National Geodetic Survey Positioning America for the Future www.ngs.noaa.gov

Nuts & Bolts of Submitting a Digital Leveling Project to NGS





NOAA's National Geodetic Survey Positioning America for the Future www.ngs.noaa.gov

Instructors



Edward Carlson
National Geodetic Survey
Pacific Region Geodetic Advisor
(808) 532-5302
Email ~ ed.carlson@noaa.gov



Curt Smith
National Geodetic Survey
Montana/Idaho State Advisor
(208) 332-7197
Email ~ curt.smith@noaa.gov

Assisting:

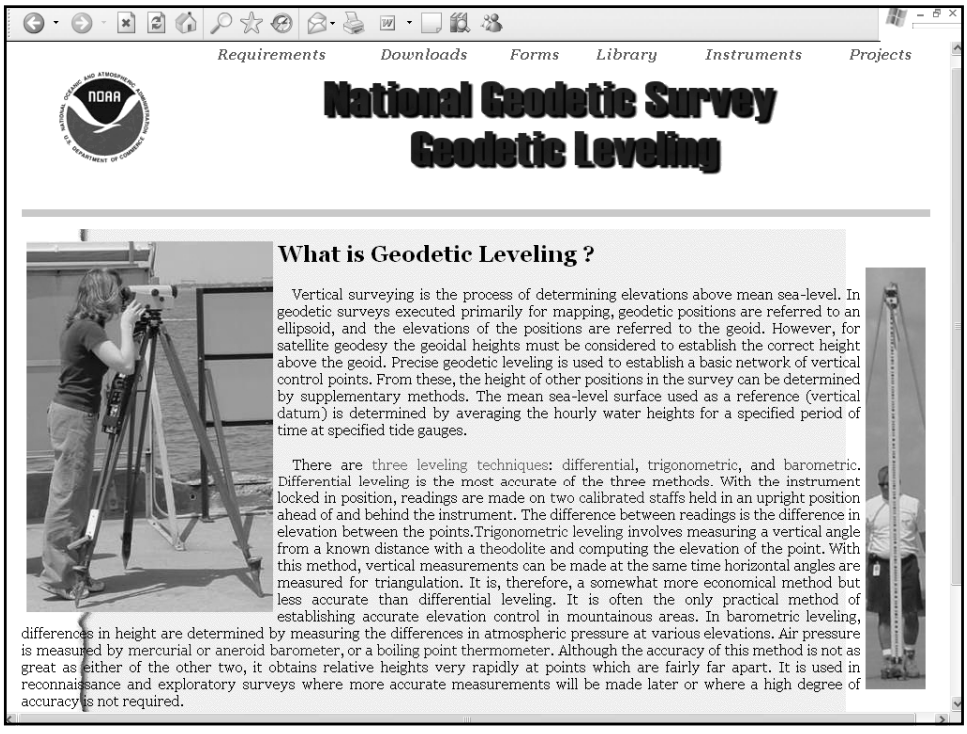


Dave Minkel
National Geodetic Survey
Arizona State Advisor
(602) 542-1569
Email ~ dave.minkel@noaa,gov

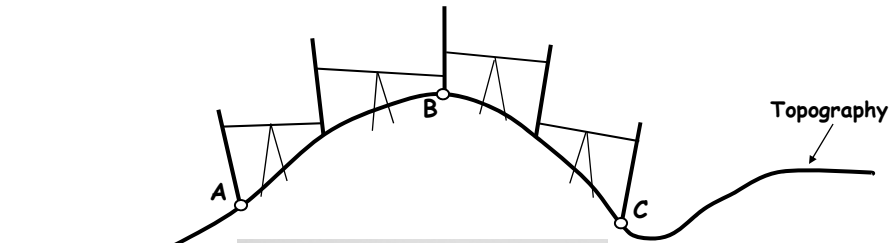
Course Outline

- Overview of Leveling
- Project Planning
- Field Procedures
- Data Processing
  - Program WinDesc
  - Program Translev
  - Program LOCUS
- Project Reports
- Data Submission



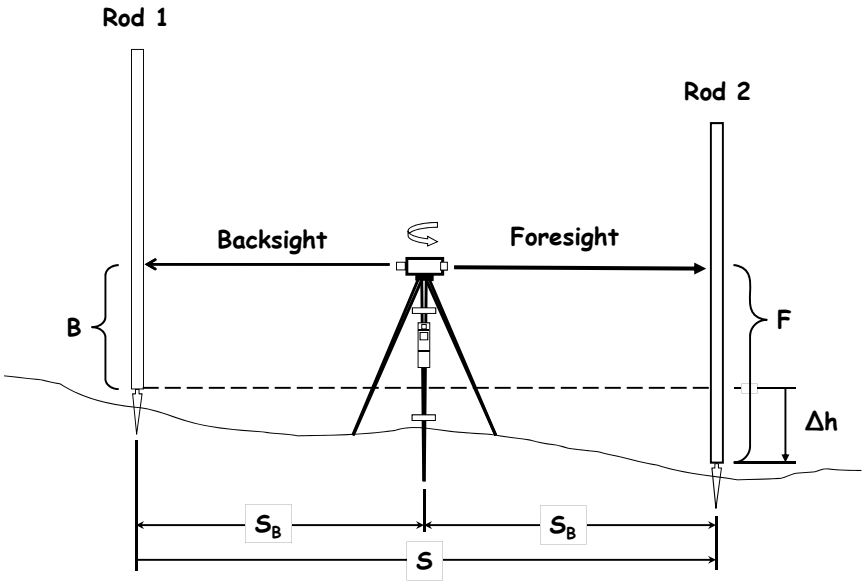


Leveled Height Differences



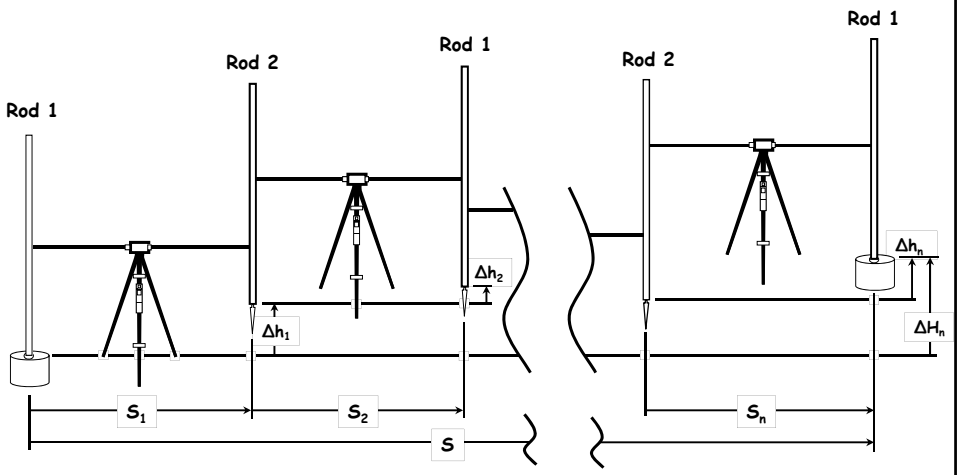


Setup of Leveling, $\Delta h = B - F$ and $S = S_B + S_F$



Section of Leveling

$\Delta H = \Delta h_1 + \Delta h_2 + \ldots + \Delta h_n$ and $S = S_1 + S_2 + \ldots + S_n$



Section of Leveling



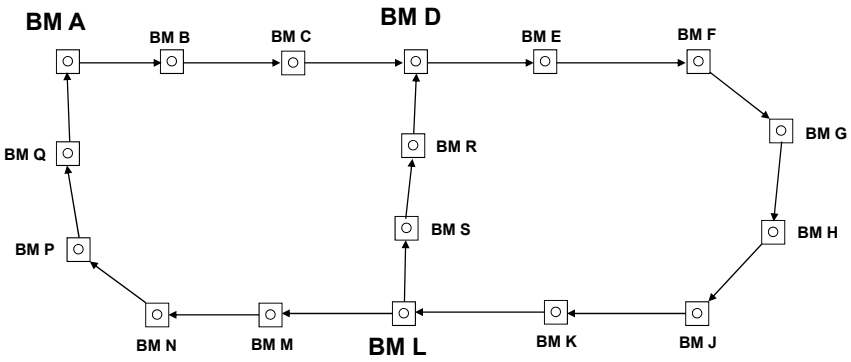
BM = Bench Mark
TP = Turning Point

Level Line



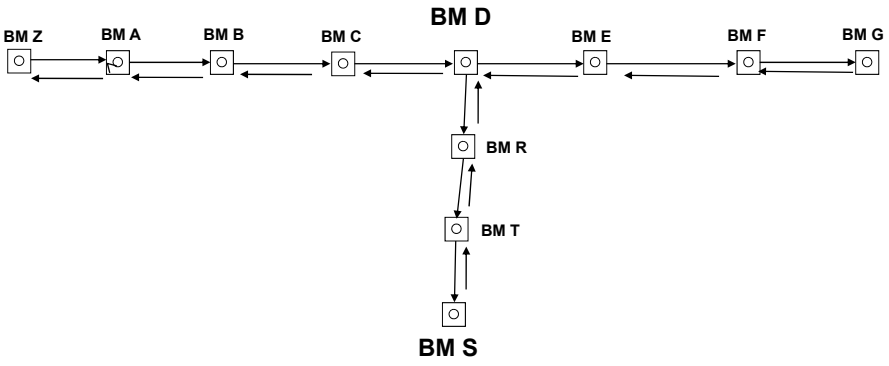
BM = Bench Mark

Level Loop(s)



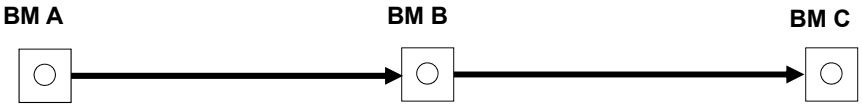
BM = Bench Mark
⟶ = Forward Running

Level Spur



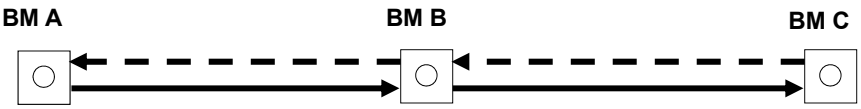
BM = Bench Mark
⟶ = Forward Running
⟵ = Reverse Running

Single Run

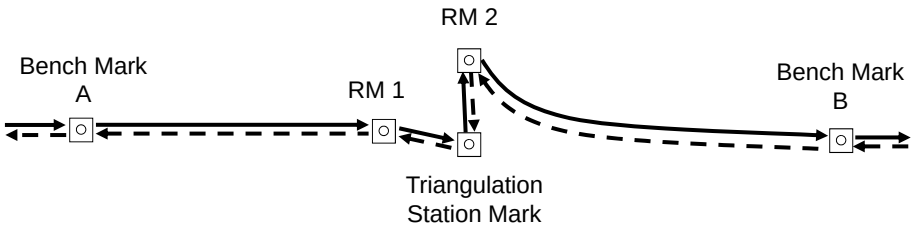


BM = Bench Mark
⟶ = One Way Leveling

Double Run

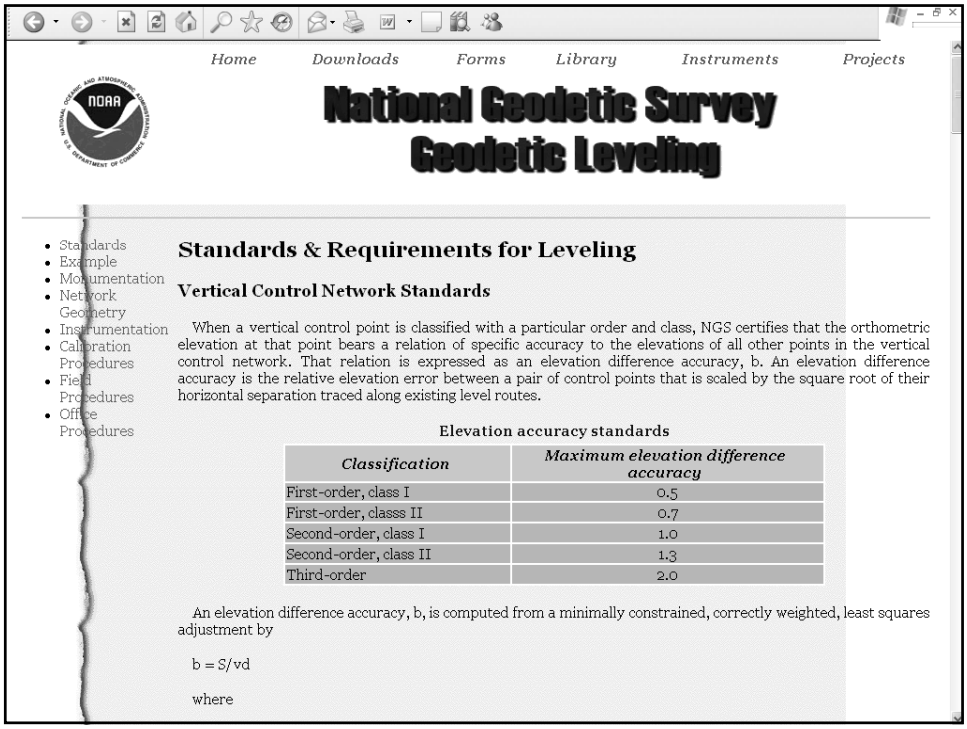


BM = Bench Mark
= Forward Running
= Backward Running



Leveling routes through a cluster of control points
at a triangulation station

BM = Bench Mark
= Forward Running
= Backward Running



Home Downloads Forms Library Instruments Projects

National Geodetic Survey
Geodetic Leveling

- Standards
- Example
- Monumentation
- Network Geometry
- Instrumentation
- Calibration Procedures
- Field Procedures
- Office Procedures

Standards & Requirements for Leveling

Vertical Control Network Standards

When a vertical control point is classified with a particular order and class, NGS certifies that the orthometric elevation at that point bears a relation of specific accuracy to the elevations of all other points in the vertical control network. That relation is expressed as an elevation difference accuracy, b. An elevation difference accuracy is the relative elevation error between a pair of control points that is scaled by the square root of their horizontal separation traced along existing level routes.

Elevation accuracy standards

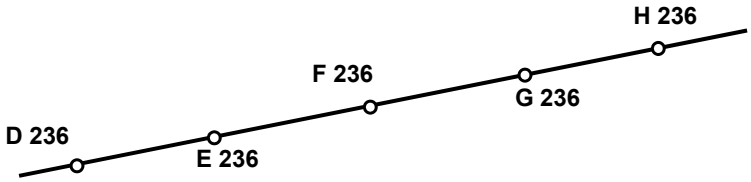
Classification	*Maximum elevation difference accuracy*
First-order, class I	0.5
First-order, classs II	0.7
Second-order, class I	1.0
Second-order, class II	1.3
Third-order	2.0

An elevation difference accuracy, b, is computed from a minimally constrained, correctly weighted, least squares adjustment by

$b = S/vd$

where

What Does First-Order, Class II Accuracy Mean?



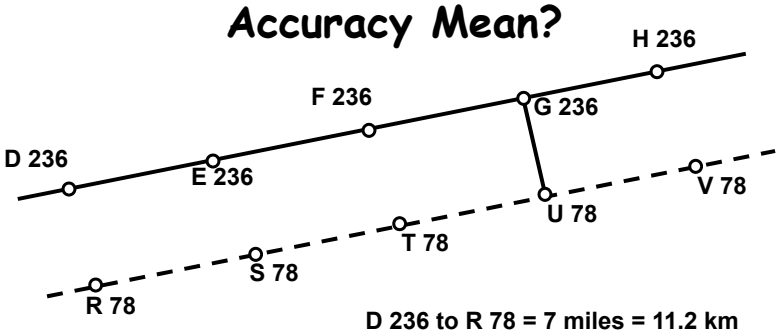
D 236 to G 236 = 3 miles = 4.8 km

Therefore, the accuracy of the vertical relationship between D 236 and G 236 is:

$$0.7 \sqrt{4.8} = 1.5 \text{ mm}$$

Each section = 1 mile = 1.6 km

What Does Second-Order, Class I Accuracy Mean?



D 236 to R 78 = 7 miles = 11.2 km

Therefore, the accuracy of the vertical relationship between D 236 and R 78 is:

$$1.0 \sqrt{11.2} = 3.3 \text{ mm}$$

$$\text{NOT: } 1.0 \sqrt{1.6} = 1.3 \text{ mm}$$

Each section = 1 mile = 1.6 km

FGCS Specifications and Procedures to Incorporate Electronic Digital/Bar-Code Leveling Systems[a]

3.5 Geodetic Leveling

Geodetic leveling is a measurement system comprised of elevation differences observed between nearby ends. Geodetic leveling is used to extend vertical control.

Network Geometry

Order Class	First I	First II	Second I	Second II	Third
Bench mark spacing not more than (km)	3	3	3	3	3
Average bench mark spacing not more than (km)	1.6	1.6	1.6	3.0	3.0
Line length between network control points not more than (km)	300[a]	100[a]	50[a]	50[a]	25[b]
Minimum bench mark ties	6	6	4	4	4

[a] Electronic Digital/Bar-Code Leveling Systems, 25 km

[b] Electronic Digital/Bar Code Leveling Systems, 10 km

As specified in above table, new surveys are required to tie to existing network bench marks at the beginning and end of the leveling line. These network bench marks must have an order (and class) equivalent to or better than the intended order (and class) of the new survey.

First-order surveys are required to perform valid check connections to a minimum of six bench marks, three at each end. All other surveys require a minimum of four valid check connections, two at each end.

A valid "check connection" means that the observed elevation difference agrees with the published adjusted elevation difference within the tolerance limit of the new survey. Checking the elevation difference between two bench marks located on the same structure, or so close together that both may have been affected by the same localized disturbance, is not considered a proper check.

In addition, the survey is required to connect to any network control points within 3 km of its path. However, if the survey is run parallel to existing control, then the following table specifies the maximum spacing of extra connections between the survey and the existing control.

When using Electronic Digital/Bar-Code Leveling Systems for area projects, there must be at least 4 contiguous loops and the loop size must not exceed 25 km. *(Note: This specification may be amended at a future date after sufficient data have been evaluated and it is proven that there are no significant uncorrected systematic errors remaining in Electronic Digital/Bar-Code Leveling Systems.)*

[a] NGS' analyses of the data will be the final determination if the data meet the desired FGCS order and class standards.

FGCSVERT (ver. 4.1 5/27/2004) 1

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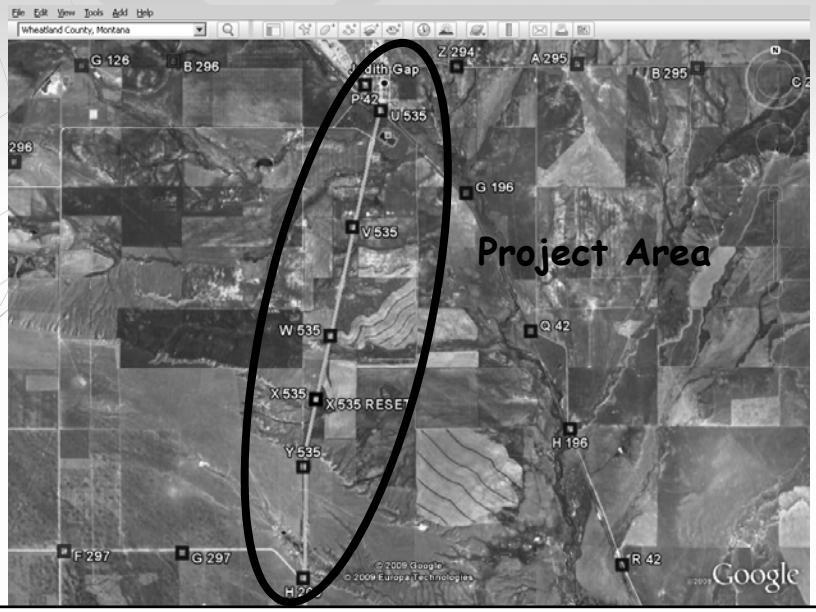
FGCS Specifications and Procedures to Incorporate Electronic Digital/Bar-Code Leveling Systems

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Project Planning



Mark Reconnaissance Critical for Project Preparation



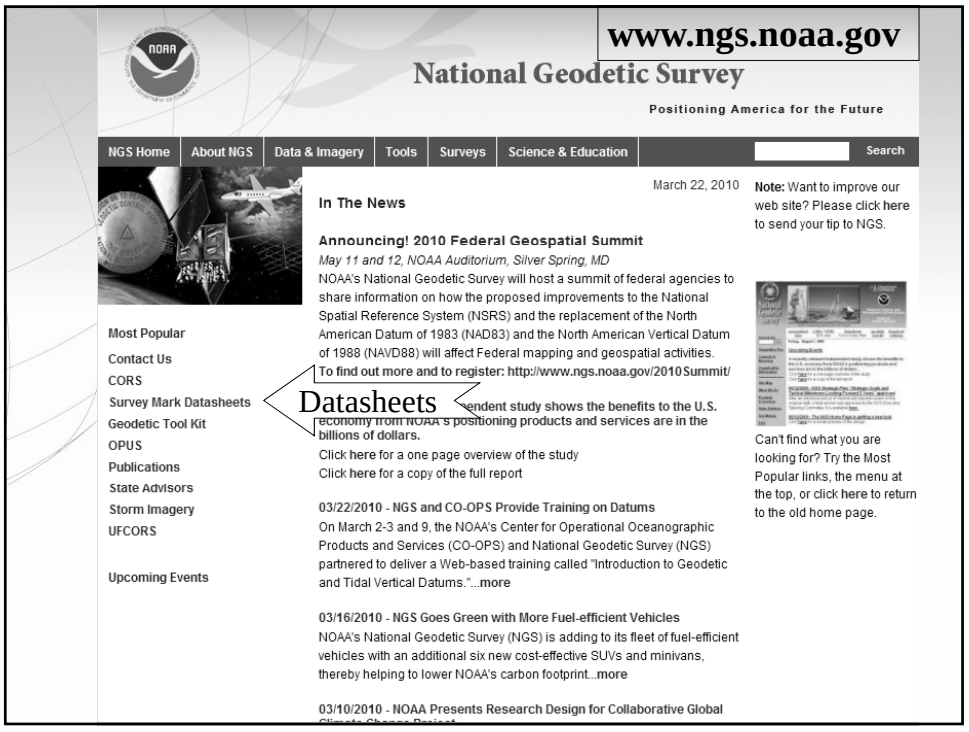


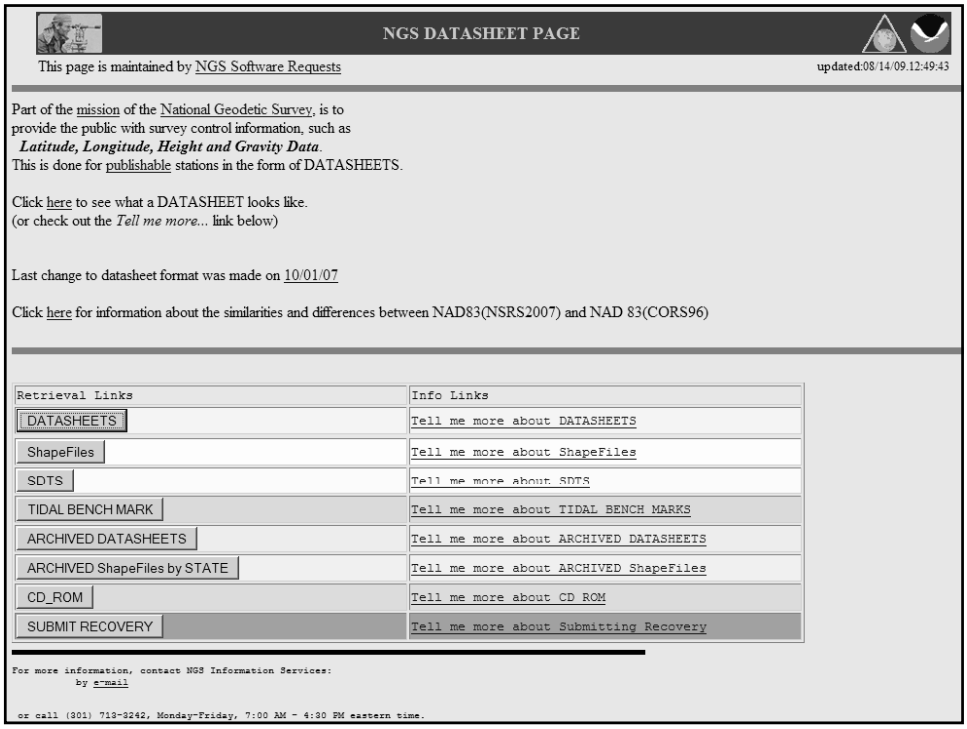


Project Planning

- **Recon Old Marks and Locations for New Marks**
  - Include extra points for tie points
  - Use GPS to check uncorrected heights
  - Use DS-World to map existing vertical control
    http://www.ngs.noaa.gov/PC_PROD/PARTNERS/index.shtml
  - Use datasheets to find marks in the field
    http://www.ngs.noaa.gov/cgi-bin/datasheet.prl

- **Search database by PID and Project ID to list level lines**
  - Enter PID for known station to get L-*number*
    (Select 'Determine' from top of page)
  - Enter L-*number* to find other stations in that L-*number*
    (Enter L-*number* in 'Enter Survey Project ID:' box)





NGS DATASHEET PAGE

This page is maintained by NGS Software Requests

updated:08/14/09.12:49:43

Part of the mission of the National Geodetic Survey, is to provide the public with survey control information, such as ***Latitude, Longitude, Height and Gravity Data***. This is done for publishable stations in the form of DATASHEETS.

Click here to see what a DATASHEET looks like. (or check out the *Tell me more...* link below)

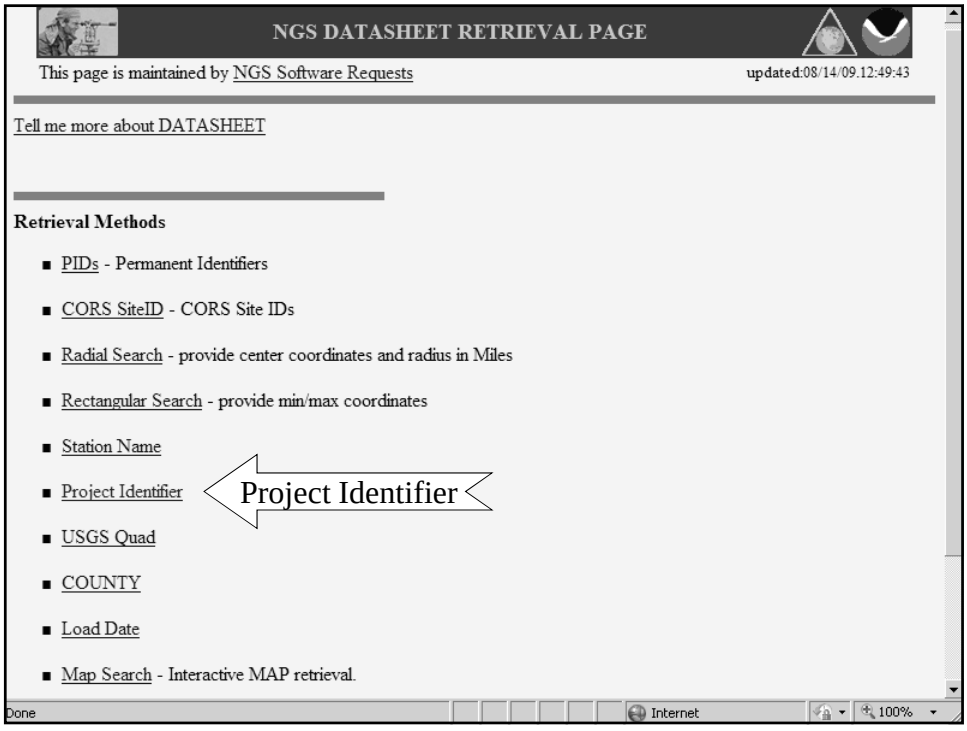
Last change to datasheet format was made on 10/01/07

Click here for information about the similarities and differences between NAD83(NSRS2007) and NAD 83(CORS96)

Retrieval Links	Info Links
DATASHEETS	Tell me more about DATASHEETS
ShapeFiles	Tell me more about ShapeFiles
SDTS	Tell me more about SDTS
TIDAL BENCH MARK	Tell me more about TIDAL BENCH MARKS
ARCHIVED DATASHEETS	Tell me more about ARCHIVED DATASHEETS
ARCHIVED ShapeFiles by STATE	Tell me more about ARCHIVED ShapeFiles
CD_ROM	Tell me more about CD ROM
SUBMIT RECOVERY	Tell me more about Submitting Recovery

For more information, contact NGS Information Services:
by e-mail

or call (301) 713-3242, Monday-Friday, 7:00 AM - 4:30 PM eastern time.



NGS DATASHEET RETRIEVAL PAGE

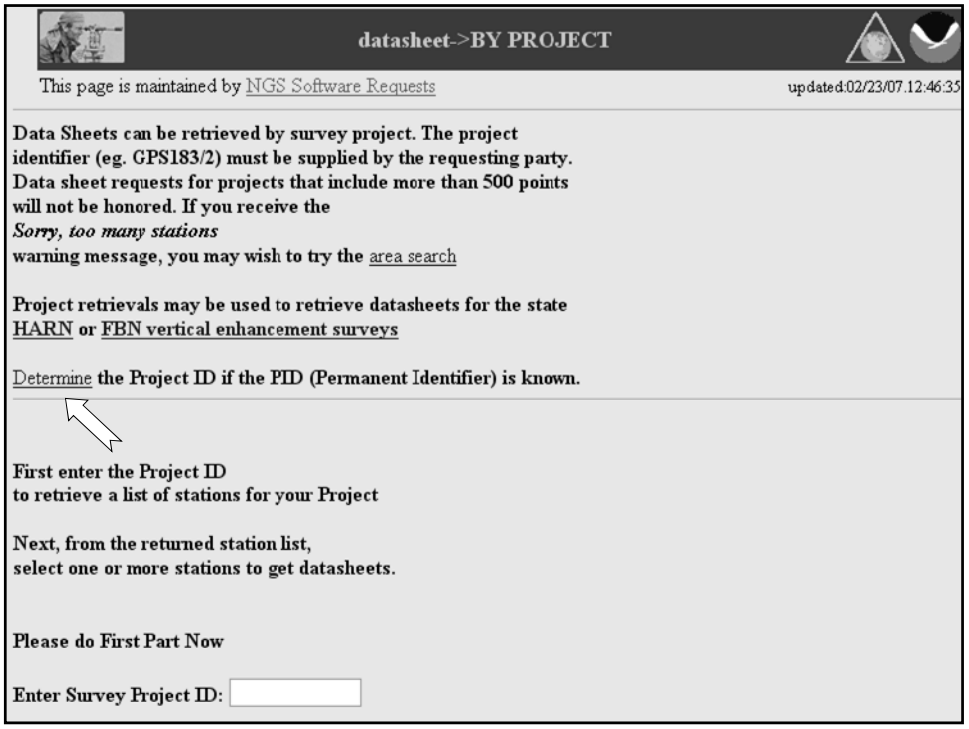
This page is maintained by NGS Software Requests

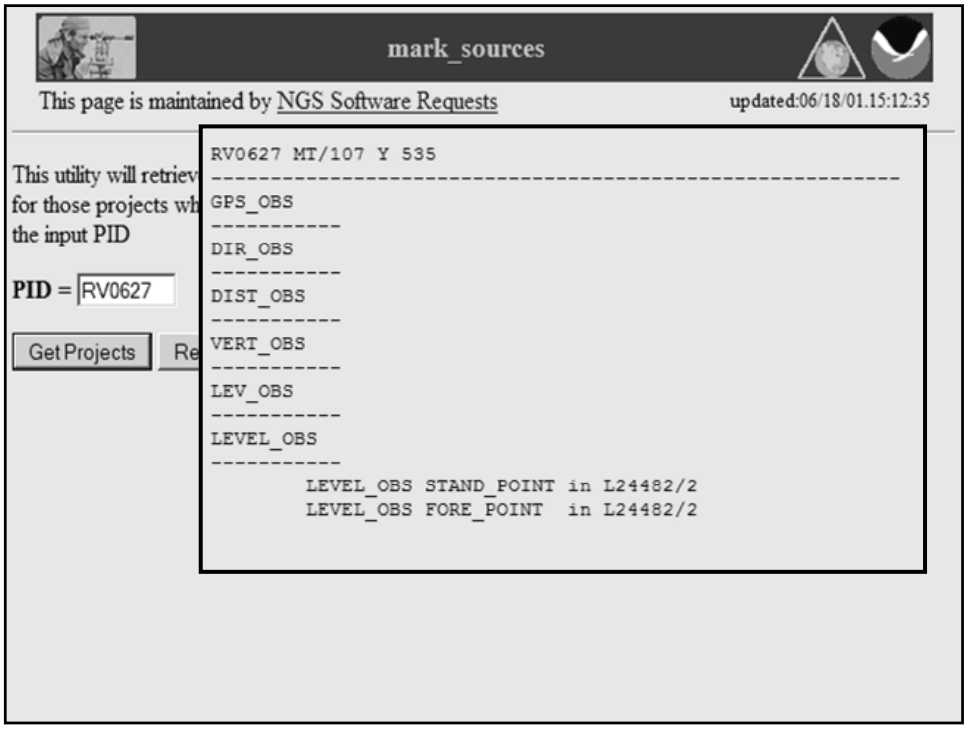
updated:08/14/09.12:49:43

Tell me more about DATASHEET

Retrieval Methods

- PIDs - Permanent Identifiers
- CORS SiteID - CORS Site IDs
- Radial Search - provide center coordinates and radius in Miles
- Rectangular Search - provide min/max coordinates
- Station Name
- Project Identifier
- USGS Quad
- COUNTY
- Load Date
- Map Search - Interactive MAP retrieval.


datasheet->BY PROJECT
This page is maintained by NGS Software Requests
updated:02/23/07.12:46:35
Data Sheets can be retrieved by survey project. The project identifier (eg. GPS183/2) must be supplied by the requesting party. Data sheet requests for projects that include more than 500 points will not be honored. If you receive the
Sorry, too many stations
warning message, you may wish to try the area search
Project retrievals may be used to retrieve datasheets for the state HARN or FBN vertical enhancement surveys
Determine the Project ID if the PID (Permanent Identifier) is known.
First enter the Project ID
to retrieve a list of stations for your Project
Next, from the returned station list,
select one or more stations to get datasheets.
Please do First Part Now
Enter Survey Project ID:


mark_sources
This page is maintained by NGS Software Requests
updated:06/18/01.15:12:35
This utility will retriev
for those projects wh
the input PID
PID = RV0627
Get Projects
Re
RV0627 MT/107 Y 535
GPS_OBS
DIR_OBS
DIST_OBS
VERT_OBS
LEV_OBS
LEVEL_OBS
LEVEL_OBS STAND_POINT in L24482/2
LEVEL_OBS FORE_POINT in L24482/2

First enter the Project ID
to retrieve a list of stations for your Project

Next, from the returned station list,
select one or more stations to get datasheets.

Please do First Part Now

Enter Survey Project ID: L24482/2

Marks to include:

- Retrieve only those marks determined in the project
- Retrieve all marks observed in the project
- Retrieve all marks occupied as Stand_point

Data Type Desired:

- Any Horz. and/or Vert. Control
- GPS Sites Only
- Any Horizontal Control

Stability Desired:

- Any Stability
- Stability A only
- Stability B or better

Submit Reset

Station List Results for: L24482/2

Help

Re-Sort-By ○ Dist ○ Pid ○ H ○ V ○ Vert_Source ○ Latitude ○ Longitude ○ Stab ◉ Designation

```
|....|RV0626|. 1|88/ADJUSTED|N463820......|W1094550......|A...|X 535
|....|RV0664|. 1|88/ADJUSTED|N461804......|W1090124......|B...|X 536
|....|RV0687|. 1|88/ADJUSTED|N460320......|W1085304......|A...|X 537
|....|QW0388|. 1|88/ADJUSTED|N454328......|W1084810......|B...|X 538
|....|RV0609|. 1|88/ADJUSTED|N465905......|W1094521......|A...|Y 527
|....|RV0643|B 1|88/ADJUSTED|N461926.84358|W1092701.94033|B...|Y 532
|....|RV0627|. 1|88/ADJUSTED|N463751......|W1094558......|B...|Y 535
|....|RV0665|. 1|88/ADJUSTED|N461822......|W1090018......|B...|Y 536
|....|RV0688|. 1|88/ADJUSTED|N460211......|W1085301......|B...|Y 537
|....|QW0389|0 1|88/ADJUSTED|N454249.76748|W1084723.97225|B...|Y 538
|....|RV0508|. 1|88/ADJUSTED|N464045......|W1094421......|C...|Z 294
|....|RV0644|. 1|88/ADJUSTED|N461912......|W1092617......|A...|Z 532
|....|RV0628|. 1|88/ADJUSTED|N463518......|W1094558......|B...|Z 535
|....|RV0666|. 1|88/ADJUSTED|N461827......|W1085854......|B...|Z 536
|....|RV0669|. 1|88/ADJUSTED|N460130......|W1085301......|B...|Z 537
|....|QW0390|. 1|88/ADJUSTED|N454217......|W1084647......|B...|Z 538
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Database retrieval time = 00:00:37

Select All

Get Datasheets (for the stations I've selected above)

Move (the above station list to a File->Print Window)

Reset

Return to Datasheet Home Page

Station List Results for: L24482/2

Help

Re-Sort-By ○ Dist ○ Pid ○ H ○ V ○ Vert_Source ◉ Latitude ○ Longitude ○ Stab ○ Designation

```
|....|RV0592|. 1|88/ADJUSTED|N463608......|W1094555......|C...|L 7 U AZ MK
|....|RV0588|. 1|88/ADJUSTED|N463703......|W1094558......|B...|H 200
|....|RV0589|. 1|88/ADJUSTED|N463714......|W1094714......|C...|G 297
|....|RV0627|. 1|88/ADJUSTED|N463751......|W1094558......|B...|Y 535
|....|RV0626|. 1|88/ADJUSTED|N463820......|W1094550......|A...|X 535
|....|RV0625|. 1|88/ADJUSTED|N463848......|W1094541......|B...|W 535
|....|RV0624|. 1|88/ADJUSTED|N463935......|W1094527......|B...|V 535
|....|RV0623|. 1|88/ADJUSTED|N464026......|W1094509......|B...|U 535
|....|RV0383|. 1|88/ADJUSTED|N464037......|W1094519......|C...|P 42
|....|RV0508|. 1|88/ADJUSTED|N464045......|W1094421......|C...|Z 294
|....|RV0622|. 1|88/ADJUSTED|N464118......|W1094459......|A...|T 535
|....|RV0621|. 1|88/ADJUSTED|N464147......|W1094438......|B...|S 535
|....|RV0380|. 1|88/ADJUSTED|N464224......|W1094418......|A...|F 196
|....|RV0379|. 1|88/ADJUSTED|N464255......|W1094428......|B...|M 42
|....|RV0620|. 1|88/ADJUSTED|N464334......|W1094432......|B...|R 535
|....|RV0619|. 1|88/ADJUSTED|N464407......|W1094445......|B...|Q 535
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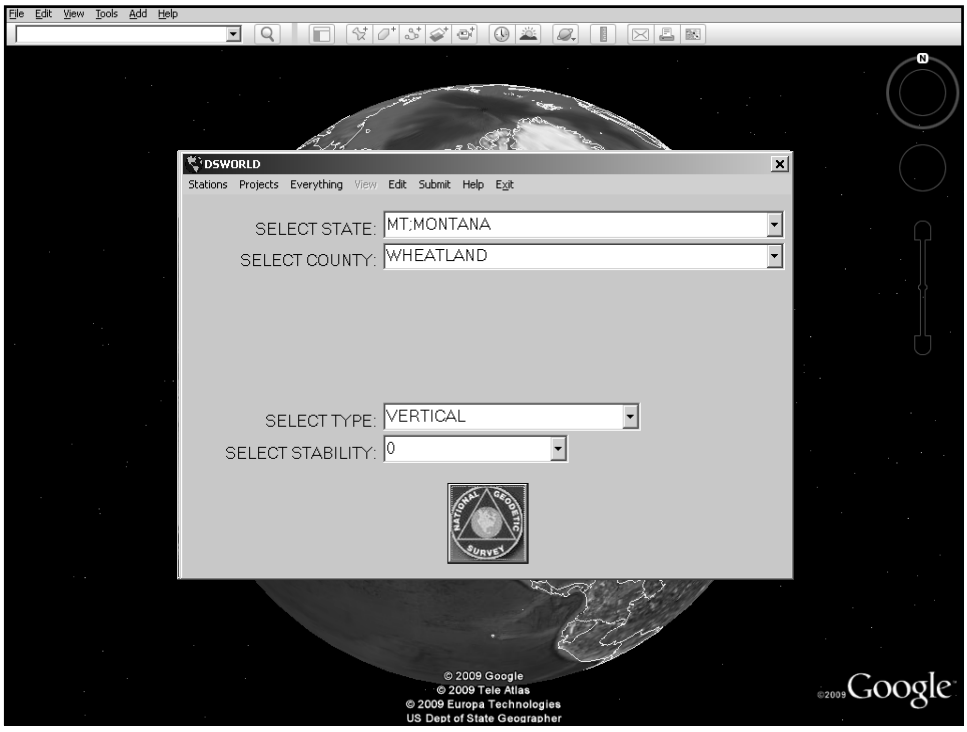
Select All

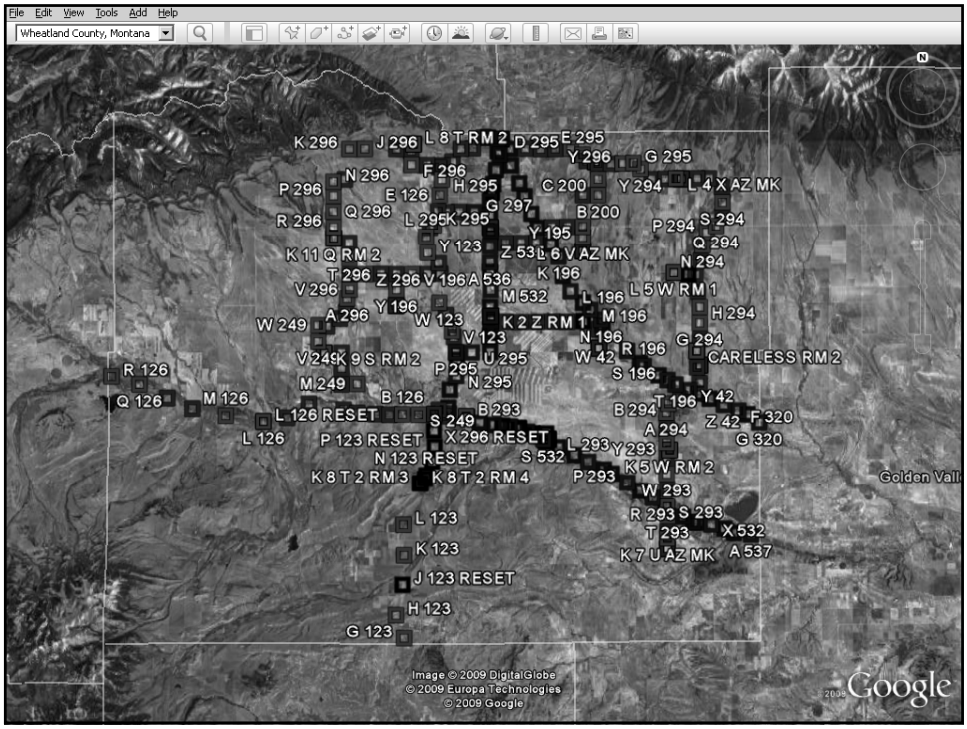
Get Datasheets (for the stations I've selected above)

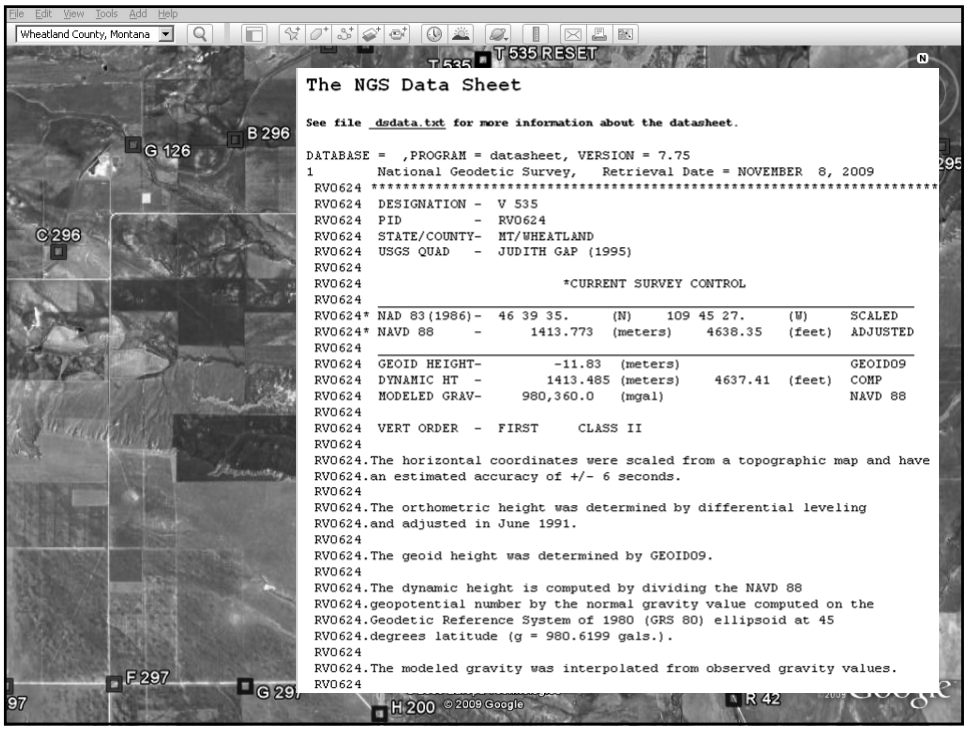
Move (the above station list to a File->Print Window)

Reset

Return to Datasheet Home Page




File Edit View Tools Add Help
Wheatland County, Montana
K 296
J 296
L 8 T RM 2
D 295
E 295
Y 296
G 295
N 296
F 296
H 295
C 200
Y 294
L 4 X AZ MK
P 296
E 126
G 297
B 200
Q 296
L 295
K 295
P 294
S 294
R 296
Y 195
Q 294
Y 123
Z 53
L 6 V AZ MK
K 11 Q RM 2
N 294
T 296
Z 296
V 196
A 536
K 196
V 296
M 532
L 196
L 5 W RM 1
Y 196
M 196
H 294
W 249
A 296
W 123
K 2 Z RM 1
V 123
N 196
G 294
V 24
K 9 S RM 2
U 295
W 42
R 196
CARELESS RM 2
R 126
P 295
S 196
M 249
N 295
Q 126
M 126
B 126
T 196
Y 42
B 293
B 294
L 126 RESET
S 249
Z 42
F 320
A 294
L 126
P 123 RESET
X 296 RESET
G 320
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Y 293
N 123 RESET
S 532
K 5 W RM 2
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K 8 T 2 RM 4
P 293
W 293
R 293
S 293
L 123
T 293
X 532
K 123
K 7 U AZ MK
A 537
J 123 RESET
H 123
G 123
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
© 2009 Google
Google


File Edit View Tools Add Help
Wheatland County, Montana
T 535 RESET
B 296
G 126
C 296
F 297
G 297
H 200
© 2009 Google
R 42
The NGS Data Sheet
See file dsdata.txt for more information about the datasheet.
DATABASE = ,PROGRAM = datasheet, VERSION = 7.75
1 National Geodetic Survey, Retrieval Date = NOVEMBER 8, 2009
RV0624 **********
RV0624 DESIGNATION - V 535
RV0624 PID - RV0624
RV0624 STATE/COUNTY- MT/WHEATLAND
RV0624 USGS QUAD - JUDITH GAP (1995)
RV0624
RV0624 *CURRENT SURVEY CONTROL
RV0624
RV0624* NAD 83(1986)- 46 39 35. (N) 109 45 27. (W) SCALED
RV0624* NAVD 88 - 1413.773 (meters) 4638.35 (feet) ADJUSTED
RV0624
RV0624 GEOID HEIGHT- -11.83 (meters) GEOID09
RV0624 DYNAMIC HT - 1413.485 (meters) 4637.41 (feet) COMP
RV0624 MODELED GRAV- 980,360.0 (mgal) NAVD 88
RV0624
RV0624 VERT ORDER - FIRST CLASS II
RV0624
RV0624.The horizontal coordinates were scaled from a topographic map and have
RV0624.an estimated accuracy of +/- 6 seconds.
RV0624
RV0624.The orthometric height was determined by differential leveling
RV0624.and adjusted in June 1991.
RV0624
RV0624.The geoid height was determined by GEOID09.
RV0624
RV0624.The dynamic height is computed by dividing the NAVD 88
RV0624.geopotential number by the normal gravity value computed on the
RV0624.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
RV0624.degrees latitude (g = 980.6199 gals.).
RV0624
RV0624.The modeled gravity was interpolated from observed gravity values.
RV0624

Collect Digital Photos of Old Marks

Label Photos and Photo File Names Correctly

Add photo caption in the field or in the office

http://www.ngs.noaa.gov/ContractingOpportunities/PR_SOW_v9C.pdf

Caption format: ***aaaaaaaaaaaa, aannnn, naa, yyyymmdd***

Station Name, PID, Photo Number and Direction, Date

Example: **AX1234, B 123, 3NE, 20090511**

File Name format: ***aannnn-aaaaaaaaaaaa-naa-yyyymmdd.jpg***

PID-Station Name-Photo Number and Direction-Date.jpg

Example: **AX1234-B_123-3NE-20090511.jpg**

Note, "_" (underscores) used to fill blanks in station names in File Names.
Use original digital *.jpg images, converted from *.pdf may not work.

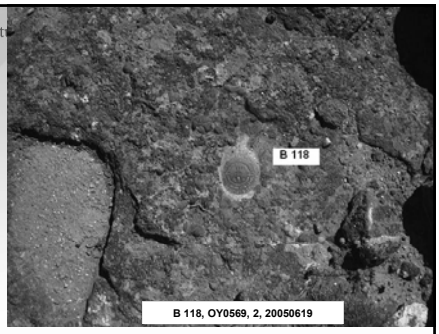
Required Photographs

- **All Marks Recovered and/or Described**
  - 1. **Close-up** (taken vertically)
  - 2. **From Eye Level** (taken vertically)
  - 3. **Horizontal View(s)**, mark in foreground
- **Image Size**
  - About **800 by 1000 pixels** when submitted
- **File Size**
  - Maximum file size for each image is 500 KB, **typical file size should be about 50 - 100KB**

Sample Photo Captions and File Names	
For new stations	B 145, 3NE, 20090511
	B_145-3NE-20090511.jpg
For existing stations	AB1234, B 145, 3NE, 20090511
	AB1234-B_145-3NE-20090511.jpg

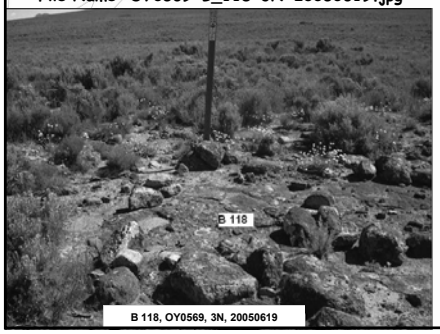


File Name: OY0569-B_118-1-20050619.jpg

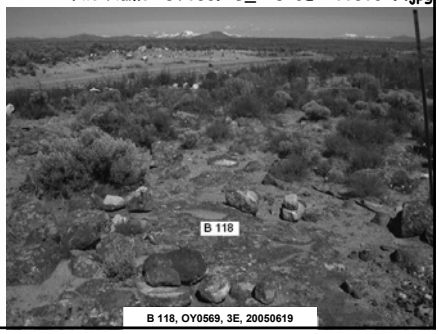


File Name: OY0569-B_118-2-20050619.jpg

File Name: OY0569-B_118-3N-20050619.jpg



File Name: OY0569-B_118-3E-20050619.jpg



Recovery Notes of Old Marks

- Write updated recovery notes in field
  - Station Description/Recovery Form
    http://www.ngs.noaa.gov/PROJECTS/FBN/
- Update descriptions in NGS "Submit Recovery" program.
- Import datasheets from NGS into WinDesc
  - Update descriptions in WinDesc

NATIONAL GEODETIC SURVEY STATI

4-char ID: BALD Designation:
PID: QE2736 Alias:
Country: (USA / USA) State: OR
Latitude: N44 49 49.17602 " Longitude: W

Original Description (check one):	
☐ P	Preliminary (mark has not been set yet)
☐ D	A newly set mark
☑ R	A recovered mark
Established by: (NGS / CGS / Other:)	Oregon DOT
Date:	Chief of Party (Initials): ???

Monument Stability (check one):	
☑ A	Of the most reliable nature; expected to hold well
☐ B	Will probably hold position and elevation well
☐ C	May hold well, but subject to ground movement
☐ D	Of questionable or unknown reliability

Setting Information:	
Marker Type: (Rod / Disk / Other)	
Setting Type: (Bedrock / Concrete / Other:)	
✓ / N / ?	Monument contains magnetic material?

Special Type (check all applicable):	
☐ F	Fault monitoring site
☐ T	Tidal Station
☑ --	Control Station: (FBN / CBN / Benchmark)
☐ --	Airport Control Station: (PACS / SACS)
✓ /N	Mark is suitable for GPS use?

See Back of Form to

General Station Location: The station is located in about 10 km south from Lincoln Bay, 13 km north from Depoe Bay, and at the US101 Boiler Bay wayside rest area.

(Describe general location; include airline distances to three towns or mapped features.)

Ownership: The station is on the property of Oregon State Department of Parks and Recreation.

(name, address, phone of landowner)

To Reach Narrative: To reach the station from the intersection of US routes 5 and 101 in Depoe Bay, go north on US 101 for 1 km to the south entrance of the Boiler Bay wayside. Bear left on entrance road for 0.4 km to the parking area on the left. Pack northwest inside fence for about 90 meters to end of fence and the station on the right.

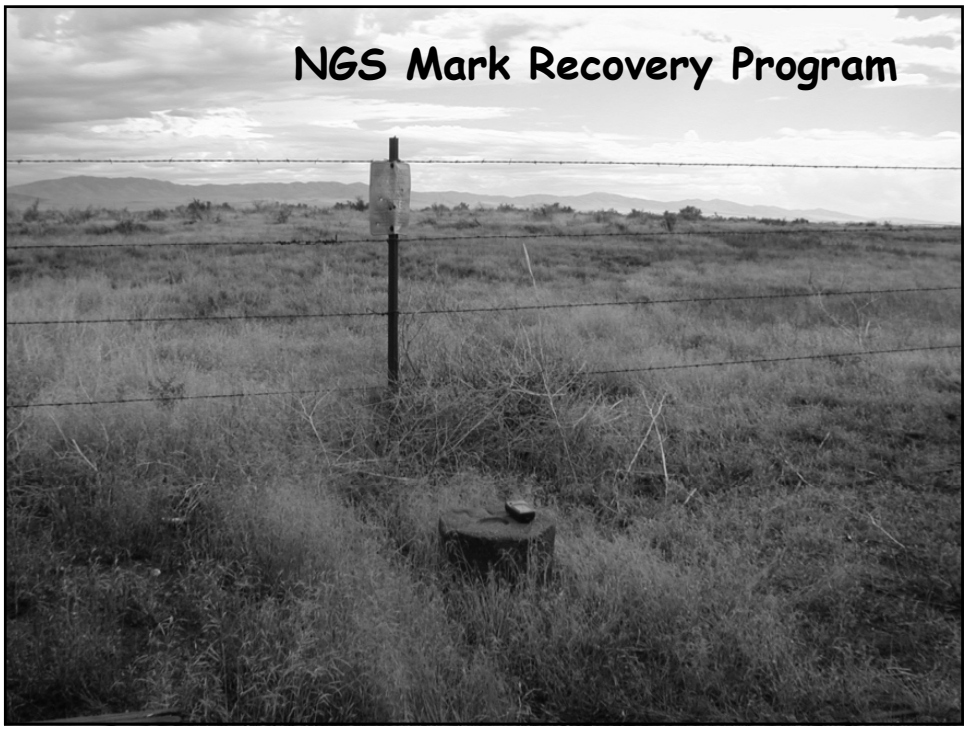
(Leg-by-leg distances and directions from major road intersection to mark)

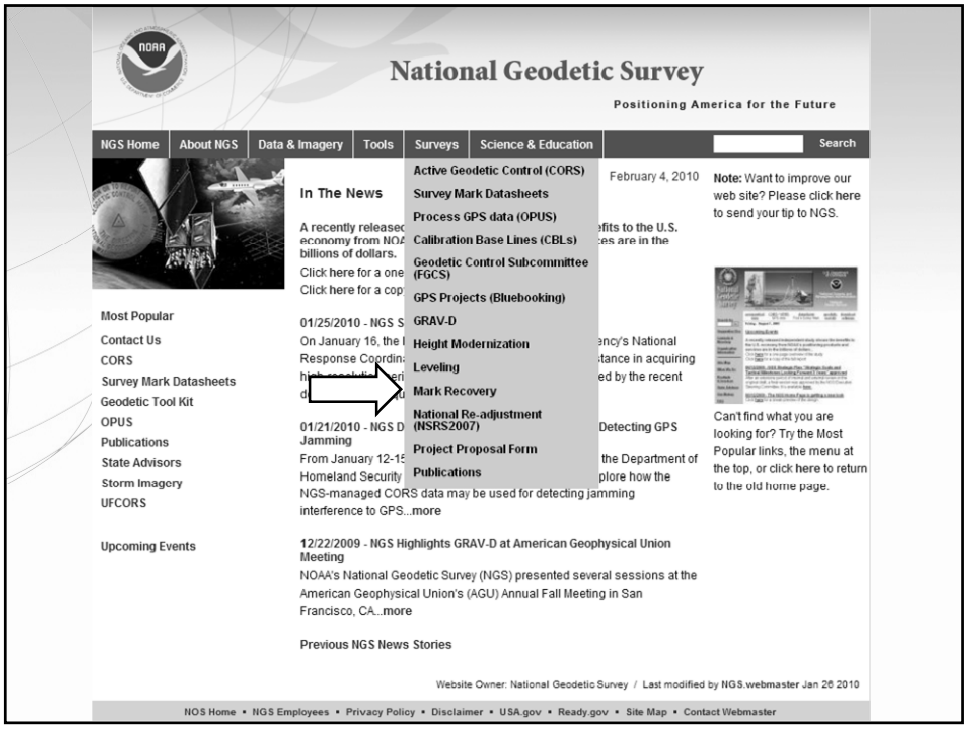
Monument Description and Measurements: The station is set into drill hole in bedrock, 7.6 m south from the north fence corner, 8.8 m east from the west fence corner, and 3.6 m southeast from the northwest end of the outcrop.

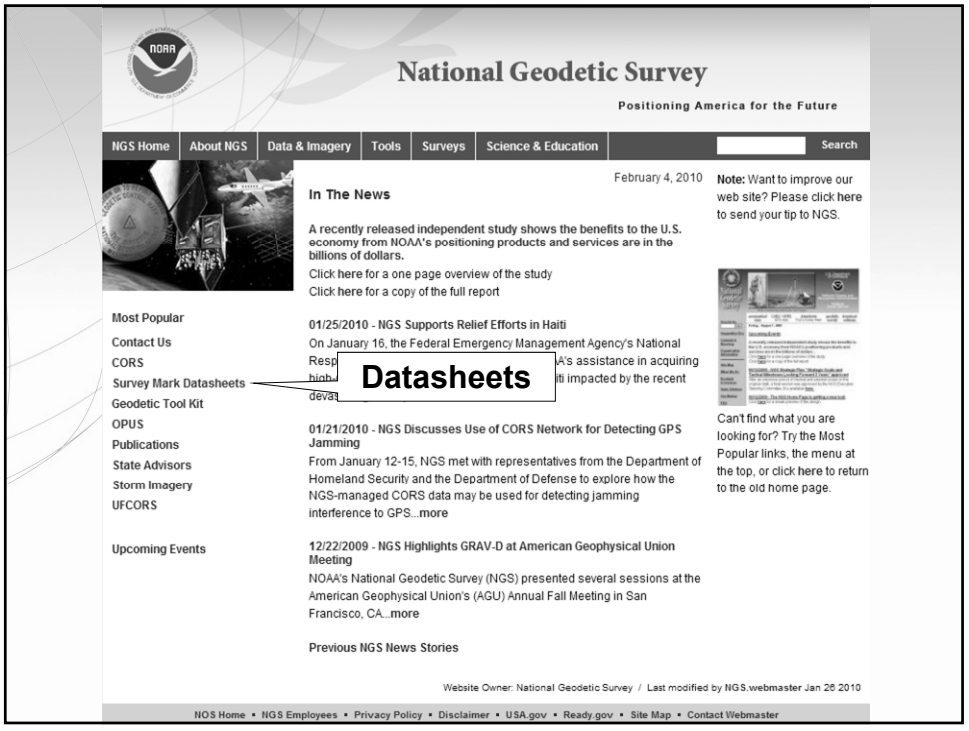
(Add at least three measurements to permanent, identifiable, nearby objects; and a description of the monument size, shape, height, etc.)

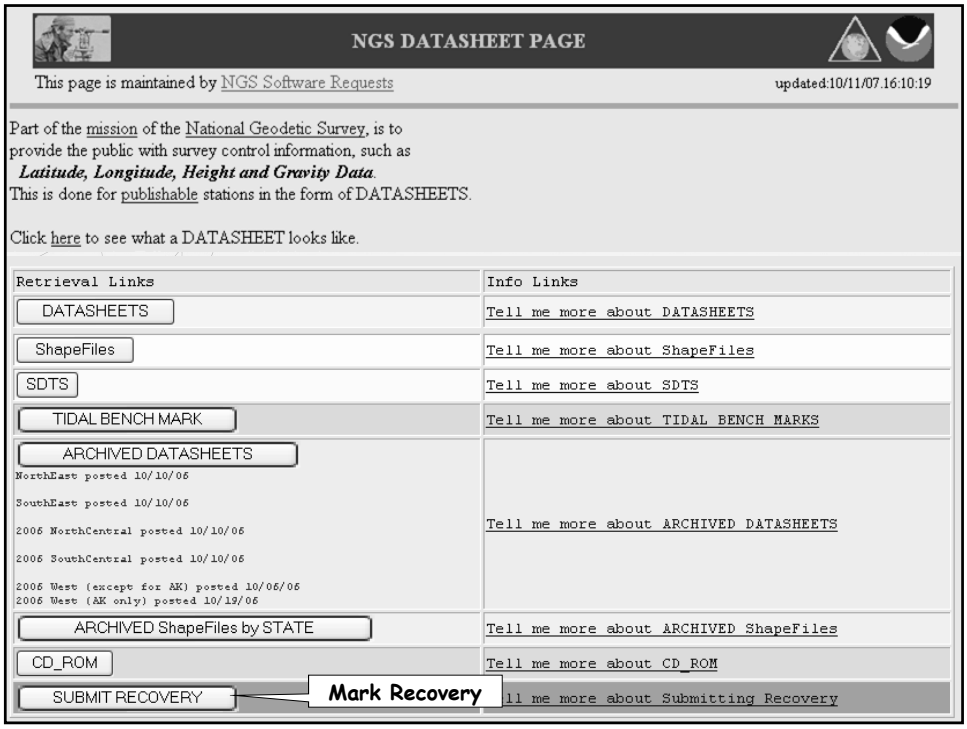
NOTE: - Include a pencil rubbing, sketch, or photographs of mark.

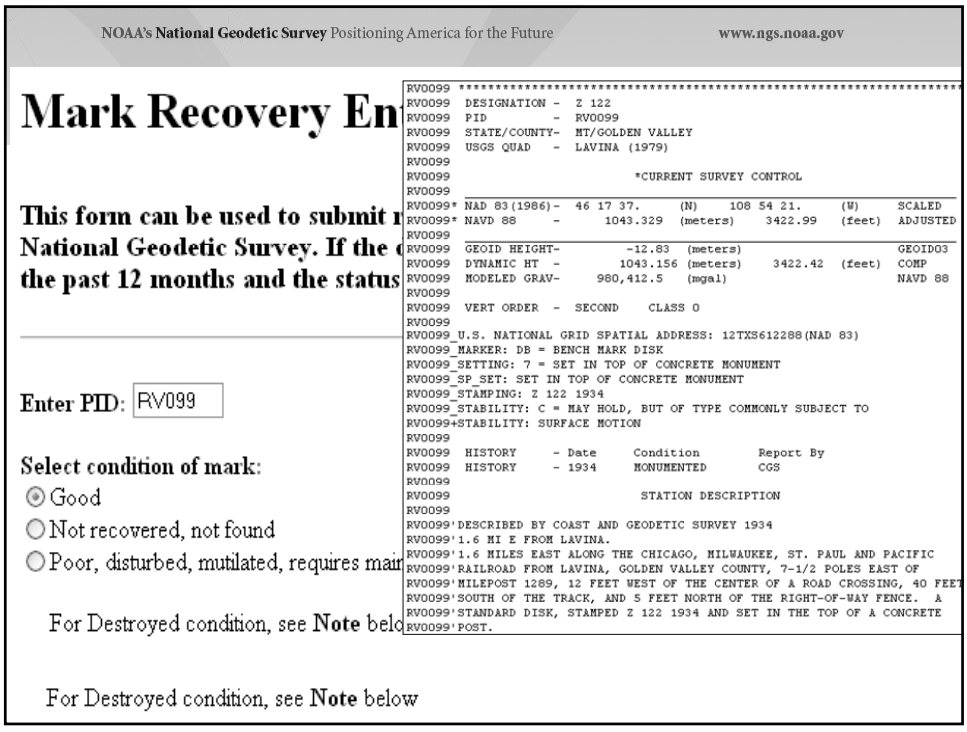
Described by: John Q. Surveyor Phone: (301) 713-3194 e-mail: jqs@ordot.gov




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A recently released independent study shows the benefits to the U.S. economy from NOAA's positioning products and services are in the billions of dollars.
Click here for a one page overview of the study
Click here for a copy of the full report
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01/25/2010 - NGS Supports Relief Efforts in Haiti
On January 16, the Federal Emergency Management Agency's National
A's assistance in acquiring
iti impacted by the recent
01/21/2010 - NGS Discusses Use of CORS Network for Detecting GPS Jamming
From January 12-15, NGS met with representatives from the Department of Homeland Security and the Department of Defense to explore how the NGS-managed CORS data may be used for detecting jamming interference to GPS...more
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NGS DATASHEET PAGE
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updated:10/11/07.16:10:19
Part of the mission of the National Geodetic Survey, is to provide the public with survey control information, such as
Latitude, Longitude, Height and Gravity Data.
This is done for publishable stations in the form of DATASHEETS.
Click here to see what a DATASHEET looks like.
Retrieval Links
Info Links
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Tell me more about DATASHEETS
ShapeFiles
Tell me more about ShapeFiles
SDTS
Tell me more about SDTS
TIDAL BENCH MARK
Tell me more about TIDAL BENCH MARKS
ARCHIVED DATASHEETS
NorthEast posted 10/10/06
SouthEast posted 10/10/06
2006 NorthCentral posted 10/10/06
2006 SouthCentral posted 10/10/06
2006 West (except for AK) posted 10/06/06
2006 West (AK only) posted 10/19/06
Tell me more about ARCHIVED DATASHEETS
ARCHIVED ShapeFiles by STATE
Tell me more about ARCHIVED ShapeFiles
CD_ROM
Tell me more about CD_ROM
SUBMIT RECOVERY
Mark Recovery
ll me more about Submitting Recovery


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www.ngs.noaa.gov
Mark Recovery En
This form can be used to submit r
National Geodetic Survey. If the
the past 12 months and the status
Enter PID: RV099
Select condition of mark:
Good
Not recovered, not found
Poor, disturbed, mutilated, requires mai
For Destroyed condition, see Note belo
RV0099 DESIGNATION - Z 122
RV0099 PID - RV0099
RV0099 STATE/COUNTY- MT/GOLDEN VALLEY
RV0099 USGS QUAD - LAVINA (1979)
RV0099 *CURRENT SURVEY CONTROL
RV0099* NAD 83(1986)- 46 17 37. (N) 108 54 21. (W) SCALED
RV0099* NAVD 88 - 1043.329 (meters) 3422.99 (feet) ADJUSTED
RV0099 GEOID HEIGHT- -12.83 (meters) GEOID03
RV0099 DYNAMIC HT - 1043.156 (meters) 3422.42 (feet) COMP
RV0099 MODELED GRAV- 980,412.5 (mgal) NAVD 88
RV0099 VERT ORDER - SECOND CLASS 0
RV0099_U.S. NATIONAL GRID SPATIAL ADDRESS: 12TXS612288(NAD 83)
RV0099_MARKER: DB = BENCH MARK DISK
RV0099_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
RV0099_SP_SET: SET IN TOP OF CONCRETE MONUMENT
RV0099_STAMPING: Z 122 1934
RV0099_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
RV0099+STABILITY: SURFACE MOTION
RV0099 HISTORY - Date Condition Report By
RV0099 HISTORY - 1934 MONUMENTED CGS
RV0099 STATION DESCRIPTION
RV0099'DESCRIBED BY COAST AND GEODETIC SURVEY 1934
RV0099'1.6 MI E FROM LAVINA.
RV0099'1.6 MILES EAST ALONG THE CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
RV0099'RAILROAD FROM LAVINA, GOLDEN VALLEY COUNTY, 7-1/2 POLES EAST OF
RV0099'MILEPOST 1289, 12 FEET WEST OF THE CENTER OF A ROAD CROSSING, 40 FEET
RV0099'SOUTH OF THE TRACK, AND 5 FEET NORTH OF THE RIGHT-OF-WAY FENCE. A
RV0099'STANDARD DISK, STAMPED Z 122 1934 AND SET IN THE TOP OF A CONCRETE
RV0099'POST.
For Destroyed condition, see Note below

Note: For destroyed marks do one of the following:

1) If you have found the actual marker separated from its setting, you can report the point as destroyed. To do so please send the report on the destroyed mark as an email to Deb Brown (Deb.Brown@noaa.gov). If you send this email, please do not submit the current form, Deb Brown will submit the report for you. **In addition, please submit proof of the mark's destruction via actual disk, rubbing, photo, or digital picture (preferred) to Deb Brown:**

Deb Brown, N/NGS143
National Geodetic Survey, NOAA
1315 East West Highway
Silver Spring, MD 20910

2) If you did not find the actual marker, then you should enter notes concerning evidence of its possible destruction as text records and select "Not recovered, not found" as the condition of mark.



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Enter agency code of the recovering organization/agency:

- ○ USPSQD - U.S. Power Squadron
- ○ GEOCAC - Geocaching
- ◉ INDIV - Local Surveyor or Engineer
- ○ NGS - National Geodetic Survey
- ○ Other - Enter the approved agency code of the organization which recovered the mark in the textbox below.

If you do not know your approved agency code, you can generate the latest contributors' list from NGS' integrated database (NGSIDB). On this list the agency code starts in column 1 and the agency full name follows it. The list is sorted alphabetically by agency code. If your agency or firm is not on this list and you would like to be assigned a specific agency code, please contact Deb Brown at NGS to make the appropriate arrangements.

Enter initials of the person who recovered the mark (Optional): CLS

www.ngs.noaa.gov

Contributors List

MORGAN	WEBB A MORGAN AND ASSOCIATES PA
MORMAI	MORRISON-MAIERLE INC
MORRI	MORRISON MAIERLE INC
MORRIT	MORRIS AND RITCHIE ASSOCIATES, INCORPORATED
MORSUR	MORRISON SURVEYING COMPANY
MOSLSA	MISSOURI STATE LAND SURVEY AUTHORITY
MPA	MASSACHUSETTS PORT AUTHORITY
MPHI	MORRIS P HEBERT INCORPORATED
MPRR	MISSOURI PACIFIC RAILROAD
MPS	MACNAMEE PORTER AND SEELEY
MRC	MISSISSIPPI RIVER COMMISSION
MRGCD	MIDDLE RIO GRANDE CONSERVATION DISTRICT
MRIVER	MOUNTAIN RIVER ENGINEERING
MRMSC	MILWAUKEE-RACINE METROPOLITAN SEWAGE COMM
MS-059	JACKSON COUNTY MISSISSIPPI
MS-135	TALLAHATCHIE COUNTY MISSISSIPPI
MS-145	UNION COUNTY MISSISSIPPI
MS1220	CITY OF JACKSON MISSISSIPPI
MSAM	MOUNTAIN SURVEYING AND MAPPING INC
MSCD	METROPOLITAN STATE COLLEGE-DENVER
MSDEQ	MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
MSDJWM	MS DELTA JOINT WATER MGMT DISTRICT
MSDOT	MISSISSIPPI DEPARTMENT OF TRANSPORTATION
MSE	MSE CORPORATION
MSGS	MISSISSIPPI GEODETIC SURVEY
MSHD	MISSISSIPPI STATE HIGHWAY DEPARTMENT
MSHUNI	MARSHALL UNIVERSITY, RAHALL TRANSPORTATION INSTITUTE
MSI	MEASUREMENT SCIENCE INCORPORATED
MSLACO	MISSOULA COUNTY SURVEYOR
MSM	MEURER SERAFINI AND MEURER INCORPORATED
MSP+L	MISSISSIPPI POWER AND LIGHT COMPANY
MSSU	MISSISSIPPI STATE UNIVERSITY
MSU	UNIVERSITY OF MISSISSIPPI
MTARLS	MONTANA ASSOCIATION OF REGISTERED LAND SURVEYORS
MTBOR	MONTANA BUREAU OF PUBLIC ROADS
MTDH	MONTANA DEPARTMENT OF HIGHWAYS
MTDNR	MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
MTDOT	MONTANA DEPARTMENT OF TRANSPORTATION
MTGS	MONTANA GEODETIC SURVEY
MTMS	MONTANA STATE UNIVERSITY NORTHERN
MTNWCO	MONTANA NORTHWEST COMPANY

The date of recovery must be expressed as a numerical month (between 1 and 12), a numerical day of the month, and a four character numerical year. The month, day, and year may be separated by spaces or by commas.

Valid examples are:
`4,25,1998` for April 25, 1998
`4 25 1998` for April 25, 1998

The current program is not valid for dates before 1990.

Enter date of recovery: 5 16 2007

Enter your name and email address:

Privacy Statement: Your name and email address will be used only to contact you if there is a problem in loading your recovery. They will not be used for any other purpose.

Enter name: Curt Smith
Enter email address: Curt.Smith@noaa.gov

You can, if you wish, enter up to 15 lines of text in the space below. Actually, 15 lines means 15 Carriage Returns. I.e., if you use the wrap-around feature you can actually enter up to 6 lines of text for **each** of those 15 lines.

The only characters that are allowed are: letters, numbers, blank or space ( ), comma (,), period or decimal (.), apostrophe or single quote ('), asterisk (*), plus sign (+), minus sign or hyphen (-), equal sign (=), slash (/), left parenthesis ((), and right parenthesis ()).

Warning: Do not enter personal phone numbers.

Note: Text such as RECOVERED AS DESCRIBED, or MARK NOT FOUND, or DESCRIPTION IS ADEQUATE, etc. is not necessary.

```
THE DESCRIBED RAILROAD IS NOW ABANDONDED.  TO REACH THE STATION FROM
THE INTERSETION OF U.S. HIGHWAY 12 AND RAILWAY AVENUE EAST IN
LAVINA, GO EAST ON RAILWAY AVENUE EAST FOR 1.0 MILES TO A BEND IN
THE ROAD.  BEAR NORTH THRU THE DOUBLE IRON GATE AND THEN GO EAST ON
OLD RAILROAD GRADE FOR 0.65 MILES TO THE MARK ON THE RIGHT.
```

submit

For assistance contact Deb Brown
Email: Deb.Brown@noaa.gov

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Verify Station Name for Mark Recovery

The Station Name for PID RV0099 is:

Z 122

State: MONTANA
County: GOLDEN VALLEY

Is this the correct station?

◉ Yes ○ No

submit

```
RV0099 ***********************************************************************
RV0099  DESIGNATION -  Z 122
RV0099  PID         -  RV0099
RV0099  STATE/COUNTY-  MT/GOLDEN VALLEY
RV0099  USGS QUAD   -  LAVINA (1979)
RV0099
RV0099                          *CURRENT SURVEY CONTROL
RV0099
RV0099* NAD 83(1986)-  46 17 37.      (N)     108 54 21.      (W)     SCALED
RV0099* NAVD 88     -       1043.329  (meters)    3422.99   (feet)  ADJUSTED
RV0099
RV0099  GEOID HEIGHT-          -12.83  (meters)                      GEOID03
RV0099  DYNAMIC HT  -        1043.156 (meters)    3422.42   (feet)  COMP
RV0099  MODELED GRAV-     980,412.5   (mgal)                        NAVD 88
RV0099
RV0099  VERT ORDER  -  SECOND    CLASS 0
RV0099
RV0099_U.S. NATIONAL GRID SPATIAL ADDRESS: 12TXS612288(NAD 83)
RV0099_MARKER: DB = BENCH MARK DISK
RV0099_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
RV0099_SP_SET: SET IN TOP OF CONCRETE MONUMENT
RV0099_STAMPING: Z 122 1934
RV0099_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
RV0099+STABILITY: SURFACE MOTION
RV0099
RV0099  HISTORY     - Date     Condition        Report By
RV0099  HISTORY     - 1934     MONUMENTED       CGS
RV0099
RV0099                           STATION DESCRIPTION
RV0099
RV0099'DESCRIBED BY COAST AND GEODETIC SURVEY 1934
RV0099'1.6 MI E FROM LAVINA.
RV0099'1.6 MILES EAST ALONG THE CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
RV0099'RAILROAD FROM LAVINA, GOLDEN VALLEY COUNTY, 7-1/2 POLES EAST OF
RV0099'MILEPOST 1289, 12 FEET WEST OF THE CENTER OF A ROAD CROSSING, 40 FEET
RV0099'SOUTH OF THE TRACK, AND 5 FEET NORTH OF THE RIGHT-OF-WAY FENCE.  A
RV0099'STANDARD DISK, STAMPED Z 122 1934 AND SET IN THE TOP OF A CONCRETE
RV0099'POST.
```

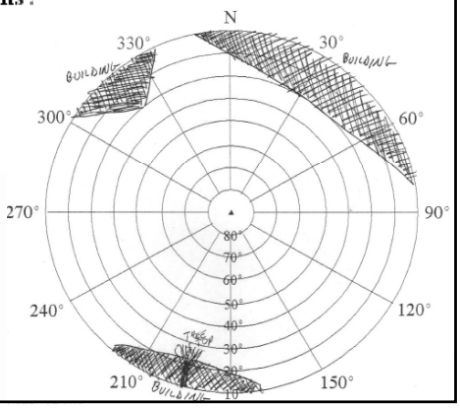
Satellite Usage

Generally, a station is suitable for satellite observations if there is a clear and unobstructed view of the sky from approximately 15 degrees above the horizon at the location of the station. Small objects such as a light pole or small tree are excepted.

Is this station suitable for satellite observations?

◉ Yes ○ No ○ Don't know

submit



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Thank you for submitting this recovery. These data will be processed and should appear in the National Spatial Reference System within 30 days.

If you would like to submit another recovery, you may go back to the initial form and change only those items which need to be changed. I.e., to submit additional recoveries without re-keying items which do not change, do as follows: Hit the "Back" button a couple of times until you get back to the initial form. Then change only those items which need to be changed. Then re-submit the form. Your old information will be retained and re-submitted along with the newly-keyed information.

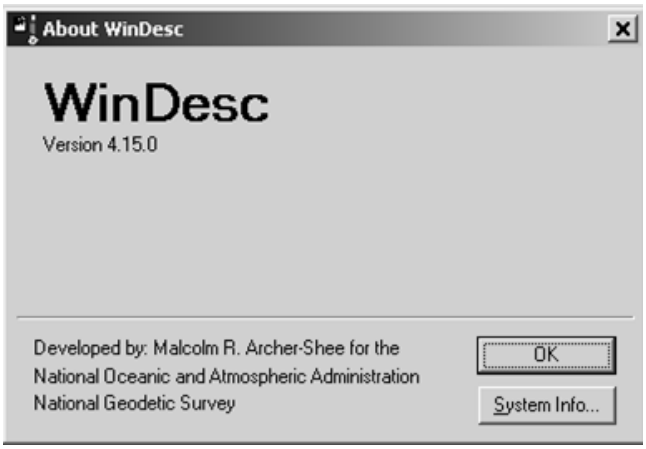
Existing Datasheet

```
RV0099 ***********************************************************************
RV0099  DESIGNATION -  Z 122
RV0099  PID         -  RV0099
RV0099  STATE/COUNTY-  MT/GOLDEN VALLEY
RV0099  USGS QUAD   -  LAVINA (1979)
RV0099
RV0099                          *CURRENT SURVEY CONTROL
RV0099
RV0099* NAD 83(1986)-  46 17 37.      (N)     108 54 21.      (W)      SCALED
RV0099* NAVD 88     -      1043.329  (meters)     3422.99   (feet)  ADJUSTED
RV0099
RV0099  GEOID HEIGHT-          -12.83  (meters)                        GEOID03
RV0099  DYNAMIC HT  -         1043.156 (meters)     3422.42  (feet)  COMP
RV0099  MODELED GRAV-      980,412.5   (mgal)                         NAVD 88
RV0099
RV0099  VERT ORDER  -  SECOND    CLASS 0
RV0099
RV0099_U.S. NATIONAL GRID SPATIAL ADDRESS: 12TXS612288(NAD 83)
RV0099_MARKER: DB = BENCH MARK DISK
RV0099_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
RV0099_SP_SET: SET IN TOP OF CONCRETE MONUMENT
RV0099_STAMPING: Z 122 1934
RV0099_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
RV0099+STABILITY: SURFACE MOTION
RV0099
RV0099  HISTORY     - Date     Condition        Report By
RV0099  HISTORY     - 1934     MONUMENTED       CGS
RV0099
RV0099                           STATION DESCRIPTION
RV0099
RV0099'DESCRIBED BY COAST AND GEODETIC SURVEY 1934
RV0099'1.6 MI E FROM LAVINA.
RV0099'1.6 MILES EAST ALONG THE CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
RV0099'RAILROAD FROM LAVINA, GOLDEN VALLEY COUNTY, 7-1/2 POLES EAST OF
RV0099'MILEPOST 1289, 12 FEET WEST OF THE CENTER OF A ROAD CROSSING, 40 FEET
RV0099'SOUTH OF THE TRACK, AND 5 FEET NORTH OF THE RIGHT-OF-WAY FENCE.  A
RV0099'STANDARD DISK, STAMPED Z 122 1934 AND SET IN THE TOP OF A CONCRETE
RV0099'POST.
```

Updated Datasheet

```
RV0099
RV0099_U.S. NATIONAL GRID SPATIAL ADDRESS: 12TXS612288(NAD 83)
RV0099_MARKER: DB = BENCH MARK DISK
RV0099_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
RV0099_SP_SET: SET IN TOP OF CONCRETE MONUMENT
RV0099_STAMPING: Z 122 1934
RV0099_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
RV0099+STABILITY: SURFACE MOTION
RV0099_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR SATELLITE
RV0099+SATELLITE: OBSERVATIONS - May 14, 2007
RV0099
RV0099  HISTORY     - Date     Condition        Report By
RV0099  HISTORY     - 1934     MONUMENTED       CGS
RV0099  HISTORY     - 20070514 GOOD             INDIV
RV0099
RV0099                           STATION DESCRIPTION
RV0099
RV0099'DESCRIBED BY COAST AND GEODETIC SURVEY 1934
RV0099'1.6 MI E FROM LAVINA.
RV0099'1.6 MILES EAST ALONG THE CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
RV0099'RAILROAD FROM LAVINA, GOLDEN VALLEY COUNTY, 7-1/2 POLES EAST OF
RV0099'MILEPOST 1289, 12 FEET WEST OF THE CENTER OF A ROAD CROSSING, 40 FEET
RV0099'SOUTH OF THE TRACK, AND 5 FEET NORTH OF THE RIGHT-OF-WAY FENCE.  A
RV0099'STANDARD DISK, STAMPED Z 122 1934 AND SET IN THE TOP OF A CONCRETE
RV0099'POST.
RV0099'
RV0099'                          STATION RECOVERY (2007)
RV0099'
RV0099'RECOVERY NOTE BY LOCAL SURVEYOR OR ENGINEER 2007 (CLS)
RV0099'THE DESCRIBED RAILROAD IS NOW ABANDONED.  TO REACH THE STATION FROM
RV0099'THE INTERESCETION OF U.S. HIGHWAY 12 AND RAILWAY AVENUE EAST IN
RV0099'LAVINA, GO EAST ON RAILWAY AVENUE EAST FOR 1.0 MILES TO A BEND IN THE
RV0099'ROAD.  BEAR NORTH THRU THE DOUBLE IRON GATE AND THEN GO EAST ON OLD
RV0099'RAILROAD GRADE FOR 0.65 MILES TO THE MARK ON THE RIGHT.
```

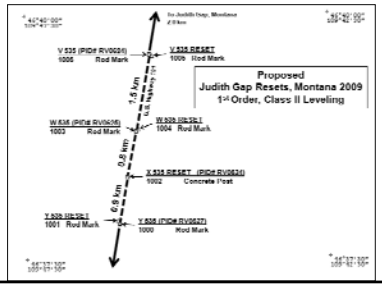
Program WinDesc

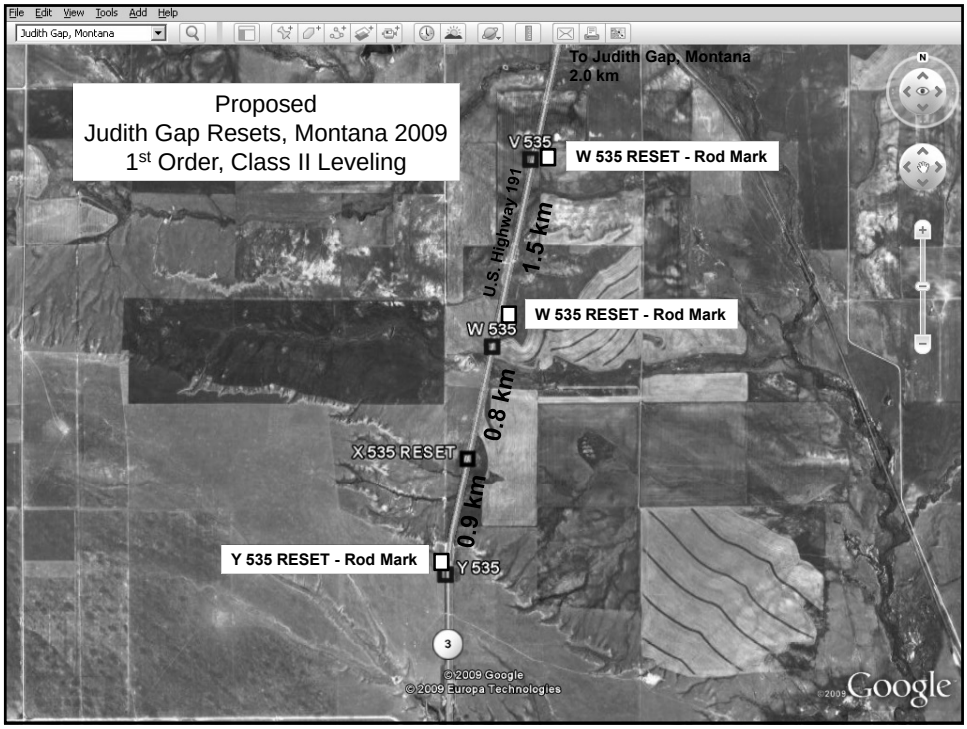


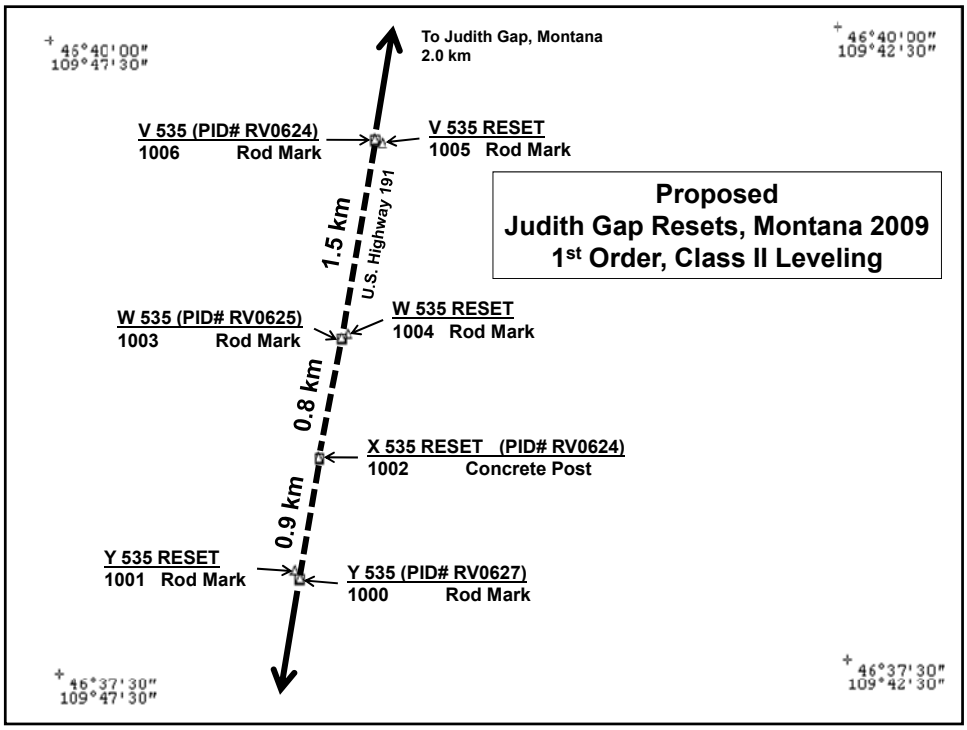
Second Option – will be discussed later

Create Proposed Project Map

- Create an overview map showing:
  - Existing marks
  - Planned new locations
  - Marks not found
  - Destroyed marks or in poor condition



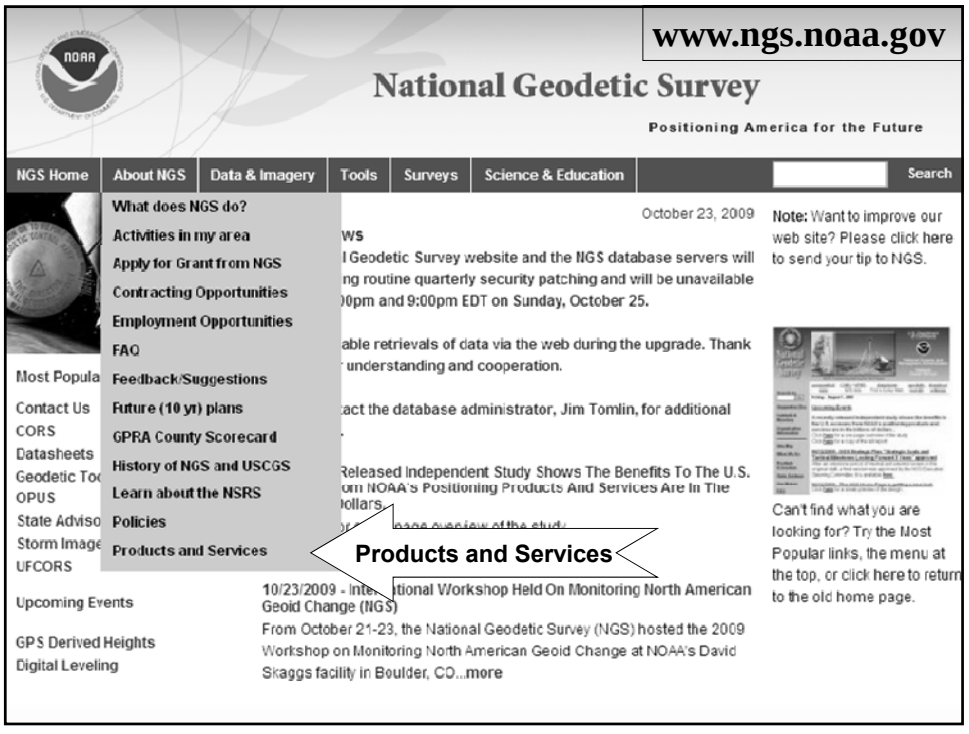

Proposed
Judith Gap Resets, Montana 2009
1st Order, Class II Leveling
To Judith Gap, Montana
2.0 km
V 535
W 535 RESET - Rod Mark
U.S. Highway 191
1.5 km
W 535 RESET - Rod Mark
W 535
0.8 km
X 535 RESET
0.9 km
Y 535 RESET - Rod Mark
Y 535
3
© 2009 Google
© 2009 Europa Technologies
Google

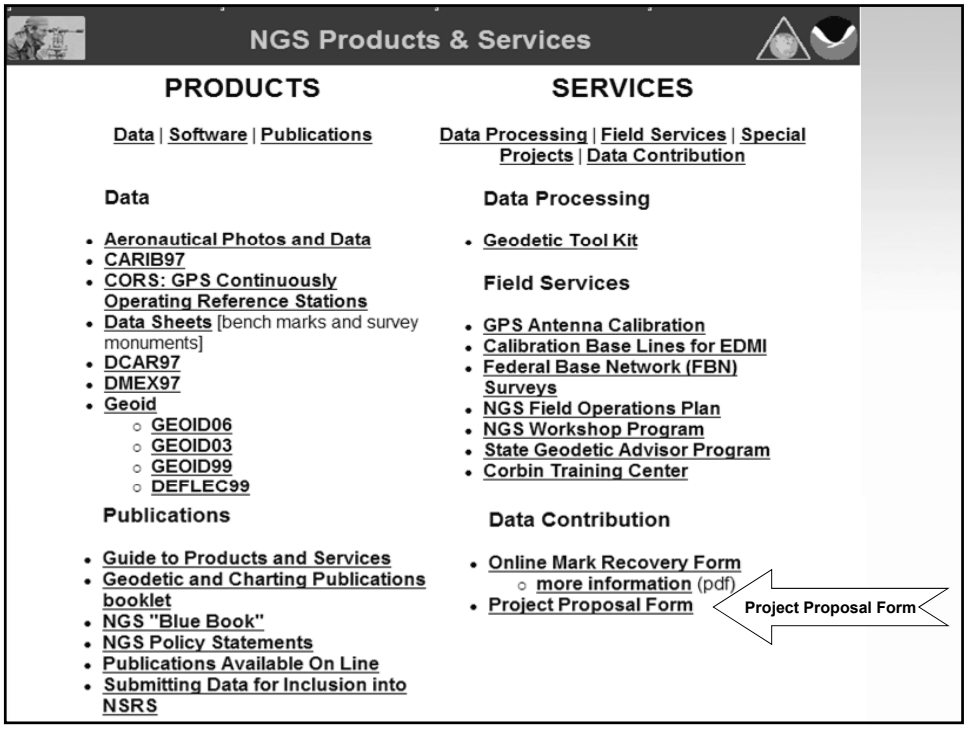

46°40'00"
109°47'30"
To Judith Gap, Montana
2.0 km
46°40'00"
109°42'30"
V 535 (PID# RV0624)
1006 Rod Mark
V 535 RESET
1005 Rod Mark
1.5 km
U.S. Highway 191
Proposed
Judith Gap Resets, Montana 2009
1st Order, Class II Leveling
W 535 (PID# RV0625)
1003 Rod Mark
W 535 RESET
1004 Rod Mark
0.8 km
X 535 RESET (PID# RV0624)
1002 Concrete Post
0.9 km
Y 535 RESET
1001 Rod Mark
Y 535 (PID# RV0627)
1000 Rod Mark
46°37'30"
109°47'30"
46°37'30"
109°42'30"

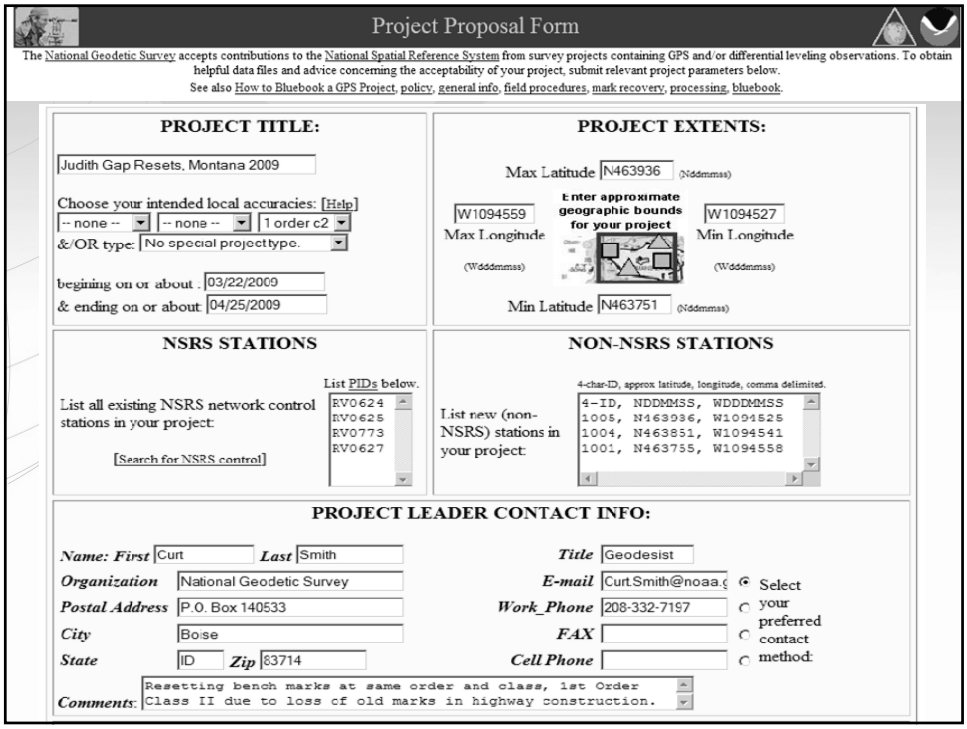
Submit Project Proposal to NGS

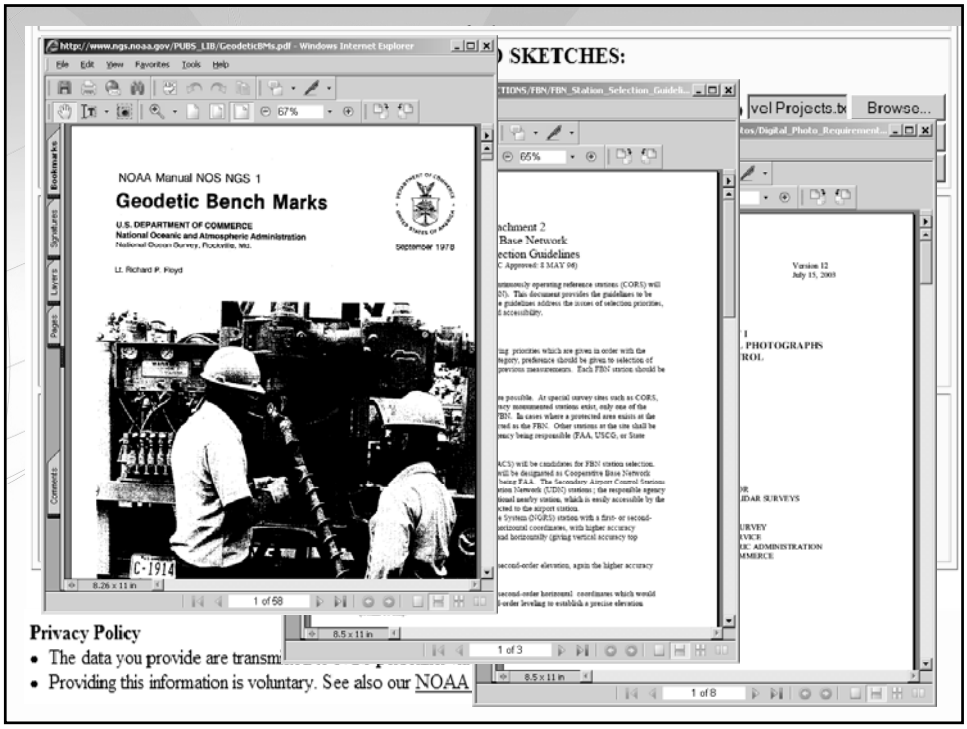
- Fill out NGS on-line Project Proposal form
- Include project map, min. max lat/long, existing mark PIDS, non-NSRS point lat/long, preliminary photos
- Acquire project "L-*number*"
- Acquire sequence for new station names

- Project Proposals, found at: http://www.ngs.noaa.gov/PROJECTS/proposals/project1.shtml




NGS Products & Services
PRODUCTS
SERVICES
Data | Software | Publications
Data Processing | Field Services | Special Projects | Data Contribution
Data
Aeronautical Photos and Data
CARIB97
CORS: GPS Continuously Operating Reference Stations
Data Sheets [bench marks and survey monuments]
DCAR97
DMEX97
Geoid
GEOID06
GEOID03
GEOID99
DEFLEC99
Publications
Guide to Products and Services
Geodetic and Charting Publications booklet
NGS "Blue Book"
NGS Policy Statements
Publications Available On Line
Submitting Data for Inclusion into NSRS
Data Processing
Geodetic Tool Kit
Field Services
GPS Antenna Calibration
Calibration Base Lines for EDMI
Federal Base Network (FBN) Surveys
NGS Field Operations Plan
NGS Workshop Program
State Geodetic Advisor Program
Corbin Training Center
Data Contribution
Online Mark Recovery Form
more information (pdf)
Project Proposal Form
Project Proposal Form


Project Proposal Form
The National Geodetic Survey accepts contributions to the National Spatial Reference System from survey projects containing GPS and/or differential leveling observations. To obtain helpful data files and advice concerning the acceptability of your project, submit relevant project parameters below.
See also How to Bluebook a GPS Project, policy, general info, field procedures, mark recovery, processing, bluebook.
PROJECT TITLE:
Judith Gap Resets, Montana 2009
Choose your intended local accuracies: [Help]
-- none --
-- none --
1 order c2
&/OR type: No special project type.
begining on or about . 03/22/2009
& ending on or about 04/25/2009
PROJECT EXTENTS:
Max Latitude N463936 (Nddmmss)
W1094559 Max Longitude (Wdddmmss)
Enter approximate geographic bounds for your project
W1094527 Min Longitude (Wdddmmss)
Min Latitude N463751 (Nddmmss)
NSRS STATIONS
List all existing NSRS network control stations in your project:
[Search for NSRS control]
List PIDs below.
RV0624
RV0625
RV0773
RV0627
NON-NSRS STATIONS
List new (non-NSRS) stations in your project:
4-char-ID, approx latitude, longitude, comma delimited.
4-ID, NDDMMSS, WDDMMSS
1005, N463936, W1094525
1004, N463851, W1094541
1001, N463755, W1094558
PROJECT LEADER CONTACT INFO:
Name: First Curt Last Smith
Organization National Geodetic Survey
Postal Address P.O. Box 140533
City Boise
State ID Zip 83714
Title Geodesist
E-mail Curt.Smith@noaa.g
Work_Phone 208-332-7197
FAX
Cell Phone
Select your preferred contact method:
Comments: Resetting bench marks at same order and class, 1st Order Class II due to loss of old marks in highway construction.



Leveling Projects - Project Proposal

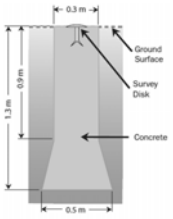
- **Assigns Project "L" Numbers**
  - **NGS, Geodetic Standards and Applications Branch**
  - **Bob Siclari**
  - **301-713-3194 ext. 130**
  - **Bob.Siclari@noaa.gov**

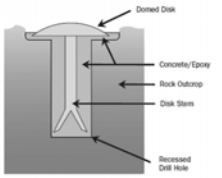
Example: L-12345 Boise, Idaho via U.S. Highway 55 to Emmet, Idaho

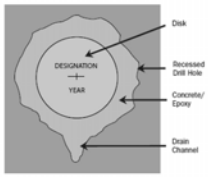
New Marks

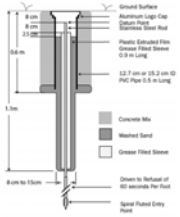
- Set new marks
  - NOAA Manual NOS NGS 1, Geodetic Bench Marks *(Sept. 1978)*
  - Bench Mark Reset Procedures *(September 2007)*

  http://www.ngs.noaa.gov/PUBS_LIB/pub_index.html
- Collect photos of new marks
  - Label Correctly
- Write descriptions of new marks in field







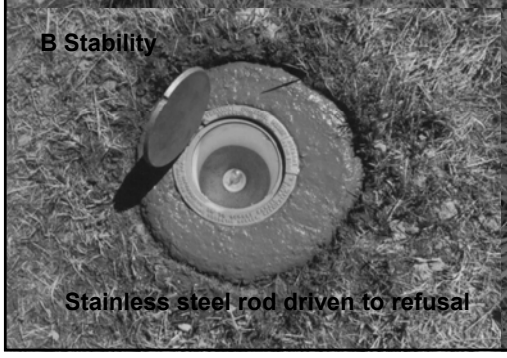




Physically Monumented Points

Stability Codes

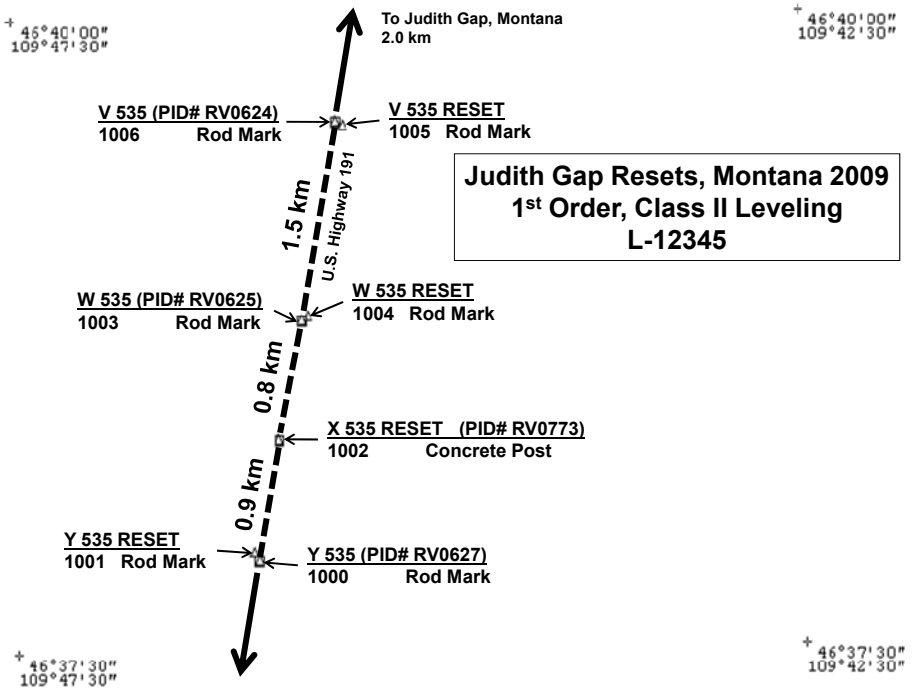
A = Most reliable and expected to hold position/elevation well
B = Probably hold position/elevation well
C = May hold, but of type commonly subject to surface motion
D = Mark of questionable or unknown stability

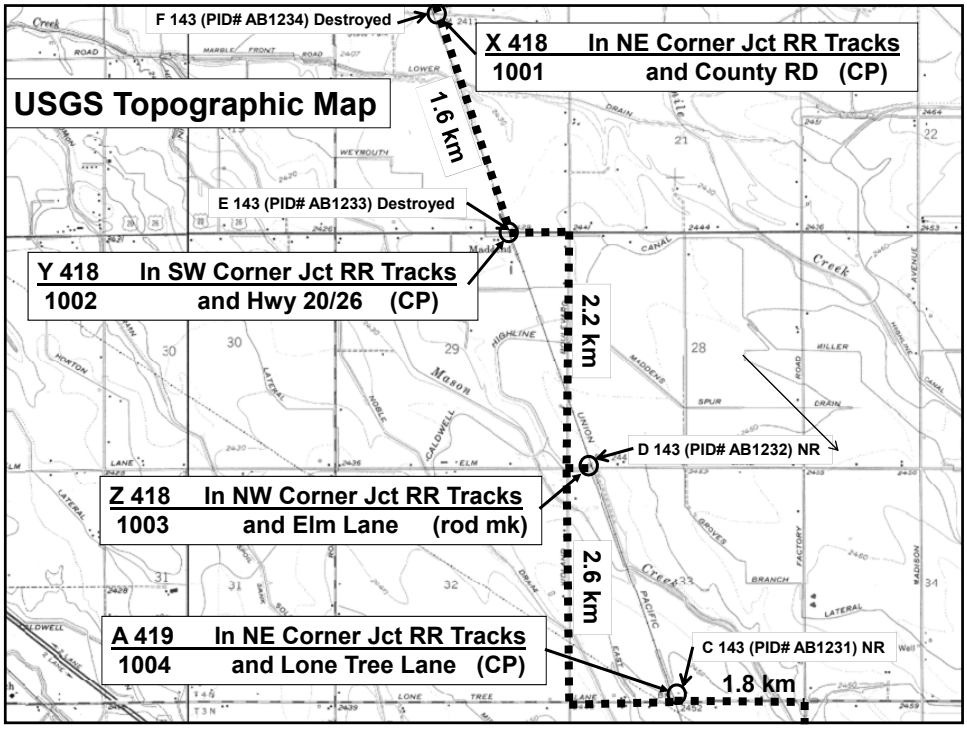




Create Detailed Project Maps

- Show station names and SSN's
- Show brief description of mark
- Show distance between marks
- Show direction crew will actually level
- Use programs such as Google Earth or other mapping software.

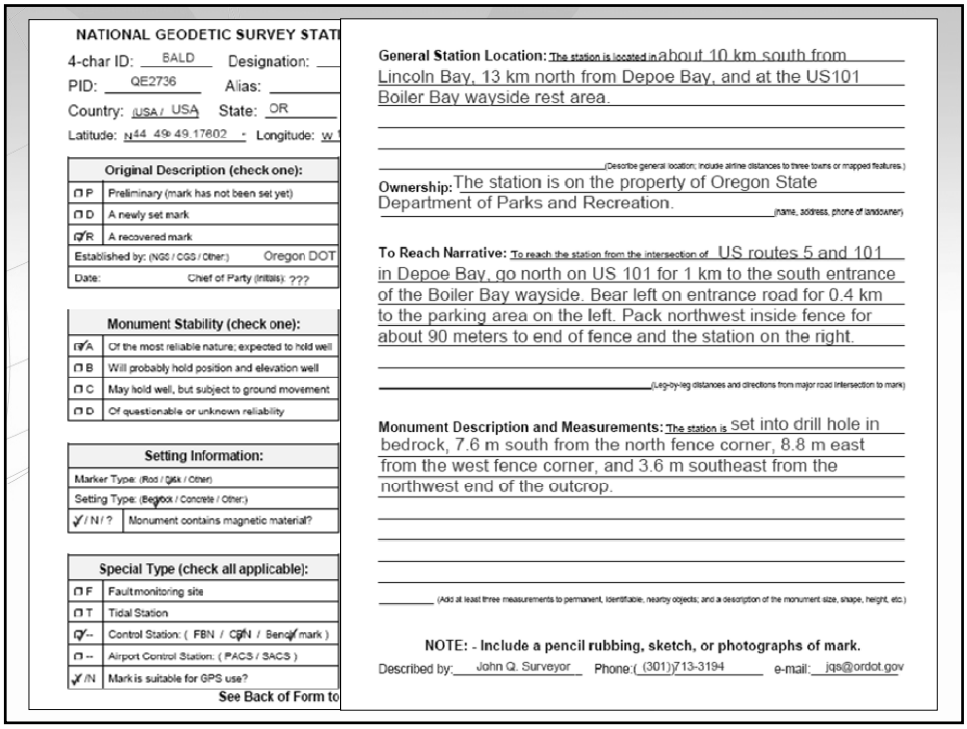




NOAA's National Geodetic Survey Positioning America for the Future www.ngs.noaa.gov

Write Station Descriptions

- WinDesc – most current version
  http://www.ngs.noaa.gov/PC_PROD/pc_prod.shtml
- Import existing marks
  - Recovery notes and any necessary updates
- Enter descriptions for new marks
- Export descriptions to NGS D-file format
- Check and correct errors - WinDesc



NATIONAL GEODETIC SURVEY STATI

4-char ID: BALD Designation:
PID: QE2736 Alias:
Country: (USA / USA) State: OR
Latitude: N44 49 49.17602 " Longitude: W

Original Description (check one):	
☐ P	Preliminary (mark has not been set yet)
☐ D	A newly set mark
☑ R	A recovered mark
Established by: (NGS / CGS / Other:)	Oregon DOT
Date:	Chief of Party (Initials): ???

Monument Stability (check one):	
☑ A	Of the most reliable nature; expected to hold well
☐ B	Will probably hold position and elevation well
☐ C	May hold well, but subject to ground movement
☐ D	Of questionable or unknown reliability

Setting Information:	
Marker Type: (Rod / Disk / Other)	
Setting Type: (Bedrock / Concrete / Other:)	
✓ / N / ?	Monument contains magnetic material?

Special Type (check all applicable):	
☐ F	Fault monitoring site
☐ T	Tidal Station
☑ --	Control Station: (FBN / CBN / Bench mark)
☐ --	Airport Control Station: (PACS / SACS)
✓ /N	Mark is suitable for GPS use?

See Back of Form to

General Station Location: The station is located in about 10 km south from Lincoln Bay, 13 km north from Depoe Bay, and at the US101 Boiler Bay wayside rest area.

(Describe general location; include airline distances to three towns or mapped features.)

Ownership: The station is on the property of Oregon State Department of Parks and Recreation.

(name, address, phone of landowner)

To Reach Narrative: To reach the station from the intersection of US routes 5 and 101 in Depoe Bay, go north on US 101 for 1 km to the south entrance of the Boiler Bay wayside. Bear left on entrance road for 0.4 km to the parking area on the left. Pack northwest inside fence for about 90 meters to end of fence and the station on the right.

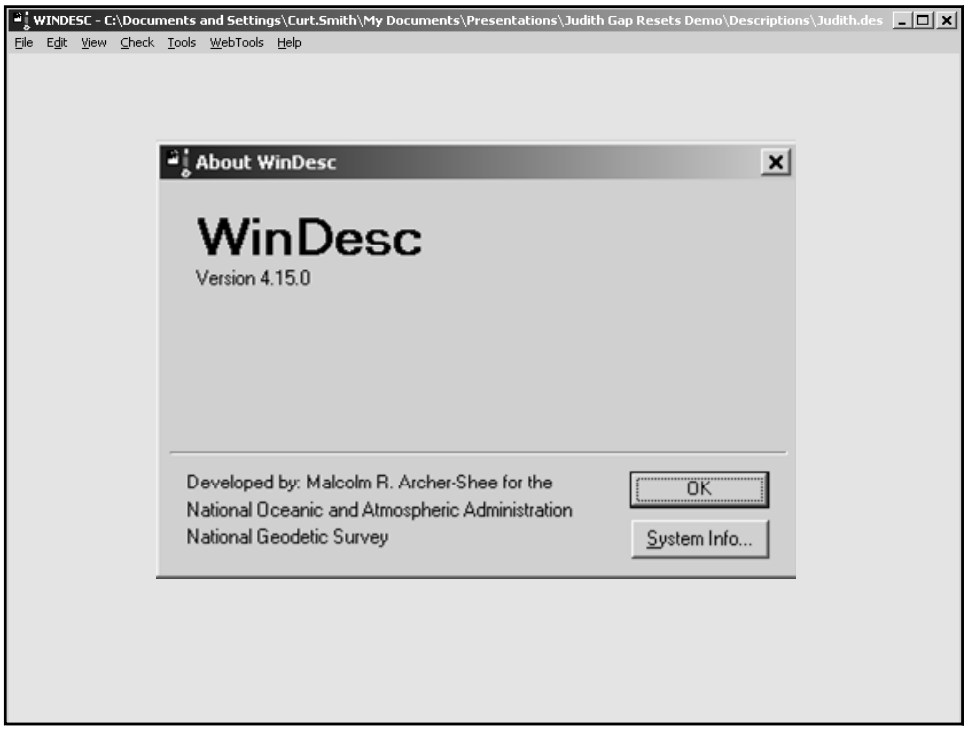
(Leg-by-leg distances and directions from major road intersection to mark)

Monument Description and Measurements: The station is set into drill hole in bedrock, 7.6 m south from the north fence corner, 8.8 m east from the west fence corner, and 3.6 m southeast from the northwest end of the outcrop.

(Add at least three measurements to permanent, identifiable, nearby objects; and a description of the monument size, shape, height, etc.)

NOTE: - Include a pencil rubbing, sketch, or photographs of mark.

Described by: John Q. Surveyor Phone: (301) 713-3194 e-mail: jqs@ordot.gov



Field Procedures







erica for

Technical data	LEICA DNA03	LEICA DNA10
Area of use	– Quick measurements of heights, height differences and stake outs – I. and II. order levelling – Precision measurements	– Quick measurements of heights, height differences and stake outs – Cadastral levelling – Technical levelling
Accuracy	Standard deviation height measurement per 1km double-run (ISO 17123-2)	
Electronic measurements:		
with invar staffs	0.3mm	0.9mm
with standard staffs	1.0mm	1.5mm
Optical measurements	2.0mm	2.0mm
Standard deviation distance measurement (electr.)	1cm/20m (500ppm)	
Range		
Electronic measurement	1.8m – 110m	
Optical measurement	from 0.6m	
Electronic measurement		
Resolution height measurement	0.01mm, 0.0001ft, 0.0005inch	0.1mm, 0.001ft
Time for single measurement	typically 3 seconds	
Measurement modes	Single, average, median, repeated single measurements	
Measurement programs	Measure & Record, staff height/distance BF, aBF, BFFB, aBFFB	
Coding	Remark, Free code, Quick code	
Data storage		
Internal memory	6000 measurements or 1650 station	
Backup	PCMCIA card (ATA-Flash/SRAM) SRAM compatible with Omnidrive MCR4	
Online operations	GSI format via RS232	
Data exchange internal memory	GSI8/GSI16/XML/flexible formats	
Telescope magnification	24x	
Compensator		
Type	Pendulum compensator with magnetic damping	
Slope range	± 10'	
Compensator setting accuracy	0.3"	0.8"
Display	LCD, 8 lines at 24 characters	
Battery operated		
GEB111	12h operation	
GEB121	24h operation	
Battery adapter GAD39	Alkaline battery, 6x LR6/AA/AM3, 1.5V	
Weight	2.8kg (incl. battery GEB111)	
Environmental conditions		
Working temperature	–20°C to +50°C	
Storage temperature	–40°C to +70°C	
Dust/water (IEC60529)	IP53	
Humidity	95%, non condensing	

The second generation of digital levels by Leica, the inventors of the first digital level, with modern and ergonomic design, large LC-display, cutting edge electronic technology, excellent optical and mechanical systems.

DNA03
For height measurements with 0.3 mm standard deviation per km double levelling (

http://www.leica-geosystems.com/corporate/en/products/levels/lgs_5287.htm



Trimble Precision Levels

High quality easy-to-use optical and digital levels

TECHNICAL SPECIFICATIONS	AL228	AL232
Height accuracy, standard deviation (DIN 18723)		
1 km two-way levelling	1.5 mm (0.004 ft)	1.0 mm (0.003 ft)
Telescope magnification	28x	32x
Field of view	1° 20' (1.5 mgon)	
Aperture	36 mm (1.4 in)	
Shortest focus	0.6 m (2 ft)	
Compensator	Air damped	
Instrument dimensions	130 mm x 190 mm x 135 mm (5.1 in x 7.5 in x 5.3 in)	
Weight (instrument only)	1.6 kg (3.5 lb)	

TECHNICAL SPECIFICATIONS	DiNi 12	DiNi 12T	DiNi 22
Height accuracy (electronic measurement), standard deviation (DIN 18723) 1 km two-way levelling			
Precise leveling rod, coded scale	0.3 mm (0.0015 ft)	0.3 mm (0.0015 ft)	0.7 mm (0.002 ft)
Engineer's folding staff, coded scale	1.0 mm (0.003 ft)	1.0 mm (0.003 ft)	1.3 mm (0.004 ft)
Distance accuracy (electronic measurement)			
Tacheometer mode (±50 cm staff intercept)			
Precise leveling rod, coded scale		0.5 D* x 0.001 m	
Engineer's folding staff, coded scale		1.0 D* x 0.001 m	
Leveling mode (0.3 m staff intercept, range 20 m)			
Precise leveling rod, coded scale	20 mm (0.066 ft)	20 mm (0.066 ft)	25 mm (0.082 ft)
Engineer's folding staff, coded scale	25 mm (0.082 ft)	25 mm (0.082 ft)	30 mm (0.098 ft)
Angle accuracy			
External graduated circle			
Read to / Estimate to	1'/(1 gon) / 0.1'/(0.1 gon)		1'/(1 gon) / 0.1'/(0.1 gon)
Electronic circle (absolute code)			
Angular units		grad / deg.min.sec / deg	
Standard deviation for one bearing		6" / 2 mgon	
Electronic measuring range	1.5–100 m (5–328 ft)		
Measurement time	3 s	3 s	2 s
Telescope magnification	32x	32x	26x
Compensator			
Tilt range	±15' (±270 mgon)		
Setting accuracy	±0.2"/ ±0.06 mgon		±0.5"/ ±0.16 mgon
Display	Four lines of 21 characters each, graphic capability		
Keyboard	22 keys, alpha numeric		
Leveling methods	BF, BFFB, BFBJ, BBJF**		BF, BFFB**
Recording			
Data memory	SRAM Card options from 256 KB to 8 MB		Integrated data memory for 2200 data lines
On-line	RS 232 C interface for external connection (download and remote control)		
Power supply	NiMH battery pack: 6.0 V; 1.1 Ah rechargeable, charging time with LG 20 one hour		
Fully charged battery life	3 days	3 days	1 week
Operating temperature	–20 °C to +50 °C (–5 °F to +122 °F)		
Weight (instrument only)	3.5 kg (7.7 lb)	3.7 kg (8.2 lb)	3.2 kg (7.0 lb)

In accordance with DIN ISO 9001 / EN 29001.
Specifications are subject to change without prior notice.
** D = Distance in meters*
*** B = Backsight, F = Foresight*

Trimble DiNi digital levels
Using the DiNi 12, DiNi 12T and DiNi 22 digital levels you can save up to 50 percent of your time and costs, through reduced reading errors, writing errors, calculation of the limits, values - all measurements and calculations are very fast.

http://www.trimble.com/levels.html



Model	DL-101C	DL-102C
Telescope		
Magnification	32×	30×
Objective Aperture	45mm	
Field of View	1°20′	
Resolving power	3″	
Compensator		
Working Range	±12′	±15′
Setting Accuracy	±0.3″	±0.5″
Height Measurement		
Accuracy (Standard deviation for 1km double-run levelling)		
Electronic reading	0.4mm w/Invar staff	1.0mm w/Fiberglass staff
Optical reading	1.0mm	1.5mm
Least Count	0.1mm / 0.01mm (0.001ft / 0.0001ft)	1mm / 0.1mm (0.01ft / 0.001ft)
Distance Measurement		
Least Count	1cm / 1mm	1cm
Accuracy	1cm to 3cm	
Measuring Range	2m to 100m (7ft to 328ft): Fiberglass staff / Aluminum staff 2m to 60m(7ft to 197ft): Invar staff	
Measuring Time	3 sec	
Circular Level Sensitivity	8′/2m	10′/2m
Others		
Display	24-line, 35-digit per line Dot matrix LCD with backlight	
Data Storage	PCMCIA card (64KB to 2MB) Internal memory approx. 8,000 data	
Data Transmission	RS-232C port provided	
Keyboard	Alphanumeric input	
Timer	Built-in-timer	
Horizontal Circle	360° or 400gon	
Power Supply	AA size dry-cell batteries × 6 [Option: Rechargeable Battery BT-31Q]	
Operating Time	10 hours (Dry cell - Alkaline) [30 hours (BT-31Q Rechargeable Battery)]	
Ambient Temperature Range	-20°C to +50°C [-4°F to +122°F]	
Dimensions	237 × 196 × 141mm [9.33 × 7.72 × 5.55inch]	
Weight	2.8kg[6.16 lbs] (including on-board battery)	
Data Card	PC card based on PCMCIA (SRAM: 64K to 2M byte)	
Staff		
Aluminum staff 3A-3M	Length: 5.0m[16.40ft] (Slide Type: 3pcs.)	
Fiberglass staff 3G-3M	Length: 3.0m[9.84ft] (1.5m[4.92ft] × 2 pcs.) Graduation: 1cm graduation with 5mm pattern (front surface)	
Invar staff 3I-3/T or 3I-3	Length: 3.0m[9.84ft]	

TOPCON's DL-101C / 102C takes accuracy and ease of operation to a higher level with its Advanced Image Processing Technology. The outstanding features make the DL-101C / 102C ideal for high precision applications including the performance of 1st and 2nd order leveling and deformation monitoring.

http://www.topcon.co.jp/eng/survey/dl.html



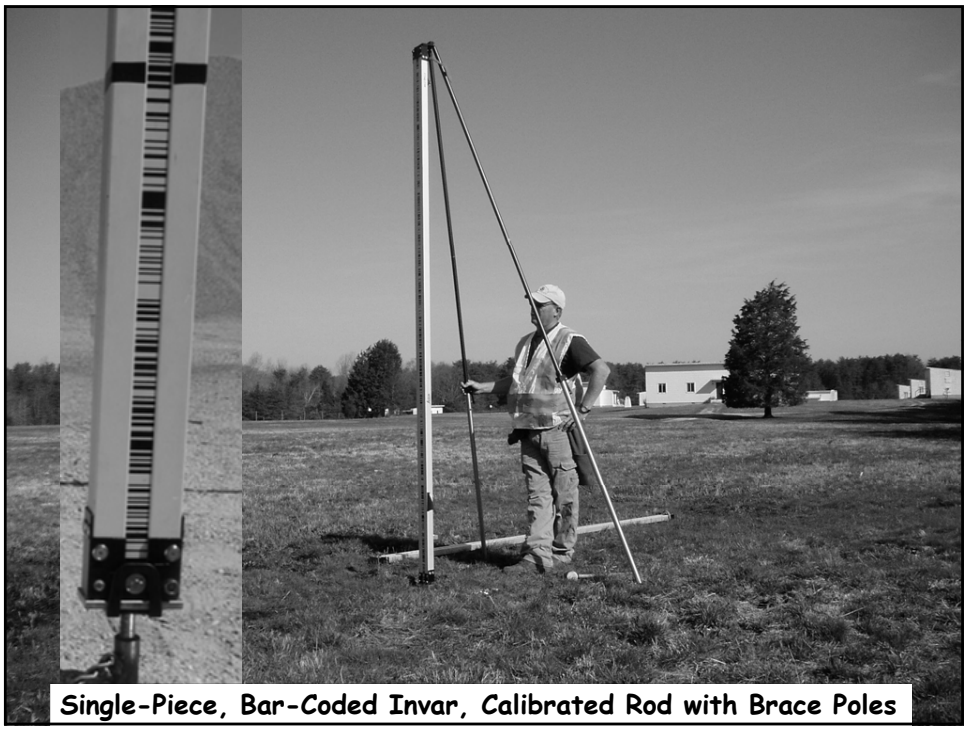
The SDL1X Digital Level is designed to achieve the highest precision and productivity in leveling and height measurement applications. The SDL1X sets the ultimate benchmark for the precision digital levels with innovative features never before available in the industry including 0.2mm precision, Auto Focus, View Finder for quick sighting and a remote trigger for wireless operation. When precision and measurement speed matter, SDL1X is the ideal digital level for the job.

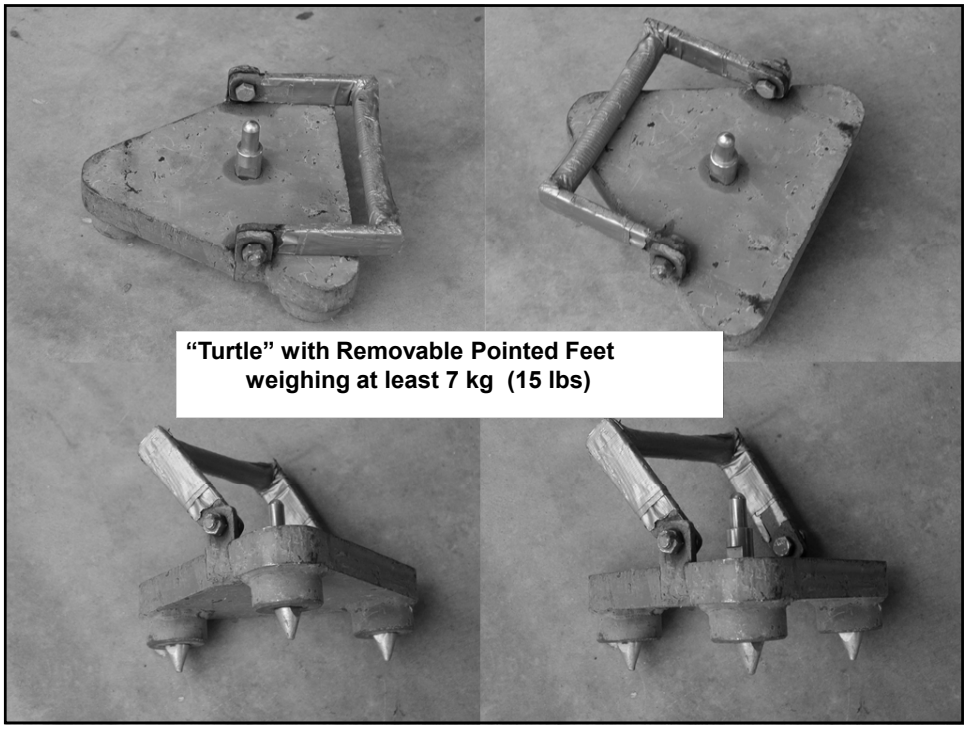
http://www.sokkia.com/Products/Detail/sdl1x.aspx

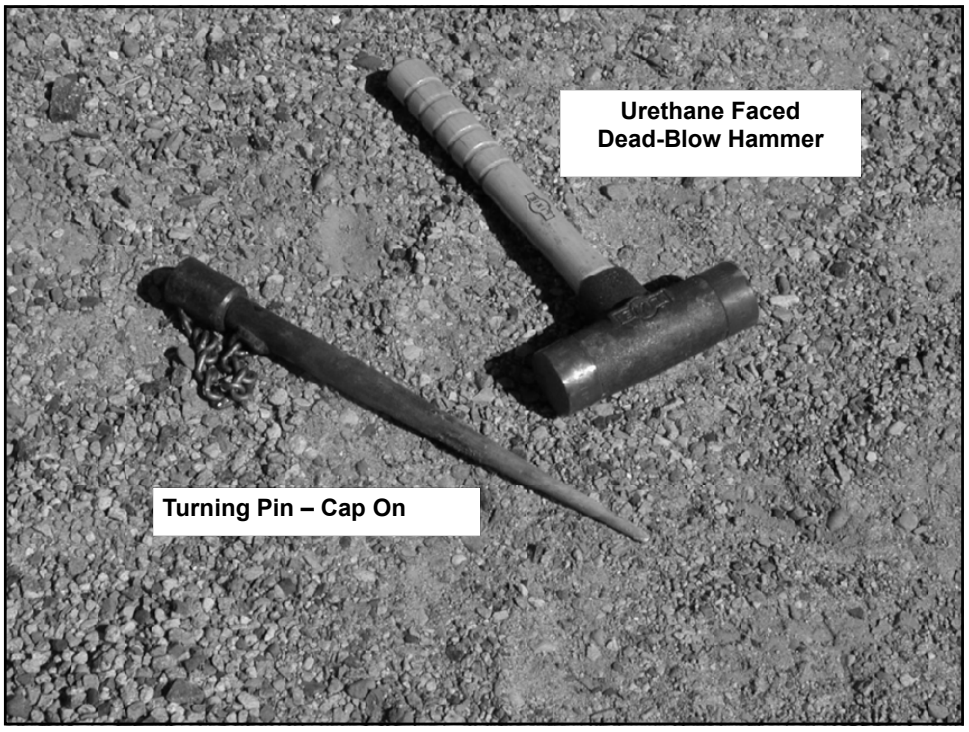
SDL1X Advanced		
Height accuracy (ISO 17123-2)*1	Electronic	0.2mm (0.008in.)*2 with BIS30A staff 0.3mm (0.012in.) with BIS20/30 staffs 1.0mm (0.04in.) with BGS staffs
	Visual	1.0mm (0.04in.)
Distance accuracy (0=measuring distance)	Electronic	<±10mm (<±0.4in.): up to 10m (33ft.) <±0.1% x D: to 50m (to 164ft.) <±0.2% x D: to 100m (to 328ft.)
C & R correction		K=0.142 / 0.20 / none, selectable
Measuring range	Electronic	1.6 to 100m (5.3 to 328ft.)
	Visual	from 1.6m (5.0ft.)
Measuring mode		Single / Repeat / Average / Rapid-repeat
Display resolution (selectable in all modes)	Height	0.00001 / 0.0001 / 0.001m (0.0001 / 0.001 / 0.01ft.)
	Distance	0.001 / 0.01 / 0.1m (0.01 / 0.1 / 1ft.)
Measuring time	Single/Repeat	<2.5s
	Average	<2.5s x [number of measurements]
	Rapid-repeat	<1s
Auto Focus	Method	Distance and Contrast measurement (Passive)
	Range	1.6 to 100m (5.3 to 328ft.)
	AF/MF modes	Automatic conversion
Telescope		Objective aperture: 45mm (1.8in.) Magnification: 32x, Resolving power: 3" Minimum focus 1.6m (5ft.), Field of view: 1°20'
View Finder		Magnification: 4.5x, Field of view: 3°
Compensator	Type	Pendulum compensator with magnetic damping system
	Working range	±12'
	Setting accuracy	±0.3"
Tilt warning	Sensor	Dual-axis liquid tilt sensor
	Functions	Graphic display, beep tones, Disabling measurement at ±8.5' tilt (On/Off selectable)
Display		LCD graphic display with LED backlight
Keyboard		Alphanumeric, 27 keys with backlight
DLC1 remote trigger		Infrared, 3 keys (Trigger, ESC, Enter)
Data storage	Internal memory	10,000 points
	External memory	SD card (max.2GB), USB flash memory (max.4GB)
Interface	RS-232C	Baud rate 1,200 to 57,600bps
	USB	USB 1.1 Host Type A
Bluetooth wireless modem (optional)		Ver. 2.0, Class 1, Range: 100m (328ft.)
Sensitivity of levels	Circular level	8'/2mm
	LCD graphic level	±12'/inner circle, ±24'/outer circle
Horizontal circle	Graduation	1° (1gon) Estimation: 0.1° (0.1gon)
Dust and water protection		IP54 (IEC60529:2001)
Operating temperature		-20 to +50°C (-4 to 122°F)
Size		W226 x D260 x H200mm (W8.9 x D10.2 x H7.9in.)
Weight with battery		3.7kg (8.2 lb.)
Power supply	Input voltage	7.2V DC (nominal)
	Standard battery	BDC58 (Rechargeable Li-Ion, 4.3Ah)
	Operating time (at 20°C (68°F))	Approx. 12 hours w/o Auto Focus Approx. 9 hours w/Auto Focus
Battery level display		4 levels and low level message
Auto power cut-off		30 minutes after operation / none, selectable

*1 Standard deviation for 1km double-run leveling.
*2 Conditions for the highest accuracy: Low level of atmospheric turbulence, stable ambient temperature, no direct sunlight on instrument and staff.


Rigid Leg Tripod With Thermister Equipment


Single-Piece, Bar-Coded Invar, Calibrated Rod with Brace Poles


"Turtle" with Removable Pointed Feet
weighing at least 7 kg (15 lbs)

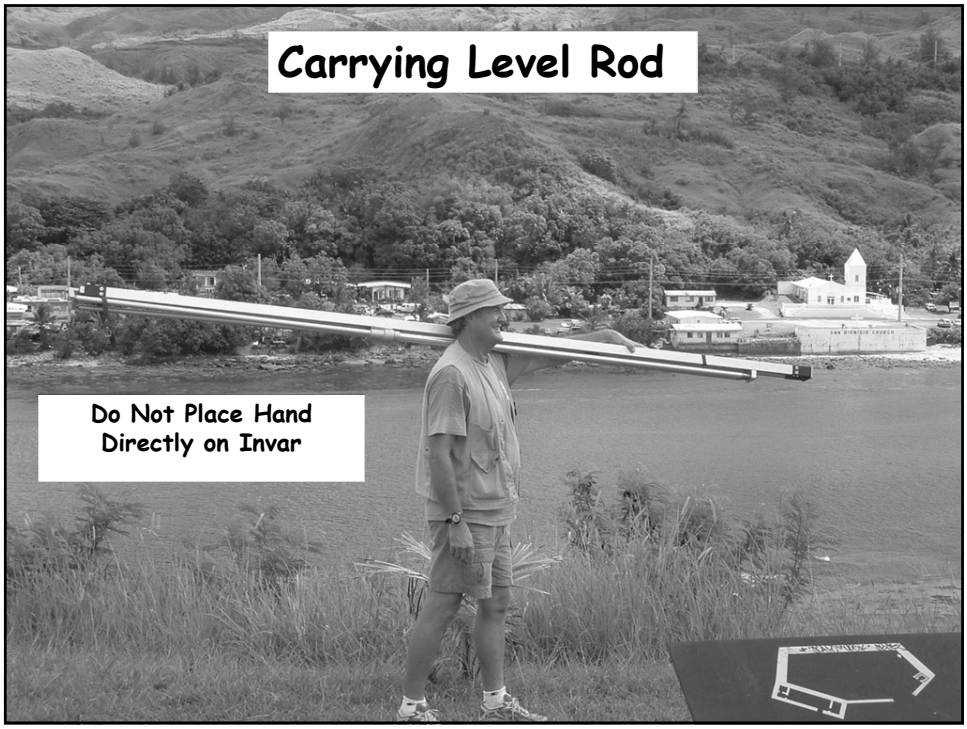

Urethane Faced
Dead-Blow Hammer
Turning Pin – Cap On



Typical Level Unit

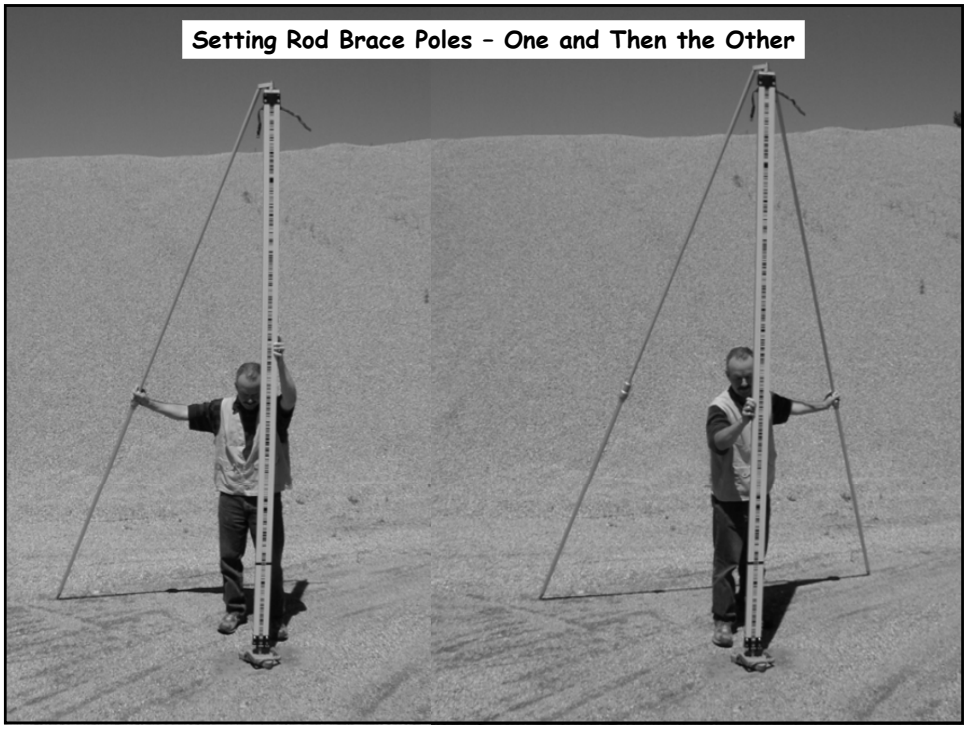
- One Observer (Instrument Person)*
- Two Rod People*
- One or Two Vehicles
  - One capable of transporting equipment – rods*
  - Drop one vehicle at end of day's work
- Safety People if Necessary
  - Warning Person to drive behind crew
- One Pacer to Help with Setups
- Computer to Download and Process Data*

* Required

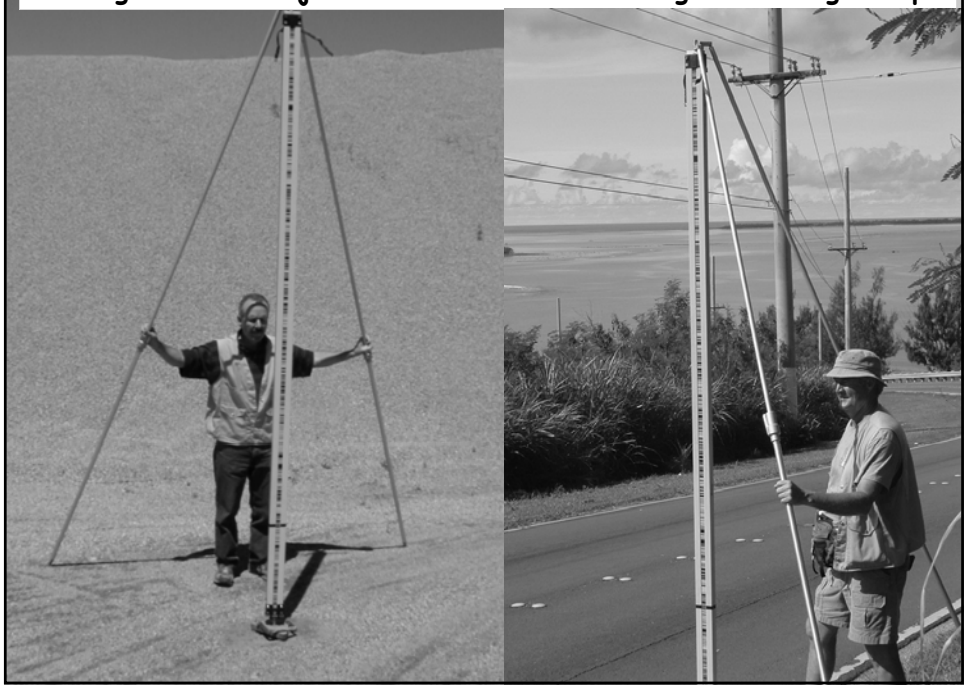

Carrying Level Rod
Do Not Place Hand Directly on Invar


Turning Plate "Turtle" Setup – Feet Firmly Set in Clean, Organic-Free Soil

Setting Rod Brace Poles – One and Then the Other



Leveling Rod with Adjustable Brace Poles – Holding Rod During Setup





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Always Protect Bottom of Rod

Do Not Place Rod on Ground!

Place Rod on Shoe When Idly Holding Rod

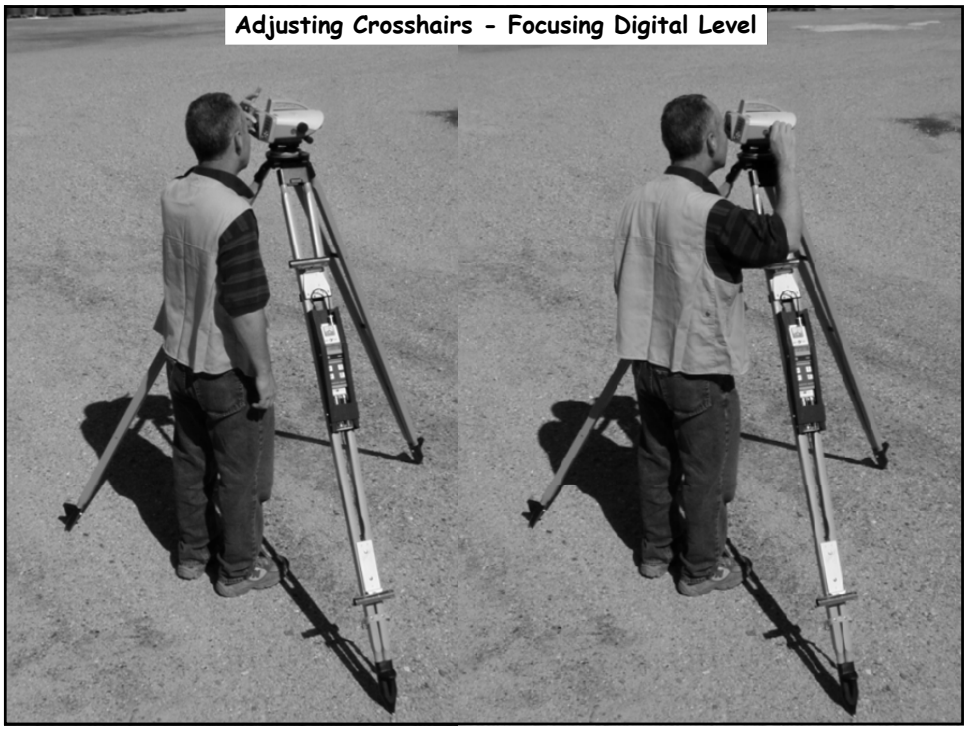


Rod on Turning Pin Using Centering Guide


Carrying Tripod and Instrument
"Comfortably" Upright


and Instrument
veman" Style
Not Good for Instrument

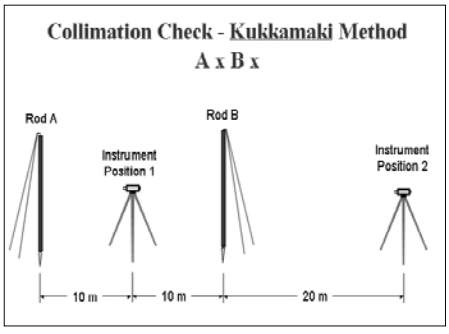

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Gently But Firmly Step Tripod Feet Into Ground

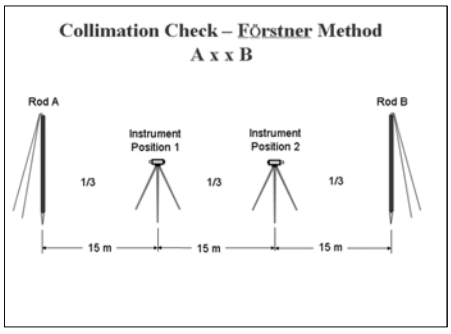

Adjusting Crosshairs - Focusing Digital Level

Rules – Short List

- Do C-Check/ Peg Test everyday
- Never Setup on Asphalt
- Double Run Everything
- Never Read Below 0.5 Meter on Rod
- All Three Crosshairs Must be on Invar
- Same Rod on Starting and Ending BM
- Use Pins or Turtles as Turning Points
- Always Keep a Hand on Rod when Setup
- Keep Setup Imbalance at a Minimum

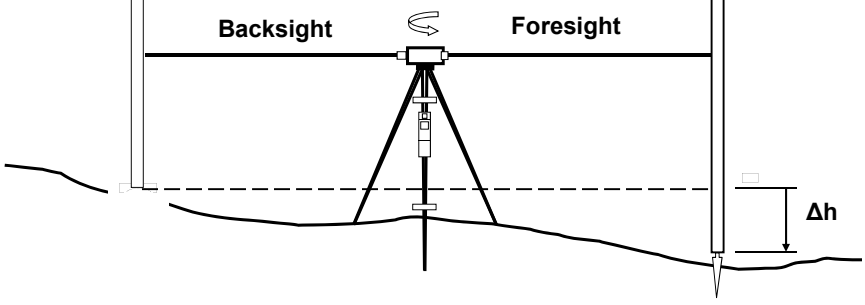
Collimation Check
C-Check
Peg Test



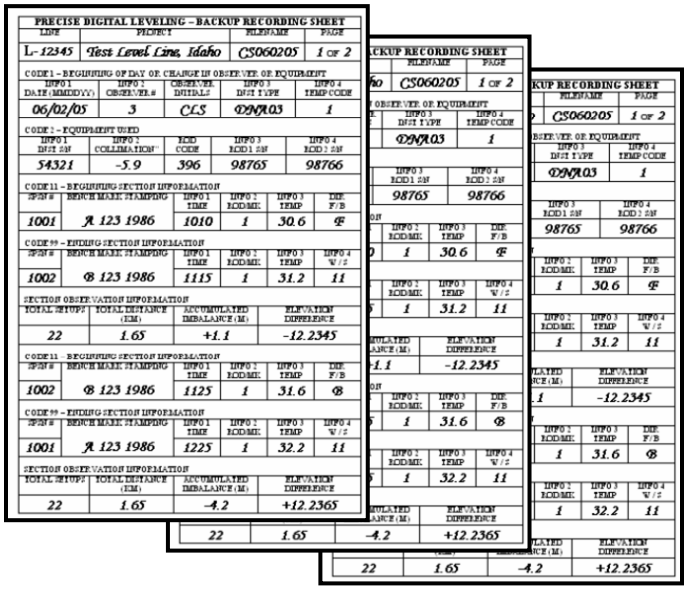


Observing Scheme

1. Plumb Level
2. Take Backsight
3. Take Foresight
4. Take temps
5. Move the next setup



Observing Guides and Field Notes



PRECISE DIGITAL LEVELING – BACKUP RECORDING SHEET

LINE	PROJECT		FILENAME	PAGE
L-12345	Test Level Line, Idaho		CS060205	1 OF 2

CODE 1 – BEGINNING OF DAY OR CHANGE IN OBSERVER OR EQUIPMENT

INFO 1 DATE (MMDDYY)	INFO 2 OBSERVER #	OBSERVER INITIALS	INFO 3 DIST TYPE	INFO 4 TEMP CODE
06/02/05	3	CLS	DNA03	1

CODE 2 – EQUIPMENT USED

INFO 1 DIST SN	INFO 2 COLLIMATION"	ROD CODE	INFO 3 ROD 1 SN	INFO 4 ROD 2 SN
54321	-5.9	396	98765	98766

CODE 11 – BEGINNING SECTION INFORMATION

SPUR #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	DIR F/B
1001	A 123 1986	1010	1	30.6	F

CODE 99 – ENDING SECTION INFORMATION

SPUR #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	INFO 4 W / S
1002	B 123 1986	1115	1	31.2	11

SECTION OBSERVATION INFORMATION

TOTAL SETUPS	TOTAL DISTANCE (KM)	ACCUMULATED IMBALANCE (M)	ELEVATION DIFFERENCE
22	1.65	+1.1	-12.2345

CODE 11 – BEGINNING SECTION INFORMATION

SPUR #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	DIR F/B
1002	B 123 1986	1125	1	31.6	B

CODE 99 – ENDING SECTION INFORMATION

SPUR #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	INFO 4 W / S
1001	A 123 1986	1225	1	32.2	11

SECTION OBSERVATION INFORMATION

TOTAL SETUPS	TOTAL DISTANCE (KM)	ACCUMULATED IMBALANCE (M)	ELEVATION DIFFERENCE
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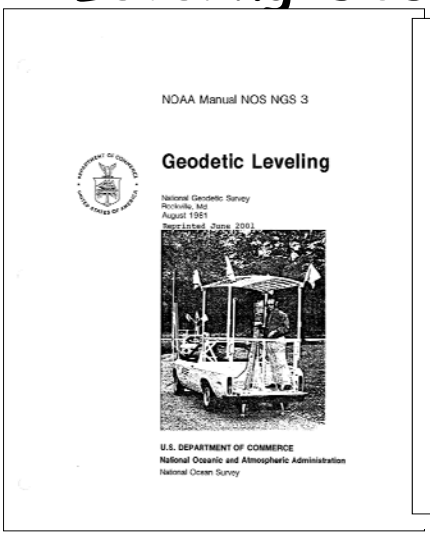
F = -12.2345 m
B = +12.2365 m
0.0020 m

Allowable Section Closure

First Order, Class II
$4\sqrt{1.65} = 5.138$ mm

Second Order, Class I
$6\sqrt{1.65} = 7.707$ mm

Corrections Applied to NGS' Leveling Observations

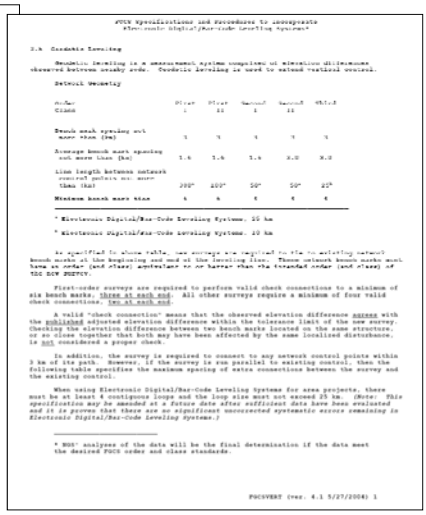


NOAA Manual NOS NGS 3

Geodetic Leveling

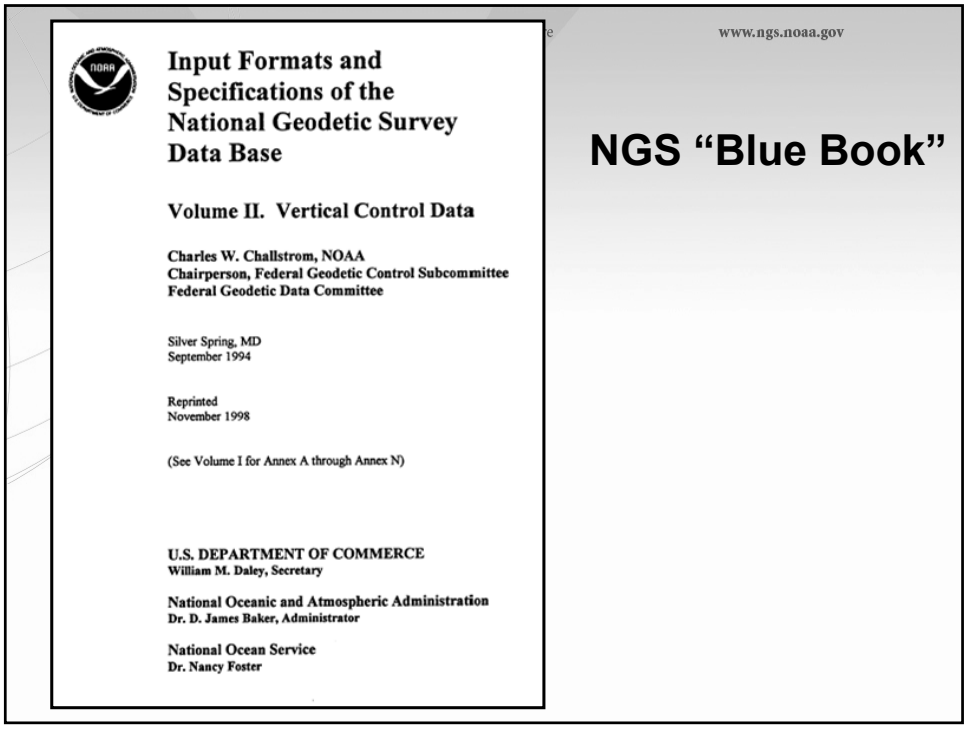
National Geodetic Survey
Rockville, Md
August 1981
Reprinted June 2001

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey



Some of the Corrections Applied to NGS' Leveling Observations

- Curvature
- Refraction
- Collimation
- Rod Scale
- Calibration
- Astronomic
- Gravity



Leveling Tips

- Always practice – SAFETY FIRST!!!!
- Carry instrument upright between setups
- Do not leave the instrument setup unattended
- Do not let level or thermistors get wet
- Never read below 0.5 meters on rod
- Ensure upper stadia crosshair is not above Invar when reading near the top of the rod
- Maintain tight setup imbalances
- Don't point the instrument into the sun
- Orchestrate setups so instrument is not pointing into low sun angle

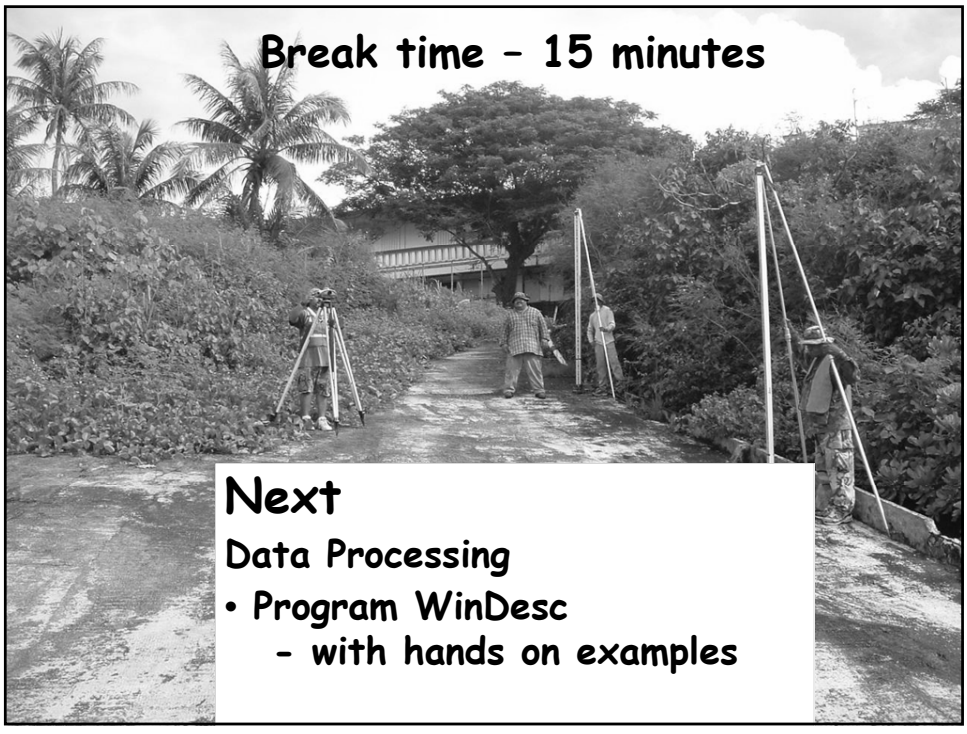
Rodman Leveling Tips

- DO NOT DROP RODS!!
- Keep one hand on rod at all times
- Keep rod faces clean – do not touch Invar
- Always protect base of rod – keep off ground
- Never setup rod or instrument on asphalt
- Turn rod to change shadows if measurement fails
- Rod person calls out BM designation for check
- Start and end with the same rod on mark
- Backsight rod person does not move until foresight has been recorded and observer directs

Rodman Leveling Tips (continued)

- Make sure base of rod is directly on the turning point or BM not on centering guide
- Be aware of your surroundings carrying rod
- Spacer must have a backsight and a foresight
- Do not forget to retrieve spacer after setup
- Double run all sections
- Plan reverse leveling during a different time of day from the first level run
- Place visible mark on rod to indicate 0.5 m

Questions?


Break time – 15 minutes
Next
Data Processing
• Program WinDesc
- with hands on examples