

VERTICAL DATUM DIFFERENCES IN SOUTHEASTERN WISCONSIN

**SOUTHEASTERN WISCONSIN
REGIONAL PLANNING COMMISSION**

KENOSHA COUNTY

Leon T. Dreger
Thomas J. Gorlinski
Sheila M. Siegler

MILWAUKEE COUNTY

Daniel J. Diliberti
William Ryan Drew
Tyrone P. Dumas

OZAUKEE COUNTY

Leroy A. Bley
Thomas H. Buestrin,
Vice-Chairman
Elroy J. Schreiner

WAUKESHA COUNTY

Duane H. Bluemke
Robert F. Hamilton
Paul G. Vrakas

RACINE COUNTY

David B. Falstad, Chairman
Martin J. Itzin
Jean M. Jacobson,
Secretary

WALWORTH COUNTY

John D. Ames
Anthony F. Balestrieri
Allen L. Morrison, Treasurer

WASHINGTON COUNTY

Lawrence W. Hillman
Daniel S. Schmidt
Patricia A. Strachota

**SOUTHEASTERN WISCONSIN REGIONAL
PLANNING COMMISSION STAFF**

Kurt W. Bauer, PE, AICP, RLS Executive Director
Philip C. Evenson, AICP Assistant Director
Kenneth R. Yunker, PE Assistant Director
Robert P. Biebel, PE Chief Environmental Engineer
Monica C. Drewniany, AICP Chief Special Projects Planner
Leland H. Kreblin, RLS Chief Planning Illustrator
Elizabeth A. Larsen Administrative Officer
Donald R. Martinson, PE Chief Transportation Engineer
John R. Meland Chief Economic Development Planner
Thomas D. Patterson Geographic Information Systems Manager
Bruce P. Rubin Chief Land Use Planner
Roland O. Tonn, AICP Chief Community Assistance Planner

TECHNICAL REPORT NUMBER 35

VERTICAL DATUM DIFFERENCES IN SOUTHEASTERN WISCONSIN

Prepared by

Earl F. Burkholder, PLS, PE
Consulting Geodetic Engineer
Circleville, Ohio 43113-7240

for the

Southeastern Wisconsin Regional Planning Commission

December 1995

Inside Region \$2.00
Outside Region \$5.00

(This page intentionally left blank)

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

916 N. EAST AVENUE • P.O. BOX 1607 • WAUKESHA, WISCONSIN 53187-1607 •

TELEPHONE (414) 547-6721
TELECOPIER (414) 547-1103

Serving the Counties of

KENOSHA
MILWAUKEE
OZAUKEE
RACINE
WALWORTH
WASHINGTON
WAUKESHA

December 7, 1995

STATEMENT OF THE EXECUTIVE DIRECTOR

Since early 1964, the Regional Planning Commission has recommended to the governmental agencies operating within the Southeastern Wisconsin Region the use of a unique system of survey control as a basis for the compilation of large-scale topographic and cadastral maps, and as a basis for the conduct of land and engineering surveys. More recently, the Commission has also recommended the use of this system as a basis for the development of automated, parcel-based land information systems within the Region.

The recommended survey control system involves the remonumentation of the U. S. Public Land Survey corners within the Region and the establishment of State Plane Coordinates for those corners in order to provide a reliable horizontal survey control network. The system, however, also includes the establishment of elevations for the remonumented corners and for related auxiliary benchmarks to provide a reliable vertical survey control network fully integrated with the horizontal survey control network. As of January 1996, the recommended horizontal and vertical survey control system will have been extended over a total area of 1,840 square miles, or about 68 percent of the approximately 2,700-square-mile Region; and elevations determined for about 8,300 U. S. Public Land Survey System corners and accessories thereto, and for an additional 1,800 benchmarks which are not U. S. Public Land Survey System corners. All of these elevations were determined to meet Federal standards for Second Order Class II differential level networks.

All of this vertical survey control work within the Region has been referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29), a datum formerly known as Mean Sea Level Datum. The Federal government in 1977 determined to undertake a readjustment of the national vertical control survey network and to adopt a new datum, known as the North American Vertical Datum of 1988 (NAVD 88). The new vertical survey control datum does not provide any significant advantages over the continued use of the old datum within the seven-county Southeastern Wisconsin Region. Indeed, the introduction of the new datum may be expected only to entail unnecessary cost and potential confusion in the use of benchmark elevations. This potential confusion may lead to costly errors in surveys made for public works engineering and construction, and for the exercise of land use regulations relating particularly to floodlands. In this respect, it should be noted that the differences between the two datums within the Region range from about 0.10 foot to about 0.36 foot, just enough to cause serious problems if neglected in the conduct of engineering surveys, and in the administration of floodland zoning regulations. Since no benefits can be shown as attendant to the very large costs that would be entailed in shifting from NGVD 29 to NAVD 88 within the Region, the Southeastern Wisconsin Regional Planning Commission has determined to continue to utilize NGVD 29 as a basis for its surveying and mapping activities within Southeastern Wisconsin.

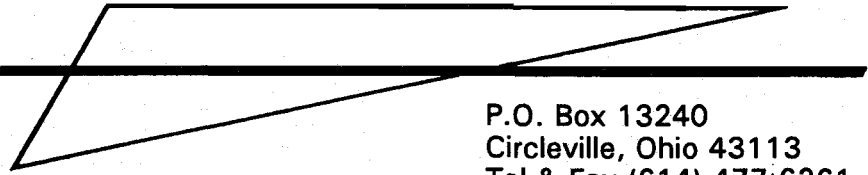
In order to facilitate the use of the NAVD 88 datum within the Region by such agencies as may desire to do so despite good reasons to the contrary, the Commission in October 1994 entered into an agreement with Mr. Earl F. Burkholder, Consulting Geodetic Engineer, to review existing transformation methodologies, develop as may be necessary new methodologies, and propose recommended methodologies for the ready and reliable bidirectional transformation of elevations between the two vertical datums concerned. The work was completed in December 1995 and the results are presented in this report. The transformation methodologies herein presented permit the ready conversion of elevations between the two datums concerned to various levels of accuracy, including a level of accuracy adequate to maintain the integrity of the Second Order Class II benchmark elevations within the Region.

Respectfully submitted,



Kurt W. Bauer
Executive Director

(This page intentionally left blank)



EARL F. BURKHOLDER, PLS, PE
Consulting Geodetic Engineer

P.O. Box 13240
Circleville, Ohio 43113
Tel & Fax (614) 477-6261

December 1, 1995

Dr Kurt Bauer, Executive Director
Southeastern Wisconsin Regional Planning Commission
P.O. Box 1607
Waukesha, Wisconsin 53187

Dear Dr. Bauer,

Transmitted herewith is the report entitled, "Vertical Datum Differences in Southeastern Wisconsin." The report documents the relationship between the National Geodetic Vertical Datum of 1929 (NGVD 29) as presently used throughout the seven-county area served by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and the North American Vertical Datum of 1988 (NAVD 88) as published by the National Geodetic Survey (NGS) of the National Oceanic Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

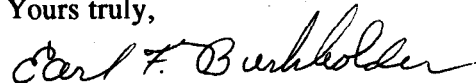
The Southeastern Wisconsin Regional Planning Commission has, over a period of more than 30 years, established and promoted use of elevations referenced to the NGVD 29 for topographic mapping, for floodplain delineation, for sewerage, drainage, flood control and water quality studies, and for hydrologic and hydraulic computations. The Commission has also maintained a system of closely spaced monumented benchmarks throughout the region as part of the infrastructure which supports public works engineering and site development. The value of the information accumulated in the NGVD 29 database over the past 30 years will be preserved and enhanced by documenting the relationship between the two datums throughout the Region.

Three options for determining the relationship between the two datums were identified. The most costly option would be to resurvey all benchmarks within the Region on the new datum. Another option, also costly, would be to abstract all control leveling information from existing records and readjust all control leveling networks. The third option would be to employ an interpolating program known as VERTCON developed for that purpose by the NGS. As a combination of options two and three, this report documents the performance of VERTCON against both the elevations published by the NGS and representative lines of Second-Order leveling completed by the Commission.

For the comparatively small number of cases where a First-Order vertical datum transformation is required the resurvey option is recommended. However, elevations for thousands of existing Second- and Third-Order benchmarks scattered throughout the Region can be efficiently converted from one datum to the other using VERTCON as described in the report. The relationship to and use of the International Great Lakes Datum is also described.

Thank you for the opportunity to be of service to the Commission.

Yours truly,



Earl F. Burkholder, PLS, PE
Consulting Geodetic Engineer

(This page intentionally left blank)

TABLE OF CONTENTS

	Page		Page
Introduction and Summary	1	Accuracy Considerations	6
Vertical Datums	2	Iso-Hypsometric Map of	
Goals and Objectives	5	VERTCON Predictions	12
Existing SEWRPC Leveling Networks	5	Conclusions and Recommendations	14

LIST OF APPENDICES

Appendix		Page
A	VERTCON Documents	19
A-1	VERTCON Version 2.0	21
A-2	VERTCON Version 2.0 - Input Options	24
A-3	VERTCON Version 2.0 - Output Formats	25
A-4	Development of Iso-Hypsometric Map of VERTCON Results for Southeastern Wisconsin	26
A-5	VERTCON Results in Foot Units on 10,000-Ft. Grid	27
B	Comparison of VERTCON Predicted Differences with Published Datum Differences at First- and Second-Order USC&GS and NGS Benchmarks in Southeastern Wisconsin	47
B-1	Comments and Overview	49
B-2	Data Set: First- & Second-Order USC&GS and NGS Benchmark Elevations on NGVD 29 and NAVD 88	50
B-3	VERTCON Version 2.0 Results (Meters) for USC&GS and NGS First- and Second-Order Benchmarks	58
B-4	Difference of Differences for First- and Second-Order USC&GS and NGS Benchmarks	65
B-5	Listing of VERTCON Misfits for USC&GS and NGS First- and Second-Order Benchmarks	91
B-6	Summary and Conclusions Drawn from the Comparison of VERTCON Predicted Differences with Differences of Known Common Datum Values	95

Appendix		Page
C	SEWRPC Watershed Leveling Network Comparisons	99
C-1	Introduction and Overview	101
	Map C-1 Commission-Established Benchmarks Used for Additional VERTCON Comparisons	102
C-2	Milwaukee River Watershed and Fox River Watershed Control Benchmarks and Elevations	103
C-3	Fox River Watershed Control Leveling Data	104
	Fox River Watershed Level Network - NGVD 29	109
	Fox River Watershed Level Network - NAVD 88	113
	Computed Fox River Watershed Elevations - NGVD 29	117
	Computed Fox River Watershed Elevations - NAVD 88	124
	Data Set: Second-Order Benchmarks - Fox River Watershed Adjusted Elevations on NGVD 29 and NAVD 88	131
	Data Set: Second-Order Benchmarks - Fox River Watershed Published Elevations on NGVD 29 and Adjusted Elevations NAVD 88	134
	VERTCON Version 2.0 Results (Meters) for Fox River Watershed Benchmarks	137
	Difference of Differences for Fox River Watershed - Option 1	140
	Difference of Differences for Fox River Watershed - Option 2	148
	VERTCON Misfits on Fox River Watershed Benchmarks	156
	Map C-2 Fox River Watershed Level Network Diagram and Observed Elevations Differences	108
C-4	Milwaukee River Watershed Control Leveling Data	159
	Milwaukee River Watershed Level Network - NGVD 29	163
	Milwaukee River Watershed Level Network - NAVD 88	166
	Computed Milwaukee River Watershed Elevations - NGVD 29	169
	Computed Milwaukee River Watershed Elevations - NAVD 88	172
	Data Set: Second-Order Benchmarks - Milwaukee River Watershed Adjusted Elevations on NGVD 29 and NAVD 88	175
	Data Set: Second-Order Benchmarks - Milwaukee River Watershed Published Elevations on NGVD 29 and Adjusted Elevations NAVD 88	176
	VERTCON Version 2.0 Results (Meters) for Milwaukee River Watershed Benchmarks	177
	Difference of Differences for Milwaukee River Watershed - Option 1	178
	Difference of Differences for Milwaukee River Watershed - Option 2	182
	VERTCON Misfits on Milwaukee River Watershed Benchmarks	186
	Map C-3 Milwaukee River Watershed Level Network Diagram and Observed Elevation Differences	162
C-5	Order and Class of SEWRPC Leveling	188
	Table C-1 Standards for Control Leveling	188
	Table C-2 Summary of Least Squares Network Adjustments Using Distance-Weighted Observations on NGVD 29	189
	Table C-3 Summary of Least Squares Network Adjustments Using Distance-Weighted Observations on NAVD 88	189
D	Summary of Software and Utilities	191

LIST OF TABLES

Table		Page
1	Geodetic Control Leveling Standards	8

LIST OF FIGURES

Figure		Page
1	Equipotential Surfaces around the Earth	3
2	Undulation of a Level Surface	3

LIST OF MAPS

Map		Page
1	United States Coast and Geodetic Survey (USC&GS) and National Geodetic Survey (NGS) Lines of Leveling in the Southeastern Wisconsin Region	7
2	Iso-Hypsometric Map of VERTCON 2.0 Predictions for Southeastern Wisconsin	13

(This page intentionally left blank)

VERTICAL DATUM DIFFERENCES IN SOUTHEASTERN WISCONSIN

INTRODUCTION AND SUMMARY

This technical report, Vertical Datum Differences in Southeastern Wisconsin, follows, and may be considered a companion document to, SEWRPC Technical Report No. 34, A Mathematical Relationship Between NAD27 and NAD83 (91) State Plane Coordinates in Southeastern Wisconsin, 1994. While Technical Report No. 34 addresses issues associated with horizontal survey control and the relationship between horizontal datums, this report addresses issues associated with vertical survey control and the relationship between the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88) in Southeastern Wisconsin.

Since the early 1960s, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) has established and promoted use of a network of horizontal and vertical geodetic survey control stations throughout the approximately 2,700-square-mile, seven-county Region consisting of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties in Wisconsin. During that time, the Commission has provided leadership and guidance in promulgating standards and specifications for the conduct of the surveys necessary to densify the geodetic survey control network; to collect data for the planning and design and for the layout of public works; and to locate real property corners throughout the Region. In that capacity, the Commission is concerned with issues related to survey datums, both horizontal and vertical. SEWRPC Technical Report No. 7, Horizontal and Vertical Survey Control in Southeastern Wisconsin, 2nd Edition (SEWRPC 1990), documents and describes the surveying and mapping procedures espoused by the Commission.

At the national level, both the horizontal and vertical control survey datums have been readjusted and new values (coordinates and elevations) for each First- and Second-order monumented control point have been published by the National Geodetic Survey (NGS). The horizontal adjustment was completed in 1986 and the vertical adjustment in 1991. Improvements in each datum are significant at the national level and in specific problem areas throughout the United States but, due to the rigor and specificity with which points throughout the

SEWRPC area were established, the relative positions of points within the region are largely unchanged. The existing NAD27 horizontal control and the NGVD 29 vertical control networks remain sufficient as a basis for referencing spatial data within Southeastern Wisconsin; for the control of large-scale topographic and cadastral mapping; and for the control of land and public works surveys within the SEWRPC area.

Nonetheless, the following factors contributed to the Commission's determination to examine datum issues:

- With publication of the new datums, the numbers representing latitude and longitude positions and elevations are different. That does not mean that the new numbers are necessarily better, but it does adversely affect the ability of users to exchange reliable spatial information between databases.
- The new global positioning system (GPS) technology delivers three-dimensional spatial information which can be used independent of a datum. However, established practice is to attach and relate GPS results to the newer datums.
- Collecting spatial data is far more efficient and economical than in the past. Using modern data collection technology, persons in many disciplines and organizations now routinely collect spatial data—often of excellent quality—at a fraction of the cost for the collection of the same data as recently as 20 years ago. Unless there is a particular concern about datum differences, many persons routinely use the newer datums by default.
- Although the horizontal and vertical components of the newer datums are still conceptually segregated, these new datums are technologically compatible with modern three-dimensional data collection systems and the global geocentric reference system in which the datums exist. In the future, both horizontal and vertical spatial information will likely be integrated into one three-dimensional database. In the three-dimensional environment, datum transformation issues will become moot as universally accepted

transformation parameters and equations will permit ready conversions between datums. Choice of a datum will be up to the user and will be on par with the current choice of deciding to work in either feet or meters. That is, making and documenting the choice of a datum will be more important than the consequences of choosing one or the other.

Both the State of Wisconsin and the Commission have led the nation in designing and implementing systems for land records modernization and spatial referencing for land-related features and attributes. The development by the Commission of its geographic information system for regional planning purposes in the 1960s and 1970s evolved into the development of parcel-based land information systems within the Region in the 1980s and 1990s. The value of spatial information so assembled is established and preserved to the extent that all users are able to share compatible spatial data referenced to a common datum.

The current challenge is to continue in the tradition of sharing compatible data in spite of the fact that different datums exist and various disciplines and agencies do not all use the same datum. One way to ensure data compatibility would be to resurvey the location of all points of interest with respect to the newer datums. Even with spatial data collection becoming ever more economical, that option is prohibitively costly. Another option would be to abstract survey measurements (observations) from existing records and recompute and readjust all local survey networks holding the new datum values fixed on controlling points. The effort necessary to abstract consistent data from voluminous records and key them into computer files is also prohibitively costly. The third option is to test and adopt some interpolating procedure whereby the difference between datums is predictable at any point within the Region at a documented level of accuracy. With such a relationship known and readily available, each user has the option of moving data from one datum to another. With respect to vertical datums, the third option, use of an interpolating program—called VERTCON—developed by the National Geodetic Survey is the focus of this report.

The study underlying this report included two important components: 1) developing comparisons of VERTCON predicted changes from one datum to the other against datum differences obtained from the elevations of all common First- and Second-Order benchmarks in the Region as published by

the National Geodetic Survey; and 2) applying the same comparison technique to representative points throughout the Region whose elevations were determined according to Commission-recommended procedures. In the first comparison of VERTCON predicted differences with published differences, all but 35 of 413 common points agreed within 0.05 foot, and 288 of 413 common points agreed within 0.02 foot. In the second comparison of VERTCON predicted differences with differences at Commission-established points, all but 6 of 160 common points agreed within 0.05 foot, and 112 of 160 points agreed within 0.02 foot. If reasons for the statistical outliers are determined, the overall statistics might be improved.

It was accordingly concluded that VERTCON can be used reliably to convert existing Third-Order elevations from the National Geodetic Vertical Datum of 1929 (NGVD 29) to the North American Vertical Datum of 1988 (NAVD 88) within the seven-county SEWRPC Region; and that, with proper checks and procedures, VERTCON can also be used to transform Second-Order elevations. Resurvey procedures are recommended for the transformation, establishment, and re-establishment of First-Order elevations on existing or newly monumented benchmarks.

VERTICAL DATUMS

A simple definition of a vertical control datum given by the National Geodetic Survey (NGS, 1986) is a set of fundamental elevations to which other elevations are referenced and the coordinate system specified by the fundamental elevations. Although the wording of that definition is specific and has been very carefully chosen, an intuitive understanding of elevation as the distance above or below mean sea level is commonplace and most users are quite comfortable with the concept of basing elevations on "mean sea level." However, as a concession to accuracy, unambiguous meaning, and compatibility, it is necessary to be more specific about elevations and reference surfaces.

The fundamental elevation referred to in the foregoing definition is an equipotential surface often called the geoid—as opposed to a mathematically smooth "best fitting" ellipsoid—and is described as a frictionless imaginary surface along which a unit mass can move without the expenditure of work. In a local sense, "no work" implies that the distance between mass centers (elevation) has not changed. Since work is defined as a force (gravity) acting through some distance and no work is expended,

an equipotential surface is the same as a level surface in the idealized case. In the past, mean sea level was assumed to be an equipotential surface—the geoid—and used as the fundamental elevation. That assumption is acceptable to the extent that barometric pressure is the same worldwide, sea-water temperature is uniform around the world, no surface winds are piling water up on some far-off shore, and no ocean currents exist. Although a good approximation, mean sea level does not meet more rigid requirements for a physical realization of an equipotential surface.

Separately, the physical location of an equipotential surface is influenced by the combined effect of two concepts from physical geodesy: 1) centrifugal force due to rotation of the earth; and, 2) gravitational attraction. The earth's rotation is quite regular and the effect of that rotation can be computed quite precisely, but gravitational attraction varies according to the non-uniform distribution of mass within the earth. The two effects are shown separately in Figures 1 and 2.

Figure 1 shows the whole earth and successive non-parallel level surfaces which are spaced closer together at the poles than at the equator. For precise leveling over long north-south distances, the non-parallel characteristics of the level surfaces must be accommodated. This is especially true if the leveling is adjacent to a large body of water, such as Lake Michigan, and if hydraulic gradients are to be computed.

Figure 2 shows a local mass concentration near which an equipotential surface—the geoid—is warped according to the strength of the attraction and location of the mass. An equipotential, or level, surface is always perpendicular to the direction of the local plumb line. Consequently, a level surface is continuous, an important consideration in mathematical modeling, and undulations in the geoid are correlated with variations in gravity measurements.

Geodetic leveling has been conducted throughout the United States since the mid- 1800s. From the very beginning, leveling results have been reported as elevations with respect to mean sea level, as well as to other more precisely defined datums. As more data were collected and more precise models employed, a truer picture of the physical world emerged. Summary descriptions of relevant vertical datums follow:

Mean Sea Level Datum of 1929: The Mean Sea Level Datum of 1929 was based upon computation

Figure 1

EQUIPOTENTIAL SURFACES AROUND THE EARTH

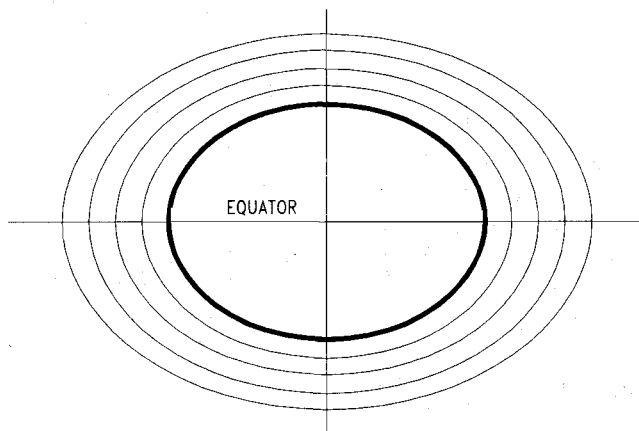
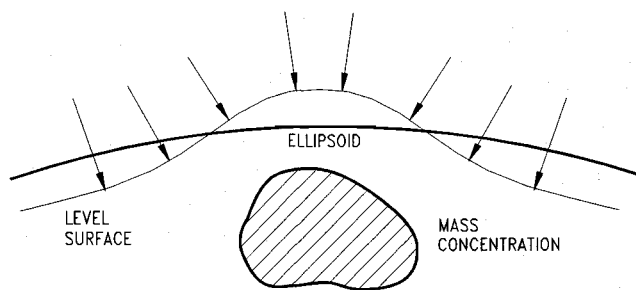


Figure 2

UNDULATION OF A LEVEL SURFACE



and adjustment of about 47,000 miles of leveling in the United States combined with about 20,000 miles of leveling in Canada comprising numerous loops and connected to 26 tide gauging stations in both countries. It was commonly called the "Sea Level Datum of 1929" because of its dependence on mean sea level as determined by the tide gauges. Technical problems relating to ocean currents, lack of uniform barometric pressure and other issues were known, but judged less consequential than the observational errors in the network and the resulting confusion in the engineering community if the published elevations of benchmarks near the sea coasts would not be compatible with local mean sea level as determined by tide observations.

National Geodetic Vertical Datum of 1929: The National Geodetic Vertical Datum of 1929 is, except for the name, identical to the Mean Sea Level Datum of 1929. To eliminate confusion caused by the implication that "zero elevation" on an ocean beach could be used to determine coastal boundary

lines and offshore jurisdictional limits, the name was changed in 1973 to eliminate the words "sea level" from the title.

International Great Lakes Datum of 1955: Due to the fact that level surfaces are not parallel, the elevation—taken as distance above the geoid—of the south end of Lake Michigan is higher than the northern end by nearly 0.25 foot¹ when in fact, the hydraulic gradient is zero. In order to accommodate this apparent discrepancy, a more specific definition of the water surface is given by geopotential numbers which reflect the unchanging work potential of the level surface and dynamic heights which can be used to compute correct hydraulic gradients throughout the Great Lakes system.

Zilkoski, Richards & Young (1992) summarize the history of leveling in the Great Lakes region and describe development of the International Great Lakes Datum (IGLD) of 1955 as a joint effort of the United States and Canada through an international coordinating committee which decided upon a separate vertical datum for the Great Lakes area based upon dynamic heights to provide a means for the more accurate measurement of geopotential hydraulic head between points. The IGLD 1955 was determined by holding the elevation of local mean water level fixed at a station near the mouth of the St. Lawrence River, Point-au-Pere (Father's Point), Quebec. All other points on the IGLD 1955 were referenced to that one initial benchmark.

International Great Lakes Datum of 1985: Due to melting and retreat of the glaciers from the upper midwest and the Hudson Bay area in Canada, the earth continues to rebound with removal of that extra load from the earth's crust. As a result, surface elevations change throughout the glaciated area and the hydraulic characteristics of the Great Lakes system are affected. Therefore, it was expected that the IGLD would be updated every 25 to 35 years and that the work of the international coordinating committee would be ongoing. Updated elevations based upon more recent data, modern surveying technology, and refined adjustment techniques have resulted in a new International Great Lakes datum, the IGLD 1985.

North American Datum of 1988: Concurrent with the update of the International Great Lakes Datum and other international cooperative leveling activities, the National Geodetic Survey began a project in October 1977 to readjust the vertical control survey network throughout North America, with the new datum to be known as the North American Vertical Datum of 1988. The leveling adjustment projects overlapped and shared data and features such that, except for the units of elevations published, the NAVD 88 and IGLD 1985 are identical. Both datums are based upon the same primary tidal benchmark at Father's Point, Rimouski, Quebec, Canada,² and all benchmarks in both systems have identical geopotential numbers. The difference between the two systems (Zilkoski 1992) is that elevations (dynamic heights) for the IGLD 1985 are computed by dividing the geopotential number by normal gravity at latitude 45° north (980.6199 gals), and NAVD 88 elevations are obtained by dividing the same geopotential number by local gravity computed using the Helmert Height reduction formula, equations 16.98 and 16.99 of Vanicek & Krakiwsky (1986). In each case, the unit of elevation is meters but the difference lies in the value of gravity used to compute the elevation from identical geopotential numbers for each benchmark.

Summarizing from Zilkoski (1991), readjustment of the entire vertical control network was completed by the National Geodetic Survey in June 1991. With publication of the final adjusted heights, there is now, in effect, a single datum for the entire North American continent as both the NGVD 29 and IGLD 1955 are replaced by the NAVD 88. The resulting network represents a uniform set of elevations throughout and eliminates height discrepancies caused by inconsistent adjustments, previously unmodeled systematic errors, and blunders. The new datum is also consistent with GPS derived orthometric heights using a high-resolution geoid model, such as GEOID93.

¹By equation 5-26 of Davis, et al (1981).

² The IGLD 1985 and the NAVD 88 datums both have only one common reference benchmark. However, in 1984, that one primary tidal reference was transferred from "Father's Point" to "Rimouski" via precise leveling (Ed McKay, NGS, personal communication).

GOALS AND OBJECTIVES

The goals of the study underlying this report were to identify issues relating to relationships between vertical datums within Southeastern Wisconsin and to provide users the means whereby information on one datum can be transformed to another within known limits of accuracy and precision. Within those goals, four specific objectives were to:

- Preserve, to the extent possible and reasonable, the value of the extensive existing Second-Order and Third-Order benchmarks and elevations which have been established throughout the Region.
- Satisfy the Federal Emergency Management Administration (FEMA) mapping requirements for converting elevations used in the National Flood Insurance Program to the NAVD 88 within the Region.
- Provide for the reliable transformation of surveyed benchmark elevations from the NGVD 29 to the NAVD 88 and from NAVD 88 to NGVD 29.
- Identify the presence of the International Great Lakes Datum and show how IGLD dynamic heights are related to orthometric heights of the NAVD 88.

EXISTING SEWRPC LEVELING NETWORKS

In February 1964, the Southeastern Wisconsin Regional Planning Commission published SEWRPC Planning Guide No. 2, Official Mapping Guide, which contains a description of the system of survey control recommended by the Commission for use by governmental agencies operating within the seven-county Southeastern Wisconsin Region. Since then, the recommended systems of horizontal and vertical survey control have been widely implemented throughout the Region. And, as the basic survey data are of direct benefit to land surveyors, civil engineers and other disciplines in both private and governmental endeavors, the Commission collated and published these data in 1968 as SEWRPC Technical Report No. 7, Horizontal and Vertical Survey Control in Southeastern Wisconsin. The original supply of 500 copies of the report was quickly exhausted and the Commission continued to field numerous inquiries relating to control survey data.

In August 1990, the Commission published the 2nd Edition of SEWRPC Technical Report No. 7, updating the horizontal and vertical control survey information for the region. Additionally, the 2nd Edition contained the 1984 version of the "Standards and Specifications for Geodetic Control Networks" promulgated by the Federal Geodetic Control Committee and an appendix on "Geodetic Datums" which raised the issues relating to datums addressed herein and in the companion SEWRPC Technical Report No. 34.

The networks of horizontal and vertical control survey monuments existing within the seven-county Region are extensive. As of January 1, 1996, a total of 8,317 U. S. Public Land Survey section and quarter-section corners have been located, monumented, and placed on the state plane coordinate and vertical control survey systems. Thus, the envisioned control survey network was about 71 percent complete, the ultimate goal being to provide both horizontal state plane coordinates and vertical elevations for each of the nearly 11,800 section and quarter-section corners within the Region. If progress of the past 30 years is extrapolated to completion, all corners should be surveyed by about the year 2010. It is to be noted, however, that the control survey systems in three of the more densely developed counties of the Region—Kenosha, Milwaukee, and Racine—are 100 percent complete. The point is that the system of survey control required to support orderly land use and infrastructure development within the rapidly urbanizing seven-county Region is largely in place and functioning well.

As stated in SEWRPC Technical Report No. 7, the state plane coordinates of each monumented section and quarter-section corner are determined from a control survey having an accuracy of Third-Order, Class I, or better; and the elevation of each such corner is determined from a control survey having an accuracy of Second-Order, Class II, or better, according to Federal Geodetic Control Committee specifications. All survey control in the Region is based upon the First- and Second-Order geodetic control stations established by the U. S. Coast and Geodetic Survey (USC&GS) and the successor National Geodetic Survey (NGS). The control leveling within the Region performed by the former Lake Survey Division of the U. S. Army Corps of Engineers is also integrated into the regional control survey network.

As shown in Map 1, the lines of First- and Second-Order vertical control crisscross the Region, generally following existing and abandoned railway lines. Additionally, lines of Second-Order levels have been run throughout many portions of the Region, the locations of which are shown in Appendix D of SEWRPC Technical Report No. 7, 2nd Edition (1990). A number of these supplementary level lines were run in the 1960s and 1970s by the Commission as part of its comprehensive watershed and areawide flood control, drainage, and water quality planning efforts. Leveling to establish elevations on the individual section and quarter-section corners is based, for the most part, upon these supplementary level lines.

A collation of the horizontal and vertical survey control established by the Commission is contained in Appendix C of SEWRPC Technical Report No. 7, 2nd Edition (1990). Appendix C of that report is divided into seven sections, one for each county. The first page of each section consists of a county index map on which the status of large-scale mapping within the county is indicated by shading and the location of each U. S. Public Land Survey section corner relocated, monumented, and coordinated under programs, undertaken or recommended by the Commission, are clearly identified. The actual control survey information (state plane coordinates and elevations) is presented in a series of control survey diagrams, each diagram covering six U. S. Public Land Survey sections. These data are referenced to the North American Datum of 1927 (horizontal) and National Geodetic Vertical Datum of 1929 (vertical) and comprise the data of primary interest to the user publics. The continuing value of this information will be enhanced to the extent it can be related to the new datums, both horizontal and vertical. The companion document, SEWRPC Technical Report No. 34, addresses issues related to the horizontal datums and this report considers issues related to the vertical datums.

ACCURACY CONSIDERATIONS

In the ideal case, a mathematical equation would exist whereby elevations on one datum could be transformed exactly to elevations on another datum. However, that is not the case as the relationship between the NGVD 29 and NAVD 88 is complex, reflecting the presence of some systematic distortion and small random errors in both systems. This report recommends that an interpolation program, VERTCON, be used to determine vertical datum

differences. However, VERTCON has some limitations which need to be considered. In cases where use of VERTCON does not yield acceptable results, another method, such as recomputation using existing observations, or resurvey—either using established proven differential leveling techniques or emerging GPS technology—will be required.

Two documents pertinent to accuracy considerations are the National Map Accuracy Standards (NMAS) which have been used since 1947, and the 1984 Standards and Specifications for Geodetic Control Networks as promulgated by the Federal Geodetic Control Committee (FGCC 1984).³ Both documents relate to issues of vertical accuracy, but neither document is considered exclusively applicable.

National Map Accuracy Standards: The NMAS are applicable when judging the veracity of feature location on a map. Although they have been used in the current form since 1947, the NMAS have also been evaluated in light of modern digital mapping practice and are still considered applicable for the original purpose of judging the quality of maps in the various topographic mapping series. Evaluation of the NMAS for digital products and larger scale map applications continues (Chamard 1995).

According to the NMAS, the horizontal accuracy of a well-defined point is to be within 1/30 of an inch for maps plotted at a scale of 1:20,000 or larger; and vertical accuracy applied to contour maps is to be such that no more than 10 percent of points tested shall be in error by more than one-half a contour interval. The choice of a vertical datum is thus a mapping consideration, and the adequacy of VERTCON to adequately transform elevations on different vertical datums becomes an issue. Even if meeting the NMAS were the only criterion for the required accuracy of the elevation of a given point, the vertical datum differences within the Region are large enough to be of concern with respect to large-scale topographic maps having a vertical contour interval of two feet. For example, the maximum difference between NGVD 29 and NAVD 88 in the seven-county Region area is about 0.36 foot. While this difference may be considered inconsequential with respect to a topographic map having a 10-foot contour interval, ignoring the 0.36-foot datum differ-

³The FGCC is now called the Federal Geodetic Control Subcommittee (FGCS).

Map 1

UNITED STATES COAST AND GEODETIC SURVEY (USC&GS) AND NATIONAL GEODETIC SURVEY (NGS) LINES OF LEVELING IN THE SOUTHEASTERN WISCONSIN REGION

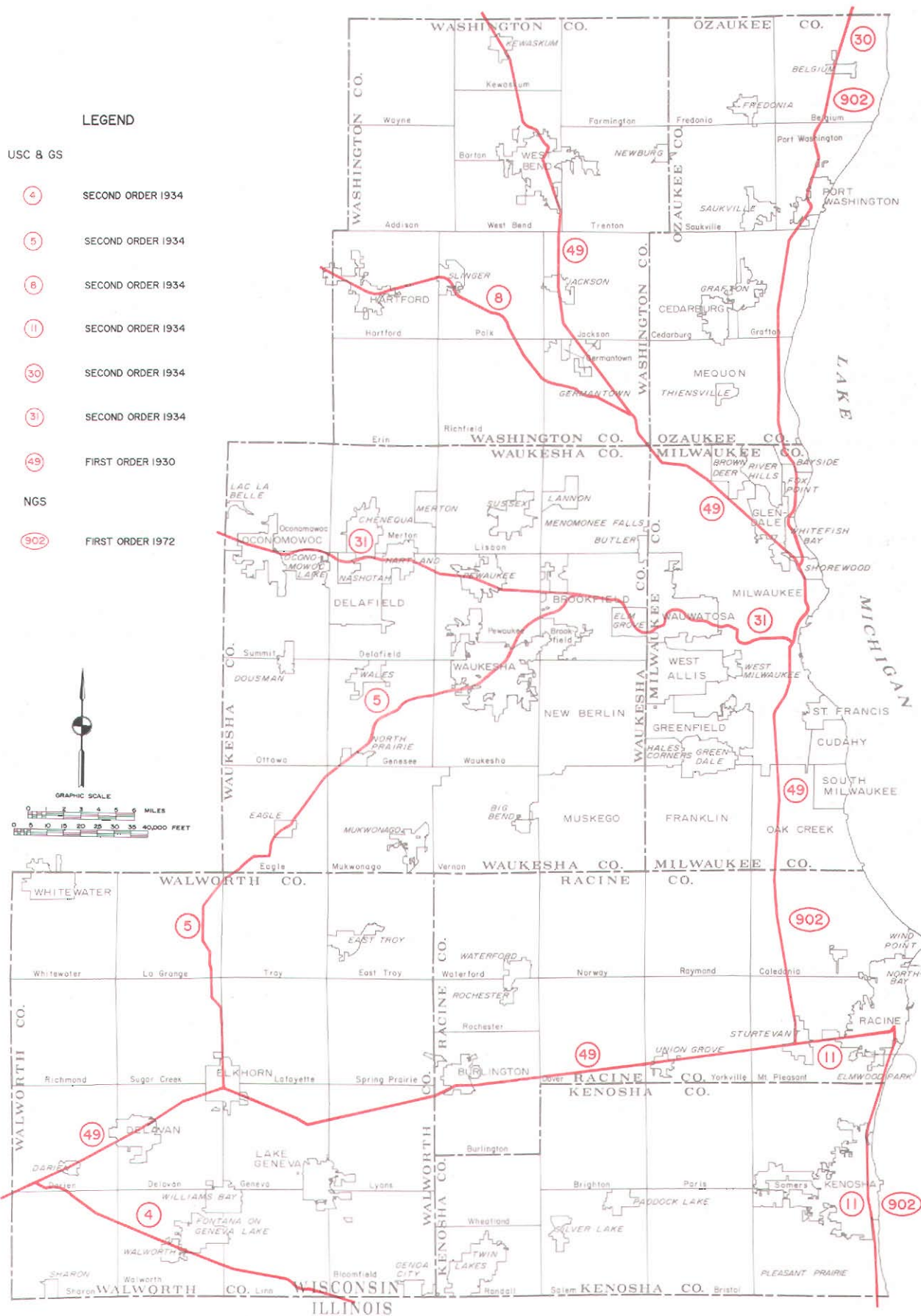


Table 1

GEODETTIC CONTROL LEVELING STANDARDS

Order	Prior to 1974	
	Allowable Misclosure—Section or Loop	
	Metric Units	English Units
First	4 mm $\sqrt{\text{Km}}$	0.017 ft $\sqrt{\text{Mi}}$
Second	8.4 mm $\sqrt{\text{Km}}$	0.035 ft $\sqrt{\text{Mi}}$
Third	12 mm $\sqrt{\text{Km}}$	0.050 ft $\sqrt{\text{Mi}}$

Order and Class	Since 1974			
	Allowable Misclosure—Section		Allowable Misclosure—Loop	
	Metric Units	English Units	Metric Units	English Units
First, I	3 mm $\sqrt{\text{Km}}$	0.012 ft $\sqrt{\text{Mi}}$	4 mm $\sqrt{\text{Km}}$	0.017 ft $\sqrt{\text{Mi}}$
First, II	4 mm $\sqrt{\text{Km}}$	0.017 ft $\sqrt{\text{Mi}}$	5 mm $\sqrt{\text{Km}}$	0.021 ft $\sqrt{\text{Mi}}$
Second, I	6 mm $\sqrt{\text{Km}}$	0.025 ft $\sqrt{\text{Mi}}$	6 mm $\sqrt{\text{Km}}$	0.025 ft $\sqrt{\text{Mi}}$
Second, II	8 mm $\sqrt{\text{Km}}$	0.033 ft $\sqrt{\text{Mi}}$	8 mm $\sqrt{\text{Km}}$	0.033 ft $\sqrt{\text{Mi}}$
Third	12 mm $\sqrt{\text{Km}}$	0.050 ft $\sqrt{\text{Mi}}$	12 mm $\sqrt{\text{Km}}$	0.050 ft $\sqrt{\text{Mi}}$

ence with respect to a large-scale map having a two-foot contour interval may be significant, particularly when dealing with problems such as flood hazard area delineation.

Conventional Leveling Standards: The FGCS standards and specifications applicable to vertical control surveys are much more stringent than the NMAS and are intended to be applied to observed elevation differences. Of course, it is presumed the accuracy of published elevations are compatible with the accuracy of the observed elevation differences. It is not possible to add a First-Order elevation difference to a Second-Order benchmark elevation and end up with a First-Order elevation. Neither can one add an observed elevation difference to an elevation published on one datum to find an elevation on another datum. But, an observed elevation difference is independent of a datum and can be used on either one. That is, a given observed difference between two points—"A" and "B"—can be added to a NGVD 29 elevation on Point A to find the NGVD 29 elevation on Point B. The same observed difference can be added to a NAVD 88 elevation on Point A to find the NAVD 88 elevation on Point B.

Conventional leveling standards are quoted for orders and class much the same as for horizontal control. First-Order is the most precise followed by

Second- and Third-Order. Leveling conducted by the Commission in the 1960s and early 1970s for watershed studies and to control large-scale topographic mapping (see Appendix C) was performed according to specifications designed to meet standards then in effect for Second-Order leveling. Since then, leveling standards have become more stringent and additional categories have been added such that the First- and Second-Order classes each have two subclasses with Class I being more precise and accurate than Class II. Table 1 summarizes standards for geodetic leveling, both as in effect prior to 1974, and as currently in effect, the new standards having been promulgated by the Federal Geodetic Control Committee in 1974. In each case, the standards expressed as maximum allowable misclosures are computed as a coefficient times the square root of the leveled distance.

Beginning in 1974, leveling standards are provided for sections—double run lines beginning on one point and closing on another—and for loops—a collection of sections which form a closed circuit. The standards prior to 1974 are provided for double-run sections only. Two important points applicable in either case are: 1) the standard applies specifically to the observed elevation differences; and 2) the allowable misclosure grows with the square root of the leveled distance, whether loop or section.

These considerations are important when evaluating comparisons of VERTCON predicted datum differences with observed and published datum differences at various benchmark locations.

Implications of GPS Technology: The FGCS Standards and Specifications for Geodetic Control Networks were developed for conventional surveying procedures and do not include standards and specifications for GPS surveying. Separate GPS standards and specifications have been developed by the NGS (1988) and published as "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques." However, that document has not yet been officially sanctioned by the FGCS and efforts are underway to develop a comprehensive document which will accommodate both conventional and modern positioning technologies. A draft version of "Standards for Geodetic Control Networks" was released (NGS 1994) in October 1994. A distinguishing feature of the draft standard is a proposal to treat local accuracy (with respect to adjacent surveyed points) separately from network accuracy (with respect to the datum).

It is not within the scope of this study to provide an exposition on the establishment of elevations using GPS, but since GPS observations can and will be used to establish elevations on both the NGVD 29 and NAVD 88, the following comments are appropriate. GPS measurements are routinely used to determine precise ellipsoidal heights at occupied points and ellipsoidal height differences between points. Conventional elevations, more specifically referred to as orthometric heights, can be computed from GPS ellipsoidal heights if an accurate geoid height is known for the same point. Accurate geoid heights are difficult to obtain but geoid height differences are much easier to model. Thus, if an accurate ellipsoid height difference is known and accurate geoid undulation differences are available, a reliable elevation can be determined for a point relative to a known benchmark. Procedures for attaching differences to datum specific elevations are:

- GPS can provide very accurate ellipsoid heights and height differences. These differences, while specifically applicable to the World Geodetic System 1984 (WGS 84), are locally datum independent and those height components can be attached to a vertical datum of the user's choice; e.g., NGVD 29 or NAVD 88.

- Determination of accurate relative geoid undulations has been improved significantly with publication of GEOID93 by the NGS. While absolute geoid undulations at specific points are not very accurate, the relative geoid undulation between points up to 60 miles apart is much better (Milbert & Schultz 1994).
- With accurate ellipsoid height differences from GPS and precise geoid undulation differences from GEOID93, these datum independent differences can be attached to a known elevation at Point A to compute the elevation of Point B, on either datum.

This brief summary indicates how GPS can be used to determine elevations on either datum. Accuracy considerations for GPS derived elevations are different than the "distance dependent" specifications for leveling given in the FGCC (1984) document and are considered at some length in the NGS (1988) document. The change in leveling standards is driven by convergence of "horizontal" and "vertical" into an integrated "spatial" positioning standard which, at present has not been fully developed or finalized. "Accuracy Standards for Modern Three-Dimensional Geodetic Networks," (Leick 1993) is a report of an Ad Hoc Committee of the American Congress on Surveying & Mapping (ACSM) which was charged with examining existing standards in light of new measurement technology (GPS), the evaluation of point-position standards as a supplement to existing distance-dependent standards, and the integration of "horizontal" and "vertical" standards into a single spatial position standard. The 1994 NGS draft document incorporates some, but does not embrace all, of the ACSM report recommendations.

With the ongoing evolution of standards and specifications for evaluating vertical accuracies, the conclusions given in this report will be qualified as necessary with the idea of being consistent, to the extent possible, with both past standards and those being considered for possible future implementation. The FGCS standards have been applied to the control leveling networks in the past and should continue to be applied until revised standards and specifications are formally approved and adopted by the professional organizations concerned or by the Federal government.

Limitations of VERTCON 2.0: As previously stated, VERTCON 2.0 is a program published by the NGS which computes the modeled difference in ortho-

metric height between the NGVD 29 and NAVD 88 at a location specified by latitude and longitude. The interpolated results obtained from VERTCON are based upon known datum difference values scattered over the North American continent. Text accompanying the program (see Appendix A), indicates that tests of the predictive capability of the physical model show a 2.0 cm root mean square agreement at 381,833 data points within North America. The text emphasizes that VERTCON 2.0 is a datum transformation model, and cannot maintain the full vertical control accuracy of geodetic leveling. However, VERTCON 2.0 accuracy should be adequate for a variety of mapping and charting purposes. A significant part of the study on which this report is based consisted of developing very specific comparisons of the VERTCON predicted datum differences with computed datum differences at: 1) each First- and Second-Order common benchmark location within the Region published by the NGS; and 2) representative SEWRPC benchmark locations in areas not crossed by NGS published level lines. In each case, the VERTCON predicted differences agreed with published and computed datum differences better than the 2.0 cm—or 0.07 foot—root mean square error claimed by NGS, suggesting that the NGS accuracy estimate is a conservative one within the seven-county Region.

Federal Emergency Management Agency (FEMA)

Requirements: Part of the impetus for documenting the vertical datum differences in Southeastern Wisconsin is the set of mapping requirements promulgated by FEMA under the National Flood Insurance Program administered by the Federal Insurance Administration. Under these requirements as set forth in Appendix 6 to "Flood Insurance Study Guidelines and Specifications for Study Contractors" published by FEMA in 1993, the NAVD 88 is to be used generally for all new flood hazard mapping, but specifically for:

- Initial Studies (Type 15). Initial flood insurance studies (FIS) which are based upon detailed hydrologic and hydraulic analyses to establish flood flows and stages and attendant inundation areas are required to use NAVD 88. Exceptions must be approved by the FEMA Project Officer prior to study initiation.
- Restudies (Type 19). Studies intended to extensively revise previously completed flood insurance studies may use NAVD 88 or

NAVD 29 at the discretion of the FEMA Project Officer. If NGVD 29 is used for the study, then a conversion factor, including documentation of how that factor was derived, is to be included in the study materials submitted to FEMA.

- Limited Map Maintenance Program (LMMP) Studies. The use of NAVD 88 for studies intended to minimally revise previously published FISs is at the discretion of the FEMA Project Officer. If NGVD 29 is used for such studies, then a conversion factor, including documentation of how that factor was derived, is to be included in the study materials submitted to FEMA.

Section A6-3.B in the same appendix lists three basic conversion methods available as options to new users of the NAVD 88 as: 1) least squares adjustment of existing leveling data into the NAVD 88; 2) rigorous transformation of benchmark heights using datum conversion correctors; and 3) simplified transformation using average bias shift factors. The program VERTCON 2.0 is not mentioned in the FEMA publications because VERTCON 2.0 was released after the FEMA publication was issued. VERTCON 2.0 should be acceptable for methods 2) and 3) described above.

Wisconsin Department of Natural Resources:

Another significant problem presented by the difference between the NGVD 29 and NAVD 88 datums relates to the extensive floodplain and floodway mapping and the hydraulic gradelines which have been computed throughout the seven-county Region for such mapping. Theoretically, changing the datum—the reference elevation—for all flood hazard area mapping will not change the actual location of the floodplain, floodway, depth of water for a given flood, the regional flood profile, or the flood flow capacity of any given watercourse. But, Chapter NR 116 of the Wisconsin Administrative Code (1986), "Wisconsin's Floodplain Management Program," contains extensive references to water surface profiles, regional flood profiles, regional flood heights, and other elevation-related terms. It also defines the following terms specifically in Section NR 116.03:

- "Flood protection elevation" means an elevation two feet above the regional flood elevation.

- "Increase in regional flood height" means a calculated upward rise in the regional flood elevation, the permissible increase being limited to a maximum of 0.01 foot, resulting from a comparison of existing and proposed channel, floodway, and floodplain conditions which is directly attributable to development in the floodplain but not attributable to manipulation of mathematical variables, such as roughness factors, expansion and contract coefficients, and discharge.
- "NGVD" or "National Geodetic Vertical Datum" means elevations referenced to mean sea level datum, 1929 adjustment.

Section NR 116.07(4)(b) states, "All information used shall be referenced directly to NGVD unless the elevation datum is otherwise approved by the Department," and Section NR 116.07(4)(f) states, "The regional flood profile and changes to that profile caused by development in the floodplain, as determined by the hydraulic model, shall be calculated to the nearest 0.01 foot."

Again, if all NGVD 29 elevations concerned in flood hazard delineations—including the hydraulic data, such as channel profiles and cross sections, bridge deck, and roadway elevations, the flood profiles and topographic maps on which the flood hazard areas are delineated—could be converted instantaneously and within each watershed to elevations on the NAVD 88, there would be little or no impact on the results of any hydraulic studies or on flood profiles and mapped flood hazard areas. But, as the transition is made from NGVD 29 to NAVD 88, there will be cases in which the datum difference becomes an irritating source of confusion and the potential cause of costly misunderstandings and possible wrong decisions. Transition policies, if and when adopted, need to be thoughtfully considered and carefully implemented to avoid unnecessary problems.

The reason for including this discussion in this section on accuracy considerations has to do with the statutory stipulation that any computation of or change in the flood profile shall be calculated to the nearest 0.01 foot. A literal interpretation of that statement implies that any conversion of elevations from the NGVD 29 to equivalent NAVD 88 must meet or exceed that criterion. Allowing for the possibility that such a literal interpretation might

prevail when considering a transition from the NGVD 29 to NAVD 88, the following points need to be made:

- Once computed and accepted, it is logical to insist, essentially on zero tolerance, that the elevations be shown and used to the nearest 0.01 foot. It must be acknowledged, however, that hydraulic factors and flow assumptions contributing to the gradeline computation contain sufficient uncertainties that the propagated uncertainty of the computed profile elevation is greater than 0.01 foot.
- If benchmark elevations on which flow cross sections are based were to be resurveyed, even on the same datum, with the same equipment, with the same observers, and under similar conditions, there is a very high likelihood the benchmark elevations would differ by more than 0.01 foot due to presence of random error. The existing vertical control level network—even if all benchmarks were First-Order—cannot realistically be expected to support the 0.01 foot accuracy requirement.
- Even if benchmark elevations might have been perfectly surveyed on the NGVD 29 and if hydraulic grade line computations could be made exactly, without uncertainty, it would still be impossible to convert NGVD 29 elevations to NAVD 88 elevations within 0.01 foot because there is no exact relationship between the two datums. The best approach possible would be to resurvey, or recompute, all the existing elevations based upon benchmark elevations on the NAVD 88 datum according to the most exacting techniques and procedures. That, however, would be unrealistic as even the most precise First-Order level networks permit a misclosure of more than 0.01 foot in the distance of one mile (see Table 1).

Admittedly, it is important to document the difference between the NGVD 29 and NAVD 88 as accurately as possible and reasonable. It is unrealistic, however, to suggest the difference can be determined, either using VERTCON or with extensive additional high precision surveying, with an accuracy which will support the criteria listed in NR 116.

ISO-HYPSOMETRIC MAP OF VERTCON PREDICTIONS

When one uses the program VERTCON 2.0 to compute predicted differences between NGVD 29 and NAVD 88, the result is unique to the latitude and longitude (or state plane coordinate) position specified by the user. And, VERTCON 2.0 results vary from place to place according to what is required to most closely match the published datum differences in the area as determined from common benchmarks within the National Geodetic Survey database. One way to depict VERTCON 2.0 results which shows this variation throughout the seven-county Region is a map with lines connecting points having the same VERTCON 2.0 result. Such a map is Map 2 and is referred to as an Iso-Hypsometric Map of VERTCON 2.0 predictions.

Map 2 was developed from a data set of gridded points spaced at 10,000-foot intervals covering the entire seven-county Region (see computer printout in Appendix A). The VERTCON 2.0 predicted datum difference was computed at each grid intersection, converted from meters to feet, and plotted with a 0.02-foot interval much the same way as a contour map is plotted. The sign convention for VERTCON 2.0 is NAVD 88 - NGVD 29 and all differences on the map are negative accordingly as the NAVD 88 datum surface is further from the center of the earth than is the NGVD 29 datum surface throughout the seven-county Region. The following equations are intended to be used in the algebraic sense with values obtained from the map (all units in feet).

$$\text{NAVD 88 elev.} = \text{NGVD 29 elev.} + \text{the NEGATIVE map difference.}$$

$$\text{NGVD 29 elev.} = \text{NAVD 88 elev.} - \text{the NEGATIVE map difference.}$$

There are limitations associated with use of data scaled from the map in Map 2. The implication of plotting lines at an interval of 0.02 foot is that one should be able to use the data at that level. The lines shown on the map are a faithful representation of VERTCON 2.0 results and, if the VERTCON 2.0 results were exact, data from the map could be confidently used at the 0.02-foot level. However, VERTCON 2.0 results are an approximation of the actual datum differences and, as described by the comparisons in the next section, the iso-hypsometric map data should be interpreted as having a standard deviation of about 0.03 feet.

An apparent anomalous feature of the iso-hypsometric map is the depression approximately centered on the City of Milwaukee central business district, and a corresponding rise northwesterly of the City of Racine. Careful investigation of the available data for these areas revealed:

- The shape of the iso-hypsometric lines on the map is that necessary to match reliable published datum differences for First- and Second-Order benchmarks in the area. VERTCON Version 2.0 models those differences quite well.
- Of the 435 common benchmark elevations in the seven-county region published by the National Geodetic Survey (NGS), one of them (T 105) had an elevation difference too large to attribute to datum differences. Apparently "T 105" has been disturbed or moved. Published datum differences at 21 other benchmarks, as documented and summarized in Appendix B, lying generally between the depression and rise on the iso-hypsometric map do not conform to VERTCON 2.0 predictions.
- NGVD 29 elevations for those 21 points as listed in the NGS CD-ROM data base dated September, 1994, were not based upon adjusted field observations, but on a VERTCON Version 1.0 determination of datum difference applied to the adjusted First-Order NAVD 88 elevation for the points.

As noted in Appendix B, those 21 benchmarks—and benchmark "T 105"—were eliminated as "known" points and not used in the comparisons described in the next section. However, monuments for many of those points still exist and the NAVD 88 elevations for those points are listed by NGS as First-Order. NGS has never published reliable NGVD 29 elevations for those 21 points.

Results obtained from VERTCON 2.0 were compared with National Geodetic Survey (NGS) published elevation datum differences and separately with elevation differences based upon Commission-established Second-Order elevations in two large watersheds of the Region, the Fox River Watershed and the Milwaukee River Watershed. Software utilities used in making the comparisons are described in Appendix D.

Map 2

ISO-HYPSOMETRIC MAP OF VERTCON 2.0 PREDICTIONS FOR SOUTHEASTERN WISCONSIN

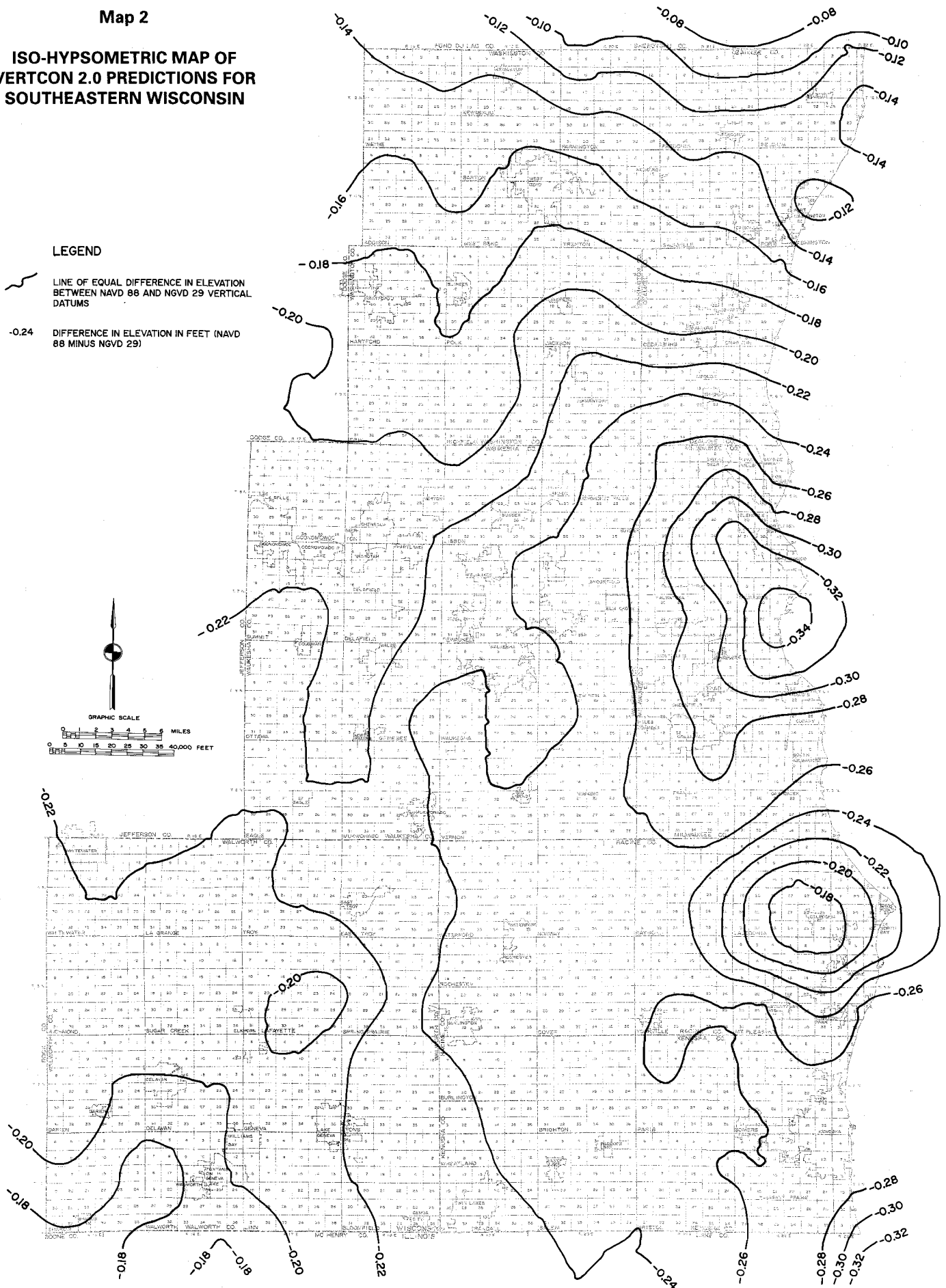
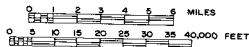
LEGEND

— LINE OF EQUAL DIFFERENCE IN ELEVATION
BETWEEN NAVD 88 AND NGVD 29 VERTICAL
DATUMS

-0.24 DIFFERENCE IN ELEVATION IN FEET (NAVD
88 MINUS NGVD 29)



GRAPHIC SCALE



Comparisons of VERTCON 2.0 results with NGS published differences for benchmarks along lines shown in Map 1 are tabulated in Appendix B and summarized as follows:

- 35 of 413, or 8 percent, of the differences exceeded 0.05 foot.
- 288 of 413, or 70 percent, of the differences were within 0.02 foot.
- The standard deviation—the 68 percent confidence level—of the 413 differences is 0.03 foot.

At the 95 percent confidence level, it can be stated that VERTCON 2.0 results are accurate within 0.06 foot along the NGS level lines. The data also indicate the VERTCON 2.0 misfits, while generally following the normal error distribution curve, do not strictly conform to the commonly used bell curve. VERTCON 2.0 misfits in the seven-county Region have both a greater central tendency and a greater spread between the limits than random error theory predicts.

Comparisons of VERTCON 2.0 results with differences obtained at Commission-established Second-Order benchmarks in the aforementioned watersheds are tabulated in Appendix C and may be summarized as follows:

- 6 of 160, or 4 percent, of the misfits exceeded 0.05 foot
- 112 of 160, or 70 percent, of the misfits were within 0.02 foot
- The standard deviation—or 68 percent confidence level—of the 160 misfits is 0.03 foot.

At the 95 percent confidence level, it can be stated that VERTCON 2.0 results are within 0.06 foot in the two watershed areas tested. These data match the standard error bell curve more closely.

CONCLUSIONS AND RECOMMENDATIONS

The following summarizes the findings and conclusions of this study:

- The vertical difference between the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88) is less than 0.40 foot

throughout the seven-county Southeastern Wisconsin Region; and can be modeled within 0.06 foot at the 95 percent confidence level with the program VERTCON, Version 2.0, available from the National Geodetic Survey.

- The vertical difference between the NGVD 29 and the NAVD 88 at points throughout the seven-county Southeastern Wisconsin Region can be interpolated from the Iso-Hypsometric Map (Map 2) of this report with accuracies adequate for the preparation of maps meeting National Map Accuracy Standards and for some land and engineering survey applications. However, the accuracy of datum differences interpolated from the Iso-Hypsometric Map cannot be expected to be better than that obtained from using the VERTCON 2.0 program at the same point.
- The National Geodetic Vertical Datum of 1929 and the International Great Lakes Datum of 1955 are both replaced by the new North American Vertical Datum of 1988 (NAVD 88). The NAVD 88 and the International Great Lakes Datum of 1985 have identical geopotential numbers associated with each benchmark. The difference in elevations for the two datums arises from the value of gravity used to convert the geopotential numbers to elevations. They are:

$$\text{IGLD 85 elev. (meters)} = \frac{\text{Geopotential number}}{980.6199 \text{ gals.}}$$

$$\text{NAVD 88 elev. (meters)} = \frac{\text{Geopotential number}}{\text{Local "Helmert" gravity value}}$$

where the local "Helmert" gravity value is (equations 16.98 & 16.99 of Vanicek & Krakiwsky (1980)) the value of gravity taken from the NGS data sheet for the benchmark plus $0.0424 H_1$, and H_1 is the observed (accurate at least to three significant digits) orthometric height of the benchmark in meters.

- The relationship between lake levels, local datums, and the NGVD 29 is discussed by Bauer (1989). That article contains a comprehensive summary of local datums existing or being used throughout the seven-county Region and relates them all to the NGVD 29. With the exception of the International Great Lakes Datum (IGLD), nothing in this study changes the data or conclusions reached there.

Rather, a new datum, the NAVD 88, is added to the list and this study documents the relationship between the NGVD 29 and the NAVD 88.

The IGLD exception is that the IGLD 1955 datum has been revised and updated to the IGLD 1985. And, the revision to the IGLD was defined as described above such that the geopotential numbers for both the IGLD 1985 and the NAVD 88 are identical. The elevations on the two datums for the same benchmark are different according to the value of gravity used to convert geopotential numbers to elevations.

Recommendations based upon the study findings and conclusions are:

- **Third-Order:** The VERTCON 2.0 program is recommended for use throughout the seven-county Region for converting Third-Order elevations from NGVD 29 to NAVD 88 and for converting Third-Order NAVD 88 elevations to NGVD 29 elevations. Differences obtained from the Iso-Hypsometric Map can also be used to convert Third-Order elevations from one datum to the other.
- **Second-Order:** Use of the Iso-Hypsometric Map is not recommended for making Second-Order elevation conversions. The VERTCON 2.0 program can be generally used throughout the seven-county Region to convert Second-Order NGVD 29 elevations to NAVD 88 elevations and NAVD 88 elevations to NGVD 29 elevations, including Second-Order Class II elevations—the class used by the Commission to establish benchmark elevations within the Region. Specific reliance on VERTCON 2.0 derived conversions for benchmarks in a given area should be supported by including up to 10 percent representative common benchmarks having known elevations on both

datums. The number of such common “blind test” points should be increased (say from one common point per U. S. Public Land Survey Section) as:

1. The size of the general area grows from a Section to a Township to a County or larger.
 2. The density of benchmarks whose elevations are being converted is such that distance between them is routinely less than one-half mile.
 3. Unacceptable comparisons are encountered at common points included in the project. In the case of unacceptable comparisons, the veracity of elevations being converted should be documented and unresolved problems brought to the attention of the Commission.
 4. Efforts are made to meet Second-Order, Class I standards instead of Second-Order, Class II standards (see Table 1).
- **First-Order:** VERTCON 2.0 is not recommended for converting First-Order elevations from one datum to another. If First-Order elevations are to be established on either datum, it is recommended conventional First-Order leveling equipment and procedures be used to observe First-Order elevation differences. Those differences can then be attached to existing First-Order benchmarks on either datum. It is also acknowledged that new technology, such as GPS, may be utilized in the future to establish First-Order elevations and that establishment of such elevations should be in accordance with standards and specifications still being developed, formulated, and tested.

(This page intentionally left blank)

REFERENCES

- Bauer, K. W., 1989, "Lake Levels and Datum Differences," Technical Record, Vol. 4, No. 5, pp 21-29, Southeastern Wisconsin Regional Planning Commission, Waukesha, Wisconsin.
- Berry, R. M., 1976, "History of Geodetic Leveling in the United States," Surveying & Mapping, Vol. 36, No. 2, pp 137-153.
- Burkholder, E. F., 1987, "Geodesy," Chapter 12, The Surveying Handbook, edited by Russell C. Brinker and Roy Minnick, Van Nostrand Reinhold Company, New York, New York.
- Chamard, Roger R., June 1995, Personal Communication.
- Davis, R. E., F. S. Foote, J. M. Anderson, E. M. Mikhail, 1981; Surveying: Theory & Practice 6th Ed., McGraw-Hill Book Company, New York, New York.
- FEMA, 1993, "Flood Insurance Study Guidelines and Specifications for Study Contractors," FEMA 37, Federal Emergency Management Agency, Federal Insurance Administration, Washington, D. C., 20472
- FEMA, 1992, "Converting the National Flood Insurance Program to the North American Datum of 1988: Guidelines for Community Officials, Engineers, and Surveyors," Federal Emergency Management Agency, Federal Insurance Administration, Washington, D. C., 20472.
- Leick, Alfred, 1993, "Accuracy Standards for Modern Three-Dimensional Geodetic Networks," Surveying and Land Information Systems, Vol. 53, No. 2, pp 111-116.
- Milbert, Dennis G. and Donald G. Schultz, 1994, "Readme File," packaged with GEOID93 (a computer program), National Geodetic Information Center, Silver Spring, Maryland.
- NGS, 1986, Geodetic Glossary, National Geodetic Information Center, Silver Spring, Maryland.
- NGS, 1988, "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques," National Geodetic Information Center, Silver Spring, Maryland.
- NGS, 1994, "Standards for Geodetic Control Networks," National Geodetic Information Center, Silver Spring, Maryland.
- SEWRPC Technical Report No. 34, 1994, "A Mathematical Relationship Between NAD27 and NAD83 (91) State Plane Coordinates in Southeastern Wisconsin," Southeastern Wisconsin Regional Planning Commission, Waukesha, Wisconsin.
- SEWRPC Technical Report No. 7, 2nd Edition, 1990, "Horizontal and Vertical Survey Control in Southeastern Wisconsin," Southeastern Wisconsin Regional Planning Commission, Waukesha, Wisconsin.
- Wisconsin Administrative Code, 1986, "Wisconsin's Floodplain Management Program," Chapter NR 116, Register No. 362.
- Vanicek, P. & Edward Krakiwsky, 1986, Geodesy: The Concepts 2nd Ed., North Holland, Amsterdam, New York, Oxford, Tokyo.
- Zilkoski, D. B., J. H. Richards, & G. M. Young, 1992, "Results of the General Adjustment of the North American Datum of 1988," Surveying and Land Information Systems, Vol. 52, No. 3, pp 133-149.

Zilkoski, D. B., 1991, "North American Vertical Datum of 1988: Benefits of Improved Set of Heights Outweigh Conversion Costs," Proceedings of Fall GIS/LIS Conference, October 27 - November 1, 1991, Atlanta, Georgia.

Zilkoski, D. B., 1992, "North American Vertical Datum and International Great Lakes Datum: They Are Now One and the Same," Proceedings of the U. S. Hydrographic Conference, Baltimore, Maryland.

Appendix A
VERTCON DOCUMENTS

(This page intentionally left blank)

Appendix A-1

VERTCON Version 2.0

README file 18-aug-94 RJF/dgm

PURPOSE: Program VERTCON computes the modeled difference in orthometric height between the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29) for a given location specified by latitude and longitude.

A partial list of contents of the floppies are:

VERTCON.EXE	VERTical datum CONversion program (compiled from VERTCON.FOR, a FORTRAN source code)
VERTCONE.94	VERTCON datum transformation grid file; eastern USA (non-readable, i.e., binary, file)
VERTCONC.94	VERTCON datum transformation grid file; central USA (non-readable, i.e., binary, file)
VERTCONW.94	VERTCON datum transformation grid file; western USA (non-readable, i.e., binary, file)
README.TXT	User's instruction file

A number of sample output and batch files are included as examples, in addition to some utility routines described later in this document.

To install:

- 1) Make sure the original diskettes are write-protected!
- 2) Make a subdirectory on hard disk; for example: mkdir NGVDCONV
- 3) Go into subdirectory; for example: cd NGVDCONV
- 4) Copy the diskettes into the subdirectory; for example: copy B:*. *.* /v
- 5) Put the original diskettes in a safe place!

To execute:

Type VERTCON and follow the prompts.

To terminate:

VERTCON computations can be stopped at any time by the Control-C (i.e., <ctrl-c>) key combination. Interactive processing can also be terminated by entering 0. (i.e., zero WITH DECIMAL POINT)

BUT PLEASE DON'T START YET; KEEP READING THIS DOCUMENT.

How program VERTCON works:

The software and three files of datum transformation grids for the conterminous United States (CONUS) are provided on the diskettes. VERTCON returns the orthometric height difference between NAVD 88 and NGVD 29 at the geodetic position specified by the user. VERTCON interpolates the datum transformation at a point from the appropriate grid in your subdirectory.

Data Input:

The user can key in latitude and longitude on a point-by-point basis or can create an input file using a text editor. Several file formats are provided, including the internal bench mark file record format of the Vertical Network Branch, NGS. These formats are detailed in a "Help" menu option which appears when the input filename is specified.

Most horizontal positions of the bench marks used to generate VERTCON were scaled from USGS topographic maps. The estimated uncertainty of the scaled positions, 6", is greater than the differences between NAD 27 and NAD 83. Therefore, the latitude and longitude provided to VERTCON can be on either the NAD 27 or NAD 83 datum.

Data Output:

Results are collected into an output file. The default name of this file is VERTCON.OUT, but the user can choose any legal filename. (A word of advice: don't use misleading extensions such as .EXE, .BAT, etc.). The format of the output file is linked to the format of the input file to maintain consistency.

-----> THE SENSE OF THE SIGNS <-----

The grids contain a model of (NAVD 88 - NGVD 29) height differences.

If a NAVD 88 height is desired when a NGVD 29 height is given, ADD the model value ALGEBRAICALLY to the NGVD 29 height.

If a NGVD 29 height is desired when a NAVD 88 height is given, SUBTRACT the model value ALGEBRAICALLY from the NAVD 88 height.

The VERTCON 2.0 Model

The VERTCON 2.0 model was computed on May 5, 1994 using 381,833 datum difference values. A key part of the computation procedure was the development of the predictable, physical components of the differences between the NAVD 88 and NGVD 29 datums. This included models of refraction effects on geodetic leveling, and gravity and elevation influences on the new NAVD 88 datum. Tests of the predictive capability of the physical model show a 2.0 cm RMS agreement at our 381,833 data points. For this reason, the VERTCON 2.0 model can be considered accurate at the 2 cm(one sigma) level. Since 381,833 data values were used to develop the corrections to the physical model, VERTCON 2.0 will display even better overall accuracy than that displayed by the uncorrected physical model. This higher accuracy will be particularly noticeable in the eastern United States.

Using VERTCON 2.0

It should be emphasized that VERTCON 2.0 is a datum transformation model, and can not maintain the full vertical control accuracy of geodetic leveling. Ideally, one should process level data using the latest reduction software and adjust it to established NAVD 88 control. However, VERTCON 2.0 accuracy is suitable for a variety of mapping and charting purposes.

The VERTCON 2.0 model expresses datum differences between NAVD 88 and NGVD 29 due to removal of distortions in the level data, as well as due to the physical differences in the height systems. In some rare cases, these local NGVD 29 distortions could be 20 cm or more. If both ends of your old vertical survey were tied to one of these "problem" lines, then the datum difference of the problem line is appropriate to use to transform the survey data. If both ends of a vertical survey are tied to "undistorted lines", then it is appropriate to use a slightly distant point to compute the transformation, no matter how close your survey data may approach a given problem line. The possible presence of a problem NGVD 29 line in the vicinity of your survey will become evident if dramatically different datum transformation values are computed within a small area.

It must also be emphasized that VERTCON 2.0 is not to be considered reliable beyond the boundaries of the lower 48 United States. The VERTCON program will interpolate values in Canada, Mexico, or in the ocean, due to the grid structure of the model. Those values do not contain important model components present in the conterminous U.S. model. Future versions of VERTCON may be extended into neighboring countries.

The Defense Mapping Agency

The Defense Mapping Agency (DMA) has been of immense help in this endeavor. DMA has provided a major portion of the NGS land gravity data set. DMA has also been instrumental in the creation of the various 30" elevation grids in existence. Although the work of the DMA generally precludes public recognition, their cooperation in this work is gratefully acknowledged.

Other Programs:

The datum shift grids and VERTCON software are provided on standard disc operating system (DOS) controlled (IBM-compatible) personal computers (PC). In support of other computer systems, the following utility software is included:

CONVASCI—copy unformatted (binary) grid files into ASCII files for transfer to other systems

CONVBIN—will restore the ASCII files into binary grid files on the new system.

Other Future Plans:

A continuing development effort is underway to improve VERTCON results. NGVD 29 normal orthometric heights are being analyzed for localized monument and/or crustal motion effects, for inconsistent adjustments, and other effects. Computed height differences which are significantly influenced by such effects will be flagged and rated for reliability in future versions.

For More Information

For Products Available From the National Geodetic Survey:

National Geodetic Information Center
N/CG174, SSMC3-9450
National Geodetic Survey, NOAA
1315 East-West Highway
Silver Spring, MD 20910-3282
Telephone: 301-713-3242

For Information on VERTCON 2.0, and Future Research:

Dr. Dennis G. Milbert
NOAA, National Geodetic Survey, N/CG18
1315 East-West Hwy., SSMC3-8113
Silver Spring, MD 20910-3282
Telephone: 301-713-3202
Fax: 301-713-4322
Internet: dennis@ngs.noaa.gov

or

David B. Zilkoski
Vertical Network Branch
N/CG13, SSMC3-8752
Telephone: 301-713-3191
Fax: 301-713-4324

Appendix A-2

VERTCON Version 2.0 - Input Options

This is an example of the screen prompt when using keyboard input.

=====

INTERACTIVE PROCESSING

Station Name, Latitude and Longitude are entered -

[station name entry is not required; the position entries (i.e., latitude & longitude) are identified with generated sequence numbers when station name is not entered]

Latitudes and Longitudes may be entered in three formats:

- (1) degrees, minutes, and decimal seconds, OR
- (2) degrees, and decimal minutes OR
- (3) decimal degrees.

[decimal points must be entered !]

Degrees, minutes and seconds can be separated by either blanks or commas.

To terminate session:

- (1) key in 'n' or 'N' for 'another computation ?' prompt - or -
- (2) press <RETURN> for latitude or longitude prompt - or -
- (3) enter <ctrl-c>

This is example of VERTCON input Free Format #1.

=====

35-422	WI-101	1/0	42 48 51.0 087 54 52.0
52-06	WIHD	1/0	42 42 52.0 087 47 58.0
58-02	WI3100	1/0	42 56 40.0 087 54 34.0

(latitude values start in column 41)

This is example of VERTCON input Free Format #2.

=====

42 48 51.0 087 54 52.0	35-422	WI-101	1/0
42 42 52.0 087 47 58.0	52-06	WIHD	1/0
42 56 40.0 087 54 34.0	58-02	WI3100	1/0

(station name starts in column 41)

Note: As used in this example, the station name is 40 characters long and includes:

- Station designation (char 1-15)
- Monumenting agency (char 16-30)
- Order and class (char 31-40)

Appendix A-3

VERTCON Version 2.0 - Output Formats

This is example of VERTCON results using interactive input from keyboard.

```
=====
Station Name: 35-422      WI-101      1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 48 51.00000 87 54 52.00000  -0.062

Station Name: 52-06      WIHD      1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 42 52.00000 87 47 58.00000  -0.074

Station Name: 58-02      WI3100    1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 56 40.00000 87 54 34.00000  -0.083
```

This is example VERTCON output when using input Free Format #1.

```
=====
Station Name: 35-422      WI-101      1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 48 51.00000 87 54 52.00000  -0.062

Station Name: 52-06      WIHD      1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 42 52.00000 87 47 58.00000  -0.074

Station Name: 58-02      WI3100    1/0
Latitude      Longitude  NAVD 88 - NGVD 29 (meters)
42 56 40.00000 87 54 34.00000  -0.083
```

This is example VERTCON output when using input Free Format #2.

VERTCON Version 2.0

```
42 48 51.0 087 54 52.0      -0.062 35-422      WI-101      1/0
42 42 52.0 087 47 58.0      -0.074 52-06      WIHD      1/0
42 56 40.0 087 54 34.0      -0.083 58-02      WI3100    1/0
```

Note: As used in this example, the station name is 40 characters long & includes:

- Station designation (char 1-15)
- Monumenting agency (char 16-30)
- Order and class (char 31-40)

Appendix A-4

Development of Iso-Hypsometric Map of VERTCON Results for Southeastern Wisconsin

The program VERTCON was used to develop a map of iso-lines of predicted datum differences in the seven-county Southeastern Wisconsin region. The overall procedure was to use VERTCON to compute predicted datum differences on a 10,000 NAD 27 state plane coordinate foot grid spacing covering the entire Region. Using software utilities listed below and described in Appendix D, the VERTCON results were converted from meters to feet and plotted as contour lines superimposed upon an appropriate base map. Specific steps included:

- A program "GENFILE3" was used to develop a file of latitudes and longitudes for the grid intersection points. A grid spacing of 10,000 feet was chosen for a range of x values from 2,232,000 feet to 2,590,000 feet and y values from 180,000 feet to 580,000 feet. Other ranges and/or interval could have been chosen. The program "GENFILE3" assigns grid numbers to the intersections automatically. The grid intersection name and the state plane coordinates of each point are printed as a 40 character station name starting in column 41. The file is of the Free Format #2 as described in "Input Options."
- The program VERTCON was used to compute predicted datum differences at each grid intersection defined by latitude and longitude. VERTCON results are printed in columns 32 - 39 **in meters**.
- Another program "VERTFOOT" was used to convert the VERTCON results from meters to feet. The results of using all three programs are given in **feet** in the next section.
- A generic contouring program was used to develop the contour lines and superimpose them on a base map of the seven-county Region.

Appendix A-5

VERTCON RESULTS IN FOOT UNITS ON 10,000-FT. GRID

VERTCON Version 2.0 Results (Answer in feet)					
Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 29 15.42321	88 48 49.35827	-.171	E 1 - N 1	2320000.000	180000.000
42 30 54.18943	88 48 47.45896	-.177	E 1 - N 2	2320000.000	190000.000
42 32 32.95589	88 48 45.55796	-.187	E 1 - N 3	2320000.000	200000.000
42 34 11.72256	88 48 43.65526	-.197	E 1 - N 4	2320000.000	210000.000
42 35 50.48942	88 48 41.75087	-.203	E 1 - N 5	2320000.000	220000.000
42 37 29.25644	88 48 39.84478	-.207	E 1 - N 6	2320000.000	230000.000
42 39 8.02362	88 48 37.93699	-.203	E 1 - N 7	2320000.000	240000.000
42 40 46.79091	88 48 36.02750	-.203	E 1 - N 8	2320000.000	250000.000
42 42 25.55831	88 48 34.11631	-.200	E 1 - N 9	2320000.000	260000.000
42 44 4.32578	88 48 32.20341	-.203	E 1 - N10	2320000.000	270000.000
42 45 43.09331	88 48 30.28880	-.207	E 1 - N11	2320000.000	280000.000
42 47 21.86088	88 48 28.37249	-.210	E 1 - N12	2320000.000	290000.000
42 49 6.2845	88 48 26.45446	-.210	E 1 - N13	2320000.000	300000.000
42 50 39.39602	88 48 24.53471	-.210	E 1 - N14	2320000.000	310000.000
42 52 18.16355	88 48 22.61325	-.217	E 1 - N15	2320000.000	320000.000
42 53 56.93102	88 48 20.69007	-.220	E 1 - N16	2320000.000	330000.000
42 55 35.69842	88 48 18.76516	-.220	E 1 - N17	2320000.000	340000.000
42 57 14.46571	88 48 16.83853	-.220	E 1 - N18	2320000.000	350000.000
42 58 53.23289	88 48 14.91018	-.217	E 1 - N19	2320000.000	360000.000
43 0 31.99991	88 48 12.98010	-.213	E 1 - N20	2320000.000	370000.000
43 2 10.76677	88 48 11.04828	-.213	E 1 - N21	2320000.000	380000.000
43 3 49.53344	88 48 9.11473	-.210	E 1 - N22	2320000.000	390000.000
43 5 28.29990	88 48 7.17945	-.210	E 1 - N23	2320000.000	400000.000
43 7 7.06612	88 48 5.24242	-.207	E 1 - N24	2320000.000	410000.000
43 8 45.83208	88 48 3.30366	-.203	E 1 - N25	2320000.000	420000.000
43 10 24.59776	88 48 1.36315	-.200	E 1 - N26	2320000.000	430000.000
43 12 3.36314	88 47 59.42090	-.200	E 1 - N27	2320000.000	440000.000
43 13 42.12820	88 47 57.47690	-.200	E 1 - N28	2320000.000	450000.000
43 15 20.89290	88 47 55.53115	-.200	E 1 - N29	2320000.000	460000.000
43 16 59.65724	88 47 53.58365	-.200	E 1 - N30	2320000.000	470000.000
43 18 38.42118	88 47 51.63439	-.194	E 1 - N31	2320000.000	480000.000
43 20 17.18470	88 47 49.68338	-.187	E 1 - N32	2320000.000	490000.000
43 21 55.94779	88 47 47.73061	-.177	E 1 - N33	2320000.000	500000.000
43 23 34.71042	88 47 45.77607	-.171	E 1 - N34	2320000.000	510000.000
43 25 13.47256	88 47 43.81977	-.167	E 1 - N35	2320000.000	520000.000
43 26 52.23420	88 47 41.86171	-.164	E 1 - N36	2320000.000	530000.000
43 28 30.99531	88 47 39.90187	-.151	E 1 - N37	2320000.000	540000.000
43 30 9.75587	88 47 37.94026	-.138	E 1 - N38	2320000.000	550000.000
43 31 48.51585	88 47 35.97688	-.135	E 1 - N39	2320000.000	560000.000
43 33 27.27524	88 47 34.01173	-.131	E 1 - N40	2320000.000	570000.000
43 35 6.03401	88 47 32.04479	-.128	E 1 - N41	2320000.000	580000.000
42 29 13.99609	88 46 35.91958	-.177	E 2 - N 1	2330000.000	180000.000
42 30 52.76168	88 46 33.96094	-.184	E 2 - N 2	2330000.000	190000.000
42 32 31.52750	88 46 32.00055	-.194	E 2 - N 3	2330000.000	200000.000
42 34 10.29353	88 46 30.03842	-.207	E 2 - N 4	2330000.000	210000.000
42 35 49.05975	88 46 28.07454	-.217	E 2 - N 5	2330000.000	220000.000
42 37 27.82614	88 46 26.10891	-.213	E 2 - N 6	2330000.000	230000.000
42 39 6.59267	88 46 24.14153	-.210	E 2 - N 7	2330000.000	240000.000
42 40 45.35932	88 46 22.17240	-.207	E 2 - N 8	2330000.000	250000.000
42 42 24.12608	88 46 20.20150	-.203	E 2 - N 9	2330000.000	260000.000
42 44 2.89291	88 46 18.22885	-.203	E 2 - N10	2330000.000	270000.000
42 45 41.65980	88 46 16.25444	-.207	E 2 - N11	2330000.000	280000.000
42 47 20.42673	88 46 14.27826	-.213	E 2 - N12	2330000.000	290000.000
42 48 59.19366	88 46 12.30032	-.217	E 2 - N13	2330000.000	300000.000
42 50 37.96058	88 46 10.32061	-.220	E 2 - N14	2330000.000	310000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 52 16.72747	88 46 8.33913	-.223	E 2 - N15	2330000.000	320000.000
42 53 55.49431	88 46 .35587	-.226	E 2 - N16	2330000.000	330000.000
42 55 34.26106	88 46 4.37084	-.223	E 2 - N17	2330000.000	340000.000
42 57 13.02771	88 46 2.38403	-.217	E 2 - N18	2330000.000	350000.000
42 58 51.79424	88 46 .39544	-.217	E 2 - N19	2330000.000	360000.000
43 0 30.56063	88 45 58.40507	-.213	E 2 - N20	2330000.000	370000.000
43 2 9.32684	88 45 56.41291	-.213	E 2 - N21	2330000.000	380000.000
43 3 48.09287	88 45 54.41896	-.210	E 2 - N22	2330000.000	390000.000
43 5 26.85868	88 45 52.42323	-.207	E 2 - N23	2330000.000	400000.000
43 7 5.62426	88 45 50.42570	-.207	E 2 - N24	2330000.000	410000.000
43 8 44.38958	88 45 48.42637	-.207	E 2 - N25	2330000.000	420000.000
43 10 23.15462	88 45 46.42525	-.203	E 2 - N26	2330000.000	430000.000
43 12 1.91935	88 45 44.42233	-.200	E 2 - N27	2330000.000	440000.000
43 13 40.68376	88 45 42.41761	-.197	E 2 - N28	2330000.000	450000.000
43 15 19.44782	88 45 40.41108	-.194	E 2 - N29	2330000.000	460000.000
43 16 58.21151	88 45 38.40275	-.187	E 2 - N30	2330000.000	470000.000
43 18 36.97480	88 45 36.39260	-.184	E 2 - N31	2330000.000	480000.000
43 20 15.73769	88 45 34.38065	-.177	E 2 - N32	2330000.000	490000.000
43 21 54.50013	88 45 32.36687	-.171	E 2 - N33	2330000.000	500000.000
43 23 33.26211	88 45 30.35129	-.164	E 2 - N34	2330000.000	510000.000
43 25 12.02361	88 45 28.33388	-.157	E 2 - N35	2330000.000	520000.000
43 26 50.78460	88 45 26.31465	-.154	E 2 - N36	2330000.000	530000.000
43 28 29.54506	88 45 24.29360	-.148	E 2 - N37	2330000.000	540000.000
43 30 8.30497	88 45 22.27072	-.138	E 2 - N38	2330000.000	550000.000
43 31 47.06431	88 45 20.24601	-.138	E 2 - N39	2330000.000	560000.000
43 33 25.82305	88 45 18.21947	-.138	E 2 - N40	2330000.000	570000.000
43 35 4.58117	88 45 16.19109	-.131	E 2 - N41	2330000.000	580000.000
42 29 12.52508	88 44 22.48262	-.177	E 3 - N 1	2340000.000	180000.000
42 30 51.29000	88 44 20.46466	-.184	E 3 - N 2	2340000.000	190000.000
42 32 30.05516	88 44 18.44489	-.194	E 3 - N 3	2340000.000	200000.000
42 34 8.82054	88 44 16.42333	-.203	E 3 - N 4	2340000.000	210000.000
42 35 47.58610	88 44 14.39996	-.217	E 3 - N 5	2340000.000	220000.000
42 37 26.35183	88 44 12.37480	-.213	E 3 - N 6	2340000.000	230000.000
42 39 5.11770	88 44 10.34783	-.210	E 3 - N 7	2340000.000	240000.000
42 40 43.88369	88 44 8.31905	-.207	E 3 - N 8	2340000.000	250000.000
42 42 22.64979	88 44 6.28846	-.203	E 3 - N 9	2340000.000	260000.000
42 44 1.41596	88 44 4.25606	-.207	E 3 - N10	2340000.000	270000.000
42 45 40.18219	88 44 2.22184	-.210	E 3 - N11	2340000.000	280000.000
42 47 18.94846	88 44 .18581	-.220	E 3 - N12	2340000.000	290000.000
42 48 57.71473	88 43 58.14796	-.223	E 3 - N13	2340000.000	300000.000
42 50 36.48099	88 43 56.10828	-.226	E 3 - N14	2340000.000	310000.000
42 52 15.24722	88 43 54.06678	-.226	E 3 - N15	2340000.000	320000.000
42 53 54.01339	88 43 52.02345	-.230	E 3 - N16	2340000.000	330000.000
42 55 32.77949	88 43 49.97830	-.223	E 3 - N17	2340000.000	340000.000
42 57 11.54548	88 43 47.93131	-.220	E 3 - N18	2340000.000	350000.000
42 58 50.31134	88 43 45.88249	-.217	E 3 - N19	2340000.000	360000.000
43 0 29.07707	88 43 43.83183	-.213	E 3 - N20	2340000.000	370000.000
43 2 7.84262	88 43 41.77933	-.213	E 3 - N21	2340000.000	380000.000
43 3 46.60798	88 43 39.72499	-.210	E 3 - N22	2340000.000	390000.000
43 5 25.37313	88 43 37.66880	-.207	E 3 - N23	2340000.000	400000.000
43 7 4.13804	88 43 35.61077	-.203	E 3 - N24	2340000.000	410000.000
43 8 42.90270	88 43 33.55089	-.203	E 3 - N25	2340000.000	420000.000
43 10 21.66707	88 43 31.48915	-.203	E 3 - N26	2340000.000	430000.000
43 12 .43114	88 43 29.42557	-.200	E 3 - N27	2340000.000	440000.000
43 13 39.19489	88 43 27.36012	-.197	E 3 - N28	2340000.000	450000.000
43 15 17.95828	88 43 25.29282	-.190	E 3 - N29	2340000.000	460000.000
43 16 56.72131	88 43 23.22365	-.184	E 3 - N30	2340000.000	470000.000
43 18 35.48394	88 43 21.15262	-.177	E 3 - N31	2340000.000	480000.000
43 20 14.24615	88 43 19.07973	-.174	E 3 - N32	2340000.000	490000.000
43 21 53.00793	88 43 17.00496	-.167	E 3 - N33	2340000.000	500000.000
43 23 31.76924	88 43 14.92832	-.157	E 3 - N34	2340000.000	510000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 25 10.53007	88 43 12.84981	-.154	E 3 - N35	2340000.000	520000.000
43 26 49.29040	88 43 10.76942	-.154	E 3 - N36	2340000.000	530000.000
43 28 28.05019	88 43 8.68715	-.151	E 3 - N37	2340000.000	540000.000
43 30 6.80944	88 43 6.60300	-.144	E 3 - N38	2340000.000	550000.000
43 31 45.56811	88 43 4.51696	-.144	E 3 - N39	2340000.000	560000.000
43 33 24.32618	88 43 2.42904	-.141	E 3 - N40	2340000.000	570000.000
43 35 3.08363	88 43 .33923	-.138	E 3 - N41	2340000.000	580000.000
42 29 11.01016	88 42 9.04746	-.177	E 4 - N 1	2350000.000	180000.000
42 30 49.77441	88 42 6.97017	-.177	E 4 - N 2	2350000.000	190000.000
42 32 28.53889	88 42 4.89103	-.184	E 4 - N 3	2350000.000	200000.000
42 34 7.30358	88 42 2.81004	-.187	E 4 - N 4	2350000.000	210000.000
42 35 46.06847	88 42 .72719	-.194	E 4 - N 5	2350000.000	220000.000
42 37 24.83352	88 41 58.64249	-.200	E 4 - N 6	2350000.000	230000.000
42 39 3.59871	88 41 56.55593	-.207	E 4 - N 7	2350000.000	240000.000
42 40 42.36403	88 41 54.46751	-.207	E 4 - N 8	2350000.000	250000.000
42 42 21.12944	88 41 52.37723	-.207	E 4 - N 9	2350000.000	260000.000
42 43 59.89494	88 41 50.28508	-.207	E 4 - N10	2350000.000	270000.000
42 45 38.66049	88 41 48.19106	-.210	E 4 - N11	2350000.000	280000.000
42 47 17.42607	88 41 46.09517	-.220	E 4 - N12	2350000.000	290000.000
42 48 56.19166	88 41 43.99741	-.223	E 4 - N13	2350000.000	300000.000
42 50 34.95725	88 41 41.89778	-.226	E 4 - N14	2350000.000	310000.000
42 52 13.72279	88 41 39.79626	-.230	E 4 - N15	2350000.000	320000.000
42 53 52.48828	88 41 37.69286	-.233	E 4 - N16	2350000.000	330000.000
42 55 31.25369	88 41 35.58759	-.230	E 4 - N17	2350000.000	340000.000
42 57 10.01900	88 41 33.48042	-.223	E 4 - N18	2350000.000	350000.000
42 58 48.78419	88 41 31.37137	-.220	E 4 - N19	2350000.000	360000.000
43 0 27.54923	88 41 29.26042	-.217	E 4 - N20	2350000.000	370000.000
43 2 6.31410	88 41 27.14759	-.213	E 4 - N21	2350000.000	380000.000
43 3 45.07878	88 41 25.03285	-.210	E 4 - N22	2350000.000	390000.000
43 5 23.84325	88 41 22.91622	-.207	E 4 - N23	2350000.000	400000.000
43 7 2.60748	88 41 20.79769	-.203	E 4 - N24	2350000.000	410000.000
43 8 41.37145	88 41 18.67725	-.203	E 4 - N25	2350000.000	420000.000
43 10 20.13514	88 41 16.55491	-.200	E 4 - N26	2350000.000	430000.000
43 11 58.89852	88 41 14.43066	-.200	E 4 - N27	2350000.000	440000.000
43 13 37.66158	88 41 12.30449	-.190	E 4 - N28	2350000.000	450000.000
43 15 16.42429	88 41 10.17642	-.187	E 4 - N29	2350000.000	460000.000
43 16 55.18663	88 41 8.04642	-.180	E 4 - N30	2350000.000	470000.000
43 18 33.94858	88 41 5.91451	-.177	E 4 - N31	2350000.000	480000.000
43 20 12.71011	88 41 3.78068	-.174	E 4 - N32	2350000.000	490000.000
43 21 51.47120	88 41 1.64492	-.171	E 4 - N33	2350000.000	500000.000
43 23 30.23183	88 40 59.50723	-.161	E 4 - N34	2350000.000	510000.000
43 25 8.99197	88 40 57.36762	-.161	E 4 - N35	2350000.000	520000.000
43 26 47.75161	88 40 55.22607	-.161	E 4 - N36	2350000.000	530000.000
43 28 26.51072	88 40 53.08259	-.157	E 4 - N37	2350000.000	540000.000
43 30 5.26927	88 40 50.93717	-.154	E 4 - N38	2350000.000	550000.000
43 31 44.02725	88 40 48.78981	-.151	E 4 - N39	2350000.000	560000.000
43 33 22.78464	88 40 46.64051	-.148	E 4 - N40	2350000.000	570000.000
43 35 1.54140	88 40 44.48926	-.144	E 4 - N41	2350000.000	580000.000
42 29 9.45134	88 39 55.61415	-.184	E 5 - N 1	2360000.000	180000.000
42 30 48.21489	88 39 53.47753	-.177	E 5 - N 2	2360000.000	190000.000
42 32 26.97868	88 39 51.33902	-.174	E 5 - N 3	2360000.000	200000.000
42 34 5.74267	88 39 49.19860	-.177	E 5 - N 4	2360000.000	210000.000
42 35 44.50686	88 39 47.05627	-.187	E 5 - N 5	2360000.000	220000.000
42 37 23.27121	88 39 44.91204	-.197	E 5 - N 6	2360000.000	230000.000
42 39 2.03571	88 39 42.76589	-.207	E 5 - N 7	2360000.000	240000.000
42 40 40.80032	88 39 40.61784	-.207	E 5 - N 8	2360000.000	250000.000
42 42 19.56504	88 39 38.46786	-.207	E 5 - N 9	2360000.000	260000.000
42 43 58.32984	88 39 36.31597	-.207	E 5 - N10	2360000.000	270000.000
42 45 37.09469	88 39 34.16215	-.207	E 5 - N11	2360000.000	280000.000
42 47 15.85957	88 39 32.00641	-.210	E 5 - N12	2360000.000	290000.000
42 48 54.62446	88 39 29.84874	-.217	E 5 - N13	2360000.000	300000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 50 33.38934	88 39 27.68915	-.230	E 5 - N14	2360000.000	310000.000
42 52 12.15419	88 39 25.52762	-.236	E 5 - N15	2360000.000	320000.000
42 53 50.91898	88 39 23.36416	-.240	E 5 - N16	2360000.000	330000.000
42 55 29.68369	88 39 21.19876	-.230	E 5 - N17	2360000.000	340000.000
42 57 8.44830	88 39 19.03142	-.223	E 5 - N18	2360000.000	350000.000
42 58 47.21278	88 39 16.86214	-.223	E 5 - N19	2360000.000	360000.000
43 0 25.97712	88 39 14.69091	-.220	E 5 - N20	2360000.000	370000.000
43 2 4.74129	88 39 12.51774	-.213	E 5 - N21	2360000.000	380000.000
43 3 43.50526	88 39 10.34262	-.210	E 5 - N22	2360000.000	390000.000
43 5 22.26903	88 39 8.16554	-.207	E 5 - N23	2360000.000	400000.000
43 7 1.03255	88 39 5.98651	-.207	E 5 - N24	2360000.000	410000.000
43 8 39.79582	88 39 3.80552	-.207	E 5 - N25	2360000.000	420000.000
43 10 18.55881	88 39 1.62257	-.203	E 5 - N26	2360000.000	430000.000
43 11 57.32149	88 38 59.43766	-.194	E 5 - N27	2360000.000	440000.000
43 13 36.08384	88 38 57.25078	-.187	E 5 - N28	2360000.000	450000.000
43 15 14.84585	88 38 55.06193	-.180	E 5 - N29	2360000.000	460000.000
43 16 53.60748	88 38 52.87111	-.180	E 5 - N30	2360000.000	470000.000
43 18 32.36873	88 38 50.67832	-.180	E 5 - N31	2360000.000	480000.000
43 20 11.12955	88 38 48.48355	-.180	E 5 - N32	2360000.000	490000.000
43 21 49.88993	88 38 46.28680	-.180	E 5 - N33	2360000.000	500000.000
43 23 28.64986	88 38 44.08807	-.174	E 5 - N34	2360000.000	510000.000
43 25 7.40929	88 38 41.88735	-.171	E 5 - N35	2360000.000	520000.000
43 26 46.16823	88 38 39.68465	-.171	E 5 - N36	2360000.000	530000.000
43 28 24.92663	88 38 37.47996	-.167	E 5 - N37	2360000.000	540000.000
43 30 3.68448	88 38 35.27328	-.161	E 5 - N38	2360000.000	550000.000
43 31 42.44175	88 38 33.06459	-.157	E 5 - N39	2360000.000	560000.000
43 33 21.19843	88 38 30.85392	-.151	E 5 - N40	2360000.000	570000.000
43 34 59.95449	88 38 28.64124	-.148	E 5 - N41	2360000.000	580000.000
42 29 7.84863	88 37 42.18273	-.184	E 6 - N 1	2370000.000	180000.000
42 30 46.61146	88 37 39.98680	-.180	E 6 - N 2	2370000.000	190000.000
42 32 25.37453	88 37 37.78891	-.177	E 6 - N 3	2370000.000	200000.000
42 34 4.13781	88 37 35.58907	-.180	E 6 - N 4	2370000.000	210000.000
42 35 42.90127	88 37 33.38726	-.190	E 6 - N 5	2370000.000	220000.000
42 37 21.66491	88 37 31.18350	-.197	E 6 - N 6	2370000.000	230000.000
42 39 4.2868	88 37 28.97777	-.207	E 6 - N 7	2370000.000	240000.000
42 40 39.19258	88 37 26.77008	-.203	E 6 - N 8	2370000.000	250000.000
42 42 17.95658	88 37 24.56041	-.203	E 6 - N 9	2370000.000	260000.000
42 43 56.72066	88 37 22.34878	-.207	E 6 - N10	2370000.000	270000.000
42 45 35.48479	88 37 20.13516	-.210	E 6 - N11	2370000.000	280000.000
42 47 14.24895	88 37 17.91957	-.210	E 6 - N12	2370000.000	290000.000
42 48 53.01312	88 37 15.70200	-.217	E 6 - N13	2370000.000	300000.000
42 50 31.77729	88 37 13.48245	-.223	E 6 - N14	2370000.000	310000.000
42 52 10.54141	88 37 11.26092	-.230	E 6 - N15	2370000.000	320000.000
42 53 49.30548	88 37 9.03739	-.236	E 6 - N16	2370000.000	330000.000
42 55 28.06947	88 37 6.81187	-.233	E 6 - N17	2370000.000	340000.000
42 57 6.83336	88 37 4.58436	-.226	E 6 - N18	2370000.000	350000.000
42 58 45.59712	88 37 2.35486	-.226	E 6 - N19	2370000.000	360000.000
43 0 24.36073	88 37 1.12335	-.223	E 6 - N20	2370000.000	370000.000
43 2 3.12418	88 36 57.88985	-.217	E 6 - N21	2370000.000	380000.000
43 3 41.88743	88 36 55.65434	-.213	E 6 - N22	2370000.000	390000.000
43 5 20.65047	88 36 53.41682	-.213	E 6 - N23	2370000.000	400000.000
43 6 59.41328	88 36 51.17729	-.213	E 6 - N24	2370000.000	410000.000
43 8 38.17582	88 36 48.93575	-.213	E 6 - N25	2370000.000	420000.000
43 10 16.93808	88 36 46.69220	-.207	E 6 - N26	2370000.000	430000.000
43 11 55.70004	88 36 44.44662	-.203	E 6 - N27	2370000.000	440000.000
43 13 34.46167	88 36 42.19903	-.200	E 6 - N28	2370000.000	450000.000
43 15 13.22296	88 36 39.94942	-.197	E 6 - N29	2370000.000	460000.000
43 16 51.98387	88 36 37.69777	-.197	E 6 - N30	2370000.000	470000.000
43 18 30.74438	88 36 35.44410	-.197	E 6 - N31	2370000.000	480000.000
43 20 9.50448	88 36 33.18840	-.197	E 6 - N32	2370000.000	490000.000
43 21 48.26414	88 36 30.93067	-.194	E 6 - N33	2370000.000	500000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 23 27.02334	88 36 28.67089	-.187	E 6 - N34	2370000.000	510000.000
43 25 5.78205	88 36 26.40908	-.180	E 6 - N35	2370000.000	520000.000
43 26 44.54025	88 36 24.14523	-.171	E 6 - N36	2370000.000	530000.000
43 28 23.29793	88 36 21.87933	-.167	E 6 - N37	2370000.000	540000.000
43 30 2.05505	88 36 19.61138	-.161	E 6 - N38	2370000.000	550000.000
43 31 40.81160	88 36 17.34138	-.157	E 6 - N39	2370000.000	560000.000
43 33 19.56755	88 36 15.06933	-.151	E 6 - N40	2370000.000	570000.000
43 34 58.32288	88 36 12.79522	-.135	E 6 - N41	2370000.000	580000.000
42 29 6.20201	88 35 28.75326	-.184	E 7 - N 1	2380000.000	180000.000
42 30 44.96411	88 35 26.49801	-.184	E 7 - N 2	2380000.000	190000.000
42 32 23.72644	88 35 24.24076	-.187	E 7 - N 3	2380000.000	200000.000
42 34 2.48898	88 35 21.98149	-.190	E 7 - N 4	2380000.000	210000.000
42 35 41.25171	88 35 19.72022	-.197	E 7 - N 5	2380000.000	220000.000
42 37 20.01461	88 35 17.45693	-.200	E 7 - N 6	2380000.000	230000.000
42 38 58.77765	88 35 15.19162	-.203	E 7 - N 7	2380000.000	240000.000
42 40 37.54081	88 35 12.92429	-.200	E 7 - N 8	2380000.000	250000.000
42 42 16.30407	88 35 10.65494	-.203	E 7 - N 9	2380000.000	260000.000
42 43 55.06740	88 35 8.38356	-.207	E 7 - N10	2380000.000	270000.000
42 45 33.83080	88 35 6.11015	-.213	E 7 - N11	2380000.000	280000.000
42 47 12.59422	88 35 3.83472	-.213	E 7 - N12	2380000.000	290000.000
42 48 51.35765	88 35 1.55725	-.213	E 7 - N13	2380000.000	300000.000
42 50 30.12107	88 34 59.27774	-.220	E 7 - N14	2380000.000	310000.000
42 52 8.88446	88 34 56.99620	-.226	E 7 - N15	2380000.000	320000.000
42 53 47.64779	88 34 54.71261	-.233	E 7 - N16	2380000.000	330000.000
42 55 26.41104	88 34 52.42698	-.230	E 7 - N17	2380000.000	340000.000
42 57 5.17418	88 34 50.13930	-.226	E 7 - N18	2380000.000	350000.000
42 58 43.93720	88 34 47.84957	-.226	E 7 - N19	2380000.000	360000.000
43 0 22.70008	88 34 45.55779	-.223	E 7 - N20	2380000.000	370000.000
43 2 1.46278	88 34 43.26395	-.220	E 7 - N21	2380000.000	380000.000
43 3 40.22529	88 34 40.96806	-.217	E 7 - N22	2380000.000	390000.000
43 5 18.98759	88 34 38.67010	-.217	E 7 - N23	2380000.000	400000.000
43 6 57.74965	88 34 36.37008	-.213	E 7 - N24	2380000.000	410000.000
43 8 36.51145	88 34 34.06800	-.213	E 7 - N25	2380000.000	420000.000
43 10 15.27297	88 34 31.76384	-.210	E 7 - N26	2380000.000	430000.000
43 11 54.03419	88 34 29.45761	-.210	E 7 - N27	2380000.000	440000.000
43 13 32.79507	88 34 27.14931	-.207	E 7 - N28	2380000.000	450000.000
43 15 11.55561	88 34 24.83893	-.207	E 7 - N29	2380000.000	460000.000
43 16 50.31578	88 34 22.52647	-.207	E 7 - N30	2380000.000	470000.000
43 18 29.07555	88 34 20.21192	-.207	E 7 - N31	2380000.000	480000.000
43 20 7.83490	88 34 17.89529	-.207	E 7 - N32	2380000.000	490000.000
43 21 46.59382	88 34 15.57657	-.200	E 7 - N33	2380000.000	500000.000
43 23 25.35227	88 34 13.25576	-.194	E 7 - N34	2380000.000	510000.000
43 25 4.11023	88 34 10.93285	-.180	E 7 - N35	2380000.000	520000.000
43 26 42.86769	88 34 8.60785	-.164	E 7 - N36	2380000.000	530000.000
43 28 21.62462	88 34 6.28074	-.161	E 7 - N37	2380000.000	540000.000
43 30 38.100	88 34 3.95153	-.157	E 7 - N38	2380000.000	550000.000
43 31 39.13680	88 34 1.62022	-.151	E 7 - N39	2380000.000	560000.000
43 33 17.89200	88 33 59.28679	-.141	E 7 - N40	2380000.000	570000.000
43 34 56.64658	88 33 56.95126	-.125	E 7 - N41	2380000.000	580000.000
42 29 4.51150	88 33 15.32580	-.180	E 8 - N 1	2390000.000	180000.000
42 30 43.27284	88 33 13.01124	-.187	E 8 - N 2	2390000.000	190000.000
42 32 22.03442	88 33 10.69462	-.203	E 8 - N 3	2390000.000	200000.000
42 34 7.79620	88 33 8.37593	-.207	E 8 - N 4	2390000.000	210000.000
42 35 39.55817	88 33 6.05518	-.200	E 8 - N 5	2390000.000	220000.000
42 37 18.32031	88 33 3.73237	-.200	E 8 - N 6	2390000.000	230000.000
42 38 57.08259	88 33 1.40748	-.203	E 8 - N 7	2390000.000	240000.000
42 40 35.84500	88 32 59.08052	-.203	E 8 - N 8	2390000.000	250000.000
42 42 14.60750	88 32 56.75149	-.203	E 8 - N 9	2390000.000	260000.000
42 43 53.37008	88 32 54.42037	-.210	E 8 - N10	2390000.000	270000.000
42 45 32.13271	88 32 52.08718	-.213	E 8 - N11	2390000.000	280000.000
42 47 10.89538	88 32 49.75190	-.217	E 8 - N12	2390000.000	290000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 48 49.65805	88 32 47.41453	-.217	E 8 - N13	2390000.000	300000.000
42 50 28.42071	88 32 45.07507	-.213	E 8 - N14	2390000.000	310000.000
42 52 7.18334	88 32 42.73352	-.220	E 8 - N15	2390000.000	320000.000
42 53 45.94590	88 32 40.38988	-.230	E 8 - N16	2390000.000	330000.000
42 55 24.70839	88 32 38.04413	-.226	E 8 - N17	2390000.000	340000.000
42 57 3.47078	88 32 35.69629	-.223	E 8 - N18	2390000.000	350000.000
42 58 42.23304	88 32 33.34634	-.226	E 8 - N19	2390000.000	360000.000
43 0 20.99515	88 32 30.99429	-.226	E 8 - N20	2390000.000	370000.000
43 1 59.75709	88 32 28.64012	-.223	E 8 - N21	2390000.000	380000.000
43 3 38.51884	88 32 26.28385	-.217	E 8 - N22	2390000.000	390000.000
43 5 17.28038	88 32 23.92545	-.217	E 8 - N23	2390000.000	400000.000
43 6 56.04168	88 32 21.56494	-.213	E 8 - N24	2390000.000	410000.000
43 8 34.80271	88 32 19.20231	-.213	E 8 - N25	2390000.000	420000.000
43 10 13.56347	88 32 16.83756	-.210	E 8 - N26	2390000.000	430000.000
43 11 52.32392	88 32 14.47068	-.210	E 8 - N27	2390000.000	440000.000
43 13 31.08404	88 32 12.10166	-.207	E 8 - N28	2390000.000	450000.000
43 15 9.84382	88 32 9.73052	-.207	E 8 - N29	2390000.000	460000.000
43 16 48.60322	88 32 7.35724	-.210	E 8 - N30	2390000.000	470000.000
43 18 27.36223	88 32 4.98182	-.210	E 8 - N31	2390000.000	480000.000
43 20 6.12081	88 32 2.60427	-.203	E 8 - N32	2390000.000	490000.000
43 21 44.87896	88 32 .22456	-.197	E 8 - N33	2390000.000	500000.000
43 23 23.63665	88 31 57.84271	-.184	E 8 - N34	2390000.000	510000.000
43 25 2.39385	88 31 55.45872	-.171	E 8 - N35	2390000.000	520000.000
43 26 41.15054	88 31 53.07256	-.154	E 8 - N36	2390000.000	530000.000
43 28 19.90670	88 31 50.68426	-.154	E 8 - N37	2390000.000	540000.000
43 29 58.66231	88 31 48.29379	-.157	E 8 - N38	2390000.000	550000.000
43 31 37.41735	88 31 45.90116	-.148	E 8 - N39	2390000.000	560000.000
43 33 16.17178	88 31 43.50637	-.138	E 8 - N40	2390000.000	570000.000
43 34 54.92559	88 31 41.10941	-.125	E 8 - N41	2390000.000	580000.000
42 29 2.77709	88 31 1.90040	-.190	E 9 - N 1	2400000.000	180000.000
42 30 41.53766	88 30 59.52652	-.197	E 9 - N 2	2400000.000	190000.000
42 32 20.29846	88 30 57.15054	-.207	E 9 - N 3	2400000.000	200000.000
42 33 59.05946	88 30 54.77244	-.210	E 9 - N 4	2400000.000	210000.000
42 35 37.82066	88 30 52.39222	-.210	E 9 - N 5	2400000.000	220000.000
42 37 16.58202	88 30 50.00988	-.203	E 9 - N 6	2400000.000	230000.000
42 38 55.34353	88 30 47.62542	-.200	E 9 - N 7	2400000.000	240000.000
42 40 34.10515	88 30 45.23883	-.200	E 9 - N 8	2400000.000	250000.000
42 42 12.86688	88 30 42.85011	-.200	E 9 - N 9	2400000.000	260000.000
42 43 51.62868	88 30 40.45927	-.207	E 9 - N10	2400000.000	270000.000
42 45 30.39053	88 30 38.06628	-.213	E 9 - N11	2400000.000	280000.000
42 47 9.15242	88 30 35.67116	-.220	E 9 - N12	2400000.000	290000.000
42 48 47.91431	88 30 33.27390	-.220	E 9 - N13	2400000.000	300000.000
42 50 26.67619	88 30 30.87449	-.217	E 9 - N14	2400000.000	310000.000
42 52 5.43804	88 30 28.47294	-.220	E 9 - N15	2400000.000	320000.000
42 53 44.19983	88 30 26.06924	-.223	E 9 - N16	2400000.000	330000.000
42 55 22.96154	88 30 23.66339	-.226	E 9 - N17	2400000.000	340000.000
42 57 1.72314	88 30 21.25538	-.230	E 9 - N18	2400000.000	350000.000
42 58 40.48462	88 30 18.84522	-.230	E 9 - N19	2400000.000	360000.000
43 0 19.24595	88 30 16.43289	-.230	E 9 - N20	2400000.000	370000.000
43 1 58.00711	88 30 14.01840	-.226	E 9 - N21	2400000.000	380000.000
43 3 36.76808	88 30 11.60175	-.220	E 9 - N22	2400000.000	390000.000
43 5 15.52883	88 30 9.18292	-.217	E 9 - N23	2400000.000	400000.000
43 6 54.28935	88 30 6.76192	-.213	E 9 - N24	2400000.000	410000.000
43 8 33.04961	88 30 4.33875	-.213	E 9 - N25	2400000.000	420000.000
43 10 11.80958	88 30 1.91340	-.207	E 9 - N26	2400000.000	430000.000
43 11 50.56925	88 29 59.48587	-.203	E 9 - N27	2400000.000	440000.000
43 13 29.32859	88 29 57.05615	-.200	E 9 - N28	2400000.000	450000.000
43 15 8.08758	88 29 54.62425	-.200	E 9 - N29	2400000.000	460000.000
43 16 46.84619	88 29 52.19015	-.203	E 9 - N30	2400000.000	470000.000
43 18 25.60442	88 29 49.75387	-.200	E 9 - N31	2400000.000	480000.000
43 20 4.36222	88 29 47.31539	-.190	E 9 - N32	2400000.000	490000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 21 43.11958	88 29 44.87471	-.177	E 9 - N33	2400000.000	500000.000
43 23 21.87648	88 29 42.43182	-.164	E 9 - N34	2400000.000	510000.000
43 25 63.290	88 29 39.98673	-.154	E 9 - N35	2400000.000	520000.000
43 26 39.38880	88 29 37.53944	-.144	E 9 - N36	2400000.000	530000.000
43 28 18.14418	88 29 35.08993	-.151	E 9 - N37	2400000.000	540000.000
43 29 56.89900	88 29 32.63821	-.157	E 9 - N38	2400000.000	550000.000
43 31 35.65325	88 29 30.18428	-.148	E 9 - N39	2400000.000	560000.000
43 33 14.40690	88 29 27.72812	-.141	E 9 - N40	2400000.000	570000.000
43 34 53.15992	88 29 25.26974	-.135	E 9 - N41	2400000.000	580000.000
42 29 99.879	88 28 48.47710	-.203	E10 - N 1	2410000.000	180000.000
42 30 39.75856	88 28 46.04392	-.207	E10 - N 2	2410000.000	190000.000
42 32 18.51856	88 28 43.60857	-.210	E10 - N 3	2410000.000	200000.000
42 33 57.27877	88 28 41.17106	-.213	E10 - N 4	2410000.000	210000.000
42 35 36.03917	88 28 38.73137	-.213	E10 - N 5	2410000.000	220000.000
42 37 14.79974	88 28 36.28952	-.210	E10 - N 6	2410000.000	230000.000
42 38 53.56045	88 28 33.84548	-.200	E10 - N 7	2410000.000	240000.000
42 40 32.32128	88 28 31.39927	-.197	E10 - N 8	2410000.000	250000.000
42 42 11.08220	88 28 28.95087	-.194	E10 - N 9	2410000.000	260000.000
42 43 49.84321	88 28 26.50029	-.203	E10 - N10	2410000.000	270000.000
42 45 28.60426	88 28 24.04753	-.213	E10 - N11	2410000.000	280000.000
42 47 7.36535	88 28 21.59257	-.220	E10 - N12	2410000.000	290000.000
42 48 46.12645	88 28 19.13541	-.226	E10 - N13	2410000.000	300000.000
42 50 24.88753	88 28 16.67606	-.223	E10 - N14	2410000.000	310000.000
42 52 3.64858	88 28 14.21451	-.223	E10 - N15	2410000.000	320000.000
42 53 42.40956	88 28 11.75076	-.220	E10 - N16	2410000.000	330000.000
42 55 21.17047	88 28 9.28480	-.220	E10 - N17	2410000.000	340000.000
42 56 59.93128	88 28 6.81663	-.217	E10 - N18	2410000.000	350000.000
42 58 38.69195	88 28 4.34625	-.220	E10 - N19	2410000.000	360000.000
43 0 17.45248	88 28 1.87366	-.223	E10 - N20	2410000.000	370000.000
43 1 56.21284	88 27 59.39885	-.223	E10 - N21	2410000.000	380000.000
43 3 34.97301	88 27 56.92182	-.223	E10 - N22	2410000.000	390000.000
43 5 13.73296	88 27 54.44256	-.217	E10 - N23	2410000.000	400000.000
43 6 52.49268	88 27 51.96108	-.213	E10 - N24	2410000.000	410000.000
43 8 31.25213	88 27 49.47737	-.213	E10 - N25	2410000.000	420000.000
43 10 10.01130	88 27 46.99142	-.207	E10 - N26	2410000.000	430000.000
43 11 48.77016	88 27 44.50324	-.200	E10 - N27	2410000.000	440000.000
43 13 27.52870	88 27 42.01283	-.200	E10 - N28	2410000.000	450000.000
43 15 6.28689	88 27 39.52017	-.200	E10 - N29	2410000.000	460000.000
43 16 45.04470	88 27 37.02526	-.203	E10 - N30	2410000.000	470000.000
43 18 23.80212	88 27 34.52811	-.200	E10 - N31	2410000.000	480000.000
43 20 2.55912	88 27 32.02871	-.190	E10 - N32	2410000.000	490000.000
43 21 41.31568	88 27 29.52705	-.177	E10 - N33	2410000.000	500000.000
43 23 20.07177	88 27 27.02314	-.164	E10 - N34	2410000.000	510000.000
43 24 58.82738	88 27 24.51696	-.154	E10 - N35	2410000.000	520000.000
43 26 37.58248	88 27 22.00853	-.151	E10 - N36	2410000.000	530000.000
43 28 16.33705	88 27 19.49782	-.151	E10 - N37	2410000.000	540000.000
43 29 55.09106	88 27 16.98485	-.154	E10 - N38	2410000.000	550000.000
43 31 33.84450	88 27 14.46961	-.151	E10 - N39	2410000.000	560000.000
43 33 12.59734	88 27 11.95209	-.148	E10 - N40	2410000.000	570000.000
43 34 51.34956	88 27 9.43229	-.135	E10 - N41	2410000.000	580000.000
42 28 59.17659	88 26 35.05596	-.210	E11 - N 1	2420000.000	180000.000
42 30 37.93555	88 26 32.56348	-.213	E11 - N 2	2420000.000	190000.000
42 32 16.69474	88 26 30.06878	-.217	E11 - N 3	2420000.000	200000.000
42 33 55.45413	88 26 27.57185	-.217	E11 - N 4	2420000.000	210000.000
42 35 34.21372	88 26 25.07270	-.217	E11 - N 5	2420000.000	220000.000
42 37 12.97347	88 26 22.57133	-.213	E11 - N 6	2420000.000	230000.000
42 38 51.73336	88 26 20.06773	-.210	E11 - N 7	2420000.000	240000.000
42 40 30.49337	88 26 17.56189	-.200	E11 - N 8	2420000.000	250000.000
42 42 9.25348	88 26 15.05382	-.194	E11 - N 9	2420000.000	260000.000
42 43 48.01366	88 26 12.54351	-.203	E11 - N10	2420000.000	270000.000
42 45 26.77390	88 26 10.03096	-.213	E11 - N11	2420000.000	280000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 47 5.53417	88 26 7.51616	-.223	E11 - N12	2420000.000	290000.000
42 48 44.29445	88 26 4.99912	-.230	E11 - N13	2420000.000	300000.000
42 50 23.05471	88 26 2.47983	-.230	E11 - N14	2420000.000	310000.000
42 52 1.81494	88 25 59.95828	-.226	E11 - N15	2420000.000	320000.000
42 53 40.57511	88 25 57.43448	-.220	E11 - N16	2420000.000	330000.000
42 55 19.33520	88 25 54.90842	-.213	E11 - N17	2420000.000	340000.000
42 56 58.09518	88 25 52.38009	-.210	E11 - N18	2420000.000	350000.000
42 58 36.85504	88 25 49.84950	-.213	E11 - N19	2420000.000	360000.000
43 0 15.61475	88 25 47.31665	-.217	E11 - N20	2420000.000	370000.000
43 1 54.37429	88 25 44.78152	-.217	E11 - N21	2420000.000	380000.000
43 3 33.13363	88 25 42.24411	-.217	E11 - N22	2420000.000	390000.000
43 5 11.89276	88 25 39.70443	-.213	E11 - N23	2420000.000	400000.000
43 6 50.65166	88 25 37.16246	-.213	E11 - N24	2420000.000	410000.000
43 8 29.41029	88 25 34.61822	-.213	E11 - N25	2420000.000	420000.000
43 10 8.16863	88 25 32.07168	-.207	E11 - N26	2420000.000	430000.000
43 11 46.92668	88 25 29.52286	-.200	E11 - N27	2420000.000	440000.000
43 13 25.68439	88 25 26.97174	-.197	E11 - N28	2420000.000	450000.000
43 15 4.44175	88 25 24.41833	-.197	E11 - N29	2420000.000	460000.000
43 16 43.19874	88 25 21.86262	-.197	E11 - N30	2420000.000	470000.000
43 18 21.95533	88 25 19.30460	-.197	E11 - N31	2420000.000	480000.000
43 20 7.1151	88 25 16.74428	-.187	E11 - N32	2420000.000	490000.000
43 21 39.46724	88 25 14.18165	-.180	E11 - N33	2420000.000	500000.000
43 23 18.22251	88 25 11.61671	-.167	E11 - N34	2420000.000	510000.000
43 24 56.97730	88 25 9.04945	-.161	E11 - N35	2420000.000	520000.000
43 26 35.73157	88 25 6.47988	-.157	E11 - N36	2420000.000	530000.000
43 28 14.48531	88 25 3.90798	-.157	E11 - N37	2420000.000	540000.000
43 29 53.23850	88 25 1.33376	-.157	E11 - N38	2420000.000	550000.000
43 31 31.99112	88 24 58.75721	-.151	E11 - N39	2420000.000	560000.000
43 33 10.74313	88 24 56.17834	-.141	E11 - N40	2420000.000	570000.000
43 34 49.49452	88 24 53.59712	-.131	E11 - N41	2420000.000	580000.000
42 28 57.31050	88 24 21.63704	-.213	E12 - N 1	2430000.000	180000.000
42 30 36.06862	88 24 19.08526	-.217	E12 - N 2	2430000.000	190000.000
42 32 14.82698	88 24 16.53120	-.220	E12 - N 3	2430000.000	200000.000
42 33 53.58554	88 24 13.97487	-.223	E12 - N 4	2430000.000	210000.000
42 35 32.34429	88 24 11.41626	-.223	E12 - N 5	2430000.000	220000.000
42 37 11.10320	88 24 8.85537	-.226	E12 - N 6	2430000.000	230000.000
42 38 49.86226	88 24 6.29220	-.226	E12 - N 7	2430000.000	240000.000
42 40 28.62143	88 24 3.72675	-.217	E12 - N 8	2430000.000	250000.000
42 42 7.38070	88 24 1.15900	-.207	E12 - N 9	2430000.000	260000.000
42 43 46.14005	88 23 58.58897	-.213	E12 - N10	2430000.000	270000.000
42 45 24.89945	88 23 56.01664	-.223	E12 - N11	2430000.000	280000.000
42 47 3.65888	88 23 53.44201	-.230	E12 - N12	2430000.000	290000.000
42 48 42.41832	88 23 50.86508	-.236	E12 - N13	2430000.000	300000.000
42 50 21.17775	88 23 48.28585	-.233	E12 - N14	2430000.000	310000.000
42 51 59.93714	88 23 45.70431	-.230	E12 - N15	2430000.000	320000.000
42 53 38.69647	88 23 43.12046	-.220	E12 - N16	2430000.000	330000.000
42 55 17.45572	88 23 40.53430	-.220	E12 - N17	2430000.000	340000.000
42 56 56.21486	88 23 37.94582	-.220	E12 - N18	2430000.000	350000.000
42 58 34.97388	88 23 35.35502	-.217	E12 - N19	2430000.000	360000.000
43 0 13.73275	88 23 32.76190	-.213	E12 - N20	2430000.000	370000.000
43 1 52.49145	88 23 30.16646	-.210	E12 - N21	2430000.000	380000.000
43 3 31.24995	88 23 27.56868	-.210	E12 - N22	2430000.000	390000.000
43 5 10.00824	88 23 24.96858	-.213	E12 - N23	2430000.000	400000.000
43 6 48.76629	88 23 22.36613	-.213	E12 - N24	2430000.000	410000.000
43 8 27.52408	88 23 19.76135	-.210	E12 - N25	2430000.000	420000.000
43 10 6.28158	88 23 17.15423	-.207	E12 - N26	2430000.000	430000.000
43 11 45.03878	88 23 14.54477	-.200	E12 - N27	2430000.000	440000.000
43 13 23.79565	88 23 11.93295	-.197	E12 - N28	2430000.000	450000.000
43 15 2.55217	88 23 9.31879	-.194	E12 - N29	2430000.000	460000.000
43 16 41.30832	88 23 6.70227	-.190	E12 - N30	2430000.000	470000.000
43 18 20.06407	88 23 4.08340	-.190	E12 - N31	2430000.000	480000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 19 58.81940	88 23 1.46216	-.187	E12 - N32	2430000.000	490000.000
43 21 37.57428	88 22 58.83856	-.184	E12 - N33	2430000.000	500000.000
43 23 16.32871	88 22 56.21260	-.174	E12 - N34	2430000.000	510000.000
43 24 55.08265	88 22 53.58426	-.167	E12 - N35	2430000.000	520000.000
43 26 33.83608	88 22 50.95355	-.161	E12 - N36	2430000.000	530000.000
43 28 12.58897	88 22 48.32046	-.157	E12 - N37	2430000.000	540000.000
43 29 51.34132	88 22 45.68500	-.157	E12 - N38	2430000.000	550000.000
43 31 30.09308	88 22 43.04715	-.144	E12 - N39	2430000.000	560000.000
43 33 8.84425	88 22 40.40692	-.131	E12 - N40	2430000.000	570000.000
43 34 47.59479	88 22 37.76429	-.125	E12 - N41	2430000.000	580000.000
42 28 55.40052	88 22 8.22039	-.223	E13 - N 1	2440000.000	180000.000
42 30 34.15779	88 22 5.60931	-.223	E13 - N 2	2440000.000	190000.000
42 32 12.91529	88 22 2.99590	-.226	E13 - N 3	2440000.000	200000.000
42 33 51.67299	88 22 .38016	-.226	E13 - N 4	2440000.000	210000.000
42 35 30.43089	88 21 57.76209	-.226	E13 - N 5	2440000.000	220000.000
42 37 9.18894	88 21 55.14170	-.230	E13 - N 6	2440000.000	230000.000
42 38 47.94714	88 21 52.51896	-.233	E13 - N 7	2440000.000	240000.000
42 40 26.70546	88 21 49.89389	-.230	E13 - N 8	2440000.000	250000.000
42 42 5.46388	88 21 47.26648	-.223	E13 - N 9	2440000.000	260000.000
42 43 44.22237	88 21 44.63672	-.226	E13 - N10	2440000.000	270000.000
42 45 22.98091	88 21 42.00462	-.230	E13 - N11	2440000.000	280000.000
42 47 1.73949	88 21 39.37016	-.233	E13 - N12	2440000.000	290000.000
42 48 40.49807	88 21 36.73335	-.236	E13 - N13	2440000.000	300000.000
42 50 19.25664	88 21 34.09418	-.236	E13 - N14	2440000.000	310000.000
42 51 58.01517	88 21 31.45265	-.236	E13 - N15	2440000.000	320000.000
42 53 36.77364	88 21 28.80876	-.230	E13 - N16	2440000.000	330000.000
42 55 15.53203	88 21 26.16250	-.233	E13 - N17	2440000.000	340000.000
42 56 54.29031	88 21 23.51387	-.236	E13 - N18	2440000.000	350000.000
42 58 33.04847	88 21 20.86287	-.230	E13 - N19	2440000.000	360000.000
43 0 11.80648	88 21 18.20949	-.223	E13 - N20	2440000.000	370000.000
43 1 50.56432	88 21 15.55373	-.217	E13 - N21	2440000.000	380000.000
43 3 29.32196	88 21 12.89559	-.213	E13 - N22	2440000.000	390000.000
43 5 8.07939	88 21 10.23506	-.213	E13 - N23	2440000.000	400000.000
43 6 46.83658	88 21 7.57214	-.213	E13 - N24	2440000.000	410000.000
43 8 25.59350	88 21 4.90683	-.210	E13 - N25	2440000.000	420000.000
43 10 4.35015	88 21 2.23913	-.207	E13 - N26	2440000.000	430000.000
43 11 43.10648	88 20 59.56902	-.203	E13 - N27	2440000.000	440000.000
43 13 21.86249	88 20 56.89652	-.194	E13 - N28	2440000.000	450000.000
43 15 .61815	88 20 54.22161	-.184	E13 - N29	2440000.000	460000.000
43 16 39.37343	88 20 51.54429	-.187	E13 - N30	2440000.000	470000.000
43 18 18.12831	88 20 48.86455	-.190	E13 - N31	2440000.000	480000.000
43 19 56.88278	88 20 46.18241	-.187	E13 - N32	2440000.000	490000.000
43 21 35.63680	88 20 43.49784	-.184	E13 - N33	2440000.000	500000.000
43 23 14.39036	88 20 40.81085	-.177	E13 - N34	2440000.000	510000.000
43 24 53.14344	88 20 38.12144	-.171	E13 - N35	2440000.000	520000.000
43 26 31.89600	88 20 35.42960	-.161	E13 - N36	2440000.000	530000.000
43 28 10.64803	88 20 32.73533	-.154	E13 - N37	2440000.000	540000.000
43 29 49.39951	88 20 30.03862	-.151	E13 - N38	2440000.000	550000.000
43 31 28.15041	88 20 27.33947	-.138	E13 - N39	2440000.000	560000.000
43 33 6.90071	88 20 24.63789	-.121	E13 - N40	2440000.000	570000.000
43 34 45.65038	88 20 21.93386	-.118	E13 - N41	2440000.000	580000.000
42 28 53.44665	88 19 54.80606	-.230	E14 - N 1	2450000.000	180000.000
42 30 32.20304	88 19 52.13568	-.230	E14 - N 2	2450000.000	190000.000
42 32 10.95967	88 19 49.46292	-.230	E14 - N 3	2450000.000	200000.000
42 33 49.71650	88 19 46.78778	-.230	E14 - N 4	2450000.000	210000.000
42 35 28.47352	88 19 44.11026	-.226	E14 - N 5	2450000.000	220000.000
42 37 7.23070	88 19 41.43036	-.230	E14 - N 6	2450000.000	230000.000
42 38 45.98802	88 19 38.74806	-.236	E14 - N 7	2450000.000	240000.000
42 40 24.74547	88 19 36.06338	-.240	E14 - N 8	2450000.000	250000.000
42 42 3.50301	88 19 33.37630	-.240	E14 - N 9	2450000.000	260000.000
42 43 42.26062	88 19 30.68682	-.236	E14 - N10	2450000.000	270000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 45 21.01829	88 19 27.99494	-.236	E14 - N11	2450000.000	280000.000
42 46 59.77599	88 19 25.30066	-.236	E14 - N12	2450000.000	290000.000
42 48 38.53369	88 19 22.60397	-.240	E14 - N13	2450000.000	300000.000
42 50 17.29138	88 19 19.90487	-.240	E14 - N14	2450000.000	310000.000
42 51 56.04903	88 19 17.20335	-.240	E14 - N15	2450000.000	320000.000
42 53 34.80662	88 19 14.49942	-.240	E14 - N16	2450000.000	330000.000
42 55 13.56413	88 19 11.79307	-.243	E14 - N17	2450000.000	340000.000
42 56 52.32154	88 19 9.08429	-.246	E14 - N18	2450000.000	350000.000
42 58 31.07882	88 19 6.37308	-.240	E14 - N19	2450000.000	360000.000
43 0 9.83595	88 19 3.65945	-.233	E14 - N20	2450000.000	370000.000
43 1 48.59290	88 19 .94338	-.226	E14 - N21	2450000.000	380000.000
43 3 27.34967	88 18 58.22488	-.223	E14 - N22	2450000.000	390000.000
43 5 6.10621	88 18 55.50393	-.223	E14 - N23	2450000.000	400000.000
43 6 44.86252	88 18 52.78054	-.220	E14 - N24	2450000.000	410000.000
43 8 23.61857	88 18 50.05471	-.210	E14 - N25	2450000.000	420000.000
43 10 2.37433	88 18 47.32642	-.203	E14 - N26	2450000.000	430000.000
43 11 41.12978	88 18 44.59568	-.197	E14 - N27	2450000.000	440000.000
43 13 19.88491	88 18 41.86249	-.190	E14 - N28	2450000.000	450000.000
43 14 58.63968	88 18 39.12683	-.187	E14 - N29	2450000.000	460000.000
43 16 37.39408	88 18 36.38871	-.184	E14 - N30	2450000.000	470000.000
43 18 16.14808	88 18 33.64812	-.177	E14 - N31	2450000.000	480000.000
43 19 54.90166	88 18 30.90507	-.180	E14 - N32	2450000.000	490000.000
43 21 33.65480	88 18 28.15954	-.177	E14 - N33	2450000.000	500000.000
43 23 12.40748	88 18 25.41153	-.164	E14 - N34	2450000.000	510000.000
43 24 51.15966	88 18 22.66105	-.157	E14 - N35	2450000.000	520000.000
43 26 29.91134	88 18 19.90808	-.151	E14 - N36	2450000.000	530000.000
43 28 8.66249	88 18 17.15262	-.144	E14 - N37	2450000.000	540000.000
43 29 47.41308	88 18 14.39468	-.141	E14 - N38	2450000.000	550000.000
43 31 26.16309	88 18 11.63424	-.135	E14 - N39	2450000.000	560000.000
43 33 4.91250	88 18 8.87130	-.128	E14 - N40	2450000.000	570000.000
43 34 43.66129	88 18 6.10587	-.115	E14 - N41	2450000.000	580000.000
42 28 51.44889	88 17 41.39410	-.240	E15 - N 1	2460000.000	180000.000
42 30 30.20439	88 17 38.66442	-.236	E15 - N 2	2460000.000	190000.000
42 32 8.96012	88 17 35.93232	-.233	E15 - N 3	2460000.000	200000.000
42 33 47.71606	88 17 33.19778	-.233	E15 - N 4	2460000.000	210000.000
42 35 26.47218	88 17 30.46081	-.230	E15 - N 5	2460000.000	220000.000
42 37 5.22847	88 17 27.72140	-.233	E15 - N 6	2460000.000	230000.000
42 38 43.98490	88 17 24.97955	-.240	E15 - N 7	2460000.000	240000.000
42 40 22.74145	88 17 22.23526	-.243	E15 - N 8	2460000.000	250000.000
42 42 1.49809	88 17 19.48852	-.249	E15 - N 9	2460000.000	260000.000
42 43 40.25481	88 17 16.73932	-.243	E15 - N10	2460000.000	270000.000
42 45 19.01158	88 17 13.98768	-.243	E15 - N11	2460000.000	280000.000
42 46 57.76838	88 17 11.23357	-.240	E15 - N12	2460000.000	290000.000
42 48 36.52518	88 17 8.47700	-.240	E15 - N13	2460000.000	300000.000
42 50 15.28198	88 17 5.71797	-.240	E15 - N14	2460000.000	310000.000
42 51 54.03873	88 17 2.95647	-.243	E15 - N15	2460000.000	320000.000
42 53 32.79542	88 17 .19250	-.243	E15 - N16	2460000.000	330000.000
42 55 11.55204	88 16 57.42606	-.243	E15 - N17	2460000.000	340000.000
42 56 50.30854	88 16 54.65714	-.246	E15 - N18	2460000.000	350000.000
42 58 29.06492	88 16 51.88573	-.243	E15 - N19	2460000.000	360000.000
43 0 7.82115	88 16 49.11185	-.236	E15 - N20	2460000.000	370000.000
43 1 46.57721	88 16 46.33547	-.233	E15 - N21	2460000.000	380000.000
43 3 25.33307	88 16 43.55661	-.230	E15 - N22	2460000.000	390000.000
43 5 4.08872	88 16 40.77525	-.233	E15 - N23	2460000.000	400000.000
43 6 42.84412	88 16 37.99139	-.226	E15 - N24	2460000.000	410000.000
43 8 21.59927	88 16 35.20503	-.213	E15 - N25	2460000.000	420000.000
43 10 .35413	88 16 32.41617	-.203	E15 - N26	2460000.000	430000.000
43 11 39.10868	88 16 29.62480	-.197	E15 - N27	2460000.000	440000.000
43 13 17.86290	88 16 26.83091	-.190	E15 - N28	2460000.000	450000.000
43 14 56.61677	88 16 24.03452	-.187	E15 - N29	2460000.000	460000.000
43 16 35.37026	88 16 21.23560	-.184	E15 - N30	2460000.000	470000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 18 14.12336	88 16 18.43417	-.180	E15 - N31	2460000.000	480000.000
43 19 52.87604	88 16 15.63021	-.174	E15 - N32	2460000.000	490000.000
43 21 31.62828	88 16 12.82372	-.167	E15 - N33	2460000.000	500000.000
43 23 10.38005	88 16 10.01470	-.164	E15 - N34	2460000.000	510000.000
43 24 49.13133	88 16 7.20314	-.157	E15 - N35	2460000.000	520000.000
43 26 27.88210	88 16 4.38905	-.151	E15 - N36	2460000.000	530000.000
43 28 6.63234	88 16 1.57241	-.148	E15 - N37	2460000.000	540000.000
43 29 45.38203	88 15 58.75323	-.144	E15 - N38	2460000.000	550000.000
43 31 24.13113	88 15 55.93150	-.138	E15 - N39	2460000.000	560000.000
43 33 2.87964	88 15 53.10722	-.131	E15 - N40	2460000.000	570000.000
43 34 41.62752	88 15 50.28038	-.118	E15 - N41	2460000.000	580000.000
42 28 49.40724	88 15 27.98456	-.230	E16 - N 1	2470000.000	180000.000
42 30 28.16183	88 15 25.19560	-.230	E16 - N 2	2470000.000	190000.000
42 32 6.91665	88 15 22.40415	-.233	E16 - N 3	2470000.000	200000.000
42 33 45.67167	88 15 19.61022	-.236	E16 - N 4	2470000.000	210000.000
42 35 24.42688	88 15 16.81380	-.240	E16 - N 5	2470000.000	220000.000
42 37 3.18225	88 15 14.01489	-.243	E16 - N 6	2470000.000	230000.000
42 38 41.93777	88 15 11.21349	-.246	E16 - N 7	2470000.000	240000.000
42 40 20.69340	88 15 8.40959	-.249	E16 - N 8	2470000.000	250000.000
42 41 59.44913	88 15 5.60319	-.253	E16 - N 9	2470000.000	260000.000
42 43 38.20493	88 15 2.79428	-.246	E16 - N10	2470000.000	270000.000
42 45 16.96078	88 14 59.98287	-.243	E16 - N11	2470000.000	280000.000
42 46 55.71667	88 14 57.16894	-.243	E16 - N12	2470000.000	290000.000
42 48 34.47256	88 14 54.35250	-.243	E16 - N13	2470000.000	300000.000
42 50 13.22843	88 14 51.53354	-.243	E16 - N14	2470000.000	310000.000
42 51 51.98427	88 14 48.71206	-.243	E16 - N15	2470000.000	320000.000
42 53 30.74004	88 14 45.88806	-.240	E16 - N16	2470000.000	330000.000
42 55 9.49573	88 14 43.06153	-.240	E16 - N17	2470000.000	340000.000
42 56 48.25132	88 14 40.23246	-.240	E16 - N18	2470000.000	350000.000
42 58 27.00678	88 14 37.40087	-.240	E16 - N19	2470000.000	360000.000
43 0 5.76209	88 14 34.56673	-.240	E16 - N20	2470000.000	370000.000
43 1 44.51723	88 14 31.73005	-.236	E16 - N21	2470000.000	380000.000
43 3 23.27217	88 14 28.89083	-.236	E16 - N22	2470000.000	390000.000
43 5 2.02690	88 14 26.04906	-.236	E16 - N23	2470000.000	400000.000
43 6 40.78138	88 14 23.20474	-.233	E16 - N24	2470000.000	410000.000
43 8 19.53560	88 14 20.35786	-.223	E16 - N25	2470000.000	420000.000
43 9 58.28954	88 14 17.50842	-.213	E16 - N26	2470000.000	430000.000
43 11 37.04317	88 14 14.65642	-.203	E16 - N27	2470000.000	440000.000
43 13 15.79647	88 14 11.80186	-.197	E16 - N28	2470000.000	450000.000
43 14 54.54942	88 14 8.94472	-.187	E16 - N29	2470000.000	460000.000
43 16 33.30199	88 14 6.08502	-.190	E16 - N30	2470000.000	470000.000
43 18 12.05417	88 14 3.22273	-.194	E16 - N31	2470000.000	480000.000
43 19 50.80592	88 14 .35787	-.180	E16 - N32	2470000.000	490000.000
43 21 29.55723	88 13 57.49043	-.171	E16 - N33	2470000.000	500000.000
43 23 8.30808	88 13 54.62039	-.171	E16 - N34	2470000.000	510000.000
43 24 47.05844	88 13 51.74777	-.167	E16 - N35	2470000.000	520000.000
43 26 25.80828	88 13 48.87256	-.157	E16 - N36	2470000.000	530000.000
43 28 4.55760	88 13 45.99474	-.154	E16 - N37	2470000.000	540000.000
43 29 43.30636	88 13 43.11433	-.148	E16 - N38	2470000.000	550000.000
43 31 22.05454	88 13 40.23131	-.138	E16 - N39	2470000.000	560000.000
43 33 .80212	88 13 37.34569	-.128	E16 - N40	2470000.000	570000.000
43 34 39.54907	88 13 34.45745	-.112	E16 - N41	2470000.000	580000.000
42 28 47.32171	88 13 14.57751	-.230	E17 - N 1	2480000.000	180000.000
42 30 26.07536	88 13 11.72926	-.233	E17 - N 2	2480000.000	190000.000
42 32 4.82924	88 13 8.87847	-.240	E17 - N 3	2480000.000	200000.000
42 33 43.58333	88 13 6.02515	-.246	E17 - N 4	2480000.000	210000.000
42 35 22.33761	88 13 3.16928	-.249	E17 - N 5	2480000.000	220000.000
42 37 1.09205	88 13 .31088	-.249	E17 - N 6	2480000.000	230000.000
42 38 39.84663	88 12 57.44992	-.249	E17 - N 7	2480000.000	240000.000
42 40 18.60133	88 12 54.58642	-.249	E17 - N 8	2480000.000	250000.000
42 41 57.35612	88 12 51.72036	-.249	E17 - N 9	2480000.000	260000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 43 36.11099	88 12 48.85174	-.249	E17 - N10	2480000.000	270000.000
42 45 14.86590	88 12 45.98057	-.249	E17 - N11	2480000.000	280000.000
42 46 53.62085	88 12 43.10682	-.249	E17 - N12	2480000.000	290000.000
42 48 32.37580	88 12 40.23051	-.249	E17 - N13	2480000.000	300000.000
42 50 11.13074	88 12 37.35163	-.249	E17 - N14	2480000.000	310000.000
42 51 49.88564	88 12 34.47018	-.246	E17 - N15	2480000.000	320000.000
42 53 28.64048	88 12 31.58614	-.240	E17 - N16	2480000.000	330000.000
42 55 7.39523	88 12 28.69953	-.233	E17 - N17	2480000.000	340000.000
42 56 46.14988	88 12 25.81033	-.226	E17 - N18	2480000.000	350000.000
42 58 24.90440	88 12 22.91854	-.230	E17 - N19	2480000.000	360000.000
43 0 3.65877	88 12 20.02416	-.236	E17 - N20	2480000.000	370000.000
43 1 42.41297	88 12 17.12718	-.240	E17 - N21	2480000.000	380000.000
43 3 21.16697	88 12 14.22760	-.243	E17 - N22	2480000.000	390000.000
43 4 59.92076	88 12 11.32542	-.243	E17 - N23	2480000.000	400000.000
43 6 38.67430	88 12 8.42064	-.240	E17 - N24	2480000.000	410000.000
43 8 17.42758	88 12 5.51324	-.230	E17 - N25	2480000.000	420000.000
43 9 56.18058	88 12 2.60324	-.220	E17 - N26	2480000.000	430000.000
43 11 34.93327	88 11 59.69061	-.213	E17 - N27	2480000.000	440000.000
43 13 13.68563	88 11 56.77537	-.210	E17 - N28	2480000.000	450000.000
43 14 52.43763	88 11 53.85750	-.203	E17 - N29	2480000.000	460000.000
43 16 31.18926	88 11 50.93701	-.207	E17 - N30	2480000.000	470000.000
43 18 9.94049	88 11 48.01388	-.207	E17 - N31	2480000.000	480000.000
43 19 48.69130	88 11 45.08812	-.194	E17 - N32	2480000.000	490000.000
43 21 27.44167	88 11 42.15972	-.184	E17 - N33	2480000.000	500000.000
43 23 6.19157	88 11 39.22868	-.180	E17 - N34	2480000.000	510000.000
43 24 44.94098	88 11 36.29500	-.174	E17 - N35	2480000.000	520000.000
43 26 23.68989	88 11 33.35866	-.167	E17 - N36	2480000.000	530000.000
43 28 2.43826	88 11 30.41968	-.157	E17 - N37	2480000.000	540000.000
43 29 41.18607	88 11 27.47804	-.148	E17 - N38	2480000.000	550000.000
43 31 19.93330	88 11 24.53374	-.131	E17 - N39	2480000.000	560000.000
43 32 58.67993	88 11 21.58677	-.115	E17 - N40	2480000.000	570000.000
43 34 37.42594	88 11 18.63714	-.098	E17 - N41	2480000.000	580000.000
42 28 45.19229	88 11 1.17298	-.236	E18 - N 1	2490000.000	180000.000
42 30 23.94499	88 10 58.26545	-.240	E18 - N 2	2490000.000	190000.000
42 32 2.69792	88 10 55.35532	-.246	E18 - N 3	2490000.000	200000.000
42 33 41.45105	88 10 52.44261	-.249	E18 - N 4	2490000.000	210000.000
42 35 20.20438	88 10 49.52731	-.249	E18 - N 5	2490000.000	220000.000
42 36 58.95786	88 10 46.60941	-.249	E18 - N 6	2490000.000	230000.000
42 38 37.71149	88 10 43.68891	-.246	E18 - N 7	2490000.000	240000.000
42 40 16.46523	88 10 40.76580	-.249	E18 - N 8	2490000.000	250000.000
42 41 55.21907	88 10 37.84009	-.249	E18 - N 9	2490000.000	260000.000
42 43 33.97298	88 10 34.91177	-.249	E18 - N10	2490000.000	270000.000
42 45 12.72694	88 10 31.98083	-.249	E18 - N11	2490000.000	280000.000
42 46 51.48093	88 10 29.04728	-.253	E18 - N12	2490000.000	290000.000
42 48 30.23493	88 10 26.11110	-.253	E18 - N13	2490000.000	300000.000
42 50 8.98891	88 10 23.17230	-.253	E18 - N14	2490000.000	310000.000
42 51 47.74285	88 10 20.23087	-.253	E18 - N15	2490000.000	320000.000
42 53 26.49673	88 10 17.28681	-.249	E18 - N16	2490000.000	330000.000
42 55 5.25053	88 10 14.34011	-.243	E18 - N17	2490000.000	340000.000
42 56 44.00422	88 10 11.39078	-.233	E18 - N18	2490000.000	350000.000
42 58 22.75778	88 10 8.43880	-.236	E18 - N19	2490000.000	360000.000
43 0 1.51119	88 10 5.48418	-.240	E18 - N20	2490000.000	370000.000
43 1 40.26443	88 10 2.52690	-.240	E18 - N21	2490000.000	380000.000
43 3 19.01748	88 9 59.56698	-.243	E18 - N22	2490000.000	390000.000
43 4 57.77030	88 9 56.60439	-.243	E18 - N23	2490000.000	400000.000
43 6 36.52288	88 9 53.63915	-.240	E18 - N24	2490000.000	410000.000
43 8 15.27520	88 9 50.67124	-.236	E18 - N25	2490000.000	420000.000
43 9 54.02724	88 9 47.70067	-.233	E18 - N26	2490000.000	430000.000
43 11 32.77897	88 9 44.72742	-.230	E18 - N27	2490000.000	440000.000
43 13 11.53036	88 9 41.75150	-.226	E18 - N28	2490000.000	450000.000
43 14 50.28140	88 9 38.77291	-.220	E18 - N29	2490000.000	460000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 16 29.03207	88 9 35.79163	-.217	E18 - N30	2490000.000	470000.000
43 18 7.78234	88 9 32.80766	-.213	E18 - N31	2490000.000	480000.000
43 19 46.53219	88 9 29.82101	-.200	E18 - N32	2490000.000	490000.000
43 21 25.28159	88 9 26.83166	-.190	E18 - N33	2490000.000	500000.000
43 23 4.03053	88 9 23.83961	-.180	E18 - N34	2490000.000	510000.000
43 24 42.77898	88 9 20.84487	-.174	E18 - N35	2490000.000	520000.000
43 26 21.52691	88 9 17.84742	-.164	E18 - N36	2490000.000	530000.000
43 28 27.432	88 9 14.84727	-.151	E18 - N37	2490000.000	540000.000
43 29 39.02116	88 9 11.84440	-.135	E18 - N38	2490000.000	550000.000
43 31 17.76743	88 9 8.83882	-.115	E18 - N39	2490000.000	560000.000
43 32 56.51310	88 9 5.83052	-.095	E18 - N40	2490000.000	570000.000
43 34 35.25814	88 9 2.81950	-.079	E18 - N41	2490000.000	580000.000
42 28 43.01898	88 8 47.77104	-.243	E19 - N 1	2500000.000	180000.000
42 30 21.77071	88 8 44.80422	-.249	E19 - N 2	2500000.000	190000.000
42 32 52.267	88 8 41.83477	-.249	E19 - N 3	2500000.000	200000.000
42 33 39.27483	88 8 38.86267	-.249	E19 - N 4	2500000.000	210000.000
42 35 18.02718	88 8 35.88793	-.246	E19 - N 5	2500000.000	220000.000
42 36 56.77969	88 8 32.91054	-.246	E19 - N 6	2500000.000	230000.000
42 38 35.53234	88 8 29.93050	-.246	E19 - N 7	2500000.000	240000.000
42 40 14.28511	88 8 26.94779	-.249	E19 - N 8	2500000.000	250000.000
42 41 53.03798	88 8 23.96243	-.249	E19 - N 9	2500000.000	260000.000
42 43 31.79091	88 8 20.97441	-.249	E19 - N10	2500000.000	270000.000
42 45 10.54390	88 8 17.98371	-.249	E19 - N11	2500000.000	280000.000
42 46 49.29691	88 8 14.99035	-.253	E19 - N12	2500000.000	290000.000
42 48 28.04993	88 8 11.99431	-.253	E19 - N13	2500000.000	300000.000
42 50 6.80294	88 8 8.99559	-.256	E19 - N14	2500000.000	310000.000
42 51 45.55590	88 8 5.99420	-.256	E19 - N15	2500000.000	320000.000
42 53 24.30881	88 8 2.99011	-.256	E19 - N16	2500000.000	330000.000
42 55 3.06163	88 7 59.98334	-.253	E19 - N17	2500000.000	340000.000
42 56 41.81434	88 7 56.97387	-.243	E19 - N18	2500000.000	350000.000
42 58 20.56692	88 7 53.96171	-.243	E19 - N19	2500000.000	360000.000
42 59 59.31936	88 7 50.94685	-.243	E19 - N20	2500000.000	370000.000
43 1 38.07162	88 7 47.92928	-.246	E19 - N21	2500000.000	380000.000
43 3 16.82368	88 7 44.90901	-.246	E19 - N22	2500000.000	390000.000
43 4 55.57552	88 7 41.88603	-.246	E19 - N23	2500000.000	400000.000
43 6 34.32713	88 7 38.86033	-.246	E19 - N24	2500000.000	410000.000
43 8 13.07847	88 7 35.83191	-.243	E19 - N25	2500000.000	420000.000
43 9 51.82952	88 7 32.80077	-.240	E19 - N26	2500000.000	430000.000
43 11 30.58027	88 7 29.76691	-.240	E19 - N27	2500000.000	440000.000
43 13 9.33068	88 7 26.73032	-.233	E19 - N28	2500000.000	450000.000
43 14 48.08074	88 7 23.69099	-.226	E19 - N29	2500000.000	460000.000
43 16 26.83042	88 7 20.64893	-.220	E19 - N30	2500000.000	470000.000
43 18 5.57971	88 7 17.60413	-.210	E19 - N31	2500000.000	480000.000
43 19 44.32857	88 7 14.55658	-.200	E19 - N32	2500000.000	490000.000
43 21 23.07699	88 7 11.50629	-.187	E19 - N33	2500000.000	500000.000
43 23 1.82495	88 7 8.45325	-.177	E19 - N34	2500000.000	510000.000
43 24 40.57241	88 7 5.39745	-.167	E19 - N35	2500000.000	520000.000
43 26 19.31936	88 7 2.33889	-.161	E19 - N36	2500000.000	530000.000
43 27 58.06578	88 6 59.27757	-.151	E19 - N37	2500000.000	540000.000
43 29 36.81164	88 6 56.21348	-.138	E19 - N38	2500000.000	550000.000
43 31 15.55692	88 6 53.14662	-.121	E19 - N39	2500000.000	560000.000
43 32 54.30160	88 6 50.07699	-.102	E19 - N40	2500000.000	570000.000
43 34 33.04566	88 6 47.00458	-.085	E19 - N41	2500000.000	580000.000
42 28 40.80179	88 6 34.37173	-.240	E20 - N 1	2510000.000	180000.000
42 30 19.55253	88 6 31.34564	-.243	E20 - N 2	2510000.000	190000.000
42 31 58.30349	88 6 28.31686	-.243	E20 - N 3	2510000.000	200000.000
42 33 37.05467	88 6 25.28538	-.243	E20 - N 4	2510000.000	210000.000
42 35 15.80602	88 6 22.25120	-.243	E20 - N 5	2510000.000	220000.000
42 36 54.55754	88 6 19.21433	-.246	E20 - N 6	2510000.000	230000.000
42 38 33.30920	88 6 16.17474	-.246	E20 - N 7	2510000.000	240000.000
42 40 12.06097	88 6 13.13245	-.249	E20 - N 8	2510000.000	250000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 41 50.81284	88 6 10.08744	-.246	E20 - N 9	2510000.000	260000.000
42 43 29.56479	88 6 7.03971	-.246	E20 - N10	2510000.000	270000.000
42 45 8.31678	88 6 3.98927	-.246	E20 - N11	2510000.000	280000.000
42 46 47.06880	88 6 .93610	-.249	E20 - N12	2510000.000	290000.000
42 48 25.82082	88 5 57.88020	-.253	E20 - N13	2510000.000	300000.000
42 50 4.57283	88 5 54.82157	-.256	E20 - N14	2510000.000	310000.000
42 51 43.32480	88 5 51.76021	-.259	E20 - N15	2510000.000	320000.000
42 53 22.07670	88 5 48.69610	-.259	E20 - N16	2510000.000	330000.000
42 55 .82853	88 5 45.62926	-.256	E20 - N17	2510000.000	340000.000
42 56 39.58024	88 5 42.55966	-.249	E20 - N18	2510000.000	350000.000
42 58 18.33183	88 5 39.48732	-.249	E20 - N19	2510000.000	360000.000
42 59 57.08326	88 5 36.41222	-.253	E20 - N20	2510000.000	370000.000
43 1 35.83452	88 5 33.33437	-.253	E20 - N21	2510000.000	380000.000
43 3 14.58559	88 5 30.25375	-.256	E20 - N22	2510000.000	390000.000
43 4 53.33643	88 5 27.17037	-.256	E20 - N23	2510000.000	400000.000
43 6 32.08703	88 5 24.08422	-.256	E20 - N24	2510000.000	410000.000
43 8 10.83737	88 5 20.99530	-.253	E20 - N25	2510000.000	420000.000
43 9 49.58743	88 5 17.90360	-.249	E20 - N26	2510000.000	430000.000
43 11 28.33717	88 5 14.80913	-.246	E20 - N27	2510000.000	440000.000
43 13 7.08658	88 5 11.71187	-.240	E20 - N28	2510000.000	450000.000
43 14 45.83564	88 5 8.61182	-.230	E20 - N29	2510000.000	460000.000
43 16 24.58432	88 5 5.50898	-.217	E20 - N30	2510000.000	470000.000
43 18 3.33261	88 5 2.40334	-.203	E20 - N31	2510000.000	480000.000
43 19 42.08047	88 4 59.29491	-.194	E20 - N32	2510000.000	490000.000
43 21 20.82788	88 4 56.18368	-.184	E20 - N33	2510000.000	500000.000
43 22 59.57483	88 4 53.06963	-.171	E20 - N34	2510000.000	510000.000
43 24 38.32129	88 4 49.95278	-.161	E20 - N35	2510000.000	520000.000
43 26 17.06724	88 4 46.83312	-.157	E20 - N36	2510000.000	530000.000
43 27 55.81265	88 4 43.71063	-.148	E20 - N37	2510000.000	540000.000
43 29 34.55751	88 4 40.58533	-.135	E20 - N38	2510000.000	550000.000
43 31 13.30178	88 4 37.45720	-.121	E20 - N39	2510000.000	560000.000
43 32 52.04546	88 4 34.32624	-.105	E20 - N40	2510000.000	570000.000
43 34 30.78851	88 4 31.19245	-.085	E20 - N41	2510000.000	580000.000
42 28 38.54072	88 4 20.97511	-.240	E21 - N 1	2520000.000	180000.000
42 30 17.29045	88 4 17.88974	-.240	E21 - N 2	2520000.000	190000.000
42 31 56.04040	88 4 14.80164	-.243	E21 - N 3	2520000.000	200000.000
42 33 34.79056	88 4 11.71078	-.246	E21 - N 4	2520000.000	210000.000
42 35 13.54091	88 4 8.61718	-.253	E21 - N 5	2520000.000	220000.000
42 36 52.29141	88 4 5.52082	-.256	E21 - N 6	2520000.000	230000.000
42 38 31.04206	88 4 2.42170	-.259	E21 - N 7	2520000.000	240000.000
42 40 9.79282	88 3 59.31981	-.259	E21 - N 8	2520000.000	250000.000
42 41 48.54367	88 3 56.21516	-.256	E21 - N 9	2520000.000	260000.000
42 43 27.29460	88 3 53.10774	-.253	E21 - N10	2520000.000	270000.000
42 45 6.04558	88 3 49.99755	-.246	E21 - N11	2520000.000	280000.000
42 46 44.79658	88 3 46.88457	-.243	E21 - N12	2520000.000	290000.000
42 48 23.54759	88 3 43.76882	-.243	E21 - N13	2520000.000	300000.000
42 50 2.29858	88 3 40.65028	-.253	E21 - N14	2520000.000	310000.000
42 51 41.04953	88 3 37.52896	-.259	E21 - N15	2520000.000	320000.000
42 53 19.80042	88 3 34.40484	-.262	E21 - N16	2520000.000	330000.000
42 54 58.55123	88 3 31.27792	-.266	E21 - N17	2520000.000	340000.000
42 56 37.30193	88 3 28.14820	-.266	E21 - N18	2520000.000	350000.000
42 58 16.05250	88 3 25.01568	-.269	E21 - N19	2520000.000	360000.000
42 59 54.80291	88 3 21.88035	-.272	E21 - N20	2520000.000	370000.000
43 1 33.55315	88 3 18.74221	-.272	E21 - N21	2520000.000	380000.000
43 3 12.30320	88 3 15.60126	-.269	E21 - N22	2520000.000	390000.000
43 4 51.05302	88 3 12.45749	-.272	E21 - N23	2520000.000	400000.000
43 6 29.80261	88 3 9.31089	-.269	E21 - N24	2520000.000	410000.000
43 8 8.55193	88 3 6.16147	-.262	E21 - N25	2520000.000	420000.000
43 9 47.30096	88 3 3.00921	-.259	E21 - N26	2520000.000	430000.000
43 11 26.04968	88 2 59.85413	-.259	E21 - N27	2520000.000	440000.000
43 13 4.79807	88 2 56.69620	-.246	E21 - N28	2520000.000	450000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 14 43.54611	88 2 53.53543	-.230	E21 - N29	2520000.000	460000.000
43 16 22.29377	88 2 50.37182	-.213	E21 - N30	2520000.000	470000.000
43 18 1.04103	88 2 47.20536	-.197	E21 - N31	2520000.000	480000.000
43 19 39.78787	88 2 44.03604	-.187	E21 - N32	2520000.000	490000.000
43 21 18.53426	88 2 40.86387	-.177	E21 - N33	2520000.000	500000.000
43 22 57.28018	88 2 37.68883	-.167	E21 - N34	2520000.000	510000.000
43 24 36.02562	88 2 34.51093	-.157	E21 - N35	2520000.000	520000.000
43 26 14.77054	88 2 31.33016	-.151	E21 - N36	2520000.000	530000.000
43 27 53.51493	88 2 28.14652	-.141	E21 - N37	2520000.000	540000.000
43 29 32.25876	88 2 24.96000	-.128	E21 - N38	2520000.000	550000.000
43 31 11.00201	88 2 21.77061	-.115	E21 - N39	2520000.000	560000.000
43 32 49.74466	88 2 18.57832	-.102	E21 - N40	2520000.000	570000.000
43 34 28.48668	88 2 15.38315	-.082	E21 - N41	2520000.000	580000.000
42 28 36.23577	88 2 7.58123	-.243	E22 - N 1	2530000.000	180000.000
42 30 14.98446	88 2 4.43660	-.243	E22 - N 2	2530000.000	190000.000
42 31 53.73339	88 2 1.28917	-.249	E22 - N 3	2530000.000	200000.000
42 33 32.48252	88 1 58.13894	-.253	E22 - N 4	2530000.000	210000.000
42 35 11.23183	88 1 54.98591	-.256	E22 - N 5	2530000.000	220000.000
42 36 49.98130	88 1 51.83007	-.259	E22 - N 6	2530000.000	230000.000
42 38 28.73091	88 1 48.67141	-.262	E22 - N 7	2530000.000	240000.000
42 40 7.48064	88 1 45.50994	-.262	E22 - N 8	2530000.000	250000.000
42 41 46.23046	88 1 42.34566	-.262	E22 - N 9	2530000.000	260000.000
42 43 24.98036	88 1 39.17854	-.253	E22 - N10	2530000.000	270000.000
42 45 3.73030	88 1 36.00860	-.246	E22 - N11	2530000.000	280000.000
42 46 42.48027	88 1 32.83583	-.243	E22 - N12	2530000.000	290000.000
42 48 21.23024	88 1 29.66023	-.246	E22 - N13	2530000.000	300000.000
42 49 59.98020	88 1 26.48178	-.259	E22 - N14	2530000.000	310000.000
42 51 38.73012	88 1 23.30050	-.269	E22 - N15	2530000.000	320000.000
42 53 17.47997	88 1 20.11636	-.272	E22 - N16	2530000.000	330000.000
42 54 56.22974	88 1 16.92938	-.276	E22 - N17	2530000.000	340000.000
42 56 34.97940	88 1 13.73955	-.276	E22 - N18	2530000.000	350000.000
42 58 13.72893	88 1 10.54685	-.279	E22 - N19	2530000.000	360000.000
42 59 52.47831	88 1 7.35130	-.282	E22 - N20	2530000.000	370000.000
43 1 31.22751	88 1 4.15288	-.279	E22 - N21	2530000.000	380000.000
43 3 9.97652	88 1 .95159	-.279	E22 - N22	2530000.000	390000.000
43 4 48.72530	88 0 57.74742	-.289	E22 - N23	2530000.000	400000.000
43 6 27.47385	88 0 54.54038	-.292	E22 - N24	2530000.000	410000.000
43 8 6.22213	88 0 51.33046	-.276	E22 - N25	2530000.000	420000.000
43 9 44.97012	88 0 48.11766	-.266	E22 - N26	2530000.000	430000.000
43 11 23.71780	88 0 44.90196	-.262	E22 - N27	2530000.000	440000.000
43 13 2.46515	88 0 41.68338	-.249	E22 - N28	2530000.000	450000.000
43 14 41.21214	88 0 38.46189	-.236	E22 - N29	2530000.000	460000.000
43 16 19.95876	88 0 35.23751	-.213	E22 - N30	2530000.000	470000.000
43 17 58.70498	88 0 32.01022	-.194	E22 - N31	2530000.000	480000.000
43 19 37.45077	88 0 28.78003	-.184	E22 - N32	2530000.000	490000.000
43 21 16.19612	88 0 25.54692	-.171	E22 - N33	2530000.000	500000.000
43 22 54.94101	88 0 22.31089	-.161	E22 - N34	2530000.000	510000.000
43 24 33.68540	88 0 19.07195	-.151	E22 - N35	2530000.000	520000.000
43 26 12.42928	88 0 15.83008	-.144	E22 - N36	2530000.000	530000.000
43 27 51.17262	88 0 12.58529	-.131	E22 - N37	2530000.000	540000.000
43 29 29.91540	88 0 9.33756	-.118	E22 - N38	2530000.000	550000.000
43 31 8.65761	88 0 6.08690	-.102	E22 - N39	2530000.000	560000.000
43 32 47.39921	88 0 2.83329	-.085	E22 - N40	2530000.000	570000.000
43 34 26.14018	87 59 59.57675	-.066	E22 - N41	2530000.000	580000.000
42 28 33.88694	87 59 54.19014	-.249	E23 - N 1	2540000.000	180000.000
42 30 12.63458	87 59 50.98625	-.246	E23 - N 2	2540000.000	190000.000
42 31 51.38246	87 59 47.77950	-.253	E23 - N 3	2540000.000	200000.000
42 33 30.13053	87 59 44.56990	-.259	E23 - N 4	2540000.000	210000.000
42 35 8.87879	87 59 41.35745	-.256	E23 - N 5	2540000.000	220000.000
42 36 47.62722	87 59 38.14213	-.256	E23 - N 6	2540000.000	230000.000
42 38 26.37577	87 59 34.92395	-.256	E23 - N 7	2540000.000	240000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 40 5.12445	87 59 31.70290	-.259	E23 - N 8	2540000.000	250000.000
42 41 43.87322	87 59 28.47897	-.262	E23 - N 9	2540000.000	260000.000
42 43 22.62206	87 59 25.25217	-.249	E23 - N10	2540000.000	270000.000
42 45 1.37095	87 59 22.02249	-.236	E23 - N11	2540000.000	280000.000
42 46 40.11986	87 59 18.78993	-.236	E23 - N12	2540000.000	290000.000
42 48 18.86878	87 59 15.55447	-.240	E23 - N13	2540000.000	300000.000
42 49 57.61768	87 59 12.31613	-.259	E23 - N14	2540000.000	310000.000
42 51 36.36654	87 59 9.07489	-.272	E23 - N15	2540000.000	320000.000
42 53 15.11534	87 59 5.83074	-.279	E23 - N16	2540000.000	330000.000
42 54 53.86405	87 59 2.58370	-.282	E23 - N17	2540000.000	340000.000
42 56 32.61265	87 58 59.33375	-.282	E23 - N18	2540000.000	350000.000
42 58 11.36113	87 58 56.08088	-.289	E23 - N19	2540000.000	360000.000
42 59 50.10945	87 58 52.82511	-.295	E23 - N20	2540000.000	370000.000
43 1 28.85759	87 58 49.56641	-.292	E23 - N21	2540000.000	380000.000
43 3 7.60554	87 58 46.30479	-.289	E23 - N22	2540000.000	390000.000
43 4 46.35327	87 58 43.04024	-.308	E23 - N23	2540000.000	400000.000
43 6 25.10075	87 58 39.77276	-.318	E23 - N24	2540000.000	410000.000
43 8 3.84797	87 58 36.50234	-.299	E23 - N25	2540000.000	420000.000
43 9 42.59490	87 58 33.22899	-.282	E23 - N26	2540000.000	430000.000
43 11 21.34153	87 58 29.95269	-.266	E23 - N27	2540000.000	440000.000
43 13 .08781	87 58 26.67345	-.249	E23 - N28	2540000.000	450000.000
43 14 38.83375	87 58 23.39125	-.233	E23 - N29	2540000.000	460000.000
43 16 17.57930	87 58 20.10610	-.217	E23 - N30	2540000.000	470000.000
43 17 56.32446	87 58 16.81800	-.197	E23 - N31	2540000.000	480000.000
43 19 35.06919	87 58 13.52692	-.184	E23 - N32	2540000.000	490000.000
43 21 13.81348	87 58 10.23289	-.171	E23 - N33	2540000.000	500000.000
43 22 52.55730	87 58 6.93588	-.161	E23 - N34	2540000.000	510000.000
43 24 31.30062	87 58 3.63589	-.154	E23 - N35	2540000.000	520000.000
43 26 10.04344	87 58 .33293	-.144	E23 - N36	2540000.000	530000.000
43 27 48.78572	87 57 57.02698	-.135	E23 - N37	2540000.000	540000.000
43 29 27.52744	87 57 53.71805	-.118	E23 - N38	2540000.000	550000.000
43 31 6.26857	87 57 50.40613	-.098	E23 - N39	2540000.000	560000.000
43 32 45.00911	87 57 47.09121	-.079	E23 - N40	2540000.000	570000.000
43 34 23.74902	87 57 43.77329	-.059	E23 - N41	2540000.000	580000.000
42 28 31.49423	87 57 40.80190	-.259	E24 - N 1	2550000.000	180000.000
42 30 10.24081	87 57 37.53874	-.256	E24 - N 2	2550000.000	190000.000
42 31 48.98761	87 57 34.27269	-.259	E24 - N 3	2550000.000	200000.000
42 33 27.73461	87 57 31.00372	-.262	E24 - N 4	2550000.000	210000.000
42 35 6.48180	87 57 27.73185	-.259	E24 - N 5	2550000.000	220000.000
42 36 45.22915	87 57 24.45706	-.259	E24 - N 6	2550000.000	230000.000
42 38 23.97664	87 57 21.17935	-.259	E24 - N 7	2550000.000	240000.000
42 40 2.72424	87 57 17.89872	-.259	E24 - N 8	2550000.000	250000.000
42 41 41.47194	87 57 14.61516	-.259	E24 - N 9	2550000.000	260000.000
42 43 20.21971	87 57 11.32868	-.236	E24 - N10	2550000.000	270000.000
42 44 58.96752	87 57 8.03926	-.210	E24 - N11	2550000.000	280000.000
42 46 37.71536	87 57 4.74691	-.210	E24 - N12	2550000.000	290000.000
42 48 16.46321	87 57 1.45161	-.217	E24 - N13	2550000.000	300000.000
42 49 55.21103	87 56 58.15337	-.246	E24 - N14	2550000.000	310000.000
42 51 33.95882	87 56 54.85217	-.269	E24 - N15	2550000.000	320000.000
42 53 12.70654	87 56 51.54803	-.276	E24 - N16	2550000.000	330000.000
42 54 51.45417	87 56 48.24093	-.279	E24 - N17	2550000.000	340000.000
42 56 30.20170	87 56 44.93086	-.282	E24 - N18	2550000.000	350000.000
42 58 8.94910	87 56 41.61783	-.295	E24 - N19	2550000.000	360000.000
42 59 47.69634	87 56 38.30183	-.315	E24 - N20	2550000.000	370000.000
43 1 26.44341	87 56 34.98286	-.315	E24 - N21	2550000.000	380000.000
43 3 5.19028	87 56 31.66091	-.308	E24 - N22	2550000.000	390000.000
43 4 43.93692	87 56 28.33598	-.328	E24 - N23	2550000.000	400000.000
43 6 22.68333	87 56 25.00807	-.335	E24 - N24	2550000.000	410000.000
43 8 1.42947	87 56 21.67716	-.312	E24 - N25	2550000.000	420000.000
43 9 40.17532	87 56 18.34326	-.285	E24 - N26	2550000.000	430000.000
43 11 18.92086	87 56 15.00637	-.262	E24 - N27	2550000.000	440000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 12 57.66607	87 56 11.66647	-.243	E24 - N28	2550000.000	450000.000
43 14 36.41092	87 56 8.32357	-.230	E24 - N29	2550000.000	460000.000
43 16 15.15540	87 56 4.97766	-.213	E24 - N30	2550000.000	470000.000
43 17 53.89947	87 56 1.62873	-.194	E24 - N31	2550000.000	480000.000
43 19 32.64312	87 55 58.27679	-.180	E24 - N32	2550000.000	490000.000
43 21 11.38632	87 55 54.92182	-.171	E24 - N33	2550000.000	500000.000
43 22 50.12906	87 55 51.56383	-.157	E24 - N34	2550000.000	510000.000
43 24 28.87130	87 55 48.20281	-.148	E24 - N35	2550000.000	520000.000
43 26 7.61303	87 55 44.83876	-.144	E24 - N36	2550000.000	530000.000
43 27 46.35422	87 55 41.47167	-.135	E24 - N37	2550000.000	540000.000
43 29 25.09486	87 55 38.10153	-.118	E24 - N38	2550000.000	550000.000
43 31 3.83491	87 55 34.72835	-.102	E24 - N39	2550000.000	560000.000
43 32 42.57436	87 55 31.35212	-.079	E24 - N40	2550000.000	570000.000
43 34 21.31318	87 55 27.97283	-.062	E24 - N41	2550000.000	580000.000
42 28 29.05765	87 55 27.41656	-.262	E25 - N 1	2560000.000	180000.000
42 30 7.80313	87 55 24.09415	-.262	E25 - N 2	2560000.000	190000.000
42 31 46.54884	87 55 20.76878	-.262	E25 - N 3	2560000.000	200000.000
42 33 25.29476	87 55 17.44045	-.259	E25 - N 4	2560000.000	210000.000
42 35 4.04086	87 55 14.10916	-.259	E25 - N 5	2560000.000	220000.000
42 36 42.78712	87 55 10.77490	-.262	E25 - N 6	2560000.000	230000.000
42 38 21.53351	87 55 7.43767	-.262	E25 - N 7	2560000.000	240000.000
42 40 28.002	87 55 4.09747	-.262	E25 - N 8	2560000.000	250000.000
42 41 39.02663	87 55 7.5429	-.262	E25 - N 9	2560000.000	260000.000
42 43 17.77330	87 54 57.40812	-.226	E25 - N10	2560000.000	270000.000
42 44 56.52002	87 54 54.05897	-.184	E25 - N11	2560000.000	280000.000
42 46 35.26677	87 54 50.70683	-.184	E25 - N12	2560000.000	290000.000
42 48 14.01352	87 54 47.35169	-.187	E25 - N13	2560000.000	300000.000
42 49 52.76025	87 54 43.99355	-.223	E25 - N14	2560000.000	310000.000
42 51 31.50694	87 54 40.63241	-.253	E25 - N15	2560000.000	320000.000
42 53 10.25356	87 54 37.26827	-.266	E25 - N16	2560000.000	330000.000
42 54 49.00010	87 54 33.90111	-.272	E25 - N17	2560000.000	340000.000
42 56 27.74653	87 54 30.53094	-.272	E25 - N18	2560000.000	350000.000
42 58 6.49283	87 54 27.15775	-.299	E25 - N19	2560000.000	360000.000
42 59 45.23898	87 54 23.78153	-.335	E25 - N20	2560000.000	370000.000
43 1 23.98495	87 54 20.40229	-.348	E25 - N21	2560000.000	380000.000
43 3 2.73072	87 54 17.02002	-.358	E25 - N22	2560000.000	390000.000
43 4 41.47627	87 54 13.63471	-.335	E25 - N23	2560000.000	400000.000
43 6 20.22158	87 54 10.24636	-.308	E25 - N24	2560000.000	410000.000
43 7 58.96662	87 54 6.85497	-.279	E25 - N25	2560000.000	420000.000
43 9 37.71137	87 54 3.46054	-.256	E25 - N26	2560000.000	430000.000
43 11 16.45581	87 54 0.06305	-.243	E25 - N27	2560000.000	440000.000
43 12 55.19992	87 53 56.66250	-.233	E25 - N28	2560000.000	450000.000
43 14 33.94367	87 53 53.25889	-.223	E25 - N29	2560000.000	460000.000
43 16 12.68704	87 53 49.85222	-.207	E25 - N30	2560000.000	470000.000
43 17 51.43001	87 53 46.44249	-.190	E25 - N31	2560000.000	480000.000
43 19 30.17256	87 53 43.02968	-.177	E25 - N32	2560000.000	490000.000
43 21 8.91466	87 53 39.61379	-.167	E25 - N33	2560000.000	500000.000
43 22 47.65629	87 53 36.19482	-.148	E25 - N34	2560000.000	510000.000
43 24 26.39743	87 53 32.77277	-.135	E25 - N35	2560000.000	520000.000
43 26 5.13806	87 53 29.34763	-.138	E25 - N36	2560000.000	530000.000
43 27 43.87815	87 53 25.91939	-.135	E25 - N37	2560000.000	540000.000
43 29 22.61768	87 53 22.48806	-.121	E25 - N38	2560000.000	550000.000
43 31 1.35662	87 53 19.05363	-.105	E25 - N39	2560000.000	560000.000
43 32 40.09497	87 53 15.61609	-.085	E25 - N40	2560000.000	570000.000
43 34 18.83268	87 53 12.17544	-.069	E25 - N41	2560000.000	580000.000
42 28 26.57719	87 53 14.03417	-.266	E26 - N 1	2570000.000	180000.000
42 30 5.32156	87 53 10.65250	-.266	E26 - N 2	2570000.000	190000.000
42 31 44.06617	87 53 7.26783	-.262	E26 - N 3	2570000.000	200000.000
42 33 22.81097	87 53 3.88014	-.262	E26 - N 4	2570000.000	210000.000
42 35 1.55596	87 53 4.8944	-.262	E26 - N 5	2570000.000	220000.000
42 36 40.30111	87 52 57.09572	-.262	E26 - N 6	2570000.000	230000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
42 38 19.04639	87 52 53.69897	-.262	E26 - N 7	2570000.000	240000.000
42 39 57.79179	87 52 50.29920	-.256	E26 - N 8	2570000.000	250000.000
42 41 36.53728	87 52 46.89639	-.246	E26 - N 9	2570000.000	260000.000
42 43 15.28284	87 52 43.49055	-.213	E26 - N10	2570000.000	270000.000
42 44 54.02845	87 52 40.08167	-.171	E26 - N11	2570000.000	280000.000
42 46 32.77408	87 52 36.66974	-.171	E26 - N12	2570000.000	290000.000
42 48 11.51972	87 52 33.25477	-.177	E26 - N13	2570000.000	300000.000
42 49 50.26534	87 52 29.83675	-.210	E26 - N14	2570000.000	310000.000
42 51 29.01091	87 52 26.41566	-.236	E26 - N15	2570000.000	320000.000
42 53 7.75642	87 52 22.99152	-.256	E26 - N16	2570000.000	330000.000
42 54 46.50184	87 52 19.56431	-.266	E26 - N17	2570000.000	340000.000
42 56 25.24716	87 52 16.13404	-.269	E26 - N18	2570000.000	350000.000
42 58 3.99234	87 52 12.70069	-.292	E26 - N19	2570000.000	360000.000
42 59 42.73737	87 52 9.26426	-.325	E26 - N20	2570000.000	370000.000
43 1 21.48222	87 52 5.82476	-.338	E26 - N21	2570000.000	380000.000
43 3 22.688	87 52 2.38216	-.348	E26 - N22	2570000.000	390000.000
43 4 38.97131	87 51 58.93648	-.325	E26 - N23	2570000.000	400000.000
43 6 17.71550	87 51 55.48771	-.302	E26 - N24	2570000.000	410000.000
43 7 56.45942	87 51 52.03583	-.276	E26 - N25	2570000.000	420000.000
43 9 35.20305	87 51 48.58086	-.253	E26 - N26	2570000.000	430000.000
43 11 13.94637	87 51 45.12278	-.243	E26 - N27	2570000.000	440000.000
43 12 52.68936	87 51 41.66159	-.230	E26 - N28	2570000.000	450000.000
43 14 31.43199	87 51 38.19728	-.217	E26 - N29	2570000.000	460000.000
43 16 10.17424	87 51 34.72986	-.200	E26 - N30	2570000.000	470000.000
43 17 48.91609	87 51 31.25931	-.184	E26 - N31	2570000.000	480000.000
43 19 27.65751	87 51 27.78564	-.167	E26 - N32	2570000.000	490000.000
43 21 6.39849	87 51 24.30883	-.151	E26 - N33	2570000.000	500000.000
43 22 45.13900	87 51 20.82889	-.125	E26 - N34	2570000.000	510000.000
43 24 23.87901	87 51 17.34581	-.108	E26 - N35	2570000.000	520000.000
43 26 2.61852	87 51 13.85959	-.125	E26 - N36	2570000.000	530000.000
43 27 41.35748	87 51 10.37022	-.135	E26 - N37	2570000.000	540000.000
43 29 20.09589	87 51 6.87769	-.128	E26 - N38	2570000.000	550000.000
43 30 58.83371	87 51 3.38201	-.115	E26 - N39	2570000.000	560000.000
43 32 37.57093	87 50 59.88317	-.092	E26 - N40	2570000.000	570000.000
43 34 16.30752	87 50 56.38116	-.072	E26 - N41	2570000.000	580000.000
42 28 24.05286	87 51 65.478	-.279	E27 - N 1	2580000.000	180000.000
42 30 2.79610	87 50 57.21387	-.276	E27 - N 2	2580000.000	190000.000
42 31 41.53958	87 50 53.76989	-.269	E27 - N 3	2580000.000	200000.000
42 33 20.28325	87 50 50.32285	-.266	E27 - N 4	2580000.000	210000.000
42 34 59.02711	87 50 46.87274	-.266	E27 - N 5	2580000.000	220000.000
42 36 37.77113	87 50 43.41956	-.266	E27 - N 6	2580000.000	230000.000
42 38 16.51528	87 50 39.96330	-.262	E27 - N 7	2580000.000	240000.000
42 39 55.25955	87 50 36.50396	-.249	E27 - N 8	2580000.000	250000.000
42 41 34.00390	87 50 33.04153	-.230	E27 - N 9	2580000.000	260000.000
42 43 12.74833	87 50 29.57602	-.203	E27 - N10	2580000.000	270000.000
42 44 51.49281	87 50 26.10741	-.171	E27 - N11	2580000.000	280000.000
42 46 30.23731	87 50 22.63571	-.174	E27 - N12	2580000.000	290000.000
42 48 8.98181	87 50 19.16090	-.184	E27 - N13	2580000.000	300000.000
42 49 47.72629	87 50 15.68299	-.210	E27 - N14	2580000.000	310000.000
42 51 26.47073	87 50 12.20197	-.233	E27 - N15	2580000.000	320000.000
42 53 5.21511	87 50 8.71784	-.249	E27 - N16	2580000.000	330000.000
42 54 43.95940	87 50 5.23058	-.262	E27 - N17	2580000.000	340000.000
42 56 22.70358	87 50 1.74021	-.269	E27 - N18	2580000.000	350000.000
42 58 1.44762	87 49 58.24670	-.285	E27 - N19	2580000.000	360000.000
42 59 40.19152	87 49 54.75007	-.312	E27 - N20	2580000.000	370000.000
43 1 18.93523	87 49 51.25030	-.322	E27 - N21	2580000.000	380000.000
43 2 57.67875	87 49 47.74740	-.328	E27 - N22	2580000.000	390000.000
43 4 36.42204	87 49 44.24135	-.312	E27 - N23	2580000.000	400000.000
43 6 15.16509	87 49 40.73215	-.292	E27 - N24	2580000.000	410000.000
43 7 53.90787	87 49 37.21980	-.272	E27 - N25	2580000.000	420000.000
43 9 32.65036	87 49 33.70429	-.253	E27 - N26	2580000.000	430000.000

VERTCON Version 2.0 Results (Answer in feet)

Latitude	Longitude	Answer	Grid	NAD27X	NAD27Y
43 11 11.39254	87 49 30.18562	-.240	E27 - N27	2580000.000	440000.000
43 12 50.13439	87 49 26.66379	-.226	E27 - N28	2580000.000	450000.000
43 14 28.87588	87 49 23.13879	-.213	E27 - N29	2580000.000	460000.000
43 16 7.61699	87 49 19.61062	-.197	E27 - N30	2580000.000	470000.000
43 17 46.35770	87 49 16.07927	-.184	E27 - N31	2580000.000	480000.000
43 19 25.09798	87 49 12.54473	-.167	E27 - N32	2580000.000	490000.000
43 21 3.83782	87 49 9.00701	-.148	E27 - N33	2580000.000	500000.000
43 22 42.57718	87 49 5.46611	-.128	E27 - N34	2580000.000	510000.000
43 24 21.31605	87 49 1.92200	-.115	E27 - N35	2580000.000	520000.000
43 26 .05441	87 48 58.37470	-.135	E27 - N36	2580000.000	530000.000
43 27 38.79223	87 48 54.82419	-.144	E27 - N37	2580000.000	540000.000
43 29 17.52949	87 48 51.27048	-.141	E27 - N38	2580000.000	550000.000
43 30 56.26617	87 48 47.71355	-.135	E27 - N39	2580000.000	560000.000
43 32 35.00224	87 48 44.15341	-.125	E27 - N40	2580000.000	570000.000
43 34 13.73769	87 48 40.59004	-.089	E27 - N41	2580000.000	580000.000
42 28 21.48465	87 48 47.27845	-.315	E28 - N 1	2590000.000	180000.000
42 30 .22675	87 48 43.77829	-.299	E28 - N 2	2590000.000	190000.000
42 31 38.96907	87 48 40.27502	-.282	E28 - N 3	2590000.000	200000.000
42 33 17.71160	87 48 36.76863	-.266	E28 - N 4	2590000.000	210000.000
42 34 56.45431	87 48 33.25911	-.269	E28 - N 5	2590000.000	220000.000
42 36 35.19717	87 48 29.74647	-.269	E28 - N 6	2590000.000	230000.000
42 38 13.94018	87 48 26.23071	-.269	E28 - N 7	2590000.000	240000.000
42 39 52.68329	87 48 22.71181	-.266	E28 - N 8	2590000.000	250000.000
42 41 31.42650	87 48 19.18977	-.262	E28 - N 9	2590000.000	260000.000
42 43 10.16978	87 48 15.66458	-.233	E28 - N10	2590000.000	270000.000
42 44 48.91310	87 48 12.13626	-.190	E28 - N11	2590000.000	280000.000
42 46 27.65645	87 48 8.60478	-.190	E28 - N12	2590000.000	290000.000
42 48 6.39980	87 48 5.07014	-.200	E28 - N13	2590000.000	300000.000
42 49 45.14313	87 48 1.53235	-.223	E28 - N14	2590000.000	310000.000
42 51 23.88641	87 47 57.99139	-.240	E28 - N15	2590000.000	320000.000
42 53 2.62963	87 47 54.44727	-.253	E28 - N16	2590000.000	330000.000
42 54 41.37276	87 47 50.89998	-.266	E28 - N17	2590000.000	340000.000
42 56 20.11579	87 47 47.34950	-.272	E28 - N18	2590000.000	350000.000
42 57 58.85868	87 47 43.79585	-.282	E28 - N19	2590000.000	360000.000
42 59 37.60141	87 47 40.23902	-.299	E28 - N20	2590000.000	370000.000
43 1 16.34397	87 47 36.67899	-.305	E28 - N21	2590000.000	380000.000
43 2 55.08633	87 47 33.11577	-.308	E28 - N22	2590000.000	390000.000
43 4 33.82847	87 47 29.54936	-.295	E28 - N23	2590000.000	400000.000
43 6 12.57036	87 47 25.97974	-.282	E28 - N24	2590000.000	410000.000
43 7 51.31198	87 47 22.40691	-.266	E28 - N25	2590000.000	420000.000
43 9 30.05331	87 47 18.83088	-.249	E28 - N26	2590000.000	430000.000
43 11 8.79433	87 47 15.25163	-.236	E28 - N27	2590000.000	440000.000
43 12 47.53502	87 47 11.66916	-.223	E28 - N28	2590000.000	450000.000
43 14 26.27535	87 47 8.08347	-.210	E28 - N29	2590000.000	460000.000
43 16 5.01530	87 47 4.49455	-.197	E28 - N30	2590000.000	470000.000
43 17 43.75484	87 47 .90240	-.184	E28 - N31	2590000.000	480000.000
43 19 22.49397	87 46 57.30701	-.171	E28 - N32	2590000.000	490000.000
43 21 1.23264	87 46 53.70839	-.154	E28 - N33	2590000.000	500000.000
43 22 39.97084	87 46 50.10651	-.141	E28 - N34	2590000.000	510000.000
43 24 18.70855	87 46 46.50139	-.131	E28 - N35	2590000.000	520000.000
43 25 57.44575	87 46 42.89301	-.141	E28 - N36	2590000.000	530000.000
43 27 36.18240	87 46 39.28137	-.144	E28 - N37	2590000.000	540000.000
43 29 14.91850	87 46 35.66648	-.144	E28 - N38	2590000.000	550000.000
43 30 53.65401	87 46 32.04831	-.135	E28 - N39	2590000.000	560000.000
43 32 32.38892	87 46 28.42687	-.118	E28 - N40	2590000.000	570000.000
43 34 11.12319	87 46 24.80216	-.075	E28 - N41	2590000.000	580000.000

(This page intentionally left blank)

Appendix B

COMPARISON OF VERTCON PREDICTED DIFFERENCES WITH PUBLISHED DATUM DIFFERENCES AT FIRST- AND SECOND-ORDER USC&GS AND NGS BENCHMARKS IN SOUTHEASTERN WISCONSIN

(This page intentionally left blank)

Appendix B-1

Comments and Overview

This appendix contains a comparison of datum differences as predicted by the program, VERTCON, with differences obtained by subtracting published NGVD 29 elevations from recently published NAVD 88 elevations for the same points. Comparisons were made for all First- and Second-Order bench marks established and/or published by the NGS throughout the seven-county Region. The following items are included in Appendix B:

Data Set:

The format of the data file (sans the header) is compatible with Free Format #2 as required by VERTCON and includes the latitude/longitude position of the point, its name, the agency who established it, the assigned order & class, elevations for both NAVD 88 and NGVD 29 in meters, and the Permanent Identification (PID) number. This file is used as input for two programs, VERTCON and COMPARE.

VERTCON Results:

This file is the output of VERTCON after using the previous data set as input. VERTCON adds the middle column of numbers preceding the station name and listed under "meters." This file is also used in the COMPARE program.

Difference of Differences:

The program "COMPARE" (Version 4) was used to read both data files, to tabulate the differences (in compatible feet units), to compute state plane coordinates for each bench mark, and to show the comparison of differences as the "fit." There are 435 points listed sequentially and alphabetically.

Listing of VERTCON Misfits:

The listing of results for all 435 points ranks them by misfit (worst to best) in a format which can be used to plot each bench mark location by state plane coordinates, show the misfit at the point, and label the point by name.

Summary and Conclusions:

The VERTCON misfits are summarized according to magnitude and pertinent comments are made about the number of points falling into each category. Finally, conclusions drawn from the comparisons are listed.

Appendix B-2

Data Set: First- & Second-Order USC&GS and NGS Benchmark Elevations on NGVD 29 and NAVD 88

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
43 02 14.0	087 54 52.0	102	WI3100	1/0	181.215	181.321	OL0154
43 20 03.0	088 17 07.0	1068.964	USGS	2/0	325.701	325.755	OM0065
43 05 48.0	088 01 38.0	154	WI3100	2/0	230.556	230.640	OM0120
43 05 22.0	088 01 44.0	156	WI3100	2/0	226.832	226.916	OM0119
43 02 33.0	087 54 18.0	2 USLS	USLS	2/0	193.584	193.674	OL0132
43 03 16.0	088 02 46.0	219	CGS	2/0	212.330	212.414	OM0080
42 48 51.0	087 54 52.0	35-422	WI-101	1/0	219.666	219.634	NG0326
42 59 59.0	088 15 22.0	37	WIGS	2/0	246.872	246.945	NH0013
43 06 30.0	088 26 36.0	398	CGS	2/0	274.664	274.728	OM0105
43 06 25.0	088 25 54.0	399	CGS	2/0	274.678	274.742	OM0104
43 05 59.0	088 23 39.0	400	CGS	2/0	284.277	284.342	OM0101
43 04 42.0	088 14 28.0	44	CGS	2/0	263.418	263.490	OM0088
43 05 00.0	088 15 30.0	45	CGS	2/0	260.032	260.105	OM0089
43 05 27.0	088 18 22.0	46	CGS	2/0	266.297	266.367	OM0095
43 05 36.0	088 18 46.0	47	CGS	2/0	268.966	269.035	OM0096
43 06 00.0	088 20 34.0	48	CGS	2/0	281.784	281.850	OM0097
43 05 58.0	088 21 25.0	49	CGS	2/0	285.564	285.629	OM0099
43 06 07.0	088 22 56.0	50	CGS	2/0	284.945	285.010	OM0100
42 42 52.0	087 47 58.0	52.06	WIHD	1/0	192.806	192.87	NG0368
42 56 40.0	087 54 34.0	58-02	WI3100	1/0	212.137	212.21	NG0347
42 56 20.0	087 54 34.0	65-19	WI3100	1/0	212.446	212.52	NG0345
42 55 49.0	087 54 35.0	68-04	WI3100	1/0	222.930	223.01	NG0344
43 06 17.0	088 01 39.0	750	WI3100	2/0	228.616	228.700	OM0121
43 00 18.0	088 13 55.0	822	USGS	2/0	250.272	250.343	OM0116
43 05 08.0	088 15 58.0	856	CGS	2/0	260.678	260.750	OM0094
43 04 02.0	088 01 37.0	905	WI3100	2/0	213.248	213.332	OM0118
43 00 09.0	087 53 22.0	908 7057 TOWER	USLS	1/2	181.897	182.00	OL0279
43 05 54.0	088 24 09.0	940	USGS	2/0	286.325	286.390	OM0102
43 19 11.0	088 22 50.0	983	USGS	2/0	299.498	299.556	OM0060
43 02 28.0	088 03 45.0	A 106	CGS	2/0	221.474	221.556	OM0081
42 44 25.0	088 33 07.0	A 115	-	2/0	274.065	274.12	NH0792
42 42 28.0	087 49 33.0	A 116	CGS	1/0	203.361	203.419	NG0294
42 33 49.0	088 49 53.0	A 118	CGS	2/0	287.942	288.000	NH0268
43 03 18.0	088 01 38.0	A 120	CGS	2/0	207.549	207.633	OM0117
43 07 57.0	087 57 05.0	A 134	NGS	1/0	209.239	209.33	OL0116
42 53 24.0	087 54 41.0	A 137	NGS	1/0	215.649	215.618	NG0334
42 43 36.0	087 46 56.0	A 138	NGS	1/0	191.617	191.67	NG0365
42 29 41.0	088 25 21.0	A 17	CGS	2/0	268.786	268.852	NH0086
42 28 44.0	088 22 44.0	A 226	CGS	2/0	270.213	270.278	NH0093
42 38 33.0	088 24 50.0	A 3	CGS	1/2	259.736	259.804	NH0002
43 09 46.0	087 59 51.0	A 4	CGS	2/0	222.345	222.425	OL0119
42 56 51.0	087 54 03.0	A 72	CGS	1/0	206.212	206.297	NG0350
43 19 13.0	088 22 47.0	A 86	CGS	2/0	300.378	300.435	OM0061
43 23 13.0	087 52 55.0	A 87	CGS	2/0	204.481	204.528	OL0071
42 42 34.0	088 32 31.0	AA 115	CGS	2/0	278.016	278.07	NH0334
42 57 29.0	087 53 32.0	AP 1960 STA A	CGS	1/0	203.919	204.00	NG0356
42 57 29.0	087 53 31.0	AP 1965 STA A2	CGS	1/0	203.937	204.02	NG0357
42 55 52.0	087 53 49.0	AP STA B 2	CGS	1/0	213.464	213.433	NG0342
42 55 52.0	087 53 49.0	AP STA B	CGS	1/0	213.589	213.67	NG0343
43 06 21.0	088 01 49.0	AP STA A	CGS	2/0	225.806	225.891	OM0122

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
42 56 52.0	087 53 47.0	ARP 2	CGS	1/0	203.712	203.786	NG0349
43 02 33.0	088 04 45.0	B 106	CGS	2/0	227.277	227.356	OM0082
42 41 37.0	088 32 30.0	B 115	CGS	2/0	302.109	302.171	NH0336
42 42 19.0	087 51 05.0	B 116	CGS	1/0	220.516	220.586	NG0296
42 34 09.0	088 48 56.0	B 118	CGS	2/0	282.961	283.022	NH0269
43 06 26.0	088 01 37.0	B 120	CGS	2/0	226.072	226.157	OM0123
43 07 15.0	087 56 06.0	B 134	NGS	1/0	197.544	197.64	OL0121
42 54 02.0	087 54 40.0	B 137	NGS	1/0	220.519	220.488	NG0335
42 43 33.0	087 47 19.0	B 138	NGS	1/0	189.789	189.84	NG0366
42 28 48.0	088 23 03.0	B 17	CGS	2/0	271.051	271.116	NH0092
42 26 59.0	087 49 05.0	B 19	CGS	2/0	181.706	181.818	NG0225
42 27 03.0	088 18 23.0	B 226	CGS	2/0	243.178	243.252	NH0101
42 39 04.0	088 21 33.0	B 3	CGS	1/2	244.281	244.353	NH0003
43 10 39.0	088 02 42.0	B 4	CGS	2/0	224.500	224.580	OM0046
42 33 09.0	088 51 44.0	B 78	CGS	2/0	289.116	289.169	NH0266
43 19 06.0	088 22 38.0	B 86	CGS	2/0	302.408	302.466	OM0062
43 23 14.0	087 52 32.0	B 87 RESET '51	CGS	1/0	186.343	186.38	OL0074
43 23 14.0	087 52 32.0	B 87	CGS	2/0	186.188	186.235	OL0073
43 03 13.0	087 53 13.0	B	USLS	1/0	181.637	181.73	OL0146
42 44 04.0	087 47 04.0	BOHN	USLS	1/0	179.945	179.906	NG0361
43 23 16.0	087 52 09.0	BOLLARD	USLS	1/0	180.057	180.09	OL0079
43 03 39.0	088 06 34.0	C 106	CGS	2/0	252.367	252.443	OM0084
42 41 04.0	088 32 30.0	C 115	-	2/0	309.036	309.098	NH0855
42 42 11.0	087 52 46.0	C 116	CGS	1/0	206.616	206.698	NG0300
42 34 34.0	088 47 45.0	C 118	CGS	2/0	284.598	284.662	NH0271
43 06 52.0	087 55 28.0	C 134	NGS	1/0	192.023	192.12	OL0122
42 52 37.0	087 54 42.0	C 137	NGS	1/0	206.987	206.956	NG0333
42 43 12.0	087 47 37.0	C 138	NGS	1/0	191.796	191.86	NG0367
42 28 24.0	088 20 43.0	C 17	CGS	2/0	269.752	269.822	NH0095
43 12 22.0	088 04 39.0	C 4	CGS	1/2	252.773	252.847	OM0047
42 33 25.0	088 50 59.0	C 78	CGS	2/0	289.793	289.848	NH0267
43 19 43.0	088 19 07.0	C 86	CGS	2/0	310.286	310.343	OM0063
43 23 18.0	087 52 17.0	C 87 RESET '69	CGS	1/0	189.271	189.31	OL0076
43 23 18.0	087 52 17.0	C 87	CGS	2/0	188.618	188.664	OL0075
43 00 05.0	087 53 16.0	CAP	USLS	1/0	178.883	178.99	OL0282
42 55 43.0	087 55 00.0	CAROV L N BASE	CGS	1/0	230.318	230.288	NG0339
42 55 44.0	087 55 00.0	CAROV L NB RM 1	CGS	1/0	229.824	229.794	NG0340
42 55 42.0	087 55 00.0	CAROV L NB RM 2	CGS	1/0	230.120	230.090	NG0338
43 32 34.0	087 49 50.0	CEDAR AZ	CGS	1/0	231.086	231.11	OL0166
43 02 29.0	087 54 31.0	CITY HALL	USLS	1/0	181.098	181.200	OL0131
42 35 20.0	087 48 56.0	CROSS	USLS	1/0	177.816	177.90	NG0263
42 35 14.0	088 45 00.0	D 115	CGS	2/0	264.779	264.849	NH0304
42 42 06.0	087 53 40.0	D 116	CGS	2/0	214.628	214.710	NG0301
42 34 48.0	088 46 41.0	D 118	CGS	2/0	280.303	280.369	NH0272
43 06 32.0	087 54 59.0	D 134	NGS	1/0	195.643	195.74	OL0124
42 51 23.0	087 54 46.0	D 137	NGS	1/0	217.859	217.827	NG0330
42 41 50.0	087 47 47.0	D 138	NGS	1/0	191.320	191.42	NG0288
42 27 24.0	088 18 23.0	D 17	CGS	2/0	248.602	248.676	NH0099
42 40 07.0	088 15 26.0	D 3	CGS	1/2	234.501	234.576	NH0007
43 14 08.0	088 06 08.0	D 4	CGS	1/2	267.787	267.85	OM0048
42 30 42.0	088 29 32.0	D 78	CGS	2/0	300.413	300.475	NH0329
43 19 48.0	088 17 22.0	D 86	CGS	2/0	320.430	320.484	OM0064
43 24 12.0	087 52 59.0	D 87	CGS	1/0	210.286	210.331	OL0070
42 34 39.0	088 47 33.0	DANE	CGS	2/0	282.166	282.219	NH0270
42 36 06.0	088 42 30.0	DARIEN	CGS	2/0	287.963	288.022	NH0277
42 34 58.0	088 45 43.0	DOOR	CGS	2/0	266.757	266.827	NH0273
43 04 20.0	088 09 44.0	E 106	CGS	2/0	253.103	253.178	OM0086
43 04 17.0	088 08 46.0	E 114	CGS	2/0	254.105	254.180	OM0107
42 34 49.0	088 43 01.0	E 115	-	2/0	278.606	278.65	NH0796
42 30 07.0	088 28 49.0	E 118	CGS	2/0	301.739	301.801	NH0024

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
43 05 47.0	087 53 59.0	E 134	NGS	1/0	199.154	199.24	OL0126
42 50 34.0	087 54 48.0	E 137	MRMSC	1/0	203.596	203.564	NG0328
42 40 30.0	087 48 20.0	E 138	NGS	1/0	187.885	187.96	NG0284
42 29 20.0	088 24 32.0	E 226	CGS	2/0	266.990	267.056	NH0087
42 40 31.0	088 11 16.0	E 3	CGS	1/2	244.637	244.713	NH0008
43 15 31.0	088 07 32.0	E 4	CGS	1/2	271.334	271.401	OM0049
42 31 11.0	088 32 24.0	E 78	CGS	2/0	314.437	314.497	NH0327
43 18 37.0	088 15 37.0	E 86	CGS	2/0	323.037	323.093	OM0066
43 25 53.0	087 52 22.0	E 87	CGS	2/0	215.946	215.990	OL0066
43 23 16.0	087 52 03.0	EAST USLS	USLS	1/0	178.054	178.09	OL0081
43 18 08.0	088 13 59.0	EE 86	CGS	2/0	305.330	305.389	OM0067
42 39 57.0	088 32 33.0	ELKHORN	CGS	2/0	304.360	304.422	NH0284
43 04 24.0	088 11 54.0	F 106	CGS	2/0	260.824	260.898	OM0087
43 03 56.0	088 09 41.0	F 114	CGS	2/0	251.683	251.757	OM0108
42 33 41.0	088 40 45.0	F 115	-	2/0	293.070	293.12	NH0797
42 30 07.0	088 27 42.0	F 118	CGS	2/0	295.219	295.282	NH0025
43 05 26.0	087 53 49.0	F 134	NGS	1/0	195.713	195.80	OL0127
42 49 33.0	087 54 50.0	F 137	NGS	1/0	208.745	208.713	NG0327
42 39 38.0	087 48 44.0	F 138	NGS	1/0	189.211	189.29	NG0283
42 28 32.0	088 21 35.0	F 226	CGS	2/0	269.060	269.128	NH0094
42 40 43.0	088 08 57.0	F 3	CGS	1/2	244.533	244.610	NH0009
43 17 41.0	088 09 41.0	F 4	CGS	1/2	257.541	257.60	OM0050
42 36 03.0	088 42 42.0	F 78	CGS	2/0	285.351	285.411	NH0276
43 16 42.0	088 12 44.0	F 86	CGS	2/0	295.591	295.652	OM0068
43 27 17.0	087 52 18.0	F 87	CGS	1/0	219.661	219.704	OL0064
43 15 24.0	088 11 35.0	FF 86	CGS	2/0	296.678	296.740	OM0069
43 03 13.0	087 53 12.0	FLUSHING	USLS	1/0	179.082	179.17	OL0147
43 10 08.0	087 53 00.0	FOX AZ	CGS	1/0	207.420	207.48	OL0104
43 10 02.0	087 53 07.0	FOX	CGS	1/0	209.374	209.44	OL0107
43 10 02.0	087 53 07.0	FOX RM 2	CGS	1/0	208.738	208.80	OL0105
43 10 02.0	087 53 07.0	FOX RM 1	CGS	1/0	208.577	208.64	OL0106
43 05 06.0	088 15 51.0	G 106	CGS	2/0	261.789	261.862	OM0090
43 03 08.0	088 11 31.0	G 114	CGS	2/0	250.751	250.825	OM0109
42 33 00.0	088 38 37.0	G 115	CGS	2/0	297.798	297.848	NH0312
42 29 59.0	088 26 32.0	G 118	CGS	2/0	275.679	275.745	NH0026
43 04 53.0	087 53 26.0	G 134	NGS	1/0	193.679	193.76	OL0128
42 48 51.0	087 54 52.0	G 137	NGS	1/0	218.704	218.74	NG0322
42 37 59.0	087 49 28.0	G 138	NGS	1/0	185.854	185.93	NG0277
42 28 16.0	088 20 05.0	G 226	CGS	2/0	265.651	265.722	NH0097
42 41 02.0	088 05 27.0	G 3	CGS	1/2	255.124	255.200	NH0010
43 19 25.0	088 09 58.0	G 4	CGS	1/2	273.190	273.253	OM0051
42 35 00.0	088 45 40.0	G 78	CGS	2/0	264.182	264.253	NH0274
43 14 33.0	088 09 41.0	G 86	CGS	2/0	274.934	275.002	OM0070
43 28 51.0	087 51 36.0	G 87	CGS	2/0	225.207	225.248	OL0062
43 05 01.0	088 15 51.0	H 106	CGS	2/0	260.651	260.724	OM0092
43 02 49.0	088 12 08.0	H 114	CGS	2/0	250.800	250.873	OM0110
42 32 21.0	088 36 36.0	H 115	CGS	2/0	304.155	304.20	NH0318
42 29 57.0	088 26 22.0	H 118	CGS	2/0	276.102	276.167	NH0027
43 04 07.0	087 53 28.0	H 134	NGS	1/0	191.084	191.17	OL0129
42 48 00.0	087 54 54.0	H 137	NGS	1/0	220.585	220.62	NG0320
42 37 26.0	087 49 33.0	H 138	NGS	1/0	188.184	188.26	NG0276
42 27 49.0	088 19 14.0	H 226	CGS	2/0	256.578	256.651	NH0098
42 29 32.0	087 49 00.0	H 273	NGS	1/0	181.800	181.90	NG0234
42 41 16.0	088 03 03.0	H 3	CGS	1/2	237.974	238.053	NH0011
43 22 07.0	088 09 53.0	H 4	CGS	1/2	292.768	292.823	OM0052
42 35 42.0	088 43 37.0	H 78	CGS	2/0	272.873	272.937	NH0275
43 13 41.0	088 06 37.0	H 86	CGS	2/0	262.896	262.970	OM0071
43 29 53.0	087 51 19.0	H 87	CGS	2/0	224.428	224.468	OL0060
43 01 43.0	087 54 13.0	HANSEN	USLS	1/0	179.965	180.06	OL0136
42 28 59.0	088 23 37.0	HEBRON AZ	CGS	2/0	271.928	271.993	NH0088

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
42 29 12.0	088 23 37.0	HEBRON	CGS	2/0	277.094	277.159	NH0091
42 29 12.0	088 23 37.0	HEBRON RM1	CGS	2/0	276.857	276.921	NH0090
42 29 12.0	088 23 37.0	HEBRON RM2	CGS	2/0	275.569	275.634	NH0089
43 13 36.0	088 06 07.0	HH 86	CGS	2/0	269.169	269.242	OM0072
42 48 51.0	087 53 52.0	HUSHER	CGS	1/0	228.540	228.508	NG0324
42 48 51.0	087 53 52.0	HUSHER RM 1	CGS	1/0	227.146	227.115	NG0323
42 48 51.0	087 53 52.0	HUSHER RM 2	CGS	1/0	229.032	229.001	NG0325
43 06 00.0	088 20 50.0	J 106	CGS	2/0	280.728	280.794	OM0098
43 01 21.0	088 13 19.0	J 114	CGS	2/0	248.730	248.803	OM0111
42 32 11.0	088 35 57.0	J 115	CGS	2/0	305.557	305.613	NH0319
43 03 10.0	087 53 11.0	J 134	NGS	1/0	179.260	179.35	OL0148
42 47 06.0	087 54 54.0	J 137	NGS	1/0	218.831	218.87	NG0319
42 36 55.0	087 49 31.0	J 138	NGS	1/0	187.139	187.22	NG0272
42 29 01.0	087 48 59.0	J 273	NGS	1/0	181.834	181.93	NG0232
42 41 31.0	088 00 18.0	J 3	CGS	1/2	228.248	228.329	NH0012
43 24 44.0	088 10 32.0	J 4	CGS	1/2	279.238	279.293	OM0053
42 35 03.0	088 44 33.0	J 78	CGS	2/0	269.536	269.605	NH0305
43 13 03.0	088 05 00.0	J 86	CGS	2/0	264.457	264.532	OM0073
43 30 50.0	087 50 57.0	J 87	CGS	1/0	223.140	223.180	OL0164
43 06 10.0	088 25 14.0	K 106	CGS	2/0	277.586	277.650	OM0103
43 00 42.0	088 13 53.0	K 114	CGS	2/0	249.534	249.606	OM0113
42 31 57.0	088 35 59.0	K 115	CGS	2/0	304.157	304.213	NH0320
43 30 00.0	087 51 16.0	K 133	NGS	1/0	223.556	223.59	OL0163
43 02 35.0	087 53 44.0	K 134	NGS	1/0	180.256	180.35	OL0149
42 46 13.0	087 54 52.0	K 137	NGS	1/0	220.793	220.83	NG0318
42 35 50.0	087 49 18.0	K 138	NGS	1/0	184.740	184.81	NG0270
42 28 01.0	087 48 57.0	K 273	NGS	1/0	180.855	180.95	NG0229
42 41 47.0	087 57 14.0	K 3	CGS	1/2	231.583	231.66	NG0303
43 25 36.0	088 10 55.0	K 4	CGS	1/2	272.014	272.069	OM0054
42 34 58.0	088 44 07.0	K 78	CGS	2/0	271.378	271.446	NH0306
43 11 31.0	088 03 57.0	K 86	CGS	2/0	236.411	236.490	OM0074
43 32 34.0	087 50 18.0	K 87	CGS	1/0	221.934	221.961	OL0168
42 34 03.0	087 49 28.0	KENOSHA 1	CGS	1/0	186.054	186.12	NG0257
42 35 03.0	087 49 31.0	KENOSHA 2	CGS	2/0	185.866	185.94	NG0260
42 37 23.0	087 49 35.0	KENOSHA 3	CGS	2/0	187.951	188.03	NG0274
42 35 21.0	087 48 55.0	KENOSHA LIGHT	USLS	1/0	184.169	184.25	NG0265
43 06 26.0	088 27 18.0	L 106	CGS	2/0	270.703	270.768	OM0106
43 00 39.0	088 13 48.0	L 114	CGS	2/0	252.120	252.192	OM0114
42 31 52.0	088 35 57.0	L 115	CGS	2/0	304.205	304.260	NH0321
43 34 19.0	087 47 59.0	L 133	NGS	1/0	201.255	201.29	OL0173
43 02 28.0	087 54 15.0	L 134	NGS	1/0	193.586	193.68	OL0151
42 45 17.0	087 54 08.0	L 137	NGS	1/0	218.750	218.79	NG0315
42 35 17.0	087 49 12.0	L 138	NGS	1/0	183.574	183.65	NG0261
42 26 59.0	087 49 03.0	L 273	NGS	1/0	180.460	180.55	NG0226
42 42 00.0	087 54 52.0	L 3	-	2/0	223.383	223.465	NG0382
43 27 20.0	088 11 48.0	L 4	CGS	1/2	284.630	284.67	OM0056
42 34 49.0	088 43 01.0	L 78	CGS	2/0	275.019	275.084	NH0307
43 10 34.0	088 02 39.0	L 86	CGS	2/0	227.732	227.812	OM0075
43 33 55.0	087 49 18.0	L 87	CGS	1/0	212.769	212.813	OL0170
43 23 14.0	087 52 01.0	LIGHT USLS	USLS	1/0	179.048	179.09	OL0082
43 00 08.0	087 53 20.0	LINCOLN USLS	USLS	1/0	181.231	181.33	OL0280
43 06 18.0	088 28 48.0	M 106	CGS	2/0	269.321	269.386	OM0260
43 00 32.0	088 13 56.0	M 114	CGS	2/0	253.925	253.996	OM0115
42 31 32.0	088 33 39.0	M 115	CGS	2/0	307.200	307.262	NH0325
43 34 19.0	087 49 01.0	M 133	NGS	1/0	208.484	208.52	OL0172
43 00 51.0	087 54 15.0	M 134	NGS	1/0	179.912	180.01	OL0137
42 44 31.0	087 54 12.0	M 137	NGS	1/0	227.534	227.60	NG0314
42 35 19.0	087 48 46.0	M 138	NGS	1/0	178.567	178.65	NG0268
42 42 02.0	087 54 19.0	M 3	CGS	1/0	221.484	221.565	NG0306
43 29 56.0	088 12 55.0	M 4	CGS	1/2	284.777	284.823	OM0028

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
42 33 19.0	088 39 37.0	M 78	CGS	2/0	302.553	302.605	NH0311
43 07 32.0	087 56 29.0	M 86	CGS	1/0	203.542	203.665	OL0117
43 34 02.0	087 49 30.0	M 87	CGS	1/0	216.681	216.719	OL0171
42 57 28.0	087 54 33.0	MITCHELL AZ	CGS	2/0	203.798	203.87	NG0355
42 57 31.0	087 54 03.0	MITCHELL	CGS	1/0	205.392	205.476	NG0353
42 57 31.0	087 54 03.0	MITCHELL RM 1	CGS	1/0	205.359	205.444	NG0354
42 57 31.0	087 54 03.0	MITCHELL RM 2	CGS	1/0	205.456	205.539	NG0352
42 30 53.0	088 31 02.0	MM 115	CGS	2/0	309.082	309.143	NH0328
43 06 31.0	088 29 45.0	N 106	CGS	2/0	265.971	266.037	OM0261
42 59 53.0	088 15 43.0	N 114	CGS	2/0	250.789	250.861	NH0014
42 30 38.0	088 29 03.0	N 115	-	2/0	300.734	300.80	NH0856
43 33 11.0	087 49 49.0	N 133	NGS	1/0	223.924	223.95	OL0169
43 00 11.0	087 53 43.0	N 134	NGS	1/0	181.992	182.09	OL0138
42 43 11.0	087 54 19.0	N 137	NGS	1/0	220.322	220.39	NG0308
42 34 28.0	087 49 18.0	N 138	NGS	1/0	183.197	183.26	NG0258
42 44 17.0	087 54 37.0	N 3	CGS	1/0	221.304	221.361	NG0312
43 32 09.0	088 14 23.0	N 4	CGS	1/2	298.008	298.050	OM0029
42 31 39.0	088 34 03.0	N 78	CGS	2/0	303.896	303.957	NH0324
43 08 01.0	087 54 37.0	N 86	CGS	2/0	207.752	207.831	OL0114
43 35 11.0	087 48 46.0	N 87	CGS	2/0	208.977	209.017	OL0175
42 42 44.0	087 48 22.0	NO 19		1/0	195.579	195.64	NG0369
42 42 43.0	087 48 59.0	NO 27		1/0	196.460	196.52	NG0374
43 00 12.0	087 53 27.0	NAVY USLS	DOD	1/0	182.999	183.10	OL0278
42 43 33.0	087 46 53.0	NO 100		1/0	189.243	189.30	NG0364
42 44 04.0	087 47 02.0	NORTH	USLS	1/0	178.565	178.62	NG0362
43 06 43.0	088 30 07.0	OCONOMOWOC	CGS	2/0	262.673	262.738	OM0270
43 06 27.0	088 29 52.0	P 106	CGS	2/0	264.584	264.649	OM0263
42 59 17.0	088 18 52.0	P 114	USGS	2/0	255.655	255.727	NH0015
42 29 51.0	088 25 57.0	P 115	CGS	2/0	274.505	274.571	NH0085
43 18 33.0	087 55 12.0	P 130	NGS	1/0	221.241	221.29	OL0092
43 31 41.0	087 50 35.0	P 133	NGS	1/0	222.059	222.09	OL0165
42 59 30.0	087 53 27.0	P 134	-	1/0	189.320	189.42	NG0375
42 42 32.0	087 54 16.0	P 137	NGS	1/0	218.571	218.65	NG0307
42 33 31.0	087 49 17.0	P 138	NGS	1/0	184.184	184.25	NG0256
42 45 38.0	087 54 54.0	P 3	CGS	1/0	223.947	223.991	NG0317
43 34 19.0	088 16 38.0	P 4	CGS	1/2	307.238	307.275	OM0030
42 30 37.0	088 28 54.0	P 78	CGS	2/0	298.350	298.412	NH0023
43 08 39.0	087 54 04.0	P 86	CGS	2/0	211.942	212.018	OL0112
42 35 24.0	087 48 58.0	PARK	USLS	1/0	183.290	183.37	NG0264
42 44 08.0	087 54 18.0	PLEASANT 2 RM6	CGS	1/0	229.893	229.96	NG0310
42 44 08.0	087 54 18.0	PLEASANT 2 RM5	CGS	1/0	229.282	229.34	NG0313
42 44 19.0	087 55 03.0	PLEASANT 2 AZ	CGS	1/0	222.316	222.37	NG0311
42 44 08.0	087 54 18.0	PLEASANT 2	CGS	1/0	230.956	231.02	NG0309
43 01 50.0	087 53 59.0	PRINTING	USLS	1/0	180.664	180.76	OL0135
43 06 32.0	088 29 56.0	Q 106	CGS	2/0	263.801	263.866	OM0264
42 58 37.0	088 20 51.0	Q 114	CGS	2/0	274.379	274.450	NH0016
43 16 48.0	087 55 08.0	Q 130	NGS	1/0	205.951	206.01	OL0094
43 29 05.0	087 51 32.0	Q 133	NGS	1/0	224.362	224.40	OL0061
42 58 43.0	087 52 55.0	Q 134	-	1/0	199.942	200.05	NG0376
42 42 06.0	087 53 40.0	Q 137	NGS	1/0	213.423	213.50	NG0302
42 31 55.0	087 49 04.0	Q 138	NGS	1/0	183.578	183.66	NG0253
42 48 26.0	087 55 29.0	Q 3	CGS	1/2	222.435	222.518	NG0321
42 34 20.0	088 42 05.0	Q 78	CGS	2/0	284.029	284.090	NH0308
43 09 46.0	087 54 01.0	Q 86	CGS	1/0	204.656	204.730	OL0109
43 06 37.0	088 29 58.0	R 106	CGS	2/0	263.517	263.582	OM0265
42 57 58.0	088 22 16.0	R 114	CGS	2/0	276.843	276.913	NH0017
42 31 19.0	087 49 04.0	R 115	CGS	1/0	183.537	183.629	NG0251
43 08 52.0	087 54 02.0	R 130	NGS	1/0	211.929	212.02	OL0110
43 28 13.0	087 51 46.0	R 133	NGS	1/0	223.168	223.20	OL0063
42 57 59.0	087 52 11.0	R 134	NGS	1/0	210.220	210.188	NG0377

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
42 42 15.0	087 52 09.0	R 137	NGS	1/0	204.978	205.05	NG0299
42 30 28.0	087 49 02.0	R 138	NGS	1/0	185.702	185.80	NG0249
42 33 11.0	088 51 38.0	R 2	CGS	2/0	288.306	288.360	NH0265
42 51 25.0	087 55 31.0	R 3	-	1/2	212.271	212.35	NG0389
42 33 57.0	088 41 23.0	R 78	CGS	2/0	286.923	286.982	NH0309
43 10 35.0	087 54 06.0	R 86	CGS	1/0	207.120	207.188	OL0103
42 43 06.0	087 48 54.0	RACINE	CGS	1/0	196.410	196.47	NG0372
42 43 06.0	087 48 54.0	RACINE RM 3	CGS	1/0	196.523	196.59	NG0370
42 43 06.0	087 48 54.0	RACINE RM 5	CGS	1/0	196.379	196.44	NG0373
42 43 06.0	087 48 54.0	RACINE RM 4	CGS	1/0	195.803	195.87	NG0371
43 00 06.0	087 53 16.0	RARITAN USLS	DOD	1/0	179.337	179.44	OL0281
42 27 24.0	088 18 23.0	RV 1 CNWRR	CNWRR	2/0	243.331	243.406	NH0100
42 26 47.0	088 18 23.0	RV 2 CNWRR	CNWRR	2/0	242.362	242.436	NH0102
42 27 25.0	087 49 02.0	RV 57	CNWRR	1/0	181.991	182.103	NG0227
42 30 37.0	087 49 01.0	RV 62	CNWRR	1/0	184.807	184.90	NG0250
42 31 41.0	087 49 05.0	RV 63	CNWRR	1/0	182.850	182.93	NG0252
42 32 43.0	087 49 12.0	RV 64	CNWRR	2/0	186.304	186.38	NG0255
42 33 24.0	087 49 17.0	RV 65 CNWRR	-	2/0	185.250	185.32	NG0387
42 35 49.0	087 49 33.0	RV 66	CGS	1/0	191.385	191.46	NG0269
42 36 23.0	087 49 33.0	RV 67 CNWRR	-	2/0	187.261	187.34	NG0386
42 37 07.0	087 49 36.0	RV 68	CNWRR	2/0	189.706	189.78	NG0273
42 38 08.0	087 49 25.0	RV 69	CNWRR	2/0	186.082	186.16	NG0275
42 39 15.0	087 48 55.0	RV 70	CNWRR	2/0	190.816	190.89	NG0279
42 39 46.0	087 48 42.0	RV 71	CNWRR	2/0	190.017	190.09	NG0280
42 40 17.0	087 48 28.0	RV 72	CNWRR	2/0	188.334	188.41	NG0282
42 41 00.0	087 48 09.0	RV 73	CNWRR	1/0	189.807	189.88	NG0285
42 41 40.0	087 47 49.0	RV 74	CNWRR	1/0	189.769	189.86	NG0287
42 42 30.0	087 47 47.0	RV 75	CNWRR	1/0	191.036	191.13	NG0289
43 07 22.0	088 32 55.0	S 106	CGS	2/0	272.070	272.135	OH0268
42 56 41.0	088 23 13.0	S 114	CGS	2/0	286.914	286.982	NH0018
42 32 35.0	087 49 11.0	S 115	CGS	1/0	186.082	186.159	NG0254
43 10 09.0	087 54 02.0	S 130	NGS	1/0	203.526	203.59	OL0108
43 26 16.0	087 52 31.0	S 133	NGS	1/0	221.030	221.07	OL0065
42 57 33.0	087 51 50.0	S 134	NGS	1/0	215.389	215.47	NG0378
42 42 19.0	087 51 06.0	S 137	NGS	1/0	220.472	220.54	NG0298
42 33 47.0	088 49 56.0	S 2	CGS	1/2	287.130	287.183	NH0278
42 54 57.0	087 55 24.0	S 3	-	1/2	222.789	222.88	NG0388
42 33 41.0	088 40 42.0	S 78	CGS	2/0	293.384	293.440	NH0310
43 12 02.0	087 55 00.0	S 86	CGS	1/0	208.417	208.495	OL0101
42 44 04.0	087 47 06.0	SHOP	DOD	1/0	180.419	180.380	NG0360
43 23 23.0	087 52 01.0	SLIP USLS	USLS	1/0	178.075	178.11	OL0080
43 34 57.0	087 48 00.0	STA 9	WIHD	1/0	209.440	209.48	OL0174
43 02 14.0	087 54 57.0	T 105	CGS	1/0	181.196	181.471	OL0155
42 56 07.0	088 24 14.0	T 114	-	2/0	288.492	288.55	NH0808
42 35 02.0	087 49 18.0	T 115	CGS	1/0	186.165	186.227	NG0259
43 11 19.0	087 54 46.0	T 130	NGS	1/0	202.236	202.30	OL0102
43 25 38.0	087 52 19.0	T 133	NGS	1/0	217.795	217.83	OL0067
43 02 02.0	087 55 03.0	T 134	NGS	1/0	178.999	179.14	OL0156
42 42 25.0	087 50 09.0	T 137	NGS	1/0	211.696	211.75	NG0295
42 36 44.0	088 40 57.0	T 2	CGS	1/2	286.346	286.406	NH0279
42 57 33.0	087 55 33.0	T 3	-	1/2	207.052	207.14	NG0390
42 31 52.0	088 39 03.0	T 78	CGS	2/0	288.833	288.883	NH0314
43 13 10.0	087 55 08.0	T 86	CGS	1/0	206.302	206.376	OL0099
42 35 19.0	087 48 51.0	TANK	USLS	1/0	178.691	178.77	NG0267
43 06 42.0	087 55 41.0	TOWER WISN TV	CGS	1/0	190.909	191.03	OL0123
42 54 55.0	088 26 04.0	U 114	CGS	2/0	285.771	285.838	NH0019
42 36 09.0	087 49 32.0	U 115	NGS	1/0	189.776	189.862	NG0271
43 12 24.0	087 55 16.0	U 130	NGS	1/0	215.756	215.83	OL0100
43 25 16.0	087 52 31.0	U 133	NGS	1/0	215.255	215.29	OL0068
42 57 31.0	087 52 47.0	U 134	NGS	1/0	215.496	215.57	NG0358

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
42 42 32.0	087 48 57.0	U 137	NGS	1/0	195.237	195.31	NG0292
42 37 47.0	088 38 18.0	U 2	CGS	1/2	286.531	286.593	NH0280
42 59 10.0	087 54 55.0	U 3	CGS	2/0	195.744	195.834	NG0359
42 31 52.0	088 39 08.0	U 78	CGS	2/0	289.514	289.563	NH0315
43 14 13.0	087 55 08.0	U 86	CGS	1/0	205.912	205.980	OL0097
43 14 13.0	087 55 08.0	U 86	CGS	1/0	205.912	205.980	OL0097
42 53 37.0	088 27 19.0	V 114	CGS	2/0	288.861	288.928	NH0020
42 38 39.0	087 49 12.0	V 115	CGS	1/0	188.708	188.788	NG0278
43 13 45.0	087 55 09.0	V 130	NGS	1/0	201.415	201.48	OL0098
43 24 40.0	087 52 47.0	V 133	NGS	1/0	220.121	220.16	OL0069
42 57 28.0	087 54 33.0	V 134	NGS	1/0	203.681	203.76	NG0351
42 42 34.0	087 48 23.0	V 137	NGS	1/0	195.194	195.27	NG0291
42 38 24.0	088 36 54.0	V 2	CGS	1/2	295.077	295.139	NH0281
43 00 11.0	087 53 43.0	V 3	CGS	1/0	180.598	180.70	OL0144
42 31 53.0	088 38 36.0	V 78	CGS	2/0	291.147	291.197	NH0313
43 15 49.0	087 55 08.0	V 86	CGS	1/0	204.903	204.970	OL0095
42 29 30.0	088 27 42.0	VEEN AZ	CGS	2/0	298.191	298.254	NH0084
42 29 40.0	088 27 21.0	VEEN	CGS	2/0	293.669	293.733	NH0083
42 29 40.0	088 27 22.0	VEEN RM1	CGS	2/0	294.017	294.081	NH0081
42 29 41.0	088 27 22.0	VEEN RM2	CGS	2/0	293.876	293.940	NH0082
42 52 08.0	087 54 47.0	VOR AZ MK	CGS	1/0	213.086	213.054	NG0332
42 52 06.0	087 54 34.0	VOR RM 2	CGS	1/0	215.196	215.165	NG0331
43 03 13.0	087 53 13.0	W 1	USLS	1/0	188.987	189.076	OL0145
42 52 45.0	088 28 27.0	W 114	USGS	2/0	289.288	289.354	NH0021
42 40 06.0	087 48 32.0	W 115	CGS	2/0	189.367	189.44	NG0281
43 15 01.0	087 55 06.0	W 130	NGS	1/0	208.809	208.87	OL0096
43 23 13.0	087 52 55.0	W 133	NGS	1/0	201.371	201.41	OL0072
42 56 56.0	087 54 35.0	W 134	NGS	1/0	209.860	209.94	NG0348
42 55 20.0	087 54 36.0	W 137	NGS	1/0	222.424	222.50	NG0337
42 39 10.0	088 35 25.0	W 2	CGS	1/2	290.976	291.038	NH0282
43 00 51.0	087 54 15.0	W 3 RESET 1942	CGS	1/0	179.329	179.434	OL0134
43 00 51.0	087 54 15.0	W 3	-	1/2	179.985	180.07	OL0275
43 02 27.0	087 53 52.0	W 3 USLS	USLS	1/0	181.074	181.17	OL0133
43 02 19.0	087 54 14.0	W 6	USLS	1/0	189.969	190.06	OL0150
42 32 45.0	088 37 51.0	W 78	CGS	2/0	298.426	298.478	NH0316
43 17 36.0	087 55 09.0	W 86	CGS	1/0	206.870	206.929	OL0093
43 23 52.0	087 51 43.0	WASHINGTON	NGS	1/0	212.433	212.408	OL0085
43 23 52.0	087 51 43.0	WASHINGTON RM1	CGS	1/0	212.735	212.709	OL0084
43 23 52.0	087 51 43.0	WASHINGTON RM2	CGS	1/0	212.777	212.751	OL0086
42 35 19.0	087 48 51.0	WATER	USLS	1/0	179.619	179.70	NG0266
43 00 52.0	088 13 54.0	WAUKESHA	CGS	2/0	249.783	249.854	OM0112
43 02 58.0	088 00 25.0	WAUWATOSA	CGS	2/0	211.278	211.363	OM0078
42 35 20.0	087 48 55.0	WL 245	USLS	1/0	179.193	179.27	NG0262
42 43 58.0	087 47 02.0	WL 246	USLS	1/0	181.242	181.29	NG0363
43 23 16.0	087 52 09.0	WL 249 USLS	USLS	1/0	181.963	182.00	OL0078
43 23 27.0	087 51 58.0	WORK USLS	USLS	1/0	179.512	179.55	OL0083
42 51 27.0	088 29 58.0	WM 114	CGS	2/0	272.260	272.326	NH0022
43 02 59.0	088 00 26.0	X 105	CGS	2/0	199.713	199.798	OM0076
42 50 22.0	088 32 16.0	X 114	CGS	2/0	291.355	291.421	NH0330
42 41 20.0	087 47 59.0	X 115	CGS	1/0	190.499	190.580	NG0286
43 08 26.0	087 54 09.0	X 130	NGS	1/0	213.914	214.00	OL0111
43 21 45.0	087 54 17.0	X 133	NGS	1/0	215.610	215.66	OL0088
42 56 25.0	087 54 34.0	X 134	NGS	1/0	209.091	209.17	NG0346
42 50 42.0	087 54 47.0	X 137	NGS	1/0	205.474	205.442	NG0329
42 39 46.0	088 33 16.0	X 2	CGS	2/0	302.327	302.389	NH0283
43 03 19.0	087 53 10.0	X 3	CGS	2/0	187.510	187.59	OL0130
42 32 26.0	088 36 48.0	X 78	CGS	2/0	304.649	304.703	NH0317
43 20 26.0	088 27 30.0	X 85	CGS	2/0	310.808	310.864	OM0057
43 19 15.0	087 54 57.0	X 86	CGS	1/0	211.583	211.638	OL0091
42 49 07.0	088 33 38.0	XX 114	CGS	2/0	290.967	291.033	NH0331

Latitude	Longitude	Name	Agency	Order/Class	NAVD88	NGVD 29	PID
43 02 57.0	088 00 31.0	Y 105	CGS	2/0	204.656	204.742	OM0077
42 48 01.0	088 33 44.0	Y 114	CGS	2/0	300.417	300.483	NH0332
42 42 37.0	087 47 47.0	Y 115	CGS	1/0	190.730	190.854	NG0290
43 07 56.0	087 54 46.0	Y 130	NGS	1/0	206.999	207.08	OL0113
43 23 13.0	087 52 13.0	Y 133	NGS	1/0	179.933	179.97	OL0077
42 55 48.0	087 54 37.0	Y 134	NGS	1/0	222.926	223.00	NG0341
42 45 23.0	087 54 15.0	Y 137	NGS	1/0	220.423	220.46	NG0316
42 39 36.0	088 31 19.0	Y 2	CGS	1/2	303.308	303.370	NH0285
43 06 13.0	087 54 31.0	Y 3	CGS	1/0	195.425	195.517	OL0125
42 32 00.0	088 35 20.0	Y 78	CGS	2/0	308.471	308.528	NH0322
43 20 12.0	088 25 43.0	Y 85	CGS	2/0	299.359	299.416	OM0058
43 21 04.0	087 54 31.0	Y 86	CGS	1/0	216.476	216.529	OL0089
43 21 04.0	087 54 31.0	Y 86	CGS	1/0	216.476	216.529	OL0089
43 03 25.0	088 02 36.0	Z 105	CGS	2/0	209.964	210.047	OM0079
42 46 17.0	088 33 18.0	Z 114	CGS	2/0	278.389	278.45	NH0333
42 42 32.0	087 48 58.0	Z 115	CGS	2/0	195.394	195.477	NG0293
43 07 55.0	087 55 56.0	Z 130	NGS	1/0	203.708	203.79	OL0115
43 20 14.0	087 54 44.0	Z 133	NGS	1/0	215.820	215.87	OL0090
42 54 54.0	087 54 40.0	Z 134	NGS	1/0	220.096	220.066	NG0336
42 42 02.0	087 54 19.0	Z 137	NGS	1/0	222.038	222.12	NG0305
42 38 37.0	088 27 54.0	Z 2	CGS	1/2	302.721	302.78	NH0001
43 07 56.0	087 57 04.0	Z 3	CGS	1/0	209.248	209.333	OL0120
42 31 51.0	088 34 47.0	Z 78	CGS	2/0	312.442	312.500	NH0323
43 19 12.0	088 22 44.0	Z 85	CGS	2/0	299.911	299.969	OM0059
43 22 33.0	087 53 30.0	Z 86	CGS	1/0	212.469	212.517	OL0087

Appendix B-3

VERTCON Version 2.0 Results (Meters) for USC&GS and NGS First- and Second-Order Benchmarks

Note: Input file for VERTCON is in Free Format #2 and is the same (without headers) as the input file for "COMPARE" program. The VERTCON program adds the "meters" column of numbers. This VERTCON output file is also required by the "COMPARE" program.

Latitude	Longitude	Meters	Name	Agency	Order/Class
43 02 14.0	087 54 52.0	-.105	102	WI3100	1/0
43 20 03.0	088 17 07.0	-.054	1068.964	USGS	2/0
43 05 48.0	088 01 38.0	-.087	154	WI3100	2/0
43 05 22.0	088 01 44.0	-.087	156	WI3100	2/0
43 02 33.0	087 54 18.0	-.108	2 USLS	USLS	2/0
43 03 16.0	088 02 46.0	-.083	219	CGS	2/0
42 48 51.0	087 54 52.0	-.062	35-422	WI-101	1/0
42 59 59.0	088 15 22.0	-.073	37	WIGS	2/0
43 06 30.0	088 26 36.0	-.065	398	CGS	2/0
43 06 25.0	088 25 54.0	-.065	399	CGS	2/0
43 05 59.0	088 23 39.0	-.065	400	CGS	2/0
43 04 42.0	088 14 28.0	-.072	44	CGS	2/0
43 05 00.0	088 15 30.0	-.072	45	CGS	2/0
43 05 27.0	088 18 22.0	-.069	46	CGS	2/0
43 05 36.0	088 18 46.0	-.069	47	CGS	2/0
43 06 00.0	088 20 34.0	-.066	48	CGS	2/0
43 05 58.0	088 21 25.0	-.065	49	CGS	2/0
43 06 07.0	088 22 56.0	-.065	50	CGS	2/0
42 42 52.0	087 47 58.0	-.074	52.06	WIHD	1/0
42 56 40.0	087 54 34.0	-.083	58-02	WI3100	1/0
42 56 20.0	087 54 34.0	-.083	65-19	WI3100	1/0
42 55 49.0	087 54 35.0	-.083	68-04	WI3100	1/0
43 06 17.0	088 01 39.0	-.087	750	WI3100	2/0
43 00 18.0	088 13 55.0	-.072	822	USGS	2/0
43 05 08.0	088 15 58.0	-.071	856	CGS	2/0
43 04 02.0	088 01 37.0	-.085	905	WI3100	2/0
43 00 09.0	087 53 22.0	-.104	908 7057 TOWER	USLS	1/2
43 05 54.0	088 24 09.0	-.065	940	USGS	2/0
43 19 11.0	088 22 50.0	-.058	983	USGS	2/0
43 02 28.0	088 03 45.0	-.081	A 106	CGS	2/0
42 44 25.0	088 33 07.0	-.064	A 115	-	2/0
42 42 28.0	087 49 33.0	-.070	A 116	CGS	1/0
42 33 49.0	088 49 53.0	-.057	A 118	CGS	2/0
43 03 18.0	088 01 38.0	-.085	A 120	CGS	2/0
43 07 57.0	087 57 05.0	-.098	A 134	NGS	1/0
42 53 24.0	087 54 41.0	-.082	A 137	NGS	1/0
42 43 36.0	087 46 56.0	-.070	A 138	NGS	1/0
42 29 41.0	088 25 21.0	-.065	A 17	CGS	2/0
42 28 44.0	088 22 44.0	-.067	A 226	CGS	2/0
42 38 33.0	088 24 50.0	-.067	A 3	CGS	1/2
43 09 46.0	087 59 51.0	-.082	A 4	CGS	2/0
42 56 51.0	087 54 03.0	-.083	A 72	CGS	1/0
43 19 13.0	088 22 47.0	-.058	A 86	CGS	2/0
43 23 13.0	087 52 55.0	-.041	A 87	CGS	2/0
42 42 34.0	088 32 31.0	-.062	AA 115	CGS	2/0
42 57 29.0	087 53 32.0	-.086	AP 1960 STA A	CGS	1/0
42 57 29.0	087 53 31.0	-.086	AP 1965 STA A2	CGS	1/0
42 55 52.0	087 53 49.0	-.083	AP STA B 2	CGS	1/0
42 55 52.0	087 53 49.0	-.083	AP STA B	CGS	1/0
43 06 21.0	088 01 49.0	-.086	AP STA A	CGS	2/0
42 56 52.0	087 53 47.0	-.082	ARP 2	CGS	1/0
43 02 33.0	088 04 45.0	-.079	B 106	CGS	2/0
42 41 37.0	088 32 30.0	-.061	B 115	CGS	2/0
42 42 19.0	087 51 05.0	-.065	B 116	CGS	1/0
42 34 09.0	088 48 56.0	-.059	B 118	CGS	2/0
43 06 26.0	088 01 37.0	-.087	B 120	CGS	2/0

Latitude	Longitude	Meters	Name	Agency	Order/Class
43 07 15.0	087 56 06.0	-.097	B 134	NGS	1/0
42 54 02.0	087 54 40.0	-.083	B 137	NGS	1/0
42 43 33.0	087 47 19.0	-.070	B 138	NGS	1/0
42 28 48.0	088 23 03.0	-.066	B 17	CGS	2/0
42 26 59.0	087 49 05.0	-.099	B 19	CGS	2/0
42 27 03.0	088 18 23.0	-.073	B 226	CGS	2/0
42 39 04.0	088 21 33.0	-.072	B 3	CGS	1/2
43 10 39.0	088 02 42.0	-.079	B 4	CGS	2/0
42 33 09.0	088 51 44.0	-.054	B 78	CGS	2/0
43 19 06.0	088 22 38.0	-.058	B 86	CGS	2/0
43 23 14.0	087 52 32.0	-.040	B 87 RESET '51	CGS	1/0
43 23 14.0	087 52 32.0	-.040	B 87	CGS	2/0
43 03 13.0	087 53 13.0	-.108	B	USLS	1/0
42 44 04.0	087 47 04.0	-.067	BOHN	USLS	1/0
43 23 16.0	087 52 09.0	-.038	BOLLARD	USLS	1/0
43 03 39.0	088 06 34.0	-.076	C 106	CGS	2/0
42 41 04.0	088 32 30.0	-.061	C 115	-	2/0
42 42 11.0	087 52 46.0	-.073	C 116	CGS	1/0
42 34 34.0	088 47 45.0	-.062	C 118	CGS	2/0
43 06 52.0	087 55 28.0	-.096	C 134	NGS	1/0
42 52 37.0	087 54 42.0	-.080	C 137	NGS	1/0
42 43 12.0	087 47 37.0	-.072	C 138	NGS	1/0
42 28 24.0	088 20 43.0	-.069	C 17	CGS	2/0
43 12 22.0	088 04 39.0	-.075	C 4	CGS	1/2
42 33 25.0	088 50 59.0	-.054	C 78	CGS	2/0
43 19 43.0	088 19 07.0	-.055	C 86	CGS	2/0
43 23 18.0	087 52 17.0	-.039	C 87 RESET '69	CGS	1/0
43 23 18.0	087 52 17.0	-.039	C 87	CGS	2/0
43 00 05.0	087 53 16.0	-.104	CAP	USLS	1/0
42 55 43.0	087 55 00.0	-.084	CAROVL N BASE	CGS	1/0
42 55 44.0	087 55 00.0	-.084	CAROVL NB RM 1	CGS	1/0
42 55 42.0	087 55 00.0	-.084	CAROVL NB RM 2	CGS	1/0
43 32 34.0	087 49 50.0	-.033	CEDAR AZ	CGS	1/0
43 02 29.0	087 54 31.0	-.107	CITY HALL	USLS	1/0
42 35 20.0	087 48 56.0	-.082	CROSS	USLS	1/0
42 35 14.0	088 45 00.0	-.067	D 115	CGS	2/0
42 42 06.0	087 53 40.0	-.077	D 116	CGS	2/0
42 34 48.0	088 46 41.0	-.064	D 118	CGS	2/0
43 06 32.0	087 54 59.0	-.096	D 134	NGS	1/0
42 51 23.0	087 54 46.0	-.077	D 137	NGS	1/0
42 41 50.0	087 47 47.0	-.081	D 138	NGS	1/0
42 27 24.0	088 18 23.0	-.073	D 17	CGS	2/0
42 40 07.0	088 15 26.0	-.076	D 3	CGS	1/2
43 14 08.0	088 06 08.0	-.071	D 4	CGS	1/2
42 30 42.0	088 29 32.0	-.062	D 78	CGS	2/0
43 19 48.0	088 17 22.0	-.054	D 86	CGS	2/0
43 24 12.0	087 52 59.0	-.039	D 87	CGS	1/0
42 34 39.0	088 47 33.0	-.062	DANE	CGS	2/0
42 36 06.0	088 42 30.0	-.061	DARIEN	CGS	2/0
42 34 58.0	088 45 43.0	-.065	DOOR	CGS	2/0
43 04 20.0	088 09 44.0	-.074	E 106	CGS	2/0
43 04 17.0	088 08 46.0	-.074	E 114	CGS	2/0
42 34 49.0	088 43 01.0	-.061	E 115	-	2/0
42 30 07.0	088 28 49.0	-.063	E 118	CGS	2/0
43 05 47.0	087 53 59.0	-.096	E 134	NGS	1/0
42 50 34.0	087 54 48.0	-.073	E 137	MRMSC	1/0
42 40 30.0	087 48 20.0	-.081	E 138	NGS	1/0
42 29 20.0	088 24 32.0	-.065	E 226	CGS	2/0
42 40 31.0	088 11 16.0	-.076	E 3	CGS	1/2
43 15 31.0	088 07 32.0	-.068	E 4	CGS	1/2
42 31 11.0	088 32 24.0	-.059	E 78	CGS	2/0
43 18 37.0	088 15 37.0	-.055	E 86	CGS	2/0
43 25 53.0	087 52 22.0	-.040	E 87	CGS	2/0
43 23 16.0	087 52 03.0	-.038	EAST	USLS	1/0
43 18 08.0	088 13 59.0	-.059	EE 86	CGS	2/0
42 39 57.0	088 32 33.0	-.061	ELKHORN	CGS	2/0
43 04 24.0	088 11 54.0	-.074	F 106	CGS	2/0
43 03 56.0	088 09 41.0	-.074	F 114	CGS	2/0
42 33 41.0	088 40 45.0	-.055	F 115	-	2/0
42 30 07.0	088 27 42.0	-.064	F 118	CGS	2/0
43 05 26.0	087 53 49.0	-.098	F 134	NGS	1/0

Latitude	Longitude	Meters	Name	Agency	Order/Class
42 49 33.0	087 54 50.0	-.066	F 137	NGS	1/0
42 39 38.0	087 48 44.0	-.081	F 138	NGS	1/0
42 28 32.0	088 21 35.0	-.068	F 226	CGS	2/0
42 40 43.0	088 08 57.0	-.076	F 3	CGS	1/2
43 17 41.0	088 09 41.0	-.065	F 4	CGS	1/2
42 36 03.0	088 42 42.0	-.061	F 78	CGS	2/0
43 16 42.0	088 12 44.0	-.061	F 86	CGS	2/0
43 27 17.0	087 52 18.0	-.041	F 87	CGS	1/0
43 15 24.0	088 11 35.0	-.063	FF 86	CGS	2/0
43 03 13.0	087 53 12.0	-.108	FLUSHING	USLS	1/0
43 10 08.0	087 53 00.0	-.076	FOX AZ	CGS	1/0
43 10 02.0	087 53 07.0	-.077	FOX	CGS	1/0
43 10 02.0	087 53 07.0	-.077	FOX RM 2	CGS	1/0
43 10 02.0	087 53 07.0	-.077	FOX RM 1	CGS	1/0
43 05 06.0	088 15 51.0	-.071	G 106	CGS	2/0
43 03 08.0	088 11 31.0	-.074	G 114	CGS	2/0
42 33 00.0	088 38 37.0	-.052	G 115	CGS	2/0
42 29 59.0	088 26 32.0	-.065	G 118	CGS	2/0
43 04 53.0	087 53 26.0	-.100	G 134	NGS	1/0
42 48 51.0	087 54 52.0	-.062	G 137	NGS	1/0
42 37 59.0	087 49 28.0	-.081	G 138	NGS	1/0
42 28 16.0	088 20 05.0	-.070	G 226	CGS	2/0
42 41 02.0	088 05 27.0	-.076	G 3	CGS	1/2
43 19 25.0	088 09 58.0	-.062	G 4	CGS	1/2
42 35 00.0	088 45 40.0	-.065	G 78	CGS	2/0
43 14 33.0	088 09 41.0	-.067	G 86	CGS	2/0
43 28 51.0	087 51 36.0	-.040	G 87	CGS	2/0
43 05 01.0	088 15 51.0	-.071	H 106	CGS	2/0
43 02 49.0	088 12 08.0	-.074	H 114	CGS	2/0
42 32 21.0	088 36 36.0	-.055	H 115	CGS	2/0
42 29 57.0	088 26 22.0	-.065	H 118	CGS	2/0
43 04 07.0	087 53 28.0	-.104	H 134	NGS	1/0
42 48 00.0	087 54 54.0	-.056	H 137	NGS	1/0
42 37 26.0	087 49 33.0	-.081	H 138	NGS	1/0
42 27 49.0	088 19 14.0	-.072	H 226	CGS	2/0
42 29 32.0	087 49 00.0	-.092	H 273	NGS	1/0
42 41 16.0	088 03 03.0	-.079	H 3	CGS	1/2
43 22 07.0	088 09 53.0	-.056	H 4	CGS	1/2
42 35 42.0	088 43 37.0	-.064	H 78	CGS	2/0
43 13 41.0	088 06 37.0	-.071	H 86	CGS	2/0
43 29 53.0	087 51 19.0	-.039	H 87	CGS	2/0
43 01 43.0	087 54 13.0	-.107	HANSEN	USLS	1/0
42 28 59.0	088 23 37.0	-.066	HEBRON AZ	CGS	2/0
42 29 12.0	088 23 37.0	-.066	HEBRON	CGS	2/0
42 29 12.0	088 23 37.0	-.066	HEBRON RM1	CGS	2/0
42 29 12.0	088 23 37.0	-.066	HEBRON RM2	CGS	2/0
43 13 36.0	088 06 07.0	-.071	HH 86	CGS	2/0
42 48 51.0	087 53 52.0	-.058	HUSHER	CGS	1/0
42 48 51.0	087 53 52.0	-.058	HUSHER RM 1	CGS	1/0
42 48 51.0	087 53 52.0	-.058	HUSHER RM 2	CGS	1/0
43 06 00.0	088 20 50.0	-.065	J 106	CGS	2/0
43 01 21.0	088 13 19.0	-.072	J 114	CGS	2/0
42 32 11.0	088 35 57.0	-.056	J 115	CGS	2/0
43 03 10.0	087 53 11.0	-.108	J 134	NGS	1/0
42 47 06.0	087 54 54.0	-.056	J 137	NGS	1/0
42 36 55.0	087 49 31.0	-.082	J 138	NGS	1/0
42 29 01.0	087 48 59.0	-.093	J 273	NGS	1/0
42 41 31.0	088 00 18.0	-.080	J 3	CGS	1/2
43 24 44.0	088 10 32.0	-.053	J 4	CGS	1/2
42 35 03.0	088 44 33.0	-.065	J 78	CGS	2/0
43 13 03.0	088 05 00.0	-.073	J 86	CGS	2/0
43 30 50.0	087 50 57.0	-.036	J 87	CGS	1/0
43 06 10.0	088 25 14.0	-.065	K 106	CGS	2/0
43 00 42.0	088 13 53.0	-.072	K 114	CGS	2/0
42 31 57.0	088 35 59.0	-.056	K 115	CGS	2/0
43 30 00.0	087 51 16.0	-.039	K 133	NGS	1/0
43 02 35.0	087 53 44.0	-.110	K 134	NGS	1/0
42 46 13.0	087 54 52.0	-.056	K 137	NGS	1/0
42 35 50.0	087 49 18.0	-.082	K 138	NGS	1/0
42 28 01.0	087 48 57.0	-.097	K 273	NGS	1/0
42 41 47.0	087 57 14.0	-.079	K 3	CGS	1/2

Latitude	Longitude	Meters	Name	Agency	Order/Class
43 25 36.0	088 10 55.0	-.052	K 4	CGS	1/2
42 34 58.0	088 44 07.0	-.064	K 78	CGS	2/0
43 11 31.0	088 03 57.0	-.077	K 86	CGS	2/0
43 32 34.0	087 50 18.0	-.031	K 87	CGS	1/0
42 34 03.0	087 49 28.0	-.081	KENOSHA 1	CGS	1/0
42 35 03.0	087 49 31.0	-.082	KENOSHA 2	CGS	2/0
42 37 23.0	087 49 35.0	-.081	KENOSHA 3	CGS	2/0
42 35 21.0	087 48 55.0	-.082	KENOSHA LIGHT	USLS	1/0
43 06 26.0	088 27 18.0	-.065	L 106	CGS	2/0
43 00 39.0	088 13 48.0	-.072	L 114	CGS	2/0
42 31 52.0	088 35 57.0	-.056	L 115	CGS	2/0
43 34 19.0	087 47 59.0	-.027	L 133	NGS	1/0
43 02 28.0	087 54 15.0	-.109	L 134	NGS	1/0
42 45 17.0	087 54 08.0	-.053	L 137	NGS	1/0
42 35 17.0	087 49 12.0	-.082	L 138	NGS	1/0
42 26 59.0	087 49 03.0	-.099	L 273	NGS	1/0
42 42 00.0	087 54 52.0	-.079	L 3	-	2/0
43 27 20.0	088 11 48.0	-.050	L 4	CGS	1/2
42 34 49.0	088 43 01.0	-.061	L 78	CGS	2/0
43 10 34.0	088 02 39.0	-.079	L 86	CGS	2/0
43 33 55.0	087 49 18.0	-.028	L 87	CGS	1/0
43 23 14.0	087 52 01.0	-.038	LIGHT USLS	USLS	1/0
43 00 08.0	087 53 20.0	-.104	LINCOLN USLS	USLS	1/0
43 06 18.0	088 28 48.0	-.065	M 106	CGS	2/0
43 00 32.0	088 13 56.0	-.072	M 114	CGS	2/0
42 31 32.0	088 33 39.0	-.059	M 115	CGS	2/0
43 34 19.0	087 49 01.0	-.026	M 133	NGS	1/0
43 00 51.0	087 54 15.0	-.106	M 134	NGS	1/0
42 44 31.0	087 54 12.0	-.057	M 137	NGS	1/0
42 35 19.0	087 48 46.0	-.082	M 138	NGS	1/0
42 42 02.0	087 54 19.0	-.079	M 3	CGS	1/0
43 29 56.0	088 12 55.0	-.045	M 4	CGS	1/2
42 33 19.0	088 39 37.0	-.053	M 78	CGS	2/0
43 07 32.0	087 56 29.0	-.098	M 86	CGS	1/0
43 34 02.0	087 49 30.0	-.027	M 87	CGS	1/0
42 57 28.0	087 54 33.0	-.086	MITCHELL AZ	CGS	2/0
42 57 31.0	087 54 03.0	-.086	MITCHELL	CGS	1/0
42 57 31.0	087 54 03.0	-.086	MITCHELL RM 1	CGS	1/0
42 57 31.0	087 54 03.0	-.086	MITCHELL RM 2	CGS	1/0
42 30 53.0	088 31 02.0	-.061	MM 115	CGS	2/0
43 06 31.0	088 29 45.0	-.065	N 106	CGS	2/0
42 59 53.0	088 15 43.0	-.073	N 114	CGS	2/0
42 30 38.0	088 29 03.0	-.063	N 115	-	2/0
43 33 11.0	087 49 49.0	-.031	N 133	NGS	1/0
43 00 11.0	087 53 43.0	-.105	N 134	NGS	1/0
42 43 11.0	087 54 19.0	-.069	N 137	NGS	1/0
42 34 28.0	087 49 18.0	-.081	N 138	NGS	1/0
42 44 17.0	087 54 37.0	-.060	N 3	CGS	1/0
43 32 09.0	088 14 23.0	-.041	N 4	CGS	1/2
42 31 39.0	088 34 03.0	-.059	N 78	CGS	2/0
43 08 01.0	087 54 37.0	-.087	N 86	CGS	2/0
43 35 11.0	087 48 46.0	-.019	N 87	CGS	2/0
42 42 44.0	087 48 22.0	-.074	NO 19	-	1/0
42 42 43.0	087 48 59.0	-.071	NO 27	-	1/0
43 00 12.0	087 53 27.0	-.104	NAVY USLS	DOD	1/0
42 43 33.0	087 46 53.0	-.071	NO 100	-	1/0
42 44 04.0	087 47 02.0	-.067	NORTH	USLS	1/0
43 06 43.0	088 30 07.0	-.065	OCONOMOWOC	CGS	2/0
43 06 27.0	088 29 52.0	-.066	P 106	CGS	2/0
42 59 17.0	088 18 52.0	-.072	P 114	USGS	2/0
42 29 51.0	088 25 57.0	-.065	P 115	CGS	2/0
43 18 33.0	087 55 12.0	-.057	P 130	NGS	1/0
43 31 41.0	087 50 35.0	-.034	P 133	NGS	1/0
42 59 30.0	087 53 27.0	-.100	P 134	-	1/0
42 42 32.0	087 54 16.0	-.075	P 137	NGS	1/0
42 33 31.0	087 49 17.0	-.081	P 138	NGS	1/0
42 45 38.0	087 54 54.0	-.056	P 3	CGS	1/0
43 34 19.0	088 16 38.0	-.036	P 4	CGS	1/2
42 30 37.0	088 28 54.0	-.063	P 78	CGS	2/0
43 08 39.0	087 54 04.0	-.081	P 86	CGS	2/0
42 35 24.0	087 48 58.0	-.082	PARK	USLS	1/0

Latitude	Longitude	Meters	Name	Agency	Order/Class
42 44 08.0	087 54 18.0	-.061	PLEASANT 2 RM6	CGS	1/0
42 44 08.0	087 54 18.0	-.061	PLEASANT 2 RM5	CGS	1/0
42 44 19.0	087 55 03.0	-.061	PLEASANT 2 AZ	CGS	1/0
42 44 08.0	087 54 18.0	-.061	PLEASANT 2	CGS	1/0
43 01 50.0	087 53 59.0	-.109	PRINTING	USLS	1/0
43 06 32.0	088 29 56.0	-.066	Q 106	CGS	2/0
42 58 37.0	088 20 51.0	-.071	Q 114	CGS	2/0
43 16 48.0	087 55 08.0	-.062	Q 130	NGS	1/0
43 29 05.0	087 51 32.0	-.039	Q 133	NGS	1/0
42 58 43.0	087 52 55.0	-.094	Q 134	-	1/0
42 42 06.0	087 53 40.0	-.077	Q 137	NGS	1/0
42 31 55.0	087 49 04.0	-.084	Q 138	NGS	1/0
42 48 26.0	087 55 29.0	-.061	Q 3	CGS	1/2
42 34 20.0	088 42 05.0	-.058	Q 78	CGS	2/0
43 09 46.0	087 54 01.0	-.077	Q 86	CGS	1/0
43 06 37.0	088 29 58.0	-.065	R 106	CGS	2/0
42 57 58.0	088 22 16.0	-.069	R 114	CGS	2/0
42 31 19.0	087 49 04.0	-.086	R 115	CGS	1/0
43 08 52.0	087 54 02.0	-.080	R 130	NGS	1/0
43 28 13.0	087 51 46.0	-.040	R 133	NGS	1/0
42 57 59.0	087 52 11.0	-.088	R 134	NGS	1/0
42 42 15.0	087 52 09.0	-.070	R 137	NGS	1/0
42 30 28.0	087 49 02.0	-.089	R 138	NGS	1/0
42 33 11.0	088 51 38.0	-.054	R 2	CGS	2/0
42 51 25.0	087 55 31.0	-.079	R 3	-	1/2
42 33 57.0	088 41 23.0	-.056	R 78	CGS	2/0
43 10 35.0	087 54 06.0	-.076	R 86	CGS	1/0
42 43 06.0	087 48 54.0	-.069	RACINE	CGS	1/0
42 43 06.0	087 48 54.0	-.069	RACINE RM 3	CGS	1/0
42 43 06.0	087 48 54.0	-.069	RACINE RM 5	CGS	1/0
42 43 06.0	087 48 54.0	-.069	RACINE RM 4	CGS	1/0
43 00 06.0	087 53 16.0	-.104	RARITAN USLS	DOD	1/0
42 27 24.0	088 18 23.0	-.073	RV 1 CNWRR	CNWRR	2/0
42 26 47.0	088 18 23.0	-.072	RV 2 CNWRR	CNWRR	2/0
42 27 25.0	087 49 02.0	-.098	RV 57	CNWRR	1/0
42 30 37.0	087 49 01.0	-.088	RV 62	CNWRR	1/0
42 31 41.0	087 49 05.0	-.085	RV 63	CNWRR	1/0
42 32 43.0	087 49 12.0	-.081	RV 64	CNWRR	2/0
42 33 24.0	087 49 17.0	-.081	RV 65 CNWRR		2/0
42 35 49.0	087 49 33.0	-.082	RV 66	CGS	1/0
42 36 23.0	087 49 33.0	-.082	RV 67 CNWRR		2/0
42 37 07.0	087 49 36.0	-.081	RV 68	CNWRR	2/0
42 38 08.0	087 49 25.0	-.081	RV 69	CNWRR	2/0
42 39 15.0	087 48 55.0	-.081	RV 70	CNWRR	2/0
42 39 46.0	087 48 42.0	-.081	RV 71	CNWRR	2/0
42 40 17.0	087 48 28.0	-.081	RV 72	CNWRR	2/0
42 41 00.0	087 48 09.0	-.081	RV 73	CNWRR	1/0
42 41 40.0	087 47 49.0	-.081	RV 74	CNWRR	1/0
42 42 30.0	087 47 47.0	-.077	RV 75	CNWRR	1/0
43 07 22.0	088 32 55.0	-.065	S 106	CGS	2/0
42 56 41.0	088 23 13.0	-.068	S 114	CGS	2/0
42 32 35.0	087 49 11.0	-.082	S 115	CGS	1/0
43 10 09.0	087 54 02.0	-.077	S 130	NGS	1/0
43 26 16.0	087 52 31.0	-.041	S 133	NGS	1/0
42 57 33.0	087 51 50.0	-.086	S 134	NGS	1/0
42 42 19.0	087 51 06.0	-.065	S 137	NGS	1/0
42 33 47.0	088 49 56.0	-.057	S 2	CGS	1/2
42 54 57.0	087 55 24.0	-.084	S 3	-	1/2
42 33 41.0	088 40 42.0	-.055	S 78	CGS	2/0
43 12 02.0	087 55 00.0	-.074	S 86	CGS	1/0
42 44 04.0	087 47 06.0	-.066	SHOP	DOD	1/0
43 23 23.0	087 52 01.0	-.037	SLIP USLS	USLS	1/0
43 34 57.0	087 48 00.0	-.021	STA 9	WIHD	1/0
43 02 14.0	087 54 57.0	-.104	T 105	CGS	1/0
42 56 07.0	088 24 14.0	-.066	T 114	-	2/0
42 35 02.0	087 49 18.0	-.082	T 115	CGS	1/0
43 11 19.0	087 54 46.0	-.076	T 130	NGS	1/0
43 25 38.0	087 52 19.0	-.039	T 133	NGS	1/0
43 02 02.0	087 55 03.0	-.103	T 134	NGS	1/0
42 42 25.0	087 50 09.0	-.068	T 137	NGS	1/0
42 36 44.0	088 40 57.0	-.060	T 2	CGS	1/2

Latitude	Longitude	Meters	Name	Agency	Order/Class
42 57 33.0	087 55 33.0	-.088	T 3	-	1/2
42 31 52.0	088 39 03.0	-.053	T 78	CGS	2/0
43 13 10.0	087 55 08.0	-.072	T 86	CGS	1/0
42 35 19.0	087 48 51.0	-.082	TANK	USLS	1/0
43 06 42.0	087 55 41.0	-.098	TOWER WISH TV	CGS	1/0
42 54 55.0	088 26 04.0	-.066	U 114	CGS	2/0
42 36 09.0	087 49 32.0	-.082	U 115	NGS	1/0
43 12 24.0	087 55 16.0	-.074	U 130	NGS	1/0
43 25 16.0	087 52 31.0	-.039	U 133	NGS	1/0
42 57 31.0	087 52 47.0	-.086	U 134	NGS	1/0
42 42 32.0	087 48 57.0	-.073	U 137	NGS	1/0
42 37 47.0	088 38 18.0	-.061	U 2	CGS	1/2
42 59 10.0	087 54 55.0	-.097	U 3	CGS	2/0
42 31 52.0	088 39 08.0	-.053	U 78	CGS	2/0
43 14 13.0	087 55 08.0	-.070	U 86	CGS	1/0
43 14 13.0	087 55 08.0	-.070	U 86	CGS	1/0
42 53 37.0	088 27 19.0	-.067	V 114	CGS	2/0
42 38 39.0	087 49 12.0	-.081	V 115	CGS	1/0
43 13 45.0	087 55 09.0	-.071	V 130	NGS	1/0
43 24 40.0	087 52 47.0	-.039	V 133	NGS	1/0
42 57 28.0	087 54 33.0	-.086	V 134	NGS	1/0
42 42 34.0	087 48 23.0	-.075	V 137	NGS	1/0
42 38 24.0	088 36 54.0	-.062	V 2	CGS	1/2
43 00 11.0	087 53 43.0	-.105	V 3	CGS	1/0
42 31 53.0	088 38 36.0	-.053	V 78	CGS	2/0
43 15 49.0	087 55 08.0	-.066	V 86	CGS	1/0
42 29 30.0	088 27 42.0	-.063	VEEN AZ	CGS	2/0
42 29 40.0	088 27 21.0	-.064	VEEN	CGS	2/0
42 29 40.0	088 27 22.0	-.064	VEEN RM1	CGS	2/0
42 29 41.0	088 27 22.0	-.064	VEEN RM2	CGS	2/0
42 52 08.0	087 54 47.0	-.079	VOR AZ MK	CGS	1/0
42 52 06.0	087 54 34.0	-.078	VOR RM 2	CGS	1/0
43 03 13.0	087 53 13.0	-.108	W 1	USLS	1/0
42 52 45.0	088 28 27.0	-.068	W 114	USGS	2/0
42 40 06.0	087 48 32.0	-.081	W 115	CGS	2/0
43 15 01.0	087 55 06.0	-.068	W 130	NGS	1/0
43 23 13.0	087 52 55.0	-.041	W 133	NGS	1/0
42 56 56.0	087 54 35.0	-.083	W 134	NGS	1/0
42 55 20.0	087 54 36.0	-.083	W 137	NGS	1/0
42 39 10.0	088 35 25.0	-.062	W 2	CGS	1/2
43 00 51.0	087 54 15.0	-.106	W 3 RESET 1942	CGS	1/0
43 00 51.0	087 54 15.0	-.106	W 3	-	1/2
43 02 27.0	087 53 52.0	-.110	W 3 USLS	USLS	1/0
43 02 19.0	087 54 14.0	-.108	W 6	USLS	1/0
42 32 45.0	088 37 51.0	-.053	W 78	CGS	2/0
43 17 36.0	087 55 09.0	-.060	W 86	CGS	1/0
43 23 52.0	087 51 43.0	-.034	WASHINGTON	NGS	1/0
43 23 52.0	087 51 43.0	-.034	WASHINGTON RM1	CGS	1/0
43 23 52.0	087 51 43.0	-.034	WASHINGTON RM2	CGS	1/0
42 35 19.0	087 48 51.0	-.082	WATER	USLS	1/0
43 00 52.0	088 13 54.0	-.072	WAUKWSHA	CGS	2/0
43 02 58.0	088 00 25.0	-.085	WAUWATOSA	CGS	2/0
42 35 20.0	087 48 55.0	-.082	WL 245	USLS	1/0
42 43 58.0	087 47 02.0	-.067	WL 246	USLS	1/0
43 23 16.0	087 52 09.0	-.038	WL 249 USLS	USLS	1/0
43 23 27.0	087 51 58.0	-.037	WORK USLS	USLS	1/0
42 51 27.0	088 29 58.0	-.066	WW 114	CGS	2/0
43 02 59.0	088 00 26.0	-.085	X 105	CGS	2/0
42 50 22.0	088 32 16.0	-.065	X 114	CGS	2/0
42 41 20.0	087 47 59.0	-.082	X 115	CGS	1/0
43 08 26.0	087 54 09.0	-.083	X 130	NGS	1/0
43 21 45.0	087 54 17.0	-.050	X 133	NGS	1/0
42 56 25.0	087 54 34.0	-.083	X 134	NGS	1/0
42 50 42.0	087 54 47.0	-.074	X 137	NGS	1/0
42 39 46.0	088 33 16.0	-.062	X 2	CGS	2/0
43 03 19.0	087 53 10.0	-.108	X 3	CGS	2/0
42 32 26.0	088 36 48.0	-.054	X 78	CGS	2/0
43 20 26.0	088 27 30.0	-.057	X 85	CGS	2/0
43 19 15.0	087 54 57.0	-.056	X 86	CGS	1/0
42 49 07.0	088 33 38.0	-.066	XX 114	CGS	2/0
43 02 57.0	088 00 31.0	-.085	Y 105	CGS	2/0

Latitude	Longitude	Meters	Name	Agency	Order/Class
42 48 01.0	088 33 44.0	-.066	Y 114	CGS	2/0
42 42 37.0	087 47 47.0	-.076	Y 115	CGS	1/0
43 07 56.0	087 54 46.0	-.088	Y 130	NGS	1/0
43 23 13.0	087 52 13.0	-.039	Y 133	NGS	1/0
42 55 48.0	087 54 37.0	-.083	Y 134	NGS	1/0
42 45 23.0	087 54 15.0	-.053	Y 137	NGS	1/0
42 39 36.0	088 31 19.0	-.061	Y 2	CGS	1/2
43 06 13.0	087 54 31.0	-.096	Y 3	CGS	1/0
42 32 00.0	088 35 20.0	-.057	Y 78	CGS	2/0
43 20 12.0	088 25 43.0	-.057	Y 85	CGS	2/0
43 21 04.0	087 54 31.0	-.052	Y 86	CGS	1/0
43 21 04.0	087 54 31.0	-.052	Y 86	CGS	1/0
43 03 25.0	088 02 36.0	-.083	Z 105	CGS	2/0
42 46 17.0	088 33 18.0	-.065	Z 114	CGS	2/0
42 42 32.0	087 48 58.0	-.073	Z 115	CGS	2/0
43 07 55.0	087 55 56.0	-.094	Z 130	NGS	1/0
43 20 14.0	087 54 44.0	-.053	Z 133	NGS	1/0
42 54 54.0	087 54 40.0	-.083	Z 134	NGS	1/0
42 42 02.0	087 54 19.0	-.079	Z 137	NGS	1/0
42 38 37.0	088 27 54.0	-.062	Z 2	CGS	1/2
43 07 56.0	087 57 04.0	-.098	Z 3	CGS	1/0
42 31 51.0	088 34 47.0	-.058	Z 78	CGS	2/0
43 19 12.0	088 22 44.0	-.058	Z 85	CGS	2/0
43 22 33.0	087 53 30.0	-.046	Z 86	CGS	1/0

Appendix B-4

Difference of Differences for First- & Second-Order USC&GS and NGS Benchmarks

PROGRAM: COMPARE - VERSION 1.04
MASTER DATA FILE: NGSBMS.DAT
VERTCON INPUT FILE: NGSBMS.OUT
PROGRAM RESULTS FILE: NGSBMS.ANS

COMPARISON OF PUBLISHED ELEVATION DATUM DIFFERENCES WITH DIFFERENCES OBTAINED FROM VERTCON

PROJECT: FIRST- and SECOND-ORDER NGS BMS IN SEWRPC AREA

NAME	AGENCY		ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
102	WI3100	1/0	OL0154					
43 2 14.0	2557530.	181.215	594.536					
87 54 52.0	385000.	181.321	594.884	-.348	-.344	-.003		
1068.964	USGS	2/0	OM0065					
43 20 3.0	2456180.	325.701	1068.571					
88 17 7.0	490950.	325.755	1068.748	-.177	-.177	.000		
154	WI3100	2/0	OM0120					
43 5 48.0	2526870.	230.556	756.416					
88 1 38.0	405930.	230.640	756.691	-.276	-.285	.010		
156	WI3100	2/0	OM0119					
43 5 22.0	2526490.	226.832	744.198					
88 1 44.0	403290.	226.916	744.474	-.276	-.285	.010		
2 USLS	USLS	2/0	OL0132					
43 2 33.0	2560000.	193.584	635.117					
87 54 18.0	386990.	193.674	635.412	-.295	-.354	.059		
219	CGS	2/0	OM0080					
43 3 16.0	2522190.	212.330	696.619					
88 2 46.0	390430.	212.414	696.895	-.276	-.272	-.003		
35-422	WI-101	1/0	NG0326					
42 48 51.0	2559560.	219.666	720.688					
87 54 52.0	303730.	219.634	720.583	.105	-.203	.308		
37	WIGS	2/0	NH0013					
42 59 59.0	2466490.	246.872	809.946					
88 15 22.0	369240.	246.945	810.185	-.240	-.240	.000		
398	CGS	2/0	OM0105					
43 6 30.0	2415680.	274.664	901.127					
88 26 36.0	407830.	274.728	901.337	-.210	-.213	.003		
399	CGS	2/0	OM0104					
43 6 25.0	2418800.	274.678	901.173					
88 25 54.0	407380.	274.742	901.383	-.210	-.213	.003		
400	CGS	2/0	OM0101					
43 5 59.0	2428860.	284.277	932.665					
88 23 39.0	404940.	284.342	932.879	-.213	-.213	.000		

NAME	LATITUDE LONGITUDE	AGENCY NAD27X NAD27Y	ORDER NAVD88 NGVD29	US SURV. FEET	PID PUB DIFF	DIFF BY VERTCON	FIT (feet)
44	43 4 42.0 88 14 28.0	CGS 2469900. 397970.	2/0 263.418 263.490	864.231 864.467	OM0088 - .236	- .236	.000
45	43 5 .0 88 15 30.0	CGS 2465260. 399690.	2/0 260.032 260.105	853.122 853.361	OM0089 - .240	- .236	- .003
46	43 5 27.0 88 18 22.0	CGS 2452440. 402160.	2/0 266.297 266.367	873.676 873.906	OM0095 - .230	- .226	- .003
47	43 5 36.0 88 18 46.0	CGS 2450640. 403040.	2/0 268.966 269.035	882.433 882.659	OM0096 - .226	- .226	.000
48	43 6 .0 88 20 34.0	CGS 2442580. 405310.	2/0 281.784 281.850	924.486 924.703	OM0097 - .217	- .217	.000
49	43 5 58.0 88 21 25.0	CGS 2438800. 405030.	2/0 285.564 285.629	936.888 937.101	OM0099 - .213	- .213	.000
50	43 6 7.0 88 22 56.0	CGS 2432040. 405810.	2/0 284.945 285.010	934.857 935.070	OM0100 - .213	- .213	.000
52.06	42 42 52.0 87 47 58.0	WIHD 2591370. 268200.	1/0 192.806 192.870	632.564 632.774	NG0368 - .210	- .243	.033
58-02	42 56 40.0 87 54 34.0	WI3100 2559710. 351230.	1/0 212.137 212.210	695.986 696.226	NG0347 - .240	- .272	.033
65-19	42 56 20.0 87 54 34.0	WI3100 2559760. 349210.	1/0 212.446 212.520	697.000 697.243	NG0345 - .243	- .272	.030
68-04	42 55 49.0 87 54 35.0	WI3100 2559770. 346070.	1/0 222.930 223.010	731.396 731.659	NG0344 - .262	- .272	.010
750	43 6 17.0 88 1 39.0	WI3100 2526730. 408860.	2/0 228.616 228.700	750.051 750.327	OM0121 - .276	- .285	.010
822	43 0 18.0 88 13 55.0	USGS 2472910. 371300.	2/0 250.272 250.343	821.101 821.334	OM0116 - .233	- .236	.003
856	43 5 8.0 88 15 58.0	CGS 2463170. 400460.	2/0 260.678 260.750	855.241 855.477	OM0094 - .236	- .233	- .003
905	43 4 2.0 88 1 37.0	WI3100 2527200. 395200.	2/0 213.248 213.332	699.631 699.907	OM0118 - .276	- .279	.003
908 7057 TOWER	43 0 9.0 87 53 22.0	USLS 2564530. 372520.	1/2 181.897 182.000	596.774 597.112	OL0279 - .338	- .341	.003
940	43 5 54.0 88 24 9.0	USGS 2426650. 404390.	2/0 286.325 286.390	939.385 939.598	OM0102 - .213	- .213	.000

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
983	USGS	2/0	OM0060				
43 19 11.0	2430940.	299.498	982.603				
88 22 50.0	485180.	299.556	982.793	-.190	-.190	.000	
A 106	CGS	2/0	OM0081				
43 2 28.0	2517920.	221.474	726.619				
88 3 45.0	385460.	221.556	726.888	-.269	-.266	-.003	
A 115	-	2/0	NH0792				
42 44 25.0	2389010.	274.065	899.162				
88 33 7.0	273180.	274.120	899.342	-.180	-.210	.030	
A 116	CGS	1/0	NG0294				
42 42 28.0	2584340.	203.361	667.194				
87 49 33.0	265580.	203.419	667.384	-.190	-.230	.039	
A 118	CGS	2/0	NH0268				
42 33 49.0	2314840.	287.942	944.690				
88 49 53.0	207630.	288.000	944.880	-.190	-.187	-.003	
A 120	CGS	2/0	OM0117				
43 3 18.0	2527230.	207.549	680.934				
88 1 38.0	390750.	207.633	681.209	-.276	-.279	.003	
A 134	NGS	1/0	OL0116				
43 7 57.0	2546800.	209.239	686.478				
87 57 5.0	419470.	209.330	686.777	-.299	-.322	.023	
A 137	NGS	1/0	NG0334				
42 53 24.0	2559690.	215.649	707.508				
87 54 41.0	331380.	215.618	707.407	.102	-.269	.371	
A 138	NGS	1/0	NG0365				
42 43 36.0	2595880.	191.617	628.663				
87 46 56.0	272770.	191.670	628.837	-.174	-.230	.056	
A 17	CGS	2/0	NH0086				
42 29 41.0	2425470.	268.786	881.842				
88 25 21.0	184340.	268.852	882.059	-.217	-.213	-.003	
A 226	CGS	2/0	NH0093				
42 28 44.0	2437340.	270.213	886.524				
88 22 44.0	178790.	270.278	886.737	-.213	-.220	.007	
A 3	CGS	1/2	NH0002				
42 38 33.0	2426770.	259.736	852.151				
88 24 50.0	238230.	259.804	852.374	-.223	-.220	-.003	
A 4	CGS	2/0	OL0119				
43 9 46.0	2534230.	222.345	729.477				
87 59 51.0	430210.	222.425	729.739	-.262	-.269	.007	
A 72	CGS	1/0	NG0350				
42 56 51.0	2561990.	206.212	676.547				
87 54 3.0	352400.	206.297	676.826	-.279	-.272	-.007	
A 86	CGS	2/0	OM0061				
43 19 13.0	2431160.	300.378	985.490				
88 22 47.0	485380.	300.435	985.677	-.187	-.190	.003	
A 87	CGS	2/0	OL0071				
43 23 13.0	2562980.	204.481	670.868				
87 52 55.0	512640.	204.528	671.022	-.154	-.135	-.020	
AA 115	CGS	2/0	NH0334				
42 42 34.0	2391890.	278.016	912.124				
88 32 31.0	262000.	278.070	912.301	-.177	-.203	.026	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
AP 1960 STA A	CGS	1/0	NG0356				
42 57 29.0	2564200.	203.919	669.024				
87 53 32.0	356310.	204.000	669.290	-.266	-.282	.016	
AP 1965 STA A2	CGS	1/0	NG0357				
42 57 29.0	2564270.	203.937	669.083				
87 53 31.0	356310.	204.020	669.356	-.272	-.282	.010	
AP STA B 2	CGS	1/0	NG0342				
42 55 52.0	2563180.	213.464	700.340				
87 53 49.0	346460.	213.433	700.238	.102	-.272	.374	
AP STA B	CGS	1/0	NG0343				
42 55 52.0	2563180.	213.589	700.750				
87 53 49.0	346460.	213.670	701.016	-.266	-.272	.007	
AP STA A	CGS	2/0	OM0122				
43 6 21.0	2525980.	225.806	740.832				
88 1 49.0	409250.	225.891	741.111	-.279	-.282	.003	
ARP 2	CGS	1/0	NG0349				
42 56 52.0	2563170.	203.712	668.345				
87 53 47.0	352540.	203.786	668.588	-.243	-.269	.026	
B 106	CGS	2/0	OM0082				
43 2 33.0	2513460.	227.277	745.658				
88 4 45.0	385870.	227.356	745.917	-.259	-.259	.000	
B 115	CGS	2/0	NH0336				
42 41 37.0	2392060.	302.109	991.169				
88 32 30.0	256230.	302.171	991.373	-.203	-.200	-.003	
B 116	CGS	1/0	NG0296				
42 42 19.0	2577500.	220.516	723.476				
87 51 5.0	264490.	220.586	723.706	-.230	-.213	-.016	
B 118	CGS	2/0	NH0269				
42 34 9.0	2319080.	282.961	928.348				
88 48 56.0	209710.	283.022	928.548	-.200	-.194	-.007	
B 120	CGS	2/0	OM0123				
43 6 26.0	2526850.	226.072	741.705				
88 1 37.0	409780.	226.157	741.983	-.279	-.285	.007	
B 134	NGS	1/0	OL0121				
43 7 15.0	2551280.	197.544	648.109				
87 56 6.0	415330.	197.640	648.424	-.315	-.318	.003	
B 137	NGS	1/0	NG0335				
42 54 2.0	2559670.	220.519	723.486				
87 54 40.0	335230.	220.488	723.384	.102	-.272	.374	
B 138	NGS	1/0	NG0366				
42 43 33.0	2594170.	189.789	622.666				
87 47 19.0	272420.	189.840	622.833	-.167	-.230	.062	
B 17	CGS	2/0	NH0092				
42 28 48.0	2435910.	271.051	889.273				
88 23 3.0	179170.	271.116	889.486	-.213	-.217	.003	
B 19	CGS	2/0	NG0225				
42 26 59.0	2588890.	181.706	596.147				
87 49 5.0	171620.	181.818	596.515	-.367	-.325	-.043	
B 226	CGS	2/0	NH0101				
42 27 3.0	2457110.	243.178	797.826				
88 18 23.0	168960.	243.252	798.069	-.243	-.240	-.003	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
B 3	CGS	1/2	NH0003				
42 39 4.0	2441430.	244.281	801.445				
88 21 33.0	241650.	244.353	801.681	-.236	-.236	.000	
B 4	CGS	2/0	OM0046				
43 10 39.0	2521430.	224.500	736.547				
88 2 42.0	435270.	224.580	736.810	-.262	-.259	-.003	
B 78	CGS	2/0	NH0266				
42 33 9.0	2306590.	289.116	948.541				
88 51 44.0	203460.	289.169	948.715	-.174	-.177	.003	
B 86	CGS	2/0	OM0062				
43 19 6.0	2431840.	302.408	992.150				
88 22 38.0	484690.	302.466	992.341	-.190	-.190	.000	
B 87 RESET '51	CGS	1/0	OL0074				
43 23 14.0	2564670.	186.343	611.360				
87 52 32.0	512790.	186.380	611.482	-.121	-.131	.010	
B 87	CGS	2/0	OL0073				
43 23 14.0	2564670.	186.188	610.852				
87 52 32.0	512790.	186.235	611.006	-.154	-.131	-.023	
B	USLS	1/0	OL0146				
43 3 13.0	2564730.	181.637	595.921				
87 53 13.0	391160.	181.730	596.226	-.305	-.354	.049	
BOHN	USLS	1/0	NG0361				
42 44 4.0	2595200.	179.945	590.370				
87 47 4.0	275590.	179.906	590.242	.128	-.220	.348	
BOLLARD	USLS	1/0	OL0079				
43 23 16.0	2566360.	180.057	590.737				
87 52 9.0	513030.	180.090	590.845	-.108	-.125	.016	
C 106	CGS	2/0	OM0084				
43 3 39.0	2505210.	252.367	827.974				
88 6 34.0	392360.	252.443	828.223	-.249	-.249	.000	
C 115	-	2/0	NH0855				
42 41 4.0	2392120.	309.036	1013.896				
88 32 30.0	252890.	309.098	1014.099	-.203	-.200	-.003	
C 116	CGS	1/0	NG0300				
42 42 11.0	2569980.	206.616	677.873				
87 52 46.0	263490.	206.698	678.142	-.269	-.240	-.030	
C 118	CGS	2/0	NH0271				
42 34 34.0	2324360.	284.598	933.719				
88 47 45.0	212320.	284.662	933.929	-.210	-.203	-.007	
C 134	NGS	1/0	OL0122				
43 6 52.0	2554150.	192.023	629.995				
87 55 28.0	413070.	192.120	630.314	-.318	-.315	-.003	
C 137	NGS	1/0	NG0333				
42 52 37.0	2559730.	206.987	679.090				
87 54 42.0	326630.	206.956	678.988	.102	-.262	.364	
C 138	NGS	1/0	NG0367				
42 43 12.0	2592880.	191.796	629.251				
87 47 37.0	270260.	191.860	629.461	-.210	-.236	.026	
C 17	CGS	2/0	NH0095				
42 28 24.0	2446450.	269.752	885.011				
88 20 43.0	176950.	269.822	885.241	-.230	-.226	-.003	

NAME	AGENCY	ORDER	PID					
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
C 4	CGS	1/2	OM0047					
43 12 22.0	2512530.	252.773	829.306					
88 4 39.0	445490.	252.847	829.549	-.243	-.246	.003		
C 78	CGS	2/0	NH0267					
42 33 25.0	2309940.	289.793	950.763					
88 50 59.0	205130.	289.848	950.943	-.180	-.177	-.003		
C 86	CGS	2/0	OM0063					
43 19 43.0	2447360.	310.286	1017.997					
88 19 7.0	488740.	310.343	1018.184	-.187	-.180	-.007		
C 87 RESET '69	CGS	1/0	OL0076					
43 23 18.0	2565770.	189.271	620.967					
87 52 17.0	513220.	189.310	621.095	-.128	-.128	.000		
C 87	CGS	2/0	OL0075					
43 23 18.0	2565770.	188.618	618.824					
87 52 17.0	513220.	188.664	618.975	-.151	-.128	-.023		
CAP USLS	USLS	1/0	OL0282					
43 0 5.0	2564980.	178.883	586.885					
87 53 16.0	372130.	178.990	587.236	-.351	-.341	-.010		
CAROVL N BASE	CGS	1/0	NG0339					
42 55 43.0	2557920.	230.318	755.635					
87 55 .0	345420.	230.288	755.537	.098	-.276	.374		
CAROVL NB RM 1	CGS	1/0	NG0340					
42 55 44.0	2557920.	229.824	754.014					
87 55 .0	345520.	229.794	753.916	.098	-.276	.374		
CAROVL NB RM 2	CGS	1/0	NG0338					
42 55 42.0	2557920.	230.120	754.985					
87 55 .0	345310.	230.090	754.887	.098	-.276	.374		
CEDAR AZ	CGS	1/0	OL0166					
43 32 34.0	2575150.	231.086	758.155					
87 49 50.0	569770.	231.110	758.233	-.079	-.108	.030		
CITY HALL	USLS	1/0	OL0131					
43 2 29.0	2559050.	181.098	594.152					
87 54 31.0	386560.	181.200	594.487	-.335	-.351	.016		
CROSS	USLS	1/0	NG0263					
42 35 20.0	2588240.	177.816	583.385					
87 48 56.0	222340.	177.900	583.660	-.276	-.269	-.007		
D 115	CGS	2/0	NH0304					
42 35 14.0	2336640.	264.779	868.696					
88 45 .0	216550.	264.849	868.925	-.230	-.220	-.010		
D 116	CGS	2/0	NG0301					
42 42 6.0	2565960.	214.628	704.159					
87 53 40.0	262880.	214.710	704.428	-.269	-.253	-.016		
D 118	CGS	2/0	NH0272					
42 34 48.0	2329120.	280.303	919.627					
88 46 41.0	213800.	280.369	919.844	-.217	-.210	-.007		
D 134	NGS	1/0	OL0124					
43 6 32.0	2556350.	195.643	641.872					
87 54 59.0	411100.	195.740	642.190	-.318	-.315	-.003		
D 137	NGS	1/0	NG0330					
42 51 23.0	2559620.	217.859	714.759					
87 54 46.0	319130.	217.827	714.654	.105	-.253	.358		

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
D 138	NGS	1/0	NG0288				
42 41 50.0	2592350.	191.320	627.689				
87 47 47.0	261940.	191.420	628.017	-.328	-.266	-.062	
D 17	CGS	2/0	NH0099				
42 27 24.0	2457060.	248.602	815.622				
88 18 23.0	171080.	248.676	815.865	-.243	-.240	-.003	
D 3	CGS	1/2	NH0007				
42 40 7.0	2468720.	234.501	769.359				
88 15 26.0	248590.	234.576	769.605	-.246	-.249	.003	
D 4	CGS	1/2	OM0048				
43 14 8.0	2505690.	267.787	878.565				
88 6 8.0	456070.	267.850	878.771	-.207	-.233	.026	
D 78	CGS	2/0	NH0329				
42 30 42.0	2406550.	300.413	985.605				
88 29 32.0	190160.	300.475	985.808	-.203	-.203	.000	
D 86	CGS	2/0	OM0064				
43 19 48.0	2455110.	320.430	1051.277				
88 17 22.0	489400.	320.484	1051.455	-.177	-.177	.000	
D 87	CGS	1/0	OL0070				
43 24 12.0	2562530.	210.286	689.913				
87 52 59.0	518610.	210.331	690.061	-.148	-.128	-.020	
DANE	CGS	2/0	NH0270				
42 34 39.0	2325250.	282.166	925.740				
88 47 33.0	212840.	282.219	925.914	-.174	-.203	.030	
DARIEN	CGS	2/0	NH0277				
42 36 6.0	2347780.	287.963	944.759				
88 42 30.0	221980.	288.022	944.952	-.194	-.200	.007	
DOOR	CGS	2/0	NH0273				
42 34 58.0	2333450.	266.757	875.185				
88 45 43.0	214880.	266.827	875.415	-.230	-.213	-.016	
E 106	CGS	2/0	OM0086				
43 4 20.0	2491020.	253.103	830.389				
88 9 44.0	396200.	253.178	830.635	-.246	-.243	-.003	
E 114	CGS	2/0	OM0107				
43 4 17.0	2495330.	254.105	833.676				
88 8 46.0	395990.	254.180	833.922	-.246	-.243	-.003	
E 115	-	2/0	NH0796				
42 34 49.0	2345580.	278.606	914.060				
88 43 1.0	214150.	278.650	914.204	-.144	-.200	.056	
E 118	CGS	2/0	NH0024				
42 30 7.0	2409840.	301.739	989.955				
88 28 49.0	186680.	301.801	990.159	-.203	-.207	.003	
E 134	NGS	1/0	OL0126				
43 5 47.0	2560920.	199.154	653.391				
87 53 59.0	406660.	199.240	653.673	-.282	-.315	.033	
E 137	MRMSC	1/0	NG0328				
42 50 34.0	2559600.	203.596	667.965				
87 54 48.0	314170.	203.564	667.860	.105	-.240	.344	
E 138	NGS	1/0	NG0284				
42 40 30.0	2590100.	187.885	616.419				
87 48 20.0	253780.	187.960	616.665	-.246	-.266	.020	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
E 226	CGS	2/0	NH0087				
42 29 20.0	2429180.	266.990	875.950				
88 24 32.0	182280.	267.056	876.166	-.217	-.213	-.003	
E 3	CGS	1/2	NH0008				
42 40 31.0	2487340.	244.637	802.613				
88 11 16.0	251410.	244.713	802.863	-.249	-.249	.000	
E 4	CGS	1/2	OM0049				
43 15 31.0	2499290.	271.334	890.202				
88 7 32.0	464330.	271.401	890.421	-.220	-.223	.003	
E 78	CGS	2/0	NH0327				
42 31 11.0	2393620.	314.437	1031.615				
88 32 24.0	192870.	314.497	1031.812	-.197	-.194	-.003	
E 86	CGS	2/0	OM0066				
43 18 37.0	2463010.	323.037	1059.831				
88 15 37.0	482380.	323.093	1060.014	-.184	-.180	-.003	
E 87	CGS	2/0	OL0066				
43 25 53.0	2565000.	215.946	708.483				
87 52 22.0	528900.	215.990	708.627	-.144	-.131	-.013	
EAST USLS	USLS	1/0	OL0081				
43 23 16.0	2566810.	178.054	584.165				
87 52 3.0	513040.	178.090	584.284	-.118	-.125	.007	
EE 86	CGS	2/0	OM0067				
43 18 8.0	2470320.	305.330	1001.737				
88 13 59.0	479600.	305.389	1001.930	-.194	-.194	.000	
ELKHORN	CGS	2/0	NH0284				
42 39 57.0	2392020.	304.360	998.554				
88 32 33.0	246100.	304.422	998.758	-.203	-.200	-.003	
F 106	CGS	2/0	OM0087				
43 4 24.0	2481360.	260.824	855.720				
88 11 54.0	396390.	260.898	855.963	-.243	-.243	.000	
F 114	CGS	2/0	OM0108				
43 3 56.0	2491300.	251.683	825.730				
88 9 41.0	393770.	251.757	825.973	-.243	-.243	.000	
F 115	-	2/0	NH0797				
42 33 41.0	2355860.	293.070	961.514				
88 40 45.0	207430.	293.120	961.678	-.164	-.180	.016	
F 118	CGS	2/0	NH0025				
42 30 7.0	2414860.	295.219	968.564				
88 27 42.0	186770.	295.282	968.771	-.207	-.210	.003	
F 134	NGS	1/0	OL0127				
43 5 26.0	2561710.	195.713	642.102				
87 53 49.0	404550.	195.800	642.387	-.285	-.322	.036	
F 137	NGS	1/0	NG0327				
42 49 33.0	2559600.	208.745	684.858				
87 54 50.0	307990.	208.713	684.753	.105	-.217	.322	
F 138	NGS	1/0	NG0283				
42 39 38.0	2588450.	189.211	620.770				
87 48 44.0	248470.	189.290	621.029	-.259	-.266	.007	
F 226	CGS	2/0	NH0094				
42 28 32.0	2442540.	269.060	882.741				
88 21 35.0	177680.	269.128	882.964	-.223	-.223	.000	

NAME	LATITUDE LONGITUDE	AGENCY NAD27X NAD27Y	ORDER NAVD88 NGVD29	US SURV. FEET	PID PUB DIFF	DIFF BY VERTCON	FIT (feet)
F 3		CGS	1/2		NH0009		
	42 40 43.0	2497690.	244.533	802.272			
	88 8 57.0	252860.	244.610	802.525	-.253	-.249	-.003
F 4		CGS	1/2		OM0050		
	43 17 41.0	2489450.	257.541	844.949			
	88 9 41.0	477280.	257.600	845.143	-.194	-.213	.020
F 78		CGS	2/0		NH0276		
	42 36 3.0	2346890.	285.351	936.189			
	88 42 42.0	221670.	285.411	936.386	-.197	-.200	.003
F 86		CGS	2/0		OM0068		
	43 16 42.0	2476050.	295.591	969.785			
	88 12 44.0	471010.	295.652	969.985	-.200	-.200	.000
F 87		CGS	1/0		OL0064		
	43 27 17.0	2565080.	219.661	720.671			
	87 52 18.0	537410.	219.704	720.812	-.141	-.135	-.007
FF 86		CGS	2/0		OM0069		
	43 15 24.0	2481330.	296.678	973.351			
	88 11 35.0	463220.	296.740	973.554	-.203	-.207	.003
FLUSHING		USLS	1/0		OL0147		
	43 3 13.0	2564800.	179.082	587.538			
	87 53 12.0	391160.	179.170	587.827	-.289	-.354	.066
FOX AZ		CGS	1/0		OL0104		
	43 10 8.0	2564620.	207.420	680.510			
	87 53 .0	433180.	207.480	680.707	-.197	-.249	.052
FOX		CGS	1/0		OL0107		
	43 10 2.0	2564120.	209.374	686.921			
	87 53 7.0	432560.	209.440	687.138	-.217	-.253	.036
FOX RM 2		CGS	1/0		OL0105		
	43 10 2.0	2564120.	208.738	684.835			
	87 53 7.0	432560.	208.800	685.038	-.203	-.253	.049
FOX RM 1		CGS	1/0		OL0106		
	43 10 2.0	2564120.	208.577	684.306			
	87 53 7.0	432560.	208.640	684.513	-.207	-.253	.046
G 106		CGS	2/0		OM0090		
	43 5 6.0	2463690.	261.789	858.886			
	88 15 51.0	400270.	261.862	859.126	-.240	-.233	-.007
G 114		CGS	2/0		OM0109		
	43 3 8.0	2483240.	250.751	822.672			
	88 11 31.0	388740.	250.825	822.915	-.243	-.243	.000
G 115		CGS	2/0		NH0312		
	42 33 .0	2365510.	297.798	977.026			
	88 38 37.0	203430.	297.848	977.190	-.164	-.171	.007
G 118		CGS	2/0		NH0026		
	42 29 59.0	2420120.	275.679	904.457			
	88 26 32.0	186060.	275.745	904.673	-.217	-.213	-.003
G 134		NGS	1/0		OL0128		
	43 4 53.0	2563500.	193.679	635.429			
	87 53 26.0	401260.	193.760	635.694	-.266	-.328	.062
G 137		NGS	1/0		NG0322		
	42 48 51.0	2559560.	218.704	717.531			
	87 54 52.0	303730.	218.740	717.649	-.118	-.203	.085

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
G 138	NGS	1/0	NG0277				
42 37 59.0	2585420.	185.854	609.756				
87 49 28.0	238370.	185.930	610.005	-.249	-.266	.016	
G 226	CGS	2/0	NH0097				
42 28 16.0	2449310.	265.651	871.557				
88 20 5.0	176190.	265.722	871.790	-.233	-.230	-.003	
G 3	CGS	1/2	NH0010				
42 41 2.0	2513330.	255.124	837.019				
88 5 27.0	255130.	255.200	837.269	-.249	-.249	.000	
G 4	CGS	1/2	OM0051				
43 19 25.0	2487970.	273.190	896.291				
88 9 58.0	487770.	273.253	896.498	-.207	-.203	-.003	
G 78	CGS	2/0	NH0274				
42 35 .0	2333670.	264.182	866.737				
88 45 40.0	215090.	264.253	866.970	-.233	-.213	-.020	
G 86	CGS	2/0	OM0070				
43 14 33.0	2489870.	274.934	902.013				
88 9 41.0	458250.	275.002	902.236	-.223	-.220	-.003	
G 87	CGS	2/0	OL0062				
43 28 51.0	2567930.	225.207	738.867				
87 51 36.0	547000.	225.248	739.001	-.135	-.131	-.003	
H 106	CGS	2/0	OM0092				
43 5 1.0	2463700.	260.651	855.152				
88 15 51.0	399760.	260.724	855.392	-.240	-.233	-.007	
H 114	CGS	2/0	OM0110				
43 2 49.0	2480530.	250.800	822.833				
88 12 8.0	386750.	250.873	823.073	-.240	-.243	.003	
H 115	CGS	2/0	NH0318				
42 32 21.0	2374630.	304.155	997.882				
88 36 36.0	199630.	304.200	998.029	-.148	-.180	.033	
H 118	CGS	2/0	NH0027				
42 29 57.0	2420870.	276.102	905.845				
88 26 22.0	185870.	276.167	906.058	-.213	-.213	.000	
H 134	NGS	1/0	OL0129				
43 4 7.0	2563470.	191.084	626.915				
87 53 28.0	396600.	191.170	627.197	-.282	-.341	.059	
H 137	NGS	1/0	NG0320				
42 48 .0	2559540.	220.585	723.703				
87 54 54.0	298570.	220.620	723.817	-.115	-.184	.069	
H 138	NGS	1/0	NG0276				
42 37 26.0	2585140.	188.184	617.400				
87 49 33.0	235020.	188.260	617.650	-.249	-.266	.016	
H 226	CGS	2/0	NH0098				
42 27 49.0	2453190.	256.578	841.790				
88 19 14.0	173540.	256.651	842.029	-.240	-.236	-.003	
H 273	NGS	1/0	NG0234				
42 29 32.0	2588860.	181.800	596.455				
87 49 .0	187110.	181.900	596.784	-.328	-.302	-.026	
H 3	CGS	1/2	NH0011				
42 41 16.0	2524050.	237.974	780.753				
88 3 3.0	256800.	238.053	781.012	-.259	-.259	.000	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
H 4	CGS	1/2	OM0052				
43 22 7.0	2487970.	292.768	960.523				
88 9 53.0	504180.	292.823	960.703	-.180	-.184	.003	
H 78	CGS	2/0	NH0275				
42 35 42.0	2342810.	272.873	895.251				
88 43 37.0	219480.	272.937	895.461	-.210	-.210	.000	
H 86	CGS	2/0	OM0071				
43 13 41.0	2503610.	262.896	862.518				
88 6 37.0	453290.	262.970	862.761	-.243	-.233	-.010	
H 87	CGS	2/0	OL0060				
43 29 53.0	2569020.	224.428	736.311				
87 51 19.0	553310.	224.468	736.442	-.131	-.128	-.003	
HANSEN	USLS	1/0	OL0136				
43 1 43.0	2560500.	179.965	590.435				
87 54 13.0	381940.	180.060	590.747	-.312	-.351	.039	
HEBRON AZ	CGS	2/0	NH0088				
42 28 59.0	2433340.	271.928	892.150				
88 23 37.0	180230.	271.993	892.364	-.213	-.217	.003	
HEBRON	CGS	2/0	NH0091				
42 29 12.0	2433320.	277.094	909.099				
88 23 37.0	181550.	277.159	909.312	-.213	-.217	.003	
HEBRON RM1	CGS	2/0	NH0090				
42 29 12.0	2433320.	276.857	908.322				
88 23 37.0	181550.	276.921	908.532	-.210	-.217	.007	
HEBRON RM2	CGS	2/0	NH0089				
42 29 12.0	2433320.	275.569	904.096				
88 23 37.0	181550.	275.634	904.309	-.213	-.217	.003	
HH 86	CGS	2/0	OM0072				
43 13 36.0	2505840.	269.169	883.099				
88 6 7.0	452830.	269.242	883.338	-.240	-.233	-.007	
HUSHER	CGS	1/0	NG0324				
42 48 51.0	2564030.	228.540	749.802				
87 53 52.0	303850.	228.508	749.697	.105	-.190	.295	
HUSHER RM 1	CGS	1/0	NG0323				
42 48 51.0	2564030.	227.146	745.228				
87 53 52.0	303850.	227.115	745.126	.102	-.190	.292	
HUSHER RM 2	CGS	1/0	NG0325				
42 48 51.0	2564030.	229.032	751.416				
87 53 52.0	303850.	229.001	751.314	.102	-.190	.292	
J 106	CGS	2/0	OM0098				
43 6 .0	2441400.	280.728	921.022				
88 20 50.0	405280.	280.794	921.238	-.217	-.213	-.003	
J 114	CGS	2/0	OM0111				
43 1 21.0	2475450.	248.730	816.042				
88 13 19.0	377730.	248.803	816.281	-.240	-.236	-.003	
J 115	CGS	2/0	NH0319				
42 32 11.0	2377570.	305.557	1002.482				
88 35 57.0	198670.	305.613	1002.665	-.184	-.184	.000	
J 134	NGS	1/0	OL0148				
43 3 10.0	2564880.	179.260	588.122				
87 53 11.0	390860.	179.350	588.417	-.295	-.354	.059	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
J 137	NGS	1/0	NG0319				
42 47 6.0	2559680.	218.831	717.948				
87 54 54.0	293100.	218.870	718.076	-.128	-.184	.056	
J 138	NGS	1/0	NG0272				
42 36 55.0	2585370.	187.139	613.972				
87 49 31.0	231880.	187.220	614.238	-.266	-.269	.003	
J 273	NGS	1/0	NG0232				
42 29 1.0	2589020.	181.834	596.567				
87 48 59.0	183980.	181.930	596.882	-.315	-.305	-.010	
J 3	CGS	1/2	NH0012				
42 41 31.0	2536330.	228.248	748.844				
88 0 18.0	258610.	228.329	749.109	-.266	-.262	-.003	
J 4	CGS	1/2	OM0053				
43 24 44.0	2484750.	279.238	916.133				
88 10 32.0	520010.	279.293	916.314	-.180	-.174	-.007	
J 78	CGS	2/0	NH0305				
42 35 3.0	2338680.	269.536	884.303				
88 44 33.0	215470.	269.605	884.529	-.226	-.213	-.013	
J 86	CGS	2/0	OM0073				
43 13 3.0	2510880.	264.457	867.639				
88 5 .0	449610.	264.532	867.885	-.246	-.240	-.007	
J 87	CGS	1/0	OL0164				
43 30 50.0	2570490.	223.140	732.085				
87 50 57.0	559120.	223.180	732.216	-.131	-.118	-.013	
K 106	CGS	2/0	OM0103				
43 6 10.0	2421800.	277.586	910.713				
88 25 14.0	405920.	277.650	910.923	-.210	-.213	.003	
K 114	CGS	2/0	OM0113				
43 0 42.0	2473010.	249.534	818.679				
88 13 53.0	373730.	249.606	818.916	-.236	-.236	.000	
K 115	CGS	2/0	NH0320				
42 31 57.0	2377440.	304.157	997.888				
88 35 59.0	197250.	304.213	998.072	-.184	-.184	.000	
K 133	NGS	1/0	OL0163				
43 30 .0	2569220.	223.556	733.450				
87 51 16.0	554020.	223.590	733.562	-.112	-.128	.016	
K 134	NGS	1/0	OL0149				
43 2 35.0	2562520.	180.256	591.390				
87 53 44.0	387250.	180.350	591.698	-.308	-.361	.052	
K 137	NGS	1/0	NG0318				
42 46 13.0	2559960.	220.793	724.385				
87 54 52.0	287740.	220.830	724.506	-.121	-.184	.062	
K 138	NGS	1/0	NG0270				
42 35 50.0	2586510.	184.740	606.101				
87 49 18.0	225330.	184.810	606.331	-.230	-.269	.039	
K 273	NGS	1/0	NG0229				
42 28 1.0	2589330.	180.855	593.355				
87 48 57.0	177910.	180.950	593.667	-.312	-.318	.007	
K 3	CGS	1/2	NG0303				
42 41 47.0	2550030.	231.583	759.785				
87 57 14.0	260560.	231.660	760.038	-.253	-.259	.007	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
K 4	CGS	1/2	OM0054				
43 25 36.0	2482930.	272.014	892.433				
88 10 55.0	525230.	272.069	892.613	-.180	-.171	-.010	
K 78	CGS	2/0	NH0306				
42 34 58.0	2340630.	271.378	890.346				
88 44 7.0	214990.	271.446	890.569	-.223	-.210	-.013	
K 86	CGS	2/0	OM0074				
43 11 31.0	2515760.	236.411	775.625				
88 3 57.0	440400.	236.490	775.884	-.259	-.253	-.007	
K 87	CGS	1/0	OL0168				
43 32 34.0	2573090.	221.934	728.128				
87 50 18.0	569720.	221.961	728.217	-.089	-.102	.013	
KENOSHA 1	CGS	1/0	NG0257				
42 34 3.0	2586050.	186.054	610.412				
87 49 28.0	214480.	186.120	610.629	-.217	-.266	.049	
KENOSHA 2	CGS	2/0	NG0260				
42 35 3.0	2585660.	185.866	609.795				
87 49 31.0	220550.	185.940	610.038	-.243	-.269	.026	
KENOSHA 3	CGS	2/0	NG0274				
42 37 23.0	2585000.	187.951	616.636				
87 49 35.0	234710.	188.030	616.895	-.259	-.266	.007	
KENOSHA LIGHT	USLS	1/0	NG0265				
42 35 21.0	2588310.	184.169	604.228				
87 48 55.0	222440.	184.250	604.494	-.266	-.269	.003	
L 106	CGS	2/0	OM0106				
43 6 26.0	2412570.	270.703	888.131				
88 27 18.0	407360.	270.768	888.345	-.213	-.213	.000	
L 114	CGS	2/0	OM0114				
43 0 39.0	2473390.	252.120	827.164				
88 13 48.0	373440.	252.192	827.400	-.236	-.236	.000	
L 115	CGS	2/0	NH0321				
42 31 52.0	2377600.	304.205	998.046				
88 35 57.0	196750.	304.260	998.226	-.180	-.184	.003	
L 133	NGS	1/0	OL0173				
43 34 19.0	2583050.	201.255	660.284				
87 47 59.0	580610.	201.290	660.399	-.115	-.089	-.026	
L 134	NGS	1/0	OL0151				
43 2 28.0	2560240.	193.586	635.123				
87 54 15.0	386490.	193.680	635.432	-.308	-.358	.049	
L 137	NGS	1/0	NG0315				
42 45 17.0	2563380.	218.750	717.682				
87 54 8.0	282160.	218.790	717.814	-.131	-.174	.043	
L 138	NGS	1/0	NG0261				
42 35 17.0	2587050.	183.574	602.276				
87 49 12.0	222000.	183.650	602.525	-.249	-.269	.020	
L 273	NGS	1/0	NG0226				
42 26 59.0	2589040.	180.460	592.059				
87 49 3.0	171620.	180.550	592.354	-.295	-.325	.030	
L 3	-	2/0	NG0382				
42 42 .0	2560600.	223.383	732.882				
87 54 52.0	262140.	223.465	733.151	-.269	-.259	-.010	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
L 4	CGS	1/2	OM0056				
43 27 20.0	2478800.	284.630	933.824				
88 11 48.0	535680.	284.670	933.955	-.131	-.164	.033	
L 78	CGS	2/0	NH0307				
42 34 49.0	2345580.	275.019	902.292				
88 43 1.0	214150.	275.084	902.505	-.213	-.200	-.013	
L 86	CGS	2/0	OM0075				
43 10 34.0	2521670.	227.732	747.151				
88 2 39.0	434770.	227.812	747.413	-.262	-.259	-.003	
L 87	CGS	1/0	OL0170				
43 33 55.0	2577300.	212.769	698.060				
87 49 18.0	578030.	212.813	698.204	-.144	-.092	-.052	
LIGHT USLS	USLS	1/0	OL0082				
43 23 14.0	2566960.	179.048	587.427				
87 52 1.0	512840.	179.090	587.564	-.138	-.125	-.013	
LINCOLN USLS	USLS	1/0	OL0280				
43 0 8.0	2564680.	181.231	594.589				
87 53 20.0	372420.	181.330	594.914	-.325	-.341	.016	
M 106	CGS	2/0	OM0260				
43 6 18.0	2405910.	269.321	883.597				
88 28 48.0	406430.	269.386	883.811	-.213	-.213	.000	
M 114	CGS	2/0	OM0115				
43 0 32.0	2472810.	253.925	833.086				
88 13 56.0	372720.	253.996	833.319	-.233	-.236	.003	
M 115	CGS	2/0	NH0325				
42 31 32.0	2387970.	307.200	1007.872				
88 33 39.0	194900.	307.262	1008.075	-.203	-.194	-.010	
M 133	NGS	1/0	OL0172				
43 34 19.0	2578480.	208.484	684.001				
87 49 1.0	580490.	208.520	684.119	-.118	-.085	-.033	
M 134	NGS	1/0	OL0137				
43 0 51.0	2560490.	179.912	590.261				
87 54 15.0	376670.	180.010	590.583	-.322	-.348	.026	
M 137	NGS	1/0	NG0314				
42 44 31.0	2563200.	227.534	746.501				
87 54 12.0	277500.	227.600	746.718	-.217	-.187	-.030	
M 138	NGS	1/0	NG0268				
42 35 19.0	2588990.	178.567	585.849				
87 48 46.0	222260.	178.650	586.121	-.272	-.269	-.003	
M 3	CGS	1/0	NG0306				
42 42 2.0	2563060.	221.484	726.652				
87 54 19.0	262400.	221.565	726.918	-.266	-.259	-.007	
M 4	CGS	1/2	OM0028				
43 29 56.0	2473520.	284.777	934.306				
88 12 55.0	551360.	284.823	934.457	-.151	-.148	-.003	
M 78	CGS	2/0	NH0311				
42 33 19.0	2360990.	302.553	992.626				
88 39 37.0	205280.	302.605	992.797	-.171	-.174	.003	
M 86	CGS	1/0	OL0117				
43 7 32.0	2549530.	203.542	667.787				
87 56 29.0	417010.	203.665	668.191	-.404	-.322	-.082	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
M 87	CGS	1/0	OL0171				
43 34 2.0	2576390.	216.681	710.894				
87 49 30.0	578720.	216.719	711.019	-.125	-.089	-.036	
MITCHELL AZ	CGS	2/0	NG0355				
42 57 28.0	2559660.	203.798	668.627				
87 54 33.0	356090.	203.870	668.863	-.236	-.282	.046	
MITCHELL	CGS	1/0	NG0353				
42 57 31.0	2561890.	205.392	673.857				
87 54 3.0	356450.	205.476	674.133	-.276	-.282	.007	
MITCHELL RM 1	CGS	1/0	NG0354				
42 57 31.0	2561890.	205.359	673.749				
87 54 3.0	356450.	205.444	674.028	-.279	-.282	.003	
MITCHELL RM 2	CGS	1/0	NG0352				
42 57 31.0	2561890.	205.456	674.067				
87 54 3.0	356450.	205.539	674.339	-.272	-.282	.010	
MM 115	CGS	2/0	NH0328				
42 30 53.0	2399790.	309.082	1014.047				
88 31 2.0	191160.	309.143	1014.247	-.200	-.200	.000	
N 106	CGS	2/0	OM0261				
43 6 31.0	2401660.	265.971	872.607				
88 29 45.0	407670.	266.037	872.823	-.217	-.213	-.003	
N 114	CGS	2/0	NH0014				
42 59 53.0	2464940.	250.789	822.797				
88 15 43.0	368600.	250.861	823.033	-.236	-.240	.003	
N 115	-	2/0	NH0856				
42 30 38.0	2408730.	300.734	986.658				
88 29 3.0	189800.	300.800	986.875	-.217	-.207	-.010	
N 133	NGS	1/0	OL0169				
43 33 11.0	2575130.	223.924	734.657				
87 49 49.0	573520.	223.950	734.743	-.085	-.102	.016	
N 134	NGS	1/0	OL0138				
43 0 11.0	2562960.	181.992	597.085				
87 53 43.0	372680.	182.090	597.407	-.322	-.344	.023	
N 137	NGS	1/0	NG0308				
42 43 11.0	2562880.	220.322	722.840				
87 54 19.0	269390.	220.390	723.063	-.223	-.226	.003	
N 138	NGS	1/0	NG0258				
42 34 28.0	2586730.	183.197	601.039				
87 49 18.0	217030.	183.260	601.246	-.207	-.266	.059	
N 3	CGS	1/0	NG0312				
42 44 17.0	2561370.	221.304	726.062				
87 54 37.0	276030.	221.361	726.249	-.187	-.197	.010	
N 4	CGS	1/2	OM0029				
43 32 9.0	2466750.	298.008	977.715				
88 14 23.0	564680.	298.050	977.852	-.138	-.135	-.003	
N 78	CGS	2/0	NH0324				
42 31 39.0	2386160.	303.896	997.032				
88 34 3.0	195580.	303.957	997.232	-.200	-.194	-.007	
N 86	CGS	2/0	OL0114				
43 8 1.0	2557760.	207.752	681.600				
87 54 37.0	420150.	207.831	681.859	-.259	-.285	.026	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAV88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
N 87	CGS	2/0	OL0175				
43 35 11.0	2579450.	208.977	685.619				
87 48 46.0	585780.	209.017	685.750	-.131	-.062	-.069	
NO 19		1/0	NG0369				
42 42 44.0	2589600.	195.579	641.662				
87 48 22.0	267340.	195.640	641.862	-.200	-.243	.043	
NO 27		1/0	NG0374				
42 42 43.0	2586840.	196.460	644.553				
87 48 59.0	267160.	196.520	644.749	-.197	-.233	.036	
NAVY USLS	DOD	1/0	OL0278				
43 0 12.0	2564150.	182.999	600.389				
87 53 27.0	372810.	183.100	600.721	-.331	-.341	.010	
NO 100		1/0	NG0364				
42 43 33.0	2596110.	189.243	620.875				
87 46 53.0	272470.	189.300	621.062	-.187	-.233	.046	
NORTH	USLS	1/0	NG0362				
42 44 4.0	2595350.	178.565	585.842				
87 47 2.0	275590.	178.620	586.022	-.180	-.220	.039	
OCONOMOWOC	CGS	2/0	OM0270				
43 6 43.0	2400000.	262.673	861.786				
88 30 7.0	408860.	262.738	862.000	-.213	-.213	.000	
P 106	CGS	2/0	OM0263				
43 6 27.0	2401140.	264.584	868.056				
88 29 52.0	407260.	264.649	868.269	-.213	-.217	.003	
P 114	USGS	2/0	NH0015				
42 59 17.0	2450970.	255.655	838.761				
88 18 52.0	364670.	255.727	838.998	-.236	-.236	.000	
P 115	CGS	2/0	NH0085				
42 29 51.0	2422750.	274.505	900.605				
88 25 57.0	185300.	274.571	900.822	-.217	-.213	-.003	
P 130	NGS	1/0	OL0092				
43 18 33.0	2553570.	221.241	725.855				
87 55 12.0	484050.	221.290	726.016	-.161	-.187	.026	
P 133	NGS	1/0	OL0165				
43 31 41.0	2571980.	222.059	728.539				
87 50 35.0	564320.	222.090	728.640	-.102	-.112	.010	
P 134	-	1/0	NG0375				
42 59 30.0	2564260.	189.320	621.127				
87 53 27.0	368560.	189.420	621.455	-.328	-.328	.000	
P 137	NGS	1/0	NG0307				
42 42 32.0	2563210.	218.571	717.095				
87 54 16.0	265440.	218.650	717.354	-.259	-.246	-.013	
P 138	NGS	1/0	NG0256				
42 33 31.0	2586950.	184.184	604.277				
87 49 17.0	211270.	184.250	604.494	-.217	-.266	.049	
P 3	CGS	1/0	NG0317				
42 45 38.0	2559900.	223.947	734.733				
87 54 54.0	284200.	223.991	734.877	-.144	-.184	.039	
P 4	CGS	1/2	OM0030				
43 34 19.0	2456540.	307.238	1007.997				
88 16 38.0	577640.	307.275	1008.118	-.121	-.118	-.003	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
P 78	CGS	2/0	NH0023				
42 30 37.0	2409410.	298.350	978.837				
88 28 54.0	189710.	298.412	979.040	-.203	-.207	.003	
P 86	CGS	2/0	OL0112				
43 8 39.0	2560110.	211.942	695.346				
87 54 4.0	424060.	212.018	695.596	-.249	-.266	.016	
PARK	USLS	1/0	NG0264				
42 35 24.0	2588080.	183.290	601.344				
87 48 58.0	222740.	183.370	601.606	-.262	-.269	.007	
PLEASANT 2 RM6	CGS	1/0	NG0310				
42 44 8.0	2562810.	229.893	754.241				
87 54 18.0	275160.	229.960	754.460	-.220	-.200	-.020	
PLEASANT 2 RM5	CGS	1/0	NG0313				
42 44 8.0	2562810.	229.282	752.236				
87 54 18.0	275160.	229.340	752.426	-.190	-.200	.010	
PLEASANT 2 AZ	CGS	1/0	NG0311				
42 44 19.0	2559430.	222.316	729.382				
87 55 3.0	276190.	222.370	729.559	-.177	-.200	.023	
PLEASANT 2	CGS	1/0	NG0309				
42 44 8.0	2562810.	230.956	757.728				
87 54 18.0	275160.	231.020	757.938	-.210	-.200	-.010	
PRINTING	USLS	1/0	OL0135				
43 1 50.0	2561520.	180.664	592.728				
87 53 59.0	382670.	180.760	593.043	-.315	-.358	.043	
Q 106	CGS	2/0	OM0264				
43 6 32.0	2400840.	263.801	865.487				
88 29 56.0	407760.	263.866	865.700	-.213	-.217	.003	
Q 114	CGS	2/0	NH0016				
42 58 37.0	2442210.	274.379	900.192				
88 20 51.0	360440.	274.450	900.425	-.233	-.233	.000	
Q 130	NGS	1/0	OL0094				
43 16 48.0	2554130.	205.951	675.691				
87 55 8.0	473430.	206.010	675.884	-.194	-.203	.010	
Q 133	NGS	1/0	OL0061				
43 29 5.0	2568190.	224.362	736.094				
87 51 32.0	548420.	224.400	736.219	-.125	-.128	.003	
Q 134	-	1/0	NG0376				
42 58 43.0	2566760.	199.942	655.976				
87 52 55.0	363870.	200.050	656.331	-.354	-.308	-.046	
Q 137	NGS	1/0	NG0302				
42 42 6.0	2565960.	213.423	700.205				
87 53 40.0	262880.	213.500	700.458	-.253	-.253	.000	
Q 138	NGS	1/0	NG0253				
42 31 55.0	2588180.	183.578	602.289				
87 49 4.0	201580.	183.660	602.558	-.269	-.276	.007	
Q 3	CGS	1/2	NG0321				
42 48 26.0	2556870.	222.435	729.772				
87 55 29.0	301140.	222.518	730.044	-.272	-.200	-.072	
Q 78	CGS	2/0	NH0308				
42 34 20.0	2349820.	284.029	931.852				
88 42 5.0	211280.	284.090	932.052	-.200	-.190	-.010	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
Q 86	CGS	1/0	OL0109				
43 9 46.0	2560160.	204.656	671.442				
87 54 1.0	430840.	204.730	671.685	-.243	-.253	.010	
R 106	CGS	2/0	OM0265				
43 6 37.0	2400680.	263.517	864.555				
88 29 58.0	408260.	263.582	864.769	-.213	-.213	.000	
R 114	CGS	2/0	NH0017				
42 57 58.0	2435970.	276.843	908.276				
88 22 16.0	356370.	276.913	908.505	-.230	-.226	-.003	
R 115	CGS	1/0	NG0251				
42 31 19.0	2588280.	183.537	602.154				
87 49 4.0	197930.	183.629	602.456	-.302	-.282	-.020	
R 130	NGS	1/0	OL0110				
43 8 52.0	2560220.	211.929	695.304				
87 54 2.0	425380.	212.020	695.602	-.299	-.262	-.036	
R 133	NGS	1/0	OL0063				
43 28 13.0	2567290.	223.168	732.177				
87 51 46.0	543130.	223.200	732.282	-.105	-.131	.026	
R 134	NGS	1/0	NG0377				
42 57 59.0	2570140.	210.220	689.697				
87 52 11.0	359500.	210.188	689.592	.105	-.289	.394	
R 137	NGS	1/0	NG0299				
42 42 15.0	2572730.	204.978	672.499				
87 52 9.0	263960.	205.050	672.735	-.236	-.230	-.007	
R 138	NGS	1/0	NG0249				
42 30 28.0	2588560.	185.702	609.257				
87 49 2.0	192770.	185.800	609.579	-.322	-.292	-.030	
R 2	CGS	2/0	NH0265				
42 33 11.0	2307040.	288.306	945.884				
88 51 38.0	203670.	288.360	946.061	-.177	-.177	.000	
R 3	-	1/2	NG0389				
42 51 25.0	2556270.	212.271	696.426				
87 55 31.0	319250.	212.350	696.685	-.259	-.259	.000	
R 78	CGS	2/0	NH0309				
42 33 57.0	2353000.	286.923	941.347				
88 41 23.0	209000.	286.982	941.540	-.194	-.184	-.010	
R 86	CGS	1/0	OL0103				
43 10 35.0	2559670.	207.120	679.526				
87 54 6.0	435790.	207.188	679.749	-.223	-.249	.026	
RACINE	CGS	1/0	NG0372				
42 43 6.0	2587150.	196.410	644.388				
87 48 54.0	269500.	196.470	644.585	-.197	-.226	.030	
RACINE RM 3	CGS	1/0	NG0370				
42 43 6.0	2587150.	196.523	644.759				
87 48 54.0	269500.	196.590	644.979	-.220	-.226	.007	
RACINE RM 5	CGS	1/0	NG0373				
42 43 6.0	2587150.	196.379	644.287				
87 48 54.0	269500.	196.440	644.487	-.200	-.226	.026	
RACINE RM 4	CGS	1/0	NG0371				
42 43 6.0	2587150.	195.803	642.397				
87 48 54.0	269500.	195.870	642.617	-.220	-.226	.007	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
RARITAN USLS	DOD	1/0		OL0281			
43 0 6.0	2564980.	179.337	588.375				
87 53 16.0	372230.	179.440	588.713	-.338	-.341	.003	
RV 1 CNWRR	CNWRR	2/0		NH0100			
42 27 24.0	2457060.	243.331	798.328				
88 18 23.0	171080.	243.406	798.575	-.246	-.240	-.007	
RV 2 CNWRR	CNWRR	2/0		NH0102			
42 26 47.0	2457140.	242.362	795.149				
88 18 23.0	167340.	242.436	795.392	-.243	-.236	-.007	
RV 57	CNWRR	1/0		NG0227			
42 27 25.0	2589050.	181.991	597.082				
87 49 2.0	174250.	182.103	597.450	-.367	-.322	-.046	
RV 62	CNWRR	1/0		NG0250			
42 30 37.0	2588610.	184.807	606.321				
87 49 1.0	193690.	184.900	606.626	-.305	-.289	-.016	
RV 63	CNWRR	1/0		NG0252			
42 31 41.0	2588140.	182.850	599.900				
87 49 5.0	200160.	182.930	600.163	-.262	-.279	.016	
RV 64	CNWRR	2/0		NG0255			
42 32 43.0	2587460.	186.304	611.232				
87 49 12.0	206420.	186.380	611.482	-.249	-.266	.016	
RV 65 CNWRR		2/0		NG0387			
42 33 24.0	2586970.	185.250	607.774				
87 49 17.0	210560.	185.320	608.004	-.230	-.266	.036	
RV 66	CGS	1/0		NG0269			
42 35 49.0	2585390.	191.385	627.902				
87 49 33.0	225200.	191.460	628.148	-.246	-.269	.023	
RV 67 CNWRR		2/0		NG0386			
42 36 23.0	2585300.	187.261	614.372				
87 49 33.0	228640.	187.340	614.631	-.259	-.269	.010	
RV 68	CNWRR	2/0		NG0273			
42 37 7.0	2584960.	189.706	622.394				
87 49 36.0	233090.	189.780	622.637	-.243	-.266	.023	
RV 69	CNWRR	2/0		NG0275			
42 38 8.0	2585620.	186.082	610.504				
87 49 25.0	239280.	186.160	610.760	-.256	-.266	.010	
RV 70	CNWRR	2/0		NG0279			
42 39 15.0	2587690.	190.816	626.035				
87 48 55.0	246120.	190.890	626.278	-.243	-.266	.023	
RV 71	CNWRR	2/0		NG0280			
42 39 46.0	2588580.	190.017	623.414				
87 48 42.0	249290.	190.090	623.654	-.240	-.266	.026	
RV 72	CNWRR	2/0		NG0282			
42 40 17.0	2589540.	188.334	617.892				
87 48 28.0	252450.	188.410	618.142	-.249	-.266	.016	
RV 73	CNWRR	1/0		NG0285			
42 41 .0	2590840.	189.807	622.725				
87 48 9.0	256840.	189.880	622.965	-.240	-.266	.026	
RV 74	CNWRR	1/0		NG0287			
42 41 40.0	2592230.	189.769	622.600				
87 47 49.0	260930.	189.860	622.899	-.299	-.266	-.033	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
RV 75	CNWRR	1/0	NG0289				
42 42 30.0	2592250.	191.036	626.757				
87 47 47.0	265990.	191.130	627.066	-.308	-.253	-.056	
S 106	CGS	2/0	OM0268				
43 7 22.0	2387470.	272.070	892.616				
88 32 55.0	412580.	272.135	892.830	-.213	-.213	.000	
S 114	CGS	2/0	NH0018				
42 56 41.0	2431880.	286.914	941.317				
88 23 13.0	348500.	286.982	941.540	-.223	-.223	.000	
S 115	CGS	1/0	NG0254				
42 32 35.0	2587550.	186.082	610.504				
87 49 11.0	205610.	186.159	610.757	-.253	-.269	.016	
S 130	NGS	1/0	OL0108				
43 10 9.0	2560030.	203.526	667.735				
87 54 2.0	433170.	203.590	667.945	-.210	-.253	.043	
S 133	NGS	1/0	OL0065				
43 26 16.0	2564280.	221.030	725.163				
87 52 31.0	531210.	221.070	725.294	-.131	-.135	.003	
S 134	NGS	1/0	NG0378				
42 57 33.0	2571770.	215.389	706.655				
87 51 50.0	356910.	215.470	706.921	-.266	-.282	.016	
S 137	NGS	1/0	NG0298				
42 42 19.0	2577420.	220.472	723.332				
87 51 6.0	264490.	220.540	723.555	-.223	-.213	-.010	
S 2	CGS	1/2	NH0278				
42 33 47.0	2314620.	287.130	942.026				
88 49 56.0	207420.	287.183	942.200	-.174	-.187	.013	
S 3	-	1/2	NG0388				
42 54 57.0	2556250.	222.789	730.934				
87 55 24.0	340720.	222.880	731.232	-.299	-.276	-.023	
S 78	CGS	2/0	NH0310				
42 33 41.0	2356090.	293.384	962.544				
88 40 42.0	207430.	293.440	962.728	-.184	-.180	-.003	
S 86	CGS	1/0	OL0101				
43 12 2.0	2555450.	208.417	683.781				
87 55 .0	444500.	208.495	684.037	-.256	-.243	-.013	
SHOP	DOD	1/0	NG0360				
42 44 4.0	2595050.	180.419	591.925				
87 47 6.0	275580.	180.380	591.797	.128	-.217	.344	
SLIP USLS	USLS	1/0	OL0080				
43 23 23.0	2566940.	178.075	584.234				
87 52 1.0	513760.	178.110	584.349	-.115	-.121	.007	
STA 9	WIHD	1/0	OL0174				
43 34 57.0	2582870.	209.440	687.138				
87 48 .0	584460.	209.480	687.269	-.131	-.069	-.062	
T 105	CGS	1/0	OL0155				
43 2 14.0	2557160.	181.196	594.474				
87 54 57.0	384990.	181.471	595.376	-.902	-.341	-.561	
T 114	-	2/0	NH0808				
42 56 7.0	2427410.	288.492	946.494				
88 24 14.0	344970.	288.550	946.684	-.190	-.217	.026	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	MAD27X MAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
T 115	CGS	1/0	NG0259				
42 35 2.0	2586640.	186.165	610.776				
87 49 18.0	220470.	186.227	610.980	-.203	-.269	.066	
T 130	NGS	1/0	OL0102				
43 11 19.0	2556590.	202.236	663.503				
87 54 46.0	440170.	202.300	663.713	-.210	-.249	.039	
T 133	NGS	1/0	OL0067				
43 25 38.0	2565260.	217.795	714.549				
87 52 19.0	527380.	217.830	714.664	-.115	-.128	.013	
T 134	NGS	1/0	OL0156				
43 2 2.0	2556740.	178.999	587.266				
87 55 3.0	383770.	179.140	587.728	-.463	-.338	-.125	
T 137	NGS	1/0	NG0295				
42 42 25.0	2581660.	211.696	694.539				
87 50 9.0	265210.	211.750	694.716	-.177	-.223	.046	
T 2	CGS	1/2	NH0279				
42 36 44.0	2354670.	286.346	939.454				
88 40 57.0	225940.	286.406	939.650	-.197	-.197	.000	
T 3	-	1/2	NG0390				
42 57 33.0	2555190.	207.052	679.303				
87 55 33.0	356490.	207.140	679.592	-.289	-.289	.000	
T 78	CGS	2/0	NH0314				
42 31 52.0	2363680.	288.833	947.613				
88 39 3.0	196520.	288.883	947.777	-.164	-.174	.010	
T 86	CGS	1/0	OL0099				
43 13 10.0	2554680.	206.302	676.842				
87 55 8.0	451370.	206.376	677.085	-.243	-.236	-.007	
TANK	USLS	1/0	NG0267				
42 35 19.0	2588610.	178.691	586.255				
87 48 51.0	222250.	178.770	586.515	-.259	-.269	.010	
TOWER WISN TV	CGS	1/0	OL0123				
43 6 42.0	2553220.	190.909	626.341				
87 55 41.0	412040.	191.030	626.738	-.397	-.322	-.075	
U 114	CGS	2/0	NH0019				
42 54 55.0	2419370.	285.771	937.567				
88 26 4.0	337520.	285.838	937.787	-.220	-.217	-.003	
U 115	NGS	1/0	NG0271				
42 36 9.0	2585420.	189.776	622.623				
87 49 32.0	227230.	189.862	622.906	-.282	-.269	-.013	
U 130	NGS	1/0	OL0100				
43 12 24.0	2554210.	215.756	707.859				
87 55 16.0	446690.	215.830	708.102	-.243	-.243	.000	
U 133	NGS	1/0	OL0068				
43 25 16.0	2564430.	215.255	706.216				
87 52 31.0	525140.	215.290	706.331	-.115	-.128	.013	
U 134	NGS	1/0	NG0358				
42 57 31.0	2567540.	215.496	707.006				
87 52 47.0	356600.	215.570	707.249	-.243	-.282	.039	
U 137	NGS	1/0	NG0292				
42 42 32.0	2587020.	195.237	640.540				
87 48 57.0	266060.	195.310	640.780	-.240	-.240	.000	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
U 2	CGS	1/2	NH0280				
42 37 47.0	2366460.	286.531	940.060				
88 38 18.0	232510.	286.593	940.264	-.203	-.200	-.003	
U 3	CGS	2/0	NG0359				
42 59 10.0	2557770.	195.744	642.203				
87 54 55.0	366380.	195.834	642.499	-.295	-.318	.023	
U 78	CGS	2/0	NH0315				
42 31 52.0	2363300.	289.514	949.847				
88 39 8.0	196510.	289.563	950.008	-.161	-.174	.013	
U 86	CGS	1/0	OL0097				
43 14 13.0	2554520.	205.912	675.563				
87 55 8.0	457740.	205.980	675.786	-.223	-.230	.007	
U 86	CGS	1/0	OL0097				
43 14 13.0	2554520.	205.912	675.563				
87 55 8.0	457740.	205.980	675.786	-.223	-.230	.007	
V 114	CGS	2/0	NH0020				
42 53 37.0	2413940.	288.861	947.705				
88 27 19.0	329520.	288.928	947.925	-.220	-.220	.000	
V 115	CGS	1/0	NG0278				
42 38 39.0	2586510.	188.708	619.119				
87 49 12.0	242450.	188.788	619.382	-.262	-.266	.003	
V 130	NGS	1/0	OL0098				
43 13 45.0	2554520.	201.415	660.809				
87 55 9.0	454910.	201.480	661.022	-.213	-.233	.020	
V 133	NGS	1/0	OL0069				
43 24 40.0	2563340.	220.121	722.180				
87 52 47.0	521460.	220.160	722.308	-.128	-.128	.000	
V 134	NGS	1/0	NG0351				
42 57 28.0	2559660.	203.681	668.243				
87 54 33.0	356090.	203.760	668.503	-.259	-.282	.023	
V 137	NGS	1/0	NG0291				
42 42 34.0	2589550.	195.194	640.399				
87 48 23.0	266320.	195.270	640.648	-.249	-.246	-.003	
V 2	CGS	1/2	NH0281				
42 38 24.0	2372670.	295.077	968.098				
88 36 54.0	236360.	295.139	968.302	-.203	-.203	.000	
V 3	CGS	1/0	OL0144				
43 0 11.0	2562960.	180.598	592.512				
87 53 43.0	372680.	180.700	592.847	-.335	-.344	.010	
V 78	CGS	2/0	NH0313				
42 31 53.0	2365700.	291.147	955.205				
88 38 36.0	196650.	291.197	955.369	-.164	-.174	.010	
V 86	CGS	1/0	OL0095				
43 15 49.0	2554280.	204.903	672.253				
87 55 8.0	467460.	204.970	672.472	-.220	-.217	-.003	
VEEN AZ	CGS	2/0	NH0084				
42 29 30.0	2414930.	298.191	978.315				
88 27 42.0	183030.	298.254	978.522	-.207	-.207	.000	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
VEEN	CGS	2/0		NH0083			
42 29 40.0	2416480.	293.669	963.479				
88 27 21.0	184070.	293.733	963.689	-.210	-.210	.000	
VEEN RM1	CGS	2/0		NH0081			
42 29 40.0	2416410.	294.017	964.621				
88 27 22.0	184070.	294.081	964.831	-.210	-.210	.000	
VEEN RM2	CGS	2/0		NH0082			
42 29 41.0	2416400.	293.876	964.158				
88 27 22.0	184170.	293.940	964.368	-.210	-.210	.000	
VOR AZ MK	CGS	1/0		NG0332			
42 52 8.0	2559430.	213.086	699.100				
87 54 47.0	323680.	213.054	698.995	.105	-.259	.364	
VOR RM 2	CGS	1/0		NG0331			
42 52 6.0	2560410.	215.196	706.022				
87 54 34.0	323500.	215.165	705.921	.102	-.256	.358	
W 1	USLS	1/0		OL0145			
43 3 13.0	2564730.	188.987	620.035				
87 53 13.0	391160.	189.076	620.327	-.292	-.354	.062	
W 114	USGS	2/0		NH0021			
42 52 45.0	2408970.	289.288	949.106				
88 28 27.0	324170.	289.354	949.322	-.217	-.223	.007	
W 115	CGS	2/0		NG0281			
42 40 6.0	2589270.	189.367	621.282				
87 48 32.0	251330.	189.440	621.521	-.240	-.266	.026	
W 130	NGS	1/0		OL0096			
43 15 1.0	2554550.	208.809	685.068				
87 55 6.0	462600.	208.870	685.268	-.200	-.223	.023	
W 133	NGS	1/0		OL0072			
43 23 13.0	2562980.	201.371	660.665				
87 52 55.0	512640.	201.410	660.793	-.128	-.135	.007	
W 134	NGS	1/0		NG0348			
42 56 56.0	2559600.	209.860	688.516				
87 54 35.0	352850.	209.940	688.778	-.262	-.272	.010	
W 137	NGS	1/0		NG0337			
42 55 20.0	2559770.	222.424	729.736				
87 54 36.0	343130.	222.500	729.985	-.249	-.272	.023	
W 2	CGS	1/2		NH0282			
42 39 10.0	2379250.	290.976	954.644				
88 35 25.0	241120.	291.038	954.847	-.203	-.203	.000	
W 3 RESET 1942	CGS	1/0		OL0134			
43 0 51.0	2560490.	179.329	588.349				
87 54 15.0	376670.	179.434	588.693	-.344	-.348	.003	
W 3	-	1/2		OL0275			
43 0 51.0	2560490.	179.985	590.501				
87 54 15.0	376670.	180.070	590.780	-.279	-.348	.069	
W 3 USLS	USLS	1/0		OL0133			
43 2 27.0	2561950.	181.074	594.074				
87 53 52.0	386430.	181.170	594.389	-.315	-.361	.046	
W 6	USLS	1/0		OL0150			
43 2 19.0	2560340.	189.969	623.257				
87 54 14.0	385580.	190.060	623.555	-.299	-.354	.056	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
W 78	CGS	2/0	NH0316				
42 32 45.0	2368980.	298.426	979.086				
88 37 51.0	201970.	298.478	979.257	-.171	-.174	.003	
W 86	CGS	1/0	OL0093				
43 17 36.0	2553940.	206.870	678.706				
87 55 9.0	478280.	206.929	678.900	-.194	-.197	.003	
WASHINGTON	NGS	1/0	OL0085				
43 23 52.0	2568190.	212.433	696.957				
87 51 43.0	516720.	212.408	696.875	.082	-.112	.194	
WASHINGTON RM1	CGS	1/0	OL0084				
43 23 52.0	2568190.	212.735	697.948				
87 51 43.0	516720.	212.709	697.863	.085	-.112	.197	
WASHINGTON RM2	CGS	1/0	OL0086				
43 23 52.0	2568190.	212.777	698.086				
87 51 43.0	516720.	212.751	698.001	.085	-.112	.197	
WATER	USLS	1/0	NG0266				
42 35 19.0	2588610.	179.619	589.300				
87 48 51.0	222250.	179.700	589.566	-.266	-.269	.003	
WAUKWSHA	CGS	2/0	OM0112				
43 0 52.0	2472910.	249.783	819.496				
88 13 54.0	374740.	249.854	819.729	-.233	-.236	.003	
WAUWATOSA	CGS	2/0	OM0078				
43 2 58.0	2532700.	211.278	693.168				
88 0 25.0	388850.	211.363	693.447	-.279	-.279	.000	
WL 245	USLS	1/0	NG0262				
42 35 20.0	2588310.	179.193	587.902				
87 48 55.0	222340.	179.270	588.155	-.253	-.269	.016	
WL 246	USLS	1/0	NG0363				
42 43 58.0	2595370.	181.242	594.625				
87 47 2.0	274990.	181.290	594.782	-.157	-.220	.062	
WL 249	USLS	1/0	OL0078				
43 23 16.0	2566360.	181.963	596.990				
87 52 9.0	513030.	182.000	597.112	-.121	-.125	.003	
WORK	USLS	1/0	OL0083				
43 23 27.0	2567150.	179.512	588.949				
87 51 58.0	514170.	179.550	589.074	-.125	-.121	-.003	
WW 114	CGS	2/0	NH0022				
42 51 27.0	2402340.	272.260	893.240				
88 29 58.0	316150.	272.326	893.456	-.217	-.217	.000	
X 105	CGS	2/0	OM0076				
43 2 59.0	2532620.	199.713	655.225				
88 0 26.0	388950.	199.798	655.504	-.279	-.279	.000	
X 114	CGS	2/0	NH0330				
42 50 22.0	2392180.	291.355	955.887				
88 32 16.0	309390.	291.421	956.104	-.217	-.213	-.003	
X 115	CGS	1/0	NG0286				
42 41 20.0	2591540.	190.499	624.995				
87 47 59.0	258880.	190.580	625.261	-.266	-.269	.003	
X 130	NGS	1/0	OL0111				
43 8 26.0	2559770.	213.914	701.816				
87 54 9.0	422730.	214.000	702.098	-.282	-.272	-.010	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
X 133	NGS	1/0	OL0088				
43 21 45.0	2557150.	215.610	707.380				
87 54 17.0	503580.	215.660	707.545	-.164	-.164	.000	
X 134	NGS	1/0	NG0346				
42 56 25.0	2559750.	209.091	685.993				
87 54 34.0	349720.	209.170	686.252	-.259	-.272	.013	
X 137	NGS	1/0	NG0329				
42 50 42.0	2559650.	205.474	674.126				
87 54 47.0	314980.	205.442	674.021	.105	-.243	.348	
X 2	CGS	2/0	NH0283				
42 39 46.0	2388820.	302.327	991.884				
88 33 16.0	244930.	302.389	992.088	-.203	-.203	.000	
X 3	CGS	2/0	OL0130				
43 3 19.0	2564930.	187.510	615.189				
87 53 10.0	391770.	187.590	615.452	-.262	-.354	.092	
X 78	CGS	2/0	NH0317				
42 32 26.0	2373730.	304.649	999.503				
88 36 48.0	200120.	304.703	999.680	-.177	-.177	.000	
X 85	CGS	2/0	OM0057				
43 20 26.0	2410110.	310.808	1019.709				
88 27 30.0	492380.	310.864	1019.893	-.184	-.187	.003	
X 86	CGS	1/0	OL0091				
43 19 15.0	2554570.	211.583	694.169				
87 54 57.0	488330.	211.638	694.349	-.180	-.184	.003	
XX 114	CGS	2/0	NH0331				
42 49 7.0	2386200.	290.967	954.614				
88 33 38.0	301690.	291.033	954.831	-.217	-.217	.000	
Y 105	CGS	2/0	OM0077				
43 2 57.0	2532250.	204.656	671.442				
88 0 31.0	388740.	204.742	671.724	-.282	-.279	-.003	
Y 114	CGS	2/0	NH0332				
42 48 1.0	2385870.	300.417	985.618				
88 33 44.0	295000.	300.483	985.835	-.217	-.217	.000	
Y 115	CGS	1/0	NG0290				
42 42 37.0	2592230.	190.730	625.753				
87 47 47.0	266700.	190.854	626.160	-.407	-.249	-.157	
Y 130	NGS	1/0	OL0113				
43 7 56.0	2557110.	206.999	679.129				
87 54 46.0	419630.	207.080	679.395	-.266	-.289	.023	
Y 133	NGS	1/0	OL0077				
43 23 13.0	2566080.	179.933	590.330				
87 52 13.0	512720.	179.970	590.452	-.121	-.128	.007	
Y 134	NGS	1/0	NG0341				
42 55 48.0	2559620.	222.926	731.383				
87 54 37.0	345960.	223.000	731.626	-.243	-.272	.030	
Y 137	NGS	1/0	NG0316				
42 45 23.0	2562850.	220.423	723.171				
87 54 15.0	282750.	220.460	723.293	-.121	-.174	.052	
Y 2	CGS	1/2	NH0285				
42 39 36.0	2397580.	303.308	995.103				
88 31 19.0	244070.	303.370	995.306	-.203	-.200	-.003	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
Y 3	CGS	1/0	OL0125				
43 6 13.0	2558480.	195.425	641.157				
87 54 31.0	409230.	195.517	641.459	-.302	-.315	.013	
Y 78	CGS	2/0	NH0322				
42 32 .0	2380360.	308.471	1012.042				
88 35 20.0	197600.	308.528	1012.229	-.187	-.187	.000	
Y 85	CGS	2/0	OM0058				
43 20 12.0	2418040.	299.359	982.147				
88 25 43.0	491110.	299.416	982.334	-.187	-.187	.000	
Y 86	CGS	1/0	OL0089				
43 21 4.0	2556220.	216.476	710.222				
87 54 31.0	499410.	216.529	710.396	-.174	-.171	-.003	
Y 86	CGS	1/0	OL0089				
43 21 4.0	2556220.	216.476	710.222				
87 54 31.0	499410.	216.529	710.396	-.174	-.171	-.003	
Z 105	CGS	2/0	OM0079				
43 3 25.0	2522910.	209.964	688.857				
88 2 36.0	391350.	210.047	689.129	-.272	-.272	.000	
Z 114	CGS	2/0	NH0333				
42 46 17.0	2387990.	278.389	913.348				
88 33 18.0	284510.	278.450	913.548	-.200	-.213	.013	
Z 115	CGS	2/0	NG0293				
42 42 32.0	2586940.	195.394	641.055				
87 48 58.0	266050.	195.477	641.327	-.272	-.240	-.033	
Z 130	NGS	1/0	OL0115				
43 7 55.0	2551920.	203.708	668.332				
87 55 56.0	419400.	203.790	668.601	-.269	-.308	.039	
Z 133	NGS	1/0	OL0090				
43 20 14.0	2555380.	215.820	708.069				
87 54 44.0	494320.	215.870	708.233	-.164	-.174	.010	
Z 134	NGS	1/0	NG0336				
42 54 54.0	2559530.	220.096	722.098				
87 54 40.0	340490.	220.066	722.000	.098	-.272	.371	
Z 137	NGS	1/0	NG0305				
42 42 2.0	2563060.	222.038	728.470				
87 54 19.0	262400.	222.120	728.739	-.269	-.259	-.010	
Z 2	CGS	1/2	NH0001				
42 38 37.0	2413010.	302.721	993.177				
88 27 54.0	238380.	302.780	993.371	-.194	-.203	.010	
Z 3	CGS	1/0	OL0120				
43 7 56.0	2546880.	209.248	686.508				
87 57 4.0	419370.	209.333	686.787	-.279	-.322	.043	
Z 78	CGS	2/0	NH0323				
42 31 51.0	2382840.	312.442	1025.070				
88 34 47.0	196730.	312.500	1025.260	-.190	-.190	.000	
Z 85	CGS	2/0	OM0059				
43 19 12.0	2431380.	299.911	983.958				
88 22 44.0	485290.	299.969	984.148	-.190	-.190	.000	
Z 86	CGS	1/0	OL0087				
43 22 33.0	2560490.	212.469	697.075				
87 53 30.0	508530.	212.517	697.233	-.157	-.151	-.007	

Appendix B-5

Listing of VERTCON Misfits for USC&GS and NGS First- and Second-Order Benchmarks

Points excluded from remaining analysis (22):

T 105	2557160	384990	-0.561	Apparently bench mark has moved.
R 134	2570140	359500	0.394	NGVD29 elevation not reliable - VERTCON 1.0
AP STA B	2563180	346460	0.374	NGVD29 elevation not reliable - VERTCON 1.0
B 137	2559670	335230	0.374	NGVD29 elevation not reliable - VERTCON 1.0
CAROV L NB	2557920	345310	0.374	NGVD29 elevation not reliable - VERTCON 1.0
CAROV L NB	2557920	345520	0.374	NGVD29 elevation not reliable - VERTCON 1.0
CAROV L N	2557920	345420	0.374	NGVD29 elevation not reliable - VERTCON 1.0
Z 134	2559530	340490	0.371	NGVD29 elevation not reliable - VERTCON 1.0
A 137	2559690	331380	0.371	NGVD29 elevation not reliable - VERTCON 1.0
C 137	2559730	326630	0.364	NGVD29 elevation not reliable - VERTCON 1.0
VOR AZ MK	2559430	323680	0.364	NGVD29 elevation not reliable - VERTCON 1.0
D 137	2559620	319130	0.358	NGVD29 elevation not reliable - VERTCON 1.0
VOR RM 2	2560410	323500	0.358	NGVD29 elevation not reliable - VERTCON 1.0
BOHN	2595200	275590	0.348	NGVD29 elevation not reliable - VERTCON 1.0
X 137	2559650	314980	0.348	NGVD29 elevation not reliable - VERTCON 1.0
E 137	2559600	314170	0.344	NGVD29 elevation not reliable - VERTCON 1.0
SHOP	2595050	275580	0.344	NGVD29 elevation not reliable - VERTCON 1.0
F 137	2559600	307990	0.322	NGVD29 elevation not reliable - VERTCON 1.0
35-422	2559560	303730	0.308	NGVD29 elevation not reliable - VERTCON 1.0
HUSHER	2564030	303850	0.295	NGVD29 elevation not reliable - VERTCON 1.0
HUSHER RM	2564030	303850	0.292	NGVD29 elevation not reliable - VERTCON 1.0
HUSHER RM	2564030	303850	0.292	NGVD29 elevation not reliable - VERTCON 1.0

Points missing by 0.1 ft to 0.2 ft (5 of 413):

WASH'TON	2568190	516720	0.197
WASH'TON RM1	2568190	516720	0.197
WASH'TON RM2	2568190	516720	0.194
Y 115	2592230	266700	-0.157
T 134	2556740	383770	-0.125

Points missing by 0.05 ft to 0.10 ft. (30 OF 413):

X 3	2564930	391770	0.092	G 134	2563500	401260	0.062
G 137	2559560	303730	0.085	WL 246	2595370	274990	0.062
M 86	2549530	417010	-0.082	H 134	2563470	396600	0.059
TOWER WIS	2553220	412040	-0.075	N 138	2586730	217030	0.059
Q 3	2556870	301140	-0.072	J 134	2564880	390860	0.059
H 137	2559540	298570	0.069	2 USLS	2560000	386990	0.059
W 3	2560490	376670	0.069	RV 75	2592250	265990	-0.056
N 87	2579450	585780	-0.069	A 138	2595880	272770	0.056
FLUSHING	2564800	391160	0.066	J 137	2559680	293100	0.056
T 115	2586640	220470	0.066	W 6	2560340	385580	0.056
B 138	2594170	272420	0.062	E 115	2345580	214150	0.056
K 137	2559960	287740	0.062	K 134	2562520	387250	0.052
STA 9	2582870	584460	-0.062	FOX AZ	2564620	433180	0.052
D 138	2592350	261940	-0.062	Y 137	2562850	282750	0.052
W 1	2564730	391160	0.062	L 87	2577300	578030	-0.052

Points missing by 0.02 ft to 0.05 ft. (90 of 413):

KENOSHA 1	2586050	214480	0.049	Q 134	2566760	363870	-0.046
L 134	2560240	386490	0.049	RV 57	2589050	174250	-0.046
B	2564730	391160	0.049	T 137	2581660	265210	0.046
FOX RM 2	2564120	432560	0.049	NO 100	2596110	272470	0.046
P 138	2586950	211270	0.049	MITCHELL	2559660	356090	0.046
FOX RM 1	2564120	432560	0.046	S 130	2560030	433170	0.043
W 3 USLS	2561950	386430	0.046	B 19	2588890	171620	-0.043

L 137	2563380	282160	0.043
PRINTING	2561520	382670	0.043
Z 3	2546880	419370	0.043
NO 19	2589600	267340	0.043
Z 130	2551920	419400	0.039
A 116	2584340	265580	0.039
T 130	2556590	440170	0.039
U 134	2567540	356600	0.039
P 3	2559900	284200	0.039
K 138	2586510	225330	0.039
HANSEN	2560500	381940	0.039
NORTH	2595350	275590	0.039
F 134	2561710	404550	0.036
NO 27	2586840	267160	0.036
RV 65 CNW	2586970	210560	0.036
M 87	2576390	578720	-0.036
R 130	2560220	425380	-0.036
FOX	2564120	432560	0.036
M 133	2578480	580490	-0.033
L 4	2478800	535680	0.033
Z 115	2586940	266050	-0.033
RV 74	2592230	260930	-0.033
H 115	2374630	199630	0.033
E 134	2560920	406660	0.033
58-02	2559710	351230	0.033
52.06	2591370	268200	0.033
R 138	2588560	192770	-0.030
C 116	2569980	263490	-0.030
Y 134	2559620	345960	0.030
DANE	2325250	212840	0.030
L 273	2589040	171620	0.030
RACINE	2587150	269500	0.030
65-19	2559760	349210	0.030
CEDAR AZ	2575150	569770	0.030
A 115	2389010	273180	0.030
M 137	2563200	277500	-0.030
RACINE RM	2587150	269500	0.026
W 115	2589270	251330	0.026

RV 73	2590840	256840	0.026
T 114	2427410	344970	0.026
RV 71	2588580	249290	0.026
H 273	2588860	187110	-0.026
C 138	2592880	270260	0.026
N 86	2557760	420150	0.026
M 134	2560490	376670	0.026
AA 115	2391890	262000	0.026
ARP 2	2563170	352540	0.026
KENOSHA 2	2585660	220550	0.026
D 4	2505690	456070	0.026
R 133	2567290	543130	0.026
R 86	2559670	435790	0.026
L 133	2583050	580610	-0.026
P 130	2553570	484050	0.026
S 3	2556250	340720	-0.023
C 87	2565770	513220	-0.023
N 134	2562960	372680	0.023
A 134	2546800	419470	0.023
B 87	2564670	512790	-0.023
PLEASANT	2559430	276190	0.023
RV 70	2587690	246120	0.023
RV 68	2584960	233090	0.023
RV 66	2585390	225200	0.023
V 134	2559660	356090	0.023
Y 130	2557110	419630	0.023
U 3	2557770	366380	0.023
W 130	2554550	462600	0.023
W 137	2559770	343130	0.023
G 78	2333670	215090	-0.020
E 138	2590100	253780	0.020
R 115	2588280	197930	-0.020
PLEASANT	2562810	275160	-0.020
V 130	2554520	454910	0.020
A 87	2562980	512640	-0.020
L 138	2587050	222000	0.020
D 87	2562530	518610	-0.020
F 4	2489450	477280	0.020

Points missing by less than 0.02 ft. (288 of 413):

BOLLARD U	2566360	513030	0.016
RV 62	2588610	193690	-0.016
H 138	2585140	235020	0.016
RV 64	2587460	206420	0.016
RV 63	2588140	200160	0.016
D 116	2565960	262880	-0.016
K 133	2569220	554020	0.016
WL 245	2588310	222340	0.016
N 133	2575130	573520	0.016
AP 1960 S	2564200	356310	0.016
B 116	2577500	264490	-0.016
CITY HALL	2559050	386560	0.016
RV 72	2589540	252450	0.016
G 138	2585420	238370	0.016
S 134	2571770	356910	0.016
S 115	2587550	205610	0.016
DOOR	2333450	214880	-0.016
LINCOLN U	2564680	372420	0.016
P 86	2560110	424060	0.016
F 115	2355860	207430	0.016
Y 3	2558480	409230	0.013
J 78	2338680	215470	-0.013
K 78	2340630	214990	-0.013
J 87	2570490	559120	-0.013
X 134	2559750	349720	0.013
P 137	2563210	265440	-0.013
Z 114	2387990	284510	0.013

S 2	2314620	207420	0.013
U 133	2564430	525140	0.013
LIGHT USL	2566960	512840	-0.013
U 78	2363300	196510	0.013
U 115	2585420	227230	-0.013
L 78	2345580	214150	-0.013
S 86	2555450	444500	-0.013
T 133	2565260	527380	0.013
E 87	2565000	528900	-0.013
K 87	2573090	569720	0.013
N 115	2408730	189800	-0.010
Z 2	2413010	238380	0.010
MITCHELL	2561890	356450	0.010
N 3	2561370	276030	0.010
L 3	2560600	262140	-0.010
Z 133	2555380	494320	0.010
M 115	2387970	194900	-0.010
Z 137	2563060	262400	-0.010
156	2526490	403290	0.010
154	2526870	405930	0.010
RV 67 CNW	2585300	228640	0.010
RV 69	2585620	239280	0.010
V 3	2562960	372680	0.010
W 134	2559600	352850	0.010
V 78	2365700	196650	0.010
TANK	2588610	222250	0.010
68-04	2559770	346070	0.010

T 78	2363680	196520	0.010	905	2527200	395200	0.003
S 137	2577420	264490	-0.010	X 115	2591540	258880	0.003
750	2526730	408860	0.010	A 118	2314840	207630	-0.003
PLEASANT	2562810	275160	0.010	G 226	2449310	176190	-0.003
PLEASANT	2562810	275160	-0.010	W 78	2368980	201970	0.003
P 133	2571980	564320	0.010	C 78	2309940	205130	-0.003
AP 1965 S	2564270	356310	0.010	S 133	2564280	531210	0.003
NAVY USLS	2564150	372810	0.010	WATER	2588610	222250	0.003
X 130	2559770	422730	-0.010	WAUKWSHA	2472910	374740	0.003
R 78	2353000	209000	-0.010	G 118	2420120	186060	-0.003
Q 86	2560160	430840	0.010	WL 249 US	2566360	513030	0.003
Q 130	2554130	473430	0.010	A 106	2517920	385460	-0.003
Q 78	2349820	211280	-0.010	S 78	2356090	207430	-0.003
CAP USLS	2564980	372130	-0.010	W 86	2553940	478280	0.003
D 115	2336640	216550	-0.010	46	2452440	402160	-0.003
H 86	2503610	453290	-0.010	X 114	2392180	309390	-0.003
J 273	2589020	183980	-0.010	45	2465260	399690	-0.003
B 87 RESE	2564670	512790	0.010	F 118	2414860	186770	0.003
K 4	2482930	525230	-0.010	398	2415680	407830	0.003
PARK	2588080	222740	0.007	X 85	2410110	492380	0.003
D 118	2329120	213800	-0.007	E 86	2463010	482380	-0.003
C 118	2324360	212320	-0.007	219	2522190	390430	-0.003
A 72	2561990	352400	-0.007	E 106	2491020	396200	-0.003
T 86	2554680	451370	-0.007	U 2	2366460	232510	-0.003
F 87	2565080	537410	-0.007	Y 105	2532250	388740	-0.003
DARIEN	2347780	221980	0.007	ELKHORN	2392020	246100	-0.003
F 138	2588450	248470	0.007	V 86	2554280	467460	-0.003
Y 133	2566080	512720	0.007	V 137	2589550	266320	-0.003
J 86	2510880	449610	-0.007	V 115	2586510	242450	0.003
AP STA B	2563180	346460	0.007	E 114	2495330	395990	-0.003
U 86	2554520	457740	0.007	X 86	2554570	488330	0.003
H 106	2463700	399760	-0.007	E 118	2409840	186680	0.003
U 86	2554520	457740	0.007	E 226	2429180	182280	-0.003
J 4	2484750	520010	-0.007	399	2418800	407380	0.003
SLIP USLS	2566940	513760	0.007	W 3 RESET	2560490	376670	0.003
R 137	2572730	263960	-0.007	856	2463170	400460	-0.003
C 86	2447360	488740	-0.007	Y 86	2556220	499410	-0.003
G 115	2365510	203430	0.007	822	2472910	371300	0.003
RACINE RM	2587150	269500	0.007	F 78	2346890	221670	0.003
G 106	2463690	400270	-0.007	Y 2	2397580	244070	-0.003
RACINE RM	2587150	269500	0.007	F 3	2497690	252860	-0.003
A 226	2437340	178790	0.007	U 114	2419370	337520	-0.003
Q 138	2588180	201580	0.007	FF 86	2481330	463220	0.003
Z 86	2560490	508530	-0.007	E 4	2499290	464330	0.003
A 4	2534230	430210	0.007	E 78	2393620	192870	-0.003
RV 2 CNWR	2457140	167340	-0.007	D 17	2457060	171080	-0.003
HEBRON RM	2433320	181550	0.007	K 106	2421800	405920	0.003
RV 1 CNWR	2457060	171080	-0.007	P 106	2401140	407260	0.003
HH 86	2505840	452830	-0.007	P 115	2422750	185300	-0.003
K 3	2550030	260560	0.007	AP STA A	2525980	409250	0.003
W 114	2408970	324170	0.007	B 4	2521430	435270	-0.003
B 120	2526850	409780	0.007	B 78	2306590	203460	0.003
CROSS	2588240	222340	-0.007	N 4	2466750	564680	-0.003
K 273	2589330	177910	0.007	P 78	2409410	189710	0.003
K 86	2515760	440400	-0.007	J 114	2475450	377730	-0.003
KENOSHA 3	2585000	234710	0.007	J 106	2441400	405280	-0.003
M 3	2563060	262400	-0.007	P 4	2456540	577640	-0.003
MITCHELL	2561890	356450	0.007	J 3	2536330	258610	-0.003
W 133	2562980	512640	0.007	J 138	2585370	231880	0.003
B 118	2319080	209710	-0.007	A 86	2431160	485380	0.003
N 78	2386160	195580	-0.007	N 137	2562880	269390	0.003
EAST USLS	2566810	513040	0.007	L 115	2377600	196750	0.003
C 17	2446450	176950	-0.003	M 114	2472810	372720	0.003
Y 86	2556220	499410	-0.003	KENOSHA L	2588310	222440	0.003
WORK USLS	2567150	514170	-0.003	L 86	2521670	434770	-0.003
C 4	2512530	445490	0.003	B 17	2435910	179170	0.003
D 3	2468720	248590	0.003	B 134	2551280	415330	0.003
908 7057	2564530	372520	0.003	B 226	2457110	168960	-0.003

MITCHELL	2561890	356450	0.003	R 106	2400680	408260	0.000
N 106	2401660	407670	-0.003	H 3	2524050	256800	0.000
N 114	2464940	368600	0.003	S 114	2431880	348500	0.000
B 115	2392060	256230	-0.003	G 114	2483240	388740	0.000
M 138	2588990	222260	-0.003	983	2430940	485180	0.000
M 4	2473520	551360	-0.003	H 118	2420870	185870	0.000
M 78	2360990	205280	0.003	G 3	2513330	255130	0.000
Q 106	2400840	407760	0.003	S 106	2387470	412580	0.000
H 87	2569020	553310	-0.003	C 106	2505210	392360	0.000
D 134	2556350	411100	-0.003	B 3	2441430	241650	0.000
H 4	2487970	504180	0.003	B 106	2513460	385870	0.000
102	2557530	385000	-0.003	MM 115	2399790	191160	0.000
HEBRON	2433320	181550	0.003	L 114	2473390	373440	0.000
A 17	2425470	184340	-0.003	M 106	2405910	406430	0.000
HEBRON AZ	2433340	180230	0.003	L 106	2412570	407360	0.000
RARITAN U	2564980	372230	0.003	B 86	2431840	484690	0.000
G 87	2567930	547000	-0.003	P 114	2450970	364670	0.000
G 86	2489870	458250	-0.003	P 134	2564260	368560	0.000
G 4	2487970	487770	-0.003	J 115	2377570	198670	0.000
H 114	2480530	386750	0.003	K 115	2377440	197250	0.000
H 226	2453190	173540	-0.003	K 114	2473010	373730	0.000
C 134	2554150	413070	-0.003	OCONOMOWO	2400000	408860	0.000
A 120	2527230	390750	0.003	VEEN RM2	2416400	184170	0.000
C 115	2392120	252890	-0.003	50	2432040	405810	0.000
R 114	2435970	356370	-0.003	E 3	2487340	251410	0.000
HEBRON RM	2433320	181550	0.003	VEEN AZ	2414930	183030	0.000
A 3	2426770	238230	-0.003	VEEN	2416480	184070	0.000
Q 133	2568190	548420	0.003	VEEN RM1	2416410	184070	0.000
Y 78	2380360	197600	0.000	W 2	2379250	241120	0.000
X 133	2557150	503580	0.000	44	2469900	397970	0.000
Y 85	2418040	491110	0.000	WAUWATOSA	2532700	388850	0.000
1068.964	2456180	490950	0.000	400	2428860	404940	0.000
WW 114	2402340	316150	0.000	49	2438800	405030	0.000
X 105	2532620	388950	0.000	48	2442580	405310	0.000
D 78	2406550	190160	0.000	47	2450640	403040	0.000
XX 114	2386200	301690	0.000	EE 86	2470320	479600	0.000
X 78	2373730	200120	0.000	T 3	2555190	356490	0.000
37	2466490	369240	0.000	F 86	2476050	471010	0.000
Y 114	2385870	295000	0.000	U 130	2554210	446690	0.000
Z 78	2382840	196730	0.000	940	2426650	404390	0.000
D 86	2455110	489400	0.000	C 87 RESE	2565770	513220	0.000
Z 105	2522910	391350	0.000	T 2	2354670	225940	0.000
Z 85	2431380	485290	0.000	F 226	2442540	177680	0.000
X 2	2388820	244930	0.000	V 133	2563340	521460	0.000
R 2	2307040	203670	0.000	F 106	2481360	396390	0.000
R 3	2556270	319250	0.000	V 2	2372670	236360	0.000
H 78	2342810	219480	0.000	U 137	2587020	266060	0.000
Q 114	2442210	360440	0.000	V 114	2413940	329520	0.000
Q 137	2565960	262880	0.000	F 114	2491300	393770	0.000

Statistics for VERTICON misfit:

Mean of misfit	=	0.0074 feet
Standard deviation of misfit	=	0.030 feet
Standard deviation of the mean	=	0.001 feet

Appendix B-6

Summary and Conclusions Drawn from the Comparison of VERTCON Predicted Differences With Differences of Known Common Datum Values

As shown on Map B-1, there is a total of 435 NGS common datum points throughout the Region. And, as shown in the previous section, 27 of those 435 points show a misfit greater than 0.10 feet. In the case of T 105, the benchmark elevation for NAVD 88 differs by more than 0.56 feet from its NGVD 29 elevation. Apparently the benchmark has moved.

Misfits for the next 21 points differ by values ranging from 0.292 feet to 0.394 feet. Upon investigation it was discovered that reliable NGVD 29 elevations for those points were never published by the NGS and that the NGVD 29 values for them as listed in the CD-ROM data base were computed with Version 1.0 of VERTCON whereas the current comparison was made to VERTCON Version 2.0. Therefore, the first 22 points were eliminated from further consideration. Of the remaining 413 points, misfits at five of them were over 0.1 feet. No reason for those discrepancies has been discovered.

The next category includes 30 points and groups misfits in the range of 0.05 feet to 0.10 feet. A plot of all points which miss by more than 0.05 feet (Map B-2) shows a concentration along the Lake Michigan Shoreline. The underlying data (known elevations on both datums for common points) on which VERTCON results are based does not extend offshore, implying less precise interpolation results can be expected as one approaches an abrupt edge of known data, the Lake Michigan shoreline.

Two more groupings show those points with misfits in the range of 0.02 feet to 0.05 feet and those agreeing within 0.02 feet. Statistics for the various grouping are based upon 413 valid comparisons:

Range	Number of Points	Percentage of Total
Greater than 0.10 feet	5	1.2
0.05 feet to 0.10 feet	30	7.3
0.02 feet to 0.05 feet	90	21.8
Less than 0.02 feet	288	69.7
Total	413	100.0

The statistical standard deviation of the 413 misfits is 0.030 feet. Associating levels of confidence with multiples of standard deviations, one would expect 68 percent of the misfits to be within 0.030 feet and 99.7 percent should be within 0.090 feet. Comparison with the table shows a greater percentage with a smaller grouping than the theoretical predication, but it also shows a greater number of misfits which exceed the three standard deviation theoretical limit. The misfits exhibit normal distribution characteristics, but do not fall completely within theoretical limits. Undoubtedly, other factors are also involved.

A systematic bias in the data might explain some of the difference. For example, the overall mean of the misfits is 0.007 feet which is quite small and the standard deviation of the mean is even smaller—0.001 feet. By comparison, this systematic bias is significantly smaller than the randomness in the misfits described by a standard deviation of 0.03 feet.

The plot of misfits which shows most large differences to be along the Lake Michigan shoreline is also evidence of a deficiency (in the spacing) in the underlying VERTCON data. That can explain why some of the misfits exceed the three standard deviation limit, but without additional published datum differences in the offshore areas, that bias will be difficult to identify.

Map B-1

**FIRST- AND SECOND-ORDER
USC&GS AND NGS BENCHMARKS
COMMON TO NGVD 29 AND NAVD 88**



Map B-2

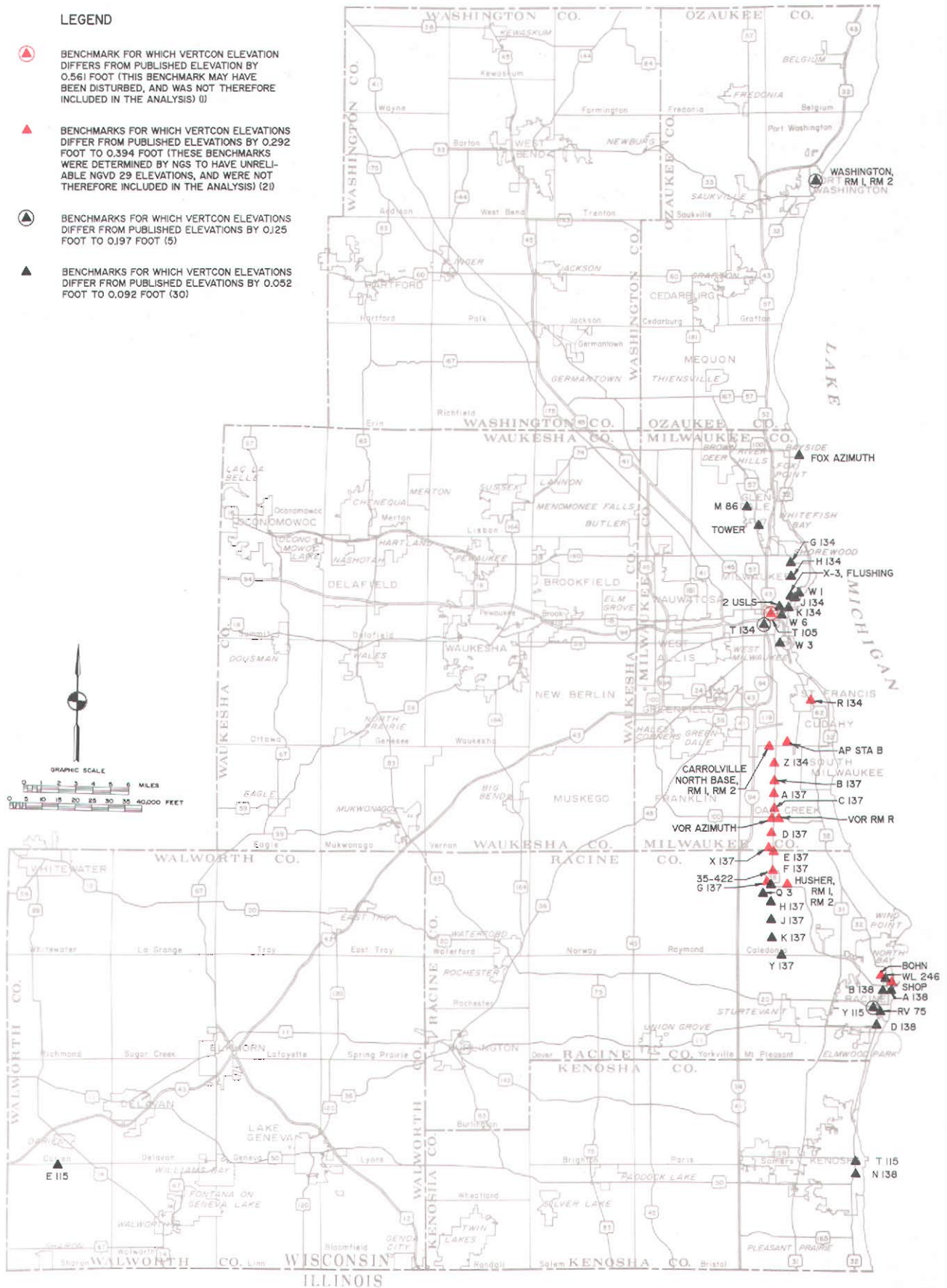
USC&GS AND NGS BENCHMARKS COMMON TO NGVD 29 AND NAVD 88 FOR WHICH VERTCON ELEVATIONS DIFFER FROM PUBLISHED ELEVATIONS BY 0.05 FOOT OR MORE

N 87 ▲ STA 9

▲ L 87

LEGEND

- ▲ BENCHMARK FOR WHICH VERTCON ELEVATION DIFFERS FROM PUBLISHED ELEVATION BY 0.061 FOOT (THIS BENCHMARK MAY HAVE BEEN DISTURBED, AND WAS NOT THEREFORE INCLUDED IN THE ANALYSIS) (1)
- ▲ BENCHMARKS FOR WHICH VERTCON ELEVATIONS DIFFER FROM PUBLISHED ELEVATIONS BY 0.292 FOOT TO 0.394 FOOT (THESE BENCHMARKS WERE DETERMINED BY NGS TO HAVE UNRELIABLE NGVD 29 ELEVATIONS, AND WERE NOT THEREFORE INCLUDED IN THE ANALYSIS) (2)
- ▲ BENCHMARKS FOR WHICH VERTCON ELEVATIONS DIFFER FROM PUBLISHED ELEVATIONS BY 0.25 FOOT TO 0.197 FOOT (5)
- ▲ BENCHMARKS FOR WHICH VERTCON ELEVATIONS DIFFER FROM PUBLISHED ELEVATIONS BY 0.052 FOOT TO 0.092 FOOT (30)



Based upon comparisons along lines of published benchmark elevations on both datums, it can be said VERTCON is accurate within 0.03 feet at the 1 sigma level. Additional tests are required before such a statement can be extended to cover areas within the seven-county Region not covered by NGS published level lines. Such tests were conducted in two watershed study areas within the seven-county Region and are documented in Appendix C.

The Iso-Hypsometric map of VERTCON predictions shows two anomalies in the Milwaukee area. One is a rise and the other is a depression of VERTCON results in comparison to the surrounding areas. Efforts were made to discover the reason for the pattern but nothing conclusive was evident. The comparison of published differences with VERTCON differences agree quite well in the area which means the VERTCON model represents the datum differences. Two pertinent points are:

- Most of the 21 points for which NGS has not published reliable NGVD 29 elevations lie generally between the depression and the rise. NGS has not been able to establish any correlation between the VERTCON pattern and the location of the eliminated points.
- The focus of this study was to document how well the datum differences can be modeled—with first attention given to VERTCON. While evidence shows that VERTCON models the datum differences quite well in the area, the underlying reason for the anomalies, such as possible gravity effects, goes beyond the scope of this study.

Appendix C

SEWRPC WATERSHED LEVELING NETWORK COMPARISONS

(This page intentionally left blank)

Appendix C-1

Introduction and Overview

This appendix documents comparison of VERTCON predictions with datum differences obtained from actual leveling in two watershed study areas in the Southeastern Wisconsin Region—the Fox River Watershed in parts of Waukesha, Walworth, Kenosha, and Racine Counties and the Milwaukee River Watershed in parts of Milwaukee, Ozaukee, Washington, and Sheboygan Counties. The Second-Order control leveling for those two watersheds was run in the mid to late 1960s in support of water quality studies being conducted at the time and those NGVD 29 benchmarks have been used as a Supplemental Control Network for other leveling in those areas.

As documented in Appendix B, the program VERTCON gives results which compare quite well with datum differences along the NGS published lines of leveling. The question to be answered here is, “How well does VERTCON predict the difference between NGVD 29 and NAVD 88 in areas not covered by NGS level lines?” Comparisons were made on representative lines and selected random points in the two watershed areas in an attempt to answer that question.

As shown on Map C-1, representative lines across each watershed were chosen with the idea of “bridging” between NGS published level lines. Incidental to recomputing those lines, adjusted elevations on other “local network junction” points were also computed and included in the comparison. The 1960s observed elevation differences along the watershed leveling lines were abstracted from existing SEWRPC records and tabulated in control loops having connections to existing First- and Second-Order NGS published benchmarks.

With observed elevation differences for the control leveling loops and with elevations of the NGS benchmarks, the loop networks were adjusted holding the published elevations for the NGS benchmarks on each datum separately. Individual benchmark elevations for points “in line” were then computed on each datum between the fixed network junction points. These are the benchmarks at which VERTCON comparisons were made.

With these data in hand, two options are considered separately:

1. Make a comparison of VERTCON predictions with the difference between the computed (adjusted) NAVD 88 elevations and the similarly computed (adjusted) NGVD 29 elevations and,
2. Make a comparison of VERTCON predictions with the difference between the computed (adjusted) NAVD 88 elevations and the published elevations for the Supplemental Benchmarks.

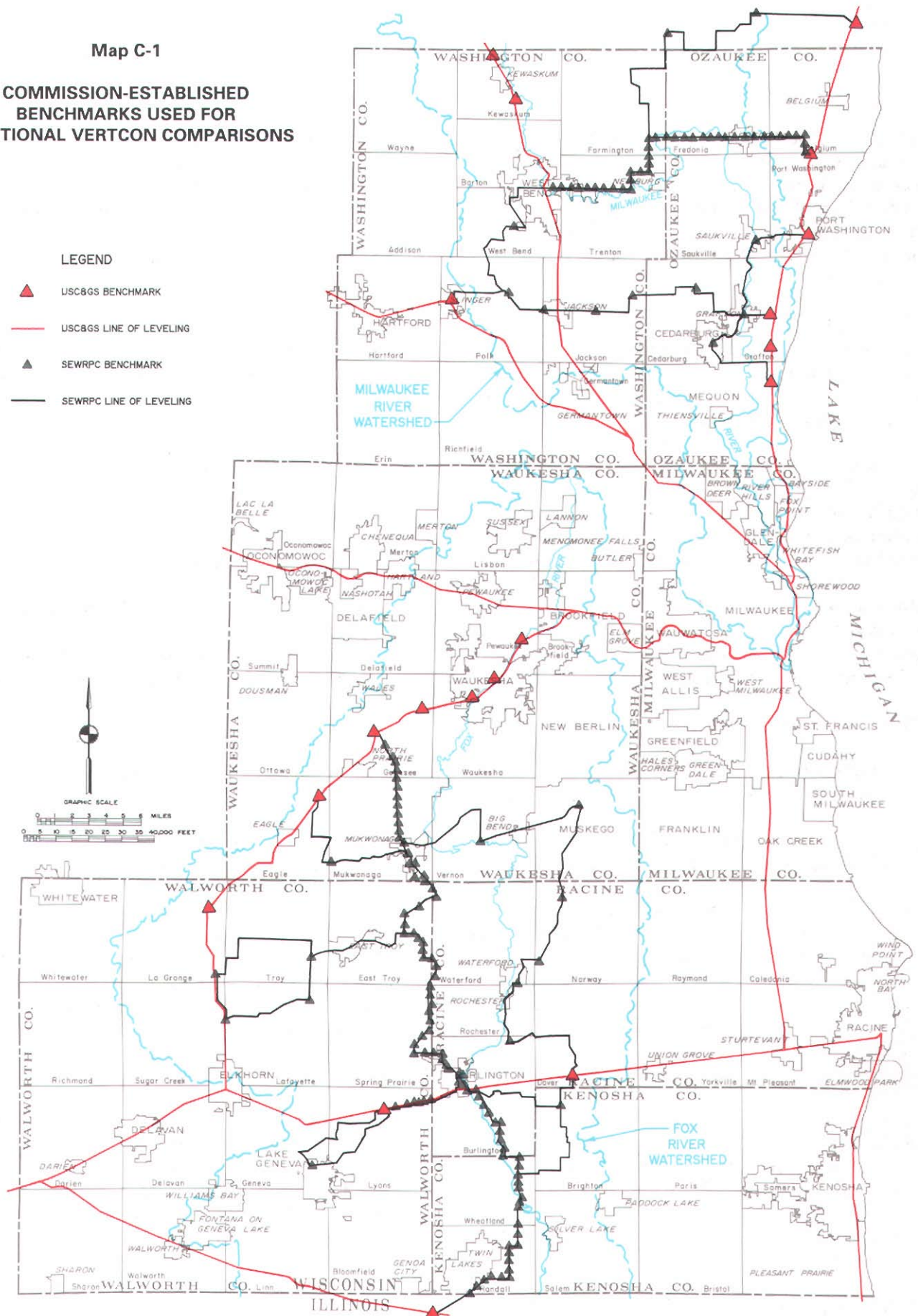
Ideally, there should be little or no difference between the two options. The observed elevation differences and the adjusted elevations along the level lines are well documented in the field books. Instead of attempting to reconstruct the sequential adjustments performed in the 1960s, all network differences were weighted according to distances and a simultaneous least squares adjustment was performed. Each watershed network was adjusted twice, once holding the NAVD 88 elevations on the NGS benchmarks and again holding the NGVD 29 NGS elevations. The least squares adjustment values for the NGVD 29 benchmarks were quite close to the published NGVD 29 elevations, but that difference must not be ignored when making judgements about comparisons of datum differences with VERTCON predictions.

Understandably, one would expect VERTCON predicted differences to agree better with option 1 because, except for the beginning benchmarks being on different datums, the computational procedures are the identical. In option 2, the variations introduced by the sequential adjustment in the 1960s also appears in the difference of the differences. Given the random nature of VERTCON modeling errors and of the sequential adjustment effects, one would expect the differences of the differences by option 2 to be greater than for option 1. It is worthy of note that VERTCON predictions agree significantly better in the option 1 comparisons on the Fox River Watershed network while option 1 on the Milwaukee River Watershed is only slightly better. In each case the performance of VERTCON on the SEWRPC established benchmarks nearly matches its performance on NGS published benchmark elevations.

COMMISSION-ESTABLISHED BENCHMARKS USED FOR

LEGEND

 USC&GS BENCHMARK
 USC&GS LINE OF LEVELING
 SEWRPC BENCHMARK
 SEWRPC LINE OF LEVELING



Appendix C-2

Milwaukee River Watershed and Fox River Watershed Control Benchmarks and Elevations

Milwaukee River Watershed - Benchmarks Used:

PID	Name	County	NAVD 88 (feet)	NGVD 29 (feet)	Notes
OL0074	B 87 (reset)	Ozaukee	611.360	611.553	1
OL0064	F 87	Ozaukee	720.671	720.812	
OM0054	K 4	Washington	892.433	892.613	2
OM0028	M 4	Washington	934.306	934.457	
OL0171	M 87	Sheboygan	710.894	711.019	3
OM0065	MILL	Washington	1068.571	1068.748	4
OM0029	N 4	Washington	977.715	977.852	
OL0095	V 86	Ozaukee	672.252	672.472	
OL0093	W 86	Ozaukee	678.706	678.900	
OL0091	X 86	Ozaukee	694.169	694.349	

Fox River Watershed - Benchmarks Used:

PID	Name	County	NAVD 88 (feet)	NGVD 29 (feet)	Notes
NH0003	B 3	Walworth	801.445	801.681	
NH0099	D 17	McHenry Co., IL	815.622	815.865	
NH0009	F 3	Racine	802.272	802.525	5
OM0110	H 114	Waukesha	822.833	823.073	
NH0014	N 114	Waukesha	822.797	823.033	
NH0015	P 114	Waukesha	838.761	838.998	
NH0017	R 114	Waukesha	908.276	908.505	
NH0331	XX 114	Walworth	954.614	954.831	
OM0112	Waukesha	Waukesha	819.496	819.729	
NH0019	U 114	Waukesha	937.567	937.787	

- Notes:
1. Benchmark B 87 was reset in 1951 and NGVD 29 elevation of 611.553 feet was used in subsequent SEWRPC leveling, see Milwaukee River Field Book 3, Page 39 and U. S. Coast and Geodetic Survey Benchmark List, Wisconsin Line 30, Revised February 9, 1959.
 2. Benchmark was used in 1968, but has since been destroyed and is not shown on Milwaukee Watershed Map.
 3. Benchmark is listed on Milwaukee Watershed Map as M 86.
 4. Benchmark is designated as '1068.964' in the NGS data base.
 5. Benchmark was reported loose in 1966 and was not used either then or now.

Appendix C-3

Fox River Watershed Control Leveling Data

Tabulated from SEWRPC original survey field books April 21, 1995, and updated on basis of a field check November, 1995.

Fox River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
D 17	(10-39)	815.786	
		36.794	36.794
FX U32	(10-26)	852.580	
FX U32	(10-49)	852.652	
		-92.976	-92.976
RR Spike	(9-74) & (10-40)	759.676	
RR Spike	(9-74)	759.710	
		92.870	92.870
FX U32	(10-26)	852.580	
RR Spike	(9-74)	759.676	
		10.263	10.263
FX U15	(9-71)	769.939	
		6.022	6.022
RX U3	(9-60)	775.961	
		-16.692	
RX M40	(9-58)	759.269	
RX M40	(5-50)	759.218	
		2.592	-14.100
FX M40	(5-50)	761.810	
		22.220	
Burlington	(5-52 & 54)	784.030	
		17.585	39.805
B 3	(5-60)	801.615	

Fox River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
B 3	(11-24)	801.681	
		115.884	115.884
FX Z15	(11-35)	917.565	
		-115.751	-115.751
B 3	(11-47)	801.814	
H 114	(2-41)	823.072	
		-8.257	-8.257
FX C11	(2-48)	814.815	
		4.851	4.851
Waukesha	(2-48)	819.666	
FX C11	(2-49)	814.875	
		-3.410	
TP NE Cor	(2-49)	811.465	
			25.468
TP NE Cor	(2-49)	811.465	
		28.878	
RX E5	(2-52 & 61)	840.343	
		-17.317	-17.317
N 114	(2-53)	823.026	
RX E5	(2-52)	840.343	
		2.530	
FX E5	(2-52)	842.873	
		-48.084	-45.554
FX F1	(2-55)	794.789	
P 114	(2-60)	838.988	
		-44.192	-44.192
FX F1	(2-55)	794.796	
FX F1	(2-68)	794.853	
		-1.597	
FX J5	(2-71, 4-23)	793.256	
		119.673	118.076
RX J17	(4-35)	912.929	
		-4.341	-4.341
R 114	(4-38)	908.588	

Fox River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
RX J17	(4-42)	912.860	
		-5.273	-5.273
FX J24	(4-44)	907.587	
U 114	(4-51)	937.787	
		-121.325	-121.325
FX N13	(4-59)	816.462	
		24.453	24.453
RX N24	(4-66)	840.915	
		-5.342	-5.342
FX N29	(4-67)	835.573	
		71.953	71.953
FX J24	(4-72)	907.526	
RX N24	(6-21)	840.923	
		-19.949	-19.949
RX O13	(6-31)	820.974	
		-39.943	-39.943
FX O31	(6-44)	781.031	
		-19.170	-19.170
FX M40	(6-52)	761.861	
XX 114	(6-53)	954.831	
		-30.969	-30.969
TP 6-58	(6-58)	923.862	
		-51.332	-51.332
TP 6-72	(6-72)	872.530	
		-51.651	-51.651
RX O13	(7-23)	820.879	
TP 6-58	(9-25)	923.883	
		-41.790	-41.790
FX T5	(9-30)	882.093	
		157.377	157.377
FX T15	(9-39)	1039.470	
FX T15	(9-40)	1039.561	
		-258.608	-258.608
FX O31	(9-57)	780.953	

Fox River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
TP 6-72	(7-24)	872.473	
		166.997	166.997
FX T15	(7-28)	1039.470	
FX N29	(8-60)	835.467	
		-50.304	-50.304
FX R14	(8-46)	785.163	
		21.928	21.928
UE	(8-36)	807.091	
FX R14	(8-64)	785.214	
		13.813	13.813
RX M14	(9-24)	799.027	
UE	(3-62)	807.084	
		-8.009	-8.009
RX M14	(5-24)	799.075	
		13.876	13.876
FX M21	(5-31)	812.951	
		-36.733	-36.733
FX M25	(5-35)	776.218	
		17.935	17.935
TP 5-43	(5-43)	794.153	
		-32.343	-32.343
FX M40	(5-50)	761.810	
FX M25	(5-61)	776.252	
		36.663	36.663
FX M21	(5-70)	812.915	
FX U15	(10-59)	769.967	
		34.305	34.305
TP 10-72	(10-72)	804.272	
		-1.873	-1.873
F 3 (loose)	(10-75) & (12-31)	802.399	
		-8.275	-8.275
TP 5-43	(12-40)	794.124	
RX U3	(12-16)	775.966	
		28.314	28.314
TP 10-72	(12-26)	804.280	

FOX RIVER WATERSHED LEVEL NETWORK DIAGRAM AND OBSERVED ELEVATION DIFFERENCES



FOX RIVER WATERSHED LEVEL NETWORK - NGVD 29

STAR*LEV Adjustment Program
Copyright 1990 STARPLUS SOFTWARE, INC.
Licensed for Use by Earl F. Burkholder, Consulting Geodetic Engineer
Serial Number 10424

STAR*LEV Version 1.17
Run Date : Tue Nov 14 07:31:28 1995

Summary of Files Used

Input Data File : ngvd29f3.dat
Output Listing (This File) : ngvd29f3.lst
Adjusted Elevations : ngvd29f3.pts
Project Options : ngvd29f3.prj
Error Log : ngvd29f3.err

Summary of Options Used

Type of Run was Adjustment and Error Propagation
Print Input Data File : Yes
Print Summary of All Input Observations : Yes
Default Standard Error for Elevations : FIXED
Section Length Units : Feet
Default Std Error for Diff in Elevations : 0.025 (FT / $\sqrt{\text{MILE}}$)

Listing of Input Data File

=====

```
[ 1] #
[ 2] #
[ 3] # EARL F. BURKHOLDER, PLS,PE 11-13-1995
[ 4] # CONSULTING GEODETIC ENGINEER
[ 5] # P.O. BOX 13240
[ 6] # CIRCLEVILLE, OHIO 43113
[ 7] #
[ 8] # CLIENT: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
[ 9] # WAUKESHA, WISCONSIN
[10] # KURT BAUER, EXECUTIVE DIRECTOR
[11] #
[12] # PROJECT NAME: FOX RIVER WATERSHED LEVEL NETWORK
[13] # (COMPUTED ON NGVD 29)
[14] #
[15] # NOTES: 1. ELEVATION DIFFERENCES WERE ABSTRACTED FROM SEWRPC FIELD
[16] # BOOKS AT SEWRPC OFFICES BY E. BURKHOLDER 4/21/95.
[17] #
[18] # 2. DISTANCES FOR WEIGHTING PURPOSES WERE DETERMINED BY
[19] # MULTIPLYING COORDINATE INVERSE DISTANCE BY AN ESTIMATED
[20] # FACTOR TO ACCOMMODATE FACT THAT LEVEL LINES MEANDER.
[21] #
[22] #
[23] E D-17 815.865 ! 'NGVD 29 ELEVATIONS PUBLISHED BY NGS
[24] E B-3 801.681 !
[25] E XX-114 954.831 !
[26] E U-114 937.787 !
[27] E R-114 908.505 !
[28] E P-114 838.998 !
[29] E N-114 823.033 !
[30] E WAUKESHA 819.729 !
[31] E H-114 823.073 !
[32] #
```

[33]	#	STATIONS (FROM-TO)	ELEVATION	ESTIMATED	INCREASE	STRAIGHT INVERSE
[34]	#		DIFFERENCE	DIST. FT	FACTOR	DISTANCE
[35]	#					
[36]	V	D-17-FXU32	36.794	32427	1.05	30,883 FEET
[37]	V	FXU32-RRSPIKE1	-92.976	23109	1.02	22,656 FEET
[38]	V	RRSPIKE1-FXU32	92.870	27187	1.20	22,656 FEET
[39]	V	RRSPIKE1-FXU15	10.263	8723	1.01	8,637 FEET
[40]	V	FXU15-TP10-72	34.305	28127	1.10	25,570 FEET
[41]	V	FXU15-RXU3	6.022	30809	1.05	29,342 FEET
[42]	V	RXU3-TP10-72	28.314	27526	1.04	26,467 FEET
[43]	V	RXU3-FXM40	-14.100	6374	1.03	6,188 FEET
[44]	V	FXM40-TP5-43	32.343	17154	1.01	16,984 FEET
[45]	V	TP5-43-F-3	8.275	22720	1.06	21,434 FEET
[46]	V	F-3-TP10-72	1.873	9139	1.02	8,960 FEET
[47]	V	FXM40-B-3	39.805	25912	1.01	25,655 FEET
[48]	V	B-3-FXZ15	115.884	29236	1.03	28,385 FEET
[49]	V	FXZ15-B-3	-115.751	29804	1.05	28,385 FEET
[50]	V	FXM40-FXO31	19.170	18302	1.05	17,431 FEET
[51]	V	FXO31-RXO13	39.943	32441	1.03	31,496 FEET
[52]	V	RXO13-RXN24	19.949	26857	1.07	25,100 FEET
[53]	V	RXN24-FXN29	-5.342	2414	1.01	2,390 FEET
[54]	V	FXN29-FXJ24	71.953	20859	1.01	20,652 FEET
[55]	V	FXJ24-RXJ17	5.273	6126	1.01	6,065 FEET
[56]	V	RXJ17-R-114	-4.341	9094	1.02	8,916 FEET
[57]	V	FXO31-FXT15	258.608	38274	1.06	36,108 FEET
[58]	V	RXO13-TP6-72	51.651	31571	1.05	30,068 FEET
[59]	V	TP6-72-FXT15	166.997	13151	1.00	13,151 FEET
[60]	V	TP6-72-TP6-58	51.332	33211	1.12	29,653 FEET
[61]	V	TP6-58-XX-114	30.969	20404	1.02	20,004 FEET
[62]	V	TP6-58-FXT5	-41.790	14201	1.02	13,923 FEET
[63]	V	FXT5-FXT15	157.377	27290	1.02	26,755 FEET
[64]	V	U-114-FXN13	-121.325	22534	1.05	21,461 FEET
[65]	V	FXN13-RXN24	24.453	24725	1.02	24,240 FEET
[66]	V	P-114-FXF1	-44.192	13394	1.03	13,004 FEET
[67]	V	FXF1-RXJ17	118.076	37337	1.35	27,657 FEET
[68]	V	FXN29-FXR14	-50.304	30935	1.25	24,748 FEET
[69]	V	FXR14-UE	21.928	31280	1.01	30,970 FEET
[70]	V	FXR14-RXM14	13.813	37286	1.25	29,829 FEET
[71]	V	RXM14-UE	8.009	28876	1.02	28,310 FEET
[72]	V	RXM14-FXM21	13.876	20375	1.02	19,975 FEET
[73]	V	FXM21-FXM25	-36.733	10021	1.10	9,110 FEET
[74]	V	FXM25-FXM21	36.663	13665	1.50	9,110 FEET
[75]	V	FXM25-TP5-43	17.935	21566	1.02	21,143 FEET
[76]	V	FXF1-RXE5	45.554	4517	1.01	4,472 FEET
[77]	V	RXE5-N-114	-17.317	1119	1.01	1,108 FEET
[78]	V	RXE5-FXC11	-25.468	9262	1.02	9,080 FEET
[79]	V	FXC11-WAUKESHA	4.851	501	1.01	496 FEET
[80]	V	FXC11-H-114	8.257	14755	1.03	14,325 FEET
[81]	#					
[82]	#	END OF DATA SET				
[83]	#					

Network has 9 fixed elevation stations
Number of Differences in Elevation = 45

Statistical Summary =====

Number of Observations = 45
Number of Unknowns = 28
Degrees of Freedom = 17

Data Type	Count	Weighted Residuals	Error Factor
Stations	37	0.00	0.00
Diff Elev	45	14.31	0.92
Total	82	14.31	0.92

Adjustment passes the Chi Square test at 5% level

Residuals in Observations After Adjustment

Residuals in Observed Differences in Elevations

At	To	Observed	Adjusted	Residual	Std Err	Std Res
D-17	FXU32	36.7940	36.7842	-0.0098	0.062	0.2
FXU32	RRSPIKE1	-92.9760	-92.9311	0.0449	0.052	0.9
RRSPIKE1	FXU32	92.8700	92.9311	0.0611	0.057	1.1
RRSPIKE1	FXU15	10.2630	10.2604	-0.0026	0.032	0.1
FXU15	TP10-72	34.3050	34.3229	0.0179	0.058	0.3
FXU15	RXU3	6.0220	5.9931	-0.0289	0.060	0.5
RXU3	TP10-72	28.3140	28.3298	0.0158	0.057	0.3
RXU3	FXM40	-14.1000	-14.1096	-0.0096	0.027	0.4
FXM40	TP5-43	32.3430	32.3299	-0.0131	0.045	0.3
TP5-43	F-3	8.2750	8.2475	-0.0275	0.052	0.5
F-3	TP10-72	1.8730	1.8620	-0.0110	0.033	0.3
FXM40	B-3	39.8050	39.8190	0.0140	0.055	0.3
B-3	FXZ15	115.8840	115.8181	-0.0659	0.059	1.1
FXZ15	B-3	-115.7510	-115.8181	-0.0671	0.059	1.1
FXM40	FXO31	19.1700	19.1464	-0.0236	0.047	0.5
FXO31	RXO13	39.9430	39.9426	-0.0004	0.062	0.0
RXO13	RXN24	19.9490	19.9691	0.0201	0.056	0.4
RXN24	FXN29	-5.3420	-5.3399	0.0021	0.017	0.1
FXN29	FXJ24	71.9530	71.9802	0.0272	0.050	0.5
FXJ24	RXJ17	5.2730	5.2810	0.0080	0.027	0.3
RXJ17	R-114	-4.3410	-4.3364	0.0046	0.033	0.1
FXO31	FXT15	258.6080	258.5591	-0.0489	0.067	0.7
RXO13	TP6-72	51.6510	51.6270	-0.0240	0.061	0.4
TP6-72	FXT15	166.9970	166.9895	-0.0075	0.039	0.2
TP6-72	TP6-58	51.3320	51.3257	-0.0063	0.063	0.1
TP6-58	XX-114	30.9690	30.9274	-0.0416	0.049	0.8
TP6-58	FXT5	-41.7900	-41.7637	0.0263	0.041	0.6
FXT5	FXT15	157.3770	157.4275	0.0505	0.057	0.9
U-114	FXN13	-121.3250	-121.3226	0.0024	0.052	0.0
FXN13	RXN24	24.4530	24.4557	0.0027	0.054	0.0
P-114	FXF1	-44.1920	-44.2027	-0.0107	0.040	0.3
FXF1	RXJ17	118.0760	118.0461	-0.0299	0.066	0.5
FXN29	FXR14	-50.3040	-50.3178	-0.0138	0.061	0.2
FXR14	UE	21.9280	21.8886	-0.0394	0.061	0.6
FXR14	RXM14	13.8130	13.8433	0.0303	0.066	0.5
RXM14	UE	8.0090	8.0454	0.0364	0.058	0.6
RXM14	FXM21	13.8760	13.8669	-0.0091	0.049	0.2
FXM21	FXM25	-36.7330	-36.7060	0.0270	0.034	0.8
FXM25	FXM21	36.6630	36.7060	0.0430	0.040	1.1
FXM25	TP5-43	17.9350	17.9254	-0.0096	0.051	0.2
FXF1	RXE5	45.5540	45.5540	0.0000	0.023	0.0
RXE5	N-114	-17.3170	-17.3164	0.0006	0.012	0.1
RXE5	FXC11	-25.4680	-25.4731	-0.0051	0.033	0.2
FXC11	WAUKESHA	4.8510	4.8528	0.0018	0.008	0.2
FXC11	H-114	8.2570	8.1968	-0.0602	0.042	1.4

Error Propagation

=====

Station Elevation Standard Deviations

Station	Elevation	Std Dev
D-17	815.8650	0.000
B-3	801.6810	0.000
XX-114	954.8310	0.000
U-114	937.7870	0.000
R-114	908.5050	0.000
P-114	838.9980	0.000
N-114	823.0330	0.000
WAUKESHA	819.7290	0.000
H-114	823.0730	0.000
FXU32	852.6492	0.046

RRSPIKE1	759.7181	0.048
FXU15	769.9785	0.047
TP10-72	804.3014	0.049
RXU3	775.9716	0.041
FXM40	761.8620	0.037
TP5-43	794.1919	0.047
F-3	802.4394	0.051
FXZ15	917.4991	0.038
FXO31	781.0084	0.044
RXO13	820.9510	0.045
RXN24	840.9201	0.038
FXN29	835.5802	0.038
FXJ24	907.5604	0.032
RXJ17	912.8414	0.025
FXT15	1039.5674	0.047
TP6-72	872.5779	0.046
TP6-58	923.9036	0.039
FXT5	882.1399	0.048
FXN13	816.4644	0.039
FXF1	794.7953	0.019
FXR14	785.2624	0.057
UE	807.1510	0.067
RXM14	799.1056	0.061
FXM21	812.9725	0.059
FXM25	776.2665	0.057
RXE5	840.3494	0.010
FXC11	814.8762	0.007

FOX RIVER WATERSHED LEVEL NETWORK - NAVD 88

STAR*LEV Adjustment Program
Copyright 1990 STARPLUS SOFTWARE, INC.
Licensed for Use by Earl F. Burkholder, Consulting Geodetic Engineer
Serial Number 10424

STAR*LEV Version 1.17
Run Date : Tue Nov 14 07:45:44 1995

Summary of Files Used

Input Data File	: navd88f3.dat
Output Listing (This File)	: navd88f3.lst
Adjusted Elevations	: navd88f3.pts
Project Options	: navd88f3.prj
Error Log	: navd88f3.err

Summary of Options Used

Type of Run was Adjustment and Error Propagation
Print Input Data File : Yes
Print Summary of All Input Observations : Yes
Default Standard Error for Elevations : FIXED
Section Length Units : Feet
Default Std Error for Diff in Elevations : 0.025 (FT / $\sqrt{\text{MILE}}$)

Listing of Input Data File

=====

[1]	#		
[2]	#		
[3]	#	EARL F. BURKHOLDER, PLS,PE	11-14-1995
[4]	#	CONSULTING GEODETIC ENGINEER	
[5]	#	P.O. BOX 13240	
[6]	#	CIRCLEVILLE, OHIO 43113	
[7]	#		
[8]	#	CLIENT: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION	
[9]	#	WAUKESHA, WISCONSIN	
[10]	#	KURT BAUER, EXECUTIVE DIRECTOR	
[11]	#		
[12]	#	PROJECT NAME: FOX RIVER WATERSHED LEVEL NETWORK	
[13]	#	(COMPUTED ON NAVD 88)	
[14]	#		
[15]	#	NOTES: 1. ELEVATION DIFFERENCES WERE ABSTRACTED FROM SEWRPC FIELD	
[16]	#	BOOKS AT SEWRPC OFFICES BY E. BURKHOLDER 4/21/95.	
[17]	#		
[18]	#	2. DISTANCES FOR WEIGHTING PURPOSES WERE DETERMINED BY	
[19]	#	MULTIPLYING COORDINATE INVERSE DISTANCE BY AN ESTIMATED	
[20]	#	FACTOR TO ACCOMMODATE FACT THAT LEVEL LINES MEANDER.	
[21]	#		
[22]	#		
[23]	E	D-17	815.622 ! 'NAVD 88 ELEVATIONS PUBLISHED BY NGS
[24]	E	B-3	801.445 !
[25]	E	XX-114	954.614 !
[26]	E	U-114	937.567 !
[27]	E	R-114	908.276 !
[28]	E	P-114	838.761 !
[29]	E	N-114	822.797 !
[30]	E	WAUKESHA	819.496 !
[31]	E	H-114	822.833 !
[32]	#		

	#	STATIONS (FROM-TO)	ELEVATION DIFFERENCE	ESTIMATED DIST. FT	INCREASE FACTOR	STRAIGHT INVERSE DISTANCE
[33]	#					
[34]	#					
[35]	#					
[36]	V	D-17-FXU32	36.794	32427	'1.05	30,883 FEET
[37]	V	FXU32-RRSPIKE1	-92.976	23109	'1.02	22,656 FEET
[38]	V	RRSPIKE1-FXU32	92.870	27187	'1.20	22,656 FEET
[39]	V	RRSPIKE1-FXU15	10.263	8723	'1.01	8,637 FEET
[40]	V	FXU15-TP10-72	34.305	28127	'1.10	25,570 FEET
[41]	V	FXU15-RXU3	6.022	30809	'1.05	29,342 FEET
[42]	V	RXU3-TP10-72	28.314	27526	'1.04	26,467 FEET
[43]	V	RXU3-FXM40	-14.100	6374	'1.03	6,188 FEET
[44]	V	FXM40-TP5-43	32.343	17154	'1.01	16,984 FEET
[45]	V	TP5-43-F-3	8.275	22720	'1.06	21,434 FEET
[46]	V	F-3-TP10-72	1.873	9139	'1.02	8,960 FEET
[47]	V	FXM40-B-3	39.805	25912	'1.01	25,655 FEET
[48]	V	B-3-FXZ15	115.884	29236	'1.03	28,385 FEET
[49]	V	FXZ15-B-3	-115.751	29804	'1.05	28,385 FEET
[50]	V	FXM40-FXO31	19.170	18302	'1.05	17,431 FEET
[51]	V	FXO31-RXO13	39.943	32441	'1.03	31,496 FEET
[52]	V	RXO13-RXN24	19.949	26857	'1.07	25,100 FEET
[53]	V	RXN24-FXN29	-5.342	2414	'1.01	2,390 FEET
[54]	V	FXN29-FXJ24	71.953	20859	'1.01	20,652 FEET
[55]	V	FXJ24-RXJ17	5.273	6126	'1.01	6,065 FEET
[56]	V	RXJ17-R-114	-4.341	9094	'1.02	8,916 FEET
[57]	V	FXO31-FXT15	258.608	38274	'1.06	36,108 FEET
[58]	V	RXO13-TP6-72	51.651	31571	'1.05	30,068 FEET
[59]	V	TP6-72-FXT15	166.997	13151	'1.00	13,151 FEET
[60]	V	TP6-72-TP6-58	51.332	33211	'1.12	29,653 FEET
[61]	V	TP6-58-XX-114	30.969	20404	'1.02	20,004 FEET
[62]	V	TP6-58-FXT5	-41.790	14201	'1.02	13,923 FEET
[63]	V	FXT5-FXT15	157.377	27290	'1.02	26,755 FEET
[64]	V	U-114-FXN13	-121.325	22534	'1.05	21,461 FEET
[65]	V	FXN13-RXN24	24.453	24725	'1.02	24,240 FEET
[66]	V	P-114-FXF1	-44.192	13394	'1.03	13,004 FEET
[67]	V	FXF1-RXJ17	118.076	37337	'1.35	27,657 FEET
[68]	V	FXN29-FXR14	-50.304	30935	'1.25	24,748 FEET
[69]	V	FXR14-UE	21.928	31280	'1.01	30,970 FEET
[70]	V	FXR14-RXM14	13.813	37286	'1.25	29,829 FEET
[71]	V	RXM14-UE	8.009	28876	'1.02	28,310 FEET
[72]	V	RXM14-FXM21	13.876	20375	'1.02	19,975 FEET
[73]	V	FXM21-FXM25	-36.733	10021	'1.10	9,110 FEET
[74]	V	FXM25-FXM21	36.663	13665	'1.50	9,110 FEET
[75]	V	FXM25-TP5-43	17.935	21566	'1.02	21,143 FEET
[76]	V	FXF1-RXE5	45.554	4517	'1.01	4,472 FEET
[77]	V	RXE5-N-114	-17.317	1119	'1.01	1,108 FEET
[78]	V	RXE5-FXC11	-25.468	9262	'1.02	9,080 FEET
[79]	V	FXC11-WAUKESHA	4.851	501	'1.01	496 FEET
[80]	V	FXC11-H-114	8.257	14755	'1.03	14,325 FEET
[81]	#					
[82]	#	END OF DATA SET				
[83]	#					

Network has 9 fixed elevation stations
Number of Differences in Elevation = 45

Statistical Summary
=====

Number of Observations = 45
Number of Unknowns = 28
Degrees of Freedom = 17

Data Type	Count	Weighted Residuals	Error Factor
Stations	37	0.00	0.00
Diff Elev	45	14.19	0.91
Total	82	14.19	0.91

Adjustment passes the Chi Square test at 5% level

Residuals in Observations After Adjustment

=====

Residuals in Observed Differences in Elevations

At	To	Observed	Adjusted	Residual	Std Err	Std Res
D-17	FXU32	36.7940	36.7886	-0.0054	0.062	0.1
FXU32	RRSPIKE1	-92.9760	-92.9294	0.0466	0.052	0.9
RRSPIKE1	FXU32	92.8700	92.9294	0.0594	0.057	1.0
RRSPIKE1	FXU15	10.2630	10.2615	-0.0015	0.032	0.0
FXU15	TP10-72	34.3050	34.3246	0.0196	0.058	0.3
FXU15	RXU3	6.0220	5.9954	-0.0266	0.060	0.4
RXU3	TP10-72	28.3140	28.3292	0.0152	0.057	0.3
RXU3	FXM40	-14.1000	-14.1090	-0.0090	0.027	0.3
FXM40	TP5-43	32.3430	32.3301	-0.0129	0.045	0.3
TP5-43	F-3	8.2750	8.2466	-0.0284	0.052	0.5
F-3	TP10-72	1.8730	1.8616	-0.0114	0.033	0.3
FXM40	B-3	39.8050	39.8160	0.0110	0.055	0.2
B-3	FXZ15	115.8840	115.8181	-0.0659	0.059	1.1
FXZ15	B-3	-115.7510	-115.8181	-0.0671	0.059	1.1
FXM40	FXO31	19.1700	19.1500	-0.0200	0.047	0.4
FXO31	RXO13	39.9430	39.9451	0.0021	0.062	0.0
RXO13	RXN24	19.9490	19.9692	0.0202	0.056	0.4
RXN24	FXN29	-5.3420	-5.3403	0.0017	0.017	0.1
FXN29	FXJ24	71.9530	71.9784	0.0254	0.050	0.5
FXJ24	RXJ17	5.2730	5.2804	0.0074	0.027	0.3
RXJ17	R-114	-4.3410	-4.3358	0.0052	0.033	0.2
FXO31	FXT15	258.6080	258.5636	-0.0444	0.067	0.7
RXO13	TP6-72	51.6510	51.6294	-0.0216	0.061	0.4
TP6-72	FXT15	166.9970	166.9891	-0.0079	0.039	0.2
TP6-72	TP6-58	51.3320	51.3291	-0.0029	0.063	0.0
TP6-58	XX-114	30.9690	30.9314	-0.0376	0.049	0.8
TP6-58	FXT5	-41.7900	-41.7650	0.0250	0.041	0.6
FXT5	FXT15	157.3770	157.4250	0.0480	0.057	0.8
U-114	FXN13	-121.3250	-121.3258	-0.0008	0.052	0.0
FXN13	RXN24	24.4530	24.4521	-0.0009	0.054	0.0
P-114	FXF1	-44.1920	-44.2011	-0.0091	0.040	0.2
FXF1	RXJ17	118.0760	118.0519	-0.0241	0.066	0.4
FXN29	FXR14	-50.3040	-50.3195	-0.0155	0.061	0.3
FXR14	UE	21.9280	21.8880	-0.0400	0.061	0.7
FXR14	RXM14	13.8130	13.8420	0.0290	0.066	0.4
RXM14	UE	8.0090	8.0460	0.0370	0.058	0.6
RXM14	FXM21	13.8760	13.8658	-0.0102	0.049	0.2
FXM21	FXM25	-36.7330	-36.7063	0.0267	0.034	0.8
FXM25	FXM21	36.6630	36.7063	0.0433	0.040	1.1
FXM25	TP5-43	17.9350	17.9242	-0.0108	0.051	0.2
FXF1	RXE5	45.5540	45.5538	-0.0002	0.023	0.0
RXE5	N-114	-17.3170	-17.3167	0.0003	0.012	0.0
RXE5	FXC11	-25.4680	-25.4708	-0.0028	0.033	0.1
FXC11	WAUKESHA	4.8510	4.8531	0.0021	0.008	0.3
FXC11	H-114	8.2570	8.1901	-0.0669	0.042	1.6

Error Propagation

=====

Station Elevation Standard Deviations

Station	Elevation	Std Dev
D-17	815.6220	0.000
B-3	801.4450	0.000
XX-114	954.6140	0.000
U-114	937.5670	0.000
R-114	908.2760	0.000
P-114	838.7610	0.000
N-114	822.7970	0.000
WAUKESHA	819.4960	0.000
H-114	822.8330	0.000
FXU32	852.4106	0.046

RRSPIKE1	759.4812	0.048
FXU15	769.7427	0.047
TP10-72	804.0673	0.049
RXU3	775.7381	0.041
FXM40	761.6290	0.037
TP5-43	793.9592	0.047
F-3	802.2057	0.051
FXZ15	917.2631	0.038
FXO31	780.7790	0.043
RXO13	820.7241	0.045
RXN24	840.6933	0.038
FXN29	835.3530	0.038
FXJ24	907.3314	0.032
RXJ17	912.6118	0.025
FXT15	1039.3426	0.047
TP6-72	872.3535	0.046
TP6-58	923.6826	0.039
FXT5	881.9176	0.048
FXN13	816.2412	0.039
FXF1	794.5599	0.019
FXR14	785.0335	0.057
UE	806.9214	0.067
RXM14	798.8755	0.060
FXM21	812.7413	0.058
FXM25	776.0350	0.057
RXE5	840.1137	0.010
FXC11	814.6429	0.007

COMPUTED FOX RIVER WATERSHED ELEVATIONS - NGVD 29

PROGRAM DESIGN BY:

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 3/95

PROGRAM: LEVELINE - VERSION 1.03
INPUT DATA FILE: ADJ29FR3.DAT
PROGRAM RESULTS FILE: ADJ29FR3.ASC

COMPUTATION OF ABSTRACTED/ADJUSTED ELEVATIONS ALONG EXISTING LINES.

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 14, 1995

AGENCY: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
PROJECT: FOX RIVER WATERSHED LEVEL LINES - USING 9.355 AT U32/33

BM/TP	SPC X DIST(FT)	SPC Y ACCUM DIST	PRE. EL. DIFF EL	ADJ. EL.	METERS

BEGINNING BENCHMARK DATA:					
B-3	2441427.	241654.		801.681	244.353
B-3	2441427.	241654.	801.681	801.681	244.353
	3841.	3841.	-20.459		
M-48	2445150.	242600.	781.222	781.220	238.116
	3178.	7019.	-2.555		
M-47	2448250.	243300.	778.667	778.663	237.337
	2356.	9376.	-3.197		
M-46	2450500.	244000.	775.470	775.465	236.362
	802.	10177.	-4.057		
M-45	2451300.	243950.	771.413	771.408	235.126
	2050.	12227.	6.911		
M-44	2453300.	244400.	778.324	778.318	237.232
	2050.	14277.	26.168		
M-43	2455300.	244850.	804.492	804.485	245.207
	7643.	21920.	-20.396		
RM-1	2462146.	248248.	784.096	784.085	238.989
	2422.	24343.	1.107		
M-41	2463350.	250350.	785.203	785.190	239.326
	2496.	26839.	-23.327		
M-40	2464700.	252450.	761.876	761.862	232.216

ENDING BENCHMARK DATA:

FX-M40	2464700.	252450.	761.862	761.862
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .014
COMPUTED DIFFERENCE IN ELEVATION = -39.805
PUBLISHED DIFFERENCE IN ELEVATION = -39.819

TOTAL DISTANCE ALONG LINE = 26839. FT
CORRECTION PER 1000 FEET = -.000522 FT

BEGINNING BENCHMARK DATA:

FX-M40	2464700.	252450.		761.862	232.216
FX-M40	2464700.	252450.	761.862	761.862	232.216
	2854.	2854.	2.442		
U-1	2465250.	249650.	764.304	764.308	232.962
	1806.	4660.	-1.918		
U-2	2466600.	248450.	762.386	762.393	232.378
	2102.	6762.	9.869		

U-3	2468700.	248550.	772.255	772.264	235.387
	361.	7123.	3.707		
RXU-3	2468900.	248250.	775.962	775.972	236.517

ENDING BENCHMARK DATA:

RX-U3	2468700.	248550.	775.972	775.972	
-------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.010
 COMPUTED DIFFERENCE IN ELEVATION = 14.100
 PUBLISHED DIFFERENCE IN ELEVATION = 14.110

TOTAL DISTANCE ALONG LINE = 7123. FT
 CORRECTION PER 1000 FEET = .001404 FT

BEGINNING BENCHMARK DATA:

RX-U3	2468900.	248250.		775.972	236.517
RX-U3	2468900.	248250.	775.972	775.972	236.517
	361.	361.	-3.707		
U-3	2468700.	248550.	772.265	772.265	235.387
	3030.	3391.	-11.453		
U-4	2470550.	246150.	760.812	760.815	231.897
	2930.	6321.	18.710		
U-5	2471800.	243500.	779.522	779.527	237.600
	2650.	8971.	-2.133		
U-6	2473350.	241350.	777.389	777.396	236.951
	3564.	12535.	-26.973		
U-7	2475350.	238400.	750.416	750.426	228.730
	1750.	14285.	11.972		
U-8	2477100.	238400.	762.388	762.399	232.380
	2700.	16986.	-3.389		
U-9	2477150.	235700.	758.999	759.012	231.347
	2302.	19288.	-10.701		
U-10	2477050.	233400.	748.298	748.313	228.086
	2506.	21794.	3.698		
U-11	2478250.	231200.	751.996	752.013	229.214
	3324.	25118.	-.609		
U-12	2477850.	227900.	751.387	751.407	229.029
	4502.	29621.	38.611		
U-13	2482350.	228050.	789.998	790.021	240.799
	2804.	32425.	-34.732		
U-14	2482500.	225250.	755.266	755.291	230.213
	3252.	35676.	14.684		
U-15	2482600.	222000.	769.950	769.978	234.690

ENDING BENCHMARK DATA:

FX-U15	2482600.	222000.	769.978	769.978	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.028
 COMPUTED DIFFERENCE IN ELEVATION = -6.022
 PUBLISHED DIFFERENCE IN ELEVATION = -5.994

TOTAL DISTANCE ALONG LINE = 35676. FT
 CORRECTION PER 1000 FEET = .000785 FT

BEGINNING BENCHMARK DATA:

FX-U15	2482600.	222000.		769.978	234.690
FX-U15	2482600.	222000.	769.978	769.978	234.690
	2000.	2000.	-1.155		
U-16	2482600.	220000.	768.823	768.824	234.338
	1924.	3924.	-24.693		
U-17	2482900.	218100.	744.130	744.131	226.812
	3118.	7042.	9.241		
U-18	2483750.	215100.	753.371	753.373	229.629
	1736.	8777.	6.344		
RRSPIKE	2483400.	213400.	759.715	759.718	231.563

ENDING BENCHMARK DATA:

RRSPIKE1	2483400.	213400.	759.718	759.718
----------	----------	---------	---------	---------

TOTAL MISCLOSURE =	- .003
COMPUTED DIFFERENCE IN ELEVATION =	-10.263
PUBLISHED DIFFERENCE IN ELEVATION =	-10.260

TOTAL DISTANCE ALONG LINE =	8777. FT
CORRECTION PER 1000 FEET =	.000342 FT

BEGINNING BENCHMARK DATA:

RRSPIKE1	2483400.	213400.		759.718	231.563
RRSPIKE1	2483400.	213400.	759.718	759.718	231.563
	1282.	1282.	5.762		
V-1	2482950.	212200.	765.480	765.483	233.320
	4700.	5982.	-10.134		
V-2	2483000.	207500.	755.346	755.361	230.234
	3000.	8982.	3.962		
V-3	2483000.	204500.	759.308	759.330	231.444
	3701.	12683.	91.291		
V-4	2483100.	200800.	850.599	850.630	259.273
	2723.	15406.	1.345		
V-5	2480400.	200450.	851.944	851.982	259.685
	1726.	17132.	-8.282		
V-6	2480700.	198750.	843.662	843.704	257.161
	2700.	19833.	6.753		
V-7	2480650.	196050.	850.415	850.463	259.222
	2451.	22283.	-8.434		
V-8	2480700.	193600.	841.981	842.035	256.653
	2700.	24984.	10.607		
U-32	2480750.	190900.	852.588	852.649	259.888

ENDING BENCHMARK DATA:

FX-U32	2480750.	190900.	852.649	852.649
--------	----------	---------	---------	---------

TOTAL MISCLOSURE =	- .061
COMPUTED DIFFERENCE IN ELEVATION =	92.870
PUBLISHED DIFFERENCE IN ELEVATION =	92.931

TOTAL DISTANCE ALONG LINE =	24984. FT
CORRECTION PER 1000 FEET =	.002442 FT

BEGINNING BENCHMARK DATA:

FX-U32	2480750.	190900.		852.649	259.888
FX-U32	2480750.	190900.	852.649	852.649	259.888
	2552.	2552.	9.355		
U-33	2478200.	190800.	862.004	862.005	262.740
	3052.	5604.	29.020		
U-34	2475150.	190700.	891.024	891.026	271.585
	2173.	7776.	7.766		
U-35	2473100.	189980.	898.790	898.792	273.952
	2006.	9783.	-13.625		
U-36	2471100.	189820.	885.165	885.168	269.800
	4915.	14698.	-39.337		
U-37	2468850.	185450.	845.828	845.832	257.810
	18583.	33280.	-29.973		
D-17'	2457062.	171085.	815.855	815.865	248.676

ENDING BENCHMARK DATA:

D-17	2457062.	171085.	815.865	815.865
------	----------	---------	---------	---------

TOTAL MISCLOSURE =	- .010
COMPUTED DIFFERENCE IN ELEVATION =	-36.794
PUBLISHED DIFFERENCE IN ELEVATION =	-36.784

TOTAL DISTANCE ALONG LINE = 33280. FT
CORRECTION PER 1000 FEET = .000300 FT

BEGINNING BENCHMARK DATA:

FX-M40	2464700.	252450.		761.862	232.216
FX-M40	2464700.	252450.	761.862	761.862	232.216
	1031.	1031.	-.171		
FX-043	2463900.	253100.	761.691	761.690	232.164
	721.	1752.	3.842		
FX-042	2463300.	253500.	765.533	765.531	233.334
	361.	2112.	-.002		
FX-041	2463600.	253300.	765.531	765.529	233.334
	4127.	6239.	5.732		
FX-039	2459700.	254650.	771.263	771.257	235.080
	447.	6687.	-4.493		
FX-038	2459500.	255050.	766.770	766.764	233.710
	2884.	9571.	3.456		
FX-037	2457900.	257450.	770.226	770.217	234.763
	1553.	11124.	-1.731		
FX-036	2457800.	259000.	768.495	768.485	234.235
	2550.	13675.	18.106		
FX-035	2455250.	258950.	786.601	786.588	239.753
	2652.	16327.	2.566		
FX-034	2452600.	258850.	789.167	789.152	240.534
	2650.	18977.	20.563		
FX-033	2449950.	258900.	809.730	809.712	246.801
	2602.	21579.	19.627		
FX-032	2449850.	261500.	829.357	829.337	252.782
	4311.	25890.	-48.325		
FX-031'	2452500.	264900.	781.032	781.008	238.052

ENDING BENCHMARK DATA:

FX-031	2452500.	264900.	781.008	781.008
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .024
COMPUTED DIFFERENCE IN ELEVATION = 19.170
PUBLISHED DIFFERENCE IN ELEVATION = 19.146

TOTAL DISTANCE ALONG LINE = 25890. FT
CORRECTION PER 1000 FEET = -.000927 FT

BEGINNING BENCHMARK DATA:

FX-031	2452500.	264900.		781.008	238.052
FX-031	2452500.	264900.	781.008	781.008	238.052
	2687.	2687.	-6.347		
FX-027	2454400.	266800.	774.661	774.661	236.117
	2652.	5339.	1.691		
FX-026	2454500.	269450.	776.352	776.352	236.633
	2662.	8001.	32.872		
FX-025	2454250.	272100.	809.224	809.224	246.652
	2650.	10651.	-29.644		
FX-023	2454200.	274750.	779.580	779.580	237.616
	2658.	13309.	3.046		
FX-022	2454000.	277400.	782.626	782.626	238.545
	2608.	15916.	15.870		
FX-021	2454200.	280000.	798.496	798.496	243.382
	2706.	18622.	16.980		
FX-020	2454950.	282600.	815.476	815.476	248.558
	3531.	22153.	-23.704		
FX-019	2455700.	286050.	791.772	791.772	241.333
	2430.	24583.	6.180		
FX-018	2454250.	288000.	797.952	797.952	243.216
	2500.	27083.	15.694		
FX-017	2451750.	288000.	813.646	813.646	248.000
	2451.	29533.	4.554		

FX-016	2451700.	290450.	818.200	818.200	249.388
	2700.	32233.	-7.589		
FX-015	2451700.	293150.	810.611	810.611	247.075
	1947.	34181.	-9.346		
FX-04	2450250.	294450.	801.265	801.265	244.226
	1557.	35738.	5.072		
FX-014	2449200.	295600.	806.337	806.337	245.772
	2851.	38589.	14.614		
RX-013'	2446350.	295680.	820.951	820.951	250.226

ENDING BENCHMARK DATA:

RX-013	2446350.	295680.	820.951	820.951
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .000
 COMPUTED DIFFERENCE IN ELEVATION = 39.943
 PUBLISHED DIFFERENCE IN ELEVATION = 39.943

TOTAL DISTANCE ALONG LINE = 38589. FT
 CORRECTION PER 1000 FEET = .000000 FT

BEGINNING BENCHMARK DATA:

RX-013	2446350.	295680.	820.951	820.951	250.226
RX-013	2446350.	295680.	820.951	820.951	250.226
	130.	130.	1.899		
FX-013	2446400.	295800.	822.850	822.850	250.805
	2500.	2630.	-3.966		
FX-012	2446400.	298300.	818.884	818.885	249.597
	2900.	5530.	24.850		
FX-011	2446400.	301200.	843.734	843.737	257.172
	4580.	10110.	-9.593		
FX-010	2450100.	303900.	834.141	834.147	254.248
	4897.	15008.	13.282		
FX-09	2454250.	306500.	847.423	847.431	258.298
	3100.	18108.	-6.280		
FX-08	2454250.	309600.	841.143	841.153	256.384
	2610.	20718.	38.462		
FX-07	2452700.	311700.	879.605	879.616	268.108
	2263.	22980.	-60.040		
FX-02	2451100.	313300.	819.565	819.578	249.808
	2778.	25759.	-.031		
FX-03	2448700.	311900.	819.534	819.548	249.799
	4866.	30625.	-15.069		
FX-N27	2448300.	316750.	804.465	804.482	245.207
	206.	30832.	-16.516		
FX-N28	2448500.	316800.	787.949	787.966	240.172
	806.	31638.	2.733		
FX-N26	2447700.	316700.	790.682	790.699	241.006
	447.	32085.	3.090		
FX-N25	2447300.	316500.	793.772	793.790	241.948
	4491.	36576.	47.128		
RX-N24'	2446400.	320900.	840.900	840.920	256.313

ENDING BENCHMARK DATA:

RX-N24	2446400.	320900.	840.920	840.920
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = -.020
 COMPUTED DIFFERENCE IN ELEVATION = 19.949
 PUBLISHED DIFFERENCE IN ELEVATION = 19.969

TOTAL DISTANCE ALONG LINE = 36576. FT
 CORRECTION PER 1000 FEET = .000547 FT

BEGINNING BENCHMARK DATA:

RX-N24	2446400.	320900.		840.920	256.313
RX-N24	2446400.	320900.	840.920	840.920	256.313
	2390.	2390.	-5.342		
FX-N29'	2444950.	322800.	835.578	835.580	254.685

ENDING BENCHMARK DATA:

FX-N29	2444950.	322800.	835.580	835.580	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.002
 COMPUTED DIFFERENCE IN ELEVATION = -5.342
 PUBLISHED DIFFERENCE IN ELEVATION = -5.340

TOTAL DISTANCE ALONG LINE = 2390. FT
 CORRECTION PER 1000 FEET = .000837 FT

BEGINNING BENCHMARK DATA:

FX-N29	2444950.	322800.		835.580	254.685
FX-N29	2444950.	322800.	835.580	835.580	254.685
	1950.	1950.	18.453		
FX-N30	2444950.	324750.	854.033	854.036	260.311
	2815.	4765.	3.476		
FX-N31	2444000.	327400.	857.509	857.515	261.371
	2608.	7373.	-.880		
FX-N32	2443800.	330000.	856.629	856.639	261.104
	2746.	10119.	18.084		
FX-N33	2443300.	332700.	874.713	874.726	266.617
	2702.	12821.	66.777		
FX-N34	2443200.	335400.	941.490	941.507	286.972
	2602.	15422.	-56.134		
FX-N35	2443100.	338000.	885.356	885.376	269.863
	2702.	18124.	8.552		
FX-N36	2443000.	340700.	893.908	893.932	272.471
	2652.	20776.	13.625		
FX-J24'	2442900.	343350.	907.533	907.560	276.625

ENDING BENCHMARK DATA:

FX-J24	2442900.	343350.	907.560	907.560	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.027
 COMPUTED DIFFERENCE IN ELEVATION = 71.953
 PUBLISHED DIFFERENCE IN ELEVATION = 71.980

TOTAL DISTANCE ALONG LINE = 20776. FT
 CORRECTION PER 1000 FEET = .001300 FT

BEGINNING BENCHMARK DATA:

FX-J24	2442900.	343350.		907.560	276.625
FX-J24	2442900.	343350.	907.560	907.560	276.625
	2700.	2700.	-2.748		
FX-J23	2442850.	346050.	904.812	904.815	275.788
	2266.	4966.	-43.497		
FX-J21	2442000.	348150.	861.315	861.321	262.531
	1262.	6228.	51.518		
RX-J17'	2441300.	349200.	912.833	912.841	278.235

ENDING BENCHMARK DATA:

RX-J17	2441300.	349200.	912.841	912.841	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.008
 COMPUTED DIFFERENCE IN ELEVATION = 5.273
 PUBLISHED DIFFERENCE IN ELEVATION = 5.281

TOTAL DISTANCE ALONG LINE = 6228. FT
 CORRECTION PER 1000 FEET = .001285 FT

BEGINNING BENCHMARK DATA:

RX-J17	2441300.	349200.		912.841	278.235
RX-J17	2441300.	349200.	912.841	912.841	278.235
	4966.	4966.	-53.744		
FX-J20	2439200.	353700.	859.097	859.100	261.854
	4169.	9135.	49.403		
R-114	2435997.	356368.	908.500	908.505	276.913

ENDING BENCHMARK DATA:

R-114	2435997.	356368.	908.505	908.505	
-------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.005
 COMPUTED DIFFERENCE IN ELEVATION = -4.341
 PUBLISHED DIFFERENCE IN ELEVATION = -4.336

TOTAL DISTANCE ALONG LINE = 9135. FT
 CORRECTION PER 1000 FEET = .000547 FT

COMPUTED FOX RIVER WATERSHED ELEVATIONS - NAVD 88

PROGRAM DESIGN BY:

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 3/95

PROGRAM: LEVELINE - VERSION 1.03
INPUT DATA FILE: ADJ88FR3.DAT
PROGRAM RESULTS FILE: ADJ88FR3.ASC

COMPUTATION OF ABSTRACTED/ADJUSTED ELEVATIONS ALONG EXISTING LINES.

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 14, 1995

AGENCY: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
PROJECT: FOX RIVER WATERSHED LEVEL LINES USING 9.355 AT U32/33

BM/TP	SPC X DIST(FT)	SPC Y ACCUM DIST	PRE. EL. DIFF EL	ADJ. EL.	METERS
-------	-------------------	---------------------	---------------------	----------	--------

BEGINNING BENCHMARK DATA:

B-3	2441427.	241654.		801.445	244.281
B-3	2441427.	241654.	801.445	801.445	244.281
	3841.	3841.	-20.459		
M-48	2445150.	242600.	780.986	780.984	238.045
	3178.	7019.	-2.555		
M-47	2448250.	243300.	778.431	778.428	237.265
	2356.	9376.	-3.197		
M-46	2450500.	244000.	775.234	775.230	236.291
	802.	10177.	-4.057		
M-45	2451300.	243950.	771.177	771.173	235.054
	2050.	12227.	6.911		
M-44	2453300.	244400.	778.088	778.083	237.160
	2050.	14277.	26.168		
M-43	2455300.	244850.	804.256	804.250	245.136
	7643.	21920.	-20.396		
RM-1	2462146.	248248.	783.860	783.851	238.918
	2422.	24343.	1.107		
M-41	2463350.	250350.	784.967	784.957	239.255
	2496.	26839.	-23.327		
M-40	2464700.	252450.	761.640	761.629	232.145

ENDING BENCHMARK DATA:

FX-M40	2464700.	252450.	761.629	761.629	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = .011
COMPUTED DIFFERENCE IN ELEVATION = -39.805
PUBLISHED DIFFERENCE IN ELEVATION = -39.816

TOTAL DISTANCE ALONG LINE = 26839. FT
CORRECTION PER 1000 FEET = -.000410 FT

BEGINNING BENCHMARK DATA:

FX-M40	2464700.	252450.		761.629	232.145
FX-M40	2464700.	252450.	761.629	761.629	232.145
	2854.	2854.	2.442		
U-1	2465250.	249650.	764.071	764.075	232.890
	1806.	4660.	-1.918		

U-2	2466600.	248450.	762.153	762.159	232.306
	2102.	6762.	9.869		
U-3	2468700.	248550.	772.022	772.031	235.315
	361.	7123.	3.707		
RXU-3	2468900.	248250.	775.729	775.738	236.445

ENDING BENCHMARK DATA:

RX-U3	2468700.	248550.	775.738	775.738
-------	----------	---------	---------	---------

TOTAL MISCLOSURE = -.009
 COMPUTED DIFFERENCE IN ELEVATION = 14.100
 PUBLISHED DIFFERENCE IN ELEVATION = 14.109

TOTAL DISTANCE ALONG LINE = 7123. FT
 CORRECTION PER 1000 FEET = .001264 FT

BEGINNING BENCHMARK DATA:

RX-U3	2468900.	248250.		775.738	236.445
RX-U3	2468900.	248250.	775.738	775.738	236.445
	361.	361.	-3.707		
U-3	2468700.	248550.	772.031	772.031	235.316
	3030.	3391.	-11.453		
U-4	2470550.	246150.	760.578	760.581	231.825
	2930.	6321.	18.710		
U-5	2471800.	243500.	779.288	779.293	237.529
	2650.	8971.	-2.133		
U-6	2473350.	241350.	777.155	777.162	236.879
	3564.	12535.	-26.973		
U-7	2475350.	238400.	750.182	750.191	228.659
	1750.	14285.	11.972		
U-8	2477100.	238400.	762.154	762.165	232.308
	2700.	16986.	-3.389		
U-9	2477150.	235700.	758.765	758.778	231.276
	2302.	19288.	-10.701		
U-10	2477050.	233400.	748.064	748.079	228.015
	2506.	21794.	3.698		
U-11	2478250.	231200.	751.762	751.778	229.143
	3324.	25118.	-.609		
U-12	2477850.	227900.	751.153	751.172	228.958
	4502.	29621.	38.611		
U-13	2482350.	228050.	789.764	789.786	240.727
	2804.	32425.	-34.732		
U-14	2482500.	225250.	755.032	755.057	230.142
	3252.	35676.	14.684		
U-15	2482600.	222000.	769.716	769.743	234.618

ENDING BENCHMARK DATA:

FX-U15	2482600.	222000.	769.743	769.743
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = -.027
 COMPUTED DIFFERENCE IN ELEVATION = -6.022
 PUBLISHED DIFFERENCE IN ELEVATION = -5.995

TOTAL DISTANCE ALONG LINE = 35676. FT
 CORRECTION PER 1000 FEET = .000757 FT

BEGINNING BENCHMARK DATA:

FX-U15	2482600.	222000.		769.743	234.618
FX-U15	2482600.	222000.	769.743	769.743	234.618
	2000.	2000.	-1.155		
U-16	2482600.	220000.	768.588	768.588	234.266
	1924.	3924.	-24.693		
U-17	2482900.	218100.	743.895	743.895	226.740
	3118.	7042.	9.241		

U-18	2483750.	215100.	753.136	753.137	229.557
	1736.	8777.	6.344		
RRSPIKE	2483400.	213400.	759.480	759.481	231.490

ENDING BENCHMARK DATA:

RRSPIKE1	2483400.	213400.	759.481	759.481
----------	----------	---------	---------	---------

TOTAL MISCLOSURE = - .001
 COMPUTED DIFFERENCE IN ELEVATION = -10.263
 PUBLISHED DIFFERENCE IN ELEVATION = -10.262

TOTAL DISTANCE ALONG LINE = 8777. FT
 CORRECTION PER 1000 FEET = .000114 FT

BEGINNING BENCHMARK DATA:

RRSPIKE1	2483400.	213400.		759.481	231.490
RRSPIKE1	2483400.	213400.	759.481	759.481	231.490
	1282.	1282.	5.762		
V-1	2482950.	212200.	765.243	765.246	233.247
	4700.	5982.	-10.134		
V-2	2483000.	207500.	755.109	755.123	230.162
	3000.	8982.	3.962		
V-3	2483000.	204500.	759.071	759.093	231.372
	3701.	12683.	91.291		
V-4	2483100.	200800.	850.362	850.392	259.200
	2723.	15406.	1.345		
V-5	2480400.	200450.	851.707	851.744	259.612
	1726.	17132.	-8.282		
V-6	2480700.	198750.	843.425	843.466	257.089
	2700.	19833.	6.753		
V-7	2480650.	196050.	850.178	850.226	259.149
	2451.	22283.	-8.434		
V-8	2480700.	193600.	841.744	841.798	256.580
	2700.	24984.	10.607		
U-32	2480750.	190900.	852.351	852.411	259.815

ENDING BENCHMARK DATA:

FX-U32	2480750.	190900.	852.411	852.411
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = - .060
 COMPUTED DIFFERENCE IN ELEVATION = 92.870
 PUBLISHED DIFFERENCE IN ELEVATION = 92.930

TOTAL DISTANCE ALONG LINE = 24984. FT
 CORRECTION PER 1000 FEET = .002402 FT

BEGINNING BENCHMARK DATA:

FX-U32	2480750.	190900.		852.411	259.815
FX-U32	2480750.	190900.	852.411	852.411	259.815
	2552.	2552.	9.355		
U-33	2478200.	190800.	861.766	861.766	262.667
	3052.	5604.	29.020		
U-34	2475150.	190700.	890.786	890.787	271.512
	2173.	7776.	7.766		
U-35	2473100.	189980.	898.552	898.553	273.880
	2006.	9783.	-13.625		
U-36	2471100.	189820.	884.927	884.928	269.727
	4915.	14698.	-39.337		
U-37	2468850.	185450.	845.590	845.592	257.737
	18583.	33280.	-29.973		
D-17'	2457062.	171085.	815.617	815.622	248.602

ENDING BENCHMARK DATA:

D-17	2457062.	171085.	815.622	815.622
------	----------	---------	---------	---------

TOTAL MISCLOSURE = -.005
 COMPUTED DIFFERENCE IN ELEVATION = -36.794
 PUBLISHED DIFFERENCE IN ELEVATION = -36.789

TOTAL DISTANCE ALONG LINE = 33280. FT
 CORRECTION PER 1000 FEET = .000150 FT

BEGINNING BENCHMARK DATA:

FX-M40	2464700.	252450.		761.629	232.145
FX-M40	2464700.	252450.	761.629	761.629	232.145
	1031.	1031.	-.171		
FX-043	2463900.	253100.	761.458	761.457	232.093
	721.	1752.	3.842		
FX-042	2463300.	253500.	765.300	765.299	233.264
	361.	2112.	-.002		
FX-041	2463600.	253300.	765.298	765.296	233.263
	4127.	6239.	5.732		
FX-039	2459700.	254650.	771.030	771.025	235.009
	447.	6687.	-4.493		
FX-038	2459500.	255050.	766.537	766.532	233.639
	2884.	9571.	3.456		
FX-037	2457900.	257450.	769.993	769.986	234.692
	1553.	11124.	-1.731		
FX-036	2457800.	259000.	768.262	768.253	234.164
	2550.	13675.	18.106		
FX-035	2455250.	258950.	786.368	786.357	239.682
	2652.	16327.	2.566		
FX-034	2452600.	258850.	788.934	788.921	240.464
	2650.	18977.	20.563		
FX-033	2449950.	258900.	809.497	809.482	246.731
	2602.	21579.	19.627		
FX-032	2449850.	261500.	829.124	829.107	252.712
	4311.	25890.	-48.325		
FX-031	2452500.	264900.	780.779	780.779	237.982

ENDING BENCHMARK DATA:

FX-031	2452500.	264900.	780.779	780.779
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .020
 COMPUTED DIFFERENCE IN ELEVATION = 19.170
 PUBLISHED DIFFERENCE IN ELEVATION = 19.150

TOTAL DISTANCE ALONG LINE = 25890. FT
 CORRECTION PER 1000 FEET = -.000773 FT

BEGINNING BENCHMARK DATA:

FX-031	2452500.	264900.		780.779	237.982
FX-031	2452500.	264900.	780.779	780.779	237.982
	2687.	2687.	-6.347		
FX-027	2454400.	266800.	774.432	774.432	236.047
	2652.	5339.	1.691		
FX-026	2454500.	269450.	776.123	776.123	236.563
	2662.	8001.	32.872		
FX-025	2454250.	272100.	808.995	808.995	246.582
	2650.	10651.	-29.644		
FX-023	2454200.	274750.	779.351	779.352	237.547
	2658.	13309.	3.046		
FX-022	2454000.	277400.	782.397	782.398	238.475
	2608.	15916.	15.870		
FX-021	2454200.	280000.	798.267	798.268	243.313
	2706.	18622.	16.980		
FX-020	2454950.	282600.	815.247	815.248	248.488
	3531.	22153.	-23.704		
FX-019	2455700.	286050.	791.543	791.544	241.263
	2430.	24583.	6.180		

FX-018	2454250.	288000.	797.723	797.724	243.147
	2500.	27083.	15.694		
FX-017	2451750.	288000.	813.417	813.418	247.930
	2451.	29533.	4.554		
FX-016	2451700.	290450.	817.971	817.973	249.319
	2700.	32233.	-7.589		
FX-015	2451700.	293150.	810.382	810.384	247.005
	1947.	34181.	-9.346		
FX-04	2450250.	294450.	801.036	801.038	244.157
	1557.	35738.	5.072		
FX-014	2449200.	295600.	806.108	806.110	245.703
	2851.	38589.	14.614		
RX-013'	2446350.	295680.	820.722	820.724	250.157
ENDING BENCHMARK DATA:					
RX-013	2446350.	295680.	820.724	820.724	
TOTAL MISCLOSURE =			-.002		
COMPUTED DIFFERENCE IN ELEVATION =			39.943		
PUBLISHED DIFFERENCE IN ELEVATION =			39.945		
TOTAL DISTANCE ALONG LINE =			38589. FT		
CORRECTION PER 1000 FEET =			.000052 FT		

BEGINNING BENCHMARK DATA:					
RX-013	2446350.	295680.		820.724	250.157
RX-013	2446350.	295680.	820.724	820.724	250.157
	130.	130.	1.899		
FX-013	2446400.	295800.	822.623	822.623	250.736
	2500.	2630.	-3.966		
FX-012	2446400.	298300.	818.657	818.658	249.528
	2900.	5530.	24.850		
FX-011	2446400.	301200.	843.507	843.510	257.102
	4580.	10110.	-9.593		
FX-010	2450100.	303900.	833.914	833.920	254.179
	4897.	15008.	13.282		
FX-09	2454250.	306500.	847.196	847.204	258.228
	3100.	18108.	-6.280		
FX-08	2454250.	309600.	840.916	840.926	256.315
	2610.	20718.	38.462		
FX-07	2452700.	311700.	879.378	879.389	268.038
	2263.	22980.	-60.040		
FX-02	2451100.	313300.	819.338	819.351	249.739
	2778.	25759.	-.031		
FX-03	2448700.	311900.	819.307	819.321	249.730
	4866.	30625.	-15.069		
FX-N27	2448300.	316750.	804.238	804.255	245.137
	206.	30832.	-16.516		
FX-N28	2448500.	316800.	787.722	787.739	240.103
	806.	31638.	2.733		
FX-N26	2447700.	316700.	790.455	790.472	240.936
	447.	32085.	3.090		
FX-N25	2447300.	316500.	793.545	793.563	241.878
	4491.	36576.	47.128		
RX-N24'	2446400.	320900.	840.673	840.693	256.244
ENDING BENCHMARK DATA:					
RX-N24	2446400.	320900.	840.693	840.693	
TOTAL MISCLOSURE =			-.020		
COMPUTED DIFFERENCE IN ELEVATION =			19.949		
PUBLISHED DIFFERENCE IN ELEVATION =			19.969		
TOTAL DISTANCE ALONG LINE =			36576. FT		
CORRECTION PER 1000 FEET =			.000547 FT		

BEGINNING BENCHMARK DATA:

RX-N24	2446400.	320900.		840.693	256.244
RX-N24	2446400.	320900.	840.693	840.693	256.244
	2390.	2390.	-5.342		
FX-N29'	2444950.	322800.	835.351	835.353	254.616

ENDING BENCHMARK DATA:

FX-N29	2444950.	322800.	835.353	835.353	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.002
 COMPUTED DIFFERENCE IN ELEVATION = -5.342
 PUBLISHED DIFFERENCE IN ELEVATION = -5.340

TOTAL DISTANCE ALONG LINE = 2390. FT
 CORRECTION PER 1000 FEET = .000837 FT

BEGINNING BENCHMARK DATA:

FX-N29	2444950.	322800.		835.353	254.616
FX-N29	2444950.	322800.	835.353	835.353	254.616
	1950.	1950.	18.453		
FX-N30	2444950.	324750.	853.806	853.809	260.241
	2815.	4765.	3.476		
FX-N31	2444000.	327400.	857.282	857.288	261.302
	2608.	7373.	-.880		
FX-N32	2443800.	330000.	856.402	856.412	261.035
	2746.	10119.	18.084		
FX-N33	2443300.	332700.	874.486	874.499	266.548
	2702.	12821.	66.777		
FX-N34	2443200.	335400.	941.263	941.280	286.903
	2602.	15422.	-56.134		
FX-N35	2443100.	338000.	885.129	885.149	269.794
	2702.	18124.	8.552		
FX-N36	2443000.	340700.	893.681	893.705	272.402
	2652.	20776.	13.625		
FX-J24'	2442900.	343350.	907.306	907.333	276.556

ENDING BENCHMARK DATA:

FX-J24	2442900.	343350.	907.333	907.333	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.027
 COMPUTED DIFFERENCE IN ELEVATION = 71.953
 PUBLISHED DIFFERENCE IN ELEVATION = 71.980

TOTAL DISTANCE ALONG LINE = 20776. FT
 CORRECTION PER 1000 FEET = .001300 FT

BEGINNING BENCHMARK DATA:

FX-J24	2442900.	343350.		907.331	276.555
FX-J24	2442900.	343350.	907.331	907.331	276.555
	2700.	2700.	-2.748		
FX-J23	2442850.	346050.	904.583	904.586	275.719
	2266.	4966.	-43.497		
FX-J21	2442000.	348150.	861.086	861.092	262.461
	1262.	6228.	51.518		
RX-J17'	2441300.	349200.	912.604	912.612	278.165

ENDING BENCHMARK DATA:

RX-J17	2441300.	349200.	912.612	912.612	
--------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = -.008
 COMPUTED DIFFERENCE IN ELEVATION = 5.273
 PUBLISHED DIFFERENCE IN ELEVATION = 5.281

TOTAL DISTANCE ALONG LINE = 6228. FT
 CORRECTION PER 1000 FEET = .001285 FT

BEGINNING BENCHMARK DATA:

RX-J17	2441300.	349200.		912.612	278.165
RX-J17	2441300.	349200.	912.612	912.612	278.165
	4966.	4966.	-53.744		
FX-J20	2439200.	353700.	858.868	858.871	261.784
	4169.	9135.	49.403		
R-114	2435997.	356368.	908.271	908.276	276.843

ENDING BENCHMARK DATA:

R-114	2435997.	356368.	908.276	908.276	
-------	----------	---------	---------	---------	--

TOTAL MISCLOSURE =	- .005
COMPUTED DIFFERENCE IN ELEVATION =	-4.341
PUBLISHED DIFFERENCE IN ELEVATION =	-4.336

TOTAL DISTANCE ALONG LINE =	9135. FT
CORRECTION PER 1000 FEET =	.000547 FT

Data Set: Second-Order Benchmarks - Fox River Watershed
Adjusted Elevations on NGVD 29 and NAVD 88

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 39 12.62073	88 20 42.93638	M-48	ALSTER66	2	238.045	238.116
42 39 18.92404	88 20 1.27556	M-47	ALSTER66	2	237.265	237.337
42 39 25.39186	88 19 30.98480	M-46	ALSTER66	2	236.291	236.362
42 39 24.73924	88 19 20.29480	M-45	ALSTER66	2	235.054	235.126
42 39 28.78499	88 18 53.41457	M-44	ALSTER66	2	237.160	237.232
42 39 32.82897	88 18 26.53336	M-43	ALSTER66	2	245.136	245.207
42 40 5.00352	88 16 53.99928	RM-1	USC&GS?	2	238.918	238.989
42 40 25.51672	88 16 37.30659	M-41	ALSTER66	2	239.255	239.326
42 40 45.97961	88 16 18.65729	M-40	ALSTER66	2	232.145	232.216
42 40 18.21525	88 16 12.07366	U-1	ALSTER66	2	232.890	232.962
42 40 6.08750	88 15 54.34167	U-2	ALSTER66	2	232.306	232.378
42 40 6.64254	88 15 26.21238	U-3	ALSTER66	2	235.315	235.387
42 40 3.63858	88 15 23.62001	RX-U3	ALSTER66	2	236.445	236.517
42 39 42.55857	88 15 2.13031	U-4	ALSTER66	2	231.825	231.897
42 39 16.12901	88 14 46.15103	U-5	ALSTER66	2	237.529	237.600
42 38 54.57410	88 14 26.02134	U-6	ALSTER66	2	236.879	236.951
42 38 25.02367	88 14 .10316	U-7	ALSTER66	2	228.659	228.730
42 38 24.65680	88 13 36.69626	U-8	ALSTER66	2	232.308	232.380
42 37 57.98249	88 13 36.79551	U-9	ALSTER66	2	231.276	231.347
42 37 35.28987	88 13 38.78683	U-10	ALSTER66	2	228.015	228.086
42 37 13.31157	88 13 23.36697	U-11	ALSTER66	2	229.143	229.214
42 36 40.80667	88 13 29.65482	U-12	ALSTER66	2	228.958	229.029
42 36 41.33738	88 12 29.45112	U-13	ALSTER66	2	240.727	240.799
42 36 13.65436	88 12 28.25040	U-14	ALSTER66	2	230.142	230.213
42 35 41.53803	88 12 27.84755	U-15	ALSTER66	2	234.618	234.690
42 35 21.78720	88 12 28.42212	U-16	ALSTER66	2	234.266	234.338
42 35 2.96023	88 12 24.95893	U-17	ALSTER66	2	226.740	226.812
42 34 33.15336	88 12 14.46386	U-18	ALSTER66	2	229.557	229.629
42 34 16.43961	88 12 19.62922	TP9-74	ALSTER66	2	231.490	231.563
42 34 4.68475	88 12 25.98611	V-1	ALSTER66	2	233.247	233.320
42 33 18.25979	88 12 26.66814	V-2	ALSTER66	2	230.162	230.234
42 32 48.63365	88 12 27.52956	V-3	ALSTER66	2	231.372	231.444
42 32 12.07353	88 12 27.25638	V-4	ALSTER66	2	259.200	259.273
42 32 9.18876	88 13 3.40904	V-5	ALSTER66	2	259.612	259.685
42 31 52.33724	88 12 59.88877	V-6	ALSTER66	2	257.089	257.161
42 31 25.68426	88 13 1.32727	V-7	ALSTER66	2	259.149	259.222
42 31 1.47901	88 13 1.35922	V-8	ALSTER66	2	256.580	256.653
42 30 34.80494	88 13 1.46251	U-32	ALSTER66	2	259.815	259.888
42 30 34.35448	88 13 35.52590	U-33	ALSTER66	2	262.667	262.740
42 30 34.00558	88 14 16.26266	U-34	ALSTER66	2	271.512	271.585
42 30 27.32221	88 14 43.82638	U-35	ALSTER66	2	273.880	273.952
42 30 26.15688	88 15 10.56452	U-36	ALSTER66	2	269.727	269.800
42 29 43.46554	88 15 41.81057	U-37	ALSTER66	2	257.737	257.810
42 40 52.56238	88 16 29.18451	FX-043	ALSTER66	2	232.093	232.164
42 40 56.63517	88 16 37.10455	FX-042	ALSTER66	2	233.264	233.334
42 40 54.59879	88 16 33.14449	FX-041	ALSTER66	2	233.263	233.334
42 41 8.72405	88 17 24.97397	FX-039	ALSTER66	2	235.009	235.080
42 41 12.71481	88 17 27.54132	FX-038	ALSTER66	2	233.639	233.710
42 41 36.73978	88 17 48.30221	FX-037	ALSTER66	2	234.692	234.763
42 41 52.06726	88 17 49.21709	FX-036	ALSTER66	2	234.164	234.235

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 41 52.08642	88 18 23.37046	FX-035	ALSTER66	2	239.682	239.753
42 41 51.62887	88 18 58.87616	FX-034	ALSTER66	2	240.464	240.534
42 41 52.64959	88 19 34.34141	FX-033	ALSTER66	2	246.731	246.801
42 42 18.34639	88 19 34.98150	FX-032	ALSTER66	2	252.712	252.782
42 42 51.39702	88 18 58.57927	FX-031	ALSTER66	2	237.982	238.052
42 43 9.78117	88 18 32.61893	FX-027	ALSTER66	2	236.047	236.117
42 43 35.93181	88 18 30.55961	FX-026	ALSTER66	2	236.563	236.633
42 44 2.15256	88 18 33.18841	FX-025	ALSTER66	2	246.582	246.652
42 44 28.33326	88 18 33.13831	FX-023	ALSTER66	2	237.547	237.616
42 44 54.54399	88 18 35.09808	FX-022	ALSTER66	2	238.475	238.545
42 45 20.18084	88 18 31.71159	FX-021	ALSTER66	2	243.313	243.382
42 45 45.70736	88 18 20.95306	FX-020	ALSTER66	2	248.488	248.558
42 46 19.62796	88 18 9.96012	FX-019	ALSTER66	2	241.263	241.333
42 46 39.17668	88 18 28.86599	FX-018	ALSTER66	2	243.147	243.216
42 46 39.67633	88 19 2.37989	FX-017	ALSTER66	2	247.930	248.000
42 47 3.88189	88 19 2.38733	FX-016	ALSTER66	2	249.319	249.388
42 47 30.54643	88 19 1.65668	FX-015	ALSTER66	2	247.005	247.075
42 47 43.67350	88 19 20.74856	FX-04	ALSTER66	2	244.157	244.226
42 47 55.23904	88 19 34.51896	FX-014	ALSTER66	2	245.703	245.772
42 47 56.59234	88 20 12.71674	RX-013	ALSTER66	2	250.157	250.226
42 47 57.76758	88 20 12.01412	FX-013	ALSTER66	2	250.736	250.805
42 48 22.45709	88 20 11.34521	FX-012	ALSTER66	2	249.528	249.597
42 48 51.09691	88 20 10.56909	FX-011	ALSTER66	2	257.102	257.172
42 49 17.02932	88 19 20.21009	FX-010	ALSTER66	2	254.179	254.248
42 49 41.87772	88 18 23.82902	FX-09	ALSTER66	2	258.228	258.298
42 50 12.49248	88 18 22.98417	FX-08	ALSTER66	2	256.315	256.384
42 50 33.54195	88 18 43.21233	FX-07	ALSTER66	2	268.038	268.108
42 50 49.66250	88 19 4.25078	FX-02	ALSTER66	2	249.739	249.808
42 50 36.31334	88 19 36.83772	FX-03	ALSTER66	2	249.730	249.799
42 51 24.29011	88 19 40.90051	FX-N27	ALSTER66	2	245.137	245.207
42 51 24.74428	88 19 38.20246	FX-N28	ALSTER66	2	240.103	240.172
42 51 23.91507	88 19 48.96769	FX-N26	ALSTER66	2	240.936	241.006
42 51 22.01898	88 19 54.39056	FX-N25	ALSTER66	2	241.878	241.948
42 52 5.65014	88 20 5.29151	RX-N24	ALSTER66	2	256.244	256.313
42 52 24.69971	88 20 24.25058	FX-N29	ALSTER66	2	254.616	254.685
42 52 43.95753	88 20 23.72928	FX-N30	ALSTER66	2	260.241	260.311
42 53 10.31503	88 20 35.77862	FX-N31	ALSTER66	2	261.302	261.371
42 53 36.03138	88 20 37.77093	FX-N32	ALSTER66	2	261.035	261.104
42 54 2.79410	88 20 43.76680	FX-N33	ALSTER66	2	266.548	266.617
42 54 29.47839	88 20 44.39044	FX-N34	ALSTER66	2	286.903	286.972
42 54 55.17509	88 20 45.04089	FX-N35	ALSTER66	2	269.794	269.863
42 55 21.85937	88 20 45.66483	FX-N36	ALSTER66	2	272.402	272.471
42 55 48.04984	88 20 46.30225	FX-J24	ALSTER66	2	276.556	276.625
42 56 14.72431	88 20 46.25446	FX-J23	ALSTER66	2	275.719	275.788
42 56 35.62985	88 20 57.12016	FX-J21	ALSTER66	2	262.461	262.531
42 56 46.13622	88 21 6.25049	RX-J17	ALSTER66	2	278.165	278.235
42 57 30.98646	88 21 33.28953	FX-J20	ALSTER66	2	261.784	261.854
42 43 35.81098	88 32 33.39622	FX-T5	ALSTER66	2	268.809	268.877
42 44 31.40835	88 26 42.93658	FX-T15	ALSTER66	2	316.792	316.861
42 36 13.86528	88 26 34.76694	FX-T15	ALSTER66	2	279.582	279.654
42 42 20.88030	88 13 11.13083	TP5-43	ALSTER66	2	241.999	242.070
42 45 48.96811	88 12 46.99974	FX-M25	ALSTER66	2	236.536	236.607
42 46 41.23233	88 11 07.57493	FX-M21	ALSTER66	2	247.724	247.794
42 49 45.42831	88 09 31.52460	RX-M14	ALSTER66	2	243.498	243.568
42 51 24.78976	88 25 25.99104	FX-N13	ALSTER66	2	248.791	248.859

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 52 41.44521	88 14 52.67130	FX-R14	ALSTER66	2	239.279	239.348
42 54 19.89740	88 08 18.76944	UE	ALSTER66	2	245.950	246.020
42 39 18.55394	88 09 32.87904	TP10-72	ALSTER66	2	245.080	245.152
42 34 16.43961	88 12 19.62922	TP9-74	ALSTER66	2	231.490	231.563
42 45 50.18467	88 33 13.11224	TP6-58	ALSTER66	2	281.539	281.606
42 46 41.30598	88 26 41.66023	TP6-72	ALSTER66	2	265.894	265.962

Data Set: Second-Order Benchmarks - Fox River Watershed
Published Elevations on NGVD 29 and Adjusted Elevations on NAVD 88

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 39 12.62073	88 20 42.93638	M-48	ALSTER66	2	238.045	238.116
42 39 18.92404	88 20 1.27556	M-47	ALSTER66	2	237.265	237.337
42 39 25.39186	88 19 30.98480	M-46	ALSTER66	2	236.291	236.362
42 39 24.73924	88 19 20.29480	M-45	ALSTER66	2	235.054	235.125
42 39 28.78499	88 18 53.41457	M-44	ALSTER66	2	237.160	237.231
42 39 32.82897	88 18 26.53336	M-43	ALSTER66	2	245.136	245.207
42 40 5.00352	88 16 53.99928	RM-1	USC&GS?	2	238.918	238.990
42 40 25.51672	88 16 37.30659	M-41	ALSTER66	2	239.255	239.326
42 40 45.97961	88 16 18.65729	M-40	ALSTER66	2	232.145	232.216
42 40 18.21525	88 16 12.07366	U-1	ALSTER66	2	232.890	232.961
42 40 6.08750	88 15 54.34167	U-2	ALSTER66	2	232.306	232.361
42 40 6.64254	88 15 26.21238	U-3	ALSTER66	2	235.315	235.385
42 40 3.63858	88 15 23.62001	RX-U3	ALSTER66	2	236.445	236.515
42 39 42.55857	88 15 2.13031	U-4	ALSTER66	2	231.825	231.894
42 39 16.12901	88 14 46.15103	U-5	ALSTER66	2	237.529	237.598
42 38 54.57410	88 14 26.02134	U-6	ALSTER66	2	236.879	236.948
42 38 25.02367	88 14 .10316	U-7	ALSTER66	2	228.659	228.728
42 38 24.65680	88 13 36.69626	U-8	ALSTER66	2	232.308	232.377
42 37 57.98249	88 13 36.79551	U-9	ALSTER66	2	231.276	231.344
42 37 35.28987	88 13 38.78683	U-10	ALSTER66	2	228.015	228.084
42 37 13.31157	88 13 23.36697	U-11	ALSTER66	2	229.143	229.211
42 36 40.80667	88 13 29.65482	U-12	ALSTER66	2	228.958	229.026
42 36 41.33738	88 12 29.45112	U-13	ALSTER66	2	240.727	240.796
42 36 13.65436	88 12 28.25040	U-14	ALSTER66	2	230.142	230.210
42 35 41.53803	88 12 27.84755	U-15	ALSTER66	2	234.618	234.686
42 35 21.78720	88 12 28.42212	U-16	ALSTER66	2	234.266	234.274
42 35 2.96023	88 12 24.95893	U-17	ALSTER66	2	226.740	226.809
42 34 33.15336	88 12 14.46386	U-18	ALSTER66	2	229.557	229.626
42 34 16.43961	88 12 19.62922	TP9-74	ALSTER66	2	231.490	231.560
42 34 4.68475	88 12 25.98611	V-1	ALSTER66	2	233.247	233.317
42 33 18.25979	88 12 26.66814	V-2	ALSTER66	2	230.162	230.229
42 32 48.63365	88 12 27.52956	V-3	ALSTER66	2	231.372	231.437
42 32 12.07353	88 12 27.25638	V-4	ALSTER66	2	259.200	259.264
42 32 9.18876	88 13 3.40904	V-5	ALSTER66	2	259.612	259.674
42 31 52.33724	88 12 59.88877	V-6	ALSTER66	2	257.089	257.151
42 31 25.68426	88 13 1.32727	V-7	ALSTER66	2	259.149	259.209
42 31 1.47901	88 13 1.35922	V-8	ALSTER66	2	256.580	256.639
42 30 34.80494	88 13 1.46251	U-32	ALSTER66	2	259.815	259.873
42 30 34.35448	88 13 35.52590	U-33	ALSTER66	2	262.667	262.735
42 30 34.00558	88 14 16.26266	U-34	ALSTER66	2	271.512	271.581
42 30 27.32221	88 14 43.82638	U-35	ALSTER66	2	273.880	273.949
42 30 26.15688	88 15 10.56452	U-36	ALSTER66	2	269.727	269.796
42 29 43.46554	88 15 41.81057	U-37	ALSTER66	2	257.737	257.807
42 40 52.56238	88 16 29.18451	FX-043	ALSTER66	2	232.093	232.164
42 40 56.63517	88 16 37.10455	FX-042	ALSTER66	2	233.264	233.335
42 40 54.59879	88 16 33.14449	FX-041	ALSTER66	2	233.263	233.334
42 41 8.72405	88 17 24.97397	FX-039	ALSTER66	2	235.009	235.081
42 41 12.71481	88 17 27.54132	FX-038	ALSTER66	2	233.639	233.712
42 41 36.73978	88 17 48.30221	FX-037	ALSTER66	2	234.692	234.765
42 41 52.06726	88 17 49.21709	FX-036	ALSTER66	2	234.164	234.237

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 41 52.08642	88 18 23.37046	FX-035	ALSTER66	2	239.682	239.756
42 41 51.62887	88 18 58.87616	FX-034	ALSTER66	2	240.464	240.538
42 41 52.64959	88 19 34.34141	FX-033	ALSTER66	2	246.731	246.806
42 42 18.34639	88 19 34.98150	FX-032	ALSTER66	2	252.712	252.788
42 42 51.39702	88 18 58.57927	FX-031	ALSTER66	2	237.982	238.059
42 43 9.78117	88 18 32.61893	FX-027	ALSTER66	2	236.047	236.124
42 43 35.93181	88 18 30.55961	FX-026	ALSTER66	2	236.563	236.640
42 44 2.15256	88 18 33.18841	FX-025	ALSTER66	2	246.582	246.659
42 44 28.33326	88 18 33.13831	FX-023	ALSTER66	2	237.547	237.623
42 44 54.54399	88 18 35.09808	FX-022	ALSTER66	2	238.475	238.552
42 45 20.18084	88 18 31.71159	FX-021	ALSTER66	2	243.313	243.389
42 45 45.70736	88 18 20.95306	FX-020	ALSTER66	2	248.488	248.564
42 46 19.62796	88 18 9.96012	FX-019	ALSTER66	2	241.263	241.340
42 46 39.17668	88 18 28.86599	FX-018	ALSTER66	2	243.147	243.223
42 46 39.67633	88 19 2.37989	FX-017	ALSTER66	2	247.930	248.007
42 47 3.88189	88 19 2.38733	FX-016	ALSTER66	2	249.319	249.395
42 47 30.54643	88 19 1.65668	FX-015	ALSTER66	2	247.005	247.082
42 47 43.67350	88 19 20.74856	FX-04	ALSTER66	2	244.157	244.233
42 47 55.23904	88 19 34.51896	FX-014	ALSTER66	2	245.703	245.779
42 47 56.59234	88 20 12.71674	RX-013	ALSTER66	2	250.157	250.233
42 47 57.76758	88 20 12.01412	FX-013	ALSTER66	2	250.736	250.812
42 48 22.45709	88 20 11.34521	FX-012	ALSTER66	2	249.528	249.603
42 48 51.09691	88 20 10.56909	FX-011	ALSTER66	2	257.102	257.178
42 49 17.02932	88 19 20.21009	FX-010	ALSTER66	2	254.179	254.254
42 49 41.87772	88 18 23.82902	FX-09	ALSTER66	2	258.228	258.302
42 50 12.49248	88 18 22.98417	FX-08	ALSTER66	2	256.315	256.388
42 50 33.54195	88 18 43.21233	FX-07	ALSTER66	2	268.038	268.111
42 50 49.66250	88 19 4.25078	FX-02	ALSTER66	2	249.739	249.811
42 50 36.31334	88 19 36.83772	FX-03	ALSTER66	2	249.730	249.827
42 51 24.29011	88 19 40.90051	FX-N27	ALSTER66	2	245.137	245.220
42 51 24.74428	88 19 38.20246	FX-N28	ALSTER66	2	240.103	240.186
42 51 23.91507	88 19 48.96769	FX-N26	ALSTER66	2	240.936	241.019
42 51 22.01898	88 19 54.39056	FX-N25	ALSTER66	2	241.878	241.961
42 52 5.65014	88 20 5.29151	RX-N24	ALSTER66	2	256.244	256.314
42 52 24.69971	88 20 24.25058	FX-N29	ALSTER66	2	254.616	254.687
42 52 43.95753	88 20 23.72928	FX-N30	ALSTER66	2	260.241	260.313
42 53 10.31503	88 20 35.77862	FX-N31	ALSTER66	2	261.302	261.386
42 53 36.03138	88 20 37.77093	FX-N32	ALSTER66	2	261.035	261.109
42 54 2.79410	88 20 43.76680	FX-N33	ALSTER66	2	266.548	266.622
42 54 29.47839	88 20 44.39044	FX-N34	ALSTER66	2	286.903	286.979
42 54 55.17509	88 20 45.04089	FX-N35	ALSTER66	2	269.794	269.871
42 55 21.85937	88 20 45.66483	FX-N36	ALSTER66	2	272.402	272.480
42 55 48.04984	88 20 46.30225	FX-J24	ALSTER66	2	276.556	276.634
42 56 14.72431	88 20 46.25446	FX-J23	ALSTER66	2	275.719	275.796
42 56 35.62985	88 20 57.12016	FX-J21	ALSTER66	2	262.461	262.538
42 56 46.13622	88 21 6.25049	RX-J17	ALSTER66	2	278.165	278.240
42 57 30.98646	88 21 33.28953	FX-J20	ALSTER66	2	261.784	261.857
42 43 35.81098	88 32 33.39622	FX-T5	ALSTER66	2	268.809	268.872
42 44 31.40835	88 26 42.93658	FX-T15	ALSTER66	2	316.792	316.859
42 36 13.86528	88 26 34.76694	FX-Z15	ALSTER66	2	279.582	279.654
42 42 20.88030	88 13 11.13083	TP5-43	ALSTER66	2	241.999	242.071
42 45 48.96811	88 12 46.99974	FX-M25	ALSTER66	2	236.536	236.602
42 46 41.23233	88 11 07.57493	FX-M21	ALSTER66	2	247.724	247.796
42 49 45.42831	88 09 31.52460	RX-M14	ALSTER66	2	243.498	243.565
42 51 24.78976	88 25 25.99104	FX-N13	ALSTER66	2	248.791	248.860

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
42 52 41.44521	88 14 52.67130	FX-R14	ALSTER66	2	239.279	239.334
42 54 19.89740	88 08 18.76944	UE	ALSTER66	2	245.950	246.002
42 39 18.55394	88 09 32.87904	TP10-72	ALSTER66	2	245.080	245.153
42 34 16.43961	88 12 19.62922	TP9-74	ALSTER66	2	231.490	231.560
42 45 50.18467	88 33 13.11224	TP6-58	ALSTER66	2	281.539	281.600
42 46 41.30598	88 26 41.66023	TP6-72	ALSTER66	2	265.894	265.968

VERTCON Version 2.0 Results (Meters) for Fox River Watershed Benchmarks

Note: Input file for VERTCON is in Free Format #2 and is the same (without headers) as the input file for COMPARE program. The VERTCON program adds the "meters" column of numbers. This VERTCON output file is also required by the COMPARE program.

Latitude	Longitude	Meters	Name	Agency	Order
42 39 12.62073	88 20 42.93638	-.072	M-48	ALSTER66	2
42 39 18.92404	88 20 1.27556	-.072	M-47	ALSTER66	2
42 39 25.39186	88 19 30.98480	-.073	M-46	ALSTER66	2
42 39 24.73924	88 19 20.29480	-.073	M-45	ALSTER66	2
42 39 28.78499	88 18 53.41457	-.073	M-44	ALSTER66	2
42 39 32.82897	88 18 26.53336	-.073	M-43	ALSTER66	2
42 40 5.00352	88 16 53.99928	-.075	RM-1	USC&GS?	2
42 40 25.51672	88 16 37.30659	-.075	M-41	ALSTER66	2
42 40 45.97961	88 16 18.65729	-.075	M-40	ALSTER66	2
42 40 18.21525	88 16 12.07366	-.075	U-1	ALSTER66	2
42 40 6.08750	88 15 54.34167	-.075	U-2	ALSTER66	2
42 40 6.64254	88 15 26.21238	-.076	U-3	ALSTER66	2
42 40 3.63858	88 15 23.62001	-.076	RX-U3	ALSTER66	2
42 39 42.55857	88 15 2.13031	-.076	U-4	ALSTER66	2
42 39 16.12901	88 14 46.15103	-.076	U-5	ALSTER66	2
42 38 54.57410	88 14 26.02134	-.076	U-6	ALSTER66	2
42 38 25.02367	88 14 .10316	-.076	U-7	ALSTER66	2
42 38 24.65680	88 13 36.69626	-.076	U-8	ALSTER66	2
42 37 57.98249	88 13 36.79551	-.076	U-9	ALSTER66	2
42 37 35.28987	88 13 38.78683	-.075	U-10	ALSTER66	2
42 37 13.31157	88 13 23.36697	-.076	U-11	ALSTER66	2
42 36 40.80667	88 13 29.65482	-.075	U-12	ALSTER66	2
42 36 41.33738	88 12 29.45112	-.076	U-13	ALSTER66	2
42 36 13.65436	88 12 28.25040	-.077	U-14	ALSTER66	2
42 35 41.53803	88 12 27.84755	-.076	U-15	ALSTER66	2
42 35 21.78720	88 12 28.42212	-.076	U-16	ALSTER66	2
42 35 2.96023	88 12 24.95893	-.076	U-17	ALSTER66	2
42 34 33.15336	88 12 14.46386	-.076	U-18	ALSTER66	2
42 34 16.43961	88 12 19.62922	-.076	TP9-74	ALSTER66	2
42 34 4.68475	88 12 25.98611	-.076	V-1	ALSTER66	2
42 33 18.25979	88 12 26.66814	-.075	V-2	ALSTER66	2
42 32 48.63365	88 12 27.52956	-.075	V-3	ALSTER66	2
42 32 12.07353	88 12 27.25638	-.074	V-4	ALSTER66	2
42 32 9.18876	88 13 3.40904	-.073	V-5	ALSTER66	2
42 31 52.33724	88 12 59.88877	-.073	V-6	ALSTER66	2
42 31 25.68426	88 13 1.32727	-.073	V-7	ALSTER66	2
42 31 1.47901	88 13 1.35922	-.072	V-8	ALSTER66	2
42 30 34.80494	88 13 1.46251	-.071	U-32	ALSTER66	2
42 30 34.35448	88 13 35.52590	-.071	U-33	ALSTER66	2
42 30 34.00558	88 14 16.26266	-.070	U-34	ALSTER66	2
42 30 27.32221	88 14 43.82638	-.070	U-35	ALSTER66	2
42 30 26.15688	88 15 10.56452	-.069	U-36	ALSTER66	2
42 29 43.46554	88 15 41.81057	-.070	U-37	ALSTER66	2
42 40 52.56238	88 16 29.18451	-.075	FX-043	ALSTER66	2
42 40 56.63517	88 16 37.10455	-.075	FX-042	ALSTER66	2
42 40 54.59879	88 16 33.14449	-.075	FX-041	ALSTER66	2
42 41 8.72405	88 17 24.97397	-.075	FX-039	ALSTER66	2
42 41 12.71481	88 17 27.54132	-.075	FX-038	ALSTER66	2
42 41 36.73978	88 17 48.30221	-.075	FX-037	ALSTER66	2
42 41 52.06726	88 17 49.21709	-.075	FX-036	ALSTER66	2

Latitude	Longitude	Meters	Name	Agency	Order
42 41 52.08642	88 18 23.37046	-.075	FX-035	ALSTER66	2
42 41 51.62887	88 18 58.87616	-.074	FX-034	ALSTER66	2
42 41 52.64959	88 19 34.34141	-.073	FX-033	ALSTER66	2
42 42 18.34639	88 19 34.98150	-.073	FX-032	ALSTER66	2
42 42 51.39702	88 18 58.57927	-.073	FX-031	ALSTER66	2
42 43 9.78117	88 18 32.61893	-.074	FX-027	ASLTER66	2
42 43 35.93181	88 18 30.55961	-.074	FX-026	ALSTER66	2
42 44 2.15256	88 18 33.18841	-.073	FX-025	ALSTER66	2
42 44 28.33326	88 18 33.13831	-.073	FX-023	ALSTER66	2
42 44 54.54399	88 18 35.09808	-.073	FX-022	ALSTER66	2
42 45 20.18084	88 18 31.71159	-.073	FX-021	ALSTER66	2
42 45 45.70736	88 18 20.95306	-.073	FX-020	ALSTER66	2
42 46 19.62796	88 18 9.96012	-.073	FX-019	ALSTER66	2
42 46 39.17668	88 18 28.86599	-.073	FX-018	ALSTER66	2
42 46 39.67633	88 19 2.37989	-.073	FX-017	ALSTER66	2
42 47 3.88189	88 19 2.38733	-.073	FX-016	ALSTER66	2
42 47 30.54643	88 19 1.65668	-.073	FX-015	ALSTER66	2
42 47 43.67350	88 19 20.74856	-.073	FX-04	ALSTER66	2
42 47 55.23904	88 19 34.51896	-.073	FX-014	ALSTER66	2
42 47 56.59234	88 20 12.71674	-.072	RX-013	ALSTER66	2
42 47 57.76758	88 20 12.01412	-.072	FX-013	ALSTER66	2
42 48 22.45709	88 20 11.34521	-.073	FX-012	ALSTER66	2
42 48 51.09691	88 20 10.56909	-.073	FX-011	ALSTER66	2
42 49 17.02932	88 19 20.21009	-.073	FX-010	ALSTER66	2
42 49 41.87772	88 18 23.82902	-.073	FX-09	ALSTER66	2
42 50 12.49248	88 18 22.98417	-.073	FX-08	ALSTER66	2
42 50 33.54195	88 18 43.21233	-.073	FX-07	ALSTER66	2
42 50 49.66250	88 19 4.25078	-.073	FX-02	ALSTER66	2
42 50 36.31334	88 19 36.83772	-.073	FX-03	ALSTER66	2
42 51 24.29011	88 19 40.90051	-.073	FX-N27	ALSTER66	2
42 51 24.74428	88 19 38.20246	-.073	FX-N28	ALSTER66	2
42 51 23.91507	88 19 48.96769	-.073	FX-N26	ALSTER66	2
42 51 22.01898	88 19 54.39056	-.073	FX-N25	ALSTER66	2
42 52 5.65014	88 20 5.29151	-.072	RX-N24	ALSTER66	2
42 52 24.69971	88 20 24.25058	-.072	FX-N29	ALSTER66	2
42 52 43.95753	88 20 23.72928	-.072	FX-N30	ALSTER66	2
42 53 10.31503	88 20 35.77862	-.072	FX-N31	ALSTER66	2
42 53 36.03138	88 20 37.77093	-.071	FX-N32	ALSTER66	2
42 54 2.79410	88 20 43.76680	-.071	FX-N33	ALSTER66	2
42 54 29.47839	88 20 44.39044	-.071	FX-N34	ALSTER66	2
42 54 55.17509	88 20 45.04089	-.072	FX-N35	ALSTER66	2
42 55 21.85937	88 20 45.66483	-.072	FX-N36	ALSTER66	2
42 55 48.04984	88 20 46.30225	-.073	FX-J24	ALSTER66	2
42 56 14.72431	88 20 46.25446	-.073	FX-J23	ALSTER66	2
42 56 35.62985	88 20 57.12016	-.073	FX-J21	ALSTER66	2
42 56 46.13622	88 21 6.25049	-.073	RX-J17	ALSTER66	2
42 57 30.98646	88 21 33.28953	-.071	FX-J20	ALSTER66	2
42 43 35.81098	88 32 33.39622	-.063	FX-T5	ALSTER66	2
42 44 31.40835	88 26 42.93658	-.063	FX-T15	ALSTER66	2
42 36 13.86528	88 26 34.76694	-.066	FX-Z15	ALSTER66	2
42 42 20.88030	88 13 11.13083	-.076	TP5-43	ALSTER66	2
42 45 48.96811	88 12 46.99974	-.076	FX-M25	ALSTER66	2
42 46 41.23233	88 11 07.57493	-.076	FX-M21	ALSTER66	2
42 49 45.42831	88 09 31.52460	-.078	RX-M14	ALSTER66	2
42 51 24.78976	88 25 25.99104	-.070	FX-N13	ALSTER66	2

Latitude	Longitude	Meters	Name	Agency	Order
42 52 41.44521	88 14 52.67130	-.073	FX-R14	ALSTER66	2
42 54 19.89740	88 08 18.76944	-.078	UE	ALSTER66	2
42 39 18.55394	88 09 32.87904	-.075	TP10-72	ALSTER66	2
42 34 16.43961	88 12 19.62922	-.076	TP9-74	ALSTER66	2
42 45 50.18467	88 33 13.11224	-.065	TP6-58	ALSTER66	2
42 46 41.30598	88 26 41.66023	-.067	TP6-72	ALSTER66	2

Difference of Differences for Fox River Watershed - Option 1

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 12/94

PROGRAM: COMPARE - VERSION 1.05
MASTER DATA FILE: FOXRIV31.DAT
VERTCON INPUT FILE: VCONFR1.OUT
PROGRAM RESULTS FILE: FOXRIV31.ASC

COMPARISON OF PUBLISHED ELEVATION DATUM DIFFERENCES WITH DIFFERENCES OBTAINED FROM VERTCON

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 14, 1995

PROJECT: DIFFERENCES FOR FOX RIVER WATERSHED - USING 9.355 AT U32/33

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
M-48	ALSTER66	2					
42 39 12.6	2445150.	238.045	780.986				
88 20 42.9	242600.	238.116	781.219	-.233	-.236	.003	
M-47	ALSTER66	2					
42 39 18.9	2448250.	237.265	778.427				
88 20 1.3	243300.	237.337	778.663	-.236	-.236	.000	
M-46	ALSTER66	2					
42 39 25.4	2450500.	236.291	775.231				
88 19 31.0	244000.	236.362	775.464	-.233	-.240	.007	
M-45	ALSTER66	2					
42 39 24.7	2451300.	235.054	771.173				
88 19 20.3	243950.	235.126	771.409	-.236	-.240	.003	
M-44	ALSTER66	2					
42 39 28.8	2453300.	237.160	778.082				
88 18 53.4	244400.	237.232	778.319	-.236	-.240	.003	
M-43	ALSTER66	2					
42 39 32.8	2455300.	245.136	804.250				
88 18 26.5	244850.	245.207	804.483	-.233	-.240	.007	
RM-1	USC&GS?	2					
42 40 5.0	2462150.	238.918	783.850				
88 16 54.0	248250.	238.989	784.083	-.233	-.246	.013	
M-41	ALSTER66	2					
42 40 25.5	2463350.	239.255	784.956				
88 16 37.3	250350.	239.326	785.189	-.233	-.246	.013	
M-40	ALSTER66	2					
42 40 46.0	2464700.	232.145	761.629				
88 16 18.7	252450.	232.216	761.862	-.233	-.246	.013	
U-1	ALSTER66	2					
42 40 18.2	2465250.	232.890	764.073				
88 16 12.1	249650.	232.962	764.309	-.236	-.246	.010	
U-2	ALSTER66	2					
42 40 6.1	2466600.	232.306	762.157				
88 15 54.3	248450.	232.378	762.393	-.236	-.246	.010	

NAME	AGENCY		ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
U-3	ALSTER66	2						
42 40 6.6	2468700.	235.315	772.029					
88 15 26.2	248550.	235.387	772.266	-.236	-.249	.013		
RX-U3	ALSTER66	2						
42 40 3.6	2468900.	236.445	775.737					
88 15 23.6	248250.	236.517	775.973	-.236	-.249	.013		
U-4	ALSTER66	2						
42 39 42.6	2470550.	231.825	760.579					
88 15 2.1	246150.	231.897	760.815	-.236	-.249	.013		
U-5	ALSTER66	2						
42 39 16.1	2471800.	237.529	779.293					
88 14 46.2	243500.	237.600	779.526	-.233	-.249	.016		
U-6	ALSTER66	2						
42 38 54.6	2473350.	236.879	777.161					
88 14 26.0	241350.	236.951	777.397	-.236	-.249	.013		
U-7	ALSTER66	2						
42 38 25.0	2475350.	228.659	750.192					
88 14 .1	238400.	228.730	750.425	-.233	-.249	.016		
U-8	ALSTER66	2						
42 38 24.7	2477100.	232.308	762.164					
88 13 36.7	238400.	232.380	762.400	-.236	-.249	.013		
U-9	ALSTER66	2						
42 37 58.0	2477150.	231.276	758.778					
88 13 36.8	235700.	231.347	759.011	-.233	-.249	.016		
U-10	ALSTER66	2						
42 37 35.3	2477050.	228.015	748.079					
88 13 38.8	233400.	228.086	748.312	-.233	-.246	.013		
U-11	ALSTER66	2						
42 37 13.3	2478250.	229.143	751.780					
88 13 23.4	231200.	229.214	752.013	-.233	-.249	.016		
U-12	ALSTER66	2						
42 36 40.8	2477850.	228.958	751.173					
88 13 29.7	227900.	229.029	751.406	-.233	-.246	.013		
U-13	ALSTER66	2						
42 36 41.3	2482350.	240.727	789.785					
88 12 29.5	228050.	240.799	790.021	-.236	-.249	.013		
U-14	ALSTER66	2						
42 36 13.7	2482500.	230.142	755.058					
88 12 28.3	225250.	230.213	755.290	-.233	-.253	.020		
U-15	ALSTER66	2						
42 35 41.5	2482600.	234.618	769.743					
88 12 27.8	222000.	234.690	769.979	-.236	-.249	.013		
U-16	ALSTER66	2						
42 35 21.8	2482600.	234.266	768.588					
88 12 28.4	220000.	234.338	768.824	-.236	-.249	.013		
U-17	ALSTER66	2						
42 35 3.0	2482900.	226.740	743.896					
88 12 25.0	218100.	226.812	744.132	-.236	-.249	.013		

NAME	AGENCY		ORDER		PID			
LATITUDE LONGITUDE	NAD27X NAD27Y	NAV88 NGVD29	US SURV. FEET		PUB DIFF	DIFF BY VERTCON	FIT (feet)	
U-18	ALSTER66	2						
42 34 33.2	2483750.	229.557	753.138					
88 12 14.5	215100.	229.629	753.374	-.236	-.249	.013		
TP9-74	ALSTER66	2						
42 34 16.4	2483400.	231.490	759.480					
88 12 19.6	213400.	231.563	759.720	-.240	-.249	.010		
V-1	ALSTER66	2						
42 34 4.7	2482950.	233.247	765.245					
88 12 26.0	212200.	233.320	765.484	-.240	-.249	.010		
V-2	ALSTER66	2						
42 33 18.3	2483000.	230.162	755.123					
88 12 26.7	207500.	230.234	755.359	-.236	-.246	.010		
V-3	ALSTER66	2						
42 32 48.6	2483000.	231.372	759.093					
88 12 27.5	204500.	231.444	759.329	-.236	-.246	.010		
V-4	ALSTER66	2						
42 32 12.1	2483100.	259.200	850.392					
88 12 27.3	200800.	259.273	850.632	-.240	-.243	.003		
V-5	ALSTER66	2						
42 32 9.2	2480400.	259.612	851.744					
88 13 3.4	200450.	259.685	851.983	-.240	-.240	.000		
V-6	ALSTER66	2						
42 31 52.3	2480700.	257.089	843.466					
88 12 59.9	198750.	257.161	843.702	-.236	-.240	.003		
V-7	ALSTER66	2						
42 31 25.7	2480650.	259.149	850.225					
88 13 1.3	196050.	259.222	850.464	-.240	-.240	.000		
V-8	ALSTER66	2						
42 31 1.5	2480700.	256.580	841.796					
88 13 1.4	193600.	256.653	842.036	-.240	-.236	-.003		
U-32	ALSTER66	2						
42 30 34.8	2480750.	259.815	852.410					
88 13 1.5	190900.	259.888	852.649	-.240	-.233	-.007		
U-33	ALSTER66	2						
42 30 34.4	2478200.	262.667	861.767					
88 13 35.5	190800.	262.740	862.006	-.240	-.233	-.007		
U-34	ALSTER66	2						
42 30 34.0	2475150.	271.512	890.786					
88 14 16.3	190700.	271.585	891.025	-.240	-.230	-.010		
U-35	ALSTER66	2						
42 30 27.3	2473100.	273.880	898.555					
88 14 43.8	189980.	273.952	898.791	-.236	-.230	-.007		
U-36	ALSTER66	2						
42 30 26.2	2471100.	269.727	884.929					
88 15 10.6	189820.	269.800	885.169	-.240	-.226	-.013		
U-37	ALSTER66	2						
42 29 43.5	2468850.	257.737	845.592					
88 15 41.8	185450.	257.810	845.832	-.240	-.230	-.010		

NAME	LATITUDE LONGITUDE	AGENCY NAD27X NAD27Y	ORDER NAVD88 NGVD29	US SURV. FEET	PID PUB DIFF	DIFF BY VERTCON	FIT (feet)
FX-043	42 40 52.6 88 16 29.2	ALSTER66 2463900. 253100.	2 232.093 232.164	761.458 761.691			
					-.233	-.246	.013
FX-042	42 40 56.6 88 16 37.1	ALSTER66 2463300. 253500.	2 233.264 233.334	765.300 765.530			
					-.230	-.246	.016
FX-041	42 40 54.6 88 16 33.1	ALSTER66 2463600. 253300.	2 233.263 233.334	765.297 765.530			
					-.233	-.246	.013
FX-039	42 41 8.7 88 17 25.0	ALSTER66 2459700. 254650.	2 235.009 235.080	771.025 771.258			
					-.233	-.246	.013
FX-038	42 41 12.7 88 17 27.5	ALSTER66 2459500. 255050.	2 233.639 233.710	766.531 766.764			
					-.233	-.246	.013
FX-037	42 41 36.7 88 17 48.3	ALSTER66 2457900. 257450.	2 234.692 234.763	769.985 770.218			
					-.233	-.246	.013
FX-036	42 41 52.1 88 17 49.2	ALSTER66 2457800. 259000.	2 234.164 234.235	768.253 768.486			
					-.233	-.246	.013
FX-035	42 41 52.1 88 18 23.4	ALSTER66 2455250. 258950.	2 239.682 239.753	786.357 786.590			
					-.233	-.246	.013
FX-034	42 41 51.6 88 18 58.9	ALSTER66 2452600. 258850.	2 240.464 240.534	788.922 789.152			
					-.230	-.243	.013
FX-033	42 41 52.6 88 19 34.3	ALSTER66 2449950. 258900.	2 246.731 246.801	809.483 809.713			
					-.230	-.240	.010
FX-032	42 42 18.3 88 19 35.0	ALSTER66 2449850. 261500.	2 252.712 252.782	829.106 829.336			
					-.230	-.240	.010
FX-031	42 42 51.4 88 18 58.6	ALSTER66 2452500. 264900.	2 237.982 238.052	780.779 781.009			
					-.230	-.240	.010
FX-027	42 43 9.8 88 18 32.6	ALSTER66 2454400. 266800.	2 236.047 236.117	774.431 774.661			
					-.230	-.243	.013
FX-026	42 43 35.9 88 18 30.6	ALSTER66 2454500. 269450.	2 236.563 236.633	776.124 776.353			
					-.230	-.243	.013
FX-025	42 44 2.2 88 18 33.2	ALSTER66 2454250. 272100.	2 246.582 246.652	808.994 809.224			
					-.230	-.240	.010
FX-023	42 44 28.3 88 18 33.1	ALSTER66 2454200. 274750.	2 237.547 237.616	779.352 779.578			
					-.226	-.240	.013

NAME	AGENCY	ORDER	PID					
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
FX-022	ALSTER66	2						
42 44 54.5	2454000.	238.475	782.397					
88 18 35.1	277400.	238.545	782.626	-.230	-.240	.010		
FX-021	ALSTER66	2						
42 45 20.2	2454200.	243.313	798.269					
88 18 31.7	280000.	243.382	798.496	-.226	-.240	.013		
FX-020	ALSTER66	2						
42 45 45.7	2454950.	248.488	815.248					
88 18 21.0	282600.	248.558	815.477	-.230	-.240	.010		
FX-019	ALSTER66	2						
42 46 19.6	2455700.	241.263	791.544					
88 18 10.0	286050.	241.333	791.773	-.230	-.240	.010		
FX-018	ALSTER66	2						
42 46 39.2	2454250.	243.147	797.725					
88 18 28.9	288000.	243.216	797.951	-.226	-.240	.013		
FX-017	ALSTER66	2						
42 46 39.7	2451750.	247.930	813.417					
88 19 2.4	288000.	248.000	813.647	-.230	-.240	.010		
FX-016	ALSTER66	2						
42 47 3.9	2451700.	249.319	817.974					
88 19 2.4	290450.	249.388	818.200	-.226	-.240	.013		
FX-015	ALSTER66	2						
42 47 30.5	2451700.	247.005	810.382					
88 19 1.7	293150.	247.075	810.612	-.230	-.240	.010		
FX-04	ALSTER66	2						
42 47 43.7	2450250.	244.157	801.038					
88 19 20.7	294450.	244.226	801.265	-.226	-.240	.013		
FX-014	ALSTER66	2						
42 47 55.2	2449200.	245.703	806.111					
88 19 34.5	295600.	245.772	806.337	-.226	-.240	.013		
RX-013	ALSTER66	2						
42 47 56.6	2446350.	250.157	820.723					
88 20 12.7	295680.	250.226	820.950	-.226	-.236	.010		
FX-013	ALSTER66	2						
42 47 57.8	2446400.	250.736	822.623					
88 20 12.0	295800.	250.805	822.849	-.226	-.236	.010		
FX-012	ALSTER66	2						
42 48 22.5	2446400.	249.528	818.660					
88 20 11.3	298300.	249.597	818.886	-.226	-.240	.013		
FX-011	ALSTER66	2						
42 48 51.1	2446400.	257.102	843.509					
88 20 10.6	301200.	257.172	843.738	-.230	-.240	.010		
FX-010	ALSTER66	2						
42 49 17.0	2450100.	254.179	833.919					
88 19 20.2	303900.	254.248	834.145	-.226	-.240	.013		
FX-09	ALSTER66	2						
42 49 41.9	2454250.	258.228	847.203					
88 18 23.8	306500.	258.298	847.433	-.230	-.240	.010		

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
FX-08	ALSTER66	2					
42 50 12.5	2454250.	256.315	840.927				
88 18 23.0	309600.	256.384	841.153	-.226	-.240	.013	
FX-07	ALSTER66	2					
42 50 33.5	2452700.	268.038	879.388				
88 18 43.2	311700.	268.108	879.618	-.230	-.240	.010	
FX-02	ALSTER66	2					
42 50 49.7	2451100.	249.739	819.352				
88 19 4.3	313300.	249.808	819.578	-.226	-.240	.013	
FX-03	ALSTER66	2					
42 50 36.3	2448700.	249.730	819.323				
88 19 36.8	311900.	249.799	819.549	-.226	-.240	.013	
FX-N27	ALSTER66	2					
42 51 24.3	2448300.	245.137	804.254				
88 19 40.9	316750.	245.207	804.483	-.230	-.240	.010	
FX-N28	ALSTER66	2					
42 51 24.7	2448500.	240.103	787.738				
88 19 38.2	316800.	240.172	787.964	-.226	-.240	.013	
FX-N26	ALSTER66	2					
42 51 23.9	2447700.	240.936	790.471				
88 19 49.0	316700.	241.006	790.701	-.230	-.240	.010	
FX-N25	ALSTER66	2					
42 51 22.0	2447300.	241.878	793.561				
88 19 54.4	316500.	241.948	793.791	-.230	-.240	.010	
RX-N24	ALSTER66	2					
42 52 5.7	2446400.	256.244	840.694				
88 20 5.3	320900.	256.313	840.920	-.226	-.236	.010	
FX-N29	ALSTER66	2					
42 52 24.7	2444950.	254.616	835.353				
88 20 24.3	322800.	254.685	835.579	-.226	-.236	.010	
FX-N30	ALSTER66	2					
42 52 44.0	2444950.	260.241	853.807				
88 20 23.7	324750.	260.311	854.037	-.230	-.236	.007	
FX-N31	ALSTER66	2					
42 53 10.3	2444000.	261.302	857.288				
88 20 35.8	327400.	261.371	857.515	-.226	-.236	.010	
FX-N32	ALSTER66	2					
42 53 36.0	2443800.	261.035	856.412				
88 20 37.8	330000.	261.104	856.639	-.226	-.233	.007	
FX-N33	ALSTER66	2					
42 54 2.8	2443300.	266.548	874.500				
88 20 43.8	332700.	266.617	874.726	-.226	-.233	.007	
FX-N34	ALSTER66	2					
42 54 29.5	2443200.	286.903	941.281				
88 20 44.4	335400.	286.972	941.507	-.226	-.233	.007	
FX-N35	ALSTER66	2					
42 54 55.2	2443100.	269.794	885.149				
88 20 45.0	338000.	269.863	885.376	-.226	-.236	.010	

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
FX-N36	ALSTER66	2					
42 55 21.9	2443000.	272.402	893.706				
88 20 45.7	340700.	272.471	893.932	-.226	-.236	.010	
FX-J24	ALSTER66	2					
42 55 48.0	2442900.	276.556	907.334				
88 20 46.3	343350.	276.625	907.561	-.226	-.240	.013	
FX-J23	ALSTER66	2					
42 56 14.7	2442850.	275.719	904.588				
88 20 46.3	346050.	275.788	904.814	-.226	-.240	.013	
FX-J21	ALSTER66	2					
42 56 35.6	2442000.	262.461	861.091				
88 20 57.1	348150.	262.531	861.320	-.230	-.240	.010	
RX-J17	ALSTER66	2					
42 56 46.1	2441300.	278.165	912.613				
88 21 6.3	349200.	278.235	912.843	-.230	-.240	.010	
FX-J20	ALSTER66	2					
42 57 31.0	2439200.	261.784	858.870				
88 21 33.3	353700.	261.854	859.099	-.230	-.233	.003	
FX-T5	ALSTER66	2					
42 43 35.8	2391600.	268.809	881.918				
88 32 33.4	268250.	268.877	882.141	-.223	-.207	-.016	
FX-T15	ALSTER66	2					
42 44 31.4	2417650.	316.792	1039.342				
88 26 42.9	274350.	316.861	1039.568	-.226	-.207	-.020	
FX-Z15	ALSTER66	2					
42 36 13.9	2419200.	279.582	917.262				
88 26 34.8	224000.	279.654	917.498	-.236	-.217	-.020	
TP5-43	ALSTER66	2					
42 42 20.9	2478500.	241.999	793.958				
88 13 11.1	262350.	242.070	794.191	-.233	-.249	.016	
FX-M25	ALSTER66	2					
42 45 49.0	2479850.	236.536	776.035				
88 12 47.0	283450.	236.607	776.268	-.233	-.249	.016	
FX-M21	ALSTER66	2					
42 46 41.2	2487150.	247.724	812.741				
88 11 7.6	288900.	247.794	812.971	-.230	-.249	.020	
RX-M14	ALSTER66	2					
42 49 45.4	2493900.	243.498	798.876				
88 9 31.5	307700.	243.568	799.106	-.230	-.256	.026	
FX-N13	ALSTER66	2					
42 51 24.8	2422600.	248.791	816.242				
88 25 26.0	316300.	248.859	816.465	-.223	-.230	.007	
FX-R14	ALSTER66	2					
42 52 41.4	2469600.	239.279	785.035				
88 14 52.7	325000.	239.348	785.261	-.226	-.240	.013	
UE	ALSTER66	2					
42 54 19.9	2498700.	245.950	806.921				
88 8 18.8	335600.	246.020	807.151	-.230	-.256	.026	

NAME	AGENCY		ORDER		PID			
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
TP10-72	ALSTER66	2						
42 39 18.6	2495200.	245.080	804.067					
88 9 32.9	244250.	245.152	804.303	-.236	-.246	.010		
TP9-74	ALSTER66	2						
42 34 16.4	2483400.	231.490	759.480					
88 12 19.6	213400.	231.563	759.720	-.240	-.249	.010		
TP6-58	ALSTER66	2						
42 45 50.2	2388400.	281.539	923.683					
88 33 13.1	281800.	281.606	923.902	-.220	-.213	-.007		
TP6-72	ALSTER66	2						
42 46 41.3	2417500.	265.894	872.354					
88 26 41.7	287500.	265.962	872.577	-.223	-.220	-.003		

Difference of Differences for Fox River Watershed - Option 2

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 12/94

PROGRAM: COMPARE - VERSION 1.05
MASTER DATA FILE: FOXRIV32.DAT
VERTCON INPUT FILE: VCONFR1.OUT
PROGRAM RESULTS FILE: FOXRIV32.ASC

COMPARISON OF PUBLISHED ELEVATION DATUM DIFFERENCES WITH DIFFERENCES OBTAINED FROM VERTCON

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 14, 1995

PROJECT: DIFFERENCES IN FOX RIVER WATERSHED AREA USING 9.355 AT U32/33

NAME	AGENCY		ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
M-48	ALSTER66	2						
42 39 12.6	2445150.	238.045	780.986					
88 20 42.9	242600.	238.116	781.219	-.233	-.236	.003		
M-47	ALSTER66	2						
42 39 18.9	2448250.	237.265	778.427					
88 20 1.3	243300.	237.337	778.663	-.236	-.236	.000		
M-46	ALSTER66	2						
42 39 25.4	2450500.	236.291	775.231					
88 19 31.0	244000.	236.362	775.464	-.233	-.240	.007		
M-45	ALSTER66	2						
42 39 24.7	2451300.	235.054	771.173					
88 19 20.3	243950.	235.125	771.406	-.233	-.240	.007		
M-44	ALSTER66	2						
42 39 28.8	2453300.	237.160	778.082					
88 18 53.4	244400.	237.231	778.315	-.233	-.240	.007		
M-43	ALSTER66	2						
42 39 32.8	2455300.	245.136	804.250					
88 18 26.5	244850.	245.207	804.483	-.233	-.240	.007		
RM-1	USC&GS?	2						
42 40 5.0	2462150.	238.918	783.850					
88 16 54.0	248250.	238.990	784.086	-.236	-.246	.010		
M-41	ALSTER66	2						
42 40 25.5	2463350.	239.255	784.956					
88 16 37.3	250350.	239.326	785.189	-.233	-.246	.013		
M-40	ALSTER66	2						
42 40 46.0	2464700.	232.145	761.629					
88 16 18.7	252450.	232.216	761.862	-.233	-.246	.013		
U-1	ALSTER66	2						
42 40 18.2	2465250.	232.890	764.073					
88 16 12.1	249650.	232.961	764.306	-.233	-.246	.013		

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
U-2	ALSTER66	2					
42 40 6.1	2466600.	232.306	762.157				
88 15 54.3	248450.	232.361	762.338	-.180	-.246	.066	
U-3	ALSTER66	2					
42 40 6.6	2468700.	235.315	772.029				
88 15 26.2	248550.	235.385	772.259	-.230	-.249	.020	
RX-U3	ALSTER66	2					
42 40 3.6	2468900.	236.445	775.737				
88 15 23.6	248250.	236.515	775.966	-.230	-.249	.020	
U-4	ALSTER66	2					
42 39 42.6	2470550.	231.825	760.579				
88 15 2.1	246150.	231.894	760.806	-.226	-.249	.023	
U-5	ALSTER66	2					
42 39 16.1	2471800.	237.529	779.293				
88 14 46.2	243500.	237.598	779.519	-.226	-.249	.023	
U-6	ALSTER66	2					
42 38 54.6	2473350.	236.879	777.161				
88 14 26.0	241350.	236.948	777.387	-.226	-.249	.023	
U-7	ALSTER66	2					
42 38 25.0	2475350.	228.659	750.192				
88 14 .1	238400.	228.728	750.418	-.226	-.249	.023	
U-8	ALSTER66	2					
42 38 24.7	2477100.	232.308	762.164				
88 13 36.7	238400.	232.377	762.390	-.226	-.249	.023	
U-9	ALSTER66	2					
42 37 58.0	2477150.	231.276	758.778				
88 13 36.8	235700.	231.344	759.001	-.223	-.249	.026	
U-10	ALSTER66	2					
42 37 35.3	2477050.	228.015	748.079				
88 13 38.8	233400.	228.084	748.306	-.226	-.246	.020	
U-11	ALSTER66	2					
42 37 13.3	2478250.	229.143	751.780				
88 13 23.4	231200.	229.211	752.003	-.223	-.249	.026	
U-12	ALSTER66	2					
42 36 40.8	2477850.	228.958	751.173				
88 13 29.7	227900.	229.026	751.396	-.223	-.246	.023	
U-13	ALSTER66	2					
42 36 41.3	2482350.	240.727	789.785				
88 12 29.5	228050.	240.796	790.012	-.226	-.249	.023	
U-14	ALSTER66	2					
42 36 13.7	2482500.	230.142	755.058				
88 12 28.3	225250.	230.210	755.281	-.223	-.253	.030	
U-15	ALSTER66	2					
42 35 41.5	2482600.	234.618	769.743				
88 12 27.8	222000.	234.686	769.966	-.223	-.249	.026	
U-16	ALSTER66	2					
42 35 21.8	2482600.	234.266	768.588				
88 12 28.4	220000.	234.274	768.614	-.026	-.249	.223	

NAME	AGENCY		ORDER	PID		US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29							
U-17		ALSTER66	2						
	42 35 3.0	2482900.	226.740	743.896					
	88 12 25.0	218100.	226.809	744.123	-.226	-.249	.023		
U-18		ALSTER66	2						
	42 34 33.2	2483750.	229.557	753.138					
	88 12 14.5	215100.	229.626	753.365	-.226	-.249	.023		
TP9-74		ALSTER66	2						
	42 34 16.4	2483400.	231.490	759.480					
	88 12 19.6	213400.	231.560	759.710	-.230	-.249	.020		
V-1		ALSTER66	2						
	42 34 4.7	2482950.	233.247	765.245					
	88 12 26.0	212200.	233.317	765.474	-.230	-.249	.020		
V-2		ALSTER66	2						
	42 33 18.3	2483000.	230.162	755.123					
	88 12 26.7	207500.	230.229	755.343	-.220	-.246	.026		
V-3		ALSTER66	2						
	42 32 48.6	2483000.	231.372	759.093					
	88 12 27.5	204500.	231.437	759.306	-.213	-.246	.033		
V-4		ALSTER66	2						
	42 32 12.1	2483100.	259.200	850.392					
	88 12 27.3	200800.	259.264	850.602	-.210	-.243	.033		
V-5		ALSTER66	2						
	42 32 9.2	2480400.	259.612	851.744					
	88 13 3.4	200450.	259.674	851.947	-.203	-.240	.036		
V-6		ALSTER66	2						
	42 31 52.3	2480700.	257.089	843.466					
	88 12 59.9	198750.	257.151	843.670	-.203	-.240	.036		
V-7		ALSTER66	2						
	42 31 25.7	2480650.	259.149	850.225					
	88 13 1.3	196050.	259.209	850.422	-.197	-.240	.043		
V-8		ALSTER66	2						
	42 31 1.5	2480700.	256.580	841.796					
	88 13 1.4	193600.	256.639	841.990	-.194	-.236	.043		
U-32		ALSTER66	2						
	42 30 34.8	2480750.	259.815	852.410					
	88 13 1.5	190900.	259.873	852.600	-.190	-.233	.043		
U-33		ALSTER66	2						
	42 30 34.4	2478200.	262.667	861.767					
	88 13 35.5	190800.	262.735	861.990	-.223	-.233	.010		
U-34		ALSTER66	2						
	42 30 34.0	2475150.	271.512	890.786					
	88 14 16.3	190700.	271.581	891.012	-.226	-.230	.003		
U-35		ALSTER66	2						
	42 30 27.3	2473100.	273.880	898.555					
	88 14 43.8	189980.	273.949	898.781	-.226	-.230	.003		
U-36		ALSTER66	2						
	42 30 26.2	2471100.	269.727	884.929					
	88 15 10.6	189820.	269.796	885.156	-.226	-.226	.000		

NAME	AGENCY		ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)		
U-37	ALSTER66	2						
42 29 43.5	2468850.	257.737	845.592					
88 15 41.8	185450.	257.807	845.822	-.230	-.230	.000		
FX-043	ALSTER66	2						
42 40 52.6	2463900.	232.093	761.458					
88 16 29.2	253100.	232.164	761.691	-.233	-.246	.013		
FX-042	ALSTER66	2						
42 40 56.6	2463300.	233.264	765.300					
88 16 37.1	253500.	233.335	765.533	-.233	-.246	.013		
FX-041	ALSTER66	2						
42 40 54.6	2463600.	233.263	765.297					
88 16 33.1	253300.	233.334	765.530	-.233	-.246	.013		
FX-039	ALSTER66	2						
42 41 8.7	2459700.	235.009	771.025					
88 17 25.0	254650.	235.081	771.262	-.236	-.246	.010		
FX-038	ALSTER66	2						
42 41 12.7	2459500.	233.639	766.531					
88 17 27.5	255050.	233.712	766.770	-.240	-.246	.007		
FX-037	ALSTER66	2						
42 41 36.7	2457900.	234.692	769.985					
88 17 48.3	257450.	234.765	770.225	-.240	-.246	.007		
FX-036	ALSTER66	2						
42 41 52.1	2457800.	234.164	768.253					
88 17 49.2	259000.	234.237	768.493	-.240	-.246	.007		
FX-035	ALSTER66	2						
42 41 52.1	2455250.	239.682	786.357					
88 18 23.4	258950.	239.756	786.599	-.243	-.246	.003		
FX-034	ALSTER66	2						
42 41 51.6	2452600.	240.464	788.922					
88 18 58.9	258850.	240.538	789.165	-.243	-.243	.000		
FX-033	ALSTER66	2						
42 41 52.6	2449950.	246.731	809.483					
88 19 34.3	258900.	246.806	809.729	-.246	-.240	-.007		
FX-032	ALSTER66	2						
42 42 18.3	2449850.	252.712	829.106					
88 19 35.0	261500.	252.788	829.355	-.249	-.240	-.010		
FX-031	ALSTER66	2						
42 42 51.4	2452500.	237.982	780.779					
88 18 58.6	264900.	238.059	781.032	-.253	-.240	-.013		
FX-027	ALSTER66	2						
42 43 9.8	2454400.	236.047	774.431					
88 18 32.6	266800.	236.124	774.683	-.253	-.243	-.010		
FX-026	ALSTER66	2						
42 43 35.9	2454500.	236.563	776.124					
88 18 30.6	269450.	236.640	776.376	-.253	-.243	-.010		
FX-025	ALSTER66	2						
42 44 2.2	2454250.	246.582	808.994					
88 18 33.2	272100.	246.659	809.247	-.253	-.240	-.013		

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
FX-023	ALSTER66	2					
42 44 28.3	2454200.	237.547	779.352				
88 18 33.1	274750.	237.623	779.601	-.249	-.240	-.010	
FX-022	ALSTER66	2					
42 44 54.5	2454000.	238.475	782.397				
88 18 35.1	277400.	238.552	782.649	-.253	-.240	-.013	
FX-021	ALSTER66	2					
42 45 20.2	2454200.	243.313	798.269				
88 18 31.7	280000.	243.389	798.519	-.249	-.240	-.010	
FX-020	ALSTER66	2					
42 45 45.7	2454950.	248.488	815.248				
88 18 21.0	282600.	248.564	815.497	-.249	-.240	-.010	
FX-019	ALSTER66	2					
42 46 19.6	2455700.	241.263	791.544				
88 18 10.0	286050.	241.340	791.796	-.253	-.240	-.013	
FX-018	ALSTER66	2					
42 46 39.2	2454250.	243.147	797.725				
88 18 28.9	288000.	243.223	797.974	-.249	-.240	-.010	
FX-017	ALSTER66	2					
42 46 39.7	2451750.	247.930	813.417				
88 19 2.4	288000.	248.007	813.670	-.253	-.240	-.013	
FX-016	ALSTER66	2					
42 47 3.9	2451700.	249.319	817.974				
88 19 2.4	290450.	249.395	818.223	-.249	-.240	-.010	
FX-015	ALSTER66	2					
42 47 30.5	2451700.	247.005	810.382				
88 19 1.7	293150.	247.082	810.635	-.253	-.240	-.013	
FX-04	ALSTER66	2					
42 47 43.7	2450250.	244.157	801.038				
88 19 20.7	294450.	244.233	801.288	-.249	-.240	-.010	
FX-014	ALSTER66	2					
42 47 55.2	2449200.	245.703	806.111				
88 19 34.5	295600.	245.779	806.360	-.249	-.240	-.010	
RX-013	ALSTER66	2					
42 47 56.6	2446350.	250.157	820.723				
88 20 12.7	295680.	250.233	820.973	-.249	-.236	-.013	
FX-013	ALSTER66	2					
42 47 57.8	2446400.	250.736	822.623				
88 20 12.0	295800.	250.812	822.872	-.249	-.236	-.013	
FX-012	ALSTER66	2					
42 48 22.5	2446400.	249.528	818.660				
88 20 11.3	298300.	249.603	818.906	-.246	-.240	-.007	
FX-011	ALSTER66	2					
42 48 51.1	2446400.	257.102	843.509				
88 20 10.6	301200.	257.178	843.758	-.249	-.240	-.010	
FX-010	ALSTER66	2					
42 49 17.0	2450100.	254.179	833.919				
88 19 20.2	303900.	254.254	834.165	-.246	-.240	-.007	

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAV88		US SURV.	PUB	DIFF BY	FIT
LONGITUDE	NAD27Y	NGVD29		FEET	DIFF	VERTCON	(feet)
FX-09	ALSTER66	2					
42 49 41.9	2454250.	258.228		847.203			
88 18 23.8	306500.	258.302		847.446	-.243	-.240	-.003
FX-08	ALSTER66	2					
42 50 12.5	2454250.	256.315		840.927			
88 18 23.0	309600.	256.388		841.166	-.240	-.240	.000
FX-07	ALSTER66	2					
42 50 33.5	2452700.	268.038		879.388			
88 18 43.2	311700.	268.111		879.628	-.240	-.240	.000
FX-02	ALSTER66	2					
42 50 49.7	2451100.	249.739		819.352			
88 19 4.3	313300.	249.811		819.588	-.236	-.240	.003
FX-03	ALSTER66	2					
42 50 36.3	2448700.	249.730		819.323			
88 19 36.8	311900.	249.827		819.641	-.318	-.240	-.079
FX-N27	ALSTER66	2					
42 51 24.3	2448300.	245.137		804.254			
88 19 40.9	316750.	245.220		804.526	-.272	-.240	-.033
FX-N28	ALSTER66	2					
42 51 24.7	2448500.	240.103		787.738			
88 19 38.2	316800.	240.186		788.010	-.272	-.240	-.033
FX-N26	ALSTER66	2					
42 51 23.9	2447700.	240.936		790.471			
88 19 49.0	316700.	241.019		790.743	-.272	-.240	-.033
FX-N25	ALSTER66	2					
42 51 22.0	2447300.	241.878		793.561			
88 19 54.4	316500.	241.961		793.834	-.272	-.240	-.033
RX-N24	ALSTER66	2					
42 52 5.7	2446400.	256.244		840.694			
88 20 5.3	320900.	256.314		840.924	-.230	-.236	.007
FX-N29	ALSTER66	2					
42 52 24.7	2444950.	254.616		835.353			
88 20 24.3	322800.	254.687		835.586	-.233	-.236	.003
FX-N30	ALSTER66	2					
42 52 44.0	2444950.	260.241		853.807			
88 20 23.7	324750.	260.313		854.044	-.236	-.236	.000
FX-N31	ALSTER66	2					
42 53 10.3	2444000.	261.302		857.288			
88 20 35.8	327400.	261.386		857.564	-.276	-.236	-.039
FX-N32	ALSTER66	2					
42 53 36.0	2443800.	261.035		856.412			
88 20 37.8	330000.	261.109		856.655	-.243	-.233	-.010
FX-N33	ALSTER66	2					
42 54 2.8	2443300.	266.548		874.500			
88 20 43.8	332700.	266.622		874.742	-.243	-.233	-.010
FX-N34	ALSTER66	2					
42 54 29.5	2443200.	286.903		941.281			
88 20 44.4	335400.	286.979		941.530	-.249	-.233	-.016

NAME	AGENCY	ORDER	PID				
LATITUDE LONGITUDE	NAD27X NAD27Y	NAVD88 NGVD29	US SURV. FEET	PUB DIFF	DIFF BY VERTCON	FIT (feet)	
FX-N35	ALSTER66	2					
42 54 55.2	2443100.	269.794	885.149				
88 20 45.0	338000.	269.871	885.402	-.253	-.236	-.016	
FX-N36	ALSTER66	2					
42 55 21.9	2443000.	272.402	893.706				
88 20 45.7	340700.	272.480	893.961	-.256	-.236	-.020	
FX-J24	ALSTER66	2					
42 55 48.0	2442900.	276.556	907.334				
88 20 46.3	343350.	276.634	907.590	-.256	-.240	-.016	
FX-J23	ALSTER66	2					
42 56 14.7	2442850.	275.719	904.588				
88 20 46.3	346050.	275.796	904.841	-.253	-.240	-.013	
FX-J21	ALSTER66	2					
42 56 35.6	2442000.	262.461	861.091				
88 20 57.1	348150.	262.538	861.343	-.253	-.240	-.013	
RX-J17	ALSTER66	2					
42 56 46.1	2441300.	278.165	912.613				
88 21 6.3	349200.	278.240	912.859	-.246	-.240	-.007	
FX-J20	ALSTER66	2					
42 57 31.0	2439200.	261.784	858.870				
88 21 33.3	353700.	261.857	859.109	-.240	-.233	-.007	
FX-T5	ALSTER66	2					
42 43 35.8	2391600.	268.809	881.918				
88 32 33.4	268250.	268.872	882.124	-.207	-.207	.000	
FX-T15	ALSTER66	2					
42 44 31.4	2417650.	316.792	1039.342				
88 26 42.9	274350.	316.859	1039.562	-.220	-.207	-.013	
FX-Z15	ALSTER66	2					
42 36 13.9	2419200.	279.582	917.262				
88 26 34.8	224000.	279.654	917.498	-.236	-.217	-.020	
TP5-43	ALSTER66	2					
42 42 20.9	2478500.	241.999	793.958				
88 13 11.1	262350.	242.071	794.195	-.236	-.249	.013	
FX-M25	ALSTER66	2					
42 45 49.0	2479850.	236.536	776.035				
88 12 47.0	283450.	236.602	776.252	-.217	-.249	.033	
FX-M21	ALSTER66	2					
42 46 41.2	2487150.	247.724	812.741				
88 11 7.6	288900.	247.796	812.977	-.236	-.249	.013	
RX-M14	ALSTER66	2					
42 49 45.4	2493900.	243.498	798.876				
88 9 31.5	307700.	243.565	799.096	-.220	-.256	.036	
FX-N13	ALSTER66	2					
42 51 24.8	2422600.	248.791	816.242				
88 25 26.0	316300.	248.860	816.468	-.226	-.230	.003	
FX-R14	ALSTER66	2					
42 52 41.4	2469600.	239.279	785.035				
88 14 52.7	325000.	239.334	785.215	-.180	-.240	.059	

NAME	LATITUDE LONGITUDE	AGENCY NAD27X NAD27Y	ORDER NAVD88 NGVD29	US SURV. FEET	PID PUB DIFF	DIFF BY VERTCON	FIT (feet)
UE	42 54 19.9 88 8 18.8	ALSTER66 2498700. 335600.	2 245.950 246.002	806.921 807.092			
					-.171	-.256	.085
TP10-72	42 39 18.6 88 9 32.9	ALSTER66 2495200. 244250.	2 245.080 245.153	804.067 804.306			
					-.240	-.246	.007
TP9-74	42 34 16.4 88 12 19.6	ALSTER66 2483400. 213400.	2 231.490 231.560	759.480 759.710			
					-.230	-.249	.020
TP6-58	42 45 50.2 88 33 13.1	ALSTER66 2388400. 281800.	2 281.539 281.600	923.683 923.883			
					-.200	-.213	.013
TP6-72	42 46 41.3 88 26 41.7	ALSTER66 2417500. 287500.	2 265.894 265.968	872.354 872.597			
					-.243	-.220	-.023

VERTCON Misfits on Fox River Watershed Benchmarks

Two computational options are summarized below. Option 1 shows the misfit of VERTCON predictions when compared to the differences at each station between the newly adjusted watershed level network on each datum. Option 2 shows the same VERTCON prediction compared to the differences between newly computed benchmark elevations on the NAVD 88 and the **published** NGVD 29 elevations which have been developed and used over the past 30 years. Statistics for each option are shown at the end of the tabulation.

An attempt was also made to provide information about relative VERTCON accuracy. The tabulation below also shows how the VERTCON misfit changes from station to station for each option, the inverse distance between the approximate coordinates for each station and finally the "delta misfit" is divided by the square root of the inverse distance (in miles) to find the relative accuracy coefficient for each option. This value can be compared with the English Units coefficients in Table 1 of the main text. Summarizing, the misfits of option 1 are an indication of how well VERTCON models the datum difference in areas not covered by NGS lines, option 2 is an indication of the accuracy which can be expected when converting published NGVD 29 elevations to NAVD 88 elevations using VERTCON, and the relative accuracy gives an indication of the results one can expect between adjacent bench marks. The relative accuracy can also be used to target questionable published bench mark elevations on the NGVD 29.

Station	NAD 27 X COORD	NAD 27 Y COORD	MISFIT OPTION1	MISFIT OPTION2	DELTA OPTION1	DELTA OPTION2	INVERSE DISTANCE	RELATIVE OPTION1	ACCURACY OPTION2
M-48	2445150	242600	0.003	0.003					
M-47	2448250	243300	0.000	0.000	-0.003	-0.003	3178.0	-0.00387	-0.00387
M-46	2450500	244000	0.007	0.007	0.007	0.007	2356.4	0.01048	0.01048
M-45	2451300	243950	0.003	0.007	-0.004	0.000	801.6	-0.01027	0.00000
M-44	2453300	244400	0.003	0.007	0.000	0.000	2050.0	0.00000	0.00000
M-43	2455300	244850	0.007	0.007	0.004	0.000	2050.0	0.00642	0.00000
RM-1	2462150	248250	0.013	0.010	0.006	0.003	7647.4	0.00499	0.00249
M-41	2463350	250350	0.013	0.013	0.000	0.003	2418.7	0.00000	0.00443
M-40	2464700	252450	0.013	0.013	0.000	0.000	2496.5	0.00000	0.00000
U-1	2465250	249650	0.010	0.013	-0.003	0.000	2853.5	-0.00408	0.00000
U-2	2466600	248450	0.010	0.066	0.000	0.053	1806.2	0.00000	0.09062
U-3	2468700	248550	0.013	0.020	0.003	-0.046	2102.4	0.00475	-0.07290
RX-U3	2468900	248250	0.013	0.020	0.000	0.000	360.6	0.00000	0.00000
U-4	2470550	246150	0.013	0.023	0.000	0.003	2670.7	0.00000	0.00422
U-5	2471800	243500	0.016	0.023	0.003	0.000	2930.0	0.00403	0.00000
U-6	2473350	241350	0.013	0.023	-0.003	0.000	2650.5	-0.00423	0.00000
U-7	2475350	238400	0.016	0.023	0.003	0.000	3564.1	0.00365	0.00000
U-8	2477100	238400	0.013	0.023	-0.003	0.000	1750.0	-0.00521	0.00000
U-9	2477150	235700	0.016	0.026	0.003	0.003	2700.5	0.00419	0.00419
U-10	2477050	233400	0.013	0.020	-0.003	-0.006	2302.2	-0.00454	-0.00909
U-11	2478250	231200	0.016	0.026	0.003	0.006	2506.0	0.00435	0.00871
U-12	2477850	227900	0.013	0.023	-0.003	-0.003	3324.2	-0.00378	-0.00378
U-13	2482350	228050	0.013	0.023	0.000	0.000	4502.5	0.00000	0.00000
U-14	2482500	225250	0.020	0.030	0.007	0.007	2804.0	0.00961	0.00961
U-15	2482600	222000	0.013	0.026	-0.007	-0.004	3251.5	-0.00892	-0.00510
U-16	2482600	220000	0.013	0.223	0.000	0.197	2000.0	0.00000	0.32009
U-17	2482900	218100	0.013	0.023	0.000	-0.200	1923.5	0.00000	-0.33136
U-18	2483750	215100	0.013	0.023	0.000	0.000	3118.1	0.00000	0.00000
TP9-74	2483400	213400	0.010	0.020	-0.003	-0.003	1735.7	-0.00523	-0.00523
V-1	2482950	212200	0.010	0.020	0.000	0.000	1281.6	0.00000	0.00000

Station	NAD 27 X COORD	NAD 27 Y COORD	MISFIT OPTION1	MISFIT OPTION2	DELTA OPTION1	DELTA OPTION2	INVERSE DISTANCE	RELATIVE OPTION1	ACCURACY OPTION2
V-2	2483000	207500	0.010	0.026	0.000	0.006	4700.3	0.00000	0.00636
V-3	2483000	204500	0.010	0.033	0.000	0.007	3000.0	0.00000	0.00929
V-4	2483100	200800	0.003	0.033	-0.007	0.000	3701.4	-0.00836	0.00000
V-5	2480400	200450	0.000	0.036	-0.003	0.003	2722.6	-0.00418	0.00418
V-6	2480700	198750	0.003	0.036	0.003	0.000	1726.3	0.00525	0.00000
V-7	2480650	196050	0.000	0.043	-0.003	0.007	2700.5	-0.00419	0.00979
V-8	2480700	193600	-0.003	0.043	-0.003	0.000	2450.5	-0.00440	0.00000
U-32	2480750	190900	-0.007	0.043	-0.004	0.000	2700.5	-0.00559	0.00000
U-33	2478200	190800	-0.007	0.010	0.000	-0.033	2552.0	0.00000	-0.04747
U-34	2475150	190700	-0.010	0.003	-0.003	-0.007	3051.6	-0.00395	-0.00921
U-35	2473100	189980	-0.007	0.003	0.003	0.000	2172.8	0.00468	0.00000
U-36	2471100	189820	-0.013	0.000	-0.006	-0.003	2006.4	-0.00973	-0.00487
U-37	2468850	185450	-0.010	0.000	0.003	0.000	4915.2	0.00311	0.00000
FX-043	2463900	253100	0.013	0.013	0.023	0.013	67830.9	0.00642	0.00363
FX-042	2463300	253500	0.016	0.013	0.003	0.000	721.1	0.00812	0.00000
FX-041	2463600	253300	0.013	0.013	-0.003	0.000	360.6	-0.01148	0.00000
FX-039	2459700	254650	0.013	0.010	0.000	-0.003	4127.0	0.00000	-0.00339
FX-038	2459500	255050	0.013	0.007	0.000	-0.003	447.2	0.00000	-0.01031
FX-037	2457900	257450	0.013	0.007	0.000	0.000	2884.4	0.00000	0.00000
FX-036	2457800	259000	0.013	0.007	0.000	0.000	1553.2	0.00000	0.00000
FX-035	2455250	258950	0.013	0.003	0.000	-0.004	2550.5	0.00000	-0.00576
FX-034	2452600	258850	0.013	0.000	0.000	-0.003	2651.9	0.00000	-0.00423
FX-033	2449950	258900	0.010	-0.007	-0.003	-0.007	2650.5	-0.00423	-0.00988
FX-032	2449850	261500	0.010	-0.010	0.000	-0.003	2601.9	0.00000	-0.00427
FX-031	2452500	264900	0.010	-0.013	0.000	-0.003	4310.7	0.00000	-0.00332
FX-027	2454400	266800	0.013	-0.010	0.003	0.003	2687.0	0.00421	0.00421
FX-026	2454500	269450	0.013	-0.010	0.000	0.000	2651.9	0.00000	0.00000
FX-025	2454250	272100	0.010	-0.013	-0.003	-0.003	2661.8	-0.00423	-0.00423
FX-023	2454200	274750	0.013	-0.010	0.003	0.003	2650.5	0.00423	0.00423
FX-022	2454000	277400	0.010	-0.013	-0.003	-0.003	2657.5	-0.00423	-0.00423
FX-021	2454200	280000	0.013	-0.010	0.003	0.003	2607.7	0.00427	0.00427
FX-020	2454950	282600	0.010	-0.010	-0.003	0.000	2706.0	-0.00419	0.00000
FX-019	2455700	286050	0.010	-0.013	0.000	-0.003	3530.6	0.00000	-0.00367
FX-018	2454250	288000	0.013	-0.010	0.003	0.003	2430.0	0.00442	0.00442
FX-017	2451750	288000	0.010	-0.013	-0.003	-0.003	2500.0	-0.00436	-0.00436
FX-016	2451700	290450	0.013	-0.010	0.003	0.003	2450.5	0.00440	0.00440
FX-015	2451700	293150	0.010	-0.013	-0.003	-0.003	2700.0	-0.00420	-0.00420
FX-04	2450250	294450	0.013	-0.010	0.003	0.003	1947.4	0.00494	0.00494
FX-014	2449200	295600	0.013	-0.010	0.000	0.000	1557.2	0.00000	0.00000
RX-013	2446350	295680	0.010	-0.013	-0.003	-0.003	2851.1	-0.00408	-0.00408
FX-013	2446400	295800	0.010	-0.013	0.000	0.000	130.0	0.00000	0.00000
FX-012	2446400	298300	0.013	-0.007	0.003	0.006	2500.0	0.00436	0.00872
FX-011	2446400	301200	0.010	-0.010	-0.003	-0.003	2900.0	-0.00405	-0.00405
FX-010	2450100	303900	0.013	-0.007	0.003	0.003	4580.4	0.00322	0.00322
FX-09	2454250	306500	0.010	-0.003	-0.003	0.004	4897.2	-0.00312	0.00415
FX-08	2454250	309600	0.013	0.000	0.003	0.003	3100.0	0.00392	0.00392
FX-07	2452700	311700	0.010	0.000	-0.003	0.000	2610.1	-0.00427	0.00000
FX-02	2451100	313300	0.013	0.003	0.003	0.003	2262.7	0.00458	0.00458
FX-03	2448700	311900	0.013	-0.079	0.000	-0.082	2778.5	0.00000	-0.11304
FX-N27	2448300	316750	0.010	-0.033	-0.003	0.046	4866.5	-0.00312	0.04791
FX-N28	2448500	316800	0.013	-0.033	0.003	0.000	206.2	0.01518	0.00000
FX-N26	2447700	316700	0.010	-0.033	-0.003	0.000	806.2	-0.00768	0.00000
FX-N25	2447300	316500	0.010	-0.033	0.000	0.000	447.2	0.00000	0.00000
RX-N24	2446400	320900	0.010	0.007	0.000	0.040	4491.1	0.00000	0.04337
FX-N29	2444950	322800	0.010	0.003	0.000	-0.004	2390.1	0.00000	-0.00595

	NAD 27 Station X COORD	NAD 27 Y COORD	MISFIT OPTION1	MISFIT OPTION2	DELTA OPTION1	DELTA OPTION2	INVERSE DISTANCE	RELATIVE OPTION1	ACCURACY OPTION2
FX-N30	2444950	324750	0.007	0.000	-0.003	-0.003	1950.0	-0.00494	-0.00494
FX-N31	2444000	327400	0.010	-0.039	0.003	-0.039	2815.1	0.00411	-0.05341
FX-N32	2443800	330000	0.007	-0.010	-0.003	0.029	2607.7	-0.00427	0.04127
FX-N33	2443300	332700	0.007	-0.010	0.000	0.000	2745.9	0.00000	0.00000
FX-N34	2443200	335400	0.007	-0.016	0.000	-0.006	2701.9	0.00000	-0.00839
FX-N35	2443100	338000	0.010	-0.016	0.003	0.000	2601.9	0.00427	0.00000
FX-N36	2443000	340700	0.010	-0.020	0.000	-0.004	2701.9	0.00000	-0.00559
FX-J24	2442900	343350	0.013	-0.016	0.003	0.004	2651.9	0.00423	0.00564
FX-J23	2442850	346050	0.013	-0.013	0.000	0.003	2700.5	0.00000	0.00419
FX-J21	2442000	348150	0.010	-0.013	-0.003	0.000	2265.5	-0.00458	0.00000
RX-J17	2441300	349200	0.010	-0.007	0.000	0.006	1261.9	0.00000	0.01227
FX-J20	2439200	353700	0.003	-0.007	-0.007	0.000	4965.9	-0.00722	0.00000
FX-T5	2391600	268250	-0.016	0.000	-0.019	0.007	97813.4	-0.00441	0.00163
FX-T15	2417650	274350	-0.020	-0.013	-0.004	-0.013	26754.7	-0.00178	-0.00578
FX-Z15	2419200	224000	-0.020	-0.020	0.000	-0.007	50373.9	0.00000	-0.00227
TP5-43	2478500	262350	0.016	0.013	0.036	0.033	70620.2	0.00984	0.00902
FX-M25	2479850	283450	0.016	0.033	0.000	0.020	21143.1	0.00000	0.00999
FX-M21	2487150	288900	0.020	0.013	0.004	-0.020	9110.0	0.00305	-0.01523
RX-M14	2493900	307700	0.026	0.036	0.006	0.023	19975.0	0.00308	0.01182
FX-N13	2422600	316300	0.007	0.003	-0.019	-0.033	71816.8	-0.00515	-0.00895
FX-R14	2469600	325000	0.013	0.059	0.006	0.056	47798.4	0.00199	0.01861
UE	2498700	335600	0.026	0.085	0.013	0.026	30970.5	0.00537	0.01074
TP10-72	2495200	244250	0.010	0.007	-0.016	-0.078	91417.0	-0.00385	-0.01875
TP9-74	2483400	213400	0.010	0.020	0.000	0.013	33029.7	0.00000	0.00520
TP6-58	2388400	281800	-0.007	0.013	-0.017	-0.007	117062.2	-0.00361	-0.00149
TP6-72	2417500	287500	-0.003	-0.023	0.004	-0.036	29653.0	0.00169	-0.01519
MEAN =			0.009	0.007					
STD DEV =			0.008	0.031					

Appendix C-4

Milwaukee River Watershed Control Leveling Data

Tabulated from SEWRPC original survey field books April 21, 1995.

Milwaukee River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
V 86	(1-16)	672.550	
		-6.771	-6.771
ML A15	(1-15)	665.779	
ML A15	(2-29)	665.704	
		123.966	123.966
ML AB10	(2-36)	789.670	
		-45.057	
ML B3	(2-42)	744.613	
ML B3	(1-25)	744.613	
		6.540	
RL B3	(1-26)	751.153	
			-38.517
W 86	(2-47)	678.900	
		110.717	110.717
ML AB10	(2-52)	789.617	
X 86	(1-18)	694.462	
		56.704	56.704
RL B3	(1-26)	751.166	
RL B3	(1-27)	751.059	
		74.417	74.417
ML B12	(1-46)	825.476	
		45.037	45.037
ML B20	(1-66)	870.513	
		4.864	4.864
ML B26	(2-8)	875.377	
		12.924	12.924
RBM	(2-21)	888.301	
RBM	(3-5)	888.150	
		159.585	159.585
ML D5	(3-9)	1047.735	
		21.039	21.039
MILL	(3-15)	1068.774	

Milwaukee River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
ML D5	(3-9)	1047.735 3.327	45.804
RL D5	(3-9)	1051.062	
RL D5	(5-41)	1051.053 -49.131	
ML L11	(5-51)	1001.922 28.627	
RBM	(5-52)	1030.549	-106.260
RBM	WBF(2-44)	1030.577 -42.307	
RBM 22/23	WBF(2-44)	988.270	
RBM 22/23	WBF(1-71)	988.328 16.269	
RBM 22N	WBF(1-70)	1004.597	
RBM 22N	(5-53)	1004.537 -6.869	
ML L14	(5-53)	997.668 -14.602	
RBM10/15	(5-56)	983.066	
RBM10/15	WBF(1-66)	983.092 -30.761	
RBM10/11/14/15	WBF(1-66)	952.331	
RBM10/11/14/15	(5-72)	952.311 -56.617	4.043
ML L28	(5-75)	895.694	
RL B3	(3-29)	751.059 4.113	
ML E3	(3-31)	755.172	
ML E3	(3-31)	755.165 16.909	-143.518
ML E4	(3-32)	772.074	
ML E4	(3-32)	772.081 -16.979	
RL E9	(3-35)	755.102 -143.518	
B 87 (Reset)	(3-39)	611.584	

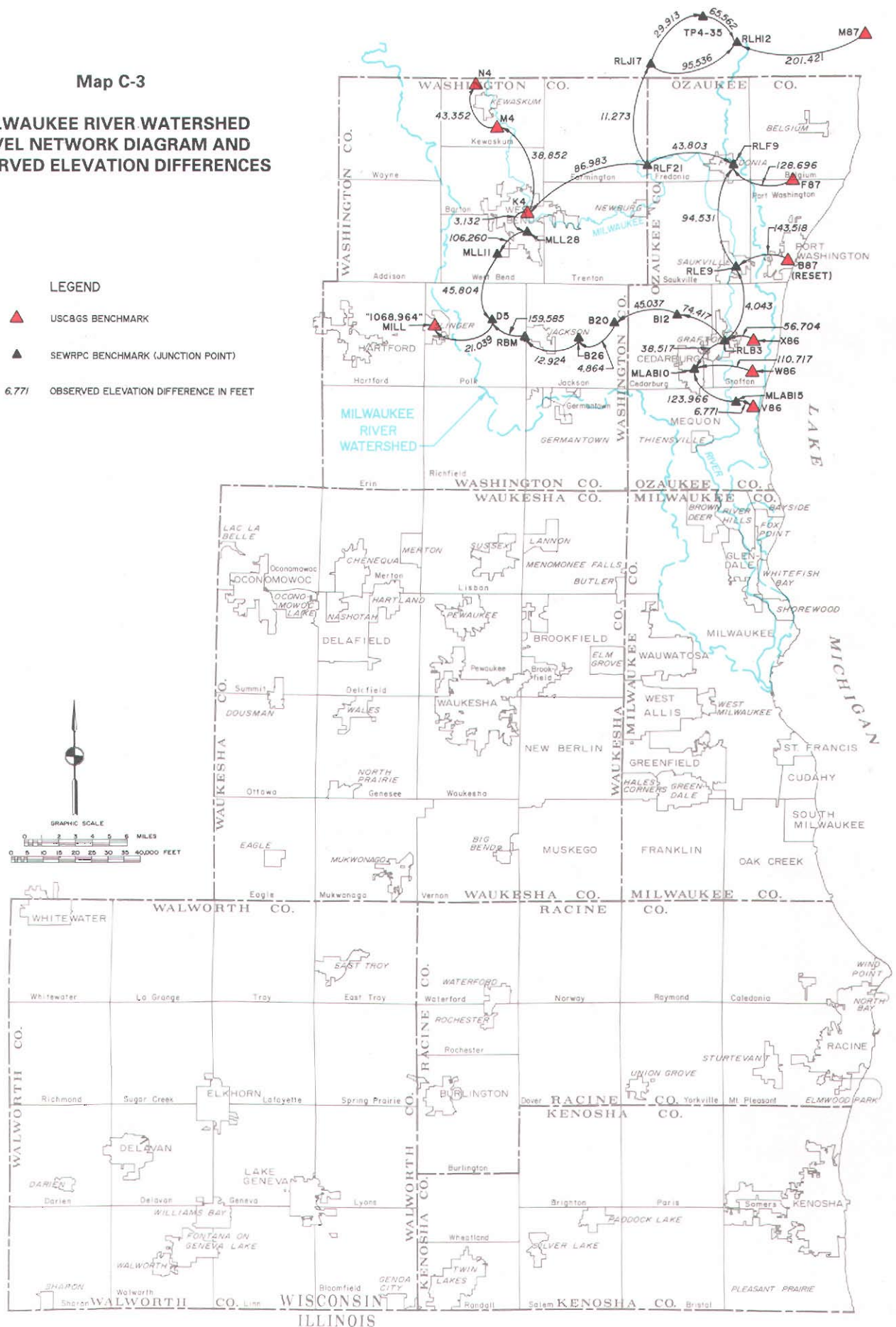
Milwaukee River Watershed:

<u>BM/Junction</u>	<u>FB & PG</u>	<u>Observed DE's</u>	<u>NETWORK DE</u>
RL E9	(4-5)	755.046	
		94.531	94.531
RL F9	(4-13)	849.577	
F 87	(3-40)	720.812	
		128.696	128.696
RL F9	(3-46)	849.508	
		-43.803	-43.803
RL F21	(3-53)	805.705	
		86.983	86.983
K 4	(3-66)	892.688	
K 4	(5-75)	892.562	
		3.132	3.132
ML L28	(5-75)	895.694	
ML L28	(6-24)	895.733	
		38.852	38.852
M 4	(6-34)	934.585	
		43.352	43.352
N 4	(6-38)	977.937	
RL F21	(4-63)	805.665	
		11.273	11.273
RL J17	(4-74)	816.938	
		95.536	95.536
RL H12	(5-11)	912.474	
RL J17	(5-12)	816.938	
		29.913	29.913
RR Spike	(5-23)	846.851	
M 87	(4-15)	711.017	
		17.998	
ML H2	(4-16)	729.015	
ML H2	(4-16)	729.051	
		183.423	
RL H12	(4-24)	912.474	
RL H12	(4-24)	912.413	
		-65.562	-65.562
RR Spike	(4-35)	846.851	

Map C-3

**MILWAUKEE RIVER WATERSHED
LEVEL NETWORK DIAGRAM AND
OBSERVED ELEVATION DIFFERENCES**

- LEGEND**
- ▲ USC&GS BENCHMARK
 - ▲ SEWRPC BENCHMARK (JUNCTION POINT)
 - 6.771 OBSERVED ELEVATION DIFFERENCE IN FEET



MILWAUKEE RIVER WATERSHED LEVEL NETWORK - NGVD 29

STAR*LEV Adjustment Program
Copyright 1990 STARPLUS SOFTWARE, INC.
Licensed for Use by Earl F. Burkholder, Consulting Geodetic Engineer
Serial Number 10424

STAR*LEV Version 1.17
Run Date : Thu Nov 02 14:52:03 1995

Summary of Files Used

This file	: ngvd29m2.wp1
Input Data File	: ngvd29m2.dat
Output Listing	: ngvd29m2.lst
Adjusted Elevations	: ngvd29m2.pts
Project Options	: ngvd29m2.prj
Error Log	: ngvd29m2.err

Summary of Options Used

Type of Run was Adjustment and Error Propagation	
Print Input Data File	: Yes
Print Summary of All Input Observations	: Yes
Default Standard Error for Elevations	: FIXED
Section Length Units	: Feet
Default Std Error for Diff in Elevations	: 0.025 (FT / $\sqrt{\text{MILE}}$)

Listing of Input Data File

=====

[1]	#		
[2]	#		
[3]	#	EARL F. BURKHOLDER, PLS,PE	11-02-1995
[4]	#	CONSULTING GEODETIC ENGINEER	
[5]	#	P.O. BOX 13240	
[6]	#	CIRCLEVILLE, OHIO 43113	
[7]	#		
[8]	#	CLIENT: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION	
[9]	#	WAUKESHA, WISCONSIN	
[10]	#	KURT BAUER, EXECUTIVE DIRECTOR	
[11]	#		
[12]	#	PROJECT NAME: MILWAUKEE RIVER WATERSHED LEVEL NETWORK	
[13]	#	(COMPUTED ON NGVD 29)	
[14]	#		
[15]	#	NOTES: 1. ELEVATION DIFFERENCES ABSTRACTED FROM SEWRPC FIELD	
[16]	#	BOOKS AT SEWRPC OFFICES BY E. BURKHOLDER 4/21/95.	
[17]	#		
[18]	#	2. DISTANCES FOR WEIGHTING PURPOSES WERE DETERMINED BY	
[19]	#	MULTIPLYING COORDINATE INVERSE DISTANCE BY AN ESTIMATED	
[20]	#	FACTOR TO ACCOMMODATE FACT THAT LEVEL LINES MEANDER.	
[21]	#		
[22]	E	B-87 (Reset)	611.553 ! 'NGVD 29 ELEVATIONS PUBLISHED BY NGS
[23]	E	F-87	720.812 !
[24]	E	K-4	892.613 !
[25]	E	M-4	934.457 !
[26]	E	M-87	711.019 !
[27]	E	MILL	1068.748 ! 'NAME ALSO LISTED AS 1068.964
[28]	E	N-4	977.852 !
[29]	E	V-86	672.472 !
[30]	E	W-86	678.900 !
[31]	E	X-86	694.349 !
[32]	#		
[33]	#		

[34]	#	STATIONS	ELEVATION	ESTIMATED	INCREASE	STRAIGHT LINE
[35]	#	(FROM-TO)	DIFFERENCE	DIST. FT	FACTOR	INVERSE DIST.
[36]	#					
[37]	V	V-86-ML-A15	-6.771	1520	'1.01	1,505 FEET
[38]	V	ML-A15-ML-AB10	123.966	22301	'1.10	20,274 FEET
[39]	V	ML-AB10-W-86	-110.717	18343	'1.02	17,983 FEET
[40]	V	ML-AB10-RL-B3	-38.517	13412	'1.05	12,773 FEET
[41]	V	RL-B3-X-86	-56.704	9225	'1.01	9,134 FEET
[42]	V	RL-B3-ML-B12	74.417	18730	'1.10	17,028 FEET
[43]	V	ML-B12-ML-B20	45.037	18695	'1.02	18,328 FEET
[44]	V	ML-B20-ML-B26	4.864	20063	'1.10	19,148 FEET
[45]	V	ML-B26-RBM	12.924	10300	'1.00	10,300 FEET
[46]	V	RBM-ML-D5	159.585	12831	'1.07	11,992 FEET
[47]	V	ML-D5-MILL	21.039	17867	'1.05	17,016 FEET
[48]	V	ML-D5-ML-L11	-45.804	25023	'1.15	21,759 FEET
[49]	V	ML-L11-ML-L28	-106.260	19552	'1.60	12,220 FEET
[50]	V	ML-L28-K4	-3.132	1330	'1.10	1,209 FEET
[51]	V	RL-B3-RL-E9	4.043	23558	'1.03	22,872 FEET
[52]	V	RL-E9-B-87(Reset)	-143.518	16751	'1.02	16,423 FEET
[53]	V	RL-E9-RL-F9	94.531	32445	'1.01	32,124 FEET
[54]	V	RL-F9-F-87	-128.696	20182	'1.06	19,040 FEET
[55]	V	RL-F9-RL-F21	-43.803	33205	'1.04	31,928 FEET
[56]	V	RL-F21-K-4	86.983	42931	'1.20	35,776 FEET
[57]	V	ML-L28-M-4	38.852	32386	'1.15	28,162 FEET
[58]	V	M-4-N-4	43.352	15245	'1.02	14,946 FEET
[59]	V	RL-F21-RL-J17	11.273	37113	'1.15	32,272 FEET
[60]	V	RL-J17-TP4-35	29.913	39662	'1.10	36,056 FEET
[61]	V	TP4-35-RL-H12	65.562	38515	'1.20	32,096 FEET
[62]	V	RL-H12-RL-J17	-95.536	32584	'1.20	27,153 FEET
[63]	V	RL-H12-M-87	-201.421	31249	'1.02	30,636 FEET
[64]	#					
[65]	#	END OF DATA SET				
[66]	#					

Network has 10 fixed elevation stations
Number of Differences in Elevation = 27

Statistical Summary

=====

Number of Observations = 27
Number of Unknowns = 17
Degrees of Freedom = 10

Data Type	Count	Weighted Residuals	Error Factor
Stations	27	0.00	0.00
Diff Elev	27	9.25	0.96
Total	54	9.25	0.96

Adjustment passes the Chi Square test at 5% level

Residuals in Observations After Adjustment

=====

Residuals in Observed Differences in Elevations

At	To	Observed	Adjusted	Residual	Std Err	Std Res
V-86	ML-A15	-6.7710	-6.7748	-0.0038	0.013	0.3
ML-A15	ML-AB10	123.9660	123.9105	-0.0555	0.051	1.1
ML-AB10	W-86	-110.7170	-110.7077	0.0093	0.047	0.2
ML-AB10	RL-B3	-38.5170	-38.5572	-0.0402	0.040	1.0
RL-B3	X-86	-56.7040	-56.7014	0.0026	0.033	0.1
RL-B3	ML-B12	74.4170	74.3823	-0.0347	0.047	0.7
ML-B12	ML-B20	45.0370	45.0024	-0.0346	0.047	0.7
ML-B20	ML-B26	4.8640	4.8269	-0.0371	0.049	0.8
ML-B26	RBM	12.9240	12.9049	-0.0191	0.035	0.5
RBM	ML-D5	159.5850	159.5613	-0.0237	0.039	0.6
ML-D5	MILL	21.0390	21.0197	-0.0193	0.046	0.4
ML-D5	ML-L11	-45.8040	-45.8233	-0.0193	0.054	0.4

ML-L11	ML-L28	-106.2600	-106.2751	-0.0151	0.048	0.3
ML-L28	K4	-3.1320	-3.1320	-0.0000	0.013	0.0
RL-B3	RL-E9	4.0430	4.0094	-0.0336	0.053	0.6
RL-E9	B-87(Reset)	-143.5180	-143.5069	0.0111	0.045	0.3
RL-E9	RL-F9	94.5310	94.4632	-0.0678	0.062	1.1
RL-F9	F-87	-128.6960	-128.7110	-0.0150	0.049	0.3
RL-F9	RL-F21	-43.8030	-43.8477	-0.0447	0.063	0.7
RL-F21	K-4	86.9830	86.9376	-0.0454	0.071	0.6
ML-L28	M-4	38.8520	38.8270	-0.0250	0.062	0.4
M-4	N-4	43.3520	43.3950	0.0430	0.042	1.0
RL-F21	RL-J17	11.2730	11.2623	-0.0107	0.066	0.2
RL-J17	TP4-35	29.9130	29.9315	0.0185	0.069	0.3
TP4-35	RL-H12	65.5620	65.5799	0.0179	0.068	0.3
RL-H12	RL-J17	-95.5360	-95.5114	0.0246	0.062	0.4
RL-H12	M-87	-201.4210	-201.4300	-0.0090	0.061	0.1

Error Propagation

=====

Station Elevation Standard Deviations

Station	Elevation	Std Dev
B-87(Reset)	611.5530	0.000
F-87	720.8120	0.000
K-4	892.6130	0.000
M-4	934.4570	0.000
M-87	711.0190	0.000
MILL	1068.7480	0.000
N-4	977.8520	0.000
V-86	672.4720	0.000
W-86	678.9000	0.000
X-86	694.3490	0.000
ML-A15	665.6972	0.013
ML-AB10	789.6077	0.027
RL-B3	751.0504	0.024
ML-B12	825.4328	0.045
ML-B20	870.4352	0.052
ML-B26	875.2621	0.051
RBM	888.1670	0.047
ML-D5	1047.7283	0.037
ML-L11	1001.9050	0.050
ML-L28	895.6300	0.048
K4	892.4980	0.049
RL-E9	755.0599	0.031
RL-F9	849.5230	0.035
RL-F21	805.6754	0.044
RL-J17	816.9376	0.056
TP4-35	846.8691	0.067
RL-H12	912.4490	0.050

MILWAUKEE RIVER WATERSHED LEVEL NETWORK - NAVD 88

STAR*LEV Adjustment Program
Copyright 1990 STARPLUS SOFTWARE, INC.
Licensed for Use by Earl F. Burkholder, Consulting Geodetic Engineer
Serial Number 10424

STAR*LEV Version 1.17
Run Date : Thu Nov 02 15:29:47 1995

Summary of Files Used

This file	: navd88m2.wp1
Input Data File	: navd88m2.dat
Output Listing	: navd88m2.lst
Adjusted Elevations	: navd88m2.pts
Project Options	: navd88m2.prj
Error Log	: navd88m2.err

Summary of Options Used

Type of Run was Adjustment and Error Propagation
Print Input Data File : Yes
Print Summary of All Input Observations : Yes
Default Standard Error for Elevations : FIXED
Section Length Units : Feet
Default Std Error for Diff in Elevations : 0.025 (FT / $\sqrt{\text{MILE}}$)

Listing of Input Data File

=====

```
[ 1]      #
[ 2]      #
[ 3]      #   EARL F. BURKHOLDER, PLS,PE                      11-02-1995
[ 4]      #   CONSULTING GEODETIC ENGINEER
[ 5]      #   P.O. BOX 13240
[ 6]      #   CIRCLEVILLE, OHIO 43113
[ 7]      #
[ 8]      #   CLIENT:  SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
[ 9]      #               WAUKESHA, WISCONSIN
[10]      #               KURT BAUER, EXECUTIVE DIRECTOR
[11]      #
[12]      #   PROJECT NAME:  MILWAUKEE RIVER WATERSHED LEVEL NETWORK
[13]      #               (COMPUTED ON NAVD 88)
[14]      #
[15]      #   NOTES: 1.  ELEVATION DIFFERENCES ABSTRACTED FROM SEWRPC FIELD
[16]      #               BOOKS AT SEWRPC OFFICES BY E. BURKHOLDER 4/21/95.
[17]      #
[18]      #               2.  DISTANCES FOR WEIGHTING PURPOSES WERE DETERMINED BY
[19]      #               MULTIPLYING COORDINATE INVERSE DISTANCE BY AN ESTIMATED
[20]      #               FACTOR TO ACCOMMODATE FACT THAT LEVEL LINES MEANDER.
[21]      #
[22]      E   B-87(RESET)          611.360  ! 'NAVD 88 ELEVATIONS PUBLISHED BY NGS
[23]      E   F-87                720.671  !
[24]      E   K-4                  892.433  !
[25]      E   M-4                  934.306  !
[26]      E   M-87                 710.894  !
[27]      E   MILL                1068.571  ! 'NAME ALSO LISTED AS 1068.964
[28]      E   N-4                  977.715  !
[29]      E   V-86                 672.252  !
[30]      E   W-86                 678.706  !
[31]      E   X-86                 694.169  !
[32]      #
[33]      #
```

[34]	#	STATIONS	ELEVATION	ESTIMATED	INCREASE	STRAIGHT LINE
[35]	#	(FROM-TO)	DIFFERENCE	DIST. FT	FACTOR	INVERSE DIST.
[36]	#					
[37]	V	V-86-ML-A15	-6.771	1520	'1.01	1,505 FEET
[38]	V	ML-A15-ML-AB10	123.966	22301	'1.10	20,274 FEET
[39]	V	ML-AB10-W-86	-110.717	18343	'1.02	17,983 FEET
[40]	V	ML-AB10-RL-B3	-38.517	13412	'1.05	12,773 FEET
[41]	V	RL-B3-X-86	-56.704	9225	'1.01	9,134 FEET
[42]	V	RL-B3-ML-B12	74.417	18730	'1.10	17,028 FEET
[43]	V	ML-B12-ML-B20	45.037	18695	'1.02	18,328 FEET
[44]	V	ML-B20-ML-B26	4.864	20063	'1.10	19,148 FEET
[45]	V	ML-B26-RBM	12.924	10300	'1.00	10,300 FEET
[46]	V	RBM-ML-D5	159.585	12831	'1.07	11,992 FEET
[47]	V	ML-D5-MILL	21.039	17867	'1.05	17,016 FEET
[48]	V	ML-D5-ML-L11	-45.804	25023	'1.15	21,759 FEET
[49]	V	ML-L11-ML-L28	-106.260	19552	'1.60	12,220 FEET
[50]	V	ML-L28-K4	-3.132	1330	'1.10	1,209 FEET
[51]	V	RL-B3-RL-E9	4.043	23558	'1.03	22,872 FEET
[52]	V	RL-E9-B-87(RESET)	-143.518	16751	'1.02	16,423 FEET
[53]	V	RL-E9-RL-F9	94.531	32445	'1.01	32,124 FEET
[54]	V	RL-F9-F-87	-128.696	20182	'1.06	19,040 FEET
[55]	V	RL-F9-RL-F21	-43.803	33205	'1.04	31,928 FEET
[56]	V	RL-F21-K-4	86.983	42931	'1.20	35,776 FEET
[57]	V	ML-L28-M-4	38.852	32386	'1.15	28,162 FEET
[58]	V	M-4-N-4	43.352	15245	'1.02	14,946 FEET
[59]	V	RL-F21-RL-J17	11.273	37113	'1.15	32,272 FEET
[60]	V	RL-J17-TP4-35	29.913	39662	'1.10	36,056 FEET
[61]	V	TP4-35-RL-H12	65.562	38515	'1.20	32,096 FEET
[62]	V	RL-H12-RL-J17	-95.536	32584	'1.20	27,153 FEET
[63]	V	RL-H12-M-87	-201.421	31249	'1.02	30,636 FEET
[64]	#					
[65]	#	END OF DATA SET				
[66]	#					

Network has 10 fixed elevation stations
Number of Differences in Elevation = 27

Statistical Summary =====

Number of Observations = 27
Number of Unknowns = 17
Degrees of Freedom = 10

Data Type	Count	Weighted Residuals	Error Factor
Stations	27	0.00	0.00
Diff Elev	27	7.79	0.88
Total	54	7.79	0.88

Adjustment passes the Chi Square test at 5% level

Residuals in Observations After Adjustment =====

Residuals in Observed Differences in Elevations

At	To	Observed	Adjusted	Residual	Std Err	Std Res
V-86	ML-A15	-6.7710	-6.7733	-0.0023	0.013	0.2
ML-A15	ML-AB10	123.9660	123.9324	-0.0336	0.051	0.7
ML-AB10	W-86	-110.7170	-110.7051	0.0119	0.047	0.3
ML-AB10	RL-B3	-38.5170	-38.5459	-0.0289	0.040	0.7
RL-B3	X-86	-56.7040	-56.6961	0.0079	0.033	0.2
RL-B3	ML-B12	74.4170	74.3850	-0.0320	0.047	0.7
ML-B12	ML-B20	45.0370	45.0050	-0.0320	0.047	0.7
ML-B20	ML-B26	4.8640	4.8297	-0.0343	0.049	0.7
ML-B26	RBM	12.9240	12.9064	-0.0176	0.035	0.5
RBM	ML-D5	159.5850	159.5630	-0.0220	0.039	0.6

ML-D5	MILL	21.0390	21.0168	-0.0222	0.046	0.5
ML-D5	ML-L11	-45.8040	-45.8158	-0.0118	0.054	0.2
ML-L11	ML-L28	-106.2600	-106.2692	-0.0092	0.048	0.2
ML-L28	K4	-3.1320	-3.1320	-0.0000	0.013	0.0
RL-B3	RL-E9	4.0430	4.0123	-0.0307	0.053	0.6
RL-E9	B-87(RESET)	-143.5180	-143.5175	0.0005	0.045	0.0
RL-E9	RL-F9	94.5310	94.4878	-0.0432	0.062	0.7
RL-F9	F-87	-128.6960	-128.6942	0.0018	0.049	0.0
RL-F9	RL-F21	-43.8030	-43.8501	-0.0471	0.063	0.8
RL-F21	K-4	86.9830	86.9179	-0.0651	0.071	0.9
ML-L28	M-4	38.8520	38.8368	-0.0152	0.062	0.2
M-4	N-4	43.3520	43.4090	0.0570	0.042	1.3
RL-F21	RL-J17	11.2730	11.2766	0.0036	0.066	0.1
RL-J17	TP4-35	29.9130	29.9360	0.0230	0.069	0.3
TP4-35	RL-H12	65.5620	65.5843	0.0223	0.068	0.3
RL-H12	RL-J17	-95.5360	-95.5203	0.0157	0.062	0.3
RL-H12	M-87	-201.4210	-201.4180	0.0030	0.061	0.0

Error Propagation

=====

Station Elevation Standard Deviations

Station	Elevation	Std Dev
B-87(RESET)	611.3600	0.000
F-87	720.6710	0.000
K-4	892.4330	0.000
M-4	934.3060	0.000
M-87	710.8940	0.000
MILL	1068.5710	0.000
N-4	977.7150	0.000
V-86	672.2520	0.000
W-86	678.7060	0.000
X-86	694.1690	0.000
ML-A15	665.4787	0.012
ML-AB10	789.4111	0.025
RL-B3	750.8651	0.022
ML-B12	825.2501	0.041
ML-B20	870.2551	0.048
ML-B26	875.0848	0.047
RBM	887.9911	0.043
ML-D5	1047.5542	0.034
ML-L11	1001.7384	0.046
ML-L28	895.4692	0.044
K4	892.3372	0.045
RL-E9	754.8775	0.028
RL-F9	849.3652	0.032
RL-F21	805.5151	0.041
RL-J17	816.7917	0.051
TP4-35	846.7277	0.061
RL-H12	912.3120	0.046

Computed Milwaukee River Watershed Elevations - NGVD 29

PROGRAM DESIGN BY: EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 3/95

PROGRAM: LEVELINE - VERSION 1.03
INPUT DATA FILE: ADJ29MR2.DAT
PROGRAM RESULTS FILE: ADJ29MR2.ASC

COMPUTATION OF ABSTRACTED/ADJUSTED ELEVATIONS ALONG EXISTING LINES.

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 10, 1995

AGENCY: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
PROJECT: MILWAUKEE RIVER WATERSHED LEVEL LINES - NGVD 29

BM/TP	SPC x DIST(FT)	SPC Y ACCUM DIST	PRE. EL. DIFF EL	ADJ. EL.	METERS
BEGINNING BENCHMARK DATA:					
F-87	2565100.	537407.		720.812	219.704
F-87	2565100.	537407.	720.812	720.812	219.704
	2498.	2498.	47.241		
ML-FL	2562640.	537840.	768.053	768.055	234.104
	2560.	5058.	-10.276		
ML-F2	2562680.	540400.	-57.777	757.780	230.972
	2605.	7663.	9.120		
ML-F3	2562520.	543000.	766.897	766.902	233.752
	2560.	10223.	14.119		
ML-F4	2559960.	543040.	781.016	781.023	238.056
	2640.	12864.	-15.495		
ML-F5	2557320.	543000.	765.521	765.529	233.334
	2441.	15305.	33.492		
ML-F6	2554880.	542920.	799.013	799.023	243.543
	3000.	18305.	13.769		
ML-F7	2551880.	542880.	812.782	812.794	247.740
	2563.	20868.	14.109		
ML-F8	2549320.	542760.	826.891	826.904	252.041
	2571.	23439.	22.617		
RL-F9	2546760.	542520.	849.508	849.523	258.935

ENDING BENCHMARK DATA:
RL-F9 2546760. 542520. 849.523 849.523

TOTAL MISCLOSURE = -.015
COMPUTED DIFFERENCE IN ELEVATION = 128.696
PUBLISHED DIFFERENCE IN ELEVATION = 128.711

TOTAL DISTANCE ALONG LINE = 23439. FT
CORRECTION PER 1000 FEET = .000640 FT

BEGINNING BENCHMARK DATA:					
RL-F9	2546760.	542520.		849.523	258.935
RL-F9	2546760.	542520.	849.523	849.523	258.935
	2801.	2801.	-37.165		
ML-F10	2543960.	542440.	812.358	812.354	247.606
	2805.	5606.	33.005		
ML-F11	2541160.	542280.	845.363	845.355	257.665
	3206.	8812.	-60.702		
ML-F12	2537960.	542080.	784.661	784.649	239.161
	1960.	10772.	81.485		

ML-F13	2536000.	542080.	866.146	866.131	263.997
	1882.	12654.	-51.630		
ML-F14	2534120.	542000.	814.516	814.498	248.260
	3284.	15938.	43.545		
ML-F15	2530840.	541840.	858.061	858.039	261.531
	2601.	18539.	30.582		
ML-F16	2528240.	541760.	888.643	888.617	270.851
	2680.	21219.	-45.217		
ML-F17	2525560.	541760.	843.426	843.396	257.068
	2683.	23901.	1.430		
ML-F18	2522880.	541640.	844.856	844.822	257.502
	2881.	26783.	-36.575		
ML-F19	2520000.	541550.	808.281	808.243	246.353
	3500.	30283.	-2.800		
ML-F20	2516500.	541500.	805.481	805.438	245.498
	1651.	31934.	.239		
RL-F21	2514850.	541450.	805.720	805.675	245.570

ENDING BENCHMARK DATA:

RL-F21	2514850.	541450.	805.675	805.675
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .045
 COMPUTED DIFFERENCE IN ELEVATION = -43.803
 PUBLISHED DIFFERENCE IN ELEVATION = -43.848

TOTAL DISTANCE ALONG LINE = 31934. FT
 CORRECTION PER 1000 FEET = -.001409 FT

BEGINNING BENCHMARK DATA:

RL-F21	2514850.	541450.		805.675	245.570
RL-F21	2514850.	541450.	805.675	805.675	245.570
	2650.	2650.	41.227		
ML-F22	2514850.	538800.	846.902	846.900	258.135
	2650.	5300.	3.781		
ML-F23	2514900.	536150.	850.683	850.678	259.287
	2702.	8002.	44.055		
ML-F24	2515000.	533450.	894.738	894.731	272.714
	2700.	10702.	.530		
ML-F25	2515000.	530750.	895.268	895.258	272.875
	2650.	13352.	13.194		
ML-F26	2512350.	530750.	908.462	908.449	276.896
	2650.	16003.	-35.294		
ML-F27	2509700.	530800.	873.168	873.153	266.138
	2650.	18653.	-17.287		
ML-F28	2509700.	528150.	855.881	855.864	260.868
	2650.	21303.	9.125		
ML-F29	2509700.	525500.	865.006	864.986	263.648
	2650.	23953.	.815		
ML-F30	2507050.	525550.	865.821	865.799	263.896
	2650.	26603.	-3.408		
ML-F31	2504400.	525550.	862.413	862.388	262.856
	2650.	29253.	-4.414		
ML-F32	2501750.	525550.	857.999	857.972	261.510
	2700.	31954.	20.239		
ML-F33	2499050.	525500.	878.238	878.208	267.678
	2600.	34554.	2.184		
ML-F34	2496450.	525450.	880.422	880.390	268.343
	2800.	37355.	5.049		
ML-F35	2493650.	525500.	885.471	885.436	269.881
	2550.	39905.	25.150		
ML-F36	2491100.	525450.	910.621	910.584	277.546
	2850.	42756.	-22.162		
ML-F37	2488250.	525400.	888.459	888.419	270.791
	2452.	45208.	51.981		
ML-F38	2485800.	525300.	940.440	940.398	286.634
	2841.	48049.	-47.782		
K-4	2482960.	525235.	892.658	892.613	272.069

ENDING BENCHMARK DATA:

K-4 2482960. 525235. 892.613 892.613

TOTAL MISCLOSURE = .045

COMPUTED DIFFERENCE IN ELEVATION = 86.983

PUBLISHED DIFFERENCE IN ELEVATION = 86.938

TOTAL DISTANCE ALONG LINE = 48049. FT

CORRECTION PER 1000 FEET = -.000937 FT

Computed Milwaukee River Watershed Elevations - NAVD 88

PROGRAM DESIGN BY:

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 3/95

PROGRAM: LEVELINE - VERSION 1.03
INPUT DATA FILE: ADJ88MR2.DAT
PROGRAM RESULTS FILE: ADJ88MR2.ASC

COMPUTATION OF ABSTRACTED/ADJUSTED ELEVATIONS ALONG EXISTING LINES.

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 10, 1995

AGENCY: SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
PROJECT: MILWAUKEE RIVER WATERSHED LEVEL LINES - NAVD 88

BM/TP	SPC X DIST(FT)	SPC Y ACCUM DIST	PRE. EL. DIFF EL	ADJ. EL.	METERS
-------	-------------------	---------------------	---------------------	----------	--------

BEGINNING BENCHMARK DATA:

F-87	2565100.	537407.		720.671	219.661
F-87	2565100.	537407.	720.671	720.671	219.661
	2498.	2498.	47.241		
ML-F1	2562640.	537840.	767.912	767.912	234.060
	2560.	5058.	-10.276		
ML-F2	2562680.	540400.	757.636	757.636	230.928
	2605.	7663.	9.120		
ML-F3	2562520.	543000.	766.756	766.755	233.708
	2560.	10223.	14.119		
ML-F4	2559960.	543040.	780.875	780.874	238.011
	2640.	12864.	-15.495		
ML-F5	2557320.	543000.	765.380	765.379	233.288
	2441.	15305.	33.492		
ML-F6	2554880.	542920.	798.872	798.871	243.496
	3000.	18305.	13.769		
ML-F7	2551880.	542880.	812.641	812.639	247.693
	2563.	20868.	14.109		
ML-F8	2549320.	542760.	826.750	826.748	251.993
	2571.	23439.	22.617		
RL-F9	2546760.	542520.	849.367	849.365	258.887

ENDING BENCHMARK DATA:

RL-F9	2546760.	542520.	849.365	849.365	
-------	----------	---------	---------	---------	--

TOTAL MISCLOSURE = .002
COMPUTED DIFFERENCE IN ELEVATION = 128.696
PUBLISHED DIFFERENCE IN ELEVATION = 128.694

TOTAL DISTANCE ALONG LINE = 23439. FT
CORRECTION PER 1000 FEET = -.000085 FT

BEGINNING BENCHMARK DATA:

RL-F9	2546760.	542520.		849.365	258.887
RL-F9	2546760.	542520.	849.365	849.365	258.887
	2801.	2801.	-37.165		
ML-F10	2543960.	542440.	812.200	812.196	247.558
	2805.	5606.	33.005		
ML-F11	2541160.	542280.	845.205	845.197	257.616
	3206.	8812.	-60.702		
ML-F12	2537960.	542080.	784.503	784.490	239.113
	1960.	10772.	81.485		
ML-F13	2536000.	542080.	865.988	865.972	263.949
	1882.	12654.	-51.630		

ML-F14	2534120. 3284.	542000. 15938.	814.358 43.545	814.339	248.211
ML-F15	2530840. 2601.	541840. 18539.	857.903 30.582	857.880	261.482
ML-F16	2528240. 2680.	541760. 21219.	888.485 -45.217	888.458	270.802
ML-F17	2525560. 2683.	541760. 23901.	843.268 1.430	843.237	257.019
ML-F18	2522880. 2881.	541640. 26783.	844.698 -36.575	844.663	257.454
ML-F19	2520000. 3500.	541550. 30283.	808.123 -2.800	808.084	246.304
ML-F20	2516500. 1651.	541500. 31934.	805.323 .239	805.278	245.449
RL-F21'	2514850.	541450.	805.562	805.515	245.521

ENDING BENCHMARK DATA:

RL-F21	2514850.	541450.	805.515	805.515
--------	----------	---------	---------	---------

TOTAL MISCLOSURE = .047
 COMPUTED DIFFERENCE IN ELEVATION = -43.803
 PUBLISHED DIFFERENCE IN ELEVATION = -43.850

TOTAL DISTANCE ALONG LINE = 31934. FT
 CORRECTION PER 1000 FEET = -.001472 FT

BEGINNING BENCHMARK DATA:

RL-F21	2514850.	541450.		805.515	245.521
RL-F21	2514850. 2650.	541450. 2650.	805.515 41.227	805.515	245.521
ML-F22	2514850. 2650.	538800. 5300.	846.742 3.781	846.738	258.086
ML-F23	2514900. 2702.	536150. 8002.	850.523 44.055	850.516	259.238
ML-F24	2515000. 2700.	533450. 10702.	894.578 .530	894.567	272.665
ML-F25	2515000. 2650.	530750. 13352.	895.108 13.194	895.094	272.825
ML-F26	2512350. 2650.	530750. 16003.	908.302 -35.294	908.284	276.846
ML-F27	2509700. 2650.	530800. 18653.	873.008 -17.287	872.986	266.087
ML-F28	2509700. 2650.	528150. 21303.	855.721 9.125	855.696	260.817
ML-F29	2509700. 2650.	525500. 23953.	864.846 .815	864.817	263.597
ML-F30	2507050. 2650.	525550. 26603.	865.661 -3.408	865.629	263.844
ML-F31	2504400. 2650.	525550. 29253.	862.253 -4.414	862.217	262.804
ML-F32	2501750. 2700.	525550. 31954.	857.839 20.239	857.799	261.458
ML-F33	2499050. 2600.	525500. 34554.	878.078 2.184	878.035	267.626
ML-F34	2496450. 2800.	525450. 37355.	880.262 5.049	880.215	268.290
ML-F35	2493650. 2550.	525500. 39905.	885.311 25.150	885.260	269.828
ML-F36	2491100. 2850.	525450. 42756.	910.461 -22.162	910.407	277.493
ML-F37	2488250. 2452.	525400. 45208.	888.299 51.981	888.241	270.736
ML-F38	2485800. 2841.	525300. 48049.	940.280 -47.782	940.219	286.579
K-4'	2482960.	525235.	892.498	892.433	272.014

ENDING BENCHMARK DATA:

K-4	2482960.	525235.	892.433	892.433
-----	----------	---------	---------	---------

TOTAL MISCLOSURE =	.065
COMPUTED DIFFERENCE IN ELEVATION =	86.983
PUBLISHED DIFFERENCE IN ELEVATION =	86.918

TOTAL DISTANCE ALONG LINE =	48049. FT
CORRECTION PER 1000 FEET =	-.001353 FT

**Data Set: Second Order Benchmarks - Milwaukee River Watershed
Adjusted Elevations on NGVD 29 and NAVD 88**

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
43 27 21.88927	87 52 50.87836	ML-F1	ALSTER68	2	234.060	234.104
43 27 47.15656	87 52 49.45406	ML-F2	ALSTER68	2	230.928	230.972
43 28 12.86897	87 52 50.72701	ML-F3	ALSTER68	2	233.708	233.752
43 28 13.90502	87 53 25.41887	ML-F4	ALSTER68	2	238.011	238.056
43 28 14.16812	87 54 1.22294	ML-F5	ALSTER68	2	233.288	233.334
43 28 13.98364	87 54 34.32929	ML-F6	ALSTER68	2	243.496	243.543
43 28 14.32943	87 55 15.01401	ML-F7	ALSTER68	2	247.693	247.740
43 28 13.77347	87 55 49.76063	ML-F8	ALSTER68	2	251.993	252.041
43 28 12.02969	87 56 24.54727	RL-F9	ALSTER68	2	258.887	258.935
43 28 11.92111	87 57 2.53370	ML-F10	ALSTER68	2	247.558	247.606
43 28 11.01908	87 57 40.54662	ML-F11	ALSTER68	2	257.616	257.665
43 28 9.81463	87 58 23.99522	ML-F12	ALSTER68	2	239.113	239.161
43 28 10.28424	87 58 50.56703	ML-F13	ALSTER68	2	263.949	263.997
43 28 9.94313	87 59 16.08056	ML-F14	ALSTER68	2	248.211	248.259
43 28 9.14253	88 0 .59997	ML-F15	ALSTER68	2	261.482	261.531
43 28 8.96690	88 0 35.87436	ML-F16	ALSTER68	2	270.802	270.851
43 28 9.59696	88 1 12.20751	ML-F17	ALSTER68	2	257.019	257.068
43 28 9.03890	88 1 48.57931	ML-F18	ALSTER68	2	257.454	257.502
43 28 8.82026	88 2 27.65280	ML-F19	ALSTER68	2	246.304	246.353
43 28 9.13587	88 3 15.11906	ML-F20	ALSTER68	2	245.449	245.498
43 28 9.02179	88 3 37.50439	RL-F21	ALSTER68	2	245.521	245.570
43 27 42.85447	88 3 38.34009	ML-F22	ALSTER68	2	258.086	258.135
43 27 16.67561	88 3 38.49789	ML-F23	ALSTER68	2	259.238	259.287
43 26 49.99152	88 3 37.99380	ML-F24	ALSTER68	2	272.665	272.714
43 26 23.33035	88 3 38.84490	ML-F25	ALSTER68	2	272.825	272.875
43 26 23.93743	88 4 14.75450	ML-F26	ALSTER68	2	276.846	276.896
43 26 25.03511	88 4 50.64870	ML-F27	ALSTER68	2	266.087	266.138
43 25 58.86749	88 4 51.47526	ML-F28	ALSTER68	2	260.817	260.868
43 25 32.69983	88 4 52.30162	ML-F29	ALSTER68	2	263.597	263.648
43 25 33.79424	88 5 28.18760	ML-F30	ALSTER68	2	263.844	263.896
43 25 34.39179	88 6 4.08937	ML-F31	ALSTER68	2	262.804	262.856
43 25 34.98621	88 6 39.99134	ML-F32	ALSTER68	2	261.458	261.510
43 25 35.09489	88 7 16.58616	ML-F33	ALSTER68	2	267.626	267.678
43 25 35.17819	88 7 51.82622	ML-F34	ALSTER68	2	268.290	268.343
43 25 36.28998	88 8 29.74572	ML-F35	ALSTER68	2	269.828	269.881
43 25 36.35607	88 9 4.30858	ML-F36	ALSTER68	2	277.493	277.546
43 25 36.48459	88 9 42.93594	ML-F37	ALSTER68	2	270.736	270.791
43 25 36.02913	88 10 16.15889	ML-F38	ALSTER68	2	286.579	286.634
43 23 53.73139	88 12 49.62267	ML-L11	ALSTER68	2	305.330	305.381
43 20 19.78050	88 13 17.55834	ML-D5	ALSTER68	2	319.295	319.348
43 19 27.09544	88 10 51.60070	RBM	ALSTER68	2	270.660	270.714
43 19 24.85274	88 08 32.28989	ML-B26	ALSTER68	2	266.726	266.780
43 20 13.06498	88 04 21.77418	ML-B20	ALSTER68	2	265.254	265.309
43 20 39.78234	88 00 22.40766	ML-B12	ALSTER68	2	251.537	251.592
43 19 11.62656	87 57 00.15441	RL-B3	ALSTER68	2	228.864	228.921
43 17 49.38237	87 59 11.15574	ML-AB10	ALSTER68	2	240.613	240.673
43 22 54.85547	87 56 12.53427	RL-E9	ALSTER68	2	230.087	230.143
43 33 23.45635	88 02 25.63834	RL-J17	ALSTER68	2	248.959	249.003
43 34 19.87320	87 56 25.09253	RL-H12	ALSTER68	2	278.073	278.115

Data Set: Second Order Benchmarks - Milwaukee River Watershed
Published Elevations on NGVD 29 and Adjusted Elevations on NAVD 88

Latitude	Longitude	Name	Agency	Order	NAVD 88	NGVD 29
43 27 21.88927	87 52 50.87836	ML-F1	ALSTER68	2	234.060	234.102
43 27 47.15656	87 52 49.45406	ML-F2	ALSTER68	2	230.928	230.970
43 28 12.86897	87 52 50.72701	ML-F3	ALSTER68	2	233.708	233.749
43 28 13.90502	87 53 25.41887	ML-F4	ALSTER68	2	238.011	238.052
43 28 14.16812	87 54 1.22294	ML-F5	ALSTER68	2	233.288	233.328
43 28 13.98364	87 54 34.32929	ML-F6	ALSTER68	2	243.496	243.536
43 28 14.32943	87 55 15.01401	ML-F7	ALSTER68	2	247.693	247.733
43 28 13.77347	87 55 49.76063	ML-F8	ALSTER68	2	251.993	252.033
43 28 12.02969	87 56 24.54727	RL-F9	ALSTER68	2	258.887	258.926
43 28 11.92111	87 57 2.53370	ML-F10	ALSTER68	2	247.558	247.597
43 28 11.01908	87 57 40.54662	ML-F11	ALSTER68	2	257.616	257.656
43 28 9.81463	87 58 23.99522	ML-F12	ALSTER68	2	239.113	239.154
43 28 10.28424	87 58 50.56703	ML-F13	ALSTER68	2	263.949	263.990
43 28 9.94313	87 59 16.08056	ML-F14	ALSTER68	2	248.211	248.252
43 28 9.14253	88 0 .59997	ML-F15	ALSTER68	2	261.482	261.524
43 28 8.96690	88 0 35.87436	ML-F16	ALSTER68	2	270.802	270.845
43 28 9.59696	88 1 12.20751	ML-F17	ALSTER68	2	257.019	257.061
43 28 9.03890	88 1 48.57931	ML-F18	ALSTER68	2	257.454	257.497
43 28 8.82026	88 2 27.65280	ML-F19	ALSTER68	2	246.304	246.349
43 28 9.13587	88 3 15.11906	ML-F20	ALSTER68	2	245.449	245.495
43 28 9.02179	88 3 37.50439	RL-F21	ALSTER68	2	245.521	245.567
43 27 42.85447	88 3 38.34009	ML-F22	ALSTER68	2	258.086	258.133
43 27 16.67561	88 3 38.49789	ML-F23	ALSTER68	2	259.238	259.284
43 26 49.99152	88 3 37.99380	ML-F24	ALSTER68	2	272.665	272.712
43 26 23.33035	88 3 38.84490	ML-F25	ALSTER68	2	272.825	272.873
43 26 23.93743	88 4 14.75450	ML-F26	ALSTER68	2	276.846	276.894
43 26 25.03511	88 4 50.64870	ML-F27	ALSTER68	2	266.087	266.135
43 25 58.86749	88 4 51.47526	ML-F28	ALSTER68	2	260.817	260.866
43 25 32.69983	88 4 52.30162	ML-F29	ALSTER68	2	263.597	263.647
43 25 33.79424	88 5 28.18760	ML-F30	ALSTER68	2	263.844	263.894
43 25 34.39179	88 6 4.08937	ML-F31	ALSTER68	2	262.804	262.855
43 25 34.98621	88 6 39.99134	ML-F32	ALSTER68	2	261.458	261.509
43 25 35.09489	88 7 16.58616	ML-F33	ALSTER68	2	267.626	267.677
43 25 35.17819	88 7 51.82622	ML-F34	ALSTER68	2	268.290	268.343
43 25 36.28998	88 8 29.74572	ML-F35	ALSTER68	2	269.828	269.881
43 25 36.35607	88 9 4.30858	ML-F36	ALSTER68	2	277.493	277.546
43 25 36.48459	88 9 42.93594	ML-F37	ALSTER68	2	270.736	270.791
43 25 36.02913	88 10 16.15889	ML-F38	ALSTER68	2	286.579	286.634
43 23 53.73139	88 12 49.62267	ML-L11	ALSTER68	2	305.330	305.392
43 20 19.78050	88 13 17.55834	ML-D5	ALSTER68	2	319.295	319.348
43 19 27.09544	88 10 51.60070	RBM	ALSTER68	2	270.660	270.718
43 19 24.85274	88 08 32.28989	ML-B26	ALSTER68	2	266.726	266.778
43 20 13.06498	88 04 21.77418	ML-B20	ALSTER68	2	265.254	265.305
43 20 39.78234	88 00 22.40766	ML-B12	ALSTER68	2	251.537	251.592
43 19 11.62656	87 57 00.15441	RL-B3	ALSTER68	2	228.864	228.923
43 17 49.38237	87 59 11.15574	ML-AB10	ALSTER68	2	240.613	240.676
43 22 54.85547	87 56 12.53427	RL-E9	ALSTER68	2	230.087	230.150
43 33 23.45635	88 02 25.63834	RL-J17	ALSTER68	2	248.959	249.003
43 34 19.87320	87 56 25.09253	RL-H12	ALSTER68	2	278.073	278.123

VERTCON Version 2.0 Results (Meters) for Milwaukee River Watershed Benchmarks

Note: Input file for VERTCON is in Free Format #2 and is the same (without headers) as the input file for COMPARE program. The VERTCON program adds the "meters" column of numbers. This VERTCON output file is also required by the COMPARE program.

Latitude	Longitude	Meters	Name	Agency	Order
43 27 21.88927	87 52 50.87836	-.041	ML-F1	ALSTER68	2
43 27 47.15656	87 52 49.45406	-.041	ML-F2	ALSTER68	2
43 28 12.86897	87 52 50.72701	-.040	ML-F3	ALSTER68	2
43 28 13.90502	87 53 25.41887	-.040	ML-F4	ALSTER68	2
43 28 14.16812	87 54 1.22294	-.039	ML-F5	ALSTER68	2
43 28 13.98364	87 54 34.32929	-.039	ML-F6	ALSTER68	2
43 28 14.32943	87 55 15.01401	-.039	ML-F7	ALSTER68	2
43 28 13.77347	87 55 49.76063	-.039	ML-F8	ALSTER68	2
43 28 12.02969	87 56 24.54727	-.040	RL-F9	ALSTER68	2
43 28 11.92111	87 57 2.53370	-.040	ML-F10	ALSTER68	2
43 28 11.01908	87 57 40.54662	-.040	ML-F11	ALSTER68	2
43 28 9.81463	87 58 23.99522	-.040	ML-F12	ALSTER68	2
43 28 10.28424	87 58 50.56703	-.039	ML-F13	ALSTER68	2
43 28 9.94313	87 59 16.08056	-.039	ML-F14	ALSTER68	2
43 28 9.14253	88 0 .59997	-.039	ML-F15	ALSTER68	2
43 28 8.96690	88 0 35.87436	-.040	ML-F16	ALSTER68	2
43 28 9.59696	88 1 12.20751	-.041	ML-F17	ALSTER68	2
43 28 9.03890	88 1 48.57931	-.042	ML-F18	ALSTER68	2
43 28 8.82026	88 2 27.65280	-.043	ML-F19	ALSTER68	2
43 28 9.13587	88 3 15.11906	-.044	ML-F20	ALSTER68	2
43 28 9.02179	88 3 37.50439	-.044	RL-F21	ALSTER68	2
43 27 42.85447	88 3 38.34009	-.045	ML-F22	ALSTER68	2
43 27 16.67561	88 3 38.49789	-.046	ML-F23	ALSTER68	2
43 26 49.99152	88 3 37.99380	-.047	ML-F24	ALSTER68	2
43 26 23.33035	88 3 38.84490	-.047	ML-F25	ALSTER68	2
43 26 23.93743	88 4 14.75450	-.047	ML-F26	ALSTER68	2
43 26 25.03511	88 4 50.64870	-.048	ML-F27	ALSTER68	2
43 25 58.86749	88 4 51.47526	-.048	ML-F28	ALSTER68	2
43 25 32.69983	88 4 52.30162	-.048	ML-F29	ALSTER68	2
43 25 33.79424	88 5 28.18760	-.049	ML-F30	ALSTER68	2
43 25 34.39179	88 6 4.08937	-.049	ML-F31	ALSTER68	2
43 25 34.98621	88 6 39.99134	-.050	ML-F32	ALSTER68	2
43 25 35.09489	88 7 16.58616	-.050	ML-F33	ALSTER68	2
43 25 35.17819	88 7 51.82622	-.050	ML-F34	ALSTER68	2
43 25 36.28998	88 8 29.74572	-.051	ML-F35	ALSTER68	2
43 25 36.35607	88 9 4.30858	-.051	ML-F36	ALSTER68	2
43 25 36.48459	88 9 42.93594	-.052	ML-F37	ALSTER68	2
43 25 36.02913	88 10 16.15889	-.052	ML-F38	ALSTER68	2
43 23 53.73139	88 12 49.62267	-.053	ML-L11	ALSTER68	2
43 20 19.78050	88 13 17.55834	-.055	ML-D5	ALSTER68	2
43 19 27.09544	88 10 51.60070	-.061	RBM	ALSTER68	2
43 19 24.85274	88 08 32.28989	-.062	ML-B26	ALSTER68	2
43 20 13.06498	88 04 21.77418	-.058	ML-B20	ALSTER68	2
43 20 39.78234	88 00 22.40766	-.054	ML-B12	ALSTER68	2
43 19 11.62656	87 57 00.15441	-.057	RL-B3	ALSTER68	2
43 17 49.38237	87 59 11.15574	-.060	ML-AB10	ALSTER68	2
43 22 54.85547	87 56 12.53427	-.049	RL-E9	ALSTER68	2
43 33 23.45635	88 02 25.63834	-.029	RL-J17	ALSTER68	2
43 34 19.87320	87 56 25.09253	-.018	RL-H12	ALSTER68	2

Difference of Differences for Milwaukee River Watershed - Option 1

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 12/94

PROGRAM COMPARE - VERSION 1.03
MASTER DATA FILE: MILRIV21.DAT
VERTCON INPUT FILE: VCON29MR.OUT
PROGRAM RESULTS FILE: MILRIV21.ASC

COMPARISON OF VERTCON PREDICTED DATUM DIFFERENCES WITH DIFFERENCE BETWEEN ADJUSTED
NAVD 88 ELEVATIONS AND ADJUSTED NGVD 29 ELEVATIONS.

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 12, 1995

PROJECT: DIFFERENCES IN MILWAUKEE RIVER WATERSHED AREA

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
ML-F1	ALSTER68	2					
43 27 21.9	2562640.	234.060	767.912				
87 52 50.9	537840.	234.104	768.056	-.144	-.135	-.010	
ML-F2	ALSTER68	2					
43 27 47.2	2562680.	230.928	757.636				
87 52 49.5	540400.	230.972	757.781	-.144	-.135	-.010	
ML-F3	ALSTER68	2					
43 28 12.9	2562520.	233.708	766.757				
87 52 50.7	543000.	233.752	766.901	-.144	-.131	-.013	
ML-F4	ALSTER68	2					
43 28 13.9	2559960.	238.011	780.874				
87 53 25.4	543040.	238.056	781.022	-.148	-.131	-.016	
ML-F5	ALSTER68	2					
43 28 14.2	2557320.	233.288	765.379				
87 54 1.2	543000.	233.334	765.530	-.151	-.128	-.023	
ML-F6	ALSTER68	2					
43 28 14.0	2554880.	243.496	798.870				
87 54 34.3	542920.	243.543	799.024	-.154	-.128	-.026	
ML-F7	ALSTER68	2					
43 28 14.3	2551880.	247.693	812.639				
87 55 15.0	542880.	247.740	812.794	-.154	-.128	-.026	
ML-F8	ALSTER68	2					
43 28 13.8	2549320.	251.993	826.747				
87 55 49.8	542760.	252.041	826.905	-.157	-.128	-.030	
RL-F9	ALSTER68	2					
43 28 12.0	2546760.	258.887	849.365				
87 56 24.5	542520.	258.935	849.523	-.157	-.131	-.026	
ML-F10	ALSTER68	2					
43 28 11.9	2543960.	247.558	812.197				
87 57 2.5	542440.	247.606	812.354	-.157	-.131	-.026	

ML-F11	ALSTER68	2					
43 28 11.0	2541160.	257.616	845.195				
87 57 40.5	542280.	257.665	845.356	-.161	-.131	-.030	
ML-F12	ALSTER68	2					
43 28 9.8	2537960.	239.113	784.490				
87 58 24.0	542080.	239.161	784.647	-.157	-.131	-.026	
ML-F13	ALSTER68	2					
43 28 10.3	2536000.	263.949	865.973				
87 58 50.6	542080.	263.997	866.130	-.157	-.128	-.030	
ML-F14	ALSTER68	2					
43 28 9.9	2534120.	248.211	814.339				
87 59 16.1	542000.	248.259	814.496	-.157	-.128	-.030	
ML-F15	ALSTER68	2					
43 28 9.1	2530840.	261.482	857.879				
88 0 .6	541840.	261.531	858.040	-.161	-.128	-.033	
ML-F16	ALSTER68	2					
43 28 9.0	2528240.	270.802	888.456				
88 0 35.9	541760.	270.851	888.617	-.161	-.131	-.030	
ML-F17	ALSTER68	2					
43 28 9.6	2525560.	257.019	843.237				
88 1 12.2	541760.	257.068	843.397	-.161	-.135	-.026	
ML-F18	ALSTER68	2					
43 28 9.0	2522880.	257.454	844.664				
88 1 48.6	541640.	257.502	844.821	-.157	-.138	-.020	
ML-F19	ALSTER68	2					
43 28 8.8	2520000.	246.304	808.082				
88 2 27.7	541550.	246.353	808.243	-.161	-.141	-.020	
ML-F20	ALSTER68	2					
43 28 9.1	2516500.	245.449	805.277				
88 3 15.1	541500.	245.498	805.438	-.161	-.144	-.016	
RL-F21	ALSTER68	2					
43 28 9.0	2514850.	245.521	805.513				
88 3 37.5	541450.	245.570	805.674	-.161	-.144	-.016	
ML-F22	ALSTER68	2					
43 27 42.9	2514850.	258.086	846.737				
88 3 38.3	538800.	258.135	846.898	-.161	-.148	-.013	
ML-F23	ALSTER68	2					
43 27 16.7	2514900.	259.238	850.517				
88 3 38.5	536150.	259.287	850.677	-.161	-.151	-.010	
ML-F24	ALSTER68	2					
43 26 50.0	2515000.	272.665	894.568				
88 3 38.0	533450.	272.714	894.729	-.161	-.154	-.007	
ML-F25	ALSTER68	2					
43 26 23.3	2515000.	272.825	895.093				
88 3 38.8	530750.	272.875	895.257	-.164	-.154	-.010	
ML-F26	ALSTER68	2					
43 26 23.9	2512350.	276.846	908.286				
88 4 14.8	530750.	276.896	908.450	-.164	-.154	-.010	
ML-F27	ALSTER68	2					
43 26 25.0	2509700.	266.087	872.987				
88 4 50.6	530800.	266.138	873.154	-.167	-.157	-.010	
ML-F28	ALSTER68	2					
43 25 58.9	2509700.	260.817	855.697				
88 4 51.5	528150.	260.868	855.864	-.167	-.157	-.010	

ML-F29	ALSTER68	2					
43 25 32.7	2509700.	263.597	864.818				
88 4 52.3	525500.	263.648	864.985	-.167	-.157	-.010	
ML-F30	ALSTER68	2					
43 25 33.8	2507050.	263.844	865.628				
88 5 28.2	525550.	263.896	865.799	-.171	-.161	-.010	
ML-F31	ALSTER68	2					
43 25 34.4	2504400.	262.804	862.216				
88 6 4.1	525550.	262.856	862.387	-.171	-.161	-.010	
ML-F32	ALSTER68	2					
43 25 35.0	2501750.	261.458	857.800				
88 6 40.0	525550.	261.510	857.971	-.171	-.164	-.007	
ML-F33	ALSTER68	2					
43 25 35.1	2499050.	267.626	878.036				
88 7 16.6	525500.	267.678	878.207	-.171	-.164	-.007	
ML-F34	ALSTER68	2					
43 25 35.2	2496450.	268.290	880.215				
88 7 51.8	525450.	268.343	880.389	-.174	-.164	-.010	
ML-F35	ALSTER68	2					
43 25 36.3	2493650.	269.828	885.261				
88 8 29.7	525500.	269.881	885.435	-.174	-.167	-.007	
ML-F36	ALSTER68	2					
43 25 36.4	2491100.	277.493	910.408				
88 9 4.3	525450.	277.546	910.582	-.174	-.167	-.007	
ML-F37	ALSTER68	2					
43 25 36.5	2488250.	270.736	888.240				
88 9 42.9	525400.	270.791	888.420	-.180	-.171	-.010	
ML-F38	ALSTER68	2					
43 25 36.0	2485800.	286.579	940.218				
88 10 16.2	525300.	286.634	940.398	-.180	-.171	-.010	
ML-L11	ALSTER68	2					
43 23 53.7	2474700.	305.330	1001.737				
88 12 49.6	514700.	305.381	1001.904	-.167	-.174	.007	
ML-D5	ALSTER68	2					
43 20 19.8	2473100.	319.295	1047.554				
88 13 17.6	493000.	319.348	1047.728	-.174	-.180	.007	
RBM	ALSTER68	2					
43 19 27.1	2484000.	270.660	887.990				
88 10 51.6	487900.	270.714	888.168	-.177	-.200	.023	
ML-B26	ALSTER68	2					
43 19 24.9	2494300.	266.726	875.084				
88 8 32.3	487900.	266.780	875.261	-.177	-.203	.026	
ML-B20	ALSTER68	2					
43 20 13.1	2512700.	265.254	870.254				
88 4 21.8	493200.	265.309	870.435	-.180	-.190	.010	
ML-B12	ALSTER68	2					
43 20 39.8	2530320.	251.537	825.251				
88 0 22.4	496320.	251.592	825.431	-.180	-.177	-.003	
RL-B3	ALSTER68	2					
43 19 11.6	2545480.	228.864	750.865				
87 57 .2	487760.	228.921	751.052	-.187	-.187	.000	
ML-AB10	ALSTER68	2					
43 17 49.4	2536000.	240.613	789.411				
87 59 11.2	479200.	240.673	789.608	-.197	-.197	.000	

RL-E9	ALSTER68	2					
43 22 54.9	2548440.	230.087	754.877				
87 56 12.5	510440.	230.143	755.061	-.184	-.161	-.023	
RL-J17	ALSTER68	2					
43 33 23.5	2519400.	248.959	816.793				
88 2 25.6	573400.	249.003	816.937	-.144	-.095	-.049	
RL-H12	ALSTER68	2					
43 34 19.9	2545800.	278.073	912.311				
87 56 25.1	579750.	278.115	912.449	-.138	-.059	-.079	

Difference of Differences for Milwaukee River Watershed - Option 2

EARL F. BURKHOLDER, PLS, PE
CONSULTING GEODETIC ENGINEER
KLAMATH FALLS, OREGON 97601
EFB: 12/94

PROGRAM: COMPARE - VERSION 1.03
MASTER DATA FILE: MILRIV22.DAT
VERTCON INPUT FILE: VCON29MR.OUT
PROGRAM RESULTS FILE: MILRIV22.ASC

COMPARISON OF PREDICTED DATUM DIFFERENCES WITH DIFFERENCE BETWEEN ADJUSTED
NAVD 88 ELEVATIONS AND PUBLISHED NGVD 29 ELEVATIONS

USER: EARL F. BURKHOLDER
DATE: NOVEMBER 12, 1995

PROJECT: DIFFERENCES IN MILWAUKEE RIVER WATERSHED AREA

NAME	AGENCY	ORDER	PID				
LATITUDE	NAD27X	NAVD88	US SURV.	PUB	DIFF BY	FIT	
LONGITUDE	NAD27Y	NGVD29	FEET	DIFF	VERTCON	(feet)	
ML-F1	ALSTER68	2					
43 27 21.9	2562640.	234.060	767.912				
87 52 50.9	537840.	234.102	768.050	-.138	-.135	-.003	
ML-F2	ALSTER68	2					
43 27 47.2	2562680.	230.928	757.636				
87 52 49.5	540400.	230.970	757.774	-.138	-.135	-.003	
ML-F3	ALSTER68	2					
43 28 12.9	2562520.	233.708	766.757				
87 52 50.7	543000.	233.749	766.892	-.135	-.131	-.003	
ML-F4	ALSTER68	2					
43 28 13.9	2559960.	238.011	780.874				
87 53 25.4	543040.	238.052	781.009	-.135	-.131	-.003	
ML-F5	ALSTER68	2					
43 28 14.2	2557320.	233.288	765.379				
87 54 1.2	543000.	233.328	765.510	-.131	-.128	-.003	
ML-F6	ALSTER68	2					
43 28 14.0	2554880.	243.496	798.870				
87 54 34.3	542920.	243.536	799.001	-.131	-.128	-.003	
ML-F7	ALSTER68	2					
43 28 14.3	2551880.	247.693	812.639				
87 55 15.0	542880.	247.733	812.771	-.131	-.128	-.003	
ML-F8	ALSTER68	2					
43 28 13.8	2549320.	251.993	826.747				
87 55 49.8	542760.	252.033	826.878	-.131	-.128	-.003	
RL-F9	ALSTER68	2					
43 28 12.0	2546760.	258.887	849.365				
87 56 24.5	542520.	258.926	849.493	-.128	-.131	.003	
ML-F10	ALSTER68	2					
43 28 11.9	2543960.	247.558	812.197				
87 57 2.5	542440.	247.597	812.324	-.128	-.131	.003	
ML-F11	ALSTER68	2					
43 28 11.0	2541160.	257.616	845.195				
87 57 40.5	542280.	257.656	845.326	-.131	-.131	.000	

ML-F12	ALSTER68	2					
43 28 9.8	2537960.	239.113	784.490				
87 58 24.0	542080.	239.154	784.624	-.135	-.131	-.003	
ML-F13	ALSTER68	2					
43 28 10.3	2536000.	263.949	865.973				
87 58 50.6	542080.	263.990	866.107	-.135	-.128	-.007	
ML-F14	ALSTER68	2					
43 28 9.9	2534120.	248.211	814.339				
87 59 16.1	542000.	248.252	814.473	-.135	-.128	-.007	
ML-F15	ALSTER68	2					
43 28 9.1	2530840.	261.482	857.879				
88 0 .6	541840.	261.524	858.017	-.138	-.128	-.010	
ML-F16	ALSTER68	2					
43 28 9.0	2528240.	270.802	888.456				
88 0 35.9	541760.	270.845	888.597	-.141	-.131	-.010	
ML-F17	ALSTER68	2					
43 28 9.6	2525560.	257.019	843.237				
88 1 12.2	541760.	257.061	843.374	-.138	-.135	-.003	
ML-F18	ALSTER68	2					
43 28 9.0	2522880.	257.454	844.664				
88 1 48.6	541640.	257.497	844.805	-.141	-.138	-.003	
ML-F19	ALSTER68	2					
43 28 8.8	2520000.	246.304	808.082				
88 2 27.7	541550.	246.349	808.230	-.148	-.141	-.007	
ML-F20	ALSTER68	2					
43 28 9.1	2516500.	245.449	805.277				
88 3 15.1	541500.	245.495	805.428	-.151	-.144	-.007	
RL-F21	ALSTER68	2					
43 28 9.0	2514850.	245.521	805.513				
88 3 37.5	541450.	245.567	805.664	-.151	-.144	-.007	
ML-F22	ALSTER68	2					
43 27 42.9	2514850.	258.086	846.737				
88 3 38.3	538800.	258.133	846.891	-.154	-.148	-.007	
ML-F23	ALSTER68	2					
43 27 16.7	2514900.	259.238	850.517				
88 3 38.5	536150.	259.284	850.668	-.151	-.151	.000	
ML-F24	ALSTER68	2					
43 26 50.0	2515000.	272.665	894.568				
88 3 38.0	533450.	272.712	894.723	-.154	-.154	.000	
ML-F25	ALSTER68	2					
43 26 23.3	2515000.	272.825	895.093				
88 3 38.8	530750.	272.873	895.251	-.157	-.154	-.003	
ML-F26	ALSTER68	2					
43 26 23.9	2512350.	276.846	908.286				
88 4 14.8	530750.	276.894	908.443	-.157	-.154	-.003	
ML-F27	ALSTER68	2					
43 26 25.0	2509700.	266.087	872.987				
88 4 50.6	530800.	266.135	873.145	-.157	-.157	.000	
ML-F28	ALSTER68	2					
43 25 58.9	2509700.	260.817	855.697				
88 4 51.5	528150.	260.866	855.858	-.161	-.157	-.003	
ML-F29	ALSTER68	2					
43 25 32.7	2509700.	263.597	864.818				
88 4 52.3	525500.	263.647	864.982	-.164	-.157	-.007	

ML-F30	ALSTER68	2					
43 25 33.8	2507050.	263.844	865.628				
88 5 28.2	525550.	263.894	865.792	-.164	-.161	-.003	
ML-F31	ALSTER68	2					
43 25 34.4	2504400.	262.804	862.216				
88 6 4.1	525550.	262.855	862.383	-.167	-.161	-.007	
ML-F32	ALSTER68	2					
43 25 35.0	2501750.	261.458	857.800				
88 6 40.0	525550.	261.509	857.967	-.167	-.164	-.003	
ML-F33	ALSTER68	2					
43 25 35.1	2499050.	267.626	878.036				
88 7 16.6	525500.	267.677	878.204	-.167	-.164	-.003	
ML-F34	ALSTER68	2					
43 25 35.2	2496450.	268.290	880.215				
88 7 51.8	525450.	268.343	880.389	-.174	-.164	-.010	
ML-F35	ALSTER68	2					
43 25 36.3	2493650.	269.828	885.261				
88 8 29.7	525500.	269.881	885.435	-.174	-.167	-.007	
ML-F36	ALSTER68	2					
43 25 36.4	2491100.	277.493	910.408				
88 9 4.3	525450.	277.546	910.582	-.174	-.167	-.007	
ML-F37	ALSTER68	2					
43 25 36.5	2488250.	270.736	888.240				
88 9 42.9	525400.	270.791	888.420	-.180	-.171	-.010	
ML-F38	ALSTER68	2					
43 25 36.0	2485800.	286.579	940.218				
88 10 16.2	525300.	286.634	940.398	-.180	-.171	-.010	
ML-L11	ALSTER68	2					
43 23 53.7	2474700.	305.330	1001.737				
88 12 49.6	514700.	305.392	1001.940	-.203	-.174	-.030	
ML-D5	ALSTER68	2					
43 20 19.8	2473100.	319.295	1047.554				
88 13 17.6	493000.	319.348	1047.728	-.174	-.180	.007	
RBM	ALSTER68	2					
43 19 27.1	2484000.	270.660	887.990				
88 10 51.6	487900.	270.718	888.181	-.190	-.200	.010	
ML-B26	ALSTER68	2					
43 19 24.9	2494300.	266.726	875.084				
88 8 32.3	487900.	266.778	875.254	-.171	-.203	.033	
ML-B20	ALSTER68	2					
43 20 13.1	2512700.	265.254	870.254				
88 4 21.8	493200.	265.305	870.421	-.167	-.190	.023	
ML-B12	ALSTER68	2					
43 20 39.8	2530320.	251.537	825.251				
88 0 22.4	496320.	251.592	825.431	-.180	-.177	-.003	
RL-B3	ALSTER68	2					
43 19 11.6	2545480.	228.864	750.865				
87 57 .2	487760.	228.923	751.058	-.194	-.187	-.007	
ML-AB10	ALSTER68	2					
43 17 49.4	2536000.	240.613	789.411				
87 59 11.2	479200.	240.676	789.618	-.207	-.197	-.010	
RL-E9	ALSTER68	2					
43 22 54.9	2548440.	230.087	754.877				
87 56 12.5	510440.	230.150	755.084	-.207	-.161	-.046	

RL-J17	ALSTER68	2					
43 33 23.5	2519400.	248.959	816.793				
88 2 25.6	573400.	249.003	816.937	-.144	-.095	-.049	
RL-H12	ALSTER68	2					
43 34 19.9	2545800.	278.073	912.311				
87 56 25.1	579750.	278.123	912.475	-.164	-.059	-.105	

VERTCON Misfits on Milwaukee River Watershed Benchmarks

Two computational options are summarized below. Option 1 shows the misfit of VERTCON predictions when compared to the differences at each station between the newly adjusted watershed level network on each datum. Option 2 shows the same VERTCON prediction compared to the differences between newly computed benchmark elevations on the NAVD 88 and the **published** NGVD 29 elevations which have been developed and used over the past 30 years. Statistics for each option are shown at the end of the tabulation.

An attempt was also made to provide information about relative VERTCON accuracy. The tabulation below also shows how the VERTCON misfit changes from station to station for each option, the inverse distance between the approximate coordinates for each station and finally the "delta misfit" is divided by the square root of the inverse distance (in miles) to find the relative accuracy coefficient for each option. This value can be compared with the English Units coefficients in Table 1 of the main text.

Summarizing, the misfits of option 1 are an indication of how well VERTCON models the datum difference in areas not covered by NGS lines, option 2 is an indication of the accuracy which can be expected when converting published NGVD 29 elevations to NAVD 88 elevations using VERTCON, and the relative accuracy gives an indication of the results one can expect between adjacent benchmarks. The relative accuracy can also be used to target questionable published bench mark elevations on the NGVD 29.

Station	NAD 27 X COORD	NAD 27 Y COORD	MISFIT OPTION1	MISFIT OPTION2	DELTA OPTION1	DELTA OPTION2	INVERSE DISTANCE	RELATIVE OPTION1	ACCURACY OPTION2
ML-F1	2562640	537840	-0.010	-0.003					
ML-F2	2562680	540400	-0.010	-0.003	0.000	0.000	2560.3	0.00000	0.00000
ML-F3	2562520	543000	-0.013	-0.003	-0.003	0.000	2604.9	-0.00427	0.00000
ML-F4	2559960	543040	-0.016	-0.003	-0.003	0.000	2560.3	-0.00431	0.00000
ML-F5	2557320	543000	-0.023	-0.003	-0.007	0.000	2640.3	-0.00990	0.00000
ML-F6	2554880	542920	-0.026	-0.003	-0.003	0.000	2441.3	-0.00441	0.00000
ML-F7	2551880	542880	-0.026	-0.003	0.000	0.000	3000.3	0.00000	0.00000
ML-F8	2549320	542760	-0.030	-0.003	-0.004	0.000	2562.8	-0.00574	0.00000
RL-F9	2546760	542520	-0.026	0.003	0.004	0.006	2571.2	0.00573	0.00860
ML-F10	2543960	542440	-0.026	0.003	0.000	0.000	2801.1	0.00000	0.00000
ML-F11	2541160	542280	-0.030	0.000	-0.004	-0.003	2804.6	-0.00549	-0.00412
ML-F12	2537960	542080	-0.026	-0.003	0.004	-0.003	3206.2	0.00513	-0.00385
ML-F13	2536000	542080	-0.030	-0.007	-0.004	-0.004	1960.0	-0.00657	-0.00657
ML-F14	2534120	542000	-0.030	-0.007	0.000	0.000	1881.7	0.00000	0.00000
ML-F15	2530840	541840	-0.033	-0.010	-0.003	-0.003	3283.9	-0.00380	-0.00380
ML-F16	2528240	541760	-0.030	-0.010	0.003	0.000	2601.2	0.00427	0.00000
ML-F17	2525560	541760	-0.026	-0.003	0.004	0.007	2680.0	0.00561	0.00983
ML-F18	2522880	541640	-0.020	-0.003	0.006	0.000	2682.7	0.00842	0.00000
ML-F19	2520000	541550	-0.020	-0.007	0.000	-0.004	2881.4	0.00000	-0.00541
ML-F20	2516500	541500	-0.016	-0.007	0.004	0.000	3500.4	0.00491	0.00000
RL-F21	2514850	541450	-0.016	-0.007	0.000	0.000	1650.8	0.00000	0.00000
ML-F22	2514850	538800	-0.013	-0.007	0.003	0.000	2650.0	0.00423	0.00000
ML-F23	2514900	536150	-0.010	0.000	0.003	0.007	2650.5	0.00423	0.00988
ML-F24	2515000	533450	-0.007	0.000	0.003	0.000	2701.9	0.00419	0.00000
L-F25	2515000	530750	-0.010	-0.003	-0.003	-0.003	2700.0	-0.00420	-0.00420
ML-F26	2512350	530750	-0.010	-0.003	0.000	0.000	2650.0	0.00000	0.00000
ML-F27	2509700	530800	-0.010	0.000	0.000	0.003	2650.5	0.00000	0.00423
ML-F28	2509700	528150	-0.010	-0.003	0.000	-0.003	2650.0	0.00000	-0.00423
ML-F29	2509700	525500	-0.010	-0.007	0.000	-0.004	2650.0	0.00000	-0.00565

Station	NAD 27 X COORD	NAD 27 Y COORD	MISFIT OPTION1	MISFIT OPTION2	DELTA OPTION1	DELTA OPTION2	INVERSE DISTANCE	RELATIVE OPTION1	ACCURACY OPTION2
ML-F30	2507050	525550	-0.010	-0.003	0.000	0.004	2650.5	0.00000	0.00565
ML-F31	2504400	525550	-0.010	-0.007	0.000	-0.004	2650.0	0.00000	-0.00565
ML-F32	2501750	525550	-0.007	-0.003	0.003	0.004	2650.0	0.00423	0.00565
ML-F33	2499050	525500	-0.007	-0.003	0.000	0.000	2700.5	0.00000	0.00000
ML-F34	2496450	525450	-0.010	-0.010	-0.003	-0.007	2600.5	-0.00427	-0.00997
ML-F35	2493650	525500	-0.007	-0.007	0.003	0.003	2800.4	0.00412	0.00412
ML-F36	2491100	525450	-0.007	-0.007	0.000	0.000	2550.5	0.00000	0.00000
ML-F37	2488250	525400	-0.010	-0.010	-0.003	-0.003	2850.4	-0.00408	-0.00408
ML-F38	2485800	525300	-0.010	-0.010	0.000	0.000	2452.0	0.00000	0.00000
ML-L11	2474700	514700	0.007	-0.030	0.017	-0.020	15348.3	0.00997	-0.01173
ML-D5	2473100	493000	0.007	0.007	0.000	0.037	21758.9	0.00000	0.01823
RBM	2484000	487900	0.023	0.010	0.016	0.003	12034.1	0.01060	0.00199
ML-B26	2494300	487900	0.026	0.033	0.003	0.023	10300.0	0.00215	0.01647
ML-B20	2512700	493200	0.010	0.023	-0.016	-0.010	19148.1	-0.00840	-0.00525
ML-B12	2530320	496320	-0.003	-0.003	-0.013	-0.026	17894.1	-0.00706	-0.01412
RL-B3	2545480	487760	0.000	-0.007	0.003	-0.004	17409.7	0.00165	-0.00220
ML-AB10	2536000	479200	0.000	-0.010	0.000	-0.003	12772.8	0.00000	-0.00193
RL-E9	2548440	510440	-0.023	-0.046	-0.023	-0.036	33625.8	-0.00911	-0.01427
RL-J17	2519400	573400	-0.049	-0.049	-0.026	-0.003	69334.6	-0.00717	-0.00083
RL-H12	2545800	579750	-0.079	-0.105	-0.030	-0.056	27152.9	-0.01323	-0.02469
Mean of misfits:			-0.015	-0.007					
Standard deviation:			0.017	0.019					

Appendix C-5

Order and Class of SEWRPC Leveling

The leveling performed by the SEWRPC in support of watershed water quality studies in the 1960s was intended to be Second-Order and has been used as such since. One benefit of this project is documented assurance of the quality of that work obtained by comparing statistics of a comprehensive least squares adjustment to previous and existing FGCS standards for control leveling, see Table C-1 following.

Table C-1

STANDARDS FOR CONTROL LEVELING

Prior to 1974		
Order	Metric Units	English Units
First	4 mm $\sqrt{\text{Km}}$	0.017 ft $\sqrt{\text{Mi}}$
Second	8.4 mm $\sqrt{\text{Km}}$	0.035 ft $\sqrt{\text{Mi}}$
Third	12 mm $\sqrt{\text{Km}}$	0.050 ft $\sqrt{\text{Mi}}$

After 1974 (FGCS)		
Order/Class	Metric Units	English Units
First/I	3 mm $\sqrt{\text{Km}}$	0.012 ft $\sqrt{\text{Mi}}$
First/II	4 mm $\sqrt{\text{Km}}$	0.017 ft $\sqrt{\text{Mi}}$
Second/I	6 mm $\sqrt{\text{Km}}$	0.025 ft $\sqrt{\text{Mi}}$
Second/II	8 mm $\sqrt{\text{Km}}$	0.033 ft $\sqrt{\text{Mi}}$
Third	12 mm $\sqrt{\text{Km}}$	0.050 ft $\sqrt{\text{Mi}}$

When performing a least squares adjustment using the STAR*LEV software package the user has an option with respect to default values selected for adjustment tolerances. If an overly restrictive default standard deviation (sigma) is chosen, the adjustment will fail to pass the Chi-Square Test of the Total Error Factor and the relative size of individual residuals will be "large." If an overly generous default value is chosen the adjustment will pass the Chi-Square Test and the standardized residuals will be smaller, but the adjustment will accommodate less precise observations.

The default tolerances choices are related to the coefficients of the FGCS standards listed in Table C-1. The STAR*LEV adjustment was run several times on each watershed using the coefficients for First-Order Class II, Second-Order Class I, and Second-Order Class II. Intermediate coefficient values of 0.02 and 0.03 were also used and tabulated below. In each case, the Second-Order Class I adjustment passes the Chi-Square Test, the Error Factor is less than 1.0, a small number of lines exceed the chosen default tolerance, and the largest standardized residual is much less than 3 (99.7% confidence level). Table C-2 is a summary of adjustments on the NGVD 29 and Table C-3 is a summary of adjustments on the NAVD 88.

Table C-2

**SUMMARY OF LEAST SQUARES NETWORK ADJUSTMENTS
USING DISTANCE-WEIGHTED OBSERVATIONS ON NGVD 29**

Order/Class	Default Sigma	Chi-Square Test @ 05%	Error Factor	# of Sections over Default	Largest Std Res.
Milwaukee River Watershed					
I/II	0.017' $\sqrt{\text{Mi}}$	Fail	1.41	8/27	1.6
	0.020' $\sqrt{\text{Mi}}$	Pass	1.20	4/27	1.4
II/I	0.025' $\sqrt{\text{Mi}}$	Pass	0.96	4/27	1.1
II/II	0.030' $\sqrt{\text{Mi}}$	Pass	0.80	0/27	0.9
	0.033' $\sqrt{\text{Mi}}$	Pass	0.73	0/27	0.8
II (old)	0.035' $\sqrt{\text{Mi}}$	Pass	0.69	0/27	0.8
Fox River Watershed					
I/II	0.017' $\sqrt{\text{Mi}}$	Fail	1.35	10/45	2.1
	0.020' $\sqrt{\text{Mi}}$	Pass	1.15	8/45	1.8
II/I	0.025' $\sqrt{\text{Mi}}$	Pass	0.92	5/45	1.4
II/II	0.030' $\sqrt{\text{Mi}}$	Pass	0.76	1/45	1.2
	0.033' $\sqrt{\text{Mi}}$	Pass	0.70	1/45	1.1
II (old)	0.035' $\sqrt{\text{Mi}}$	Pass	0.66	1/45	1.0

Table C-3

**SUMMARY OF LEAST SQUARES NETWORK ADJUSTMENTS
USING DISTANCE-WEIGHTED OBSERVATIONS ON NAVD 88**

Order/Class	Default Sigma	Chi-Square Test @ 05%	Error Factor	# of Sections over Default	Largest Std Res.
Milwaukee River Watershed					
I/II	0.017' $\sqrt{\text{Mi}}$	Pass	1.30	6/27	2.0
	0.020' $\sqrt{\text{Mi}}$	Pass	1.10	2/27	1.7
II/I	0.025' $\sqrt{\text{Mi}}$	Pass	0.88	1/27	1.3
II/II	0.030' $\sqrt{\text{Mi}}$	Pass	0.74	1/27	1.1
	0.033' $\sqrt{\text{Mi}}$	Pass	0.67	1/27	1.0
II (old)	0.035' $\sqrt{\text{Mi}}$	Pass	0.63	0/27	1.0
Fox River Watershed					
I/II	0.017' $\sqrt{\text{Mi}}$	Fail	1.34	9/45	2.4
	0.020' $\sqrt{\text{Mi}}$	Pass	1.14	7/45	2.0
II/I	0.025' $\sqrt{\text{Mi}}$	Pass	0.91	5/45	1.6
II/II	0.030' $\sqrt{\text{Mi}}$	Pass	0.76	1/45	1.3
	0.033' $\sqrt{\text{Mi}}$	Pass	0.69	1/45	1.2
II (old)	0.035' $\sqrt{\text{Mi}}$	Pass	0.65	1/45	1.1

Observations:

- The English unit categories of 0.020, 0.025 and 0.030 feet times $\sqrt{\text{distance in miles}}$ very nicely brackets the adjustment results obtained on both watersheds and both datums. The "old" standard is easily met in both watersheds.

- In each case the difference between the statistical “fit” of the two datums appears to be too small to be meaningful (other than that they are consistent).

Conclusions:

- The Commission-established leveling performed in the 1960s appears to meet the standards then in effect and, based upon the results shown, can conservatively be classified as Second-Order Class I by current standards.
- Control leveling run with similar equipment, specifications, conditions and observational finesse would support a similar Second-Order, Class I assignment.

Appendix D

SUMMARY OF SOFTWARE UTILITIES

(This page intentionally left blank)

Appendix D

Summary of Software Utilities

This appendix contains an overview of the software tools used in developing this report. The primary program is VERTCON followed by STAR*LEV and several other much lesser utilities written by the author. The program are listed here as an overview and as a reference for subsequent readers of the report or users of the programs. They are:

VERTCON Version 2.0: This program is used to compute (predict) the difference in elevation between the NGVD 29 and the NAVD 88. The program was written by and is available from the National Geodetic Survey, Silver Spring, Maryland. Appendix B is devoted to documentation of the program and its use in developing this report.

STAR*LEV Version 1.17: This program is a least squares level network adjustment program and commercially available from STARPLUS SOFTWARE, Inc. of Oakland, California. Star*Lev was used to compute the least squares adjustment on the two watershed networks using the elevation differences abstracted from the SEWRPC records. The output files include an echo of the input and pertinent sections documenting the adjustment. Other options and sections could also be selected.

COMPARE (Several versions - see below): This program was written in FORTRAN by Earl F. Burkholder. It tabulates the difference between the NGVD 29 and NAVD 88 as predicted by VERTCON and compares that difference with actual differences computed from known elevations for the bench marks included in the data files. Because input data comes from several sources, two input files are required; one file which contains the known bench marks and elevations and one which contains the VERTCON predictions for the same points. In practice, the first data file is also used as the input file for VERTCON and the VERTCON output file is used as the second input file to program COMPARE.

- | | |
|--------------|---|
| Version 1.03 | Used in Appendix C—latitude or longitude input values are listed to 5 decimal places of seconds. |
| Version 1.04 | Used in Appendix B—latitude or longitude input values are listed to the nearest 0.1 seconds of arc. |
| Version 1.05 | Used to generate plot (.plt) files with convenient fields—station name, NAD27X, NAD27Y, misfit. |

LEVELINE Version 1.03: This program was written in FORTRAN by Earl F. Burkholder and was used to perform a linear adjustment of benchmark elevations along various level lines between network junction elevations as determined by the least squares adjustment. The output file documents the adjustment as well as the input data—all in conventional levelnote format.

GENFILE Version 1.03: Written in FORTRAN by Earl F. Burkholder, this program generates the latitude or longitude positions for Wisconsin South Zone State Plane Coordinates of the 10,000 foot interval grid used to generate the Iso-Hypsometric Map. The latitude or longitude values are required input for the VERTCON program.

VERTFOOT Version 1.01: Routine output of VERTCON is the predicted datum difference in meters. Written in FORTRAN by Earl F. Burkholder, the VERTFOOT program was used to convert VERTCON output from meters to feet for the large data set used to develop the Iso-Hypsometric Map shown in Map 2. The program also formats the output in fields convenient for plotting.

The programs described herein which were written by Earl F. Burkholder are licensed to the Southeastern Wisconsin Regional Planning Commission for their unlimited in-house use. Provision for use by others is to be arranged with the author.