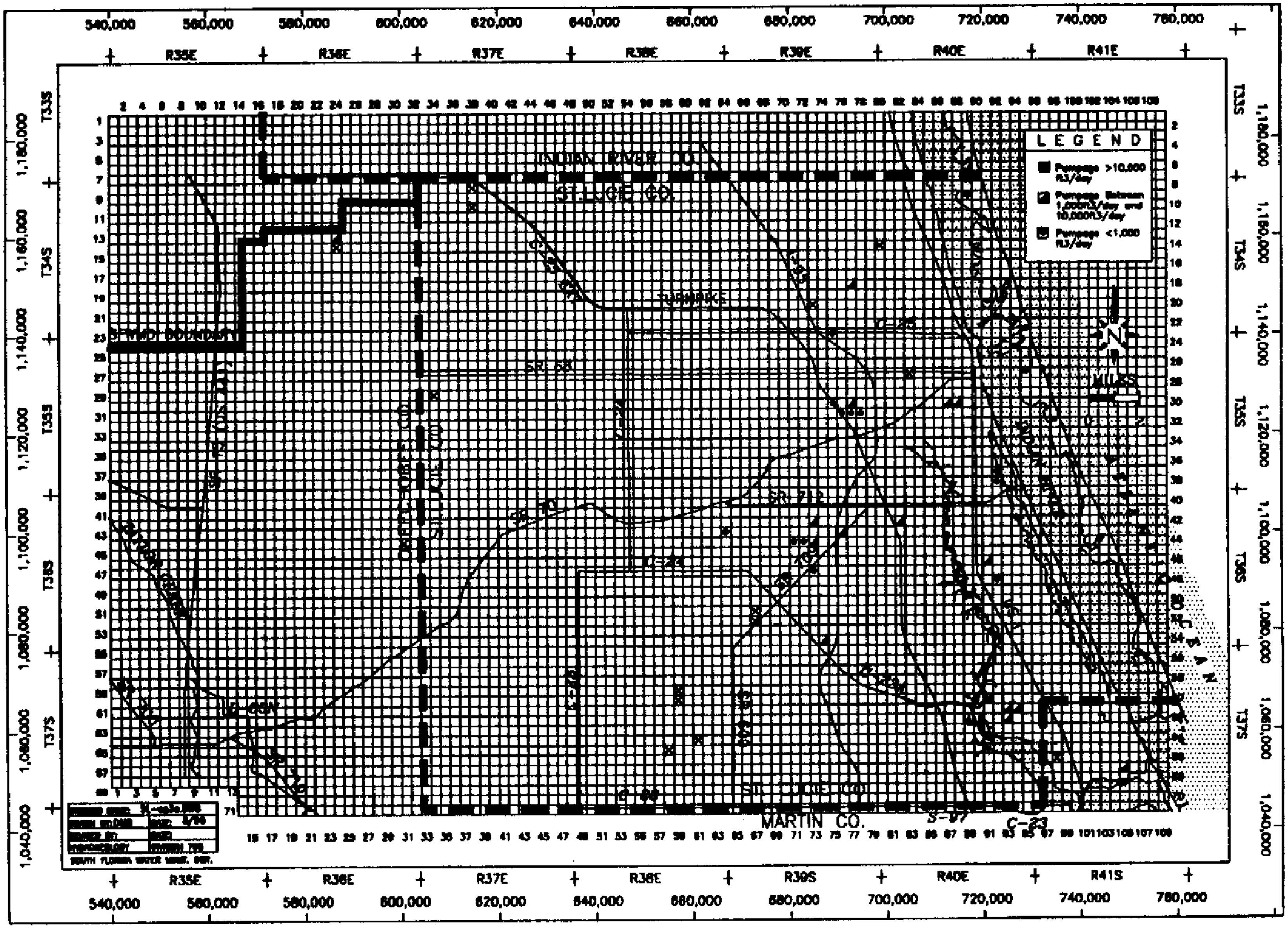


FIGURE D-4. Cells with Agricultural Water Withdrawals in Layer 3

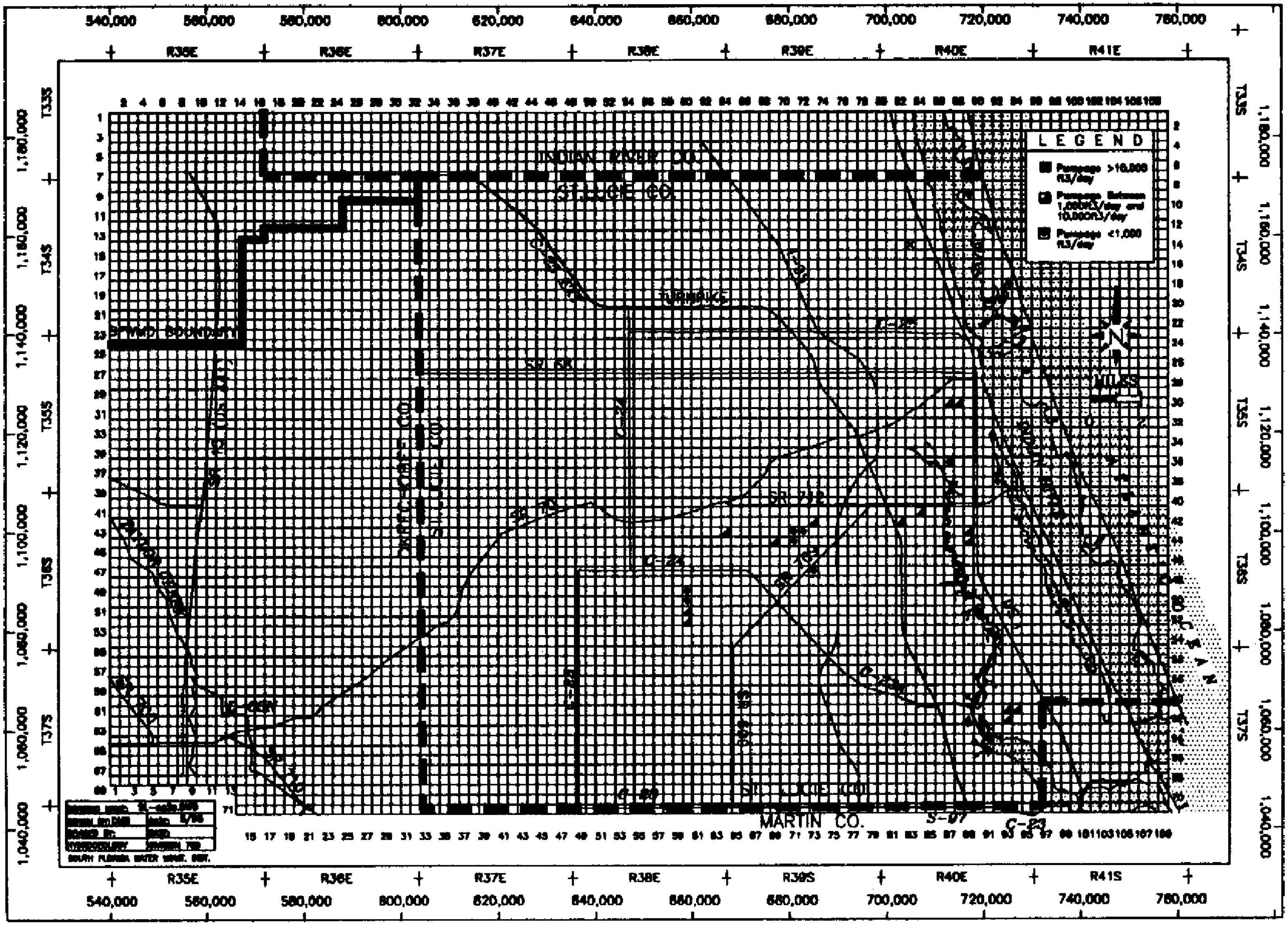


FIGURE D-3. Cells with Agricultural Water Withdrawals in Layer 2

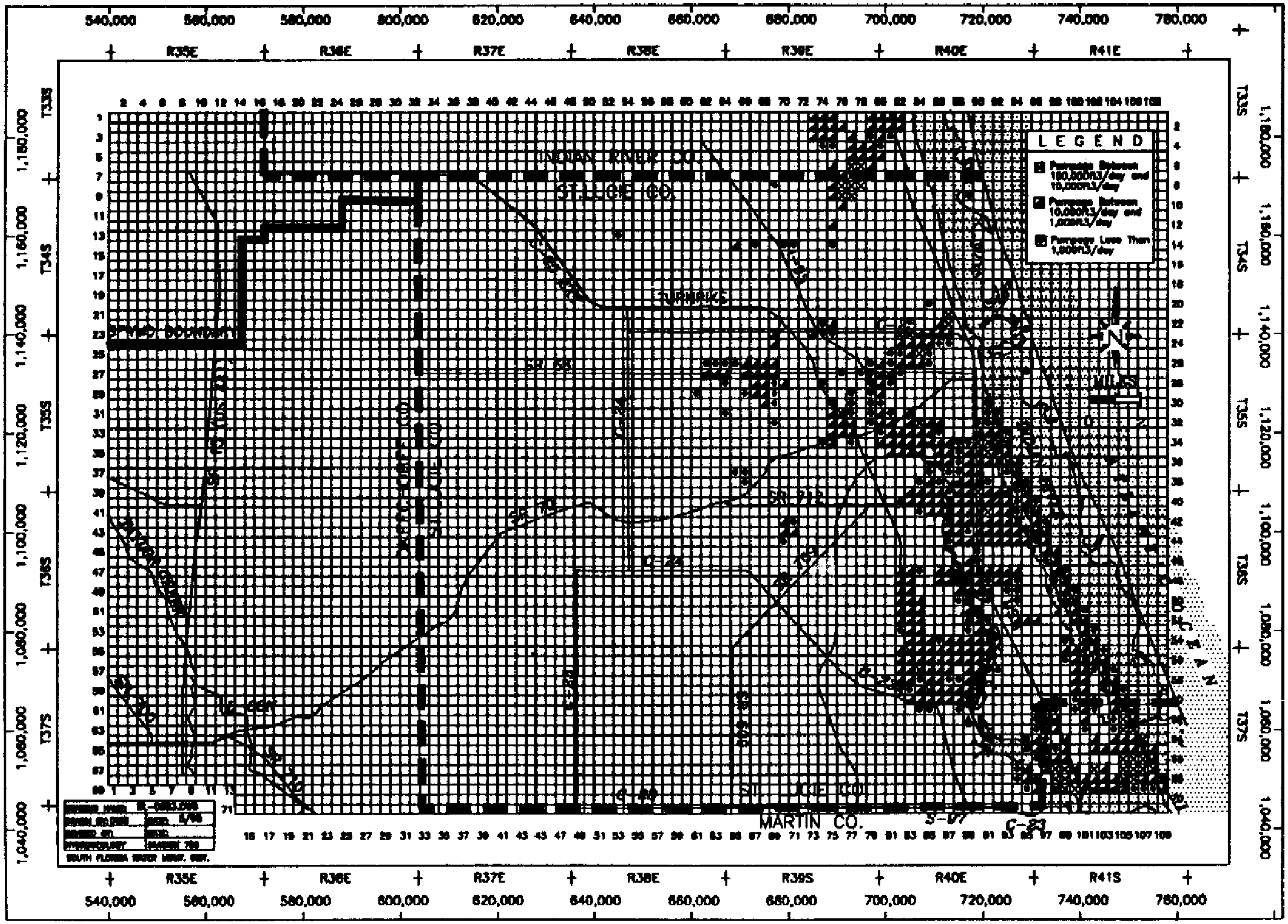


FIGURE D-6. Cells with Domestic Water Withdrawals in Layer 3

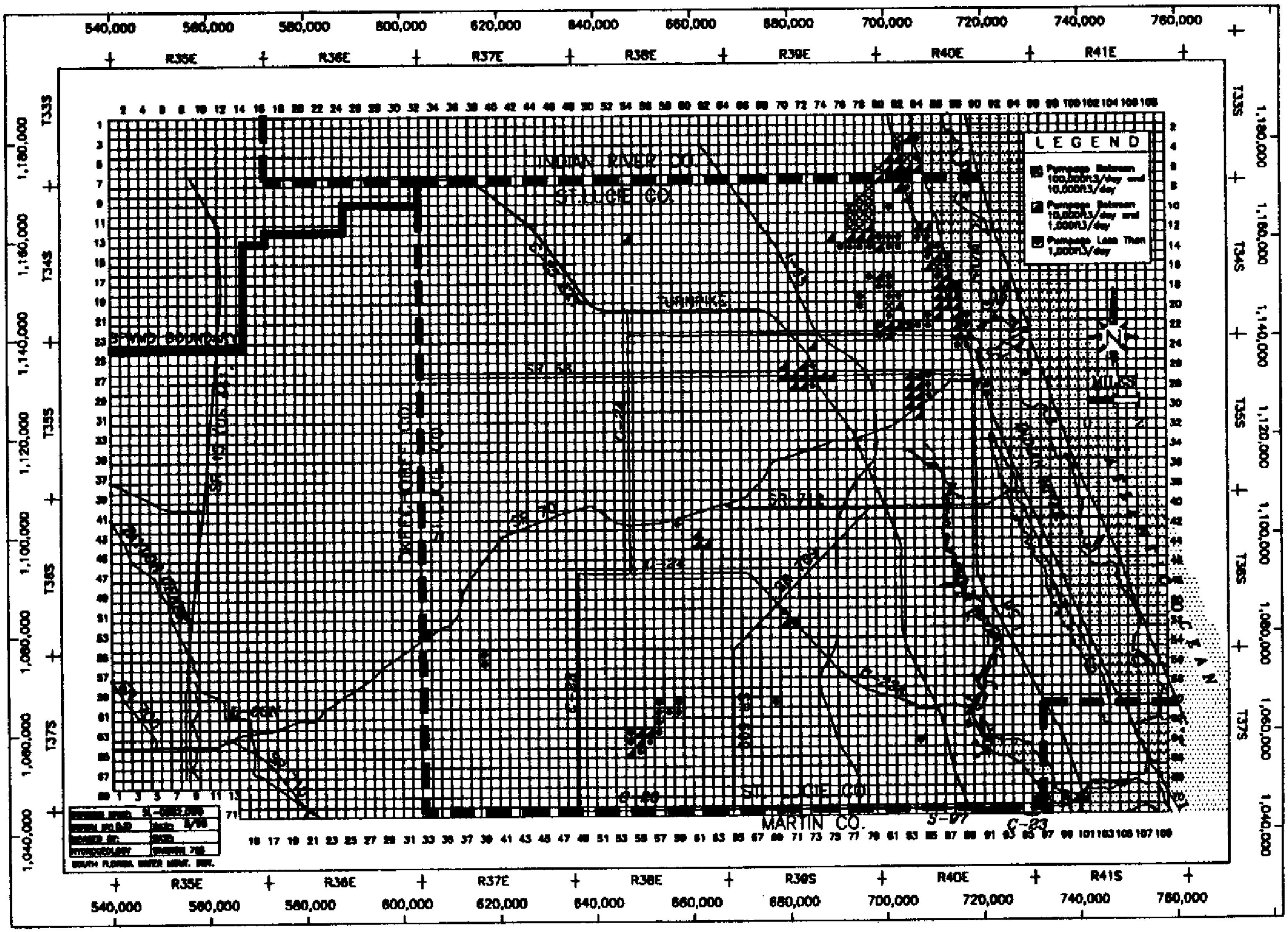


FIGURE D-5. Cells with Domestic Water Withdrawals in Layer 2

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

	5600085-N16	073	01	16.00	02	105	52	N/A	02	700	Y	711634.	1139771	GW	02								
	5600085-N17	073	01	16.00	02	105	52	N/A	02	700	Y	711231.	1139756	GW	02								
	5600085-N18	073	01	16.00	02	110	65	N/A	02	700	Y	710795.	1139790	GW	02								
	5600085-N19	073	01	16.00	02	110	62	N/A	02	550	Y	710339.	1139801	GW	02								
	5600085-N20	073	01	10.00	02	110	55	N/A	02	350	Y	709929.	1139786	GW	02								
	5600085-N21	073	01	10.00	02	110	50	N/A	02	350	Y	709427.	1139795	GW	02								
	5600085-S1	073	01	10.00	02	114	49	N/A	02	350	Y	708935.	1139796	GW	02								
	5600085-S2A	073	01	10.00	02	111	61	N/A	02	350	Y	710024.	1129822	GW	02								
	5600085-S4	073	01	12.00	02	97	60	N/A	02	300	Y	710409.	1129266	GW	02								
	5600085-S5	073	01	16.00	02	105	65	N/A	02	200	Y	710841.	1125864	GW	02								
	5600085-S6	073	01	16.00	02	105	65	N/A	02	200	Y	711366.	1125859	GW	02								
	5600085-S7	073	01	16.00	02	105	65	N/A	02	300	Y	711963.	1125922	GW	02								
	5600085-S8	073	01	16.00	02	105	65	N/A	02	600	Y	712193.	1125049	GW	02								
	5600085-S9	073	01	16.00	02	105	65	N/A	02	350	Y	712569.	1125917	GW	02								
	5600085-S10	073	01	16.00	02	105	65	N/A	02	325	Y	713593.	1125891	GW	02								
	5600085-S11	073	01	16.00	02	105	65	N/A	02	200	Y	713299.	1125380	GW	02								
	5600085-S12	073	01	16.00	02	105	65	N/A	02	400	Y	713301.	1124832	GW	02								
	5600085-S13	073	01	16.00	02	105	65	N/A	02	300	Y	713233.	1124318	GW	02								
	5600085-S14	073	01	16.00	02	105	65	N/A	02	450	Y	713837.	1124348	GW	02								
	5600085-S15	073	01	16.00	02	105	65	N/A	02	325	Y	714211.	1124360	GW	02								
	5600085-S16	073	01	16.00	02	105	65	N/A	02	500	Y	714775.	1124404	GW	02								
	5600085-S17	073	01	10.00	02	105	65	50	02	350	Y	712050.	1125420	GW	02								
	5600085-S18	073	01	10.00	02	105	65	50	02	350	Y	714067.	1125617	GW	02								
	5600085-W1	073	01	10.00	02	105	70	50	02	350	Y	714418.	1125622	GW	02								
	5600085-W2	073	01	10.00	02	105	70	50	02	350	Y	709538.	1130542	GW	02								
	5600085-W3	073	01	10.00	02	105	70	50	02	350	Y	709820.	1130567	GW	02								
	5600085-W4	073	01	10.00	02	105	70	50	02	350	Y	709599.	1130155	GW	02								
	5600085-FB1	073	01	10.00	02	700	600	N/A	02	350	Y	709838.	1130246	GW	08	Cap. estimated							
5600097	142.0		03	0.50	01	56	10/77	PWS		3	0	SPANISH LAKES MOBILE HOME PARK											
	5600097-1	84	01	8.00	02	80	60		02	220	Y	723941.	1084664	GW	02								
	5600097-R2	84	01	8.00	02	80	60		02	220	Y	723969.	1085831	GW	02								
	5600097-3	84	01	8.00	02	80	60		02	220	Y	724460.	1084436	GW	02		ORIGINAL WELL PLUGGED, REPLACED BY:R-2 WELL						
5600100W	265.12		03	1.37	01	56	11/87	GLF		4	7	TOLLMAN-HUNDLEY SPB, Club Med.					56	02	15	.8	4	234	0.75
	5600100-P11	84	01	8.00	02	100	60	N/A	02	200	N	725321.	1061391	GW	02								
	5600100-P1	84	01	8.00	02	115	70	N/A	02	250	N	725074.	1063253	GW	02								
	5600100-P2	84	01	8.00	02	115	70	N/A	02	250	N	725347.	1062850	GW	02								
	5600100-P3	84	01	8.00	02	115	70	N/A	02	250	N	726337.	1063260	GW	02								
	5600100-PS#1	84	01	N/A	---	---	---	N/A	01	800	N	722692.	1064362	SW	99	ON SITE LAKES, LAKE MANAKA, Cap.is guess							
	5600100-PS#1	84	01	N/A	---	---	---	N/A	01	800	N	722856.	1064496	SW	99	LAKE MANAKA Cap is guess							
	5600100-PS#2	84	01	N/A	---	---	---	N/A	01	800	N	7265[illegible]	1062973	SW	99	LAKE WESTMORELAND, "							
	5600100-PS#2	84	01	N/A	---	---	---	N/A	01	800	N	7266[illegible]	1062866	SW	99	LAKE WESTMORELAND, "							
	5600100-PS#3	84	01	8.00	---	---	---	N/A	01	800	N	724593.	1061517	SW	99	LAKE SAKURA, "							
	5600100-PS#3	84	01	8.00	---	---	---	N/A	01	800	N	724593.	1061517	SW	99	LAKE SAKURA, "							
	5600100-PS#3	84	01	6.00	---	---	---	N/A	01	800	N	724593.	1061517	SW	99	LAKE SAKURA, "							
5600118W	1028.32		03	299.99	02	56	3/89	AG	BOTH	19	4	E.C. LUNSFORD			56	5600118S/W	56	08	61	.8	11	1180	0.50
	5600118-1	083	01	8.00	02	900	250	FLOW	FLOW	305	NO	679433.	1093533	GW	08								
	5600118-2	083	01	8.00	02	900	250	FLOW	FLOW	305	NO	682910.	1094667	GW	08								
	5600118-4	083	01	8.00	02	900	250	FLOW	FLOW	305	NO	685131.	1103913	GW	08								
	5600118-6	083	01	8.00	02	100	90	FLOW	FLOW	300	NO	685639.	1102536	GW	02								
	5600118-7	083	01	8.00	02	100	90	FLOW	FLOW	300	NO	684690.	1097725	GW	02								
	5600118-9	083	01	10.00	02	100	90	FLOW	FLOW	300	NO	684198.	1097638	GW	02								
	5600118-10	083	01	4.00	02	80	57	FLOW	FLOW	150	NO	680566.	1097051	GW	02								
	5600118-5	083	01	8.00	02	900	---	FLOW	FLOW	120	NO	681976.	1099896	GW	08								
	5600118-8	083	01	4.00	02	900	300	FLOW	FLOW	305	NO	684105.	1101854	GW	08								
	5600118-16	083	01	8.00	02	900	300	FLOW	FLOW	150	NO	693973.	1103510	GW	08								
	5600118-17	083	01	4.00	02	900	300	FLOW	FLOW	305	NO	684078.	1104956	GW	08								
	5600118-11A	083	01	4.00	02	57	45	---	---	150	NO	684100.	1102575	GW	02								
	5600118-11B	083	01	4.00	02	57	45	---	---	150	NO	684271.	1102611	GW	02								
	5600118-12A	083	01	4.00	02	57	45	---	---	150	NO	684271.	1102611	GW	02	LOC. IS GUESS							
	5600118-12B	083	01	4.00	02	57	45	---	---	150	NO	684271.	1102611	GW	02	LOC. IS GUESS							
	5600118-13A	083	01	4.00	02	57	45	---	---	140	NO	681939.	1099415	GW	02								
	5600118-13B	083	01	4.00	02	57	45	---	---	140	NO	682116.	1099422	GW	02								
	5600118-14	083	01	8.00	02	80	75	---	---	350	NO	690996.	1100023	GW	02								
	5600118-15	083	01	8.00	02	80	75	---	---	200	NO	682026.	1098163	GW	02								
	5600118-18	083	01	---	---	---	---	---	---	10000	NO	691496.	1100355	SW	99								
	5600118-20	083	01	---	---	---	---	---	---	10000	NO	681940.	1098885	SW	99								
	5600118-21	083	01	---	---	---	---	---	---	10000	NO	681941.	1101927	SW	99	|PUMPS-DRAINAGE ONLY							
	5600118-19	083	01	---	---	---	---	---	---	10000	NO	666367.	1094879	SW	99								

TABLE D-1. WATER USE SPREADSHEET

LINE 1 HEADINGS: PERMIT NO. | AN. ALL. | ALL. UNT. | MAX MO. | NO. UTS. | CO | DATE ISS. | USE TYPE | SRC. | NO. WLS. | SW PMPS | OWNER | CO | PERMIT NO. | DEV NO. | CROP AQTYPE | SOIL TYPE | RAIN ST | IRR ACRES | IRR EFF

LINE 2+ HEADINGS (Table 1 - Existing Water Use - Facilities Information for Each Permit): PERMIT NO. | FACILITY NUMBER | QUAD. NO. | STS | WELL DIA. | DPTH CODE | TD | CD | PMP INT | PUMP TYPE | PUMP CAP. | MTR? | XPLNR | YPLNR | SRC | AQ | COMMENTS

PERMIT NO.	FACILITY NUMBER / AN. ALL.	QUAD. NO.	STS / ALL. UNT.	WELL DIA. / MAX MO.	DPTH CODE / NO. UTS.	TD / CO	CD / DATE ISS.	PMP INT / USE TYPE	PUMP TYPE / SRC.	PUMP CAP. / NO. WLS.	MTR? / SW PMPS	XPLNR / OWNER	YPLNR	SRC	AQ	COMMENTS	CO	PERMIT NO.	DEV NO.	CROP AQTYPE	SOIL TYPE	RAIN ST	IRR ACRES	IRR EFF
5600001	615		03	171	02	56	12/74	REC.	BOTH	5	3	SAVANNAS RECREATION AREA					56			02	15	.4	11	640	0.50
	5600001-1	073	01	2.00	02	75	50		02	50	N	723910	1110607	GW	02	Cap. estimated								
	5600001-2	073	01	2.00	02	75	50		02	50	N	723816	1111212	GW	02	"								
	5600001-3	073	01	2.00	02	75	50		02	50	N	723042	1111617	GW	02	"								
	5600001-4	073	04	6.00	02	?	?		FLOW	250	N	723635	1111413	GW	08	PLUGGED, WAS POT.RUN WELL								
	5600001-5	073	04	6.00	02	?	?		FLOW	250	N	723038	1112425	GW	08	PLUGGED								
	5600001-1P	073	02		01					10000	Y	705100	1139994	SW	99	THREE SW PUMPS ROUTE WATER								
	5600001-2P	073	01	14.00	01			2.7	01	7500	N	703922	1123629	SW	99	FROM C-25 THROUGH FEEDER								
	5600001-3P	073	01	24.00	01			10.5	01	17000	N	719794	1121390	SW	99	CANALS TO REC. AREA								
5600005	40		03	0.65	01	56	2/85	IND.	BOTH	4	1	TROPICANA PRODUCTS,INC.					56	5600005		2				
	5600005	072	01	6.00	02	87	78	65	02	100	Y	697616.	1106731	GW	02	FRUIT PROCESSING PLANT								
	5600005	072	01	6.00	02	87	78	65	02	100	Y	697485.	1106946	GW	02									
	5600005	072	01	6.00	02	87	78	65	02	100	Y	697429.	1107258	GW	02									
	5600005	072	01	6.00	02	76	46	65	02	150	Y	696650.	1107081	GW	02									
	5600005-C	072	04	36.00		SURF		POND			N	698074.	1106925	SW	99	S.W.emrg.fire ONSITE PONDS								
5600033	435.6		03	36.30	02	56	1/88	AG	GW	3	0	BERNARD EGAN								08	20	1.5	12	1525	0.5
5600033																				02	13	1.5	12	697	0.5
5600033																				02	13	1.5	12	240	0.5
	5600033-1	070	01	6.00	02	800		N		40		599399.	1129064	GW	08									
	5600033-2	070	01	8.00	02	1100		N		350		604614.	1127160	GW	08									
	5600033-3	070	01	10.00	02	100	80	80	02	150		607415.	1128808	GW	02									
5600034	25.76		03	8.80	02	56	12/87	AG	GW	3	0	JOHN T. MOOSE								08	13	1.5	11	56	0.85
	5600034-1	083	01	6.00	02	1300	300	N		250	N	686398.	1078432	GW	08	Cap. Estimated.								
	5600034-2	083	01	6.00	02	1260	300	N		250	N	687906.	1080110	GW	08	"								
	5600034-3	083	01	6.00	02	90	80	80	02	100	N	687287.	1078741	GW	02									
5600055	758.3		03	238.7	02	56	4/88	AG	BOTH	2	1	DAVIS,J.L. & DAVIS,C.T.								02	20	.8	11	1250	0.50
5600055	16.9		02																	02	61	.8	11	75	0.50
	5600055-1	083	01	4.00	02	90	84		02	90	N	673643.	1082906	GW	02									
	5600055-2	083	01	6.00	02	90	84		02	90	N	673201.	1083342	GW	02									
	5600055-PUMP	083	01	24.00						10000	N	677442.	1086110	SW	99	C-24								
5600076	375.3		03	225.19	02	56	11/88	AG	BOTH	6	2	McAUTHUR FARMS, INC.(GROVE #3)								02	13	.8	11	288	0.50
5600076				150.13	02	55	N/A		01											02	13	.8	11	288	0.75
	5600076-1	082	01	6.00	02	55	45		01	100	N	659320.	1082197	GW	02									
	5600076-2	082	01	6.00	02	55	45		01	100	N	659292.	1083533	GW	02									
	5600076-3	082	01	6.00	02	55	45		01	100	N	659290.	1084905	GW	02									
	5600076-4	082	01	6.00	02	55	45		01	100	N	659260.	1086172	GW	02									
	5600076-5	082	01	6.00	02	55	45		01	100	N	659175.	1088785	GW	02									
	5600076-6	082	02	12.00	02	1400	400			500	N	658986.	1081626	GW	08									
	5600076-1	082	01	36.00						21000	N	658024.	1092032	SW	99	C-24								
	5600076-2	082	01	36.00						21000	N	660277.	1092048	SW	99	C-24								
5600085	4544		03	17.18	01	56	11/85	PWS	GW	43	0	FT.PIERCE UTILITIES AUTHORITY							PWS				13,939	
	5600085-N1	073	01	10.00	02	92	45	N/A	02	350	Y	710326.	1130034	GW	02									
	5600085-N2	073	01	10.00	02	114	49	N/A	02	350	Y	710377.	1130487	GW	02									
	5600085-N3	073	01	10.00	02	114	59	N/A	02	350	Y	710366.	1131064	GW	02									
	5600085-N4	073	01	10.00	02	110	56	N/A	02	350	Y	710305.	1131503	GW	02									
	5600085-N5	073	01	10.00	02	113	65	N/A	02	350	Y	710333.	1132120	GW	02									
	5600085-N6	073	01	10.00	02	113	65	N/A	02	350	Y	710348.	1132609	GW	02									
	5600085-N7	073	01	10.00	02	113	72	N/A	02	350	Y	710326.	1130034	GW	02									
	5600085-N8A	073	04	-----	02	---	---	N/A	02	350	Y	710271.	1133130	GW	02									
	5600085-N9	073	01	10.00	02	129	70	N/A	02	350	Y	710456.	1133477	GW	02									
	5600085-N10	073	01	10.00	02	114	68	N/A	02	350	Y	710247.	1133970	GW	02									
	5600085-N11	073	01	10.00	02	100	54	N/A	02	350	Y	710276.	1134770	GW	02									
	5600085-N12	073	01	10.00	02	106	54	N/A	02	350	Y	710251.	1135148	GW	02									
	5600085-N13	073	01	10.00	02	110	60	N/A	02	350	Y	710261.	1136112	GW	02									
	5600085-N14	073	01	10.00	02	101	57	N/A	02	350	Y	710295.	1136384	GW	02									
	5600085-N15	073	01	16.00	02	105	53	N/A	02	700	Y	710159.	1137073	GW	02									

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

	5600301-4	82	1	8	02	200	100				2	150	657005.	1068187	GW	02								
	5600301-5	82	1	8	02	200	100				2	150	657371.	1067000	GW	02								
	5600301-6	94	1	8	02	200	100				2	150	654796.	1056259	GW	02								
	5600301-7	94	1	8	02	200	100				2	150	661649.	1058003	GW	02								
5600365W	9.2		3	3.39	2		71080	AGR		gw		2	0 BAILEY, CODY LEE					56 5600365W	8,1	13	1.5	11	20	0.85
	5600365-1	83	1	4	1	26	23		15		2	75	677465	1097596	GW	01								
	5600365-2	83	1	4	2	600	240				4	150	677282	1098141	GW	08								
5600401	62.05		3	5.1	2		80681	PWS		gw		3	0 SPANISH LAKES C CLUB					56 5600401W	02				259	
	5600401-1	61	1	8.00	2	100	80				3	220	697867	1168157	GW	02								
	5600401-2	61	1	8.00	2	100	80				3	220	698618	1168264	GW	02	completed well 10/89.							
	5600401-3	61	1	8.00	2	100	80				3	220	699056	1169578	GW	02								
5600406	136.00		3	22.38	2		100881	PWS		gw		2	0 HOLIDAY PINES SERVIC					56 5600406W	02				373	
	5600406-1	61	1	8.00	2	108	70				3	350	699207	1160076	GW	02								
	5600406-2	61	1	8.00	2	95	60				3	350	698945	1160061	GW	02								
5600416	4.20		2	4.20	2		10782	AGR		BOTH		2	1 DOUGLASS, P W					56 5600416W	02	13	0.8	11	20	0.85
	5600416-1	84	1	8.00	2	100	80				2	350	720570	1094835	GW	02	FILE OUT-B. KIRK							
	5600416-2	84	3	4.00	2	100	80				2	100	720577	1094321	GW	02	PERMIT EXPIRED 10/88							
	5600416-P1	84	1		1							300	720577	1094321	SW	99	ON SITE POND, Loc. guessed							
5600417	55.10		3	20.30	2		10782	AGR		both		10	3 UNIVERSITY OF FLA AGRICULTURE					56 5600417W	8,2	13	0.8	11	120	0.85
5600417																			8,2	20	0.8	11	50	0.50
5600417																			8,2	61	0.8	11	25	0.50
	5600417-1	72	1	8.00	2	800	300				4	45	686740	1128480	GW	08								
	5600417-2	72	1	6.00	2	800	300				4	45	694004	1125038	GW	08								
	5600417-3	72	1	3.00	2	800	300				4	45	694133	1124340	GW	08	Cap. est.							
	5600417-4	72	1	6.00	2	110	110				1	150	692644	1125398	GW	02								
	5600417-5	72	1	1.50	2	90	90				2	10	694079	1124649	GW	02								
	5600417-6	72	1	2.00	2	90	90				2	10	692824	1124367	GW	02								
	5600417-7	72	1	2.00	2	90	90				2	12	691454	1124438	GW	02								
	5600417-8	72	1	2.00	2	90	90				2	12	691190	1124368	GW	02								
	5600417-9	72	1	2.00	2	90	90				2	12	691139	1124709	GW	02								
	5600417-10	72	1	2.00	2	90	90				2	12	689303	1126535	GW	02								
	5600417-1S	72	1		2						1	1000	691147	1124187	SW	99	ResearchCntr.Rd.Canal							
	5600417-2S	72	1		2						1	1700	694157	1126702	SW	99	PicosRd.Canal							
	5600417-3S	72	1		2						1	2000	692888	1126721	SW	99	PicosRd.Canal							
5600418	76.10		3	12.60	2		10782	AGR		both		5	1 BURNAC PRODUCE, INC					56 5600418W	02	20	1.5	11	86	0.75
5600418																			02	61	1.5	11	22	0.50
	5600418-1	83	1	6.00	2	70	35		40		2	80	666855	1100068	GW	02								
	5600418-2	83	1	6.00	2	70	35				3	100	666801	1099643	GW	02								
	5600418-3	83	4	6.00	2	760	300				4	100	665686	1101193	GW	08	Plugged by District							
	5600418-4	83	4	6.00	2	760	300				4	100	666573	1098843	GW	08	"							
	5600418-5	83	4	6.00	2	760	300				4	100	667972	1098991	GW	08	"							
	5600418-1S	83	1		2						3	2000	667972	1098991	SW	99	C-85, Loc. guessed							
5600421	13.90		3	5.16	2		21182	AGR		both		1	1 KLASSEN, VIC					56 5600421W	02	61	0.8	11	5	0.50
5600421																			02	20	0.8	11	5	0.50
	5600421-1	84	1	2.00	2	84	64				3	75	722159	1090838	GW	02								
	5600421-1S	84	1		2						3	500	722132	1091135	SW	99	Pond							
5600429	625.50		3	230.20	2		41582	AGR		GW		5	0 MAYACA LAND CORPORATION					56 5600429W	02	13	0.8	12	1200	0.75
	5600429-1	93	1	8.00	2	240	185				2	180	605958.	1058627	GW	05	PERMITTED FLORIDAN : WRONG							
	5600429-2	93	1	8.00	2	220	130				2	180	606046.	1059637	GW	05	PROB. SURFICIAL WELLS							
	5600429-3	93	1	8.00	2	220	130				2	180	608304.	1058734	GW	05	THIS PERMIT ALL WRONG, FAC. CAP. TOO HIGH.							
	5600429-4	93	1	8.00	2	220	130				2	180	608302.	1059643	GW	05	NOT FLORIDAN, MID-HAWTHORN, MAX MO. TOO HIGH							
	5600429-5	93	3	10.00	2	1300	130				2	400	607491.	1059237	GW	05	CAPPED, USE IN FUTURE							
5600430	42.10		3	16.00	2		41582	AGR		gw		3	0 BOWDEN, R K					56 5600430W	2,8	13	1.5	11	175	0.85
	5600430-1	59	1	10.00	2	800	250				4	1000	616100	1165099	GW	08	EXPIRED							
	5600430-2	59	1	8.00	2	100	90				3	350	615100	1166995	GW	02								
	5600430-3	59	1	8.00	2	100	90				3	350	615053	1169378	GW	02								
5600432	63.40		3	23.40	2		41582	AGR		gw		9	0 SCOTT, L.W.					56 5600432W	2,8	13	1.5	11	574	0.85
	5600432-1	59	2	10.00	2	800	250				4	1000	616246	1158069	GW	08	EXPIRED							
	5600432-2	59	2	10.00	2	800	250				4	1000	616252	1155645	GW	08								
	5600432-3	59	2	8.00	2	100	90				3	150	616148	1161915	GW	02								
	5600432-4	59	2	8.00	2	100	90				3	150	616339	1160506	GW	02								

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

5600120W				18.4	02	56	---	--	GW	5	0	MINTON, E.G.					56	8,2	20	.8	11	500	0.50
	5600120-1	062	01	4.00	02			FLOW		95	N	703600	1153900	GW	08	Permit expired waiting							
	5600120-2	062	01	5.00	02			FLOW		105	N	702900	1157000	GW	08	on renewal letter response.							
	5600120-3	061	01	2.00	02	85	85			75	N	699950	1157500	GW	02								
	5600120-4	062	01	2.00	02	85	85			75	N	705300	1157050	GW	02								
	5600120-5	062	01	2.00	02	85	85			75	N	705400	1157050	GW	02								
5600122W	86.8		04	13.8	02	56	4/78	AG	BOTH	*1	1	M.R. FARINA					56	08	13	1.5	11	34.4	0.50
	5600122-1	072	01	2.00	02	160	150	PUMPED	--	75	NO	689578.	1140713	GW	02	*3 FLOWING FLORIDAN							
	5600122-2	072	01	---	---	---	---	---	PORT	1500	NO	689418.	1140522	SW	99	WELLS ON ADJECENT PROP.							
5600141W	4.15		03	9.82	02	56	6/78	AG	GW	1	0	R.& M. BOUDRIAS					56	01	13	.8	11	17	0.50
	5600141-1	083	01	3.00	02	80	55	N/A	---	100	N	702410	1101405	GW	02								
5600142W	1555		03	5.97	01	56	3/88	PWS	GW	21	0	GENERAL DEV. UTIL. (PORT ST.LUCIE)					56	02	---	---	---	---	---
	5600142-1	084	01	8.00	02	95	60	N/A	02	350	Y	713106.	1081354	GW	02								
	5600142-2	084	01	8.00	02	103	45	N/A	02	200	Y	713813.	1082268	GW	02								
	5600142-3	084	01	8.00	02	90	45	N/A	02	350	Y	713071.	1082096	GW	02								
	5600142-4	084	03	8.00	02	114	79	N/A	02	125	Y	710737.	1083830	GW	02								
	5600142-6	084	01	8.00	02	111	76	N/A	02	275	Y	709995.	1085133	GW	02								
	5600142-7	084	01	8.00	02	111	69.5	68	02	265	Y	709500.	1086889	GW	02								
	5600142-8	084	01	8.00	02	111	75	68	02	200	Y	709570.	1087756	GW	02								
	5600142-9	084	01	8.00	02	110	65	65	02	320	Y	710903.	1085147	GW	02								
	5600142-10	084	01	8.00	02	110	70	63	02	320	Y	710855.	1085866	GW	02								
	5600142-11	084	01	8.00	02	111	70	70	02	180	Y	710814.	1086900	GW	02								
	5600142-12	084	01	8.00	02	111	71	69	02	255	Y	710598.	1087728	GW	02								
	5600142-13	084	01	8.00	02	95.5	71	N/A	02	190	Y	708517.	1085159	GW	02								
	5600142-14	084	01	8.00	02	100	54.5	N/A	02	300	Y	710046.	1080336	GW	02								
	5600142-15	084	01	8.00	02	99.5	60	N/A	02	300	Y	709116.	1079166	GW	02								
	5600142-16	084	01	8.00	02	90	64.5	N/A	02	300	Y	709718.	1078168	GW	02								
	5600142-17	084	01	8.00	02	110	55	N/A	02	300	Y	714658.	1079946	GW	02								
	5600142-18	084	03	8.00	02	95	50	N/A	02	100	Y	713893.	1078676	GW	02								
	5600142-19	084	01	8.00	02	95	60	N/A	02	275	Y	703634.	1084638	GW	02								
	5600142-20	084	01	8.00	02	105	57	N/A	02	350	Y	703319.	1085331	GW	02								
	5600142-21	084	02	8.00	02	90	45	N/A	02	200	Y	706154.	1088953	GW	02								
	5600142-22	084	01	8.00	02	90	41.5	N/A	02	200	Y	710191.	1086882	GW	02								
5600155W	172.02		03	63.31	02	56	6/89	AG	GW	14	0	FIRST AM. BANK & TRUST					56	2,8	13	1.5	11	220	0.50
	5600155-1	073	01	2.00	02	1000	50	FLOW	FLOW	50	---	703452.	1132054	GW	08	Cap estimated							
	5600155-2	073	01	4.00	02	100	100	---	01	130	---	704381.	1131467	GW	02	"							
	5600155-3	073	01	4.00	02	1000	100	FLOW	FLOW	350	---	704071.	1130865	GW	08	"							
	5600155-4	073	01	3.00	02	1000	75	FLOW	FLOW	300	---	704343.	1130870	GW	08	"							
	5600155-5	073	01	4.00	02	1000	100	FLOW	FLOW	200	---	704440.	1130388	GW	08	"							
	5600155-6	073	01	4.00	02	1000	100	FLOW	FLOW	160	---	704518.	1129010	GW	08	"							
	5600155-7	073	02	8.00	02	1000	500	FLOW	FLOW	500	---	704676.	1128347	GW	08								
	5600155-8	073	02	8.00	02	1000	500	FLOW	FLOW	500	---	703726.	1127507	GW	08								
	5600155-9	073	02	8.00	02	1000	500	FLOW	FLOW	500	---	703807.	1128179	GW	08								
	5600155-10	073	02	8.00	02	1000	500	FLOW	FLOW	500	---	703784.	1129347	GW	08								
	5600155-11	072	02	8.00	02	1000	500	FLOW	FLOW	500	---	702551.	1127961	GW	08								
	5600155-12	072	02	8.00	02	1000	500	FLOW	FLOW	500	---	702549.	1129357	GW	08								
	5600155-13	072	02	8.00	02	1000	500	FLOW	FLOW	500	---	702579.	1130166	GW	08								
	5600155-14	072	02	8.00	02	1000	500	FLOW	FLOW	500	---	702575.	1131425	GW	08								
5600286W	20.7		03		02		41979	AGR	gw	3	0	ROBINSON, R D					56	8,1	13	0.8	11	45	.85
	5600286-1	84	1	4	02	850	120		4	100		716997	1100797	GW	08								
	5600286-2	84	1	4	02				4	100		716831	1100310	GW	08								
	5600286-3		1	3	02	60	50		1	100		716831	1100310	GW	02	Location is guess							
5600287W	10.7		03	5.38	02		41979	AGR	gw	2	0	MOSUCHINSKY, J					56	8,1	13	0.8	11	16	0.50
	5600287-1	84	1	4	02	875			4	100		706817	1104546	GW	08								
	5600287-2	84	1	3	02	45	45		3	70		706838	1103808	GW	01								
5600288W	4.37		03	1.61	02		41979	AGR	gw	2	0	ROBINSON, R D					56	8,1	13	0.8	11	10	0.85
	5600288-1	84	1	4	02				4	100		716861	1097963	GW	08								
	5600288-2	84	1	3	02	60	50		1	100		716821	1098219	GW	02								
5600301W	78.2		03	28.8	02		50880	AGR		7	0	MCCARTY, SR., J.M. AND					56	8,1	20	0.8	4	78.2	0.50
5600301W	3515.4			672.1	02													8,1	20	0.8	4	3515.4	0.50
	5600301-1	82	1	6	02	750	150		4	200		654388.	1068678	GW	08								
	5600301-2	82	1	6	02	750	150		4	200		659343.	1070515	GW	08								
	5600301-3	82	1	8	02	1200	600		4	350		660896.	1065674	GW	08								

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

5600579	244.00		3		2		61286	IND	gw	4	0	TREESWEET PRODUCTS COMPANY, IN					56	5600579W	02	13	.8	11	1	0.50
	5600579-1	73	1	10.00	1	70	60	50	2	200		712295	1114725	GW	02									
	5600579-2	73	1	10.00	1	70	60	55	2	200		712520	1114621	GW	02									
	5600579-3	73	1	6.00	1	70	60	55	2	250		712601	1114260	GW	02									
	5600579-4	73	1	10.00	1	70	60	40	2	150		712224	1114167	GW	02									
5600614	289.00		3	1.20	1		31287	PWS	GW	12	0	ST LUCIE WEST UTILITIES, INC					56	5600614W					4616	
	5600614-1	83	1	8.00	2	75	42	45	2	175	Y	698262.	1083208	GW	02	Wells 1-6 have								
	5600614-2	83	1	8.00	2	65	46	45	2	175	Y	698622.	1083310	GW	02	well completion reports								
	5600614-3	83	1	8.00	2	70	41	45	2	175	Y	698982.	1083514	GW	02	in file.								
	5600614-4	83	1	8.00	2	68	42	45	2	175	Y	699342.	1083718	GW	02									
	5600614-5	83	1	8.00	2	65	40	45	2	175	Y	698624.	1083008	GW	02	Coordinates are corrected								
	5600614-6	83	1	8.00	2	60	40	45	2	175	Y	698894.	1083110	GW	02	originally wrong July 27,90								
	5600614-7	83	2	8.00	2	70	30	45	2	175	Y	699714.	1081397	GW	02	The rest of wells have								
	5600614-8	83	2	8.00	2	70	30	45	2	175	Y	700533.	1079988	GW	02	no completion reports								
	5600614-9	83	2	8.00	2	70	30	45	2	175	Y	701613.	1080397	GW	02	and are only proposed								
	5600614-10	83	2	8.00	2	70	30	45	2	175	Y	701981.	1078985	GW	02									
	5600614-11	83	2	8.00	2	70	30	45	2	175	Y	701887.	1079792	GW	02									
	5600614-12	83	2	8.00	2	70	30	45	2	175	Y	702868.	1082120	GW	02	Well 12 not on site map								
5600620	22.30		3	3.80	2		51487	LAN	gw	3	0	MAX AMBACH & SONS & COMPANY					56	5600620W	02	15	0.8	11	20	0.75
	5600620-1	73	1	8.00	1	100	70	3	2	200		714426	1126164	GW	02									
	5600620-2	73	1	8.00	1	90	60	3	2	200		713514	1126367	GW	02									
	5600620-3	73	2	8.00	1	100	70	3	2	200		713983	1126910	GW	02									
5600624	6.21		3		2		61187	PWS	GW	5	0	LAKE MANOR PROPERTIES, INC.					56	5600624W	02				13	
	5600624-1	85	2	4.00	2	110	105		2	100		747142	1066651	GW	02									
	5600624-2	85	2	4.00	2	110	105		2	100		747249	1066436	GW	02									
	5600624-1E	85	1	2.00	2	27		27	2	50		747442	1066651	GW	01	Existing wells will be abandoned, Cap. estim.								
	5600624-2E	85	1	2.00	2	27		27	2	50		747462	1066651	GW	01	upon completion of								
	5600624-3E	85	1	2.00	2	27		27	2	50		747482	1066651	GW	01	proposed wells								
5600627	92.20		3		2		70987	PWS	gw	5	0	WYNNE BUILDING CORPORATION					56	5600627W	02				435	
	5600627-1	61	1	8.00	2	95	68		2	150		673428	1165715	GW	02									
	5600627-2	61	1	8.00	2	83	75		2	150		670644	1169599	GW	02									
	5600627-3	61	1	8.00	2	80	65		2	150		673444	1166080	GW	02									
	5600627-4	61	1	8.00	2	80	65		2	150		672337	1168471	GW	02									
5600633	46.00		3	7.20	2		91087	AGR		4	0	MICIVER, L.L. & NEILL, R.V.					56	5600633W	2,8	13	.8	11	100	0.85
	5600633-1	82	1	6.00	2	60	25		3	100		658309.	1081214	GW	02	TO BE REPLACED BY 8'WELL, CAP EST.								
	5600633-2	82	1	12.00	2	1100	400		4	1100		657679.	1080808	GW	08	FOR FREEZE PROTECTION ONLY,"								
	5600633-3	82	1	12.00	2	1100	400		4	1100		657592.	1080000	GW	08	FOR FREEZE PROTECTION ONLY, "								
	5600633-4	82	2	8.00	2	75	45		3	200		659031.	1081217	GW	02	TO REPLACE EXISTING 6' WELL, "								
5600637	432.70		3	73.60	2		91087	GOL	gw	14	0	ST LUCIE WEST UTILITIES, INC.					56	5600637W	02	15	0.8	11	379	0.75
	5600637-1	83	2	8.00	1	70	30	-45		350		698371	1082937	GW	02	Proposed wells								
	5600637-2	83	2	8.00	1	70	30	-45		350		697587	1082628	GW	02	to be replaced by								
	5600637-3	83	2	8.00	1	70	30	-45		350		696263	1082709	GW	02	by reclaimed water system								
	5600637-4	83	2	8.00	1	70	30	-45		350		699769	1081890	GW	02									
	5600637-5	83	2	8.00	1	70	30	-45		350		700583	1081879	GW	02									
	5600637-6	83	2	8.00	1	70	30	-45		350		701786	1082632	GW	02									
	5600637-7	83	2	8.00	1	70	30	-45		350		696871	1080118	GW	02									
	5600637-8	83	2	8.00	1	70	30	-45		350		696760	1079134	GW	02									
	5600637-9	83	2	8.00	1	70	30	-45		350		697559	1078898	GW	02									
	5600637-10	83	2	8.00	1	70	30	-45		350		700238	1082519	GW	02									
	5600637-11	83	2	8.00	1	70	30	-45		350		701386	1083155	GW	02									
	5600637-12	83	2	8.00	1	70	30	-45		350		701025	1083807	GW	02									
	5600637-13	83	2	8.00	1	70	30	-45		350		695887	1079518	GW	02									
	5600637-14	83	2	8.00	1	70	30	-45		350		696552	1078311	GW	02									
5600644	56.30		3	0.15	1		111287	LIV	gw	2	0	RAY MELEAT, INC					56	5600644W	02				700	
	5600644-1	81	1	4.00	2	70	50		1	88		605706	1078714	GW	02	Dairy farm								
	5600644-2	81	1	4.00	2	70	50		2	80		605486	1078665	GW	02									
5600668	185.40		3	68.20	2		31088	AGR	both	10	5	W LINE CITRUS GROWERS ASSN					56	5600668W	2,8	13	1.5	12	403	0.85
	5600668-1	70	1	5.00	2	600	300		4	50		607400	1143803	GW	08									
	5600668-2	70	2	12.00	2	900	350		4	1200		607446	1144755	GW	08									
	5600668-3	70	2	10.00	2	100	50		2	200		607175	1144565	GW	02									
	5600668-4	70	2	10.00	2	100	50		2	200		608499	1144552	GW	02									
	5600668-5	70	2	10.00	2	100	50		2	200		607108	1142140	GW	02									
	5600668-6	70	2	10.00	2	100	50		2	200		608666	1142124	GW	02									

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

	5600432-5	59	2	8.00	2	100	90			3	150		616221	1159283	GW	02									
	5600432-6	59	2	8.00	2	100	90			3	150		616140	1157243	GW	02									
	5600432-7	59	2	8.00	2	100	90			3	150		616255	1154772	GW	02									
	5600432-8	59	2	8.00	2	100	90			3	150		616268	1153614	GW	02									
	5600432-9	59	2	8.00	2	100	90			3	150		616244	1151987	GW	02									
5600433	16.26		3	6.00	2		41582	AGR			3	0	MCDERMID, H C					56	5600433W	2,8	13	1.5	11	148	0.85
	5600433-1	59	2	10.00	2	800	250			4	1000		616263	1164151	GW	08	EXPIRED								
	5600433-2	59	2	8.00	2	100	90			3	150		615170	1162532	GW	02									
	5600433-3	59	2	8.00	2	100	90			3	150		616959	1162750	GW	02									
5600449	45.00		3		2		10683	PWS		gw	2	0	HARBOUR RIDGE, LTD						5600449W					882	
	5600449-1	96	1	8.00	2	121	96			3	350		723702	1050219	GW	02	Primary well. 7 test wells on site.								
	5600449-2	96	1	8.00	2	110	80			3	350		726875	1047712	GW	02	Backup, 5 days/Mo.								
5600450	354.00		3		2		10683	LAN		both	2	1	HARBOUR RIDGE, LTD					56	5600450W					267	
	5600450-1	96	2	8.00	2	121	96			3	350		723702	1050219	GW	02	same wells as 449								
	5600450-2	96	2	8.00	2	110	80			3	350		726875	1047712	GW	02									
	56004501S	96	2		1				6		900		723429	1050446	SW	99	C-23,loc.guess								
5600461	139.30		3		2		71483	GOL		6	3	3	MEADOWOOD DEVLPMT CORP.					56	5600461W	02	15	0.8	11	122	0.75
	5600461-1	72	1	8.00	2	95	65			2	150		684266.	1145649	GW	02									
	5600461-2	72	1	8.00	2	95	65			2	150		684711.	1146762	GW	02									
	5600461-3	72	1	8.00	2	95	65			2	150		685701.	1146968	GW	02									
	5600461-4	72	1	8.00	2	95	65			2	150		685883.	1146464	GW	02									
	5600461-5	72	1	8.00	2	95	65			2	150		684714.	1146156	GW	02									
	5600461-6	72	1	8.00	2	95	65			2	150		685438.	1145250	GW	02									
	5600461-1S	72	1		1				20		1600		685438.	1145250	SW	99	ON SITE POND, loc. estimated								
	5600461-2S	72	1		1				20		1600		685438.	1145250	SW	99	"								
	5600461-3S	72	1		1				20		720		685438.	1145250	SW	99	"								
5600462	42.90		3	.22	1		71483	PWS		GW	3	0	MONTE CARLO C CLUB						5600462W					272	
	5600462-1	72	2	8.00	2	95	65		42	02	150 Y		686869.	1147478	GW	02	Wells proposed in 1983,coors unobtainable.								
	5600462-2	72	2	8.00	2	95	65		42	02	150 Y		684976.	1147874	GW	02	No correspondence in file								
	5600462-3	72	2	8.00	2	95	65		42	02	150 Y		683894.	1148172	GW	02	indicating an existing status as of 2-25-90.								
5600477	12.10		3		2		31584	LAN		gw	1	0	WALTON COURT PROPERTY OWNERS					56	5600477W	02	15	0.8	4	11	0.75
	5600477-1	84	2	6.00	1	100	80		12	2	200		733542	1078946	GW	02									
5600487	7.30		3		2		91384	PWS		gw	2	0	EASTWIND DEVELOPERS, INC.					56	5600487W	02				13	
	5600487-1	73	2	4.00	2	110	95			1	84		721099	1107822	GW	02									
	5600487-2	73	2	4.00	2	110	95			1	84		721352	1107819	GW	02									
5600489	28.31		02	28.31	2		101184	LAN		both	3	3	G.B.F. RESERVE DEV CORP					56	5600489W	02	15	.8	11	146	0.85
	5600489-1	83	1	2.00	2	100	70		50	2	60 Y		685413	1091831	GW	02	NEED TO CHECK WELL								
	5600489-2	83	1	2.00	2	100	70		50	2	60 Y		685415	1091528	GW	02	CONSTRUCTION REPORTS								
	5600489-3	83	1	2.00	2	100	70		50	2	60 Y		685775	1091631	GW	02	FOR THESE WELLS CONSTRUCTION								
	5600489-1S	83	1	4.00	2				18	2	2500 Y		687312	1090830	SW	99	SEC.22 T36 R39								
	5600489-2S	83	1	6.00	2				18	2	7500 Y		687312	1090830	SW	99	WELL LOCATIONS								
	5600489-3S	83	1	6.00	2				18	2	7500 Y		687312	1090830	SW	99	LOCATIONS TENTATIVE								
5600552	74.30		3		2		80885	PWS		gw	6	0	RESERVE UTILITY CORPORATION						5600552W					1098	
	5600552-1	83	1	6.00	2	80	55			3	45		685953.	1092137	GW	02	5 wells used, 1 is B.U.								
	5600552-2	83	1	6.00	2	80	55			3	45		685869.	1090823	GW	02	B.U. well not specified								
	5600552-3	83	1	6.00	2	75	55			3	80		685698.	969650.	GW	02	Completion reports dated 1988								
	5600552-4	83	1	6.00	2	75	55			3	80		686587.	1091534	GW	02	well coords. supplied by permitee								
	5600552-5	83	1	6.00	2	75	55			3	60		685239.	1090518	GW	02	stand-by well								
	5600552-6	83	1	6.00	2	75	55			3	60		685598.	1090923	GW	02	Back-Up well								
5600554	92.00		3	33.90	2		91285	AGR		gw	10	0	IGLEHART, P.C. + BYRD, W.R.					56	5600554W	02	13	0.8	12	200	0.85
	5600554-1	93	2	10.00	2	80				3	400				GW	02	From surficial aquifer								
	5600554-2	93	2	10.00	2	80				3	400				GW	02	Grove not built as of 2/89								
	5600554-3	93	2	10.00	2	80				3	400				GW	02	Well locations to be determined.								
	5600554-4	93	2	10.00	2	80				3	400				GW	02									
	5600554-5	93	2	10.00	2	80				3	400				GW	02									
	5600554-6	93	2	10.00	2	80				3	400				GW	02									
	5600554-7	93	2	10.00	2	80				3	400				GW	02									
	5600554-8	93	2	10.00	2	80				3	400				GW	02									
	5600554-9	93	2	10.00	2	80				3	400				GW	02									
	5600554-10	93	2	10.00	2	80				3	400														

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

	5600794-1	84	1	2.00		63	63	20	2	14		718587. 1094622 GW 02	G.P.								
	5600794-2	84	1	2.00		65	65	20	2	14		718405. 1094823 GW 02									
5600795	0.20						81689	PWS	gw	1	0	REVELS, PAUL		56	5600795W	02					
	5600795-1	84	2	2.00		60	50		3	15		704320. 1080309 GW 02	G.P.								
5600796	0.36						81889	PWS	gw	2	0	ORANGE-CO OF FLORIDA, INC.		56	5600796W	02					
	5600796-1	72	1	4.00		120	80		1	50		668803 1134044 GW 02	existing well to be plugged								
	5600796-2	72	2	8.00		95	95		2	100		669056 1134046 GW 02									
5600797	3.65						81889	LAN	gw	1	0	CITY OF PORT ST. LUCIE		56	5600797W	02	15			9	
	5600797-1	84	2	4.00		105	85		1	30		706072. 1072846 GW 02	G.P.								
	5600797-2	84	2	2.00		95	85		1	30		705891. 1073047 GW 02									
5600798	0.07						81889	PWS	gw	1	0	CITY OF PORT ST. LUCIE		56	5600798W	02					
	5600798-1	84	1	2.00		95	85		1	30		706095 1072713 GW 02									
5600804	0.78						82489	LAN	gw	1	0	SUNRISE FORD COMPANY		56	5600804W	02	15			1	
	5600804-1	84	1	2.00		53.5	48	5.5	3	40		718362. 1102800 GW 02	G.P.								
5600805	0.22						82589	PWS	gw	1	0	HIGH TIDE SALES,-DON WOOD		56	5600805W	02	15			0	
	5600805-1	73	2	2.00		90	80	80	1	10		705515. 1111519 GW 02	G.P.								
5600806	0.49						82889	PWS	gw	1	0	AMERICAN TIRE & MUFFLER. INC.		56	5600806W	02	15			0	
	5600806-1	84	1	2.00		60	50	20	1	75		706794. 1072849 GW 02	G.P.								
5600814	0.91						91889	PWS	gw	1	0	CROSS, MAX		56	5600814W	02	15			1	
	5600814-1	61	2	2.00		90	80	LAN	1	15		695182. 1160444 GW 02	G.P.								
5600815	0.04						92089	PWS	gw	1	0	HCW, INC.		56	5600815W	02					
	5600815-1	73	2	2.00		70	63		3	10		705769 1109993 GW 02									
5600816	9.63						101289	LAN	gw	1	0	SCHOOL BOARD/ST. LUCIE COUNTY		56	5600816W	02	15	0.8	4	9	0.75
	5600816-1	83	2	2.00		70	60		3	20		701342. 1080496 GW 02	WELL COORDS. ARE APPROX.								
	5600816-2	83	2	2.00		70	60		3	20		701338. 1081304 GW 02	NOT DRILLED YET								
5600829							101989	PWS	gw	1	0	WOVV RADIO STATION		56	5600829W	02					
	5600829-1	73	2	2.00		69	59		2	18		707071 1127971 GW 02									
4300026	46.2		03			43	4/89	GLF	BOTH	1	1	R. FILKINS (PINE LAKES GOLF CLUB)		43	26	02	15	0.8	4	50	0.75
	4300026-1	96	01	10.00	02	125	105		02	600		735585 1054791 GW 02									
	4300026-SW1	96	01							750		SW	ON-SITE LAKE								
4300510	7.13		03			43	6/89	LSC	GW	1	0	J. ATRIA JR. (MARTIN CO. BUSINESS PK)		43	510	02	15	0.4	4	6	0.75
	4300510-1	97	01	4.00	02	108	102	67	02	60 N		748562 1052120 GW 02									
	4300510-2	97	02	4.00	02	108	102	67	02	60 N		748284 1051778 GW 02									
	4300510-3	97	02	4.00	02	108	102	67	02	60 N		749195 1051661 GW 02									
4700070	112.69		03	41.48	02	47	12/88	AG	GW	4	0	J.O. AND JACK D. WOLF				8,2	13	.8	11	245	0.85
	4700070-1		01	8.00	02	120	100	70		640 N		586700 1158448 GW 02									
	4700070-2		03	8.00	02	120	100	70		250 N		586965 1160872 GW 02	CAPACITY EST								
	4700070-3		01	6.00	08	700	240		FLOW	500 N		586969 1159256 GW 08									
	4700070-4		01	12.00	08	700	294	160	FLO	1500 N		587329 1159156 GW 08									

TABLE D-1. WATER USE SPREADSHEET (CONTINUED)

	5600668-7	70	2	10.00	2	100	50		2	200	607225 1139884 GW 02							
	5600668-8	70	2	10.00	2	100	50		2	200	608582 1139840 GW 02							
	5600668-9	70	2	10.00	2	100	50		2	200	607140 1137993 GW 02							
	5600668-10	70	2	10.00	2	100	50		2	200	608938 1138095 GW 02							
	5600668-1S	70	2		1			20	1	600	607343 1142450 SW 99 On site canal							
	5600668-2S	70	2		1			20	1	600	608785 1142426 SW 99 On site canal							
	5600668-3S	70	2		1			20	1	600	607336 1140190 SW 99 On site canal							
	5600668-4S	70	2		1			20	1	600	608910 1140131 SW 99 On site canal							
	5600668-5S	70	2		1			20	1	600	608373 1144828 SW 99 On site canal							
5600682	10.50		3	1.60	2		100588 LAN		both	1	1 K. HOVNANIAN AT THE PARK ST	56	5600682W	02	15	.8	4	9 0.75
	5600682-1	84	1	8.00	1	126	107	45	2	250	721290 1066195 GW 02							
	5600682-1S	84	1		1			-2.5	2	200	721391 1066192 SW 99 On site lake							
5600721	0.30						21489 PWS		gw	1	0 NEW LIGHT ELECTRIC	56	5600721W	02				
	5600721-1	83	2	2.00		60	50		3	25	691766. 1064394 GW 02 G.P.							
5600722	0.70						21489 PWS		gw	1	0 MIDWAY MANORS, INC.	56	5600722W	02				
	5600722-1	84	2	4.00		60	50		3	30	706481 1103819 GW 02							
5600723	32.20		3				21489 AGR		gw	1	0 KUTA, GEORGE S.	56	5600723W	02	13	1.5	11	7 0.85
	5600723-1	72	1	6.00		75	75	45	2	100	693200 1150683 GW 02							
5600727	0.50						22489 PWS		gw	1	0 MERCEDES HOMES, INC.	56	5600727W	02	15			
	5600727-1	84	2	2.00		46	32	32	1	35	719627. 1069079 GW 01 Temporary PWS, GP							
5600731	13.10		3				41389 IND		gw	2	0 EXXON COMPANY USA	56	5600731W	02				2
	5600731-1	83	1	6.00	1	25	5	24	2	5	724493 1064273 GW 01							
	5600731-2	83	2	6.00	1	30	5	29	2	10	724638 1064266 GW 01							
5600739	0.30						40689 PWS		gw	1	0 M.J. FERRITER CONSTRUCTION	56	5600739W	02				
	5600739-1	83	2	2.00		60	50		3	25	691766. 1064394 GW 02 G.P.							
5600740	0.20						40689 PWS		gw	1	0 ANDRE DORAWA, PETE SCHULTZ	56	5600740W	02				
	5600740-1	84	2	2.00		60	50		3	25	704407. 1080916 GW 02							
5600751	0.63						42489 PWS		gw	1	0 VIVIAN, JOHN C.	56	5600751W	02				
	5600751-1	73	1	4.00		80	70	40	2	30	714807. 1143881 GW 02 G.P.							
5600758	4.60						50989 PWS		gw	1	0 INDIAN RIVER ACADEMY	56	5600758	02				
	5600758-1		1	2.00		80	70		1	75	699326. 1123403 GW 02 Temporary PWS, GP							
5600759	0.21						50989 PWS		gw	1	0 JAMES, GERALD	56	5600759W	02				
	5600759-1	84	1	2.00		90	80	80	1	10	711497. 1105188 GW 02							
5600760	0.04						51089 PWS		gw	1	0 YOUNG&DANIEL DICKSON CONSTRUC.	56	5600760W	02				
	5600760-1	73	1	2.00		60	50	20	1	50	709476. 1129918 GW 02 G.P.							
5600768	13.80						60789 PWS		gw	2	0 J.C. STANLEY & ASSOC., INC.	56	5600768W	02				
	5600768-1	72	1	6.00		110	90	68	2	150	684557 1141282 GW 02							
	5600768-2	72	1	6.00		110	90	68	2	150	684351 1141501 GW 02							
5600769	0.60						60789 LAN		gw	1	0 EVANS, GARY	56	5600769W	02	15			0
	5600769-1	72	1	2.00		75	70		1	30	698774. 1107446 GW 02 G.P.							
5600770	0.50						61489 PWS		gw	1	0 LAKEWOOD PARK UNITED METHODIST	56	5600770W	02				
	5600770-1	61	1	2.00		80	80	15	2	40	697701 1163070 GW 02							
5600777	0.40						70789 PWS		gw	1	0 CARTWRIGHT, JOHN & OLGA	56	5600777W	02				0
	5600777-1	83	2	2.00		60	50 LAN		3	25	690018 1064750 GW 02							
5600779	5.70						70789 LAN		gw	1	0 CITY OF PORT ST. LUCIE	56	5600779W	02	15			5
	5600779-1	84	2	6.00		90	60		2	120	704741 1082712 GW 02 Old well to be abandoned							
5600783	0.20						72189 PWS		gw	1	0 L.H. DUNN SONS, INC.	56	5600783W	02				
	5600783-1	72	2	2.00		66	60		1	10	664773 1130785 GW 02							
5600784	0.80						72489 LAN		gw	1	0 GEM ELECTRIC MFG. CO. INC.	56	5600784W	02	15			2
	5600784-1	73	2	2.00		53	48	5.5	3	40	709927 1147807 GW 02 Old well to be abandoned							
5600794	1.40						91189 PWS		gw	2	0 SUN COAST BUILDERS, G.C.	56	5600794W	02				

APPENDIX E

STATISTICAL ANALYSIS OF THE WATER LEVEL DATA

LIST OF TABLES - APPENDIX E

Table E1. Statistical Analysis of the Water Level Data (Continued)

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
GDUWT02	15.30	11.38	5.88	2.61	6.82
GDPHTWTP2	12.09	7.77	6.94	1.77	3.14
GDUWT05	2.30	0.39	-1.45	1.25	1.57
GDUWT17	8.35	7.29	6.35	0.55	0.31
STL174	12.21	11.61	10.85	0.43	0.19
STL176	12.33	11.93	10.67	0.45	0.21
GDUWT18	11.54	10.18	8.71	0.68	0.46
PG25	9.59	8.52	7.31	0.62	0.38
STL276	11.84	10.96	9.87	0.67	0.44
STL277	13.33	12.67	11.72	0.40	0.16
STL272	21.54	19.73	18.39	0.81	0.65
STL41	26.41	24.52	22.88	1.27	1.62
PG23	5.84	5.39	4.37	0.43	0.19
STL271	10.86	10.12	9.15	0.45	0.20
STL161	25.61	24.84	23.39	0.56	0.31
STL270	3.76	3.31	2.61	0.30	0.09
M-1268	5.73	4.92	4.15	0.48	0.23
W-7B	3.86	2.86	2.28	0.55	0.30
S-4B	1.45	1.16	0.63	0.26	0.07
STL274	9.72	9.04	8.44	0.36	0.13
PG13N	20.50	19.49	19.03	0.42	0.18
PG12	16.27	14.82	14.28	0.63	0.40
STL267	22.59	21.57	20.89	0.50	0.25
SLMW4D	17.26	16.52	15.55	0.55	0.30
PG16	20.26	19.44	18.50	0.41	0.17

TABLE E1. Statistical Analysis of the Water Level Data

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
STL266	9.68	8.77	8.24	0.42	0.18
PG5	17.41	16.68	15.73	0.53	0.28
FPWT8	5.46	4.62	3.66	0.48	0.23
FPWT7	7.46	5.22	2.96	1.40	1.96
FPWT6	6.61	5.42	4.41	0.68	0.46
STL42	27.11	25.88	25.12	0.54	0.29
FPWT4	0.58	0.07	-0.62	0.42	0.17
FPWT5	3.13	2.40	1.43	0.59	0.34
PG6	9.44	9.18	8.97	0.15	0.02
FPWT3	2.61	1.48	0.41	0.61	0.37
PG1	5.71	4.87	3.57	0.68	0.46
STL125	17.74	16.89	13.85	1.01	1.02
FPWT2	7.03	6.69	6.03	0.29	0.08
FPWT9	-0.52	-2.19	-3.22	0.83	0.69
FPWT1	9.49	8.00	6.49	0.79	0.62
STL136	5.99	4.80	3.22	0.79	0.63
PG7	4.61	3.61	2.77	0.62	0.38
PG10	14.76	12.21	10.66	0.97	0.93
STL172	11.94	11.17	10.47	0.49	0.24
STL130	20.21	19.19	17.97	0.63	0.40
STL269	18.16	17.13	15.76	0.67	0.45
STL268	9.44	8.37	7.18	0.78	0.61
STL278	13.91	12.68	11.03	1.03	1.06
PG26	13.09	12.16	11.34	0.57	0.33
GDUSW4S	0.85	0.05	-1.34	0.63	0.40
STL123	20.64	19.79	18.32	0.72	0.52

Table E1. Statistical Analysis of the Water Level Data (Continued)

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
W-2S	7.06	3.53	-0.76	2.39	5.70
S-2B	0.75	0.27	-0.41	0.33	0.11
STL273	21.40	20.48	18.69	0.78	0.60
STL275	4.89	4.27	4.00	0.31	0.10
PG13M	20.61	19.91	19.40	0.41	0.17
STL264	20.37	19.54	19.16	0.35	0.12
FPTW1	15.93	14.63	13.73	0.71	0.50
FPTW2	16.42	15.07	14.22	0.62	0.39
FPMW1	5.10	3.93	2.90	0.59	0.35
FPMW2	5.82	4.84	3.82	0.58	0.33
FPMW3	7.29	6.59	5.99	0.50	0.25
FPTW5	8.45	7.11	6.45	0.64	0.41
STL191	5.37	4.91	4.43	0.27	0.07
STLAPT2D4	20.63	19.70	18.33	0.69	0.47
SLMW12D	19.53	18.93	17.97	0.37	0.14
FPTW4	-2.11	-6.19	-8.61	2.46	6.05
FPTW7	-3.13	-6.11	-8.23	1.69	2.86
FPMW4	5.00	4.33	3.10	0.72	0.52
STL213	11.52	10.17	9.13	0.66	0.44
SLMW5D	20.65	19.28	14.40	2.08	4.31
STLAPT1D2	9.78	8.84	7.74	0.63	0.40
SLMW14D	11.91	11.16	10.42	0.56	0.32
SLMW13D	32.23	31.20	29.15	0.96	0.92
STLMW1D	20.54	20.18	19.44	0.32	0.10
STLAPT4D3	27.04	26.13	24.79	0.78	0.60

Table E1. Statistical Analysis of the Water Level Data (Continued)

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
STLAPT2S4	20.93	19.98	18.84	0.62	0.38
SLMW11D	5.32	4.39	2.49	0.96	0.92
FPMW5	-1.30	-3.20	-4.30	0.97	0.95
STL265	12.24	10.16	8.91	0.91	0.82
SLMW5S	20.65	19.30	14.28	2.14	4.59
STLAPT1S2	14.78	13.35	12.02	0.83	0.69
SLMW13S	32.03	30.87	28.85	0.88	0.78
STLMW1S	20.85	20.08	19.04	0.48	0.23
STLAPT4S3	27.17	26.18	24.79	0.82	0.67
PG35N	30.93	30.03	28.29	0.69	0.47
SLMW10S	30.79	30.12	28.24	0.65	0.42
PG18	19.20	18.94	18.32	0.26	0.07
GDUSW3S	1.26	0.79	0.42	0.29	0.08
GDUSW2S	2.28	1.42	0.20	0.68	0.46
GDUSW4M	1.44	0.74	-1.64	0.80	0.64
STL175	7.66	7.23	6.54	0.34	0.11
STL214	21.56	19.75	18.41	0.79	0.62
W-6B	9.61	9.09	8.28	0.47	0.22
W-1B	7.41	6.50	5.75	0.59	0.34
W-4B	5.88	4.63	2.71	1.10	1.20
W-5A	6.46	4.85	3.98	0.81	0.65
S-1A	1.92	0.93	0.42	0.50	0.25
S-5b	3.98	2.85	2.09	0.59	0.35
W-3B	5.17	4.29	3.47	0.48	0.23
S-3B	4.50	1.39	0.16	1.20	1.44

Table E1. Statistical Analysis of the Water Level Data (Continued)

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
S-4C	2.03	1.26	0.45	0.46	0.21

Table E1. Statistical Analysis of the Water Level Data (Continued)

Well Name	Maximum	Average	Minimum	Standard Deviation	Variance
SLMW10D	30.44	29.94	27.99	0.64	0.40
GDUSW3D	3.09	2.68	2.17	0.33	0.11
GDUSW2D	0.62	-0.27	-2.05	0.73	0.53
GDUSW4D	2.42	-0.01	-2.00	1.22	1.48
GDU80-7	16.48	14.70	11.89	1.43	2.05
STL173	8.22	7.29	6.04	0.62	0.38
STL177	5.25	4.24	3.60	0.47	0.22
W-6A	9.27	7.83	3.40	1.54	2.36
W-1A	7.34	6.54	5.93	0.56	0.31
W-4A	3.88	2.49	1.20	1.00	0.99
M-1254	5.40	4.53	3.75	0.49	0.24
STL185	25.30	24.71	23.35	0.55	0.31
S-1B	1.55	0.76	0.05	0.43	0.18
S-1C	1.89	0.82	0.31	0.50	0.25
S-5A	4.64	2.72	-1.56	1.47	2.16
W-7A	3.66	1.30	-0.26	1.14	1.30
W-3A	5.82	4.39	3.59	0.69	0.48
HRR1	4.61	3.38	2.51	0.53	0.28
HRR2	4.73	3.46	1.76	0.70	0.49
HRR3	3.49	2.41	1.48	0.60	0.36
S-3A	2.76	1.76	0.51	0.59	0.35
W-2D	7.03	3.89	0.09	1.62	2.62
S-2A	0.92	0.27	-0.99	0.50	0.25
HRR4	2.76	2.01	1.03	0.54	0.29
S-4A	1.52	1.13	0.93	0.18	0.03

APPENDIX F

POSSIBLE EXPLANATIONS FOR NON-CALIBRATION

The following discussion provides possible reasons why certain observation nodes failed to calibrate. The conclusions given below were based on the steady-state water level maps, calibration hydrographs, and analyses of available hydrologic data.

Monitoring well PG1 (1,30,91) meets the steady-state criteria for calibration, but does not meet the transient criterion for calibration. Only 8 out of 12 stress periods meet the calibration criterion. The remaining four stress periods miss the calibration criteria by 0.5 feet or less. Figures 14 and 20 indicate that this well is located near the coast in an area where the hydraulic gradient is fairly steep. As expected, the simulated water levels are usually lower that the observed water levels. The off-center location of the monitoring well and steep hydraulic gradient provide possible reasons for the observation node failing the transient calibration criteria.

Monitoring well PG10 (1,36,71) meets both of the steady-state criteria for successful calibration. However, the node failed to meet the transient calibration criterion. One possibility is that the steep hydraulic gradient adjacent to the monitoring well affects the calibration. The steep hydraulic gradient is caused by the difference in water levels between the NSLRWCD canals and Ten-mile Creek.

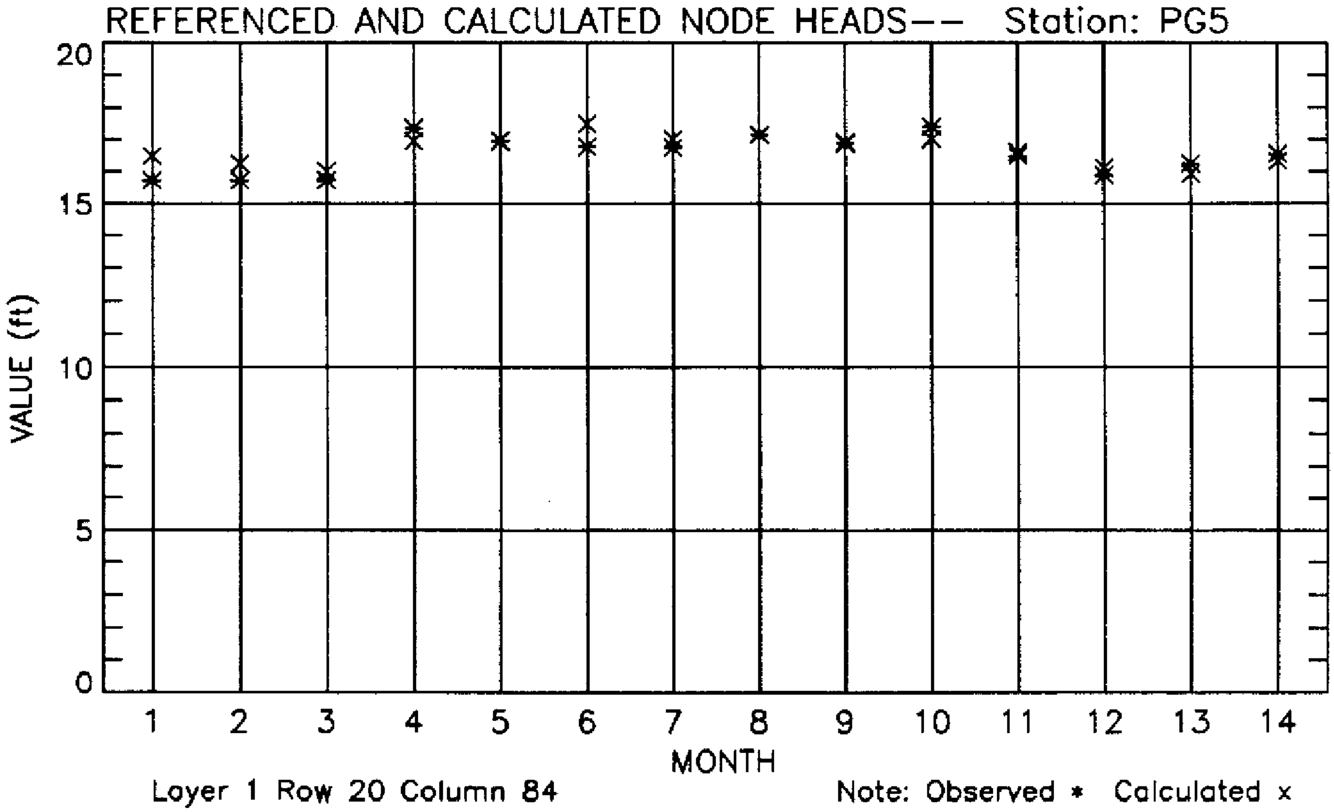
Monitoring wells SLMW5S (2,37,54) and SLMW5D (3,37,54) meet both standards for steady-state calibration. However, the wells do not meet the transient criterion for calibration. Both wells are located adjacent to the C-24 Canal. Due to the proximity of the wells to the canal, the water levels in the wells are reflective of the canal levels (Figure 9). The canal stage will fluctuate throughout a stress period. However, the average stage was used to simulate the canal stage in the model for a stress period. An examination of the stage data for G-81 at Canal C-24 shows significant fluctuations during some of the stress periods. If these daily fluctuations differ significantly from the average stage, the data from the observation wells will not meet the calibration criteria.

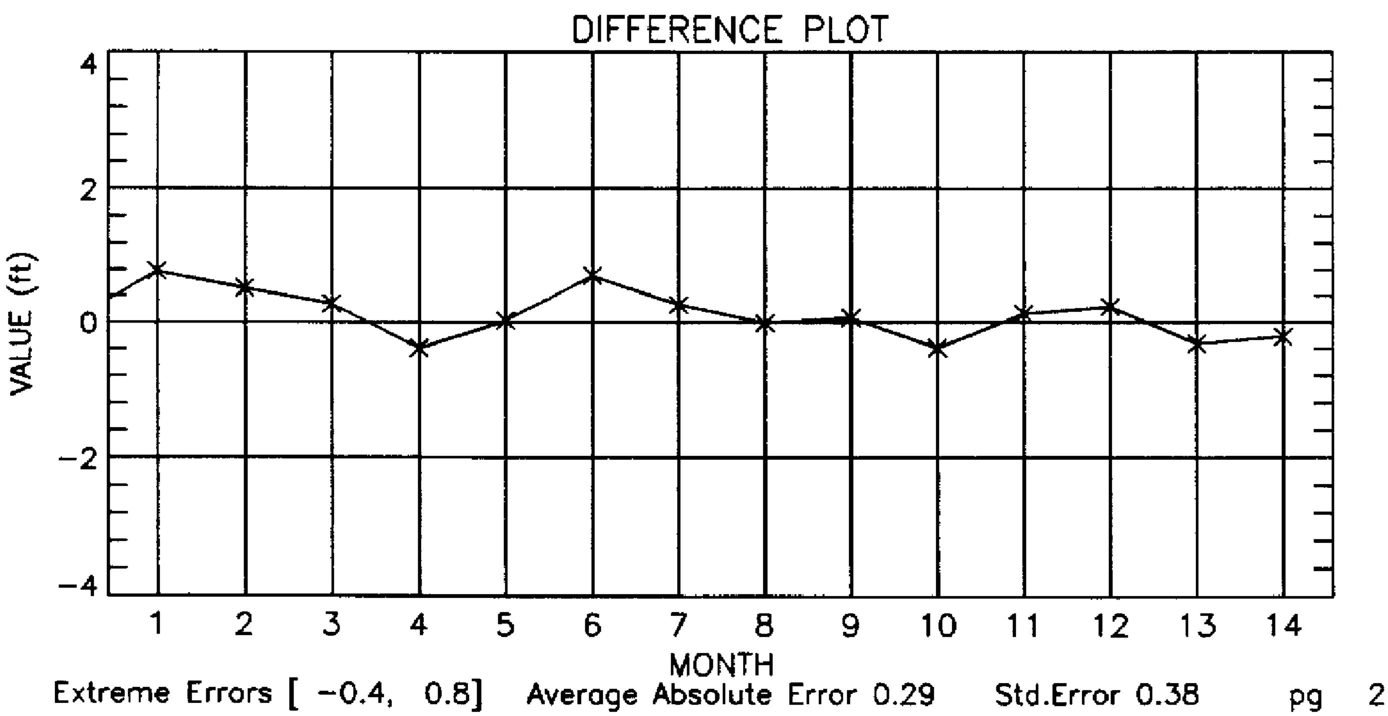
Well FPTW2 is located in cell (3,21,85). The observation node meets both standards for steady-state calibration. However, only 8 of the 12 stress periods meet the standard for successful transient calibration. The maximum difference between the observed and calculated water levels is 1.30 feet, and the average absolute error is relatively small, 0.82 feet. The observation node is located near a steep hydraulic gradient caused by Structure S-50 on the C-25 Canal. It is believed that the effects of the control structure impact the water levels in the vicinity of the observation node.

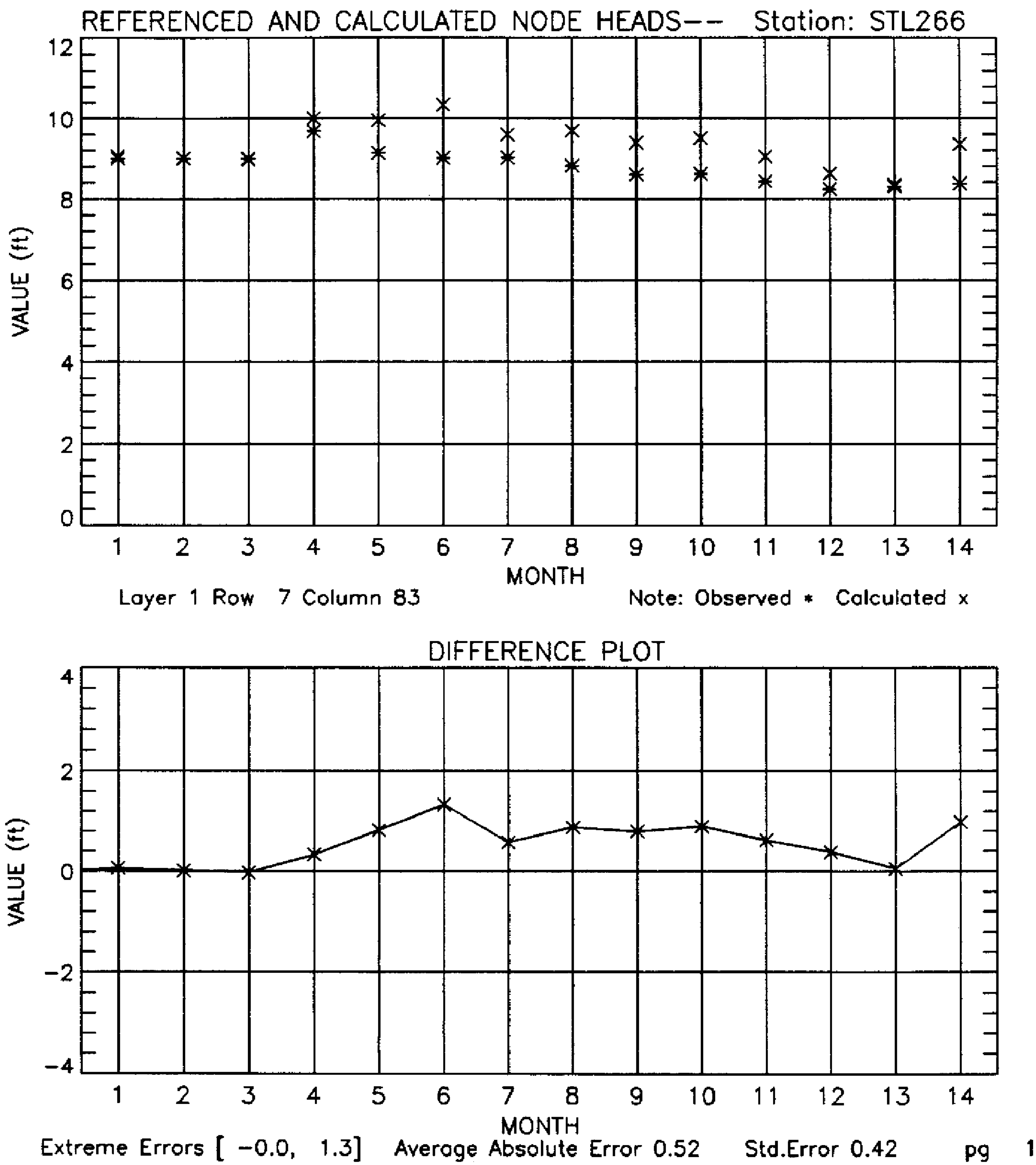
Wells FPTW4 (3,30,87) and FPTW7 (3,31,88) are located near several public water supply wells which cumulatively withdraw over 100,000 ft^3/day. Since the distance between the public water supply wells and the observation wells cannot be simulated accurately with this grid spacing, these observation nodes will not meet the calibration criteria for steady-state or transient conditions.

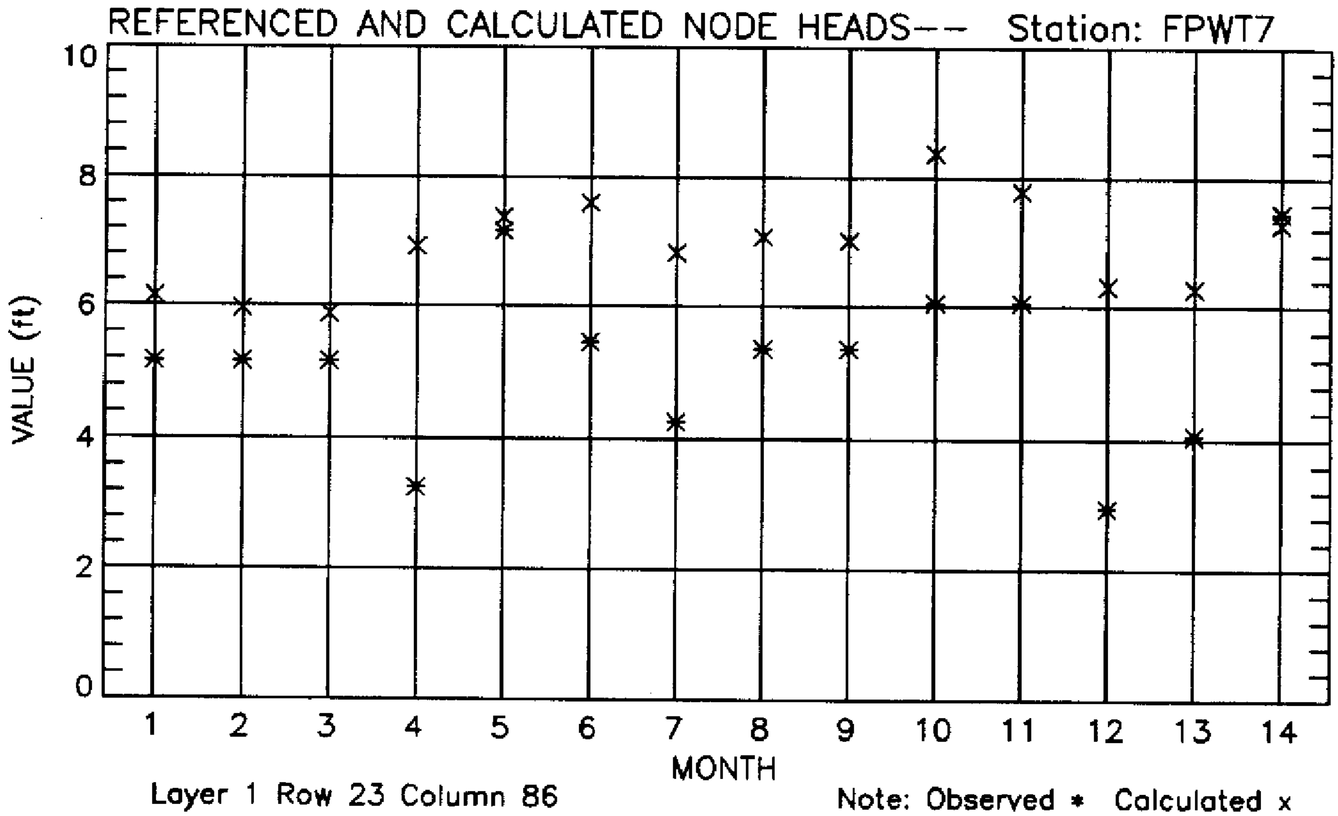
APPENDIX G

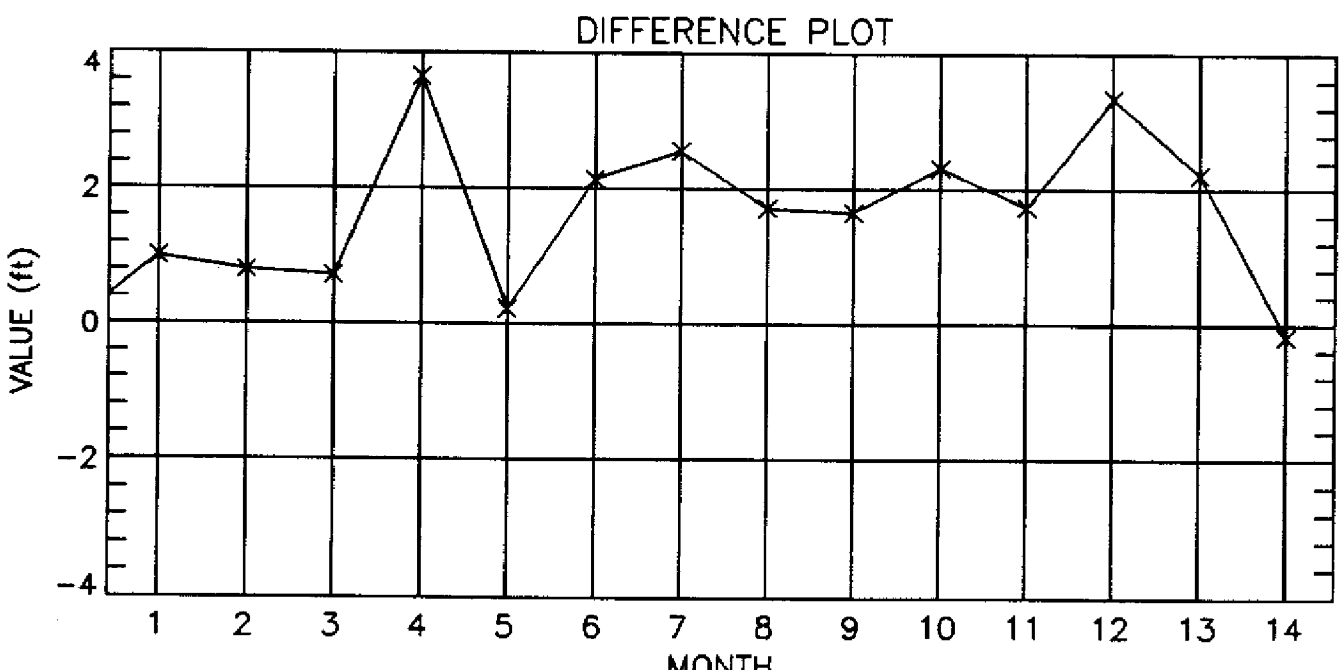
HYDROGRAPHS OF COMPUTED VS OBSERVED VALUES


REFERENCED AND CALCULATED NODE HEADS-- Station: PG5
VALUE (ft)
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 20 Column 84
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.4, 0.8] Average Absolute Error 0.29 Std.Error 0.38 pg 2

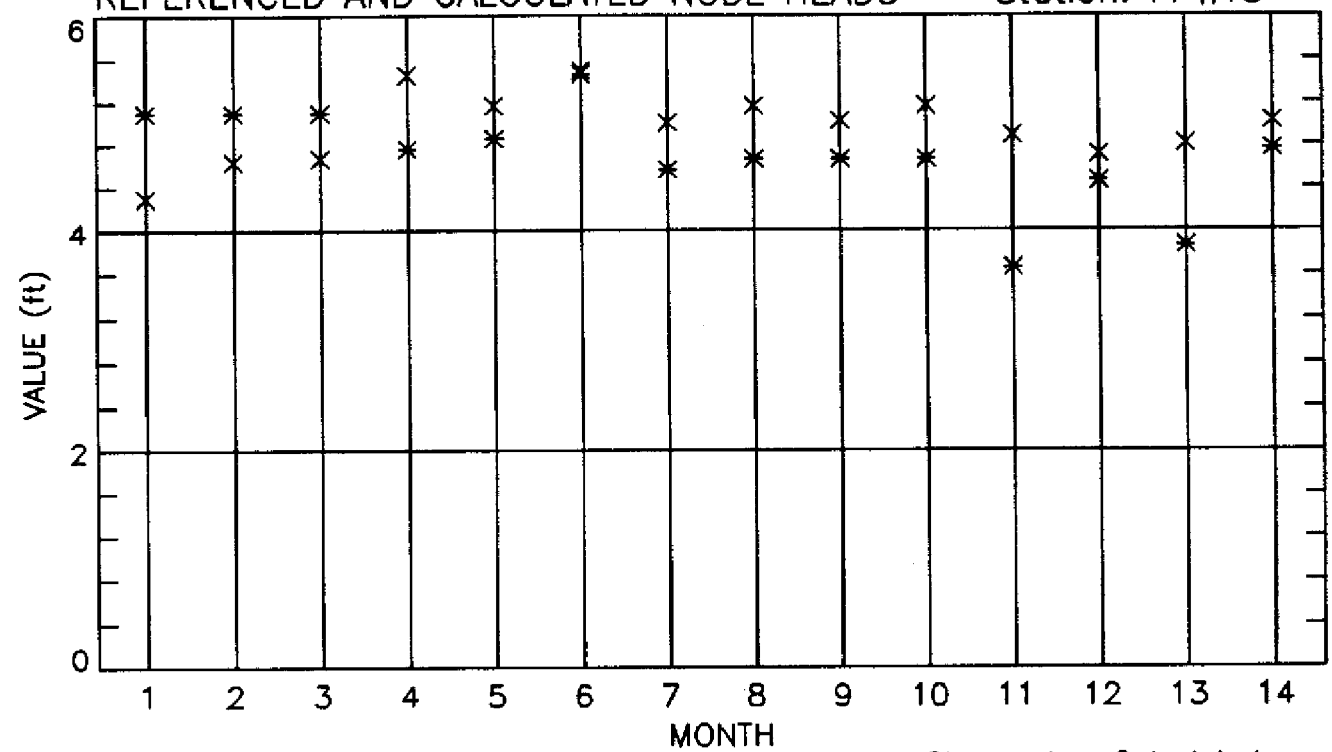

REFERENCED AND CALCULATED NODE HEADS-- Station: STL266
VALUE (ft)
MONTH
Layer 1 Row 7 Column 83
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.0, 1.3] Average Absolute Error 0.52 Std.Error 0.42 pg 1





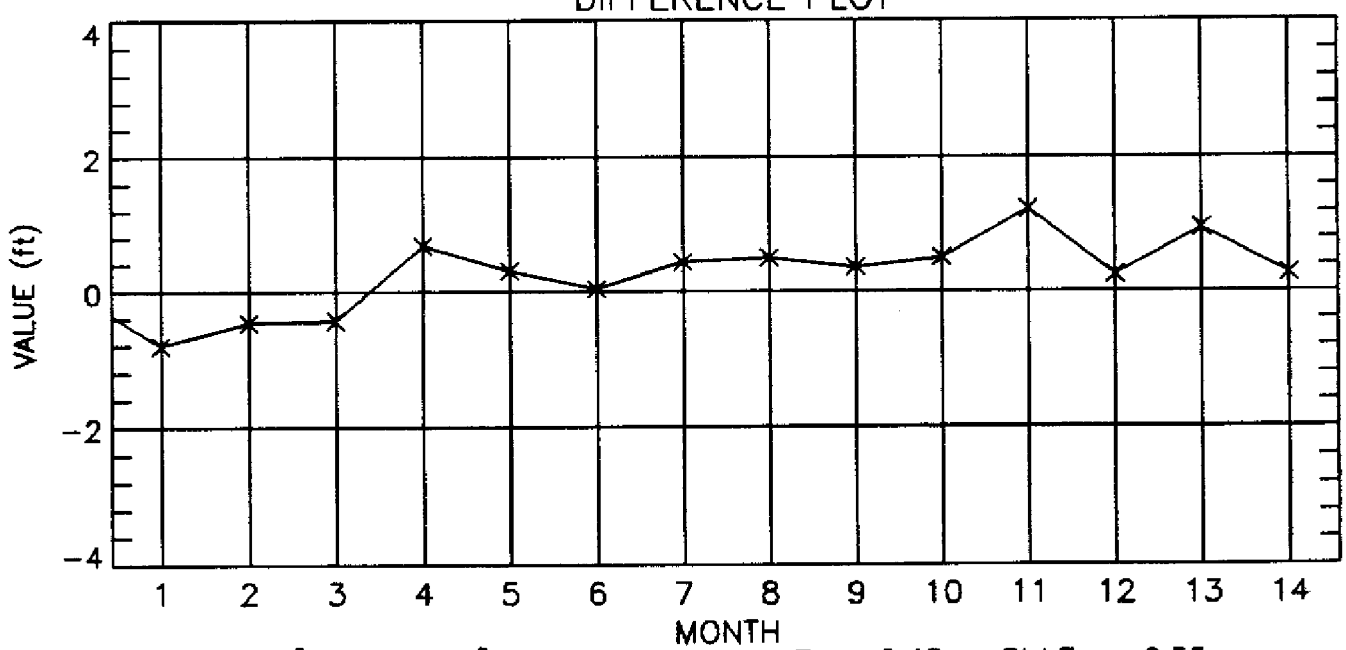
Extreme Errors [−0.2, 3.7] Average Absolute Error 1.62 Std.Error 1.11 pg 4

REFERENCED AND CALCULATED NODE HEADS-- Station: FPWT8

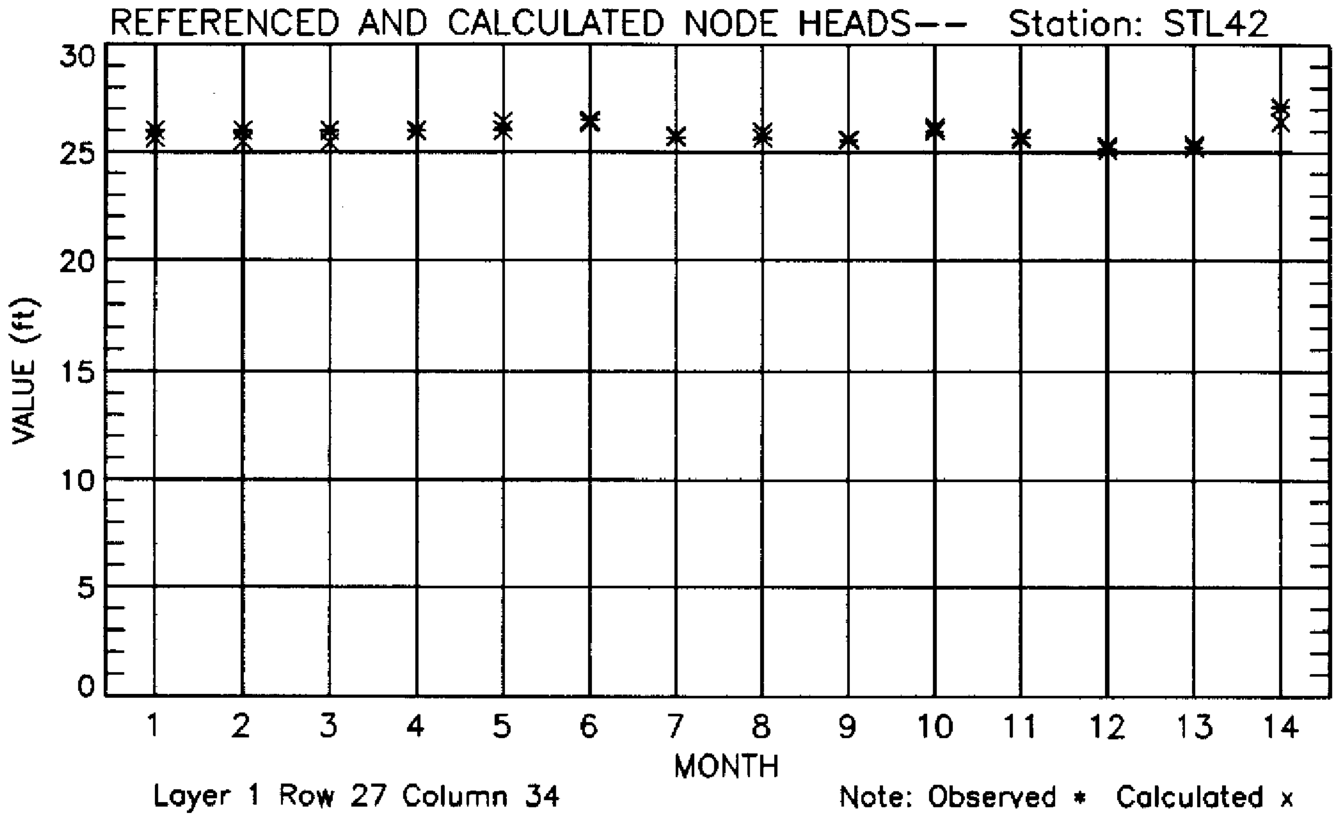


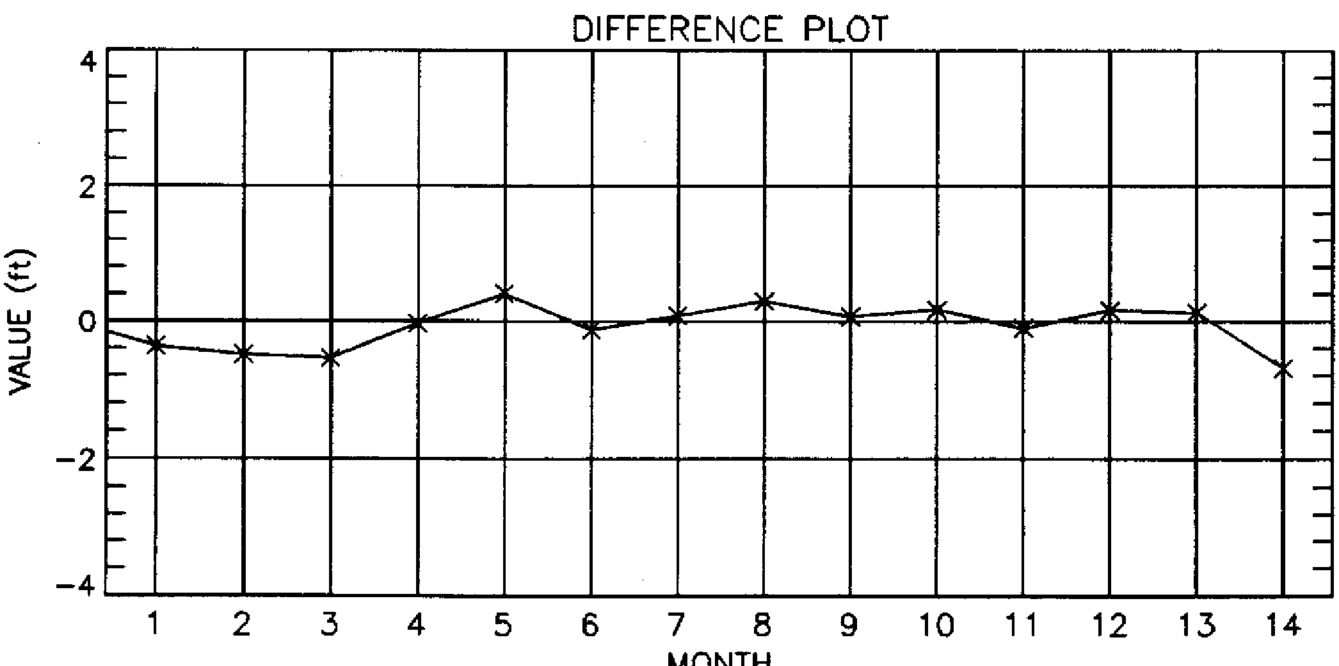
Layer 1 Row 22 Column 87 Note: Observed * Calculated x

DIFFERENCE PLOT

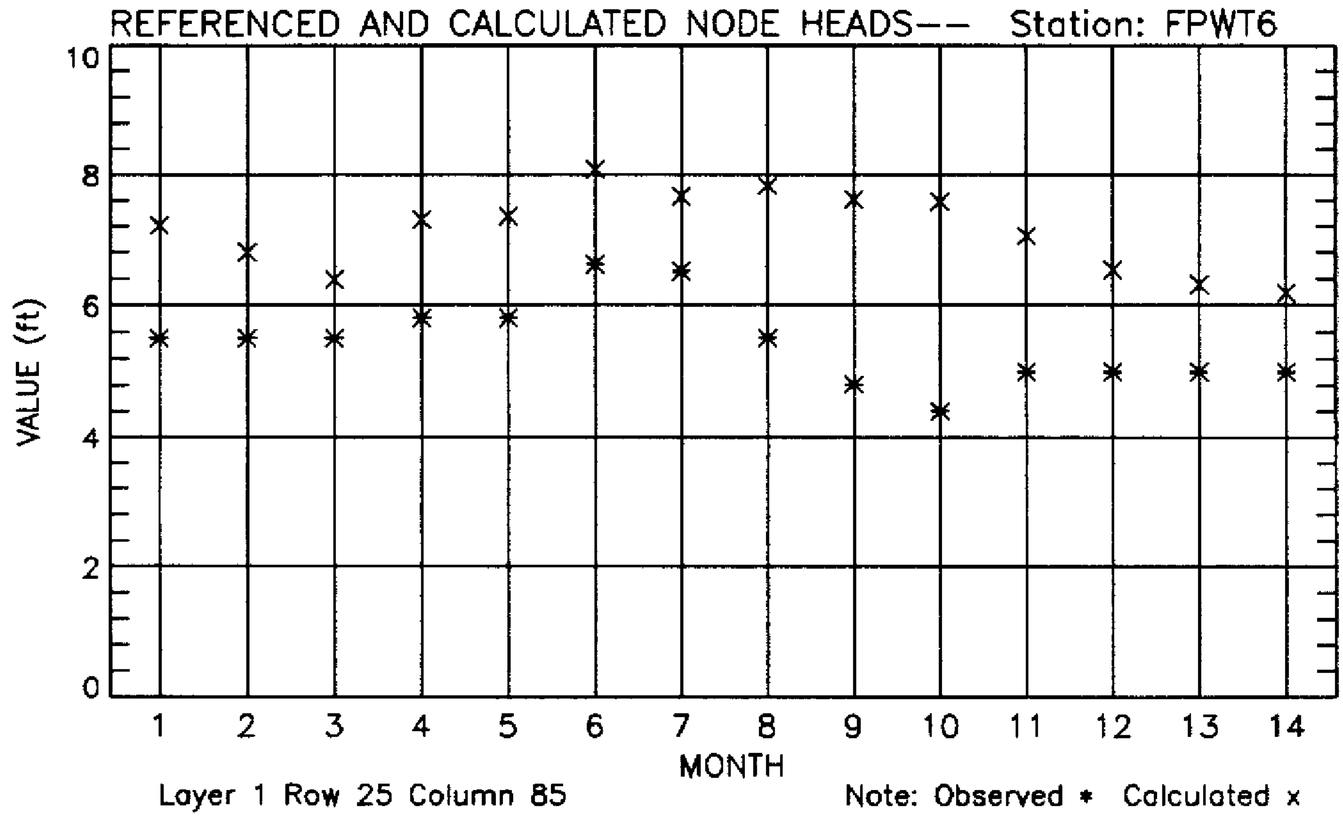


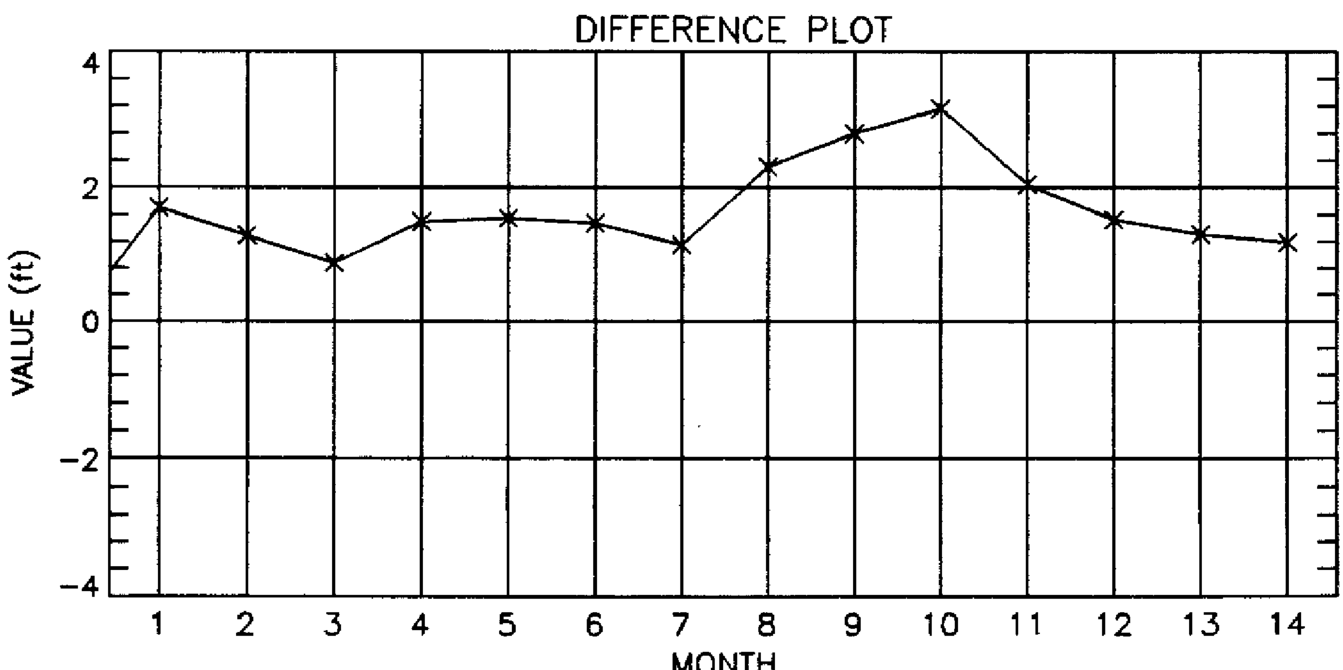
Extreme Errors [−0.8, 1.2] Average Absolute Error 0.48 Std.Error 0.55 pg 3



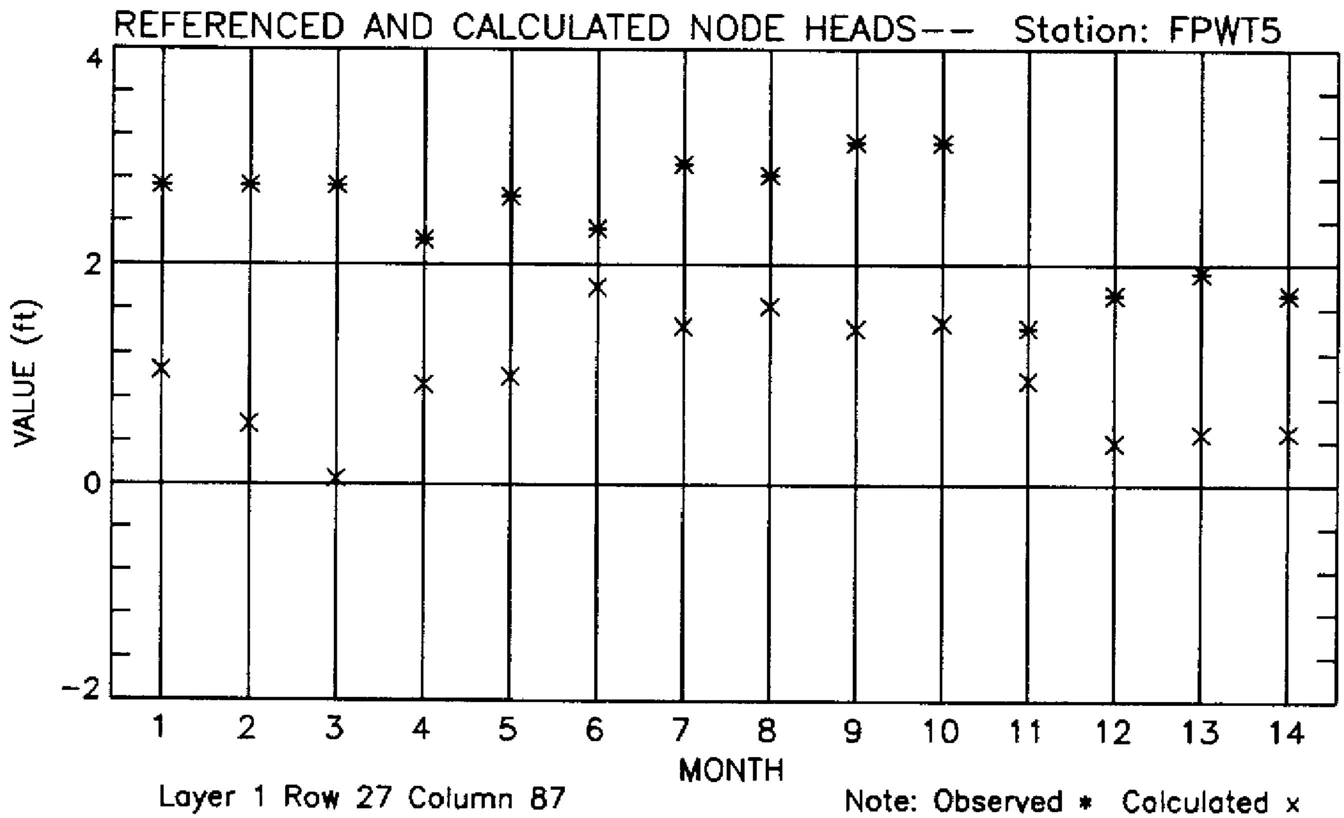


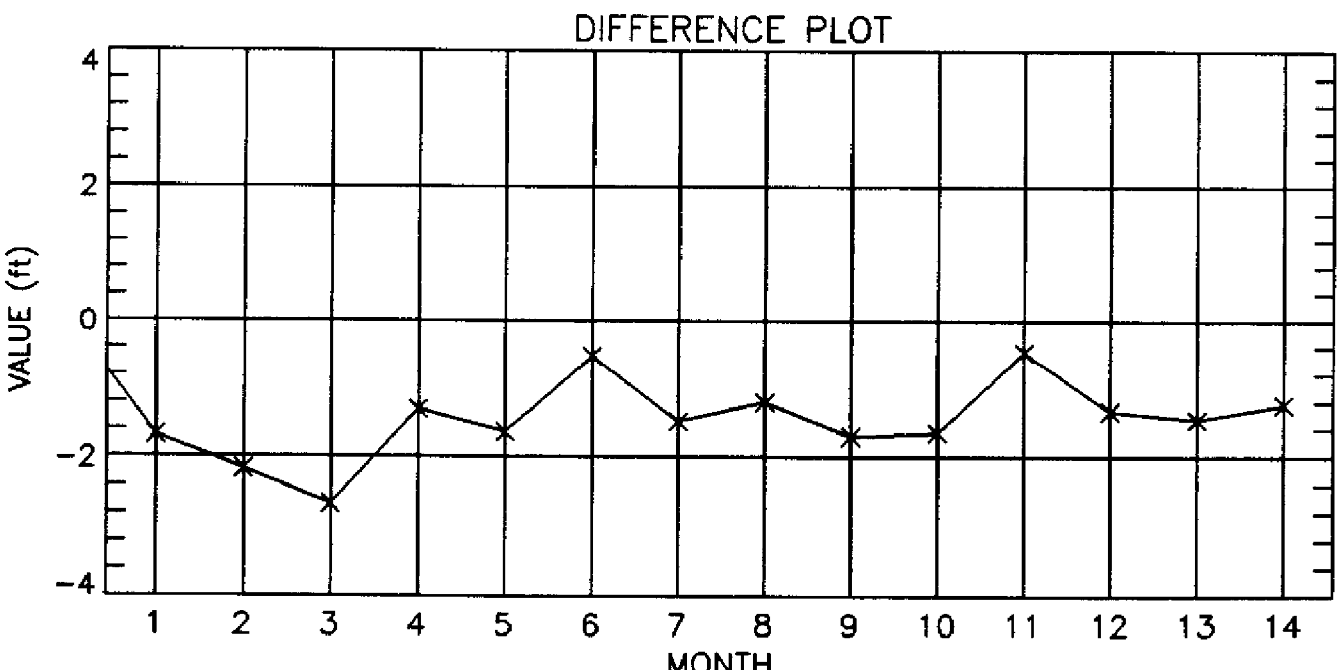
Extreme Errors [-0.7, 0.4] Average Absolute Error 0.25 Std.Error 0.33 pg 6



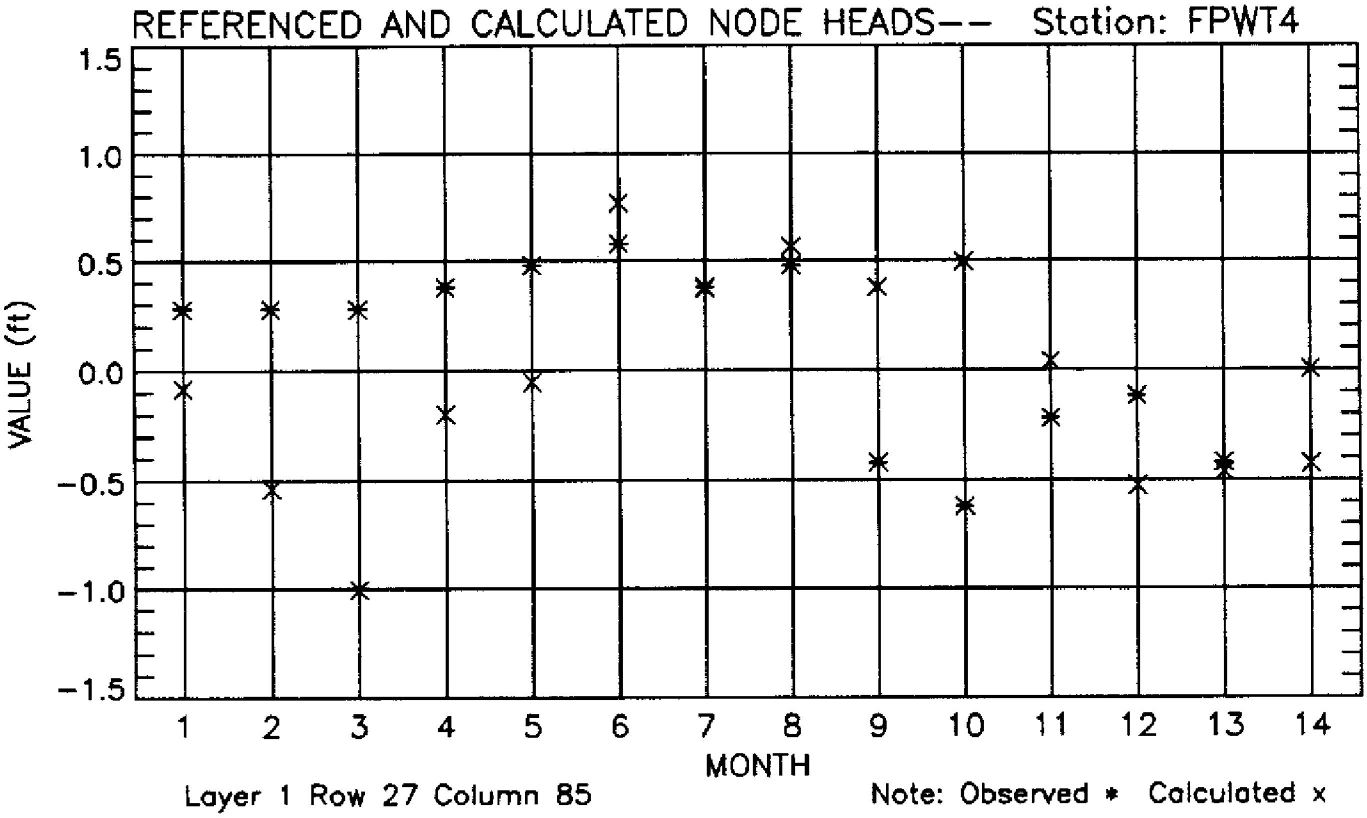


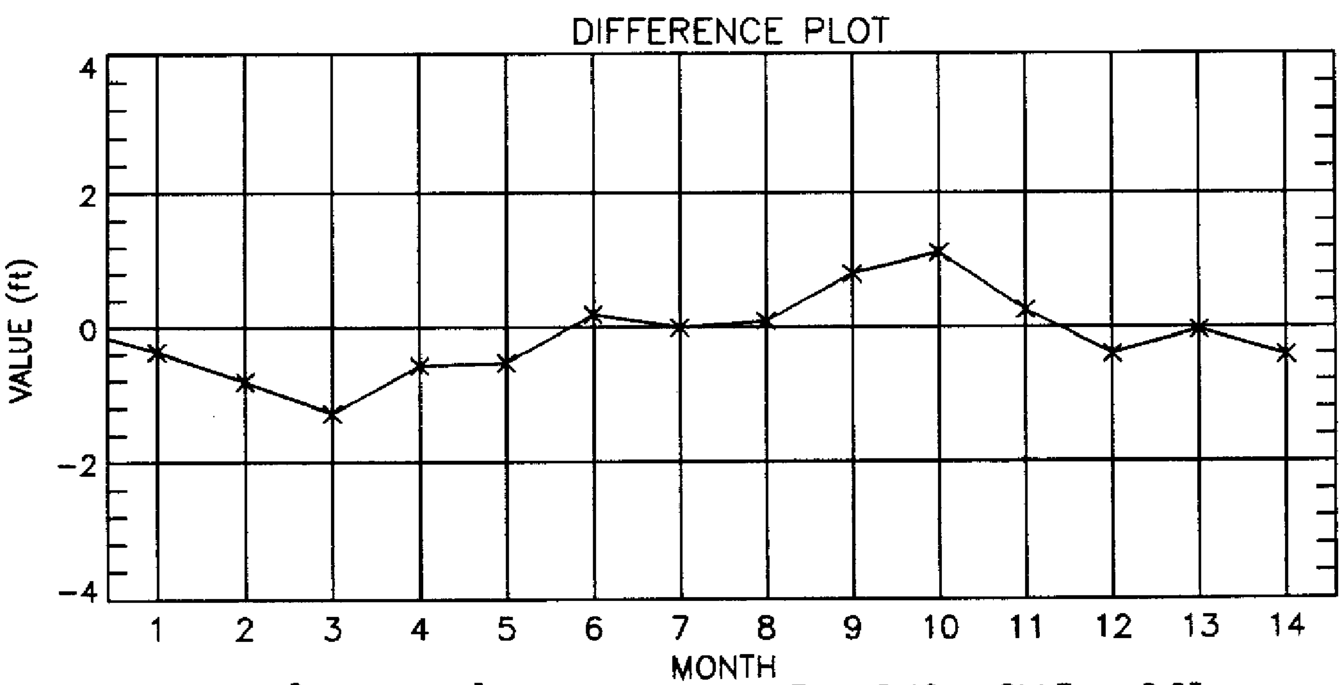
Extreme Errors [0.9, 3.2] Average Absolute Error 1.59 Std.Error 0.65 pg 5





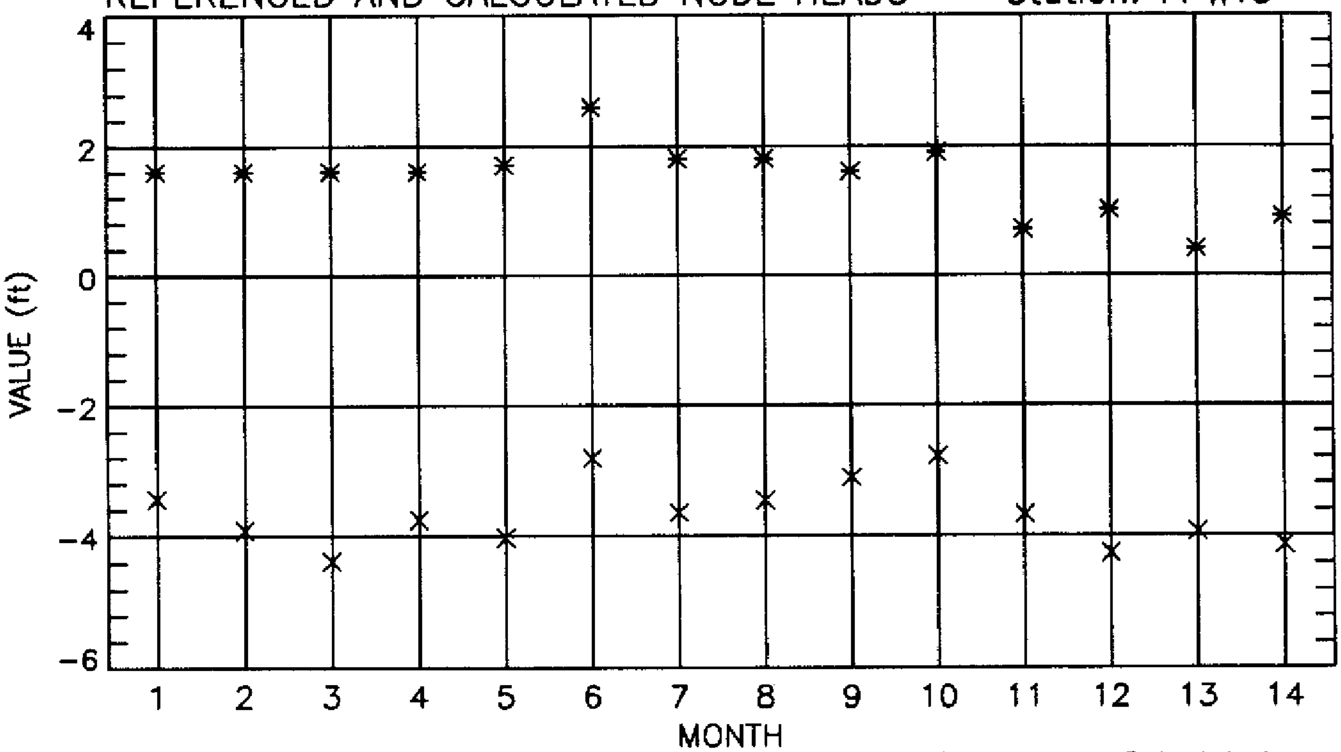
Extreme Errors [−2.7, −0.5] Average Absolute Error 1.37 Std.Error 0.57 pg 8





Extreme Errors [−1.3, 1.1] Average Absolute Error 0.46 Std.Error 0.63 pg 7

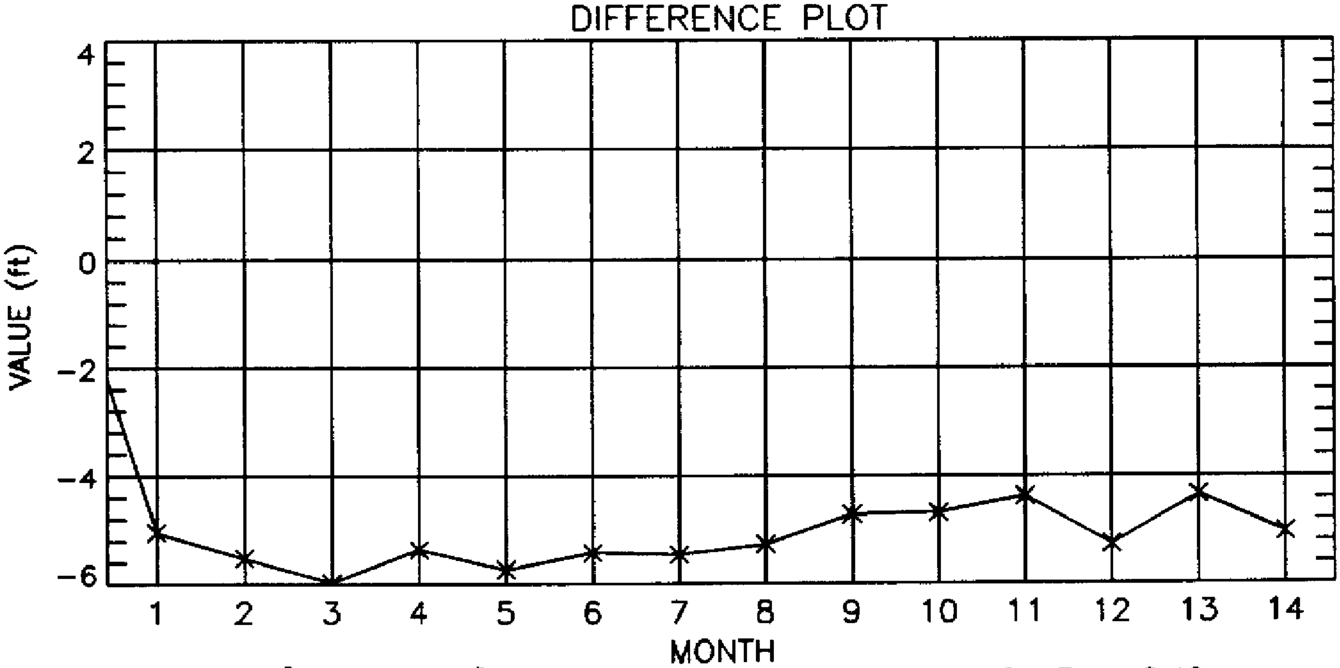
REFERENCED AND CALCULATED NODE HEADS-- Station: FPWT3



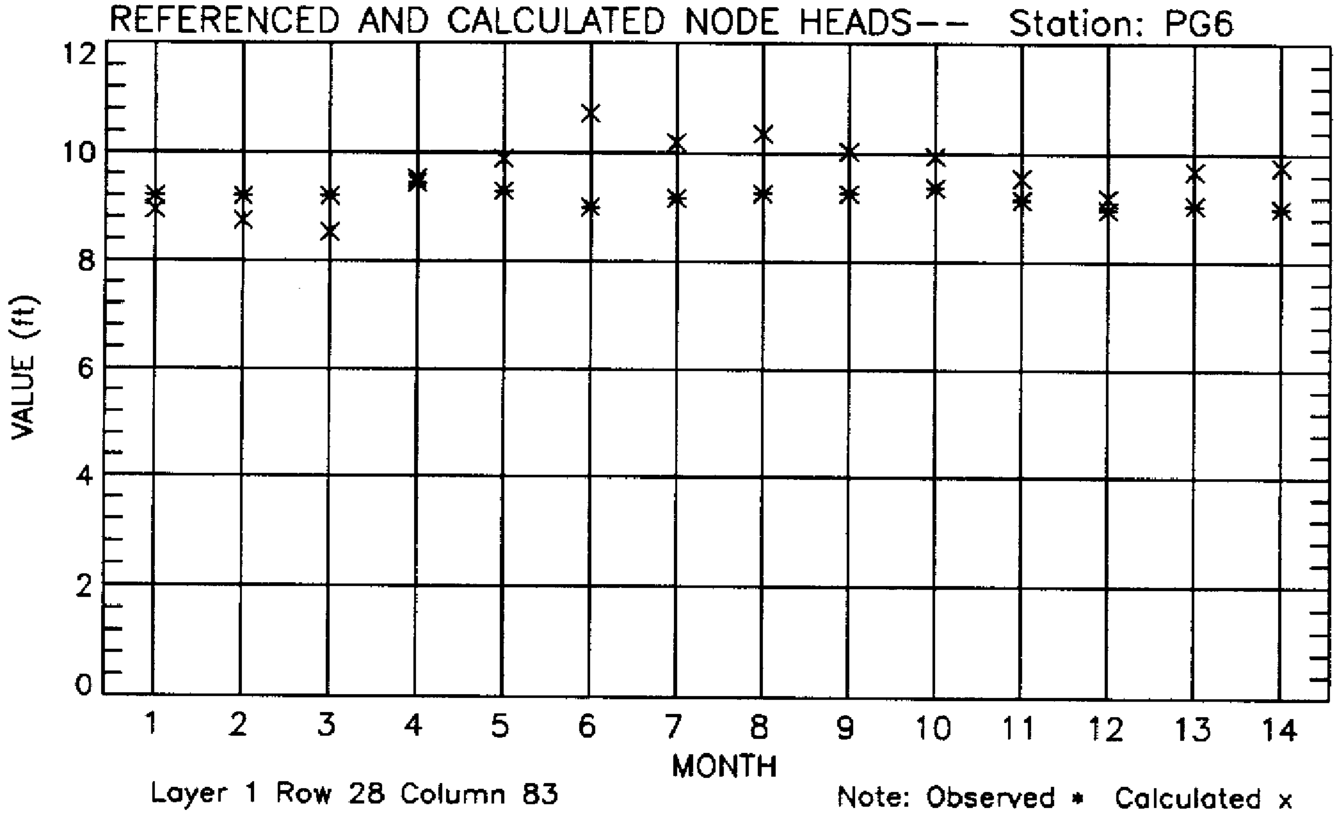
Layer 1 Row 30 Column 88

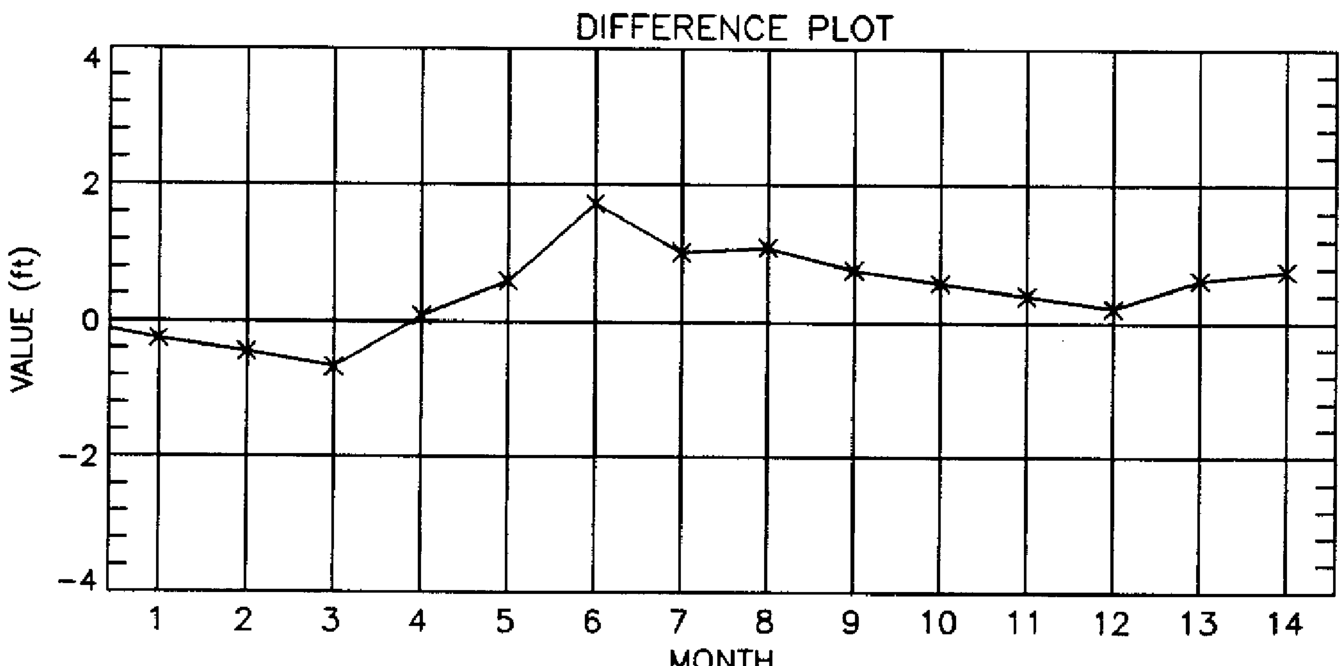
Note: Observed * Calculated x

DIFFERENCE PLOT

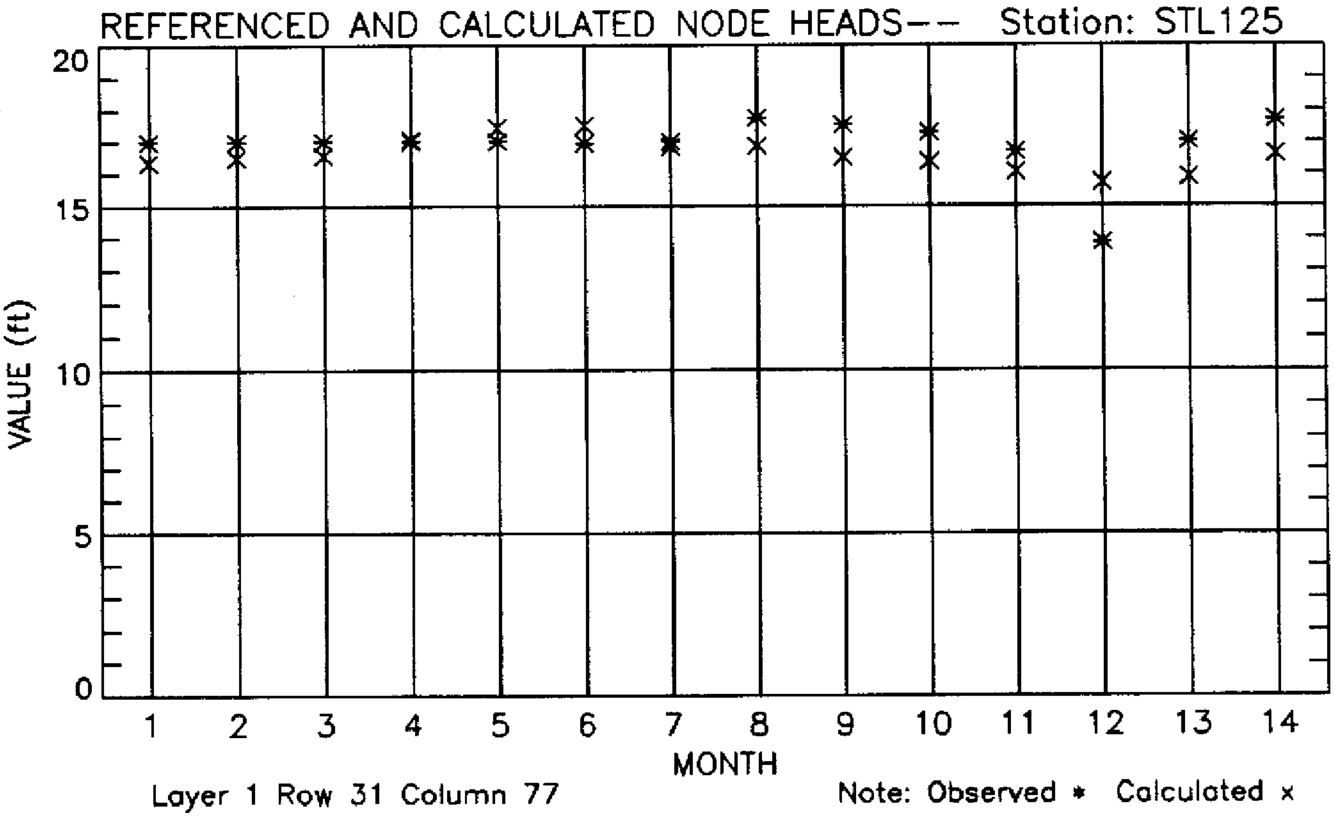


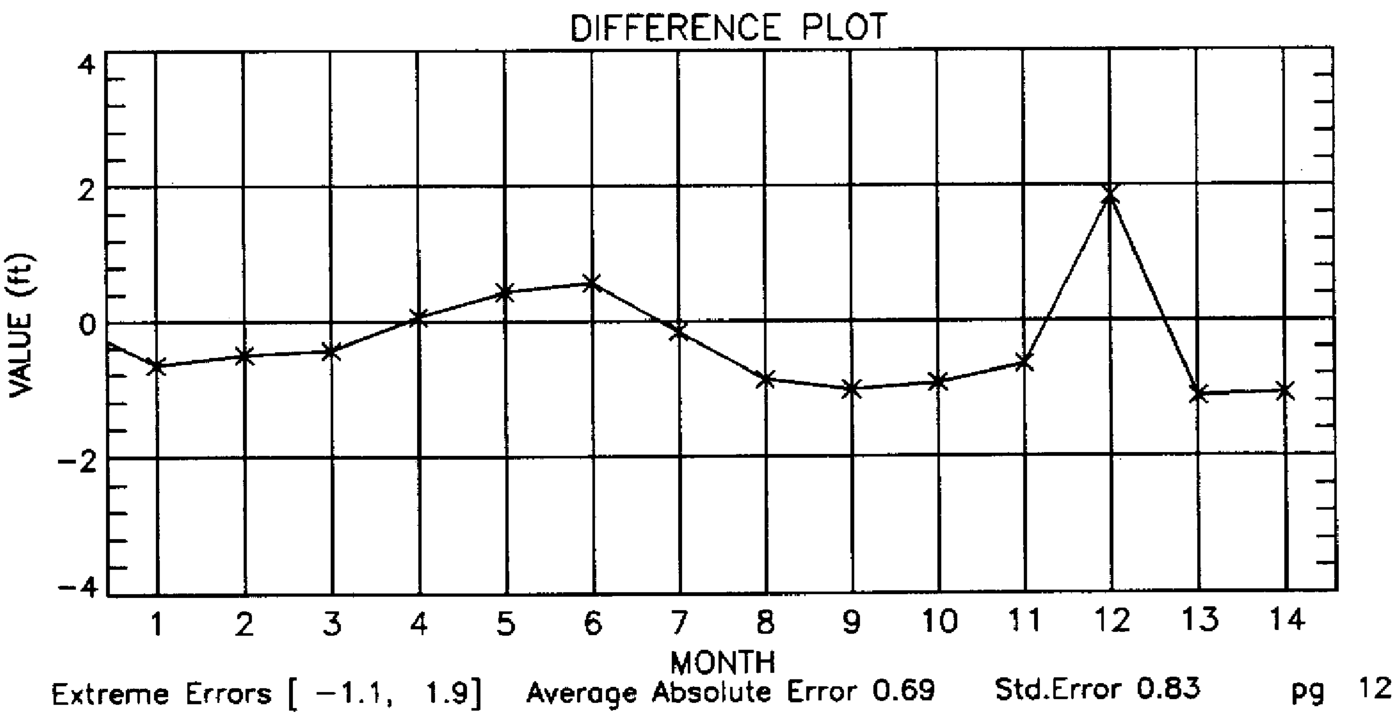
Extreme Errors [-6.0, -4.4] Average Absolute Error 4.82 Std.Error 0.49 pg 10

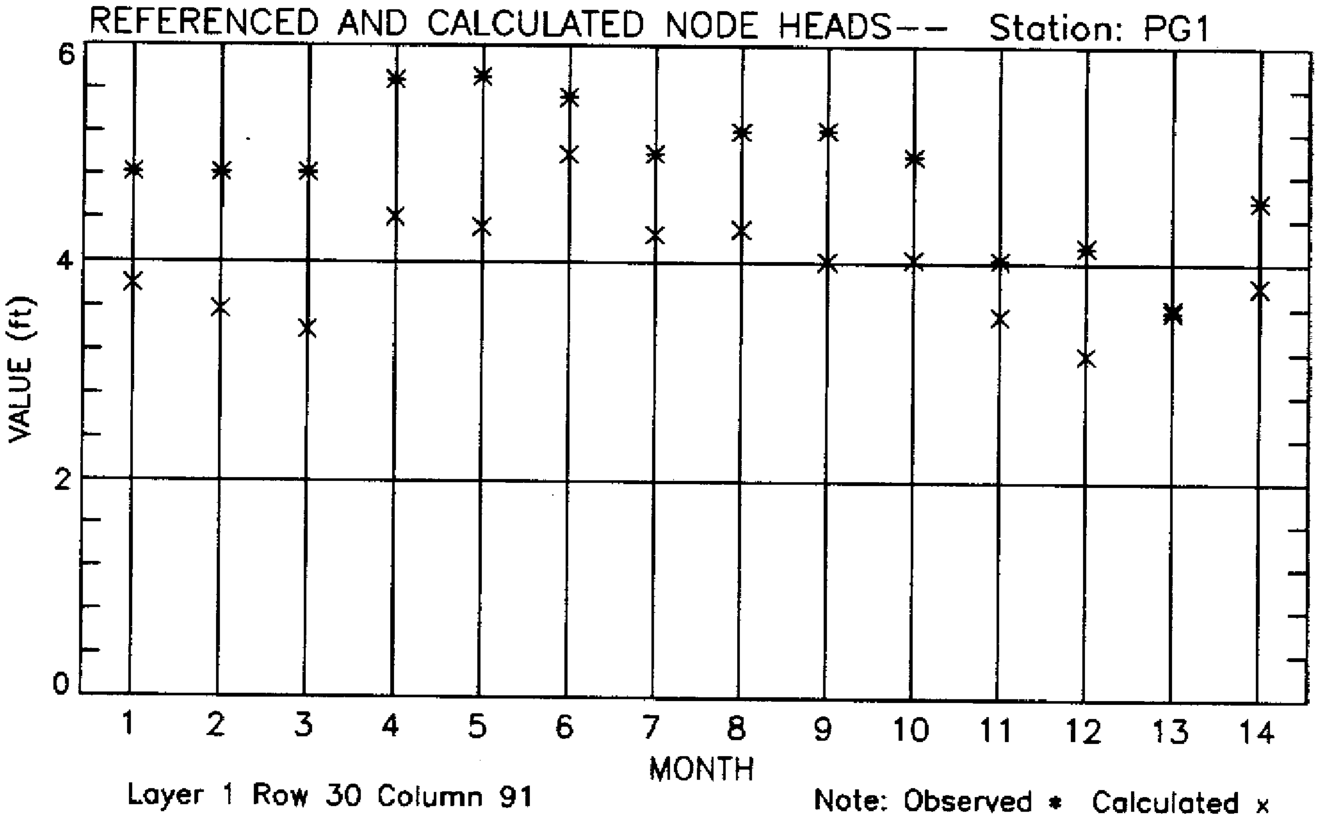


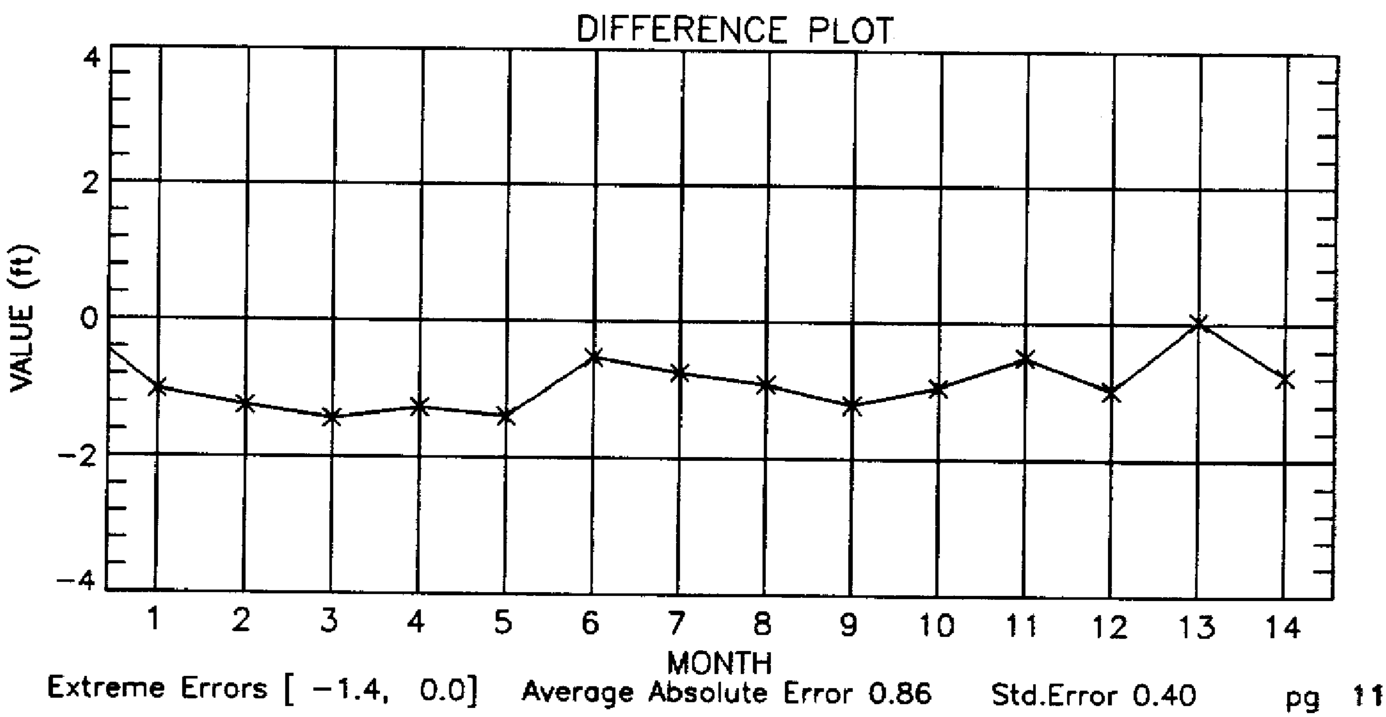


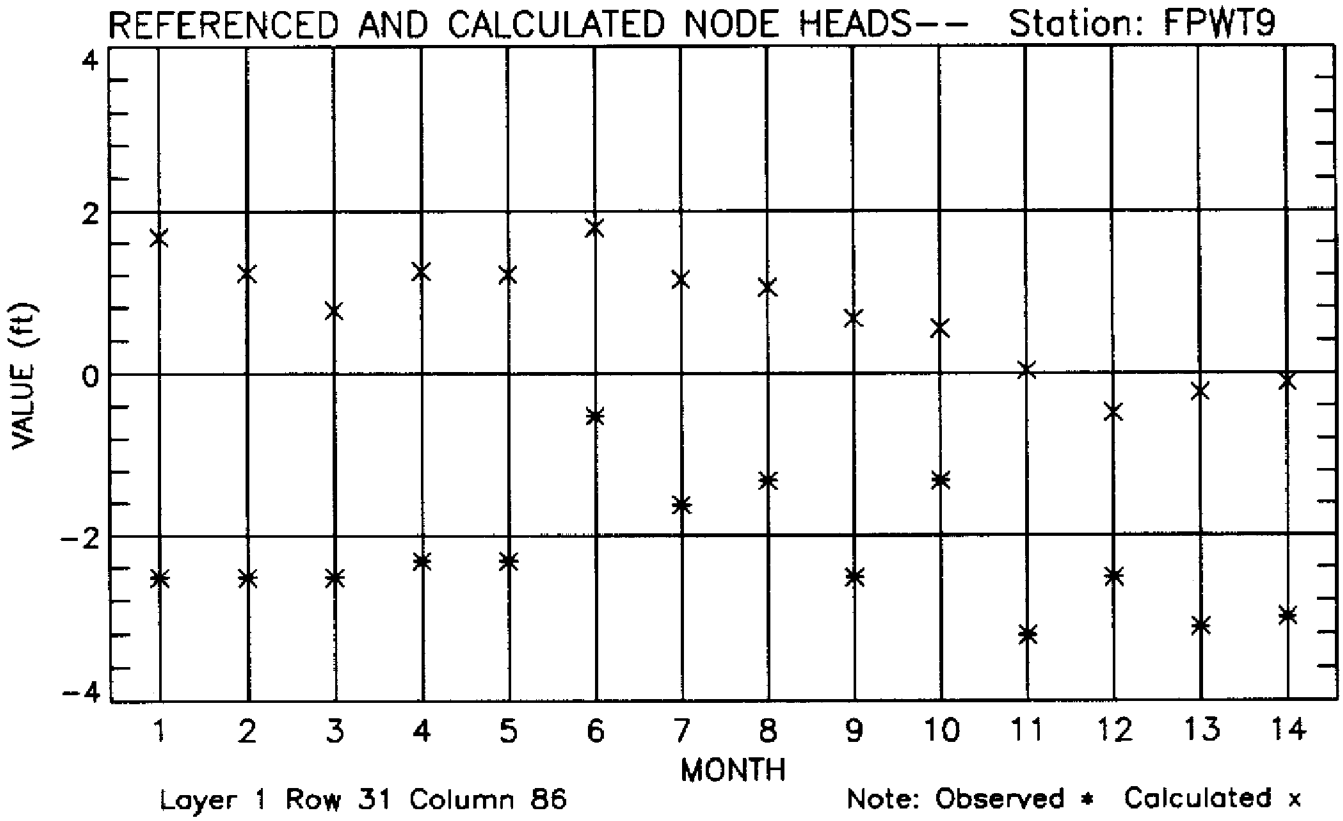
Extreme Errors [−0.7, 1.7] Average Absolute Error 0.62 Std.Error 0.65 pg 9

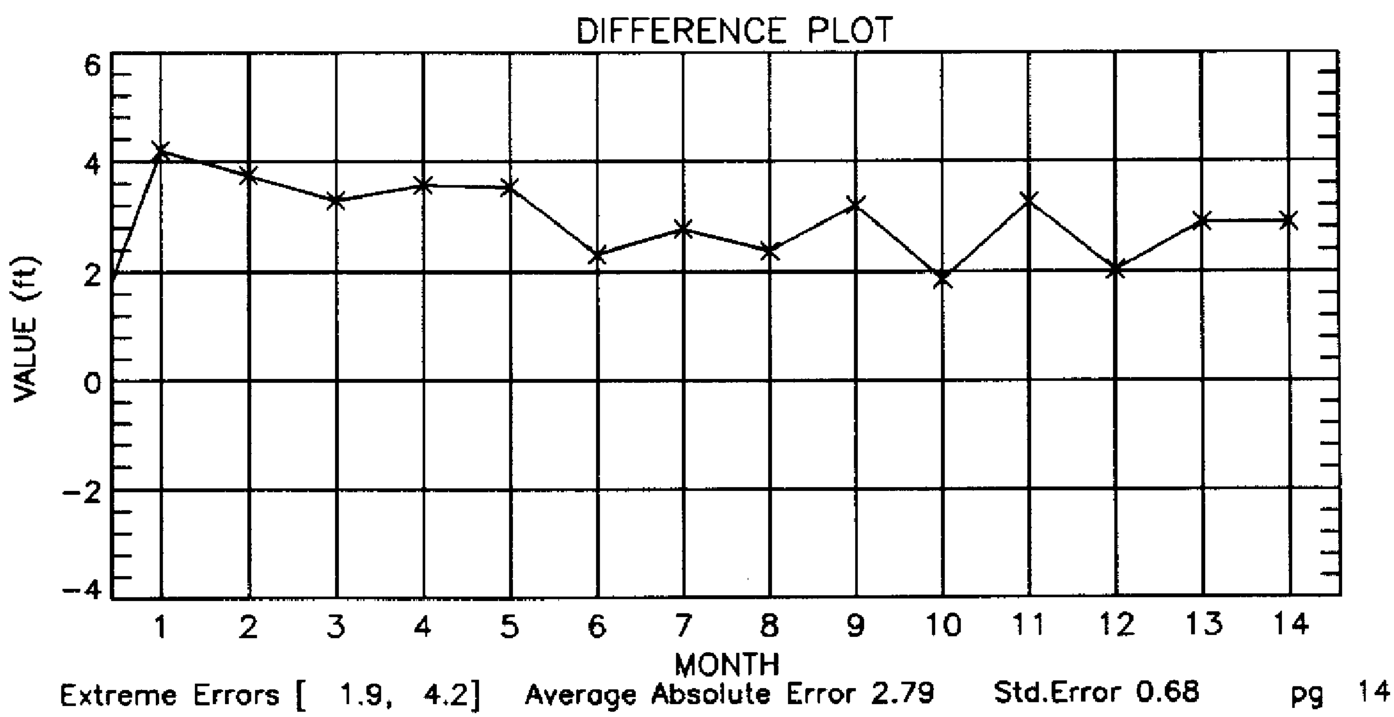

REFERENCED AND CALCULATED NODE HEADS-- Station: STL125
VALUE (ft)
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 31 Column 77
Note: Observed * Calculated x

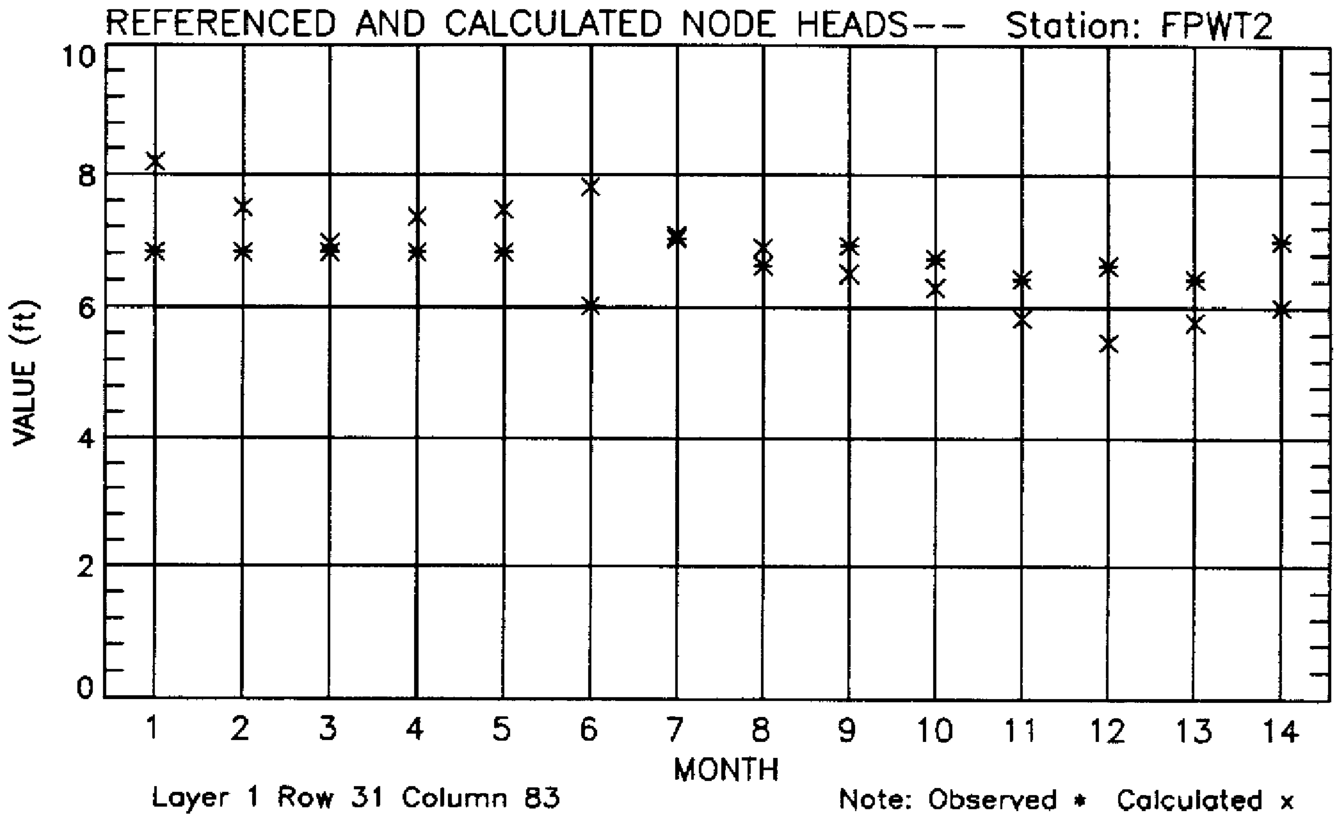

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.1, 1.9] Average Absolute Error 0.69 Std.Error 0.83 pg 12

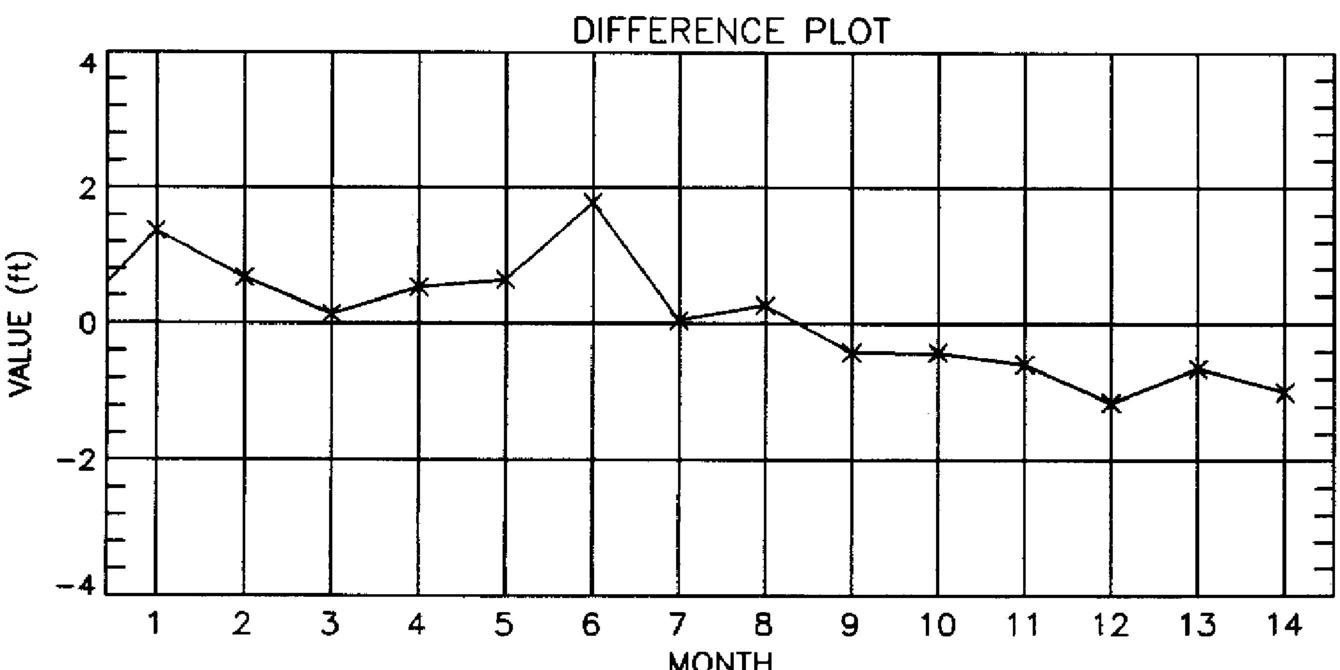

REFERENCED AND CALCULATED NODE HEADS-- Station: PG1
VALUE (ft)
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 30 Column 91
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.4, 0.0] Average Absolute Error 0.86 Std.Error 0.40 pg 11

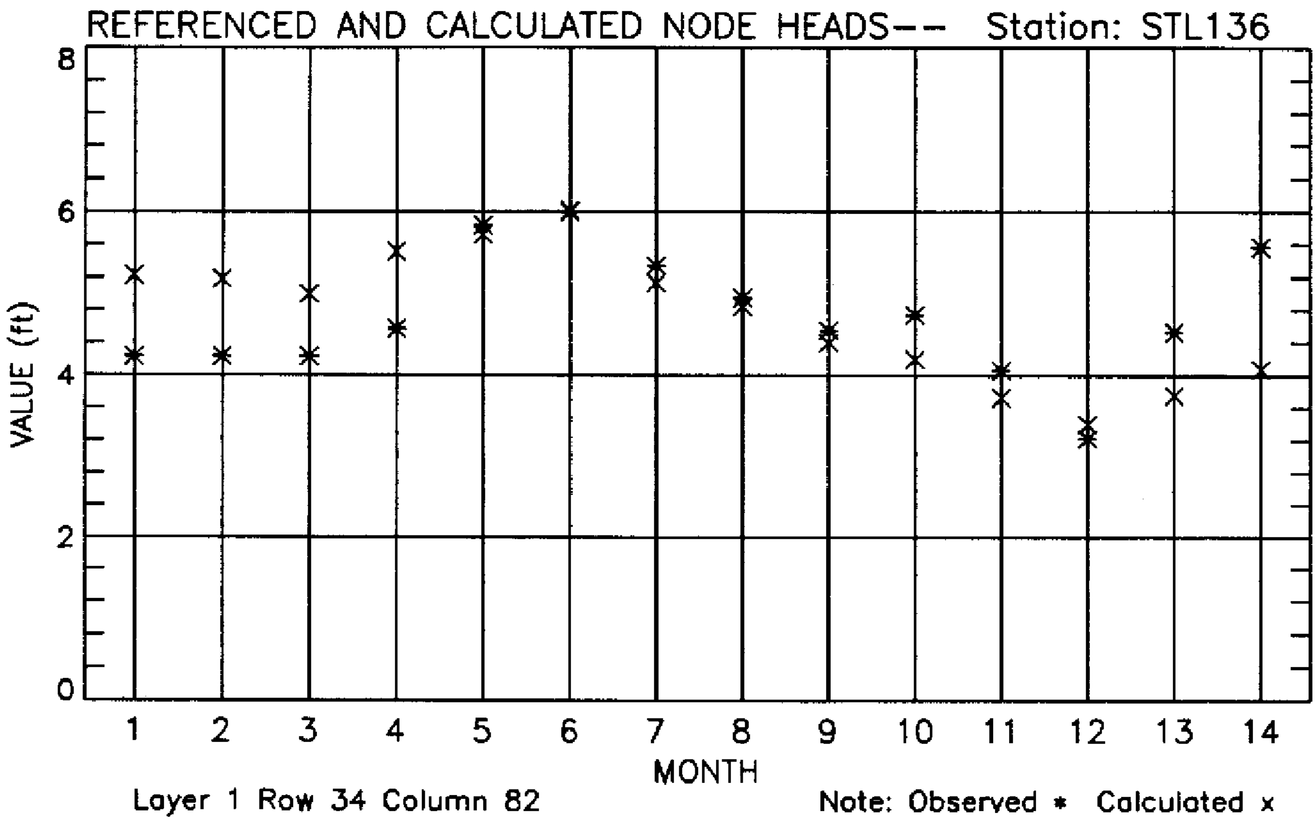

REFERENCED AND CALCULATED NODE HEADS-- Station: FPWT9
VALUE (ft)
MONTH
Layer 1 Row 31 Column 86
Note: Observed * Calculated x

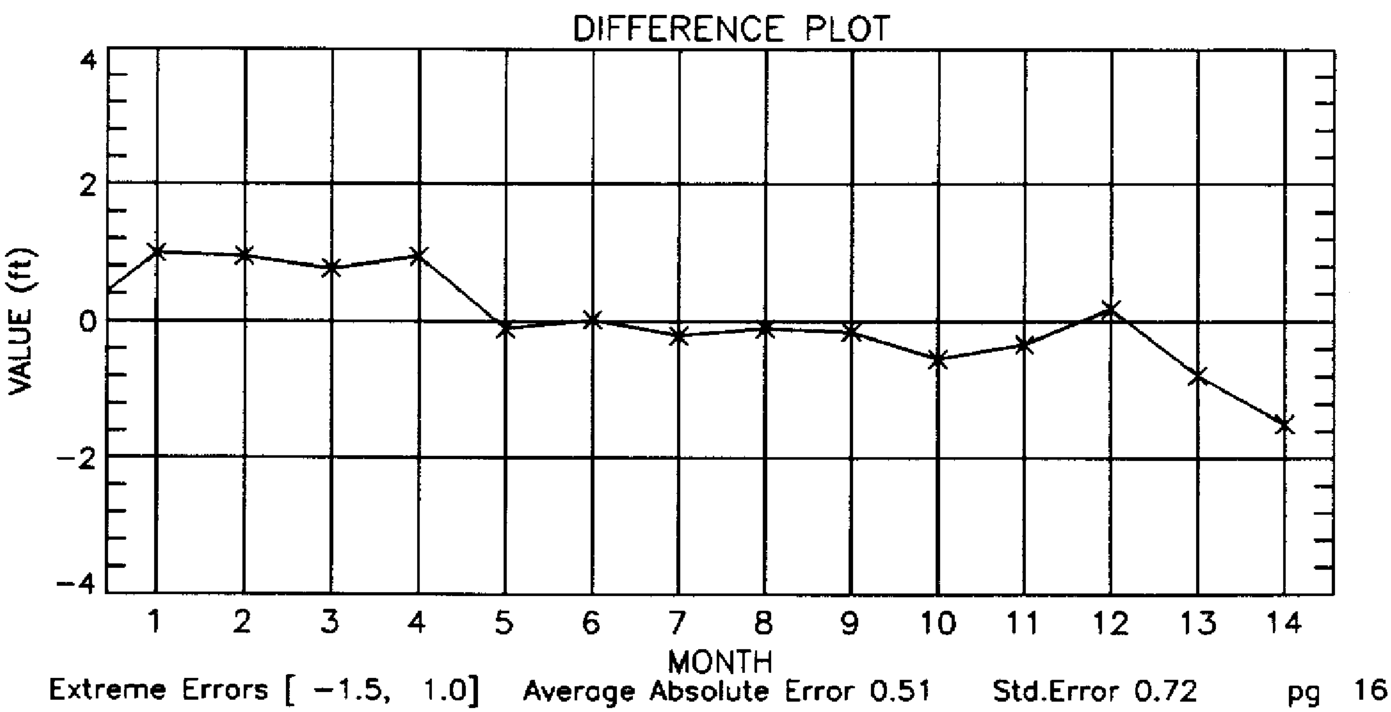

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [1.9, 4.2] Average Absolute Error 2.79 Std.Error 0.68 pg 14

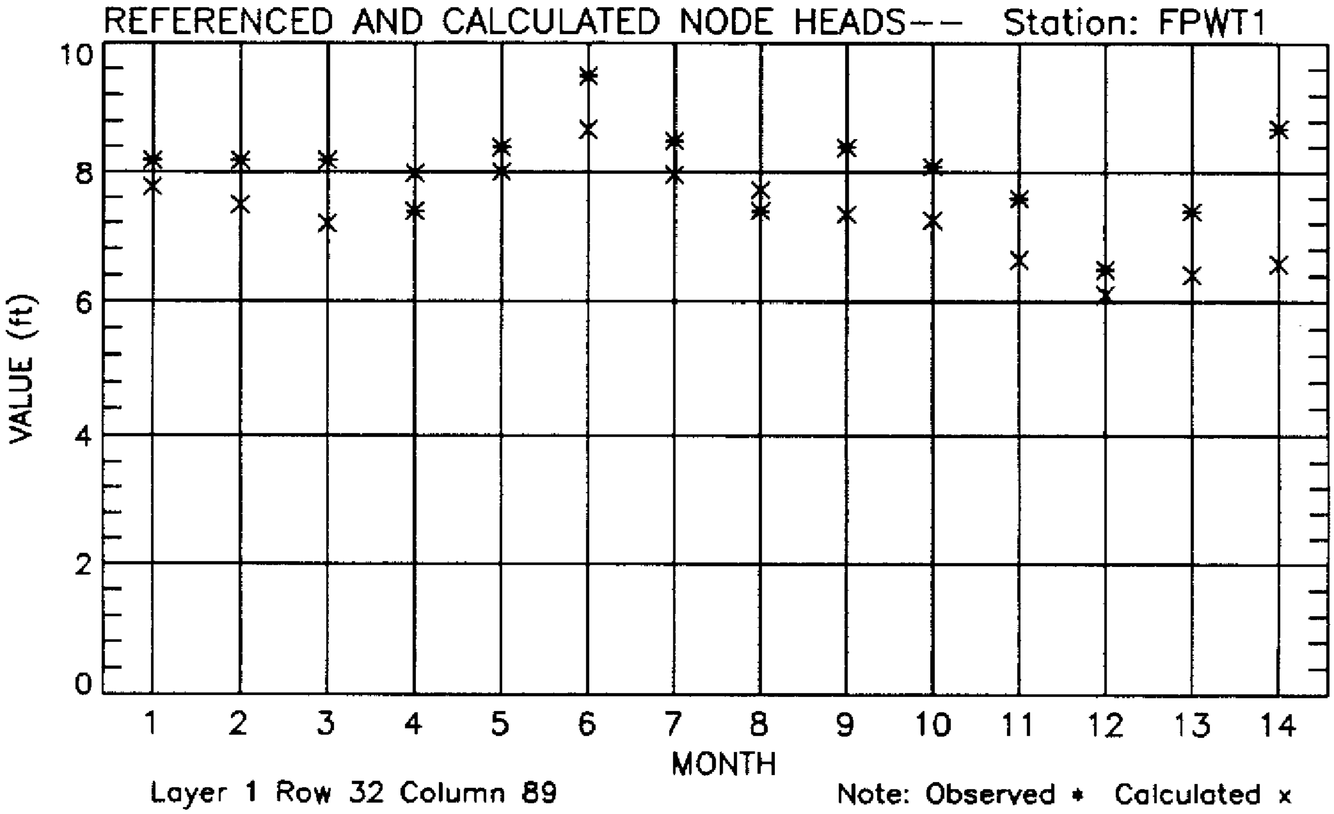


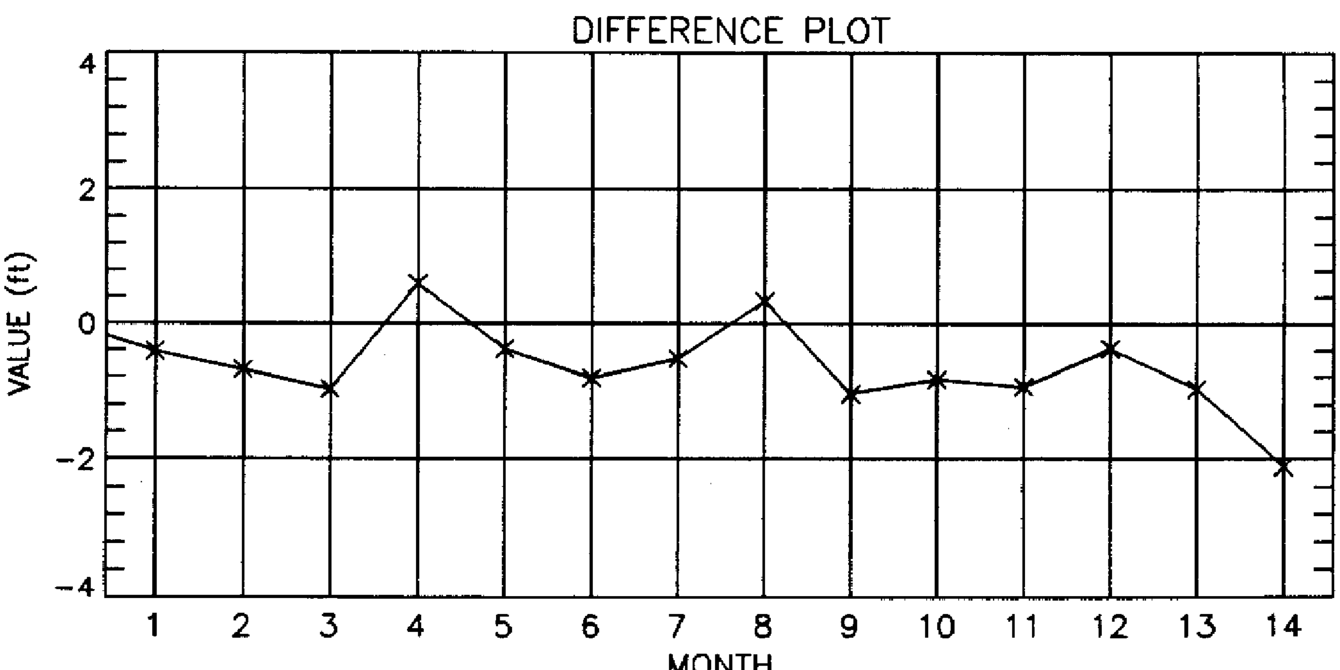


Extreme Errors [−1.2, 1.8] Average Absolute Error 0.64 Std.Error 0.86 pg 13

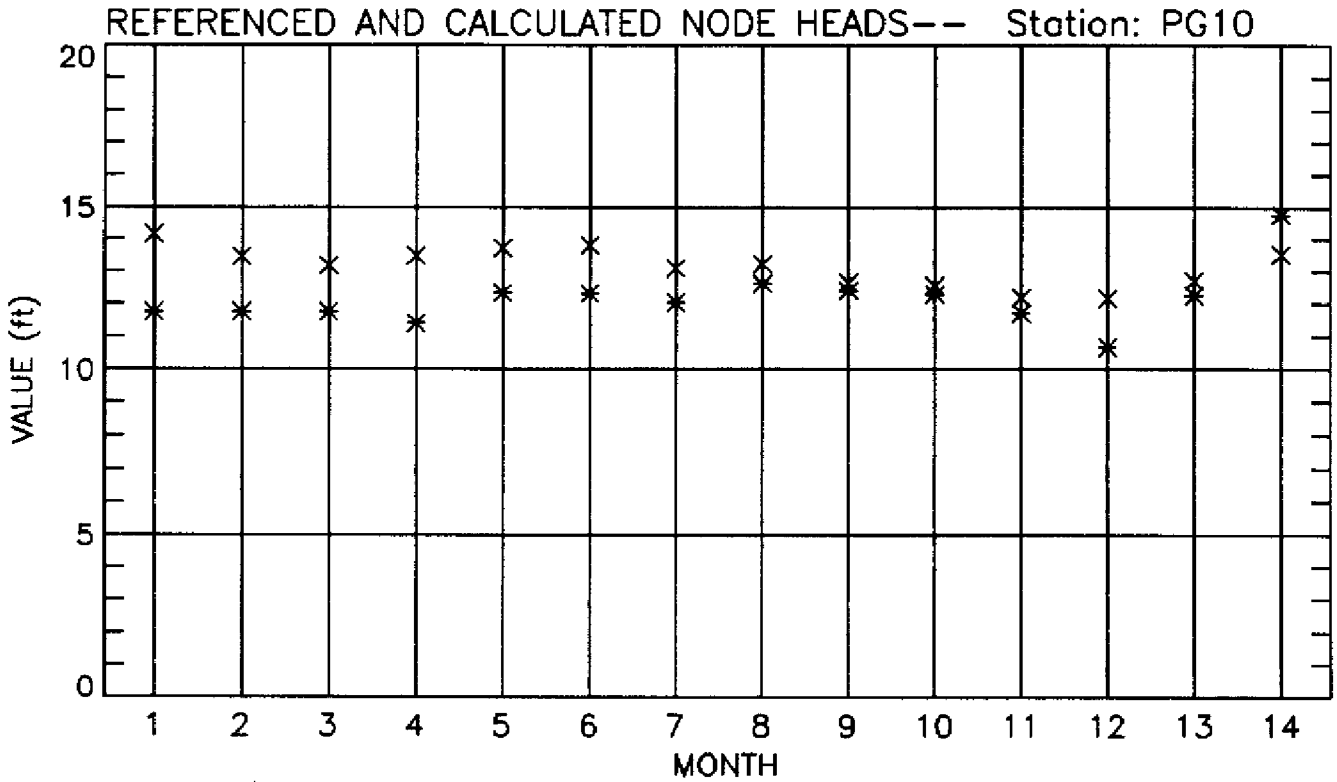

REFERENCED AND CALCULATED NODE HEADS-- Station: STL136
VALUE (ft)
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 34 Column 82
Note: Observed * Calculated x

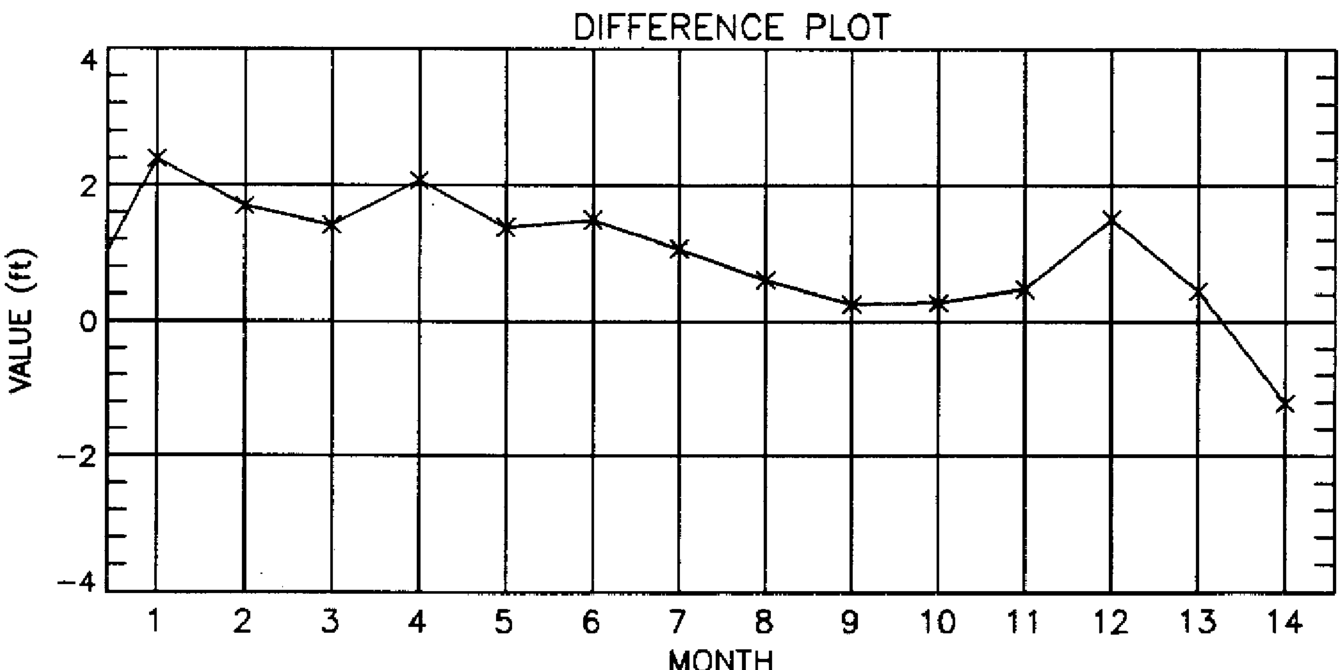

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.5, 1.0] Average Absolute Error 0.51 Std.Error 0.72 pg 16



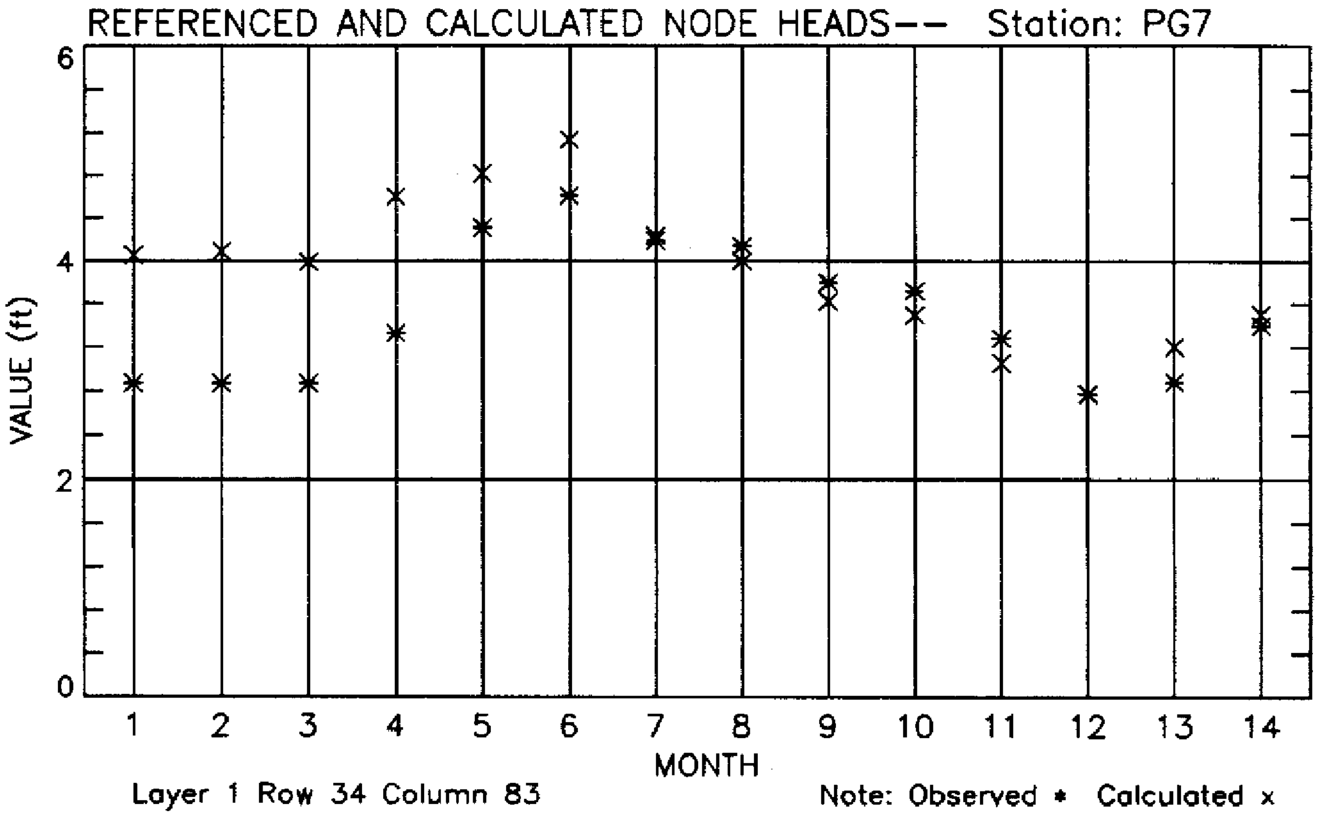


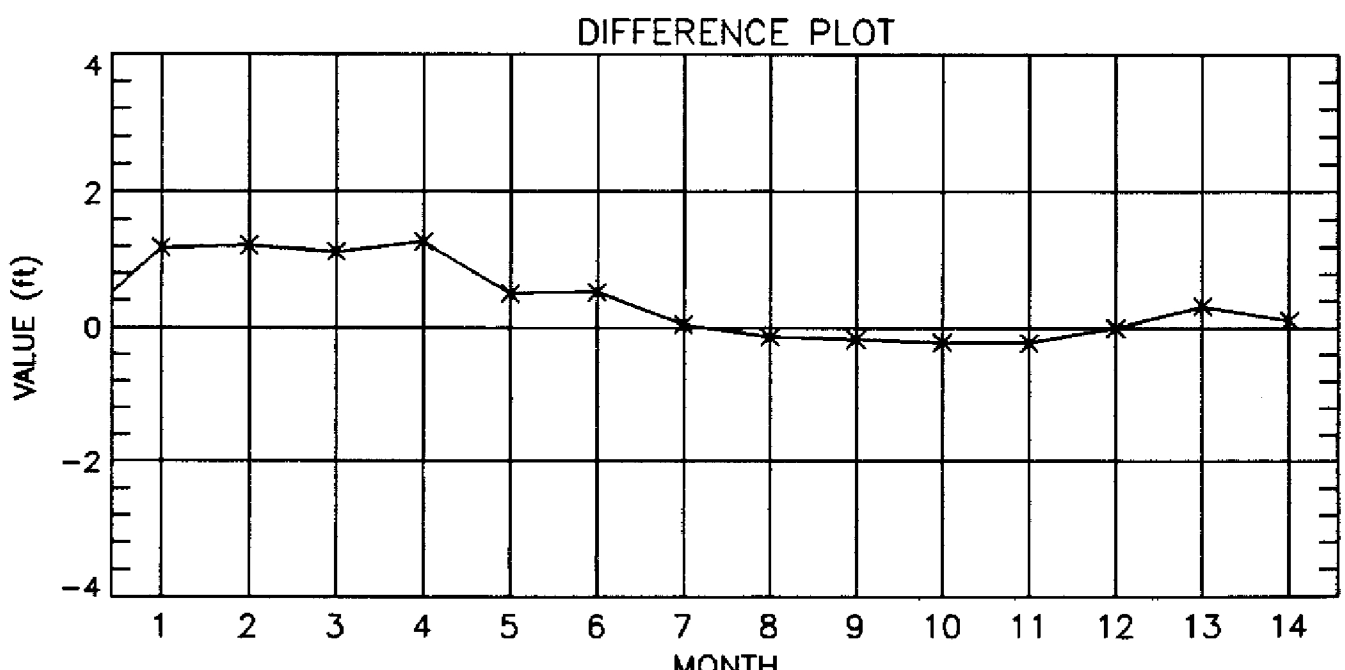
Extreme Errors [-2.1, 0.6] Average Absolute Error 0.74 Std.Error 0.65 pg 15



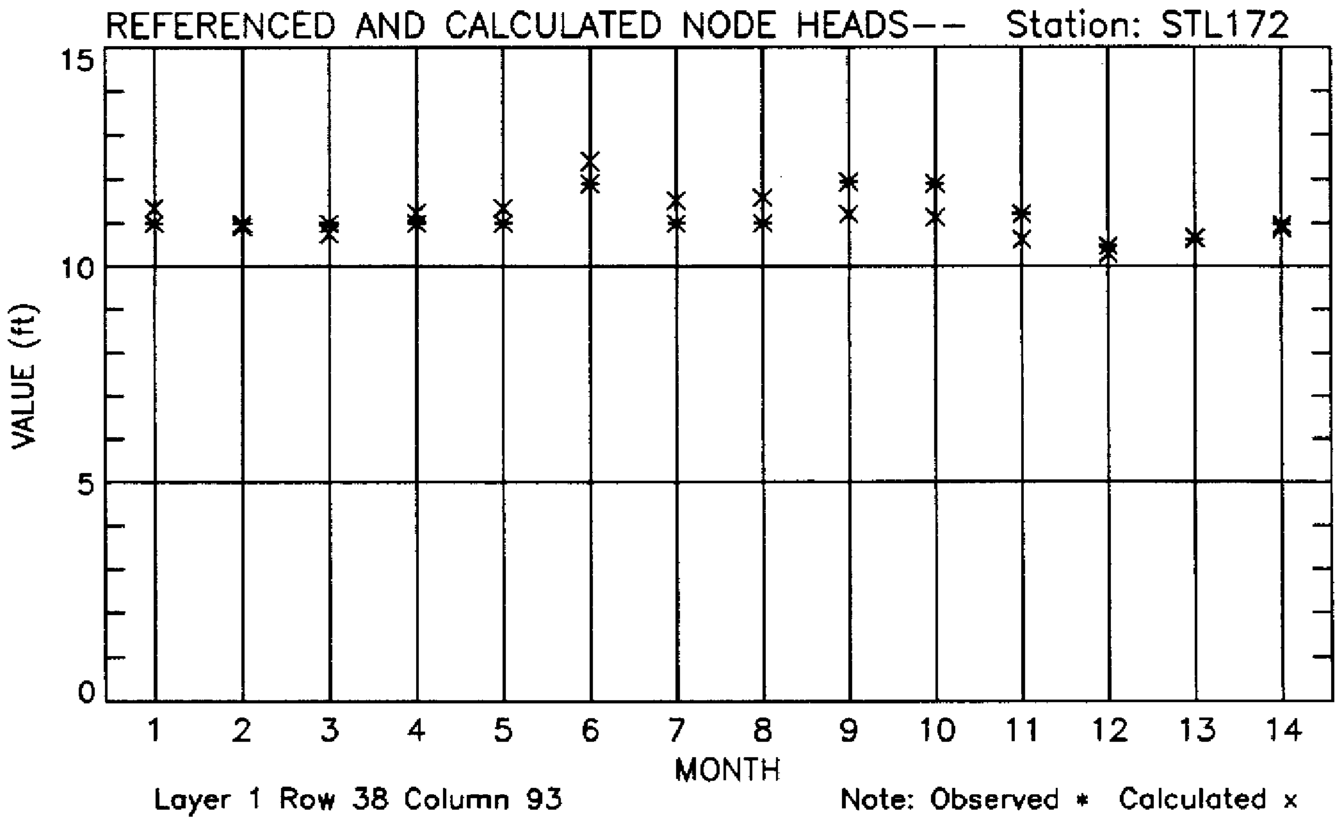


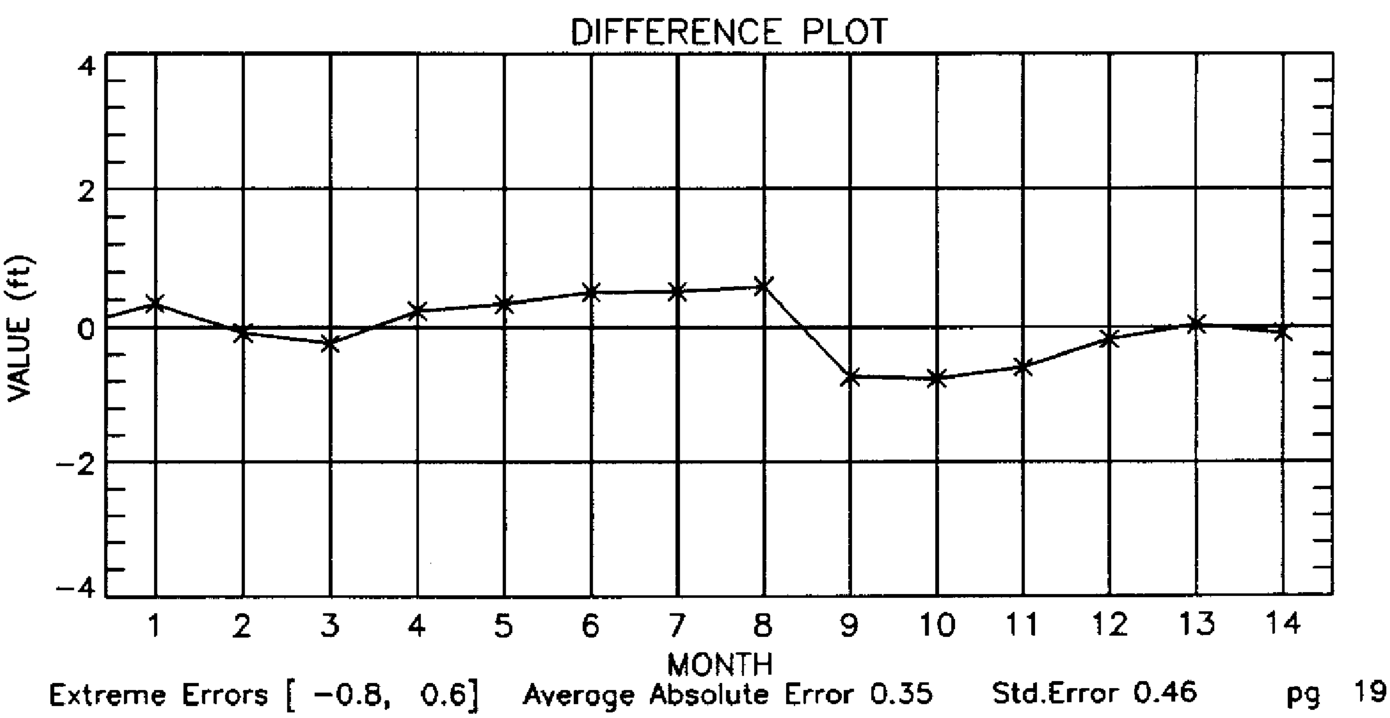
Extreme Errors [−1.2, 2.4] Average Absolute Error 1.09 Std.Error 0.93 pg 18

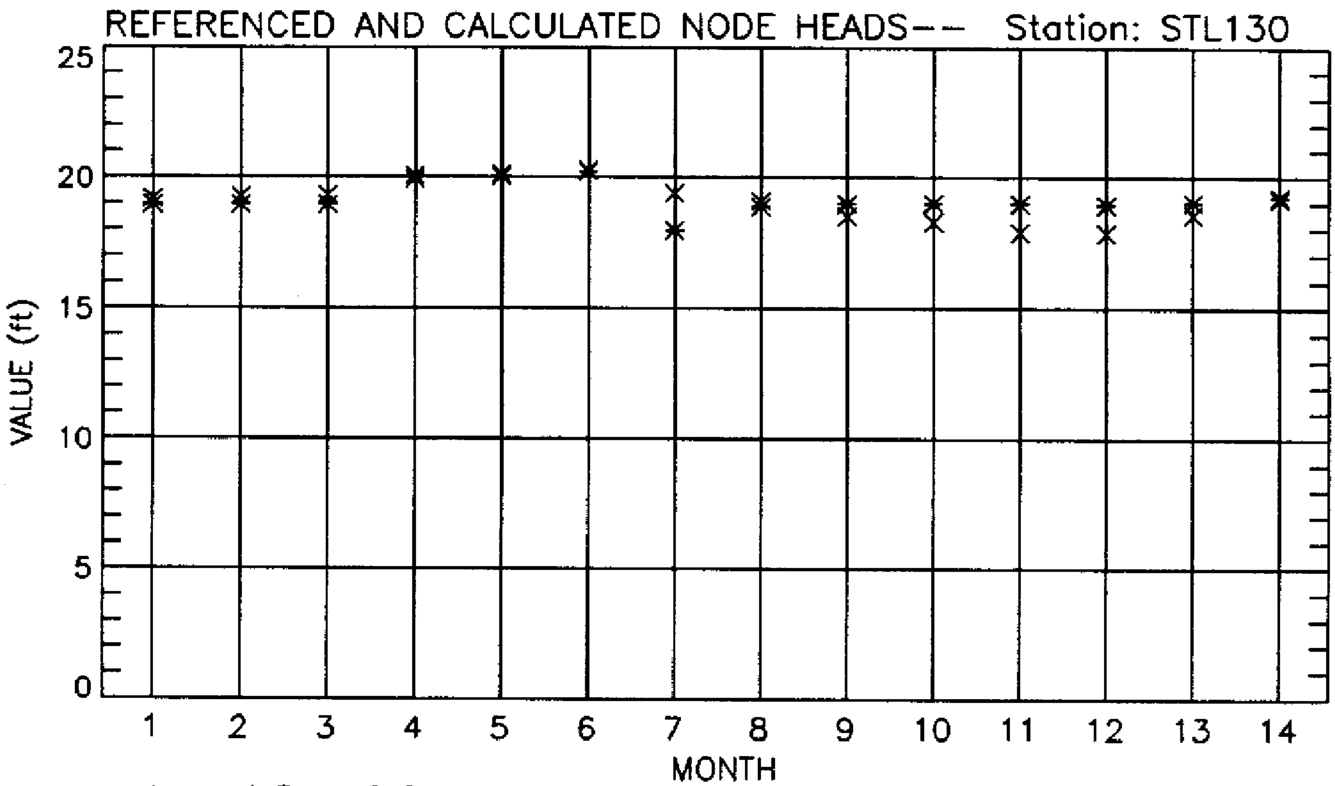




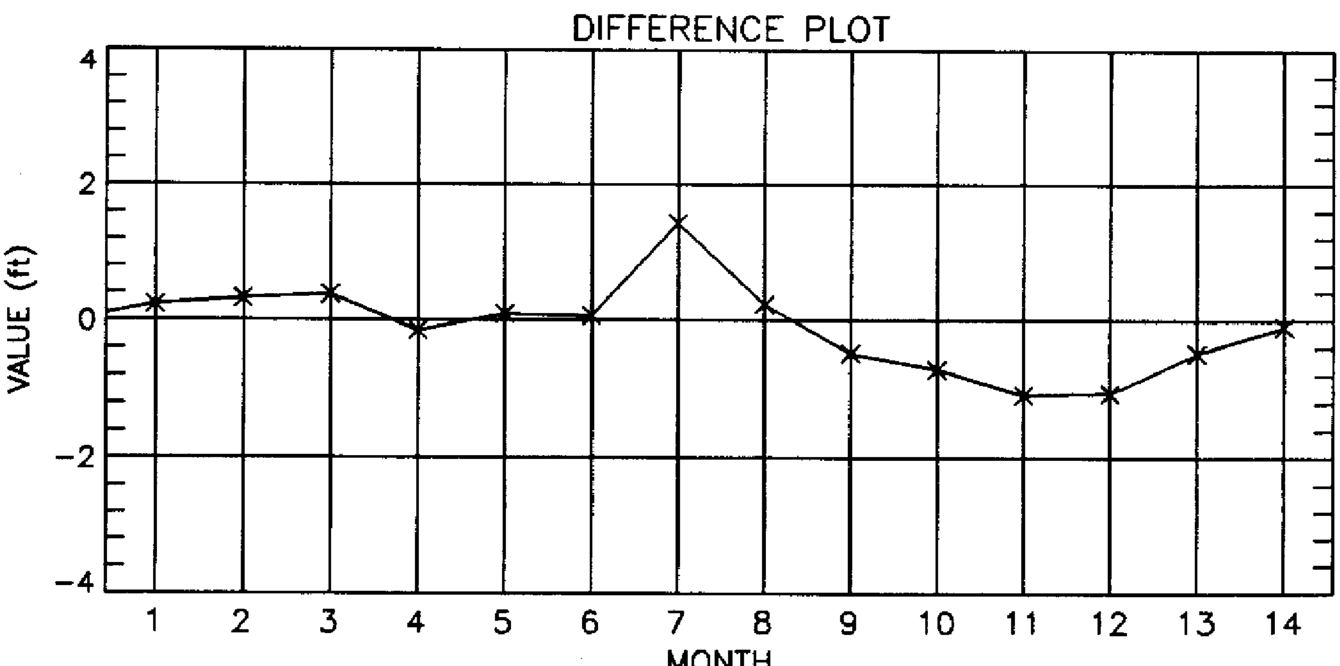
Extreme Errors [-0.2, 1.3] Average Absolute Error 0.47 Std.Error 0.58 pg 17


REFERENCED AND CALCULATED NODE HEADS-- Station: STL172
15
10
5
0
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 38 Column 93
Note: Observed * Calculated x

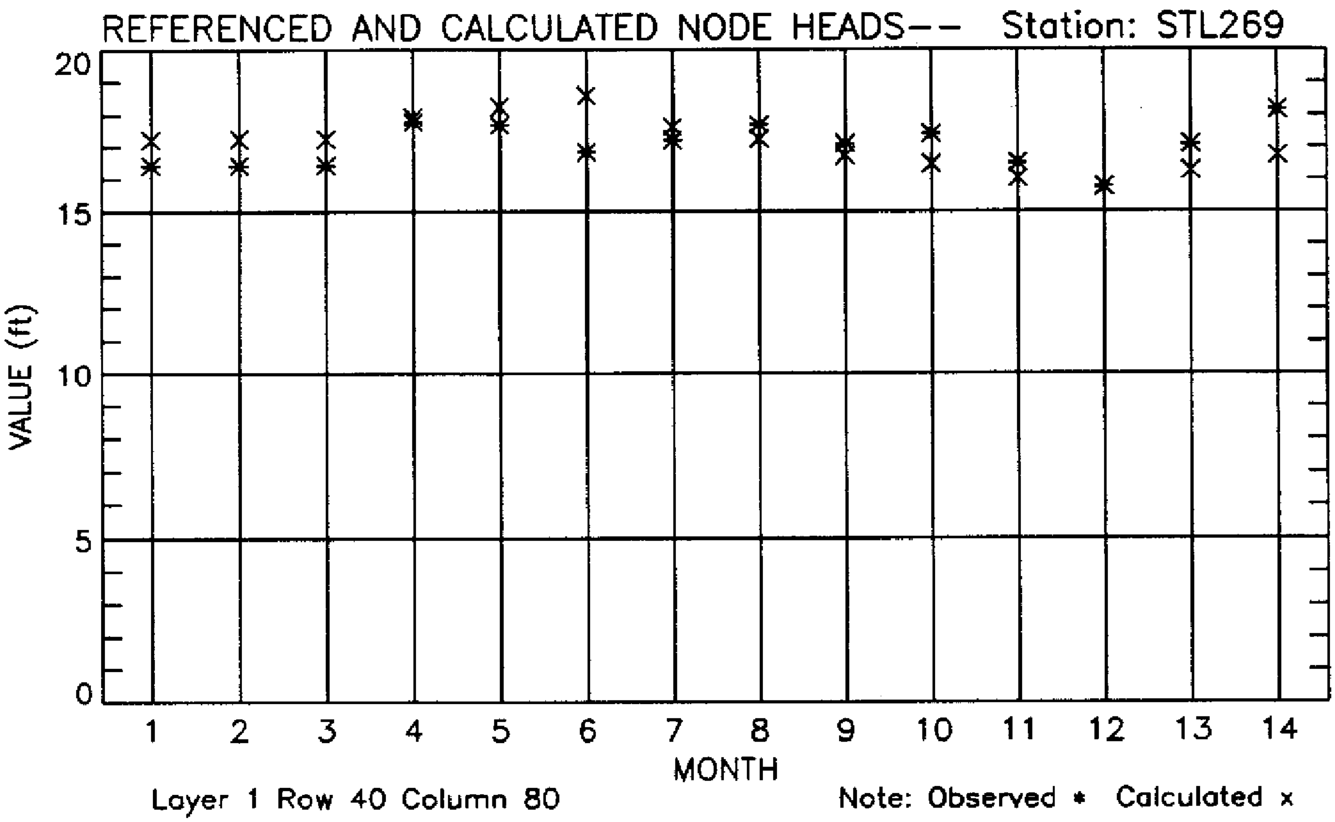

DIFFERENCE PLOT
4
2
0
-2
-4
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.8, 0.6] Average Absolute Error 0.35 Std.Error 0.46 pg 19

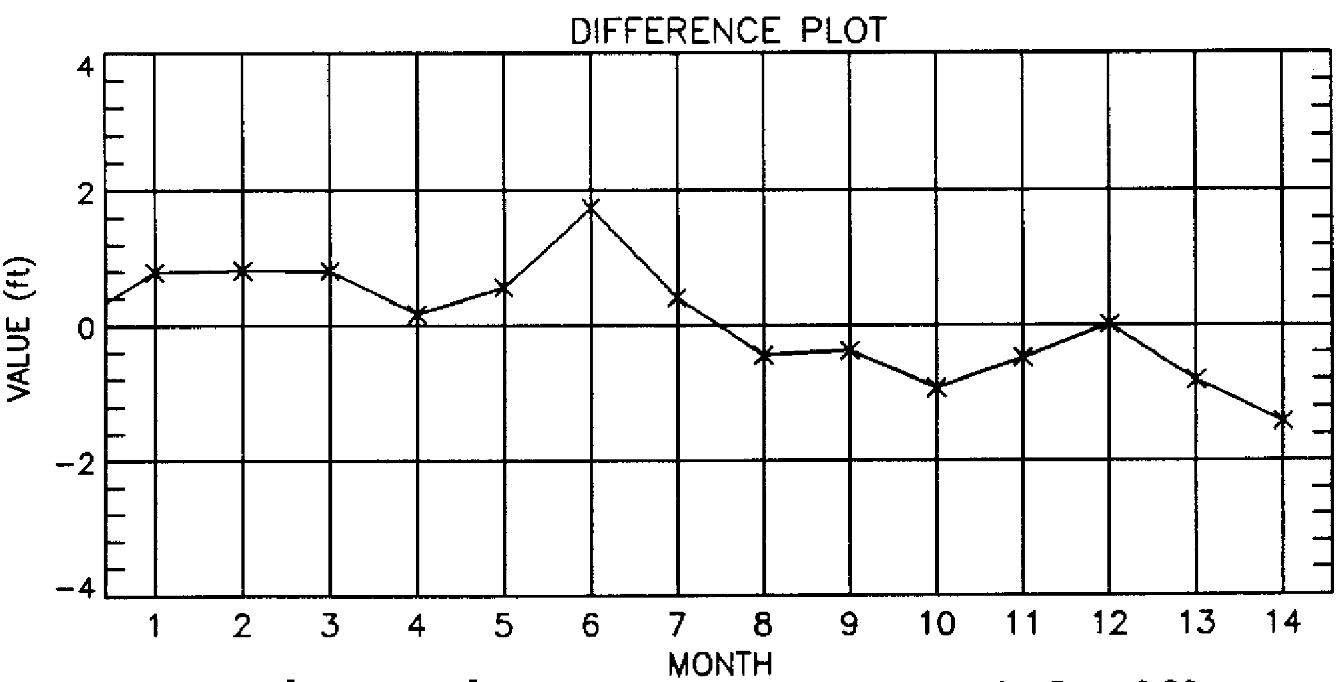


Layer 1 Row 40 Column 74 Note: Observed * Calculated x

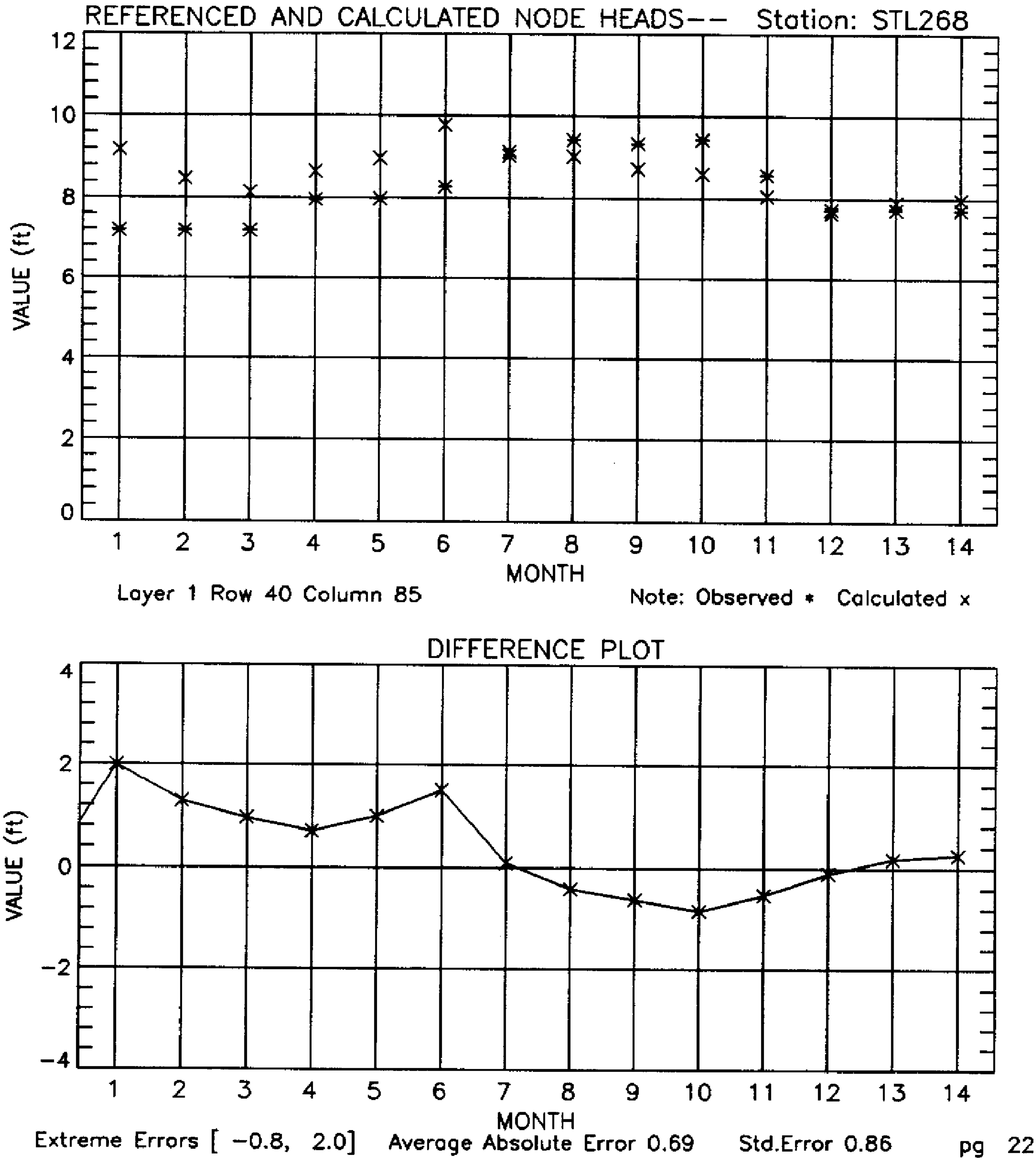


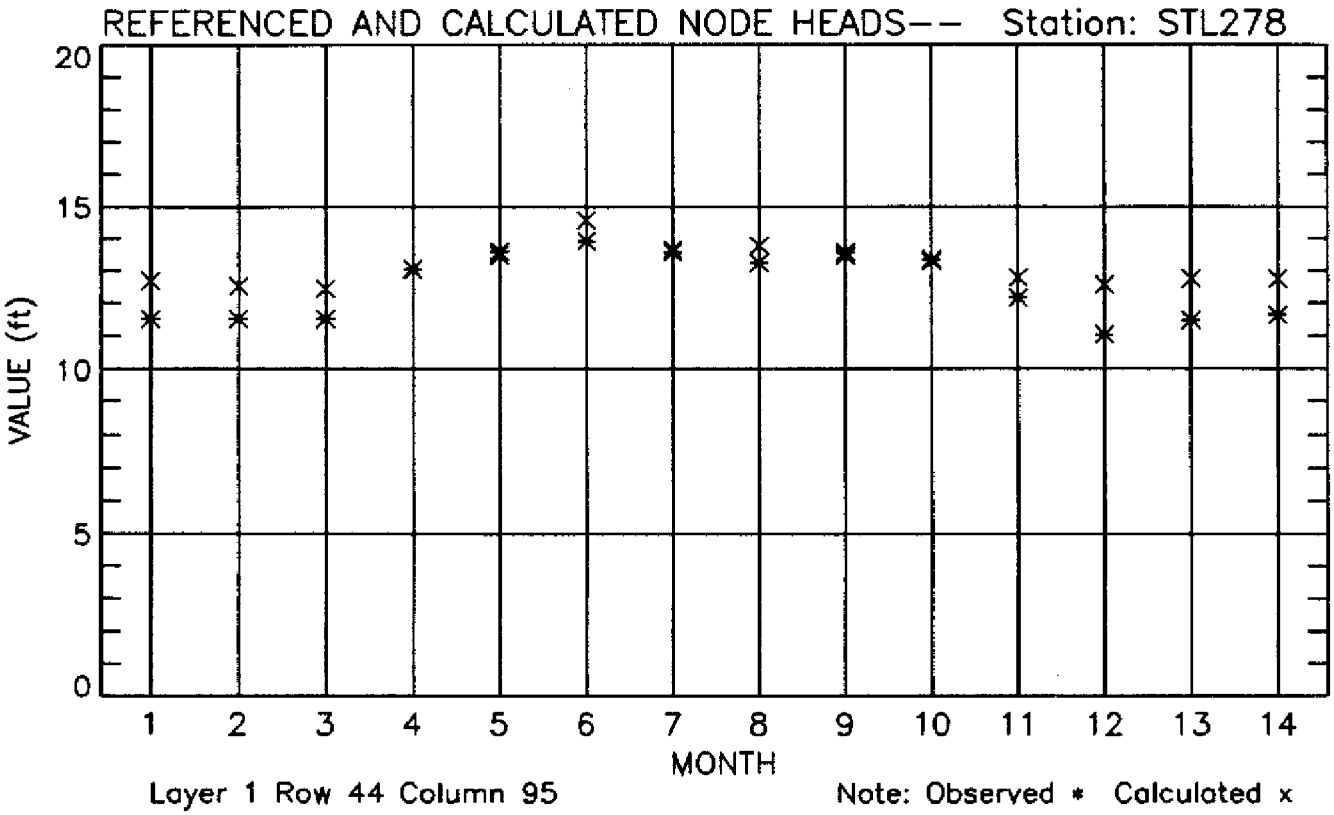
Extreme Errors [-1.1, 1.4] Average Absolute Error 0.45 Std.Error 0.65 pg 20

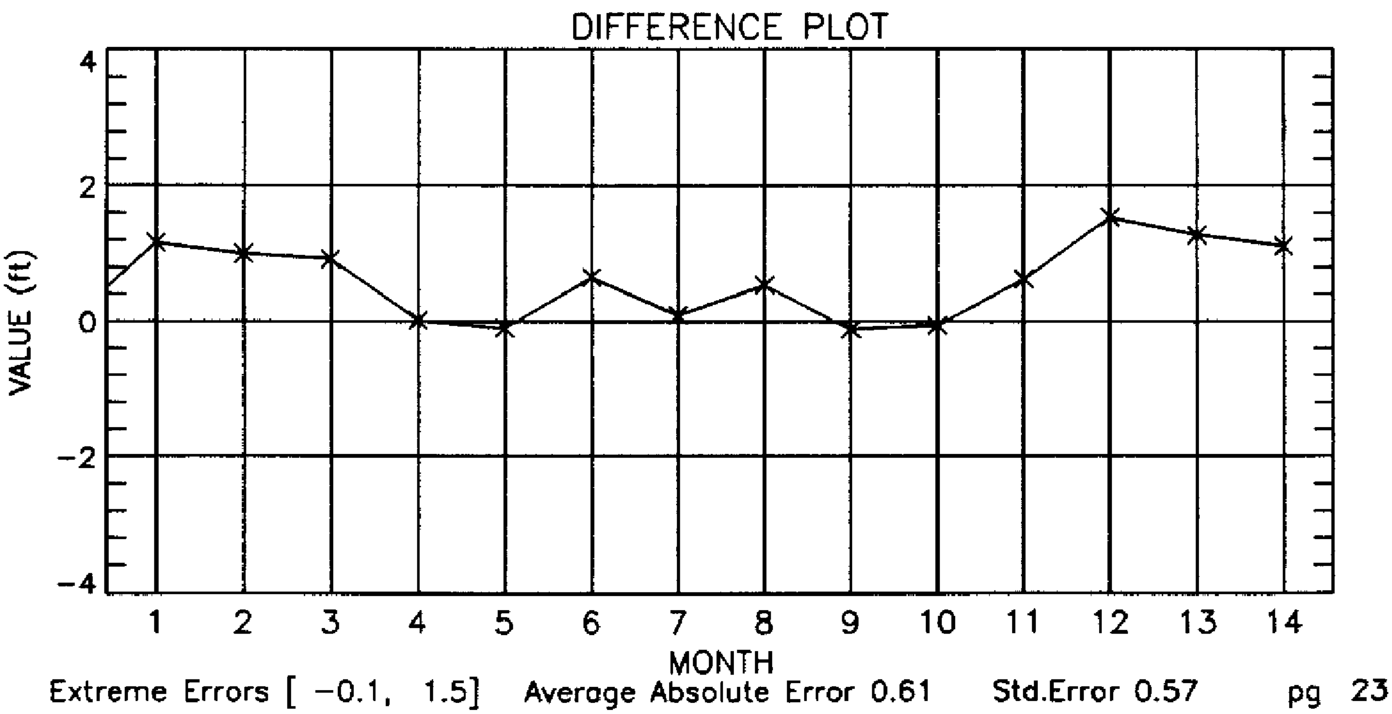


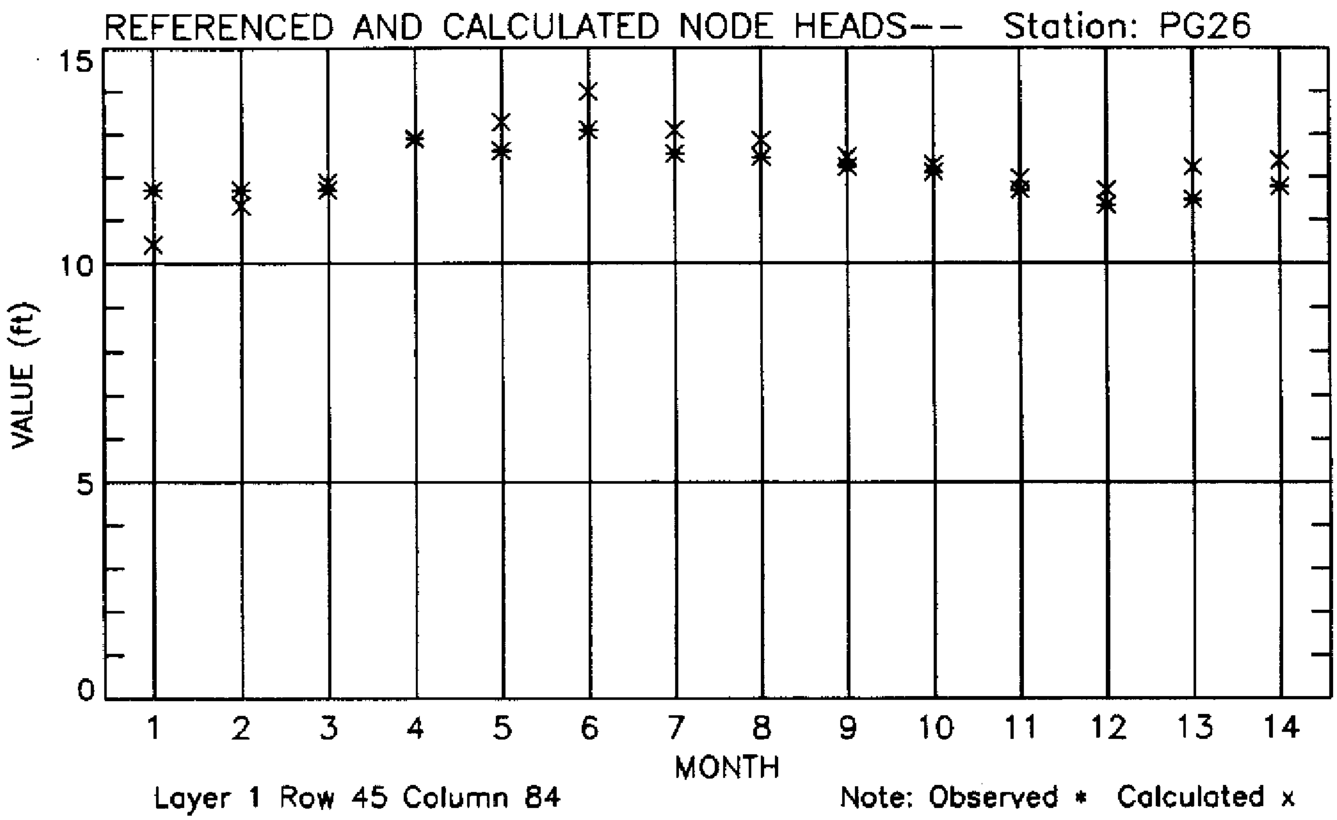


Extreme Errors [-1.4, 1.7] Average Absolute Error 0.65 Std.Error 0.86 pg 21

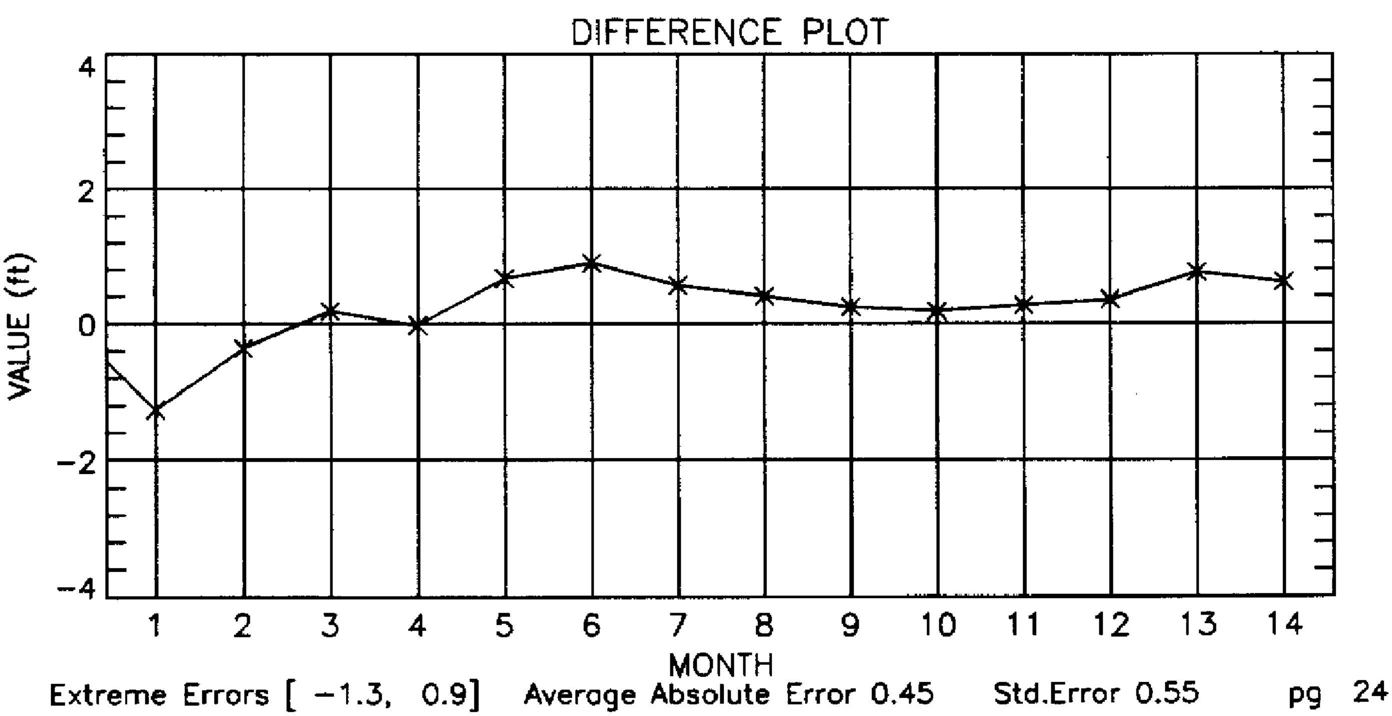

REFERENCED AND CALCULATED NODE HEADS-- Station: STL268
VALUE (ft)
MONTH
Layer 1 Row 40 Column 85
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.8, 2.0] Average Absolute Error 0.69 Std.Error 0.86
pg 22


REFERENCED AND CALCULATED NODE HEADS-- Station: STL278
VALUE (ft)
MONTH
Layer 1 Row 44 Column 95
Note: Observed * Calculated x

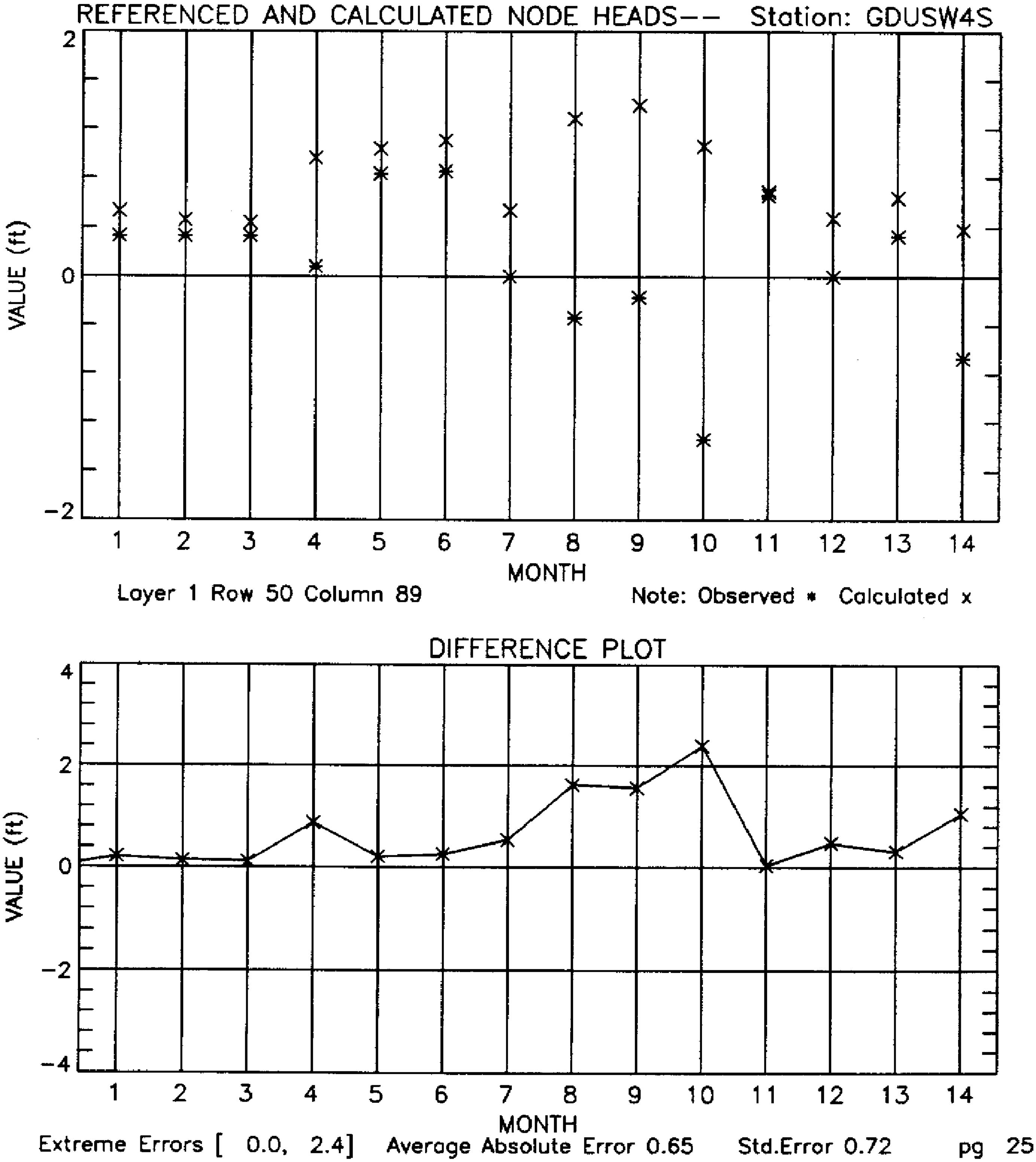

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.1, 1.5] Average Absolute Error 0.61 Std.Error 0.57 pg 23

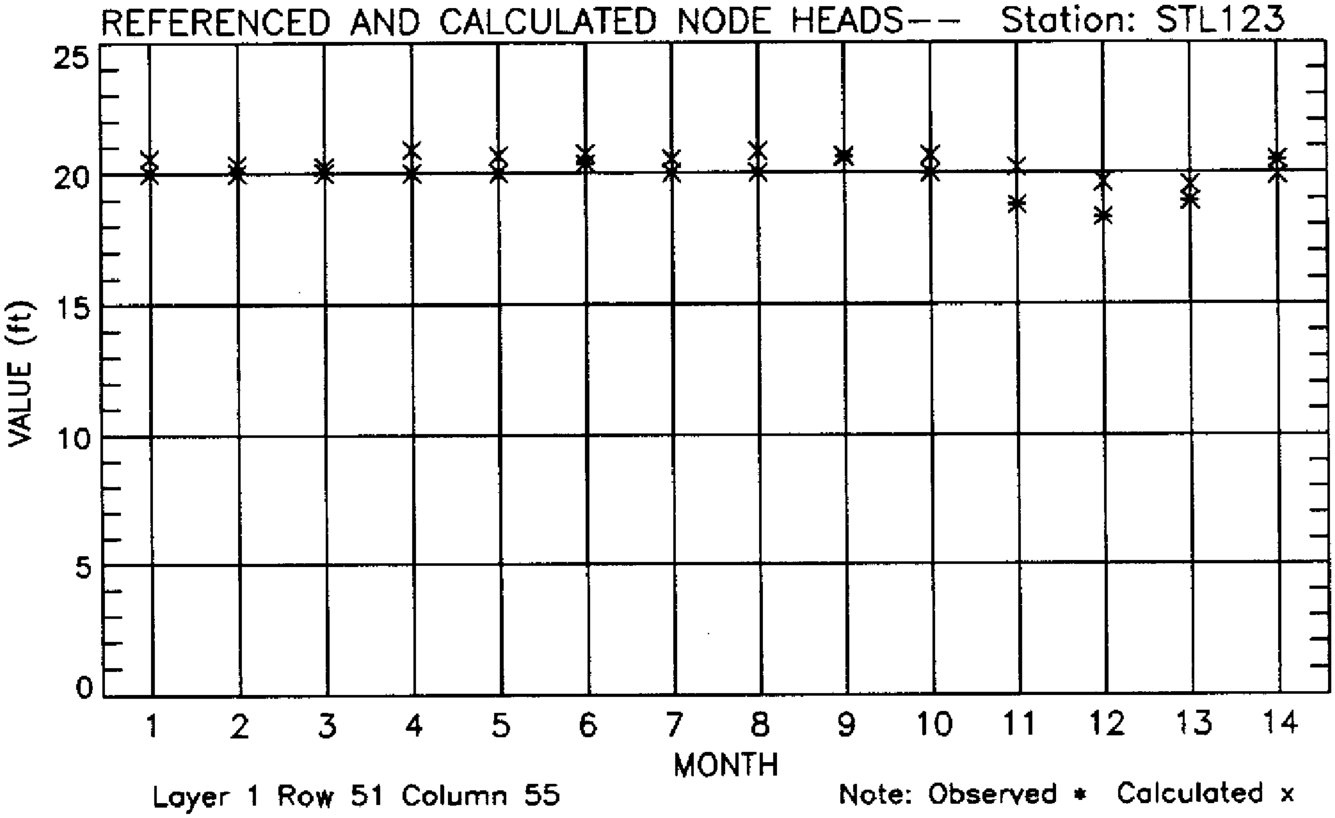


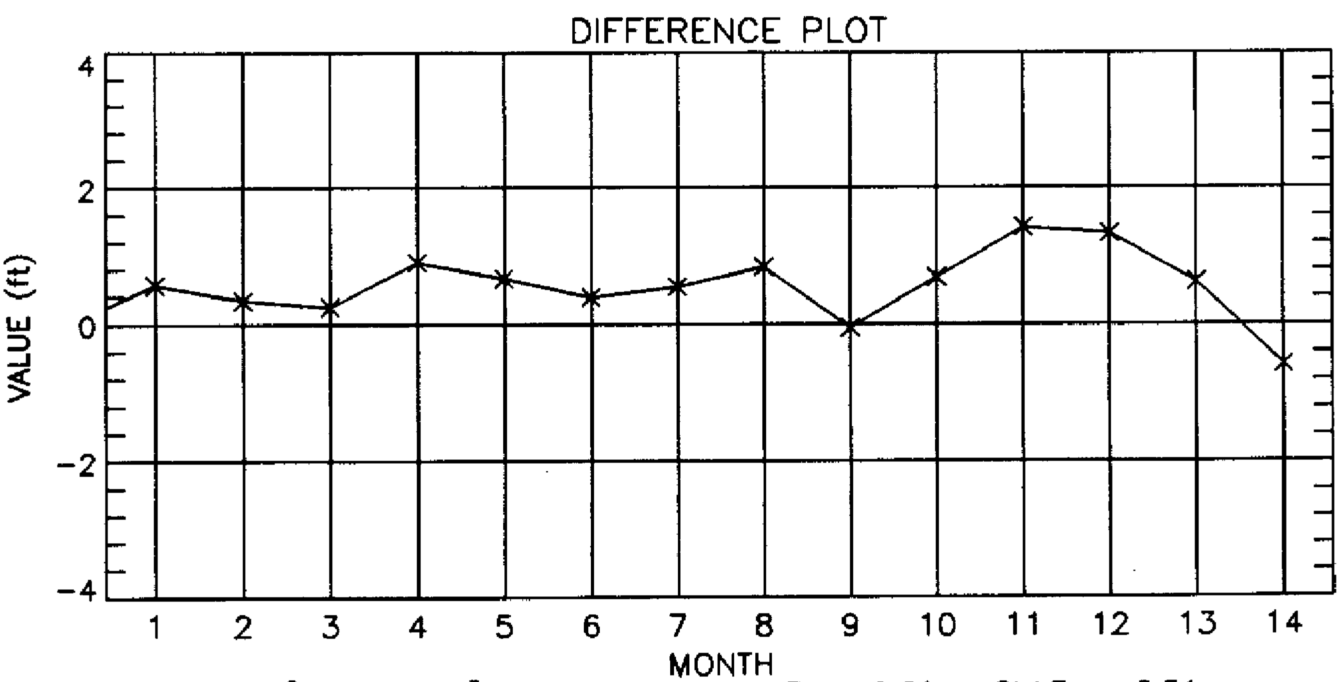
REFERENCED AND CALCULATED NODE HEADS-- Station: PG26
VALUE (ft)
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 45 Column 84
Note: Observed * Calculated x



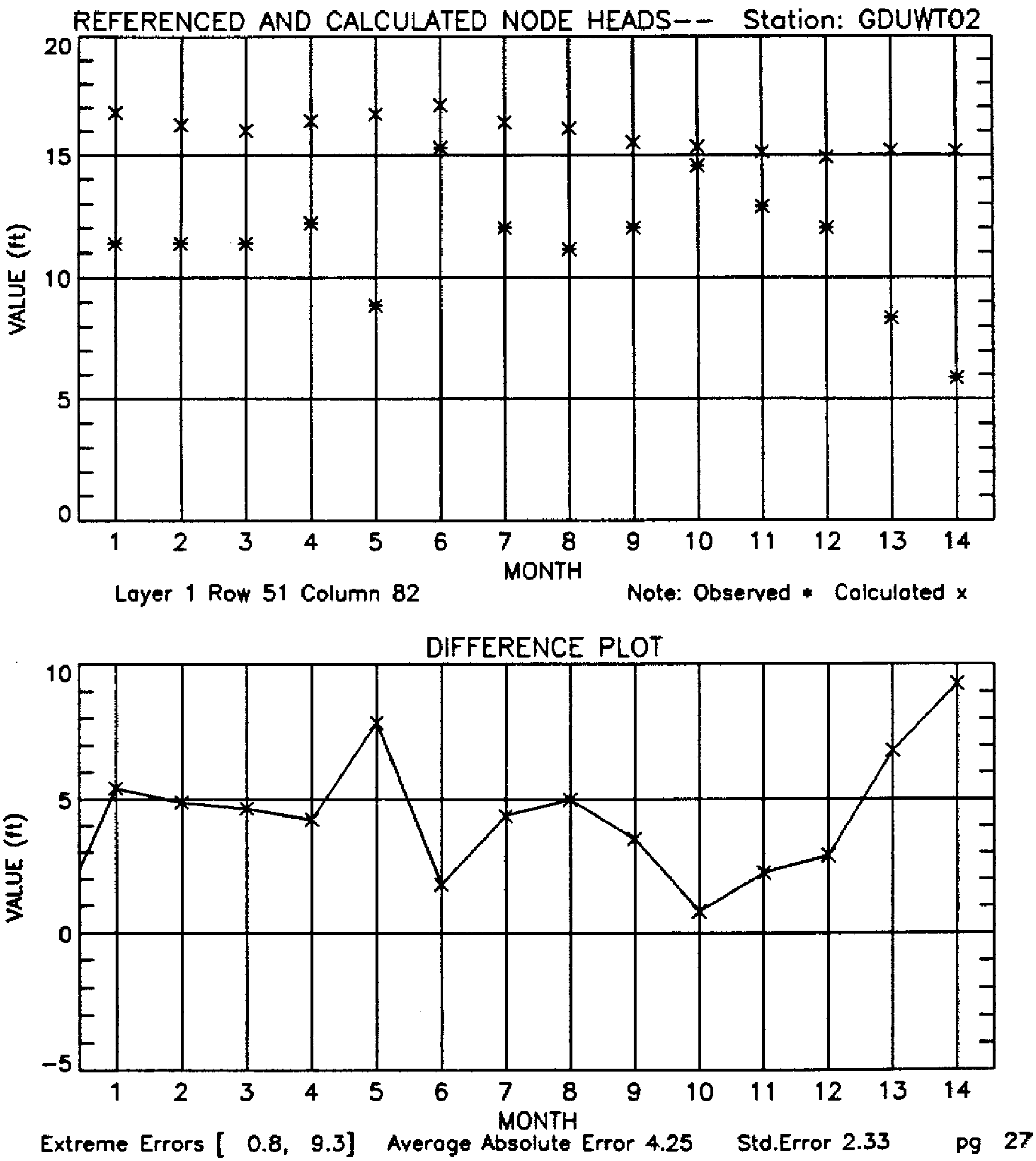
DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.3, 0.9] Average Absolute Error 0.45 Std.Error 0.55 pg 24

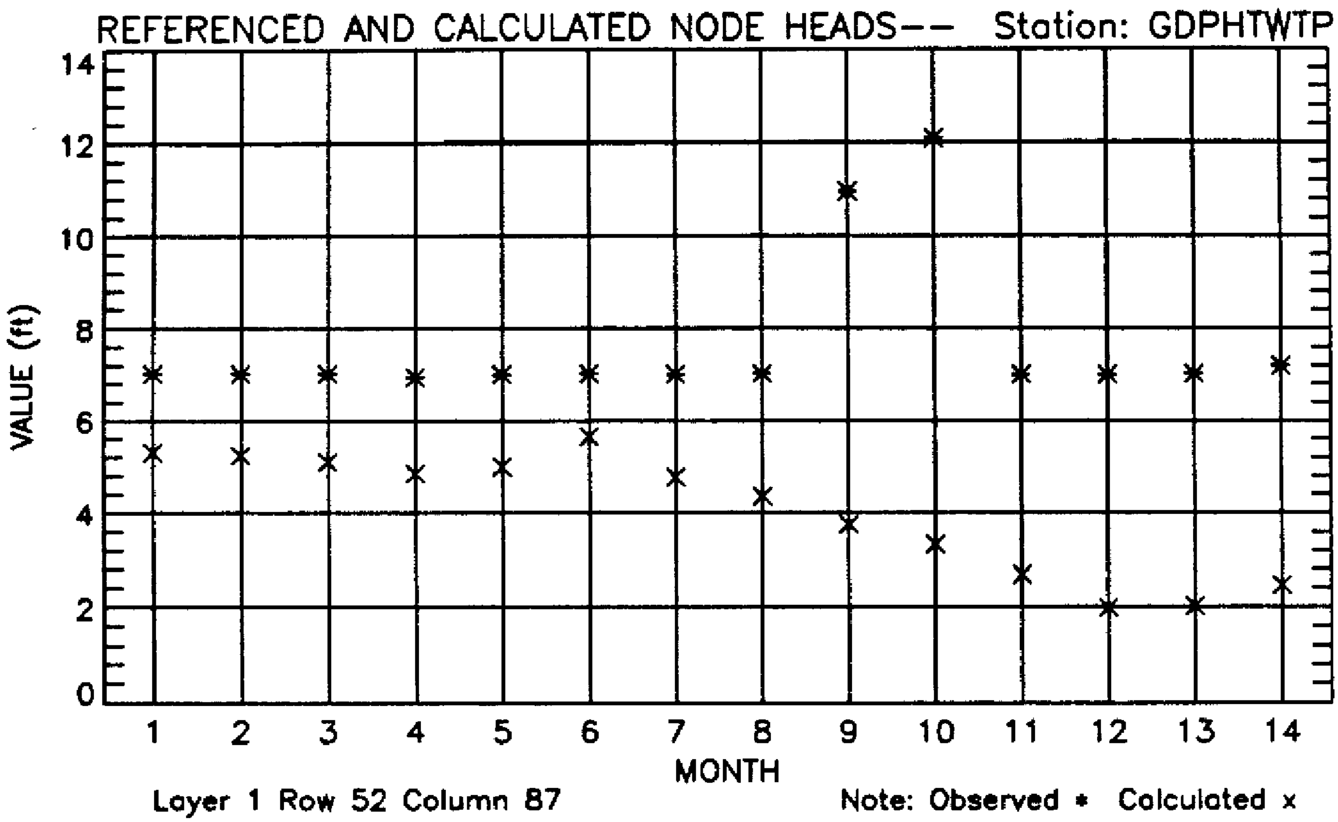

REFERENCED AND CALCULATED NODE HEADS-- Station: GDUSW4S
VALUE (ft)
2
0
-2
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 50 Column 89
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [0.0, 2.4] Average Absolute Error 0.65 Std.Error 0.72 pg 25

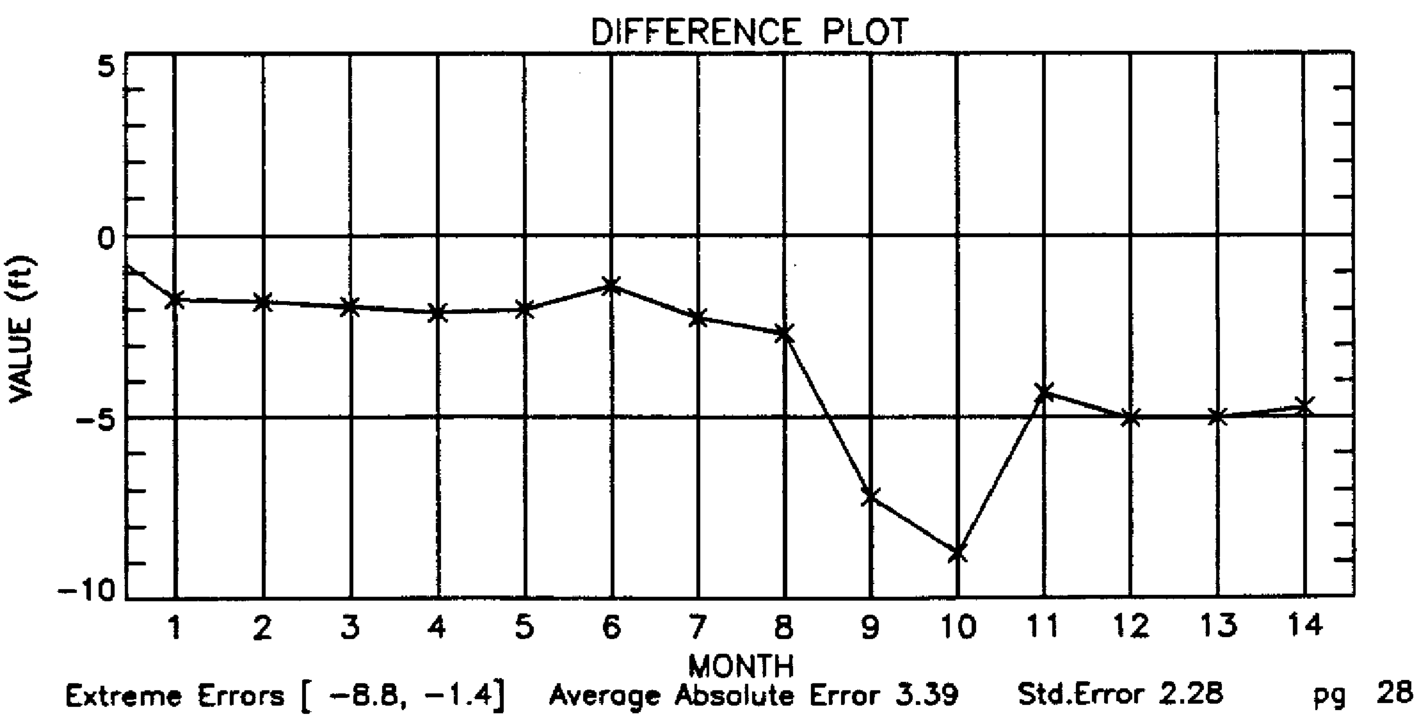


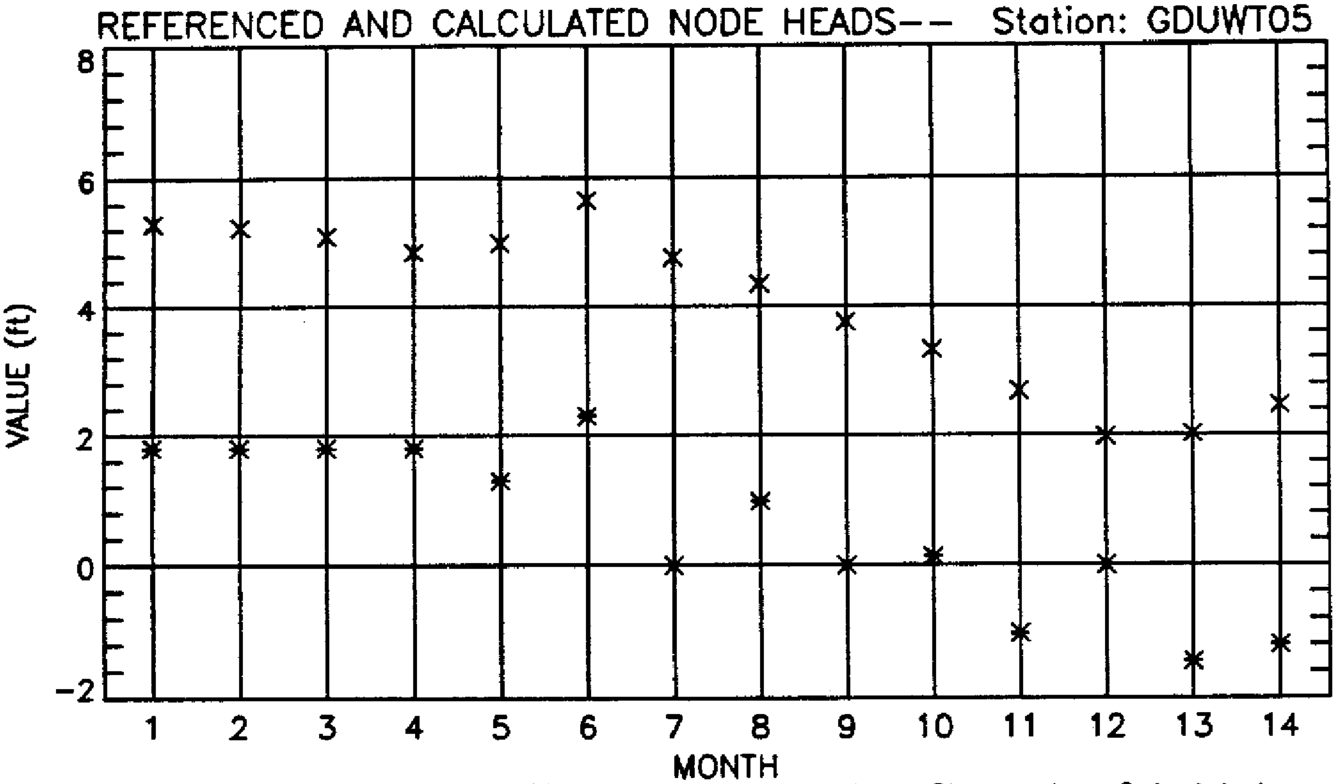


Extreme Errors [−0.6, 1.4] Average Absolute Error 0.61 Std.Error 0.51 pg 26

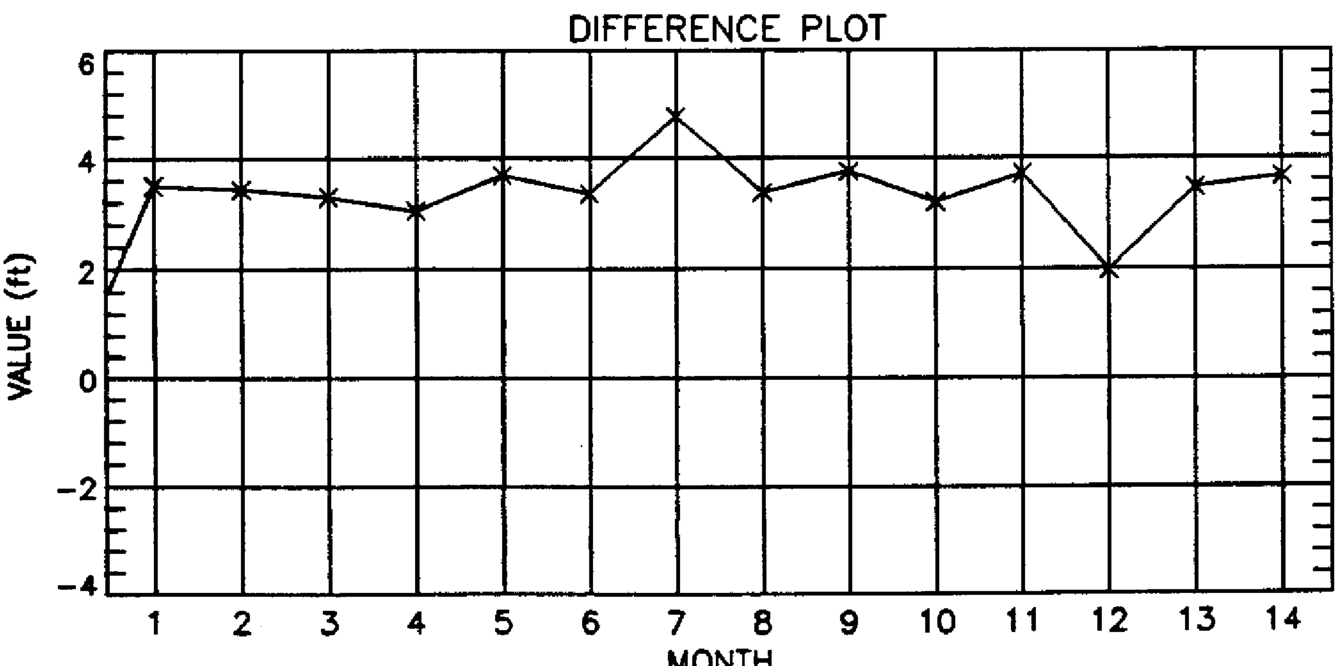

REFERENCED AND CALCULATED NODE HEADS-- Station: GDUWT02
VALUE (ft)
MONTH
Layer 1 Row 51 Column 82
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [0.8, 9.3] Average Absolute Error 4.25 Std.Error 2.33
pg 27


REFERENCED AND CALCULATED NODE HEADS-- Station: GDPHTWTP
VALUE (ft)
MONTH
Layer 1 Row 52 Column 87
Note: Observed * Calculated x

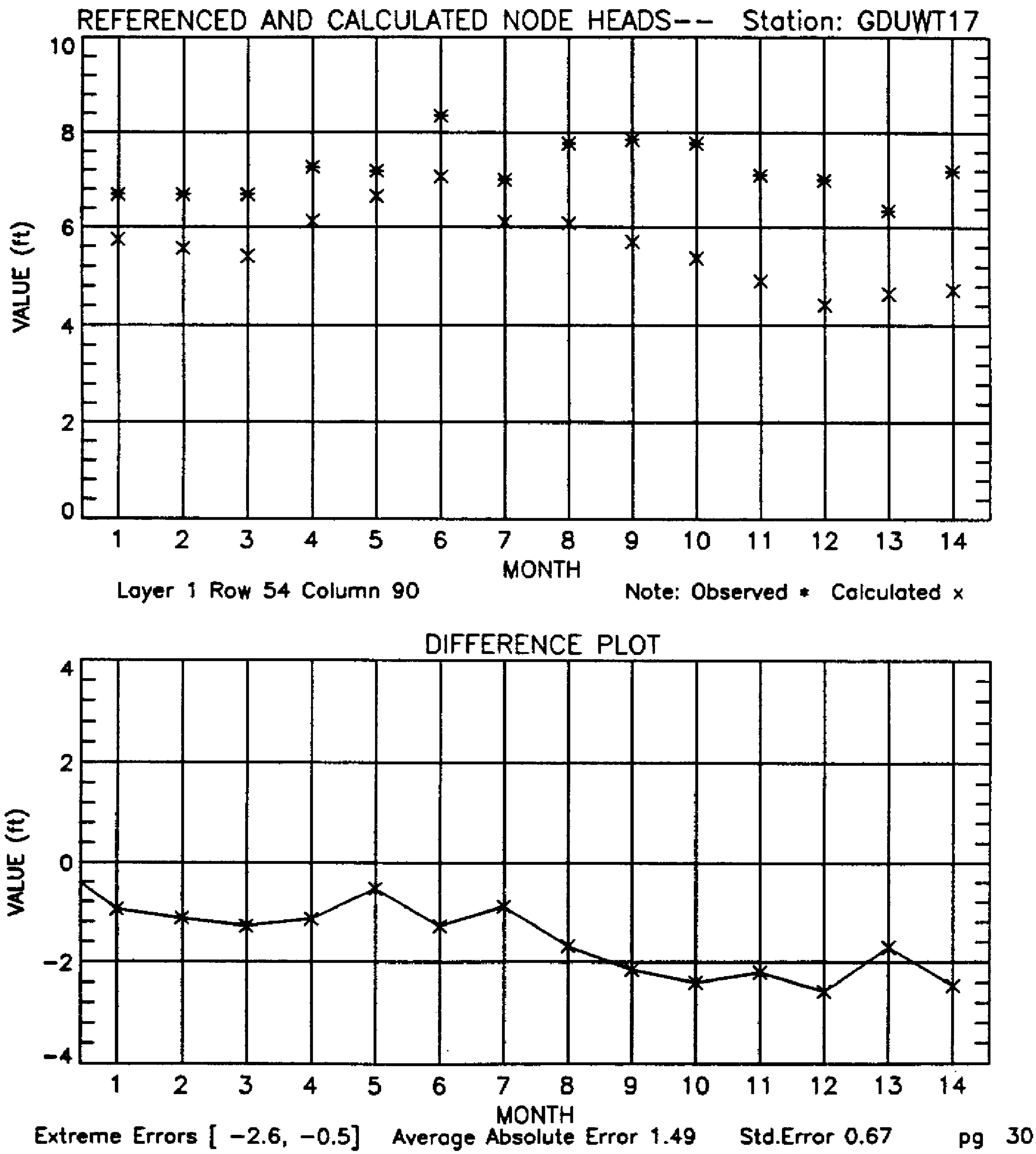

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-8.8, -1.4] Average Absolute Error 3.39 Std.Error 2.28 pg 28

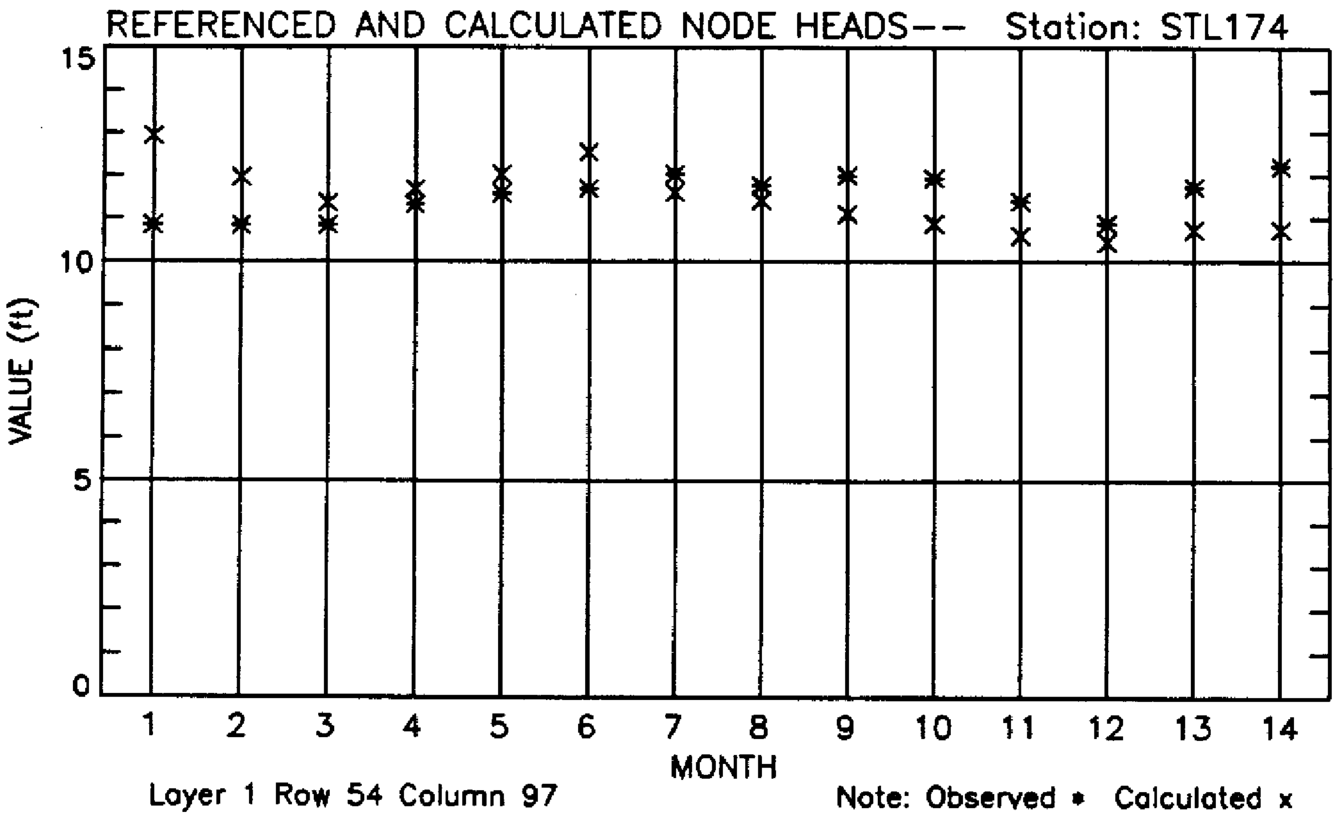


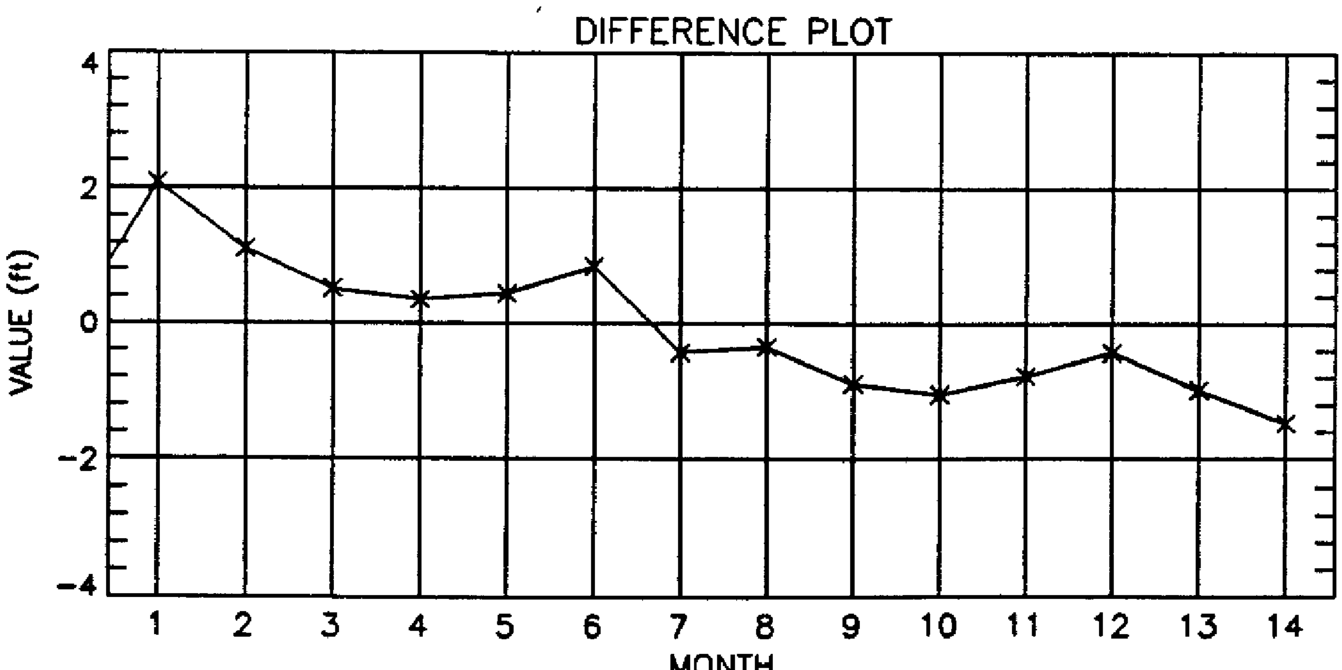
Layer 1 Row 52 Column 87 Note: Observed * Calculated x



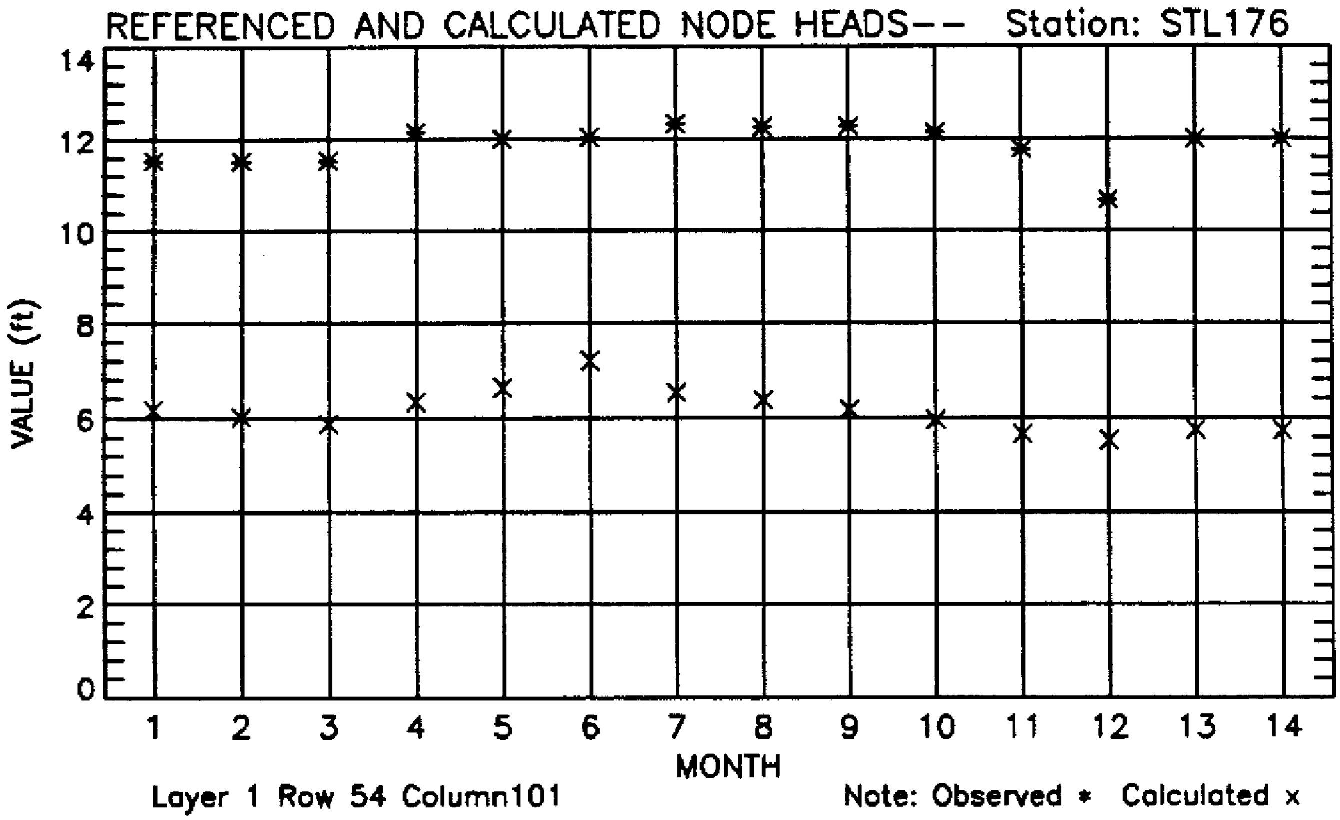
Extreme Errors [2.0, 4.8] Average Absolute Error 3.22 Std.Error 0.58 pg 29

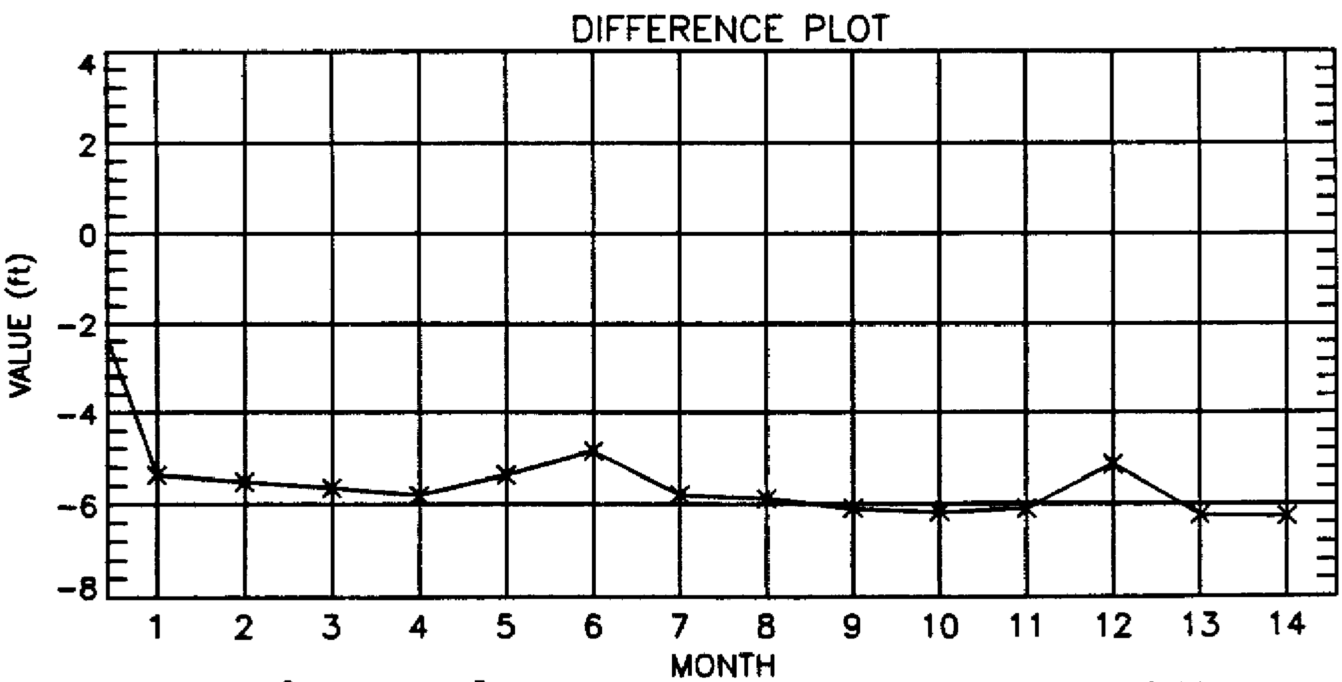

REFERENCED AND CALCULATED NODE HEADS-- Station: GDUWT17
VALUE (ft)
MONTH
Layer 1 Row 54 Column 90
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-2.6, -0.5] Average Absolute Error 1.49 Std.Error 0.67 pg 30



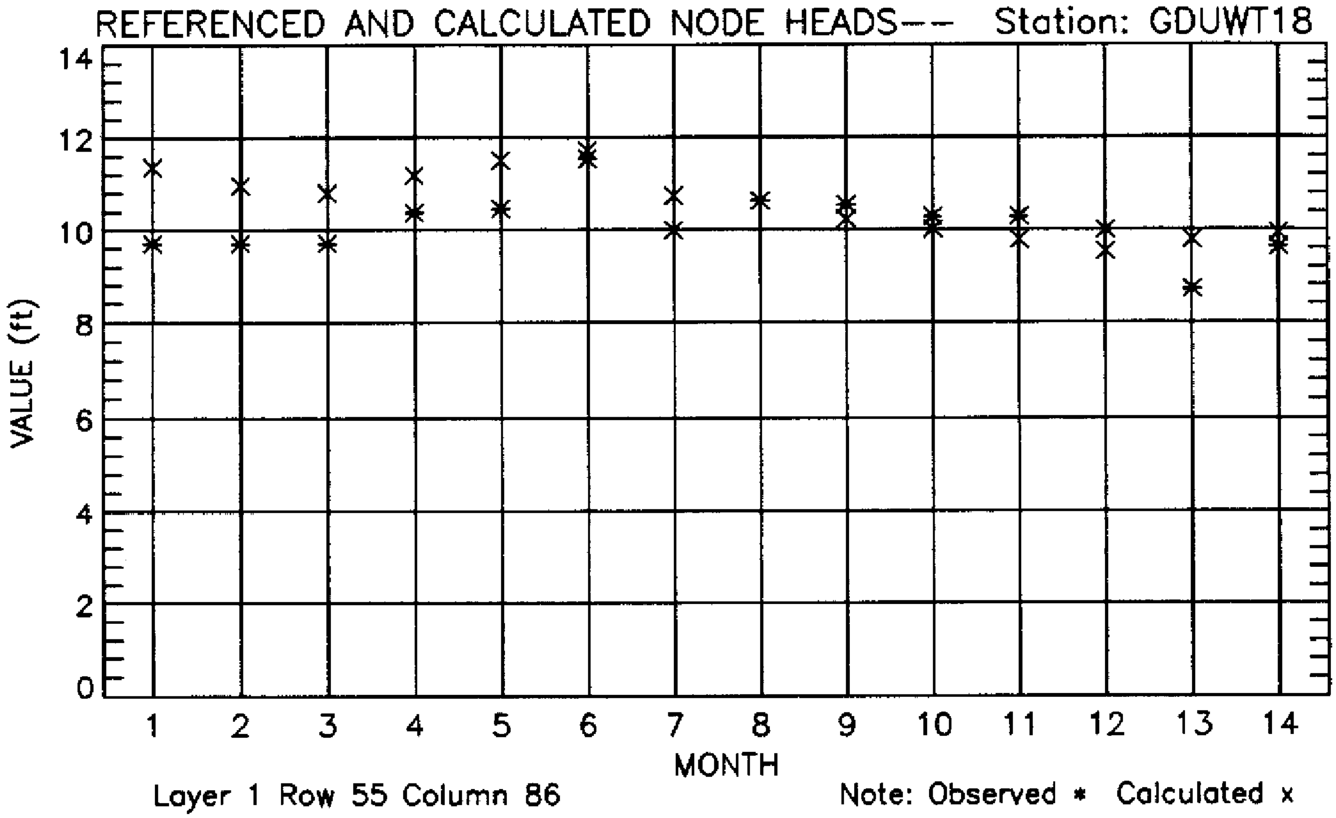


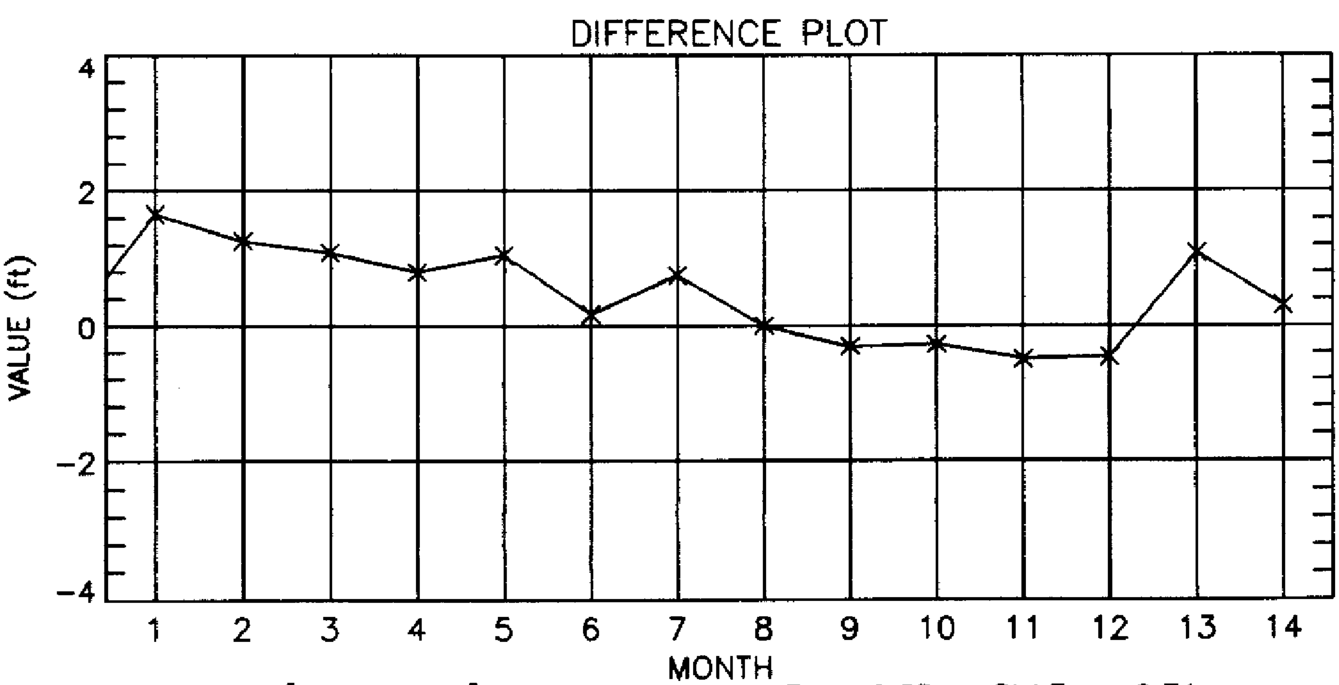
Extreme Errors [-1.5, 2.1] Average Absolute Error 0.78 Std.Error 1.00 pg 31



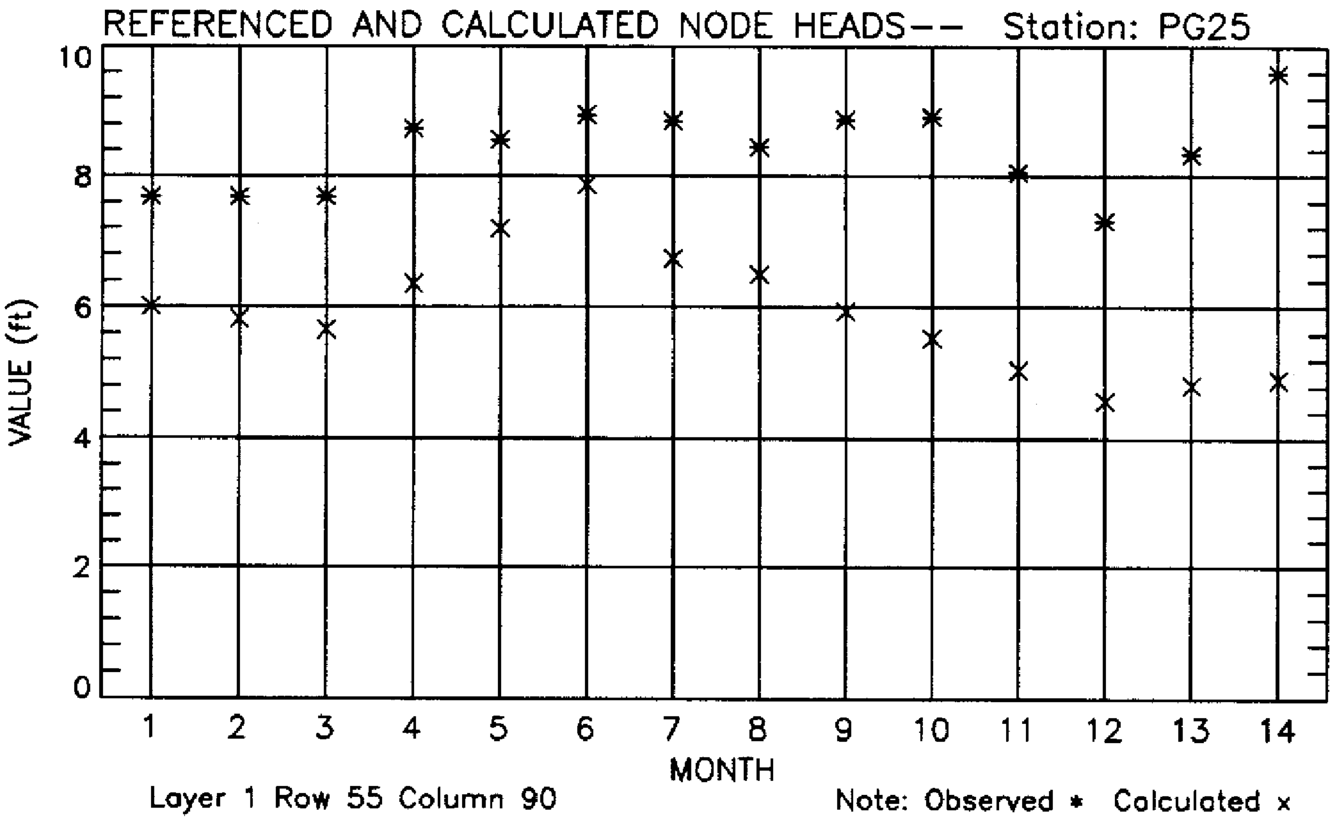


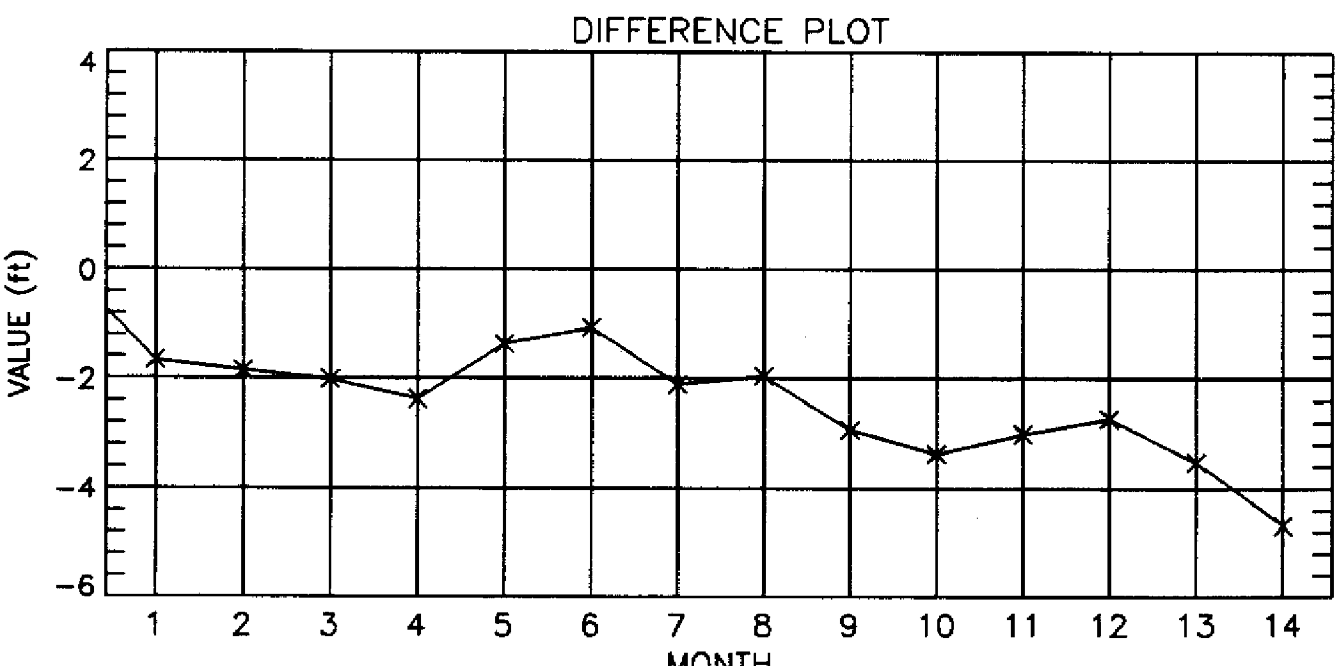
Extreme Errors [-6.3, -4.8] Average Absolute Error 5.35 Std.Error 0.44 pg 32



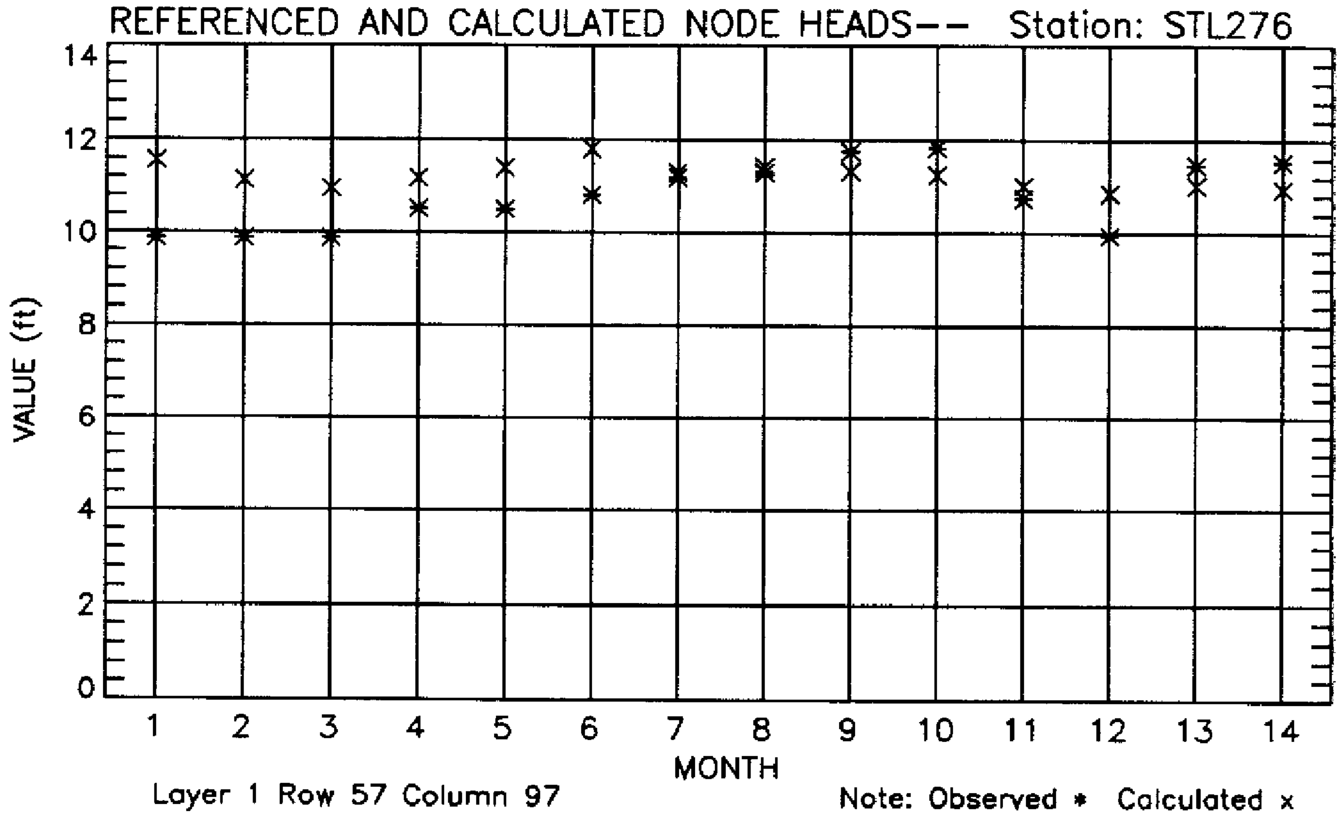


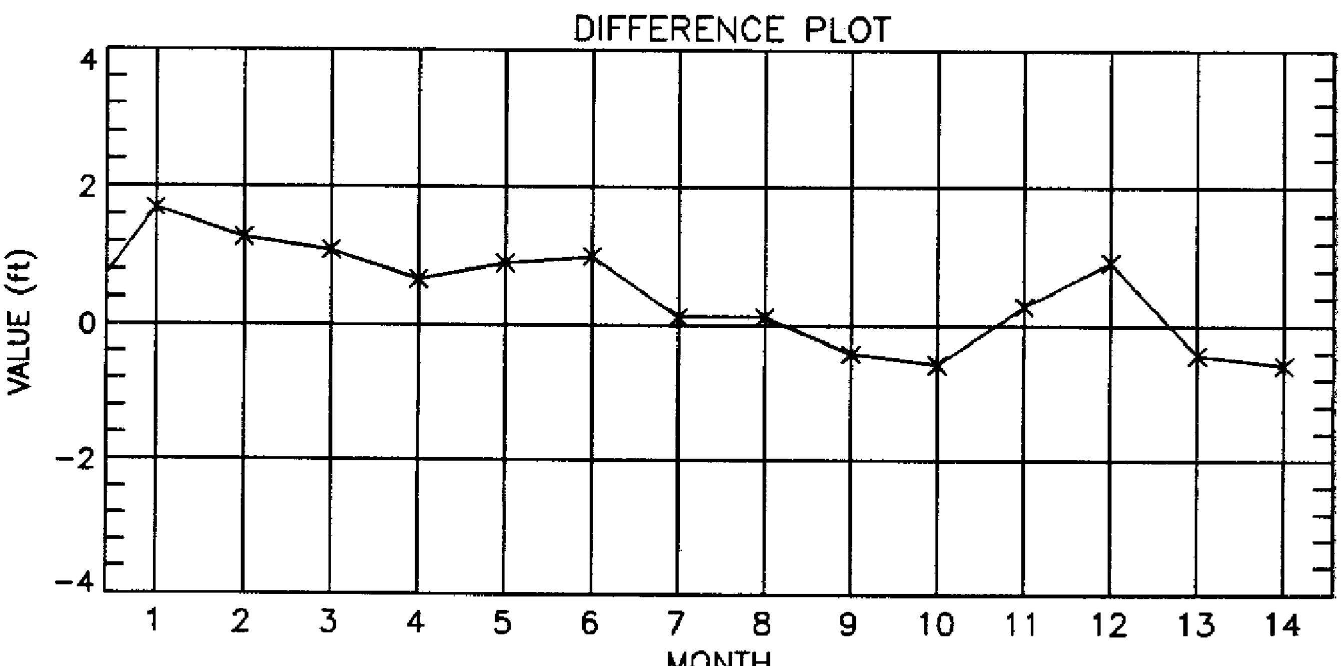
Extreme Errors [−0.5, 1.7] Average Absolute Error 0.65 Std.Error 0.71 pg 33



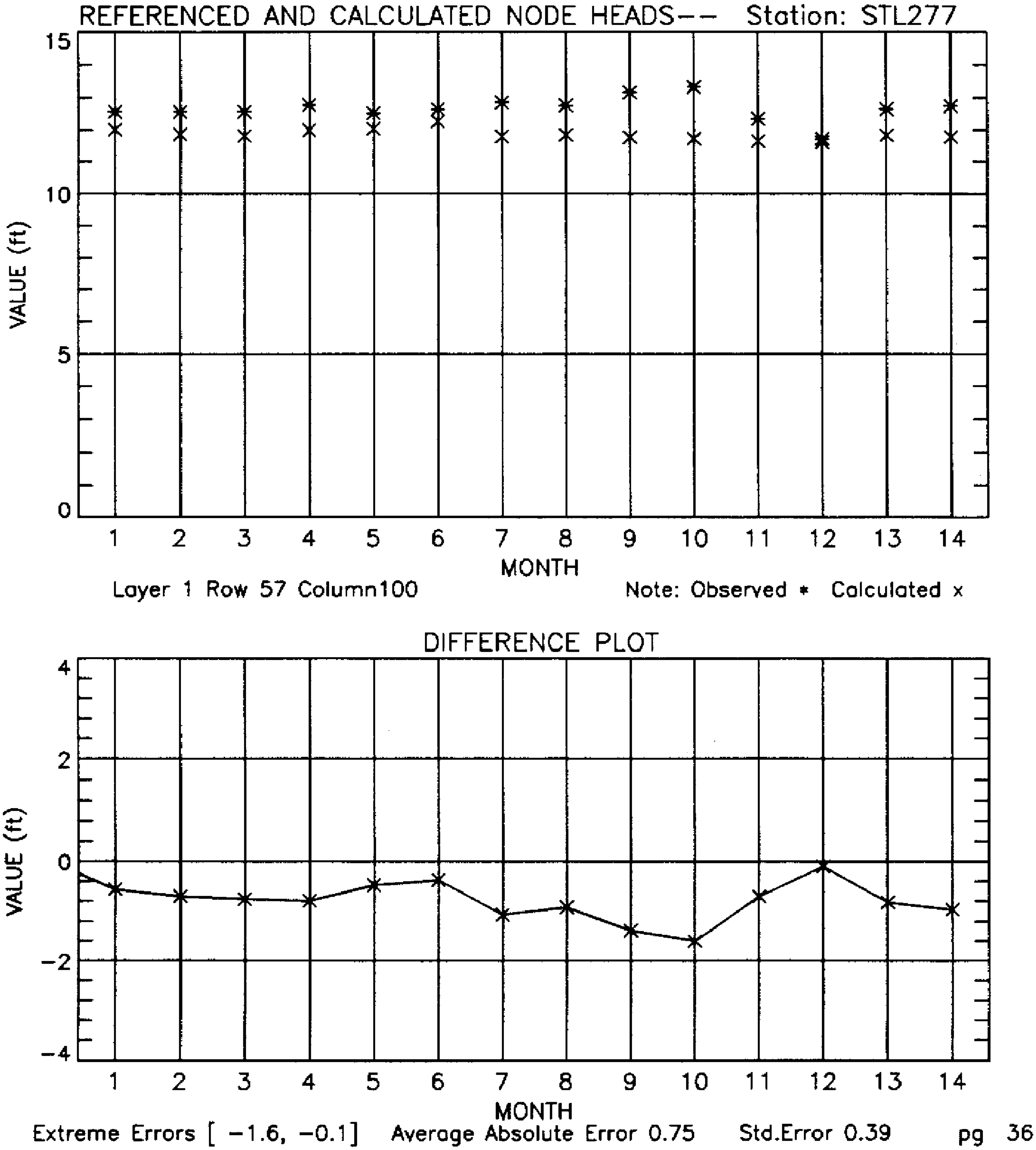


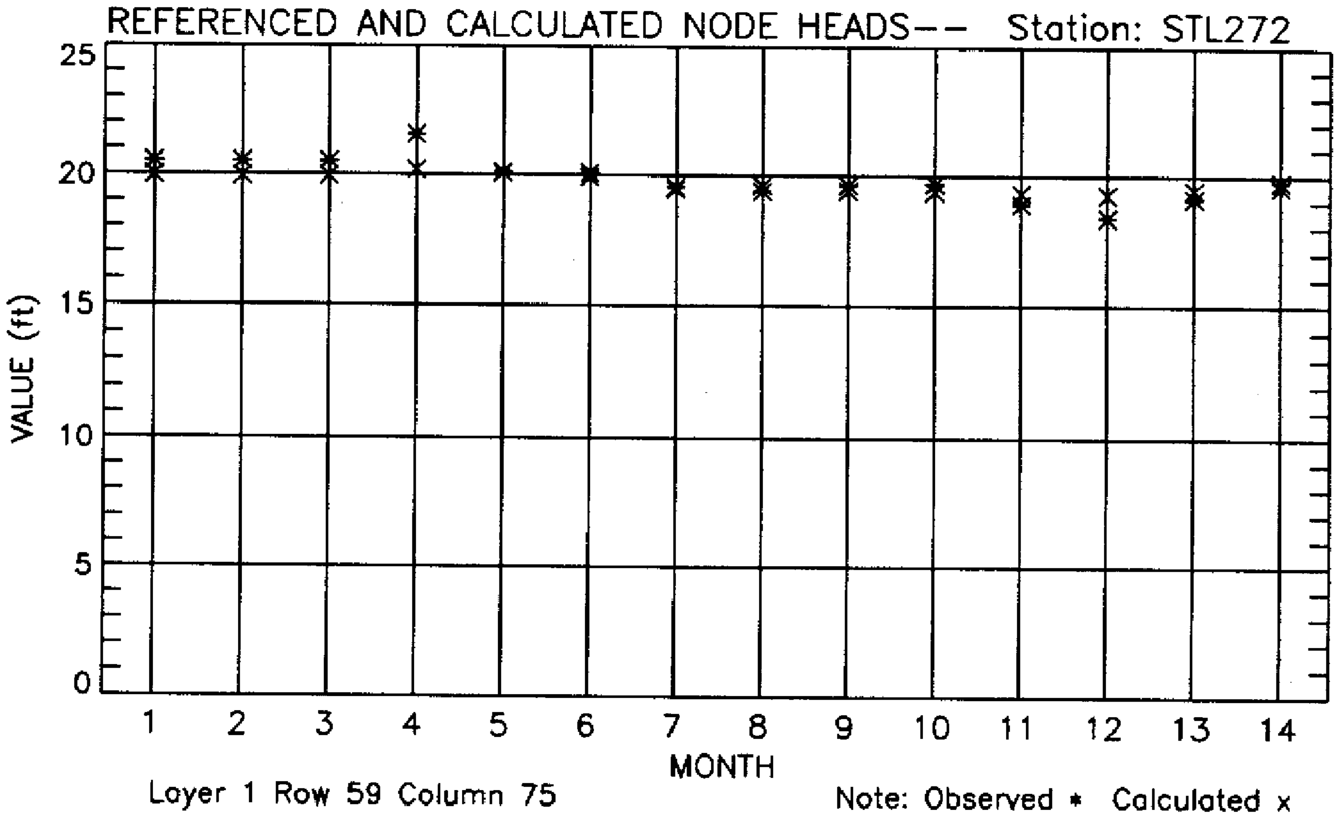
Extreme Errors [-4.7, -1.1] Average Absolute Error 2.31 Std.Error 0.97 pg 34

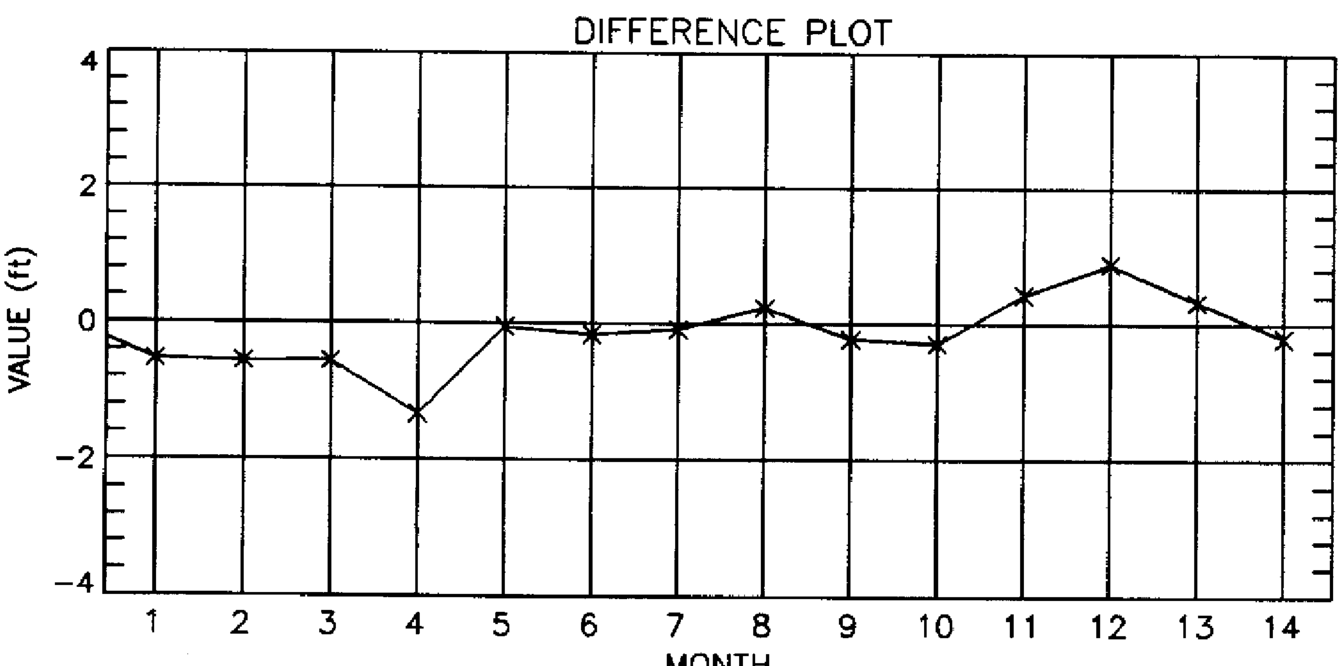




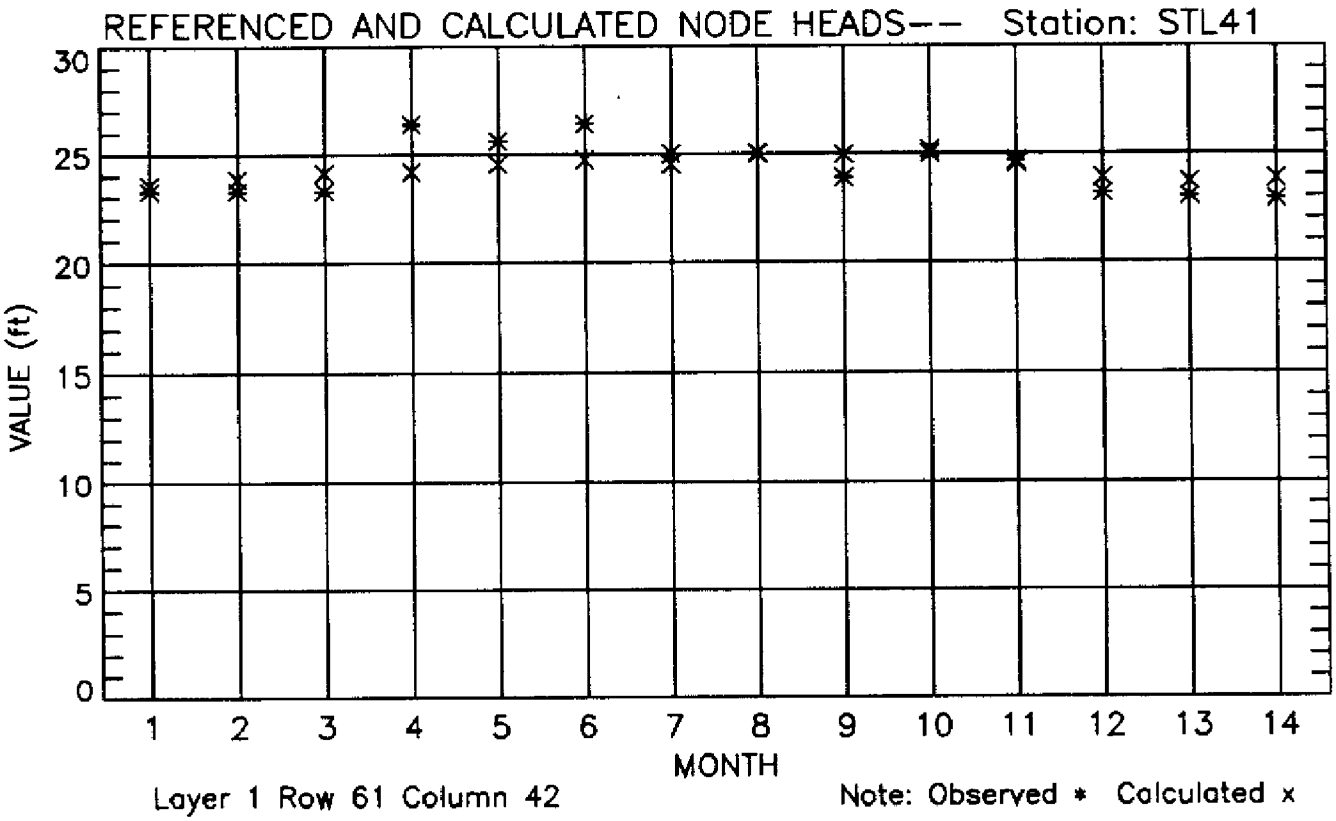
Extreme Errors [-0.6, 1.7] Average Absolute Error 0.67 Std.Error 0.75 pg 35

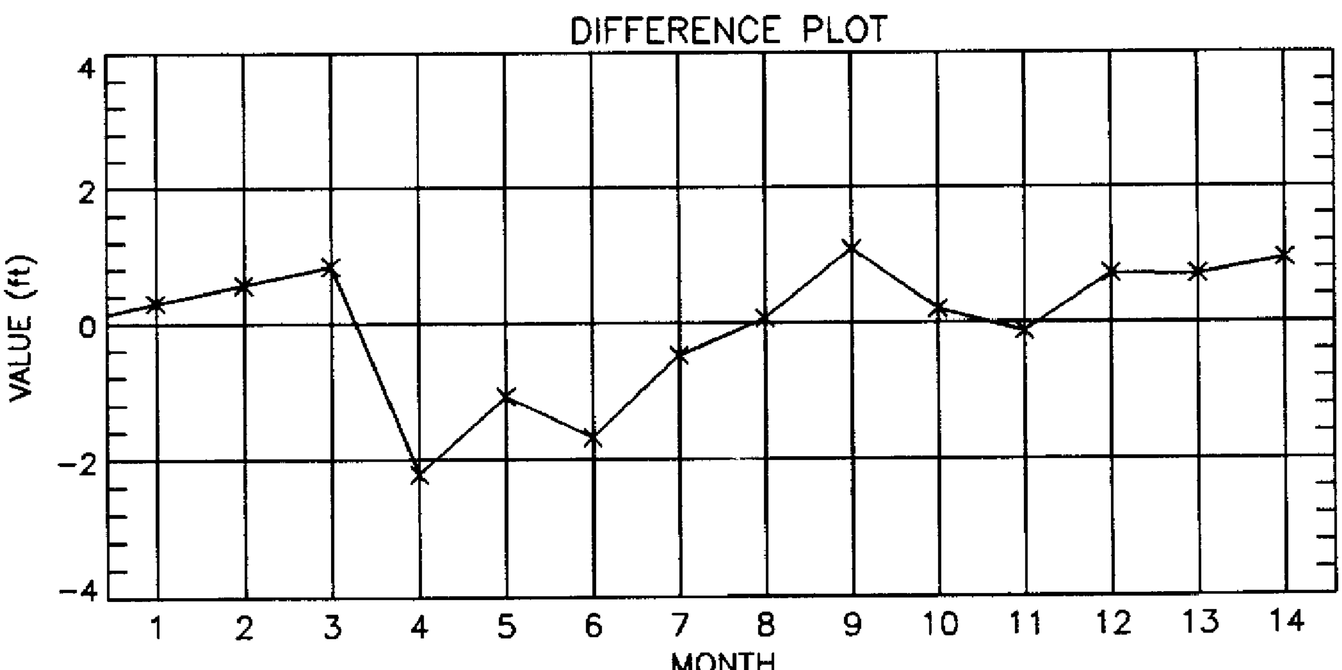

REFERENCED AND CALCULATED NODE HEADS-- Station: STL277
VALUE (ft)
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 57 Column100
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.6, -0.1] Average Absolute Error 0.75 Std.Error 0.39 pg 36



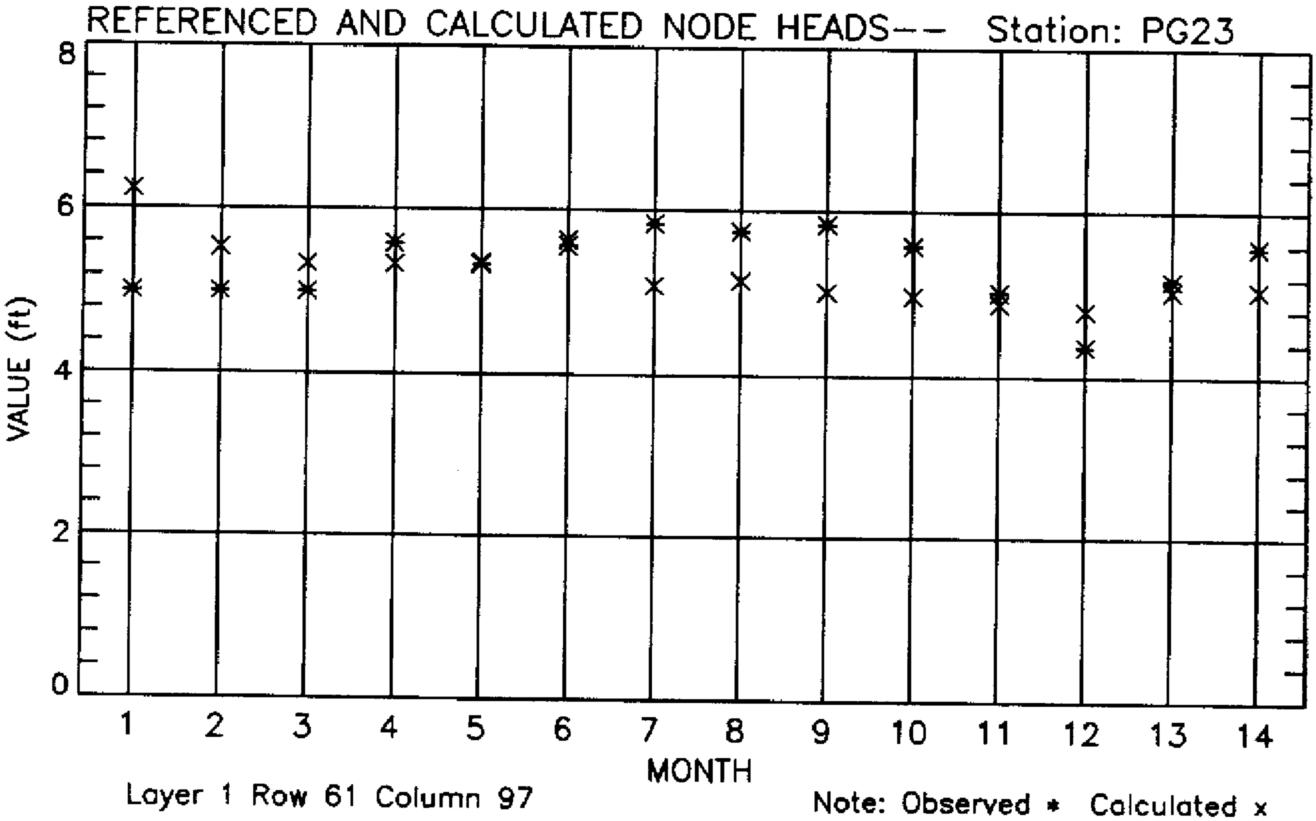


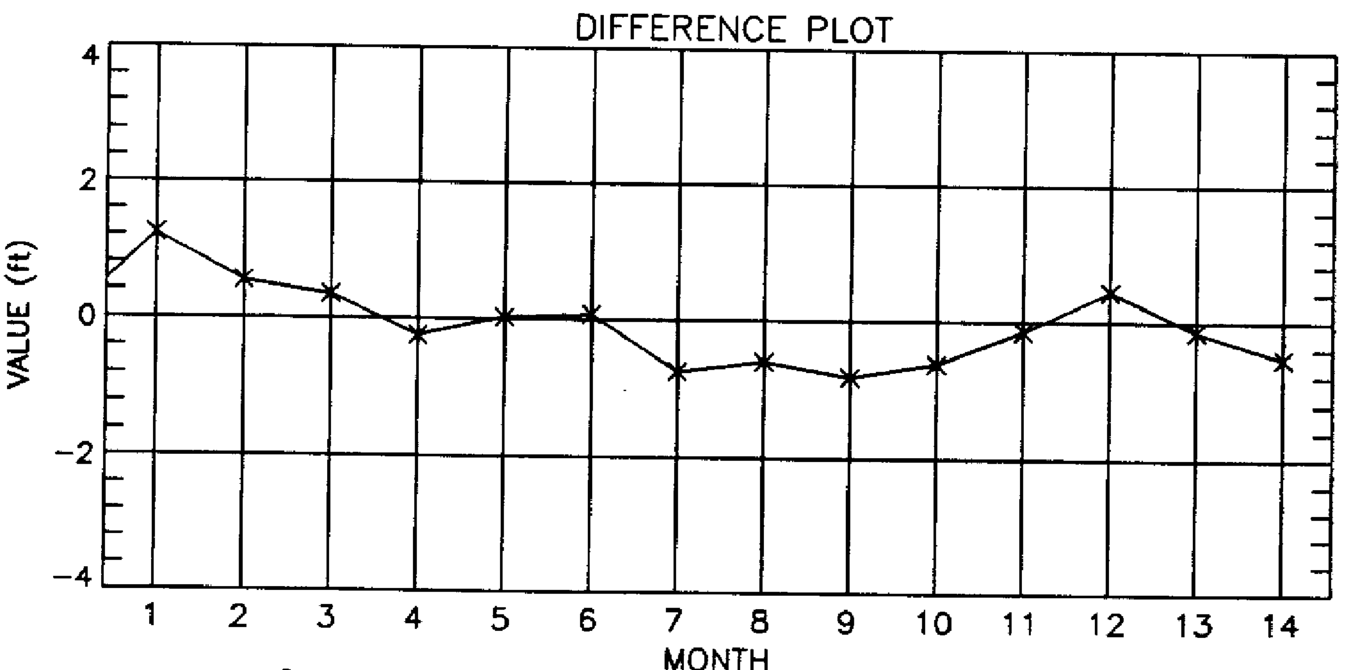
Extreme Errors [−1.3, 0.9] Average Absolute Error 0.39 Std.Error 0.54 pg 37



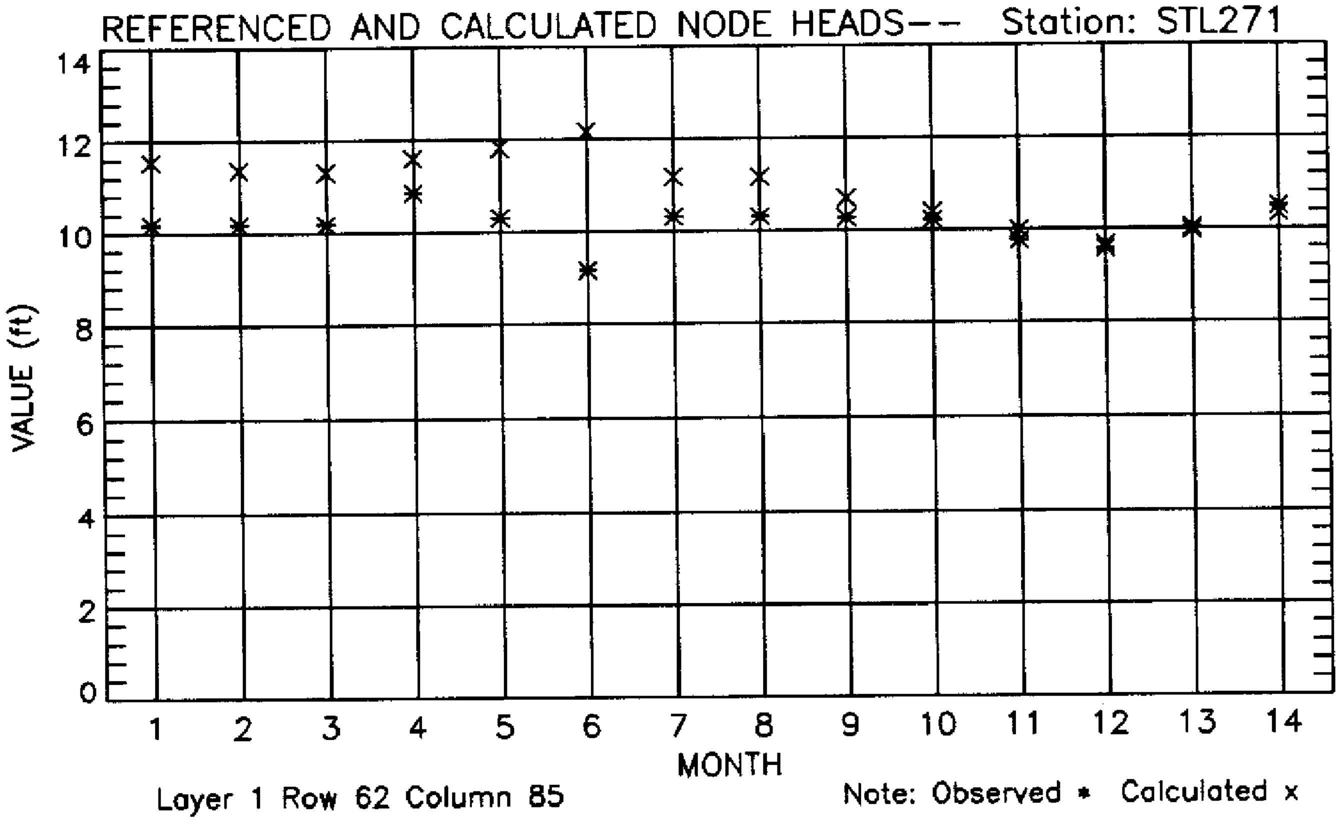


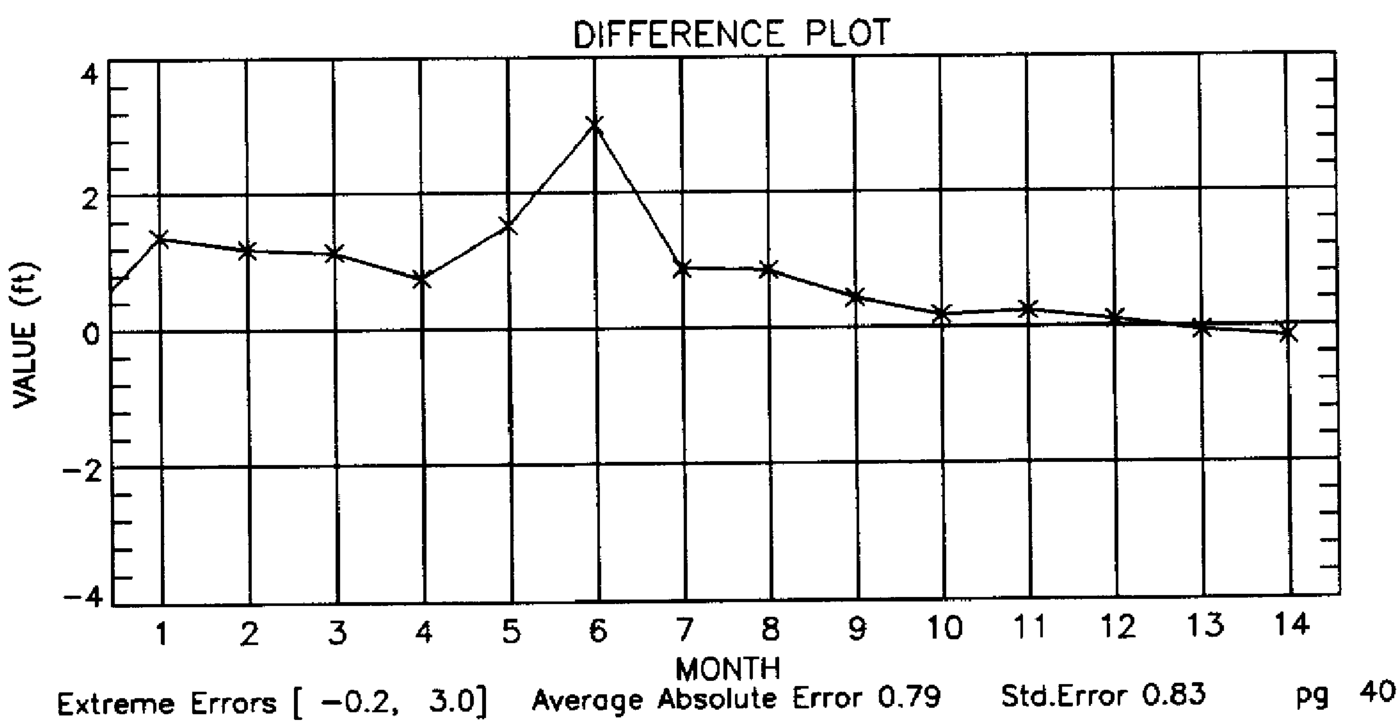
Extreme Errors [-2.2, 1.1] Average Absolute Error 0.73 Std.Error 1.02 pg 38

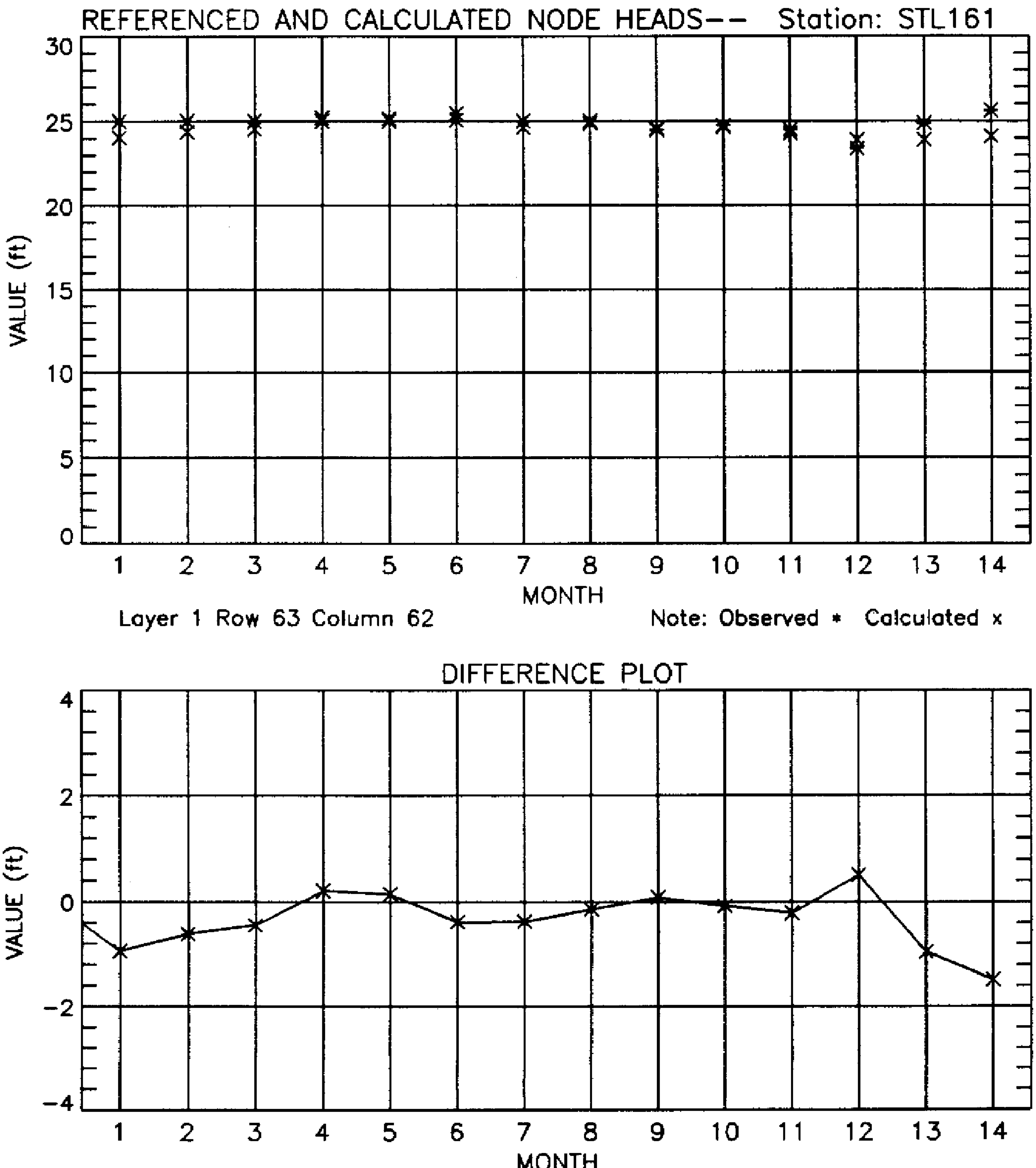




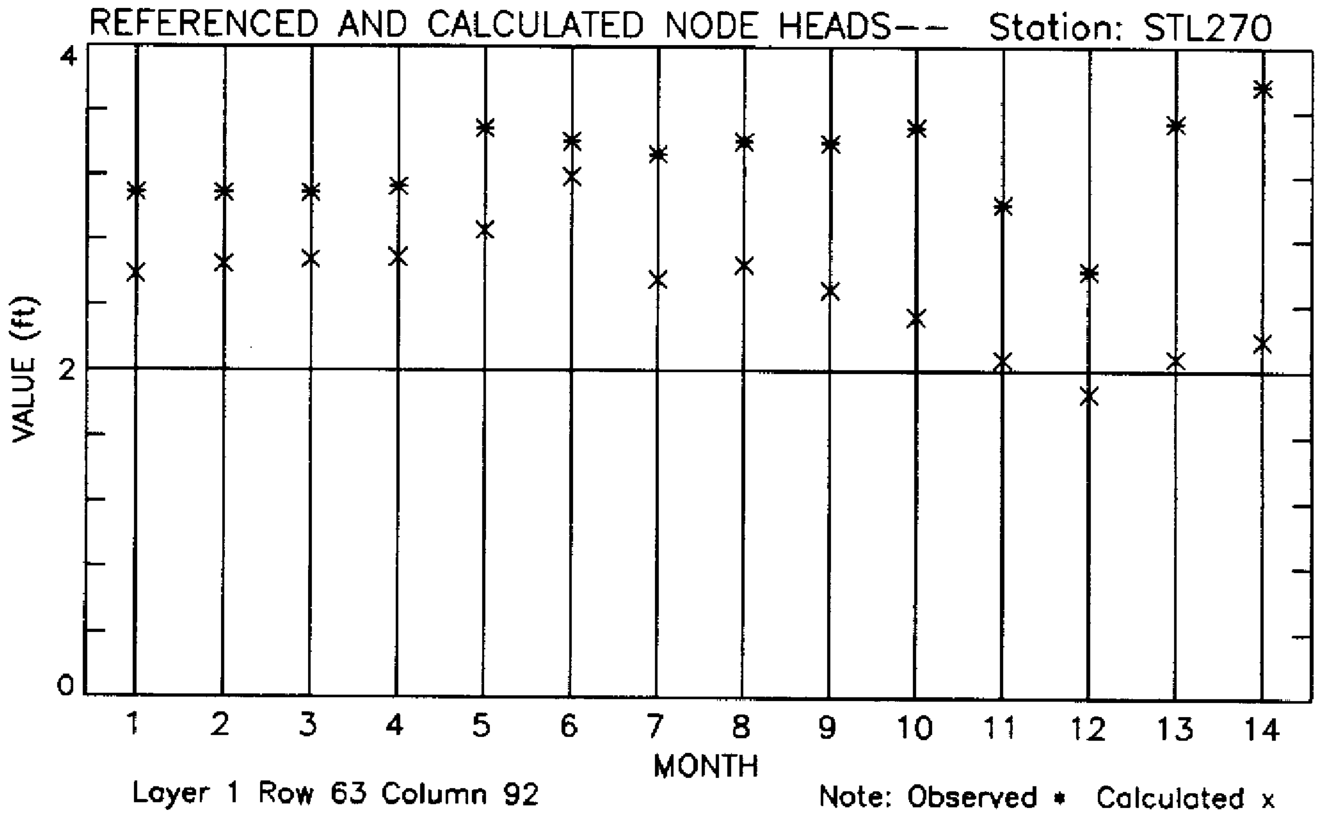
Extreme Errors [-0.8, 1.2] Average Absolute Error 0.43 Std.Error 0.58 pg 39

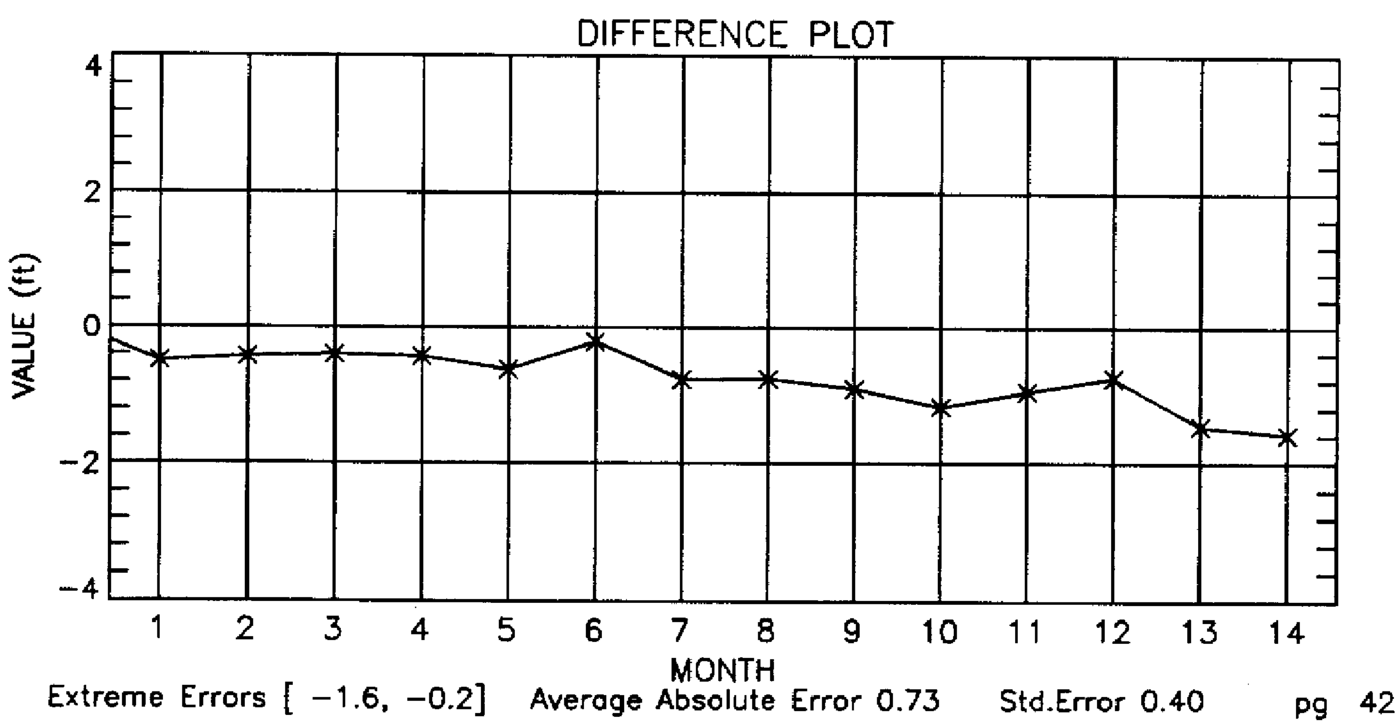

REFERENCED AND CALCULATED NODE HEADS-- Station: STL271
VALUE (ft)
MONTH
Layer 1 Row 62 Column 85
Note: Observed * Calculated x

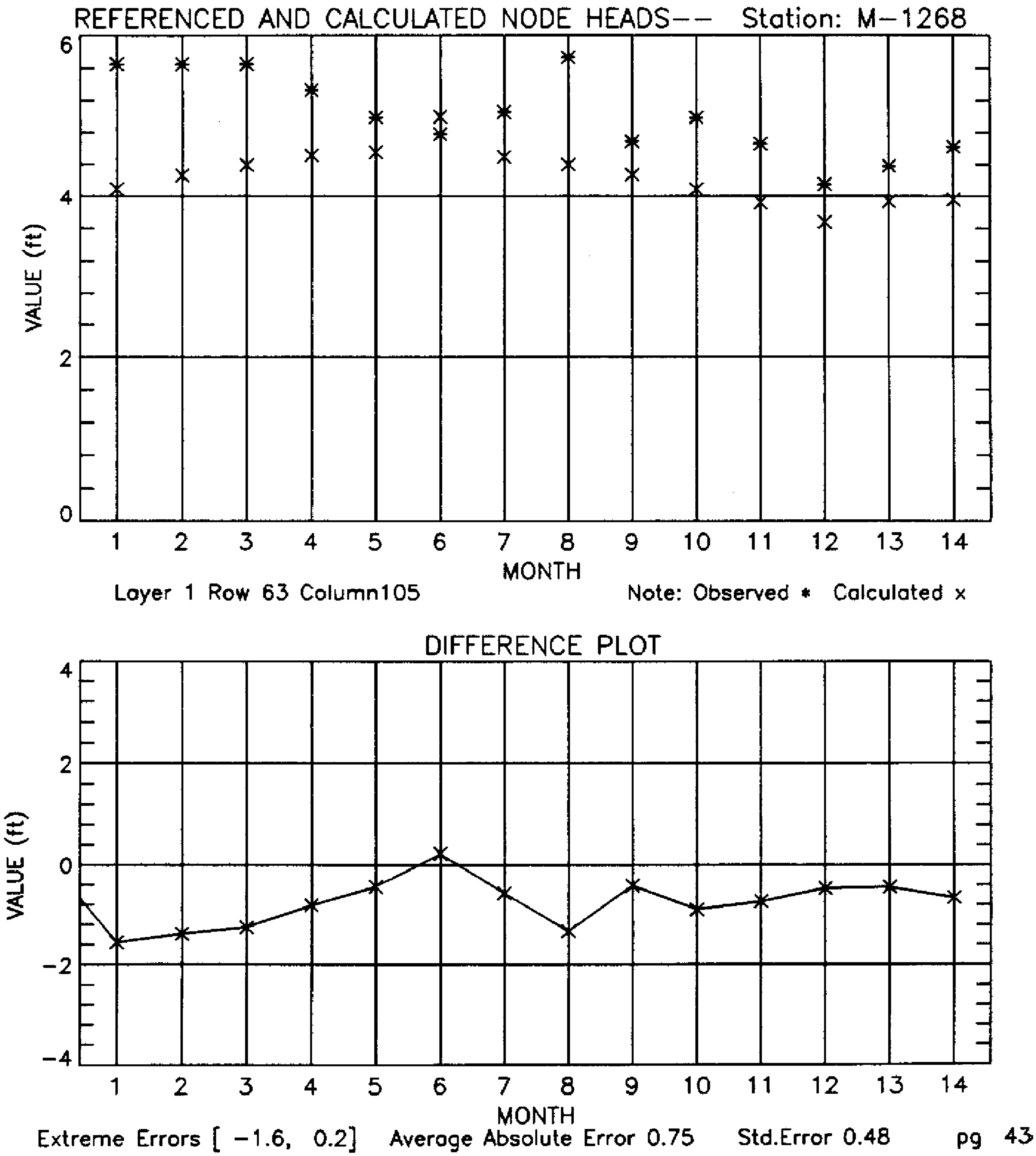

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.2, 3.0] Average Absolute Error 0.79 Std.Error 0.83 pg 40

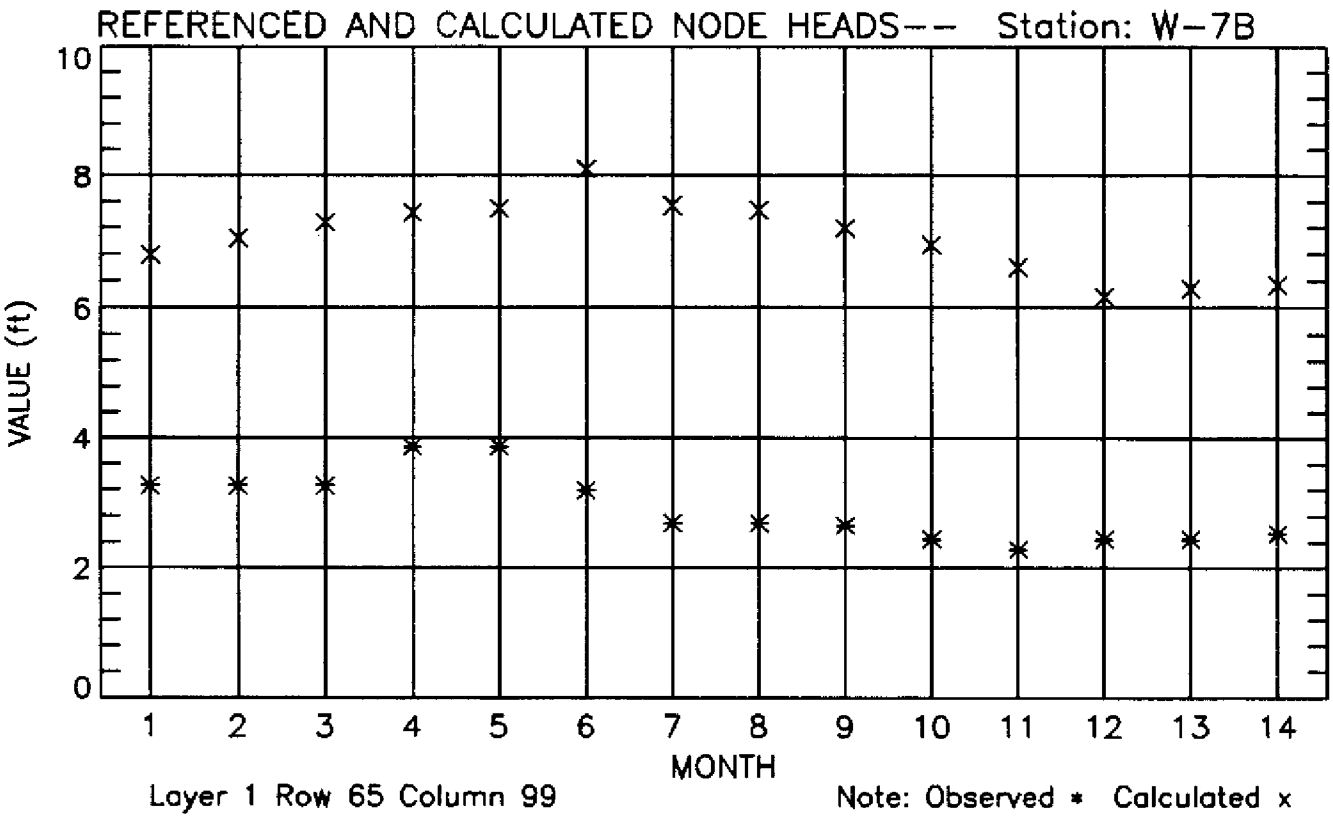


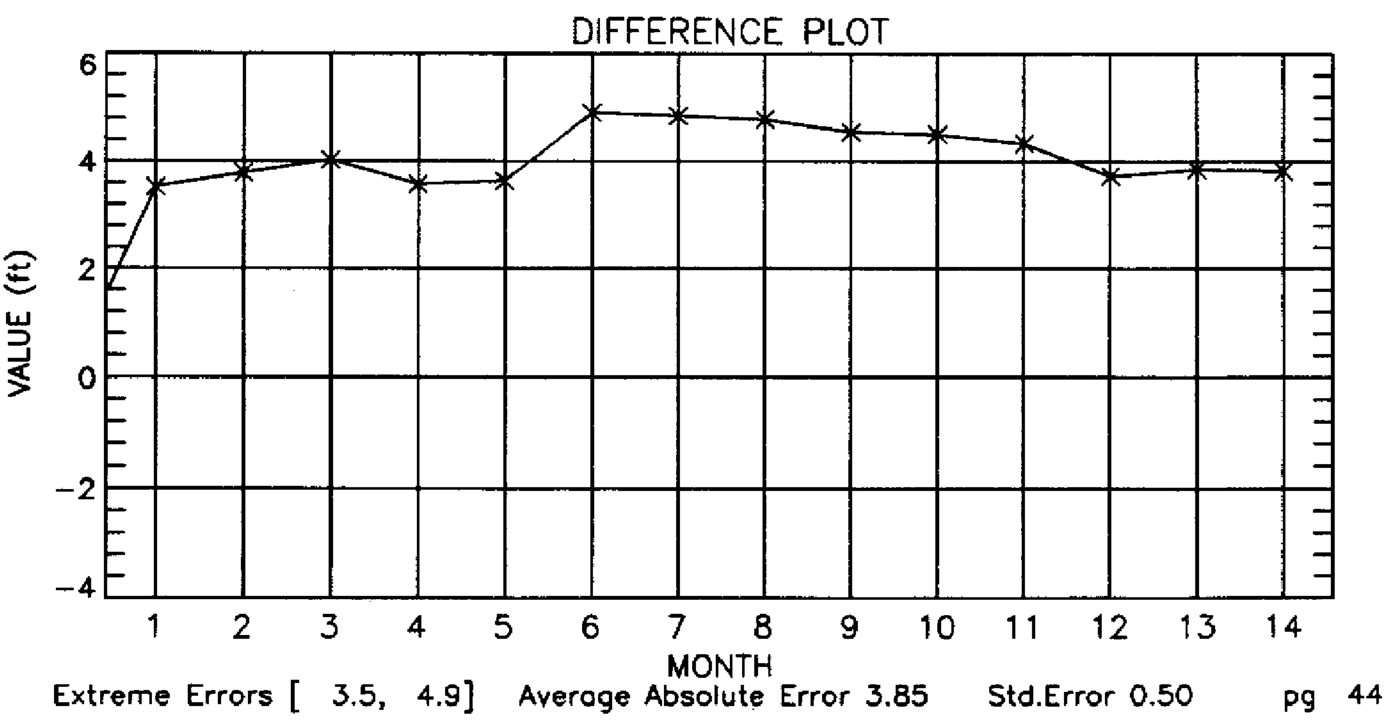
Extreme Errors [−1.5, 0.5] Average Absolute Error 0.44 Std.Error 0.53 pg 41

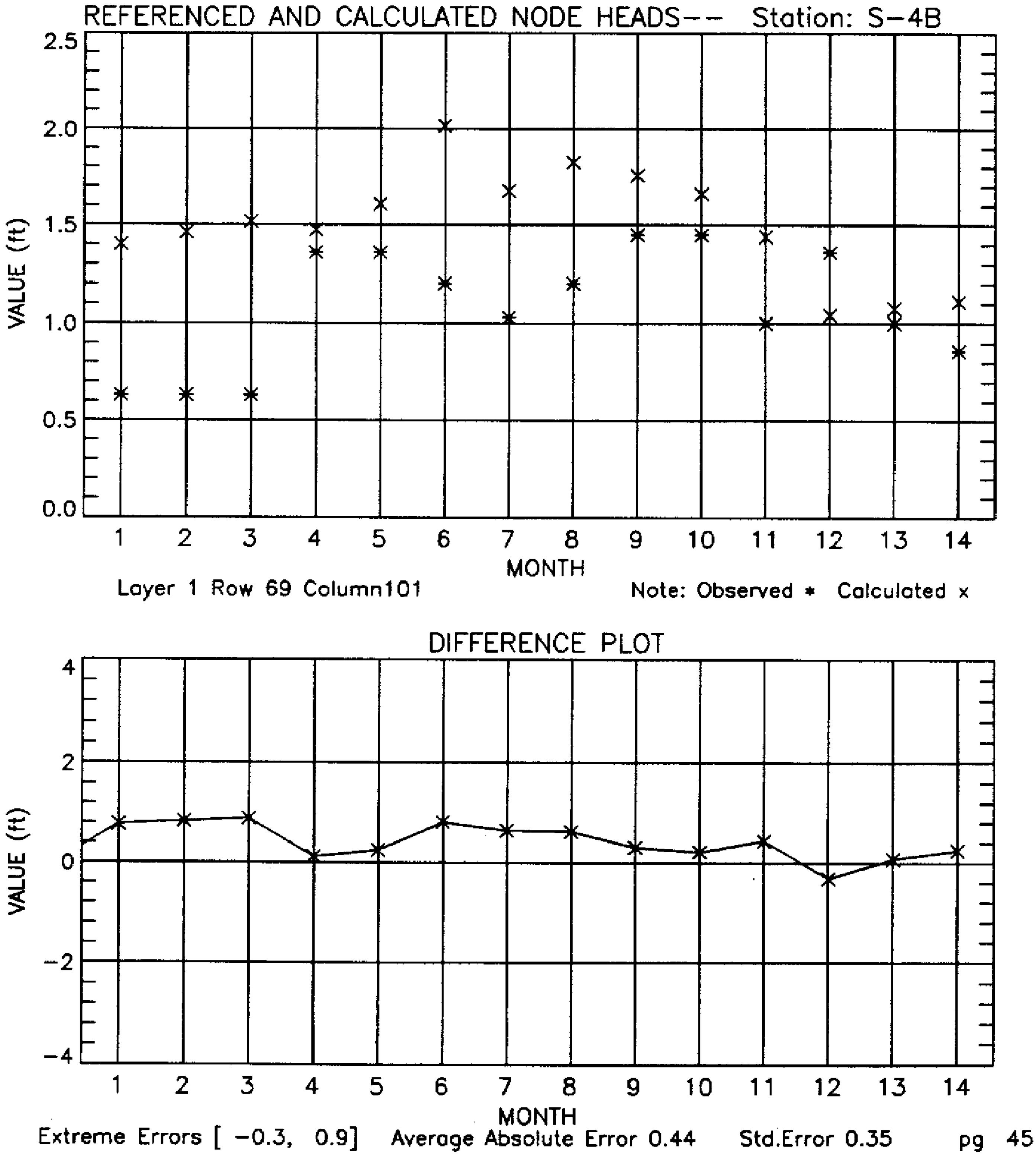

REFERENCED AND CALCULATED NODE HEADS-- Station: STL270
VALUE (ft)
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 63 Column 92
Note: Observed * Calculated x

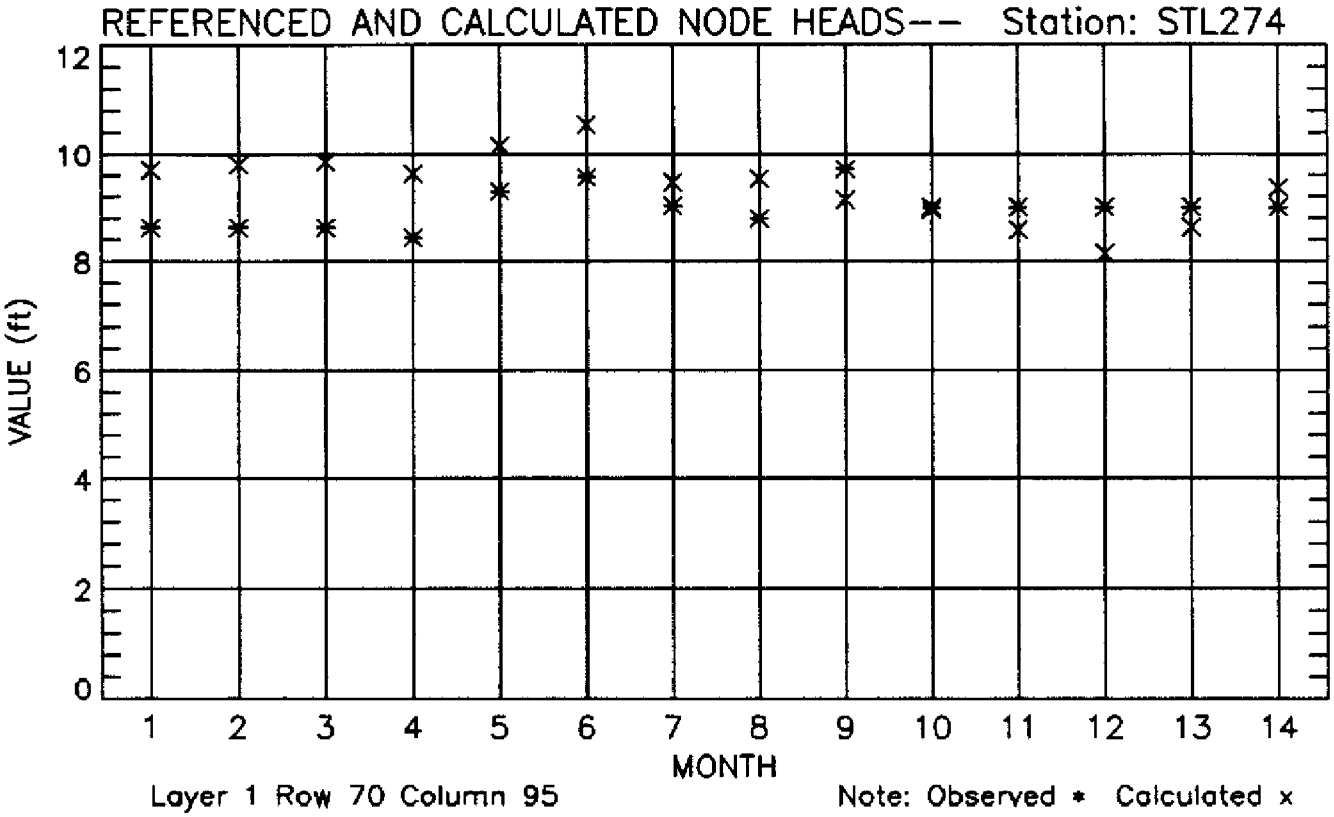

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-1.6, -0.2] Average Absolute Error 0.73 Std.Error 0.40 pg 42

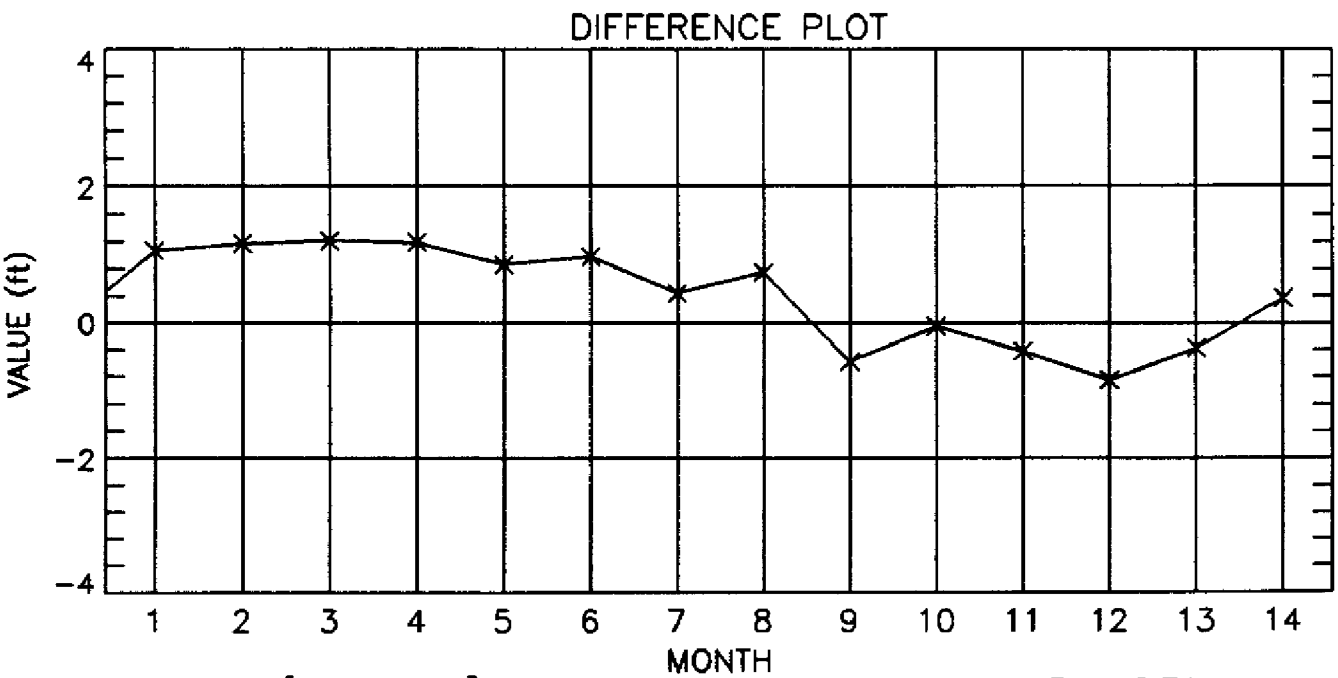

REFERENCED AND CALCULATED NODE HEADS-- Station: M-1268
VALUE (ft)
MONTH
Layer 1 Row 63 Column105
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-1.6, 0.2] Average Absolute Error 0.75 Std.Error 0.48 pg 43


REFERENCED AND CALCULATED NODE HEADS-- Station: W-7B
VALUE (ft)
MONTH
Layer 1 Row 65 Column 99
Note: Observed * Calculated x

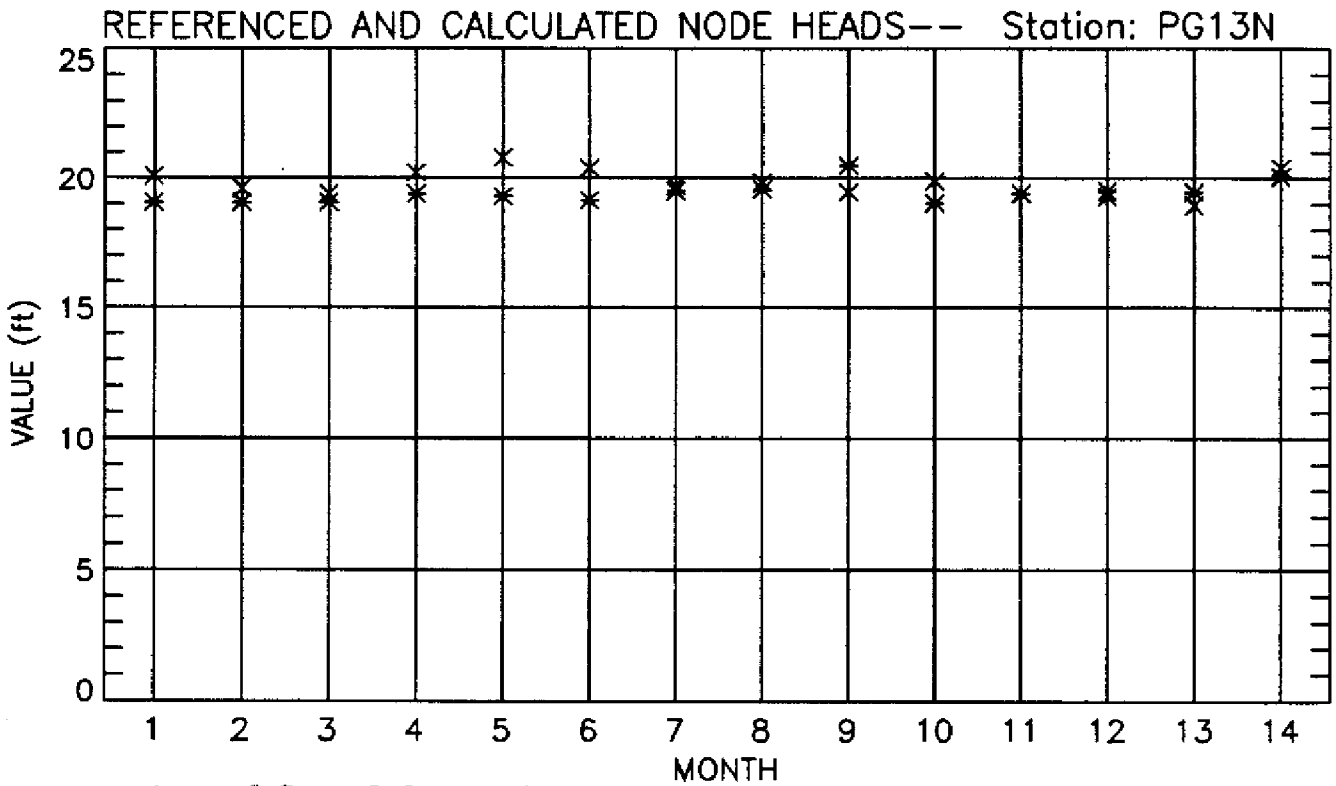

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [3.5, 4.9] Average Absolute Error 3.85 Std.Error 0.50 pg 44


REFERENCED AND CALCULATED NODE HEADS-- Station: S-4B
2.5
2.0
1.5
1.0
0.5
0.0
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 1 Row 69 Column101
Note: Observed * Calculated x
DIFFERENCE PLOT
4
2
0
-2
-4
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.3, 0.9] Average Absolute Error 0.44 Std.Error 0.35 pg 45

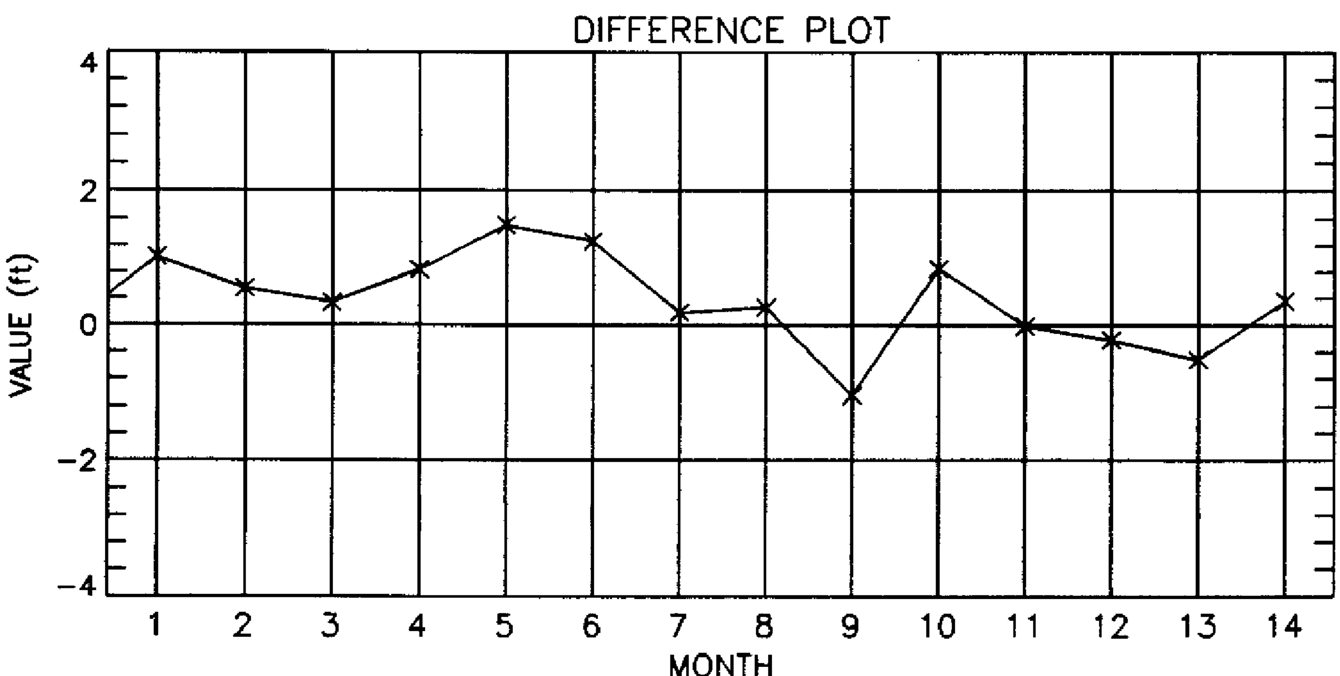




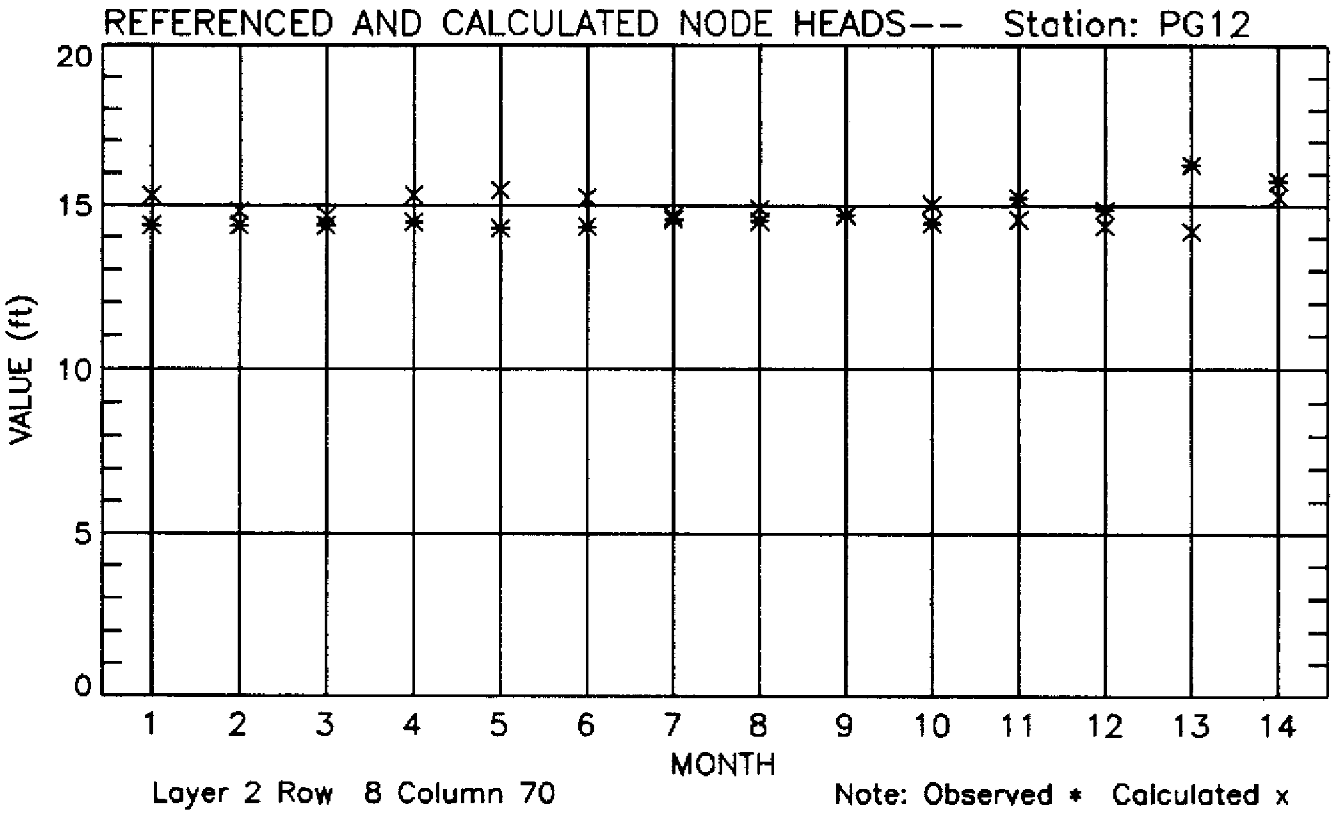
Extreme Errors [−0.9, 1.2] Average Absolute Error 0.69 Std.Error 0.74 pg 46

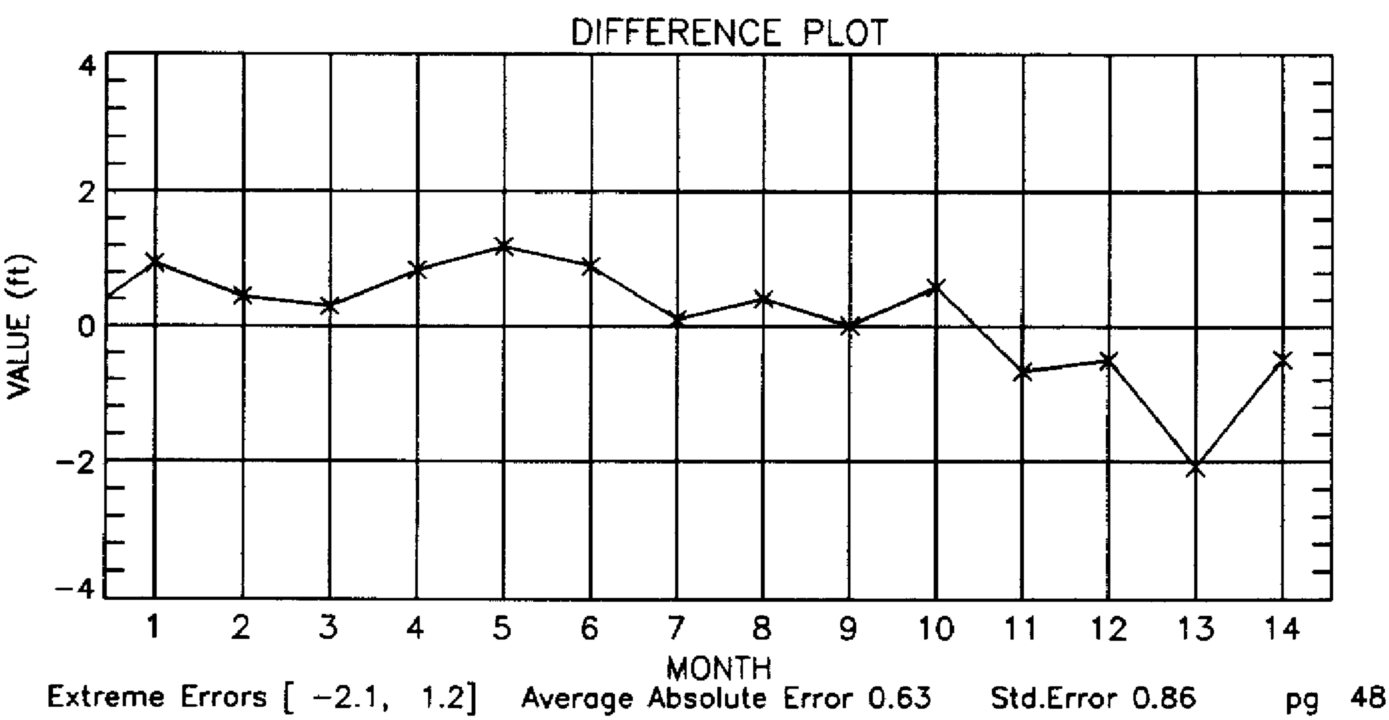


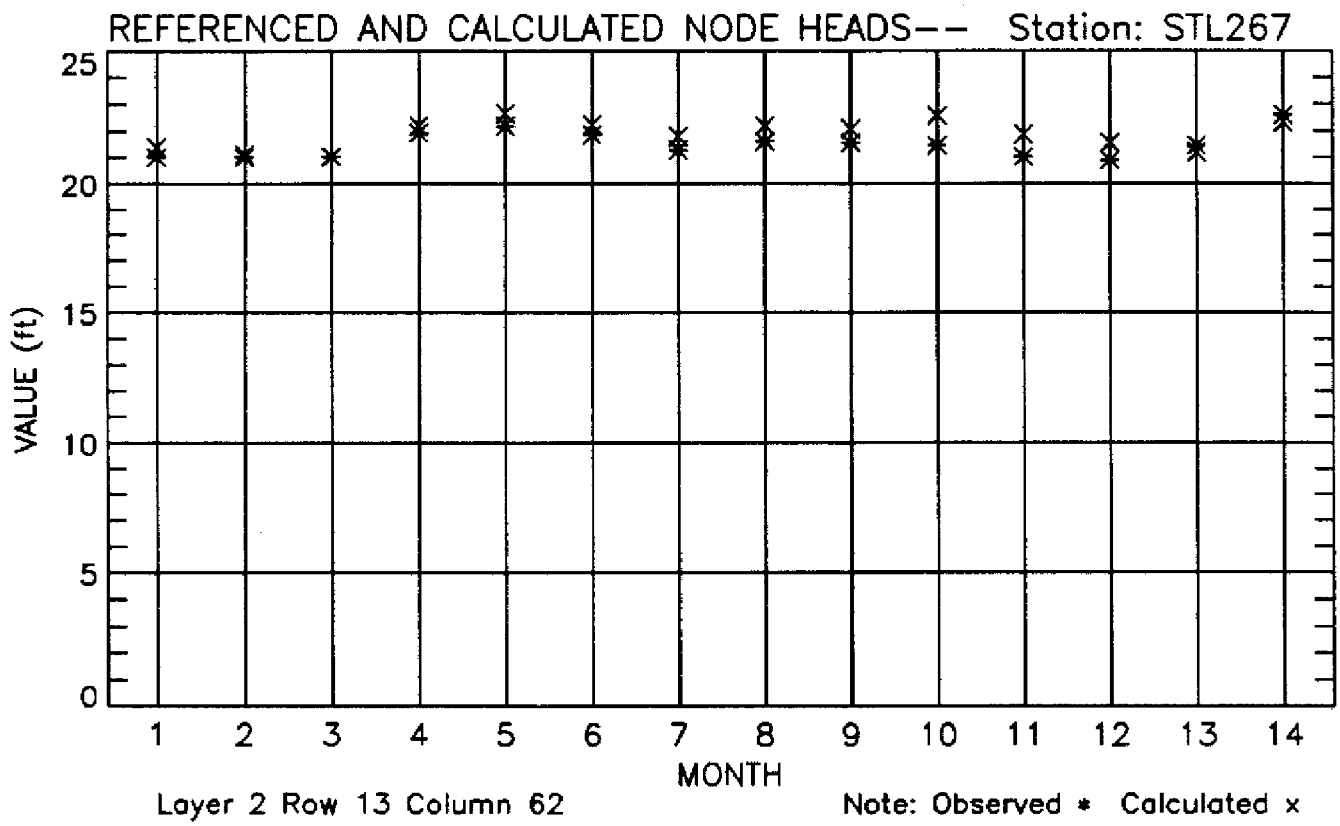
Layer 2 Row 8 Column 54 Note: Observed * Calculated x

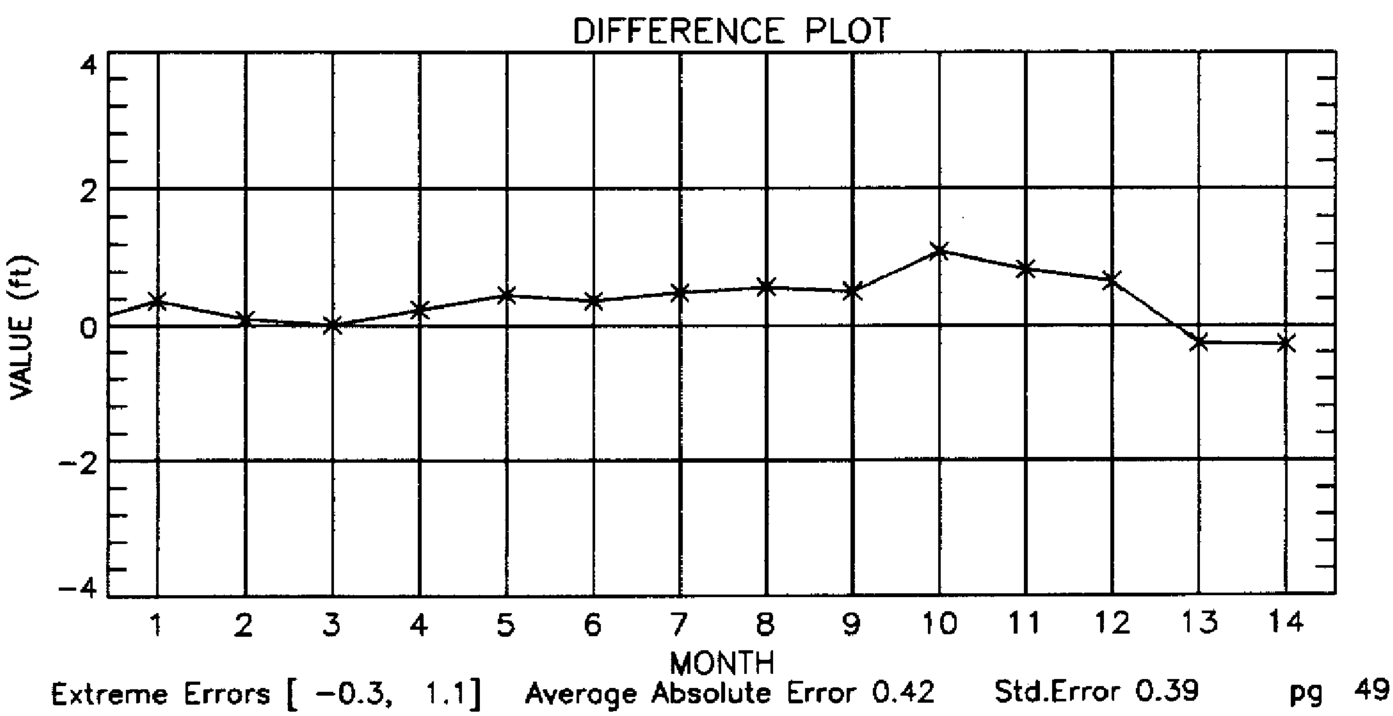


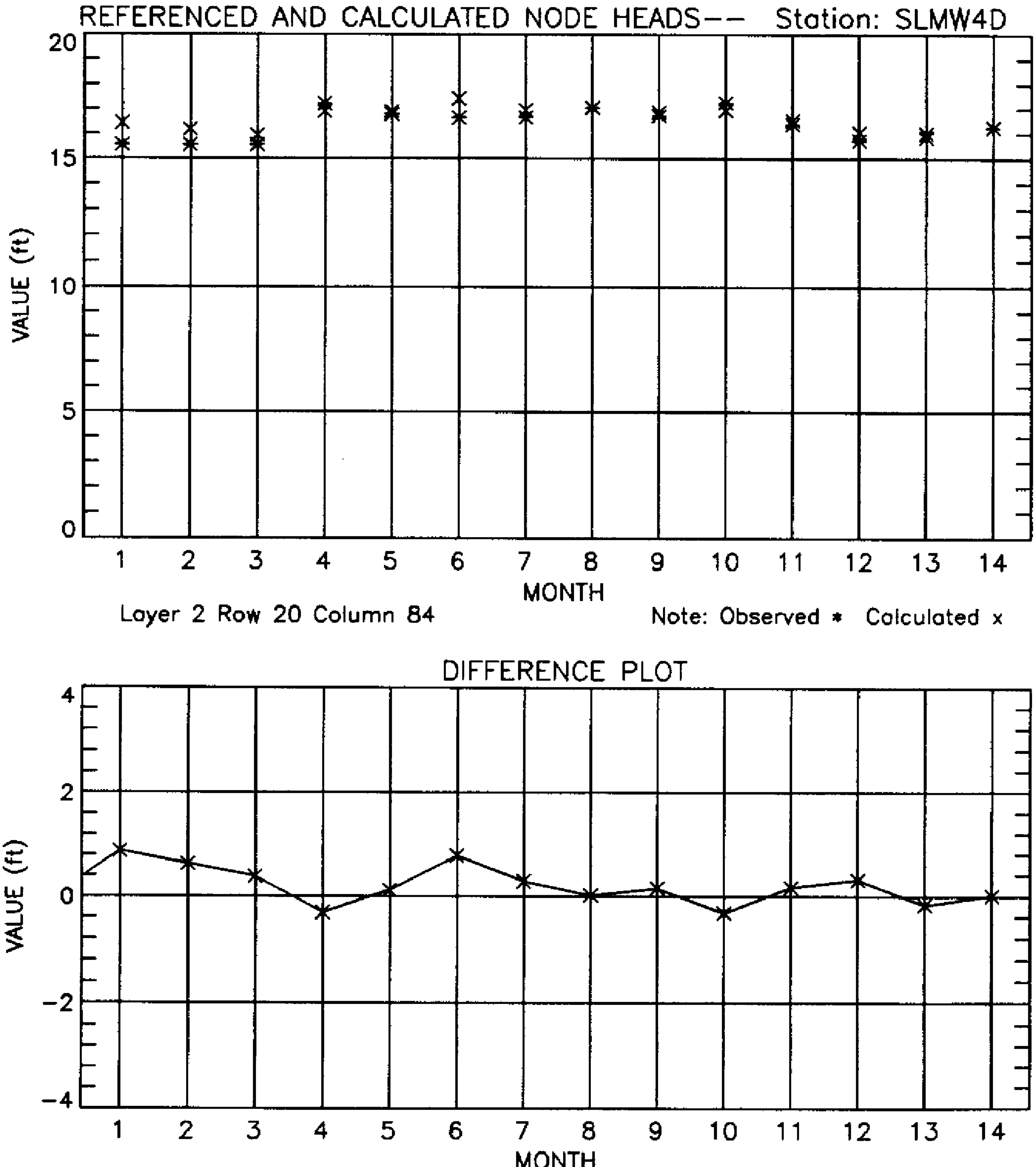
Extreme Errors [-1.0, 1.5] Average Absolute Error 0.60 Std.Error 0.70 pg 47


REFERENCED AND CALCULATED NODE HEADS-- Station: PG12
VALUE (ft)
MONTH
Layer 2 Row 8 Column 70
Note: Observed * Calculated x

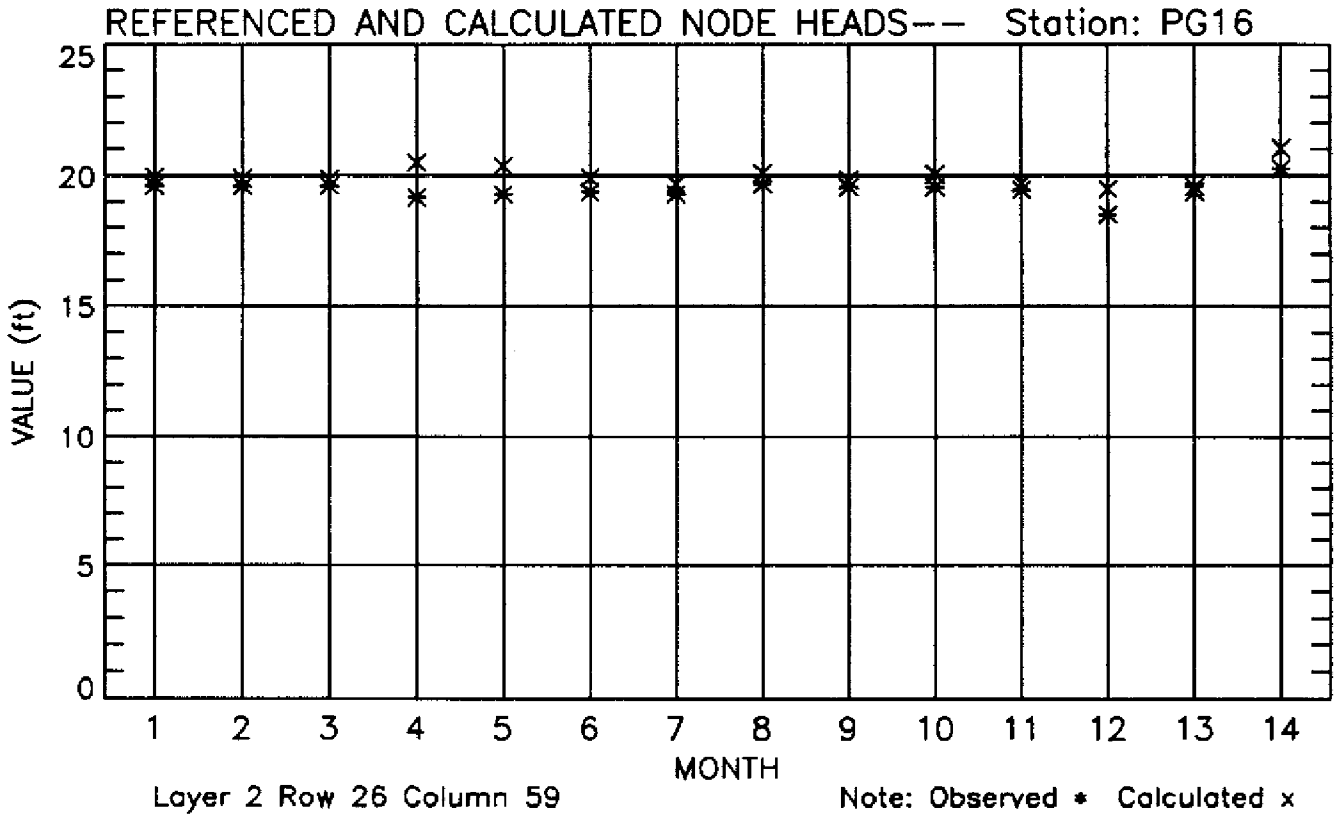

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-2.1, 1.2] Average Absolute Error 0.63 Std.Error 0.86 pg 48

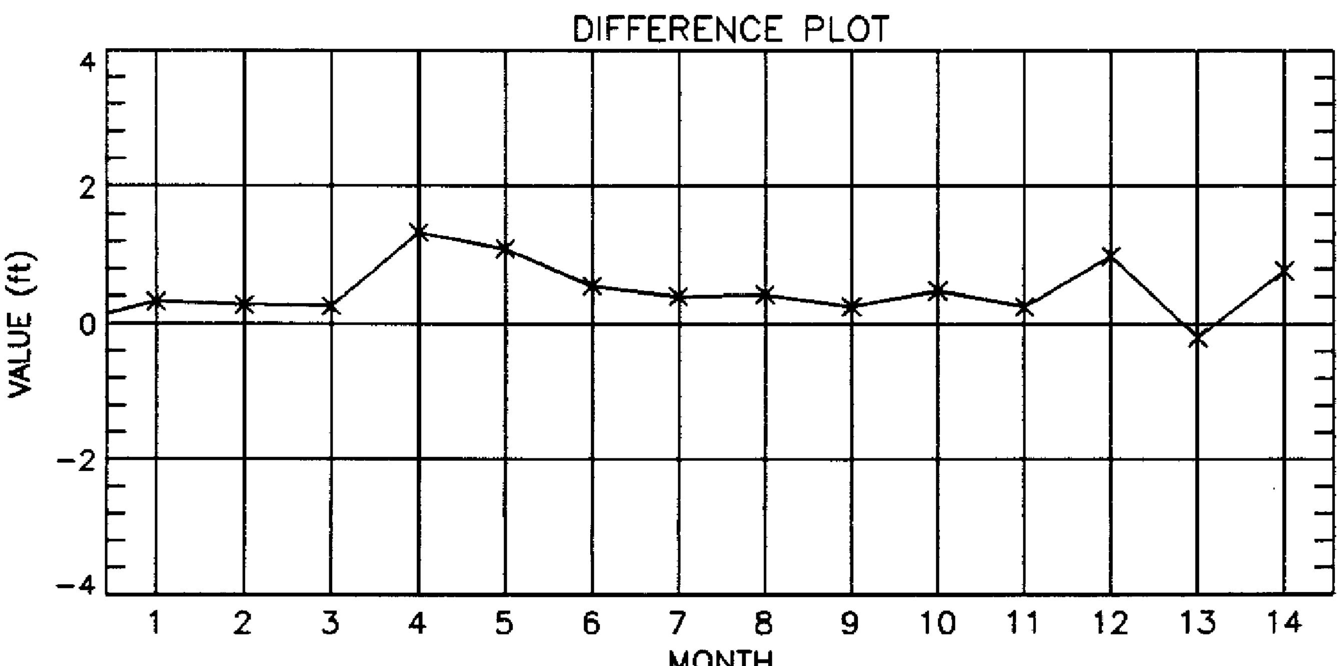

REFERENCED AND CALCULATED NODE HEADS-- Station: STL267
VALUE (ft)
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 13 Column 62
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.3, 1.1] Average Absolute Error 0.42 Std.Error 0.39 pg 49

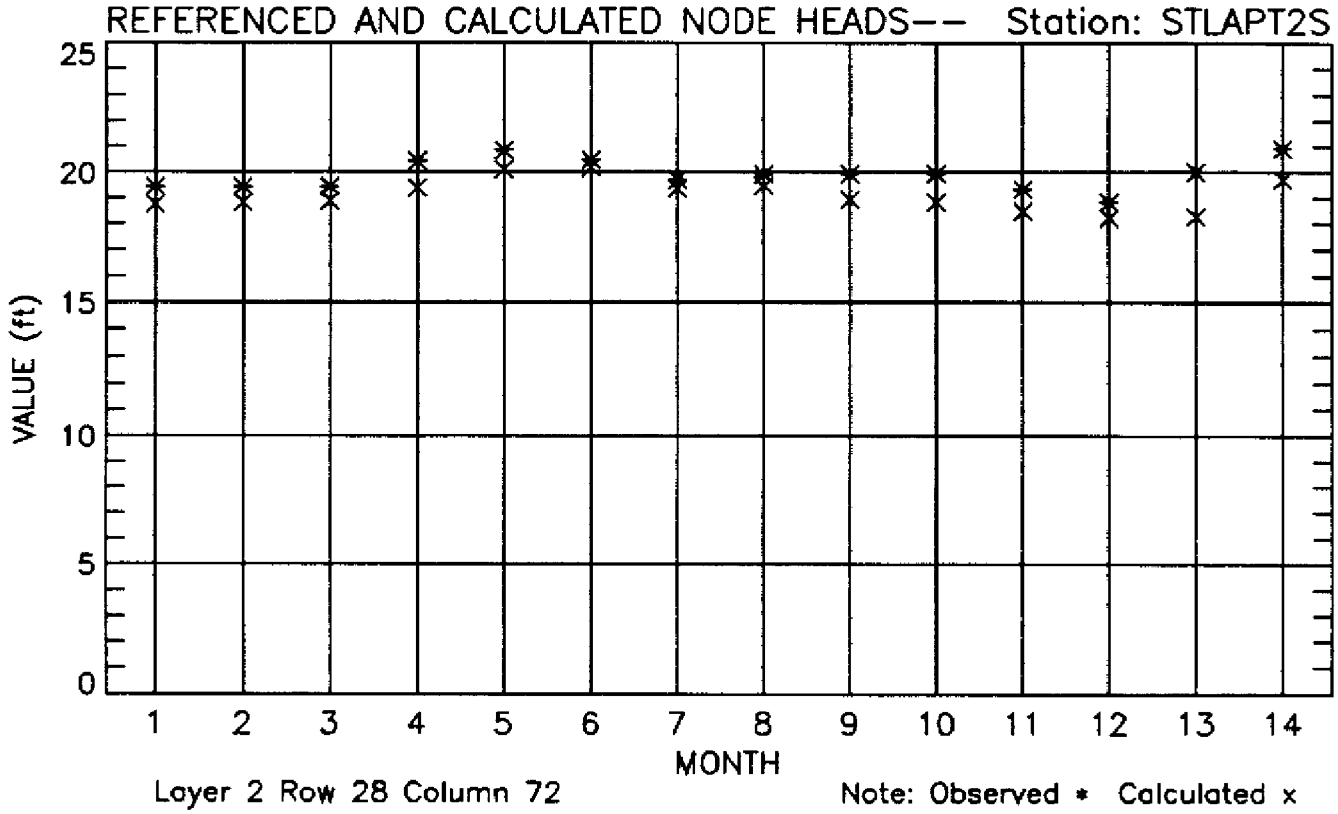


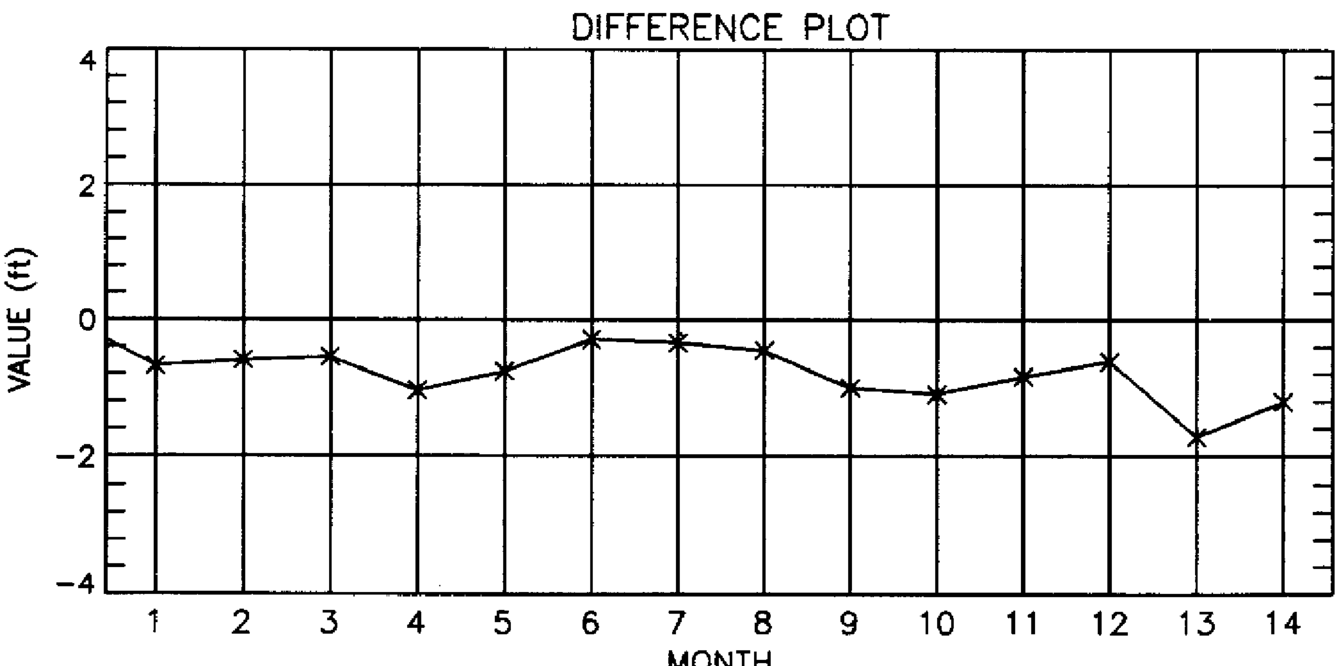
Extreme Errors [-0.3, 0.9] Average Absolute Error 0.30 Std.Error 0.37 pg 50



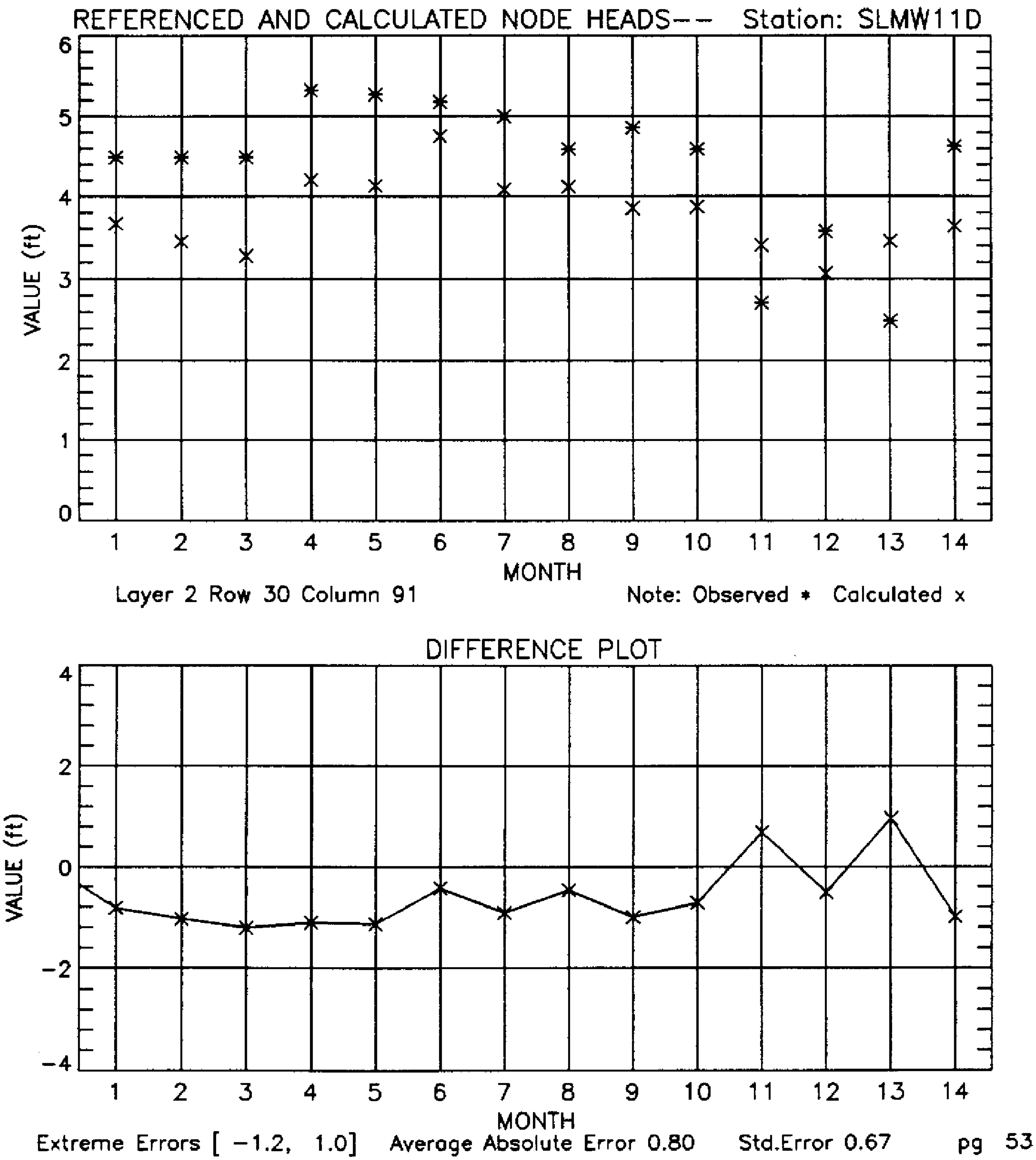


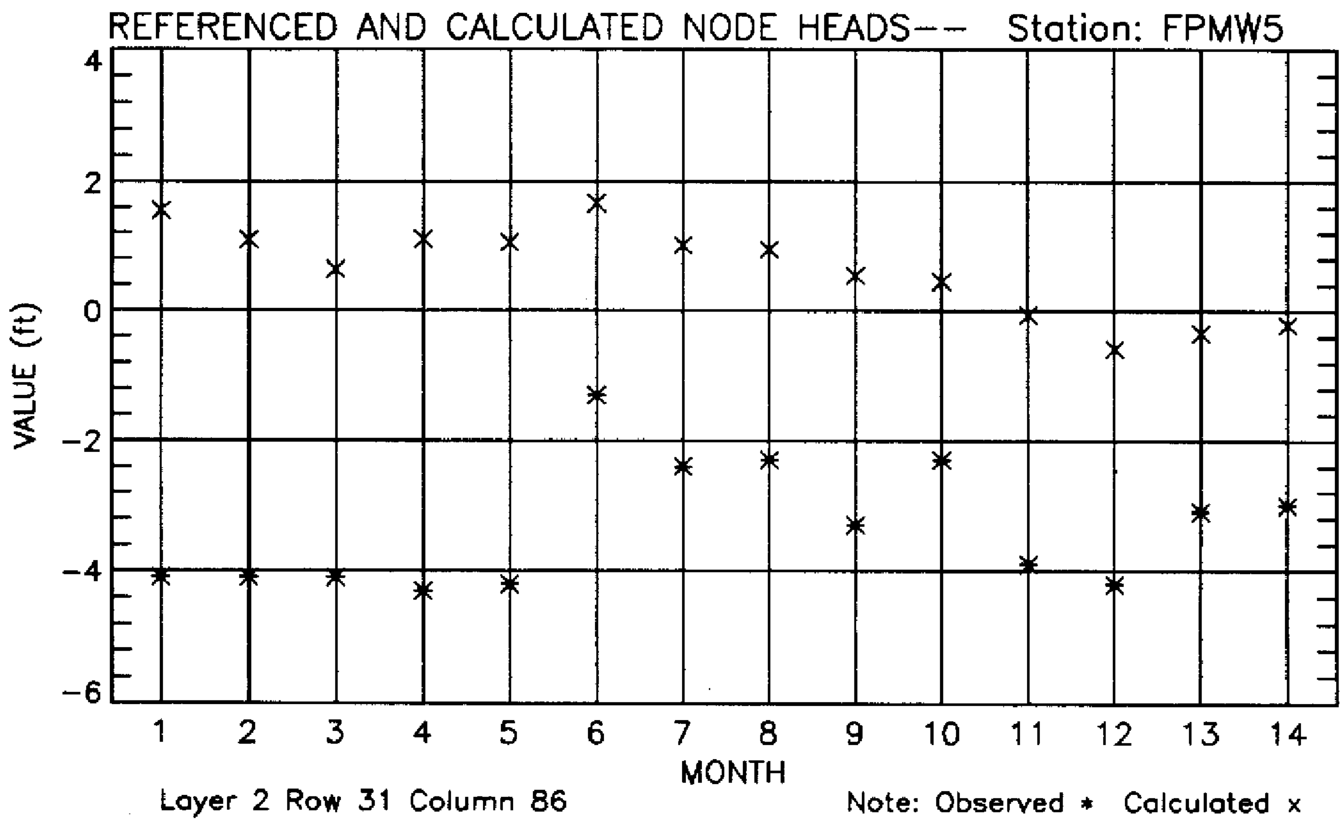
Extreme Errors [−0.2, 1.3] Average Absolute Error 0.51 Std.Error 0.40 pg 51

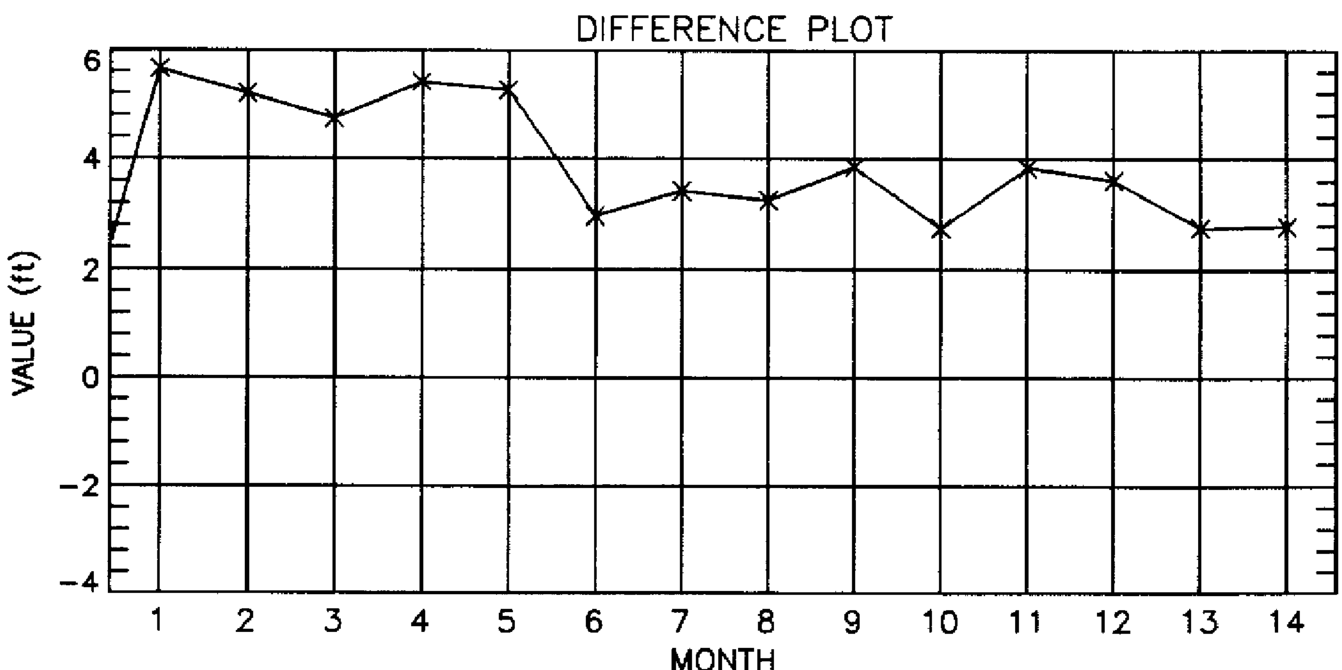




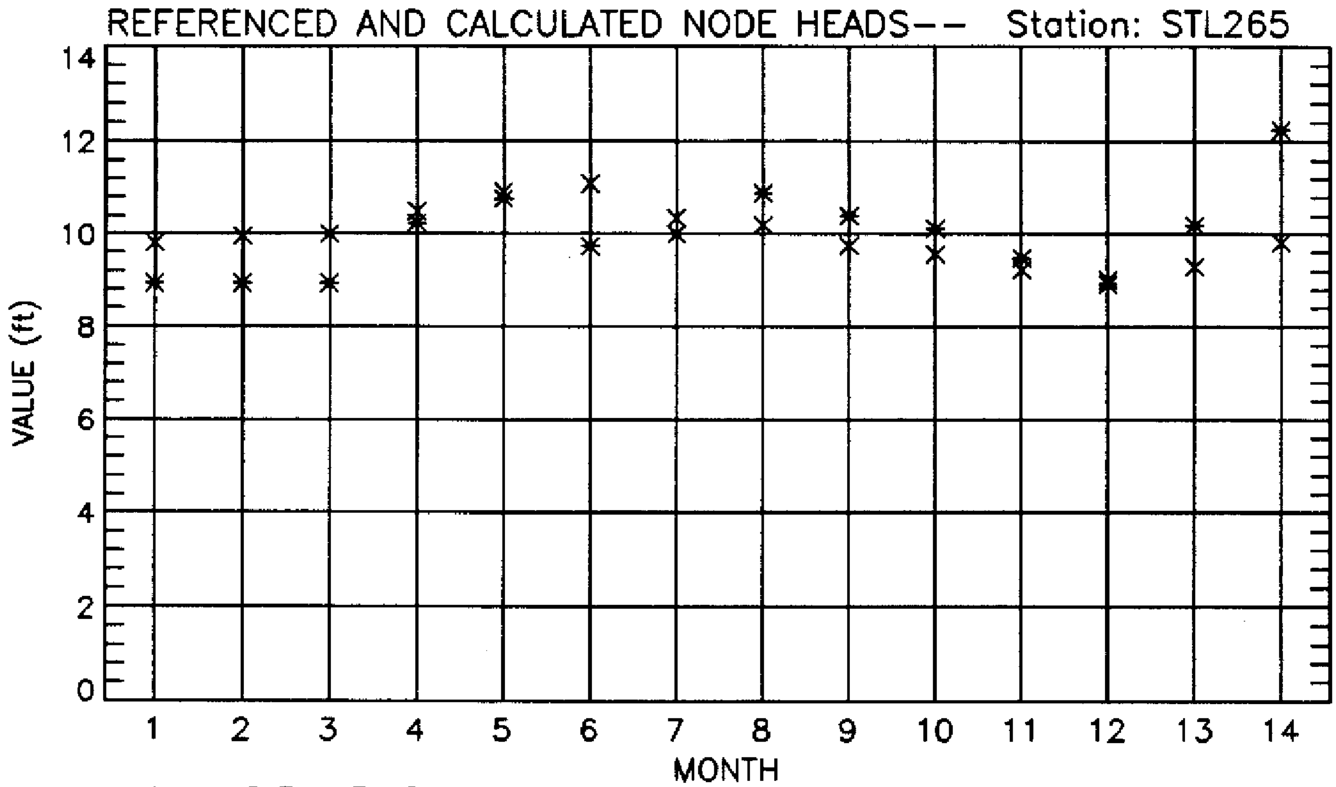
Extreme Errors [−1.7, −0.3] Average Absolute Error 0.75 Std.Error 0.39 pg 52


REFERENCED AND CALCULATED NODE HEADS-- Station: SLMW11D
VALUE (ft)
MONTH
Layer 2 Row 30 Column 91
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-1.2, 1.0] Average Absolute Error 0.80 Std.Error 0.67 pg 53

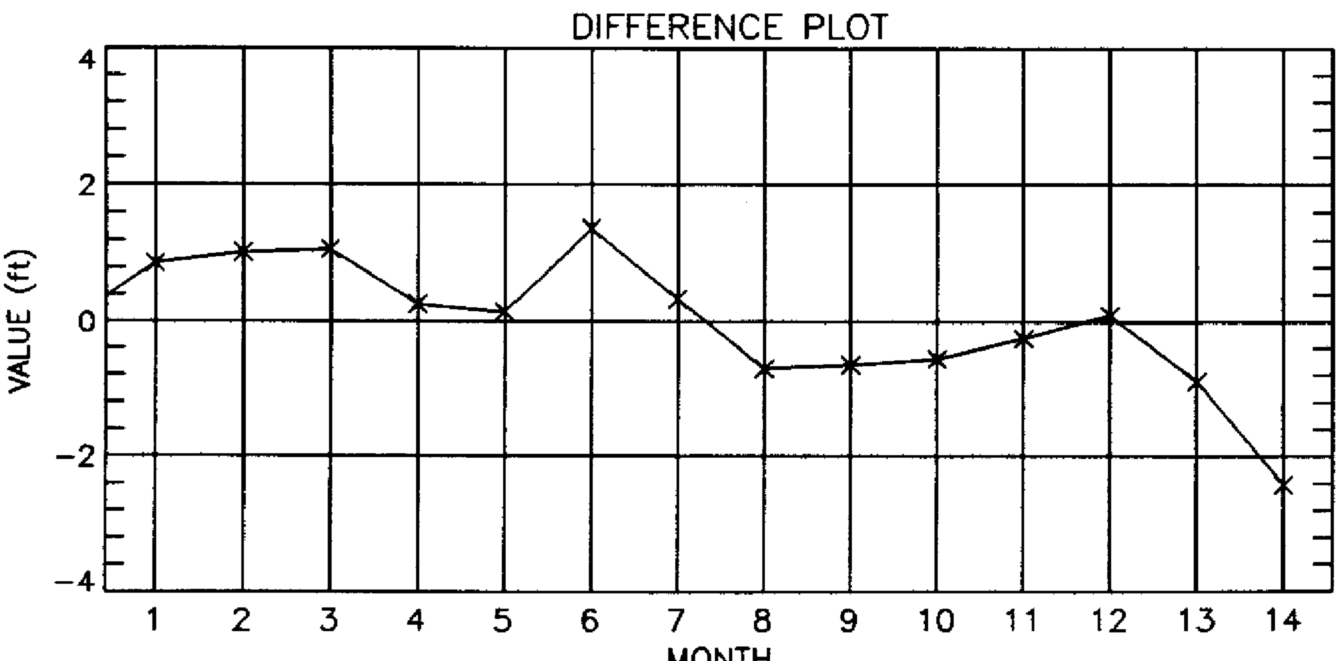




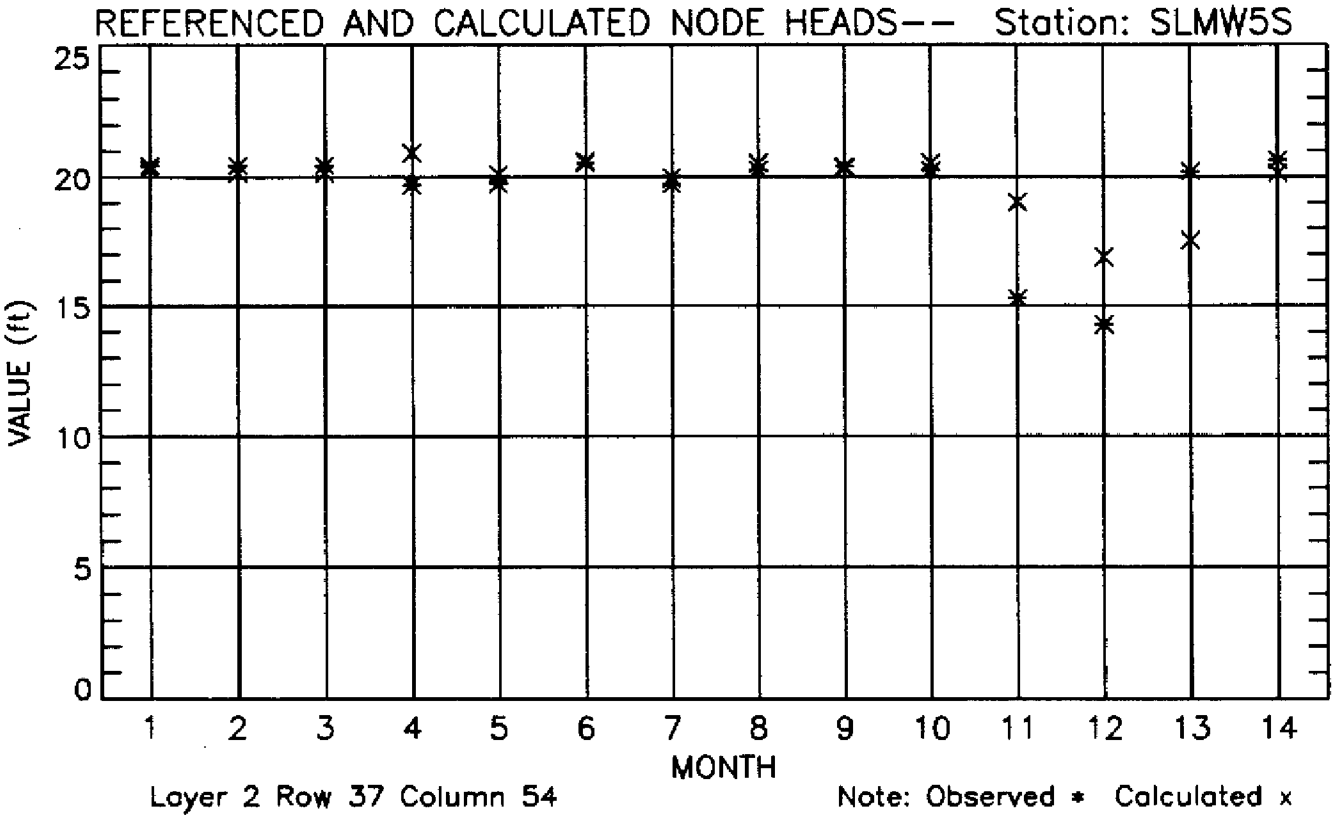
Extreme Errors [2.8, 5.6] Average Absolute Error 3.70 Std.Error 1.07 pg 54

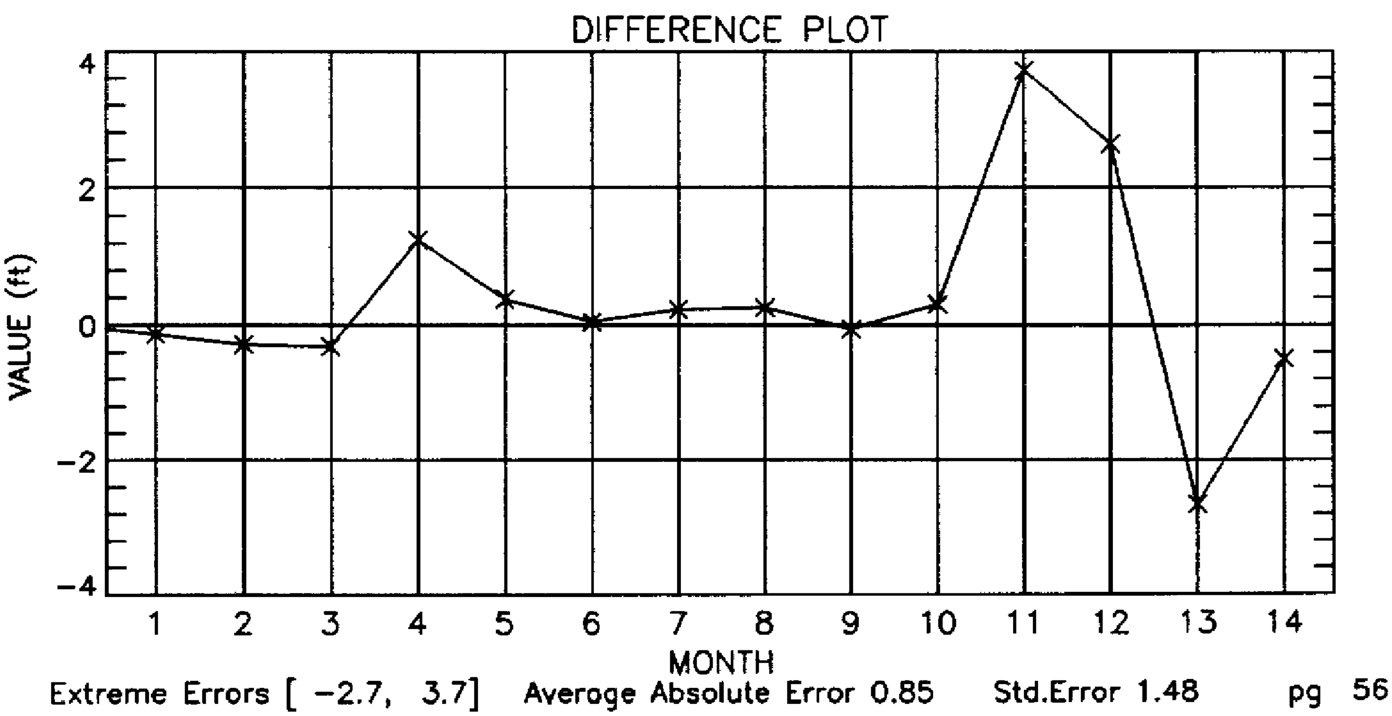


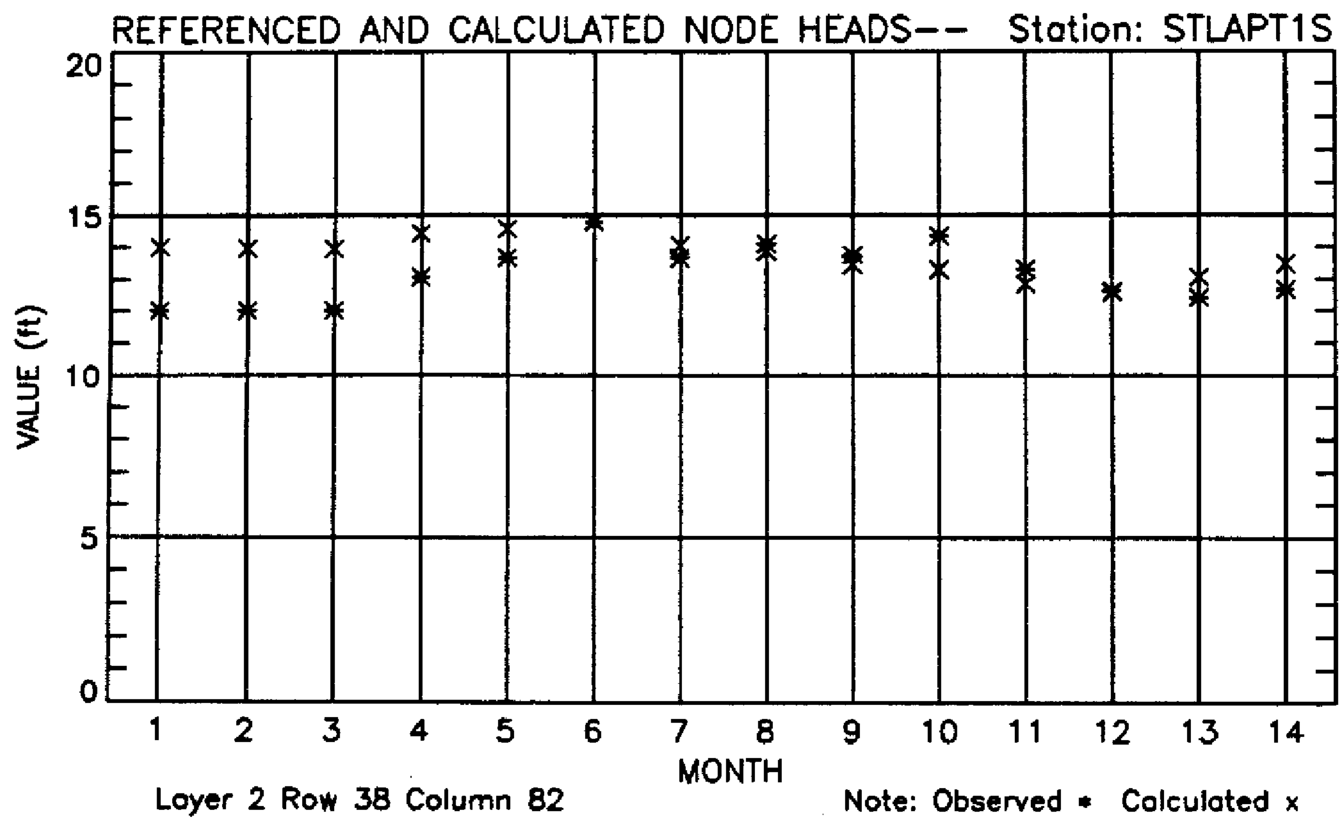
Layer 2 Row 34 Column 78 Note: Observed * Calculated x

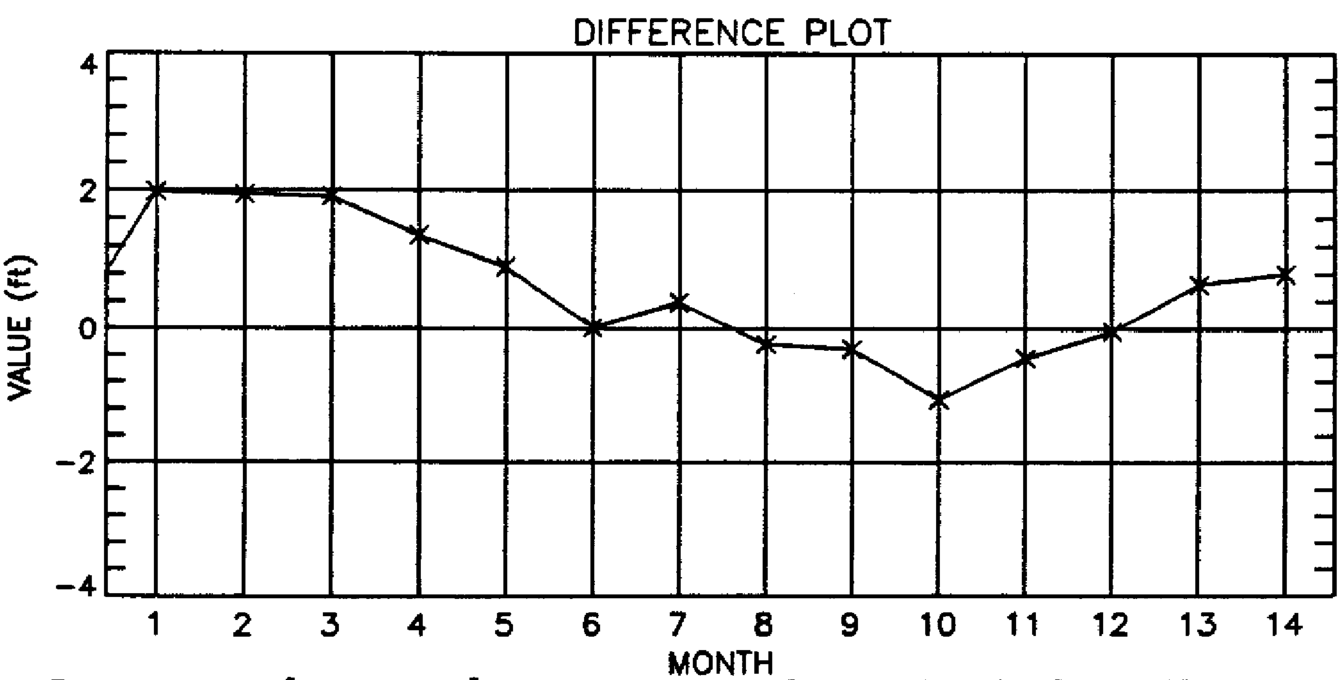


Extreme Errors [−2.4, 1.4] Average Absolute Error 0.71 Std.Error 1.00 pg 55

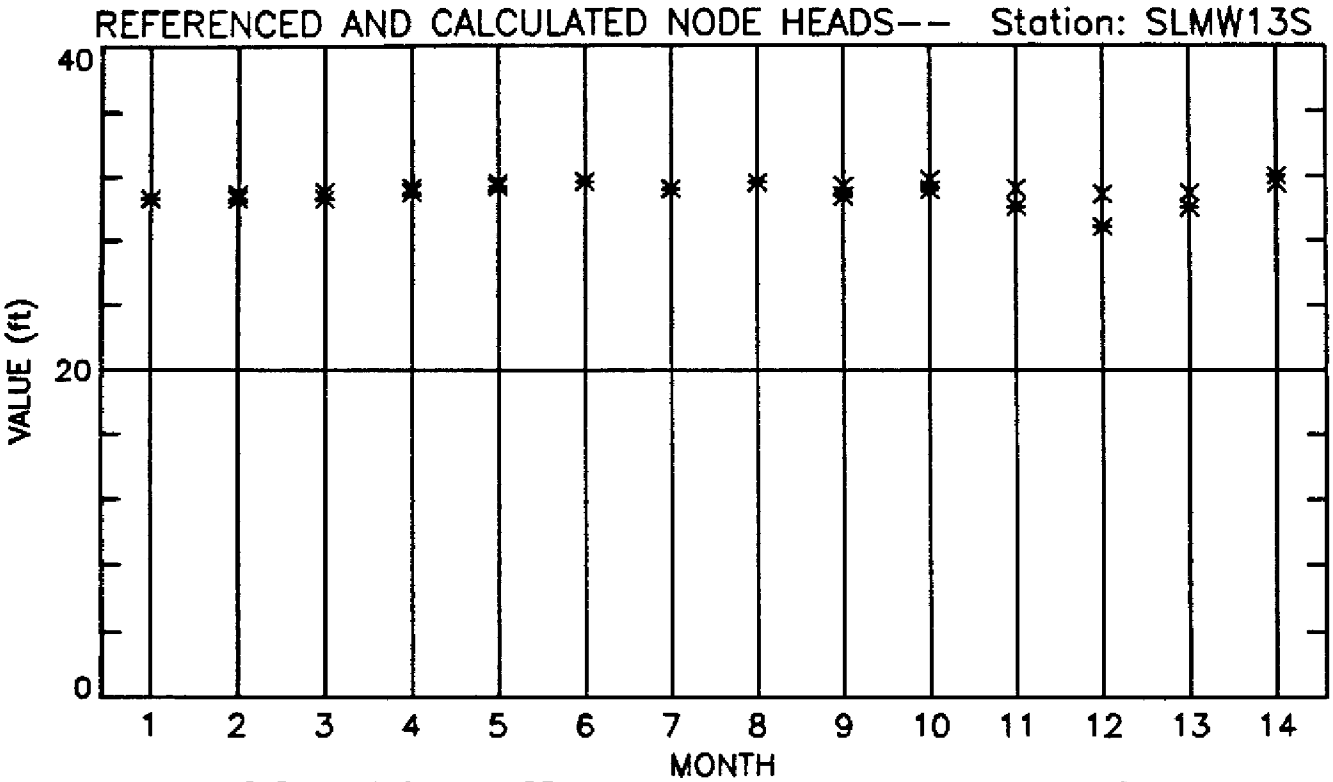

REFERENCED AND CALCULATED NODE HEADS-- Station: SLMW5S
VALUE (ft)
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 37 Column 54
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-2.7, 3.7] Average Absolute Error 0.85 Std.Error 1.48 pg 56

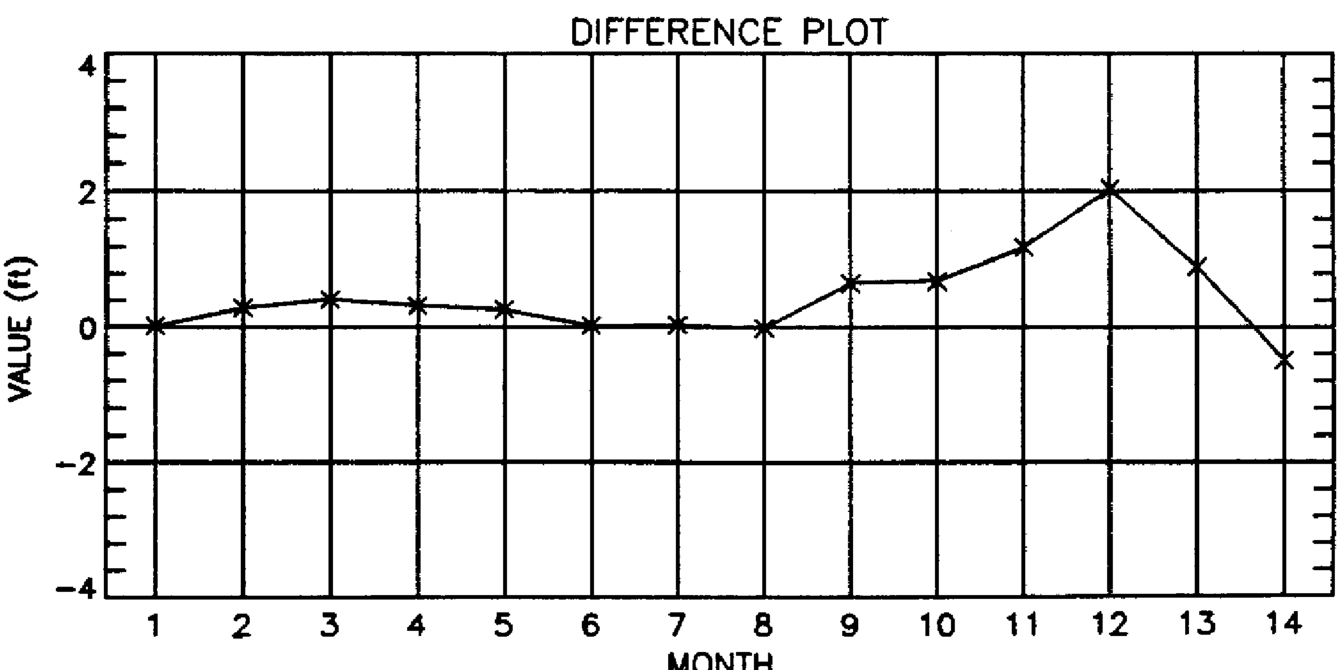




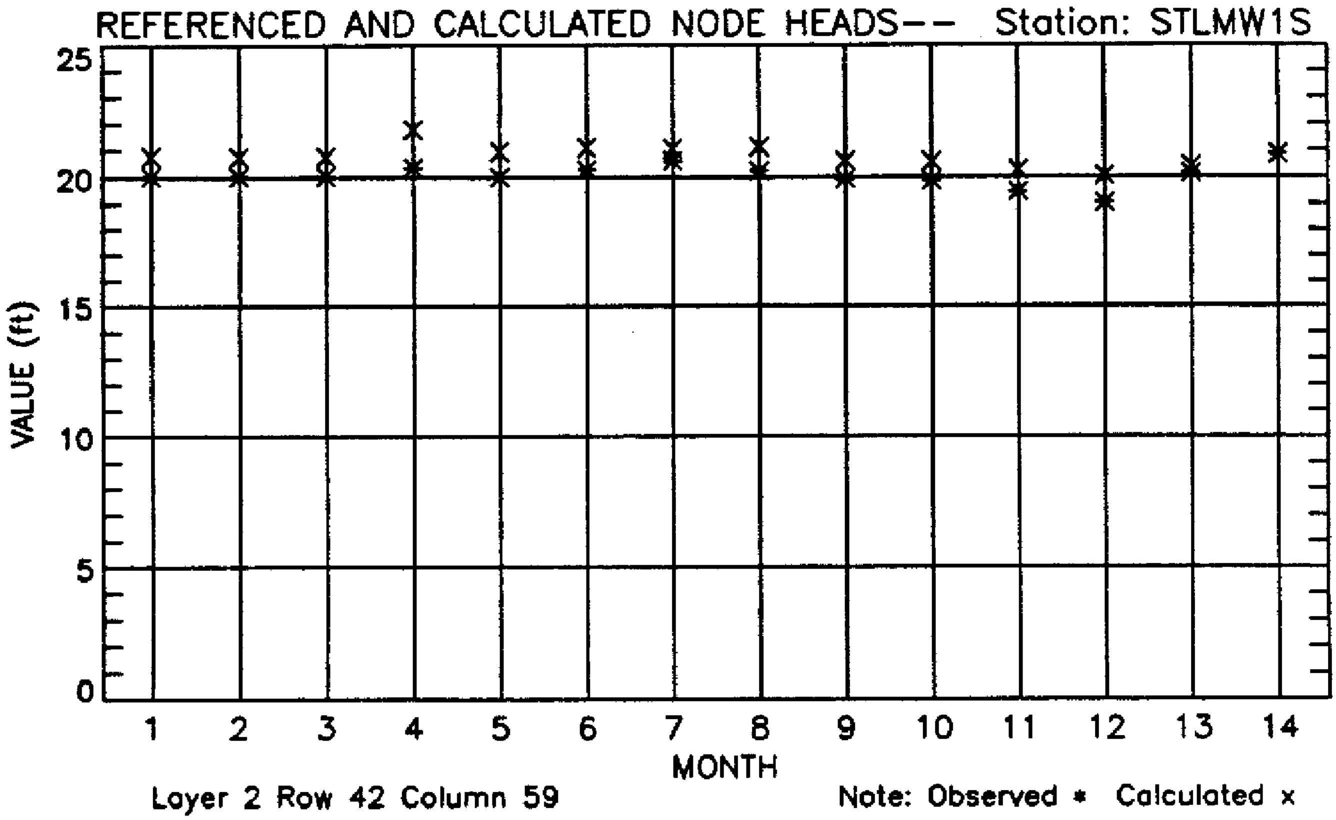
Extreme Errors [-1.1, 2.0] Average Absolute Error 0.80 Std.Error 0.97 pg 57

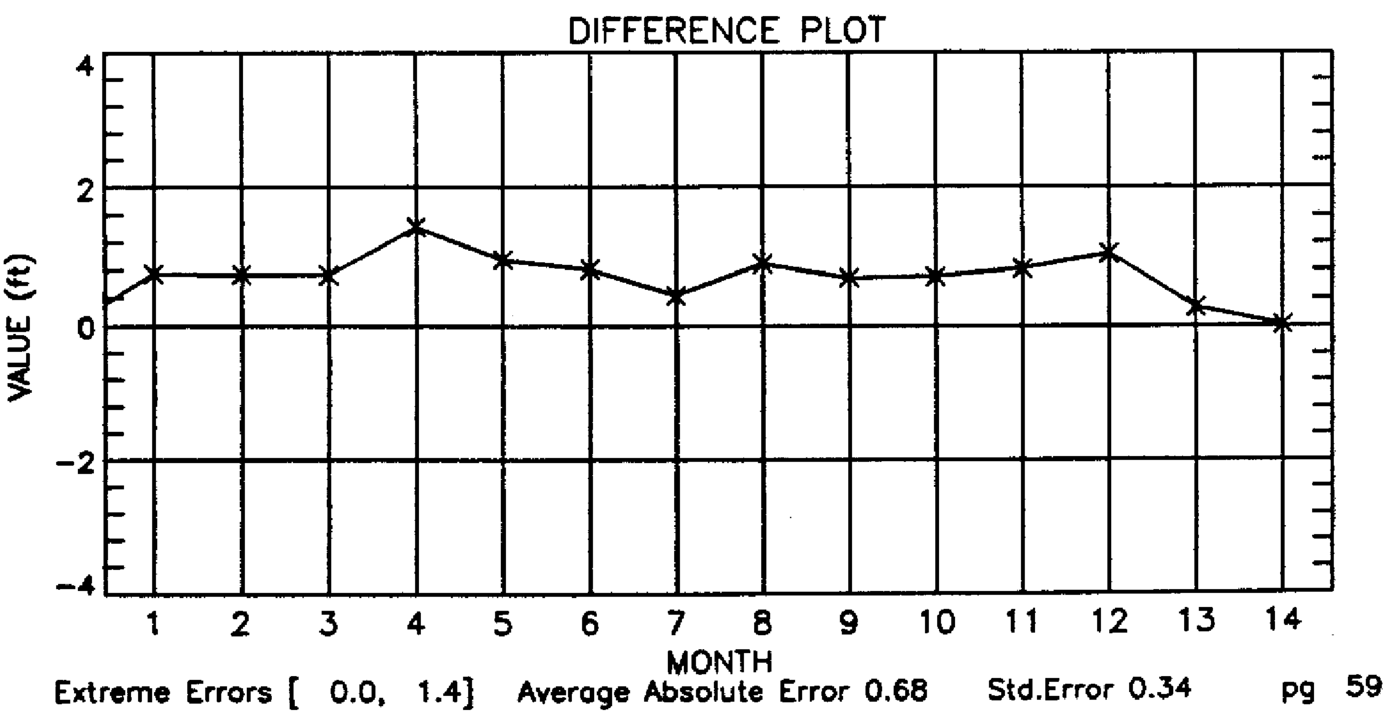


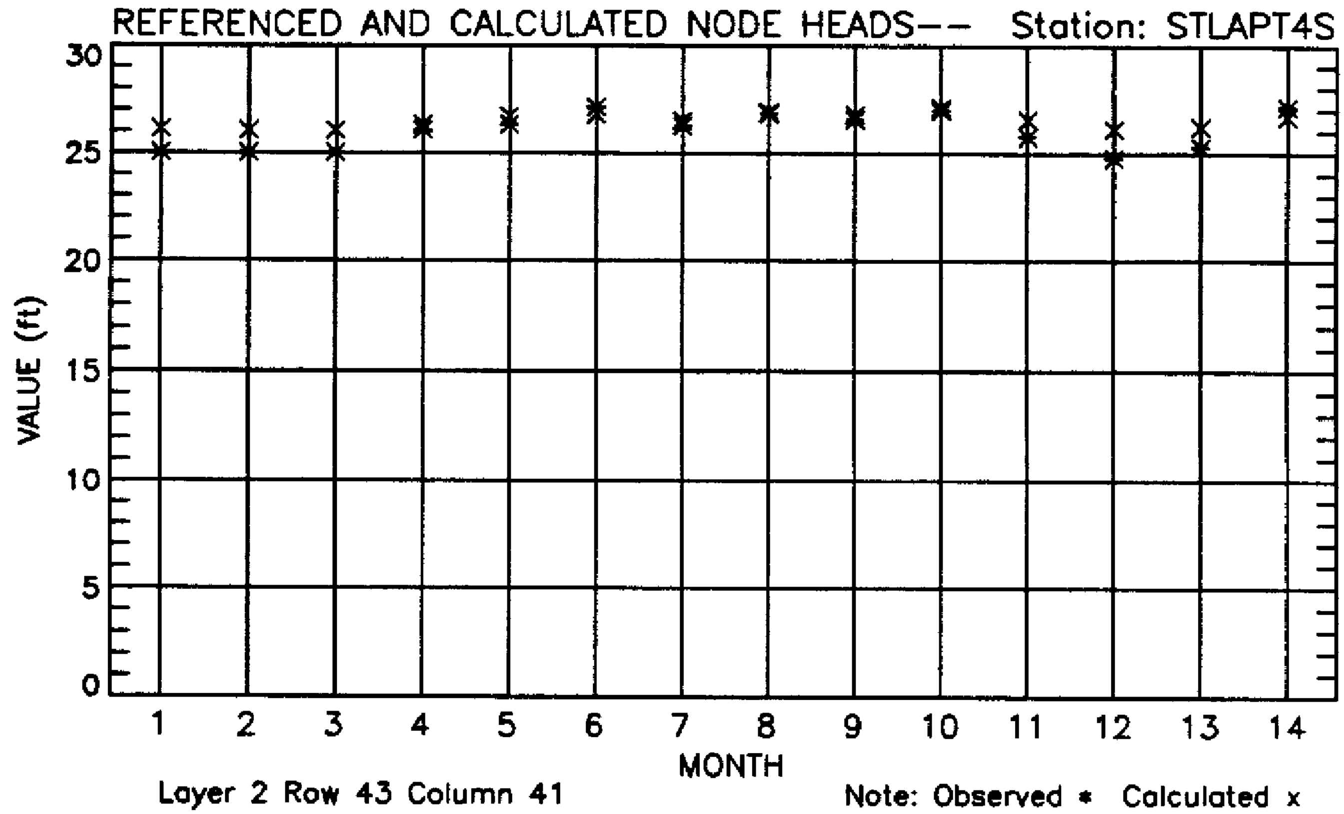
Layer 2 Row 41 Column 33 Note: Observed * Calculated x

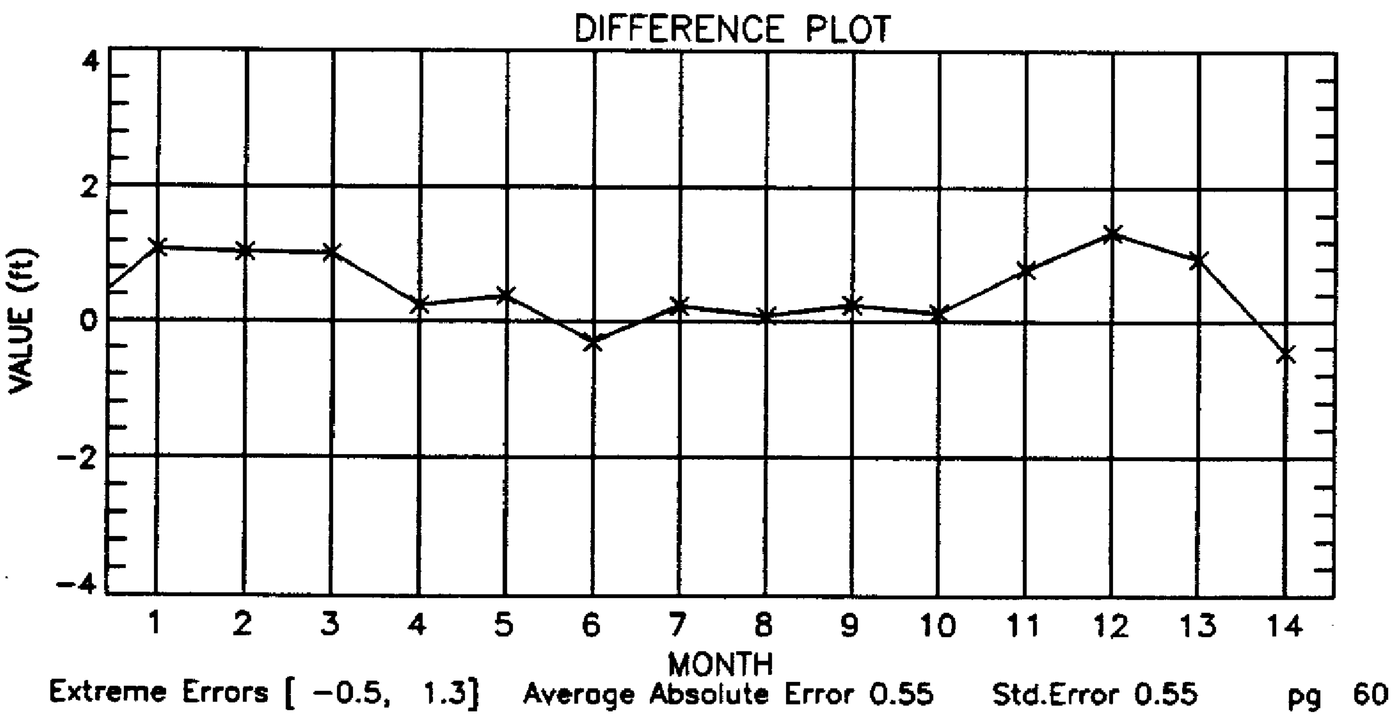


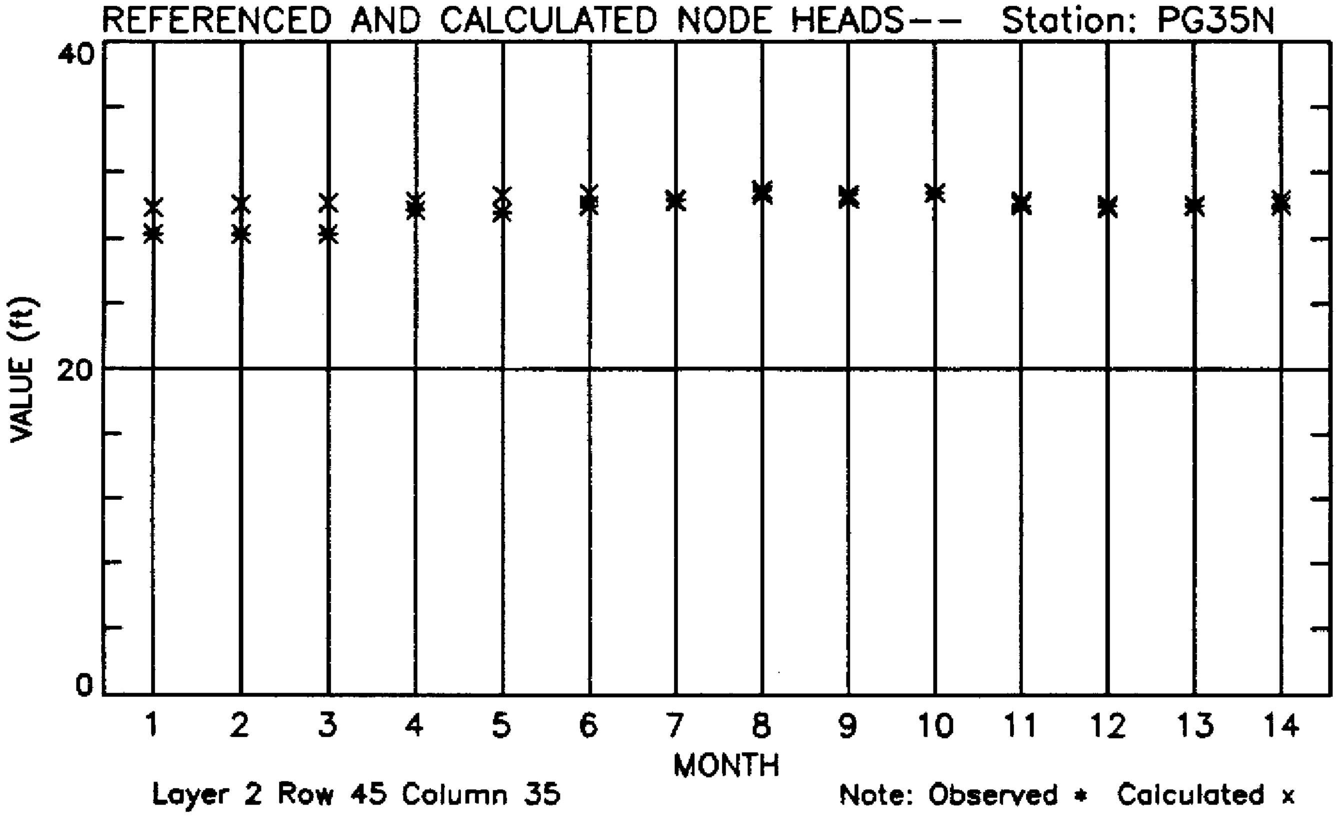
Extreme Errors [-0.5, 2.0] Average Absolute Error 0.49 Std.Error 0.63 pg 58

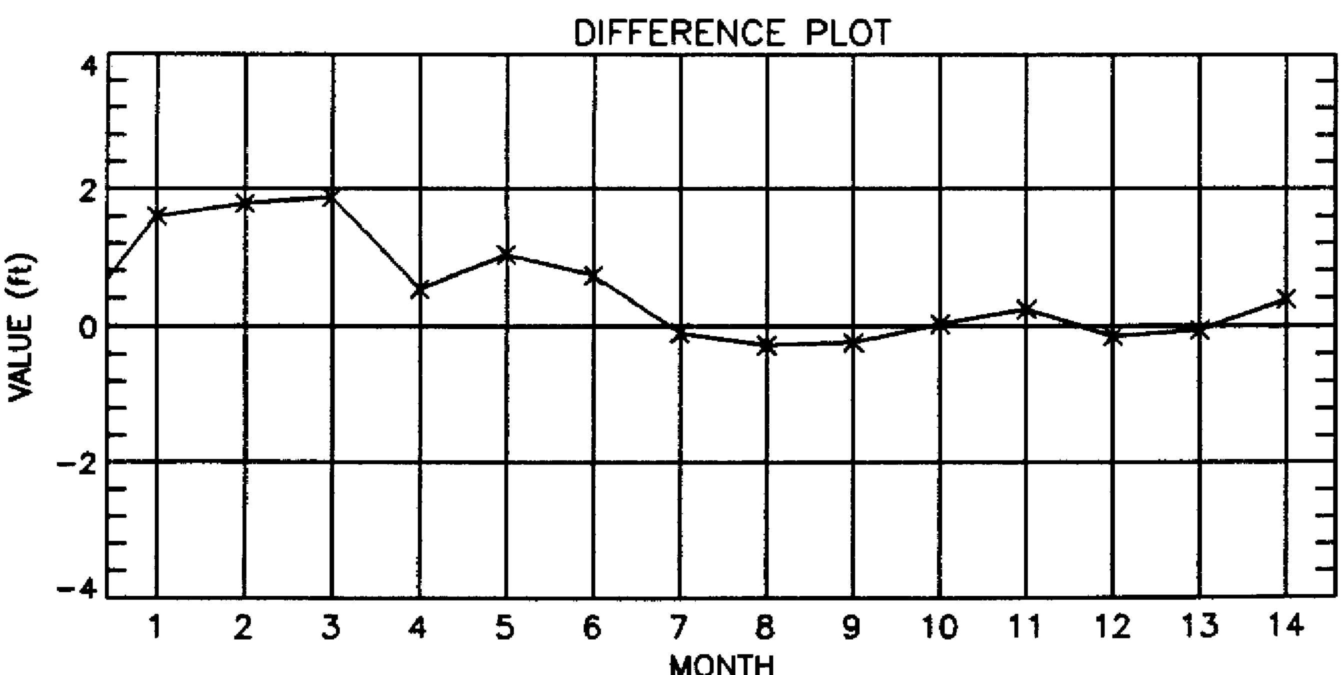

REFERENCED AND CALCULATED NODE HEADS-- Station: STLMW1S
VALUE (ft)
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 42 Column 59
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [0.0, 1.4] Average Absolute Error 0.68 Std.Error 0.34 pg 59

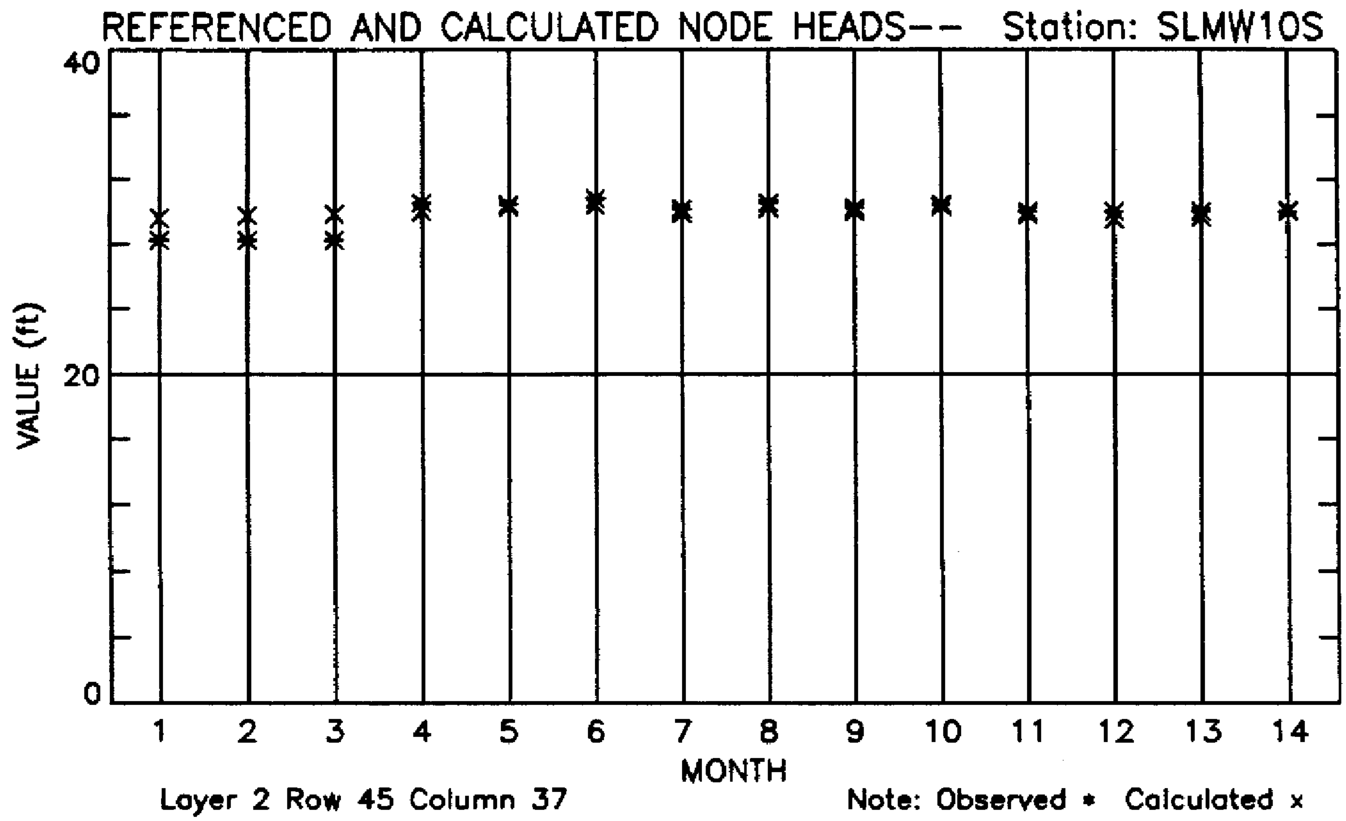

REFERENCED AND CALCULATED NODE HEADS-- Station: STLAPT4S
VALUE (ft)
MONTH
Layer 2 Row 43 Column 41
Note: Observed * Calculated x

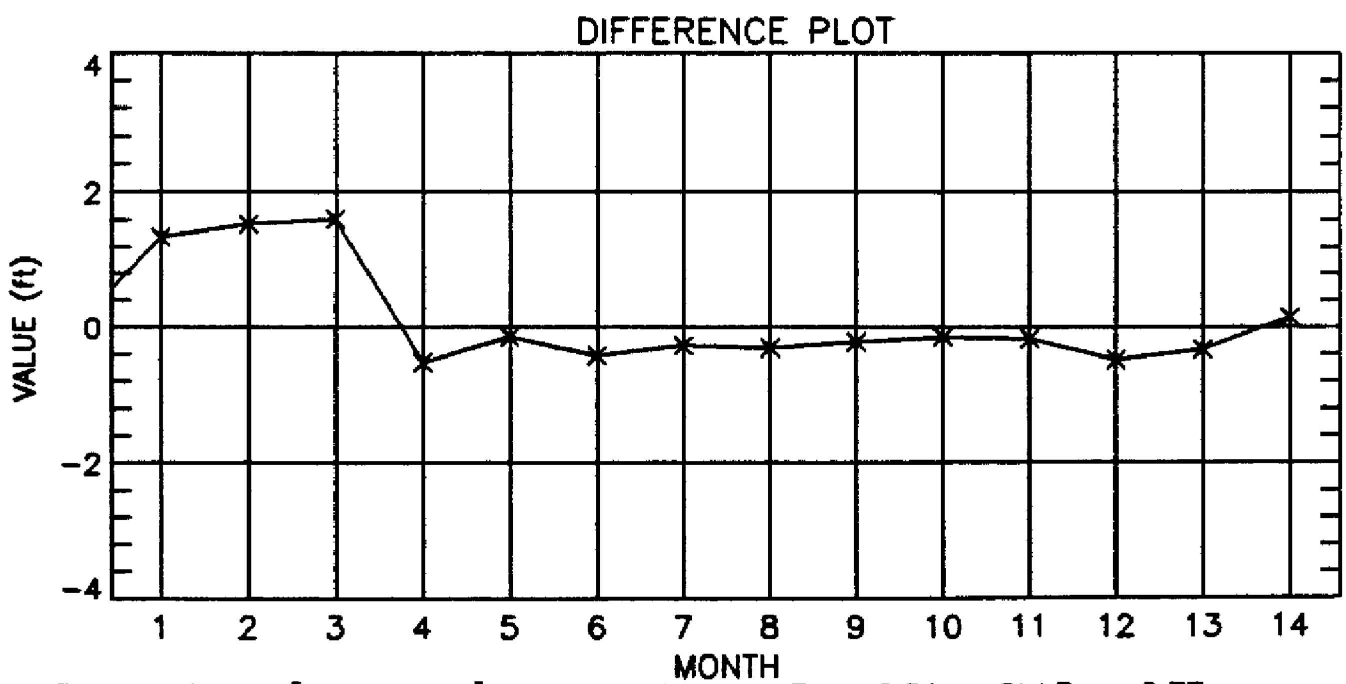

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [−0.5, 1.3] Average Absolute Error 0.55 Std.Error 0.55 pg 60



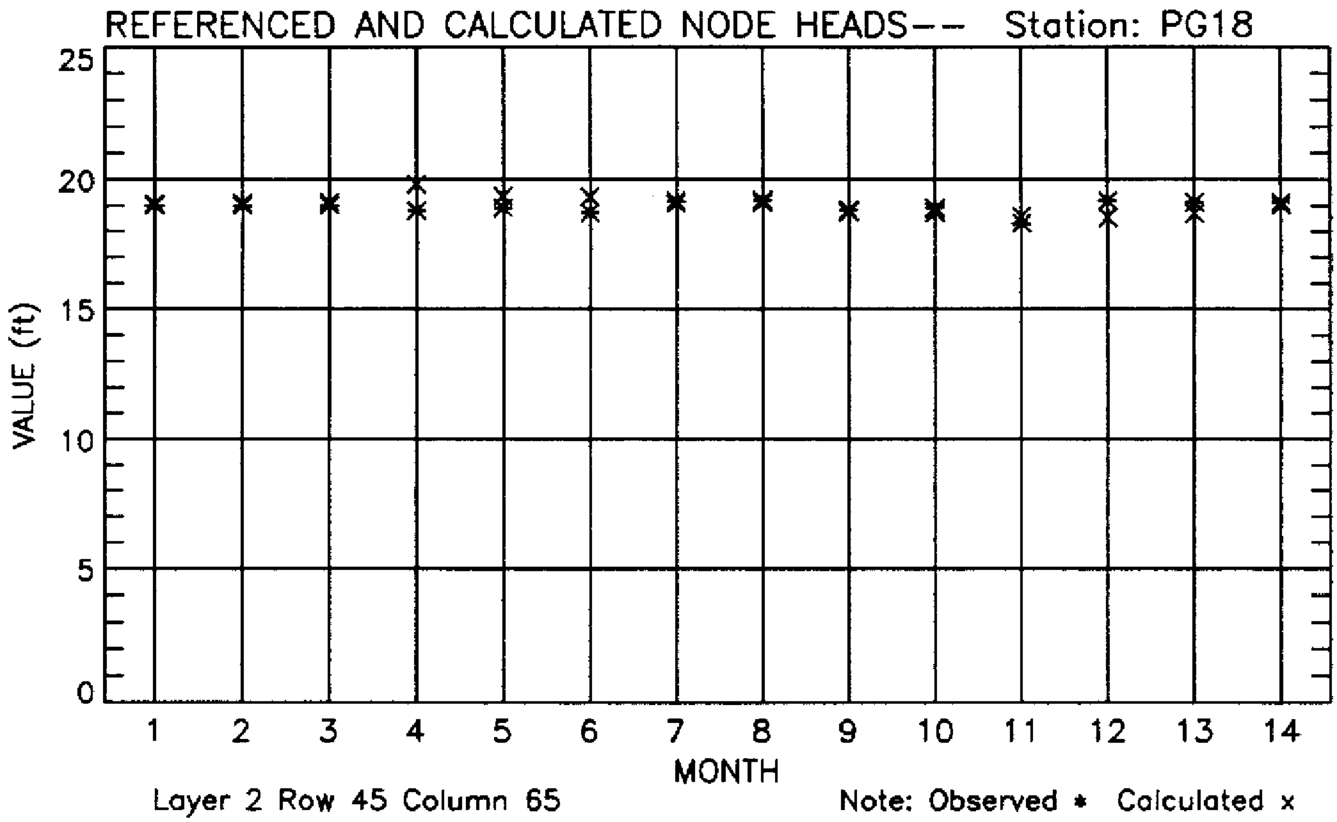


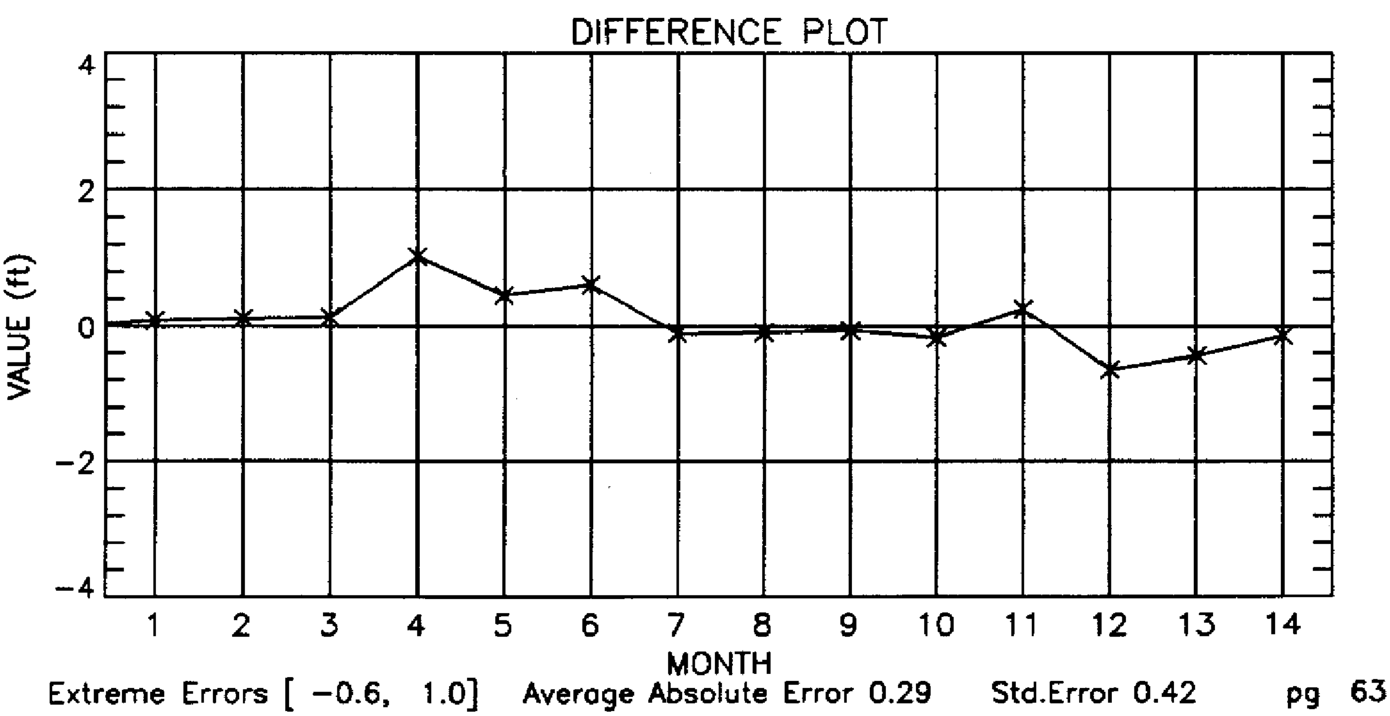
Extreme Errors [-0.3, 1.9] Average Absolute Error 0.60 Std.Error 0.77 pg 61

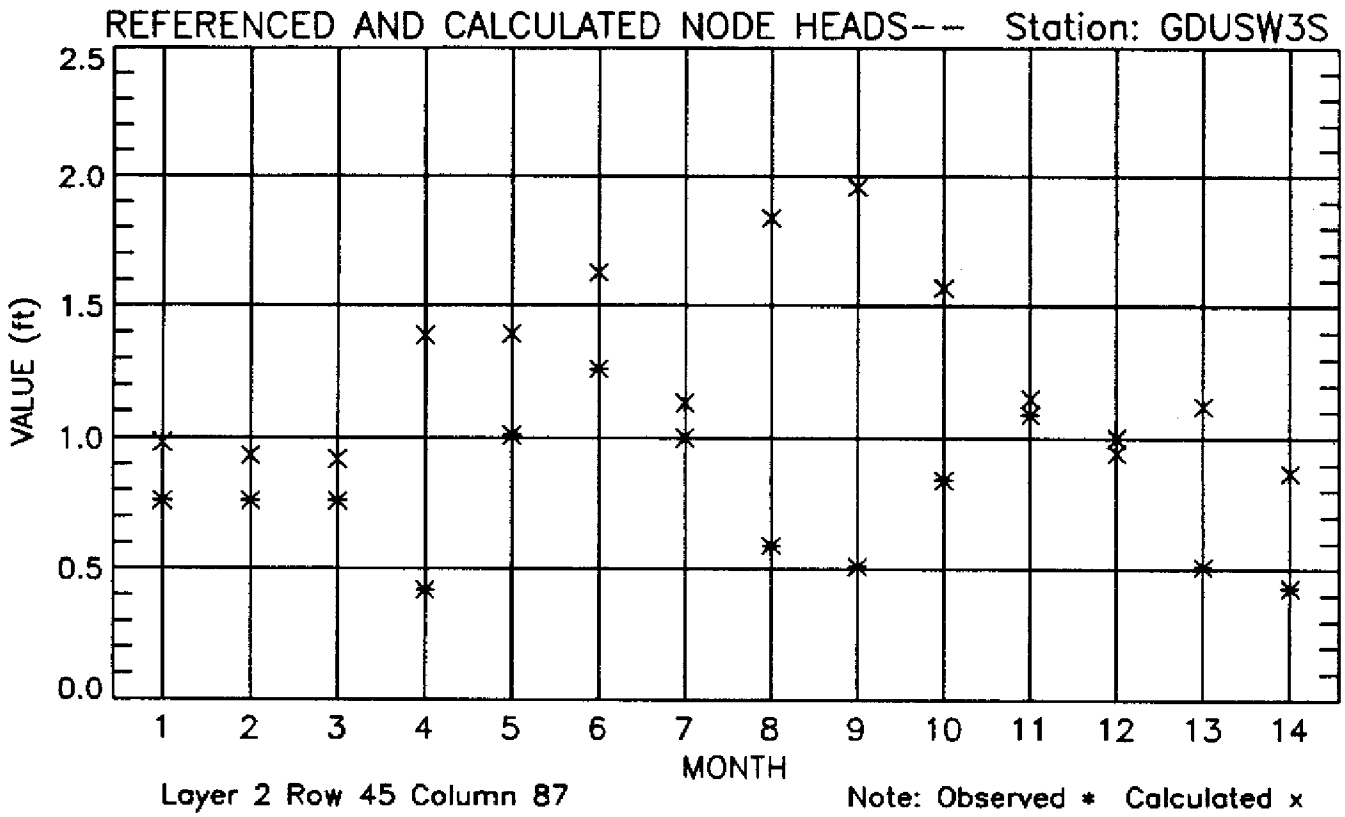




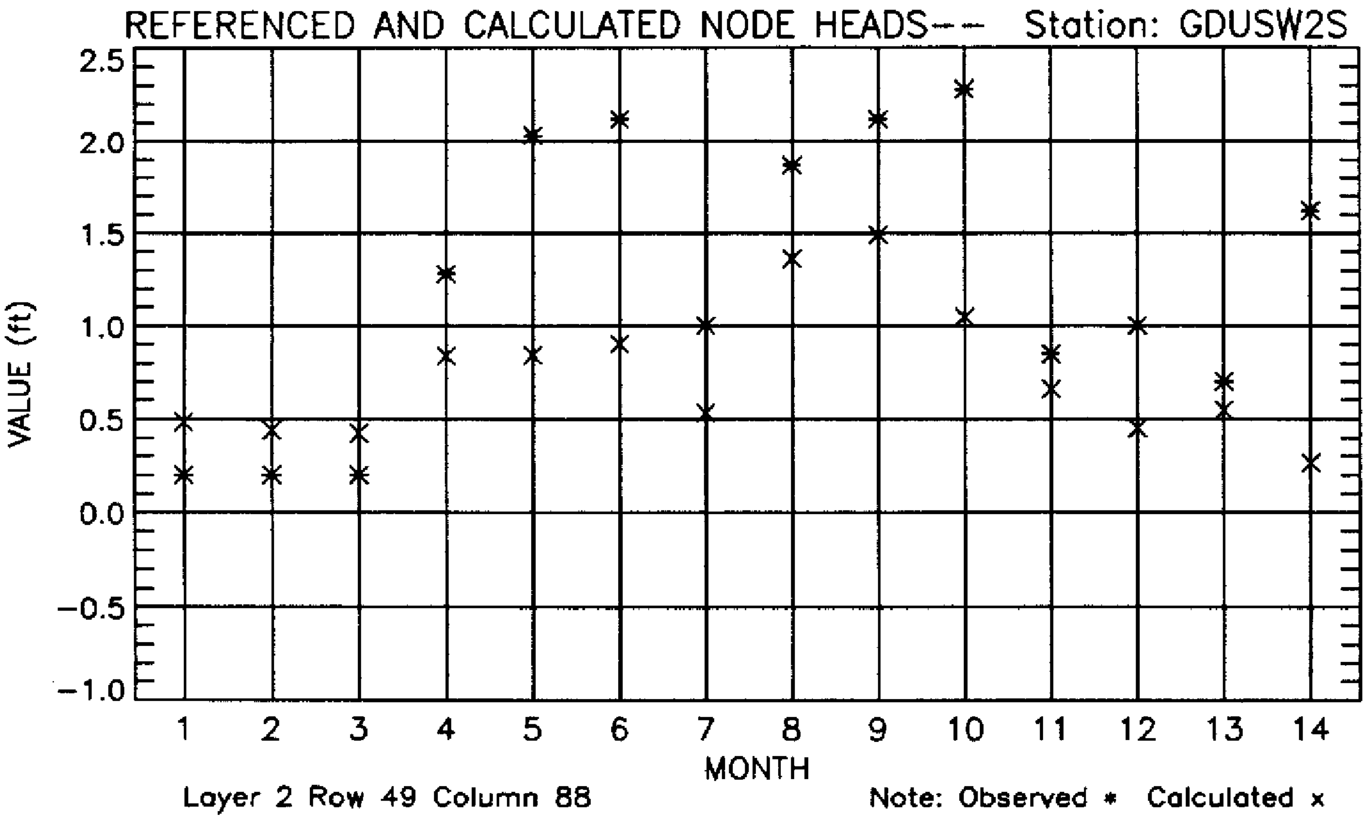
Extreme Errors [-0.5, 1.6] Average Absolute Error 0.51 Std.Error 0.77 pg 62

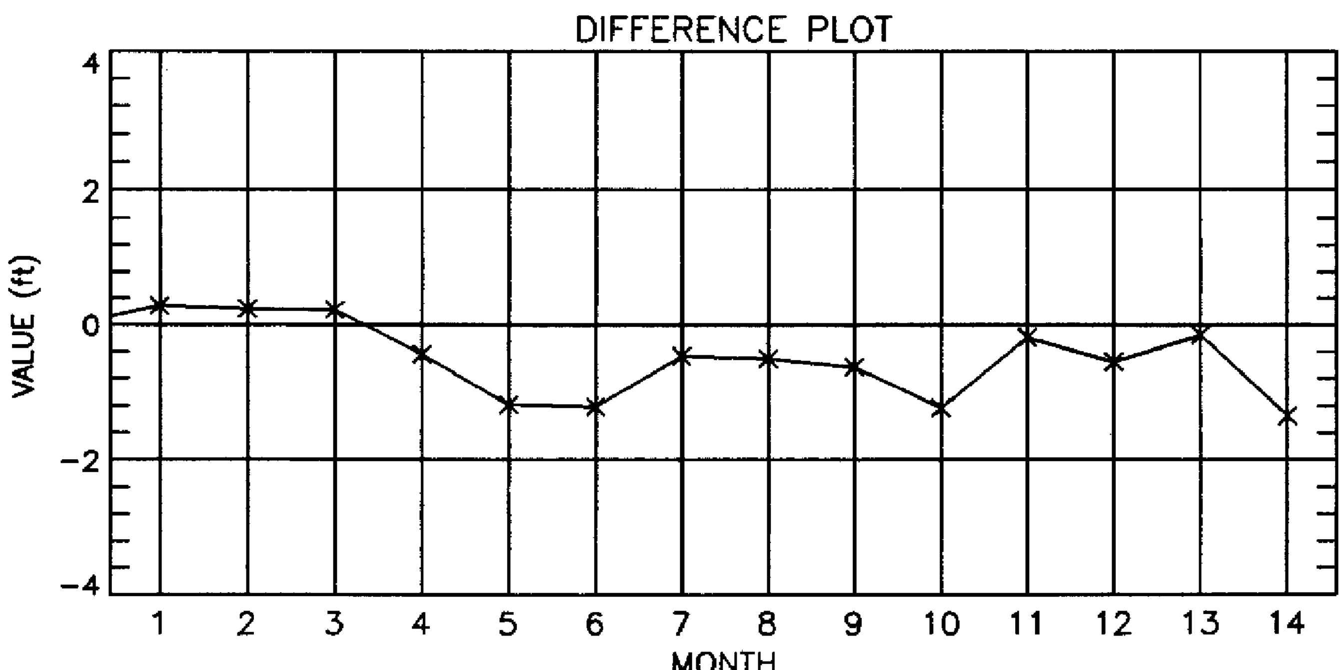

REFERENCED AND CALCULATED NODE HEADS-- Station: PG18
VALUE (ft)
MONTH
Layer 2 Row 45 Column 65
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [−0.6, 1.0] Average Absolute Error 0.29 Std.Error 0.42 pg 63

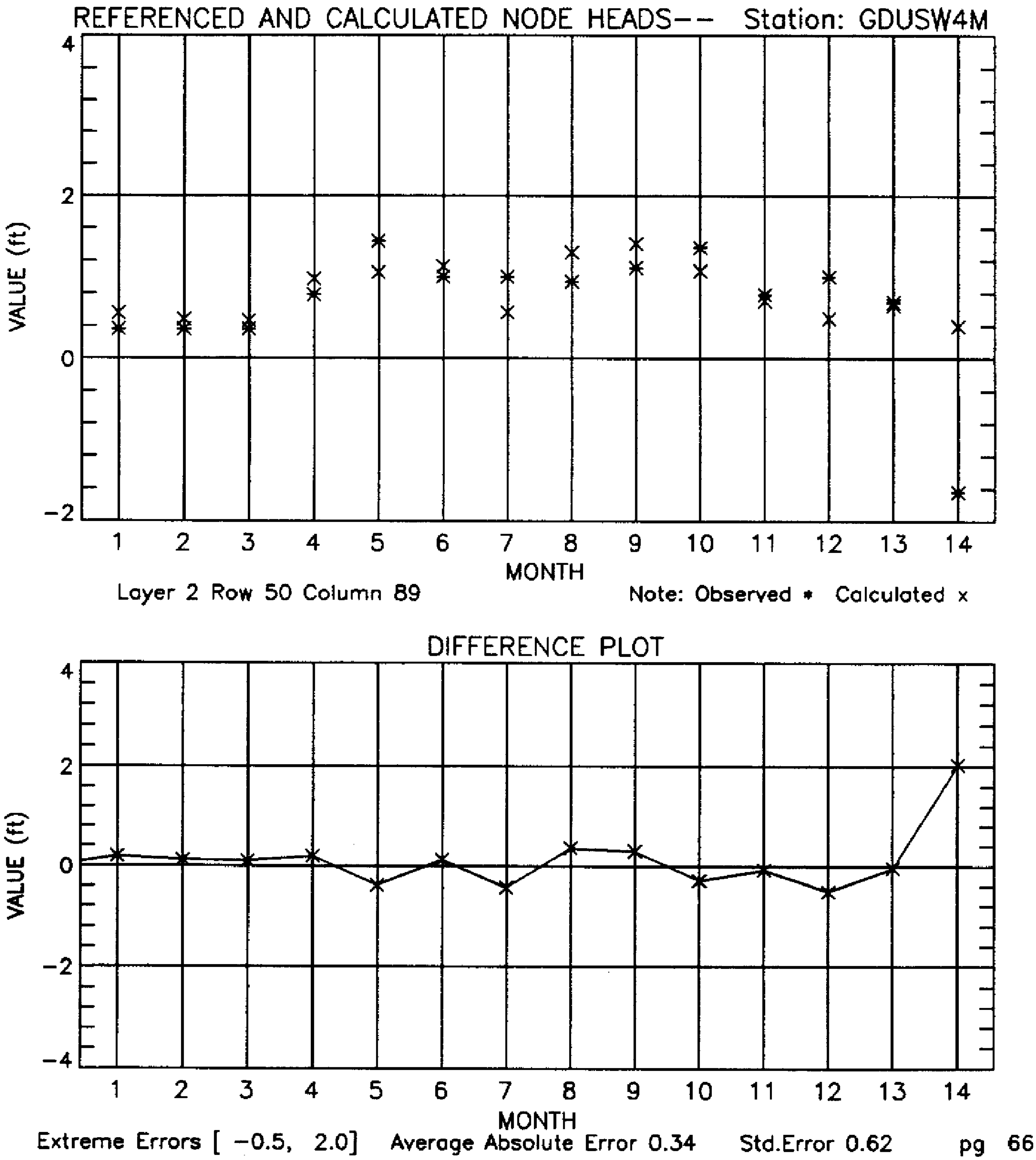


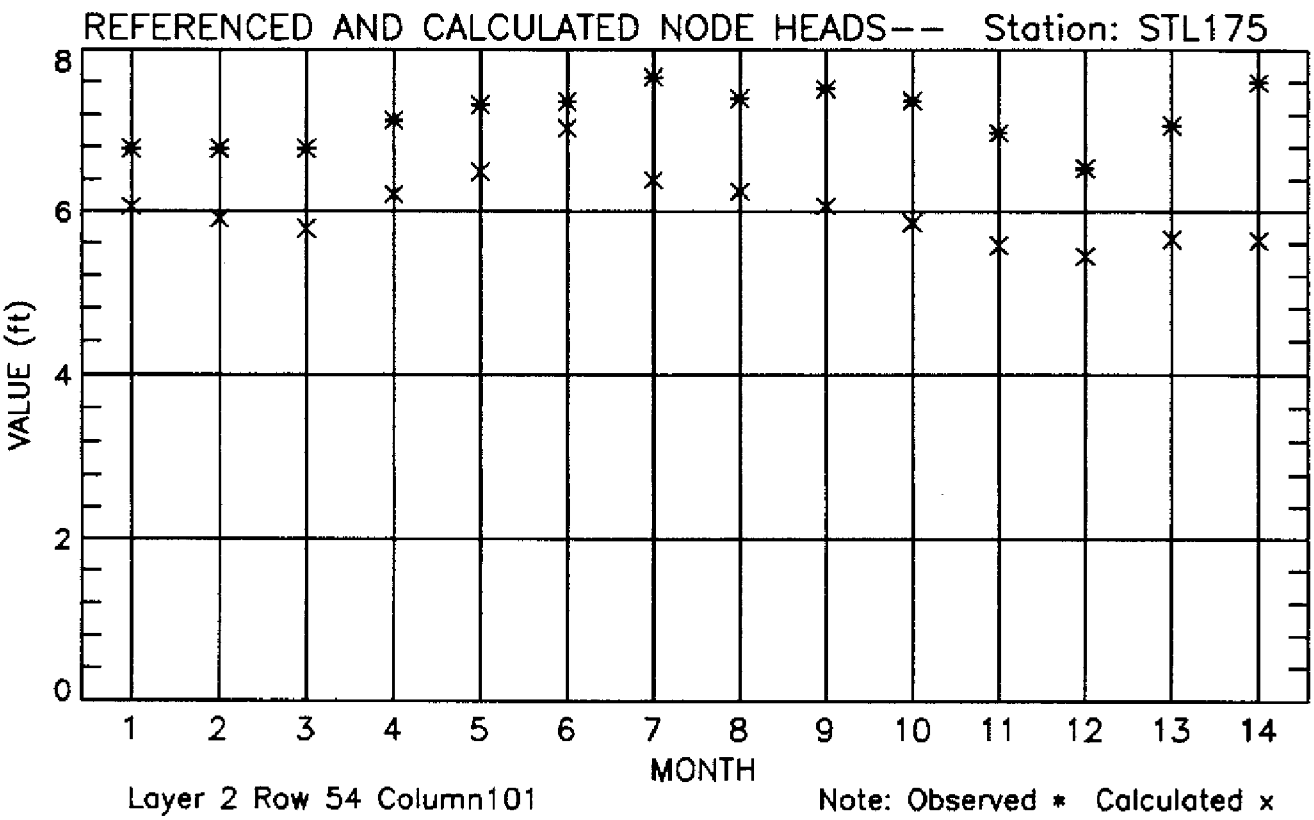
Extreme Errors [−0.1, 1.4] Average Absolute Error 0.47 Std.Error 0.46 pg 64

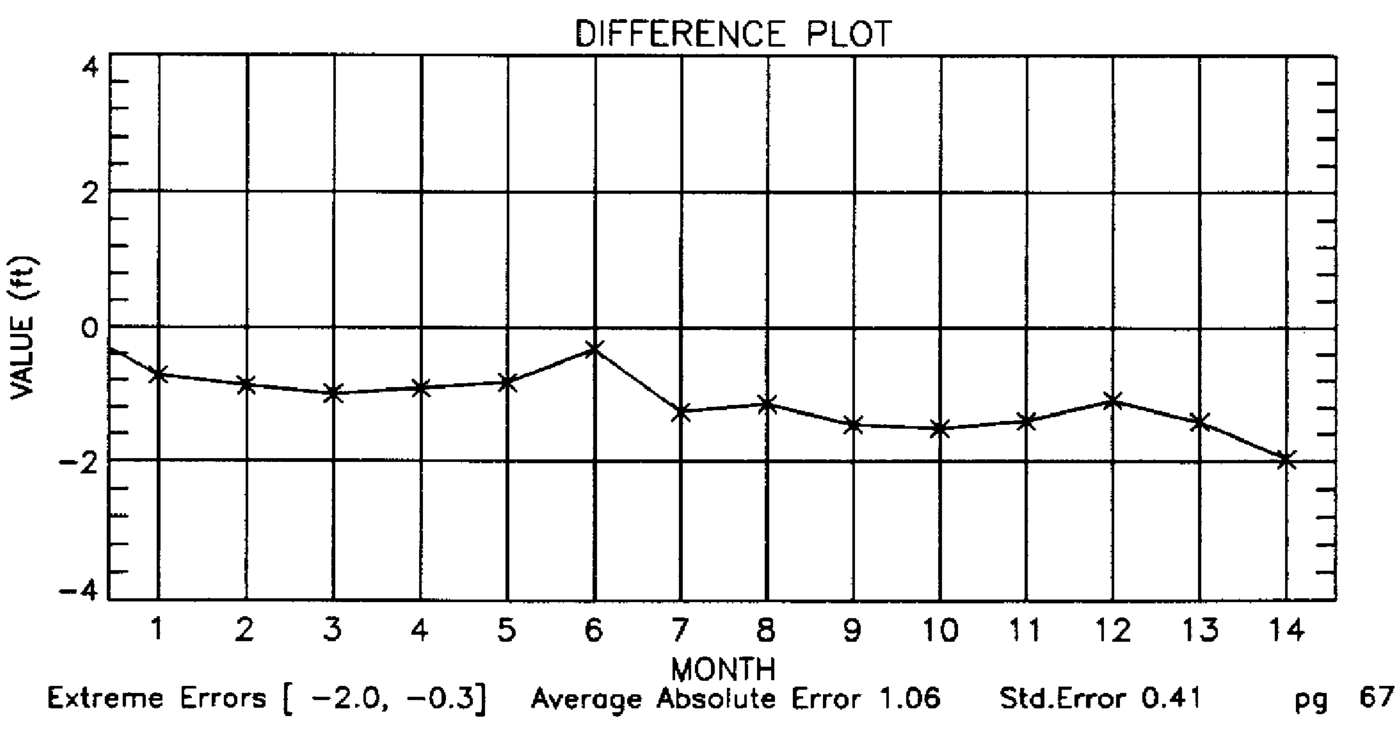


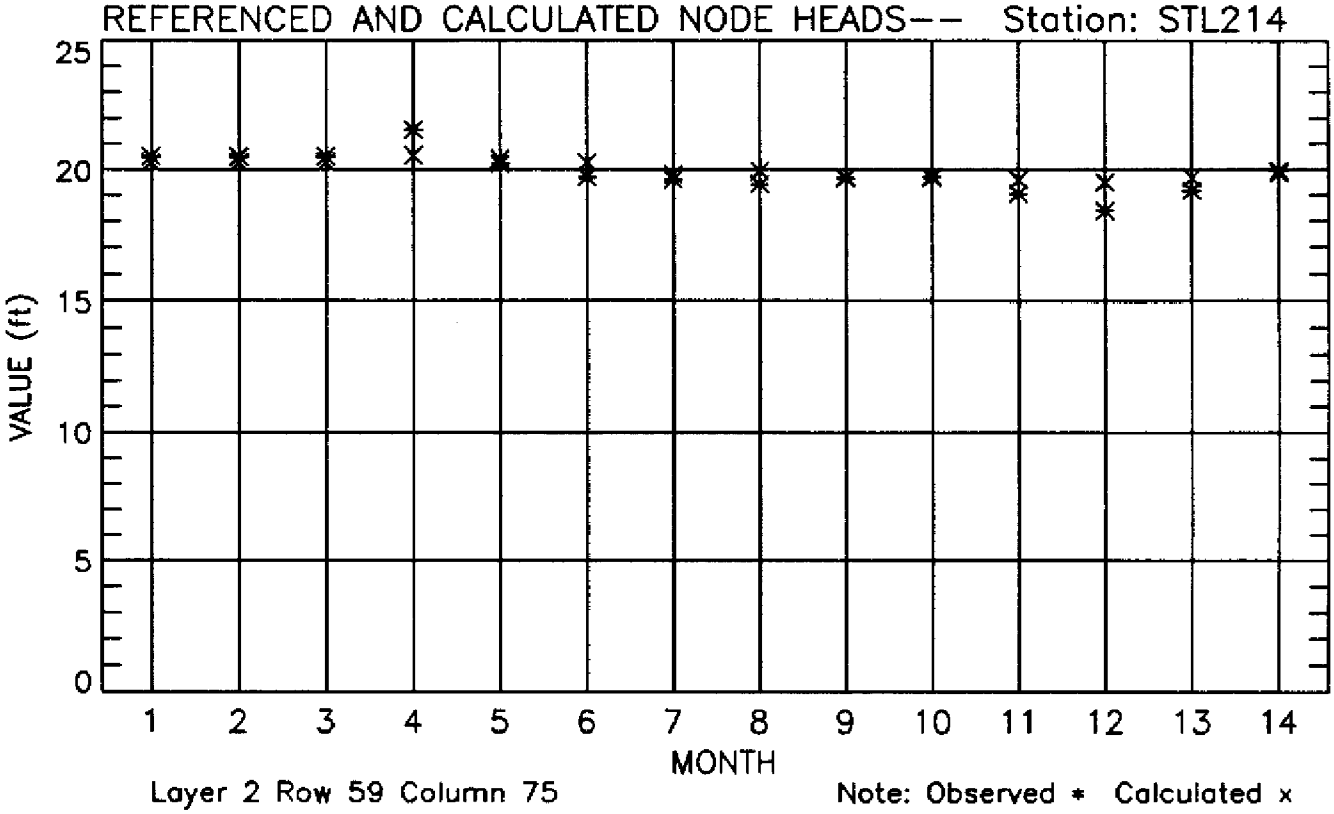


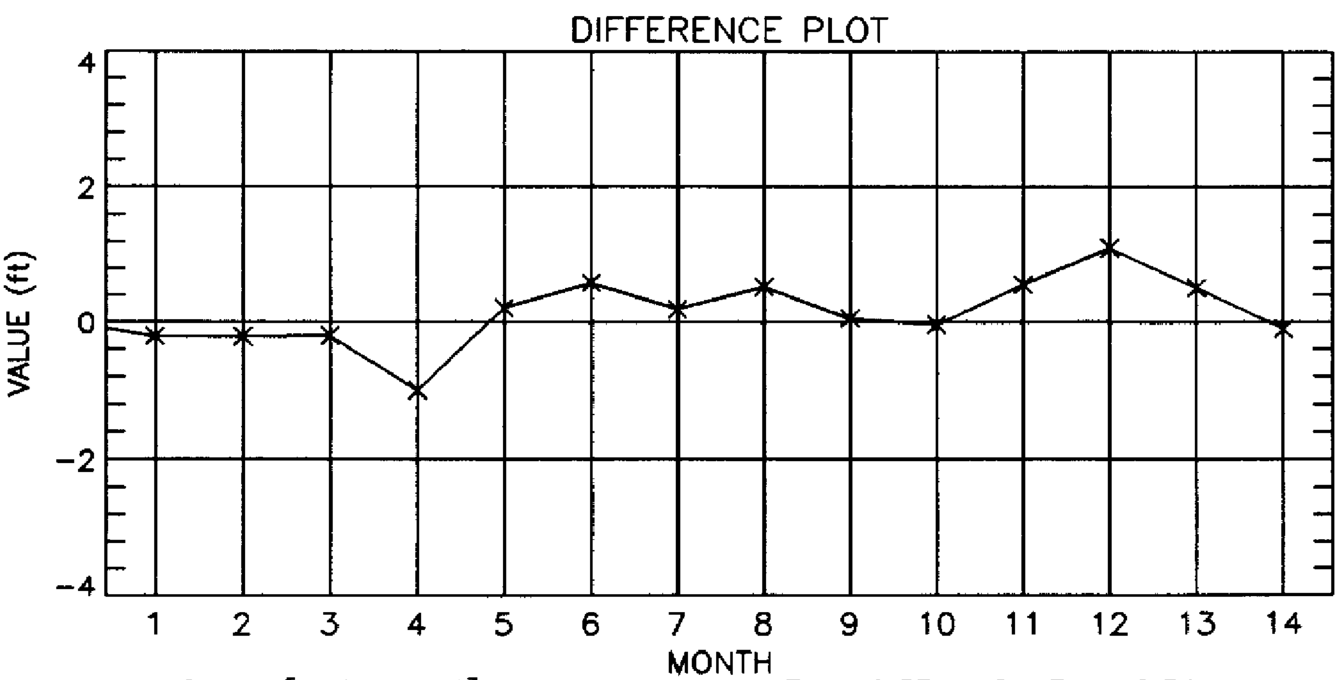
Extreme Errors [−1.4, 0.3] Average Absolute Error 0.58 Std.Error 0.57 pg 65


REFERENCED AND CALCULATED NODE HEADS-- Station: GDUSW4M
VALUE (ft)
4
2
0
-2
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 50 Column 89
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.5, 2.0] Average Absolute Error 0.34 Std.Error 0.62 pg 66

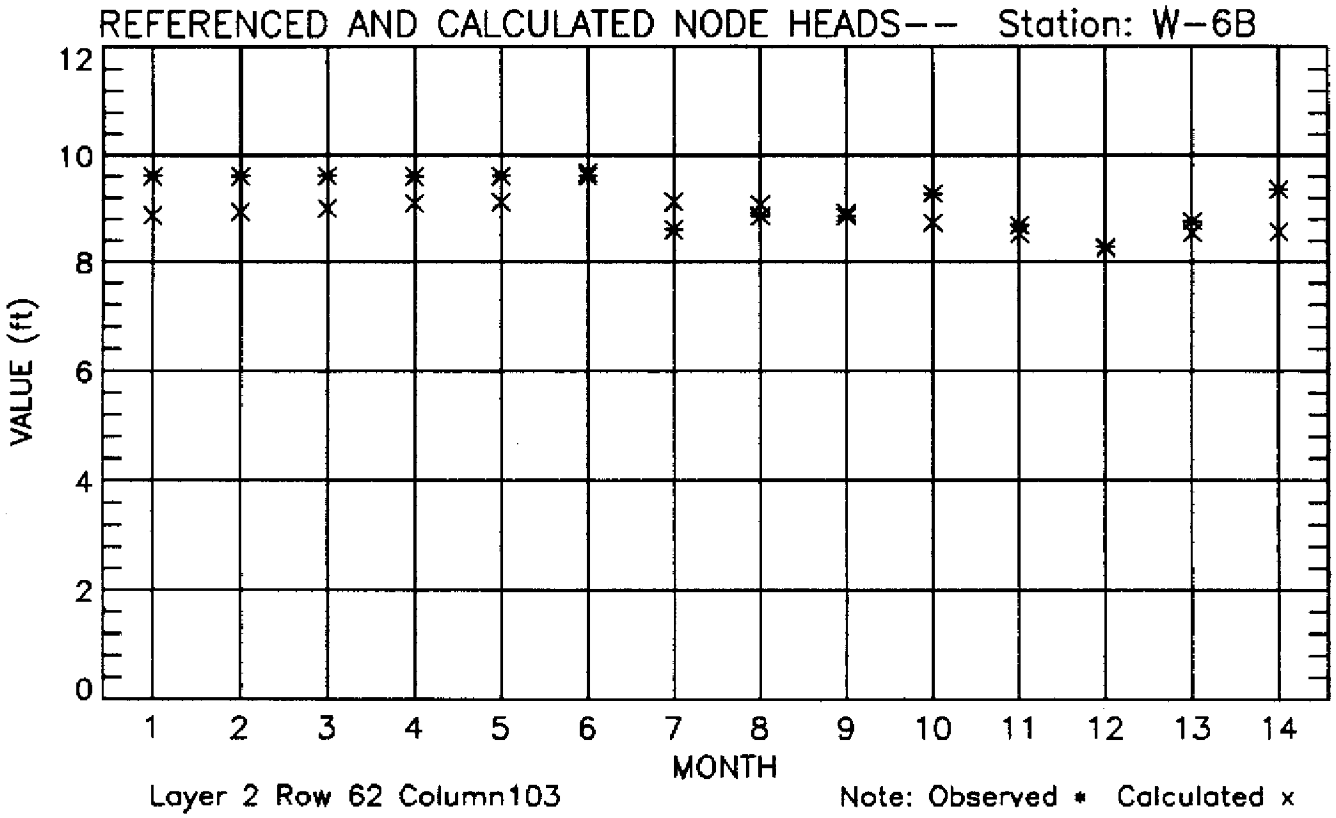

REFERENCED AND CALCULATED NODE HEADS-- Station: STL175
VALUE (ft)
0
2
4
6
8
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 54 Column101
Note: Observed * Calculated x

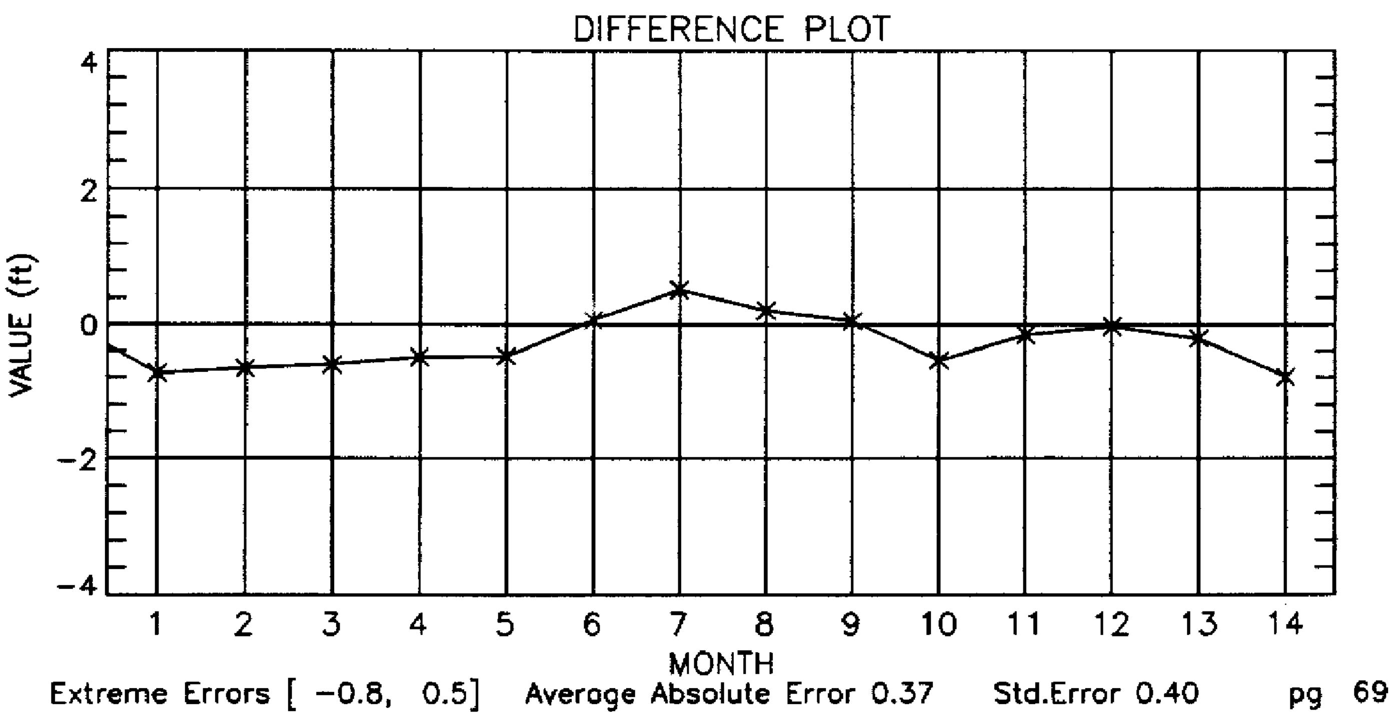

DIFFERENCE PLOT
VALUE (ft)
-4
-2
0
2
4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-2.0, -0.3] Average Absolute Error 1.06 Std.Error 0.41 pg 67



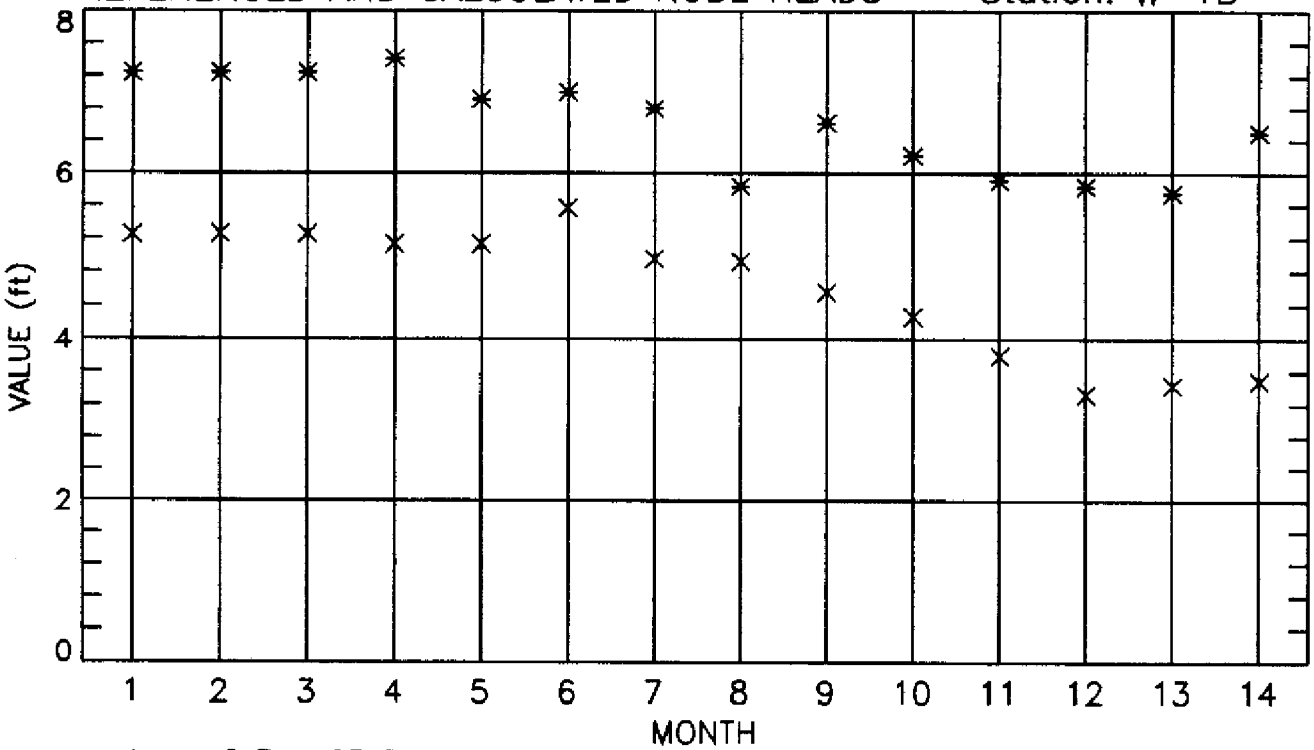


Extreme Errors [−1.0, 1.1] Average Absolute Error 0.37 Std.Error 0.51 pg 68


REFERENCED AND CALCULATED NODE HEADS-- Station: W-6B
VALUE (ft)
MONTH
Layer 2 Row 62 Column103
Note: Observed * Calculated x

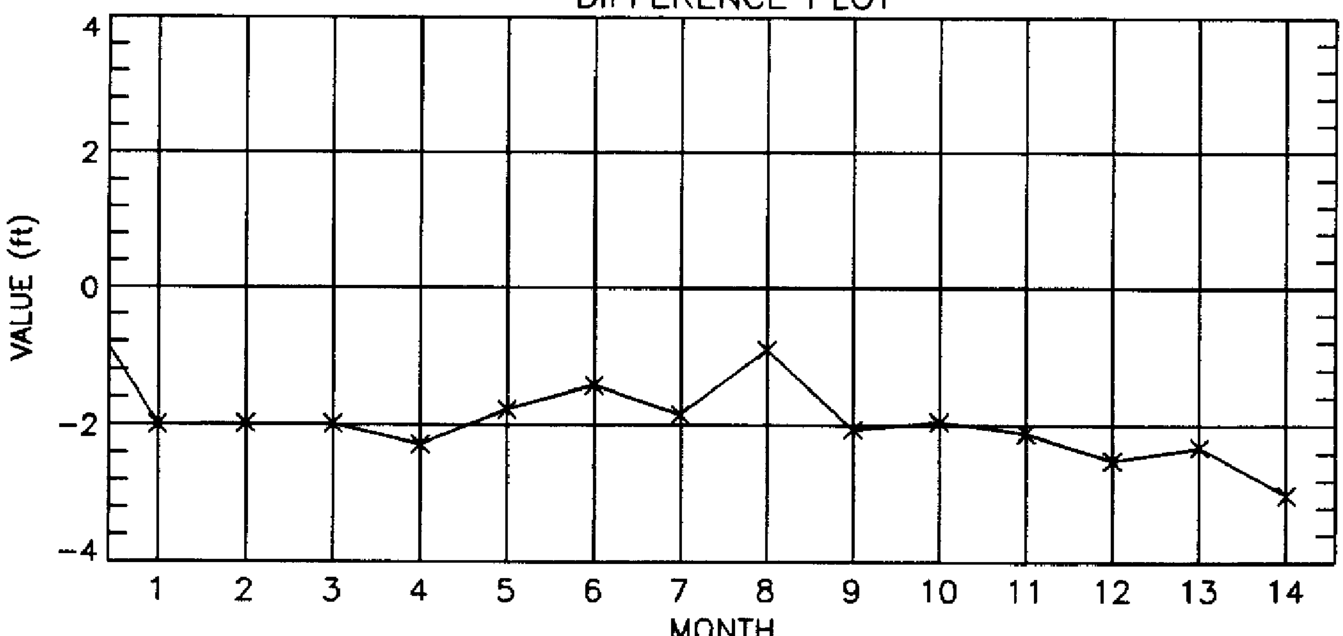

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.8, 0.5] Average Absolute Error 0.37 Std.Error 0.40 pg 69

REFERENCED AND CALCULATED NODE HEADS-- Station: W-1B

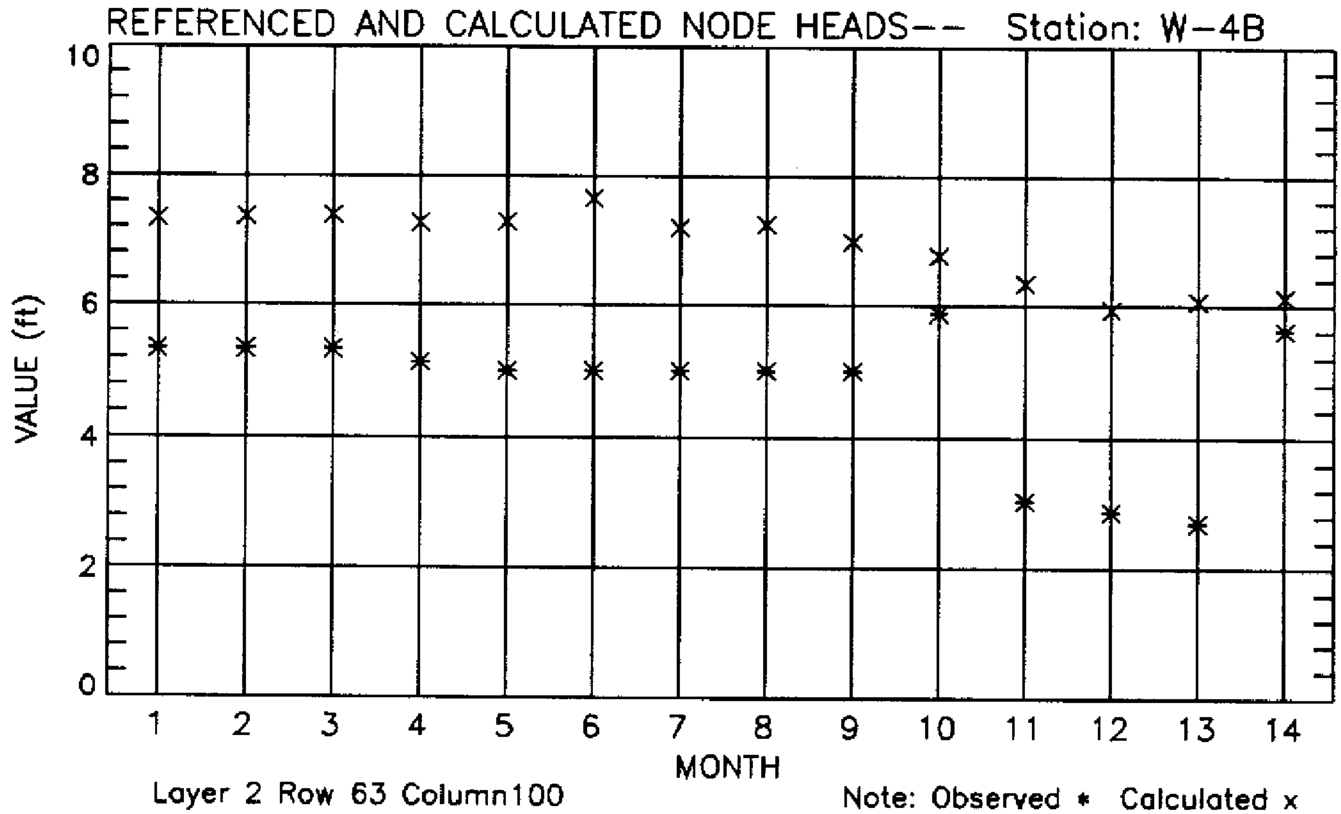


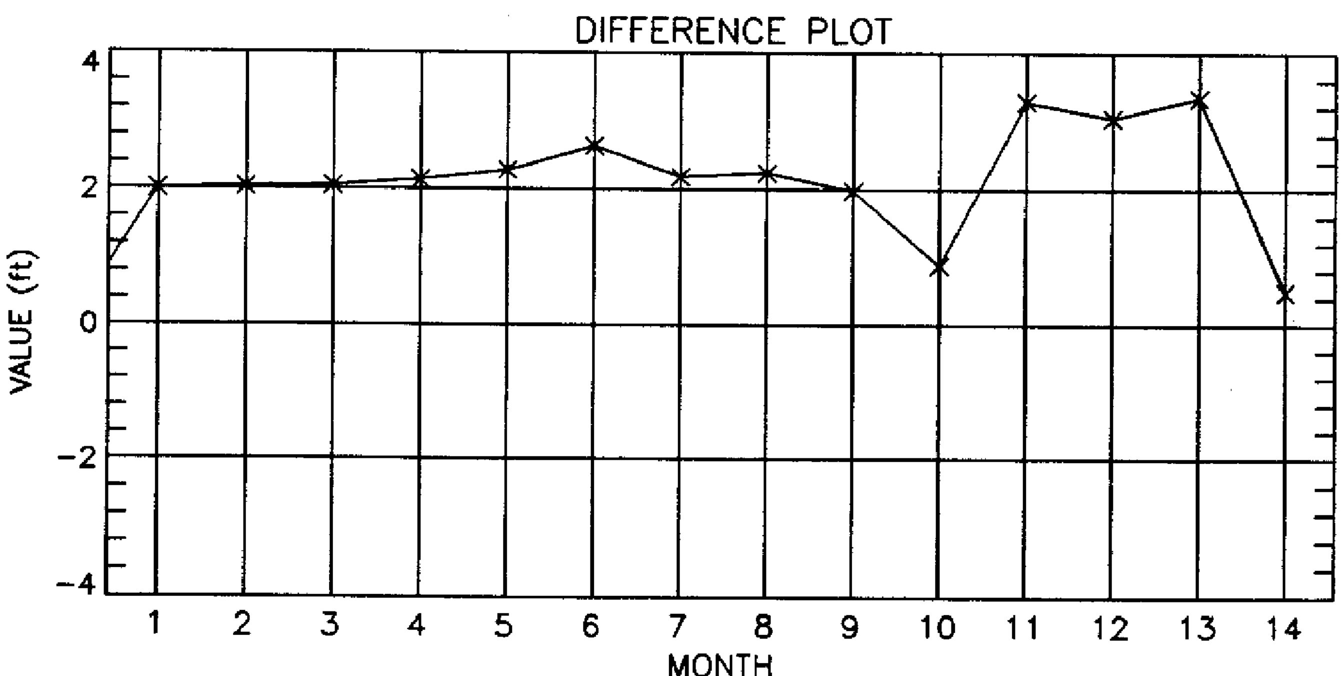
Layer 2 Row 63 Column 98 Note: Observed * Calculated x

DIFFERENCE PLOT

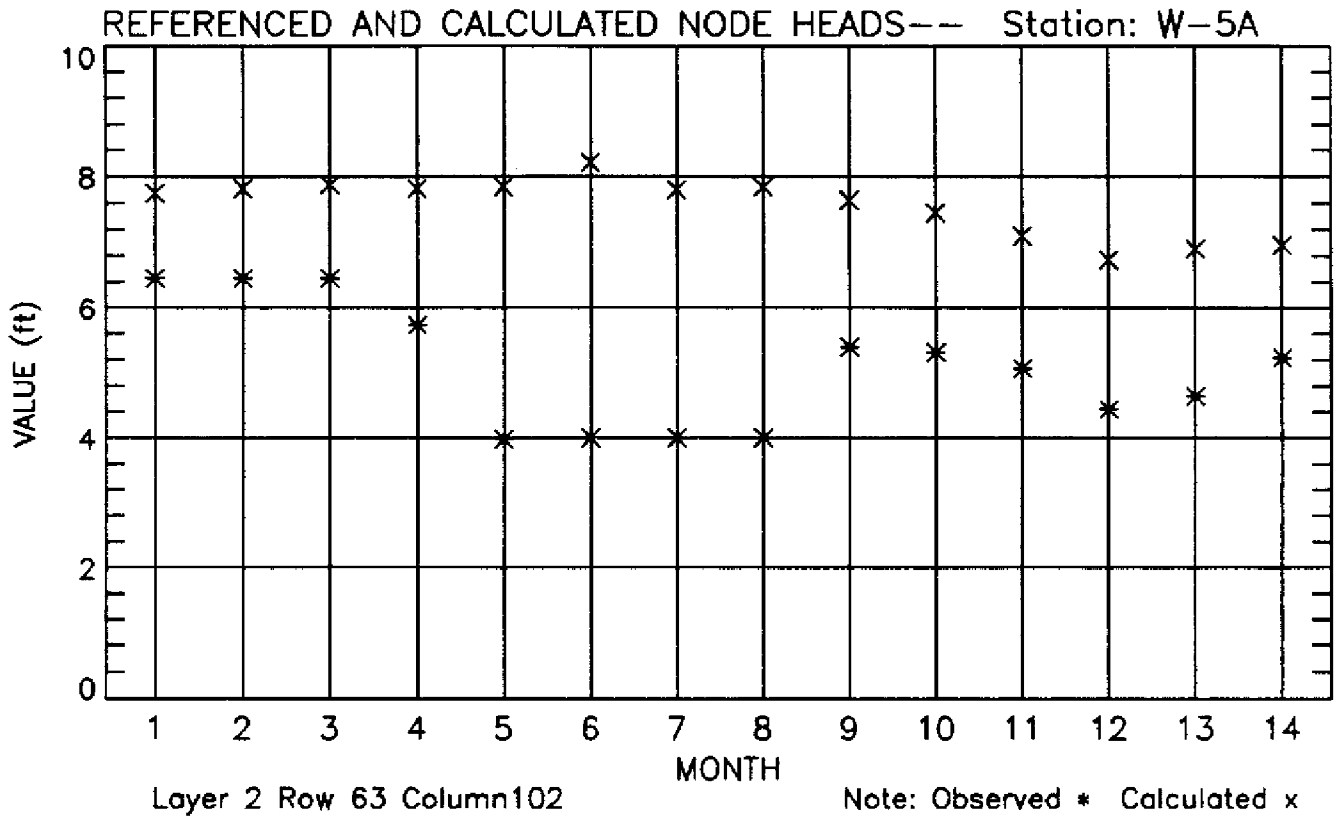


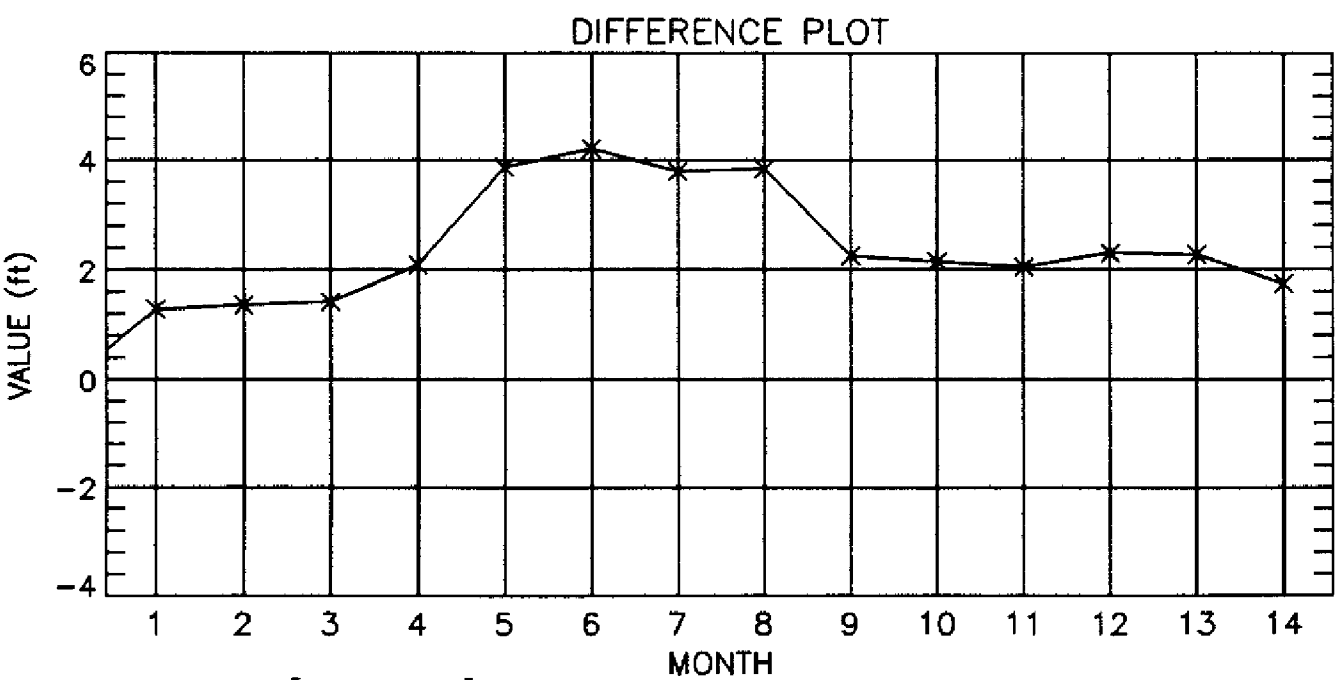
Extreme Errors [-3.0, -0.9] Average Absolute Error 1.88 Std.Error 0.48 pg 70



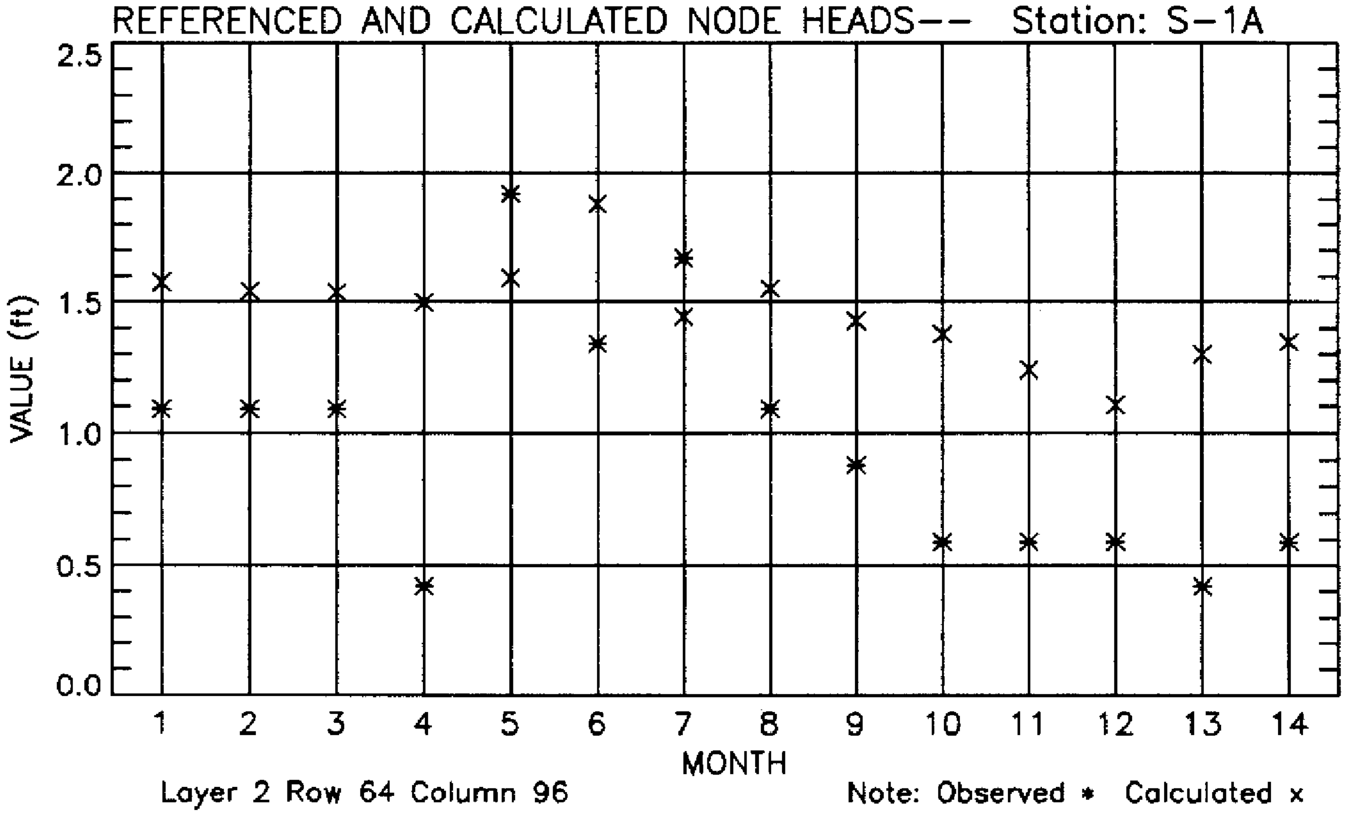


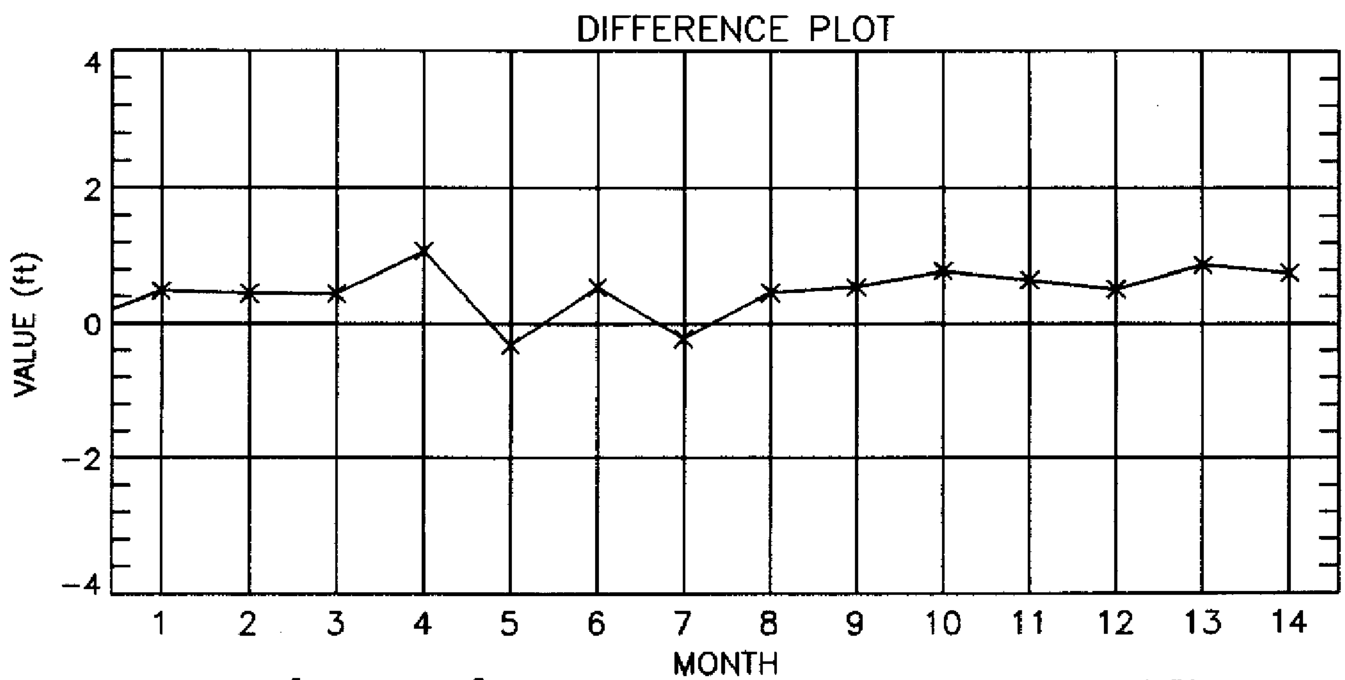
Extreme Errors [0.5, 3.4] Average Absolute Error 2.04 Std.Error 0.80 pg 71



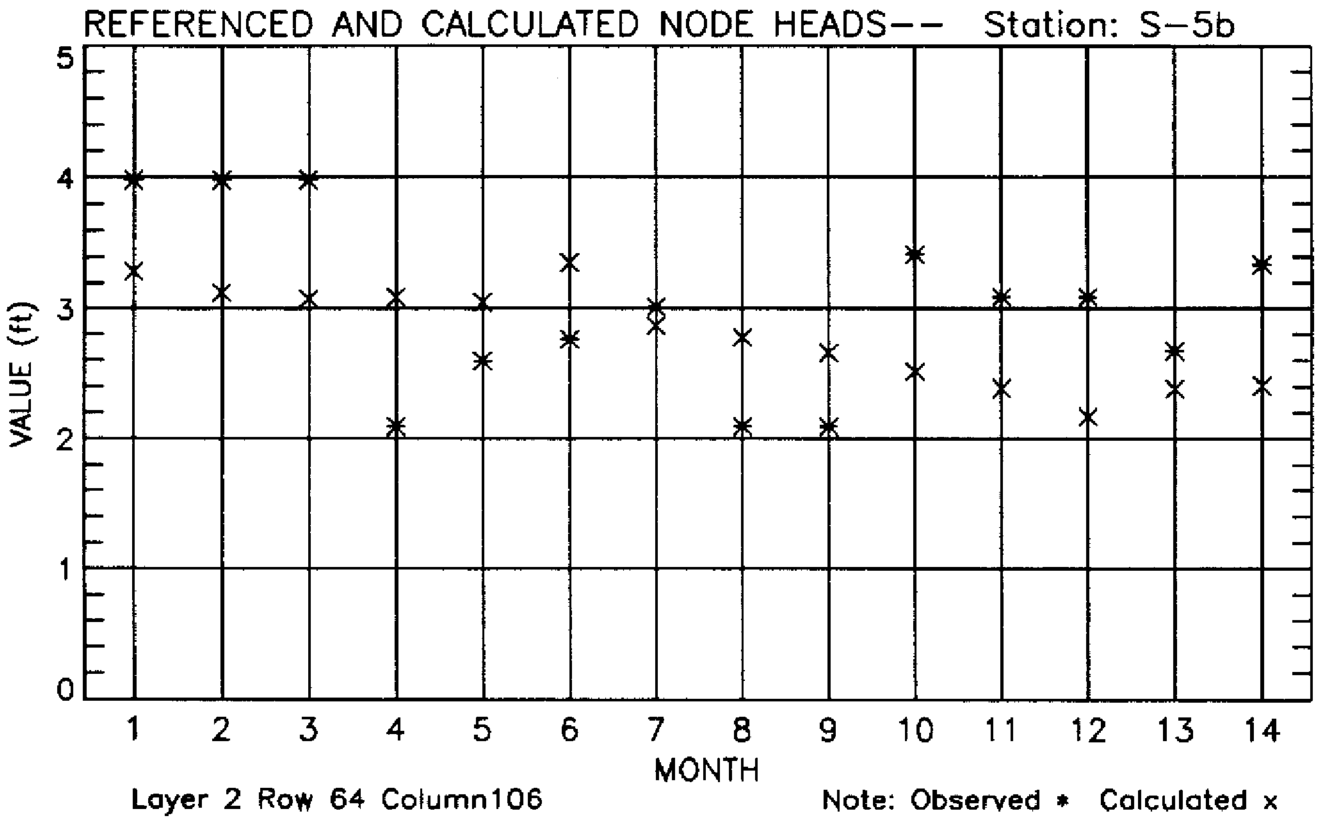


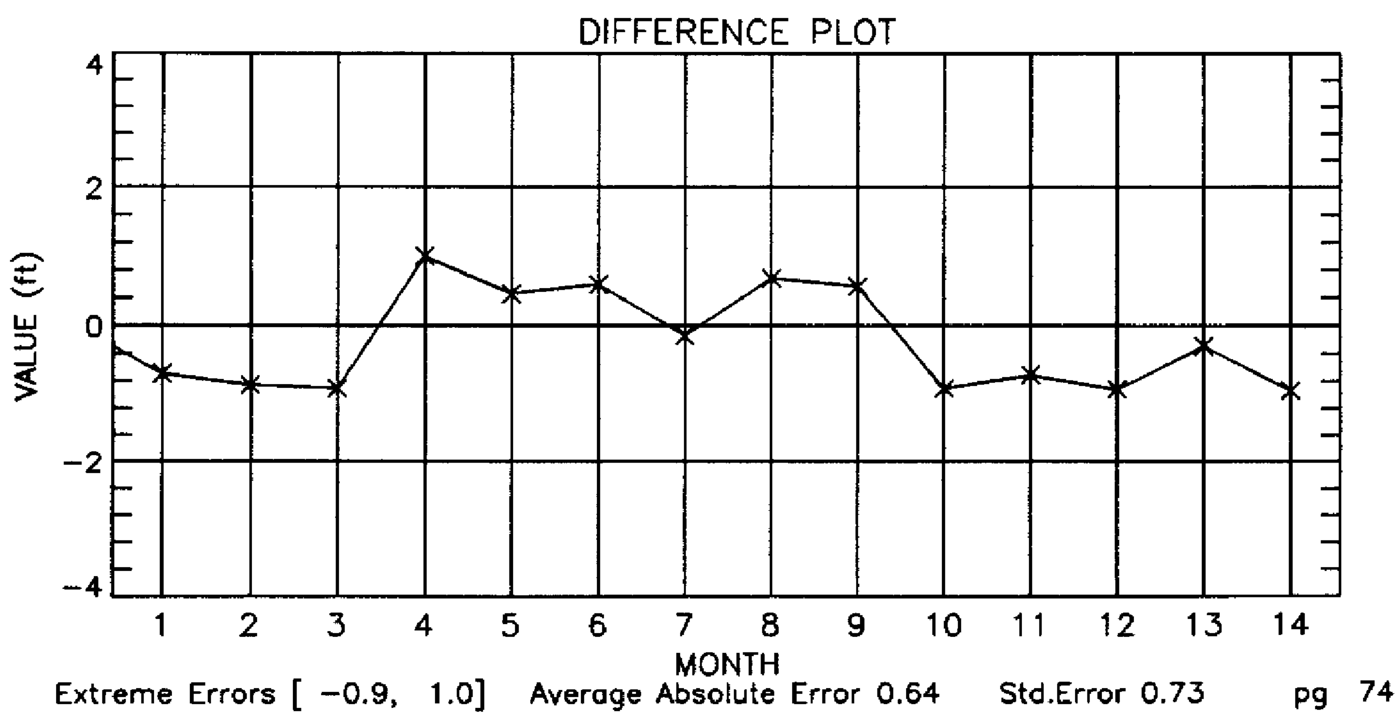
Extreme Errors [1.3, 4.2] Average Absolute Error 2.31 Std.Error 1.02 pg 72



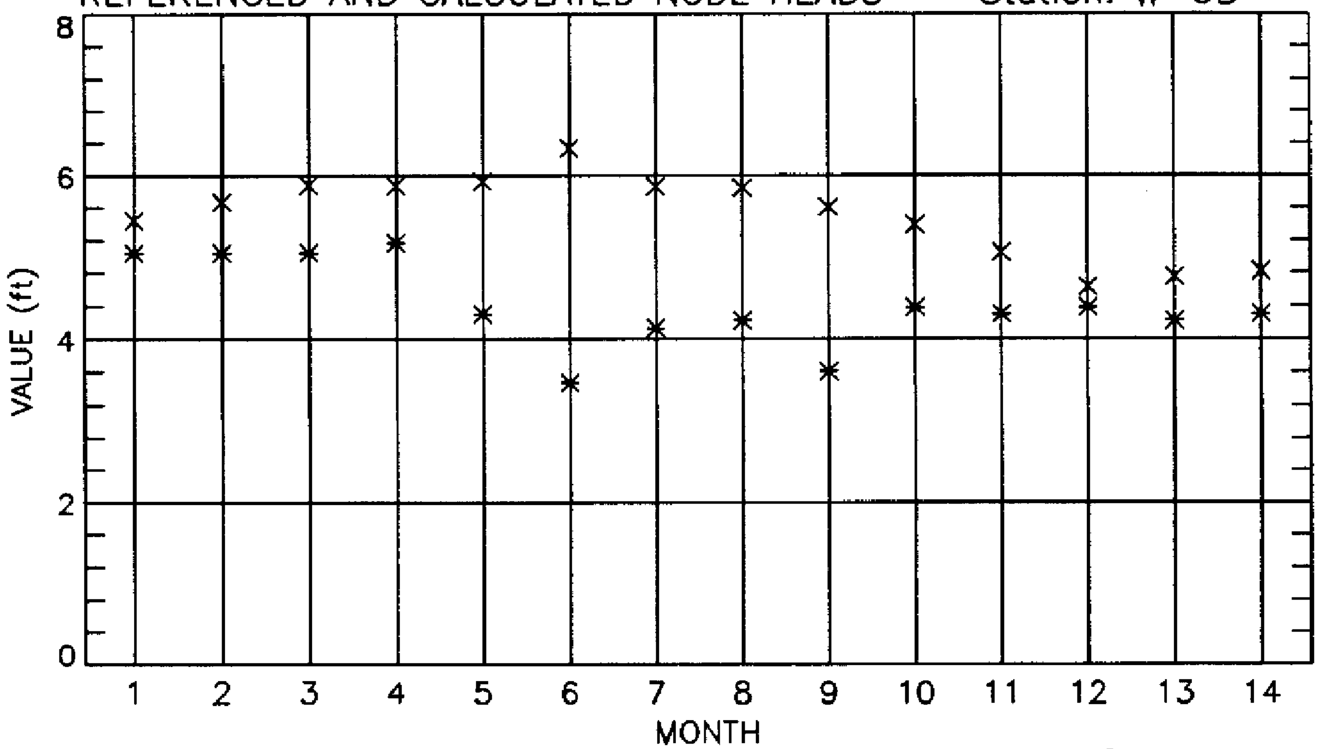


Extreme Errors [-0.3, 1.1] Average Absolute Error 0.54 Std.Error 0.38 pg 73


REFERENCED AND CALCULATED NODE HEADS-- Station: S-5b
VALUE (ft)
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 2 Row 64 Column106
Note: Observed * Calculated x

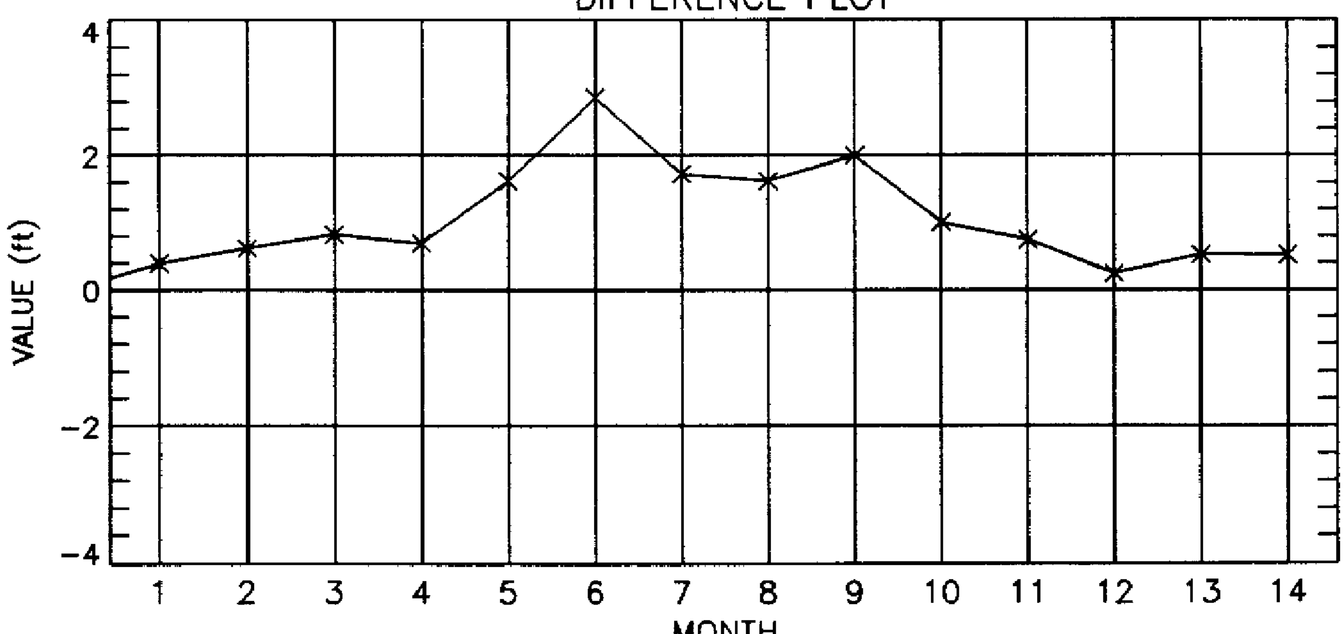

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.9, 1.0] Average Absolute Error 0.64 Std.Error 0.73 pg 74

REFERENCED AND CALCULATED NODE HEADS-- Station: W-3B

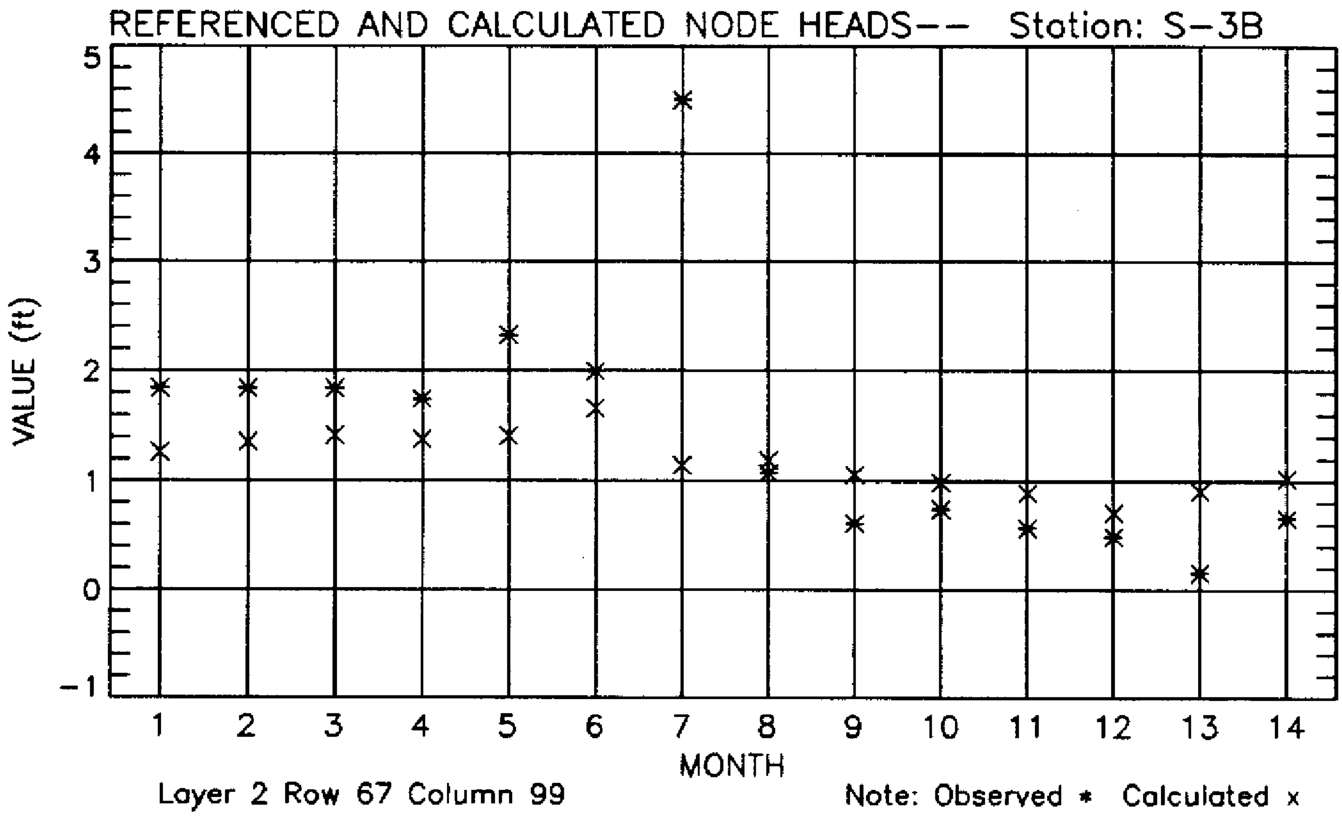


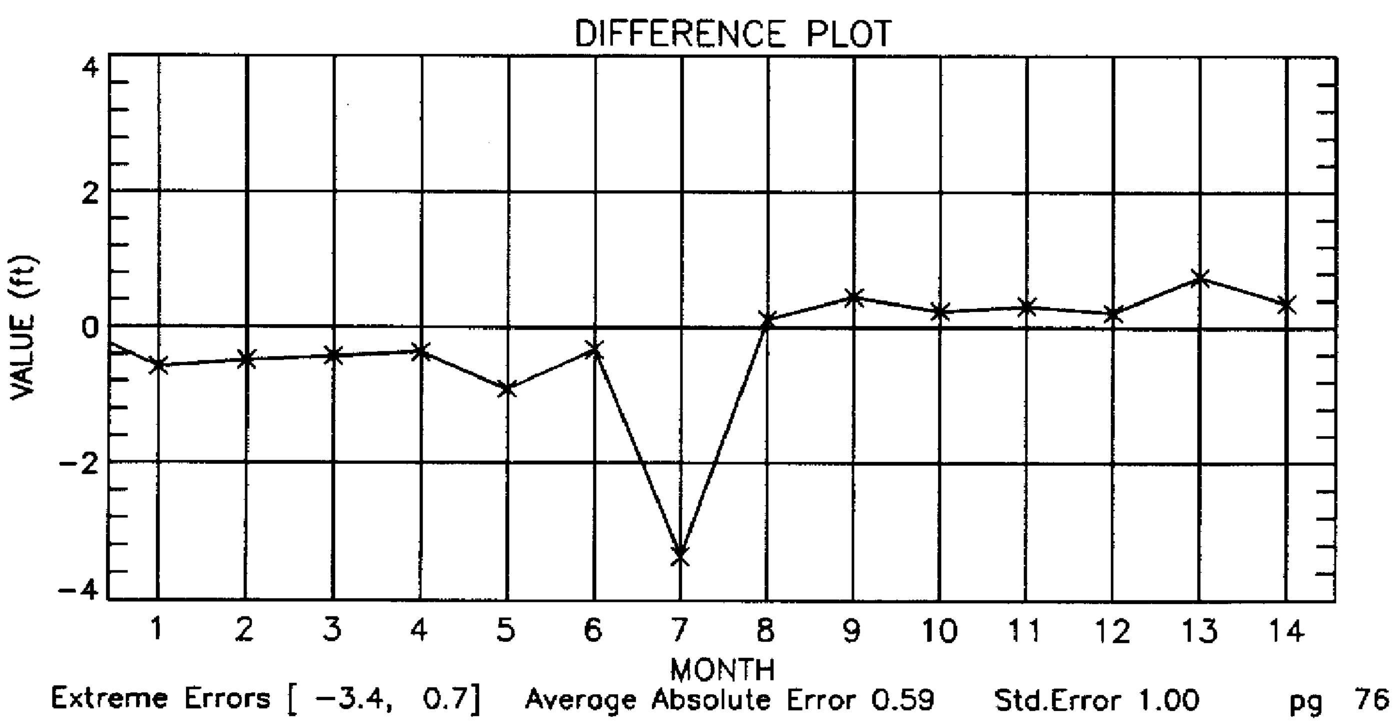
Layer 2 Row 65 Column103 Note: Observed * Calculated x

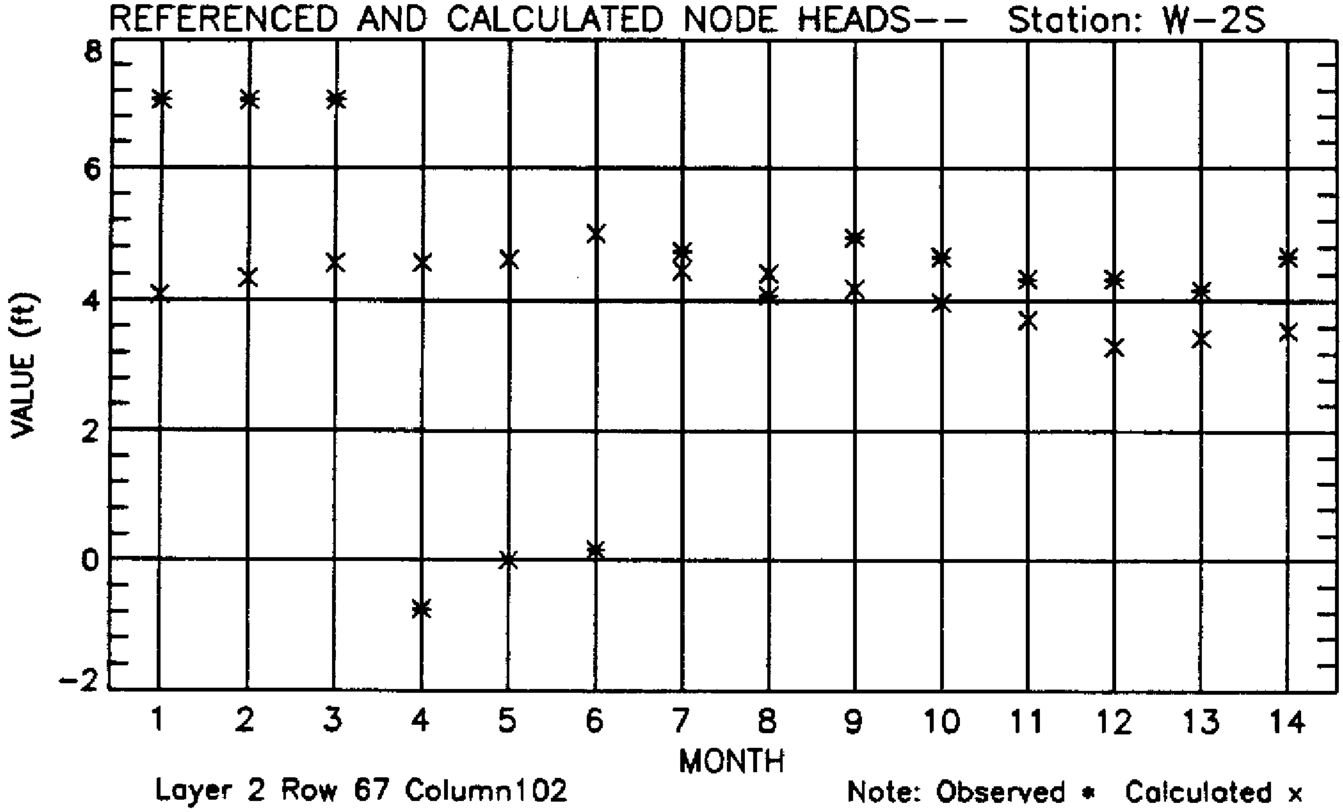
DIFFERENCE PLOT

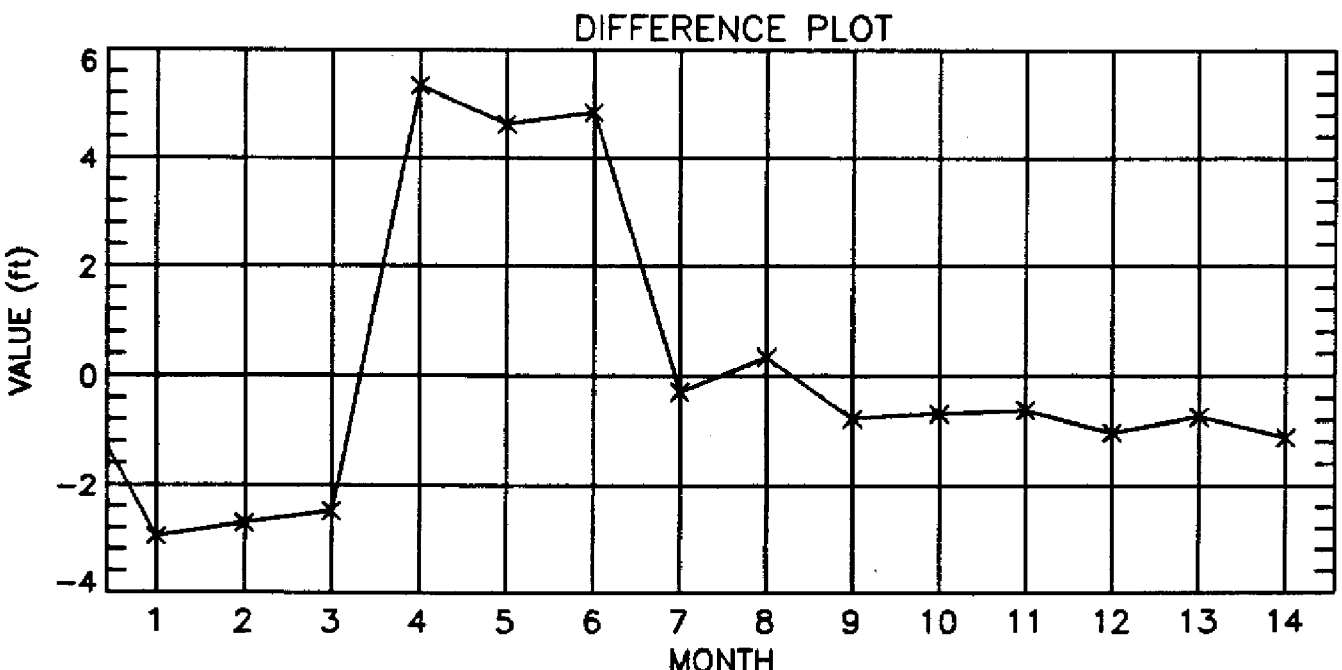


Extreme Errors [0.2, 2.9] Average Absolute Error 1.03 Std.Error 0.75 pg 75

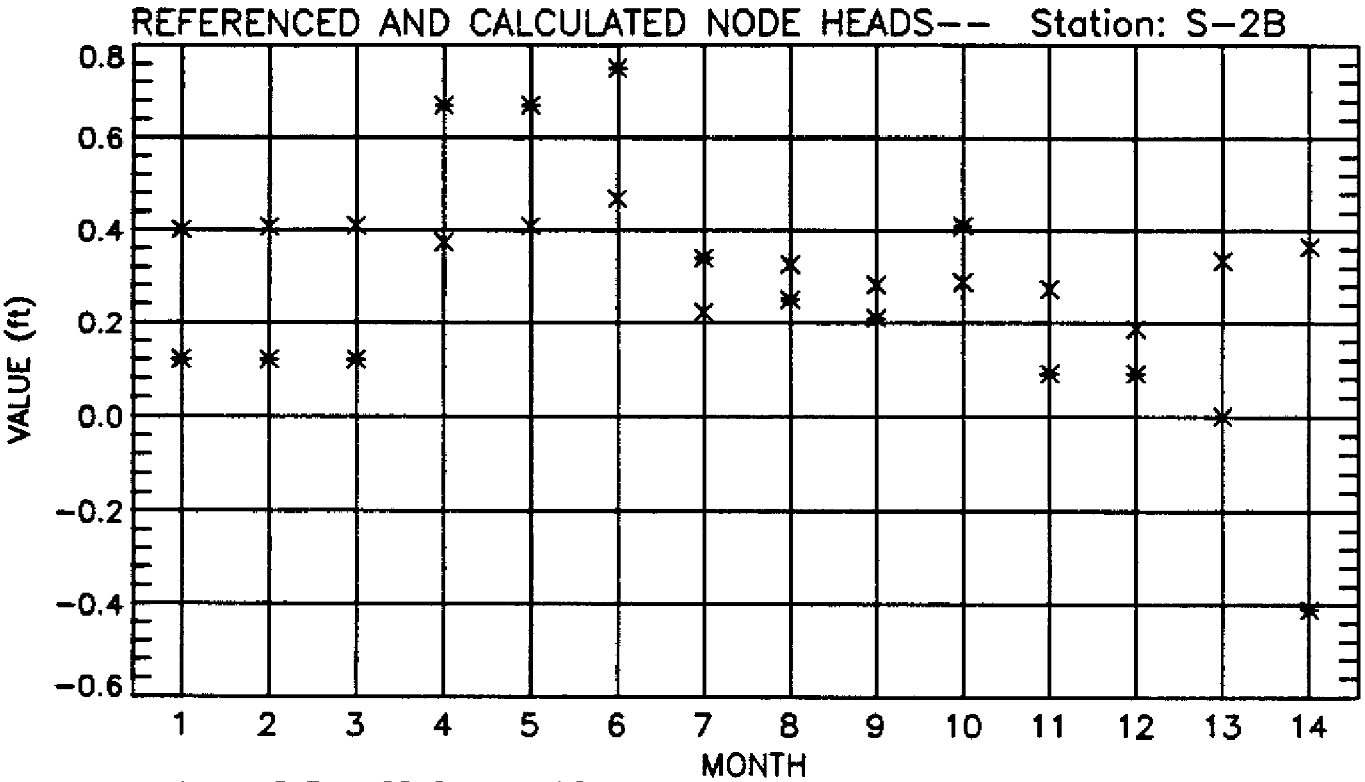

REFERENCED AND CALCULATED NODE HEADS-- Station: S-3B
VALUE (ft)
MONTH
Layer 2 Row 67 Column 99
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-3.4, 0.7] Average Absolute Error 0.59 Std.Error 1.00 pg 76

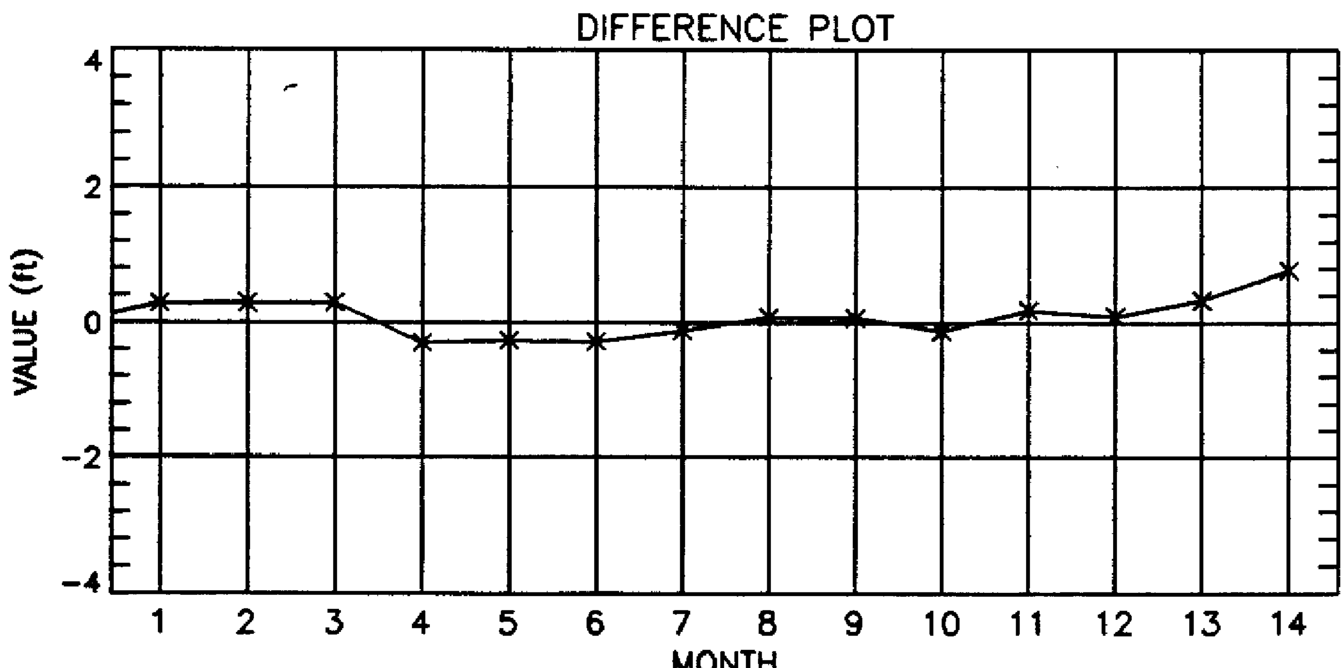




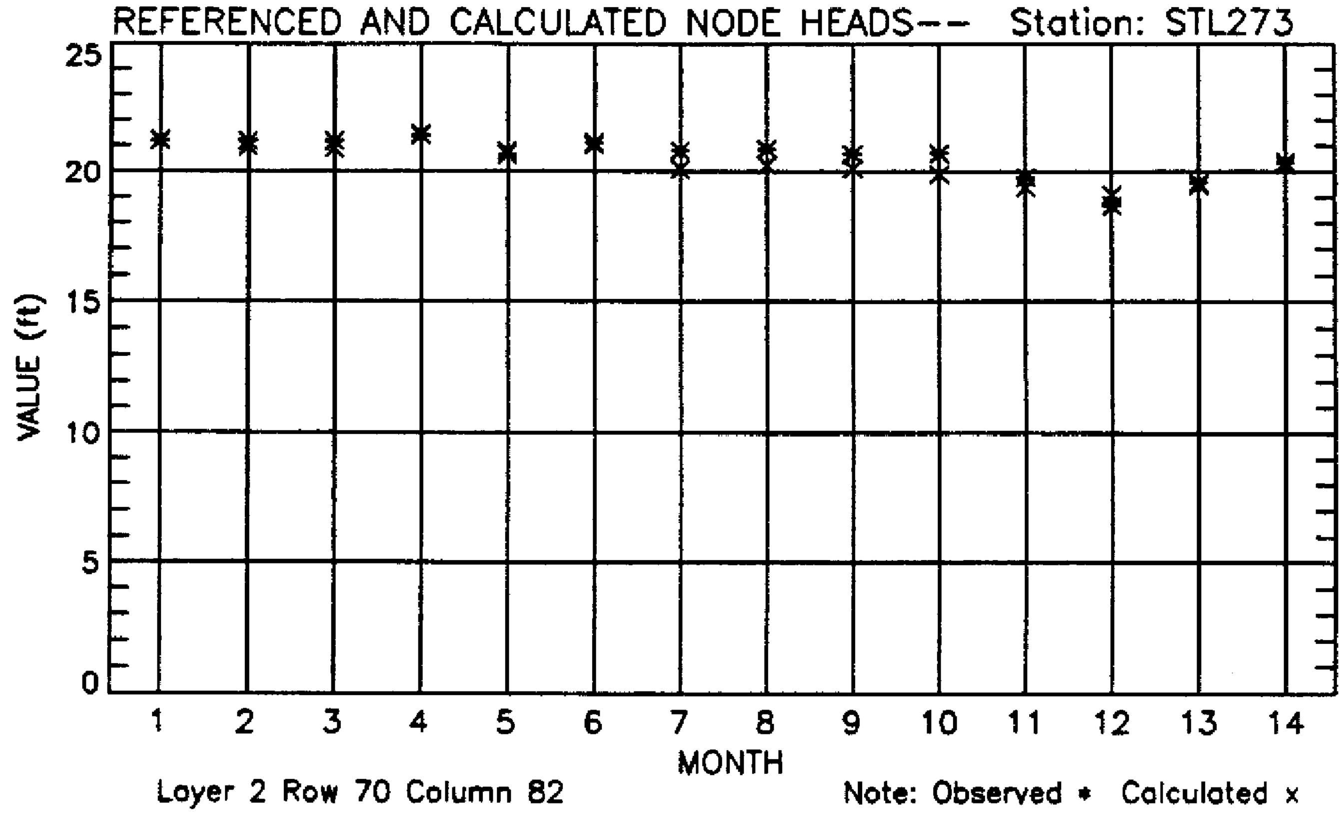
Extreme Errors [-3.0, 5.3] Average Absolute Error 1.90 Std.Error 2.77 pg 77

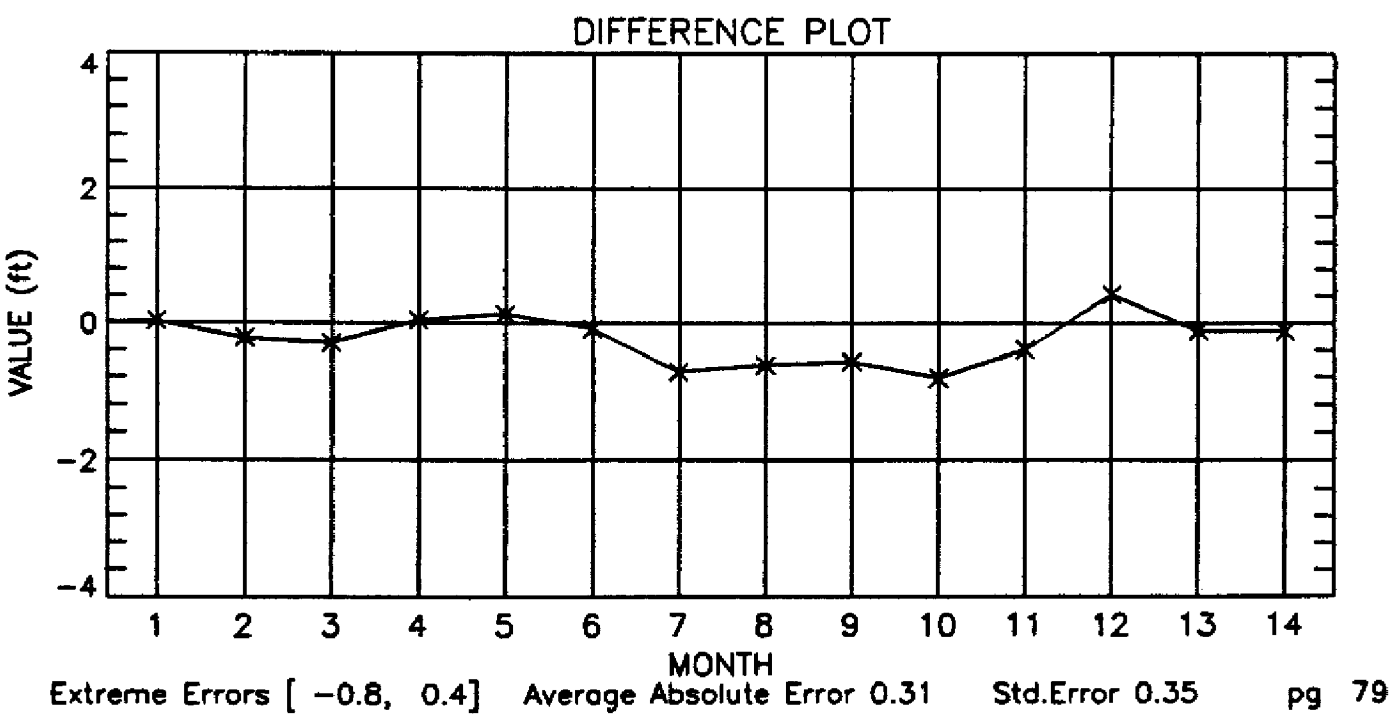


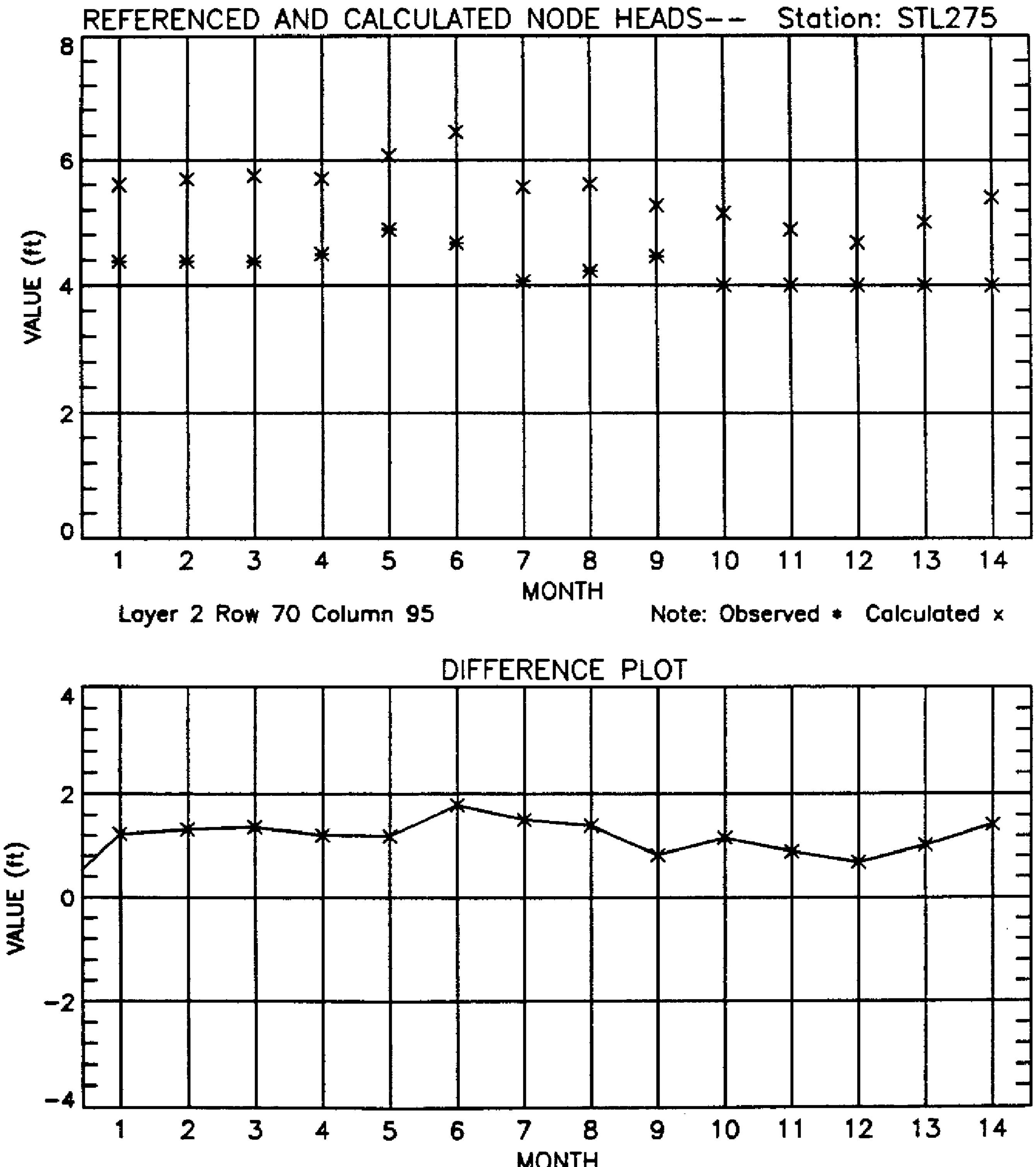
Layer 2 Row 68 Column 98 Note: Observed * Calculated x



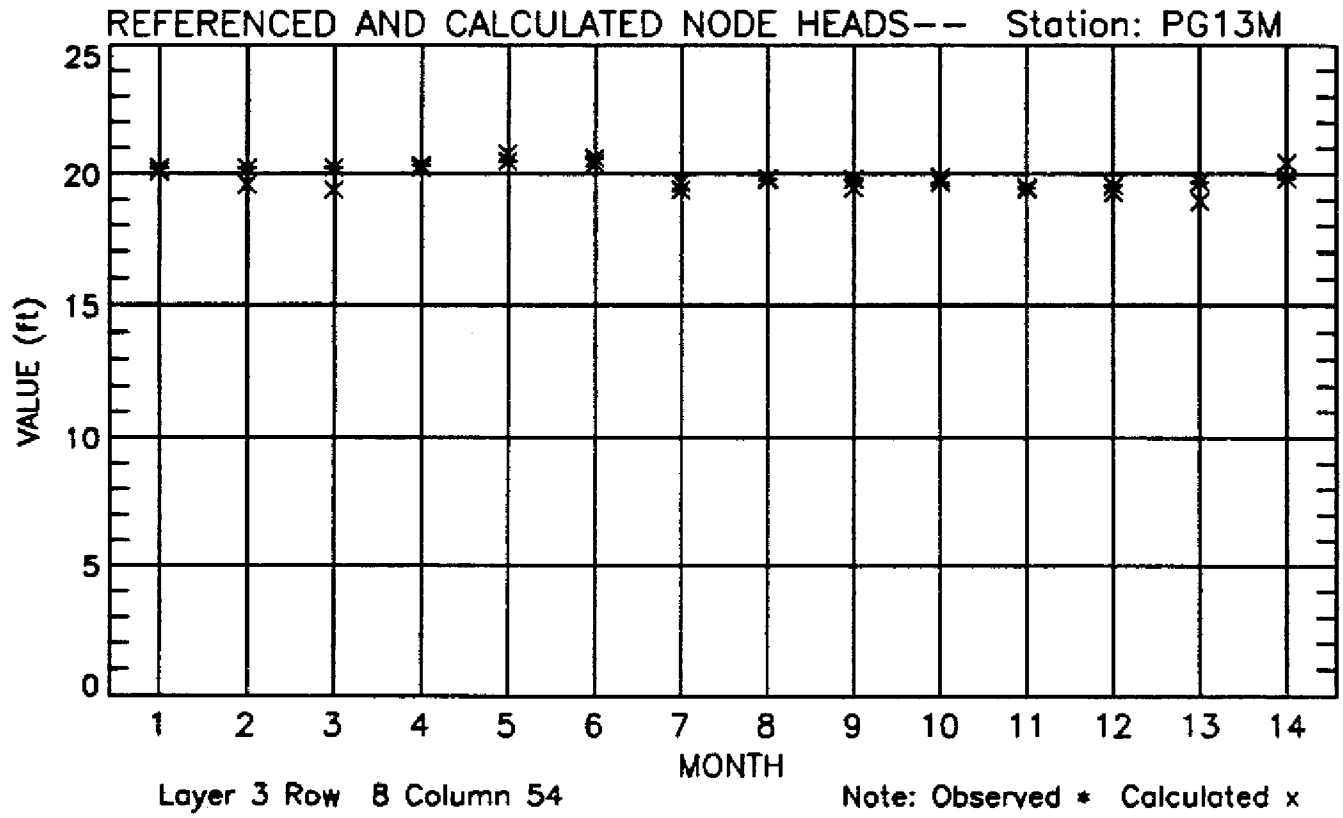
Extreme Errors [-0.3, 0.8] Average Absolute Error 0.23 Std.Error 0.30 pg 78

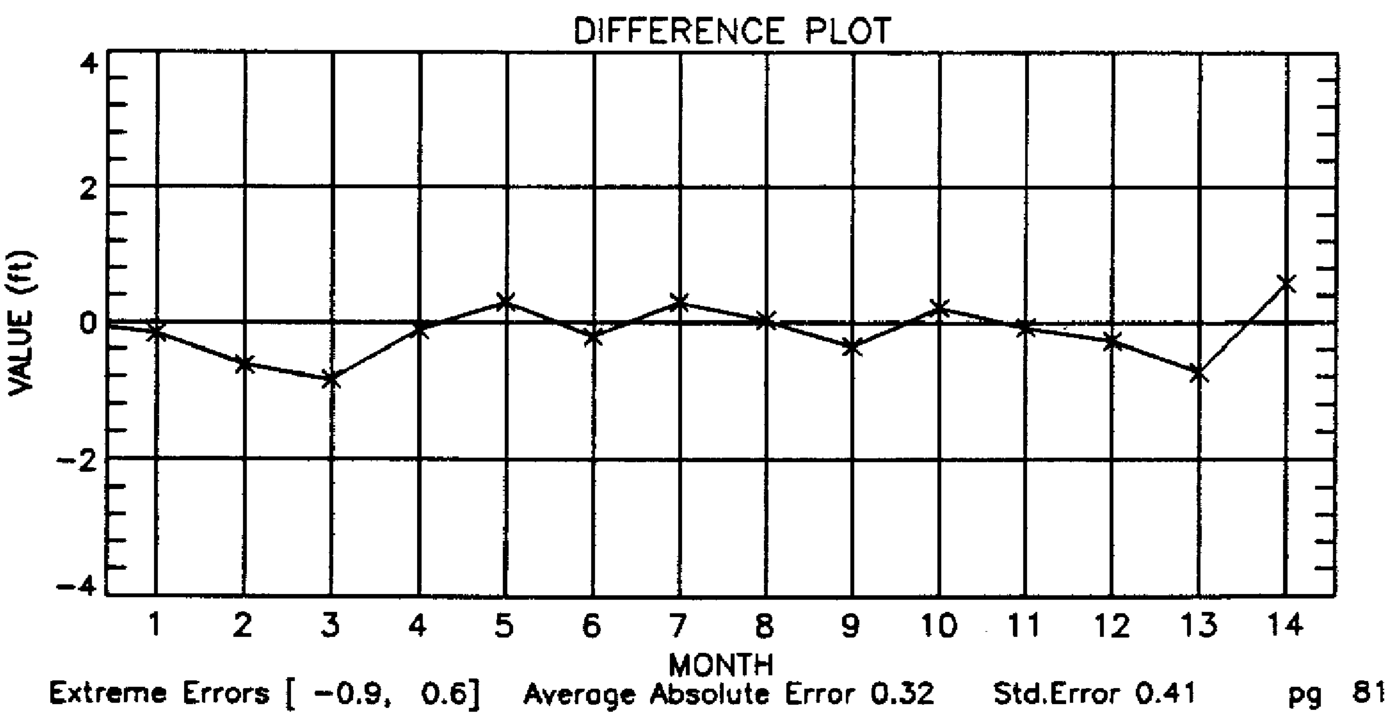

REFERENCED AND CALCULATED NODE HEADS-- Station: STL273
VALUE (ft)
MONTH
Layer 2 Row 70 Column 82
Note: Observed * Calculated x

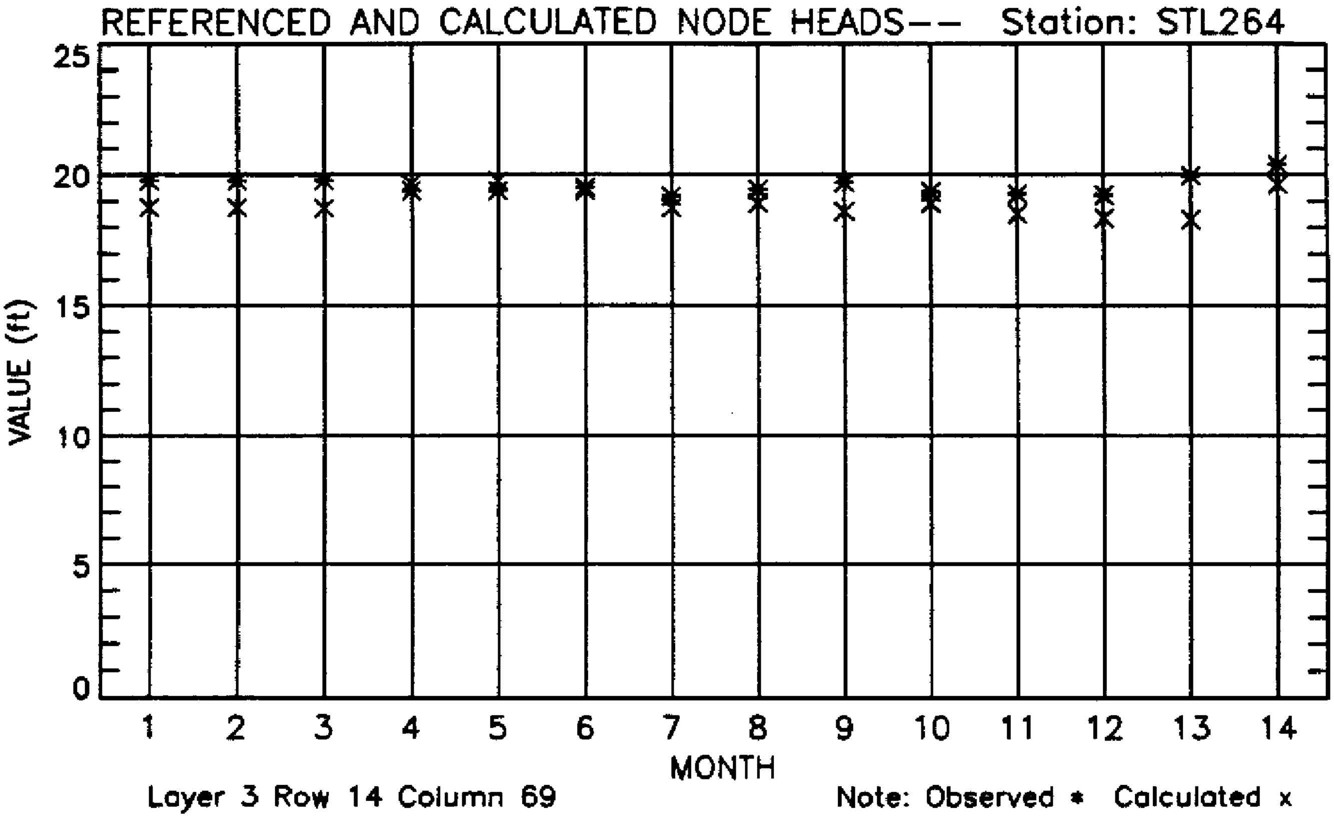

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.8, 0.4] Average Absolute Error 0.31 Std.Error 0.35 pg 79

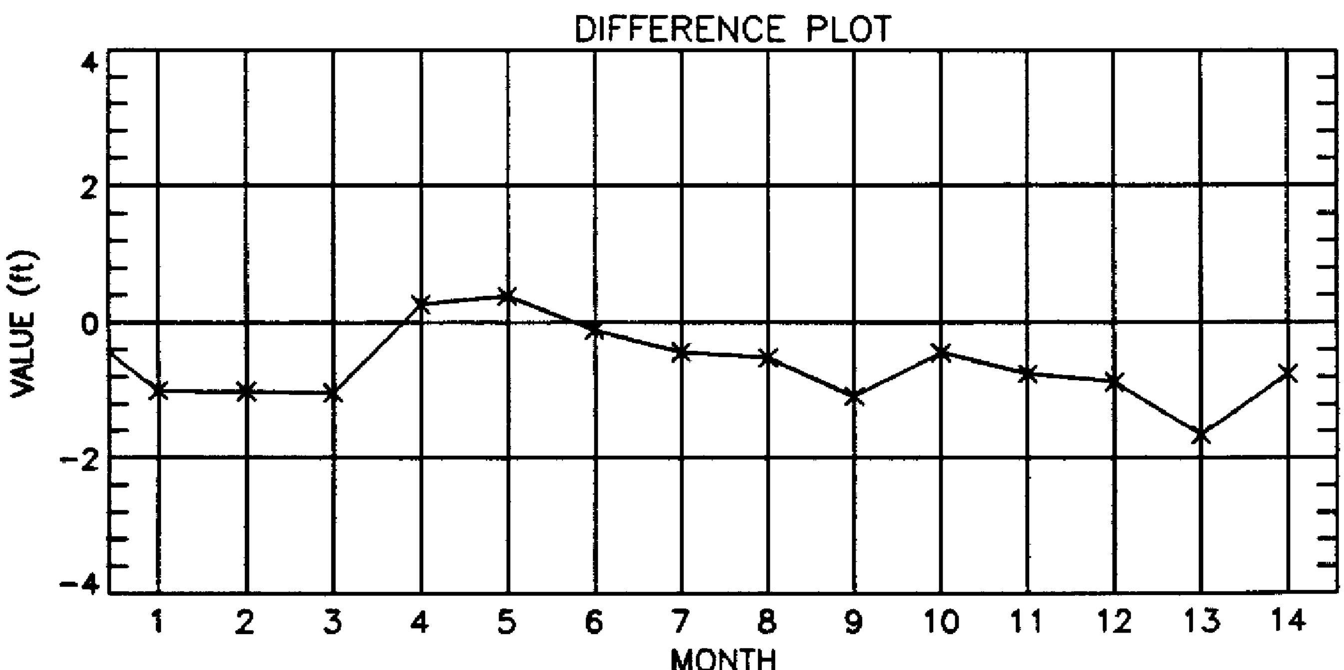


Extreme Errors [0.7, 1.8] Average Absolute Error 1.13 Std.Error 0.29 pg 80

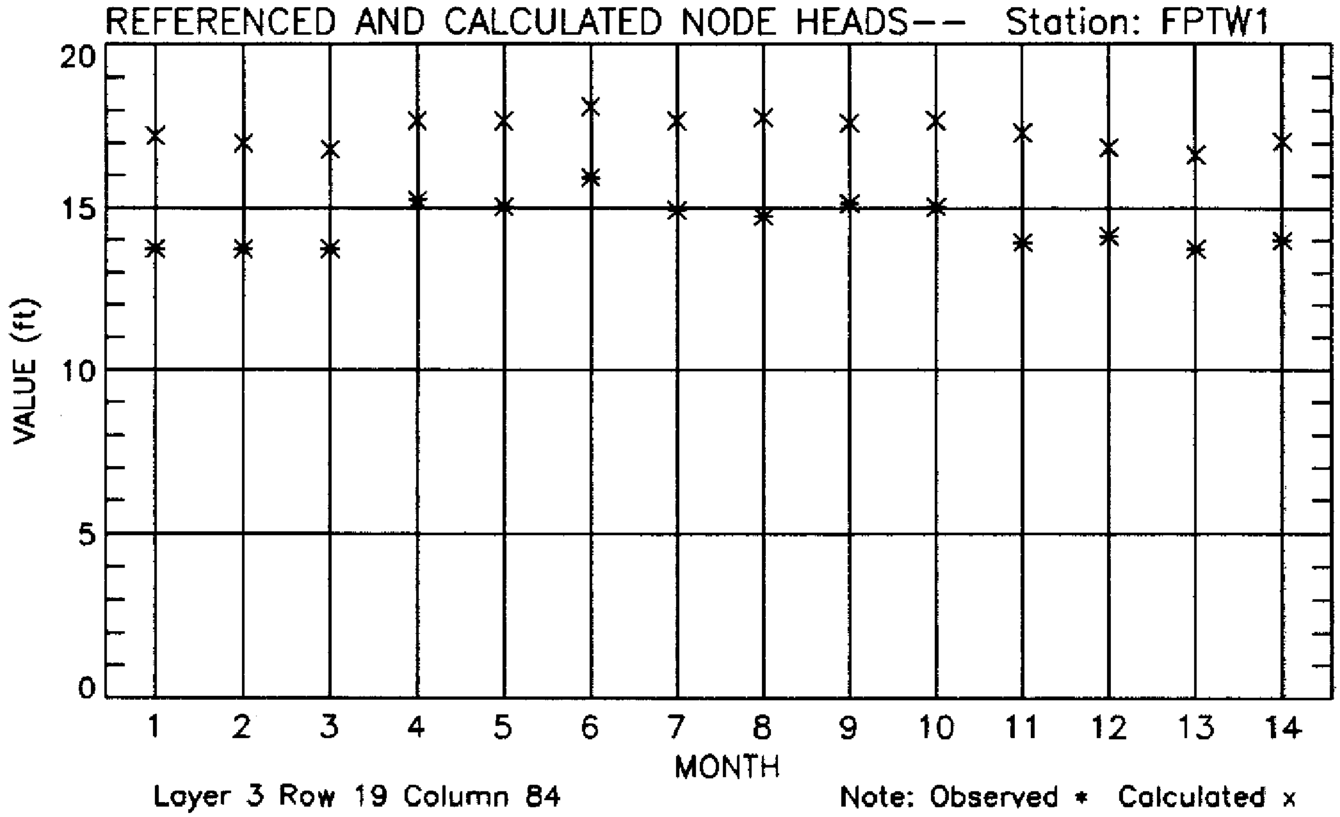

REFERENCED AND CALCULATED NODE HEADS-- Station: PG13M
VALUE (ft)
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 8 Column 54
Note: Observed * Calculated x

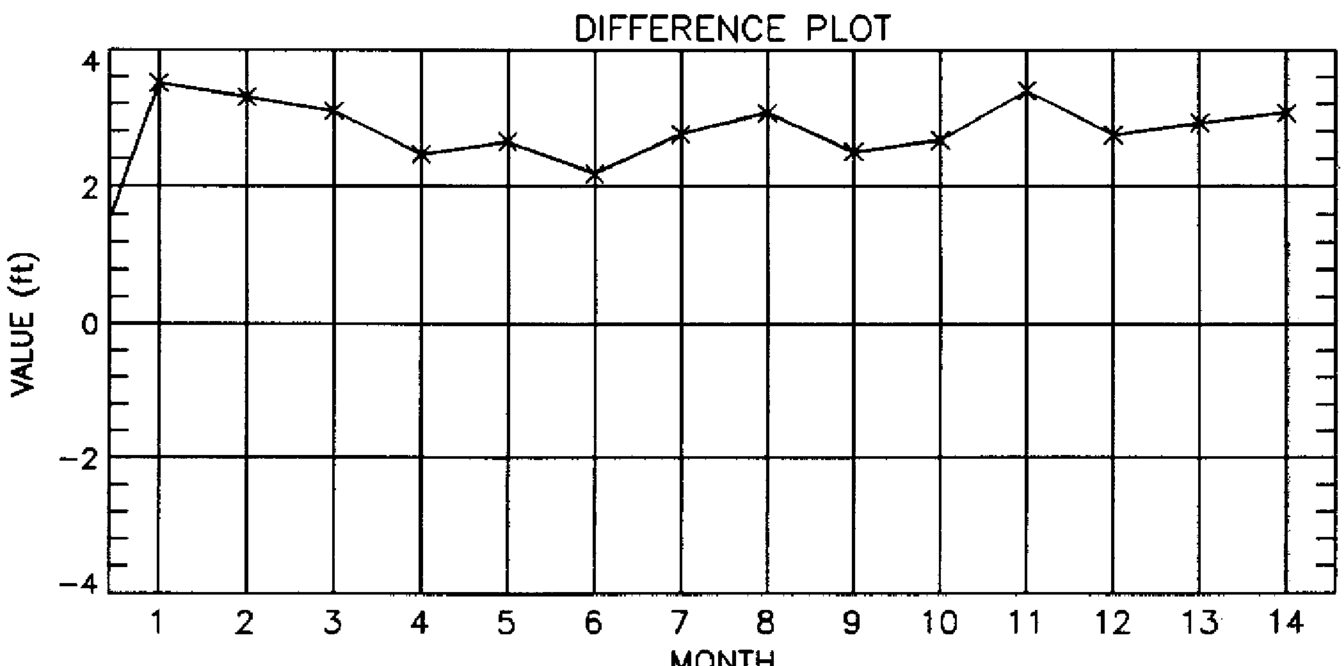

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.9, 0.6] Average Absolute Error 0.32 Std.Error 0.41 pg 81





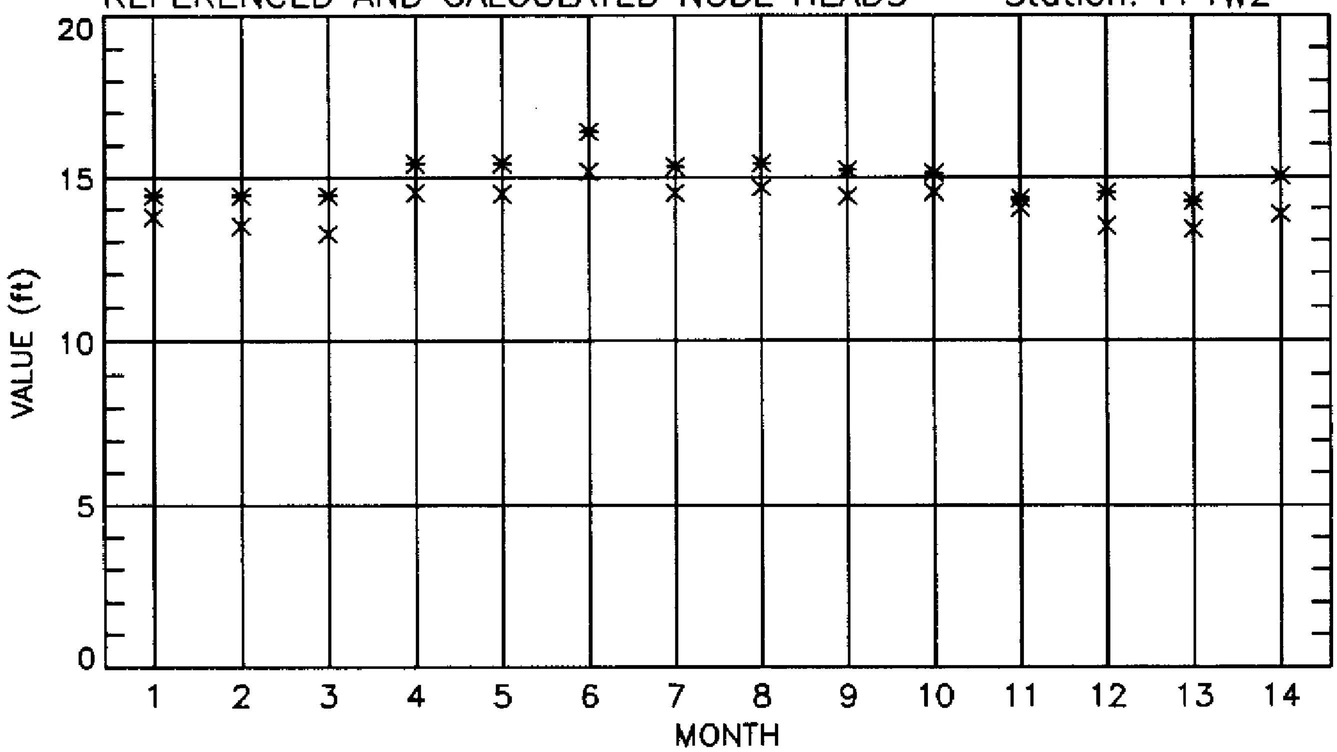
Extreme Errors [-1.7, 0.4] Average Absolute Error 0.69 Std.Error 0.55 pg 82





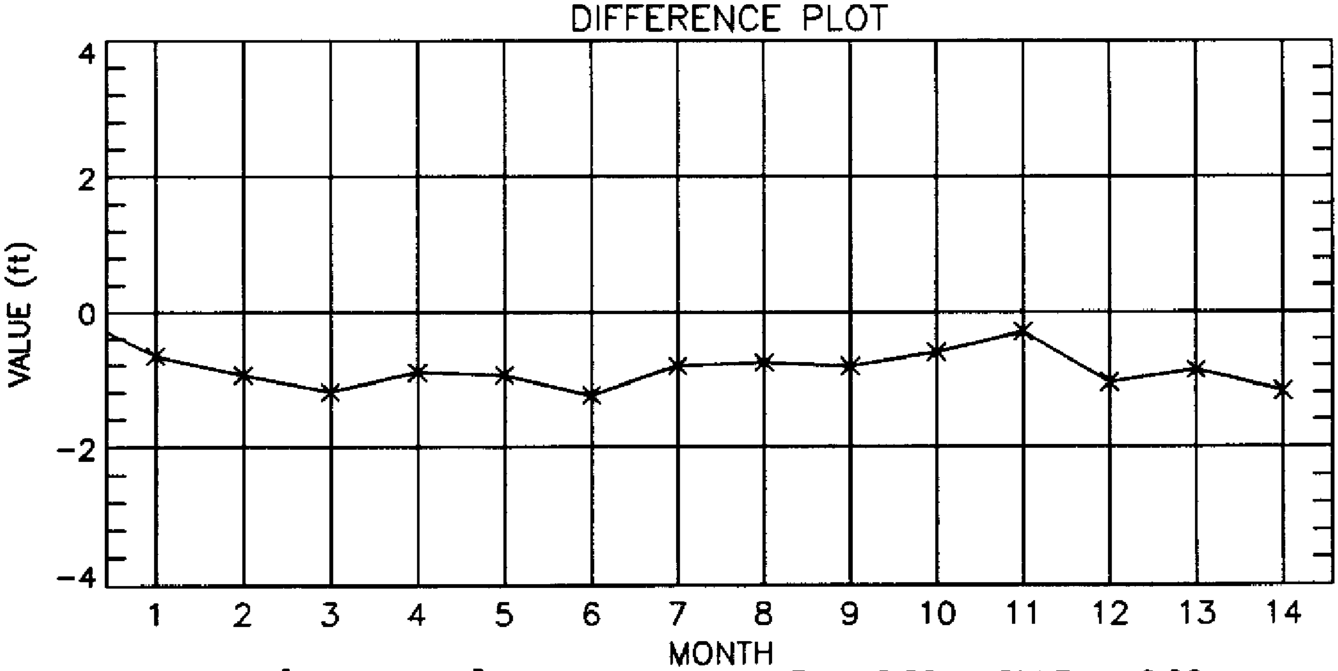
Extreme Errors [2.2, 3.5] Average Absolute Error 2.69 Std.Error 0.38 pg 83

REFERENCED AND CALCULATED NODE HEADS-- Station: FPTW2

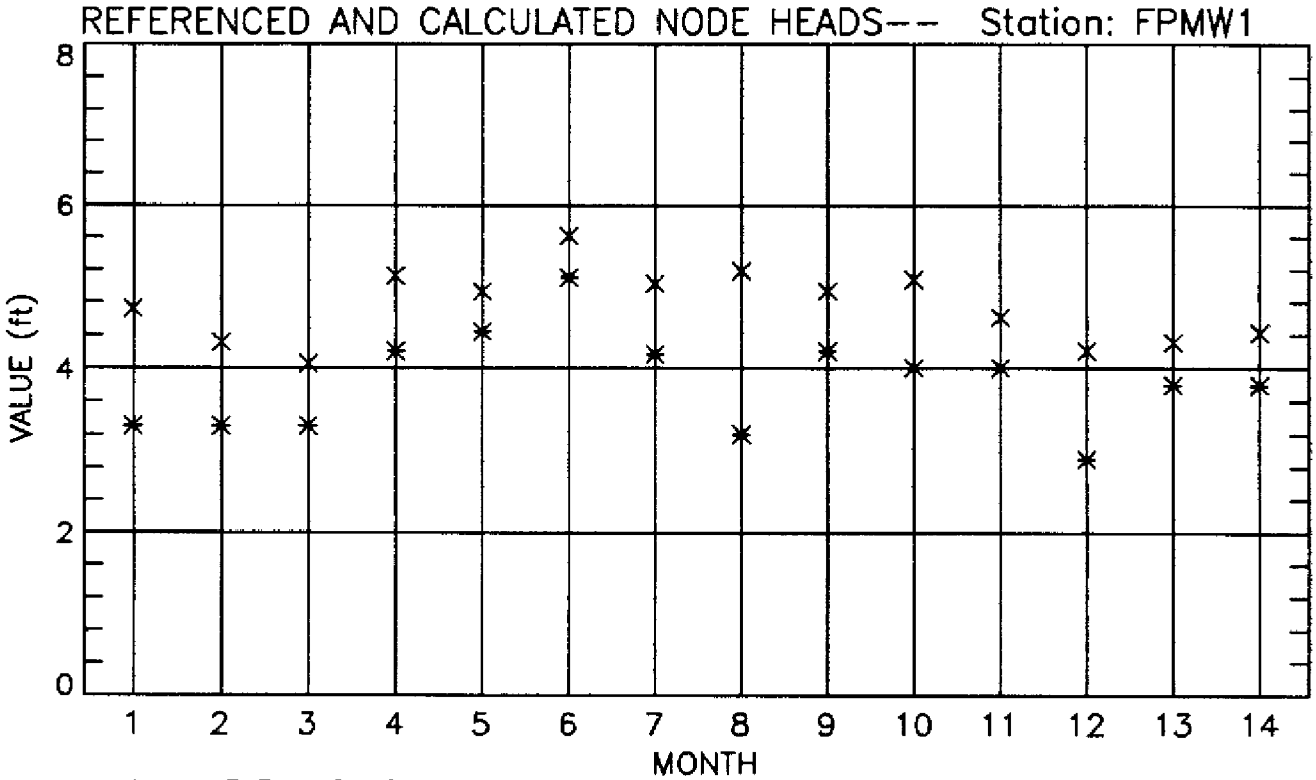


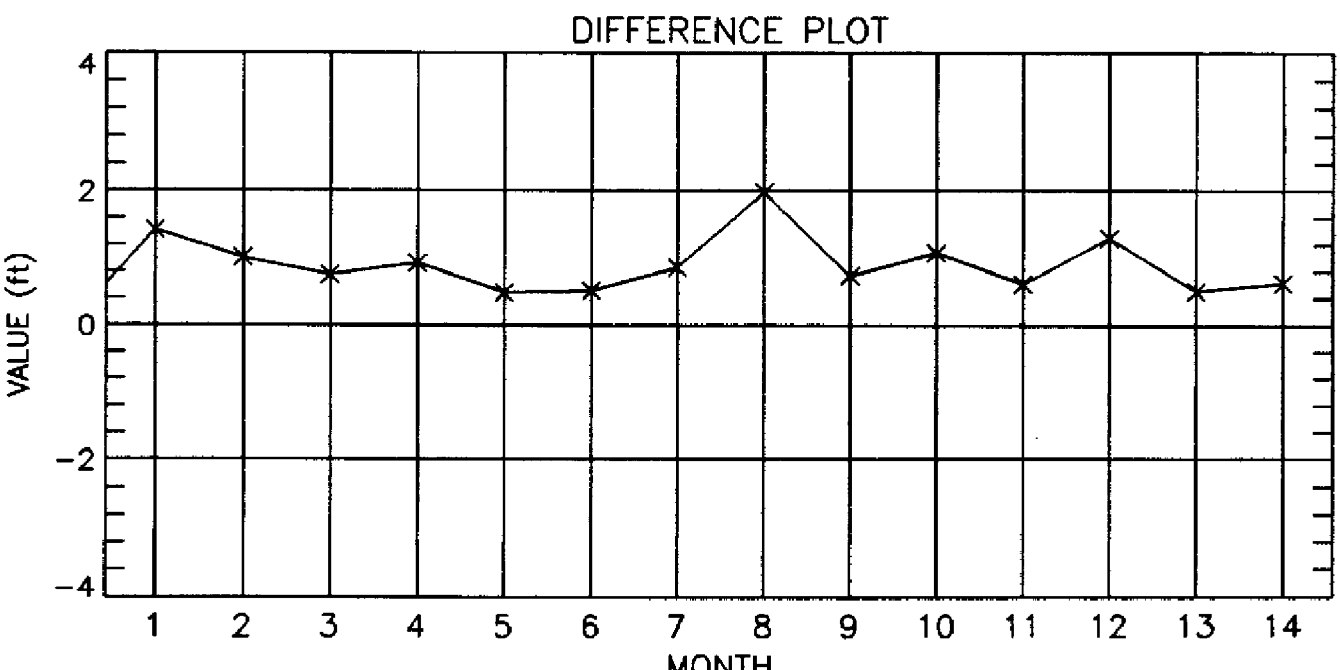
Layer 3 Row 21 Column 85 Note: Observed * Calculated x

DIFFERENCE PLOT

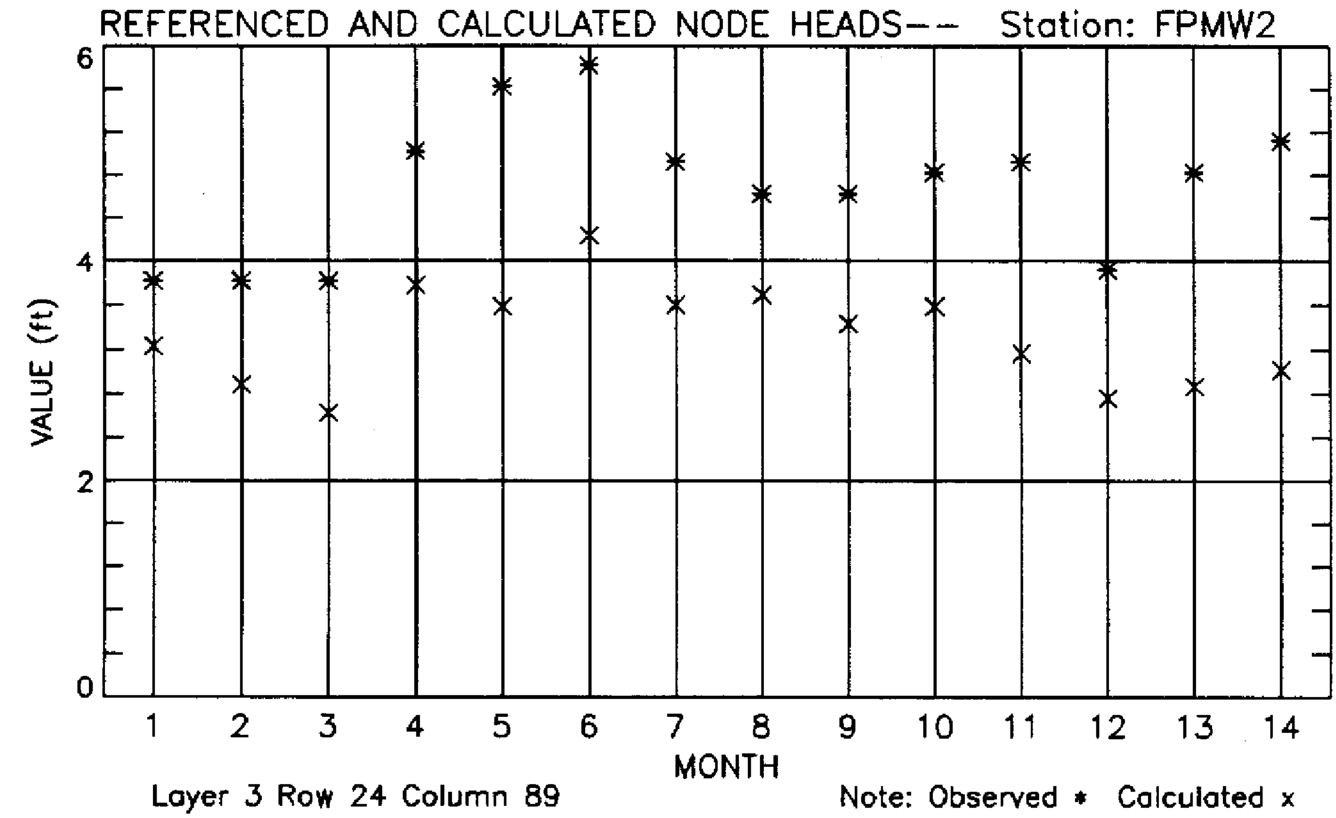


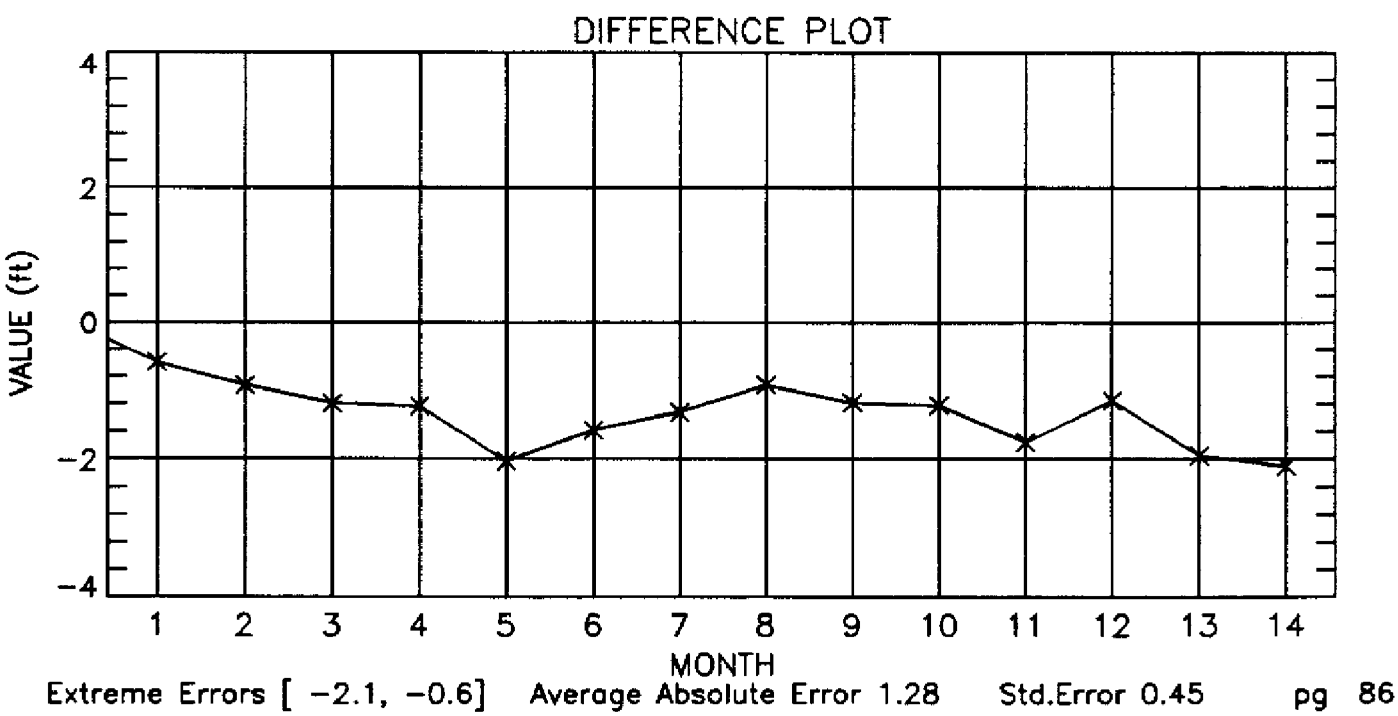
Extreme Errors [−1.3, −0.3] Average Absolute Error 0.82 Std.Error 0.26 pg 84

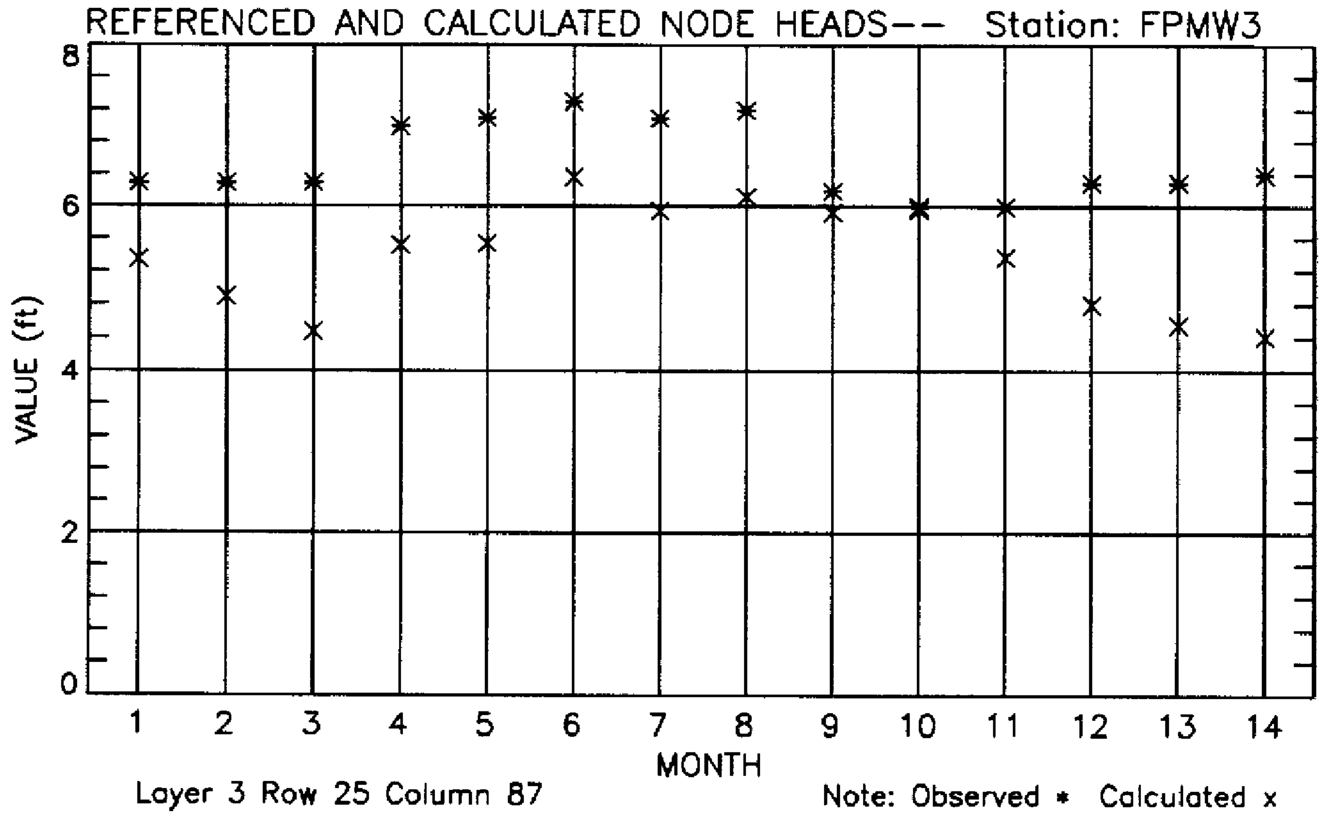


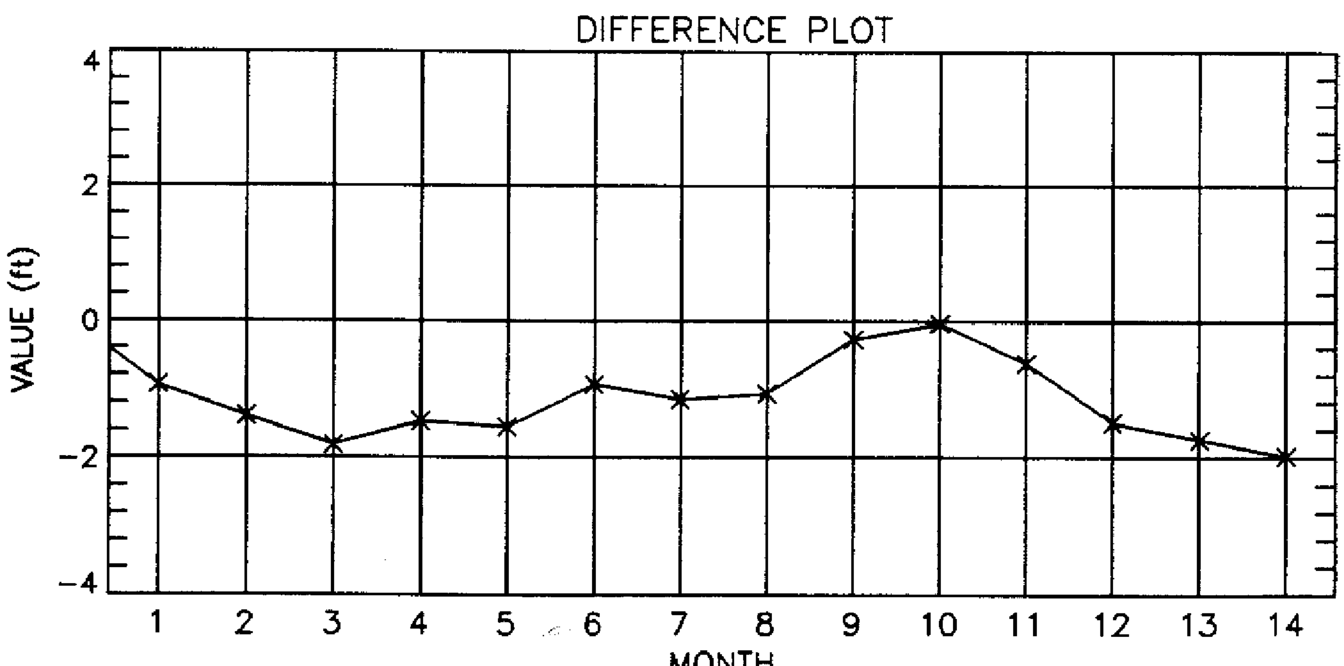


Extreme Errors [0.5, 2.0] Average Absolute Error 0.85 Std.Error 0.42 pg 85


REFERENCED AND CALCULATED NODE HEADS-- Station: FPMW2
VALUE (ft)
MONTH
Layer 3 Row 24 Column 89
Note: Observed * Calculated x

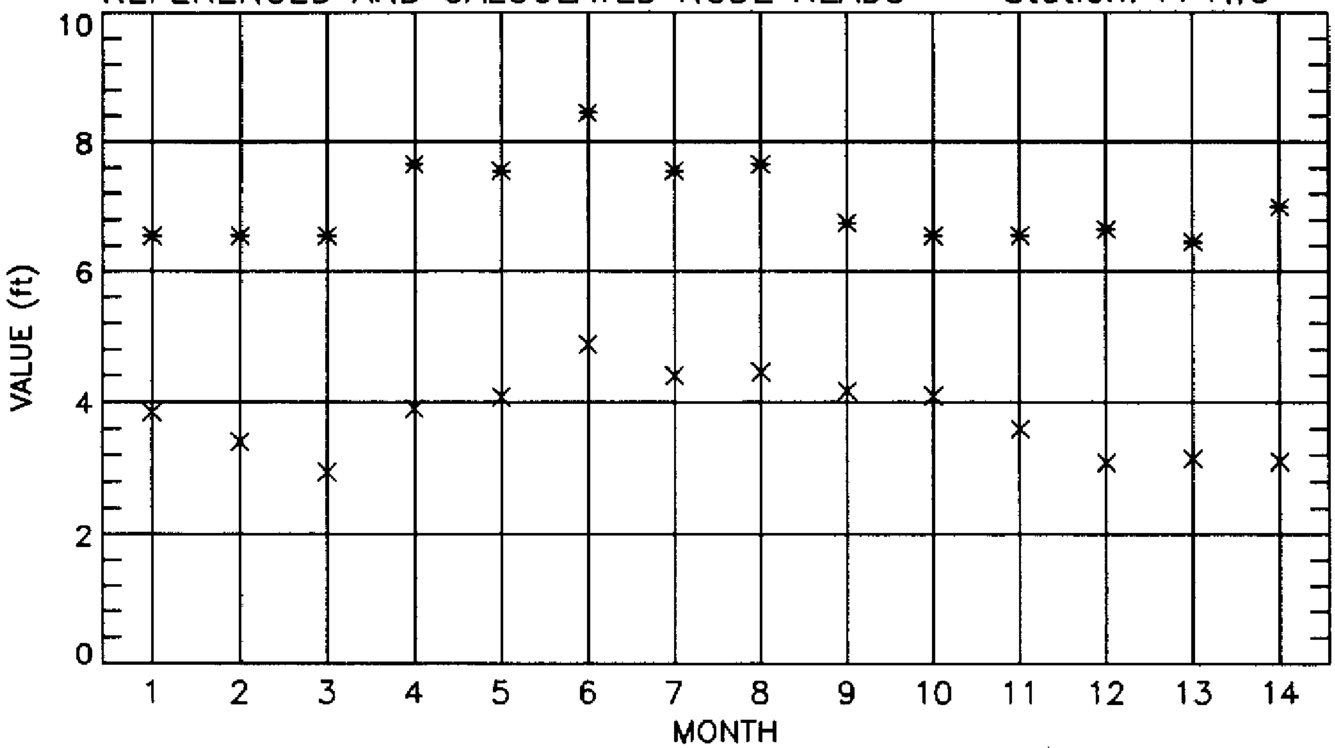

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-2.1, -0.6] Average Absolute Error 1.28 Std.Error 0.45 pg 86





Extreme Errors [-2.0, -0.0] Average Absolute Error 1.10 Std.Error 0.57 pg 87

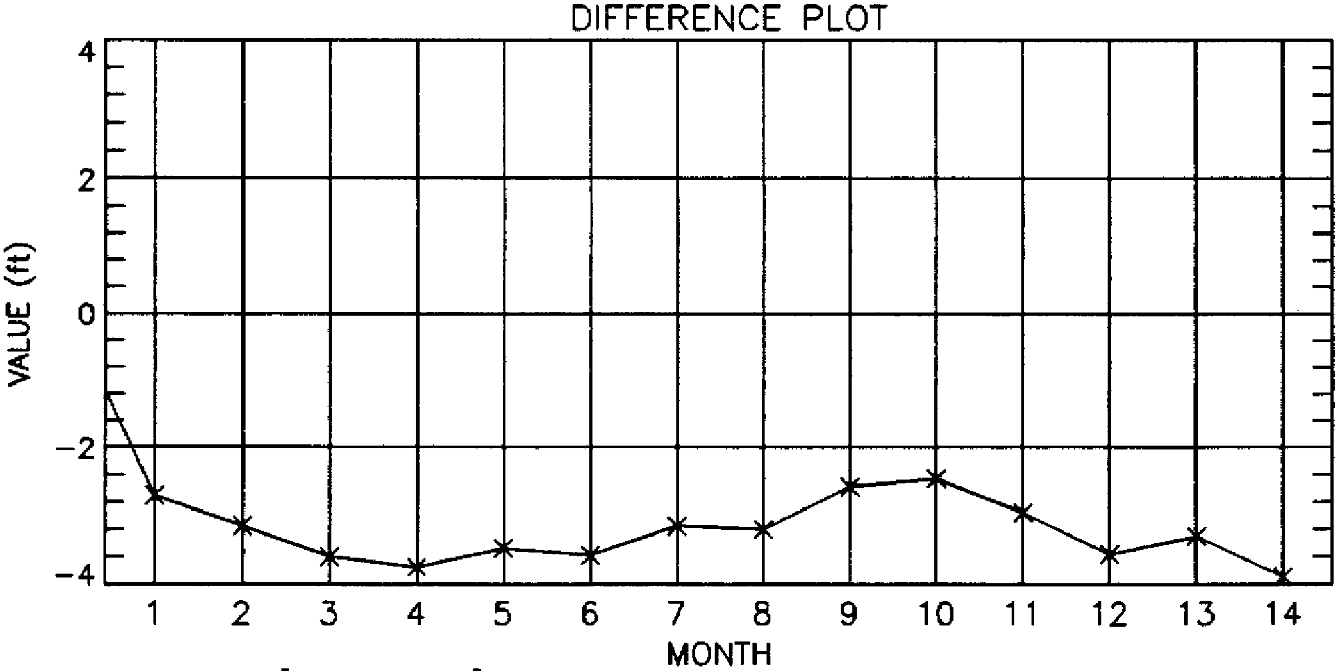
REFERENCED AND CALCULATED NODE HEADS-- Station: FPTW5



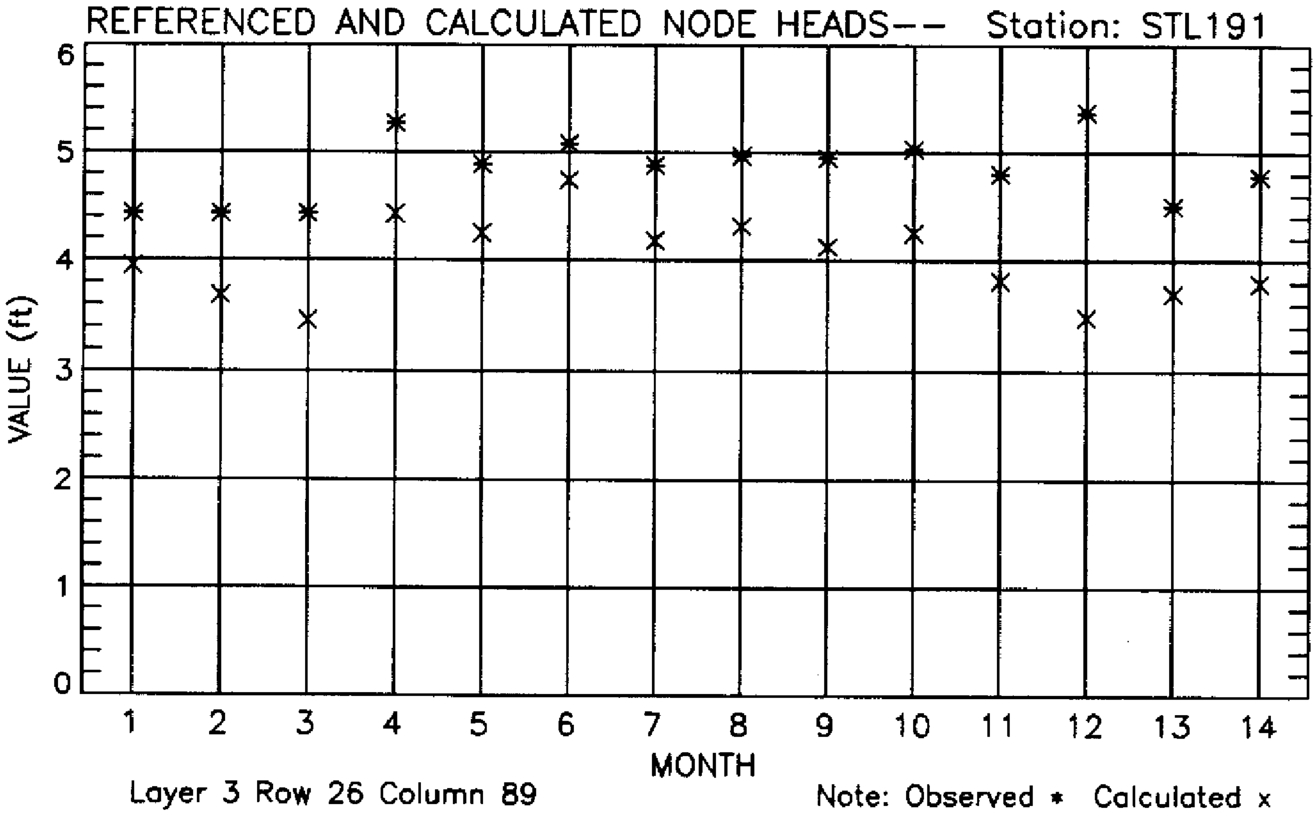
Layer 3 Row 26 Column 85

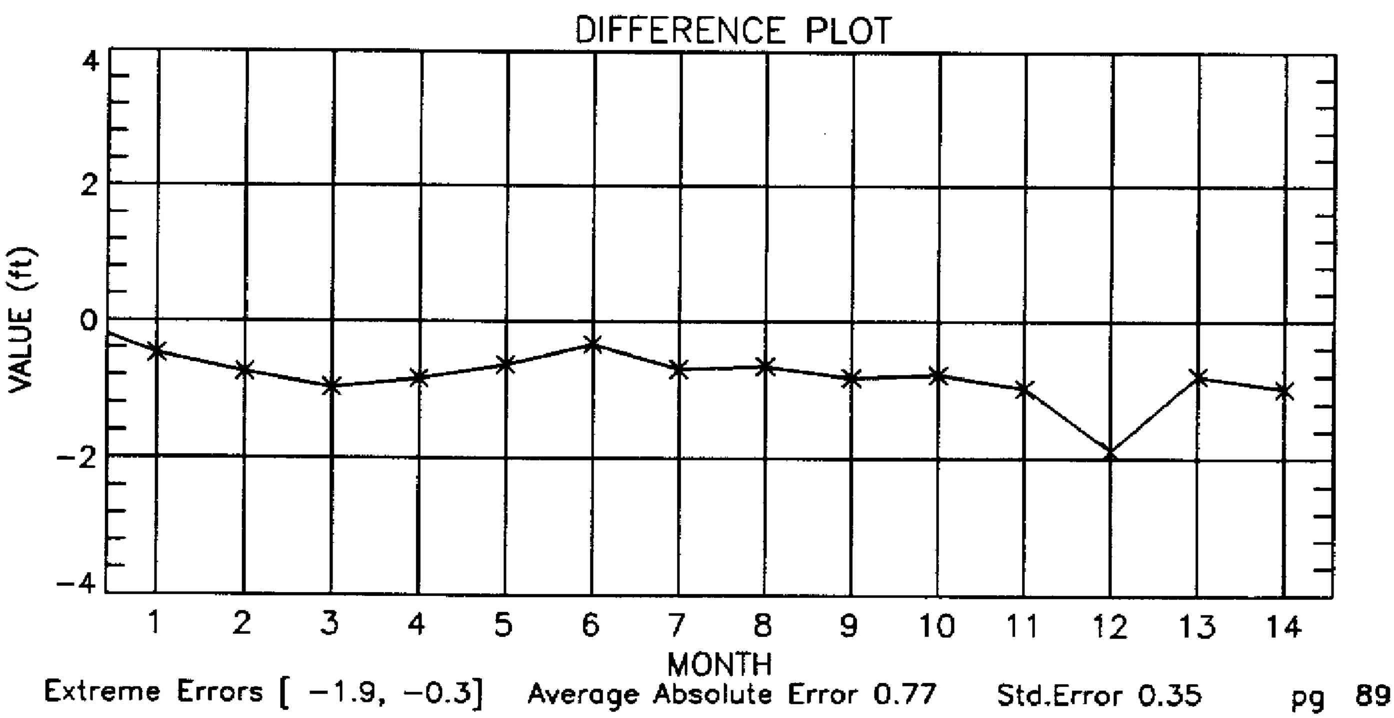
Note: Observed * Calculated x

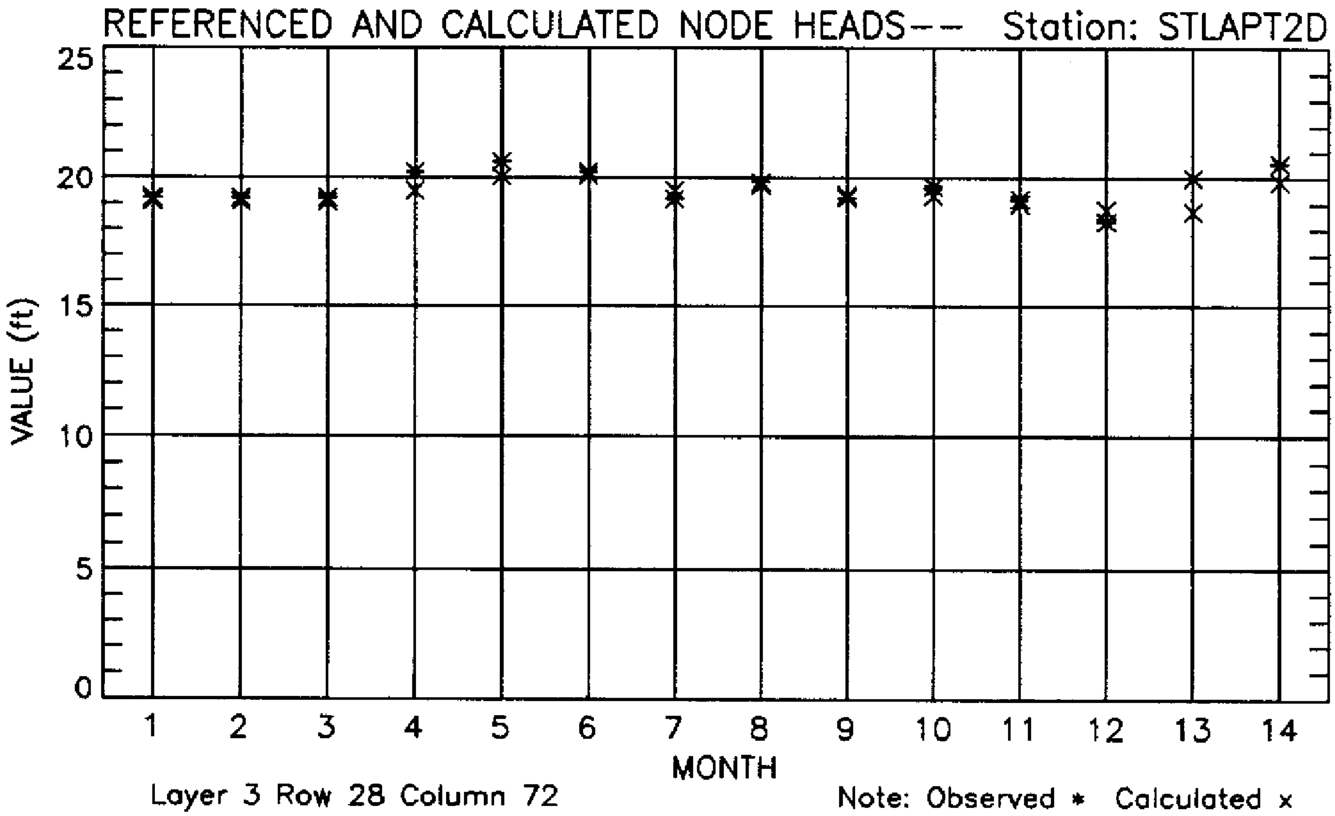
DIFFERENCE PLOT

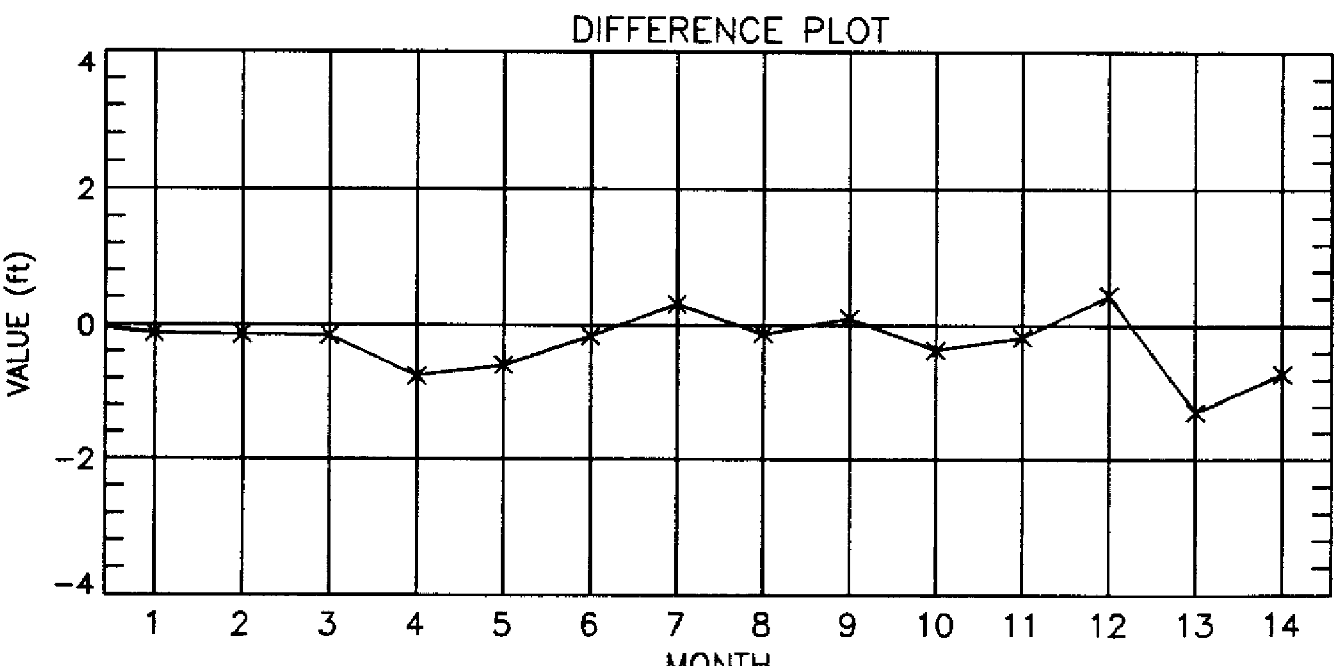


Extreme Errors [-3.9, -2.5] Average Absolute Error 3.03 Std.Error 0.44 pg 88


REFERENCED AND CALCULATED NODE HEADS-- Station: STL191
VALUE (ft)
MONTH
Layer 3 Row 26 Column 89
Note: Observed * Calculated x

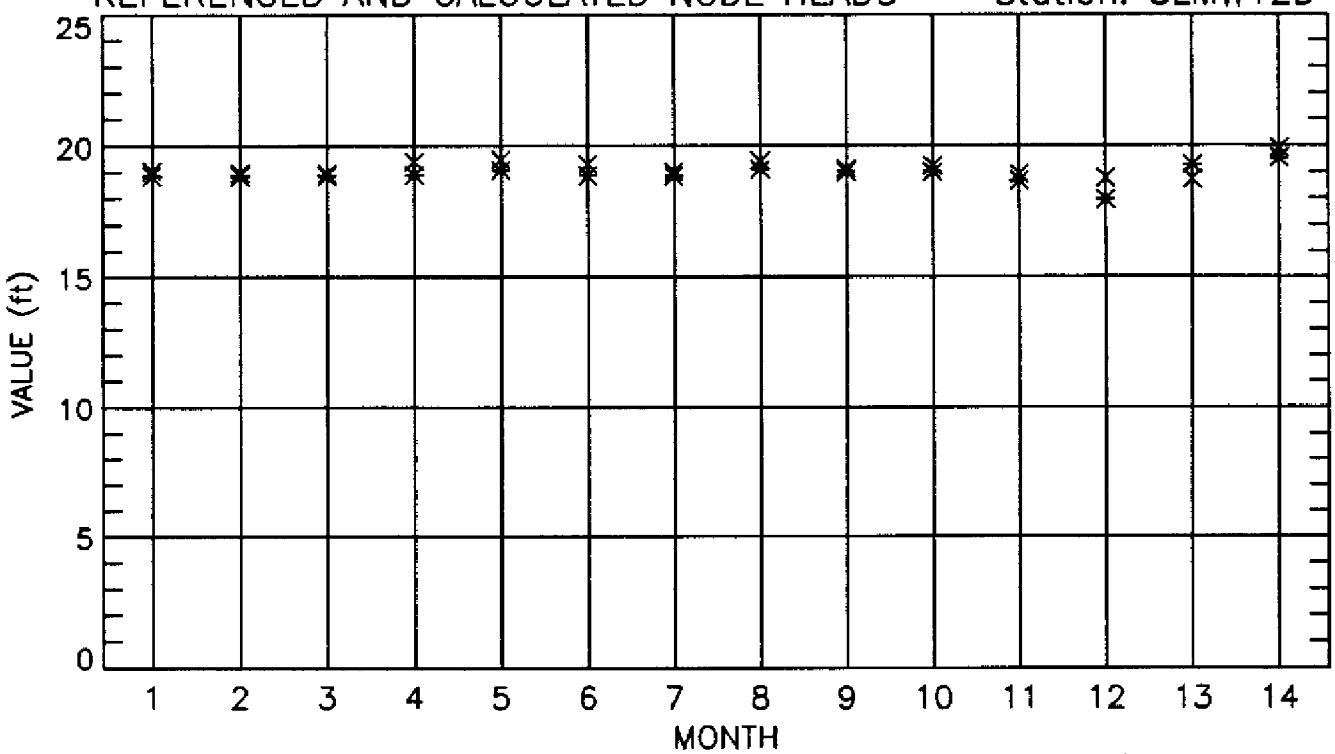

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [−1.9, −0.3] Average Absolute Error 0.77 Std.Error 0.35 pg 89





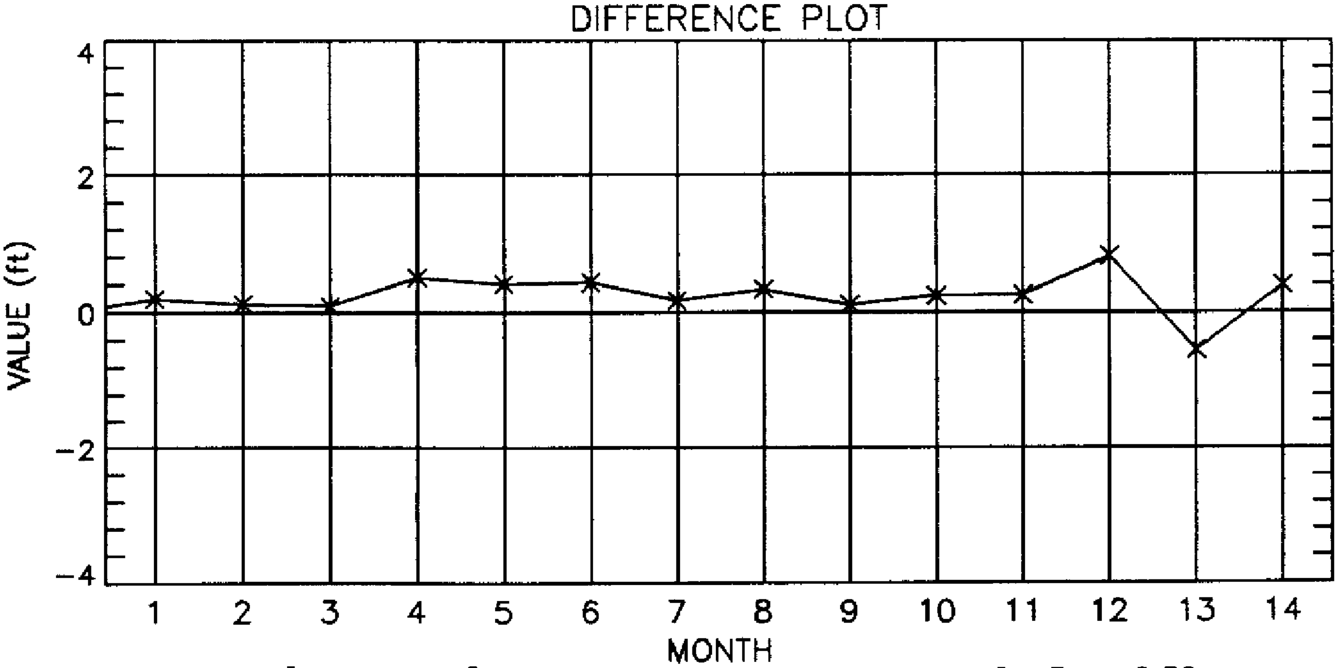
Extreme Errors [−1.3, 0.4] Average Absolute Error 0.36 Std.Error 0.45 pg 90

REFERENCED AND CALCULATED NODE HEADS-- Station: SLMW12D

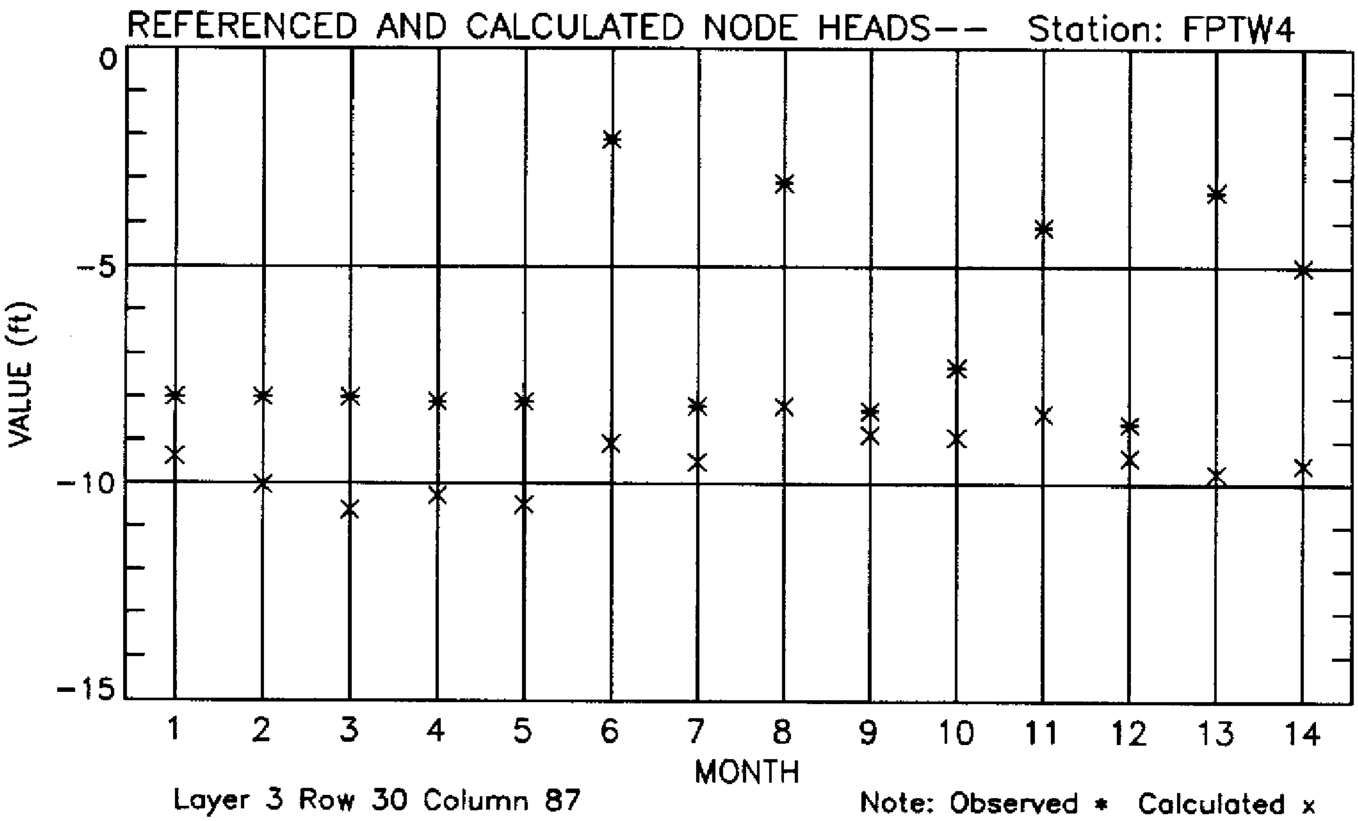


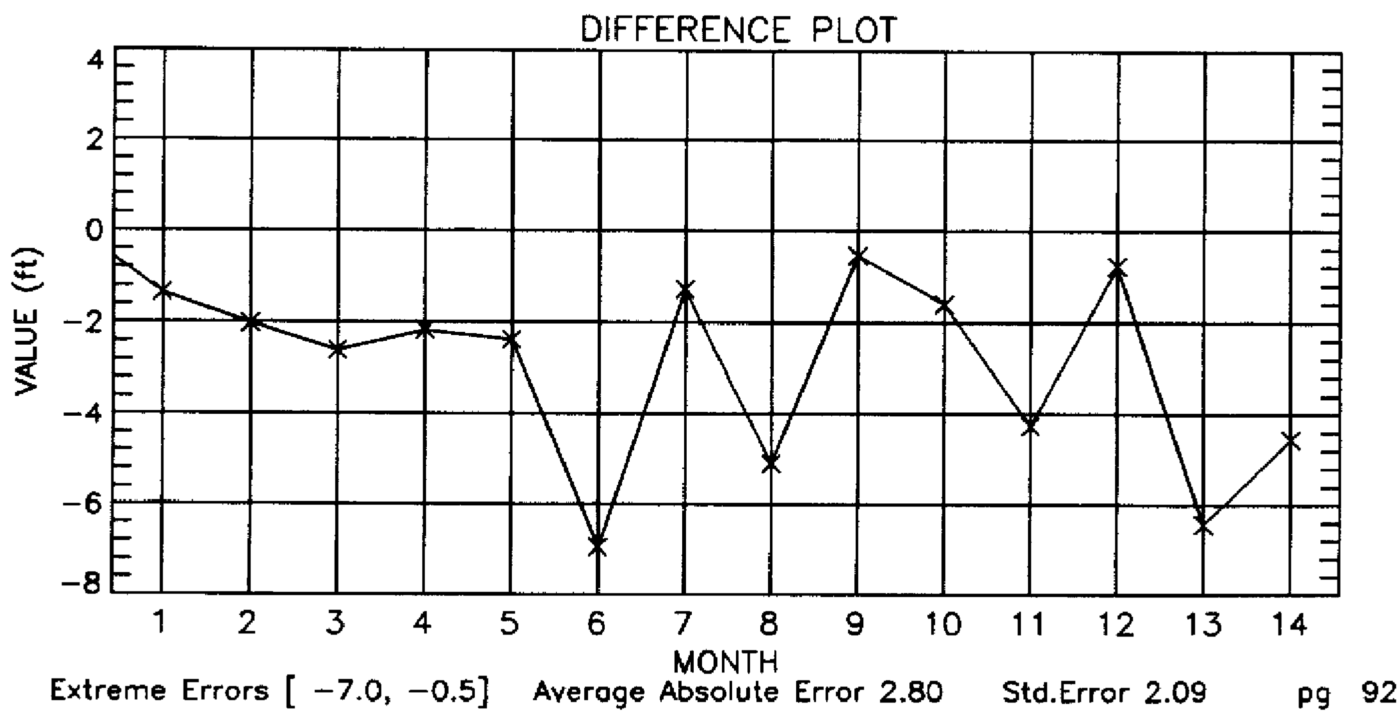
Layer 3 Row 29 Column 66 Note: Observed * Calculated x

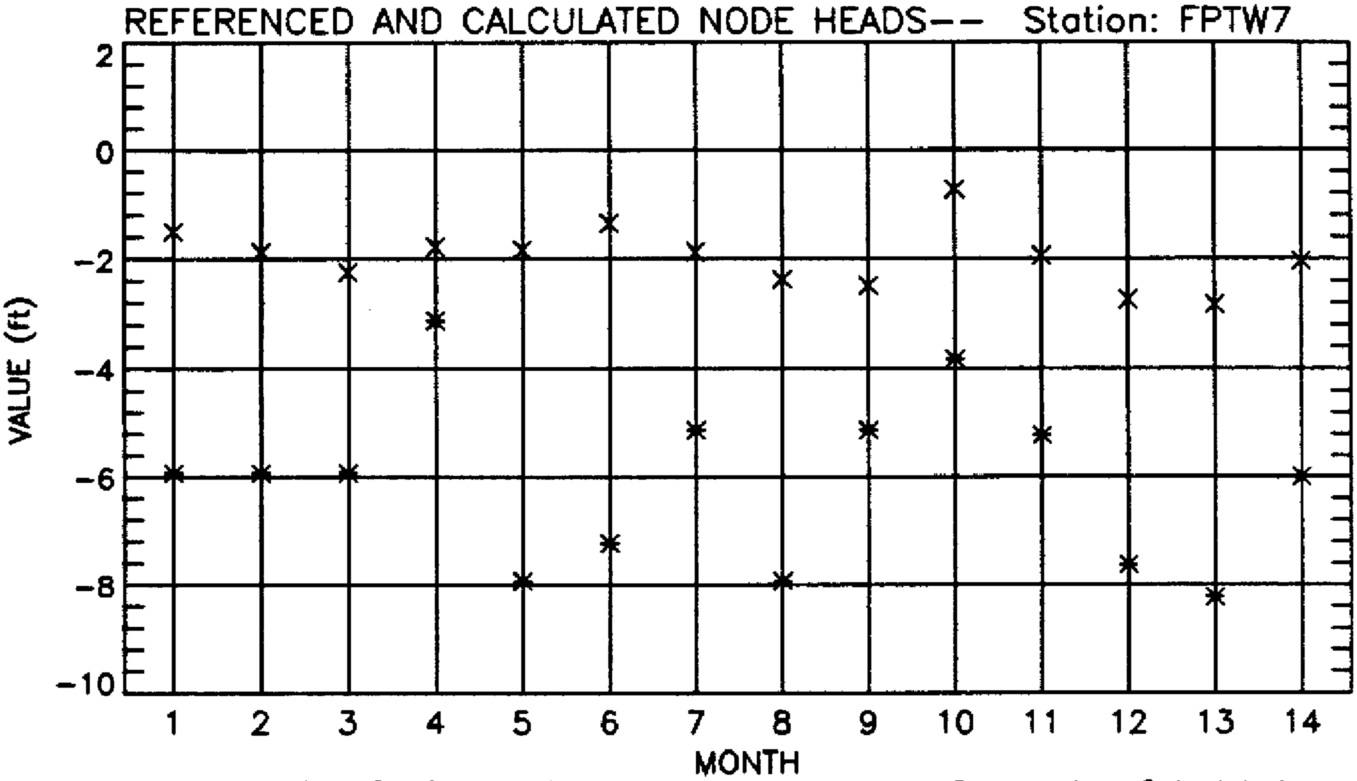
DIFFERENCE PLOT



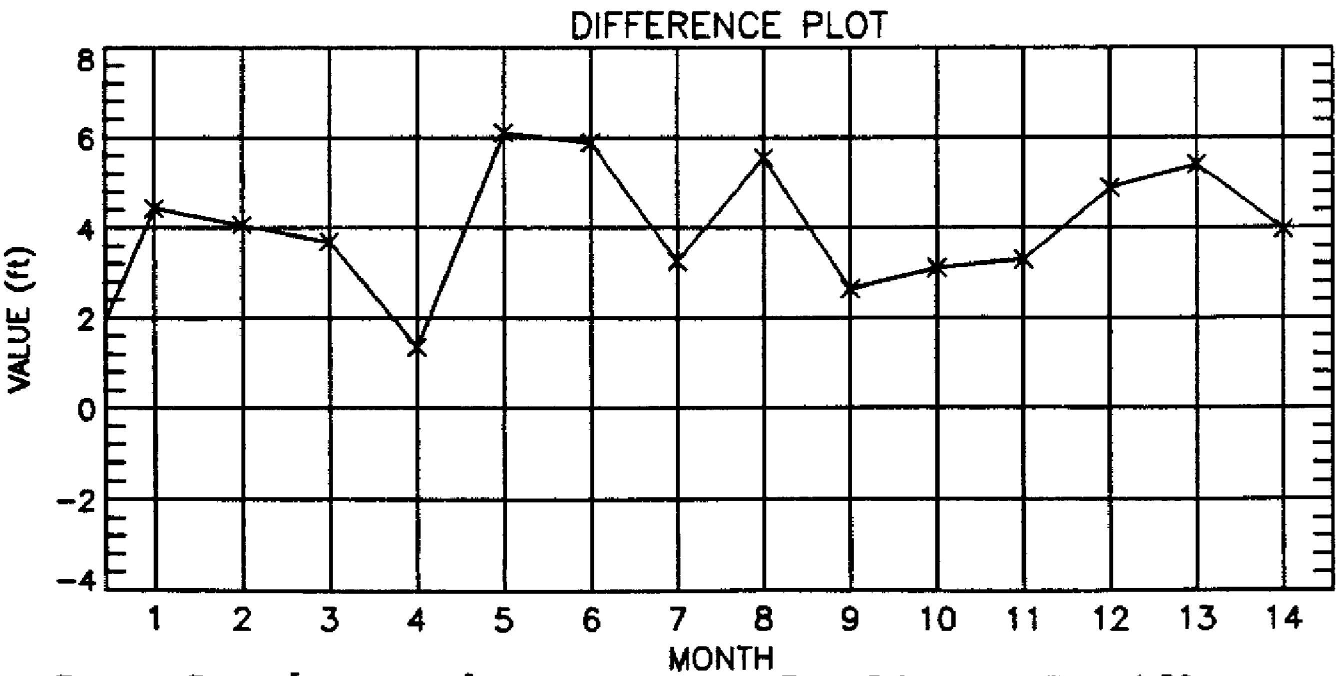
Extreme Errors [-0.5, 0.8] Average Absolute Error 0.31 Std.Error 0.30 pg 91


REFERENCED AND CALCULATED NODE HEADS-- Station: FPTW4
0
-5
-10
-15
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 30 Column 87
Note: Observed * Calculated x

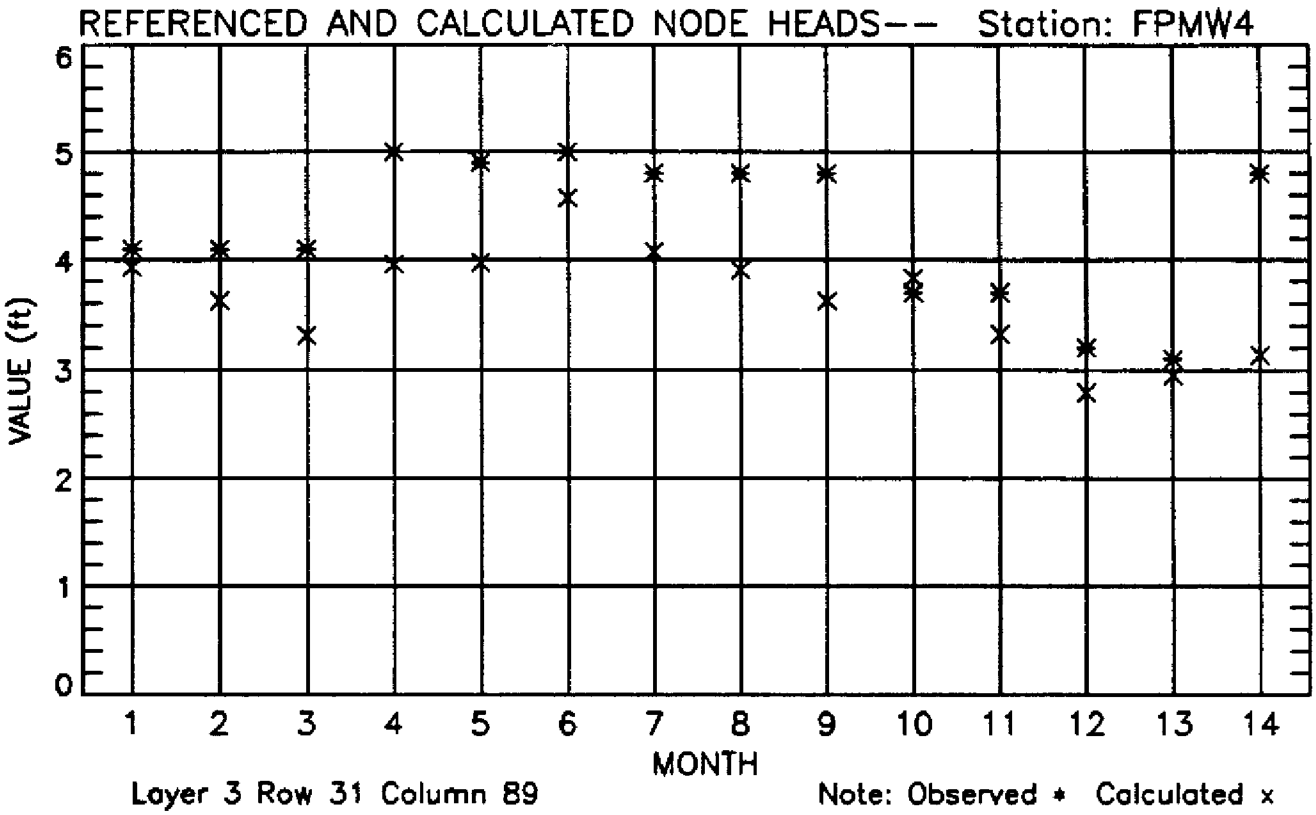

DIFFERENCE PLOT
4
2
0
-2
-4
-6
-8
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-7.0, -0.5] Average Absolute Error 2.80 Std.Error 2.09 pg 92

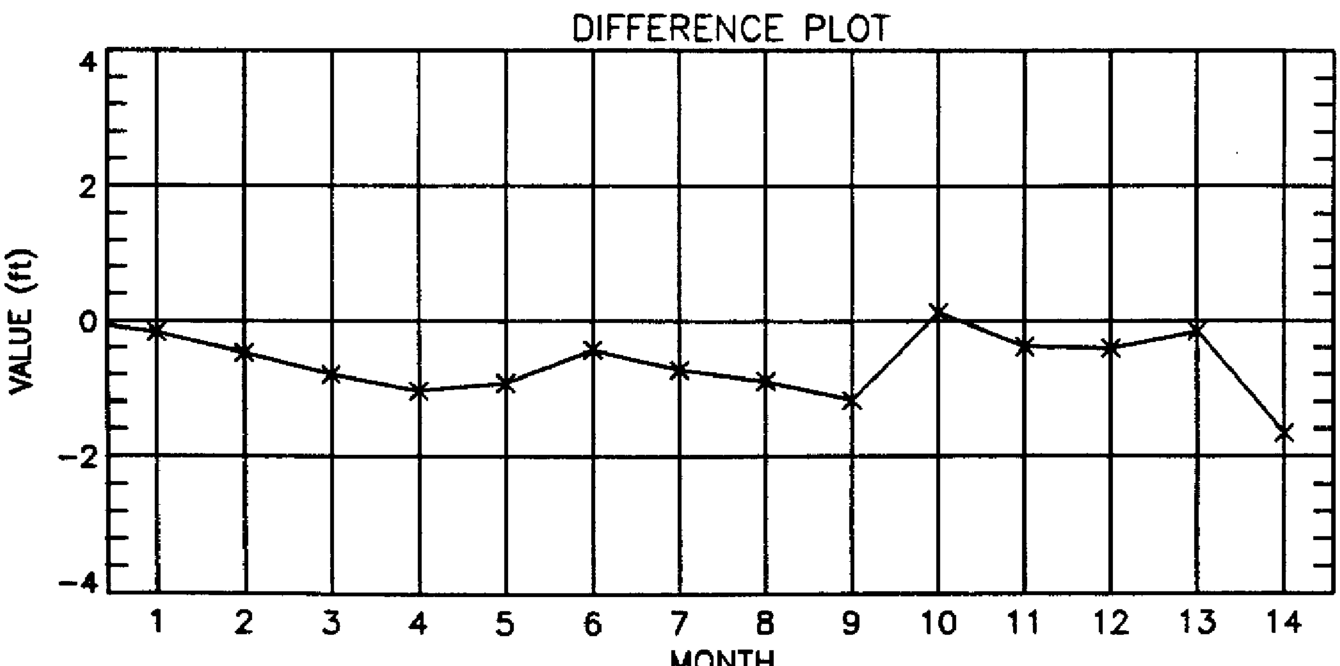


Layer 3 Row 31 Column 88 Note: Observed * Calculated x



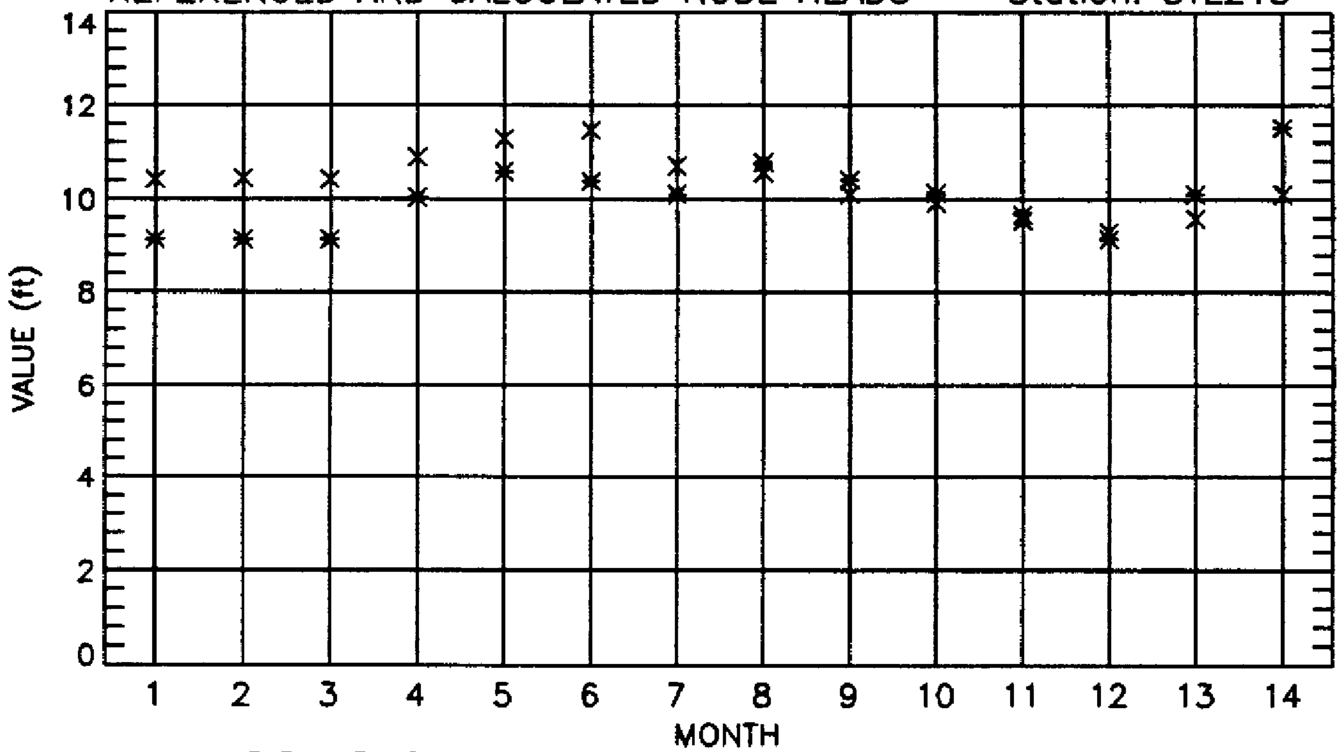
Extreme Errors [1.4, 6.1] Average Absolute Error 3.84 Std.Error 1.36 pg 93





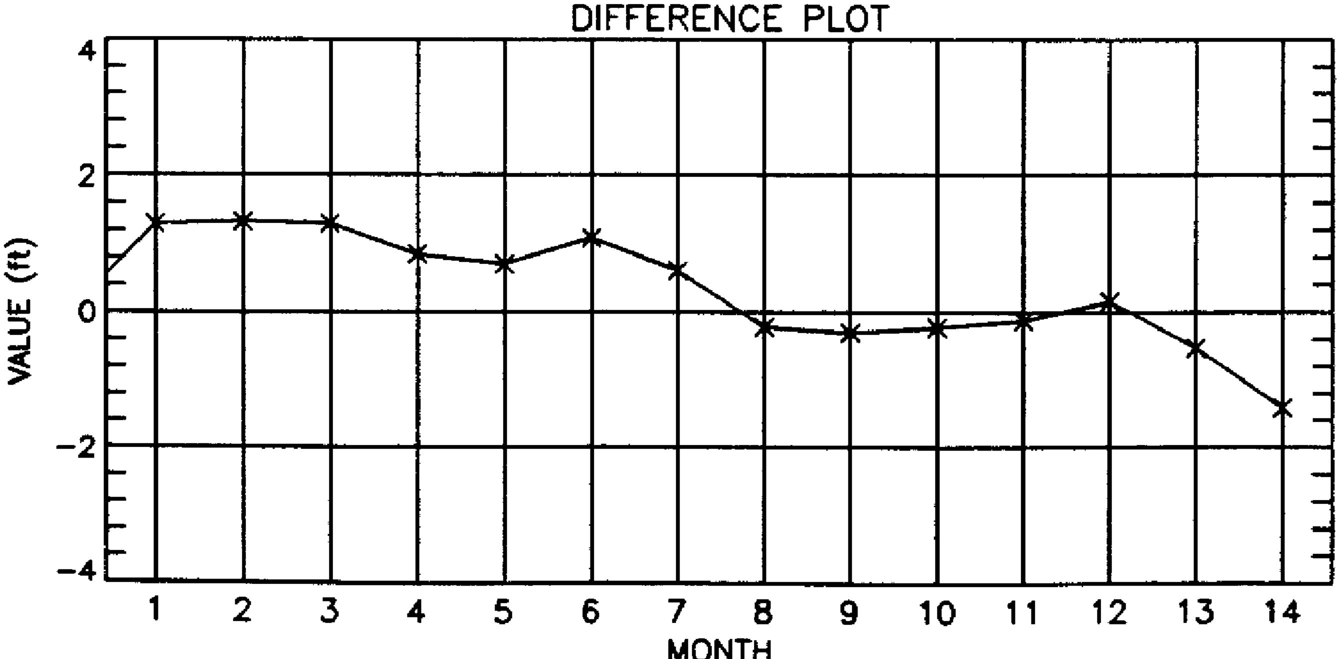
Extreme Errors [−1.7, 0.1] Average Absolute Error 0.62 Std.Error 0.47 pg 94

REFERENCED AND CALCULATED NODE HEADS-- Station: STL213

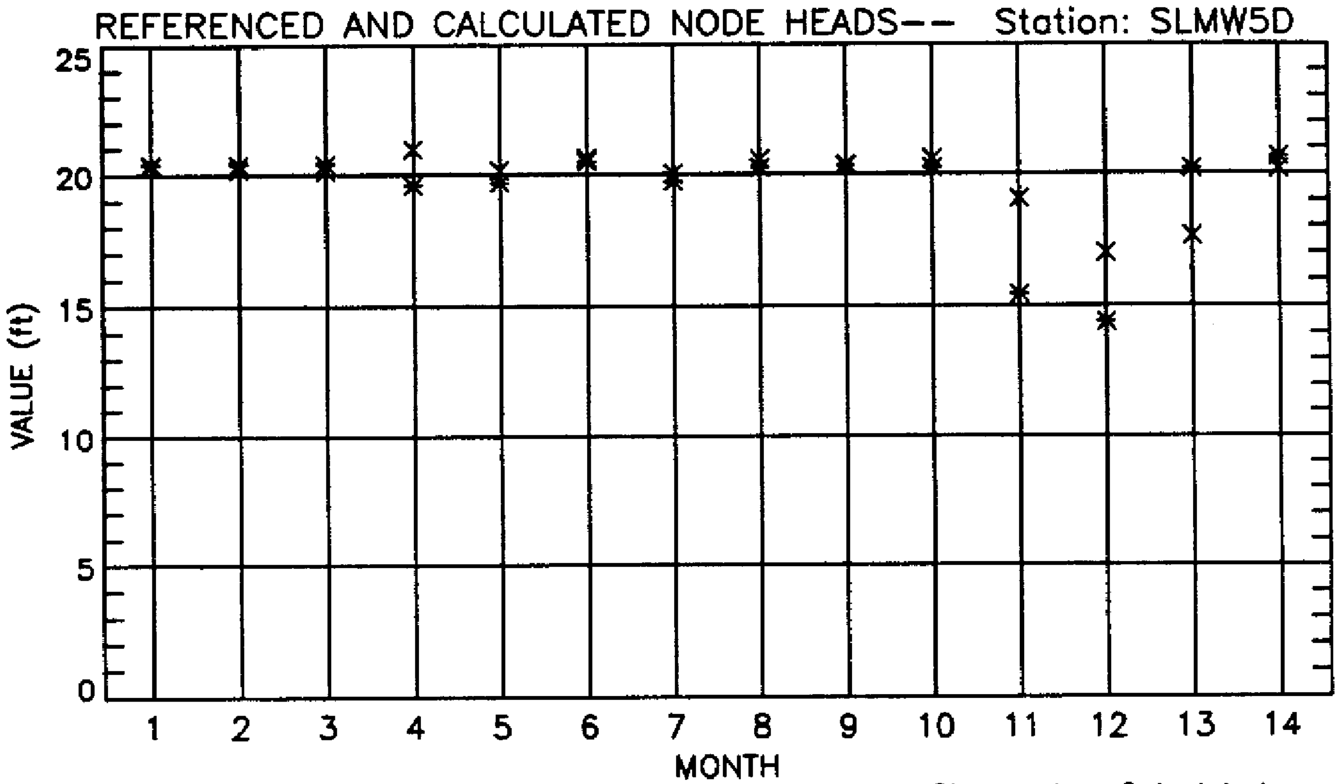


Layer 3 Row 34 Column 78 Note: Observed * Calculated x

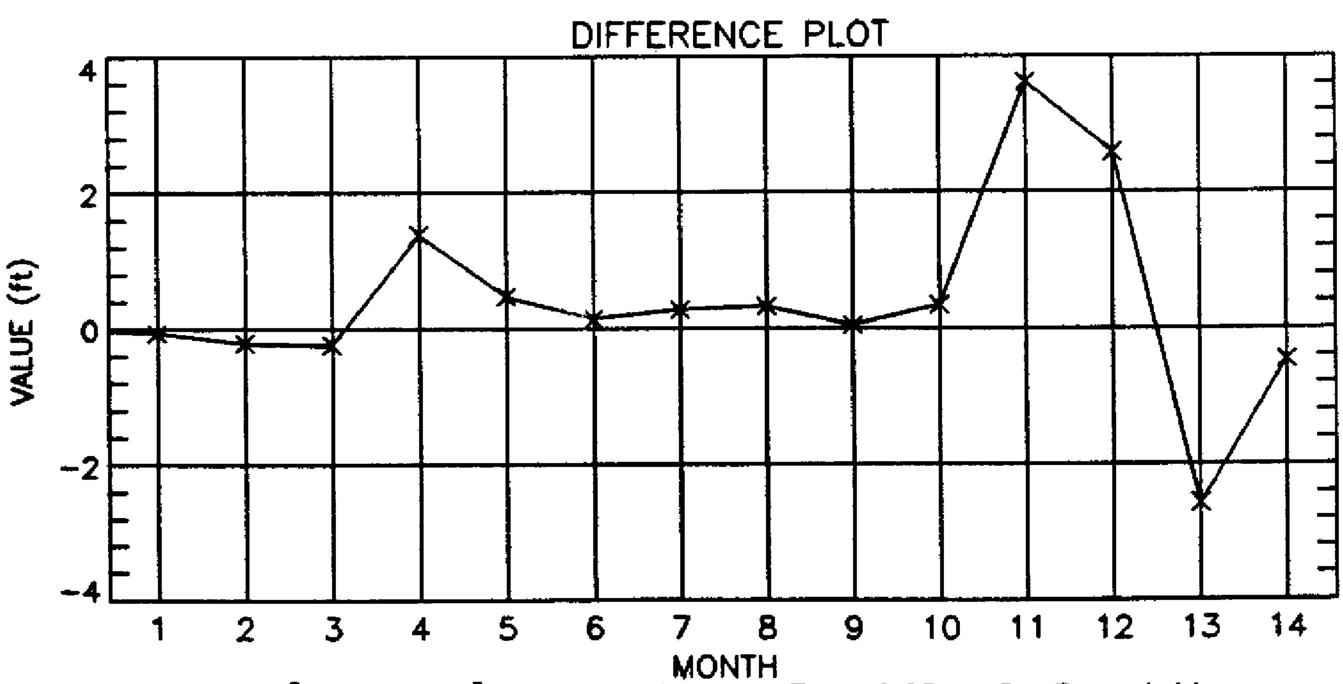
DIFFERENCE PLOT



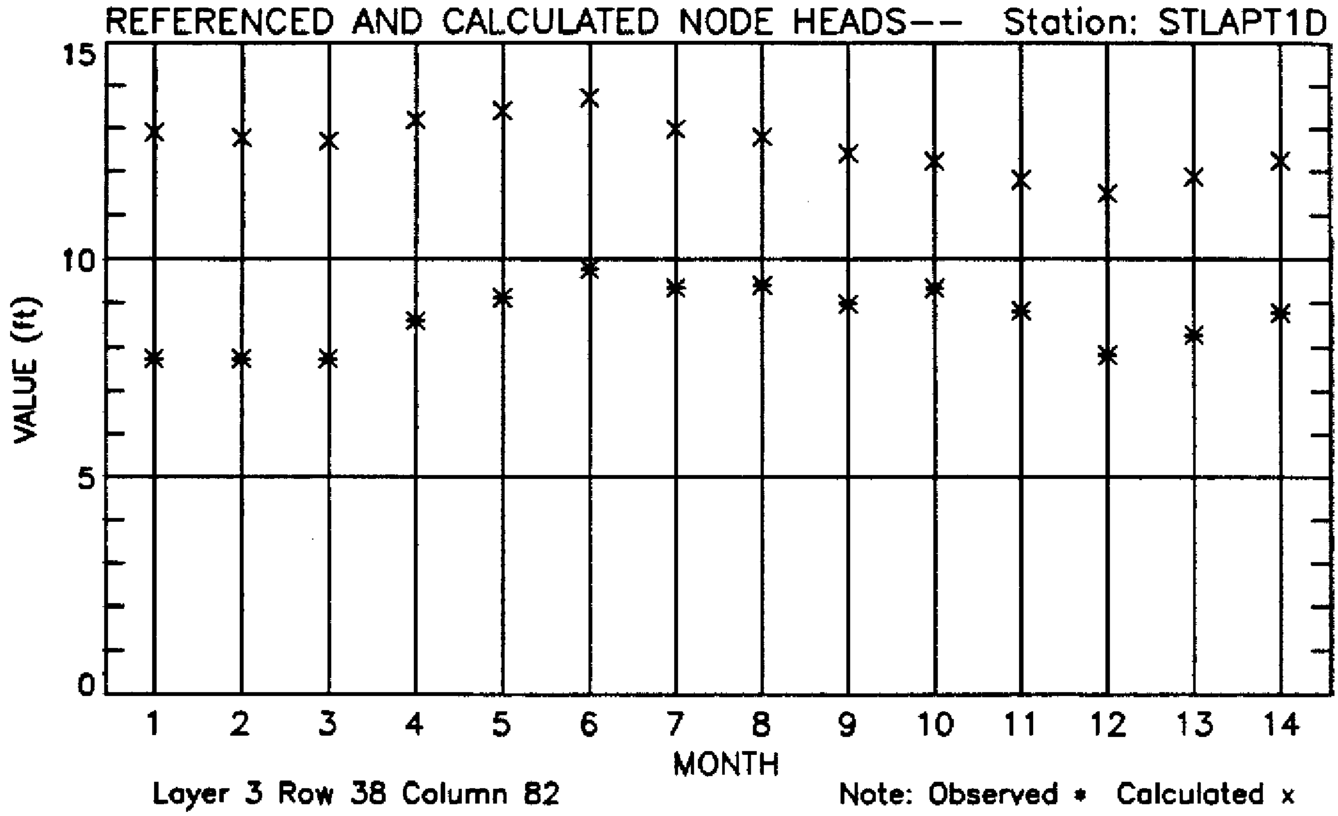
Extreme Errors [-1.4, 1.3] Average Absolute Error 0.67 Std.Error 0.83 pg 95

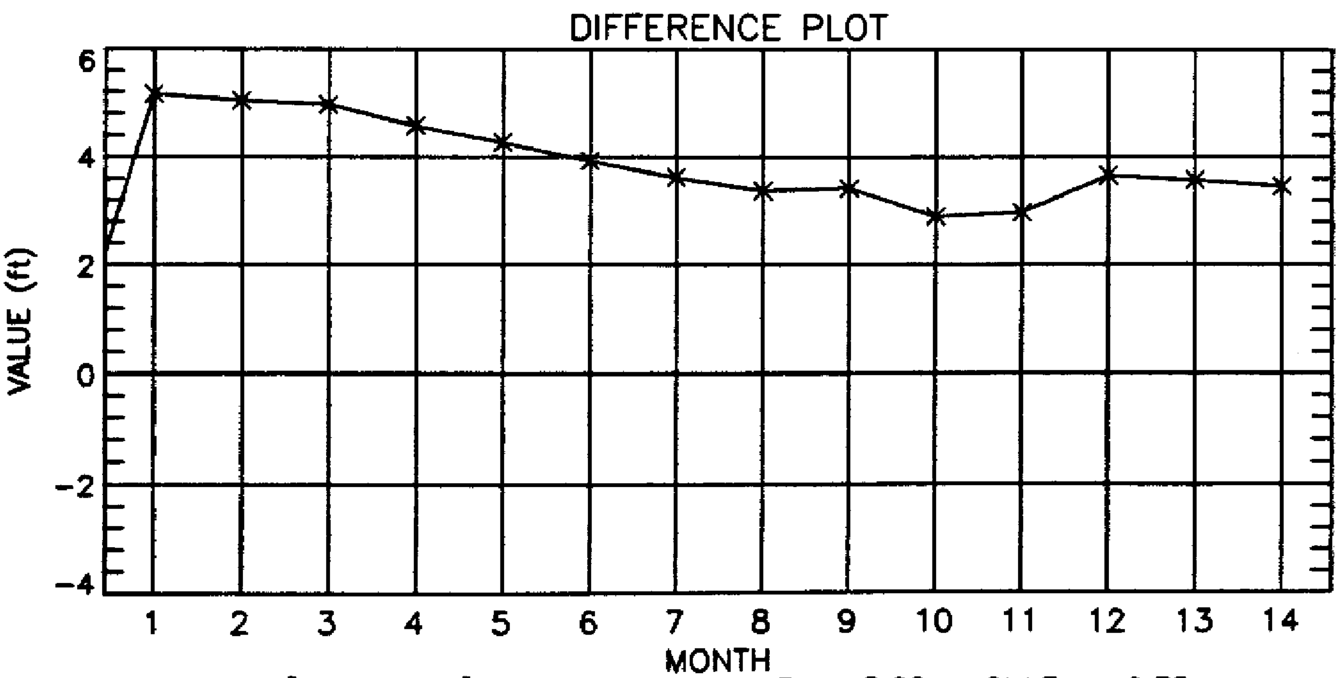


Layer 3 Row 37 Column 54 Note: Observed * Calculated x

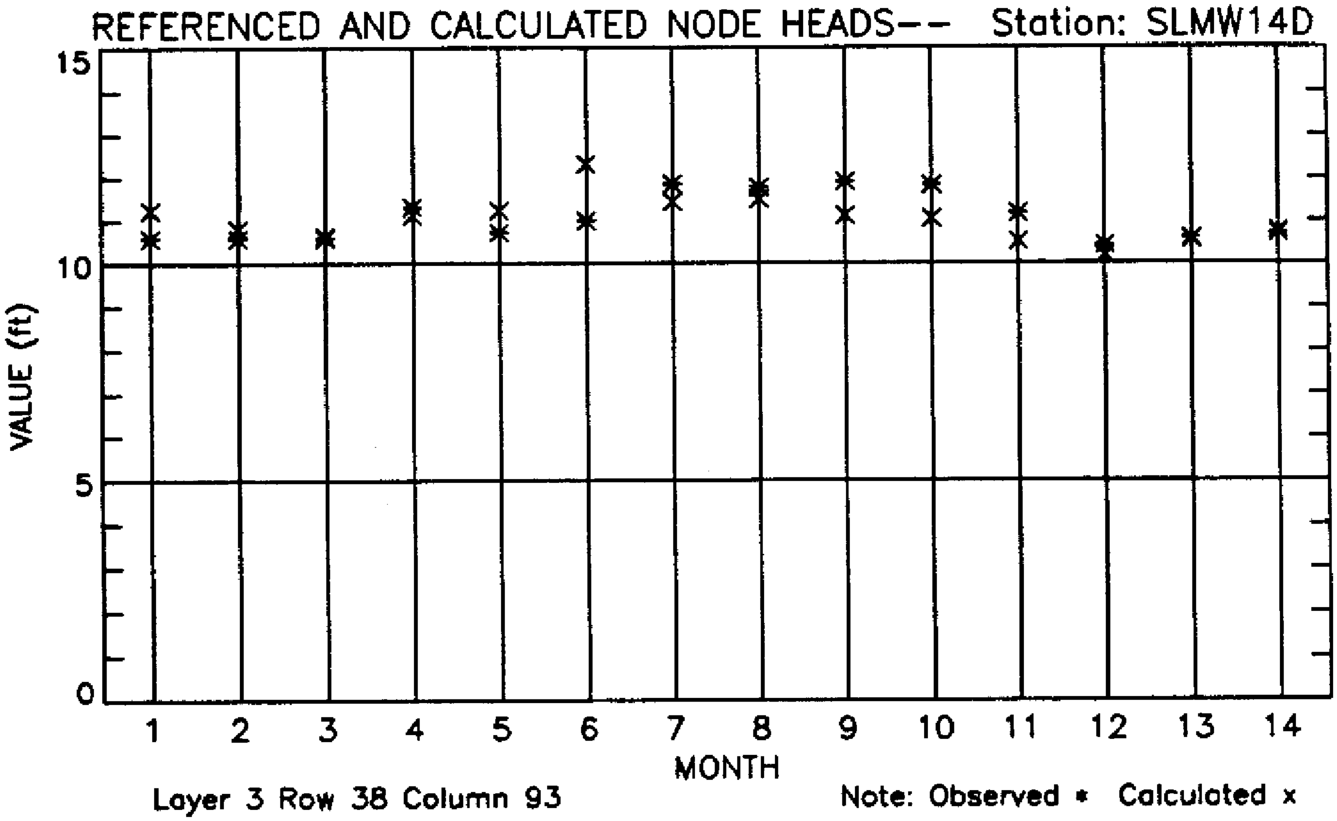


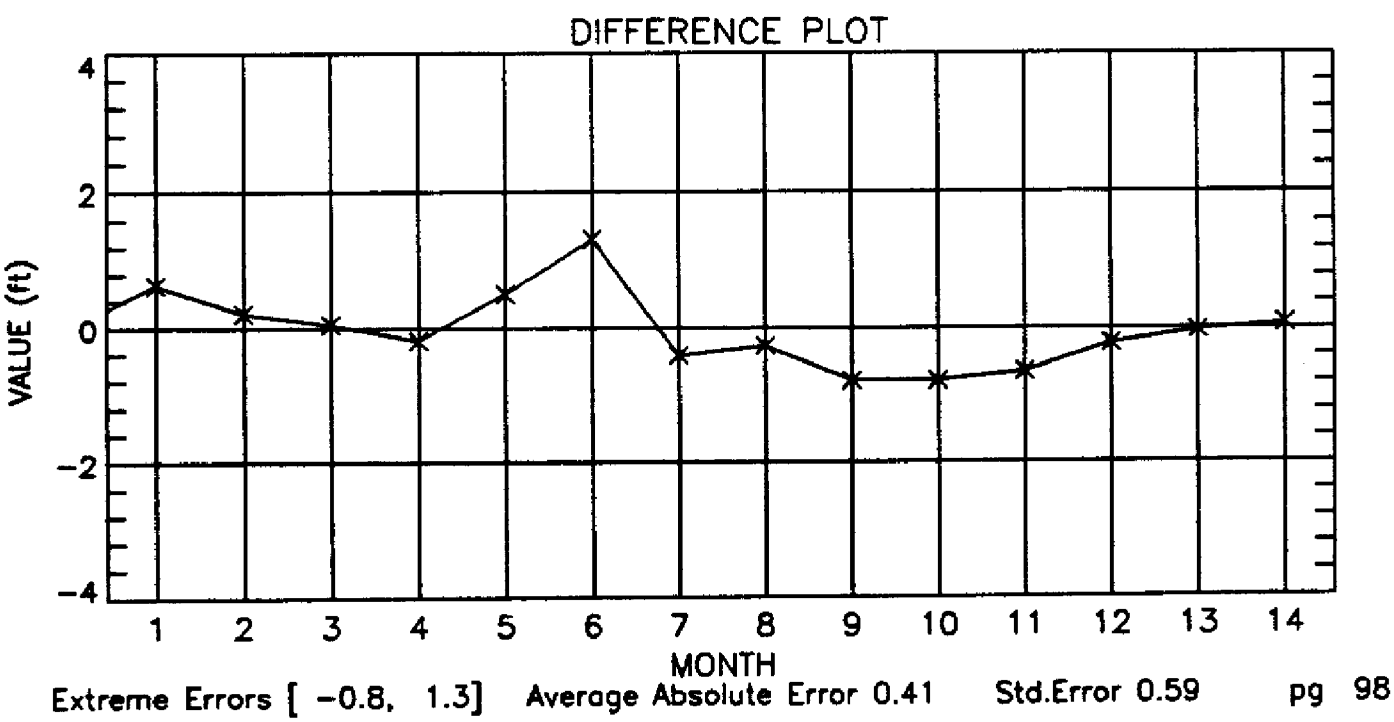
Extreme Errors [-2.6, 3.6] Average Absolute Error 0.85 Std.Error 1.44 pg 96

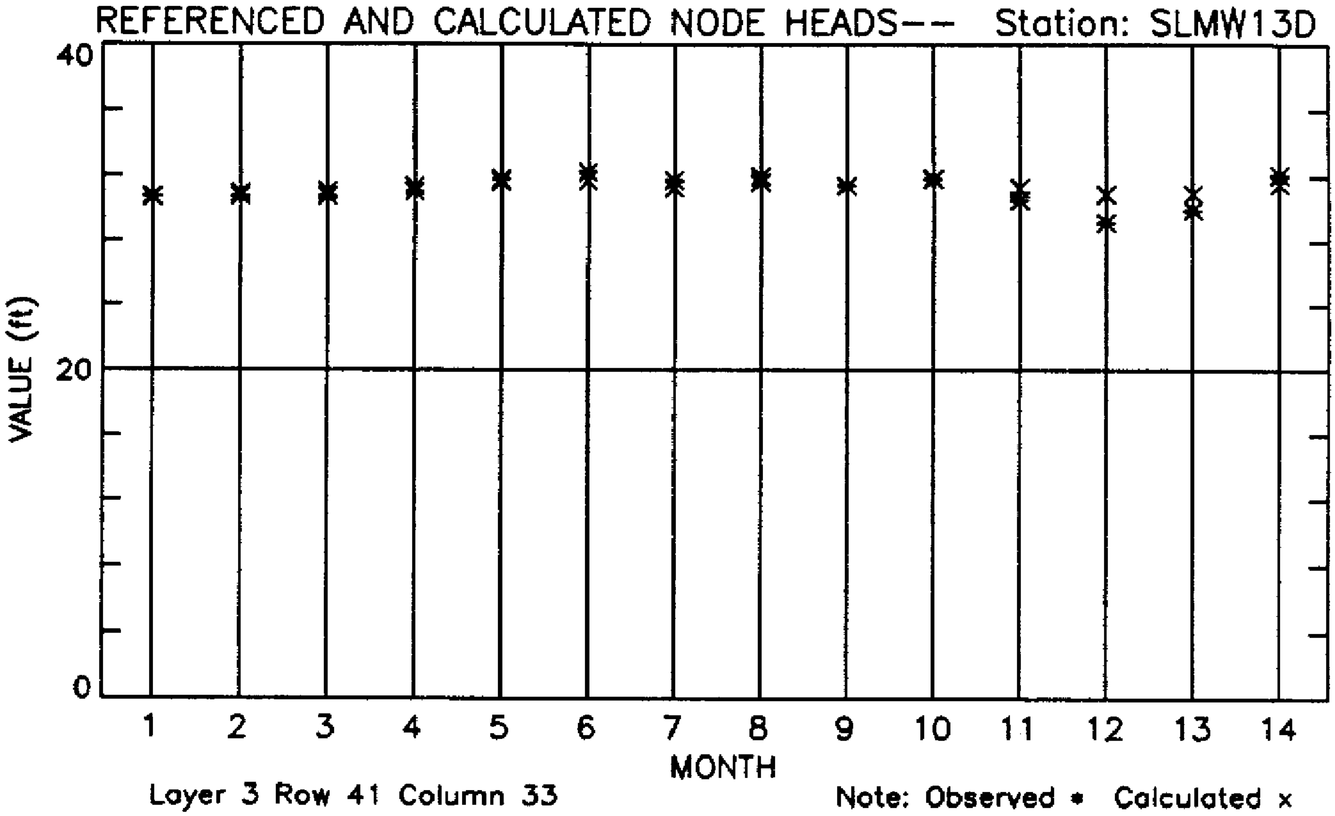


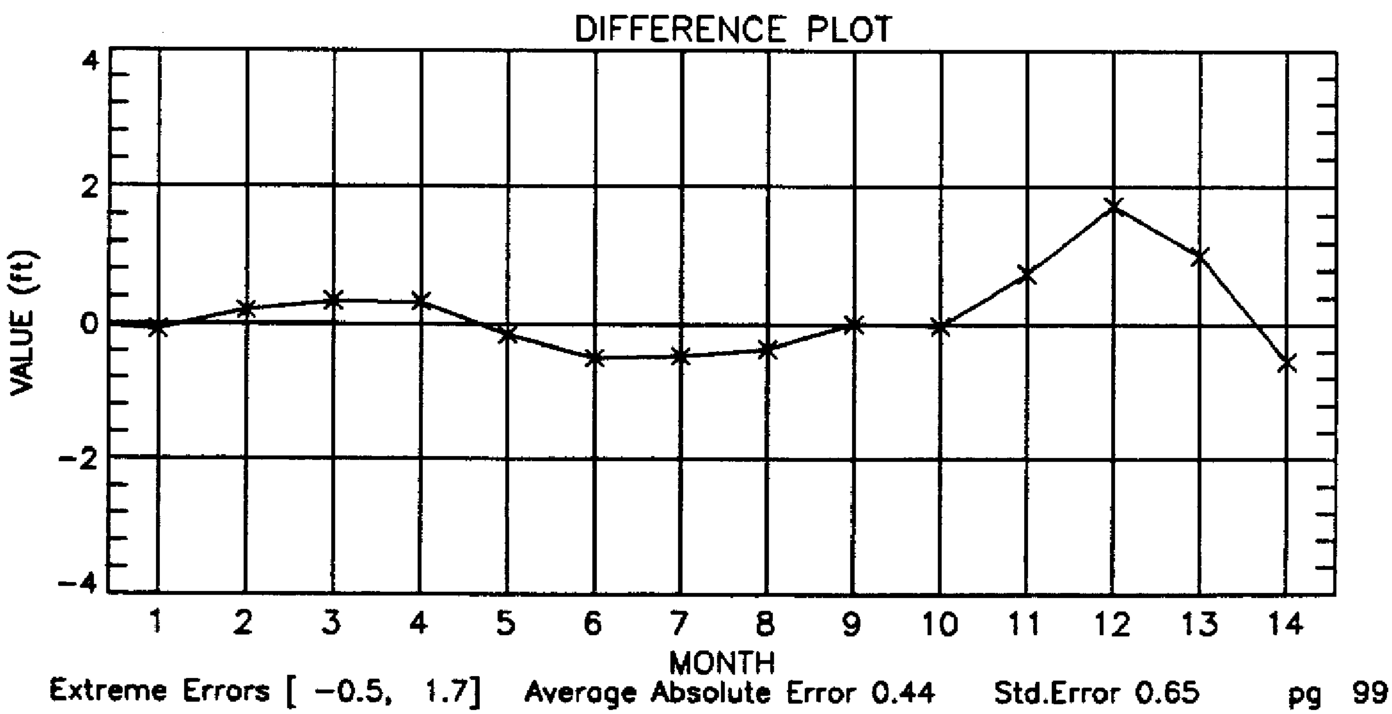


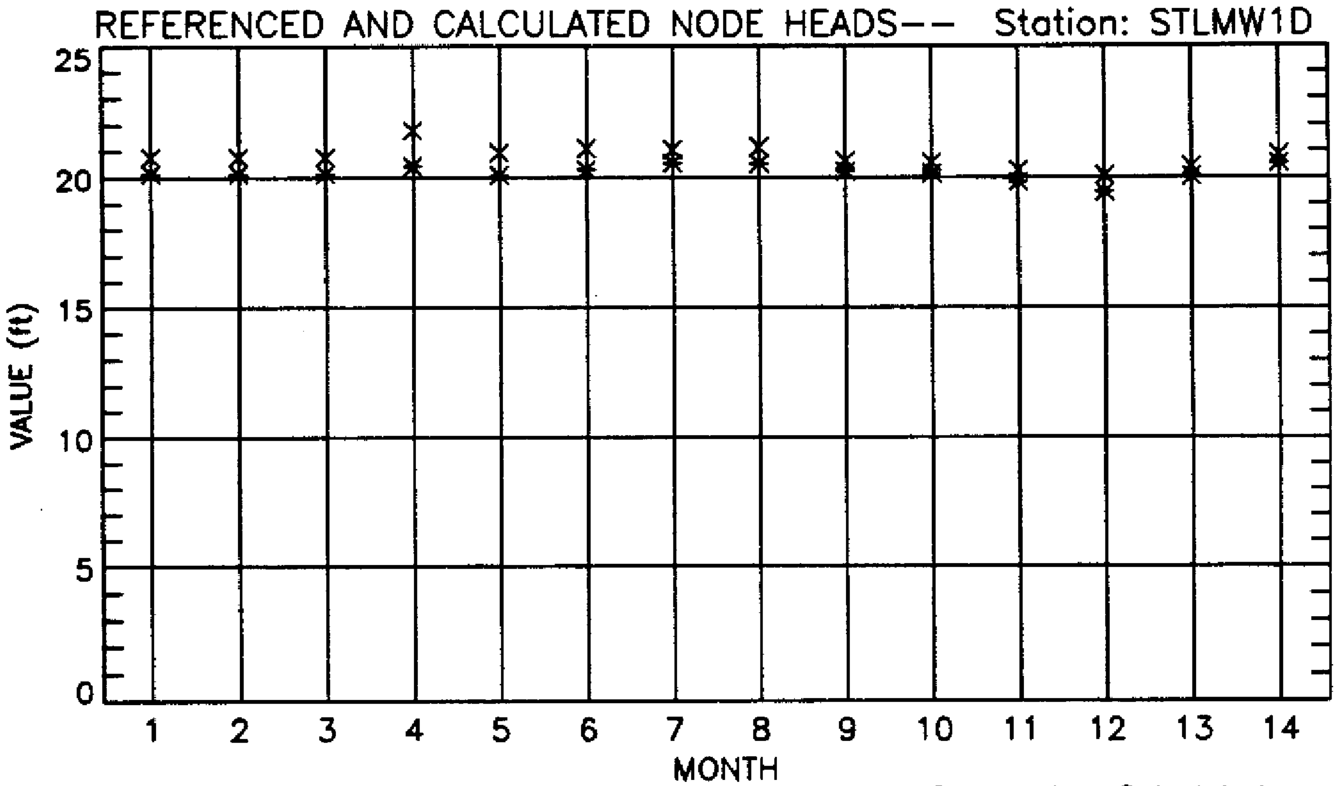
Extreme Errors [2.9, 5.2] Average Absolute Error 3.66 Std.Error 0.75 pg 97


REFERENCED AND CALCULATED NODE HEADS-- Station: SLMW14D
VALUE (ft)
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 38 Column 93
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.8, 1.3] Average Absolute Error 0.41 Std.Error 0.59 pg 98

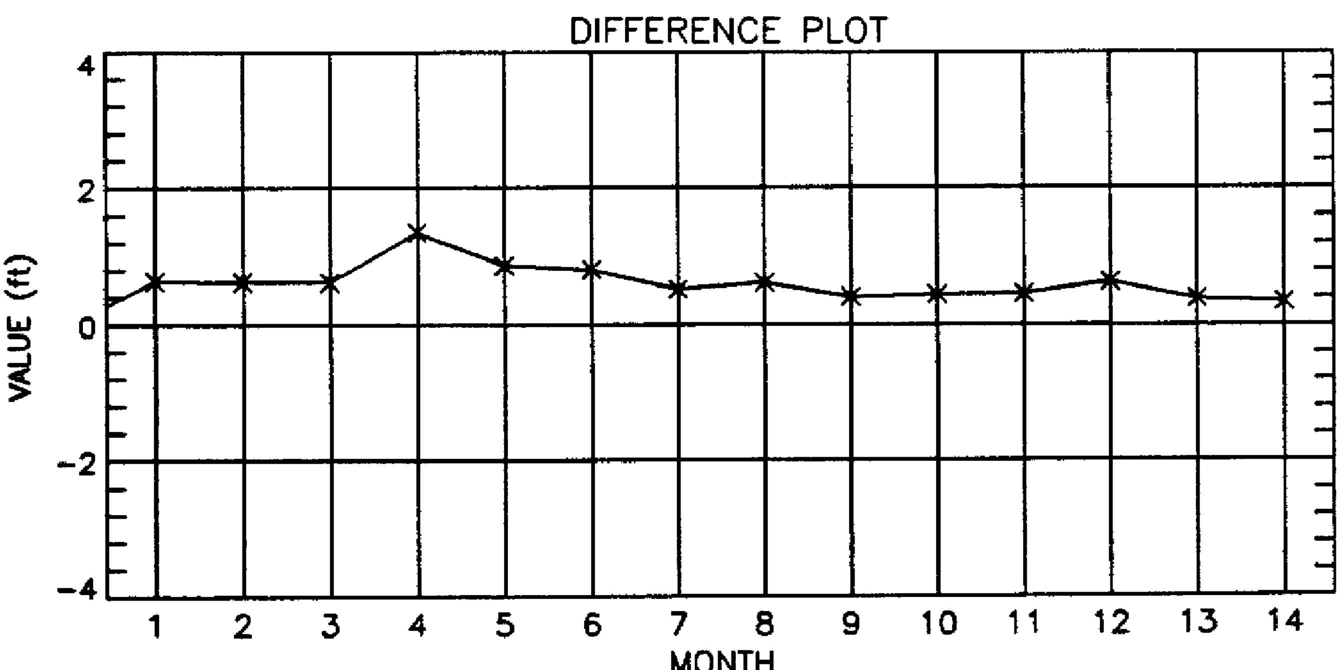

REFERENCED AND CALCULATED NODE HEADS-- Station: SLMW13D
40
20
0
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 41 Column 33
Note: Observed * Calculated x


DIFFERENCE PLOT
4
2
0
-2
-4
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.5, 1.7] Average Absolute Error 0.44 Std.Error 0.65 pg 99



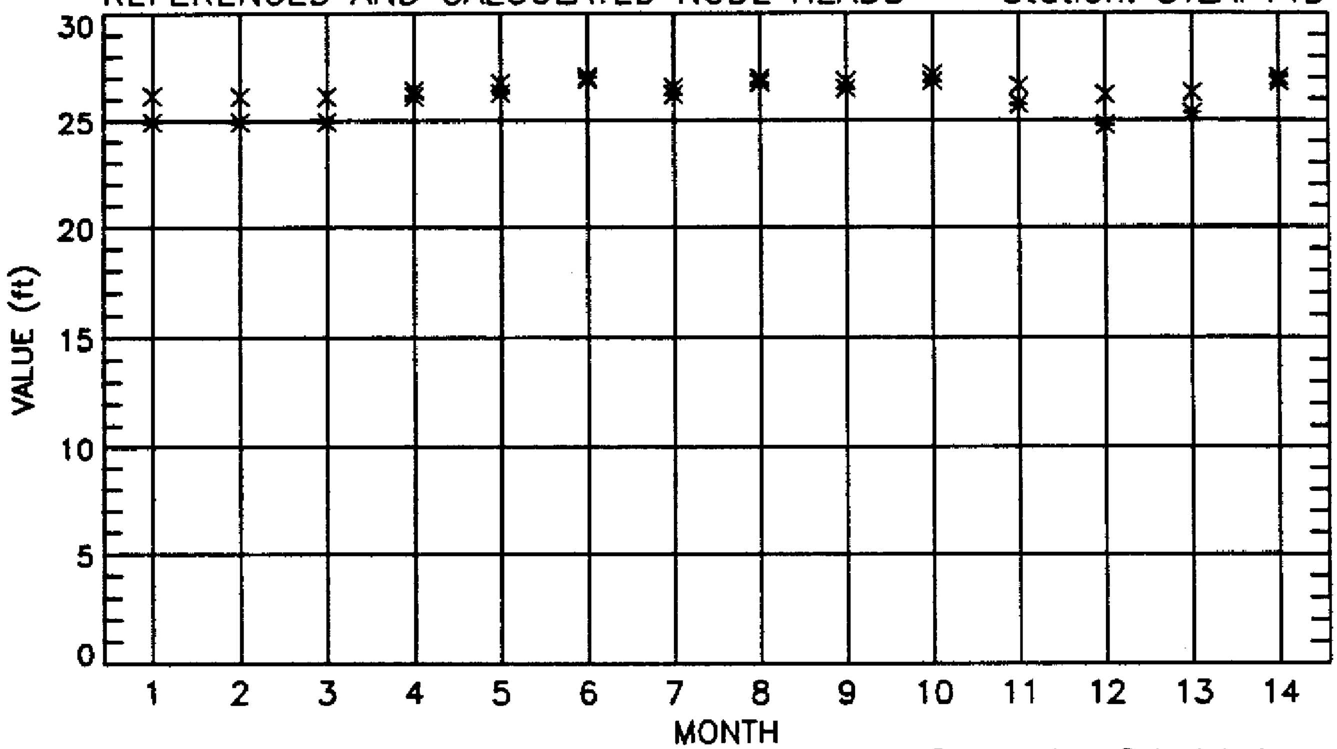
Layer 3 Row 42 Column 59

Note: Observed * Calculated x



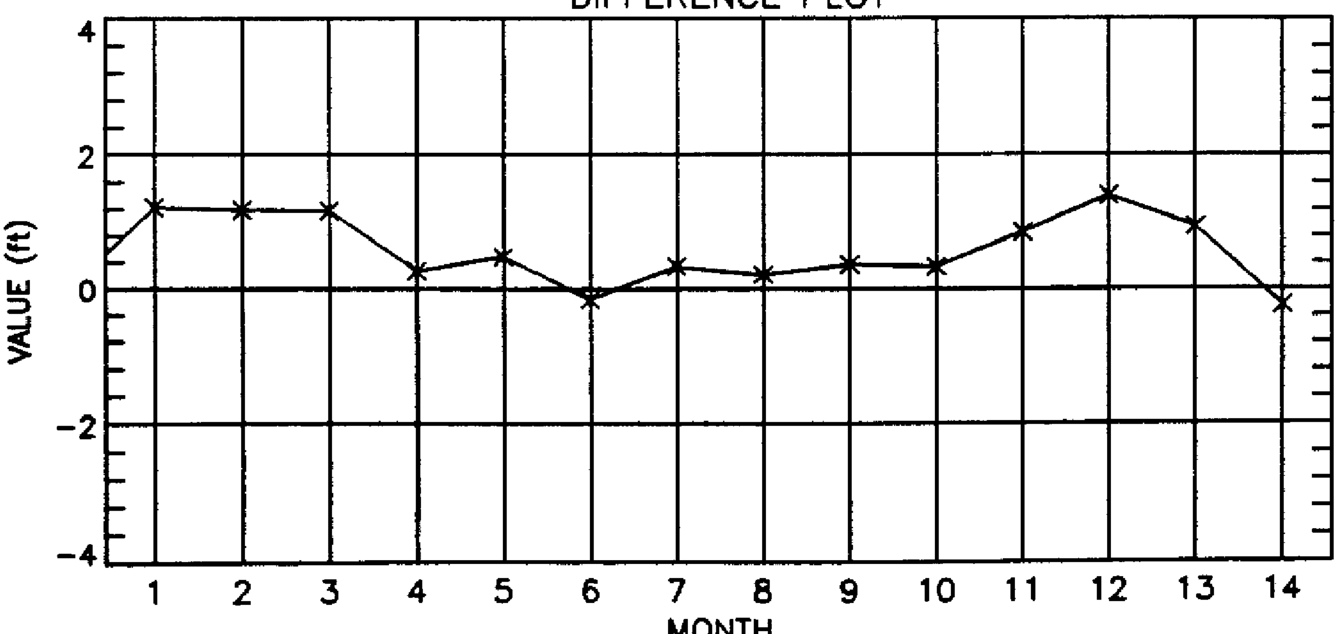
Extreme Errors [0.3, 1.3] Average Absolute Error 0.58 Std.Error 0.26 pg 100

REFERENCED AND CALCULATED NODE HEADS-- Station: STLAPT4D

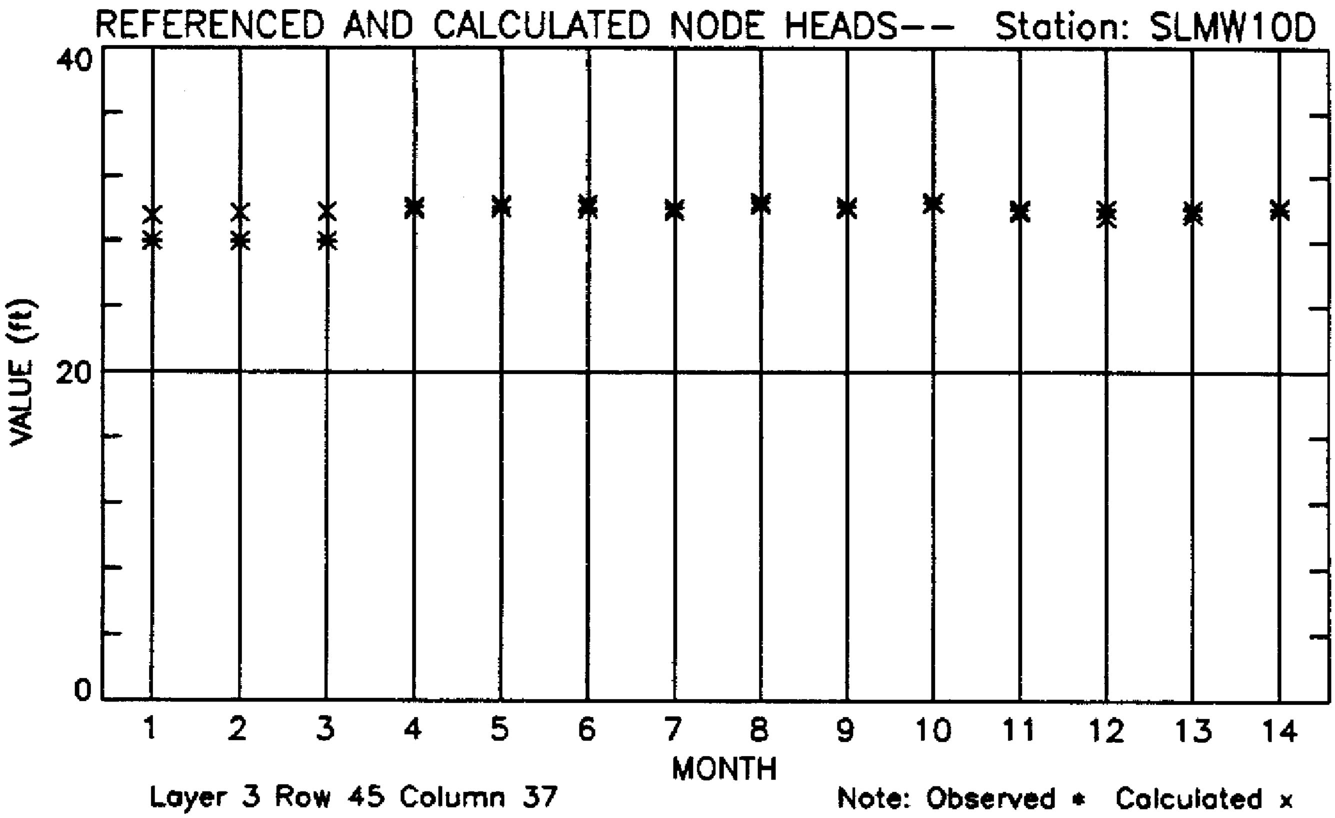


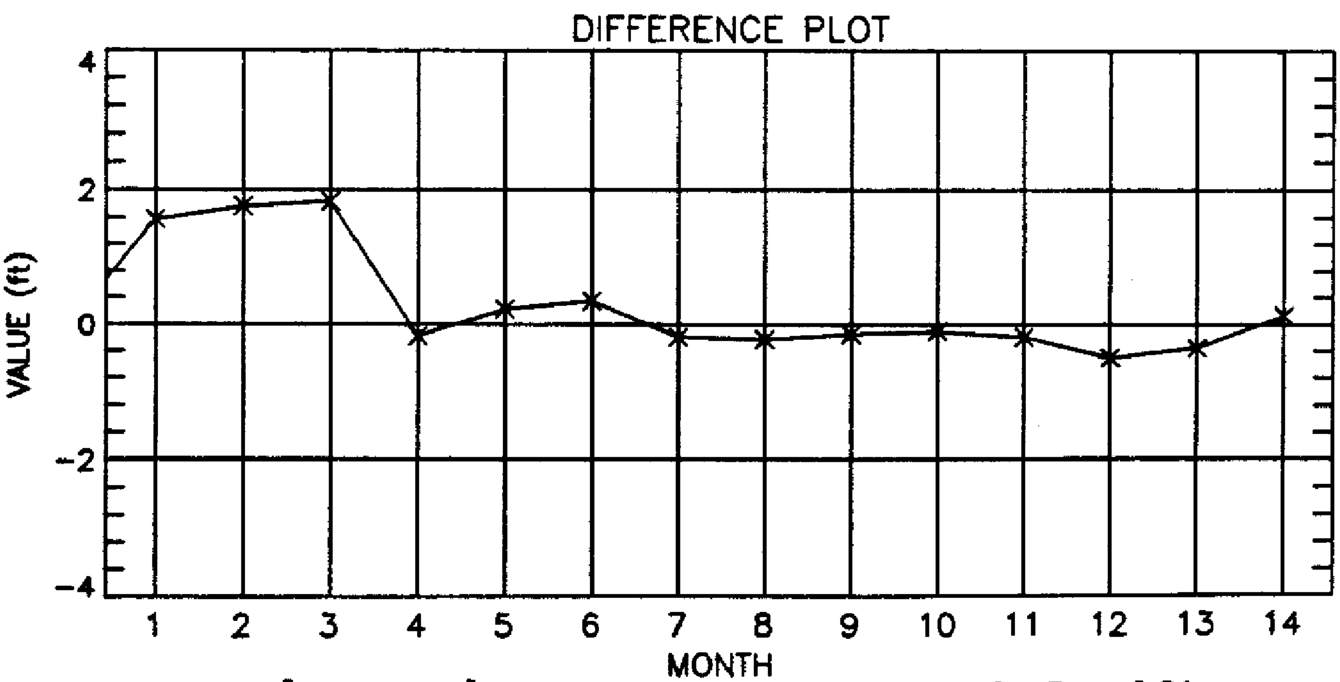
Layer 3 Row 43 Column 41 Note: Observed * Calculated x

DIFFERENCE PLOT

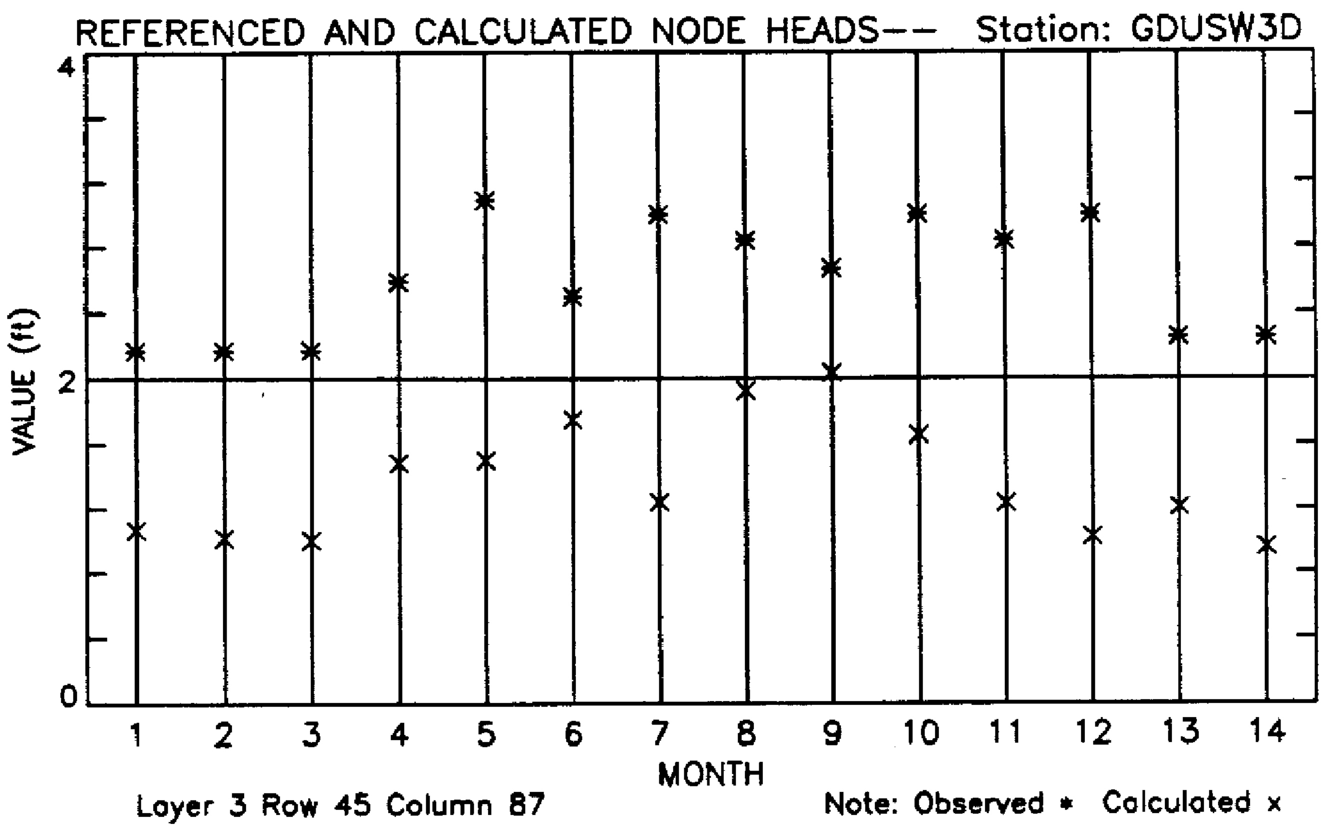


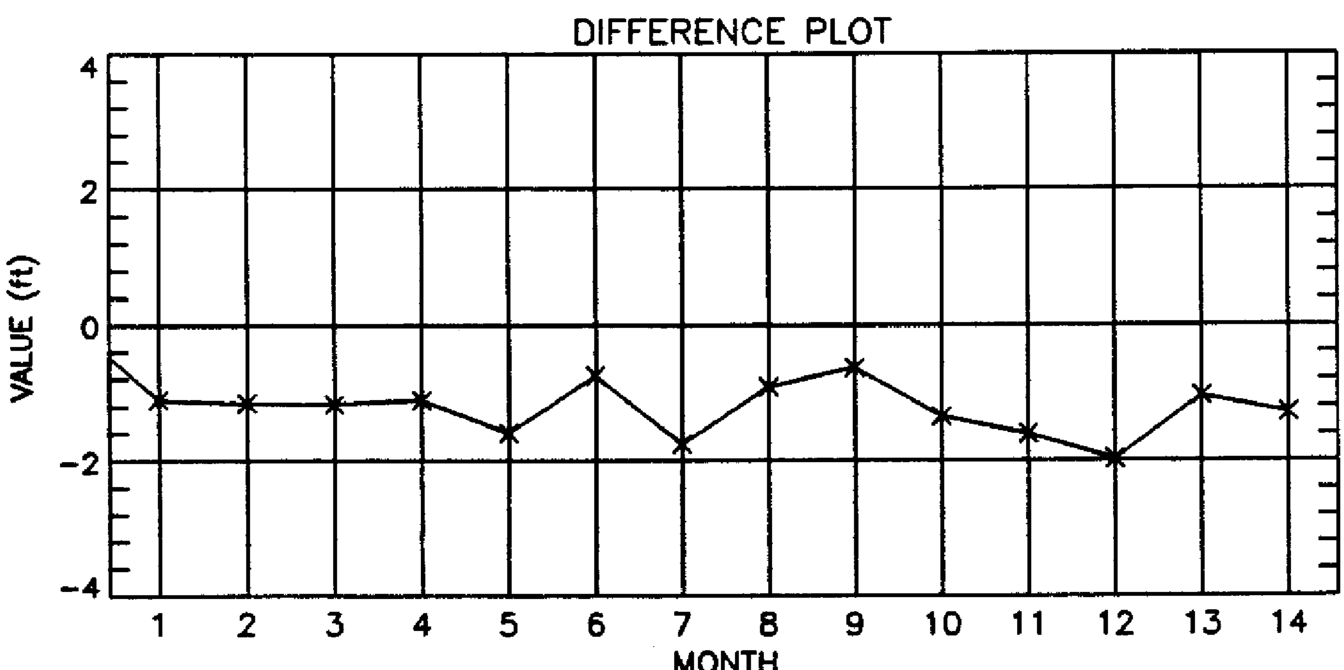
Extreme Errors [-0.2, 1.4] Average Absolute Error 0.61 Std.Error 0.53 pg 101



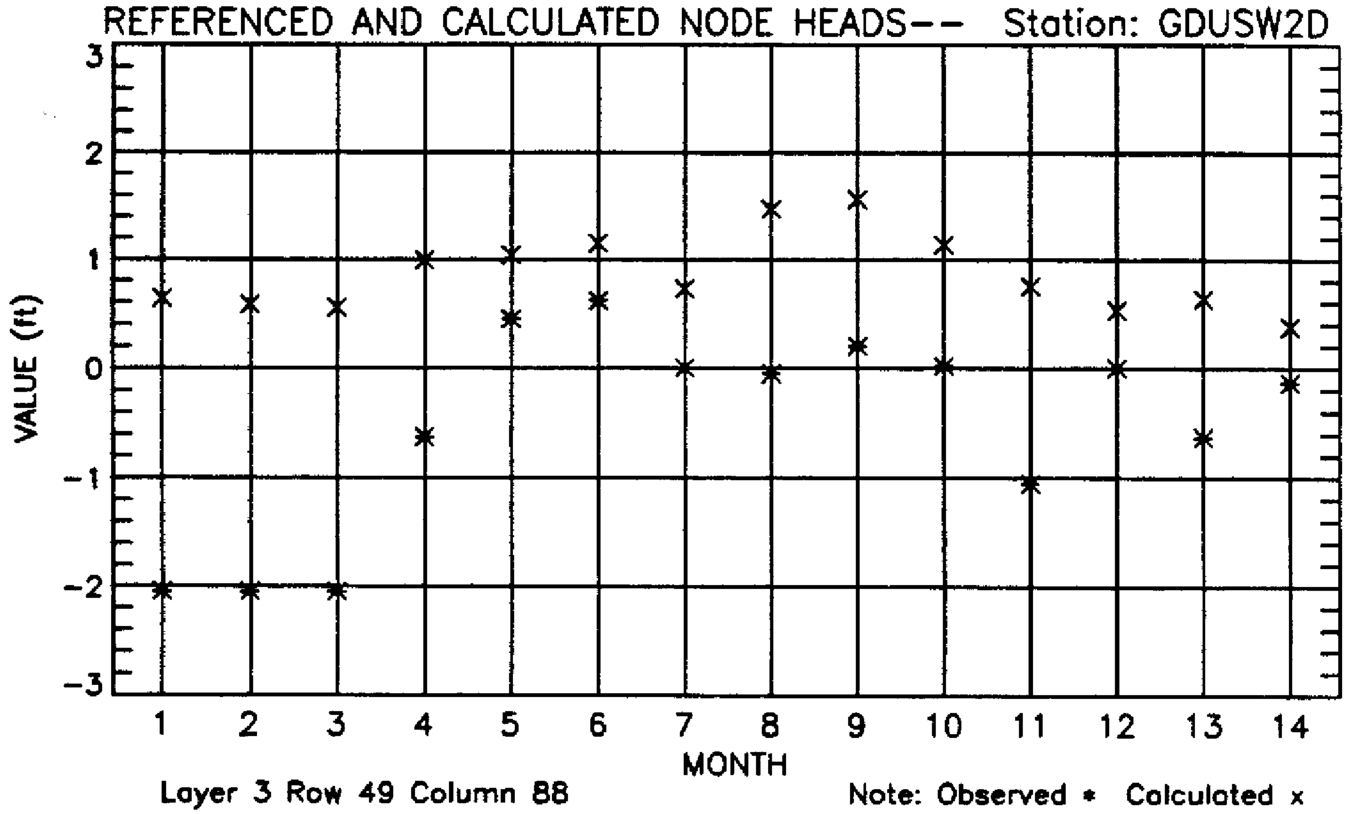


Extreme Errors [-0.5, 1.8] Average Absolute Error 0.52 Std.Error 0.81 pg 102

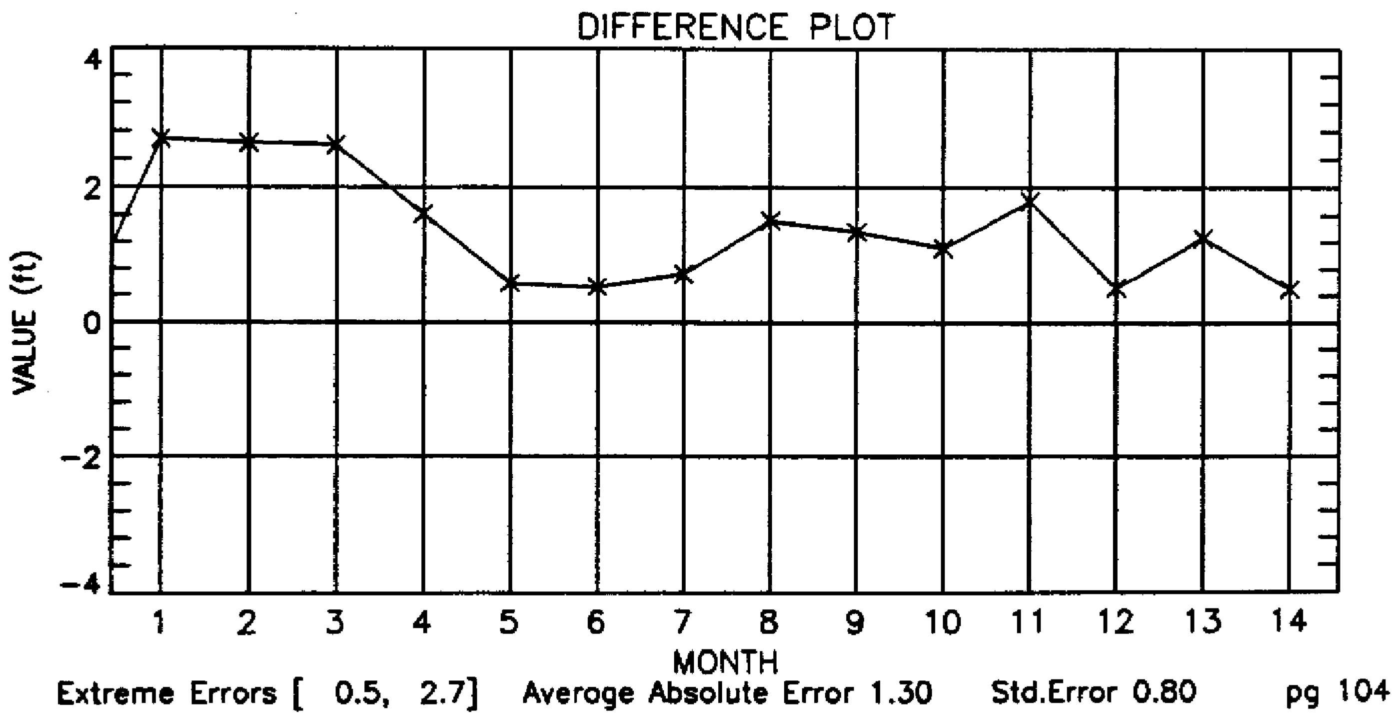




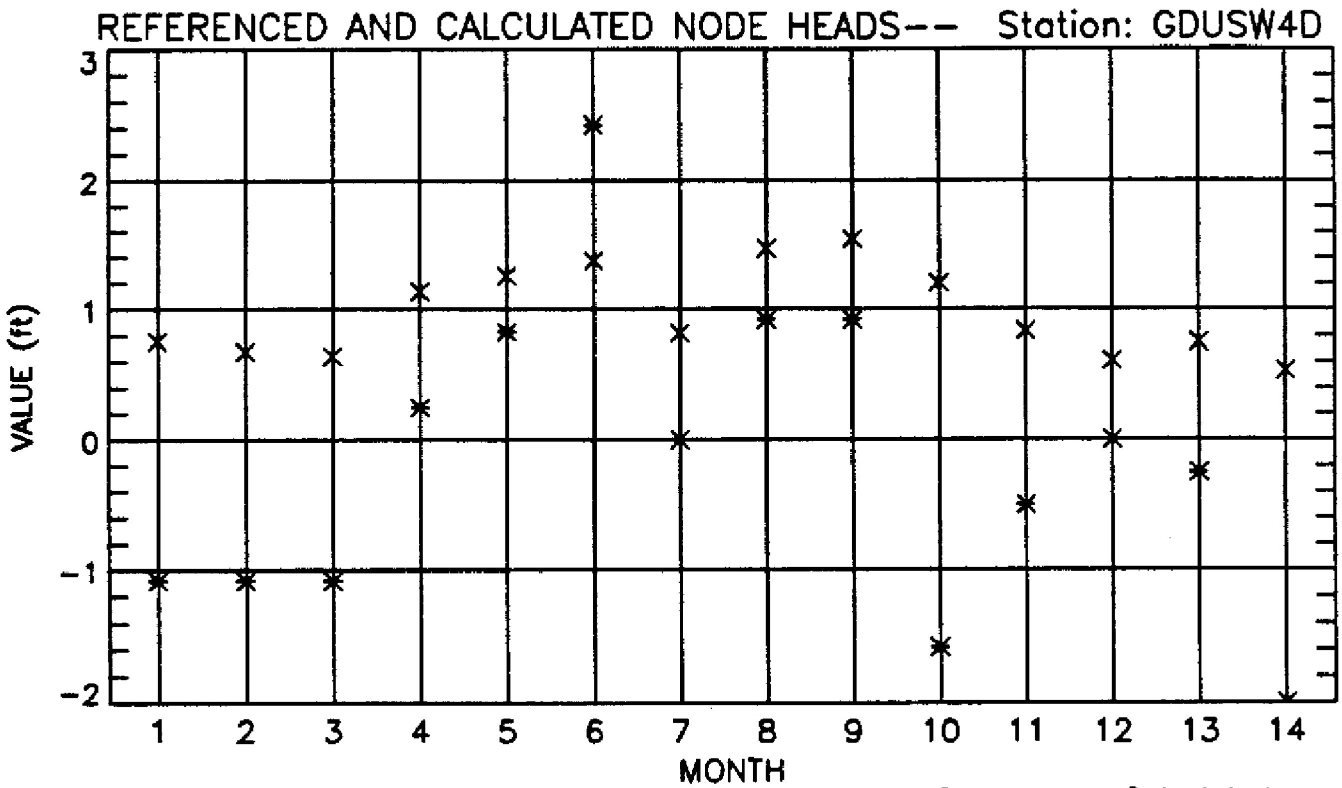
Extreme Errors [-2.0, -0.6] Average Absolute Error 1.16 Std.Error 0.38 pg 103



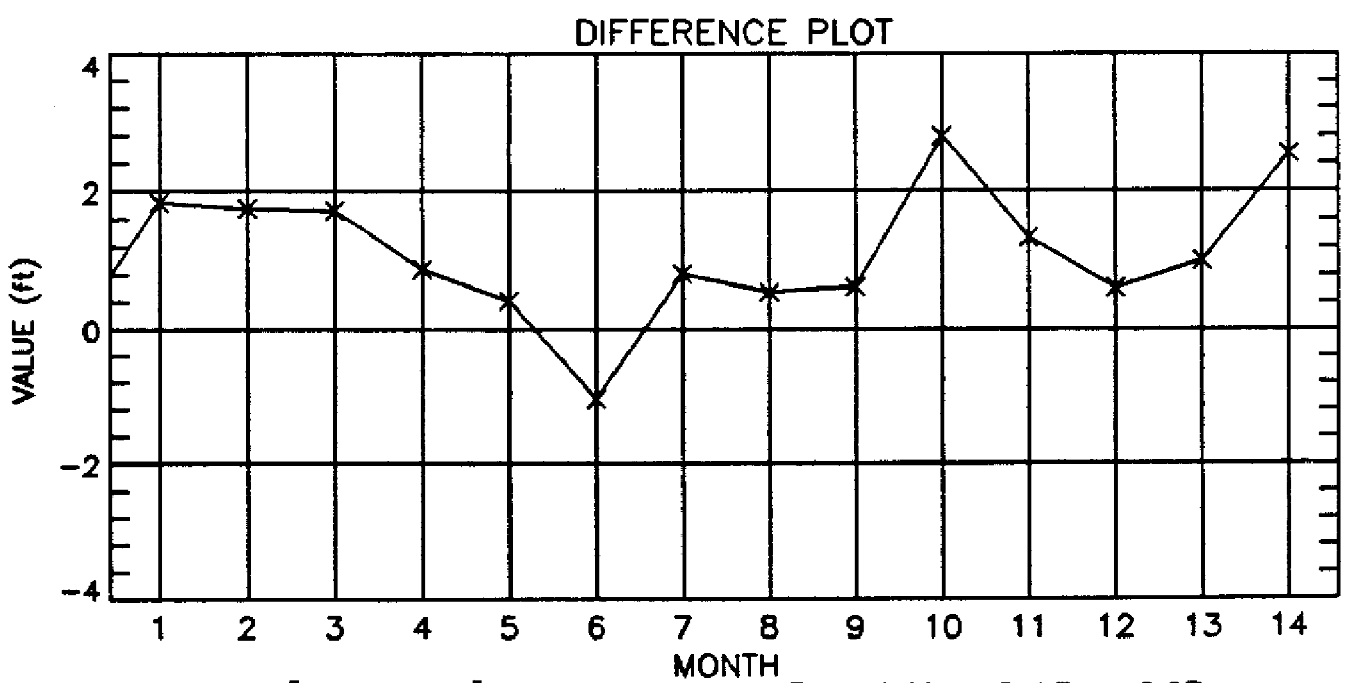
REFERENCED AND CALCULATED NODE HEADS-- Station: GDUSW2D
VALUE (ft)
3
2
1
0
-1
-2
-3
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 49 Column 88
Note: Observed * Calculated x



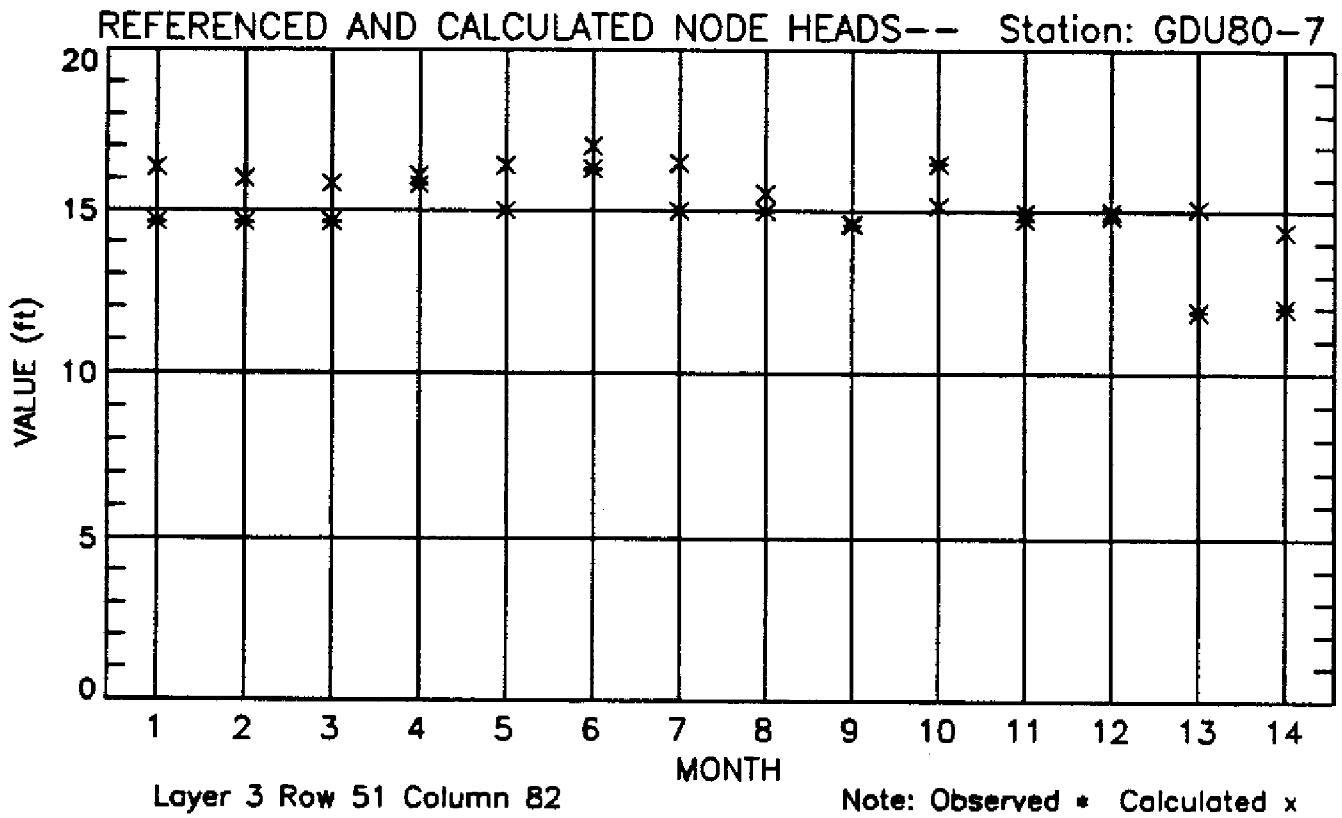
DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [0.5, 2.7] Average Absolute Error 1.30 Std.Error 0.80 pg 104

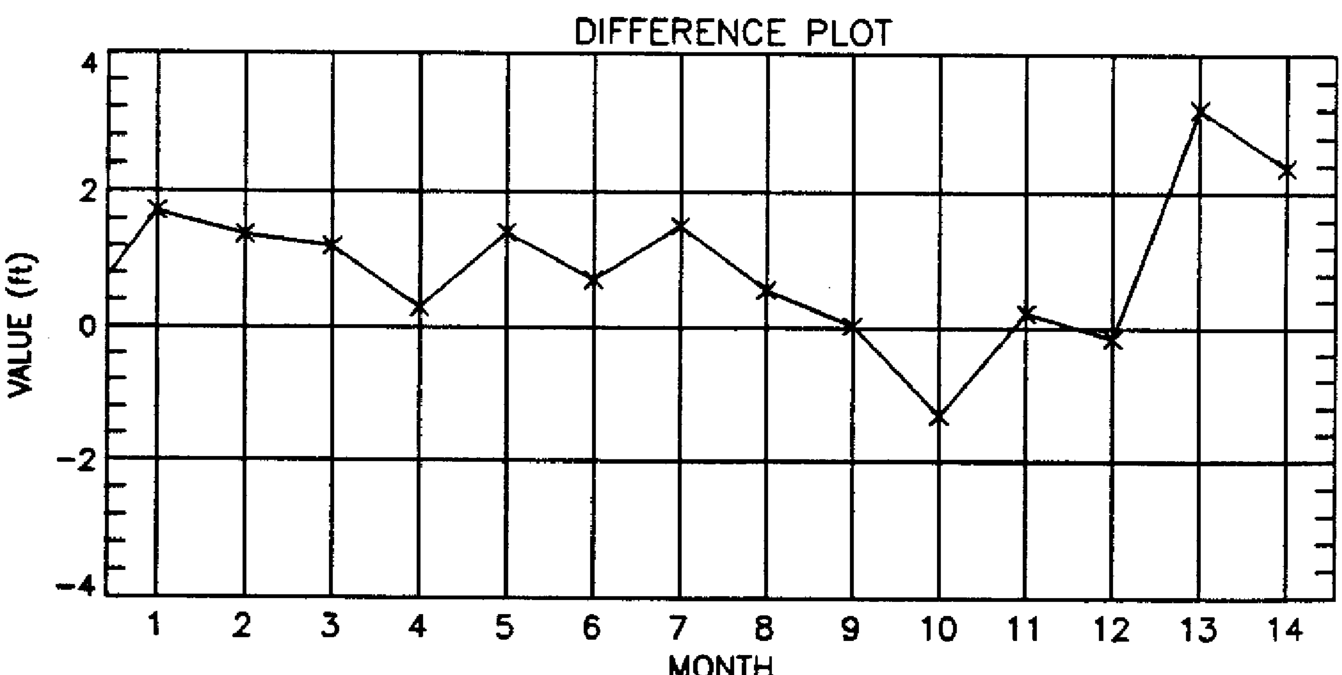


Layer 3 Row 50 Column 89 Note: Observed * Calculated x



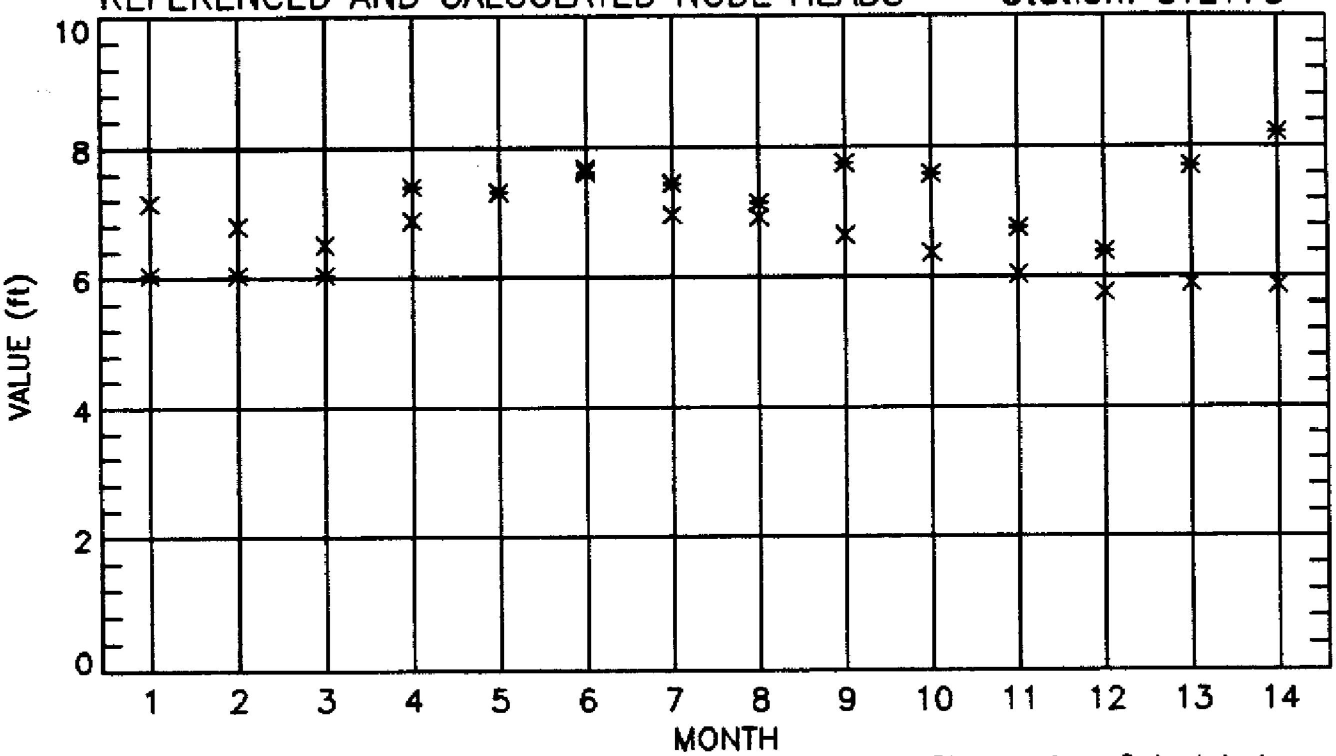
Extreme Errors [-1.0, 2.8] Average Absolute Error 1.19 Std.Error 0.97 pg 105





Extreme Errors [-1.3, 3.2] Average Absolute Error 1.07 Std.Error 1.13 pg 106

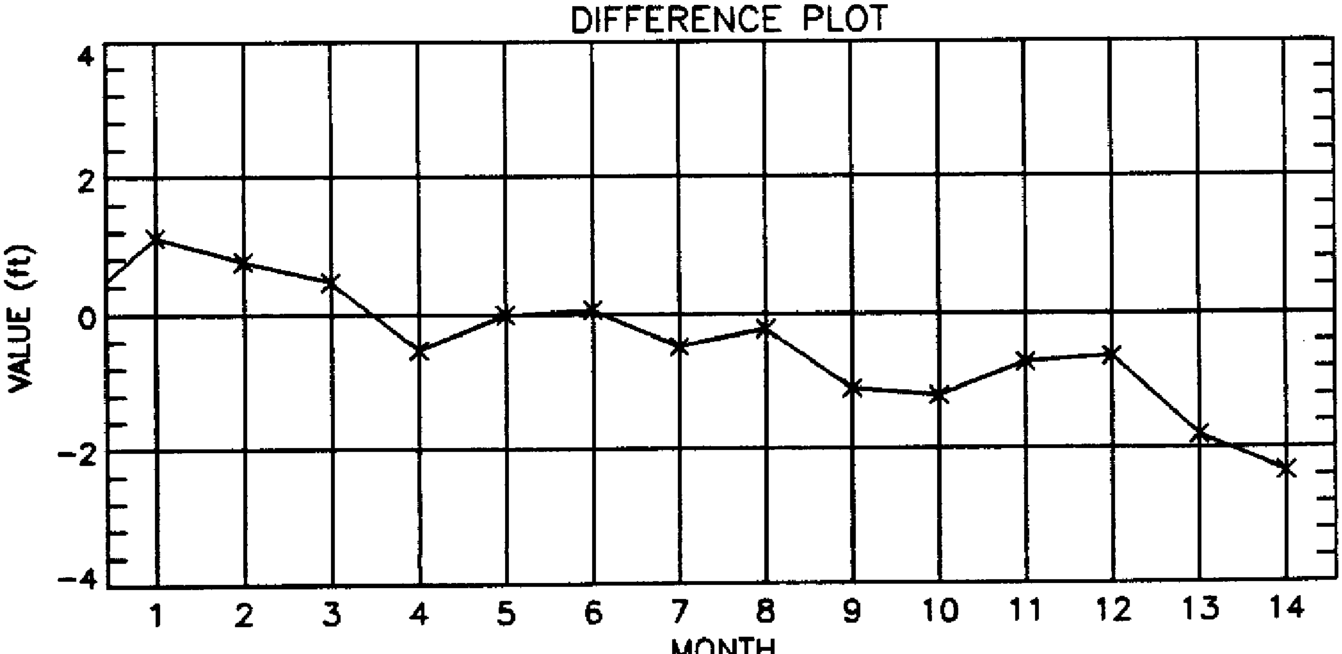
REFERENCED AND CALCULATED NODE HEADS-- Station: STL173



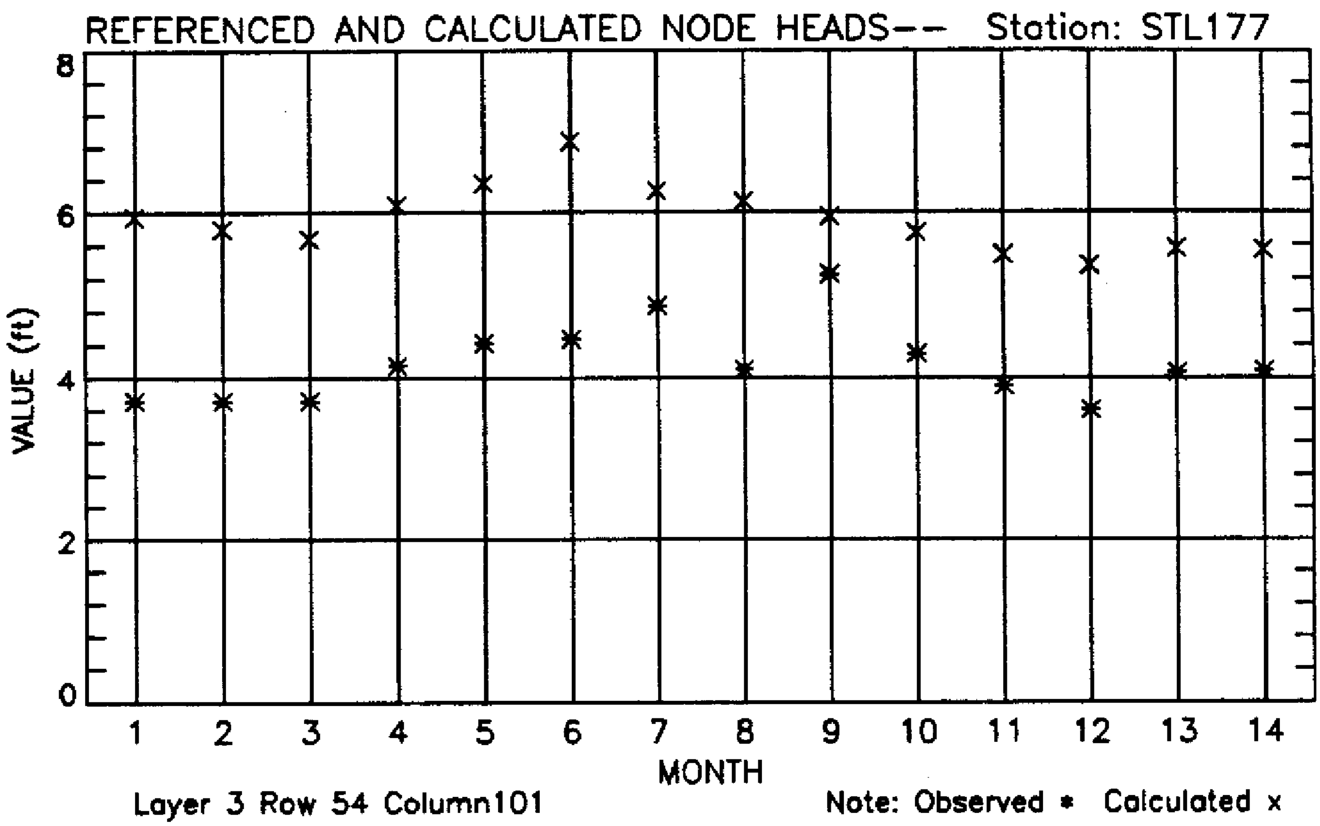
Layer 3 Row 54 Column 93

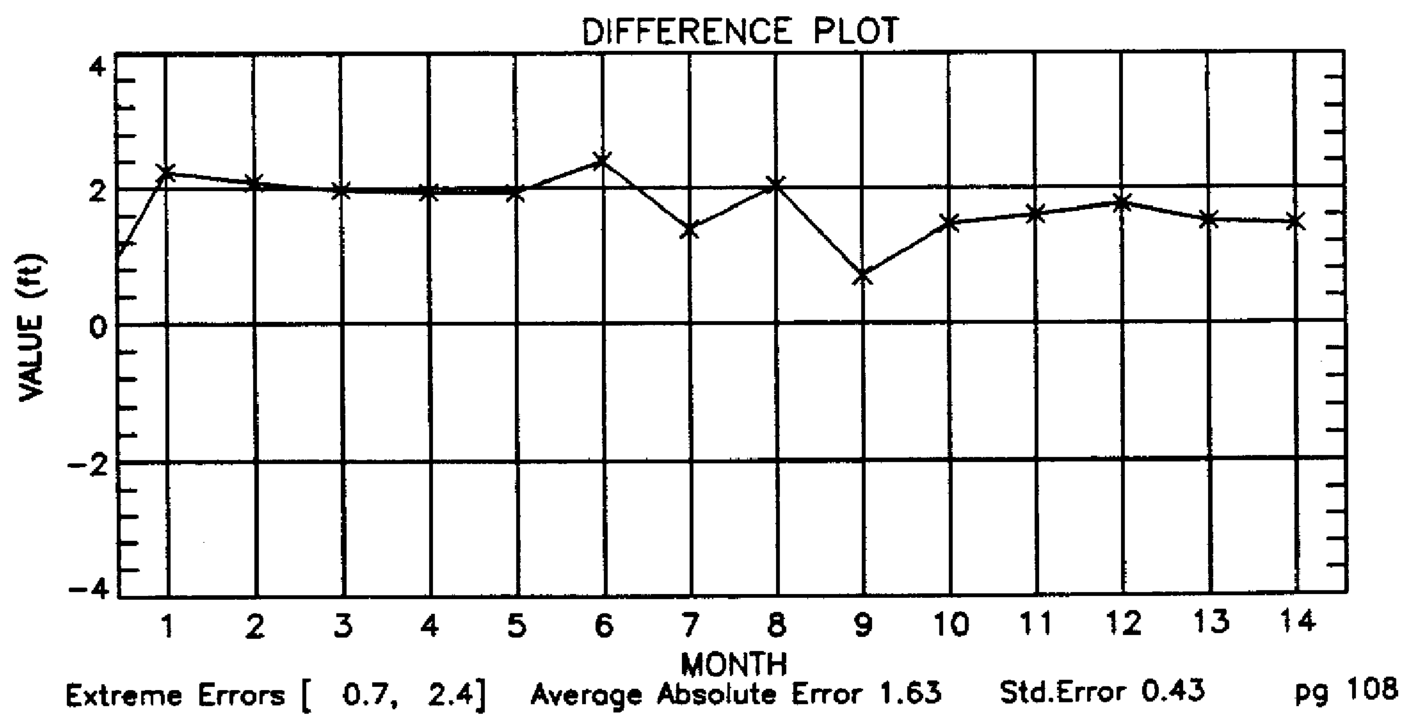
Note: Observed * Calculated x

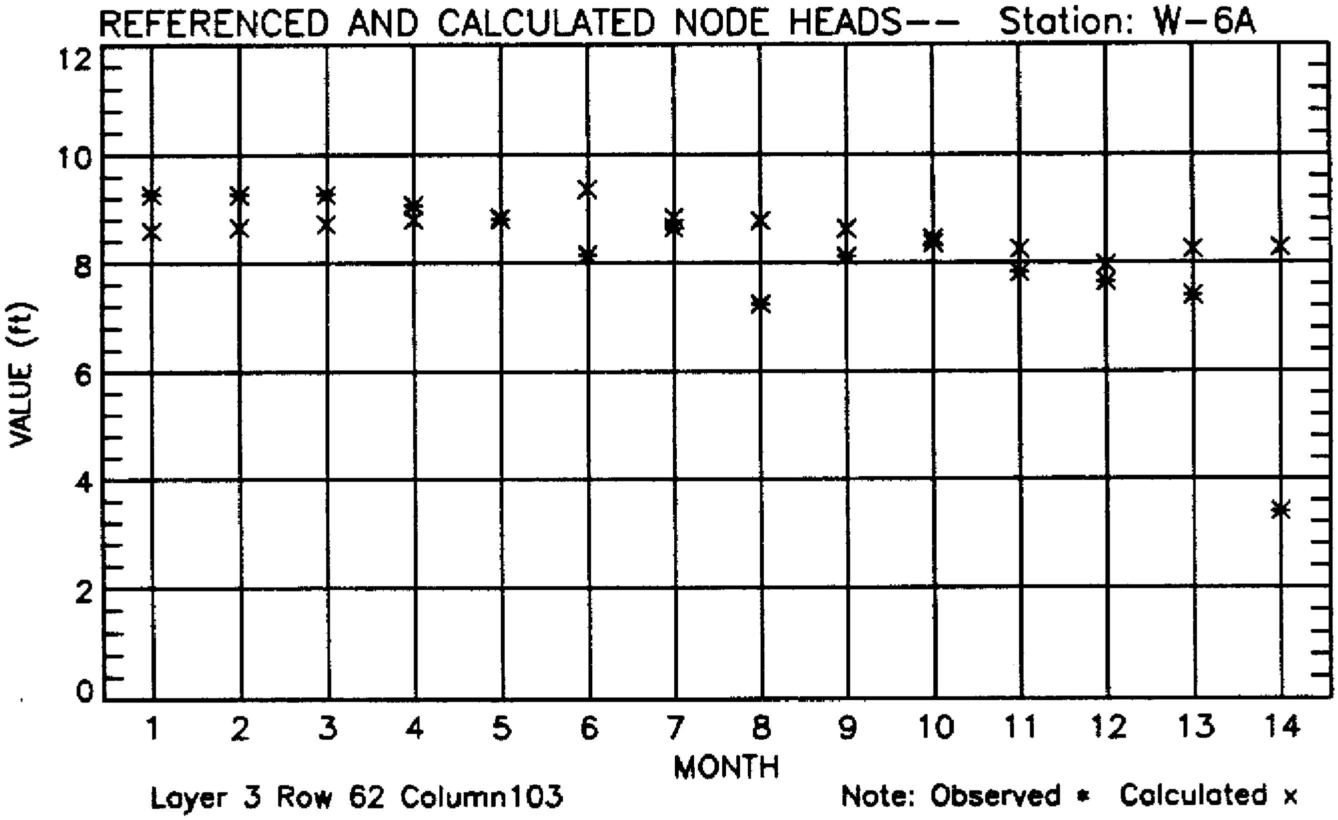
DIFFERENCE PLOT

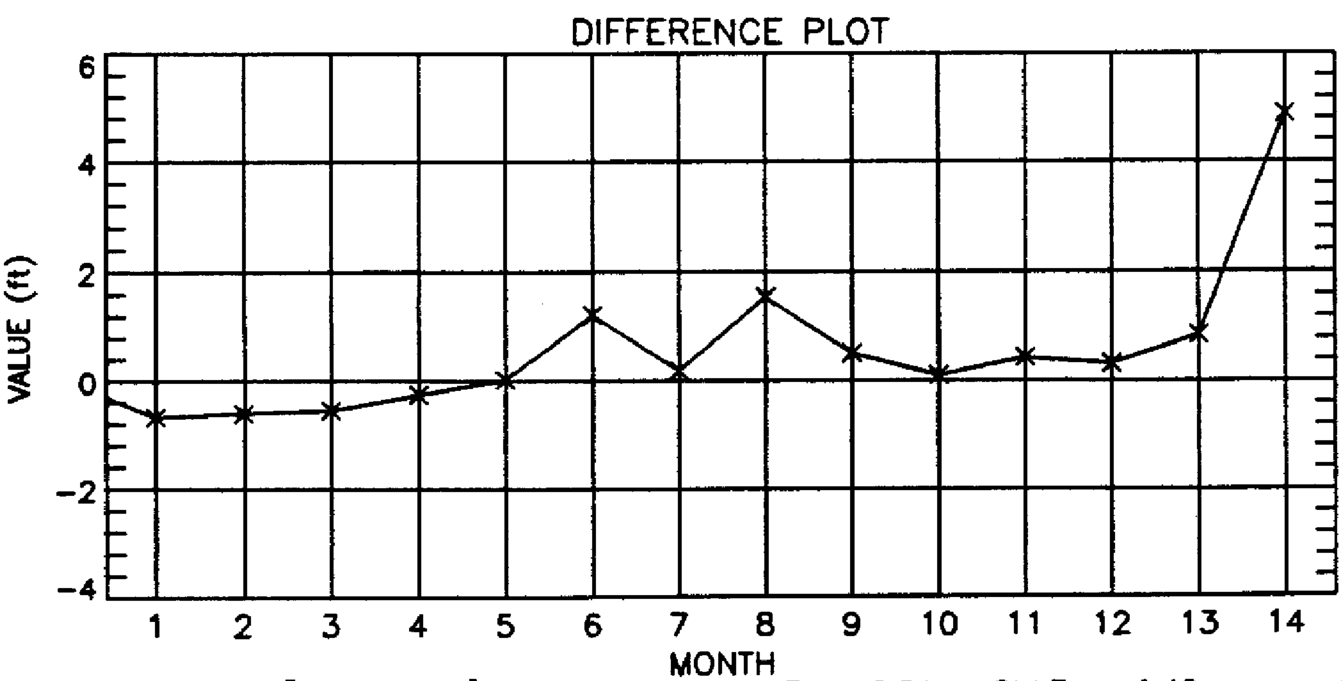


Extreme Errors [-2.4, 1.1] Average Absolute Error 0.77 Std.Error 0.96 pg 107

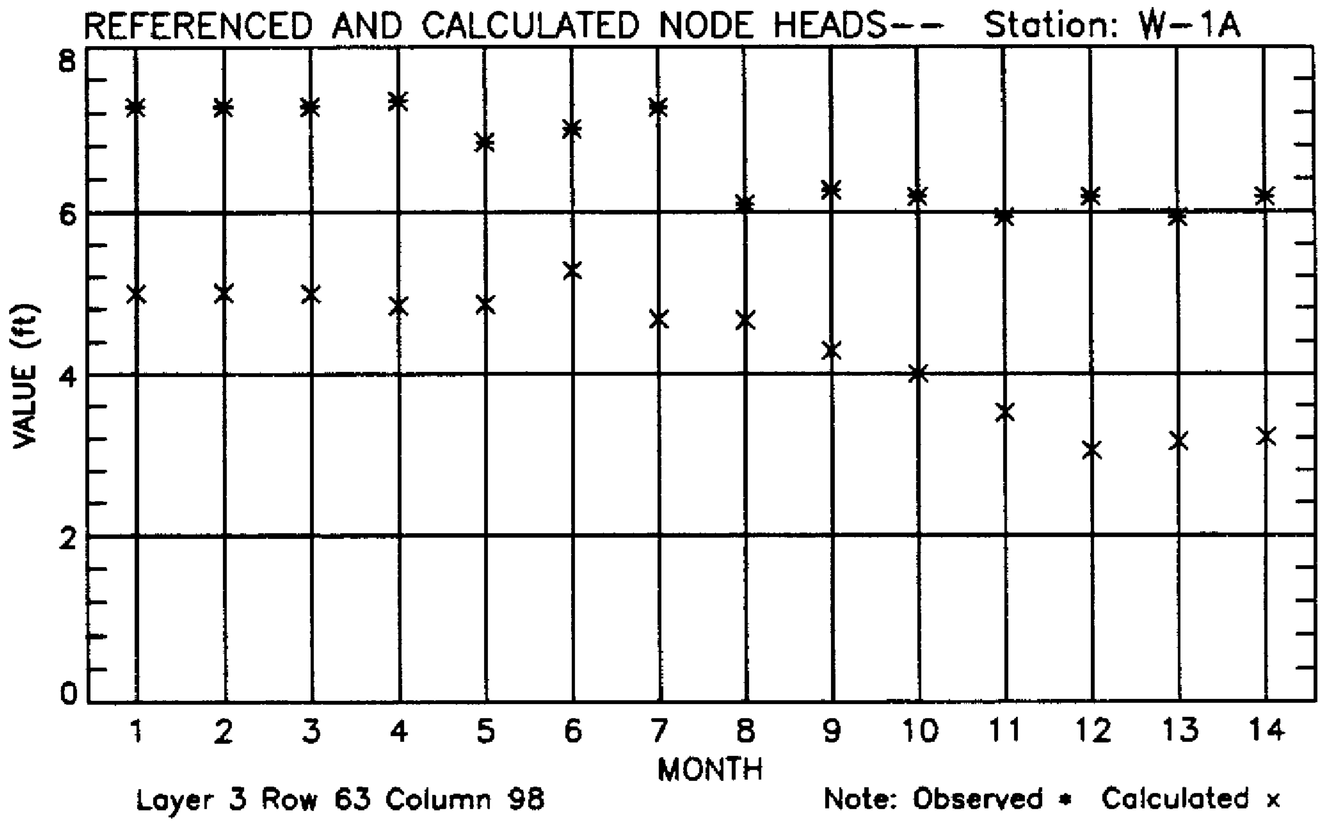

REFERENCED AND CALCULATED NODE HEADS-- Station: STL177
VALUE (ft)
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 54 Column101
Note: Observed * Calculated x

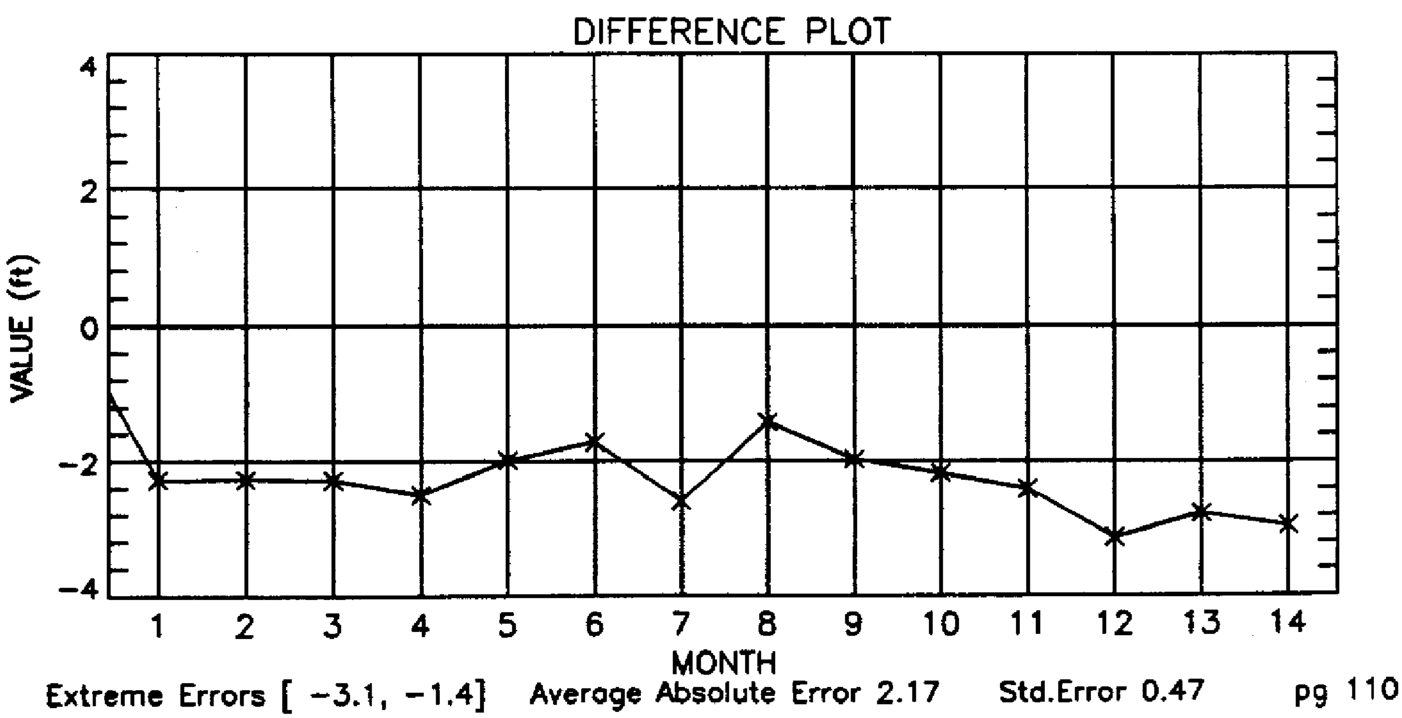

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [0.7, 2.4] Average Absolute Error 1.63 Std.Error 0.43 pg 108

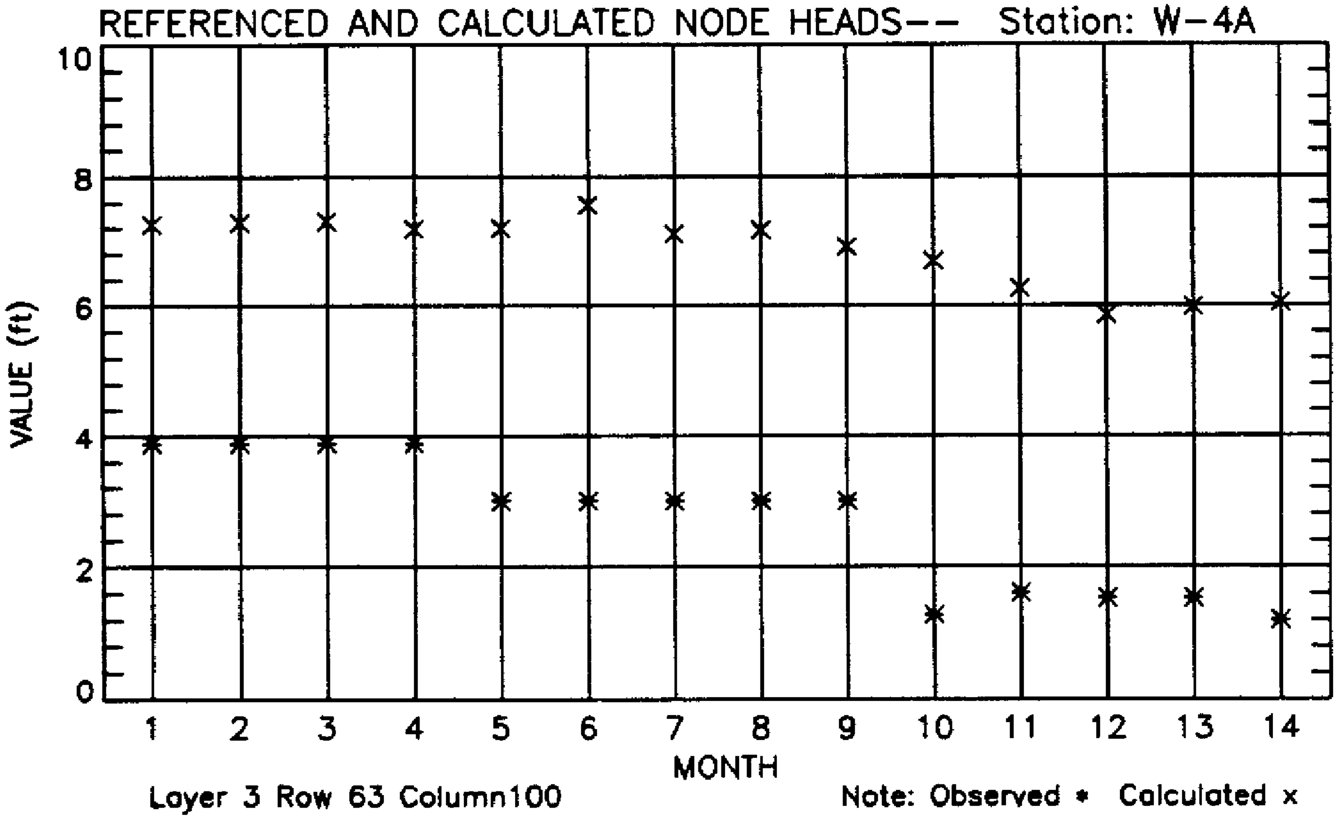


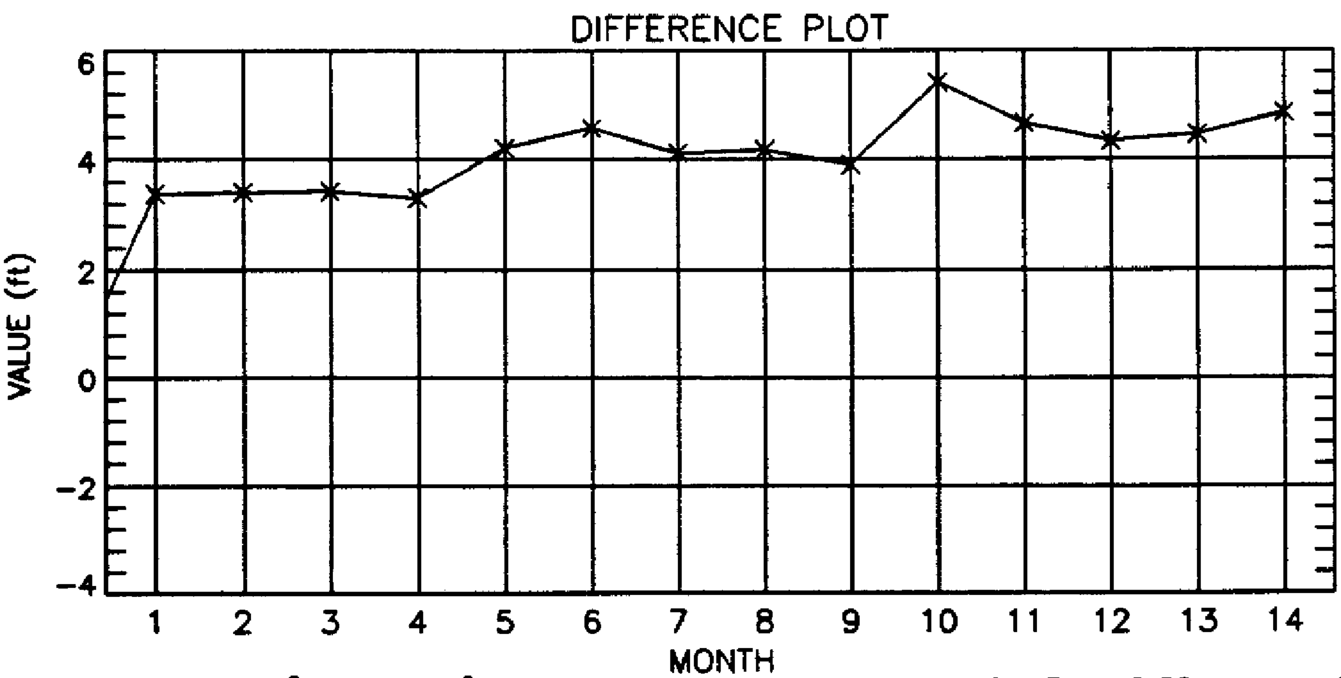


Extreme Errors [-0.7, 4.9] Average Absolute Error 0.81 Std.Error 1.40 pg 109

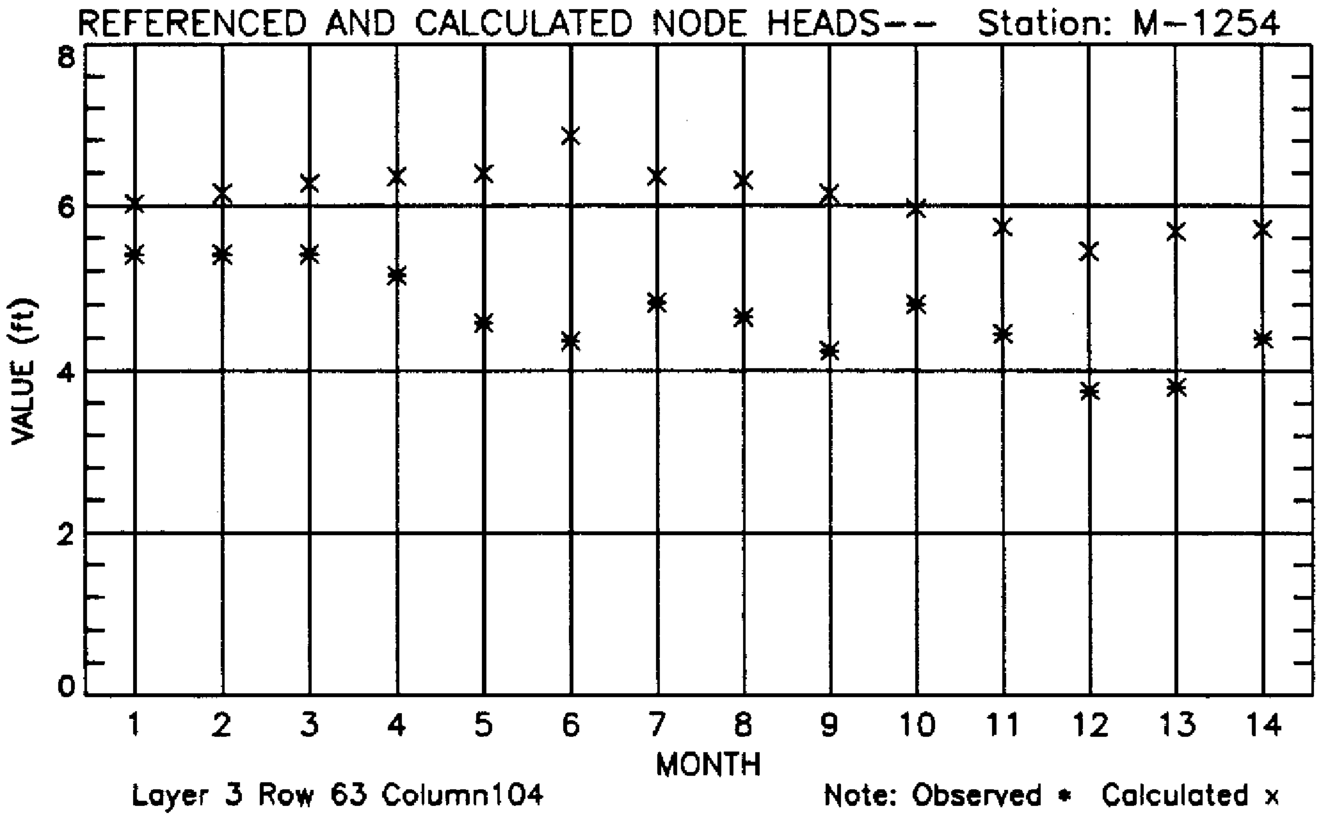

REFERENCED AND CALCULATED NODE HEADS-- Station: W-1A
VALUE (ft)
MONTH
Layer 3 Row 63 Column 98
Note: Observed * Calculated x

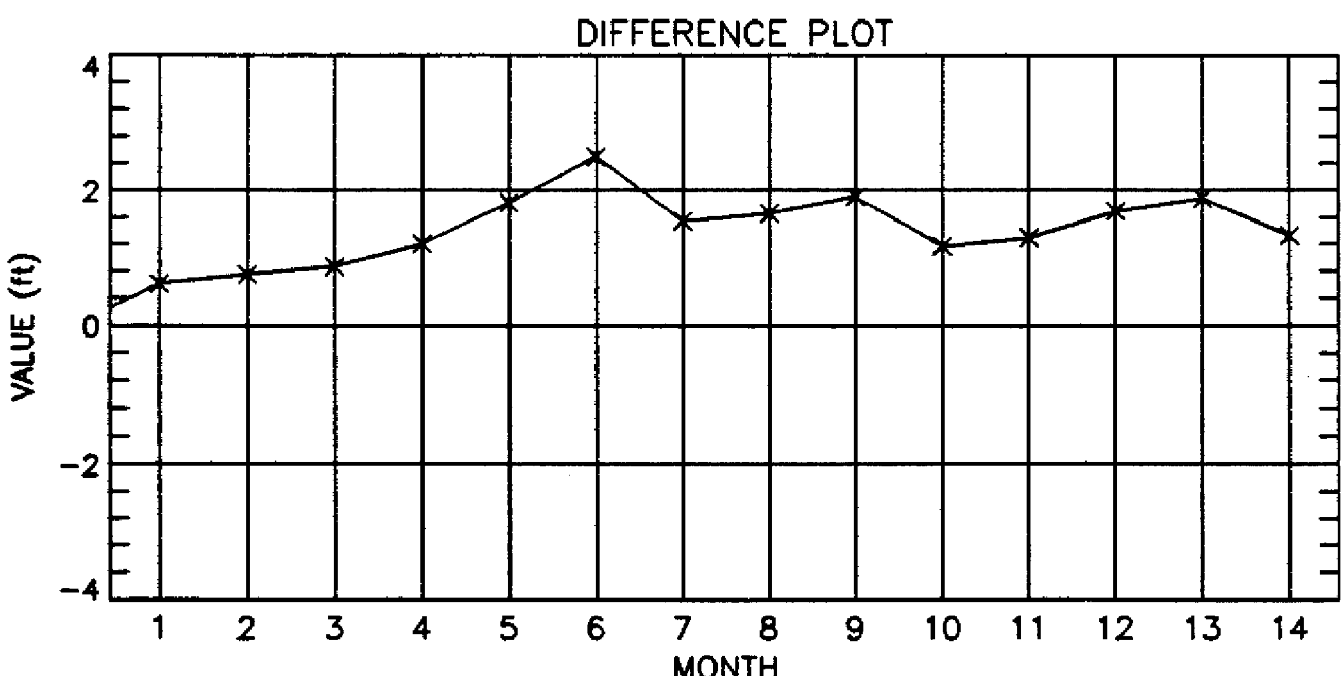

DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-3.1, -1.4] Average Absolute Error 2.17 Std.Error 0.47 pg 110



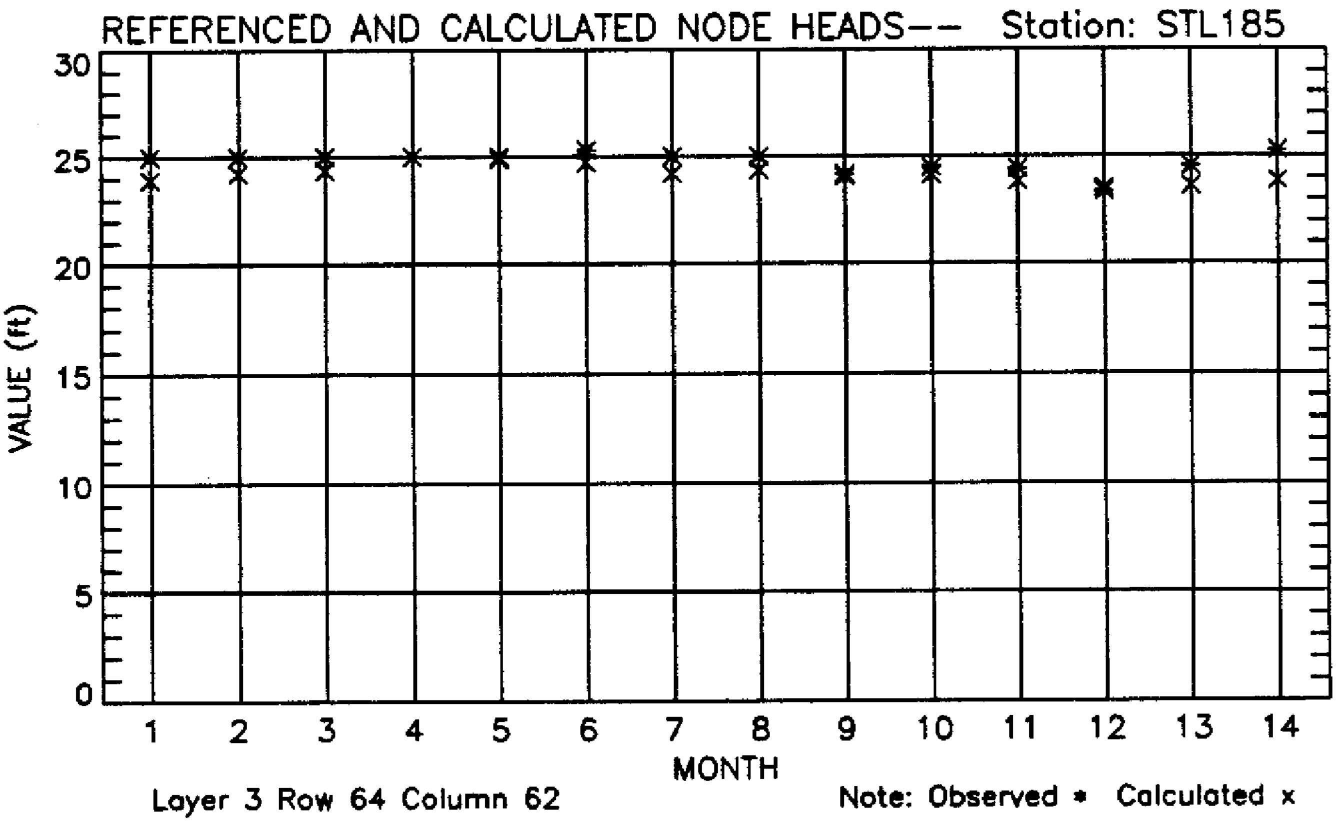


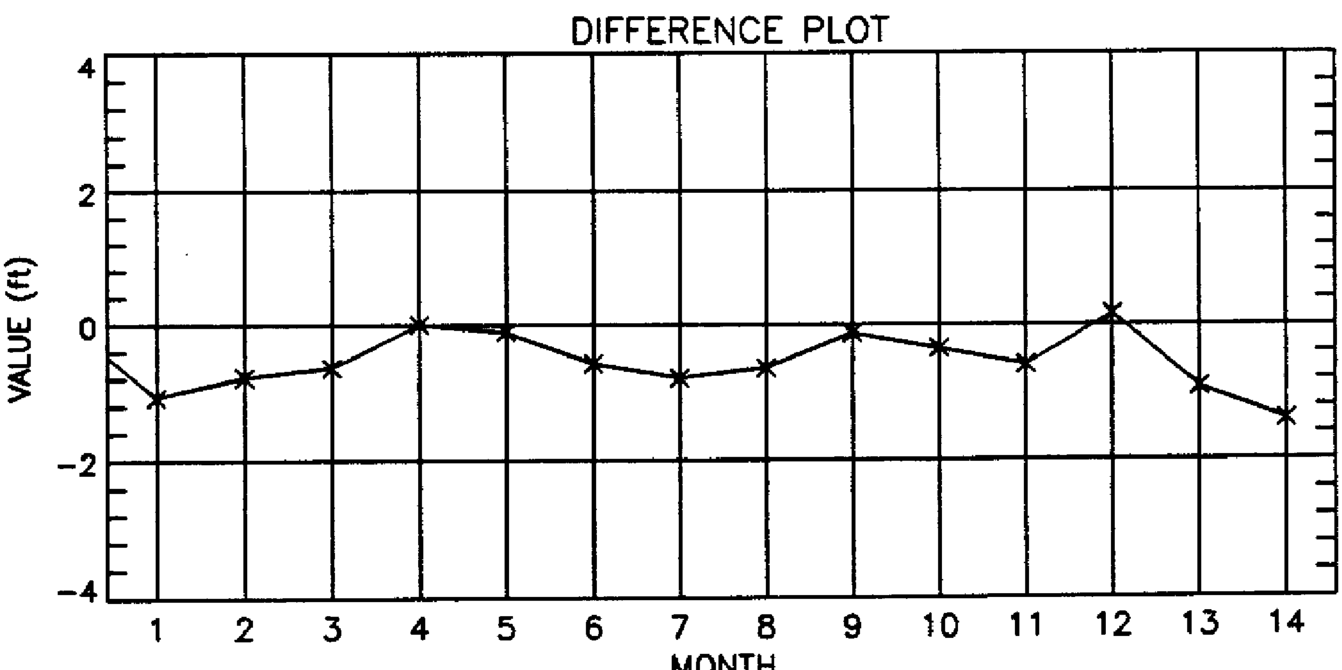
Extreme Errors [3.3, 5.4] Average Absolute Error 3.88 Std.Error 0.62 pg 111



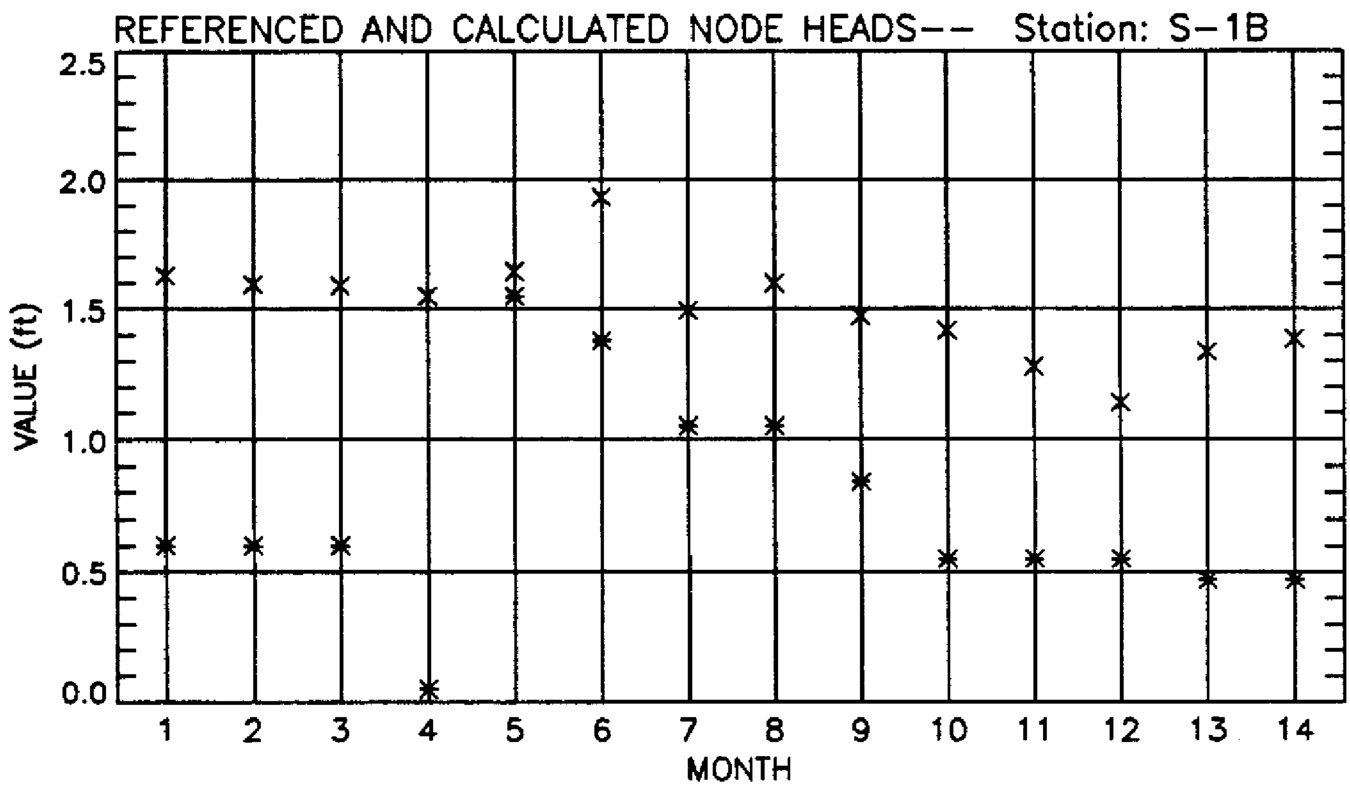


Extreme Errors [0.6, 2.5] Average Absolute Error 1.34 Std.Error 0.51 pg 112

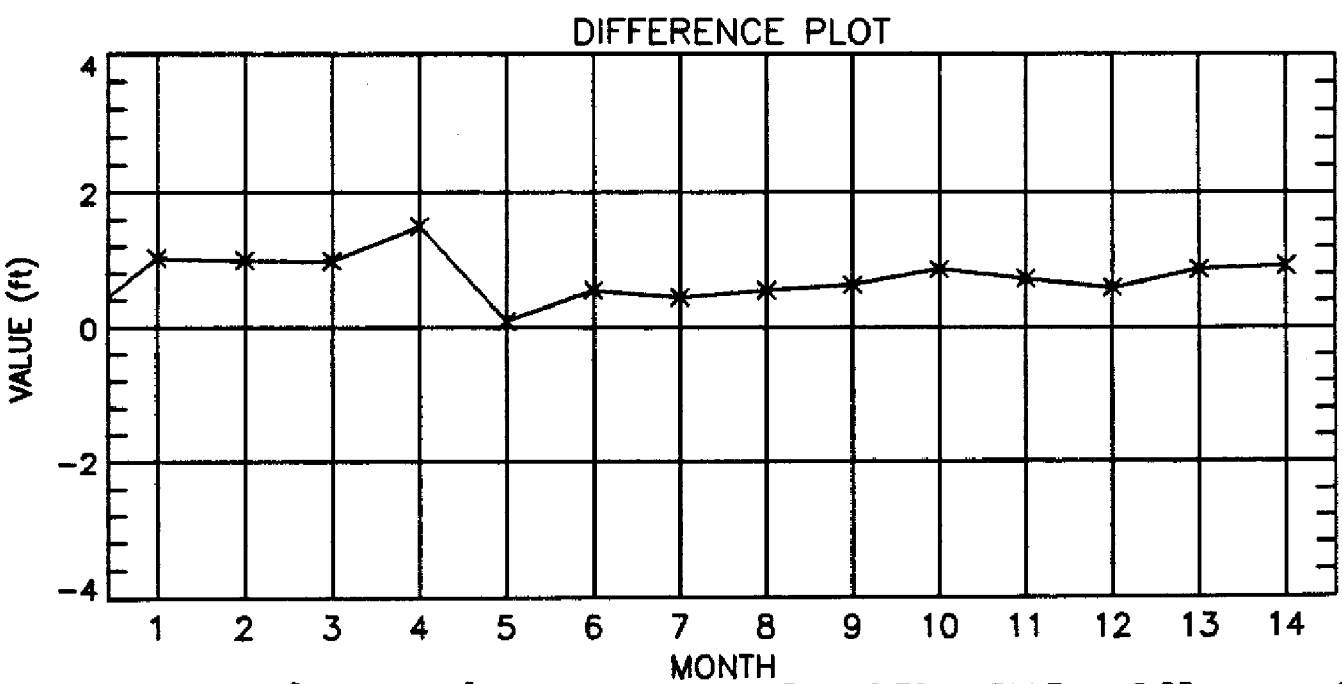




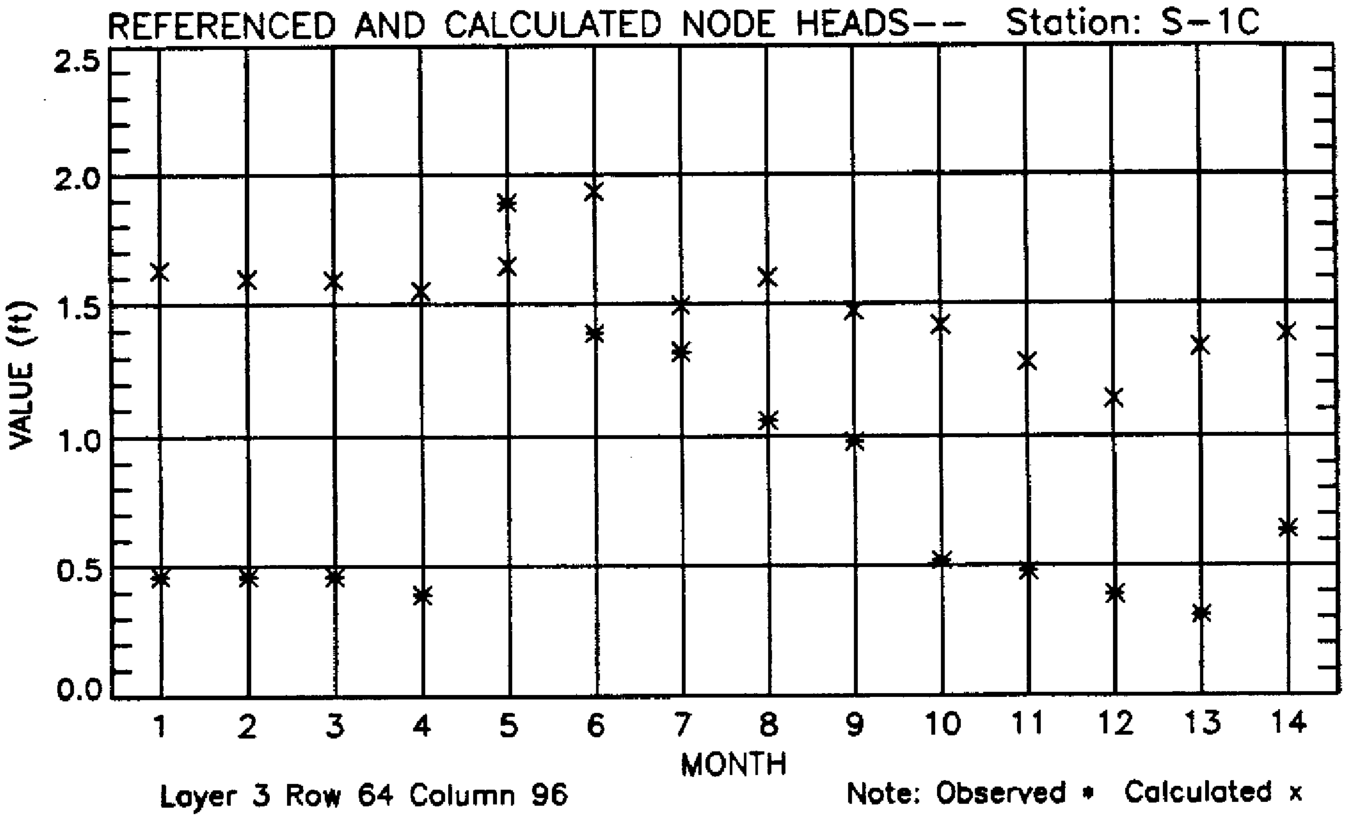
Extreme Errors [−1.4, 0.2] Average Absolute Error 0.55 Std.Error 0.44 pg 113

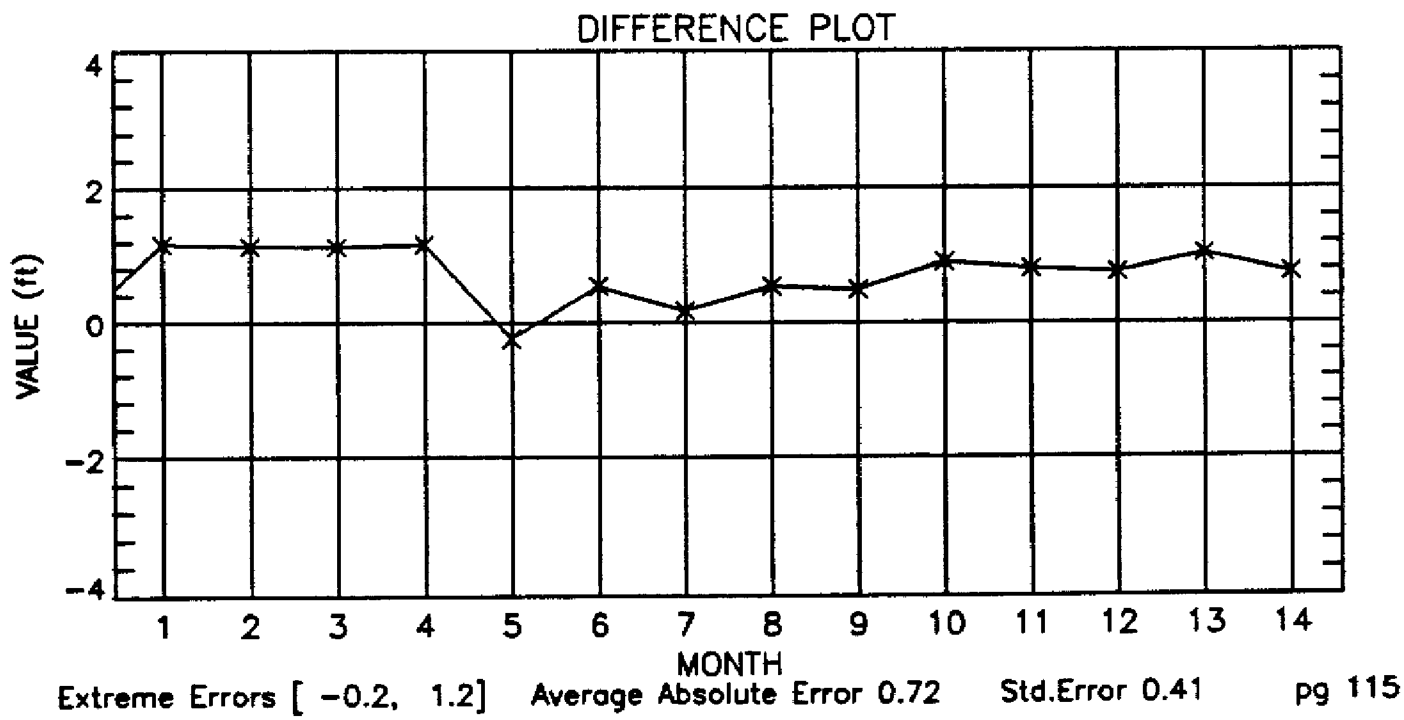


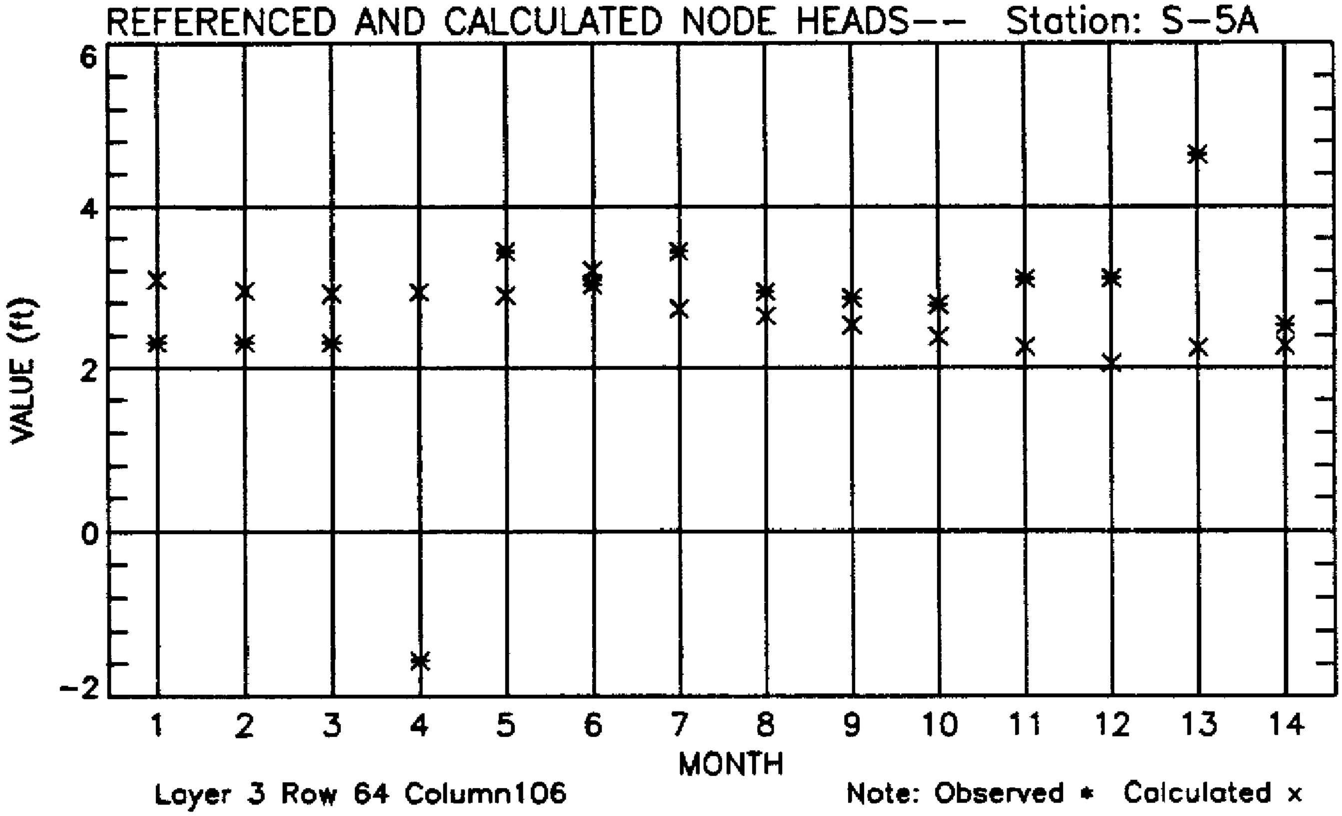
Layer 3 Row 64 Column 96 Note: Observed * Calculated x

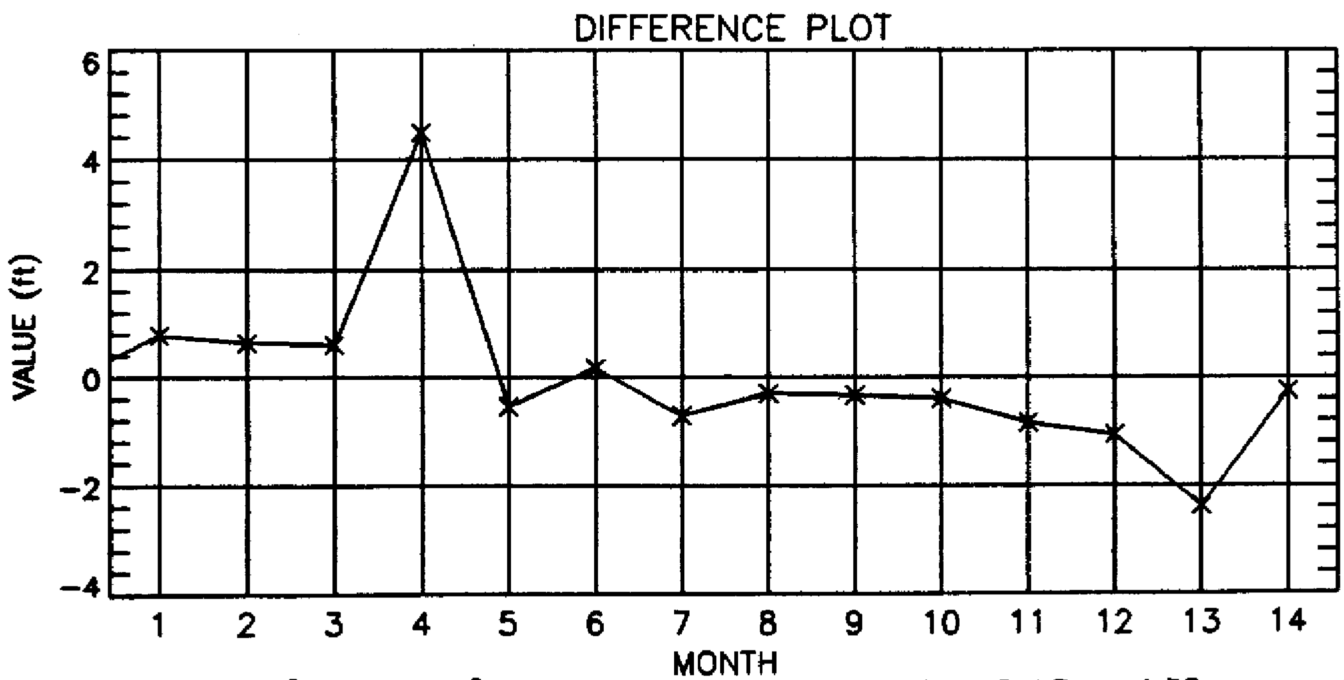


Extreme Errors [0.1, 1.5] Average Absolute Error 0.72 Std.Error 0.33 pg 114


REFERENCED AND CALCULATED NODE HEADS-- Station: S-1C
VALUE (ft)
2.5
2.0
1.5
1.0
0.5
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 64 Column 96
Note: Observed * Calculated x

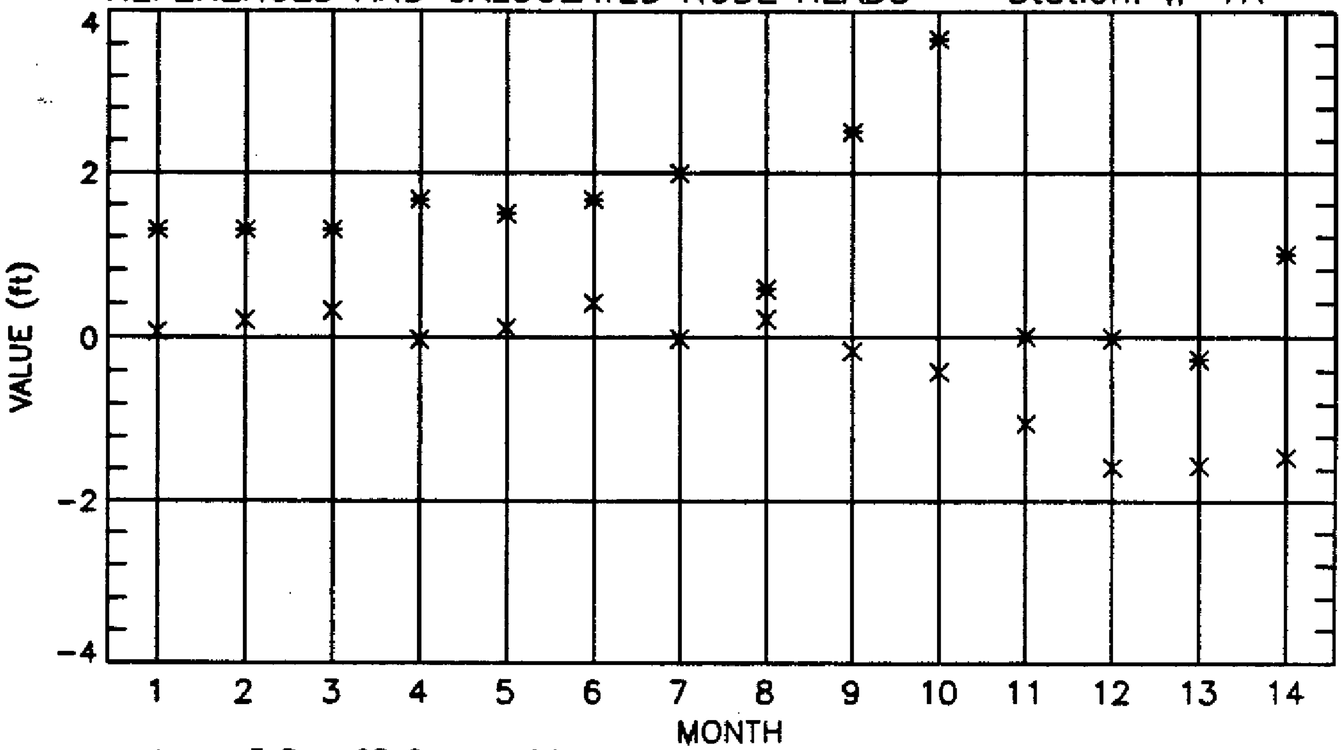

DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.2, 1.2] Average Absolute Error 0.72 Std.Error 0.41 pg 115





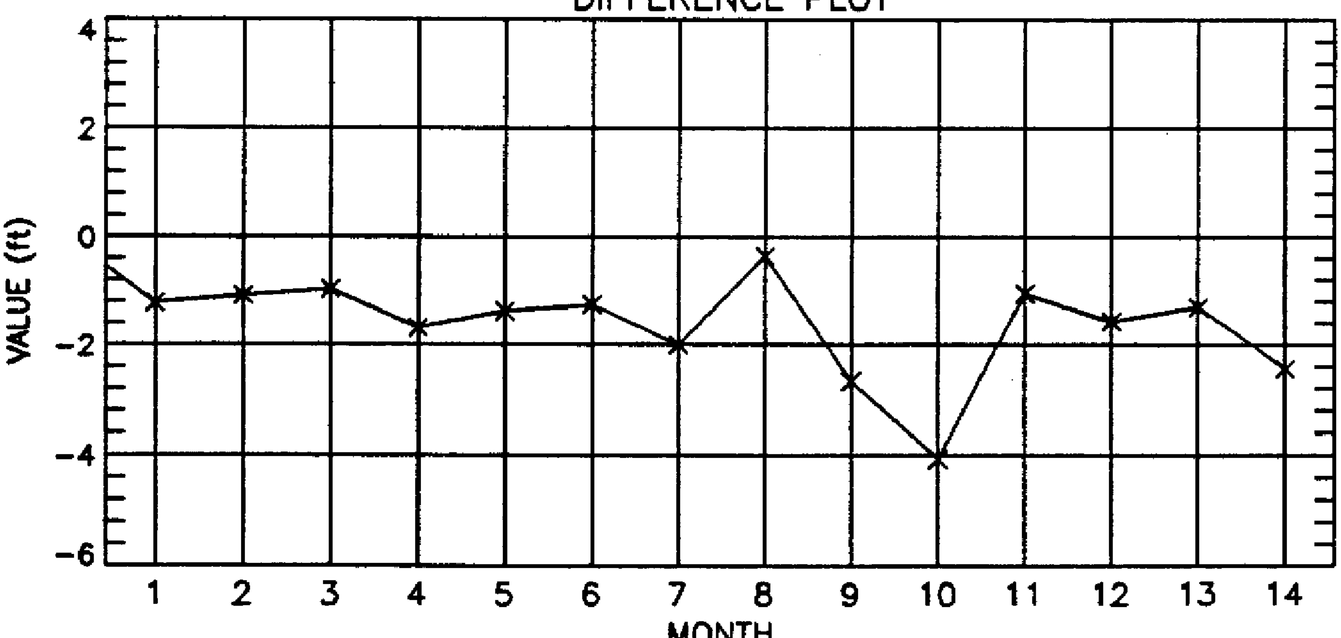
Extreme Errors [-2.4, 4.5] Average Absolute Error 0.90 Std.Error 1.53 pg 116

REFERENCED AND CALCULATED NODE HEADS-- Station: W-7A

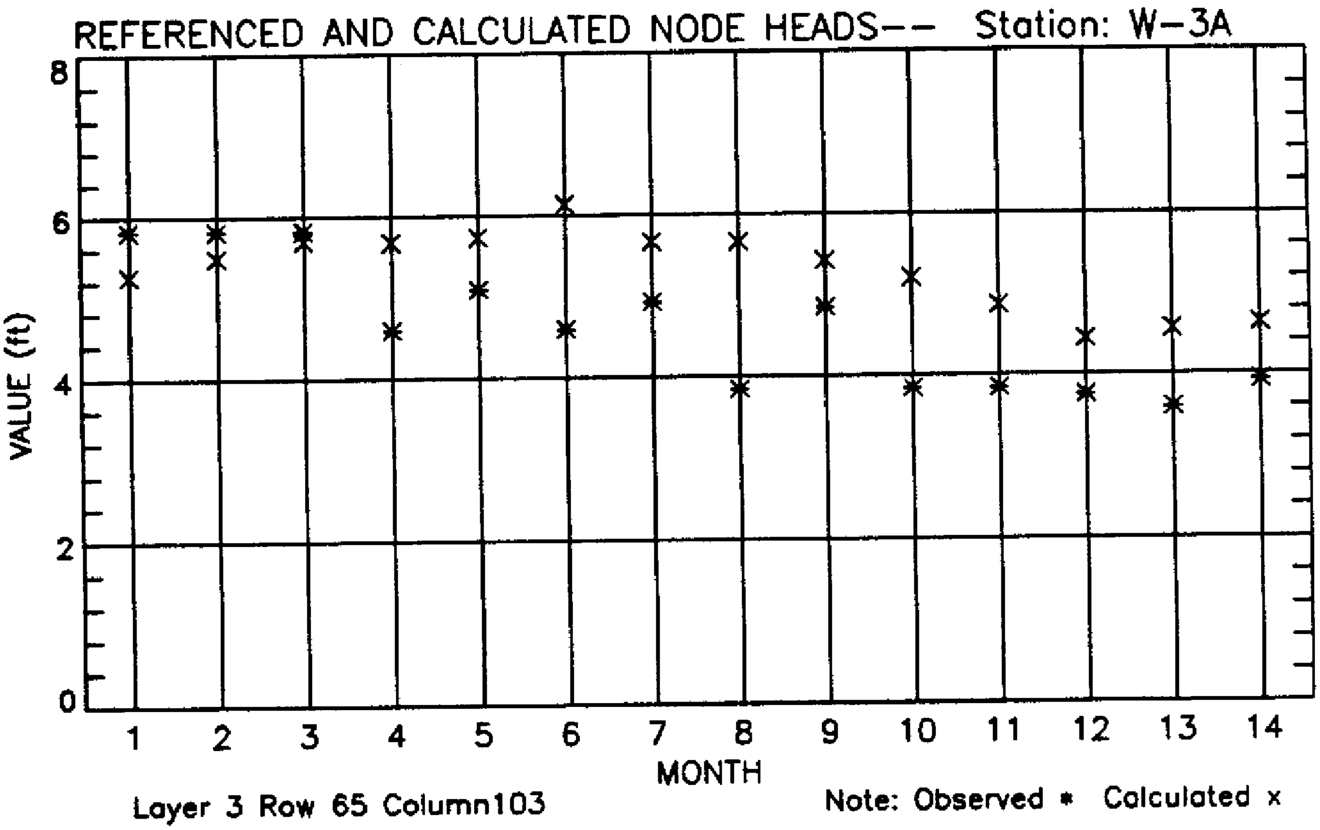


Layer 3 Row 65 Column 99 Note: Observed * Calculated x

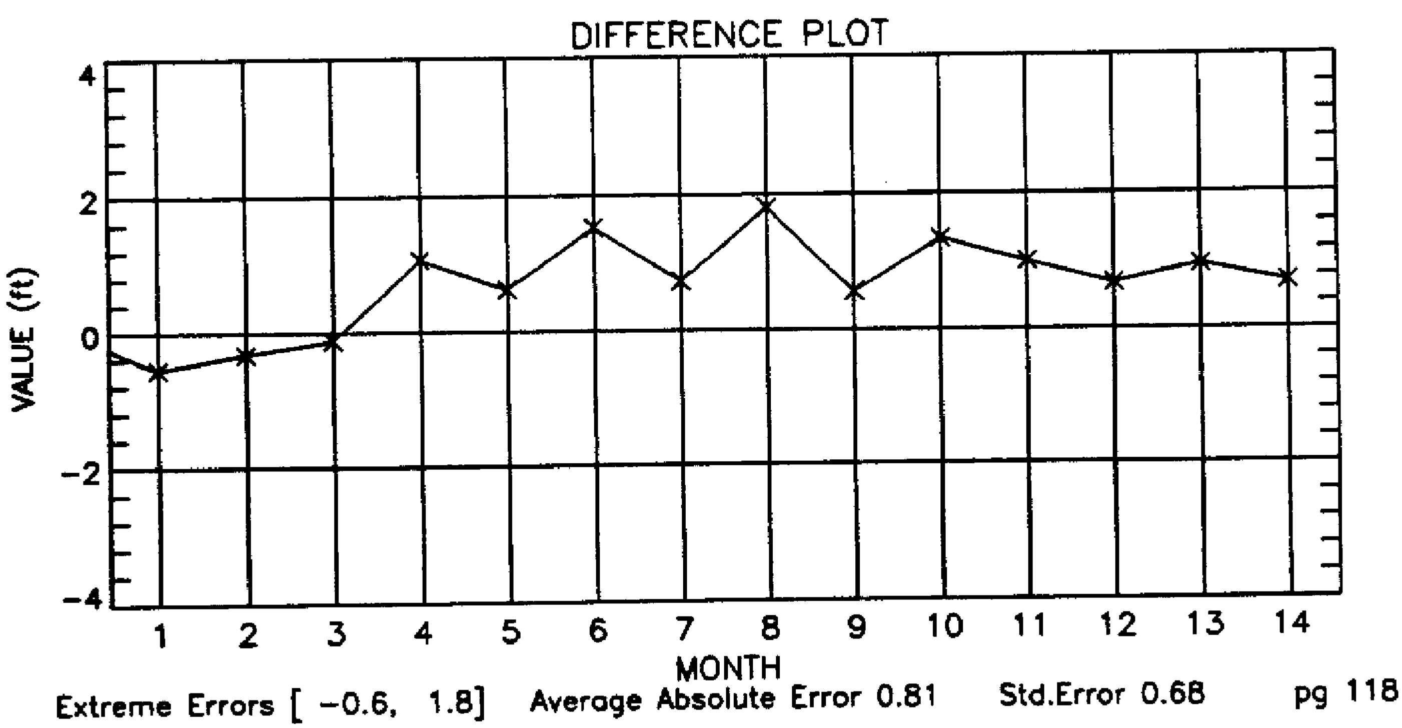
DIFFERENCE PLOT



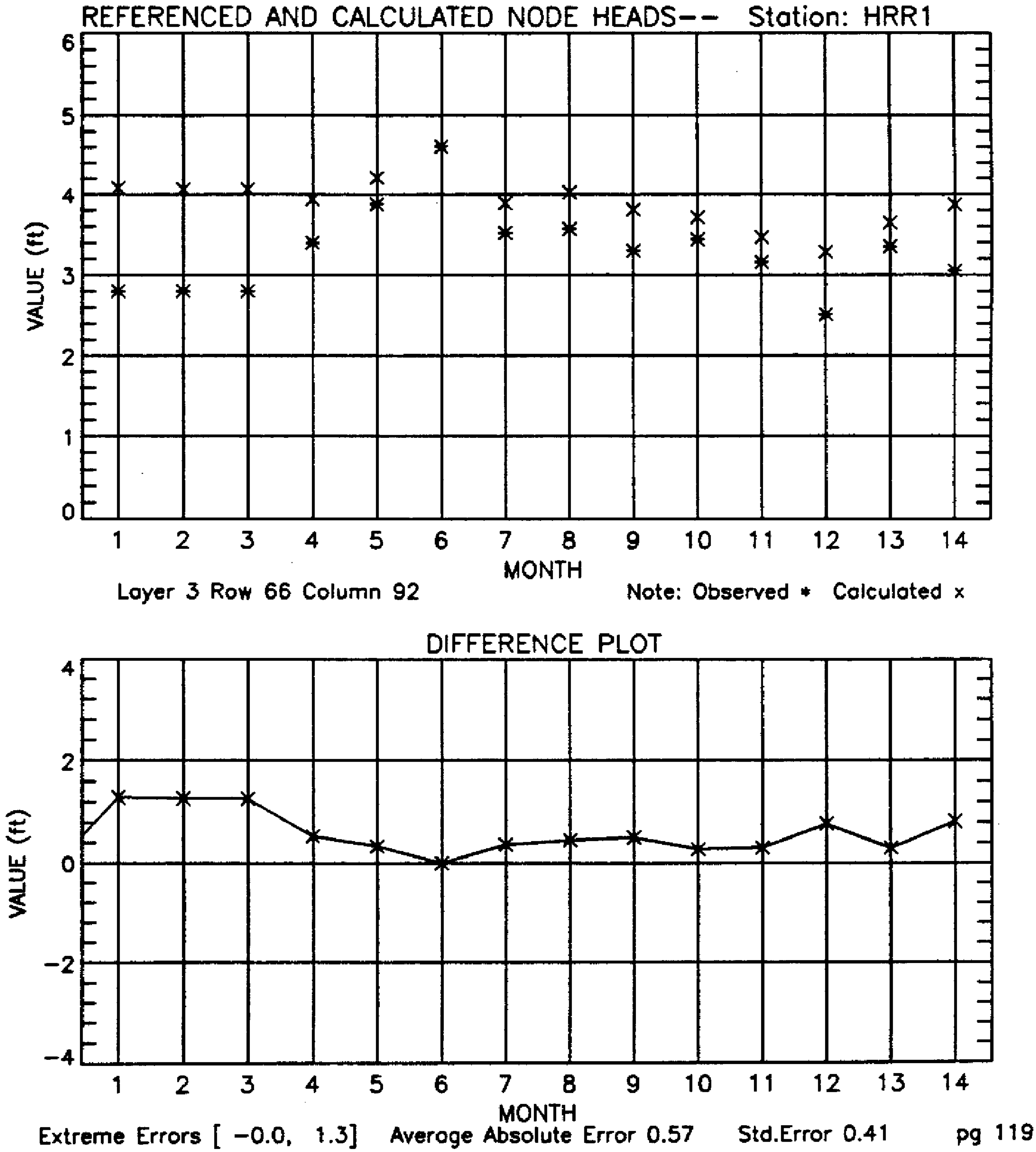
Extreme Errors [-4.1, -0.4] Average Absolute Error 1.54 Std.Error 0.92 pg 117

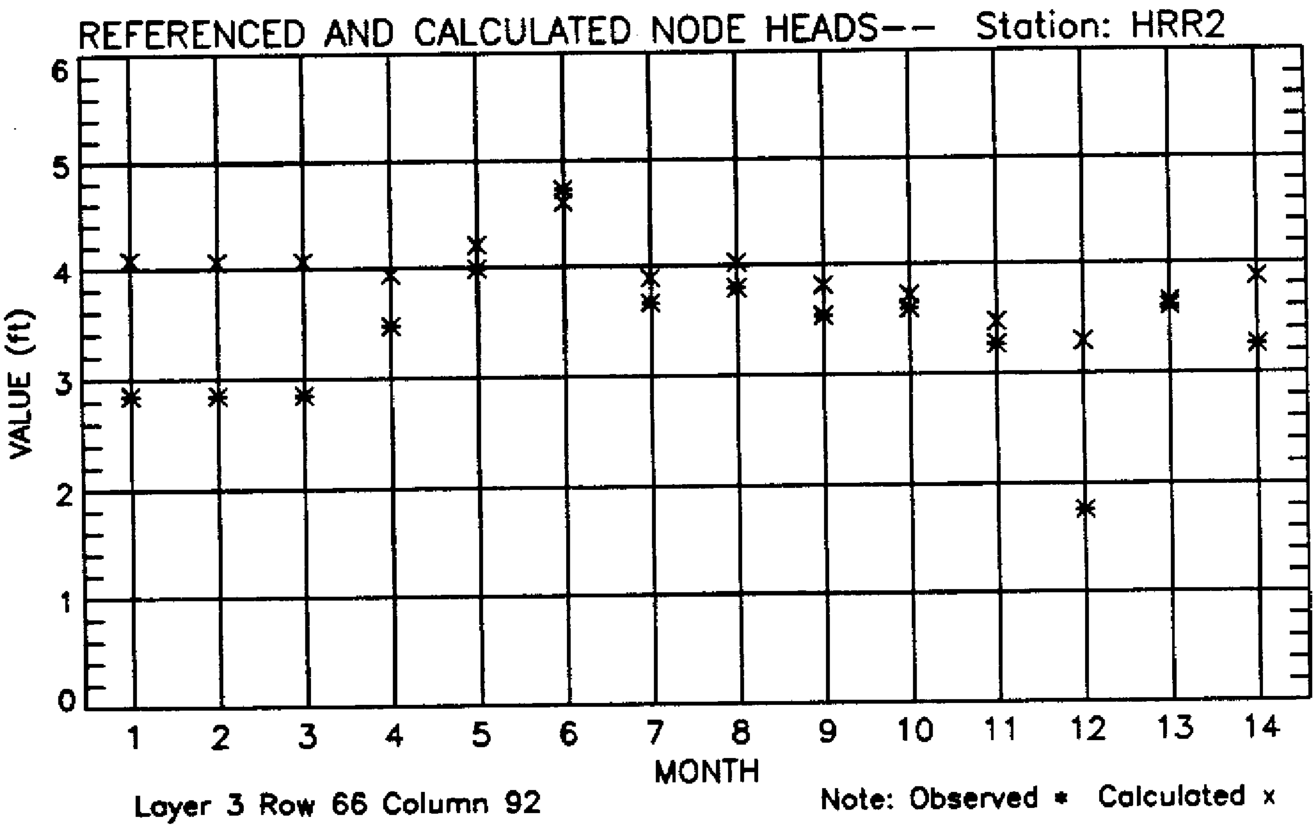


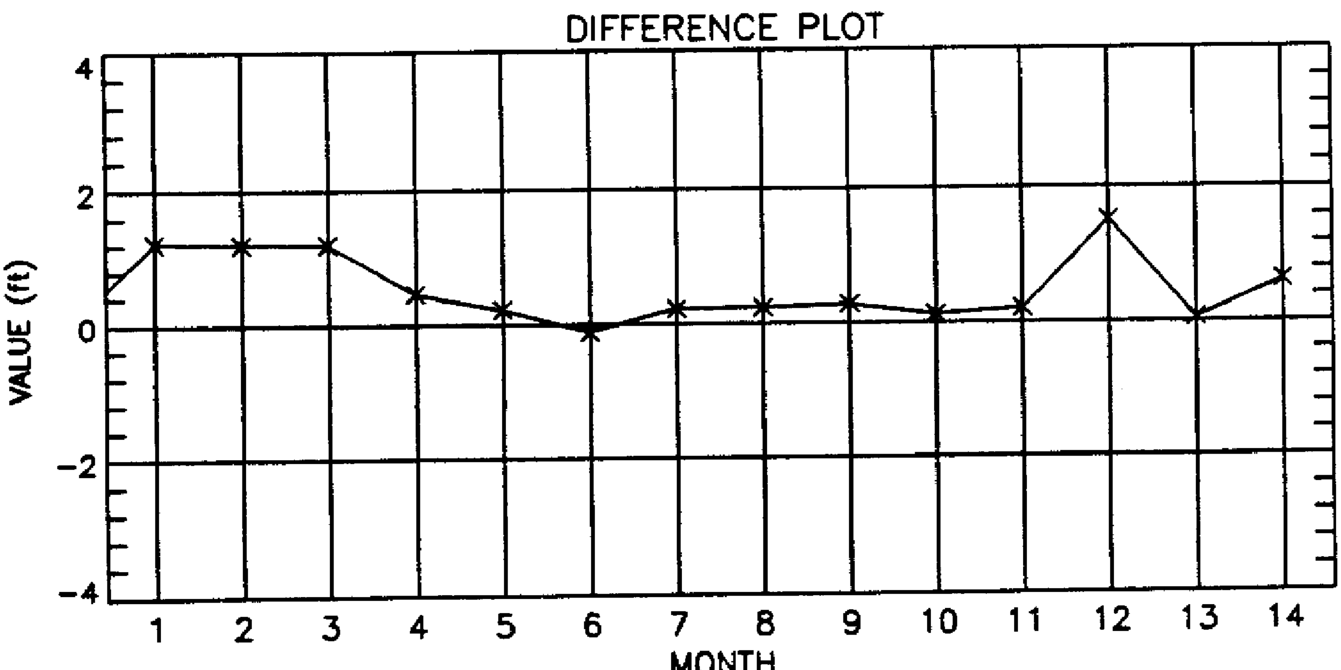
REFERENCED AND CALCULATED NODE HEADS-- Station: W-3A
VALUE (ft)
MONTH
Layer 3 Row 65 Column103
Note: Observed * Calculated x



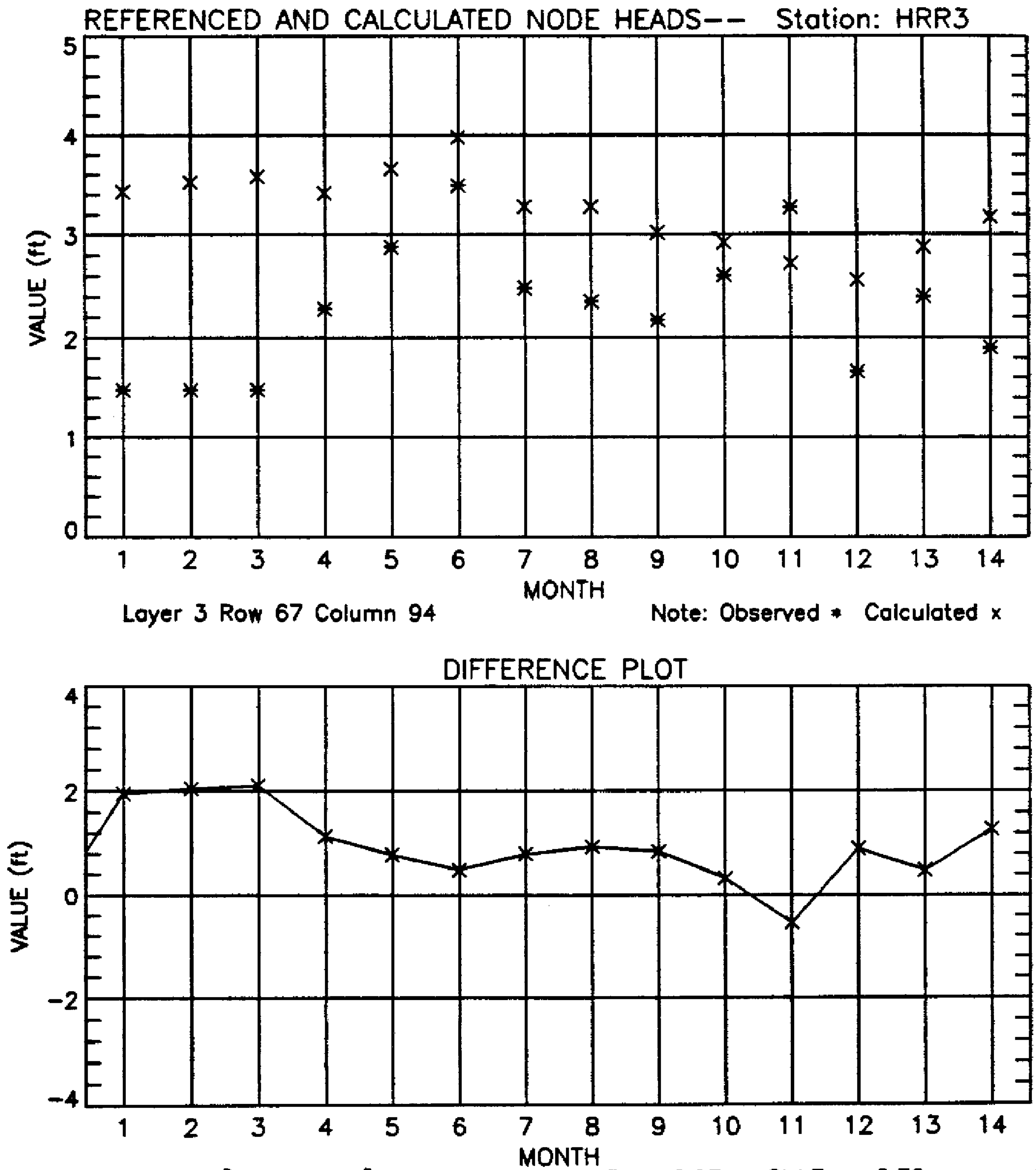
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.6, 1.8] Average Absolute Error 0.81 Std.Error 0.68 pg 118


REFERENCED AND CALCULATED NODE HEADS-- Station: HRR1
VALUE (ft)
MONTH
Layer 3 Row 66 Column 92
Note: Observed * Calculated x
DIFFERENCE PLOT
VALUE (ft)
MONTH
Extreme Errors [-0.0, 1.3] Average Absolute Error 0.57 Std.Error 0.41 pg 119

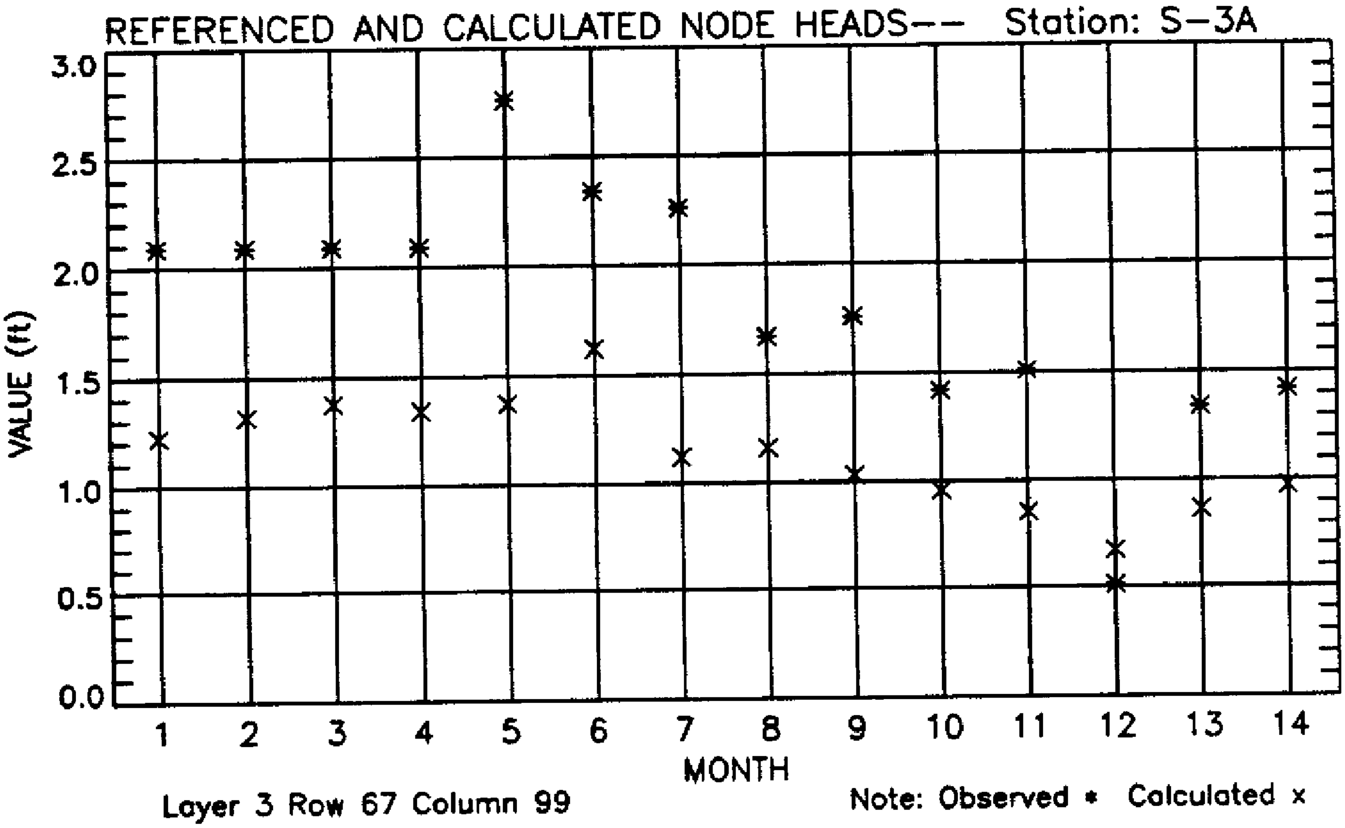


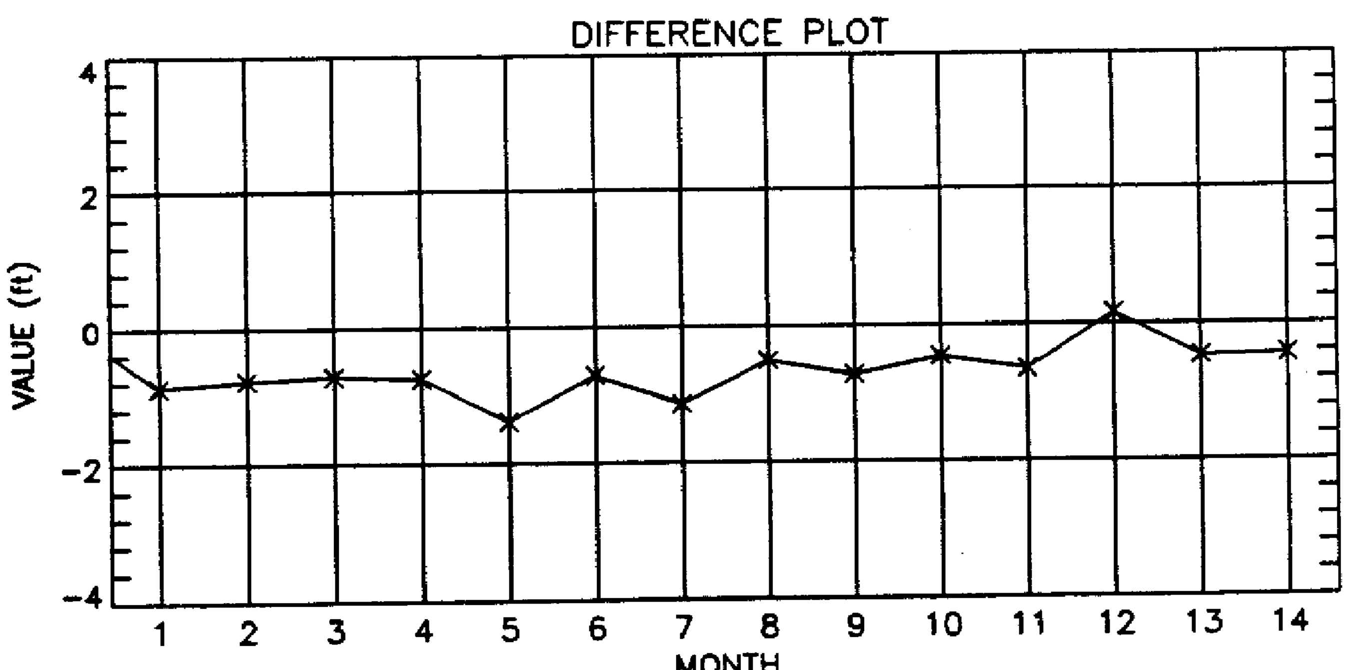


Extreme Errors [-0.1, 1.5] Average Absolute Error 0.52 Std.Error 0.53 pg 120

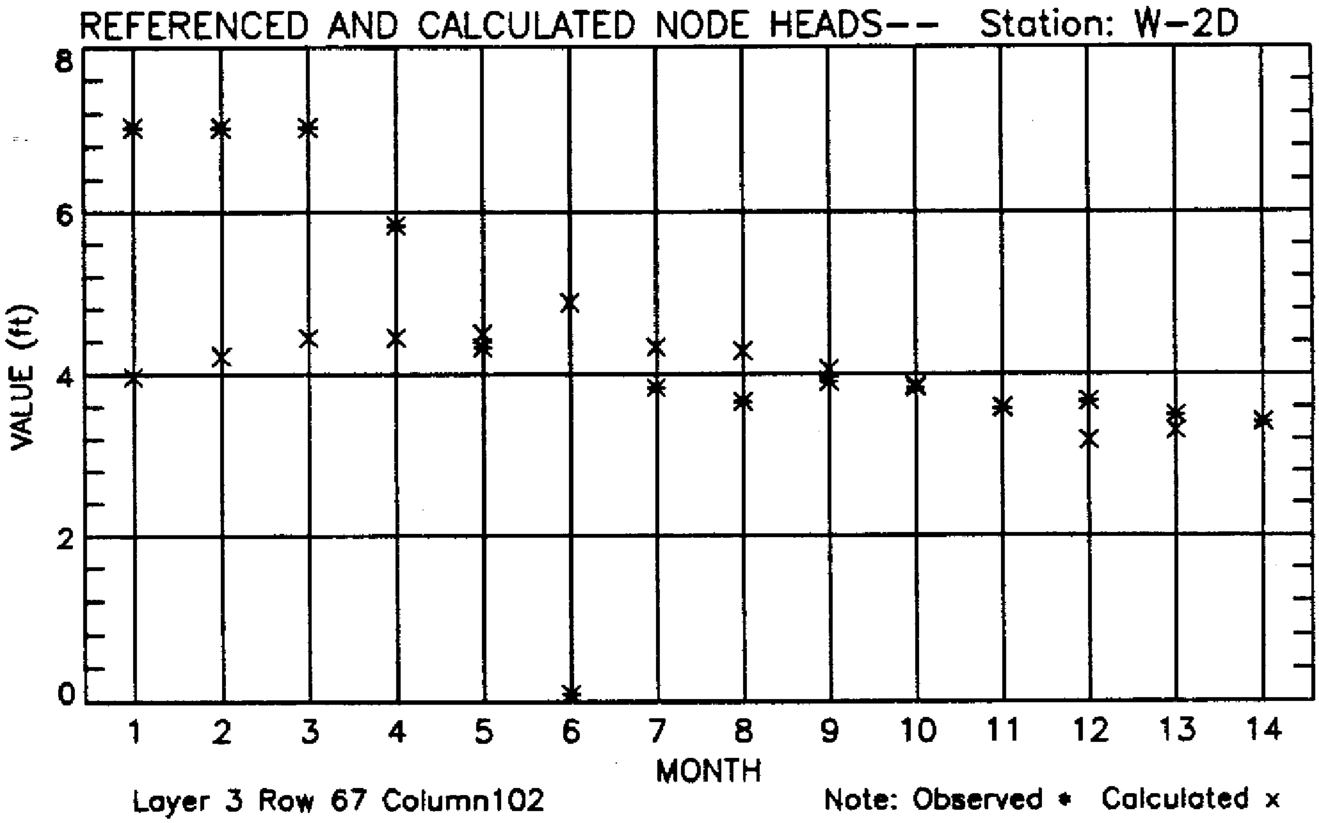


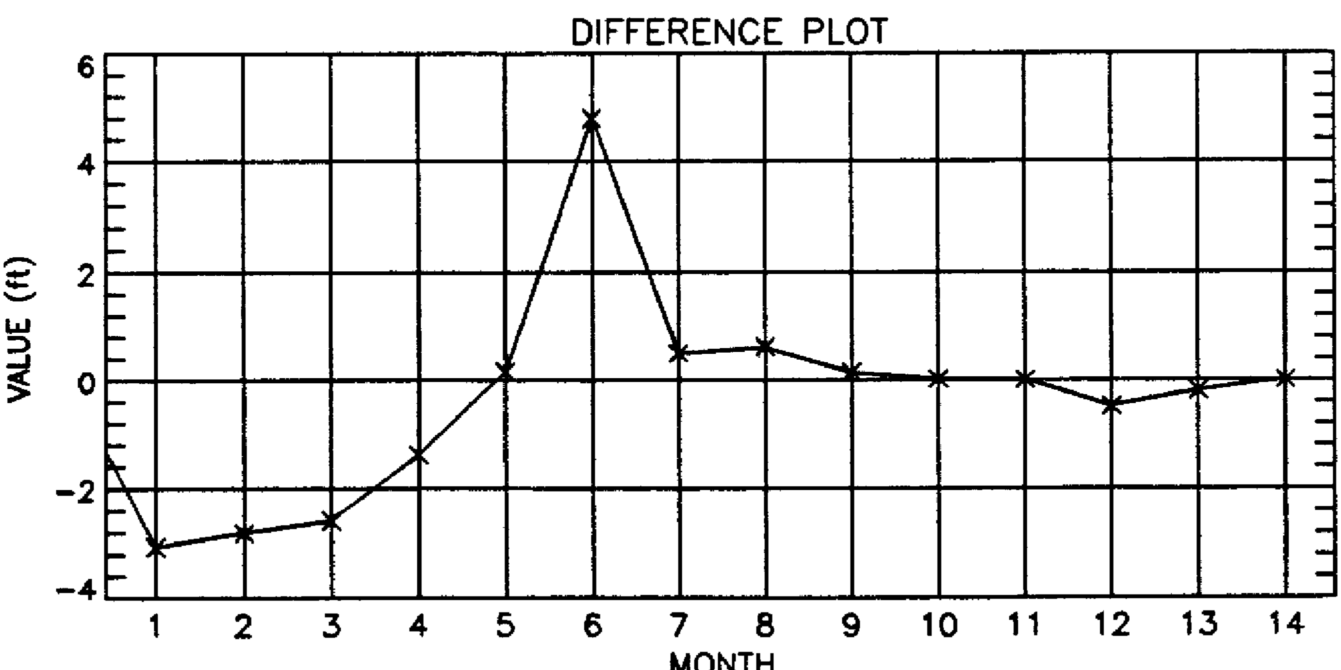
Extreme Errors [-0.6, 2.1] Average Absolute Error 0.97 Std.Error 0.72 pg 121



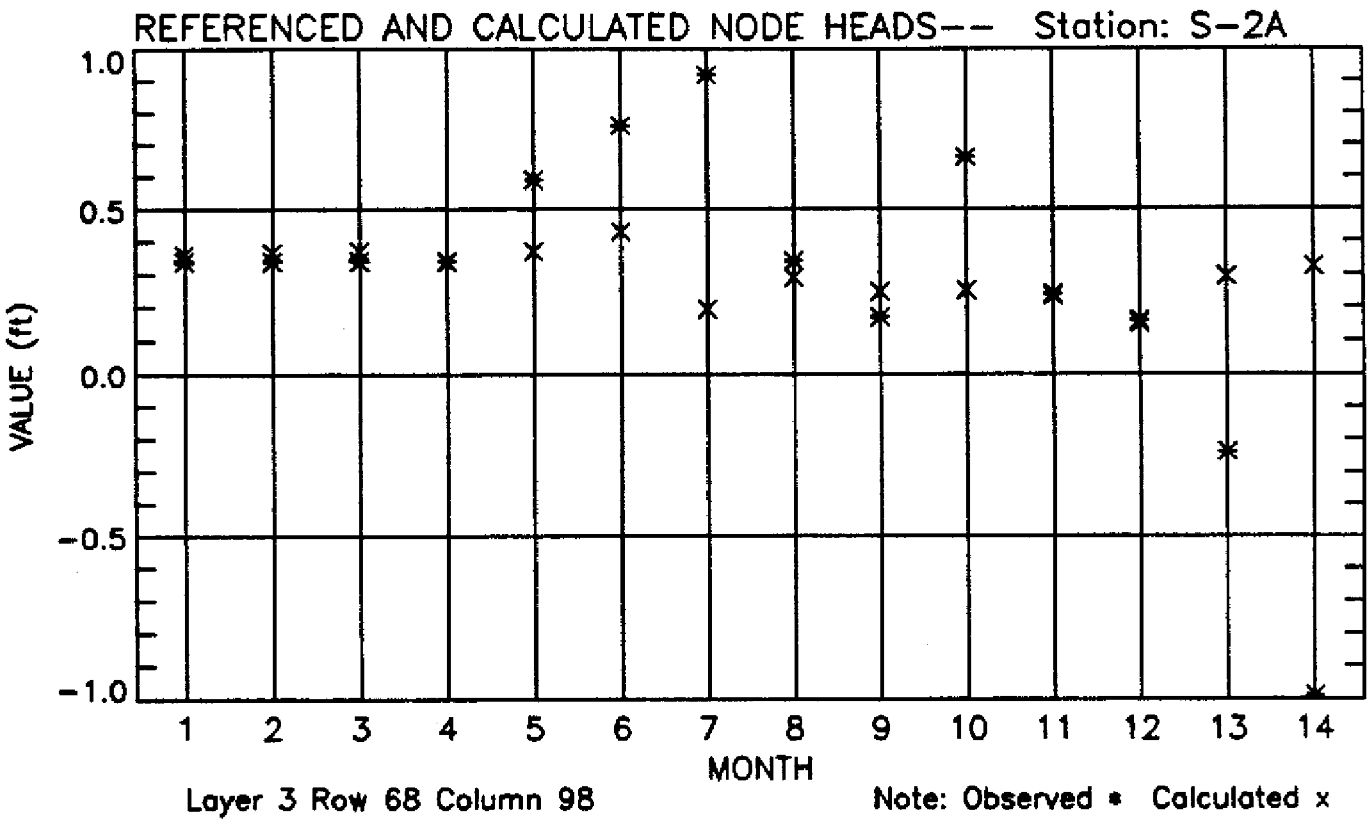


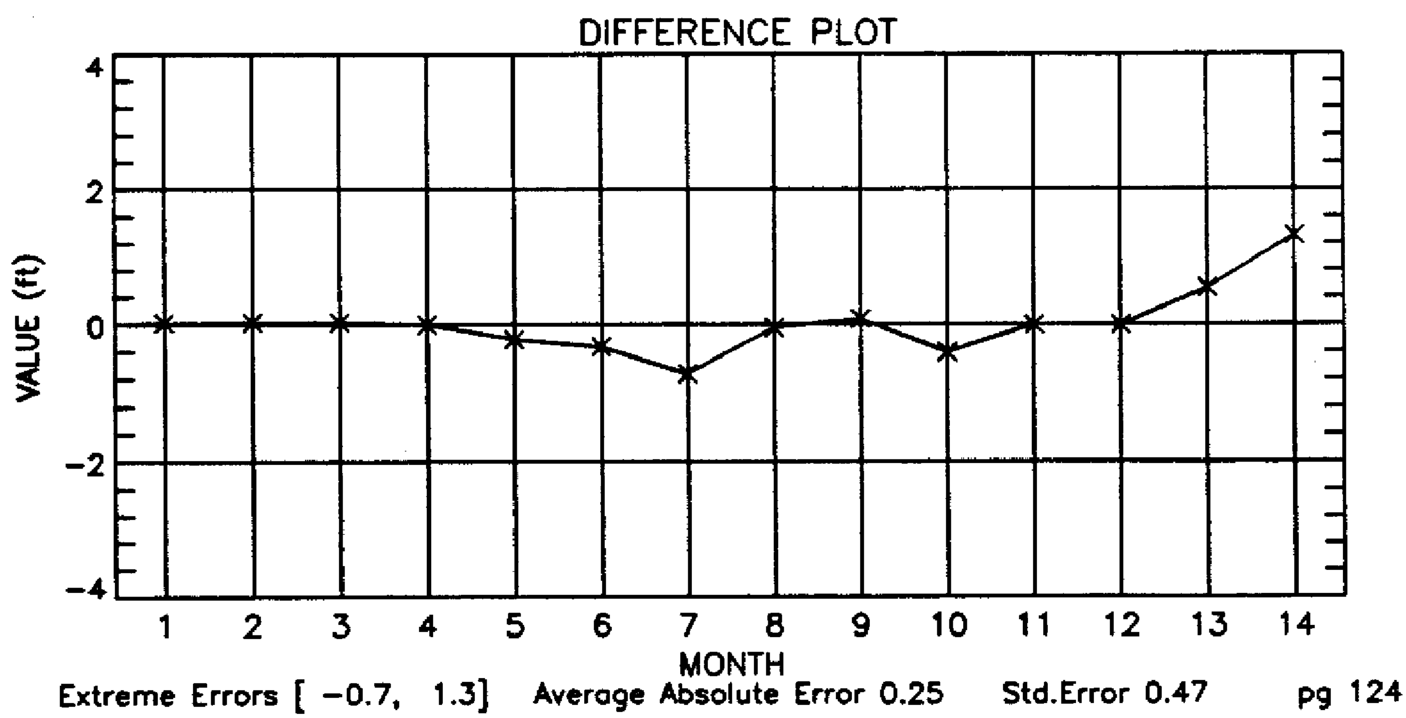
Extreme Errors [-1.4, 0.2] Average Absolute Error 0.65 Std.Error 0.36 pg 122

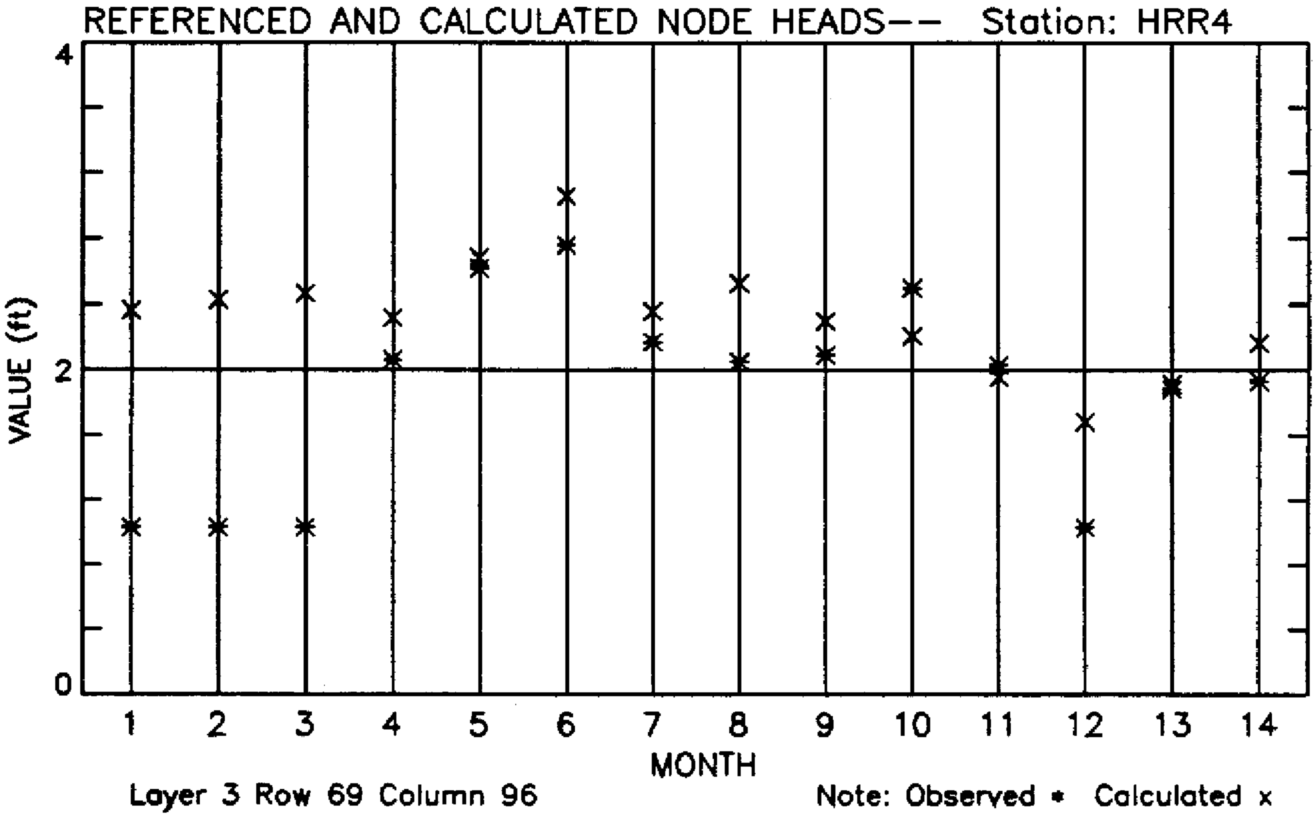


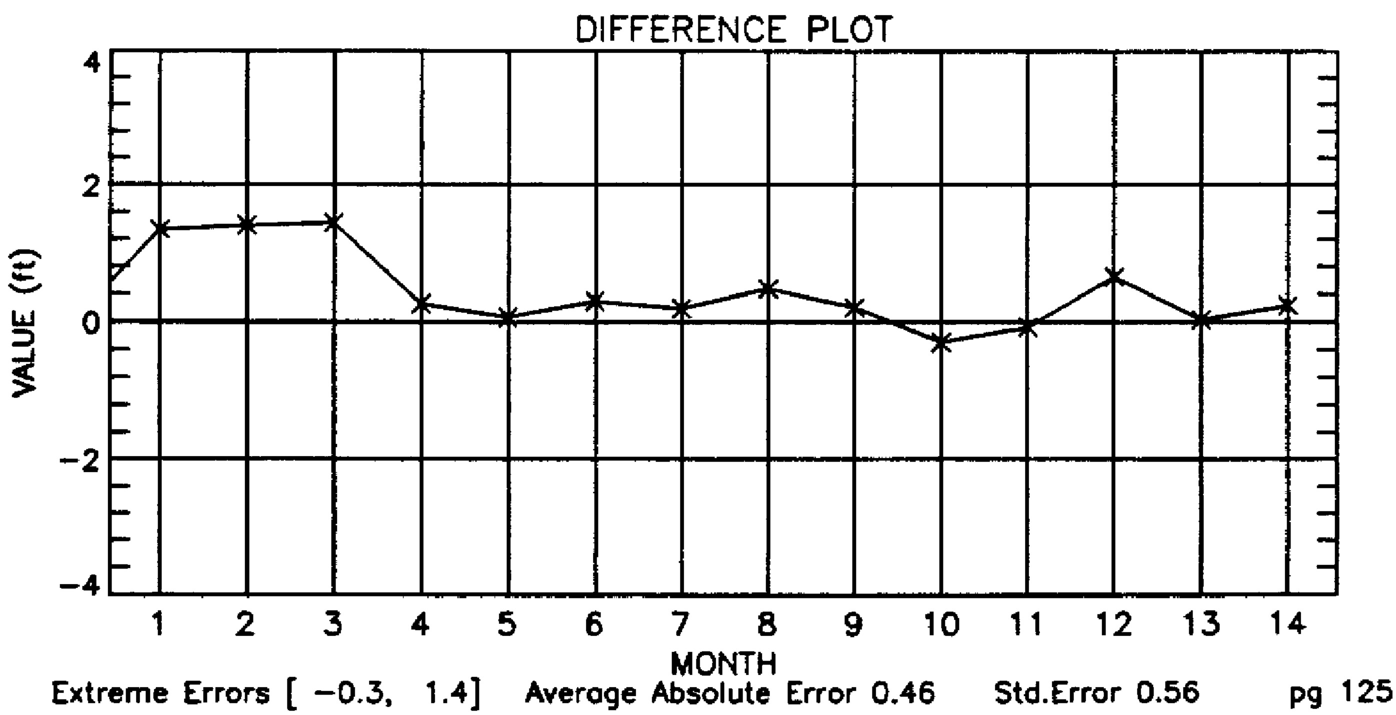


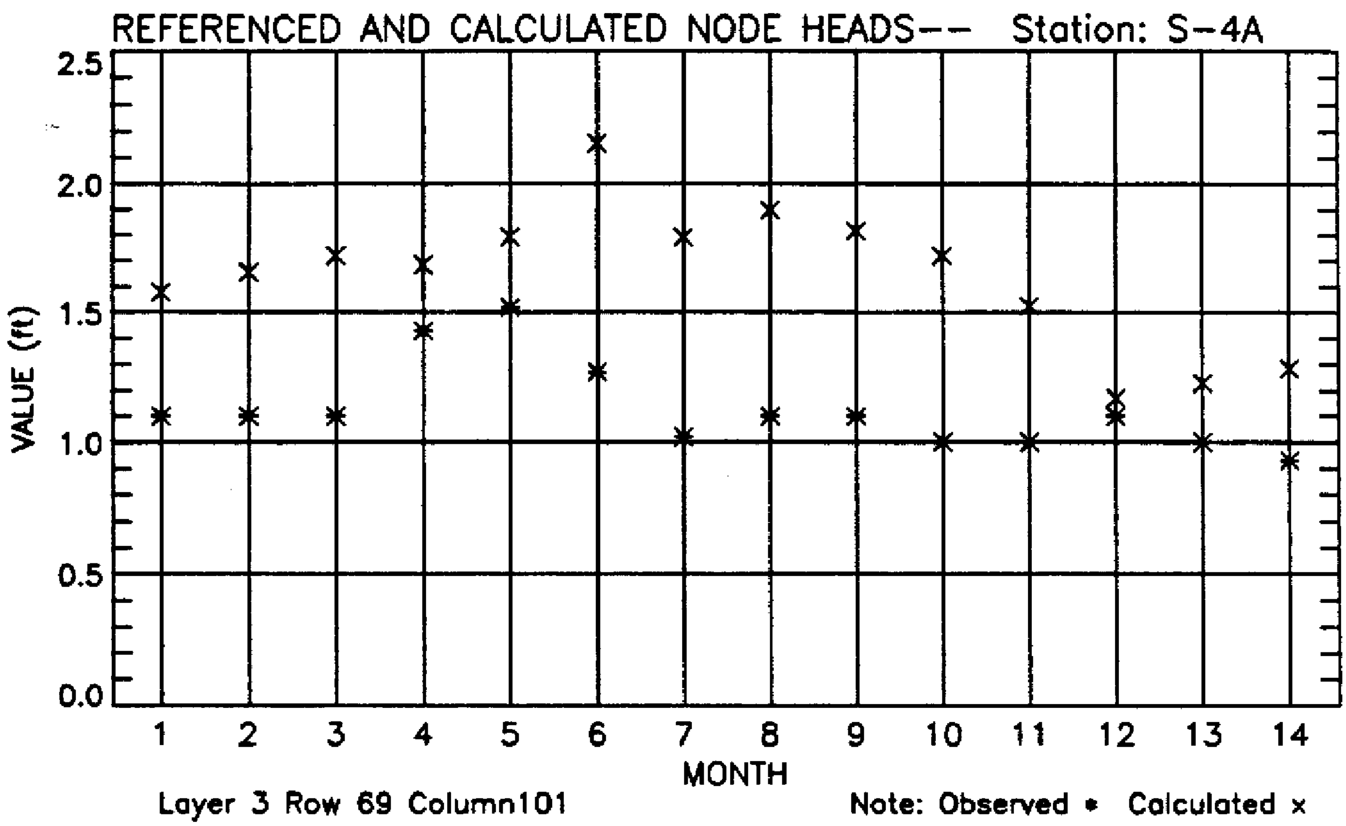
Extreme Errors [-3.1, 4.8] Average Absolute Error 1.12 Std.Error 1.93 pg 123

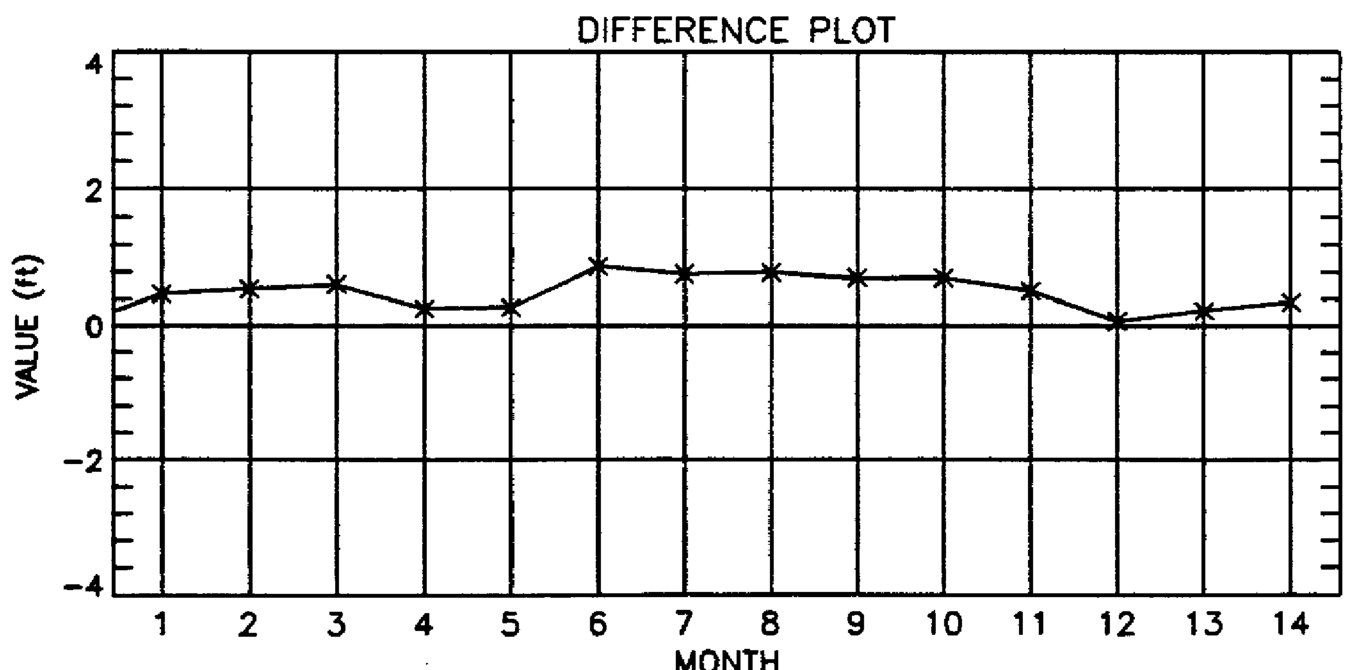

REFERENCED AND CALCULATED NODE HEADS-- Station: S-2A
VALUE (ft)
1.0
0.5
0.0
-0.5
-1.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 68 Column 98
Note: Observed * Calculated x


DIFFERENCE PLOT
VALUE (ft)
4
2
0
-2
-4
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.7, 1.3] Average Absolute Error 0.25 Std.Error 0.47 pg 124

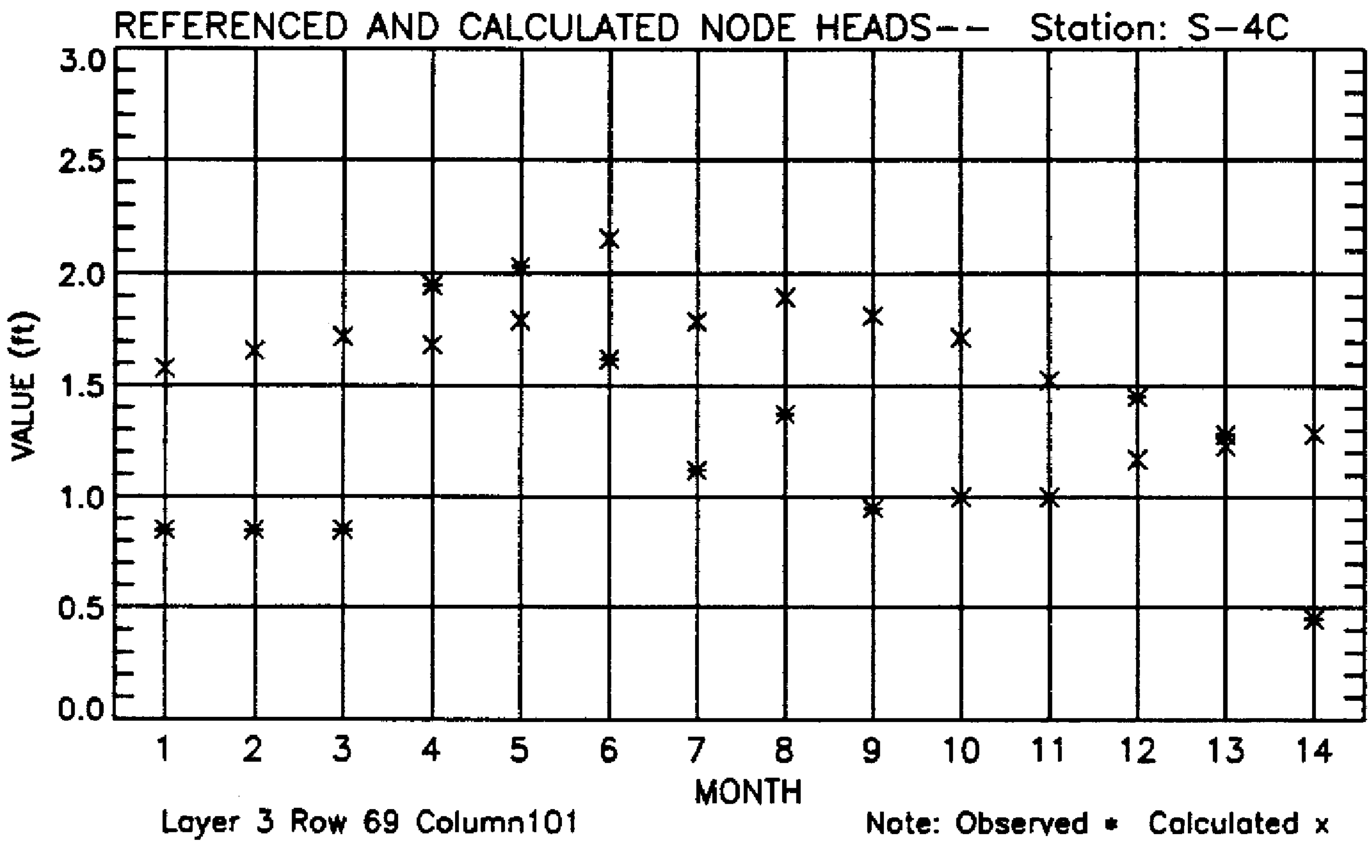

REFERENCED AND CALCULATED NODE HEADS-- Station: HRR4
4
2
0
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Layer 3 Row 69 Column 96
Note: Observed * Calculated x

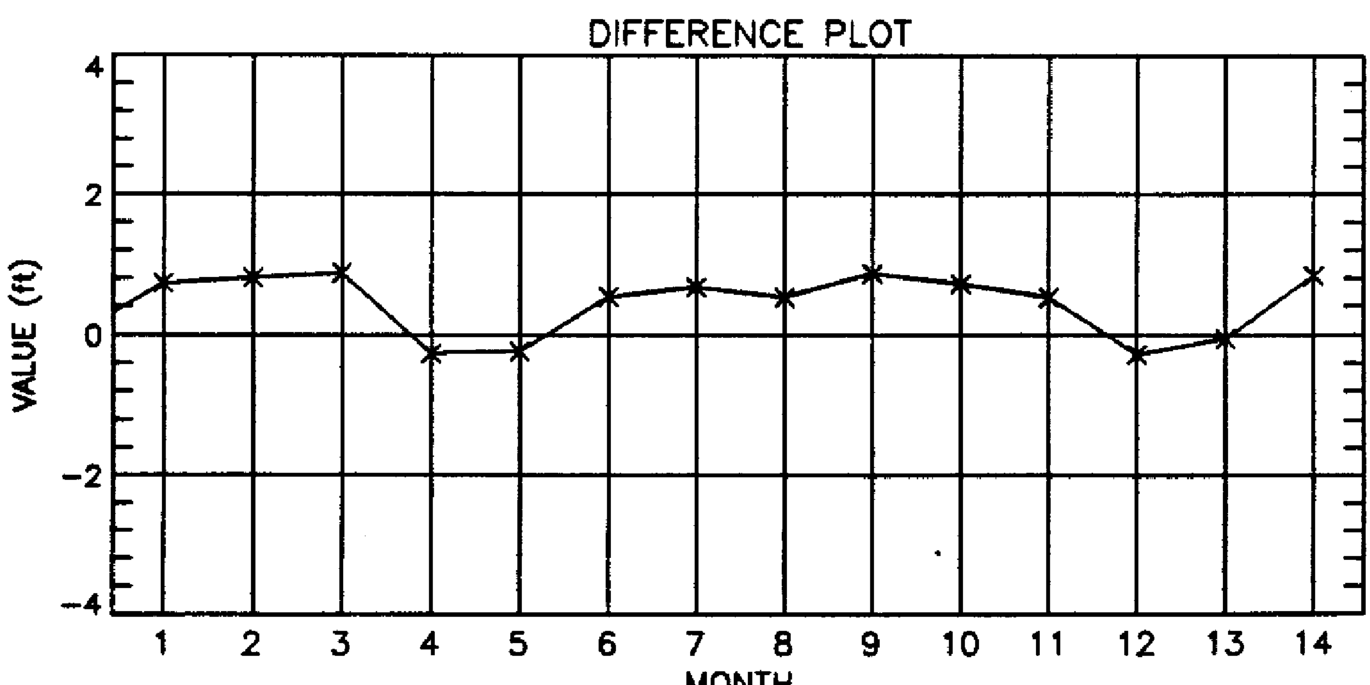

DIFFERENCE PLOT
4
2
0
-2
-4
VALUE (ft)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
MONTH
Extreme Errors [-0.3, 1.4] Average Absolute Error 0.46 Std.Error 0.56 pg 125





Extreme Errors [0.1, 0.9] Average Absolute Error 0.48 Std.Error 0.25 pg 126





Extreme Errors [-0.3, 0.9] Average Absolute Error 0.53 Std.Error 0.45 pg 127