PROJECT REPORT

CECIL COUNTY, MARYLAND
MONUMENT DENSIFICATION & HEIGHT MODERNIZATION
TO SUPPORT A HIGH-ACCURACY GEOGRAPHIC INFORMATION SYSTEM

TARGET ACCURACIES: 2.0cm HORIZONTAL (NSRS2007) & 5.0cm VERTICAL (NAVD88)

JULY 2008 - OCTOBER 2009

Prepared by:

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Client:

Cecil County Government
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David R. Black, AICP
Project Coordinator and GIS Coordinator

I. INTRODUCTION

A. AUTHORITY

This project was commissioned by Cecil County Government through a Request For Proposals (RFP) dated September 11, 2007, under the direction of David R. Black, AICP, GIS Coordinator for the Office of Planning & Zoning. The concept of the project originated from the Cecil County GIS Work Group: Geodetic Control Point Sub-Committee on October 19, 2006. The committee represented Cecil County Government employees, private business owners, and professional land surveyors, with a member of the National Geodetic Survey (NGS), Mr. William Henning, Prof.L.S., providing consultation. The project was awarded on November 8, 2007 through a competitive bid to George William Stephens, Jr. and Associates, Inc. (GWS). The acceptance of the contract was delayed until July 17, 2008 while funding was secured. Funding for this project was provided by a grant (Federal Identifier RA06155-08-02-08-01) from the Office of Economic Adjustment (OEA) as part of the Chesapeake Science and Security Corridor (CSSC) Consortium as supervised by the APG-CSSC Regional BRAC Office on May 27, 2008.

B. PURPOSE

Cecil County Government desires to create a high-accuracy geographic information system (GIS). The underlying foundation of the GIS is the creation of a high-accuracy cadastral layer. The build-up of the cadastre is a long-term project requiring the cooperation of the land surveying community with Cecil County Government. All new subdivisions and recorded boundary surveys are to be placed into a common geodetic system to enhance the GIS cadastral layer. It was determined through the Cecil County GIS Work Group and community feedback that the existing geodetic control stations provided poor coverage throughout Cecil County. In order to support proposed legislation that all newly recorded plats contain accurate coordinates on the Maryland Coordinate System, a countywide monument densification needed to occur. Therefore, it is the goal of this project to provide consistent countywide, horizontal and vertical geodetic control to be referenced and included in the National Spatial Reference System. (NSRS2007/NAVD88)

C. TIME PERIOD

Reconnaissance of the existing NGS monuments and site selection for new monuments began in July, 2008. Monument construction began November 11, 2008, and completed on December 4, 2008. Primary observations on the control network commenced on March 9, 2009 and concluded on March 26, 2009. As of May 28, 2009, all re-observations were completed. Data processing, bluebooking, and adjustments were completed on September 17, 2009.

II. LOCATION

A. GEOGRAPHY

This project was performed within Cecil County, Maryland. Cecil County is situated in the northeast corner of the State of Maryland and borders the State of Delaware on its easterly boundary and the State of Pennsylvania on its northerly boundary. The westerly boundary of Cecil County borders Harford County, Maryland and is defined by the Susquehanna River and its terminus into the tidal Chesapeake Bay. The southerly boundary adjoins Kent County, Maryland and is defined by the Sassafras River.

The land area of Cecil County is approximately 360 square miles with 217 miles of designated shoreline. The elevations range from sea level along the Chesapeake Bay to an elevation of 535 feet (163 meters) along the northern boundary near Nottingham, Pennsylvania. (Source: Maryland Geological Survey)

B. GEOGRAPHIC LIMITS

The surveys performed for this project lie within the following geographic limits:

North 39 degrees 43 minutes North Latitude
South 39 degrees 22 minutes North Latitude
East 075 degrees 46 minutes West Longitude
West 075 degrees 58 minutes West Longitude

III. PERSONNEL

A. GEORGE WILLIAM STEPHENS, JR. AND ASSOCIATES, INC.

George William Stephens, Jr. and Associates, Inc. (GWS) is a consulting engineering firm established in 1940. GWS maintains a staff of licensed professional engineers, professional land surveyors, and landscape architects serving the states of Maryland, Pennsylvania, Delaware, and Virginia. The following GWS personnel were involved in the completion of this project:

James M. Shaw, Jr., Prof.L.S., MD License No. 21211 ..... Project Supervisor/ Computations / Observer / Reconnaissance

Jeffery Hays ..... Assistant Data Preparation / Observer

David Tomb ..... Assistant Data Preparation

Ray Cramer ..... Observer / Reconnaissance

William "Bill" Jeric ..... Observer / Reconnaissance

Roy Miller ..... Observer

Christopher Twilley ..... Observer

Ryan Gilley ..... Construction Supervisor / Reconnaissance

B. CECIL COUNTY GOVERNMENT

Cecil County was established by proclamation of the Governor of Maryland in 1674. The Cecil County Government serves approximately 103,850 citizens (Maryland Department of Planning, 2010 Projection). This project was issued under the authority of the Geographic Information Systems Coordinator, as part of the Office of Planning & Zoning. The following Cecil County Government personnel were involved in the completion of this project:

David R. Black, AICP .....Project Coordinator & Cecil County Government GIS Coordinator

IV. SCOPE

A. SPECIFICATIONS

As per the RFP issued by Cecil County, Government, dated September 11, 2007, the densification of monumentation was to include 115 new monuments to be "blue booked" as per first order horizontal standards and third order (class one) vertical standards, as established by NGS.

In the response to the RFP and the final approved contract, dated July 17, 2008, GWS agreed to install 100 new monuments, based on the "Federal Geographic Data Committee, Geospatial Positioning Accuracy Standards, Part 2: Standards for Geodetic Networks, FGDC-STD-007.2-1998," with a stated goal of 1-Centimeter horizontal accuracy and 5-Centimeter vertical accuracy. Additionally, GWS agreed to approach this project as a Height Modernization project, as defined by the Federal document "Scope of Work, Height Modernization and Lidar Surveys for U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Geodetic Survey."

B. MONUMENTATION

In all, one-hundred twenty-three (123) monuments are included in the observed network. Ninety-seven (97) new static monuments are intended to be added to the NGS-IDB (National Geodetic Survey Integrated Data Base). Twenty-two (22) monuments are existing static monuments already included in the NGS-IDB, some of which are included as constrained control and others included for upgrading within this project. Three (3) monuments are NGS-CORS (Continuously Operating Reference Stations) registered in the NGS-IDB and one (1) monument is an independently operated CORS used and maintained by KeyNetGPS, Inc. as part of a virtual reference station (VRS) network. Seven (7) additional monuments with second-order or better elevations, as per the NGS-IDB, are being used to transfer elevations to new static monuments, via digital level runs, for compliance with Height Modernization standards.

C. EXISTING CONTROL

The following monuments, already included in the NGS-IDB, are utilized in the final processing and computations for this project:

Published Monument Name	Permanent Identifier
APPLE	AJ7994
BETHEL	JU3857
BOUNDARY MONUMENT 71 DEL MD RESET	JU4145
CAYOTS RESET	JU1137
CECIL	JU4122
CECILTON	JU4121
CITY	AJ7992
DOVER DNRC CORS ARP	AF9680
E 96	JV0155
JMT03	DH8015
JMT04	DH8016
JMT07	DH8019
JMT13	DH8025
JMT16	DH8028
JMT19	DH8031
JMT21	DH8033
LANCASTER COOP CORS ARP	DH4471
LAPIDUM AZ	JV6793
LUCY	JV6951
MADIX	JV4817
OGRADY	JU4414
R 114 RESET	JU4125
S 72	JV0376
SEAL	AJ7995
UNIV OF DELAWARE CORS ARP	DK4426

In addition to those monuments already listed, the following monuments are used to transfer elevations utilizing digital leveling techniques:

Published Monument Name	Permanent Identifier
BB 112	JU1555
C 198	JU4257
E 369	JV3895
H 118	JU1870
K 108	JU1842
NECK	AJ7993
V 19	JV0030

V. FIELD WORK

A. RECONNAISSANCE

The reconnaissance stage of the project began in July, 2008 and continued through November, 2008. There were two primary goals of the reconnaissance phase: (1) locate and analyze the stability and GPS-ability of existing static monuments, and (2) locate appropriate sites that met the criteria for new monument locations.

The criteria for new monument locations were as follows: (a) the location should be relative to other monuments with the goal of creating a nearly even-spaced grid that would provide a consistent coverage so that no point in Cecil County was more than 1.5 miles (2.4 km) from a high-quality NSRS monument; (b) the location should have a clear view of the sky down to 10 degrees above the horizon, particularly to the south, and was judged free of concern from future vegetative growth; (c) the location should not be encumbered by existing underground utilities whose maintenance may disturb the monument; (d) the location should be in a public right-of-way or within the typical Cecil County 30' Road Widening Easement; (e) if not in a public right-of-way or widening easement, the location should be on public lands such as parks, schools, or emergency services; and (f) if no public lands or right-of-ways are available, negotiate an agreement for free use of the property, particularly with commercial owners.

B. MONUMENT CONSTRUCTION

GWS sub-contracted The Matricciani Company to provide the boring and in-place concrete pouring for a total of ninety-eight (98) new monuments set for this project. The construction team was supervised by an employee of GWS to ensure the proper location was used and the proper procedures were followed. The setting of the monuments followed the standards detailed in "Attachment 7, Setting Concrete Marks, To General Guidance and Specifications for Aeronautical Surveys Volume A, Federal Aviation Administration, Airport Surveys."

Prior to construction, each proposed site was marked with a wooden stake and "MISS UTILITY" was contacted to mark the underground utilities. Construction consisted of: (a) drilling a 12-inch diameter hole four (4) feet in depth and belled at the bottom; (b) placing a 12-inch diameter round, cardboard form (Sonotube) in the top 12 inches of the hole and extending

approximately one inch from the ground; (c) mixing and pouring the concrete so that the top of the concrete was flush with the ground; (d) tamping the concrete to remove potential voids; (e) brushing the top of the concrete to give a finished appearance; (e) placing the aluminum disk, pre-stamped with the monument name by the GWS construction supervisor so that the disk was aligned to face north; and (f) covering the newly set monument with plastic and staking pins. The observation team at the start of the GPS observations removed the plastic covers.

C. OBSERVATION CHRONOLOGY

For an observation schedule, please see 'Appendix A' and 'Appendix C'.

D. INSTRUMENTATION

The observations performed on this job were performed using four (4) Trimble GPS receivers. Supplemental digital leveling to provide precise elevations was performed using a Trimble DiNi 22 and a precise barcode leveling rod. A list of the instruments used are as follows:

Type	B-File ID	Serial Number
Trimble 4800 GPS Receiver	010	220160896
Trimble 4800 GPS Receiver	012	220160895
Trimble 5800 GPS Receiver	011	4423134651
Trimble 5800 GPS Receiver	013	4423134751
Trimble DiNi 22 Digital Level	050	700481 A

VI. DATA PROCESSING

A. SOFTWARE USED

1. TRIMBLE GEOMATICS OFFICE

Trimble Geomatics Office (TGO), Version 1.63, Build 10

2. NATIONAL GEODETIC SURVEY ADJUSTMENT

NGS Adjustment Program, Version 5.6

B. ADJUSTMENT METHOD

The raw data was initially registered and processed using TGO. All baselines were individually analyzed to remove outliers and poor satellite residuals. The data was reviewed as a free, unconstrained adjustment, and as a minimally constrained adjustment focused on Cecilton (JU4121). Once satisfactory results were achieved, the data was exported into an NGS Bluebook format, with TGO producing the initial SERFIL, BFILE, and GFILE. The GFILE included in the final adjustment is the original GFILE created by TGO.

The NGS Adjustment program and its various utilities were used to produce the final Bluebook files. The text files were prepared and edited using the open source software program Crimson Editor, Version 3.72. The files were prepared and processed in accordance with the "Constrained Adjustment Guidelines, Last Updated: 3/22/2009" as published by NGS.

VII. COMMENTS

A. RECONNAISSANCE

Reconnaissance occurred between July and November of 2008. Initially the Cecil County GIS Coordinator provided a recommended listing of point locations. Many of the existing points could not be recovered or had environmental factors preventing them from being used for GPS observations.

Environmental factors were also a concern for many of the suggested proposed sites. Once the target existing monuments were selected, the proposed locations were selected using a cadastral and orthophotographic composite of all of Cecil County in ESRI ArcView 9.1. Final locations were field reviewed and adjusted based on the criteria previously listed in Section V.A. – "Field Work: Reconnaissance" herein.

B. SPECIFICATIONS

As noted in Section IV.A. - "Scope: Specifications" the specifications that GWS has agreed to follow are actually more stringent than Cecil County requested. It is our belief that these stricter specifications were met.

C. COMPUTATIONS

Computations were completed on September 17, 2009. Typically computations progressed as expected. There were two results or issues of concern. Firstly, there is an apparent difference in the ellipsoid heights for the CORS station versus the static monuments as compared to the existing published data (see Section VII.D.8). Additionally, there was considerable quality issues with the GPS baselines observed in the northwestern portion of Cecil County (see Section VII.D.11). After considerable fine-tuning of some baselines and making a decision to honor the current static monuments for elevation a final adjustment was achieved that provides satisfactory results.

D. PROBLEMS

1. SASSAFRAS

Originally, a monument had been installed in the sidewalk on the decking of the Maryland Route 213 Bridge (approximately North 39°21'53", West 75°52'57") as it crosses the Sassafras River at the border of Cecil County and Kent County. The monument was installed November 2008. Recovery notes and obstruction diagrams were prepared from a field reconnaissance mission on February 12, 2009. The monument was intended to be observed on March 9, 2009 as Session 68B until it was discovered at that time that the aluminum disk was sheared off leaving the neck still embedded in the concrete.

Inspection of the bridge deck and sidewalk showed parallel gouges in the concrete across the entire bridge. While it is only speculation, it is assumed that the deep gouges were caused by a snow blower used to remove a recent snowfall. With no suitable alternative, this position had to be abandoned and the network adjusted across the missing position.

2. JMT 08 (DH8020)

JMT 08 (DH8020) was intended to be used in the network. As of February 9, 2009 the monument was observed to be in place as described by the NGS datasheet. On the first day of scheduled field observations on this site, March 18, 2009, it was discovered that the monument disc was missing with an empty hole remaining in its last known position. Due to the monuments location and the fact that a snowstorm had occurred between the above listed dates, it is suspected that a snowplow likely destroyed the mark. An immediate field decision was made to move the mark to JMT 07 (DH8019) due to its close proximity to the JMT 08 location and its overall fit with the network design.

3. RAINTREE

It was reported by the recovery note and obstruction diagram team that the monument located at Raintree Drive had been improperly installed in the middle of a swale and was now loose from erosion. Reviewing the location with the construction supervisor

revealed that the monument installation had been shifted due to conflicting utilities and unfortunately had been moved into the swale.

A new site on the opposite side of the road was selected and MISS UTILITY was contacted to mark for utilities. After utility marking was completed a team was sent into the field to remove the top one-foot of the existing monument, cover the remainder of the abandoned monument with topsoil and seed, and install the new monument by hand-digging the hole to the appropriate specifications and hand-mixing and pouring the concrete. This new monument was installed on February 13, 2009 and therefore did not go through the prescribed freeze-thaw cycle before being used for observations.

4. NE HIGH

The original site was selected and installed in November 2008 after meeting with the North East High School principal and chief custodian. GWS was contacted on March 12, 2009 requesting an immediate field meeting regarding the installed monument. It was the opinion of the athletics director that the monument location interfered with the baseball field and had to be removed with haste, prior to a baseball game scheduled for March 14, 2009.

On March 13, 2009 the top one foot of the monument was removed and the remaining hole filled with topsoil and seeded. A new location was selected in agreement with the principal and chief custodian and was installed inside the fencing for the high school track. Installation of the new monument was performed by hand-digging the hole to the appropriate specifications and hand-mixing and pouring the concrete. Being installed on March 13, 2009 meant the monument did not go through the prescribed freeze-thaw cycle before being used for observations. Observations on the new monument location began on March 18, 2009.

5. 4800 RECEIVER COLLECTION IRREGULARITIES

Trimble 4800 receivers were used during the field observations. Many years of experience with the equipment has taught us that there is a small but real chance that for indeterminate reasons the receiver will fail to create a raw data file even though by

all indications it was in the process of collecting. Unfortunately, there is no means of telling if the raw data file was created until the receiver is downloaded. With the large number of sessions being recorded for this campaign it was likely that this issue would effect a few of them. The observations for Rising Sun – Session 76B, Courthouse 2008 – Session 79D, and JMT 21 – Session 84B did not result in any collected data.

6. SESSION 68D & SESSION 68E

In the process of setting up the receiver and battery pack for a Trimble 4800 at monument S 72 (JV0376), the wiring to the battery pack pulled apart and short-circuited the fuse. An attempt to do an emergency field repair resulted in another blown fuse and a complete (and sparking) battery failure. The sessions were rearranged to cover the observations originally planned for four receivers and the final sessions for the day were rescheduled to the next observation day.

7. R 114 RESET

R 114 Rest (JU4125) was primarily selected to remain in the network because of its location in the county-wide grid. The monument itself can be difficult to occupy. The monument is located on the retaining wall for the Route 232 Bridge as it crosses the Bohemia River. The point cannot be occupied using a tripod because the non-road side of the retaining wall is a drop of approximately ten feet. This necessitates the use of a fixed-height bipod with a bubble-level. The Sessions 85B and 85C had to be excluded from the network adjustment because the bipod available on that day had a broken bubble-level. An attempt was made to improvise a level set-up, but based on the results it was obviously unsuccessful.

8. CORS VS. STATIC

When comparing the ellipsoid heights of the three CORS stations used (Dover DNRC, Lancaster Co-op, and University of Delaware) to the published static monuments a 11+ centimeter difference is noted. The input was reviewed for errors and none could be identified. While it is the preference to use CORS for the minimally constrained adjustment, it was decided to constrain to the static network until NGS could review the

data to make an assessment of the anomaly. In particular, Cecilton (JU4121) was used for the final minimally constrained adjustments because of its quality and location.

9. LOYOLA R CORS

It was intended during the adjustment to use data from the continuously operating station at the Northeast River Advanced Wastewater Treatment Plant (aka Seneca Point) near the Town of Charlestown, Maryland. At the time of the field observations the station was privately owned by Loyola Spatial Systems and was under consideration by NGS to be included as part of the CORS network. Several attempts were made to acquire data for the station, but these attempts were unsuccessful. During the adjustment phase of the project the station was admitted to the CORS network as LOYOLA R CORS ARP (DL3184). Due to the lack of available data that coincides with the time of the field observations this station had to be omitted from consideration.

10. BETHEL (JU3857)

During the adjustment phase of network analysis it was noted that the existing marker Bethel (JU3857) appears to have been disturbed from its original recorded location. Analysis showed that the observations missed the recorded coordinates by 7.4 centimeters horizontally and 0.998 meters from the published orthometric elevation. An independent OPUS solution from another contractor performing work in the area verified these findings. The monument is located in an existing, active cemetery and it seems likely that the monument had been moved and reset by the cemetery.

11. NORTHWESTERN CECIL COUNTY

There was a noted difference in the quality of the GPS signals for observations in the northwestern portion of Cecil County, particularly those points within 3 to 4 miles of the Susquehanna River. To achieve a clean adjustment required considerable fine-tuning and review of the baseline residuals on each individual satellite. Many of the baselines in this area required the exclusion of one or more satellites. Of particular note was that this anomaly appeared on sessions over multiple days and based on the NGS published residuals for existing points it would appear that the data quality in this region has been poor in past observations. There was no evident reason for this problem and it may

warrant further investigation by instrumentation capable of measuring radio interference.

12. POINT NAMING

A number of the points names herein contain the suffix "2008." While this suffix is not part of the normal NGS prescribed naming, it was felt that such a designation improved the clarity of the mark from other similarly named marks in the State of Maryland.

E. RECOMMENDATIONS

It is hereby recommended that Cecil County, the State of Maryland, or NGS consider the following:

1. The vertical network for Cecil County should be updated using the appropriate methods and monument spacing. The current network has aged such that many of the original monuments cannot be found. Additionally, unless an error is found in the computations, there does appear to be a vertical conflict between the CORS network and the existing static monuments.
2. Radio or electromagnetic studies may be undertaken near the Susquehanna River to determine if there is a known source of interference of the GPS signal. Determining if there is a valid source to this possible anomaly could improve the reliability of future GPS/GNSS campaigns.

VIII. STATISTICS

A. OBSERVATION SCHEDULE

See 'Appendix A'

B. LEVEL OBSERVATIONS

See 'Appendix B'

C. REOBSERVATIONS

See 'Appendix C'

D. CONTROL COMPARISON

See 'Appendix D'

E. FINAL NETWORK

See 'Appendix E'

IX. CLOSING STATEMENT

It is with great honor and pride that I present this geodetic control network. I personally applaud Cecil County Government for its vision and its desire to establish a high-accuracy geodetic framework on which to build its geographic information system. I am humbled by the trust that was placed in me to set the foundation of this framework from which decades of data and intelligence will be built. It is my sincerest hope that it will be discovered that this trust was well placed.

The challenges were many, but so were the rewards. The rewards came in many forms, from watching the morning fog burn off and flocks of geese taking flight near the Bohemia River while collecting GPS data in the early morning, to the feeling of elation when comparing the adjustment residuals to known stations, knowing that the results are of a high-quality. This type of work might not appeal to all individuals, but to those that love geodetic surveying, they can relate to those feelings very well. Even after twenty-one years as a surveyor, I still feel a sense of wonder knowing that we can accurately locate points on the surface of the Earth to within the diameter of a common U.S. dime from satellites circling 12,550 miles overhead. This is a true testament of human ingenuity and this project, and the projects that spring forth as a result of this project, stand as evidence. Thank you for allowing me to participate in this achievement.

X. CONTACT INFORMATION

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APPENDIX A - OBSERVATION SCHEDULE

Session					Date	Proposed Time (EST)	(UTC)
	James Shaw	Bill Jeric	Ray Cramer	Chris Twilley			
68A	Meltz	Jeric	Worsell	Ogrady	Monday, March 09, 2009	9:30:00	13:30:00
68B	Sassafras (destroyed)	Jeric	Cecilton	Budd	Monday, March 09, 2009	10:35:00	14:35:00
68C	Sandy Bottom	Knight	Cecilton	Sheffield	Monday, March 09, 2009	11:40:00	15:40:00
68D	S 72 (equip problems)	Sunset	Cassidy (equip. problems)	Sheffield	Monday, March 09, 2009	12:45:00	16:45:00
68E	(equip failure)	Sunset	Cassidy	S 72	Monday, March 09, 2009	1:50:00	17:50:00
70A	Pearce 2008	Sunset	Cramer	Buttonwood	Wednesday, March 11, 2009	8:55:00	12:55:00
70B	Yacht	Town Point	Old Hope	Buttonwood	Wednesday, March 11, 2009	10:00:00	14:00:00
70C	Yacht	R 114 Reset	Veazey	New Cut	Wednesday, March 11, 2009	11:05:00	15:05:00
70D	Betwixt	Welder	Georges Point	New Cut	Wednesday, March 11, 2009	12:10:00	16:10:00
70E	Cayots Reset	BM 71 Reset	Georges Point	Bridle	Wednesday, March 11, 2009	1:15:00	17:15:00
70F	Cayots Reset	Deuce	Yearling	Courthouse 2008	Wednesday, March 11, 2009	2:20:00	18:20:00
70G	Bethel	Deuce	Wilmon	City	Wednesday, March 11, 2009	3:25:00	19:25:00
71A	Deerhaven	McKeown	Pelham	City	Thursday, March 12, 2009	7:50:00	11:50:00
71B	Milhollan	Eder	Pelham	Hutton	Thursday, March 12, 2009	8:55:00	12:55:00
71C	Shaw 2008	Eder	Triumph	Independence	Thursday, March 12, 2009	10:00:00	14:00:00
71D	Shaw 2008	Fletch	Ricketts	MacDuff	Thursday, March 12, 2009	11:05:00	15:05:00
71E	Fair Hill	London	Apple	MacDuff	Thursday, March 12, 2009	12:50:00	16:50:00
71F	Fair Hill	Brick Hill	Oz 2008	Steeplechase	Thursday, March 12, 2009	1:55:00	17:55:00
71G	Wedgewood	Raintree	Oz 2008	Brewster	Thursday, March 12, 2009	3:00:00	19:00:00
72A	Antego	Raintree	Arrowhead	Blake	Friday, March 13, 2009	8:05:00	12:05:00
72B	Blue Ball	Olivet	Fairfield	Blake	Friday, March 13, 2009	9:10:00	13:10:00
72C	Cecil	Black 2008	Fairfield	Greystone	Friday, March 13, 2009	10:15:00	14:15:00
72D	Cecil	Bethel Springs	Theodore	Kirks Mill (equip. problem)	Friday, March 13, 2009	11:20:00	15:20:00
72E	Cecil	Noyes	Theodore	Kirks Mill	Friday, March 13, 2009	12:25:00	16:25:00
76A	Crothers	Noyes	Seal	Thankless	Tuesday, March 17, 2009	7:30:00	11:30:00
76B	Rising Sun (equip problem)	Gilley	Seal	Springlawn	Tuesday, March 17, 2009	8:35:00	12:35:00
76C	Rising Sun	Horseshoe	Oak Grove	Mount Rocky	Tuesday, March 17, 2009	9:40:00	13:40:00
76D	Madix	Horseshoe	Red Hill	Old Fort	Tuesday, March 17, 2009	10:45:00	14:45:00
76E	Topeka	Huntster	Coach	Old Fort	Tuesday, March 17, 2009	11:50:00	15:50:00
76F	Camp Meeting	Colora	Coach	Greenfield	Tuesday, March 17, 2009	12:55:00	16:55:00
76G	Camp Meeting	Country	Rowland	Talbots Haven	Tuesday, March 17, 2009	2:00:00	18:00:00
76H	Granite	Country	Larkin	Lapidum Az	Tuesday, March 17, 2009	3:05:00	19:05:00
76I	E 96	Bainbridge 01	Merlyn	Lapidum Az	Tuesday, March 17, 2009	4:10:00	20:10:00
77A	Lucy	Bainbridge 01	JMT 03	Principio 2008	Wednesday, March 18, 2009	7:30:00	11:30:00
77B	JMT 04	JMT 08	JMT 03	Perry 2008	Wednesday, March 18, 2009	8:35:00	12:35:00
77C	Stone Wharf	Mountain Hill	Carpenters Point 2008	Perry 2008	Wednesday, March 18, 2009	9:40:00	13:40:00
77D	Stone Wharf	Northbay	Red Point	Cara	Wednesday, March 18, 2009	10:45:00	14:45:00
77E	Turkey Point 2008	Northbay	Brisson	Jacobs Nose	Wednesday, March 18, 2009	11:50:00	15:50:00
77F	Weed	Racine	Brisson	Amphitheatre	Wednesday, March 18, 2009	12:55:00	16:55:00
77G	Weed	NE High	Aileron	Old York	Wednesday, March 18, 2009	2:00:00	18:00:00
77H	JMT 21	NE High	Antego	JMT 13	Wednesday, March 18, 2009	3:05:00	19:05:00
77I	Black 2008	NE High	JMT 19	JMT 16	Wednesday, March 18, 2009	4:10:00	20:10:00

APPENDIX A - OBSERVATION SCHEDULE

Session					Date	Proposed Time (EST)	(UTC)
	James Shaw	**Ray Cramer**	**Jeff Hays**	**Roy Miller**			
79A	Sunset	Turkey Point 2008	Jacob's Nose	S72	Friday, March 20, 2009	7:30:00	11:30:00
79B	Buttonwood	Brisson	Jacob's Nose	Pearce 2008	Friday, March 20, 2009	8:35:00	12:35:00
79C	Courthouse 2008	Brisson	Amphitheatre	Town Point	Friday, March 20, 2009	9:40:00	13:40:00
79D	Courthouse 2008 (equip problems)	Old York	Racine	Deerhaven	Friday, March 20, 2009	10:45:00	14:45:00
79E	Amphitheatre	Old York	Cara (equip. problems)	Red Point	Friday, March 20, 2009	11:50:00	15:50:00
79F	Northbay	Carpenters Point 2008	Perry 2008	Red Point	Friday, March 20, 2009	12:55:00	16:55:00
	James Shaw	**Roy Miller**	**Ray Cramer**	**Chris Twilley**			
82A	NE High	Carpenters Point 2008	Principio 2008	Stone Wharf	Monday, March 23, 2009	7:30:00	11:30:00
82B	JMT 07	JMT 13	Principio 2008	JMT 16	Monday, March 23, 2009	8:30:00	12:30:00
82C	JMT 07	Lucy	Mountain Hill	JMT 04	Monday, March 23, 2009	9:30:00	13:30:00
82D	Lapidum Az	JMT 03	E 96	JMT 04	Monday, March 23, 2009	10:30:00	14:30:00
82E	Lucy	Talbots Haven	Bainbridge	Theodore	Monday, March 23, 2009	11:30:00	15:30:00
82F	Granite	Merlyn	Bainbridge	Camp Meeting	Monday, March 23, 2009	12:30:00	16:30:00
82G	Country	Merlyn	Mount Rocky	Colora	Monday, March 23, 2009	1:30:00	17:30:00
82H	Horseshoe	Coach	Mount Rocky	Rowland	Monday, March 23, 2009	2:30:00	18:30:00
82I	Old Fort	Larkin	Topeka	Rowland	Monday, March 23, 2009	3:30:00	19:30:00
83A	Red Hill	Madix	Topeka	Huntster	Tuesday, March 24, 2009	7:30:00	11:30:00
83B	Noyes	Talbots Haven	Greenfield	Rising Sun	Tuesday, March 24, 2009	8:30:00	12:30:00
83C	Seal	Oak Grove	Gilley	Rising Sun	Tuesday, March 24, 2009	9:30:00	13:30:00
83D	Olivet	Thankless	Springlawn	Fairfield	Tuesday, March 24, 2009	10:30:00	14:30:00
83E	Theodore	Crothers	Kirks Mill	Fairfield	Tuesday, March 24, 2009	11:30:00	15:30:00
83F	Greystone	Blue Ball	Kirks Mill	Arrowhead	Tuesday, March 24, 2009	12:30:00	16:30:00
83G	Blake	Blue Ball	Steeplechase	Brick Hill	Tuesday, March 24, 2009	1:30:00	17:30:00
	Jeff Hays	**Roy Miller**	**Ray Cramer**	**Chris Twilley**			
83H	Raintree	Fairhill	Steeplechase	London	Tuesday, March 24, 2009	2:30:00	18:30:00
83I	MacDuff	Apple	Steeplechase	Oz 2008	Tuesday, March 24, 2009	3:30:00	19:30:00
83J	Bethel Springs	JMT 13	Black 2008	Lucy	Tuesday, March 24, 2009	4:30:00	20:30:00
	James Shaw	**Jeff Hays**	**Ray Cramer**	**Chris Twilley**			
84A	JMT 19	Antego	JMT 21	Ricketts	Wednesday, March 25, 2009	7:30:00	11:30:00
84B	Aileron	Triumph	JMT 21 (Equip. Problems)	Old York	Wednesday, March 25, 2009	8:30:00	12:30:00
84C	Aileron	Milhollan	McKeown	Weed	Wednesday, March 25, 2009	9:30:00	13:30:00
84D	Fletch	Triumph	Brewster	Ricketts	Wednesday, March 25, 2009	10:30:00	14:30:00
84E	Independence	Shaw 2008	Eder	Ricketts	Wednesday, March 25, 2009	11:30:00	15:30:00
84F	Independence	Pelham	Hutton	Bethel	Wednesday, March 25, 2009	12:30:00	16:30:00
84G	BM 71 Reset	Wilmon	City	Bethel	Wednesday, March 25, 2009	1:30:00	17:30:00
84H	Bridle	Wilmon	Deuce	Yearling	Wednesday, March 25, 2009	2:30:00	18:30:00
	James Shaw	**Roy Miller**	**Ray Cramer**	**Chris Twilley**			
85A	Bridle	Ogrady	Betwixt	Meltz	Thursday, March 26, 2009	7:30:00	11:30:00
85B	R 114 Reset (Equip. Problems)	Yacht	Courthouse 2008	Cayots Reset	Thursday, March 26, 2009	8:35:00	12:35:00
85C	R 114 Reset (Equip. Problems)	Worsell	Welder	Georges Point	Thursday, March 26, 2009	9:40:00	13:40:00
85D	Budd	Worsell	Jeric	Cecilton	Thursday, March 26, 2009	10:45:00	14:45:00
85E	Cramer	Worsell	New Cut	Cecilton	Thursday, March 26, 2009	11:50:00	15:50:00
85F	Cramer	Sheffield	Sandy Bottom	Veazey	Thursday, March 26, 2009	12:55:00	16:55:00
85G	Old Hope	Sheffield	Pearce 2008	Veazey	Thursday, March 26, 2009	2:00:00	18:00:00
85H	Budd	Cassidy	Sandy Bottom	Knight	Thursday, March 26, 2009	3:05:00	19:05:00

APPENDIX B - LEVEL OBSERVATIONS

Point (4-digit)	Elev. (USFt)	Elev. (m)	Difference (m)
B112	373.086	113.717	
BRIK	399.823	121.866	8.150
C198	125.108	38.133	
SHAW	99.876	30.442	-7.691
E369	381.751	116.358	
RDHL	322.349	98.252	-18.106
H118	149.842	45.672	
JM21	153.422	46.763	1.091
K108	48.323	14.729	
COUR	39.797	12.130	-2.599
NECK	174.029	53.044	
AMPH	191.226	58.286	5.242
V019	9.318	2.840	
LAPI	9.041	2.756	-0.085

APPENDIX C - REOBSERVATION SCHEDULE

Session					Date	Proposed Time (EST)	(UTC)
	Ray Cramer	**Bill Jeric**					
113A	Black 2008	Antego			Thursday, April 23, 2009	9:15:00	13:15:00
113B	Black 2008	Antego			Thursday, April 23, 2009	10:20:00	14:20:00
113C	Wedgewood	Antego			Thursday, April 23, 2009	11:25:00	15:25:00
	Ray Cramer	**Bill Jeric**					
139A	NE High	JMT 13			Tuesday, May 19, 2009	7:30:00	11:30:00
139B	NE High	JMT 19			Tuesday, May 19, 2009	8:35:00	12:35:00
139C	JMT 21	JMT 19			Tuesday, May 19, 2009	9:40:00	13:40:00
139D	JMT 21	Ricketts			Tuesday, May 19, 2009	10:45:00	14:45:00
139E	Georges Point	R 114 Reset			Tuesday, May 19, 2009	12:30:00	16:30:00
139F	Cayots Reset	R 114 Reset			Tuesday, May 19, 2009	1:35:00	17:35:00
	James Shaw	**Bill Jeric**	**Ray Cramer**	**Chris Twilley**			
148A	Courthouse 2008	Amphitheatre	Brisson	Town Point	Thursday, May 28, 2009	8:45:00	12:45:00
148B	Courthouse 2008	Amphitheatre	Racine	Deerhaven	Thursday, May 28, 2009	9:55:00	13:55:00
148C	Veazey			Old Hope	Thursday, May 28, 2009	11:30:00	15:30:00

APPENDIX D - CONTROL COMPARISON

SSN	NGS PID	NAME	NGS Horz. Order	Published North (m)	Adjusted North (m)	North Diff. (cm)	Published East (m)	Adjusted East (m)	East Diff. (cm)	Horz. Diff. (cm)
2010	AJ7994	APPLE	0.61cm/0.47cm	226,186.631	226,186.607	-2.4	501,898.395	501,898.399	0.4	2.4
2020	JU3857	BETHEL	2nd	207,873.699	207,873.757	5.8	504,832.733	504,832.780	4.7	7.5
2030	JU3857	BOUNDARY MON 71 DEL MD RESET	3rd	203,591.021	203,591.081	6.0	505,283.857	505,283.952	9.5	11.2
2040	JU1137	CAYOTS RESET	2nd	202,642.166	202,642.189	2.3	499,088.229	499,088.267	3.8	4.4
2050	JU4122	CECIL	0.57cm/0.47cm	219,925.886	219,925.865	-2.1	489,438.532	489,438.536	0.4	2.1
2060	JU4121	CECILTON	0.57cm/0.47cm	193,170.552	193,170.552	0.0	497,248.205	497,248.205	0.0	0.0
2070	AJ7992	CITY	0.63cm/0.51cm	207,889.676	207,889.670	-0.6	502,567.035	502,567.024	-1.1	1.3
2080	JV0155	E 96	n/a	n/a	214,699.586	n/a	n/a	478,029.877	n/a	n/a
2090	DH8015	JMT03	1st	213,300.632	213,300.629	-0.3	480,547.194	480,547.205	1.1	1.1
2100	DH8016	JMT04	1st	210,877.252	210,877.244	-0.8	480,348.970	480,348.978	0.8	1.1
2110	DH8019	JMT07	1st	212,753.473	212,753.469	-0.4	482,580.311	482,580.311	0.0	0.4
2120	DH8025	JMT13	1st	215,397.704	215,397.692	-1.2	488,973.187	488,973.185	-0.2	1.2
2130	DH8028	JMT16	1st	216,339.935	216,339.917	-1.8	490,834.586	490,834.580	-0.6	1.9
2140	DH8031	JMT19	1st	216,403.242	216,403.228	-1.4	493,133.053	493,133.054	0.1	1.4
2150	DH8033	JMT21	1st	216,303.131	216,303.111	-2.0	494,703.393	494,703.394	0.1	2.0
2160	JV6793	LAPIDUM AZ	1.80cm/1.82cm	214,937.384	214,937.400	1.6	476,447.570	476,447.599	2.9	3.3
2170	JV6951	LUCY	1.69cm/1.16cm	216,061.974	216,061.984	1.0	484,518.558	484,518.569	1.1	1.5
2180	JV4817	MADIX	1st	228,428.471	228,428.524	5.3	472,520.781	472,520.800	1.9	5.6
2200	JU4414	OGRADY	1st	195,009.756	195,009.765	0.9	505,566.869	505,566.867	-0.2	0.9
2210	JU4125	R 114 RESET	n/a	n/a	199,965.579	n/a	n/a	497,340.631	n/a	n/a
2220	JV0376	S 72	n/a	n/a	192,444.682	n/a	n/a	484,734.179	n/a	n/a
2230	AJ7995	SEAL	0.71cm/0.53cm	226,452.976	226,452.955	-2.1	483,472.806	483,472.809	0.3	2.1
3010	DK4426	UNIV OF DELAWARE CORS ARP	CORS	223,880.379	223,880.360	-1.9	507,845.552	507,845.541	-1.1	2.2
3020	AF9680	DOVER DNRC CORS ARP	CORS	166,808.790	166,808.792	0.2	527,596.491	527,596.485	-0.6	0.6
3030	DH4471	LANCASTER COOP CORS ARP	CORS	263,634.624	263,634.611	-1.3	459,388.058	459,388.055	-0.3	1.3
3050	non-NGS	TWHG	KeyNET	209,021.488	209,021.478	-1.0	478,409.591	478,409.597	0.6	1.2

APPENDIX D - CONTROL COMPARISON

SSN	NGS PID	NAME	NGS Ellipsoid Order	Published Ellip. (m)	Ajdusted Ellip. (m)	Ellipsoid Diff. (cm)	NGS Ortho Order	Published Ortho (m)	Ajdusted Ortho Hgt (m)	Ortho Diff. (cm)
2010	AJ7994	APPLE	1.29cm	68.406	68.402	-0.4	GPS	101.4	101.385	-1.5
2020	JU3857	BETHEL	n/a	n/a	-19.922	n/a	3rd (+/-2cm)	14.36	13.362	-99.8
2030	JU3857	BOUNDARY MON 71 DEL MD RESET	n/a	n/a	-11.222	n/a	n/a	n/a	22.158	n/a
2040	JU1137	CAYOTS RESET	n/a	n/a	-8.470	n/a	1st-I	24.868	24.887	1.9
2050	JU4122	CECIL	1.20cm	71.294	71.272	-2.2	2nd-II	104.32	104.324	0.4
2060	JU4121	CECILTON	1.16cm	-10.359	-10.359	0.0	2nd-II	23.081	23.101	2.0
2070	AJ7992	CITY	1.35cm	-16.375	-16.384	-0.9	2nd-I	16.882	16.897	1.5
2080	JV0155	E 96	n/a	n/a	71.149	n/a	2nd-0	104.154	104.172	1.8
2090	DH8015	JMT03	3rd-I	37.379	37.382	0.3	GPS	70.4	70.457	5.7
2100	DH8016	JMT04	3rd-I	-17.647	-17.639	0.8	GPS	15.5	15.483	-1.7
2110	DH8019	JMT07	3rd-I	7.649	7.686	3.7	GPS	40.7	40.799	9.9
2120	DH8025	JMT13	3rd-I	-5.21	-5.201	0.9	GPS	27.9	27.925	2.5
2130	DH8028	JMT16	3rd-I	-16.608	-16.609	-0.1	GPS	16.5	16.511	1.1
2140	DH8031	JMT19	3rd-I	-5.015	-5.016	-0.1	GPS	28.1	28.110	1.0
2150	DH8033	JMT21	3rd-I	13.654	13.647	-0.7	GPS	46.8	46.777	-2.3
2160	JV6793	LAPIDUM AZ	7.47cm	-30.289	-30.248	4.1	VERTCON	2.7	2.755	5.5
2170	JV6951	LUCY	2.72cm	62.764	62.760	-0.4	2nd-I	95.799	95.828	2.9
2180	JV4817	MADIX	n/a	n/a	109.805	n/a	3rd (+/-2cm)	142.77	142.733	-3.7
2200	JU4414	OGRADY	4th-I	-12.056	-12.049	0.7	2nd-I	21.42	21.442	2.2
2210	JU4125	R 114 RESET	n/a	n/a	-25.785	n/a	3rd	7.59	7.598	0.8
2220	JV0376	S 72	n/a	n/a	-8.141	n/a	2nd-0	25.204	25.210	0.6
2230	AJ7995	SEAL	1.49cm	102.617	102.630	1.3	GPS	135.6	135.596	-0.4
3010	DK4426	UNIV OF DELAWARE CORS ARP	CORS	6.562	6.676	11.4	n/a	n/a	39.651	n/a
3020	AF9680	DOVER DNRC CORS ARP	CORS	-13.869	-13.732	13.7	GPS	20.49	20.628	13.8
3030	DH4471	LANCASTER COOP CORS ARP	CORS	112.073	112.188	11.5	n/a	n/a	146.271	n/a
3050	non-NGS	TWHG	KeyNET	-12.542	-12.509	3.3	n/a	n/a	20.619	n/a

SSN	NAME	LATITUDE	LONGITUDE	NORTH (m)	EAST (m)	ORTHO HGT (m)	GEOID (m)	ELLIPSOID (m)	SCALE FACTOR	COMBINED FACTOR
0010	AILERON	39 34 21.98045N	75 51 53.30008W	212,201.119	497,539.858	19.446	-33.192	-13.746	1.000023784	1.000025941
0020	AMPHITHEATER	39 30 43.48771N	75 57 7.56065W	205,373.330	490,116.895	58.317	-33.256	25.061	1.000011449	1.000007516
0030	ANTEGO	39 38 45.15799N	75 53 29.58697W	220,289.163	495,143.277	68.909	-33.072	35.837	1.000040140	1.000034516
0040	ARROWHEAD	39 40 2.69237N	75 54 11.69364W	222,668.214	494,110.648	109.550	-33.038	76.512	1.000045272	1.000033264
0050	BAINBRIDGE 01	39 36 48.33599N	76 4 17.69100W	216,513.919	479,727.783	115.555	-33.013	82.542	1.000032678	1.000019724
0060	BETHEL SPRINGS	39 37 25.39250N	75 58 49.79997W	217,740.191	487,536.255	86.266	-33.071	53.195	1.000035010	1.000026662
0070	BETWIXT	39 27 4.99428N	75 48 3.11646W	198,795.560	503,210.512	20.674	-33.439	-12.765	1.000000243	1.000002246
0080	BLACK	39 38 28.70187N	75 56 22.36084W	219,732.716	491,029.921	83.419	-33.066	50.353	1.000039070	1.000031167
0090	BLAKE	39 43 3.18483N	75 54 51.03150W	228,223.522	493,106.834	129.990	-32.999	96.991	1.000057769	1.000042547
0100	BLUEBALL	39 41 32.04553N	75 55 37.06981W	225,399.735	492,043.349	104.656	-33.007	71.649	1.000051362	1.000040118
0110	BREWSTER	39 39 56.97036N	75 50 17.69143W	222,560.742	499,690.208	53.461	-33.038	20.423	1.000044888	1.000041683
0120	BRICK HILL	39 42 55.33043N	75 52 41.72640W	228,018.525	496,189.547	121.872	-32.993	88.879	1.000057209	1.000043261
0130	BRIDLE	39 28 26.81494N	75 46 44.86651W	201,343.494	505,047.500	20.306	-33.417	-13.111	1.000004307	1.000006365
0140	BRISSON	39 28 53.97842N	75 57 52.36843W	201,984.009	489,084.869	9.508	-33.296	-23.788	1.000005692	1.000009425
0150	BUDD	39 23 4.96049N	75 50 23.72591W	191,350.151	499,942.993	20.557	-33.496	-12.939	0.999989231	0.999991261
0160	BUTTONWOOD	39 27 21.70248N	75 58 11.57887W	199,133.185	488,657.900	4.665	-33.334	-28.669	1.000001060	1.000005559
0170	CAMP MEETING	39 38 8.58077N	76 4 26.96055W	218,986.458	479,481.573	139.944	-32.981	106.963	1.000037769	1.000020983
0180	CARA	39 32 38.03674N	75 56 54.80094W	208,909.395	490,380.999	26.711	-33.218	-6.507	1.000017775	1.000018797
0190	CARPENTERS POINT 2008	39 32 31.73012N	76 0 16.11464W	208,661.011	485,576.453	4.799	-33.211	-28.412	1.000017419	1.000021878
0200	CASSIDY	39 23 55.79744N	75 58 29.87592W	192,778.594	488,291.788	22.716	-33.380	-10.664	0.999991450	0.999993123
0210	COACH	39 41 45.41954N	76 6 18.65290W	225,647.439	476,752.626	87.671	-32.929	54.742	1.000052290	1.000043699
0220	COLORA	39 40 22.06250N	76 5 36.69888W	223,086.463	477,777.705	111.427	-32.941	78.486	1.000046576	1.000034259
0230	COUNTRY	39 39 0.87515N	76 6 32.71509W	220,569.418	476,467.115	92.451	-32.944	59.507	1.000041169	1.000031830
0240	COURTHOUSE	39 30 31.96393N	75 52 17.04477W	205,100.687	497,060.857	12.158	-33.299	-21.141	1.000010830	1.000014148
0250	CRAMER	39 25 29.61330N	75 55 7.97452W	195,727.363	493,088.100	25.750	-33.402	-7.652	0.999995704	0.999996905
0260	CROTHERS	39 40 3.97909N	76 0 25.34635W	222,605.959	485,204.312	122.553	-32.994	89.559	1.000045358	1.000031303
0270	DEERHAVEN	39 32 19.65303N	75 50 43.16707W	208,449.690	499,261.397	20.691	-33.260	-12.569	1.000016739	1.000018712
0280	DEUCE	39 30 33.25966N	75 49 54.16669W	205,183.584	500,473.409	17.678	-33.324	-15.646	1.000010900	1.000013355
0290	EDER	39 36 23.76639N	75 49 40.65269W	215,996.893	500,657.443	1.512	-33.119	-31.607	1.000031149	1.000036110
0300	FAIR HILL	39 42 52.40951N	75 49 20.39006W	227,988.840	500,986.174	102.052	-32.975	69.077	1.000057001	1.000046160
0310	FAIRFIELD	39 41 18.51565N	75 58 21.55351W	224,937.374	488,129.005	126.721	-32.994	93.727	1.000050428	1.000035718
0320	FLETCH	39 39 20.32965N	75 48 33.71453W	221,462.680	502,183.219	41.218	-33.038	8.180	1.000042450	1.000041167
0330	GEORGES POINT	39 27 26.05934N	75 49 58.26379W	199,409.474	500,449.350	21.199	-33.415	-12.216	1.000001274	1.000003191
0340	GILLEY	39 42 48.81158N	76 2 49.46994W	227,652.977	481,716.087	130.796	-32.963	97.833	1.000056745	1.000041392
0350	GRANITE	39 37 34.38292N	76 7 40.39648W	217,886.347	474,879.010	73.208	-32.952	40.256	1.000035581	1.000029263
0360	GREENFIELD	39 39 51.10979N	76 3 49.38084W	222,157.668	480,345.257	105.250	-32.964	72.286	1.000044496	1.000033152
0370	GREYSTONE	39 39 54.45481N	75 56 47.81400W	222,370.339	490,392.510	108.471	-33.028	75.443	1.000044720	1.000032880
0380	HORSESHOE	39 43 3.20150N	76 6 55.26625W	228,037.859	475,857.047	119.955	-32.941	87.014	1.000057770	1.000044114
0390	HUNTSTER	39 42 19.84328N	76 10 16.76756W	226,655.571	471,069.771	138.391	-32.896	105.495	1.000054698	1.000038141
0400	HUTTON	39 35 16.37638N	75 47 25.84238W	213,960.603	503,900.851	17.676	-33.135	-15.459	1.000027030	1.000029456
0410	INDEPENDENCE	39 36 58.43038N	75 48 4.09670W	217,095.816	502,946.728	54.294	-33.083	21.211	1.000033310	1.000029981
0420	JACOBS NOSE	39 27 30.99039N	75 59 29.79100W	199,398.730	486,784.981	14.164	-33.322	-19.158	1.000001517	1.000004524
0430	JERIC	39 23 6.27598N	75 47 55.66766W	191,436.540	503,485.461	16.623	-33.516	-16.893	0.999989288	0.999991939
0440	KIRKS MILL	39 39 19.63648N	75 58 44.45762W	221,264.933	487,624.261	113.034	-33.024	80.010	1.000042405	1.000029848
0450	KNIGHT	39 22 43.98856N	75 54 42.70101W	190,627.121	493,753.436	18.234	-33.447	-15.213	0.999988333	0.999990721
0460	LARKIN	39 38 37.06380N	76 8 35.36450W	219,807.061	473,549.926	64.653	-32.922	31.731	1.000039613	1.000034633
0470	LONDON	39 43 14.54758N	75 47 24.62008W	228,707.650	503,734.571	88.647	-32.955	55.692	1.000058582	1.000049841
0480	MACDUFF	39 40 48.04212N	75 47 12.60450W	224,193.178	504,080.784	48.919	-32.993	15.926	1.000048339	1.000045840
0490	MCKEOWN	39 33 13.93596N	75 49 54.64163W	210,138.440	500,398.655	20.464	-33.232	-12.768	1.000019822	1.000021825
0500	MELTZ	39 23 55.86653N	75 46 25.65391W	192,994.386	505,618.907	17.292	-33.514	-16.222	0.999991453	0.999993998

SSN	NAME	LATITUDE	LONGITUDE	NORTH (m)	EAST (m)	ORTHO HGT (m)	GEOID (m)	ELLIPSOID (m)	SCALE FACTOR	COMBINED FACTOR
0510	MERLYN	39 37 31.70089N	76 6 6.67949W	217,825.303	477,114.887	117.683	-32.973	84.710	1.000035410	1.000022116
0520	MILHOLLAN	39 35 7.64249N	75 50 27.77037W	213,634.942	499,563.262	4.111	-33.167	-29.056	1.000026504	1.000031064
0530	MOUNT ROCKY	39 41 21.12143N	76 5 3.88193W	224,915.717	478,541.595	123.376	-32.939	90.437	1.000050607	1.000036414
0540	MOUNTAIN HILL	39 33 37.58315N	76 1 9.50774W	210,678.078	484,279.757	28.718	-33.172	-4.454	1.000021186	1.000021885
0550	NE HIGH	39 35 0.63657N	75 55 53.09493W	213,324.166	491,802.836	25.251	-33.166	-7.915	1.000026084	1.000027326
0560	NEW CUT	39 25 46.94765N	75 52 39.59637W	196,304.740	496,630.208	20.255	-33.425	-13.170	0.999996513	0.999998580
0570	NORTHBAY	39 29 48.02003N	75 59 11.82279W	203,629.265	487,167.606	10.624	-33.269	-22.645	1.000008498	1.000012051
0580	NOYES	39 40 25.05284N	76 1 23.71372W	223,240.882	483,806.185	125.217	-32.980	92.237	1.000046778	1.000032303
0590	OAK GROVE	39 42 47.91184N	76 5 6.68008W	227,591.792	478,448.097	107.629	-32.950	74.679	1.000056682	1.000044962
0600	OLD FORT	39 40 53.39682N	76 10 5.71321W	223,991.816	471,357.404	115.608	-32.875	82.733	1.000048705	1.000035721
0610	OLD HOPE	39 27 46.73715N	75 55 38.78274W	199,947.273	492,301.589	24.814	-33.341	-8.527	1.000002297	1.000003635
0620	OLD YORK	39 33 25.51088N	75 55 17.91654W	210,400.435	492,676.952	73.104	-33.203	39.901	1.000020488	1.000014226
0630	OLIVET	39 43 8.74647N	75 57 39.59165W	228,348.324	489,090.163	140.151	-32.992	107.159	1.000058166	1.000041349
0640	OZ	39 41 16.95443N	75 50 31.17434W	225,023.385	499,337.552	84.384	-33.008	51.376	1.000050320	1.000042257
0650	PEARCE 2008	39 26 11.74632N	75 57 18.39535W	196,990.330	489,954.006	20.689	-33.365	-12.676	0.999997683	0.999999672
0660	PELHAM	39 34 9.73188N	75 47 42.96186W	211,899.965	503,519.487	20.612	-33.185	-12.573	1.000023063	1.000025036
0670	PERRY 2008	39 32 51.88366N	76 3 3.76874W	209,239.899	481,566.874	7.722	-33.169	-25.447	1.000018561	1.000022555
0680	PRINCIPIO 2008	39 35 14.45472N	76 0 18.51770W	213,678.728	485,464.383	67.930	-33.126	34.804	1.000026914	1.000021452
0690	RACINE	39 32 2.81467N	75 53 56.95614W	207,873.248	494,640.382	25.811	-33.242	-7.431	1.000015797	1.000016963
0700	RAINTREE	39 41 12.14391N	75 53 23.85415W	224,823.911	495,224.834	113.744	-33.016	80.728	1.000049989	1.000037320
0710	RED HILL	39 43 10.22720N	76 11 41.51715W	228,191.443	469,037.122	98.237	-32.908	65.329	1.000058272	1.000048019
0720	RED POINT	39 31 43.00856N	75 58 0.27985W	207,194.528	488,836.804	21.766	-33.235	-11.469	1.000014698	1.000016498
0730	RICKETTS	39 38 21.38212N	75 50 25.28893W	219,610.508	499,546.572	40.987	-33.077	7.910	1.000038595	1.000037354
0740	RISING SUN	39 41 43.10514N	76 3 20.54995W	225,618.805	480,996.743	123.295	-32.955	90.340	1.000052129	1.000037951
0750	ROWLAND	39 40 3.06308N	76 7 42.26246W	222,471.353	474,790.726	84.671	-32.919	51.752	1.000045297	1.000037175
0760	SANDY BOTTOM	39 23 56.06301N	75 53 55.89084W	192,863.125	494,846.888	17.805	-33.443	-15.638	0.999991461	0.999993916
0770	SHAW 2008	39 38 11.68020N	75 48 21.98888W	219,349.205	502,490.427	30.466	-33.058	-2.592	1.000037969	1.000038375
0780	SHEFFIELD	39 24 27.48677N	75 56 18.14167W	193,791.835	491,432.224	26.443	-33.404	-6.961	0.999992864	0.999993956
0790	SPRINGLAWN	39 43 13.45344N	76 0 46.96446W	228,443.972	484,625.870	138.757	-32.977	105.780	1.000058503	1.000041902
0800	STEEPLECHASE	39 42 9.13349N	75 52 10.78845W	226,602.866	496,944.077	115.373	-32.999	82.374	1.000053945	1.000041018
0810	STONE WHARF	39 34 13.65816N	75 58 23.81849W	211,834.096	488,222.408	2.144	-33.182	-31.038	1.000023293	1.000028164
0820	SUNSET	39 25 14.90513N	75 59 39.04665W	195,199.686	486,609.961	14.760	-33.356	-18.596	0.999995024	0.999997942
0830	TALBOTS HAVEN	39 38 23.57471N	76 2 58.04943W	219,470.669	481,596.908	99.859	-32.996	66.863	1.000038737	1.000028244
0840	THANKLESS	39 41 55.71775N	75 59 42.19743W	226,063.335	486,194.817	111.952	-32.981	78.971	1.000053007	1.000040614
0850	THEODORE	39 38 23.49587N	76 0 36.69156W	219,504.060	484,967.504	126.049	-33.022	93.027	1.000038732	1.000024133
0860	TOPEKA	39 41 38.00562N	76 8 28.01723W	225,389.176	473,672.603	75.413	-32.902	42.511	1.000051775	1.000045103
0870	TOWN POINT	39 29 29.21270N	75 54 55.57003W	203,119.634	493,296.985	15.427	-33.301	-17.874	1.000007513	1.000010318
0880	TRIUMPH	39 36 28.15006N	75 51 53.74466W	216,091.962	497,480.865	18.020	-33.132	-15.112	1.000031421	1.000033792
0890	TURKEY POINT 2008	39 26 58.78907N	76 0 31.23030W	198,389.611	485,327.035	28.121	-33.324	-5.203	0.999999941	1.000000758
0900	VEAZEY	39 27 20.36884N	75 54 22.56125W	199,155.749	494,133.304	23.480	-33.366	-9.886	1.000000995	1.000002546
0910	WEDGEWOOD	39 39 47.11043N	75 52 15.00728W	222,221.572	496,897.754	71.745	-33.048	38.697	1.000044229	1.000038156
0920	WEED	39 33 14.27748N	75 52 36.98089W	210,100.335	496,523.040	19.124	-33.222	-14.098	1.000019841	1.000022054
0930	WELDER	39 25 56.01682N	75 50 9.61642W	196,629.326	500,213.369	22.465	-33.447	-10.982	0.999996939	0.999998663
0940	WILMON	39 30 49.20490N	75 48 14.82888W	205,706.033	502,839.920	21.286	-33.327	-12.041	1.000011758	1.000013647
0950	WORSELL	39 24 26.30952N	75 49 43.01912W	193,871.144	500,884.909	20.544	-33.478	-12.934	0.999992811	0.999994840
0960	YACHT	39 29 9.61308N	75 53 44.89587W	202,535.462	494,992.985	1.593	-33.322	-31.729	1.000006496	1.000011476
0970	YEARLING	39 29 44.90443N	75 48 35.72289W	203,716.613	502,366.694	22.547	-33.362	-10.815	1.000008334	1.000010031
2010	APPLE	39 41 53.59887N	75 48 43.08190W	226,186.607	501,898.399	101.385	-32.983	68.402	1.000052859	1.000042124
2020	BETHEL	39 31 58.63141N	75 46 50.19986W	207,873.757	504,832.780	13.362	-33.284	-19.922	1.000015564	1.000018691
2030	BOUNDARY MON 71 DEL MD RESET	39 29 39.58378N	75 46 33.71390W	203,591.081	505,283.952	22.158	-33.380	-11.222	1.000008055	1.000009816

SSN	NAME	LATITUDE	LONGITUDE	NORTH (m)	EAST (m)	ORTHO HGT (m)	GEOID (m)	ELLIPSOID (m)	SCALE FACTOR	COMBINED FACTOR
2040	CAYOTS RESET	39 29 11.43268N	75 50 53.48497W	202,642.189	499,088.267	24.887	-33.357	-8.470	1.000006590	1.000007920
2050	CECIL	39 38 35.55807N	75 57 29.00251W	219,925.865	489,438.536	104.324	-33.052	71.272	1.000039515	1.000028330
2060	CECILTON	39 24 5.07977N	75 52 15.37942W	193,170.552	497,248.205	23.101	-33.460	-10.359	0.999991861	0.999993487
2070	CITY	39 32 0.11802N	75 48 25.05719W	207,889.670	502,567.024	16.897	-33.281	-16.384	1.000015647	1.000018218
2080	E 96	39 35 50.06576N	76 5 29.62190W	214,699.586	478,029.877	104.172	-33.023	71.149	1.000029076	1.000017910
2090	JMT03	39 35 3.88345N	76 3 44.72541W	213,300.629	480,547.205	70.457	-33.075	37.382	1.000026279	1.000020412
2100	JMT04	39 33 45.37785N	76 3 54.07147W	210,877.244	480,348.978	15.483	-33.122	-17.639	1.000021639	1.000024407
2110	JMT07	39 34 45.45783N	76 2 19.77716W	212,753.469	482,580.311	40.799	-33.113	7.686	1.000025176	1.000023970
2120	JMT13	39 36 8.92097N	75 57 50.67233W	215,397.692	488,973.185	27.925	-33.126	-5.201	1.000030233	1.000031049
2130	JMT16	39 36 38.77715N	75 56 32.20091W	216,339.917	490,834.580	16.511	-33.120	-16.609	1.000032081	1.000034688
2140	JMT19	39 36 39.95537N	75 54 55.82600W	216,403.228	493,133.054	28.110	-33.126	-5.016	1.000032155	1.000032942
2150	JMT21	39 36 36.09952N	75 53 50.05375W	216,303.111	494,703.394	46.777	-33.130	13.647	1.000031915	1.000029773
2160	LAPIDUM AZ	39 35 58.28153N	76 6 35.83667W	214,937.400	476,447.599	2.755	-33.003	-30.248	1.000029579	1.000034326
2170	LUCY	39 36 32.05635N	76 0 57.07335W	216,061.984	484,518.569	95.828	-33.068	62.760	1.000031663	1.000021814
2180	MADIX	39 43 16.89224N	76 9 15.17296W	228,428.524	472,520.800	142.733	-32.928	109.805	1.000058750	1.000041517
2200	OGRADY	39 25 1.23371N	75 46 26.69756W	195,009.765	505,566.867	21.442	-33.491	-12.049	0.999994395	0.999996286
2210	R 114 RESET	39 27 45.35860N	75 52 7.99794W	199,965.579	497,340.631	7.598	-33.383	-25.785	1.000002228	1.000006275
2220	S 72	39 23 46.23982N	76 0 58.70353W	192,444.682	484,734.179	25.210	-33.351	-8.141	0.999991028	0.999992305
2230	SEAL	39 42 9.30555N	76 1 36.26346W	226,452.955	483,472.809	135.596	-32.966	102.630	1.000053958	1.000037851
3010	UNIV OF DELAWARE CORS ARP	39 40 36.24930N	75 44 34.82965W	223,880.360	507,845.541	39.651	-32.975	6.676	1.000047537	1.000046489
3020	DOVER DNRC CORS ARP	39 9 36.28560N	75 31 24.94565W	166,808.792	527,596.485	20.628	-34.360	-13.732	0.999962124	0.999964279
3030	LANCASTER COOP CORS ARP	40 2 21.81337N	76 18 15.26958W	263,634.611	459,388.055	146.271	-34.083	112.188	1.000156410	1.000138801
3050	TWHG	39 32 45.84544N	76 5 16.08610W	209,021.478	478,409.597	20.619	-33.128	-12.509	1.000018218	1.000020181

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