TSARP

Tropical Storm Allison Recovery DR-1379 Harris County, Texas

Benchmark Control Network

Technical Report

Greens, Vince, Sims, Hunting, Brays, Barker, Carpenter & Buffalo

September 2002 - June 2003

CDS/MUERY SERVICES
Engineering & Surveying

PATE ❖ ENGINEERS

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Section
1.

Introduction

In response to the flooding in June of 2001 that occurred during Tropical Storm Allison, the Harris County Flood Control District (HCFCD) and the Federal Emergency Management Agency (FEMA) initiated the Tropical Storm Allison Recovery Project. When the project is complete, Harris County will have new Flood Insurance Rate Maps (FIRM's). These maps will be used not only to determine flood insurance zones but also to aid the efforts to limit future flood related damages. This report covers the Control Surveying portion of the project. Control surveys were performed between September 2002 and April 2003 by five surveying firms to create a large network of benchmarks designed by Brown & Gay Engineers, Inc. known as Reference Marks (RM's) that will be shown on the new FIRM's and used by local surveyors and engineers. The five surveying firms that participated in the Control Surveying part of the project were Baseline Corporation, Pate Engineers, Inc., CDS/Muery Services, Landtech Consultants, and Thompson Surveying Corporation.

Section 2

General Requirements for the Control

2.1 Project Standards

This survey was performed as much as possible with dual frequency, full-wavelength Global Positioning System (GPS) receivers. The National Geodetic Survey (NGS) 2-centimeter standard, as published in NOAA Technical Memorandum NOS NGS-58 dated November 1997, was chosen as the project's vertical surveying standard. The horizontal standard that was chosen was the NGS Second Order Class I standard as published in the Federal Geodetic Control Committee (FGCC) document entitled "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques" dated August 1, 1989. In areas where it was impossible to use GPS due to conditions such as obstructed sky visibility, precise differential leveling was performed to connect such obstructed benchmarks to the rest of the network. Differential leveling was performed so as to meet the maximum loop misclosure specifications for the NGS Second Order Class II vertical standard for leveling, as published in the FGCC document entitled "Standards and Specifications for Geodetic Control Networks" dated September 1984.

In the interest of keeping up with the latest standards developed by NGS, the control surveyed in this network substantially meets the new NGS Classification system for Range VI positions. Range VI indicates that these positions meet the 0.02 meter - 0.05 meter Accuracy Standard for Horizontal Position, Ellipsoidal Height, and Orthometric Height (elevation) at the 95% confidence level.

2.2 Categories of Benchmarks

2.2.1 Existing Permanent BM used by TSARP IDIQ

These benchmarks were resurveyed via GPS FastStatic methods just to verify the coordinates and elevation that is listed in the shape files provided by Brown & Gay Engineers (BGE). These benchmarks needed to be occupied only one time from a single HGCSD station. If they checked within 0.3 feet, they were acceptable for this survey. If they missed more than 0.3 feet, they were observed a second time to verify our work and then report our findings. Having said that, all these stations were occupied twice.

In the event we found that one of an existing mark destroyed or not usable, we reset a new monument as follows:

Option A) Set a disk or deep rod ground mark close to the called for station;

<div align="center">or</div>

Option B) If a disk had been removed from a center span of a bridge, we either set a disk back in its place or placed it at another location on the bridge such as over the bridge abutment.

A monument sheet and to reach description along with the as surveyed coordinates and elevation have been provided. If a discrepancy exists (>0.3 feet), these stations are noted in this report.

2.2.2 New Benchmarks

New benchmarks consist of one of the following: 1) A deep rod mark; 2) A disk over a bridge abutment; 3) A disk set in the center span of a bridge; or 4) A disk set in a substantially stable headwall. These were placed in public rights-of-way, clear of underground utilities and in favorable areas where they should not be destroyed by future development activities.

All new BM's were be surveyed with GPS using the NOS NGS-58 methodology. A monument sheet and to reach description along with the NEW published coordinates and elevation have been provided for these stations.

2.2.3 Releveled Existing Benchmarks

We resurveyed these benchmarks via GPS using the NOS NGS-58 methodology unless they were not "GPS observable". In the case where they were not "GPS observable", we ran differential levels from the closest existing station tied into our network, then through the existing station, tied into the next closest station, and closed the loop back to the initial station.

In the situations where we found that one of these marks were destroyed or not usable, we set a disk or deep rod ground mark as close as practical to the called for station. If we discovered a situation where a disk in concrete had been removed AND we could set a new disk in its place, we favored this method over setting a new mark as close as practical.

A monument sheet and to reach description along with the NEW published coordinates and elevation have been provided for these stations.

2.2.4 HGCSD (Existing NGS Control)

These stations were the foundation for the stations in our network. There were direct ties to adjacent HGCSD stations as well as direct ties to the closest new and/or releveled stations. Observations for these stations were also tied back to the Continuously Operating Reference Stations (CORS) stations that are also extensometer sites (e.g. Lake Houston CORS ARP, Northeast 2250 CORS ARP or Addicks 1795 CORS ARP).

A monument sheet and to reach description along with the NEW published coordinates and elevation have been provided for these stations. The published values for all of these HGCSD category stations have been held in the horizontal component. The ellipsoid heights and elevations for these stations have changed due to subsidence in the county.

2.2.5 New Benchmarks in the Vicinity of Temporary IDIQ RM's

Our staff recovered the temporary TSARP IDIQ RM's. These stations were evaluated for their quality of monumentation. If the station is of a quality such that a new station would be a redundant work effort, we used that existing station. If not, we set either a deep rod mark or a disk over a bridge abutment. These stations were placed in public rights-of-way, clear of underground utilities, and in favorable areas where they should not be destroyed by future development activities. There were certain situations where disks were placed in concrete over a substantially vertically stable surface. This was done for economical reasons and to save time.

All new BM's were surveyed with GPS using the NOS NGS-58 methodology. If practical, the temporary station was tied to the new station (simply a side tie) in order to give an additional check on the TSARP IDIQ stations.

A monument sheet and to reach description, along with the published coordinates and elevation have been provided for these stations. These monument sheets also include the "side tie" to the existing temporary station if they exist.

Section 3.

Surveyor's Statement

Surveyor's Statement

This Benchmark Control Network Survey was performed on the ground under my direction and supervision for the Harris County Flood Control District in connection with the Tropical Storm Allison Recovery Project from September 2002 through May 2003.

_____

Michael D. McGuinness, R.P.L.S.
Registration Number 1965

_____

Date

Section 4.

Chronology of Field and Office Operations

Planning & Reconnaissance

09/17/02-11/20/02

Office staff received the preliminary benchmark locations for the watersheds from Brown & Gay Engineers. All sites were plotted and field personnel were assigned groups of benchmarks to either find or establish a proposed location.

As the field crews performed the reconnaissance survey of all (673) existing and proposed benchmarks within eight watersheds, they performed the following tasks: prepared "To Reach" descriptions; drafted site sketches; created a "sky visibility" obstruction diagram; took digital taking photos of the sites; and made pencil rubbings of the monument caps if one existed. On the new monument locations, field crews marked the proposed station with an iron rod and lath or a drill hole in concrete.

Data Management (Office)

09-17-02 – 4/23/03

From the data collected during the reconnaissance phase, site sketches were generated in AutoCAD. "To Reach" descriptions were reviewed and transcribed into a spreadsheet in a standard description format. Other duties included coordinating with Harris County Flood Control and Brown & Gay Engineers; scheduling field crew activities; and tracking progress.

Monument Setting

11/21/02 – 01/15/03

After the reconnaissance was completed, the QC/QA supervisor started the process of implementing the "One Calls" to clear the deep rod monument sites of possible underground utility obstructions prior to the crews setting the monuments. Concurrent with this activity, some of the field staff purchased materials to set monuments and then commenced setting all of the new stations. As the crews set the stations, they updated the monument sketches as required.

GPS Observations

10/10/02 – 11/14/02

01/02/03 – 04/08/03

Between three and nine crews worked on the GPS data collection phase of this project. GPS session planning was performed on a daily basis and the data from all GPS receivers was downloaded onto a server and backed up on a daily basis. Field crews typically worked 11-12 hours per day four days a week to complete the field GPS observations.

Level Loops

01/27/03 – 01/28/03

03/12,13,17,26,27/03

04/09,10,15-17,22/03

There were a total of eight monuments that could not be observed with GPS receivers due to "sky visibility" obstructions. A total of 33.3 miles of level loops were run to establish elevations on these stations.

Data Management (Office)

10-11-02 – 6/02/03

During the course of the GPS survey, baselines were processed on a daily basis to ensure all data collected were of the quality required for this survey. Loop closures and baseline comparisons were routinely checked. Periodic adjustments were also made and measured results were compared with published values. At the conclusion of the GPS data collection, a minimally constrained adjustment was run and a comparison report was generated to show the differences between the published values of the control stations and the measured values. Finally, a fully constrained adjustment was run. This time frame includes the following tasks: QA/QC review of the collected data; baseline processing; loop closure tests; baseline comparisons; adjustments of the data; periodic meetings and preparation of the deliverables.

Section 5.

Benchmark Information

5.1. Benchmark Construction

Benchmark stability was a prime consideration in the selection of new benchmark sites and construction materials. The initial approximate locations for all new benchmarks were provided by the TSARP program managers. If a substantial reinforced concrete structure such as a bridge was available in the vicinity of the selected location, a brass disk was set in a drilled hole in the concrete and fastened with epoxy cement. If no such structure of a substantial nature was available, an aluminum rod was driven into the ground to a depth of about 24 feet and surrounded at the top three feet with a greased sleeve and 6 inches of sand, with 12 inch diameter concrete around the outside and a metal protective cover over the top. The disk in concrete option was used wherever possible, and in some cases benchmark locations were moved as much as one-half mile in order to utilize an appropriate structure. In such cases the moves were approved by the TSARP program managers.

5.2. Existing Benchmarks

Existing benchmarks were also used throughout the project that had been set by surveyors and engineers in the course of performing work for FEMA and/or Harris County Flood Control. Primarily, they consist of brass disks set in the center spans of bridges over drainage ways on the downstream side. A majority of these benchmarks have a Harris County Flood Control designation on the disk. These benchmarks were observed and included in this network to compare with previously published elevations and to supplement the new network of control stations.

In addition, there were several existing benchmarks that were established by the National Geodetic Survey, Coast & Geodetic Survey, U.S. Geological Survey, the City of Houston, U. S. Army Corps of Engineers, and the Texas Department of Transportation. These benchmarks also serve to supplement the new network of stations.

Section 6.

Survey Control Basis–NGS Oct. 2000 Survey

The primary control utilized in the performance of this survey are the Continuously Operating Reference Stations (CORS) monitored by NGS. The CORS sites that are located at extensometer sites were given the highest weight in the evaluation of this control survey. In addition to these CORS sites, the network of stations surveyed in October 2000 by NGS and adjusted in 2001 made up the secondary network from which this 2003 survey is referenced. These stations consist of the Harris Galveston Coastal Subsidence District (HGCSD) network of control monuments; HGCSD's "Port-a-Measure" stations (PAM's); and other NGS stations in the Harris County region. These stations are First Order or better horizontal control stations, with orthometric heights determined using GPS observations and the GEOID99 geoid model.

The CORS stations located at the extensometer sites are constructed so as to be unaffected by the subsidence of the ground around them. They are considered by HGCSD and others to be the most stable control monuments in Harris County. The three CORS sites are as follows:

> PID AJ6426   ADDICKS 1795 CORS ARP (ADKS)
> PID AJ6430   NORTHEAST 2250 CORS ARP (NETP)
> PID AF9521   LAKE HOUSTON CORS ARP (LKHU)
>
> PID = Permanent Identifier
> ARP = Antenna Reference Point (physical bottom of the antenna)

Because all of these stations were surveyed in 2000, the published positions were referenced to the NGS 1997.00 Epoch Date. It should be noted that, although 2002.00 Epoch Date positions are currently available for the CORS sites, they were not used so as to be consistent with the rest of the existing control stations surveyed in 2000.

6.1. CORS Stations

The following is an extraction from the NGS database for the CORS stations referenced above on the 1997.00 Epoch Date.

Addicks 1795 CORS ARP (ADKS) - Epoch Date 1997.00

```
AJ6426 ********************************************************************
 AJ6426  DESIGNATION - ADDICKS 1795 CORS ARP
 AJ6426  PID         - AJ6426
 AJ6426  STATE/COUNTY- TX/HARRIS
 AJ6426  USGS QUAD   - HEDWIG VILLAGE (1982)
 AJ6426
 AJ6426                           *CURRENT SURVEY CONTROL
 AJ6426  _____
 AJ6426* NAD 83(1993)- 29 47 27.47147(N)    095 35 11.04301(W)    ADJUSTED
 AJ6426* NAVD 88     -        31.50  (meters)    103.3   (feet)   LEVELING
 AJ6426  _____
 AJ6426  X           -    -539,282.056 (meters)                   COMP
 AJ6426  Y           -  -5,513,498.309 (meters)                   COMP
 AJ6426  Z           -   3,150,287.363 (meters)                   COMP
 AJ6426  LAPLACE CORR-           0.39  (seconds)                  DEFLEC99
 AJ6426  ELLIP HEIGHT-           4.11  (meters)                   GPS OBS
 AJ6426  GEOID HEIGHT-         -27.31  (meters)                   GEOID99
 AJ6426
 AJ6426  HORZ ORDER  - B
 AJ6426  VERT ORDER  - THIRD ?
 AJ6426  ELLP ORDER  - FOURTH    CLASS II
 AJ6426
 AJ6426.The horizontal coordinates were established by GPS observations
 AJ6426.and adjusted by the National Geodetic Survey in December 2001.
 AJ6426
 AJ6426.The orthometric height was determined by differential leveling.
 AJ6426.The vertical network tie was performed by a horz. field party for horz.
 AJ6426.obs reductions. Reset procedures were used to establish the elevation.
 AJ6426
 AJ6426.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 AJ6426
 AJ6426.The Laplace correction was computed from DEFLEC99 derived deflections.
 AJ6426
 AJ6426.The ellipsoidal height was determined by GPS observations
 AJ6426.and is referenced to NAD 83.
 AJ6426
 AJ6426.The geoid height was determined by GEOID99.
 AJ6426
 AJ6426;                     North        East     Units   Scale    Converg.
 AJ6426;SPC TXSC   - 4,221,775.324  929,971.998   MT  0.99989481 +1 40 20.5
 AJ6426;UTM  15    - 3,298,427.744  249,983.183   MT  1.00037131 -1 17 08.5
 AJ6426
 AJ6426|----------------------------------------------------------------|
 AJ6426| PID    Reference Object                     Distance     Geod. Az |
 AJ6426|                                                        dddmmss.s |
 AJ6426| AJ6413 PAM 5 ARP                           55.060 METERS 06119    |
 AJ6426| AJ6409 HGCSD 26 RESET                       6.859 METERS 23427    |
 AJ6426|----------------------------------------------------------------|
 AJ6426
 AJ6426                    SUPERSEDED SURVEY CONTROL
 AJ6426
 AJ6426.No superseded survey control is available for this station.
 AJ6426
 AJ6426_MARKER: Z = SEE DESCRIPTION
```

```
AJ6426_SETTING: 0 = UNSPECIFIED SETTING
AJ6426_MAGNETIC: O = OTHER; SEE DESCRIPTION
AJ6426_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AJ6426+STABILITY: POSITION/ELEVATION WELL
AJ6426_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AJ6426+SATELLITE: SATELLITE OBSERVATIONS - 1998
AJ6426
AJ6426  HISTORY     - Date     Condition       Report By
AJ6426  HISTORY     - 1998     MONUMENTED      HGCSD
AJ6426
AJ6426                          STATION DESCRIPTION
AJ6426
AJ6426'DESCRIBED BY HARRIS-GALV CO DIST 1998
AJ6426'THE STATION IS THE ARP OF A TRIMBLE 4000ST/SST ANTENNA.
```

Northeast 2250 CORS ARP (NETP) - Epoch Date 1997.00

The Latitude, Longitude, Ellipsoid Height and Elevation of this Station were held fixed for both the minimally constrained and fully constrained adjustment.

```
        AJ6430 *****************************************************************
AJ6430  DESIGNATION -  NORTHEAST 2250 CORS ARP
AJ6430  PID         -  AJ6430
AJ6430  STATE/COUNTY-  TX/HARRIS
AJ6430  USGS QUAD   -  SETTEGAST (1995)
AJ6430
AJ6430                            *CURRENT SURVEY CONTROL
AJ6430  _____
AJ6430* NAD 83(1993)-  29 47 28.14234(N)    095 20 03.16582(W)     ADJUSTED
AJ6430* NAVD 88     -        18.07  (meters)      59.3   (feet)    LEVELING
AJ6430  _____
AJ6430  X           -    -515,007.147 (meters)                     COMP
AJ6430  Y           -  -5,515,796.814 (meters)                     COMP
AJ6430  Z           -   3,150,298.667 (meters)                     COMP
AJ6430  LAPLACE CORR-           0.47  (seconds)                     DEFLEC99
AJ6430  ELLIP HEIGHT-          -9.22  (meters)                      GPS OBS
AJ6430  GEOID HEIGHT-         -27.21  (meters)                      GEOID99
AJ6430
AJ6430  HORZ ORDER  -  B
AJ6430  VERT ORDER  -  THIRD ?
AJ6430  ELLP ORDER  -  FOURTH    CLASS II
AJ6430
AJ6430.The horizontal coordinates were established by GPS observations
AJ6430.and adjusted by the National Geodetic Survey in December 2001.
AJ6430
AJ6430.The orthometric height was determined by differential leveling.
AJ6430.The vertical network tie was performed by a horz. field party for horz.
AJ6430.obs reductions. Reset procedures were used to establish the elevation.
AJ6430
AJ6430.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AJ6430
AJ6430.The Laplace correction was computed from DEFLEC99 derived deflections.
AJ6430
AJ6430.The ellipsoidal height was determined by GPS observations
AJ6430.and is referenced to NAD 83.
AJ6430
AJ6430.The geoid height was determined by GEOID99.
AJ6430
AJ6430;                        North        East     Units   Scale     Converg.
AJ6430;SPC TXSC    - 4,222,533.781   954,341.141   MT  0.99989484 +1 47 45.3
AJ6430;UTM  15     - 3,297,927.832   274,368.846   MT  1.00022817 -1 09 36.8
AJ6430
AJ6430|-------------------------------------------------------------------|
AJ6430| PID    Reference Object                    Distance     Geod. Az  |
AJ6430|                                                         dddmmss.s |
AJ6430| AJ6425 HGCSD 29 RESET 2                    26.513 METERS 17913    |
AJ6430|-------------------------------------------------------------------|
AJ6430
AJ6430                      SUPERSEDED SURVEY CONTROL
AJ6430
AJ6430.No superseded survey control is available for this station.
AJ6430
AJ6430_MARKER: Z = SEE DESCRIPTION
AJ6430_SETTING: 0 = UNSPECIFIED SETTING
```

```
AJ6430_MAGNETIC: O = OTHER; SEE DESCRIPTION
AJ6430_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AJ6430+STABILITY: POSITION/ELEVATION WELL
AJ6430_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AJ6430+SATELLITE: SATELLITE OBSERVATIONS - 1995
AJ6430
AJ6430  HISTORY     - Date      Condition        Report By
AJ6430  HISTORY     - 1995      MONUMENTED       HGCSD
AJ6430
AJ6430                              STATION DESCRIPTION
AJ6430
AJ6430'DESCRIBED BY HARRIS-GALV CO DIST 1995
AJ6430'THIS IS THE ARP OF A TRIMBLE 4000ST/SST ANTENNA
1       National Geodetic Survey,   Retrieval Date = DECEMBER 17, 2001
```

Lake Houston CORS ARP (LKHU) – Epoch Date 1997.00

```
AF9521 **************************************************************************
 AF9521  CORS        -  This is a GPS Continuously Operating Reference Station.
 AF9521  DESIGNATION -  LAKE HOUSTON CORS ARP
 AF9521  CORS_ID     -  LKHU
 AF9521  PID         -  AF9521
 AF9521  STATE/COUNTY-  TX/HARRIS
 AF9521  USGS QUAD   -  HARMASTON (1982)
 AF9521
 AF9521                           *CURRENT SURVEY CONTROL
 AF9521  _____
 AF9521* NAD 83(CORS)- 29 54 48.43963(N)   095 08 44.68952(W)      ADJUSTED
 AF9521* NAVD 88     -       20.19  (meters)      66.2    (feet) GPS OBS
 AF9521  _____
 AF9521  EPOCH DATE  -       1997.00
 AF9521  X           -    -496,255.925 (meters)                   COMP
 AF9521  Y           -  -5,510,741.534 (meters)                   COMP
 AF9521  Z           -   3,162,058.229 (meters)                   COMP
 AF9521  ELLIP HEIGHT-          -7.17  (meters)                   GPS OBS
 AF9521  GEOID HEIGHT-         -27.24  (meters)                   GEOID99
 AF9521
 AF9521  HORZ ORDER  -  SPECIAL (CORS)
 AF9521  ELLP ORDER  -  SPECIAL (CORS)
 AF9521
 AF9521.ITRF positions are available for this station.
 AF9521.The coordinates were established by GPS observations
 AF9521.and adjusted by the National Geodetic Survey in April 1996.
 AF9521.The coordinates are valid at the epoch date displayed above.
 AF9521.The epoch date for horizontal control is a decimal equivalence
 AF9521.of Year/Month/Day.
 AF9521
 AF9521.The orthometric height was determined by GPS observations and a
 AF9521.high-resolution geoid model using precise GPS observation and
 AF9521.processing techniques.
 AF9521
 AF9521.The PID for the CORS L1 Phase Center is AI7427.
 AF9521
 AF9521.The XYZ, and position/ellipsoidal ht. are equivalent.
 AF9521
 AF9521.The ellipsoidal height was determined by GPS observations
 AF9521.and is referenced to NAD 83.
 AF9521
 AF9521.The geoid height was determined by GEOID99.
 AF9521
 AF9521;                    North        East    Units   Scale     Converg.
 AF9521;SPC TXSC   - 4,236,668.293   972,105.433   MT  0.99991407 +1 53 17.7
 AF9521
 AF9521                         SUPERSEDED SURVEY CONTROL
 AF9521
 AF9521  NAD 83(CORS)- 29 54 48.43963(N)   095 08 44.68952(W) AD(1996.00) c
 AF9521  ELLIP HT    -          -7.17  (m)                     GP(1996.00) c c
 AF9521
 AF9521.Superseded values are not recommended for survey control.
 AF9521.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 AF9521.See file dsdata.txt to determine how the superseded data were derived.
 AF9521
 AF9521_STATION IS THE ANTENNA REFERENCE POINT OF THE GPS ANTENNA
 AF9521
 AF9521                           STATION DESCRIPTION
 AF9521
```

```
AF9521'DESCRIBED BY NATIONAL GEODETIC SURVEY 1996
AF9521'STATION IS A GPS CORS.  LATEST INFORMATION INCLUDING POSITIONS AND
AF9521'VELOCITIES ARE AVAILABLE IN THE COORDINATE AND LOG FILES ACCESSIBLE
AF9521'BY ANONYMOUS FTP OR THE WORLDWIDE WEB.
AF9521'  FTP CORS.NGS.NOAA.GOV: CORS/COORD  AND  CORS/STATION_LOG
AF9521'  HTTP://WWW.NGS.NOAA.GOV  UNDER PRODUCTS AND SERVICES.
1       National Geodetic Survey,   Retrieval Date = DECEMBER 17, 2001
```

Measured Values for CORS Stations from Fully Constrained Adjustment

NGS PID–Station Name	Measured Latitude	Measured Longitude	Measured Ellipsoid Height	Measured Northing	Measured Easting	Meas. Elev.
AJ6426 - ADKS	29°47'27.47147"N	95°35'11.04301"W	13.45	13850941.21	3051083.13	103.30
AJ6430 - NETP	29°47'28.14234"N	95°20'03.16582"W	-30.25	13853429.58	3131034.23	59.29
AF9521 - LKHU	29°54'48.43963"N	95°08'44.68952"W	-23.52	13899802.56	3189315.91	66.11

Published Values for CORS Stations from Fully Constrained Adjustment

NGS PID–Station Name	Published Latitude	Published Longitude	Published Ellipsoid Height	Published Northing	Published Easting	Pub. Elev.
AJ6426 - ADKS	29°47'27.47147"N	95°35'11.04301"W	13.45	13850941.21	3051083.13	103.35
AJ6430 - NETP	29°47'28.14234"N	95°20'03.16582"W	-30.25	13853429.58	3131034.23	59.29
AF9521 - LKHU	29°54'48.43963"N	95°08'44.68952"W	-23.52	13899802.56	3189315.91	66.24

6.2. PAM Stations

Data from the following PAM sites were utilized during the course of this survey. The horizontal positions for these sites were generally within 0.02 feet. For the fully constrained adjustment, all of the PAM stations that were occupied in the NGS survey of 2000 we fixed in the horizontal component. The vertical positions for these PAM stations generally followed the predicted subsidence values generated from the ongoing studies perform by the Harris Galveston Coastal Subsidence District (HGCSD). New elevations and ellipsoid heights have been established on all of these sites and are reflected in the final position data presented in this report.

Measured Values for PAM Stations from Fully Constrained Adjustment

NGS PID–Station Name	Measured Latitude	Measured Longitude	Measured Ellipsoid Height	Measured Northing	Measured Easting	Meas. Elev.
AJ6427 - PAM 01	29°54'42.73203"N	95°36'59.80458"W	43.20	13894611.18	3040232.80	133.25
AJ6428 - PAM 02	30°00'02.33602"N	95°24'57.08654"W	23.27	13928775.40	3102815.98	113.27
AJ6412 - PAM 03	29°49'14.90336"N	95°36'48.14574"W	12.61	13861539.78	3042217.16	102.53
AA9855 - PAM 04	29°37'49.39485"N	95°35'48.67919"W	-1.66	13792478.65	3049467.41	87.74
AJ6413 - PAM 05	29°47'28.32970"N	95°35'09.24451"W	8.26	13851032.49	3051238.99	98.10
AJ6414 - PAM 06	29°48'58.91787"N	95°40'39.99963"W	26.78	13859340.05	3021849.57	116.74
AJ6415 - PAM 07	29°56'10.64628"N	95°34'35.91486"W	41.75	13903856.46	3052630.11	131.81
AJ6416 - PAM 08	29°58'46.81814"N	95°28'34.54377"W	30.79	13920569.33	3083934.61	120.83
AJ6402 - PAM 09	30°02'17.23076"N	95°04'17.24285"W	-11.50	13945895.35	3211315.78	78.30
AJ6418 - PAM 11	30°01'55.76898"N	95°51'54.77617"W	147.84	13936144.85	2960331.66	238.10
AJ6403 - PAM 12	30°03'34.89534"N	95°15'47.03819"W	-4.00	13951750.40	3150469.50	85.97
AJ6421 - PAM 15	29°40'59.65780"N	95°43'11.11405"W	13.00	13810573.56	3009901.65	102.72
AJ6422 - PAM 16	29°32'40.04777"N	95°31'38.04509"W	-17.05	13761896.77	3072502.78	71.99
AJ6423 - PAM 18	29°57'53.74662"N	95°40'41.58894"W	62.94	13913339.38	3020175.36	153.15
AJ6424 - PAM 19	29°50'28.00719"N	95°48'19.21116"W	68.56	13867208.93	2981170.04	158.63

6.3. HGCSD Category Stations

Measured Values for NGS Stations from Fully Constrained Adjustment Part of 2000 Survey

Station Name Stamping	NGS PID	Measured Latitude	Measured Longitude	Ellip. Height	Measured Northing	Measured Easting	Meas. Elev.
A 640 Reset 1962	AW1112	29°39'30.37456"N	95°13'52.11804"W	-63.00	13806234.79	3165264.29	26.15
E 8 (Not Stamped)	AW0300	29°47'05.07451"N	95°32'24.85793"W	-9.29	13849110.07	3065785.71	80.50
E 1208 1973	AW0183	29°37'48.79179"N	95°18'26.44605"W	-46.10	13795207.46	3141399.04	43.03
FIRE NO 1 1942	AW1129	29°43'05.37258"N	95°17'00.14686"W	-56.01	13827409.55	3147994.68	33.30
G 1511 1987	AW5633	29°55'57.02261"N	95°24'08.22153"W	-5.50	13904138.36	3107872.62	84.38
G1215 1973	AW0820	29°52'04.75433"N	95°15'45.47893"W	-39.11	13882074.88	3152833.95	50.51
HGCSD 11 1986	AW5511	29°57'58.14333"N	95°32'22.42912"W	30.84	13915056.19	3064047.98	120.92
HGCSD 12 Reset 1995	AB7497	29°56'24.01990"N	95°25'40.41886"W	-0.20	13906615.61	3099681.24	89.72
HGCSD 13 1986	AW5634	29°55'50.88326"N	95°18'09.77552"W	-19.60	13904501.95	3139414.49	70.19
HGCSD 14 Reset 1995	AB7498	29°56'04.42155"N	95°14'02.04791"W	-39.69	13906564.18	3161155.85	50.05
HGCSD 17 1986	AW5441	29°52'46.79604"N	95°42'14.04448"W	44.75	13882115.08	3012920.33	134.84
HGCSD 18 1986	AW5439	29°52'45.31234"N	95°36'41.68786"W	27.70	13882801.28	3042170.04	117.70
HGCSD 19 Reset 2000	AJ6408	29°51'57.74284"N	95°29'16.44438"W	-8.07	13879154.45	3081492.15	81.80
HGCSD 20 1986	AW5568	29°52'29.28005"N	95°22'11.52832"W	-17.89	13883480.73	3118786.15	71.86
HGCSD 21 1986	AW5655	29°50'57.58662"N	95°10'26.70633"W	-49.04	13876201.04	3181105.92	40.48
HGCSD 24 1986	AW5414	29°47'08.08818"N	95°49'06.69046"W	50.46	13846908.34	2977539.70	140.44
HGCSD 25 1986	AW5603	29°47'07.78457"N	95°42'53.94398"W	24.62	13847785.56	3010371.13	114.55
HGCSD 26 Reset 2000	AJ6409	29°47'27.34194"N	95°35'11.25078"W	-1.17	13850927.60	3051065.21	88.68
HGCSD 27 1986	AW5606	29°47'04.96727"N	95°31'46.17234"W	-13.21	13849200.22	3069193.19	76.55
HGCSD 29 Reset 2000	AJ6425	29°47'27.28137"N	95°20'03.15237"W	-44.52	13853342.69	3131038.14	45.02
HGCSD 3 1987	BL1994	30°01'04.67861"N	95°35'09.02479"W	49.69	13933460.84	3048851.34	139.91
HGCSD 30 1986	AW5529	29°46'11.97416"N	95°13'14.36793"W	-64.50	13846886.07	3167282.25	24.88
HGCSD 35 Reset 2000	AJ6410	29°42'35.46780"N	95°39'06.16768"W	-8.69	13820859.33	3031220.10	81.04
HGCSD 36 1986	AW5428	29°42'48.21136"N	95°35'50.23191"W	-14.78	13822644.58	3048452.40	74.90
HGCSD 37 1986	AW5431	29°43'41.15930"N	95°27'03.84667"W	-34.44	13829369.54	3094682.85	55.08
HGCSD 38 1986	AW5558	29°41'52.61443"N	95°19'24.94869"W	-53.60	13819660.53	3135464.96	35.69
HGCSD 39 Reset 1995	AB7499	29°42'10.26666"N	95°16'34.47328"W	-72.00	13821918.20	3150434.36	17.27
HGCSD 40 1986	AW5670	29°42'37.39213"N	95°12'54.75690"W	-74.39	13825278.52	3169710.88	14.85
HGCSD 45 Reset 1995	AA9854	29°40'19.84856"N	95°27'39.50966"W	-37.03	13808949.55	3092155.45	52.32
HGCSD 46 1987	AW5687	29°36'55.74347"N	95°25'18.89363"W	-39.35	13788720.56	3105183.96	49.80
HGCSD 47 1986	AW5556	29°37'12.61507"N	95°17'28.38961"W	-39.84	13791717.31	3146635.54	49.26
HGCSD 48 1986	AW5694	29°37'30.28684"N	95°13'13.86608"W	-48.65	13794220.34	3169029.08	40.41
HGCSD 5	BL 1998	30°03'40.07036"N	95°24'52.92817"W	19.21	13950771.50	3102507.24	109.30
HGCSD 66 1986	AW5411	29°43'58.13283"N	95°50'45.96860"W	46.43	13827491.06	2969312.77	136.32
J 1185 1964	AW0902	29°44'27.99553"N	95°12'42.73119"W	-85.13	13836478.91	3170408.90	4.17
LA PORTE 1952	AW1275	29°39'53.91195"N	95°03'56.69508"W	-67.22	13810340.51	3217684.62	21.88
M 1504 1986	AW5413	29°45'54.41707"N	95°49'21.71208"W	36.62	13839433.57	2976418.76	126.56
M 89 1932	AW0215	29°46'17.17822"N	95°20'56.15773"W	-41.94	13846118.93	3126591.33	47.57

Station Name Stamping	NGS PID	Measured Latitude	Measured Longitude	Ellip. Height	Measured Northing	Measured Easting	Meas. Elev.
N 23	AW0816	29°56'04.41417"N	95°14'26.50060"W	-34.02	13906494.23	3159005.58	55.73
N 20	AW0813	29°56'18.40075"N	95°17'01.92454"W	-24.09	13907469.41	3145293.10	65.71
N 21	AW0814	29°56'21.29677"N	95°16'07.63327"W	-24.43	13907913.86	3150057.84	65.35
Q 1279 1978	AW2263	29°42'50.67332"N	95°36'07.97253"W	-15.21	13822847.69	3046881.58	74.47
T 768 1943	AW0261	29°47'08.15980"N	95°45'35.13551"W	40.83	13847427.27	2996172.82	130.78
V 1146 1959	AW0973	29°42'53.15510"N	95°13'07.13852"W	-74.46	13826834.58	3168568.22	14.80
V 1182 1963	AW2293	29°40'52.55268"N	95°27'34.08396"W	-38.93	13812265.89	3092533.84	50.45
X 1181 1963	AW0311	29°47'04.51676"N	95°28'01.30931"W	-25.69	13849747.89	3088998.79	64.01
Y 1202 1972	AW0352	29°46'53.82784"N	95°19'47.31155"W	-43.10	13850008.96	3132539.16	46.41
Z 639 Reset 1965	AW1110	29°38'44.96552"N	95°13'09.06536"W	-56.27	13801773.13	3169208.71	32.84
Z 1149 1959	AW0222	29°48'46.41656"N	95°21'01.60672"W	-33.39	13861171.28	3125641.04	56.22

6.4. Other Stations

The following stations are a part of the NGS Network, but were not included in the October 2000 NGS survey. These stations have new horizontal and vertical values and are listed below.

Measured Values for NGS Stations from Fully Constrained Adjustment Not Part of 2000 Survey

Station Name Stamping	NGS PID	Measured Latitude	Measured Longitude	Ellip. Height	Measured Northing	Measured Easting	Meas. Elev.
B 659 1942	AW0358	29°48'11.14663"N	95°16'49.07484"W	-49.39	13858311.15	3147988.21	40.11
C 640 Reset 1965	AW1117	29°40'57.83735"N	95°15'10.95086"W	-67.69	13814841.21	3158030.18	21.52
G1020 1954	AW0380	29°49'42.09284"N	95°13'11.50190"W	-52.30	13868107.44	3166848.78	37.20
H 1184 1964	AW0931	29°46'18.34857"N	95°07'51.08697"W	-78.08	13848461.01	3195734.73	11.28
L-PORT 1987	AW5679	29°40'08.99514"N	95°03'53.08537"W	-66.03	13811873.87	3217951.61	23.09
W 1205	AW2058	29°37'31"N	95°16'01"W	N/A	13793800	3154300	45.40
W 658 1942	AW0366	29°47'58.50817"N	95°14'25.77261"W	-53.08	13857438.79	3160647.14	36.37
X 1496 1996	AC 6330	29°55'48.80829"N	95°20'48.33241"W	-18.48	13903854.11	3125477.18	71.35
Y 639 1942	AW3306	29°38'04.02280"N	95°12'32.01165"W	-53.99	13797745.63	3172610.35	35.08

Section 7.

Project Planning

Planning was a key element to the success of this project. There were several areas to be addressed in the planning stages of this project and are listed below.

- Review of stations included in each watershed as provided by Brown & Gay Engineers;
- Creation of acceptable forms for reconnaissance, monumentation and data collection;
- Creation of a system to file the massive amount of paper and digital data;
- Tracking of production as the project was executed;
- Designing the work flow to maximize production;
- Tracking the "One Calls" so that we were sure all deep rod monument sites were clear of underground obstructions;
- Securing and storing a sufficient amount of supplies and equipment to set the monumentation;
- Reviewing on a daily basis the GPS satellite constellation status and solar activity;
- Monitoring weather predictions as the GPS observations were taken to avoid data collection during thunderstorms;
- Designing the session observations so that the field GPS observations would be accomplished in the most efficient manner; and
- Designing and implementing a QA/QC procedure to minimize and catch errors as they occur.

Section 8.

Field Survey Narrative

8. Field Survey Narrative

In September 2002, Pate Engineering and CDS/Muery Services received the notice to proceed with this geodetic control survey. The field portions of the survey were broken down into four areas. They were reconnaissance, monument setting, GPS observations and differential leveling. CDS/Muery Services was tasked to manage this project. Field personnel from Pate Engineers and CDS/Muery Services were utilized for most of the fieldwork effort.

8.1. Reconnaissance

In the reconnaissance phase, one person and two person crews recovered the existing monumentation as provided by Brown & Gay for the following watersheds: Barker, Brays, Buffalo, Carpenter, Greens, Hunting, Sims and Vince Bayou. The survey teams also set temporary points for all proposed new monumentation. Digital photos were taken at each site. Two forms were filled out for each station. The data included but was not limited to the following: a pencil rubbing of the station disk; Key Map no.; to reach description; route sketch; detailed sketch; "sky visibility" obstructions; and stamping information.

8.2. One Calls for New Monuments

After the reconnaissance was complete, the next stage of the fieldwork was to set the new monuments in place. All of the rod monuments were cleared ahead of time with One Call to be sure sites were clear of underground utilities. This involved picking small groups of stations and faxing them to One Call, coordinating all of the responses and moving the station in the event there was an obstruction.

8.3. Monument Setting

Two person survey teams were used set all of the disks in concrete and three person teams were used to set the aluminum rods with greased sleeves and access covers. There were a total of 182 disks set in concrete and 98 rods driven to refusal or 24 feet whichever came first. The minimum depth of these rods was 12 feet, the maximum depth was 40 feet, and average depth was 21 feet.

8.4. GPS Observations

For the GPS observation portion of this project, Trimble dual-frequency, full-wavelength GPS receivers were used. Geodetic quality antennas with ground planes and fixed height tripods were also used. Because there were numerous existing benchmarks in this survey that had to be verified and/or updated, and they were in precarious locations such as on a headwall or on the edge of a bridge, the fixed height tripods could not always be used. In these situations, we did one of the following: 1) placed the GPS antenna directly over the station mark; 2) used a variable height bipod; or 3) used the fixed height tripod with two legs extended and at a lower height.

Since the GPS observation stage of this project was the largest field effort, some of the GPS observations started prior to the completion of the monumentation effort. The initial areas surveyed were watersheds where the majority of the monuments were already existing such as Brays Bayou. There were also a number of existing monuments that just needed a verification check. These were also surveyed before the monumentation was complete.

On completion of the monumentation setting, the remainder of the GPS observations were taken. The primary control stations for this survey were the three CORS stations at the extensometer sites (ADKS, LKHU & NETP). A network of PAM stations and HGCSD monuments nearly equally spaced (4-6 miles apart) formed the primary base stations for this project. These stations were observed a minimum of 5 hours on three different days. These stations were directly tied to its nearest neighboring primary base station and also tied to one or more of the three CORS stations in the network. This network formed the basis for all of the ties to the balance of the stations (local network stations) in this survey. All of the remaining stations were surveyed a minimum of two times for minimum common time period of 30-minutes and separated generally by two days and three hours. See the NOS NGS-58 Technical Memorandum for a more complete description. There were a few situations where this time separation was not strictly followed. In addition to occupying each one of the stations twice, two independent baselines were measured between its two closest neighboring stations. These stations only included the benchmarks described in sections 2.2.2. through 2.2.5.

Benchmarks described in section 2.2.1 Existing Permanent BM used by TSARP IDIQ had to be checked only via RTK or similar method. These stations were included in the overall network of new and resurveyed stations and were generally surveyed the same way as the others listed above. Only one of these stations was only occupied one time. The balance were occupied two or more times. Although the initial request was to use

the existing position and elevation of these stations if they checked within 0.3 feet, it was decided to place new positions and elevations since the quality of this survey is presumed to be of a higher standard and/or more recent than the previous survey to establish the initial position and elevation.

Following are additional criteria that were followed during the course of the GPS observation data collection:

- Data collected during all of the GPS observation periods had a VDOP less than 6;
- Fixed tripod heights were checked several times throughout the course of the survey;
- GPS data were collected at 5-second epoch intervals;
- Satellites were tracked down to 10 degrees above the horizon;
- No meteorological data were collected for any part of this survey, however, approximated temperatures and weather conditions were recorded;
- Pencil rubbings and/or close up digital pictures were taken at each observation of a station.

8.5. Differential Leveling

At the conclusion of the GPS observations, there were a total of eight stations that could not be observed with GPS due to "sky visibility" obstructions. Differential levels were run to these stations. In addition to running differential levels, a mapping grade GPS receiver was used to measure the approximate location of the station. This approximate location is depicted on the Control Station Diagram to the nearest second of latitude and longitude and to the nearest 100 feet in northing and easting. Following is a list of the stations established via differential leveling:

Loop Number		Floodplain RM Number	Adjusted Elevation (Feet)	Loop Length (Feet)	Allowable Error (Feet)	Actual Error (Feet)
1	From	010530A	44.61	110	0.003	0.001
	To	**010530**	**45.40**			
2	From	040410	75.52	11621	0.034	0.007
	Through	**040405**	**78.58**			
	To	040400	76.38			

Loop Number		Floodplain RM Number	Adjusted Elevation (Feet)	Loop Length (Feet)	Allowable Error (Feet)	Actual Error (Feet)
4	From	080030	24.88	10346	0.033	0.021
	Through	**080035**	**26.61**			
	To	080025	22.36			
5	From	210115	51.52	35956	0.061	0.035
	Through	**210120**	**48.45**			
	To	210125	58.80			
6	From	210210	61.64	17861	0.043	0.003
	Through	**210250**	**54.34**			
	To	210255	70.83			
7	From	210100	50.52	24596	0.051	0.009
	Through	**210105**	**53.78**			
	To	210110	54.62			
8	From	210080	55.60	62030	0.081	0.067
	Through	**210085**	**40.99**			
	To	210090	67.81			
9	From	150750	99.52	13297	0.037	0.003
	Through	**150145**	**102.73**			
	To	150150	103.32			

Section 9.

Data Processing Narrative

CDS/Muery Services processed all of the GPS and leveling data collected by the field personnel. GPS data were downloaded every evening and stored on a CDS/MS server. The following day, typically, the data were checked in to Trimble Geomatics Office, Version 1.60. Independent baselines (vectors) were batch processed to identify any possible problems so that additional field measurements could be made while the field crews were in the vicinity of the previous days work. After all issues with the baselines were sorted out, the baselines were reprocessed at a later date using the Precise Ephemeredes. These ephemeris files were acquired from the National Geodetic Survey web site. Precise ephemeris files are divided into three categories (precise, rapid & ultra-rapid). All of the file types were used during the course of the processing of the data. Since the vectors measured were relatively short, CDS/MS did not see a need to always use the highest quality ephemeris files.

Only satellite data tracked above 15-degree elevation masks were used to process baselines. In some situations, up to 25-degree elevation masks were used to minimize or eliminate cycle slips in the field data. All vectors processed and used in the network adjustments were either L1 fixed (baselines less than 5 kilometers) or Iono Free Fixed for baselines greater than 5 kilometers.

Typically, RMS values for each computed baseline (adjacent station pairs) did not exceed 1.5 centimeters. The only areas where, occasionally, this value was slightly higher was on "sky-visibility" obstructed control stations that had to be occupied by GPS and some of the long baseline ties to PAM stations and CORS stations. Out of 3308 total vectors processed in this survey, 100% had an RMS value less than 2.0 centimeters and 94% had an RMS value less than 1.5 centimeters. The average RMS value for this project was 0.8 centimeters.

Typically, the ellipsoid differences between baseline pairs did not exceed 2.0 centimeters. In some cases this was exceeded on ties to control stations. There were no cases where the ellipsoid height differences exceeded 5.0 centimeters.

Section 10.

Analysis of Results of Control Survey

All of the firms performed minimally constrained adjustments based on the most centrally located CORS extensometer site (NETP). The survey firms compared their minimally constrained results and found that wherever existing control stations were tied by two or more firms, the different firms' positions matched very closely. Horizontally 24 of 31 common stations matched within 0.02 feet, and none exceeded 0.035 feet. Vertically 24 of 31 common stations (ellipsoid heights) matched within 0.04 feet, and none exceeded 0.083 feet. When comparing data measured by different firms on the same stations, statistically, if all of the errors have been removed from the measurements, each firm should come up with the same answer. If this is true, then the average difference should equal zero. The average of the sum of the differences between two firm's positions on 31 stations was 0.004 feet horizontally and 0.005 feet vertically. This indicated a high level of consistency in survey quality throughout the network.

Comparisons were made between the existing control stations published values from 2000 and the measured values from this survey's minimally constrained adjustment. Horizontally, the average difference was 0.03 feet. 84 of 111 stations matched horizontally within 0.05 feet, and virtually all of the control station positions, relative to its closest neighboring control station, matched within the tolerance for NGS 1st-Order Specifications.

Vertically, the differences between published ellipsoid heights from 2000 and this survey's measured values were much higher. They averaged -0.13 feet and ranged from an apparent rise of 0.20 feet to an apparent subsidence of 0.48 feet. The majority of the marks were found to be lower in 2003 than in 2000 relative to the one extensometer benchmark held in the minimally constrained adjustment. It became apparent that most of the HGCSD 2000 benchmarks and PAM's had been affected in a vertical direction and in varying amounts by subsidence, and we were therefore unable to hold their elevations in the final network adjustments.

Based on the above analysis, the survey firms were in agreement as to how the network should be finally constrained. The recommendations were presented to the TSARP program managers and accepted. A summary of the final network constraints are as follows:

10.1. Horizontal Constraints

It was agreed that most or all of the 2000 control that was surveyed for the TSARP project matches within the 1st Order tolerance (1:100,000) and could therefore be held

in the final adjustment. The recommended method for determining whether or not this is true for any given point will be as follows:

> For a given point A, determine the distance to the closest control point B. Calculate the combined 2-d positional difference for the two points. Calculate the maximum allowable difference for line AB (distance AB x .00001). If the combined difference is less than the maximum allowed, the baseline passes the test and the published value of point A may be held. For example, given a line AB which is 15,000 feet long; Point A's delta N = -0.05 feet and delta E = 0.04 feet; Point B's delta N = 0.03 feet and delta E = - 0.02 feet. The combined differences are: delta N = 0.08 feet and delta E = 0.06 feet and the 2-d difference = 0.10 feet. The maximum allowable difference = 0.15 feet and point A can therefore be held in the final adjustment.

The metadata will contain the following reference regarding horizontal control:

> "Unit of measure is the U. S. Survey Foot. Horizontal positions are referenced to NAD83 (1993), resurveyed in 2000 and adjusted in 2001, 1997.00 Epoch Date. Coordinates are referenced to the Texas Coordinate System of 1983, South Central Zone. Positions determined using GPS substantially conform to NGS Second Order Class I Specifications."

10.2. Vertical Constraints

It was agreed that, because of subsidence in varying amounts across the county over the approximate 2.5 years that have elapsed between the two surveys, all of the 2000 benchmarks cannot be held. After further discussion it was concluded that even holding a few benchmarks might introduce distortions in the network that would be undesirable, especially at the outer fringes of the network. It was therefore agreed that a minimally constrained adjustment in the vertical component would be performed, holding the ellipsoid height of the CORS station at Northeast Treatment Plant (NETP – PID AJ6430), based on the 1997.00 Epoch Date. The published ellipsoid height is -9.22 meters or 30.249 feet). The differences due to subsidence between the TSARP channel surveys in 2001 and the TSARP control survey in 2002-2003 will be about half of the subsidence rates seen since October 2000 and in general should not exceed about 0.20 feet.

Orthometric heights of all benchmarks are determined using a two-step process. First the ellipsoid heights are converted to orthometric heights using the GEOID99 model. Then all elevations throughout the network are vertically translated by an additional amount, a single constant value for the entire network, in order to bring the orthometric height at NETP up to the published value of 18.07meters or 59.285 feet. The constant needed to bring the orthometric heights up to this published value at NETP is 0.253

feet. This constant is necessary to account for the fact that the NGS ellipsoid and geoid heights do not directly correlate mathematically to NGS published orthometric heights.

The metadata will contain the following reference regarding vertical control:

"Elevations are referenced to the NAVD88 2000 survey, adjusted in 2001 and are based on the published elevation at NORTHEAST 2250 CORS ARP (PID AJ6430), 1997.00 Epoch Date. Elevations determined by GPS substantially conform to the NOAA Technical Memorandum NOS NGS-58 2-centimeter Standard. Elevations determined by precise leveling substantially conform to the NGS Second Order Class II vertical standard for leveling, as published in the FGCC document entitled "Standards and Specifications for Geodetic Control Networks" dated September 1984."

10.3. Minimally Constrained Control Station Comparisons

Following is a table comparing the published values of the control stations in the network
with the results of the minimally constrained adjustment.

NGS Station Name	Computed Northing	Computed Easting	Pub. Elev.	Measured Northing	Measured Easting	Meas. Ellip. Ht.	Meas. Elev.	Pub. - Meas. Delta North	Pub. - Meas. Delta East	Pub. - Meas. Ellip. Height	Pub. - Meas. Delta Elev.
ADKS 1795 CORS ARP	13850941.208	3051083.129	103.346	13850941.180	3051083.137	13.449	103.296	0.028	-0.008	0.035	0.050
LKHU CORS ARP	13899802.558	3189315.907	66.240	13899802.560	3189315.910	-23.521	66.108	-0.002	-0.003	-0.035	0.132
NETP 2250 CORS ARP	13853429.580	3131034.227	59.285	13853429.580	3131034.227	-30.249	59.285	0.000	0.000	0.000	0.000
PAM 1 ARP	13894611.175	3040232.795	133.530	13894611.180	3040232.830	43.193	133.254	-0.005	-0.035	0.278	0.276
PAM 3 ARP	13861539.784	3042217.164	102.821	13861539.810	3042217.144	12.604	102.526	-0.026	0.020	0.290	0.295
PAM 5 ARP	13851032.486	3051238.991	98.327	13851032.540	3051239.031	8.271	98.102	-0.054	-0.040	0.194	0.225
PAM 6 ARP	13859340.051	3021849.571	116.995	13859340.070	3021849.562	26.776	116.736	-0.019	0.009	0.258	0.259
PAM 7 ARP	13903856.460	3052630.111	132.119	13903856.500	3052630.125	41.747	131.809	-0.040	-0.014	0.313	0.310
PAM 8 ARP	13920569.328	3083934.610	121.030	13920569.340	3083934.604	30.780	120.826	-0.012	0.006	0.224	0.204
PAM 9 ARP	13945895.346	3211315.780	78.313	13945895.340	3211315.773	-11.501	78.302	0.006	0.007	0.018	0.011
PAM 11 ARP	13936144.852	2960331.662	238.123	13936144.870	2960331.672	147.830	238.099	-0.018	-0.010	0.037	0.024
PAM 15 ARP	13810573.557	3009901.651	102.756	13810573.580	3009901.649	13.006	102.715	-0.023	0.002	0.052	0.041
PAM 16 ARP	13761896.767	3072502.784	71.981	13761896.840	3072502.710	-17.059	71.986	-0.073	0.074	-0.001	-0.005
PAM 18 ARP	13913339.382	3020175.356	153.346	13913339.390	3020175.373	62.929	153.149	-0.008	-0.017	0.194	0.197
PAM 19 ARP	13867208.930	2981170.040	158.694	13867208.930	2981170.051	68.552	158.630	0.000	-0.011	0.050	0.064
A 640 RESET	13806234.789	3165264.286	26.148	13806234.790	3165264.271	-63.003	26.147	-0.001	0.015	0.011	0.001
E 1208	13795207.457	3141399.038	43.274	13795207.500	3141398.975	-46.097	43.027	-0.043	0.063	0.231	0.247
E 8	13849110.069	3065785.708	80.610	13849110.120	3065785.661	-9.277	80.495	-0.051	0.047	0.091	0.115
FIRE RM 1	13827409.547	3147994.679	33.399	13827409.520	3147994.796	-55.981	33.303	0.027	-0.117	0.076	0.096
G 1215	13882074.884	3152833.949	50.886	13882074.870	3152833.972	-39.117	50.508	0.014	-0.023	0.305	0.378
G 1511	13904138.363	3107872.623	84.514	13904138.400	3107872.654	-5.537	84.380	-0.037	-0.031	0.156	0.134

NGS Station Name	Computed Northing	Computed Easting	Pub. Elev.	Measured Northing	Measured Easting	Meas. Ellip. Ht.	Meas. Elev.	Pub. - Meas. Delta North	Pub. - Meas. Delta East	Pub. - Meas. Ellip. Height	Pub. - Meas. Delta Elev.
HGCSD 3	13933460.843	3048851.337	140.223	13933460.840	3048851.337	49.683	139.913	0.003	0.000	0.317	0.310
HGCSD 5	13950771.503	3102507.242	109.514	13950771.500	3102507.232	19.204	109.297	0.003	0.010	0.251	0.217
HGCSD 11	13915056.194	3064047.975	121.260	13915056.240	3064047.990	30.806	120.918	-0.046	-0.015	0.362	0.342
HGCSD 12 RESET	13906615.614	3099681.239	89.862	13906615.660	3099681.251	-0.233	89.719	-0.046	-0.012	0.167	0.143
HGCSD 13	13904501.949	3139414.487	70.243	13904501.940	3139414.496	-19.610	70.185	0.009	-0.009	0.220	0.058
HGCSD 14 RESET	13906564.181	3161155.850	50.098	13906564.160	3161155.859	-39.697	50.052	0.021	-0.009	0.032	0.046
HGCSD 17	13882115.077	3012920.330	135.039	13882115.130	3012920.262	44.729	134.840	-0.053	0.068	0.218	0.199
HGCSD 18	13882801.277	3042170.037	118.077	13882801.270	3042170.049	27.694	117.700	0.007	-0.012	0.357	0.377
HGCSD 19 RESET	13879154.445	3081492.146	81.955	13879154.450	3081492.140	-8.084	81.801	-0.005	0.006	0.177	0.154
HGCSD 20	13883480.734	3118786.148	72.014	13883480.740	3118786.140	-17.908	71.860	-0.006	0.008	0.159	0.154
HGCSD 21	13876201.039	3181105.923	40.551	13876200.960	3181105.942	-49.042	40.484	0.079	-0.019	0.092	0.067
HGCSD 24	13846908.340	2977539.698	140.518	13846908.330	2977539.714	50.459	140.440	0.010	-0.016	0.099	0.078
HGSCD 25	13847785.555	3010371.125	114.862	13847785.600	3010371.114	24.622	114.550	-0.045	0.011	0.312	0.312
HGCSD 26 RESET	13850927.596	3051065.213	88.911	13850927.590	3051065.208	-1.161	88.675	0.006	0.005	0.478	0.236
HGCSD 27	13849200.222	3069193.193	76.640	13849200.270	3069193.176	-13.221	76.553	-0.048	0.017	0.098	0.087
HGCSD 29 RESET 2	13853342.693	3131038.137	45.023	13853342.660	3131038.179	-44.500	45.018	0.033	-0.042	0.243	0.005
HGCSD 30	13846886.071	3167282.249	24.869	13846886.140	3167282.277	-64.517	24.875	-0.069	-0.028	0.049	-0.006
HGCSD 35 RESET	13820859.334	3031220.102	81.135	13820859.400	3031220.159	-8.701	81.039	-0.066	-0.057	0.105	0.096
HGCSD 36	13822644.583	3048452.399	74.934	13822644.620	3048452.369	-14.778	74.895	-0.037	0.030	0.047	0.039
HGCSD 37	13829369.539	3094682.853	55.154	13829369.570	3094682.876	-34.464	55.079	-0.031	-0.023	0.351	0.075
HGCSD 38	13819660.527	3135464.956	35.761	13819660.460	3135464.868	-53.574	35.694	0.067	0.088	0.031	0.067
HGCSD 39 RESET	13821918.197	3150434.356	17.356	13821918.180	3150434.342	-71.999	17.273	0.017	0.014	0.116	0.083
HGCSD 40	13825278.522	3169710.880	14.829	13825278.540	3169710.884	-74.395	14.847	-0.018	-0.004	-0.014	-0.018
HGCSD 45 RESET	13808949.553	3092155.449	52.362	13808949.580	3092155.449	-37.025	52.319	-0.027	0.000	0.050	0.043
HGCSD 46	13788720.564	3105183.960	49.869	13788720.580	3105183.891	-39.347	49.796	-0.016	0.069	0.075	0.073
HGCSD 47	13791717.306	3146635.542	49.508	13791717.360	3146635.528	-39.813	49.259	-0.054	0.014	0.246	0.249

NGS Station Name	Computed Northing	Computed Easting	Pub. Elev.	Measured Northing	Measured Easting	Meas. Ellip. Ht.	Meas. Elev.	Pub. - Meas. Delta North	Pub. - Meas. Delta East	Pub. - Meas. Ellip. Height	Pub. - Meas. Delta Elev.
HGCSD 48	13794220.343	3169029.077	40.485	13794220.390	3169029.068	-48.637	40.411	-0.047	0.009	0.081	0.074
HGCSD 66	13827491.060	2969312.772	136.614	13827491.090	2969312.765	46.427	136.321	-0.030	0.007	0.292	0.293
J 1185	13836478.913	3170408.901	4.167	13836478.980	3170408.915	-85.137	4.171	-0.067	-0.014	-0.001	-0.004
LA PORTE	13810340.510	3217684.616	21.719	13810340.470	3217684.586	-67.187	21.880	0.040	0.030	-0.169	-0.161
M 89	13846118.928	3126591.332	47.539	13846118.920	3126591.334	-41.933	47.566	0.008	-0.002	-0.029	-0.027
N 20	13907469.414	3145293.095	65.945	13907469.400	3145293.062	-24.099	65.705	0.014	0.033	0.379	0.240
N 21	13907913.864	3150057.840	65.387	13907913.820	3150057.897	-24.421	65.354	0.044	-0.057	0.012	0.033
N 23	13906494.230	3159005.579	55.741	13906494.170	3159005.618	-34.027	55.733	0.060	-0.039	0.038	0.008
Q 1279	13822847.685	3046881.584	74.639	13822847.780	3046881.547	-15.203	74.473	-0.095	0.037	0.144	0.166
T 768	13847427.273	2996172.820	130.872	13847427.280	2996172.789	40.844	130.783	-0.007	0.031	0.068	0.089
V 1182	13812265.887	3092533.836	50.558	13812265.910	3092533.844	-38.916	50.450	-0.023	-0.008	0.071	0.108
X 1181	13849747.890	3088998.793	64.042	13849747.890	3088998.802	-25.695	64.008	0.000	-0.009	0.039	0.034
Y 1202	13850008.962	3132539.159	46.555	13850008.940	3132539.142	-43.085	46.409	0.022	0.017	0.106	0.146
Z 1149	13861171.281	3125641.041	56.365	13861171.290	3125641.019	-33.378	56.216	-0.009	0.022	0.143	0.149
Z 639 RESET	13801773.128	3169208.708	32.841	13801773.140	3169208.678	-56.276	32.835	-0.012	0.030	0.010	0.006

Max Diff.	0.079	0.088	0.478	0.378
Min Diff.	-0.095	-0.117	-0.169	-0.161
Ave Diff.	-0.011	0.003	0.142	0.119

10.4. Fully Constrained Control Station Comparisons with Previously Surveyed Stations

➢ Comparison of Fully Constrained Adjustment to Positions of stations provided by Brown & Gay Engineers, Inc. on Benchmarks that were previously surveyed.

➢ All units of measurement are U.S. Survey Feet.

➢ The published horizontal positions for all of the stations listed in Section 10.3 of the Final Report were held fixed for this survey.

➢ These horizontal stations include three CORS, twelve PAM stations, twenty eight HGCSD stations and nineteen other stations.

➢ All of the horizontal stations were included in the October 2000 survey that was performed by NGS and HGCSD.

➢ The elevation of the NGS Continuously Operating Reference Station "NORTHEAST 2250 CORS ARP" (PID AJ6430) was held fixed for this survey.

➢ Geoid99 was used to convert Ellip. Ht. to Elevations and a constant of 0.253 feet was added to the elevation to adjust to the pub. elevation for PID AJ6430.

➢ **Bold Red** indicates that the horizontal position measured differs from the Brown & Gay Engineers, Inc. provided position by more than 0.30 feet.

➢ **Bold Black** indicates that the vertical position measured differs from the Brown & Gay Engineers, Inc. provided position by more than 0.30 feet.

➢ There are several points in this listing that have large differences. A majority of these are because a new station was set or another existing station was utilized because the given station was destroyed

➢ Brays Bayou releveling has been included in this list because this bayou was part of the pilot study. Please note that the large vertical differences are due to the local subsidence in the area since the last survey.

Greens - Existing Permanent BM used by TSARP IDIQ (42)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.- Meas Delta N	Exist.- Meas Delta E	Exist.- Meas. Slope Dist	Exist.- Meas. Delta Elev.
1	150310	13878833.91	3130669.68	60.75	13878834.18	3130669.68	60.79	-0.269	-0.003	0.269	-0.042
2	150340	13889796.50	3110035.17	77.85	13889796.46	3110035.11	77.73	0.040	0.059	0.071	0.118
3	150325	13890803.28	3123371.37	68.23	13890803.46	3123371.35	68.14	-0.173	0.025	0.175	0.086
4	150320	13888063.29	3127162.62	63.28	13888063.50	3127162.73	63.09	-0.213	-0.106	0.238	0.191
5	150425	13885126.57	3145788.66	59.14	13885126.66	3145788.63	59.02	-0.088	0.028	0.092	0.122
6	150430	13886050.62	3143089.79	61.01	13886050.74	3143089.91	60.99	-0.121	-0.121	0.171	0.016
7	150350	13892946.28	3101758.65	81.99	13892946.37	3101758.66	81.91	-0.086	-0.014	0.087	0.085
8	150705	13918444.20	3097011.08	95.16	13918444.22	3097011.03	95.01	-0.015	0.054	0.056	0.153
9	150100	13906900.98	3124451.51	72.90	13906900.59	3124451.53	72.73	**0.389**	**-0.021**	**0.390**	0.169
10	150275	13871122.31	3162352.11	35.71	13871122.11	3162352.11	35.71	0.198	-0.005	0.198	-0.004
11	150115	13910600.67	3106517.80	84.69	13910600.70	3106517.53	84.58	-0.023	0.264	0.265	0.106
12	150665	13911435.21	3124173.73	77.62	13911435.18	3124173.65	77.52	0.026	0.080	0.084	0.101
13	150315	13883889.28	3127530.81	58.35	13883945.51	3127588.36	57.46	**-56.238**	**-57.553**	**80.468**	**0.889**
14	150305	13879617.00	3135472.31	56.74	13879617.03	3135472.33	56.82	-0.031	-0.018	0.036	-0.083
15	150295	13876380.08	3141046.28	47.12	13876379.97	3141046.30	47.11	0.112	-0.021	0.114	0.013
16	150085	13900277.29	3139849.00	60.59	13900277.49	3139849.02	60.42	-0.198	-0.020	0.199	0.175
17	150380	13885758.51	3134817.84	59.07	13885758.34	3134817.54	58.75	**0.170**	**0.294**	**0.340**	**0.325**
18	150110	13908817.43	3109746.19	80.95	13908817.43	3109746.01	80.93	0.000	0.177	0.177	0.021
20	150120	13912629.06	3103329.90	88.01	13912628.99	3103329.77	88.02	0.067	0.129	0.145	-0.008
21	150725	13922149.21	3095454.54	100.21	13922149.36	3095454.60	100.07	-0.147	-0.065	0.161	0.143

Greens - Existing Permanent BM used by TSARP IDIQ (42) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
22	150050	13891017.10	3160321.63	51.07	13891017.10	3160321.47	50.99	0.000	0.160	0.160	0.084
23	150640	13898152.54	3111649.52	80.73	13898152.25	3111649.41	80.71	**0.295**	**0.107**	**0.314**	0.023
24	150375	13882127.11	3134086.83	57.22	13882127.21	3134086.77	57.22	-0.097	0.064	0.116	-0.001
25	150420	13883372.37	3149087.00	56.07	13883372.43	3149087.18	56.01	-0.058	-0.181	0.190	0.056
26	150280	13874743.18	3153145.45	37.74	13874856.44	3153174.24	37.57	**-113.260**	**-28.785**	**116.861**	0.170
27	150475	13913219.17	3150677.43	64.98	13913219.10	3150677.32	64.83	0.066	0.114	0.132	0.150
28	150175	13909417.82	3065162.89	117.84	13909417.75	3065162.64	117.60	0.072	0.252	0.262	0.243
29	150635	13898635.04	3116179.51	76.41	13898635.33	3116179.47	76.45	-0.282	0.040	0.285	-0.039
30	150365	13899181.04	3085485.73	100.29	13899180.79	3085485.75	100.20	0.246	-0.016	0.247	0.093
31	150205	13858130.09	3172963.37	30.84	13858130.47	3172963.23	30.78	**-0.381**	**0.139**	**0.406**	0.061
32	150180	13907896.32	3058926.56	121.41	13907896.31	3058926.52	121.19	0.008	0.043	0.044	0.224
33	150300	13877427.02	3139411.26	48.85	13877427.13	3139411.29	48.86	-0.112	-0.036	0.118	-0.007
34	150185	13907154.57	3056572.46	122.44	13907154.40	3056572.37	122.26	0.172	0.085	0.192	0.180
35	150480	13917253.83	3148812.28	69.32	13917253.75	3148812.42	69.07	0.078	-0.137	0.158	0.254
36	150700	13915926.77	3100413.72	91.28	13915927.02	3100413.85	91.19	-0.251	-0.133	0.284	0.086
37	150630	13898814.76	3118982.34	73.07	13898814.94	3118982.36	73.07	-0.178	-0.014	0.179	-0.003
38	150740	13913128.30	3096790.59	99.51	13913128.15	3096790.59	99.32	0.152	0.004	0.152	0.186
39	150025	13859762.47	3169391.30	27.31	13859762.54	3169391.30	27.30	-0.062	-0.004	0.062	0.011
40	150290	13875351.41	3146171.04	47.38	13875351.49	3146171.09	47.38	-0.082	-0.048	0.095	0.005
41	150345	13891525.85	3105741.01	77.27	13891525.93	3105741.07	77.13	-0.080	-0.062	0.101	0.136
42	150470	13912626.04	3155959.86	68.45	13912334.51	3155972.84	67.27	**291.533**	**-12.979**	**291.822**	**1.184**

Vince Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
2001	090040	13814190.00	3170437.00	27.00	13814189.90	3170437.24	26.99	0.096	-0.236	0.255	0.007
2002	090005	13828159.00	3168096.00	2.00	13828311.63	3168063.15	2.17	-152.626	32.846	156.120	-0.170
2003	090185	13823377.00	3169259.00	14.00	13823427.29	3169320.18	14.08	-50.291	-61.178	79.196	-0.081
2004	090150	13820274.00	3176985.00	28.00	13820309.64	3177022.59	28.19	-35.640	-37.591	51.801	-0.194
2005	090135	13822306.00	3175056.00	26.00	13822350.84	3175098.49	25.71	-44.843	-42.493	61.778	0.286

Sims Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
3001	30030	13813888.16	3151962.11	27.28	13813888.08	3151961.98	27.54	0.082	0.128	0.152	-0.262
3002	30035	13813432.50	3150411.24	27.02	13813619.53	3150401.13	26.34	-187.030	10.116	187.303	0.678
3003	30040	13811317.88	3146705.08	28.44	13811317.78	3146705.04	28.52	0.101	0.042	0.109	-0.080
3004	30050	13804120.40	3138665.57	38.73	13804120.42	3138665.64	38.76	-0.017	-0.078	0.080	-0.031
3005	30060	13800375.01	3131855.84	36.14	13800375.04	3131855.87	36.15	-0.031	-0.027	0.041	-0.012
3006	30065	13801279.98	3125708.59	43.22	13801280.07	3125708.76	43.43	-0.092	-0.170	0.193	-0.211
3007	30080	13795032.23	3115968.79	51.08	13795032.21	3115968.80	51.13	0.019	-0.007	0.020	-0.054
3008	30095	13790012.46	3106523.70	53.71	13790012.42	3106523.68	53.73	0.038	0.024	0.045	-0.018
3009	30105	13790073.34	3102381.22	53.25	13790073.14	3102381.31	53.25	0.198	-0.083	0.215	0.004
3010	30135	13791704.34	3080580.68	64.83	13791704.39	3080580.72	64.87	-0.050	-0.049	0.070	-0.041
3011	30140	13791695.68	3079864.01	65.30	13791670.59	3079888.30	65.22	25.093	-24.294	34.926	0.083
3012	30145	13791730.95	3079433.83	64.39	13791627.52	3077093.63	67.88	103.427	2340.192	2342.476	-3.494
3013	30190	13819539.47	3153950.76	23.04	13819539.44	3153950.74	23.22	0.034	0.020	0.039	-0.180

Sims Existing Permanent BM used by TSARP IDIQ (5) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
3014	30240	13807214.01	3165394.13	28.11	13807213.75	3165394.28	28.21	**0.263**	**-0.147**	**0.301**	-0.097
3015	30205	13816609.52	3158423.78	20.29	13816609.56	3158424.12	20.48	**-0.035**	**-0.339**	**0.341**	-0.194
3016	30255	13800707.97	3167816.58	31.70	13800707.78	3167816.69	31.74	0.186	-0.104	0.213	-0.039
3017	30210	13816029.93	3160198.61	11.87	13816030.16	3160198.53	11.81	-0.226	0.086	0.242	0.058
3018	30220	13812723.51	3161076.02	25.21	13812723.54	3161076.22	25.27	-0.033	-0.195	0.198	-0.058
3019	30250	13801847.28	3167782.12	30.56	13801847.03	3167782.28	30.75	0.248	-0.165	0.298	-0.189
3020	30225	13811141.18	3163341.67	28.66	13811141.30	3163341.83	28.85	-0.116	-0.162	0.199	-0.187
3021	30395	13798966.22	3119205.90	40.38	13798966.31	3119205.90	40.46	-0.092	0.000	0.092	-0.078
3022	30400	13799097.64	3118982.45	41.25	13799097.53	3118982.51	41.32	0.106	-0.053	0.119	-0.069
3023	30265	13814841.17	3158029.86	21.45	13814841.21	3158030.18	21.52	**-0.044**	**-0.320**	**0.323**	-0.071
3024	30285	13804489.86	3155238.01	34.48	13804489.63	3155238.26	34.62	**0.228**	**-0.246**	**0.335**	-0.143
3025	30290	13803556.36	3155300.92	33.94	13803556.30	3155300.83	34.02	0.056	0.087	0.103	-0.084
3026	30270	13810265.87	3156243.73	32.27	13810265.70	3156243.44	32.34	**0.166**	**0.283**	**0.328**	-0.071
3027	30280	13806880.17	3155139.32	30.46	13806880.14	3155139.33	30.52	0.027	-0.009	0.028	-0.064
3028	30305	13810969.37	3161690.24	27.16	13810969.38	3161689.91	27.18	**-0.012**	**0.328**	**0.328**	-0.015
3029	30310	13810245.37	3161085.09	29.39	13810245.59	3161084.91	29.53	-0.223	0.179	0.286	-0.139
3030	30315	13809982.66	3160720.95	29.98	13809982.44	3160720.94	30.06	0.217	0.019	0.218	-0.077
3031	30340	13805561.39	3166126.39	30.70	13805561.11	3166126.27	30.99	**0.283**	**0.114**	**0.305**	-0.294

Hunting Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
4001	080035	13847383.93	3165042.37	26.54	13847400.00	3165000.00	26.61	**-16.070**	**42.370**	**45.315**	-0.071
4002	080005	13835703.53	3170340.37	13.39	13835703.40	3170340.42	13.41	0.131	-0.053	0.141	-0.021
4003	080050	13855658.78	3159179.32	31.47	13855658.81	3159179.16	31.50	-0.025	0.152	0.154	-0.034
4004	080065	13855956.00	3152994.59	35.15	13855956.10	3152994.42	35.12	-0.107	0.176	0.206	0.035
4005	080070	13854865.42	3151986.38	39.33	13854865.51	3151986.19	39.32	-0.092	0.190	0.211	0.014
4006	080075	13855646.28	3150479.85	39.78	13855646.60	3150479.64	39.79	**-0.316**	**0.204**	**0.376**	-0.010
4007	080080	13856234.14	3147343.09	40.38	13856233.94	3147343.15	40.39	0.192	-0.064	0.202	-0.005
4008	080085	13856691.33	3144952.90	45.01	13856691.48	3144952.94	45.03	-0.154	-0.035	0.158	-0.021
4009	080090	13858751.91	3143844.55	43.26	13858751.81	3143844.80	43.17	0.096	-0.255	0.272	0.095
4010	080095	13860544.03	3141133.31	48.31	13860544.12	3141133.19	48.23	-0.093	0.126	0.157	0.078
4011	080100	13860642.09	3139815.35	45.91	13860642.19	3139815.31	45.81	-0.102	0.042	0.110	0.100

Brays Relevel Existing BM (147)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5026	040005	13830872.69	3149335.43	32.87	13830872.65	3149335.22	32.78	0.043	0.212	0.216	0.086
5027	040020	13830824.75	3144247.16	20.36	13830824.74	3144247.04	20.35	0.014	0.117	0.118	0.012
5028	040025	13830903.96	3142740.67	19.09	13830903.98	3142740.50	19.04	-0.015	0.174	0.175	0.045
5029	040030	13828683.88	3141092.19	21.98	13828683.85	3141092.07	21.97	0.030	0.119	0.123	0.008
5030	040035	13825033.70	3139476.42	31.47	13825033.65	3139476.31	31.49	0.050	0.108	0.119	-0.025
5031	040040	13823744.09	3138585.24	25.71	13823743.99	3138585.13	25.65	0.099	0.117	0.153	0.060
5032	040045	13823929.37	3137539.76	32.14	13823929.34	3137539.71	32.17	0.031	0.048	0.057	-0.021
5033	040050	13824265.04	3136631.35	28.49	13824265.00	3136631.32	28.47	0.043	0.033	0.054	0.020
5034	040055	13824920.14	3135738.15	29.78	13824920.07	3135738.13	29.75	0.073	0.019	0.075	0.026
5035	040060	13825458.31	3130403.46	36.46	13825458.36	3130403.39	36.47	-0.045	0.065	0.079	-0.004
5036	040065	13824538.95	3129654.20	33.44	13824538.92	3129654.19	33.41	0.029	0.010	0.031	0.030
5037	040070	13823588.20	3124906.62	38.71	13823587.88	3124906.68	37.92	**0.325**	**-0.057**	**0.330**	**0.790**
5038	040075	13824668.79	3120302.33	37.45	13824668.79	3120302.28	37.36	0.004	0.048	0.048	0.094
5039	040080	13824351.84	3118155.80	51.05	13824351.87	3118155.78	51.01	-0.026	0.024	0.035	0.036
5040	040085	13824232.61	3117707.40	52.20	13824232.62	3117707.38	52.01	-0.007	0.021	0.022	0.187
5041	040090	13824600.47	3116757.88	41.14	13824600.48	3116757.87	41.08	-0.010	0.003	0.010	0.058
5042	040095	13824431.52	3116285.76	45.64	13824431.48	3116285.71	45.52	0.040	0.048	0.062	0.118
5043	040100	13821945.29	3113393.10	43.33	13821945.25	3113393.09	43.32	0.042	0.010	0.043	0.019
5044	040105	13820951.26	3112395.52	43.77	13820951.22	3112395.49	43.68	0.038	0.038	0.054	0.090
5045	040110	13820524.04	3110428.60	45.99	13820307.50	3110377.78	45.87	**216.543**	**50.820**	**222.426**	0.118
5046	040115	13819736.00	3108745.07	45.08	13819735.88	3108745.00	45.11	0.125	0.065	0.141	-0.030
5047	040120	13818645.15	3107972.93	47.63	13818645.08	3107972.86	47.58	0.075	0.069	0.102	0.056
5048	040125	13818553.78	3107423.89	46.55	13818553.65	3107423.80	46.53	0.131	0.095	0.162	0.025

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5049	040130	13818557.53	3105540.79	44.39	13818557.42	3105540.71	44.30	0.108	0.079	0.134	0.087
5050	040135	13817919.06	3102702.95	49.58	13817918.95	3102702.85	49.48	0.110	0.099	0.148	0.098
5051	040145	13815869.88	3098628.34	49.65	13815869.78	3098628.22	49.55	0.102	0.119	0.157	0.095
5052	040150	13813728.87	3095410.20	53.21	13813597.44	3095328.66	53.17	**131.427**	**81.539**	**154.666**	0.042
5053	040160	13811307.54	3090065.42	53.81	13811307.41	3090065.33	53.81	0.133	0.091	0.161	-0.001
5054	040165	13810742.83	3087203.45	54.08	13810742.67	3087203.36	54.05	0.164	0.082	0.183	0.022
5055	040170	13810824.19	3081905.63	59.83	13810824.08	3081905.58	59.78	0.107	0.055	0.120	0.045
5056	040175	13810752.69	3080162.62	58.56	13810752.62	3080162.47	58.37	0.069	0.147	0.162	0.189
5057	040180	13809959.41	3077021.87	59.46	13809959.28	3077021.73	59.28	0.133	0.149	0.200	0.172
5058	040185	13808965.36	3074757.38	64.41	13808965.31	3074757.20	64.23	0.050	0.181	0.188	0.180
5059	040195	13808494.54	3070856.80	62.54	13808494.45	3070856.63	62.35	0.090	0.166	0.189	0.196
5060	040200	13809790.68	3070036.97	66.31	13809790.59	3070036.87	66.11	0.088	0.102	0.135	0.204
5061	040205	13810830.54	3069471.63	64.10	13810830.39	3069471.57	63.94	0.155	0.061	0.167	0.162
5062	040210	13811290.45	3068159.61	70.06	13811290.30	3068159.53	69.93	0.152	0.074	0.169	0.132
5063	040215	13811600.45	3064541.55	67.16	13811600.35	3064541.40	66.97	0.099	0.147	0.177	0.188
5064	040220	13814493.36	3063015.38	67.94	13814493.29	3063015.27	67.68	0.072	0.114	0.135	0.265
5065	040225	13816438.07	3061309.08	71.39	13816437.98	3061308.93	71.33	0.090	0.151	0.176	0.057
5066	040230	13819496.06	3058531.43	70.59	13819495.92	3058531.28	70.31	0.140	0.147	0.203	0.276
5067	040235	13820028.09	3056838.96	72.74	13820027.85	3056838.83	72.51	0.240	0.128	0.272	0.235
5068	040240	13819972.43	3055498.00	71.10	13819972.30	3055497.92	70.90	0.126	0.077	0.148	0.199
5069	040245	13821212.72	3053172.71	73.84	13821212.59	3053172.64	73.58	0.127	0.073	0.146	0.265
5070	040250	13821859.13	3051763.65	74.05	13821858.97	3051763.60	73.84	0.162	0.054	0.171	0.216
5071	040255	13823367.54	3051597.44	79.18	13823367.42	3051597.38	78.91	0.116	0.057	0.129	0.274

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5072	040260	13826057.62	3049930.39	78.62	13826057.43	3049930.35	78.19	0.190	0.035	0.193	**0.431**
5073	040270	13825507.78	3045952.98	80.75	13825507.68	3045952.89	80.38	0.105	0.091	0.139	**0.375**
5074	040280	13823982.49	3042480.19	80.87	13823982.34	3042480.07	80.56	0.154	0.120	0.195	**0.319**
5075	040285	13823312.32	3039978.92	81.03	13823312.21	3039978.82	80.77	0.111	0.102	0.151	0.262
5076	040295	13822743.12	3033636.91	83.37	13822743.03	3033636.81	82.95	0.090	0.105	0.138	**0.417**
5077	040300	13822932.22	3030360.06	87.30	13822932.04	3030359.96	87.06	0.179	0.099	0.205	0.240
5078	040305	13823359.41	3029016.44	89.65	13823359.21	3029016.26	89.40	0.198	0.184	0.270	0.251
5079	040310	13823547.60	3028427.59	90.49	13823547.46	3028427.50	90.19	0.145	0.091	0.171	0.293
5080	040315	13823680.99	3026360.48	91.39	13823680.83	3026360.39	91.08	0.164	0.092	0.188	0.315
5081	040330	13811724.96	3094543.46	51.50	13811724.83	3094543.37	51.43	0.133	0.088	0.159	0.070
5082	040335	13809415.24	3094457.92	51.80	13809415.13	3094457.84	51.77	0.108	0.080	0.134	0.032
5083	040345	13807629.09	3093413.32	52.67	13807628.97	3093413.21	52.61	0.116	0.106	0.157	0.064
5084	040350	13806151.72	3092505.63	51.75	13806151.62	3092505.58	51.69	0.098	0.049	0.110	0.055
5085	040355	13804739.68	3091367.41	57.11	13804739.54	3091367.35	57.01	0.139	0.058	0.151	0.108
5086	040360	13801672.26	3086130.04	55.22	13801672.13	3086129.94	55.00	0.131	0.097	0.163	0.223
5087	040365	13800697.77	3084219.89	56.32	13800697.74	3084219.82	56.21	0.031	0.071	0.077	0.104
5088	040370	13800741.27	3082427.18	56.57	13800741.23	3082427.09	56.46	0.043	0.091	0.101	0.102
5089	040375	13802140.45	3079796.03	61.24	13802140.34	3079795.95	61.06	0.114	0.072	0.135	0.179
5090	040380	13802106.04	3078943.57	61.17	13802105.94	3078943.51	61.06	0.104	0.053	0.117	0.111
5091	040765	13809229.38	3087179.52	54.91	13809229.30	3087179.44	54.86	0.080	0.076	0.110	0.057
5092	040770	13807583.81	3087255.37	54.73	13807583.70	3087255.24	54.63	0.112	0.131	0.172	0.101
5093	040775	13806784.60	3087249.13	55.77	13806784.49	3087249.07	55.75	0.114	0.065	0.131	0.027
5094	040780	13803617.50	3087348.89	57.67	13803617.40	3087348.79	57.57	0.102	0.101	0.144	0.101

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5095	040785	13802798.68	3086992.86	56.47	13802798.64	3086993.16	56.48	**0.042**	**-0.299**	**0.302**	-0.009
5096	040790	13801968.96	3086269.90	56.75	13801968.41	3086270.40	56.46	**0.554**	**-0.500**	**0.746**	0.287
5097	040795	13809899.97	3077876.02	59.62	13809899.73	3077875.93	59.68	0.244	0.092	0.261	-0.060
5098	040800	13808079.32	3077955.86	61.26	13808079.21	3077955.70	61.09	0.112	0.156	0.192	0.172
5099	040805	13806511.18	3078016.57	65.71	13806511.10	3078016.43	65.67	0.079	0.145	0.165	0.035
5100	040810	13802694.01	3078167.69	59.23	13802693.95	3078167.62	59.16	0.057	0.066	0.087	0.077
5101	040815	13800887.06	3078238.86	61.43	13800886.99	3078238.79	61.30	0.071	0.069	0.099	0.129
5102	040820	13798429.11	3078334.52	62.70	13798429.03	3078334.40	62.58	0.085	0.125	0.151	0.116
5103	040825	13797459.23	3077512.86	61.90	13797459.14	3077512.73	61.71	0.088	0.130	0.157	0.187
5104	040830	13796050.78	3075012.22	63.39	13796050.84	3075012.14	63.27	-0.064	0.078	0.101	0.122
5105	040835	13796026.99	3074211.31	62.50	13796026.95	3074211.26	62.41	0.045	0.044	0.063	0.087
5106	040840	13796848.21	3071158.04	62.36	13796848.15	3071157.98	62.19	0.058	0.060	0.083	0.163
5107	040710	13814310.78	3077713.87	60.19	13814310.69	3077713.76	60.09	0.090	0.116	0.147	0.098
5108	040715	13815606.57	3077415.65	60.05	13815606.46	3077415.56	59.74	0.108	0.089	0.140	**0.309**
5109	040720	13816561.98	3077722.13	60.00	13816561.89	3077721.99	59.71	0.092	0.144	0.171	**0.295**
5110	040725	13817416.19	3077992.78	60.41	13817416.09	3077992.73	60.32	0.105	0.052	0.117	0.095
5111	040730	13818084.01	3078138.90	61.51	13818083.88	3078138.84	61.35	0.135	0.059	0.147	0.160
5112	040735	13819219.53	3078143.93	62.80	13819219.44	3078144.01	62.63	0.090	-0.078	0.119	0.169
5113	040740	13820054.45	3077952.88	63.19	13820054.28	3077952.93	62.78	0.171	-0.046	0.177	**0.409**
5114	040745	13820342.31	3077850.17	62.07	13820342.15	3077850.25	62.64	0.161	-0.079	0.179	**-0.571**
5115	040390	13808433.92	3069252.88	63.20	13808433.90	3069252.77	63.03	0.018	0.116	0.117	0.168
5116	040465	13806004.68	3068219.29	65.47	13806004.59	3068219.21	65.24	0.087	0.083	0.120	0.225

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5117	040400	13803116.77	3062355.20	76.62	13803116.78	3062355.11	76.38	-0.011	0.098	0.099	0.238
5118	040405	13802016.59	3059959.88	78.80	13802000.00	3060000.00	78.58	16.590	-40.119	43.414	0.220
5119	040410	13802127.66	3057514.03	75.84	13802127.67	3057513.93	75.52	-0.009	0.107	0.107	**0.316**
5120	040415	13803179.39	3053355.43	78.46	13803179.35	3053355.34	78.20	0.042	0.093	0.102	0.267
5121	040420	13805383.45	3049703.74	81.36	13805383.44	3049703.67	81.07	0.012	0.067	0.068	0.284
5122	040425	13805338.23	3048338.71	81.64	13805338.20	3048338.65	81.29	0.030	0.061	0.068	**0.348**
5123	040430	13806311.82	3045216.10	82.64	13806311.78	3045216.01	82.28	0.040	0.089	0.098	**0.360**
5124	040435	13807212.35	3043087.30	87.21	13807212.30	3043087.22	86.83	0.048	0.078	0.092	**0.383**
5125	040440	13807926.66	3040650.49	87.62	13807926.53	3040650.44	87.29	0.129	0.052	0.139	**0.330**
5126	040760	13815273.48	3073900.10	63.32	13815273.36	3073900.03	63.18	0.117	0.066	0.134	0.142
5127	040470	13814923.05	3067813.11	64.91	13814923.00	3067813.04	64.90	0.048	0.072	0.087	0.011
5128	040475	13816044.18	3067761.61	65.72	13816044.03	3067761.43	65.61	0.151	0.184	0.238	0.117
5129	040480	13817074.71	3067716.69	68.06	13817074.59	3067716.70	67.89	0.116	-0.003	0.116	0.175
5130	040485	13818821.40	3067637.27	68.08	13818821.29	3067637.27	68.05	0.112	0.007	0.112	0.032
5131	040855	13814776.14	3064908.60	66.29	13814776.04	3064908.53	66.16	0.103	0.072	0.126	0.125
5132	040860	13817023.59	3065017.48	68.72	13817023.51	3065017.31	68.40	0.085	0.172	0.192	**0.317**
5133	040865	13817881.04	3065287.63	68.92	13817880.96	3065287.54	68.55	0.078	0.084	0.115	**0.371**
5134	040870	13818738.35	3065561.10	68.71	13818738.25	3065561.08	68.54	0.098	0.024	0.101	0.174
5135	040875	13819705.26	3065749.32	69.36	13819705.24	3065749.14	69.26	0.024	0.182	0.184	0.103
5136	040880	13820021.01	3065736.29	69.22	13820020.95	3065736.23	68.92	0.059	0.060	0.084	**0.301**
5137	040885	13823149.78	3065164.00	70.48	13823149.68	3065163.93	70.28	0.097	0.072	0.121	0.203
5138	040890	13824344.77	3064253.90	71.79	13824344.67	3064253.84	71.61	0.097	0.062	0.115	0.172

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5139	040490	13813364.68	3063253.54	67.63	13813364.57	3063253.43	67.47	0.106	0.106	0.150	0.164
5140	040495	13812579.86	3061245.37	72.43	13812579.71	3061245.32	72.33	0.147	0.049	0.155	0.103
5141	040500	13812591.92	3059754.76	70.55	13812591.81	3059754.59	70.31	0.111	0.170	0.203	**0.248**
5142	040505	13812518.75	3057619.51	73.51	13812518.62	3057619.40	72.85	0.132	0.111	0.172	**0.659**
5143	040510	13812441.02	3055975.91	73.13	13812440.90	3055975.82	72.81	0.116	0.094	0.149	**0.320**
5144	040515	13812255.90	3051916.67	76.73	13812255.72	3051916.58	76.31	0.181	0.093	0.203	**0.418**
5145	040520	13811941.66	3049259.99	78.45	13811941.49	3049260.38	78.05	**0.171**	**-0.388**	**0.424**	0.403
5146	040545	13814189.87	3059605.58	70.34	13814189.78	3059605.44	70.10	0.090	0.133	0.161	0.247
5147	040525	13811856.25	3046626.04	81.61	13811856.15	3046625.99	81.22	0.099	0.048	0.110	**0.387**
5148	040530	13811807.84	3045411.99	83.47	13811807.77	3045411.93	83.07	0.069	0.061	0.092	**0.395**
5149	040535	13811768.31	3044558.79	82.67	13811768.19	3044558.74	82.31	0.119	0.051	0.129	**0.353**
5150	040550	13816621.09	3056982.77	71.20	13816620.98	3056982.68	70.98	0.113	0.086	0.142	0.227
5151	040555	13816570.05	3055648.31	72.77	13816569.93	3055648.25	72.49	0.121	0.064	0.137	0.273
5152	040565	13816479.77	3051657.74	74.60	13816534.05	3051627.11	74.47	**-54.279**	**30.626**	**62.323**	0.130
5153	040570	13816415.23	3049047.41	77.43	13816415.15	3049047.36	77.09	0.077	0.048	0.091	**0.333**
5154	040575	13816343.15	3046426.18	80.47	13816343.12	3046426.11	80.15	0.033	0.072	0.079	**0.325**
5155	040580	13816282.79	3045043.44	79.97	13816282.68	3045043.41	79.66	0.111	0.036	0.117	**0.310**
5156	040585	13816195.64	3043165.63	84.15	13816195.57	3043165.58	83.79	0.072	0.045	0.085	**0.363**
5157	040600	13823844.48	3058328.54	75.86	13823844.42	3058328.37	75.65	0.065	0.169	0.181	0.210
5158	040605	13825819.88	3058457.67	76.14	13825819.84	3058457.47	75.96	0.043	0.202	0.207	0.181
5159	040610	13828136.53	3058347.88	76.46	13828136.28	3058347.75	75.97	0.252	0.126	0.282	**0.499**
5160	040620	13820484.14	3051517.31	72.78	13820484.04	3051517.33	72.35	0.102	-0.020	0.104	**0.434**

Brays Relevel Existing BM (147) Continued

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
5161	040625	13820424.22	3048871.76	77.62	13820454.29	3048882.28	74.58	-30.067	-10.513	31.852	3.035
5162	040640	13820299.07	3046257.50	80.64	13820298.97	3046257.40	80.40	0.096	0.101	0.139	0.240
5163	040645	13820148.65	3043015.88	78.68	13820148.58	3043015.79	78.41	0.071	0.082	0.108	0.272
5164	040650	13820020.55	3040097.46	81.07	13820061.58	3040145.17	80.81	-41.026	-47.709	62.923	0.261
5165	040655	13819783.42	3038923.84	80.87	13819783.30	3038923.78	80.73	0.124	0.056	0.136	0.141
5166	040660	13826500.74	3041274.48	81.07	13826500.60	3041274.43	80.66	0.138	0.056	0.149	0.409
5167	040665	13826469.09	3040097.89	82.75	13826468.97	3040097.72	82.27	0.119	0.173	0.210	0.480
5168	040670	13828064.92	3037434.53	80.32	13828064.84	3037434.50	80.12	0.085	0.037	0.093	0.206
5169	040675	13830326.62	3036169.65	80.31	13830326.47	3036169.55	79.95	0.147	0.104	0.180	0.367
5170	040680	13831875.90	3036135.66	80.99	13831875.72	3036135.49	80.64	0.182	0.172	0.250	0.349
5171	040690	13818293.11	3030848.97	84.44	13818292.97	3030848.91	84.20	0.138	0.069	0.154	0.234
5172	040695	13817681.24	3027496.11	87.05	13817681.11	3027496.03	86.69	0.128	0.081	0.151	0.358

Barker Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.-Meas Delta N	Exist.-Meas Delta E	Exist.-Meas. Slope Dist	Exist.-Meas. Delta Elev.
6001	190075	13844445.51	2975402.66	136.27	13844446.93	2975396.30	133.76	-1.424	6.360	6.517	2.509
6002	190080	13846878.01	2974974.01	140.23	13846880.24	2974971.46	140.25	-2.230	2.551	3.388	-0.024
6004	190135	13847193.87	3000161.17	126.51	13847193.86	3000161.24	126.35	0.006	-0.075	0.075	0.163
6005	190145	13850532.29	2995840.45	131.42	13850532.39	2995840.24	131.24	-0.100	0.205	0.228	0.185
6006	190155	13853157.40	2989861.47	135.56	13853157.50	2989861.20	135.35	-0.098	0.272	0.289	0.209
6007	190140	13849550.72	2998598.18	130.97	13849531.92	2998655.18	130.50	18.802	-57.007	60.028	0.473
6008	190150	13852070.77	2991123.99	140.54	13852070.78	2991123.96	140.30	-0.011	0.030	0.032	0.240

Carpenters Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.- Meas Delta N	Exist.- Meas Delta E	Exist.- Meas. Slope Dist	Exist.- Meas. Delta Elev.
7001	130035	13848423.29	3187488.36	25.53	13848423.41	3187488.65	25.60	**-0.124**	**-0.284**	**0.310**	-0.069
7002	130045	13854994.72	3186601.03	28.96	13854994.85	3186601.07	28.94	-0.133	-0.045	0.140	0.017
7003	130025	13848102.52	3191791.71	18.00	13848102.67	3191791.48	17.80	-0.154	0.230	0.277	0.202
7004	130080	13848338.92	3195732.03	11.37	13848461.01	3195734.73	11.28	**-122.089**	**-2.694**	**122.119**	0.092

Buffalo Existing Permanent BM used by TSARP IDIQ (5)

BGE ID	New TSARP Number	Existing Northing	Existing Easting	Exist. Elev.	Measured Northing	Measured Easting	Meas. Elev.	Exist.- Meas Delta N	Exist.- Meas Delta E	Exist.- Meas. Slope Dist	Exist.- Meas. Delta Elev.
8001	210260	13851210.25	3074453.05	73.03	13851210.11	3074453.20	72.96	0.143	-0.151	0.208	0.072
8002	210375	13870727.83	3054158.89	102.93	13870727.78	3054158.86	102.74	0.054	0.029	0.061	0.189
8003	210380	13872592.87	3054084.87	104.40	13872592.84	3054084.89	104.19	0.033	-0.027	0.043	0.213
8004	210325	13845666.46	3041213.67	78.47	13845666.38	3041213.68	78.36	0.082	-0.010	0.083	0.110
8005	210330	13848249.98	3043669.70	77.97	13849218.83	3043644.52	82.49	**-968.854**	**25.178**	**969.181**	**-4.519**
8006	210335	13849218.89	3043644.62	82.71	13848249.89	3043669.90	77.73	**969.004**	**-25.280**	**969.334**	**4.979**
8008	210210	13849129.72	3082872.99	61.92	13849129.78	3082872.87	61.64	-0.064	0.118	0.134	0.278
8009	210215	13853088.47	3079530.64	68.44	13853088.33	3079530.74	68.31	0.143	-0.100	0.174	0.134
8010	210235	13855970.25	3073192.30	76.50	13855970.19	3073192.29	76.36	0.061	0.010	0.062	0.137
8011	210300	13844399.11	3056401.09	71.93	13844399.28	3056401.03	71.73	-0.166	0.069	0.180	0.204
8012	210305	13846666.95	3056404.15	76.05	13846667.11	3056404.14	76.00	-0.158	0.010	0.158	0.049

Section 11.

Subsidence

The Subsidence District's observed height changes at their PAM sites are in close agreement with the delta-elevations seen in the results of this TSARP control survey. It may be inferred that the delta-elevations seen by TSARP surveyors at other 2000 benchmarks are also representative of subsidence in the vicinity of those other benchmarks. A model has been developed from this data using the delta-elevations observed at all control stations of Stability Order A or B that shows the Approximate Annual Rate of Subsidence (AROS) for any given area within the network. The AROS is calculated for each RM based on this model and provided in the database. As benchmarks continue to move, this data could be used in later years to reconcile differences in benchmark height observations.

11.1. Data Provided by HGCSD

There were several pieces of data provided by the Harris Galveston Coastal Subsidence District (HGCSD) so that the issue of subsidence could be studied and correlated with the results of the 2003 survey. HGCSD provided a listing of the three extensometer sites showing the annual vertical variation from 1974 on station Addicks (ADKS) to present, and from 1980 on stations Lake Houston (LKHU) and Northeast Base (NETP) to present. In particular, the past 2 ½ years was examined to determine the vertical stability from the NGS October 2000 survey to the present 2003 survey. Since Northeast Base was going to be used as the vertical "anchor" for the survey, this data was valuable to verify there was little to no vertical movement during this period. A table of the average annual variation of each station in feet is provided below from January 1999 through January 2003. Both NETP and LKHU appear to have had very little movement since January of 2000.

Table of Annual Average Vertical Differences
at Extensometer CORS Units are in Feet

Date	ADKS	NETP	LKHU
1999	-2.968	-0.847	-0.539
2000	-3.119	-0.863	-0.551
2001	-3.202	-0.868	-0.553
2002	-3.297	-0.867	-0.558

During the course of the survey, CDS/Muery Services and Pate Engineering incorporated GPS static measurements made by HGCSD on the PAM stations listed below. In addition, HGCSD provided historical data at these sites showing the rate of subsidence. An excerpt of this data is shown below.

RELATIVE TOTOAL OBSERVED ELEVATION CHANGES (cm) UP TO DECEMBER 2001 (MONTHLY AVERAGES)

PAM NAME: **PAM 01**

Datum: Date/Elevation   1/2/1996

	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00
ADKS	-0.60	-0.60	-0.62	-0.62	-0.63	-0.64	-0.68	-0.72	-0.75			-0.77
LKHU	-0.63	-0.62	-0.66	-0.66	-0.65	-0.66	-0.71	-0.74	-0.79		-0.80	-0.79
NETP	-0.64	-0.64	-0.64	-0.63	-0.73	-0.66	-0.73	-0.75	-0.79		-0.81	-0.82
avg	-0.625	-0.621	-0.640	-0.639	-0.668	-0.653	-0.706	-0.739	-0.779		-0.803	-0.791

	Jan-01	Feb-01	Mar-03	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-03	Nov-01	Dec-01
ADKS	-0.81	-0.80		-0.80	-0.83	-0.81	-0.82	-1.00	-0.89		-0.91	-1.07
LKHU	-0.79	-0.81		-0.82	-0.80	-0.85	-0.85	-0.96	-0.91	-0.92	-0.94	-0.95
NETP	-0.82	-0.84		-0.85	-0.82	-0.86	-0.88	-0.94		-0.93	-0.94	-0.95
avg	-0.809	-0.819		-0.826	-0.816	-0.839	-0.847	-0.964	-0.900	-0.928	-0.929	-0.991

	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02	Dec-02
ADKS	-0.94	-0.93			-0.94	-0.94	-1.01	-1.02	-1.02	-1.04	-1.04	
LKHU	-0.96	-0.94		-0.97	-0.97	-0.99	-1.04	-1.09	-1.04	-1.07	-1.10	
NETP	-0.98	-0.98		-0.99	-0.99	-1.03	-1.03	-1.07	-1.06	-1.07	-1.08	
avg	-0.959	-0.950		-0.977	-0.968	-0.988	-1.024	-1.058	-1.039	-1.062	-1.076	

From the data provided by HGCSD at the PAM sites, we calculated a predicted AROS for each of the PAM's. We calculated subsidence from October 2000 to January 2003 based on the HGCSD data and added it to the published elevation of the PAM sites to determine the predicted elevation as of the date of this survey. This elevation was compared to the actual measured elevation. The results are listed below.

NGS Station Name	Published Elevation	Measured Elevation	Pub. - Meas. Elevation Difference	Approx. AROS	Predicted Subsidence	Predicted Elevation	Meas. Elev. - Pred. Elev.
PAM 1 ARP	133.53	133.25	0.28	0.13	0.28	133.25	0.01
PAM 3 ARP	102.82	102.53	0.30	0.14	0.30	102.52	0.01
PAM 5 ARP	98.33	98.10	0.23	0.10	0.22	98.11	-0.01
PAM 6 ARP	117.00	116.74	0.26	0.12	0.26	116.74	0.00
PAM 7 ARP	132.12	131.81	0.31	0.14	0.30	131.82	-0.01
PAM 8 ARP	121.03	120.83	0.20	0.10	0.22	120.81	0.01
PAM 9 ARP	78.31	78.30	0.01	0.00	0.00	78.31	-0.01
PAM 11 ARP	238.12	238.10	0.02	0.01	0.02	238.10	0.00
PAM 15 ARP	102.76	102.72	0.04	0.01	0.02	102.73	-0.02
PAM 16 ARP	71.98	71.99	-0.01	0.00	0.00	71.98	0.01
PAM 18 ARP	153.35	153.15	0.20	0.09	0.20	153.15	0.00
PAM 19 ARP	158.69	158.63	0.06	0.03	0.07	158.63	0.00

Based on these results, data from HGCSD and conversations with HGCSD, we believe that a fairly accurate prediction of the AROS has been made.

11.2. Observed Subsidence

Based on the analysis above, it was agreed that we would calculate the AROS for all of the stations in the network by creating a digital terrain model (DTM). The DTM was created using only NGS control from the October of 2000 survey that have a vertical stability of A or B order. Following are the definitions of A and B order stability:

- ➢ Stability: A = Most reliable and expected to hold
- ➢ Stability: B = Probably hold position/elevation well

This DTM was created by subtracting the Measured Elevation from Published Elevation for only the A and B Order points. A contour map at a 0.10 foot interval was created from this data. Then, the interpolated elevation difference and AROS were calculated for all of the remaining stations except for the extensometer sites. Listed below are the stations used to produce this model.

Table Listing the Stations (A and B Stability) Used to Calculate the AROS

NGS Station Name	Published Elevation	Measured Elevation	Pub. - Meas. Delta Elev.	Approx. AROS
PAM 1 ARP	133.530	133.254	0.276	0.13
PAM 3 ARP	102.821	102.526	0.295	0.14
PAM 5 ARP	98.327	98.102	0.225	0.10
PAM 6 ARP	116.995	116.736	0.259	0.12
PAM 7 ARP	132.119	131.809	0.310	0.14
PAM 8 ARP	121.030	120.826	0.204	0.10
PAM 9 ARP	78.313	78.302	0.011	0.00
PAM 11 ARP	238.123	238.099	0.024	0.01
PAM 15 ARP	102.756	102.715	0.041	0.01
PAM 16 ARP	71.981	71.986	-0.005	0.00
PAM 18 ARP	153.346	153.149	0.197	0.09
PAM 19 ARP	158.694	158.630	0.064	0.03
E 1208	43.274	43.027	0.247	0.11
G 1511	84.514	84.380	0.134	0.07
HGCSD 3	140.223	139.913	0.310	0.14
HGCSD 5	109.514	109.297	0.217	0.10
HGCSD 11	121.260	120.918	0.342	0.17
HGCSD 12 RESET	89.862	89.719	0.143	0.08
HGCSD 13	70.243	70.185	0.058	0.03
HGCSD 14 RESET	50.098	50.052	0.046	0.02
HGCSD 17	135.039	134.840	0.199	0.10
HGCSD 18	118.077	117.700	0.377	0.18
HGCSD 19 RESET	81.955	81.801	0.154	0.07
HGCSD 20	72.014	71.860	0.154	0.08
HGCSD 21	40.551	40.484	0.067	0.04
HGCSD 24	140.518	140.440	0.078	0.04
HGSCD 25	114.862	114.550	0.312	0.13
HGCSD 26 RESET	88.911	88.675	0.236	0.11
HGCSD 27	76.640	76.553	0.087	0.05
HGCSD 29 RESET 2	45.023	45.018	0.005	0.00
HGCSD 30	24.869	24.875	-0.006	0.14
HGCSD 35 RESET	81.135	81.039	0.096	0.01
HGCSD 36	74.934	74.895	0.039	0.05
HGCSD 37	55.154	55.079	0.075	0.02
HGCSD 38	35.761	35.694	0.067	0.05

Table Listing the Stations (A and B Stability) Used to Calculate the AROS Continued

NGS Station Name	Published Elevation	Measured Elevation	Pub. - Meas. Delta Elev.	Approx. AROS
HGCSD 39 RESET	17.356	17.273	0.083	0.02
HGCSD 40	14.829	14.847	-0.018	0.04
HGCSD 45 RESET	52.362	52.319	0.043	0.00
HGCSD 46	49.869	49.796	0.073	0.01
HGCSD 47	49.508	49.259	0.249	0.03
HGCSD 48	40.485	40.411	0.074	0.10
HGCSD 66	136.614	136.321	0.293	0.03
Q 1279	74.639	74.473	0.166	0.07
Y 1202	46.555	46.409	0.146	0.06
Z 1149	56.365	56.216	0.149	0.06

Section 12

Final Station Position Summary Listing

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
110370	HGCSD 5	BL1998	30°03'40.07036"N	95°24'52.92817"W	19.21	13950771.50	3102507.24	109.30
110408	NONE (ARP)	N/A	30°04'38.86031"N	95°24'50.92276"W	50.79	13956713.08	3102501.31	140.89
110595	HGCSD 3 1987	BL1994	30°01'04.67861"N	95°35'09.02479"W	49.69	13933460.84	3048851.34	139.91
130005	130005	N/A	29°46'04.74971"N	95°06'25.54204"W	-85.99	13847338.27	3203314.77	3.37
130010	130010	N/A	29°46'11.42886"N	95°06'55.02870"W	-66.26	13847926.17	3200695.25	23.10
130015	130015	N/A	29°45'25.12454"N	95°07'26.19941"W	-68.02	13843160.41	3198104.84	21.31
130020	130020	N/A	29°45'58.15748"N	95°07'27.07242"W	-67.23	13846492.69	3197917.38	22.12
130025	N100 BM01	N/A	29°46'16.09219"N	95°08'35.94379"W	-71.56	13848102.67	3191791.48	17.80
130030	N100 BM1A	N/A	29°46'17.87226"N	95°08'55.48462"W	-69.06	13848225.65	3190064.48	20.29
130035	N100 BM06	N/A	29°46'20.66782"N	95°09'24.62507"W	-63.76	13848423.41	3187488.65	25.60
130040	N100 BM02	N/A	29°46'52.78208"N	95°09'17.61788"W	-68.20	13851685.83	3187999.17	21.17
130045	N100 BM03	N/A	29°47'25.97837"N	95°09'32.24297"W	-60.45	13854994.85	3186601.07	28.94
130050	130050	N/A	29°47'59.63387"N	95°09'23.56233"W	-58.74	13858417.71	3187253.78	30.68
130055	N100 BM04	N/A	29°48'35.46771"N	95°09'31.35753"W	-55.00	13862012.82	3186448.54	34.43
130060	130060	N/A	29°48'54.28134"N	95°09'44.88752"W	-57.17	13863873.06	3185194.97	32.27
130065	130065	N/A	29°49'42.84364"N	95°08'34.88196"W	-53.78	13868978.57	3191196.38	35.69
130070	N100 BM05 Reset 99	N/A	29°50'18.68627"N	95°09'38.67563"W	-48.29	13872412.32	3185462.02	41.20
130075	N100 BM05	N/A	29°51'05.40171"N	95°09'58.08325"W	-43.52	13877072.56	3183599.13	46.00
130080	H 1184 1964	AW0931	29°46'18.34857"N	95°07'51.08697"W	-78.08	13848461.01	3195734.73	11.28

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
130085	130085	N/A	29°46'50.27922"N	95°07'59.61349"W	-67.26	13851659.73	3194877.14	22.12
130090	130090	N/A	29°47'20.80707"N	95°07'53.07110"W	-62.94	13854760.74	3195351.32	26.45
130095	130095	N/A	29°47'59.32429"N	95°07'40.81105"W	-58.05	13858685.00	3196302.15	31.36
130100	130100	N/A	29°47'45.50105"N	95°10'02.65427"W	-59.39	13856877.91	3183858.46	30.01
130105	130105	N/A	29°47'46.20976"N	95°10'18.51037"W	-60.33	13856903.71	3182459.90	29.08
130110	N111 BM05	N/A	29°47'52.93634"N	95°10'43.88013"W	-57.38	13857509.72	3180203.78	32.03
130115	130115	N/A	29°48'10.30676"N	95°10'09.87152"W	-57.63	13859361.38	3183140.89	31.78
130120	130120	N/A	29°48'25.46483"N	95°10'10.57032"W	-58.53	13860889.68	3183029.22	30.90
130125	130125	N/A	29°51'25.33009"N	95°09'36.48497"W	-48.81	13879146.88	3185433.85	40.72
130130	130130	N/A	29°50'47.92829"N	95°08'37.84066"W	-27.87	13875540.75	3190719.20	61.64
130135	130135	N/A	29°53'00.09086"N	95°09'40.33340"W	-39.49	13888702.68	3184781.04	50.09
150005	150005	N/A	29°45'26.87285"N	95°11'29.35808"W	-64.60	13842632.95	3176679.66	24.73
150010	150010	N/A	29°46'09.12130"N	95°11'27.55778"W	-59.28	13846903.37	3176699.28	30.08
150015	3845	N/A	29°46'17.55848"N	95°11'46.64264"W	-57.21	13847700.43	3174990.60	32.15
150020	P100 BM02	N/A	29°46'31.83862"N	95°12'22.48707"W	-61.88	13849039.53	3171786.76	27.50
150025	P100 BM03	N/A	29°48'18.70847"N	95°12'45.71690"W	-62.14	13859762.54	3169391.30	27.30
150030	G 1020 1954	AW0380	29°49'42.09284"N	95°13'11.50190"W	-52.30	13868107.44	3166848.78	37.20
150035	150035	N/A	29°49'28.66001"N	95°13'44.56703"W	-59.70	13866657.27	3163981.86	29.80
150040	150040	N/A	29°51'36.69919"N	95°13'25.49540"W	-44.46	13879638.25	3165243.23	45.11
150045	150045	N/A	29°52'58.34114"N	95°13'53.82494"W	-45.39	13887800.44	3162484.52	44.23
150050	P100 BM08 2001	N/A	29°53'30.85768"N	95°14'17.20952"W	-38.66	13891017.10	3160321.47	50.99
150055	150055	N/A	29°54'00.29596"N	95°14'28.97288"W	-42.41	13893955.95	3159191.05	47.26
150060	150060	N/A	29°54'39.06153"N	95°14'37.85672"W	-37.87	13897844.70	3158283.82	51.82
150065	150065	N/A	29°55'41.92882"N	95°15'14.20765"W	-37.36	13904089.37	3154883.10	52.39
150070	Cancelled	N/A	---	---	---	---	---	---
150075	Cancelled	N/A	---	---	---	---	---	---

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Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150080	150080	N/A	29°54'45.83102"N	95°17'29.66958"W	-35.92	13898045.72	3143149.80	53.82
150085	P100 BM09	N/A	29°55'08.94802"N	95°18'06.35732"W	-29.35	13900277.49	3139849.02	60.42
150090	150090	N/A	29°55'13.38724"N	95°19'51.42113"W	-24.68	13900434.55	3130594.37	65.11
150095	X 1496 1996	AC 6330	29°55'48.80829"N	95°20'48.33241"W	-18.48	13903854.11	3125477.18	71.35
150100	P100 BM12	N/A	29°56'19.26917"N	95°20'58.90310"W	-17.11	13906900.59	3124451.53	72.73
150105	P100 BM15	N/A	29°56'57.57960"N	95°23'08.62604"W	-10.22	13910414.28	3112924.58	79.67
150110	P100 BM16	N/A	29°56'42.75002"N	95°23'45.30076"W	-8.97	13908817.43	3109746.01	80.93
150115	P100 BM17	N/A	29°57'01.37845"N	95°24'21.35895"W	-5.33	13910600.70	3106517.53	84.58
150120	P100 BM18	N/A	29°57'22.41630"N	95°24'56.87283"W	-1.91	13912628.99	3103329.77	88.02
150125	P100 BM20	N/A	29°57'19.57491"N	95°25'23.02192"W	1.90	13912271.69	3101039.45	91.84
150130	150130	N/A	29°56'46.38582"N	95°26'01.19107"W	4.30	13908818.11	3097785.71	94.24
150135	P100 BM22	N/A	29°56'33.15034"N	95°26'35.03524"W	7.37	13907391.08	3094850.40	97.31
150136	GREENS 2	N/A	29°56'32.60011"N	95°26'37.58362"W	7.25	13907328.70	3094628.00	97.19
150140	150140	N/A	29°56'13.54498"N	95°27'09.18132"W	6.54	13905320.31	3091907.83	96.49
150145	P100 BM23	N/A	29°56'28"N	95°27'46"W	N/A	13906700.00	3088700.00	102.73
150150	P100 BM24	N/A	29°56'41.01296"N	95°28'26.91537"W	13.34	13907886.96	3084988.25	103.32
150155	150155	N/A	29°56'44.88067"N	95°29'01.12545"W	19.62	13908186.89	3081968.28	109.61
150160	P100 BM25 Reset 2001	N/A	29°56'55.34971"N	95°29'52.83618"W	21.28	13909107.47	3077389.53	111.29
150165	150165	N/A	29°56'49.52579"N	95°30'46.92032"W	19.30	13908377.28	3072651.40	109.32
150170	P100 BM26	N/A	29°56'57.20343"N	95°31'10.95430"W	27.47	13909089.53	3070514.95	117.51
150175	P100 BM29	N/A	29°57'02.02385"N	95°32'11.65979"W	27.55	13909417.75	3065162.64	117.60
150180	P100 BM30	N/A	29°56'48.79176"N	95°33'23.02851"W	31.12	13907896.31	3058926.52	121.19
150185	P100 BM32	N/A	29°56'42.13574"N	95°33'50.02494"W	32.19	13907154.40	3056572.37	122.26
150190	150190	N/A	29°57'11.62595"N	95°34'52.12066"W	36.93	13909972.02	3051024.87	127.03
150195	150195	N/A	29°45'31.09893"N	95°10'07.56067"W	-68.27	13843295.03	3183871.08	21.06

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150200	150200	N/A	29°47'12.26440"N	95°13'03.39263"W	-57.01	13853004.09	3168052.01	32.40
150205	150205	N/A	29°48'01.41307"N	95°12'05.79318"W	-58.65	13858130.47	3172963.23	30.78
150210	150210	N/A	29°48'16.94087"N	95°11'29.53300"W	-59.45	13859801.99	3176104.94	29.98
150215	150215	N/A	29°48'47.12498"N	95°11'07.11798"W	-59.30	13862913.65	3177979.10	30.14
150220	150220	N/A	29°49'47.15085"N	95°10'55.14296"W	-30.65	13869008.14	3178835.47	58.83
150225	150225	N/A	29°50'30.88894"N	95°11'06.73668"W	-33.69	13873390.55	3177670.84	55.82
150230	150230	N/A	29°51'11.26710"N	95°11'13.03171"W	-43.60	13877449.01	3176983.82	45.94
150235	150235	N/A	29°51'41.33325"N	95°11'16.18217"W	-47.72	13880475.42	3176607.58	41.83
150240	150240	N/A	29°52'23.06872"N	95°11'22.90947"W	-45.20	13884669.71	3175878.26	44.37
150245	HGCSD 21 1986	AW5655	29°50'57.58662"N	95°10'26.70633"W	-49.04	13876201.04	3181105.92	40.48
150250	150250	N/A	29°49'02.44605"N	95°12'09.64230"W	-56.45	13864281.23	3172424.17	33.02
150255	150255	N/A	29°49'37.81392"N	95°12'11.24752"W	-54.76	13867847.32	3172166.89	34.73
150260	150260	N/A	29°49'01.90458"N	95°12'48.37802"W	-56.59	13864115.96	3169015.75	32.88
150265	150265	N/A	29°49'54.27534"N	95°12'42.29823"W	-53.01	13869420.58	3169379.67	36.49
150270	150270	N/A	29°50'45.73092"N	95°12'14.18037"W	-52.28	13874695.77	3171686.07	37.24
150275	GAGING STATION	N/A	29°50'13.35799"N	95°14'01.42880"W	-53.82	13871122.11	3162352.11	35.71
150280	P118 BM01	N/A	29°50'53.22245"N	95°15'44.23566"W	-52.01	13874856.44	3153174.24	37.57
150285	150285	N/A	29°50'44.70555"N	95°16'29.63753"W	-53.33	13873869.03	3149205.71	36.26
150290	P118 BM02	N/A	29°51'00.32968"N	95°17'03.54658"W	-42.23	13875351.49	3146171.09	47.38
150295	P118 BM03	N/A	29°51'12.11436"N	95°18'01.34765"W	-42.52	13876379.97	3141046.30	47.11
150300	P118 BM04	N/A	29°51'22.98748"N	95°18'19.53126"W	-40.79	13877427.13	3139411.29	48.86
150305	P118 BM05	N/A	29°51'45.88570"N	95°19'03.46167"W	-32.85	13879617.03	3135472.33	56.82
150310	BM 7 Weisser	N/A	29°51'39.63327"N	95°19'58.26159"W	-28.89	13878834.18	3130669.68	60.79
150315	150315	N/A	29°52'31.16429"N	95°20'31.42572"W	-32.26	13883945.51	3127588.36	57.46
150320	P118 BM10	N/A	29°53'12.04284"N	95°20'34.79576"W	-26.65	13888063.50	3127162.73	63.09

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150325	P118 BM11	N/A	29°53'40.32574"N	95°21'16.87698"W	-21.63	13890803.46	3123371.35	68.14
150330	Weisser BM8	N/A	29°53'33.53964"N	95°22'11.93956"W	-12.40	13889967.58	3118548.52	77.39
150335	150335	N/A	29°53'34.14084"N	95°23'09.73160"W	-19.15	13889870.76	3113462.30	70.66
150340	P118 BM13	N/A	29°53'34.45229"N	95°23'48.67637"W	-12.08	13889796.46	3110035.11	77.73
150345	P118 0345 P	N/A	29°53'52.87231"N	95°24'36.83596"W	-12.71	13891525.93	3105741.07	77.13
150350	P118 BM19	N/A	29°54'08.13535"N	95°25'21.56866"W	-7.96	13892946.37	3101758.66	81.91
150355	150355	N/A	29°54'40.64090"N	95°26'46.07019"W	-3.93	13896001.67	3094225.35	85.97
150360	150360	N/A	29°55'08.63192"N	95°27'29.37676"W	7.52	13898712.28	3090330.39	97.44
150365	P108 0365P	N/A	29°55'14.71693"N	95°28'24.24657"W	10.26	13899180.79	3085485.75	100.20
150370	150370	N/A	29°50'34.15244"N	95°15'02.74705"W	-55.28	13873048.04	3156887.48	34.28
150375	P11814 BM02	N/A	29°52'11.15504"N	95°19'18.29437"W	-32.47	13882127.21	3134086.77	57.22
150380	P11814 POM2	N/A	29°52'46.85674"N	95°19'08.69995"W	-30.96	13885758.34	3134817.54	58.75
150385	150385	N/A	29°53'35.27053"N	95°18'58.02741"W	-25.75	13890675.94	3135602.56	63.98
150390	HGCSD 20 1986	AW5568	29°52'29.28005"N	95°22'11.52832"W	-17.89	13883480.73	3118786.15	71.86
150395	150395	N/A	29°52'59.45608"N	95°22'45.11763"W	-17.95	13886435.81	3115736.21	71.83
150400	150400	N/A	29°52'32.43136"N	95°23'08.89916"W	-15.31	13883642.51	3113728.15	74.46
150405	150405	N/A	29°52'41.66528"N	95°13'28.01836"W	-44.12	13886190.09	3164809.38	45.49
150410	150410	N/A	29°51'49.40320"N	95°14'58.22339"W	-42.62	13880658.18	3157041.91	46.98
150415	G 1215 1973	AW0820	29°52'04.75433"N	95°15'45.47893"W	-39.11	13882074.88	3152833.95	50.51
150420	P125 0420P	N/A	29°52'18.77637"N	95°16'27.54548"W	-33.63	13883372.43	3149087.18	56.01
150425	P125 BM03	N/A	29°52'37.17258"N	95°17'04.36156"W	-30.64	13885126.66	3145788.63	59.02
150430	P125 BM04	N/A	29°52'47.16376"N	95°17'34.66961"W	-28.68	13886050.74	3143089.91	60.99
150435	150435	N/A	29°53'15.82701"N	95°15'26.74915"W	-34.27	13889303.22	3154252.37	55.39
150440	150440	N/A	29°53'13.51699"N	95°16'20.35575"W	-32.18	13888919.32	3149543.60	57.49
150445	150445	N/A	29°53'14.54118"N	95°17'15.97830"W	-25.48	13888867.02	3144646.71	64.20

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150450	150450	N/A	29°53'28.60130"N	95°17'56.75839"W	-25.97	13890172.83	3141013.98	63.73
150455	HGCSD 14 RESET 1995	AB7498	29°56'04.42155"N	95°14'02.04791"W	-39.69	13906564.18	3161155.85	50.05
150460	N 23	AW0816	29°56'04.41417"N	95°14'26.50060"W	-34.02	13906494.23	3159005.58	55.73
150465	Cancelled	N/A	---	---	---	---	---	---
150470	None	N/A	29°57'03.16373"N	95°14'58.82447"W	-22.53	13912334.51	3155972.84	67.27
150475	P130 0475P	N/A	29°57'13.59332"N	95°15'58.67077"W	-24.99	13913219.10	3150677.32	64.83
150480	P130 BM03	N/A	29°57'54.10250"N	95°16'18.39840"W	-20.78	13917253.75	3148812.42	69.07
150485	150485	N/A	29°58'47.18061"N	95°16'42.95775"W	-10.86	13922544.02	3146482.78	79.02
150490	150490	N/A	29°59'24.07804"N	95°17'45.45119"W	-5.01	13926094.97	3140871.64	84.89
150495	150495	N/A	29°59'24.58799"N	95°18'31.30108"W	-6.45	13926019.01	3136840.24	83.45
150500	150500	N/A	30°00'16.03635"N	95°18'45.36144"W	-1.06	13931174.61	3135440.63	88.87
150510	150510	N/A	29°56'15.06640"N	95°13'25.93678"W	-32.69	13907741.34	3164296.63	57.05
150515	150515	N/A	29°57'54.14504"N	95°12'20.49019"W	-24.18	13917930.92	3169726.95	65.61
150520	150520	N/A	29°58'44.90146"N	95°11'44.59026"W	-21.10	13923158.00	3172716.15	68.72
150525	150525	N/A	29°57'48.82490"N	95°12'51.44893"W	-24.73	13917305.55	3167022.76	65.08
150530	150530	N/A	29°57'45.96311"N	95°14'00.66904"W	-21.13	13916820.06	3160946.82	68.70
150535	150535	N/A	29°58'08.76786"N	95°14'05.30945"W	-16.39	13919109.38	3160464.72	73.45
150540	150540	N/A	29°57'43.45487"N	95°14'58.18931"W	-24.93	13916404.25	3155898.18	64.90
150545	150545	N/A	29°58'44.44191"N	95°14'47.34739"W	-12.26	13922592.37	3156653.64	77.62
150550	150550	N/A	29°57'43.04204"N	95°15'12.50173"W	-27.02	13916322.23	3154641.26	62.82
150555	150555	N/A	29°58'10.04356"N	95°15'48.29681"W	-14.64	13918947.72	3151407.25	75.22
150560	150560	N/A	29°57'17.40813"N	95°16'36.60380"W	-24.38	13913497.90	3147329.94	65.44
150565	150565	N/A	29°57'30.63038"N	95°17'12.88840"W	-14.69	13914731.43	3144097.38	75.15
150570	150570	N/A	29°57'59.52054"N	95°18'26.66689"W	-14.10	13917442.92	3137518.81	75.76
150575	150575	N/A	29°57'58.73062"N	95°19'46.04915"W	-6.69	13917143.40	3130542.72	83.17

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150580	150580	N/A	29°55'06.44394"N	95°17'14.23745"W	-34.60	13900169.96	3144441.08	55.15
150585	150585	N/A	29°55'53.92283"N	95°17'33.82133"W	-23.73	13904908.97	3142566.63	66.05
150590	HGCSD 13 1986	AW5634	29°55'50.88326"N	95°18'09.77552"W	-19.60	13904501.95	3139414.49	70.19
150595	150595	N/A	29°56'15.85382"N	95°18'11.81566"W	-21.06	13907017.42	3139155.36	68.74
150600	150600	N/A	29°56'11.01301"N	95°18'56.67782"W	-18.75	13906404.14	3135225.76	71.06
150605	150605	N/A	29°56'09.71716"N	95°19'53.40078"W	-13.91	13906116.45	3130241.80	75.91
150610	N20	AW0813	29°56'18.40075"N	95°17'01.92454"W	-24.09	13907469.41	3145293.10	65.71
150615	N21	AW0814	29°56'21.29677"N	95°16'07.63327"W	-24.43	13907913.86	3150057.84	65.35
150620	HGCSD 12 RESET 1995	AB7497	29°56'24.01990"N	95°25'40.41886"W	-0.20	13906615.61	3099681.24	89.72
150625	P138 BM03	N/A	29°55'02.22690"N	95°21'19.89177"W	-20.53	13899064.36	3122848.35	69.28
150630	P138 BM02	N/A	29°55'00.94938"N	95°22'03.89165"W	-16.75	13898814.94	3118982.36	73.07
150635	P138 HARDY	N/A	29°55'00.03273"N	95°22'35.79143"W	-13.39	13898635.33	3116179.47	76.45
150640	P138 BM07	N/A	29°54'56.63918"N	95°23'27.41549"W	-9.14	13898152.25	3111649.41	80.71
150645	Cancelled	N/A	---	---	---	---	---	---
150650	150650	N/A	29°54'55.16620"N	95°24'41.54317"W	-7.68	13897802.83	3105133.92	82.19
150655	150655	N/A	29°54'53.52446"N	95°25'41.68990"W	-5.05	13897475.07	3099848.61	84.83
150660	P13801 BM01	N/A	29°54'47.21092"N	95°20'28.33857"W	-21.32	13897689.89	3127430.13	68.47
150665	Hood 2 1965	N/A	29°57'04.22321"N	95°21'00.45179"W	-12.34	13911435.18	3124173.65	77.52
150670	150670	N/A	29°57'43.22608"N	95°21'01.47827"W	-9.18	13915370.36	3123960.47	80.70
150675	150675	N/A	29°57'55.55776"N	95°22'24.13940"W	-6.39	13916389.32	3116654.59	83.51
150680	150680	N/A	29°58'17.08167"N	95°23'07.13405"W	1.51	13918445.49	3112807.59	91.43
150685	150685	N/A	29°59'01.95155"N	95°23'33.45841"W	11.07	13922904.47	3110353.66	101.01
150690	150690	N/A	29°59'47.35966"N	95°23'18.93430"W	6.62	13927528.70	3111488.68	96.57
150695	G 1511 1987	AW5633	29°55'57.02261"N	95°24'08.22153"W	-5.50	13904138.36	3107872.62	84.38
150700	P146 0407P	N/A	29°57'55.93294"N	95°25'28.86044"W	1.24	13915927.02	3100413.85	91.19

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
150705	P145 BM06	N/A	29°58'21.86814"N	95°26'06.65818"W	5.03	13918444.22	3097011.03	95.01
150710	150710	N/A	29°58'24.12115"N	95°27'10.28107"W	11.99	13918501.59	3091411.11	101.99
150715	150715	N/A	29°58'22.25503"N	95°27'49.87227"W	13.68	13918207.74	3087936.40	103.69
150720	NONE (PAM ARP)	AJ6416 PAM 8	29°58'46.81814"N	95°28'34.54377"W	30.79	13920569.33	3083934.61	120.83
150725	P145.03 BM02	N/A	29°58'58.99888"N	95°26'23.06450"W	10.07	13922149.36	3095454.60	100.07
150730	150730	N/A	29°59'20.51703"N	95°26'07.58024"W	13.26	13924363.52	3096749.42	103.26
150735	150735	N/A	30°00'20.84724"N	95°27'02.41392"W	16.58	13930308.49	3091744.90	106.63
150740	150740	N/A	29°57'29.33325"N	95°26'11.00498"W	9.37	13913128.15	3096790.59	99.32
150741	P147 BM 01	N/A	29°57'02.53144"N	95°26'10.49189"W	6.96	13910423.37	3096918.19	96.90
150745	150745	N/A	29°57'51.37630"N	95°28'47.22902"W	16.30	13914937.73	3082988.08	106.32
150750	150750	N/A	29°56'06.96936"N	95°27'30.48210"W	9.57	13904599.59	3090054.75	99.52
150755	150755	N/A	29°56'06.86268"N	95°29'00.02428"W	15.32	13904351.13	3082180.57	105.30
150760	150760	N/A	29°56'06.14785"N	95°29'52.59005"W	16.71	13904140.20	3077559.98	106.70
150765	150765	N/A	29°56'06.63428"N	95°30'17.29638"W	17.06	13904124.29	3075385.77	107.06
150770	HGCSD 11 1986	AW5511	29°57'58.14333"N	95°32'22.42912"W	30.84	13915056.19	3064047.98	120.92
150775	P155 BM02	N/A	29°57'05.03858"N	95°22'20.55486"W	-13.42	13911298.30	3117127.99	76.46
150780	150780	N/A	29°57'38.64084"N	95°23'17.05615"W	-4.71	13914537.24	3112055.26	85.20
150785	150785	N/A	29°55'09.90092"N	95°18'54.55636"W	-30.36	13900239.85	3135606.79	59.41
190005	190005	N/A	29°46'57.79984"N	95°41'07.83091"W	11.04	13847041.16	3019745.74	100.95
190010	190010	N/A	29°43'31.74705"N	95°42'32.01103"W	7.56	13826026.63	3012916.91	97.37
190015	190015	N/A	29°42'47.15464"N	95°44'38.06248"W	11.68	13821213.13	3001933.57	101.48
190020	190020	N/A	29°43'22.35866"N	95°44'53.97743"W	11.79	13824728.63	3000431.98	101.62
190025	190025	N/A	29°43'37.40770"N	95°45'20.11625"W	13.66	13826184.14	2998086.16	103.51
190030	190030	N/A	29°43'20.17885"N	95°46'02.84894"W	16.23	13824340.23	2994368.32	106.07

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
190035	190035	N/A	29°43'27.58073"N	95°46'21.25749"W	18.69	13825042.78	2992725.30	108.54
190040	190040	N/A	29°43'50.88254"N	95°46'58.47675"W	21.60	13827305.18	2989380.41	111.46
190045	190045	N/A	29°43'57.15557"N	95°47'06.16821"W	25.39	13827919.93	2988685.18	115.26
190050	190050	N/A	29°44'35.36399"N	95°48'25.23391"W	28.12	13831586.96	2981612.25	118.02
190055	HGCSD 66 1986	AW5411	29°43'58.13283"N	95°50'45.96860"W	46.43	13827491.06	2969312.77	136.32
190060	190060	N/A	29°44'58.11769"N	95°49'09.17344"W	32.05	13833778.92	2977678.02	121.96
190065	190065	N/A	29°45'21.99526"N	95°48'59.46039"W	31.94	13836213.18	2978468.19	121.87
190070	M 1504 1986	AW5413	29°45'54.41707"N	95°49'21.71208"W	36.62	13839433.57	2976418.76	126.56
190075	190075	N/A	29°46'44.30588"N	95°49'31.76577"W	43.79	13844446.93	2975396.30	133.76
190080	190080	N/A	29°47'08.50078"N	95°49'35.83610"W	50.27	13846880.24	2974971.46	140.25
190085	Cancelled	N/A	---	---	---	---	---	---
190090	None	N/A	29°48'01.73185"N	95°49'46.54695"W	55.34	13852229.58	2973882.32	145.36
190095	190095	N/A	29°48'59.71579"N	95°50'03.84796"W	60.64	13858043.19	2972200.17	150.69
190100	190100	N/A	29°49'51.88791"N	95°50'13.16884"W	63.35	13863289.04	2971236.94	153.42
190105	190105	N/A	29°50'06.71570"N	95°50'25.19021"W	66.40	13864757.66	2970138.12	156.48
190110	190110	N/A	29°46'31.65384"N	95°41'55.12549"W	9.22	13844283.34	3015654.65	99.13
190115	019015	N/A	29°45'33.30200"N	95°43'04.35737"W	16.33	13838219.85	3009721.75	106.21
190120	T101 BM01	N/A	29°46'02.37224"N	95°43'40.75521"W	20.73	13841065.21	3006432.98	110.63
190125	T101 BM02	N/A	29°46'17.26878"N	95°43'56.57638"W	23.63	13842530.35	3004997.22	113.54
190130	190130	N/A	29°46'35.19403"N	95°44'14.74697"W	27.62	13844295.58	3003346.09	117.54
190135	T101 BM03	N/A	29°47'04.75399"N	95°44'49.96090"W	36.40	13847193.86	3000161.24	126.35
190140	T101 BM05	N/A	29°47'28.30601"N	95°45'06.30993"W	40.54	13849531.92	2998655.18	130.50
190145	T101 BM06	N/A	29°47'38.97968"N	95°45'37.93255"W	41.27	13850532.39	2995840.24	131.24
190150	None	N/A	29°47'55.49402"N	95°46'30.96179"W	50.32	13852070.78	2991123.96	140.30
190155	T101 BM07	N/A	29°48'06.59278"N	95°46'44.95001"W	45.36	13853157.50	2989861.20	135.35
190160	190160	N/A	29°48'33.16484"N	95°47'01.40875"W	46.65	13855800.66	2988337.98	136.66

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
190165	T101-02 BM01	N/A	29°47'05.22403"N	95°44'18.94448"W	32.48	13847317.43	3002891.77	122.42
190170	T 768 1943	AW0261	29°47'08.15980"N	95°45'35.13551"W	40.83	13847427.27	2996172.82	130.78
190175	190175	N/A	29°47'14.09999"N	95°46'36.98777"W	60.20	13847876.49	2990708.50	150.17
190180	190180	N/A	29°47'09.73986"N	95°47'09.92502"W	45.51	13847356.39	2987819.61	135.47
190185	190185	N/A	29°47'09.79368"N	95°47'22.82577"W	46.83	13847330.60	2986683.19	136.80
190190	190190	N/A	29°47'10.00628"N	95°48'05.19291"W	47.33	13847249.80	2982951.00	137.30
190195	HGCSD 24 1986	AW5414	29°47'08.08818"N	95°49'06.69046"W	50.46	13846908.34	2977539.70	140.44
190200	Cancelled	N/A	---	---	---	---	---	---
190205	190205	N/A	29°48'06.74687"N	95°46'08.94231"W	43.77	13853260.54	2993031.74	133.76
190210	Cancelled	N/A	---	---	---	---	---	---
190215	190215	N/A	29°44'31.37124"N	95°43'52.24164"W	12.85	13831848.52	3005678.00	102.71
190220	190220	N/A	29°45'06.62374"N	95°44'25.26715"W	14.94	13835326.73	3002668.75	104.81
190225	190225	N/A	29°45'31.78668"N	95°44'30.96340"W	19.55	13837853.45	3002096.07	109.44
190230	190230	N/A	29°44'46.48843"N	95°45'04.54483"W	20.54	13833197.34	2999264.63	110.41
190235	190235	N/A	29°45'29.41127"N	95°45'25.40788"W	29.64	13837480.26	2997306.16	119.54
200080	Weisser BM 17	N/A	29°48'35.41990"N	95°44'00.75884"W	34.86	13856469.35	3004239.09	124.84
200225	HGCSD 18 1986	AW5439	29°52'45.31234"N	95°36'41.68786"W	27.70	13882801.28	3042170.04	117.70
200290	HGCSD 17 1986	AW5441	29°52'46.79604"N	95°42'14.04448"W	44.75	13882115.08	3012920.33	134.84
210005	210005	N/A	29°45'08.19915"N	95°17'51.07066"W	-55.02	13839667.55	3143114.31	34.38
210010	5557 0609	N/A	29°45'27.88681"N	95°18'46.59112"W	-59.60	13841500.63	3138160.50	29.82
210015	W100 BM18	N/A	29°45'26.03894"N	95°19'08.98443"W	-48.94	13841251.91	3136193.72	40.49
210020	Y 1202 1972	AW0352	29°46'53.82784"N	95°19'47.31155"W	-43.10	13850008.96	3132539.16	46.41
210025	210025	N/A	29°45'38.80239"N	95°19'41.65698"W	-48.77	13842450.00	3133275.05	40.68
210030	BB11 1964	N/A	29°45'42.93307"N	95°20'35.96858"W	-47.05	13842717.09	3128477.74	42.43
210035	M 89 1932	AW0215	29°46'17.17822"N	95°20'56.15773"W	-41.94	13846118.93	3126591.33	47.57

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
210040	210040	N/A	29°46'29.71064"N	95°21'01.45266"W	-31.69	13847369.65	3126085.46	57.83
210045	W100 BM08	N/A	29°45'54.13256"N	95°21'39.79767"W	-63.16	13843672.37	3122819.92	26.35
210050	Cancelled	N/A	---	---	---	---	---	---
210055	210055	N/A	29°45'37.11968"N	95°22'34.72295"W	-51.50	13841804.45	3118034.99	38.02
210060	210060	N/A	29°45'43.81794"N	95°23'02.89610"W	-59.77	13842403.88	3115532.28	29.76
210065	210065	N/A	29°45'45.16078"N	95°23'55.07812"W	-47.71	13842397.58	3110931.42	41.84
210070	W100 BM01	N/A	29°45'38.21908"N	95°24'31.52368"W	-48.76	13841597.98	3107742.48	40.80
210075	210075	N/A	29°45'40.95399"N	95°25'09.43628"W	-43.88	13841771.66	3104394.26	45.69
210080	210080	N/A	29°45'54.60407"N	95°26'25.90841"W	-34.01	13842944.11	3097615.79	55.60
210085	210085	N/A	29°45'22"N	95°26'13"W	N/A	13839700.00	3098900.00	40.99
210090	210090	N/A	29°46'06.60135"N	95°27'01.41182"W	-21.82	13844060.32	3094451.59	67.81
210095	210095	N/A	29°45'38.81307"N	95°27'21.77151"W	-42.63	13841200.31	3092743.24	46.98
210100	210100	N/A	29°45'55.47958"N	95°27'23.38695"W	-39.11	13842878.70	3092549.94	50.52
210105	210105	N/A	29°45'55"N	95°28'04"W	N/A	13842700.00	3089000.00	53.78
210110	W100 BM20	N/A	29°46'24.28443"N	95°28'46.76878"W	-35.07	13845565.08	3085117.40	54.62
210115	W100 BM02	N/A	29°46'18.60774"N	95°28'57.05680"W	-38.16	13844964.66	3084228.45	51.52
210120	210120	N/A	29°46'09"N	95°29'20"W	N/A	13843900.00	3082200.00	48.45
210125	W100 BM21	N/A	29°45'37.23603"N	95°30'02.58839"W	-30.87	13840614.36	3078581.23	58.80
210130	W100 BM03	N/A	29°45'03.95812"N	95°30'18.78177"W	-32.37	13837211.80	3077255.13	57.28
210135	210135	N/A	29°44'28.12178"N	95°30'42.34384"W	-28.14	13833531.61	3075287.22	61.50
210140	210140	N/A	29°44'50.94475"N	95°31'51.65587"W	-24.74	13835654.23	3069111.73	64.94
210145	W100 BM04	N/A	29°45'06.88844"N	95°32'22.62702"W	-25.53	13837183.13	3066335.37	64.17
210150	210150	N/A	29°44'54.93344"N	95°32'18.46290"W	-25.30	13835986.95	3066737.97	64.39
210155	W100 BM05	N/A	29°45'44.65358"N	95°33'27.40582"W	-19.63	13840827.65	3060515.97	70.12
210160	210160	N/A	29°45'51.41830"N	95°34'16.93355"W	-23.67	13841382.45	3056132.89	66.10

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
210165	W100 BM06	N/A	29°45'56.75982"N	95°34'33.19693"W	-18.16	13841879.78	3054684.42	71.62
210170	210170	N/A	29°46'01.77583"N	95°34'57.91262"W	-33.38	13842322.54	3052492.40	56.42
210175	210175	N/A	29°45'38.87687"N	95°35'21.70004"W	-12.42	13839949.31	3050464.42	77.37
210180	W100 BM07	N/A	29°45'42.81118"N	95°36'21.96412"W	-13.06	13840192.06	3045143.91	76.75
210185	BB Q2	N/A	29°46'17.64060"N	95°37'15.41817"W	-9.25	13843572.32	3040333.26	80.59
210190	210190	N/A	29°46'20.96712"N	95°37'59.63796"W	3.57	13843795.82	3036428.42	93.43
210195	HGCSD 37 1986	AW5431	29°43'41.15930"N	95°27'03.84667"W	-34.44	13829369.54	3094682.85	55.08
210200	X 1181 1963	AW0311	29°47'04.51676"N	95°28'01.30931"W	-25.69	13849747.89	3088998.79	64.01
210205	W140 BM01	N/A	29°46'39.95746"N	95°28'57.30104"W	-31.66	13847119.58	3084142.09	58.04
210210	W140 BM02	N/A	29°47'00.22708"N	95°29'11.01295"W	-28.07	13849129.78	3082872.87	61.64
210215	W140 BM03	N/A	29°47'40.39126"N	95°29'47.58038"W	-21.44	13853088.33	3079530.74	68.31
210220	W140 BM05	N/A	29°47'45.87907"N	95°30'18.35237"W	-19.07	13853561.30	3076804.27	70.69
210225	210225	N/A	29°48'04.12066"N	95°30'40.91033"W	-12.38	13855343.76	3074762.80	77.40
210230	Cancelled	N/A	---	---	---	---	---	---
210235	W140 BM07	N/A	29°48'10.78294"N	95°30'58.51754"W	-13.43	13855970.19	3073192.29	76.36
210240	210240	N/A	29°48'23.24417"N	95°31'40.03657"W	-7.09	13857119.60	3069498.88	82.72
210245	210245	N/A	29°48'21.31019"N	95°32'29.32709"W	-2.97	13856795.69	3065164.40	86.85
210250	W140.01 BM07	N/A	29°47'00"N	95°29'55"W	N/A	13849000.00	3079000.00	54.34
210255	210255	N/A	29°47'20.01831"N	95°30'29.86773"W	-18.92	13850919.95	3075868.17	70.83
210260	W140.01 BM3A	N/A	29°47'23.30744"N	95°30'45.82190"W	-16.80	13851210.11	3074453.20	72.96
210265	210265	N/A	29°47'19.90321"N	95°31'17.82203"W	-13.46	13850782.44	3071645.23	76.31
210270	HGCSD 27 1986	AW5606	29°47'04.96727"N	95°31'46.17234"W	-13.21	13849200.22	3069193.19	76.55
210275	210275	N/A	29°47'18.96937"N	95°31'52.43301"W	-10.82	13850597.60	3068599.85	78.95
210280	E 8 (Not Stamped)	AW0300	29°47'05.07451"N	95°32'24.85793"W	-9.29	13849110.07	3065785.71	80.50
210285	210285	N/A	29°47'18.16843"N	95°32'56.29793"W	-8.31	13850350.28	3062977.66	81.49

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
210290	210290	N/A	29°44'59.08548"N	95°29'45.04726"W	-27.23	13836808.80	3080241.94	62.40
210295	210295	N/A	29°44'15.03091"N	95°29'43.94061"W	-28.16	13832363.80	3080472.76	61.44
210300	W-156 BM01	N/A	29°46'21.19419"N	95°34'12.88855"W	-18.06	13844399.28	3056401.03	71.73
210305	W-156 BM03	N/A	29°46'43.63513"N	95°34'12.09858"W	-13.80	13846667.11	3056404.14	76.00
210310	210310	N/A	29°47'05.14124"N	95°33'35.78436"W	-11.72	13848932.48	3059538.77	78.08
210315	W156 BM05	N/A	29°47'26.27124"N	95°33'12.73479"W	-4.14	13851125.70	3061505.94	85.67
210320	W140.06 BM10	N/A	29°48'57.31567"N	95°32'42.16776"W	3.84	13860397.63	3063926.29	93.69
210325	W167 BM01	N/A	29°46'38.11122"N	95°37'04.74453"W	-11.49	13845666.38	3041213.68	78.36
210330	W167 BM03	N/A	29°47'12.56902"N	95°36'36.00158"W	-7.37	13849218.83	3043644.52	82.49
210335	W167 BM02	N/A	29°47'02.97322"N	95°36'36.03237"W	-12.13	13848249.89	3043669.90	77.73
210340	210340	N/A	29°47'04.93634"N	95°36'22.08462"W	13.12	13848483.74	3044892.60	102.97
210345	HGCSD 26 RESET 2000	AJ6409	29°47'27.34194"N	95°35'11.25078"W	-1.17	13850927.60	3051065.21	88.68
210350	NONE (CORS ARP)	AJ6426 ADKS	29°47'27.47147"N	95°35'11.04301"W	13.45	13850941.21	3051083.13	103.30
210355	NONE (PAM ARP)	AJ6413 PAM 5	29°47'28.32970"N	95°35'09.24451"W	8.26	13851032.49	3051238.99	98.10
210360	210360	N/A	29°48'16.18076"N	95°34'24.82766"W	1.54	13855978.32	3055009.13	91.40
210365	210365	N/A	29°49'14.78925"N	95°34'12.34273"W	3.97	13861928.14	3055934.92	93.86
210370	210370	N/A	29°49'53.99476"N	95°34'29.64560"W	9.72	13865842.00	3054295.56	99.62
210375	167.04 BM01	N/A	29°50'42.38186"N	95°34'29.57254"W	12.82	13870727.78	3054158.86	102.74
210380	W167.04 BM02	N/A	29°51'00.85906"N	95°34'29.79199"W	14.26	13872592.84	3054084.89	104.19
210385	210385	N/A	29°52'01.20171"N	95°34'35.01842"W	15.84	13878672.13	3053446.47	105.80
210390	210390	N/A	29°52'49.12297"N	95°34'33.63774"W	17.70	13883514.30	3053426.27	107.68
210395	U100 BM01	N/A	29°46'47.31303"N	95°37'25.79516"W	-10.44	13846541.88	3039332.68	79.42
210400	U100 BM02	N/A	29°47'03.56953"N	95°37'24.78071"W	-6.37	13848185.85	3039374.63	83.51
210405	210405	N/A	29°47'26.17613"N	95°37'03.08203"W	27.87	13850523.65	3041219.71	117.74

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
210410	HGCSD 25 1986	AW5603	29°47'07.78457"N	95°42'53.94398"W	24.62	13847785.56	3010371.13	114.55
210415	210415	N/A	29°45'31.72577"N	95°38'41.37988"W	-2.45	13838718.30	3032894.21	87.39
210420	210420	N/A	29°44'35.82902"N	95°38'50.85851"W	0.35	13833050.56	3032221.00	90.16
210425	210425	N/A	29°44'06.65211"N	95°39'12.33890"W	-3.81	13830050.41	3030412.65	85.99
210430	210430	N/A	29°43'21.61974"N	95°40'01.95813"W	1.28	13825378.69	3026169.87	91.06
210435	210435	N/A	29°42'42.99325"N	95°41'02.62406"W	1.76	13821326.63	3020934.00	91.53
210440	210440	N/A	29°42'27.04633"N	95°41'24.28295"W	4.78	13819662.41	3019070.58	94.54
210445	210445	N/A	29°42'21.60689"N	95°42'33.39217"W	5.96	13818941.25	3012994.51	95.73
210450	210450	N/A	29°41'45.81614"N	95°42'55.84534"W	-1.34	13815271.87	3011116.89	88.41
210455	NONE (PAM ARP)	AJ6421 PAM 15	29°40'59.65780"N	95°43'11.11405"W	13.00	13810573.56	3009901.65	102.72
010135	NONE (PAM ARP)	N/A	29°32'43.66216"N	95°18'43.43626"W	-29.78	13764355.73	3140872.19	59.10
010530	W 1205	AW2058	29°37'31"N	95°16'01"W	N/A	13793800.00	3154300.00	45.40
010531	N/A	N/A	29°37'30.61276"N	95°16'01.23612"W	-44.48	13793778.93	3154265.28	44.61
010545	HGCSD 47 1986	AW5556	29°37'12.61507"N	95°17'28.38961"W	-39.84	13791717.31	3146635.54	49.26
010560	NONE (PAM ARP)	AJ6422 PAM 16	29°32'40.04777"N	95°31'38.04509"W	-17.05	13761896.77	3072502.78	71.99
020180	L-PORT 1987	AW5679	29°40'08.99514"N	95°03'53.08537"W	-66.03	13811873.87	3217951.61	23.09
020181	LA PORTE 1952	AW1275	29°39'53.91195"N	95°03'56.69508"W	-67.22	13810340.51	3217684.62	21.88
030005	030005	N/A	29°43'06.10637"N	95°15'12.93341"W	-69.54	13827785.19	3157440.44	19.75
030010	030010	N/A	29°42'27.58810"N	95°15'27.76325"W	-63.92	13823854.65	3156258.05	25.35
030015	C100 HALE	N/A	29°41'48.72008"N	95°15'42.29070"W	-67.03	13819889.71	3155103.16	22.22
030020	C100 RAINS	N/A	29°41'33.19363"N	95°15'43.84993"W	-62.15	13818317.82	3155015.85	27.09
030025	030025	N/A	29°41'09.22691"N	95°15'47.50052"W	-61.97	13815887.94	3154771.40	27.25
030030	C100 0030C	N/A	29°40'50.32541"N	95°16'20.06072"W	-61.68	13813888.08	3151961.98	27.54
030035	030035	N/A	29°40'48.16021"N	95°16'37.84506"W	-62.88	13813619.53	3150401.13	26.34

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
030040	C100 BM04 Reset 2001	N/A	29°40'26.54658"N	95°17'20.55653"W	-60.70	13811317.78	3146705.04	28.52
030045	030045	N/A	29°39'49.81047"N	95°18'16.95705"W	-54.83	13807451.51	3141849.81	34.37
030050	C100 BM07 Reset 2001	N/A	29°39'17.84258"N	95°18'54.22374"W	-50.43	13804120.42	3138665.64	38.76
030055	030055	N/A	29°39'00.94969"N	95°19'23.10220"W	-54.61	13802334.79	3136172.77	34.58
030060	C100 BM08	N/A	29°38'42.89810"N	95°20'12.70277"W	-53.03	13800375.04	3131855.87	36.15
030065	C100 F11 Reset 2001	N/A	29°38'53.75471"N	95°21'22.01892"W	-45.76	13801280.07	3125708.76	43.43
030070	030070	N/A	29°38'43.45090"N	95°21'59.23439"W	-45.61	13800137.67	3122459.17	43.59
030075	030075	N/A	29°38'10.94620"N	95°22'43.01753"W	-48.68	13796736.26	3118699.59	40.50
030080	5533	N/A	29°37'54.91965"N	95°23'14.54660"W	-38.04	13795032.21	3115968.80	51.13
030085	030085	N/A	29°37'55.85082"N	95°23'54.42499"W	-44.68	13795017.70	3112448.55	44.50
030090	SB-77-02	N/A	29°37'22.46796"N	95°24'28.80159"W	-38.94	13791554.13	3109520.02	50.22
030095	C100 BM12	N/A	29°37'08.12138"N	95°25'03.27293"W	-35.42	13790012.42	3106523.68	53.73
030100	HGCSD 46 1987	AW5687	29°36'55.74347"N	95°25'18.89363"W	-39.35	13788720.56	3105183.96	49.80
030105	C100 BM13	N/A	29°37'09.97603"N	95°25'50.16642"W	-35.92	13790073.14	3102381.31	53.25
030110	030110	N/A	29°37'09.02822"N	95°26'18.29155"W	-36.14	13789901.79	3099903.20	53.03
030115	C100 BM15A	N/A	29°37'07.97566"N	95°26'45.05726"W	-35.91	13789723.67	3097545.32	53.26
030120	C100 BM16	N/A	29°37'10.95779"N	95°27'53.58991"W	-31.20	13789841.46	3091490.64	57.99
030125	5151 1111	N/A	29°37'18.35138"N	95°28'13.42513"W	-31.96	13790535.05	3089718.36	57.24
030130	030130	N/A	29°37'42.05697"N	95°28'51.10105"W	-28.71	13792828.20	3086322.83	60.52
030135	C100 BM18	N/A	29°37'32.64183"N	95°29'56.52165"W	-24.37	13791704.39	3080580.72	64.87
030140	C100 0140C	N/A	29°37'32.51245"N	95°30'04.37579"W	-24.02	13791670.59	3079888.30	65.22
030145	C100 BM19	N/A	29°37'32.91286"N	95°30'36.04417"W	-21.37	13791627.52	3077093.63	67.88
030150	Cancelled	N/A	---	---	---	---	---	---
030155	Cancelled	N/A	---	---	---	---	---	---
030160	030160	N/A	29°37'25.63323"N	95°30'51.36451"W	-27.23	13790852.25	3075764.14	62.02

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
030165	030165	N/A	29°42'35.42930"N	95°16'14.35561"W	-61.09	13824515.06	3152126.45	28.19
030170	HGCSD 39 Reset 1995	AB7499	29°42'10.26666"N	95°16'34.47328"W	-72.00	13821918.20	3150434.36	17.27
030175	030175	N/A	29°42'16.25894"N	95°17'16.14492"W	-62.60	13822406.36	3146742.29	26.68
030180	030180	N/A	29°41'52.22481"N	95°17'49.48011"W	-56.52	13819886.76	3143881.08	32.75
030185	030185	N/A	29°41'48.71707"N	95°18'38.34505"W	-40.71	13819396.46	3139585.16	48.57
030190	C103 PCM1	N/A	29°41'45.61857"N	95°15'55.47874"W	-66.03	13819539.44	3153950.74	23.22
030195	030195	N/A	29°41'49.94804"N	95°16'40.44707"W	-62.65	13819850.12	3149973.15	26.61
030200	030200	N/A	29°41'30.93579"N	95°17'26.52825"W	-58.63	13817801.61	3145972.31	30.62
030205	C10600 BM01	N/A	29°41'15.21038"N	95°15'05.84422"W	-68.74	13816609.56	3158424.12	20.48
030210	GAGING STATION	N/A	29°41'08.91380"N	95°14'45.94643"W	-77.40	13816030.16	3160198.53	11.81
030215	C106 BM103	N/A	29°40'59.72709"N	95°14'43.68780"W	-65.14	13815109.10	3160427.41	24.07
030220	C106 BM04	N/A	29°40'35.91547"N	95°14'37.20410"W	-63.92	13812723.54	3161076.22	25.27
030225	C106 BM05	N/A	29°40'19.53794"N	95°14'12.10882"W	-60.33	13811141.30	3163341.83	28.85
030230	030230	N/A	29°40'11.56683"N	95°13'59.64766"W	-60.85	13810371.95	3164466.38	28.32
030235	030235	N/A	29°39'52.40912"N	95°13'47.27404"W	-60.11	13808473.05	3165619.67	29.05
030240	C106 BM08	N/A	29°39'40.02002"N	95°13'50.28773"W	-60.94	13807213.75	3165394.28	28.21
030245	A 640 Reset 1962	AW1112	29°39'30.37456"N	95°13'52.11804"W	-63.00	13806234.79	3165264.29	26.15
030250	C106 BM10	N/A	29°38'46.15300"N	95°13'25.19667"W	-58.36	13801847.03	3167782.28	30.75
030255	GAGING STATION	N/A	29°38'34.86895"N	95°13'25.22381"W	-57.36	13800707.78	3167816.69	31.74
030260	Y 639 1942	AW3306	29°38'04.02280"N	95°12'32.01165"W	-53.99	13797745.63	3172610.35	35.08
030265	C 640 Reset 1965	AW1117	29°40'57.83735"N	95°15'10.95086"W	-67.69	13814841.21	3158030.18	21.52
030270	C106.01 BM02	N/A	29°40'13.12806"N	95°15'32.85731"W	-56.85	13810265.70	3156243.44	32.34
030275	030275	N/A	29°40'02.53909"N	95°15'38.48706"W	-55.36	13809180.81	3155781.29	33.83
030280	C106.01 BM04	N/A	29°39'39.97661"N	95°15'46.59389"W	-58.65	13806880.14	3155139.33	30.52
030285	C106.01 BM05	N/A	29°39'16.29063"N	95°15'46.33880"W	-54.53	13804489.63	3155238.26	34.62

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
030290	C106.01 BM06	N/A	29°39'07.03533"N	95°15'45.96794"W	-55.13	13803556.30	3155300.83	34.02
030295	030295	N/A	29°38'36.08016"N	95°15'45.82877"W	-53.10	13800431.61	3155413.00	36.04
030300	030300	N/A	29°38'03.48491"N	95°15'45.24393"W	-48.01	13797142.60	3155569.77	41.10
030305	C106.03 BM01	N/A	29°40'18.36263"N	95°14'30.88904"W	-62.01	13810969.38	3161689.91	27.18
030310	C106.03 0310 C	N/A	29°40'11.39301"N	95°14'38.00769"W	-59.65	13810245.59	3161084.91	29.53
030315	C106.03 0315 C	N/A	29°40'08.90480"N	95°14'42.22751"W	-59.12	13809982.44	3160720.94	30.06
030320	030320	N/A	29°39'49.03736"N	95°14'57.29430"W	-58.54	13807934.08	3159456.90	30.63
030325	030325	N/A	29°39'00.26815"N	95°14'50.41020"W	-56.76	13803030.06	3160221.92	32.38
030330	030330	N/A	29°38'34.31897"N	95°14'22.72911"W	-54.18	13800488.80	3162747.17	34.94
030335	030335	N/A	29°38'04.33920"N	95°14'45.52117"W	-50.11	13797397.61	3160834.35	38.99
030340	C106 BM01	N/A	29°39'23.43331"N	95°13'42.59856"W	-58.14	13805561.11	3166126.27	30.99
030345	Z 639 Reset 1965	AW1110	29°38'44.96552"N	95°13'09.06536"W	-56.27	13801773.13	3169208.71	32.84
030350	HGCSD 48 1986	AW5694	29°37'30.28684"N	95°13'13.86608"W	-48.65	13794220.34	3169029.08	40.41
030355	030355	N/A	29°40'00.19713"N	95°19'27.30652"W	-49.16	13808304.58	3135613.96	40.06
030360	030360	N/A	29°40'21.37956"N	95°19'42.73831"W	-49.02	13810400.36	3134186.18	40.21
030365	030365	N/A	29°40'30.36011"N	95°20'21.48285"W	-51.45	13811199.90	3130741.86	37.80
030370	030370	N/A	29°40'50.60561"N	95°21'19.48302"W	-30.69	13813084.10	3125564.64	58.58
030375	030375	N/A	29°40'47.64526"N	95°21'54.71664"W	-47.08	13812688.53	3122467.77	42.20
030380	E1208 1973	AW0183	29°37'48.79179"N	95°18'26.44605"W	-46.10	13795207.46	3141399.04	43.03
030385	030385	N/A	29°38'15.52934"N	95°19'48.61245"W	-48.84	13797678.60	3134067.10	40.32
030390	030390	N/A	29°38'44.29306"N	95°20'41.31696"W	-52.44	13800436.89	3129328.00	36.74
030395	C132 BM01	N/A	29°38'32.85870"N	95°22'36.49959"W	-48.74	13798966.31	3119205.90	40.46
030400	C132 BM02	N/A	29°38'34.22572"N	95°22'38.98417"W	-47.88	13799097.53	3118982.51	41.32
030405	030405	N/A	29°39'00.09466"N	95°22'50.27493"W	-44.76	13801678.38	3117905.90	44.46
030410	030410	N/A	29°40'04.24396"N	95°22'52.02225"W	-44.71	13808150.05	3117551.34	44.55

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
030415	C147 BM01	N/A	29°36'51.57992"N	95°27'38.51729"W	-34.83	13787925.30	3092879.48	54.34
030416	C145 BM 01	N/A	29°36'48.15788"N	95°27'03.71125"W	-33.91	13787672.89	3095960.50	55.25
030420	030420	N/A	29°36'40.71245"N	95°27'53.39234"W	-30.29	13786788.42	3091600.40	58.88
030425	030425	N/A	29°36'13.53878"N	95°28'17.70545"W	-31.08	13783980.17	3089538.25	58.07
030430	030430	N/A	29°37'42.42775"N	95°25'17.83707"W	-36.94	13793436.61	3105132.91	52.24
030435	030435	N/A	29°38'29.42732"N	95°25'20.05095"W	-40.54	13798175.68	3104792.43	48.68
030440	030440	N/A	29°39'44.18390"N	95°25'25.13605"W	-37.35	13805709.36	3104113.08	51.94
030445	030445	N/A	29°37'32.69077"N	95°19'48.04362"W	-44.71	13793355.33	3134253.03	44.41
040005	D100 0005D	N/A	29°43'39.21842"N	95°16'43.70084"W	-56.55	13830872.65	3149335.22	32.78
040010	040010	N/A	29°43'25.43030"N	95°17'03.43484"W	-84.61	13829425.32	3147640.57	4.71
040015	FIRE NO 1 1942	AW1129	29°43'05.37258"N	95°17'00.14686"W	-56.01	13827409.55	3147994.68	33.30
040020	BM6 Weisser	N/A	29°43'40.34342"N	95°17'41.40355"W	-68.99	13830824.74	3144247.04	20.35
040025	D100 BM02	N/A	29°43'41.59965"N	95°17'58.45515"W	-70.30	13830903.98	3142740.50	19.04
040030	D100 BM03	N/A	29°43'20.14703"N	95°18'17.93926"W	-67.36	13828683.85	3141092.07	21.97
040035	D100 BM04	N/A	29°42'44.53248"N	95°18'37.56247"W	-57.82	13825033.65	3139476.31	31.49
040040	BM5 Weisser	N/A	29°42'32.04919"N	95°18'48.12551"W	-63.67	13823743.99	3138585.13	25.65
040045	D100 045D	N/A	29°42'34.20930"N	95°18'59.90921"W	-57.15	13823929.34	3137539.71	32.17
040050	D100 0050D	N/A	29°42'37.81381"N	95°19'10.08635"W	-60.85	13824265.00	3136631.32	28.47
040055	D100 0050D	N/A	29°42'44.57404"N	95°19'19.97737"W	-59.58	13824920.07	3135738.13	29.75
040056	D100 055D2	N/A	29°42'44.00594"N	95°19'18.89202"W	-59.54	13824865.72	3135835.58	29.78
040060	D100 BM07	N/A	29°42'51.55737"N	95°20'20.25875"W	-52.88	13825458.36	3130403.39	36.47
040065	D100 BM08	N/A	29°42'42.69136"N	95°20'29.07777"W	-55.94	13824538.92	3129654.19	33.41
040070	D100 BM09	N/A	29°42'34.74752"N	95°21'23.22959"W	-51.44	13823587.88	3124906.68	37.92
040075	D100 BM10	N/A	29°42'46.86066"N	95°22'15.04198"W	-52.02	13824668.79	3120302.28	37.36
040080	D100 BM11	N/A	29°42'44.38333"N	95°22'39.48562"W	-38.37	13824351.87	3118155.78	51.01

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040085	D100 0085D	N/A	29°42'43.34076"N	95°22'44.61037"W	-37.38	13824232.62	3117707.38	52.01
040090	D100 BM12	N/A	29°42'47.27180"N	95°22'55.24466"W	-48.31	13824600.48	3116757.87	41.08
040095	D100 0095D	N/A	29°42'45.74403"N	95°23'00.65628"W	-43.87	13824431.48	3116285.71	45.52
040100	D100 BM13	N/A	29°42'22.02593"N	95°23'34.31605"W	-46.07	13821945.25	3113393.09	43.32
040105	D100 BM14	N/A	29°42'12.49401"N	95°23'45.97127"W	-45.71	13820951.22	3112395.49	43.68
040110	040110	N/A	29°42'06.73895"N	95°24'09.06611"W	-43.52	13820307.50	3110377.78	45.87
040115	D100 BM16	N/A	29°42'01.57926"N	95°24'27.77211"W	-44.28	13819735.88	3108745.00	45.11
040120	D100 0120D	N/A	29°41'51.01991"N	95°24'36.90360"W	-41.81	13818645.08	3107972.86	47.58
040125	D100 D-9A	N/A	29°41'50.28199"N	95°24'43.15856"W	-42.86	13818553.65	3107423.80	46.53
040130	D100 BM17	N/A	29°41'50.89072"N	95°25'04.50048"W	-45.09	13818557.42	3105540.71	44.30
040135	D100 BM18	N/A	29°41'45.43200"N	95°25'36.88659"W	-39.92	13817918.95	3102702.85	49.48
040140	040140	N/A	29°41'27.34108"N	95°25'50.34330"W	-42.25	13816056.24	3101572.44	47.14
040145	D100 BM19	N/A	29°41'26.38422"N	95°26'23.77599"W	-39.84	13815869.78	3098628.22	49.55
040150	D100 0150D	N/A	29°41'04.89075"N	95°27'01.95355"W	-36.22	13813597.44	3095328.66	53.17
040155	V 1182 1963	AW2293	29°40'52.55268"N	95°27'34.08396"W	-38.93	13812265.89	3092533.84	50.45
040160	D100 BM20	N/A	29°40'43.80675"N	95°28'02.38664"W	-35.57	13811307.41	3090065.33	53.81
040165	D100 K6	N/A	29°40'39.07287"N	95°28'35.01213"W	-35.34	13810742.67	3087203.36	54.05
040170	D100 BM21	N/A	29°40'41.45482"N	95°29'35.01999"W	-29.63	13810824.08	3081905.58	59.78
040175	D100 0175D	N/A	29°40'41.26464"N	95°29'54.79766"W	-31.05	13810752.62	3080162.47	58.37
040180	D100 0180D	N/A	29°40'34.34333"N	95°30'30.65803"W	-30.14	13809959.28	3077021.73	59.28
040185	D100 0185D	N/A	29°40'25.17571"N	95°30'56.65553"W	-25.20	13808965.31	3074757.20	64.23
040190	040190	N/A	29°40'18.44454"N	95°31'21.51174"W	-25.62	13808220.47	3072585.88	63.81
040195	D100 0195D	N/A	29°40'21.66442"N	95°31'41.01477"W	-27.09	13808494.45	3070856.63	62.35
040200	D100 0200D	N/A	29°40'34.73171"N	95°31'49.86830"W	-23.35	13809790.59	3070036.87	66.11
040205	040205	N/A	29°40'45.18735"N	95°31'55.92485"W	-25.53	13810830.39	3069471.57	63.94

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Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040210	D100 0210D 040210	N/A	29°40'50.12348"N	95°32'10.63909"W	-19.55	13811290.30	3068159.53	69.93
040215	040215	N/A	29°40'54.25073"N	95°32'51.53856"W	-22.53	13811600.35	3064541.40	66.97
040220	004220	N/A	29°41'23.32464"N	95°33'07.86715"W	-21.86	13814493.29	3063015.27	67.68
040225	040225	N/A	29°41'43.06672"N	95°33'26.55735"W	-18.23	13816437.98	3061308.93	71.33
040230	D100 BM22	N/A	29°42'14.13619"N	95°33'57.02225"W	-19.29	13819495.92	3058531.28	70.31
040235	D100 BM29	N/A	29°42'19.89168"N	95°34'16.02995"W	-17.11	13820027.85	3056838.83	72.51
040240	D100 BM30	N/A	29°42'19.73092"N	95°34'31.24827"W	-18.72	13819972.30	3055497.92	70.90
040245	040245	N/A	29°42'32.67805"N	95°34'57.19574"W	-16.06	13821212.59	3053172.64	73.58
040250	040250	N/A	29°42'39.48185"N	95°35'12.95468"W	-15.82	13821858.97	3051763.60	73.84
040255	040255	N/A	29°42'54.45744"N	95°35'14.33977"W	-10.76	13823367.42	3051597.38	78.91
040260	D100 BM24	N/A	29°43'21.55873"N	95°35'32.34952"W	-11.51	13826057.43	3049930.35	78.19
040265	040265	N/A	29°43'20.48257"N	95°35'43.69736"W	-13.16	13825919.64	3048933.45	76.53
040270	D100 BM25	N/A	29°43'17.26347"N	95°36'17.62509"W	-9.33	13825507.68	3045952.89	80.38
040275	040275	N/A	29°43'16.26477"N	95°36'45.88831"W	-12.67	13825334.60	3043464.99	77.05
040280	D100 BM26	N/A	29°43'03.16508"N	95°36'57.49851"W	-9.16	13823982.34	3042480.07	80.56
040285	D100 BM27	N/A	29°42'57.24907"N	95°37'26.07460"W	-8.95	13823312.21	3039978.82	80.77
040290	040290	N/A	29°42'56.24170"N	95°37'51.37993"W	-10.96	13823146.16	3037751.47	78.77
040295	D100 BM29	N/A	29°42'53.42333"N	95°38'38.15844"W	-6.79	13822743.03	3033636.81	82.95
040300	040300	N/A	29°42'56.22319"N	95°39'15.24612"W	-2.69	13822932.04	3030359.96	87.06
040305	040305	N/A	29°43'00.83080"N	95°39'30.34110"W	-0.36	13823359.21	3029016.26	89.40
040310	D100 BM28	N/A	29°43'02.86014"N	95°39'36.95489"W	0.43	13823547.46	3028427.50	90.19
040315	040315	N/A	29°43'04.76376"N	95°40'00.34690"W	1.31	13823680.83	3026360.39	91.08
040320	040320	N/A	29°42'44.27375"N	95°40'21.67477"W	3.00	13821558.46	3024539.56	92.76
040325	HGCSD 38 1986	AW5558	29°41'52.61443"N	95°19'24.94869"W	-53.60	13819660.53	3135464.96	35.69
040330	D112-00-0330D	N/A	29°40'46.59577"N	95°27'11.49694"W	-37.94	13811724.83	3094543.37	51.43

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040335	D112 0335D	N/A	29°40'23.76542"N	95°27'13.26008"W	-37.58	13809415.13	3094457.84	51.77
040340	HGCSD 45 Reset 1995	AA9854	29°40'19.84856"N	95°27'39.50966"W	-37.03	13808949.55	3092155.45	52.32
040345	D112 0345P	N/A	29°40'06.40351"N	95°27'25.71076"W	-36.73	13807628.97	3093413.21	52.61
040350	D112 0350D	N/A	29°39'52.05608"N	95°27'36.50211"W	-37.64	13806151.62	3092505.58	51.69
040355	D112 0355D	N/A	29°39'38.42333"N	95°27'49.88290"W	-32.31	13804739.54	3091367.35	57.01
040360	D112 0360D	N/A	29°39'09.63270"N	95°28'50.27044"W	-34.31	13801672.13	3086129.94	55.00
040365	D112 0365D	N/A	29°39'00.55879"N	95°29'12.24273"W	-33.09	13800697.74	3084219.82	56.21
040370	D112 0370D	N/A	29°39'01.52180"N	95°29'32.53812"W	-32.85	13800741.23	3082427.09	56.46
040375	D112 0375D	N/A	29°39'16.14745"N	95°30'01.87235"W	-28.28	13802140.34	3079795.95	61.06
040380	D112 0380D	N/A	29°39'16.05943"N	95°30'11.54186"W	-28.28	13802105.94	3078943.51	61.06
040385	040385	N/A	29°40'32.58866"N	95°29'04.18428"W	-34.23	13810010.58	3084651.10	55.17
040390	D118 BM01	N/A	29°40'21.53622"N	95°31'59.20972"W	-26.42	13808433.90	3069252.77	63.03
040395	040395	N/A	29°39'59.76586"N	95°32'40.51427"W	-23.04	13806128.08	3065675.90	66.41
040400	USACE KB-BM	N/A	29°39'30.93581"N	95°33'19.14809"W	-13.05	13803116.78	3062355.11	76.38
040405	040405	N/A	29°39'21"N	95°33'44"W	N/A	13802000.00	3060000.00	78.58
040406	D118 BM02	N/A	29°39'21.68191"N	95°33'44.48366"W	-13.08	13802116.72	3060148.42	76.35
040410	D118 BM03	N/A	29°39'22.55589"N	95°34'14.32893"W	-13.93	13802127.67	3057513.93	75.52
040415	D118 BM04	N/A	29°39'34.16817"N	95°35'01.09795"W	-11.28	13803179.35	3053355.34	78.20
040420	D118 BM05	N/A	29°39'57.03420"N	95°35'41.74583"W	-8.45	13805383.44	3049703.67	81.07
040425	040425	N/A	29°39'56.97968"N	95°35'57.22811"W	-8.24	13805338.20	3048338.65	81.29
040430	040430	N/A	29°40'07.51188"N	95°36'32.29146"W	-7.28	13806311.78	3045216.01	82.28
040435	None	N/A	29°40'17.03395"N	95°36'56.11859"W	-2.75	13807212.30	3043087.22	86.83
040440	040440	N/A	29°40'24.79931"N	95°37'23.49824"W	-2.31	13807926.53	3040650.44	87.29
040445	040445	N/A	29°40'27.55947"N	95°38'35.81178"W	2.06	13808021.61	3034266.45	91.68
040450	040450	N/A	29°40'42.28264"N	95°38'57.12280"W	-1.29	13809454.26	3032344.84	88.36

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040455	040455	N/A	29°40'47.55881"N	95°39'21.82532"W	-0.85	13809924.62	3030151.64	88.81
040460	040460	N/A	29°40'49.65304"N	95°40'47.99779"W	3.96	13809919.55	3022548.10	93.64
040465	D118.02 BM01	N/A	29°39'57.79910"N	95°32'11.73727"W	-24.19	13806004.59	3068219.21	65.24
040470	TRIB 19.77 0470D	N/A	29°41'26.17387"N	95°32'13.34644"W	-24.61	13814923.00	3067813.04	64.90
040475	D119 0475D	N/A	29°41'37.28253"N	95°32'13.55505"W	-23.92	13816044.03	3067761.43	65.61
040480	TRIB 19.77 0480D	N/A	29°41'47.49397"N	95°32'13.71610"W	-21.65	13817074.59	3067716.70	67.89
040485	TRIB 19.77 0485D	N/A	29°42'04.80227"N	95°32'14.03003"W	-21.50	13818821.29	3067637.27	68.05
040490	D120 BM01	N/A	29°41'12.08547"N	95°33'05.54515"W	-22.05	13813364.57	3063253.43	67.47
040495	040495	N/A	29°41'04.90413"N	95°33'28.56576"W	-17.20	13812579.71	3061245.32	72.33
040500	D120 BM03	N/A	29°41'05.45785"N	95°33'45.45651"W	-19.23	13812591.81	3059754.59	70.31
040505	D120 BM04	N/A	29°41'05.35416"N	95°34'09.67941"W	-16.70	13812518.62	3057619.40	72.85
040510	D120 BM05	N/A	29°41'05.06199"N	95°34'28.33233"W	-16.74	13812440.90	3055975.82	72.81
040515	D120 BM06	N/A	29°41'04.40412"N	95°35'14.39806"W	-13.26	13812255.72	3051916.58	76.31
040520	D120 BM07	N/A	29°41'02.06078"N	95°35'44.60521"W	-11.54	13811941.49	3049260.38	78.05
040525	040525	N/A	29°41'01.97443"N	95°36'14.48937"W	-8.38	13811856.15	3046625.99	81.22
040530	040530	N/A	29°41'01.84443"N	95°36'28.26451"W	-6.53	13811807.77	3045411.93	83.07
040535	040535	N/A	29°41'01.69761"N	95°36'37.94688"W	-7.29	13811768.19	3044558.74	82.31
040540	040540	N/A	29°41'01.97758"N	95°37'37.60045"W	-5.02	13811644.37	3039298.74	84.61
040545	040545	N/A	29°41'21.31467"N	95°33'46.61439"W	-19.45	13814189.78	3059605.44	70.10
040550	D122 BM01	N/A	29°41'46.13575"N	95°34'15.53193"W	-18.61	13816620.98	3056982.68	70.98
040555	D122 BM02	N/A	29°41'46.01765"N	95°34'30.67401"W	-17.10	13816569.93	3055648.25	72.49
040560	040560	N/A	29°41'44.97107"N	95°34'52.27213"W	-18.18	13816408.54	3053747.45	71.42
040565	040565	N/A	29°41'46.82606"N	95°35'16.26361"W	-15.14	13816534.05	3051627.11	74.47
040570	D122 BM04	N/A	29°41'46.39363"N	95°35'45.54317"W	-12.53	13816415.15	3049047.36	77.09
040575	040575	N/A	29°41'46.43507"N	95°36'15.27777"W	-9.49	13816343.12	3046426.11	80.15

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040580	040580	N/A	29°41'46.23414"N	95°36'30.96997"W	-9.98	13816282.68	3045043.41	79.66
040585	D122 BM06	N/A	29°41'45.91065"N	95°36'52.28301"W	-5.86	13816195.57	3043165.58	83.79
040590	040590	N/A	29°41'32.09281"N	95°37'44.38294"W	-7.38	13814667.74	3038613.11	82.28
040595	040595	N/A	29°42'42.12198"N	95°33'58.22961"W	-18.21	13822318.38	3058341.87	71.41
040600	040600	N/A	29°42'57.22741"N	95°33'57.87457"W	-13.99	13823844.42	3058328.37	75.65
040605	040605	N/A	29°43'16.73841"N	95°33'55.75318"W	-13.69	13825819.84	3058457.47	75.96
040610	040610	N/A	29°43'39.69347"N	95°33'56.22561"W	-13.71	13828136.28	3058347.75	75.97
040615	040615	N/A	29°43'27.48475"N	95°35'47.52611"W	-18.31	13826616.80	3048575.45	71.40
040620	D126 BM01	N/A	29°42'25.94675"N	95°35'16.20133"W	-17.30	13820484.04	3051517.33	72.35
040625	040625	N/A	29°42'26.41242"N	95°35'46.08151"W	-15.07	13820454.29	3048882.28	74.58
040630	HGCSD 36 1986	AW5428	29°42'48.21136"N	95°35'50.23191"W	-14.78	13822644.58	3048452.40	74.90
040635	Q 1279 1978	AW2263	29°42'50.67332"N	95°36'07.97253"W	-15.21	13822847.69	3046881.58	74.47
040640	D126 BM03	N/A	29°42'25.63076"N	95°36'15.88775"W	-9.27	13820298.97	3046257.40	80.40
040645	D126 BM04	N/A	29°42'25.07270"N	95°36'52.68344"W	-11.27	13820148.58	3043015.79	78.41
040650	040650	N/A	29°42'25.03316"N	95°37'25.25289"W	-8.88	13820061.58	3040145.17	80.81
040655	040655	N/A	29°42'22.62814"N	95°37'39.18932"W	-8.97	13819783.30	3038923.78	80.73
040660	D129 BM01	N/A	29°43'28.43096"N	95°37'10.34139"W	-9.08	13826500.60	3041274.43	80.66
040665	040665	N/A	29°43'28.45444"N	95°37'23.69303"W	-7.47	13826468.97	3040097.72	82.27
040670	D129 BM02	N/A	29°43'45.00735"N	95°37'53.36685"W	-9.64	13828064.84	3037434.50	80.12
040675	D129 BM04	N/A	29°44'07.74897"N	95°38'06.97131"W	-9.83	13830326.47	3036169.55	79.95
040680	D129 BM04	N/A	29°44'23.08998"N	95°38'06.85190"W	-9.15	13831875.72	3036135.49	80.64
040685	HGCSD 35 RESET 2000	AJ6410	29°42'35.46780"N	95°39'06.16768"W	-8.69	13820859.33	3031220.10	81.04
040690	040690	N/A	29°42'10.17596"N	95°39'11.20846"W	-5.52	13818292.97	3030848.91	84.20
040695	040695	N/A	29°42'05.06921"N	95°39'49.41287"W	-3.03	13817681.11	3027496.03	86.69
040700	040700	N/A	29°41'50.15833"N	95°40'34.96117"W	1.18	13816061.25	3023523.83	90.90

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040705	040705	N/A	29°40'53.97690"N	95°30'18.71841"W	-32.35	13811972.98	3078015.14	57.09
040710	D133 0710D	N/A	29°41'17.19953"N	95°30'21.34219"W	-29.37	13814310.69	3077713.76	60.09
040715	D133 0715D	N/A	29°41'30.11042"N	95°30'24.28304"W	-29.74	13815606.46	3077415.56	59.74
040720	D133 0720D	N/A	29°41'39.47449"N	95°30'20.48637"W	-29.77	13816561.89	3077721.99	59.71
040725	D133 0725D	N/A	29°41'47.84735"N	95°30'17.12831"W	-29.17	13817416.09	3077992.73	60.32
040730	D133 0730D	N/A	29°41'54.41242"N	95°30'15.24599"W	-28.14	13818083.88	3078138.84	61.35
040735	D133 0735D	N/A	29°42'05.64817"N	95°30'14.80249"W	-26.87	13819219.44	3078144.01	62.63
040740	D133 0740D	N/A	29°42'13.96608"N	95°30'16.68548"W	-26.73	13820054.28	3077952.93	62.78
040745	D133 0745D	N/A	29°42'16.84514"N	95°30'17.75186"W	-26.87	13820342.15	3077850.25	62.64
040750	040750	N/A	29°42'46.78744"N	95°30'43.75516"W	-24.29	13823296.78	3075468.09	65.26
040755	040755	N/A	29°43'03.27075"N	95°31'12.66536"W	-24.83	13824885.08	3072870.56	64.74
040760	040760	N/A	29°41'27.85191"N	95°31'04.23991"W	-26.31	13815273.36	3073900.03	63.18
040765	D139 0765D	N/A	29°40'24.10410"N	95°28'35.80006"W	-34.52	13809229.30	3087179.44	54.86
040770	D139 0770D	N/A	29°40'07.79700"N	95°28'35.50309"W	-34.73	13807583.70	3087255.24	54.63
040775	D139 0775D	N/A	29°39'59.89001"N	95°28'35.84596"W	-33.61	13806784.49	3087249.07	55.75
040780	D139 0780D	N/A	29°39'28.51943"N	95°28'35.79749"W	-31.75	13803617.40	3087348.79	57.57
040785	040785	N/A	29°39'20.52319"N	95°28'40.10624"W	-32.84	13802798.64	3086993.16	56.48
040790	040790	N/A	29°39'12.52275"N	95°28'48.57807"W	-32.85	13801968.41	3086270.40	56.46
040795	D140 BM10	N/A	29°40'33.50149"N	95°30'20.99830"W	-29.74	13809899.73	3077875.93	59.68
040800	D140 BM08	N/A	29°40'15.46235"N	95°30'20.71090"W	-28.31	13808079.21	3077955.70	61.09
040805	D140 BM07	N/A	29°39'59.92664"N	95°30'20.55384"W	-23.72	13806511.10	3078016.43	65.67
040810	D140 BM06	N/A	29°39'22.10793"N	95°30'20.13338"W	-30.19	13802693.95	3078167.62	59.16
040815	D140 BM04	N/A	29°39'04.20537"N	95°30'19.93894"W	-28.03	13800886.99	3078238.79	61.30
040820	D140 BM05	N/A	29°38'39.85334"N	95°30'19.68807"W	-26.73	13798429.03	3078334.40	62.58
040825	D140 0825D	N/A	29°38'30.49839"N	95°30'29.32458"W	-27.59	13797459.14	3077512.73	61.71

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
040830	D140 0830D	N/A	29°38'17.30018"N	95°30'58.12736"W	-26.03	13796050.84	3075012.14	63.27
040835	D140 0835D	N/A	29°38'17.29975"N	95°31'07.20770"W	-26.89	13796026.95	3074211.26	62.41
040840	D140 0840D	N/A	29°38'26.32485"N	95°31'41.51879"W	-27.14	13796848.15	3071157.98	62.19
040845	040845	N/A	29°38'35.52307"N	95°32'18.59104"W	-19.04	13797679.88	3067860.81	70.31
040850	040850	N/A	29°38'28.81146"N	95°33'09.88744"W	-18.61	13796868.59	3063356.67	70.76
040855	040855 2002	N/A	29°41'25.56972"N	95°32'46.31482"W	-23.36	13814776.04	3064908.53	66.16
040860	040860	N/A	29°41'47.77861"N	95°32'44.32930"W	-21.14	13817023.51	3065017.31	68.40
040865	040865	N/A	29°41'56.18487"N	95°32'40.97913"W	-21.00	13817880.96	3065287.54	68.55
040870	040870	N/A	29°42'04.58850"N	95°32'37.59142"W	-21.02	13818738.25	3065561.08	68.54
040875	040875	N/A	29°42'14.10261"N	95°32'35.13569"W	-20.31	13819705.24	3065749.14	69.26
040880	040880	N/A	29°42'17.23066"N	95°32'35.17617"W	-20.65	13820020.95	3065736.23	68.92
040885	040885	N/A	29°42'48.35951"N	95°32'40.61530"W	-19.32	13823149.68	3065163.93	70.28
040890	040890	N/A	29°43'00.45098"N	95°32'50.53231"W	-18.00	13824344.67	3064253.84	71.61
040895	040895	N/A	29°43'26.00640"N	95°31'14.46507"W	-24.47	13827175.84	3072643.64	65.13
040895	NONE (PAM ARP)	AA9855 PAM 4	29°37'49.39485"N	95°35'48.67919"W	-1.66	13792478.65	3049467.41	87.74
050190	NONE (PAM ARP)	AJ6427 PAM 1	29°54'42.73203"N	95°36'59.80458"W	43.20	13894611.18	3040232.80	133.25
050330	HGCSD 19 RESET 2000	AJ6408	29°51'57.74284"N	95°29'16.44438"W	-8.07	13879154.45	3081492.15	81.80
050435	NONE (PAM ARP)	AJ6415 PAM 7	29°56'10.64628"N	95°34'35.91486"W	41.75	13903856.46	3052630.11	131.81
070540	NONE (CORS ARP)	AF9521 LKHU	29°54'48.43963"N	95°08'44.68952"W	-23.52	13899802.56	3189315.91	66.11
070545	NONE (PAM ARP)	AJ6403 PAM 12	30°03'34.89534"N	95°15'47.03819"W	-4.00	13951750.40	3150469.50	85.97
080005	H100 BM01	N/A	29°44'20.34390"N	95°12'43.79252"W	-75.89	13835703.40	3170340.42	13.41
080010	J 1185 1964	AW0902	29°44'27.99553"N	95°12'42.73119"W	-85.13	13836478.91	3170408.90	4.17

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
080015	080015	N/A	29°44'48.01065"N	95°13'29.95249"W	-63.23	13838365.01	3166183.29	26.09
080020	080020	N/A	29°45'23.57877"N	95°13'03.05980"W	-76.31	13842032.42	3168436.33	13.03
080025	H100 BM02	N/A	29°46'02.66592"N	95°13'25.65238"W	-67.01	13845914.22	3166318.68	22.36
080030	HGCSD 30 1986	AW5529	29°46'11.97416"N	95°13'14.36793"W	-64.50	13846886.07	3167282.25	24.88
080035	H100 BM03	N/A	29°46'18"N	95°13'40"W	N/A	13847400.00	3165000.00	26.61
080040	080040	N/A	29°46'31.72834"N	95°13'56.68067"W	-65.96	13848760.12	3163491.13	23.44
080045	080045	N/A	29°47'12.04742"N	95°14'45.82611"W	-58.31	13852691.43	3159031.97	31.12
080050	H100 BM04	N/A	29°47'41.36236"N	95°14'43.07540"W	-57.94	13855658.81	3159179.16	31.50
080055	W 658 1942	AW0366	29°47'58.50817"N	95°14'25.77261"W	-53.08	13857438.79	3160647.14	36.37
080060	080060	N/A	29°48'09.82957"N	95°15'20.43145"W	-54.23	13858427.34	3155797.62	35.24
080065	H100 BM05	N/A	29°47'46.26436"N	95°15'53.13076"W	-54.35	13855956.10	3152994.42	35.12
080070	H100 BM06	N/A	29°47'35.79167"N	95°16'04.96372"W	-50.15	13854865.51	3151986.19	39.32
080075	Weisser BM13	N/A	29°47'43.99599"N	95°16'21.77210"W	-49.68	13855646.60	3150479.64	39.79
080080	COE 1985	N/A	29°47'50.79587"N	95°16'57.14270"W	-49.10	13856233.94	3147343.15	40.39
080085	Weisser BM12	N/A	29°47'56.07443"N	95°17'24.09478"W	-44.47	13856691.48	3144952.94	45.03
080090	HUNT BYU 22 1985	N/A	29°48'16.80905"N	95°17'35.92557"W	-46.35	13858751.81	3143844.80	43.17
080095	Weisser BM11	N/A	29°48'35.39355"N	95°18'06.04761"W	-41.31	13860544.12	3141133.19	48.23
080100	HUNT BYU 24 1965	N/A	29°48'36.77625"N	95°18'20.96555"W	-43.73	13860642.19	3139815.31	45.81
080105	080105	N/A	29°48'28.20663"N	95°19'01.00962"W	-48.12	13859665.76	3136316.84	41.44
080110	H100 BM12	N/A	29°48'24.18135"N	95°19'20.57199"W	-46.50	13859205.14	3134607.19	43.06
080115	Weisser BM10	N/A	29°48'24.99882"N	95°19'41.61739"W	-44.44	13859229.43	3132751.57	45.13
080120	080120	N/A	29°48'20.80899"N	95°20'21.10632"W	-46.21	13858697.38	3129287.83	43.37
080125	HUNT BYU 31	N/A	29°48'22.58722"N	95°20'31.88517"W	-42.52	13858847.21	3128333.13	47.06
080130	080130	N/A	29°48'26.35138"N	95°21'27.11836"W	-39.29	13859075.41	3123457.99	50.31
080135	080135	N/A	29°45'26.15821"N	95°14'49.44146"W	-40.72	13841990.83	3159056.76	48.65
080140	080140	N/A	29°45'35.45082"N	95°15'21.38177"W	-57.32	13842838.78	3156213.08	32.06

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
080145	080145	N/A	29°46'28.56325"N	95°14'50.94478"W	-57.14	13848286.87	3158722.11	32.26
080150	080150	N/A	29°46'38.80433"N	95°15'39.81397"W	-58.16	13849182.89	3154384.87	31.26
080155	080155	N/A	29°46'58.91787"N	95°16'33.48693"W	-54.29	13851062.66	3149593.03	35.15
080160	080160	N/A	29°47'05.00876"N	95°16'55.81416"W	-51.87	13851615.01	3147607.14	37.59
080165	B 659 1942	AW0358	29°48'11.14663"N	95°16'49.07484"W	-49.39	13858311.15	3147988.21	40.11
080170	080170	N/A	29°47'55.62158"N	95°18'51.70265"W	-48.87	13856401.76	3137240.02	40.66
080175	080175	N/A	29°47'48.03710"N	95°20'07.45945"W	-45.47	13855426.33	3130593.16	44.08
080180	NONE (CORS ARP)	AJ6430 NETP	29°47'28.14234"N	95°20'03.16582"W	-30.25	13853429.58	3131034.23	59.29
080185	HGCSD 29 RESET 2000	AJ6425	29°47'27.28137"N	95°20'03.15237"W	-44.52	13853342.69	3131038.14	45.02
080190	080190	N/A	29°49'20.83395"N	95°20'04.46469"W	-36.35	13864803.52	3130563.14	53.26
080195	080195	N/A	29°50'05.83068"N	95°19'45.82987"W	-30.00	13869397.95	3132061.04	59.63
080200	Z 1149 1959	AW0222	29°48'46.41656"N	95°21'01.60672"W	-33.39	13861171.28	3125641.04	56.22
080205	080205	N/A	29°49'07.51425"N	95°19'33.08182"W	-41.77	13863545.46	3133368.22	47.81
080210	080210	N/A	29°48'47.77852"N	95°18'40.63577"W	-46.92	13861698.31	3138048.38	42.64
090005	H100 0005	N/A	29°43'07.93209"N	95°13'12.32233"W	-87.09	13828311.63	3168063.15	2.17
090010	V 1146 1959	AW0973	29°42'53.15510"N	95°13'07.13852"W	-74.46	13826834.58	3168568.22	14.80
090011	I100 BM08	N/A	29°42'53.39080"N	95°13'06.65046"W	-72.63	13826859.76	3168610.46	16.62
090015	090015	N/A	29°42'44.97086"N	95°12'58.49751"W	-79.82	13826032.97	3169356.46	9.42
090020	HGCSD 40 1986	AW5670	29°42'37.39213"N	95°12'54.75690"W	-74.39	13825278.52	3169710.88	14.85
090025	I100 BM09	N/A	29°41'53.09121"N	95°13'00.46787"W	-65.33	13820789.81	3169352.30	23.88
090030	I100 BM02	N/A	29°41'26.95655"N	95°13'03.19637"W	-64.40	13818143.60	3169197.17	24.81
090035	090035	N/A	29°40'58.90916"N	95°12'57.13380"W	-62.21	13815329.37	3169823.22	26.98
090040	I100 BM11	N/A	29°40'47.43738"N	95°12'50.59390"W	-62.18	13814189.90	3170437.24	26.99
090045	090045	N/A	29°40'34.55084"N	95°12'36.32508"W	-60.59	13812929.71	3171737.30	28.58

HARRIS COUNTY FLOOD CONTROL DISTRICT
TROPICAL STORM ALLISON PROJECT
BENCHMARK CONTROL NETWORK

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
090050	I100 BM03	N/A	29°40'26.95422"N	95°12'29.18553"W	-59.56	13812183.20	3172391.59	29.60
090055	090055	N/A	29°40'16.85495"N	95°12'12.20811"W	-59.27	13811212.21	3173921.44	29.88
090060	090060	N/A	29°40'03.19000"N	95°12'00.90215"W	-67.15	13809865.06	3174963.05	21.99
090065	090065	N/A	29°39'53.30349"N	95°11'54.94254"W	-57.83	13808884.06	3175520.94	31.30
090070	090070	N/A	29°39'32.38324"N	95°11'42.33984"W	-55.32	13806808.23	3176700.84	33.80
090075	I100 BM06	N/A	29°39'15.47207"N	95°11'39.32985"W	-54.10	13805109.63	3177021.82	35.01
090080	I100 BM14	N/A	29°39'06.12792"N	95°11'30.73671"W	-54.22	13804190.98	3177810.27	34.88
090085	090085	N/A	29°38'39.77259"N	95°11'27.10180"W	-56.82	13801540.76	3178217.49	32.26
090090	I100 BM15	N/A	29°38'19.46377"N	95°11'26.94252"W	-52.60	13799490.98	3178298.33	36.47
090095	090095	N/A	29°38'02.67027"N	95°11'26.19973"W	-53.42	13797797.76	3178419.08	35.63
090100	090100	N/A	29°37'46.34198"N	95°11'09.62022"W	-51.82	13796197.05	3179935.09	37.22
090105	Cancelled	N/A	---	---	---	---	---	---
090110	I101 BM09	N/A	29°43'01.88273"N	95°12'46.52489"W	-75.05	13827774.48	3170356.28	14.20
090115	I101 BM07	N/A	29°42'52.60633"N	95°12'34.72569"W	-72.88	13826871.67	3171426.43	16.37
090120	I101 BM05	N/A	29°42'45.72485"N	95°12'15.03518"W	-67.96	13826233.25	3173184.23	21.28
090125	I101 BM02	N/A	29°42'32.73386"N	95°12'06.93683"W	-65.87	13824944.92	3173940.53	23.36
090130	I101 BM14	N/A	29°42'19.69009"N	95°12'00.91640"W	-64.93	13823645.33	3174513.91	24.29
090135	I101 BM13	N/A	29°42'06.69321"N	95°11'54.76761"W	-63.50	13822350.84	3175098.49	25.71
090140	090140	N/A	29°41'59.53079"N	95°11'45.59593"W	-66.77	13821654.06	3175930.38	22.44
090145	I101 BM04	N/A	29°41'54.64936"N	95°11'37.35317"W	-62.92	13821184.90	3176672.93	26.29
090150	I101 BM10	N/A	29°41'45.87605"N	95°11'33.71332"W	-61.00	13820309.64	3177022.59	28.19
090155	I101 BM11	N/A	29°41'29.98347"N	95°11'30.70270"W	-59.86	13818713.86	3177340.21	29.33
090160	I101 BM15	N/A	29°41'18.98253"N	95°11'25.82467"W	-60.74	13817617.27	3177806.38	28.44
090165	I101 BM16	N/A	29°41'07.33816"N	95°11'12.73375"W	-60.40	13816479.34	3178998.66	28.77
090170	I101 BM17	N/A	29°41'00.86299"N	95°11'00.13735"W	-59.13	13815861.88	3180130.38	30.04
090175	I101 BM19	N/A	29°40'44.44251"N	95°10'41.19997"W	-57.67	13814258.71	3181853.95	31.49

Floodplain RM Number	Stamping	NGS PID (If applic.)	Latitude	Longitude	Ellipsoid Height	Northing	Easting	Elevation
090180	090180	N/A	29°40'25.69900"N	95°10'02.15347"W	-52.15	13812479.18	3185358.16	37.00
090185	I100 BM0T	N/A	29°42'19.19935"N	95°12'59.86457"W	-75.15	13823427.29	3169320.18	14.08
090190	I101.03 BM02	N/A	29°41'21.73132"N	95°10'58.23687"W	-58.99	13817974.09	3180229.13	30.19
090195	I101.03 BM03	N/A	29°41'21.91612"N	95°10'39.77049"W	-57.87	13818045.93	3181856.28	31.31
090200	I101.03 BM04	N/A	29°41'21.85671"N	95°10'21.93176"W	-55.50	13818091.38	3183428.91	33.67
090205	I101.03 BM07	N/A	29°41'21.87593"N	95°10'13.71664"W	-54.12	13818117.03	3184152.98	35.06
110320	NONE (PAM ARP)	AJ6428 PAM 2	30°00'02.33602"N	95°24'57.08654"W	23.27	13928775.40	3102815.98	113.27
110700	NONE (PAM ARP)	AJ6423 PAM 18	29°57'53.74662"N	95°40'41.58894"W	62.94	13913339.38	3020175.36	153.15
111040	NONE (PAM ARP)	AJ6418 PAM 11	30°01'55.76898"N	95°51'54.77617"W	147.84	13936144.85	2960331.66	238.10
150096	TXDOT NO STAMPING	N/A	29°55'48.82376"N	95°20'49.55186"W	-15.50	13903852.32	3125369.89	74.32
150205	150205 IR NEAR STA ??	N/A	29°48'02.78051"N	95°12'05.68302"W	-58.09	13858268.84	3172968.45	31.33
150776	P155 BM01	N/A	29°57'09.15790"N	95°22'19.42310"W	-11.87	13911717.31	3117214.60	78.01
160300	NONE (PAM ARP)	AJ6402 PAM 9	30°02'17.23076"N	95°04'17.24285"W	-11.50	13945895.35	3211315.78	78.30
200005	NONE (PAM ARP)	AJ6412 PAM 3	29°49'14.90336"N	95°36'48.14574"W	12.61	13861539.78	3042217.16	102.53
200130	NONE (PAM ARP)	AJ6424 PAM 19	29°50'28.00719"N	95°48'19.21116"W	68.56	13867208.93	2981170.04	158.63
200135	NONE (PAM ARP)	AJ6414 PAM 6	29°48'58.91787"N	95°40'39.99963"W	26.78	13859340.05	3021849.57	116.74

Section 13.

Personnel

CDS / Muery Services

- Principal-In-Charge and Project Manager   Michael McGuinness, R.P.L.S.

- Processing and Final Report   Michael McGuinness, R.P.L.S.
  Alton Geisendorff, R.P.L.S.

- Field Supervision   Russell Henderson, R.P.L.S.

- Quality Control/Quality Assurance   Michael McMullen

- GPS Observers and Monument Setters
    - Sam LeDoux (Team Leader)
    - John McClain
    - Michael Dawson
    - James Baloy
    - Duane Owens
    - Porter Mullins

- Leveling Crew
    - John McClain – Party Chief
    - James Baloy – Instrument Man
    - Chaz Duke – Rodman/Instrument Man
    - Nathan Goldsmith – Rodman

- Monument Sketches and To Reach Description Preparation
    - Michael McMullen
    - Laurie Riojas
    - Crystal Walker

Pate Engineering, Inc.

- Principal-In-Charge   Rocky Bradshaw, R.P.L.S.

- GPS Observers and Monument Setters
  - Austin Bradshaw
  - Harold Walker
  - Steve Ward
  - Tim Hayes

Section 14.

Equipment

Static GPS Equipment	Serial Number
Trimble 4000 SSi GPS Receiver	3615A15385
	3609A14775
	3615A15357
	3615A15380
	3533A12012
Trimble 4700 GPS Receiver	0220136182
	0220216924
	0220161895
	0220143782
	0220160655
	0220199141
	0220136193
Trimble Microcentered L1/L2 Antenna with Groundplane	0220161739
	0220162862
	0220159936
	0220168566
	0220192364
	0220172910
Trimble Compact L1/L2 Antenna with Groundplane	0220091377
	0220019965
Trimble Permanent L1/L2 Antenna	0220051458

Six (6) SECO Fixed Height Tripods

Conventional Survey Equipment	Serial Number
Wild NA2002 Digital Level	91309

Leica GDF6 Tribrach
Two (2) Wild Digital Invar Rods

Appendix A.

Definitions

1-sigma	One standard error from the mean.
a posteriori errors	The a priori errors multiplied by the standard error of unit weight (reference factor) resulting from a network adjustment.
a priori errors	Errors estimated for observations prior to a network adjustment.
accuracy	The closeness of a measurement to the actual (true) value of the quantity being measured.
adjusted values	Values derived from observed data (measurement) by applying a process of eliminating errors in that data in a network adjustment.
adjustment	The process of determining and applying corrections to observations for the purpose of reducing errors in a network adjustment.
adjustment convergence	When the network adjustment has met the defined residual tolerance or last ditch residual tolerance within a defined number of iterations.
algebraic sign	The sign (+ or -) associated with a value which designates it as a positive or negative number.
Algorithm	A set of rules for solving a problem in a finite number of steps.
almanac	Data transmitted by a GPS satellite that includes orbit information on all the satellites, clock correction, and atmospheric delay parameters. The almanac facilitates rapid SV acquisition. The orbit information is a subset of the ephemeris data with reduced precision.
ambiguity	The unknown integer number of cycles of the reconstructed carrier phase contained in an unbroken set of measurements. The receiver counts the radio waves (from the satellite as they pass the antenna)

to a high degree of accuracy. However, it has no information on the number of waves to the satellite at the time it started counting. This unknown number of wavelengths between the satellite and the antenna is the ambiguity. Also known as integer ambiguity or integer bias.

antenna height The height of a GPS antenna phase center above the point being observed. The uncorrected antenna height is measured from the observed point to a designated point on the antenna, then corrected to the true vertical manually or automatically in the software.

antenna phase correction The phase center for a GPS antenna is neither a physical nor a stable point. The phase center for a GPS antenna changes with respect to the changing direction of the signal from a satellite. Most of the phase center variation depends on satellite elevation. Modeling this variation in antenna phase center location allows a variety of antenna types to be used in a single survey. Antenna phase center corrections are not as critical when two of the same antennas are used since common errors cancel out.

Anti-Spoofing (AS) A feature that allows the U.S. Department of Defense to transmit an encrypted Y-code in place of P-code. Y-code is intended to be useful only to authorized (primarily military) users. AS is used with Selective Availability to deny the full precision of GPS to civilian users.

Antenna Phase Center The electronic center of the antenna. It often does not correspond to the physical center of the antenna. The radio signal is measured at the Antenna Phase Center.

Autonomous positioning A mode of operation in which a GPS receiver computes position fixes in real time from satellite data alone, without reference to data supplied by a base station. Autonomous positioning is the least precise positioning procedure a GPS receiver can perform, yielding position fixes that are precise to ±100 meters horizontal RMS when Selective Availability is in effect, and to ±10-20 meters when it is not. Also known as absolute positioning and point positioning.

Azimuth A surveying observation used to measure the angle formed by a horizontal baseline and geodetic north. When applied to GPS observations, it refers to a normal section azimuth.

base station
An antenna and receiver set up on a known location. It is used for real-time kinematic (RTK) or differential surveys. Data can be recorded at the base station for later Postprocessing. In GPS surveying practice, you observe and compute baselines (that is, the position of one receiver relative to another). The base station acts as the position from which all other unknown positions are derived.

Baseline
The position of a point relative to another point. In GPS surveying, this is the position of one receiver relative to another. When the data from these two receivers is combined, the result is a baseline comprising a three-dimensional vector between the two stations.

Cartesian coordinates
See Earth-Centered-Earth-Fixed Cartesian coordinates.

chi-square test
An overall statistical test of the network adjustment. It is a test of the sum of the weight squares of the residuals, the number of degrees of freedom and a critical probability of 95 percent or greater. The purpose of this test is to reject or to accept the hypothesis that the predicted errors have been accurately estimated.

clock offset
The constant difference in the time reading between two clocks. In GPS, usually refers to offset between SV clocks and the clock in the user's receiver.

closure
Agreement between measured and known parts of a network.

Coarse Acquisition (C/A) code
A pseudorandom noise (PRN) code modulated onto an L1 signal. This code helps the receiver compute the distance from the satellite.

code
The GPS code is a pseudorandom noise (PRN) code that is modulated onto the GPS carrier signals. The C/A code is unclassified and is available for use by civilian applications. The P code is also known and unclassified, but may be encrypted for national defense purposes. Code measurements are the basis of GPS navigation and positioning. Code also is used in conjunction with carrier phase measurements to obtain more accurate survey quality baseline solutions.

component
One of the three surveying observations used to define a three-dimensional baseline between two control points. The same baseline can be defined by azimuth, delta height, and distance (in ellipsoid coordinates); by delta X, delta Y, and delta Z in (Earth

Centered Cartesian coordinates); and by delta north, delta east, and delta up (in local plane coordinates).

constellation
A specific set of satellites used in calculating positions: three satellites for 2D fixes, four satellites for 3D fixes. All satellites are visible to a GPS receiver at one time. The optimum constellation is the constellation with the lowest PDOP. See also PDOP.

constrained
To hold (fix) a quantity (observation and coordinate) as true in a network adjustment.

constraint
External limitations imposed upon the adjustable quantities (observations and coordinates) in a network adjustment.

control point
A monumented point to which coordinates have been, or are in the process of being, assigned by the use of surveying observations.

conventional observation
An observation in the field obtained using a total station, level or theodolite and EDM or tape.

correlated
Said of two or more observations (or derived quantities) which have at least one common source of error.

covariance
A measure of the correlation of errors between two observations or derived quantities. Also refers to an off-diagonal term (that is, not a variance) in a variance-covariance matrix.

covariance matrix
A matrix that defines the variance and covariance of an observation. The elements of the diagonal are the variance and all elements on either side of the diagonal are the covariance.

covariant values
This is the publication of the propagated (computed) a posteriori errors in azimuth, distance, and height between pairs of control points resulting from a network adjustment. The term covariant indicates that this computation involves the use of covariant terms in the variance-covariance matrix of adjusted control points.

cycle slip
An interruption in a receiver's lock onto a satellite's radio signals. A cycle slip requires the re-estimation of integer ambiguity terms during baseline processing.

data logging
The process of recording satellite data in a file stored in the receiver, a data collector, or on a PC card.

data message   A message, included in the GPS signal, that reports on the location and health of the satellites as well as any clock correction. It includes information about the health of other satellites as well as their approximate position.

datum   A mathematical model of the earth designed to fit part or all of the geoid. It is defined by the relationship between an ellipsoid and a point on the topographic surface established as the origin of the datum. It is usually referred to as a geodetic datum. The size and shape of an ellipsoid, and the location of the center of the ellipsoid with respect to the center of the earth, usually define world geodetic datums.

Datum transformation   Defines the transformation that is used to transform the coordinates of a point defined in one datum to coordinates in a different datum.

There are a number of different datum transformation methods:

Seven-Parameter
Three-Parameter (also referred to as Molodensky)

Datum Grid   Multiple Regression

Datum transformations usually convert data collected in the WGS-84 datum (by GPS methods) onto datums used for surveying and mapping purposes in individual regions and countries.

de-correlate   To remove the covariances between observations. This may be done through elaborate orthogonalv transformations, or by computing separate horizontal and vertical adjustments.

deflection of the vertical   The angular difference between the upward direction of the plumb line (vertical) and the perpendicular (normal) to the ellipsoid.

degrees of freedom   A measure of the redundancy in a network.

delta elevation   The difference in elevation between two points.

delta N, delta E, delta U   Coordinate differences expressed in a Local Geodetic Horizon coordinate system.

delta X, delta Y, delta Z   Coordinate differences expressed in a Cartesian coordinate system.

differential positioning The precise measurement of the relative position of two receivers that are tracking the same satellites simultaneously.

DOP Dilution of Precision

An indicator of the quality of a GPS position. It takes account of each satellite's location relative to the other satellites in the constellation, and their geometry in relation to the GPS receiver. A low DOP value indicates a higher probability of accuracy. Standard DOPs for GPS applications are:

PDOP Position (three coordinates)

HDOP Horizontal (two horizontal coordinates)

RDOP

VDOP Vertical (height only)

Doppler shift The apparent change in frequency of a signal caused by the relative motion of satellites and the receiver.

double differencing An arithmetic method of differencing carrier phases simultaneously measured by two receivers tracking the same satellites. This method removes the satellite and receiver clock errors.

dual-frequency A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.

Earth-Centered-Earth-Fixed (ECEF) A Cartesian coordinate system used by the WGS-84 reference frame.
In this coordinate system, the center of the system is at the earth's center of mass. The z axis is coincident with the mean rotational axis of the earth and the x axis passes through $0\times$ N and $0\times$ E. The y axis is perpendicular to the plane of the x and z axes.

easting Eastward reading of grid values. Left to right on a grid (X-axis).

elevation The height above mean sea level or the vertical distance above the geoid. Elevation is sometimes referred to as the orthometric height.

elevation mask   An angle which is normally set from 10-20 degrees. If you track satellites from above this angle, you avoid interference caused by buildings, trees, and multipath errors.

ellipsoid   A mathematical model of the earth formed by rotating an ellipse around its minor axis. For ellipsoids that model the earth, the minor axis is the polar axis, and the major axis is the equatorial axis.

You define an ellipsoid by specifying the lengths of both axes, or by specifying the length of the major axis and the flattening.

Two quantities define an ellipsoid; these are usually given as the length of the semimajor axis, a, and the flattening, where b is the length of the semi-minor axis.

ellipsoid distance   The length of the normal section between two points. Ellipsoid distance is not the same as the geodesic distance.

ellipsoid height   The distance, measured along the normal, from the surface of the ellipsoid to a point.

ephemeris   A set of data that describes the position of a celestial object as a function of time. Each GPS satellite periodically transmits a broadcast ephemeris describing its predicted positions through the near future, uploaded by the Control Segment. Postprocessing programs can also use an ultra rapid, rapid or precise ephemeris that describes the exact positions of a satellite in the past.

epoch   The measurement interval of a GPS receiver. The epoch varies according to the survey type:

epoch interval   The measurement interval used by a GPS receiver; also called a cycle.

Epoch Date   At the time NGS performed the October 2000 survey for the CORS network, NGS used ITRF positions and velocities that were consistent with the IERS's solution known as ITRF96 with an Epoch Date of 1997.00 (that is, 1 January 1997). The Epoch Date denotes the date for which estimated positions correspond. An appropriate velocity must be applied to estimate positions for another date. A site's velocity characterizes various forms of crustal motion including the motion associated with plate tectonics, subsurface fluid withdrawal, and crustal loading/ unloading.

Relative to the ITRF, even points located on the rigid part of the North American tectonic plate move continuously at rates ranging from 9 to 21 mm/yr in the coterminous 48 states. For several of the older CORS, NGS has also computed ITRF positions and velocities that are consistent with the IERS solution known as ITRF94 (epoch 1996.0) and/or ITRF positions and velocities consistent with the IERS solution known as ITRF93 (epoch 1995.0).

error   The difference between the measured value of a quantity and its true value. Surveying errors are generally divided into three categories: blunders, systematic errors, and random errors. Least squares analysis is used to detect and eliminate blunders and systematic errors, and least squares adjustment is used to measure and properly distribute random error.

error ellipse   A coordinate error ellipse is a graphical representation of the magnitude and direction of the error of network adjusted points.

events   A record of the occurrence of an event, such as the closing of a photogrammetric camera's shutter. A GPS receiver can log an event mark containing the time of the event and an alphanumeric comment entered through the keypad to describe the event. An event can be triggered through the keypad or by an electrical signal input on one of the receiver's ports.

FastStatic   A method of GPS surveying using occupations of up to 20 minutes to collect GPS raw data, then postprocessing to achieve sub-centimeter precisions. Typically the occupation times vary based on the number of satellites (SVs) in view. Also referred to as RapidStatic.

fixed   See constrained.

fixed coordinates   Point coordinates that do not move when performing a network adjustment.

fixed solution   A solution obtained when the baseline processor is able to resolve the integer ambiguity search with enough confidence to select one set of integers over another. It is called a fixed solution because the ambiguities are all fixed from their estimated float values to their proper integer values.

flattening   A mathematical expression of the relative lengths of the major and minor axes of an ellipsoid.

flattening inverse   An expression of the flattening that is easier to read and edit.

float solution   A solution obtained when the baseline processor is unable to resolve the integer ambiguity search with enough confidence to select one set of integers over another. It is called a float solution because the ambiguity includes a fractional part and is non-integer.

free adjustment   Performing a network adjustment in which no point (coordinate) is constrained. The network adjustment uses inner constraints.

frequency distribution   The size and spread of residuals in a data set. Graphically shown in histograms.

fully constrained   A network adjustment in which all points in the network which are part of a larger control network are held fixed to their published coordinate values. Used to merge smaller with larger control networks and old to newer networks.

GDOP   Geometric Dilution of Precision

                                    The relationship between errors in user position and time, and errors in satellite range. See also DOP.

geodetic azimuth   The angle between the geodetic meridian and the tangent to the geodesic line of the observer, measured in the plane perpendicular to the ellipsoid normal of the observer. Clockwise from north.

geodetic datum   A mathematical model designed to fit part or all of the geoid. It is defined by the relationship between an ellipsoid and a point on the topographic surface established as the origin of a datum.The size and shape of an ellipsoid and the location of the center of the ellipsoid
                                    with respect to the center of the earth define world geodetic datums.

                                    Various datums have been established to suit particular regions. For example, European maps are often based on the European datum of 1950 (ED-50). Maps of the United States are often based on the North American Datum of 1927 or 1983 (NAD-27, NAD-83). All GPS coordinates are based on the WGS-84 datum surface.

geographic (geodetic) coordinates   Latitude, longitude, and ellipsoid height.

geoid   The surface of gravitational equipotential that closely approximates mean sea level. It is not a uniform mathematical shape, but is an irregular figure with an overall shape similar to an ellipsoid.

Generally, the elevations of points are measured with reference to the geoid. However, points fixed by GPS methods have heights established in the WGS-84 datum (a mathematical figure).

The relationship between the WGS-84 datum and the geoid must be determined by observation, as there is no single mathematical definition that can describe the relationship. You must use conventional survey methods to observe the elevation above the geoid, then compare the results with the height above the WGS-84 ellipsoid at the same point.

By gathering a large number of observations of the separation between the geoid and the WGS-84 datum (geoidal separation), grid files of the separation values can be established. This allows the interpolation of the geoidal separation at intermediate positions. Files containing these grids of geoidal separations are referred to as geoid models. Given a WGS-84 position that falls within the extents of a geoid model, the model can return the interpolated geoidal separation at this position.

geoid model   A mathematical representation of the geoid for a specific area, or for the whole earth. The software uses the geoid model to generate geoid separations for your points in the network.

geoid separation   The distance between the ellipsoid and geoid at a given point.

GPS   Global Positioning System

GPS is based on a constellation of twenty-four (24) satellites orbiting the earth at a very high altitude.

GPS baseline   A three-dimensional measurement between a pair of stations for which simultaneous GPS data has been collected and processed with differencing techniques.

Represented as delta X, delta Y, and delta Z; or azimuth, distance, and delta height.

GPS observations	A GPS baseline with its associated errors. As the adjustment progresses the observations become adjusted GPS observations.
GPS raw data	The data collected by a GPS receiver for the purpose of processing at a later time.
GPS time	A measure of time used by the NAVSTAR GPS system. GPS time is based on Universal Time Coordinated (UTC) but does not add periodic *leap seconds* to correct for changes in the earth's period of rotation.
grid	A two-dimensional horizontal rectangular coordinate system, such as a map projection.
grid conversion	The conversion between geographic and map projection coordinates.
grid distance	The distance between two points that is expressed in mapping projection coordinates.
ground distance	The distance (horizontal distance with curvature applied) between two ground points.
HDOP	Horizontal Dilution of Precision
height measurement rod	A measuring tool supplied with an external GPS antenna and used for measuring the height of the antenna above a point.
HI	Height of instrument. Synonymous with antenna heights for GPS.
histogram	A graphical display of the size and distribution of residuals in a network adjustment.
horizontal control point	A point with horizontal coordinate accuracy only. The elevation or ellipsoid height is of a lower order of accuracy or is unknown.
horizontal distance	The distance between two points, computed horizontally from the elevation of either point.
horizontal position	A point with horizontal coordinates only.

independent

Subnetworks, observations, and control points not connected by geometry or errors. This term is the opposite of correlated.

inner constraint

A network adjustment computed without fixing any point coordinates.

integer ambiguity

The whole number of cycles in a carrier phase pseudorange between the GPS satellite and the GPS receiver.

integer search

GPS baseline processing, whether real-time or postprocessed, requires fixed integer solutions for the best possible results. The software that processes the GPS measurements used to derive a baseline does an integer search to obtain a fixed integer solution. The search involves trying various combinations of integer values and selecting the best results.

iono free

Ionospheric free solution (IonoFree)

A solution that uses a combination of GPS measurements to model and remove the effects of the ionosphere on the GPS signals. This solution is often used for high-order control surveying, particularly when observing long baselines.

ionosphere

The band of charged particles 80 to 120 miles above the earth's surface. It affects the accuracy of GPS measurements if you measure long baselines using single-frequency receivers.

ionospheric modeling

The time delay caused by the ionosphere varies with respect to the frequency of the GPS signals and affects both the L1 and L2 signals differently. When dual frequency receivers are used the carrier phase observations for both frequencies can be used to model and eliminate most of the ionospheric effects. When dual frequency measurements are not available an ionospheric model broadcast by the GPS satellites can be used to reduce ionospheric affects. The use of the broadcast model, however, is not as effective as the use of dual frequency measurements.

iteration

A complete set of adjustment computations that includes the formation of the observation equations, normal equations, coordinate adjustments, and computation of residuals.

kinematic surveying

A method of GPS surveying using short Stop and Go occupations, while maintaining lock on at least 4 satellites. Can be done in real-time or postprocessed to centimeter precisions.

known point initialization   Known point is used in conjunction with kinematic initialization. If two known points are available, the baseline processor can calculate an inverse between the two points and derive an initialization vector. This initialization vector, with known baseline components, is used to help solve for the integer ambiguity. If the processor is able to successfully resolve this ambiguity a fixed integer solution is possible, yielding the best solutions for kinematic surveys.

L1   The primary L-band carrier used by GPS satellites to transmit satellite data. Its frequency is 1575.42 MHz. It is modulated by C/A code, P code, and a Navigation Message.

L2   The secondary L-band carrier used by GPS satellites to transmit satellite data. Its frequency is 1227.6 MHz. It is modulated by P code and a Navigation Message.

least squares   A mathematical method for the adjustment of observations, based on the theory of probability. In this adjustment method, the sum of the squares of all the weighted residuals is minimized.

level of confidence   A measure of the confidence in our results, expressed in a percentage or sigma.

level of significance   An expression of probability. A one-sigma (standard) error is said to have a level of significance of 68 percent. For one-dimensional errors, a 95 percent level of significance is expressed by 1.96 sigma, and a percent level of significance is expressed by 2.576 sigma.

local ellipsoid   The ellipsoid specified by a coordinate system. The WGS-84 coordinates are first transformed onto this ellipsoid, then converted to grid coordinates.

local geodetic coordinates   The latitude, longitude, and height of a point. The coordinates are expressed in terms of the local ellipsoid.

local geodetic   At any point, a plane at the ellipsoid height of a given point which is

horizon   parallel to the tangent plane to the ellipsoid at that point. Coordinate values for the local geodetic horizon are expressed as North, East, and Up. The LGH is used for rotating EC Cartesian Coordinate differences, before modeling a baseline on the ellipsoid. Azimuth values computed from LGH components must be corrected for skew normals as part of modeling on the ellipsoid.

loop closure	Loop closures provide an indication as to the amount of error in a set of observations within a network.
	A loop closure is calculated by selecting a point from which one or more observations were taken, adding one of those observations to the point's coordinates, and calculating coordinates of the second point based on that observation. This process is repeated one or more times around a loop, finally ending at the original starting point. If there were no errors in the observations, the final calculated coordinate would be exactly the same as the original starting coordinate. By subtracting the calculated coordinate from the original coordinate, a misclosure is determined. Dividing this error by the length of the line allows the error to be expressed in parts per million.
	This technique can also be used between two different points when both points are known with a high degree of accuracy. This is also known as a traverse closure.
major axis	See ellipsoid.
mapping angle	The angle between grid north on a mapping projection and the meridian of longitude at a given point. Also know as convergence.
mapping projection	A rigorous mathematical expression of the curved surface of the ellipsoid on a rectangular coordinate grid.
mean sea level	The mean height of the surface of the ocean for all stages of the tide. Used as a reference for elevations.
Minimally constrained	A network adjustment in which only enough constraints to define the coordinate system are employed. Used to measure internal consistency in observations.
minor axis	See ellipsoid.
modeling	Expressing an observation and its related errors mathematically and geometrically on some defined coordinate system, such as an ellipsoid.
multipath	Interference (similar to *ghosts* on a television screen) that occurs when GPS signals arrive at an antenna after traveling different paths. The signal traveling the longer path yields a larger

pseudorange estimate and increases the error. Multiple paths may arise from reflections from structures near the antenna.

narrow-lane A linear combination of L1 and L2 carrier phase observations (L1 + L2) that is useful for canceling out ionospheric effects in collected baseline data. The effective wavelength of the narrow-lane is 10.7 centimeters.

NAVDATA NAVDATA is the 1500-bit navigation message broadcast by each satellite. This message contains system time, clock correction parameters, ionospheric delay model parameters, and details of the satellite's ephemeris and health. The information is used to process GPS signals to obtain user position and velocity.

network A set of baselines. See also subnetwork.

network adjustment Solution of simultaneous equations designed to achieve closure in a survey network by minimizing the sum of the weighted squares of the residuals of the observations.

network status An indication that a particular observation will be included in the adjustment.

Network means that it is included in the adjustment

Non-network means that it is excluded from the adjustment.

NMEA National Marine Electronics Association
The NMEA 0183 Standard defines the interface for marine electronic navigational devices. This standard defines a number of *strings* referred to as NMEA strings that contain navigational details such as positions.

normal In geodesy, the straight line perpendicular to the surface of the ellipsoid.

normal distribution curve A graphical illustration of the theoretical distribution of random variables around an expected value according to probability theory. Used with histograms.

northing Northward reading of a grid value.

observation residual The correction applied to an observation, as determined by the adjustment.

observations	See surveying observations.
occupation time	The amount of time required on a station, or point, to achieve successful process of a GPS baseline. The amount of time will vary depending on the surveying technique, the type of GPS receiver used, and the precision required for the final results. Occupation times can vary from a couple of seconds (kinematic surveys) to several hours (control or deformation surveys that require the highest levels of precision and repeatability).
origin	The intersection of axes in a coordinate system. The point of beginning.
orthometric height	The distance between a point and the surface of the geoid. It is usually called the elevation.
OTF search method	GPS baseline processing, whether real-time or postprocessed, requires fixed integer solutions for the best possible results. (See integer search.)
	Historically, this search was done using measurements collected while two or more receivers were stationary on their respective points. Modern receivers and software can use the measurements collected while the roving receiver is moving. Because the receiver is moving, the data is described as collected *On-the-fly* (OTF) and the integer search using this data is an *OTF search*.
outlier	An observation which is identified by statistical analysis as having a residual too large for its estimated error. The term derives from the graphical position of an observation in a histogram.
over-determined	A network for which more measurements have been made than are necessary to compute the coordinates of the network. Related to redundancy.
P-code	The *precise* code transmitted by the GPS satellites. Each satellite has a unique code that is modulated onto both the L1 and L2 carrier waves. The P-code is replaced by a Y-code when Anti-Spoofing is active.
parameter	An independent variable in terms of which the coordinates of points on a line or surface are given. See unknowns.
PDOP	Position Dilution of Precision

A unitless figure of merit expressing the relationship between the error in user position, and the error in satellite position. Geometrically, PDOP is proportional to 1 divided by the volume of the pyramid formed by lines running from the receiver to four satellites that are observed. Values considered 'good' for positioning are small, for example 3. Values greater than 7 are considered poor. Thus, small PDOP is associated with widely separated satellites.

PDOP is related to horizontal and vertical DOP by:

$$PDOP^2 = HDOP^2 + VDOP^2$$

PDOP cutoff

A receiver parameter specifying a maximum PDOP value for positioning. When the geometric orientation of the satellites yields a PDOP greater than the mask value, the receiver stops computing position fixes.

PDOP mask

The highest PDOP value at which a receiver will compute positions.

phase center

See antenna phase correction.

phase center models

A model used to apply a correction to a GPS signal based on a specific antenna type. The correction is based on the elevation of the satellite above the horizon and models electrical variations in the antenna phase center location. These models are useful for eliminating errors introduced when identical antennas are not used at both the base and rover points. See also antenna phase correction.

plumbing

The act of aligning the antenna or instrument along a vertical line (plumb line) perpendicular to the equipotential surface of earth's gravity field.

point positions

See autonomous positioning.

postprocess

To process satellite data on a computer after it has been collected.

PPM

Parts per million
A standardized representation of a scale error in distance measurements. A 1 PPM error would result in 1 millimeter of measurement error for every 1000 meters of distance traveled.

precise ephemeris

See ephemeris.

precision
A measure of how closely random variables tend to cluster around a computed value. High precision implies small residuals. Usually expressed as one part in, or alternatively, as parts per million.

PRN
Pseudorandom number

A sequence of digital 1's and 0's that appear to be randomly distributed like noise, but that can be exactly reproduced. PRN codes have a low autocorrelation value for all delays or lags except when they are exactly coincident.

Each NAVSTAR satellite can be identified by its unique C/A and P pseudorandom noise codes, so the term *PRN* is sometimes used as another name for GPS satellite or SV.

probability
A statistical percentage expressing what portion of a hypothetical number of observations will fall within the defined limits. Sometimes called level of significance.

probable value
The adjusted value for observations and other quantities, assuming that the adjustment has been done correctly. The closest approximation to true value that is possible.

projection
Used to create flat maps that represent the surface of the earth or parts of that surface.

propagated error
Computed errors derived from estimated observational errors and expressed in terms of coordinate positions. Propagated coordinate errors may, in turn, be propagated into relative errors in azimuth, distance, and delta height between points.

A Quality Acceptance test
One or more software evaluation tests performed on raw GPS measurement data to determine if the data passes or fails a set of tolerance values that you define. These tests either remove data from further processing or mark data requiring quality improvements.

ratio
During initialization, the receiver determines the integer number of wavelengths for each satellite. For a particular set of integers, it works out the probability that it is the correct set.

Ratio is the ratio of the probability of correctness of the currently best set of integers to the probability of correctness of the next-best set. Thus, a high ratio indicates that the best set of integers is much

better than any other set. This gives us confidence that it is correct. The ratio must be above 5 for new point and OTF initializations.

RDOP Relative Dilution of Precision

Real-Time Kinematic A method of GPS surveying in real-time using short (stop and go) occupation, while maintaining lock on at least 4 satellites. This method requires a wireless data link between the base and rover receivers.

Rectangular coordinates Coordinates in any system in which the axes of reference intersect at right angles.

K reduced column profile An abbreviated version of the normal equations in which the equations are reordered to minimize the computer memory required to store all nonzero elements.

redundancy The amount by which a control network is overdetermined, or has more observations than are needed to strictly compute its parts.

redundancy number A measure of the degrees of freedom in a portion, rather than the entirety, of a control network.

redundant baselines A baseline observed to a point that has already been connected to the network by other observations. A redundant baseline can be either an independent reobservation of a previous measurement, or an observation to a point from another base. It is redundant because it provides more information than is necessary to uniquely determine a point. Redundant observations are very useful, however, in that they provide a check on the quality of previous measurements.

redundant A repeated observation, or an observation which contributes to over-

observation determining a network.

reference factor See standard error of unit weight.

reference frame The coordinate system of a datum.

reference station A base station.

reference variance The square of the reference factor.

relative errors   Errors and precisions expressed for and between pairs of network-adjusted control points.

residual   The correction, or adjustment, of an observation to achieve overall closure in a control network. Also, any difference between an observed quantity and a computed value for that quantity.

RINEX   Receiver INdependent EXchange format
                          A standard GPS raw data file format used to exchange files from multiple receiver manufacturers.

RMS   Root Mean Square
                          RMS expresses the accuracy of point measurement. It is the radius of the error circle within which approximately 68% of position fixes are found. It can be expressed in distance units or in wavelength cycles.

RMSE   Root Mean Square Error

rotated meridian   A zone constant for the oblique Mercator mapping projection.

rotation   In transformations, an angle through which a coordinate axis is moved around the coordinate system origin.

rover   Any mobile GPS receiver and field computer that is collecting data in the field. The position of a roving receiver can be differentially-corrected relative to a stationary base GPS receiver.

RTCM   Radio Technical Commission for Maritime Services
                          A Commission established to define a differential data link for the real-time differential correction of roving GPS receivers.

RTK   Real-time kinematic

                          A type of GPS survey.

satellite geometry   Position and movement of GPS satellites during a GPS survey.

scalar   In least squares, a value applied to the variances (errors) based on the required level of confidence.

scale   A multiplier used on coordinate and other linear variables, such as for map projections and transformations.

SDMS   Survey Data Management System

A set of format definitions for the storage of survey data. AASHTO maintains this system.

Selective Availability (S/A)
Artificial degradation of the GPS satellite signal by the U.S. Department of Defense. The error in position caused by S/A can be up to 100 meters.

semimajor axis
One-half of the major axis.

semiminor axis
One-half of the minor axis.

session
A period during which one or more GPS receivers log satellite measure data.

set-up error
Errors in tribrach centering or height of instrument at a control point.

sideshot
An observed baseline with no redundancy.

sigma
A mathematical symbol or term for standard error.

single-frequency
A type of receiver that only uses the L1 GPS signal. There is no compensation for ionospheric effects.

site calibration
A process of computing parameters that establishes the relationship between WGS-84 positions (latitude, longitude and ellipsoid height) determined by GPS observations and local known coordinates defined by a map projection and elevations above mean sea level. The parameters are used to generate local grid coordinates from WGS-84 (and vice-versa) real-time in the field when using RTK surveying methods.

skyplot
A polar plot that shows the paths of visible satellites for the time interval selected for the graph. The elevation of the satellite is represented in the radial dimension and the azimuth is shown in the angular dimension. The result depicts the satellite's path as it appears to an observer looking down from a place directly above the survey point.

solution types
A description of both the data and techniques used to obtain baseline solutions from GPS measurements. Typical solution types include descriptions such as code, float, and fixed. These describe techniques used by the baseline processor to obtain a baseline solution. Solution types also may include descriptions such as L1, L2, wide-lane, narrow-lane, or ionospheric free. These describe the

way the GPS measurements are combined to achieve particular results.

slope distance

The distance in the plane parallel to the vertical difference (slope) between the points.

SNR

Signal-to-Noise Ratio

A measure of the strength of a satellite signal. SNR ranges from 0 (no signal) to around 35.

standard error

A statistical estimate of error, according to which 68 percent of an infinite number of observations will theoretically have absolute errors less than or equal to this value.

standard error of unit weight

A measure of the magnitude of observational residuals in an adjusted network as compared to estimated preadjustment observational errors.

State Plane Coordinates

Special definitions of Transverse Mercator and Lambert conformal mapping projections adopted by statute in the USA. There is one set of such zones for NAD-27, and another for NAD-83.

static (surveying)

A method of GPS surveying using long occupations (hours in some cases) to collect GPS raw data, then postprocessing to achieve sub-centimeter precisions.

static network

The static network describes the geometry and order in which GPS baselines collected using static and fast static techniques are organized and processed. The baseline processor first examines the project for points with the highest quality coordinates, and then builds the processing network from those points. The result is a set of static baselines that are derived using accurate initial coordinates.

status

Every observation and set of keyed-in coordinates for a point has a status field (available in the *Summary* page of the *Properties* window).

The status can be Enabled, Enabled as check, or Disabled:

Enabled observations and coordinates are always used by recomputation in determining the calculated position for the point.

Enabled as check observations and coordinates are only used if there are no Enabled ones Disabled observations and coordinates are never used.

stochastic model A general reference to the techniques used to estimate errors in a network adjustment.

subsidence The sinking of large portions of the Earth's crust.

surveying observations Measurements made at or between control points using surveying equipment, including GPS receivers and conventional equipment.

SV Satellite Vehicle (or Space Vehicle)

systematic errors An error that occurs with the same sign, and often the same magnitude, in a number of related observations.

tau (value) A value computed from an internal frequency distribution based upon the number of observations, degrees of freedom, and a given probability percentage (95%). This value is used to determine if an observation is not fitting with the others in the adjustment. If an observations residual exceeds the tau, it is flagged as an outlier. Known as tau lines in the histogram of standardized residuals, vertical lines left and right of the center vertical line.

tau criterion Allen Pope's statistical technique for detecting observation outliers. For more information, see Pope (1976).

TDOP Time Dilution of Precision

terrestrial observation An observation in the field using a laser rangefinder conventional instrument.

TOW Time of Week

TOW in seconds, from midnight Saturday night/Sunday morning GPS time.

tracking The process of receiving and recognizing signals from a satellite.

transformation The rotation, shift, and scaling of a network to move it from one coordinate system to another.

Transformation group	A selected group of observations used to compute transformation parameters unique to that group of observations. Typically, the observations within the group are the same type with similar errors and measured using a common method.
transformation parameters	A set of parameters derived for a network adjustment or user-defined, that transform one datum to another. Typically with GPS the parameters are generated to transform WGS-84 to the local datum.
tribrach	Centering device used for mounting GPS antennas and other survey instruments on survey tripods.
tribrach centering errors	The errors associated with centering (plumbing) the tribrach over the observed point. These errors are estimated. The estimate is based on surveying the quality of surveying methods and should be conservative.
tropo correction	Tropospheric correction The correction applied to a satellite measurement to correct for tropospheric delay.
tropo model	tropospheric model GPS signals are delayed by the troposphere. The amount of the delay will vary with the temperature, humidity, pressure, height of the station above sea level, and the elevation of the GPS satellites above the horizon. Corrections to the code and phase measurements can be made using a tropo model to account for these delays.
univariate	A mathematical function describing the behavior of one-dimensional random errors, in angle, distance, difference in height, elevation, and ellipsoid height.
URA	User Range Accuracy A measure of the errors that may be introduced by satellite problems and Selective Availability (S/A) if a particular satellite vehicle (SV) is used. A URA of 32 meters indicates that S/A is enabled. The URA value is set by the Control Segment and is broadcast by the satellites.
unknowns	The computed adjustments to coordinates and transformation parameters. Also used to compute observation residuals.

US Survey Foot   1200/3937 meter. The official unit of linear measure for NAD-27.

UTC   Universal Time Coordinated
A time standard based on local solar mean time at the Greenwich meridian. See also GPS time.

variance   The square of the standard error.

variance component estimation   A least-squares technique for estimating the relative error of different portions of a network.

variance group   One of the groups of observations for which variance component estimation is being used in a network adjustment.

variance-covariance matrix   The set of numbers expressing the variances and covariances in a group of observations.

VDOP   Vertical Dilution of Precision

vector   A three-dimensional line between two points.

vertical   Similar to the normal, except that it is computed from the tangent plane to the geoid instead of the ellipsoid.

vertical adjustment   A network adjustment of vertical observations and coordinates only.

vertical control point   A point with vertical coordinate accuracy only. The horizontal position is of a lower order of accuracy or is unknown.

weight   The inverse of the variance of an observation.

weights   The set of weights, or the inverse of the variance-covariance matrix of correlated observations.

WGS-84   World Geodetic System (1984)

The mathematical ellipsoid used by GPS since January 1987.

wide-lane   A linear combination of L1 and L2 carrier phase observations (L1 - L2). This is useful for its low effective wavelength (86.2 centimeters) and for finding integer ambiguities on long baselines.

X, Y and Z   In the Earth Centered Cartesian system, X refers to the direction of the coordinate axis running from the system origin to the Greenwich Meridian; Y to the axis running from the origin through the 90× east longitude meridian, and Z to the polar ice cap. In rectangular coordinate systems, X refers to the east-west axis, Y to the north-south axis, and Z to the height axis.

Y-code   Y-code is an encrypted form of the information contained in the P-code. Satellites transmit Y-code in place of P-code when Anti-Spoofing is in effect.

zenith delay   The delay, caused by the troposphere, of a GPS signal observed from a satellite directly overhead. As a satellite approaches the horizon, the signal path through the troposphere becomes longer and the delay increases.

Appendix B.

Leveling Data

Adjusted Elevations

13110A	44.61	Loop 1 Length: 110 Ft		Allowable Error: 0.003 Ft Actual Error: 0.001 Ft
13110	45.396	No.	13793825.3	East 3154266.436
		Lat.	29°37'31.07121"N	Long. 95°16'01.20624"W

5119	75.52			
5117	76.38	Loop 2 Length: 11,621 Ft		Allowable Error: 0.034 Ft Actual Error: 0.007 Ft
5118	78.584	No.	13802016.06	East 3059959.319
		Lat.	29°39'20.74081"N	Long. 95°33'46.65970"W

4038	24.88			
4030	22.36	Loop 4 Length: 10,346 Ft		Allowable Error: 0.033 Ft Actual Error: 0.021 Ft
4001	26.611	No.	13847382.152	East 3165043.353
		Lat.	29°46'17.59829"N	Long. 95°13'39.57919"W

8066	51.52			
8067	58.80	Loop 5 Length: 35,956 Ft		Allowable Error: 0.061 Ft Actual Error: 0.035 Ft
8014	48.445	No.	13843933.5	East 3082202.896
		Lat.	29°46'09.00633"N	Long. 95°29'20.38326"W

8008	61.64			
8076	70.83	Loop 6 Length: 17,861 Ft		Allowable Error: 0.043 Ft Actual Error: 0.003 Ft
8074	54.341	No.	13848994.64	East 3079027.074
		Lat.	29°47'00.03147"N	Long. 95°29'54.68546"W

8070	50.52				
8059	54.62	Loop 7 Length: 24,596 Ft		Allowable Error: 0.051 Ft Actual Error: 0.009 Ft	
8033	53.776	No.	13842690.46	East	3088976.129
		Lat.	29°45'54.68696"N	Long.	95°28'03.98515"W

8031	55.60				
8029	67.81	Loop 8 Length: 62,030 Ft		Allowable Error: 0.081 Ft Actual Error: 0.067 Ft	
8032	40.989	No.	13839725.57	East	3098860.045
		Lat.	29°45'22.38017"N	Long.	95°26'12.90888"W

0120	99.52				
0132	103.32	Loop 9 Length:13,297 Ft		Allowable Error: 0.037 Ft Actual Error: 0.003 Ft	
0045	102.732	No.	13906662.223	East	3088667.587
		Lat.	29°56'27.79453"N	Long.	95°27'45.53236"W

Loop 1

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Raw Field File: C:\AUTOLEVE\GIF\LOOP1.RAW

Date Processed: 05-14-03 14:41:08

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID		E	D	Sum E	Sum D	Descriptor
13110A	131102	B	5.0580	28.4400	0.0000	0.0000	
13110	13110	F	4.2720	26.1500	0.7860	54.5900	

Point	ID		E	D	Sum E	Sum D	Descriptor
13110	13110	B	4.4980	26.3100	0.0000	0.0000	
13110A	131102	F	5.2850	28.3100	-0.7870	54.6200	

Process Completed with 0 Errors and 0 Warnings

Loop 2

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Raw Field File: C:\AUTOLEVE\GIF\LOOP2.RAW

Date Processed: 05-14-03 14:53:01

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
5119	5119 B	4.8110	119.3600	0.0000	0.0000	
	1 F	6.3130	114.2100	-1.5020	233.5700	
	1 B	4.0970	123.2600			
	2 F	5.4320	131.1300	-2.8370	487.9600	
	2 B	3.9140	199.2800			
	3 F	3.8590	198.0000	-2.7820	885.2400	
	3 B	4.7090	204.0700			
	4 F	5.2030	208.2700	-3.2760	1297.5800	
	4 B	4.4330	224.3400			
	5 F	3.0280	218.3100	-1.8710	1740.2300	
	5 B	7.0180	209.9400			
	6 F	5.4580	212.9600	-0.3110	2163.1300	
	6 B	3.6130	168.3400			
	7 F	4.3660	177.3600	-1.0640	2508.8300	
	7 B	6.9960	295.7000			
5118	8 F	2.8730	299.2400	3.0590	3103.7700	

Point	ID	E	D	Sum E	Sum D	Descriptor
5118	8 B	3.4030	224.7400	0.0000	0.0000	
	9 F	7.9900	214.8900	-4.5870	439.6300	
	9 B	2.6990	209.7800			
	10 F	5.2110	217.0300	-7.0990	866.4400	
	10 B	3.3250	210.1400			
	11 F	5.7350	206.5300	-9.5090	1283.1100	
	11 B	5.2970	194.1300			
	12 F	5.1840	201.4100	-9.3960	1678.6500	
	12 B	4.6050	187.1100			
	13 F	4.7430	186.7100	-9.5340	2052.4700	
	13 B	1.1920	217.6500			
	14 F	3.2810	217.4200	-11.6230	2487.5400	
	14 B	6.7120	69.3200			
	15 F	1.8870	68.1400	-6.7980	2625.0000	
	15 B	7.0490	48.7900			
5117	5117 F	2.4620	58.2700	-2.2110	2732.0600	

Point	ID	E	D	Sum E	Sum D	Descriptor
5117	5117 B	1.7220	98.3600	0.0000	0.0000	
	16 F	7.8860	103.7400	-6.1640	202.1000	
	16 B	0.7770	121.0000			
	17 F	7.5650	120.4400	-12.9520	443.5400	
	17 B	8.6340	189.7600			
	18 F	3.2850	188.2900	-7.6030	821.5900	
	18 B	4.9380	152.4300			
	19 F	4.8760	167.9800	-7.5410	1142.0000	
	19 B	6.0670	144.5500			
	20 F	5.6830	148.9800	-7.1570	1435.5300	
	20 B	5.4450	199.6400			
	21 F	2.9310	204.6900	-4.6430	1839.8600	
	21 B	4.9480	208.6300			
	22 F	3.3820	208.8600	-3.0770	2257.3500	
	22 B	8.5770	231.3600			
5118	5118 F	3.2880	232.4100	2.2120	2721.1200	

Point	ID	E	D	Sum E	Sum D	Descriptor
5118	5118 B	3.2000	281.7300	0.0000	0.0000	
	23 F	6.3320	288.5200	-3.1320	570.2500	
	23 B	4.9650	190.0300			
	24 F	4.7320	191.9300	-2.8990	952.2100	
	24 B	5.4640	200.4900			
	25 F	7.6040	187.1100	-5.0390	1339.8100	
	25 B	3.3970	184.4500			
	26 F	5.2950	203.6700	-6.9370	1727.9300	
	26 B	5.8750	222.6400			
	27 F	4.9330	224.8400	-5.9950	2175.4100	
	27 B	4.7480	219.6200			
	28 F	3.1990	222.4700	-4.4460	2617.5000	
	28 B	4.7820	215.4500			
5119	5119 F	3.3890	230.7700	-3.0530	3063.7200	

Process Completed with 0 Errors and 0 Warnings

<u>Loop 4</u>

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Raw Field File: C:\AUTOLEVE\GIF\LOOP4.RAW

Date Processed: 05-14-03 15:07:12

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
4038	4038 B	4.0750	158.3000	0.0000	0.0000	
	1 F	4.1180	155.1800	-0.0430	313.4800	
	1 B	4.2540	208.2000			
	2 F	4.1250	200.9800	0.0860	722.6600	
	2 B	5.0910	224.6100			
	3 F	6.3790	224.5100	-1.2020	1171.7800	
	3 B	3.6400	241.0400			
	4 F	5.0970	245.0800	-2.6590	1657.9000	
	4 B	7.0210	201.2100			
	5 F	3.1630	196.3900	1.1990	2055.5000	
	5 B	4.0000	117.9800			
4001	4001 F	3.4510	122.8300	1.7480	2296.3100	

Point	ID	E	D	Sum E	Sum D	Descriptor
4001	4001 B	4.4360	129.8600	0.0000	0.0000	
	6 F	7.3200	123.9200	-2.8840	253.7800	
	6 B	6.1710	238.8100			
	7 F	4.6260	237.0400	-1.3390	729.6300	
	7 B	5.0980	254.0700			
	8 F	4.5340	256.5300	-0.7750	1240.2300	
	8 B	5.8600	261.0600			
	9 F	4.7250	266.6300	0.3600	1767.9200	
	9 B	3.4580	236.6500			
	10 F	5.9240	234.4200	-2.1060	2238.9900	
	10 B	2.9110	240.9100			
	11 F	4.5330	241.0400	-3.7280	2720.9400	
	11 B	4.3730	109.4200			
4030	4030 F	4.8850	119.3200	-4.2400	2949.6800	

Point	ID	E	D	Sum E	Sum D	Descriptor
4030	4030 B	5.1300	228.1800	0.0000	0.0000	
	12 F	4.5890	220.7300	0.5410	448.9100	
	12 B	6.0850	231.5900			
	13 F	3.0580	229.4900	3.5680	909.9900	
	13 B	6.0140	239.5700			
	14 F	4.3700	236.5800	5.2120	1386.1400	
	14 B	3.5740	194.7500			
	15 F	5.4000	201.3400	3.3860	1782.2300	
	15 B	4.3480	245.3100			
	16 F	5.1300	244.8800	2.6040	2272.4200	
	16 B	4.2910	285.1000			
4001	4001 F	2.6530	247.3700	4.2420	2804.8900	

Point	ID	E	D	Sum E	Sum D	Descriptor
4001	4001 B	4.2170	274.6700	0.0000	0.0000	
	17 F	7.6350	274.1800	-3.4180	548.8500	
	17 B	3.5550	238.1200			
	18 F	3.3230	253.7400	-3.1860	1040.7100	
	18 B	6.4080	268.2400			
	19 F	4.8010	260.6300	-1.5790	1569.5800	
	19 B	4.1620	239.0700			
	20 F	4.3200	247.2100	-1.7370	2055.8600	
	20 B	4.7340	130.8400			
4038	4038 F	4.7270	107.9400	-1.7300	2294.6400	

Process Completed with 0 Errors and 0 Warnings

Loop 5

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Raw Field File: C:\AUTOLEVE\GIF\LOOP5.RAW

Date Processed: 05-14-03 14:53:58

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
8066	8066 B	6.9890	201.2100	0.0000	0.0000	
	1 F	2.8250	200.1600	4.1640	401.3700	
	1 B	4.7700	242.4900			
	2 F	5.4070	242.0300	3.5270	885.8900	
	2 B	5.3720	244.0000			
	3 F	3.8140	245.1100	5.0850	1375.0000	
	3 B	4.6030	254.4000			
	4 F	5.7080	250.9800	3.9800	1880.3800	
	4 B	6.5260	189.7600			
	5 F	4.6690	185.5000	5.8370	2255.6400	
	5 B	4.0020	147.9300			
	6 F	3.3160	145.4400	6.5230	2549.0100	
	6 B	5.3640	255.0500			
	7 F	3.8440	253.3500	8.0430	3057.4100	
	7 B	8.7250	255.8400			
	8 F	4.3230	250.4900	12.4450	3563.7400	
	8 B	5.2980	266.0400			
	9 F	4.7170	263.6100	13.0260	4093.3900	

```
                 9  B    4.5230 236.8100

                10  F    5.4520 240.4500    12.0970  4570.6500

                10  B    4.0140 251.8400

                11  F    7.7620 252.8200     8.3490  5075.3100

                11  B    5.6270 204.0700

                12  F    2.6990 206.9900    11.2770  5486.3700

                12  B    5.4580 245.9300

                13  F    5.4630 244.4200    11.2720  5976.7200

                13  B    2.4900 203.9400

                14  F    6.2480 214.5000     7.5140  6395.1600

                14  B    0.5600 187.5300

8014          8014  F   11.1740 180.0800    -3.1000  6762.7700
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8014	8014 B	10.6330	179.0000	0.0000	0.0000	
	15 F	0.5640	175.4300	10.0690	354.4300	
	15 B	8.0800	262.4300			
	16 F	3.4550	262.1400	14.6940	879.0000	
	16 B	4.9510	235.7300			
	17 F	6.1510	246.8800	13.4940	1361.6100	
	17 B	1.3200	253.9000			
	18 F	1.4590	254.3600	13.3550	1869.8700	
	18 B	6.2610	241.2700			
	19 F	4.2590	250.9800	15.3570	2362.1200	
	19 B	5.2840	237.5300			
	20 F	4.7260	239.8600	15.9150	2839.5100	
	20 B	3.4850	270.0800			
	21 F	1.9740	190.2900	17.4260	3299.8800	
	21 B	3.1520	265.3200			
	22 F	3.3660	264.8300	17.2120	3830.0300	
	22 B	4.7330	261.5500			
	23 F	4.3190	261.8100	17.6260	4353.3900	
	23 B	4.1330	251.7100			
	24 F	4.8910	253.6400	16.8680	4858.7400	
	24 B	4.9660	294.2600			
	25 F	4.8560	293.7300	16.9780	5446.7300	
	25 B	4.6800	280.8700			
	26 F	4.4280	279.7600	17.2300	6007.3600	
	26 B	2.6190	243.0400			

```
              27 F   4.3700 247.7400    15.4790  6498.1400

              27 B   4.9810 274.0200

              28 F   2.7120 274.8000    17.7480  7046.9600

              28 B   3.1030 264.8000

              29 F   4.9920 270.8700    15.8590  7582.6300

              29 B   3.0740 273.5200

              30 F   5.7070 274.2400    13.2260  8130.3900

              30 B   3.1370 252.2300

              31 F   3.3500 254.3300    13.0130  8636.9500

              31 B   7.3660 303.8400

              32 F   4.9540 296.7800    15.4250  9237.5700

              32 B   5.2540  97.0100

              33 F   3.1770  88.8800    17.5020  9423.4600

              33 B   3.4470 155.2500

              34 F   7.5530 164.3400    13.3960  9743.0500

              34 B   0.1230 236.5200

              35 F   8.1880 228.5100     5.3310 10208.0800

              35 B   3.6540 260.7300

              36 F   5.8040 267.4200     3.1810 10736.2300

              36 B   7.7640 290.8800

8067         8067 F   0.6230 288.4200    10.3220 11315.5300
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8067	8067 B	0.5840	286.6100	0.0000	0.0000	
	37 F	7.7280	292.6200	-7.1440	579.2300	
	37 B	5.8510	273.1300			
	38 F	3.4370	275.2600	-4.7300	1127.6200	
	38 B	7.8190	226.4800			
	39 F	0.3210	213.5800	2.7680	1567.6800	
	39 B	7.1430	141.8300			
	40 F	3.5750	146.2600	6.3360	1855.7700	
	40 B	4.5820	201.5400			
	41 F	6.2600	212.5700	4.6580	2269.8800	
	41 B	4.6330	252.4300			
	42 F	6.5460	253.1200	2.7450	2775.4300	
	42 B	4.5260	274.0800			
	43 F	3.1070	295.8000	4.1640	3345.3100	
	43 B	5.3520	220.3400			
	44 F	3.6210	218.2400	5.8950	3783.8900	
	44 B	4.8890	254.4300			
	45 F	4.9300	246.3600	5.8540	4284.6800	
	45 B	4.2660	189.1400			
	46 F	4.9190	195.0100	5.2010	4668.8300	
	46 B	4.8270	246.5200			
	47 F	4.2640	248.4900	5.7640	5163.8400	
	47 B	5.6660	261.7100			
	48 F	4.3040	261.2900	7.1260	5686.8400	
	48 B	4.2120	260.2400			

```
              49 F   4.7160 258.5300    6.6220  6205.6100

              49 B   5.1350 264.4700

              50 F   4.8340 268.1400    6.9230  6738.2200

              50 B   5.2650 261.0200

              51 F   4.8860 261.5500    7.3020  7260.7900

              51 B   4.6330 243.8300

              52 F   5.9060 255.1500    6.0290  7759.7700

              52 B   4.0730 231.6600

              53 F   4.3600 233.7900    5.7420  8225.2200

              53 B   4.8660 258.6300

              54 F   5.6170 262.0700    4.9910  8745.9200

              54 B   4.7700 264.1100

              55 F   5.8700 263.6800    3.8910  9273.7100

              55 B   1.6860 266.5000

              56 F   6.2560 265.4200   -0.6790  9805.6300

              56 B   5.0260 260.0400

              57 F   5.1610 261.4800   -0.8140 10327.1500

              57 B   5.7240 190.1200

              58 F   3.7260 213.0600    1.1840 10730.3300

              58 B   3.8680 120.2100

              59 F   8.1070 121.9500   -3.0550 10972.4900

              59 B   0.9910 106.5000

8014        8014 F   8.2740 110.0700  -10.3380 11189.0600
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8014	8014 B	8.3600	110.9200	0.0000	0.0000	
	60 F	1.0740	105.9100	7.2860	216.8300	
	60 B	8.4920	202.6600			
	61 F	5.4570	225.4900	10.3210	644.9800	
	61 B	3.8850	209.9700			
	62 F	4.3920	215.5200	9.8140	1070.4700	
	62 B	4.7570	258.6900			
	63 F	4.4270	270.3400	10.1440	1599.5000	
	63 B	8.0120	263.1900			
	64 F	2.8860	258.1000	15.2700	2120.7900	
	64 B	5.1460	279.7900			
	65 F	4.4950	273.2300	15.9210	2673.8100	
	65 B	4.7940	265.3500			
	66 F	5.2730	261.1500	15.4420	3200.3100	
	66 B	5.0580	198.9500			
	67 F	7.4660	192.0600	13.0340	3591.3200	
	67 B	2.1650	229.9500			
	68 F	5.7390	234.0200	9.4600	4055.2900	
	68 B	5.1310	196.8800			
	69 F	5.5420	144.3900	9.0490	4396.5600	
	69 B	4.6450	227.0700			
	70 F	6.5670	215.9400	7.1270	4839.5700	
	70 B	5.7170	262.6000			
	71 F	5.0960	263.2900	7.7480	5365.4600	
	71 B	4.2740	254.7600			

```
                        72 F   5.5520 254.6900     6.4700  5874.9100

                        72 B   5.8210 202.0700

                        73 F   4.9900 205.6400     7.3010  6282.6200

                        73 B   3.1220 197.5100

8066               8066 F   7.3420 207.9100     3.0810  6688.0400
```

Process Completed with 0 Errors and 0 Warnings

Loop 6

NA3000 Version 2.02

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Raw Field File: C:\AUTOLEVE\GIF\LOOP6.RAW

Date Processed: 05-14-03 14:54:20

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
8008	8008 B	4.6040	251.7700	0.0000	0.0000	
	1 F	2.5140	250.0700	2.0900	501.8400	
	1 B	4.5320	100.9500			
	2 F	1.4360	125.6200	5.1860	728.4100	
	2 B	4.6850	251.8000			
	3 F	4.1990	251.8700	5.6720	1232.0800	
	3 B	4.6090	246.0600			
	4 F	6.7630	246.7800	3.5180	1724.9200	
	4 B	4.0170	256.1300			
	5 F	7.9440	270.5700	-0.4090	2251.6200	
	5 B	3.2490	263.5500			
	6 F	4.1140	264.8300	-1.2740	2780.0000	
	6 B	5.8730	251.0500			
	7 F	4.4750	250.0700	0.1240	3281.1200	
	7 B	5.5890	257.9100			
	8 F	4.0520	257.3800	1.6610	3796.4100	
	8 B	4.6700	134.4800			
	9 F	5.3080	55.8700	1.0230	3986.7600	

```
                      9 B   0.2720  12.8300

8074                  8074 F  8.6160  24.3800    -7.3210  4023.9700
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8074	8074 B	8.4960	24.3800	0.0000	0.0000	
	10 F	0.1520	12.8300	8.3440	37.2100	
	10 B	7.1160	151.6400			
	11 F	2.5370	199.2100	12.9230	388.0600	
	11 B	3.7770	257.0200			
	12 F	3.5970	254.9500	13.1030	900.0300	
	12 B	5.4970	260.9600			
	13 F	4.4200	263.2900	14.1800	1424.2800	
	13 B	4.5550	255.3100			
	14 F	4.1310	256.4600	14.6040	1936.0500	
	14 B	5.3110	255.7700			
	15 F	5.0170	256.8200	14.8980	2448.6400	
	15 B	5.8460	275.8500			
	16 F	4.6860	274.8700	16.0580	2999.3600	
	16 B	5.8780	315.0600			
	17 F	5.9470	303.2100	15.9890	3617.6300	
	17 B	5.5070	293.5400			
	18 F	4.3490	293.0100	17.1470	4204.1800	
	18 B	3.6930	253.6100			
	19 F	3.6380	255.3100	17.2020	4713.1000	
	19 B	4.0200	87.7000			
8076	8076 F	4.7670	123.2000	16.4550	4924.0000	

Point	ID	E	D	Sum E	Sum D	Descriptor
8076	8076 B	4.6910	216.9300	0.0000	0.0000	
	20 F	4.2090	220.5700	0.4820	437.5000	
	20 B	5.1920	262.9900			
	21 F	5.3990	262.1700	0.2750	962.6600	
	21 B	3.8590	263.9400			
	22 F	3.9360	312.5600	0.1980	1539.1600	
	22 B	4.4910	195.0500			
	23 F	5.0750	199.8400	-0.3860	1934.0500	
	23 B	4.4980	261.7400			
	24 F	5.6640	261.6100	-1.5520	2457.4000	
	24 B	4.7980	257.7800			
	25 F	5.0810	257.3200	-1.8350	2972.5000	
	25 B	4.0870	252.5900			
	26 F	4.7080	253.5400	-2.4560	3478.6300	
	26 B	4.5070	255.3100			
	27 F	5.3610	257.9100	-3.3100	3991.8500	
	27 B	3.0210	287.3400			
	28 F	3.4150	245.3700	-3.7040	4524.5600	
	28 B	2.5660	200.4900			
	29 F	6.9770	144.8500	-8.1150	4869.9000	
	29 B	0.4140	12.7300			
8074	8074 F	8.7580	24.5400	-16.4590	4907.1700	

Point	ID	E	D	Sum E	Sum D	Descriptor
8074	8074 B	8.6780	24.6700	0.0000	0.0000	
	30 F	0.3340	12.6000	8.3440	37.2700	
	30 B	7.0730	87.8300			
	31 F	6.6510	63.7800	8.7660	188.8800	
	31 B	3.8650	275.0700			
	32 F	5.1930	269.8200	7.4380	733.7700	
	32 B	4.0380	253.8400			
	33 F	5.4450	249.2100	6.0310	1236.8200	
	33 B	3.8830	262.7900			
	34 F	3.0070	251.8700	6.9070	1751.4800	
	34 B	7.7110	253.2100			
	35 F	3.9260	278.0200	10.6920	2282.7100	
	35 B	6.7250	260.1000			
	36 F	4.3160	216.4700	13.1010	2759.2800	
	36 B	4.6820	178.5800			
	37 F	6.7570	196.2300	11.0260	3134.0900	
	37 B	3.6270	202.0700			
	38 F	5.5400	198.5900	9.1130	3534.7500	
	38 B	2.6740	245.6400			
8008	8008 F	4.4590	225.4600	7.3280	4005.8500	

Process Completed with 0 Errors and 0 Warnings

Loop 7

NA3000 Version 2.02

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Raw Field File: C:\AUTOLEVE\GIF\LOOP7.RAW

Date Processed: 05-14-03 14:54:38

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
8070	8070 B	1.3090	242.9500	0.0000	0.0000	
	1 F	5.9490	252.3300	-4.6400	495.2800	
	1 B	5.6320	246.1000			
	2 F	7.6880	258.0000	-6.6960	999.3800	
	2 B	5.6080	240.5200			
	3 F	2.8090	279.1000	-3.8970	1519.0000	
	3 B	5.8620	235.7600			
	4 F	7.2070	243.0400	-5.2420	1997.8000	
	4 B	7.8310	206.1300			
	5 F	1.8170	193.3700	0.7720	2397.3000	
	5 B	6.9810	233.4600			
	6 F	4.2000	224.7000	3.5530	2855.4600	
	6 B	6.5890	244.6500			
	7 F	4.4960	255.4100	5.6460	3355.5200	
	7 B	4.5460	251.0800			
	8 F	8.1480	247.6000	2.0440	3854.2000	
	8 B	3.8820	131.5900			
	9 F	4.7150	140.4200	1.2110	4126.2100	

```
                    9  B    6.6190 269.2600

                   10  F    4.3000 241.6300      3.5300   4637.1000

                   10  B    3.8110  61.0900

8033              8033  F   4.0750  43.7700      3.2660   4741.9600
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8033	8033 B	5.5890	240.7500	0.0000	0.0000	
	11 F	4.7140	242.7800	0.8750	483.5300	
	11 B	4.2460	247.8700			
	12 F	5.0800	248.5600	0.0410	979.9600	
	12 B	3.2730	133.5600			
	13 F	3.2980	132.7800	0.0160	1246.3000	
	13 B	5.2080	240.1900			
	14 F	6.9820	259.3200	-1.7580	1745.8100	
	14 B	6.3340	264.7300			
	15 F	3.3780	265.1900	1.1980	2275.7300	
	15 B	6.9710	251.3800			
	16 F	3.7260	269.3600	4.4430	2796.4700	
	16 B	6.8460	244.9100			
	17 F	5.6590	250.2300	5.6300	3291.6100	
	17 B	1.3800	252.2000			
	18 F	4.4610	246.5900	2.5490	3790.4000	
	18 B	4.3360	246.9200			
	19 F	1.9520	245.4100	4.9330	4282.7300	
	19 B	6.3690	259.5100			
	20 F	4.1260	268.5400	7.1760	4810.7800	
	20 B	4.6590	223.2600			
	21 F	5.0360	219.4900	6.7990	5253.5300	
	21 B	4.2420	113.7100			
	22 F	6.4010	111.6500	4.6400	5478.8900	
	22 B	1.4020	119.4900			

```
           23 F   7.5440  76.6100    -1.5020  5674.9900

           23 B   0.9440 142.9800

           24 F   2.7470 130.8100    -3.3050  5948.7800

           24 B   7.5110 190.3500

           25 F   5.4300 201.7100    -1.2240  6340.8400

           25 B   1.8650 256.5600

           26 F   3.1480 258.3300    -2.5070  6855.7300

           26 B   4.8550 251.4400

           27 F   2.2940 241.2400     0.0540  7348.4100

           27 B   5.0300  93.9000

8059       8059 F   4.2290 132.2200     0.8550  7574.5300
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8059	8059 B	2.0660	252.4900	0.0000	0.0000	
	28 F	4.7830	224.7000	-2.7170	477.1900	
	28 B	3.7030	253.1200			
	29 F	5.8430	262.3400	-4.8570	992.6500	
	29 B	6.3330	201.1800			
	30 F	1.8690	218.8300	-0.3930	1412.6600	
	30 B	0.1650	246.5500			
	31 F	0.8870	247.0100	-1.1150	1906.2200	
	31 B	7.1140	141.2700			
	32 F	0.1970	144.4900	5.8020	2191.9800	
	32 B	4.3540	185.6000			
	33 F	3.7860	183.2700	6.3700	2560.8500	
	33 B	4.3450	275.3600			
	34 F	5.3920	269.2600	5.3230	3105.4700	
	34 B	1.2060	276.9400			
	35 F	4.6900	262.0100	1.8390	3644.4200	
	35 B	4.4370	255.0200			
	36 F	3.2150	251.1100	3.0610	4150.5500	
	36 B	7.3610	263.6100			
	37 F	6.7120	249.3400	3.7100	4663.5000	
	37 B	3.9690	260.7000			
	38 F	6.6730	261.3800	1.0060	5185.5800	
	38 B	3.1800	253.9700			
	39 F	6.1350	251.5100	-1.9490	5691.0600	
	39 B	5.7460	263.6100			

```
                    40 F   4.6890 262.8600   -0.8920  6217.5300

                    40 B   3.0940 184.1200

                    41 F   2.6590 161.8400   -0.4570  6563.4900

                    41 B   5.1000 264.2700

                    42 F   4.5180 259.6800    0.1250  7087.4400

                    42 B   4.5720 189.3400

8033              8033 F   5.5490 228.6700   -0.8520  7505.4500
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8033	8033 B	2.5980	250.5600	0.0000	0.0000	
	43 F	3.4390	247.0500	-0.8410	497.6100	
	43 B	2.9680	301.3100			
	44 F	0.9700	269.6500	1.1570	1068.5700	
	44 B	7.0710	275.2900			
	45 F	6.2960	267.7200	1.9320	1611.5800	
	45 B	3.2700	225.2900			
	46 F	5.7930	243.7700	-0.5910	2080.6400	
	46 B	4.1480	262.3400			
	47 F	8.1970	207.3500	-4.6400	2550.3300	
	47 B	3.7140	58.9200			
	48 F	5.7590	47.9700	-6.6850	2657.2200	
	48 B	1.7910	200.0000			
	49 F	1.9450	215.9800	-6.8390	3073.2000	
	49 B	3.9890	257.1800			
	50 F	7.5610	243.0400	-10.4110	3573.4200	
	50 B	5.1780	255.6100			
	51 F	2.1400	254.8600	-7.3730	4083.8900	
	51 B	5.1380	249.8000			
	52 F	2.6090	256.8200	-4.8440	4590.5100	
	52 B	6.3400	99.7700			
8070	8070 F	4.7550	84.1200	-3.2590	4774.4000	

Process Completed with 0 Errors and 0 Warnings

<u>Loop 8</u>

NA3000 Version 2.02

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Raw Field File: C:\AUTOLEVE\GIF\LOOP8.RAW

Date Processed: 05-14-03 14:55:00

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
8031	8031 B	5.6950	204.6300	0.0000	0.0000	
	1 F	4.0930	203.8100	1.6020	408.4400	
	1 B	4.3500	250.4600			
	2 F	3.8560	266.0800	2.0960	924.9800	
	2 B	3.1120	264.3000			
	3 F	3.1530	265.4200	2.0550	1454.7000	
	3 B	4.0960	253.3500			
	4 F	4.2470	269.2900	1.9040	1977.3400	
	4 B	4.4530	241.4700			
	5 F	3.8680	238.4200	2.4890	2457.2300	
	5 B	5.0220	277.8900			
	6 F	4.5010	271.4200	3.0100	3006.5400	
	6 B	4.0870	270.8000			
	7 F	3.2040	260.4000	3.8930	3537.7400	
	7 B	3.2590	265.1200			
	8 F	4.9970	271.7500	2.1550	4074.6100	
	8 B	4.1570	270.7700			
	9 F	5.1170	272.1500	1.1950	4617.5300	

```
 9 B   4.2240 270.6700

10 F   5.8240 280.3100   -0.4050  5168.5100

10 B   1.3880 282.2800

11 F   4.9400 279.4000   -3.9570  5730.1900

11 B   3.8630 217.9100

12 F   4.5880 199.7700   -4.6820  6147.8700

12 B   4.2450 279.0000

13 F   5.6040 274.7700   -6.0410  6701.6400

13 B   7.6420 134.1200

14 F   4.9720 184.2500   -3.3710  7020.0100

14 B   4.4160 240.1600

15 F   6.2070 235.1700   -5.1620  7495.3400

15 B   4.4890 231.8600

16 F   4.5300 227.1600   -5.2030  7954.3600

16 B   5.2720 243.5000

17 F   0.8240 239.6300   -0.7550  8437.4900

17 B   4.5500 278.3100

18 F   3.8200 286.8800   -0.0250  9002.6800

18 B   5.4380 245.7000

19 F   4.6590 256.0400    0.7540  9504.4200

19 B   4.3480 258.4600

20 F   3.4330 262.7600    1.6690 10025.6400

20 B   2.6400 215.8500

21 F   0.7940 142.2600    3.5150 10383.7500

21 B   3.0590 183.8300

22 F   5.7160 179.8200    0.8580 10747.4000
```

```
              22 B    5.6680 304.8600

              23 F    5.3290 278.3100     1.1970 11330.5700

              23 B    5.6430 271.1300

              24 F    5.0140 268.2100     1.8260 11869.9100

              24 B    5.8520 306.9200

              25 F    6.4990 313.5500     1.1790 12490.3800

              25 B    4.1720 253.4100

              26 F    4.6260 244.0300     0.7250 12987.8200

              26 B    3.4870 264.0100

              27 F    5.3840 256.7900    -1.1720 13508.6200

              27 B    4.7090 290.9800

              28 F    4.6990 288.1200    -1.1620 14087.7200

              28 B    3.8660 263.2900

              29 F    5.8800 274.9000    -3.1760 14625.9100

              29 B    4.2990 210.6600

              30 F    5.6950 213.3500    -4.5720 15049.9200

              30 B    3.4770 245.7700

              31 F    8.8070 282.0900    -9.9020 15577.7800

              31 B    2.0060 261.4500

              32 F    0.9090 195.6400    -8.8050 16034.8700

              32 B    2.5060 203.3500

8032        8032 F    8.3370 219.5200   -14.6360 16457.7400
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8032	8032 B	6.7430	102.0000	0.0000	0.0000	
	33 F	2.6130	123.7200	4.1300	225.7200	
	33 B	4.7400	276.5100			
	34 F	7.3400	274.2400	1.5300	776.4700	
	34 B	8.2830	176.5700			
	35 F	1.0630	174.8700	8.7500	1127.9100	
	35 B	6.1170	286.6500			
	36 F	3.4890	290.7800	11.3780	1705.3400	
	36 B	5.5320	271.3900			
	37 F	4.7700	270.9600	12.1400	2247.6900	
	37 B	5.6690	261.4800			
	38 F	4.9270	262.7600	12.8820	2771.9300	
	38 B	5.2560	274.2100			
	39 F	4.1940	272.4100	13.9440	3318.5500	
	39 B	5.6140	279.1700			
	40 F	4.3140	297.7700	15.2440	3895.4900	
	40 B	5.8210	146.6500			
	41 F	4.7170	151.8000	16.3480	4193.9400	
	41 B	4.5160	251.3800			
	42 F	5.0250	247.9700	15.8390	4693.2900	
	42 B	4.8360	252.6200			
	43 F	4.8110	228.4800	15.8640	5174.3900	
	43 B	5.1710	193.6300			
	44 F	5.6250	201.1800	15.4100	5569.2000	
	44 B	5.3850	283.2700			

```
45  F    2.6810  252.6600    18.1140   6105.1300

45  B    5.0520  252.3300

46  F    6.4400  275.4900    16.7260   6632.9500

46  B    3.3340  293.6700

47  F    4.7020  287.6300    15.3580   7214.2500

47  B    3.7500  281.9200

48  F    5.4890  281.1700    13.6190   7777.3400

48  B    5.0450  258.3700

49  F    7.1710  252.0300    11.4930   8287.7400

49  B    5.4340  268.2100

50  F    5.4080  261.6800    11.5190   8817.6300

50  B    4.6980  276.4800

51  F    4.9850  273.0000    11.2320   9367.1100

51  B    4.6470  273.2300

52  F    4.5110  277.7900    11.3680   9918.1300

52  B    2.0540  243.5700

53  F    2.9740  227.6600    10.4480  10389.3600

53  B    5.1280  287.7600

54  F    4.6520  264.8000    10.9240  10941.9200

54  B    6.1800  265.4900

55  F    2.7010  261.6100    14.4030  11469.0200

55  B    5.5160  275.4300

56  F    4.3260  266.1100    15.5930  12010.5600

56  B    6.3840  274.5700

57  F    4.8370  270.7700    17.1400  12555.9000

57  B    5.1760  294.7200
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              58 F   3.1260 295.7000   19.1900 13146.3200

              58 B   3.6530 266.3400

              59 F   4.7370 264.8300   18.1060 13677.4900

              59 B   7.8690 170.8300

              60 F   7.7360 156.6900   18.2390 14005.0100

              60 B   3.7820 218.7300

              61 F   0.2330 209.0200   21.7880 14432.7600

              61 B   8.0940  82.6400

8029        8029 F   3.0820 100.9200   26.8000 14616.3200
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8029	8029 B	2.7760	101.7400	0.0000	0.0000	
	62 F	7.7910	83.5000	−5.0150	185.2400	
	62 B	0.3440	231.1300			
	63 F	3.4520	221.5200	−8.1230	637.8900	
	63 B	7.4190	113.7500			
	64 F	7.6540	131.6300	−8.3580	883.2700	
	64 B	4.3470	261.4200			
	65 F	4.9180	262.0400	−8.9290	1406.7300	
	65 B	4.9580	263.4500			
	66 F	5.6260	262.9900	−9.5970	1933.1700	
	66 B	4.6180	276.6400			
	67 F	5.8460	277.8200	−10.8250	2487.6300	
	67 B	4.2390	290.3900			
	68 F	5.0480	279.7600	−11.6340	3057.7800	
	68 B	2.7720	279.0300			
	69 F	7.5870	280.8400	−16.4490	3617.6500	
	69 B	5.0760	277.3900			
	70 F	4.8720	277.6900	−16.2450	4172.7300	
	70 B	2.7980	249.6400			
	71 F	2.3460	246.0000	−15.7930	4668.3700	
	71 B	4.9060	279.8200			
	72 F	4.7160	278.9000	−15.6030	5227.0900	
	72 B	4.9440	288.7500			
	73 F	4.5870	282.3200	−15.2460	5798.1600	
	73 B	5.6200	286.3800			

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74 F    5.2020 282.5500    -14.8280  6367.0900

74 B    6.9790 274.2400

75 F    4.7800 257.6400    -12.6290  6898.9700

75 B    6.3960 277.8200

76 F    4.9230 276.6100    -11.1560  7453.4000

76 B    6.4070 283.9900

77 F    3.9990 283.2300     -8.7480  8020.6200

77 B    5.0040 267.1900

78 F    4.1530 191.3700     -7.8970  8479.1800

78 B    1.8680 211.7400

79 F    5.0320 219.3900    -11.0610  8910.3100

79 B    5.1570 140.0600

80 F    5.3680 178.9700    -11.2720  9229.3400

80 B    5.3790 205.8700

81 F    5.2570 199.7400    -11.1500  9634.9500

81 B    5.4050 270.2100

82 F    4.9110 270.0100    -10.6560 10175.1700

82 B    5.7580 259.3500

83 F    6.0530 190.9100    -10.9510 10625.4300

83 B    3.8120 181.7300

84 F    4.5820 190.8100    -11.7210 10997.9700

84 B    4.3950 257.1500

85 F    5.5090 257.5800    -12.8350 11512.7000

85 B    4.0700 256.0700

86 F    5.0130 265.2600    -13.7780 12034.0300

86 B    4.2410 272.6400
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                   87 F   5.2330 269.9500   -14.7700 12576.6200

                   87 B   4.0010 255.6100

                   88 F   5.6470 275.0300   -16.4160 13107.2600

                   88 B   3.4970 266.8600

                   89 F   8.2320 235.3700   -21.1510 13609.4900

                   89 B   1.4980 161.9700

                   90 F   5.1200 187.8300   -24.7730 13959.2900

                   90 B   6.1860 300.4300

8032             8032 F   8.2440 306.0700   -26.8310 14565.7900
```

Point	ID	E	D	Sum E	Sum D	Descriptor
8032	8032 B	7.3940	136.8100	0.0000	0.0000	
	91 F	2.2930	136.4800	5.1010	273.2900	
	91 B	2.8140	263.2500			
	92 F	5.7330	263.3900	2.1820	799.9300	
	92 B	8.6340	241.1100			
	93 F	1.1450	245.3700	9.6710	1286.4100	
	93 B	5.8170	276.6700			
	94 F	3.9510	277.2000	11.5370	1840.2800	
	94 B	5.7090	273.6200			
	95 F	3.5780	257.2800	13.6680	2371.1800	
	95 B	3.8790	300.4900			
	96 F	3.3210	286.9700	14.2260	2958.6400	
	96 B	4.2870	264.1400			
	97 F	3.7680	269.1600	14.7450	3491.9400	
	97 B	5.1160	232.9400			
	98 F	3.8100	225.0300	16.0510	3949.9100	
	98 B	5.8000	186.0900			
	99 F	5.6940	196.1000	16.1570	4332.1000	
	99 B	5.0050	253.9700			
	100 F	4.8690	259.7100	16.2930	4845.7800	
	100 B	4.2140	254.7200			
	101 F	4.5270	252.7900	15.9800	5353.2900	
	101 B	4.1210	265.2200			
	102 F	4.1450	279.2300	15.9560	5897.7400	
	102 B	7.1820	221.7800			

```
103 F    4.7780 219.7200    18.3600  6339.2400

103 B    4.3900 269.5200

104 F    5.5620 276.3800    17.1880  6885.1400

104 B    4.7680 294.0000

105 F    6.8950 288.2900    15.0610  7467.4300

105 B    4.5230 276.9000

106 F    5.5530 258.5300    14.0310  8002.8600

106 B    4.0290 274.4100

107 F    7.8570 322.0800    10.2030  8599.3500

107 B    3.7840 236.1200

108 F    4.1940 247.6700     9.7930  9083.1400

108 B    6.0870 254.7600

109 F    4.6320 266.9900    11.2480  9604.8900

109 B    4.9160 252.6900

110 F    4.6380 213.3900    11.5260 10070.9700

110 B    2.4300 260.9600

111 F    3.2000 262.2700    10.7560 10594.2000

111 B    4.2570 298.2300

112 F    2.5430 291.2700    12.4700 11183.7000

112 B    6.9490 268.9300

113 F    4.1810 283.3700    15.2380 11736.0000

113 B    4.8910 282.4100

114 F    3.0080 273.2300    17.1210 12291.6400

114 B    4.5930 290.8800

115 F    3.7100 287.6600    18.0040 12870.1800

115 B    4.5180 299.5700
```

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              116 F    4.6660 304.0300    17.8560 13473.7800

              116 B    4.8470 199.2500

              117 F    4.1490 196.2300    18.5540 13869.2600

              117 B    2.3630 270.8300

              118 F    5.5140 269.9500    15.4030 14410.0400

              118 B    4.8610 298.1000

              119 F    4.5560 282.2500    15.7080 14990.3900

              119 B    4.4500 284.9700

              120 F    4.5160 283.6900    15.6420 15559.0500

              120 B    4.1500 325.8900

              121 F    5.3620 319.0600    14.4300 16204.0000

              121 B    4.7210  88.2500

8031          8031 F   4.5510  97.6700    14.6000 16389.9200
```

Process Completed with 0 Errors and 0 Warnings

Loop 9

NA3000 Version 2.02

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Raw Field File: C:\AUTOLEVE\GIF\LOOP9.RAW

Date Processed: 05-14-03 14:55:20

Units of Entered Elevations: FEET

Units of STAR*LEV Data File: FEET

Point	ID	E	D	Sum E	Sum D	Descriptor
0120	120 B	3.7420	251.1800	0.0000	0.0000	
	1 F	4.5520	256.9200	-0.8100	508.1000	
	1 B	4.2100	229.4000			
	2 F	2.1020	236.1200	1.2980	973.6200	
	2 B	4.5710	142.5200			
	3 F	5.9090	148.0300	-0.0400	1264.1700	
	3 B	4.9360	297.6400			
	4 F	3.4910	288.9400	1.4050	1850.7500	
	4 B	3.4650	295.6700			
	5 F	1.2330	275.6600	3.6370	2422.0800	
	5 B	4.2640	54.1000			
0045	45 F	4.6990	83.5000	3.2020	2559.6800	

Point	ID	E	D	Sum E	Sum D	Descriptor
0045	45 B	4.5740	263.2900	0.0000	0.0000	
	6 F	5.1210	265.9100	-0.5470	529.2000	
	6 B	5.5290	277.0300			
	7 F	5.7730	272.6000	-0.7910	1078.8300	
	7 B	5.1550	278.6100			
	8 F	4.7830	285.5000	-0.4190	1642.9400	
	8 B	4.3540	259.3800			
	9 F	5.3450	250.9800	-1.4100	2153.3000	
	9 B	5.2160	278.4100			
	10 F	3.5130	274.7000	0.2930	2706.4100	
	10 B	4.1070	282.9700			
	11 F	4.7890	277.0000	-0.3890	3266.3800	
	11 B	5.4760	282.1200			
	12 F	4.9830	281.7600	0.1040	3830.2600	
	12 B	5.0930	138.6500			
0132	132 F	4.6330	155.2200	0.5640	4124.1300	

Point	ID	E	D	Sum E	Sum D	Descriptor
0132	132 B	4.4580	146.0000	0.0000	0.0000	
	13 F	4.9180	143.7000	-0.4600	289.7000	
	13 B	5.0350	280.9400			
	14 F	5.5830	266.0800	-1.0080	836.7200	
	14 B	5.1650	294.0300			
	15 F	4.4890	292.1900	-0.3320	1422.9400	
	15 B	3.5990	277.9200			
	16 F	5.2610	265.0300	-1.9940	1965.8900	
	16 B	5.8280	290.6500			
	17 F	5.2750	284.5800	-1.4410	2541.1200	
	17 B	5.5550	287.6300			
	18 F	5.2570	271.1900	-1.1430	3099.9400	
	18 B	5.4220	275.2300			
	19 F	5.0710	273.8800	-0.7920	3649.0500	
	19 B	4.6650	218.2700			
0045	45 F	4.4450	250.4900	-0.5720	4117.8100	

Point	ID	E	D	Sum E	Sum D	Descriptor
0045	45 B	3.7550	276.0800	0.0000	0.0000	
	20 F	5.6330	258.8900	-1.8780	534.9700	
	20 B	4.0150	277.1300			
	21 F	5.0200	249.5400	-2.8830	1061.6400	
	21 B	5.3320	271.6500			
	22 F	4.9490	266.9300	-2.5000	1600.2200	
	22 B	2.7320	190.5500			
	23 F	4.1670	187.7900	-3.9350	1978.5600	
	23 B	4.5530	257.1800			
0120	120 F	3.8150	258.7600	-3.1970	2494.5000	

Process Completed with 0 Errors and 0 Warnings