# Establishing a Control Point Database

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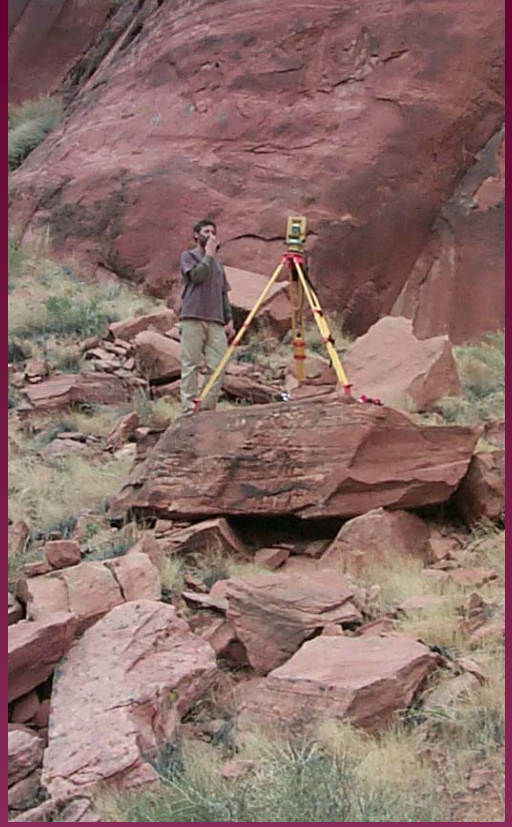
Topographic Data Collection

Control Points are used to geo-reference a variety of data collected in the canyon.

Hydrographic Data Collection

# Remote Sensing Applications

Control Points are used to geo-reference aerial photography and/or verify accuracy of geo-referenced aerial photography



GPS Technology or Conventional Survey methods are used to geo-reference Control Points


GEODETIC SURVEY

U.S. GENERAL LAND OFFICE SURVEY
PROPERTY OF
REMOVAL
1991

U.S. DEPT OF INTERIOR
NATL. PARK SERVICE


DSVW
GCMRC
01

BANNER INC.
G.C.P.S.
C.P. #
303-243-2242

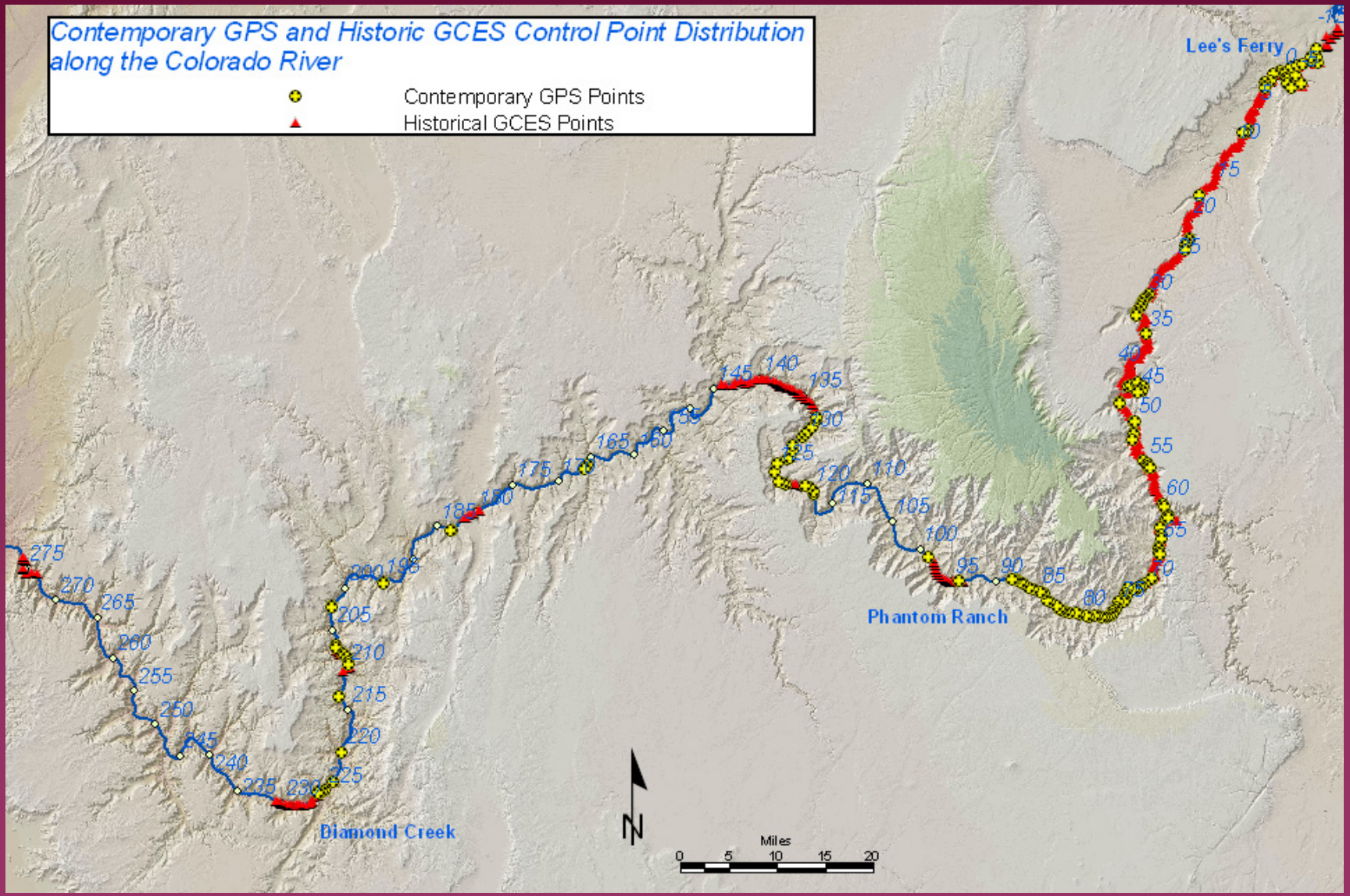








# Control Point Distribution



# Motive for Establishing a Control Point Database

- Assign each control point a unique point identifier.
- Provide a reference to historical geographic coordinates.
- Update historical geodetic coordinates to modern, universal datum.
- Provide control point precision and accuracy statistics to researchers.
- Provide researchers and contractors a resource to independently geo-reference collected field data.

# Database Input Page

printable

Point Name (Designation): GR132266R
Point Alias: 8513003,

Side Shot: Yes
Station Mile: 132.266
Field Area: Grand Canyon
Traverse: No
Station River Offset: 77.155
State: AZ
Hydro: No
River Side: Right
GPS: No
Accuracy Convention:
USGS 15 Quad: POWELL PLATEAU NW

**Navigation**

First |< Prev < Next > Last >| Add New [New]

Record Number 1 of 1

Select Or Type — Designation Name: Select One... | Alias: Select One... | GPS Cross Reference: Select One...

Search | Show All

Use % as a wild card. (Exp. MC% or %R)

**Coordinate**

Northing Meters: 592842.818
Easting Meters: 165122.114
N Latitude (dd mm ss.ss): 36 20 39.33
W Longitude (dd mm ss.ss): 112 27 14.64

Ellipsoid Ht. (m):* 586.579
Orthometric Ht. (m):* 608.18591
Orthometric Ht. Datum: 90
N Latitude (dd.ddddd): 36.344258333333
W Longitude (dd.ddddd): 112.45406666666

Hydro Azimuth:
Mapping Plane Scale Factor: .9999287
Ellipsoid (Elv.) Scale Factor: .99991171
Combined Grid Factor: .9998404
Convergence: -0-19-06.56

State Plane: 202

| | Horizontal | Vertical |
|---|---|---|
| Datum | NAD 83 (1983) | |
| Method | Conventional Survey | Conventional Survey |
| Calc By | GCES | GCES |
| Calc Date | 7/1/1994 | 7/1/1994 |

Network Relationship: Network

| | Method | Value |
|---|---|---|
| GEOID2002 | | |
| GEOID1999 | WINTG.exe | -22.934 |
| GEOID1996 | | |
| GEOID1990 | GEOID90.exe | -22.443 |

**Accuracy**

Ellipsoid Ht. Error (m):
Orthometric Ht.Error (m):
Northing Error:
Easting Error:
Latitude Error:
Longitude Error:

**Description**

Monument Type: "Chiselled ""X""""
Monument Condition: Existing or Recovered
Monument Set by: UNKNOWN
Set Date:

Collected By: Brown
Collected Date: 9/10/2003

Survey Project — Prj ID | Field Book | Page

Images 7 add/edit/view
Document Ref:

National Geodetic Survey Point ID:
National Geodetic Survey US National Grid Designator:

Point Desc: 3CM X 3CM CHISELLED "X" ON LEDGE OF BLOCKY BASALT OUTCROP AT GROUND LEVEL.
Site Desc: ON DEBRI FAN OF DUBINDORF AT BASE OF BASALT OUTCROP IMMEDIATELY DOWNSTREAM OF DRY WASH
Drive to Desc:
Red Flag Desc:

GPS Cross Reference:
Field Ties:
Comments: Vertcon 2.0 used to adjust NGVD29 Orthometric Datum to NAVD88 Ellipsoid Datum

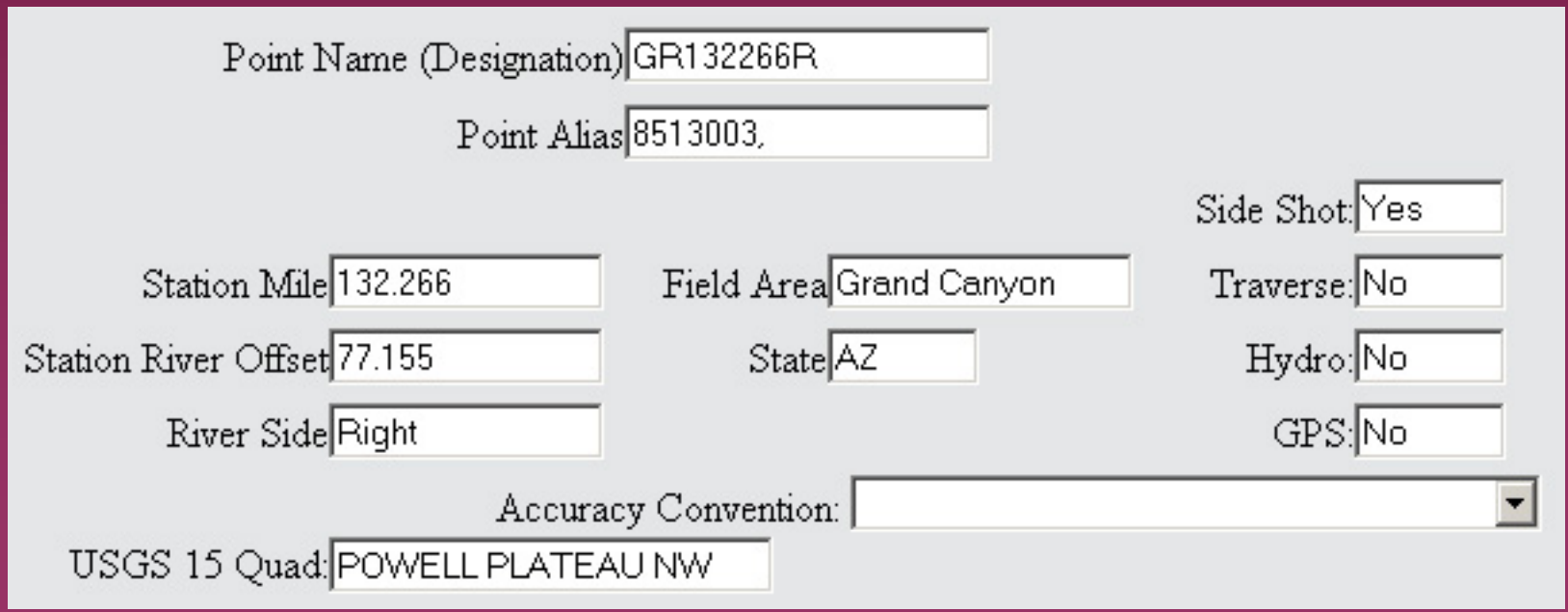
Save to History | Show Historical Info | Save/Update Record | Cancel Save/Update

Input Tracking — Checked by: Date: | Input/Update By: Brown Date: 1/1/2003

*Orthometric Height was collected, Ellipsoid Height was calculated.

# Point Name and Location

- GCMRC Name
- Point Alias (GCES Name)
- Station Mile
- Field Area
- River Side and Offset
- USGS 15" Map
- Accuracy Convention



# GCES Naming Convention Problematic

- Name is not clearly defined
- Numbering is not sequentially ordered upstream or downstream
- Single Point assigned multiple names

Example:

| GCMRC Name | GCES Name 1 | GCES Name 2 |
|---|---|---|
| MC043442L | 3012357 | 3253057 |
| MC043436L | 3012358 | 3253058 |
| MC044957R | 3103026 | 3073026 |

# GCMRC Control Point Naming Convention

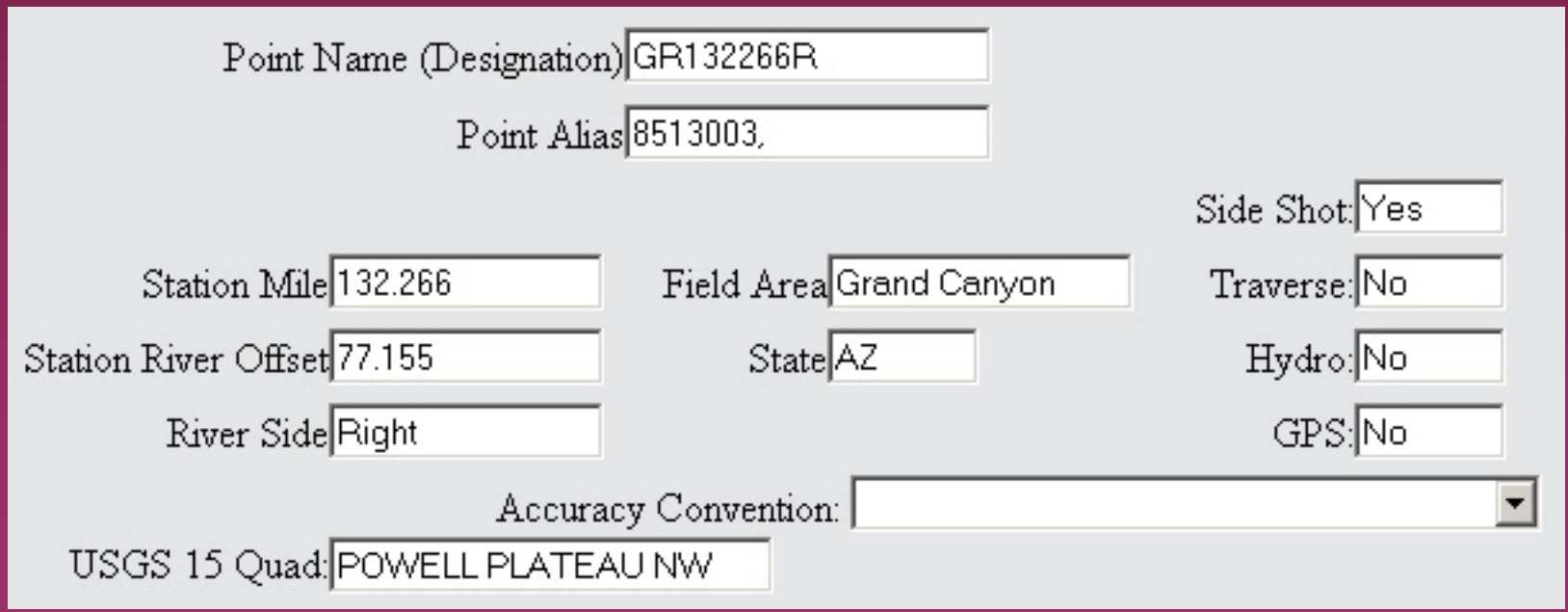
- Describes point location based on:
  - general location,
  - point mile up or down river, and
  - side of river

  Example:

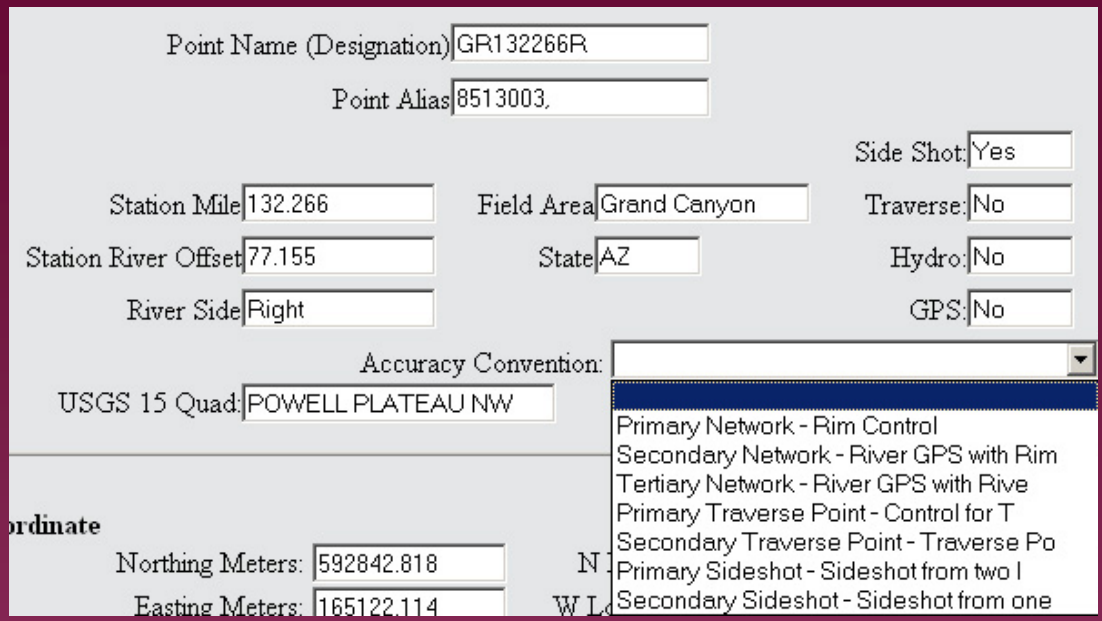
| GCMRC Name | General Location | River Mile | River Side |
|---|---|---|---|
| GL-01045L | Glen Canyon | -1.045 | Left |
| MC055802L | Marble Canyon | 55.805 | Left |
| GR225565R | Grand Canyon | 225.565 | Right |

# Point Name and Location

- GCMRC Name
- Point Alias (GCES Name)
- Station Mile
- Field Area
- River Side and Offset
- USGS 15" Map
- Accuracy Convention



# Accuracy Convention




- Primary Network - Rim Control
- Secondary Network - River GPS with Rim Control
- Tertiary Network - River GPS with River Control
- Primary Traverse Point - Control for Traverse
- Secondary Traverse Point - Traverse Point
- Primary Sideshot - Sideshot from two locations
- Secondary Sideshot - Sideshot from one location

# Coordinate

- Northing and Easting
- Latitude and Longitude
- Elevation
- Scale Factors

**Coordinate**

| | | | | | |
|---|---|---|---|---|---|
| Northing Meters: | 592842.818 | | N Latitude (dd mm ss.ss): | 36 | 20 | 39.33 |
| Easting Meters: | 165122.114 | | W Longitude (dd mm ss.ss): | 112 | 27 | 14.64 |
| Ellipsoid Ht. (m):* | 586.579 | | N Latitude (dd.ddddd): | 36.344258333333 | | |
| Orthometric Ht. (m):* | 608.18591 | | W Longitude (dd.ddddd): | 112.45406666666 | | |
| Orthometric Ht. Datum: | 90 | | | | | |
| | | | Hydro Azimuth: | | | |
| Mapping Plane Scale Factor: | .9999287 | | Combined Grid Factor: | .9998404 | | |
| Ellipsoid (Elv.) Scale Factor: | .99991171 | | Convergence: | -0-19-06.56 | | |

*Orthometric Height was collected, Ellipsoid Height was calculated.

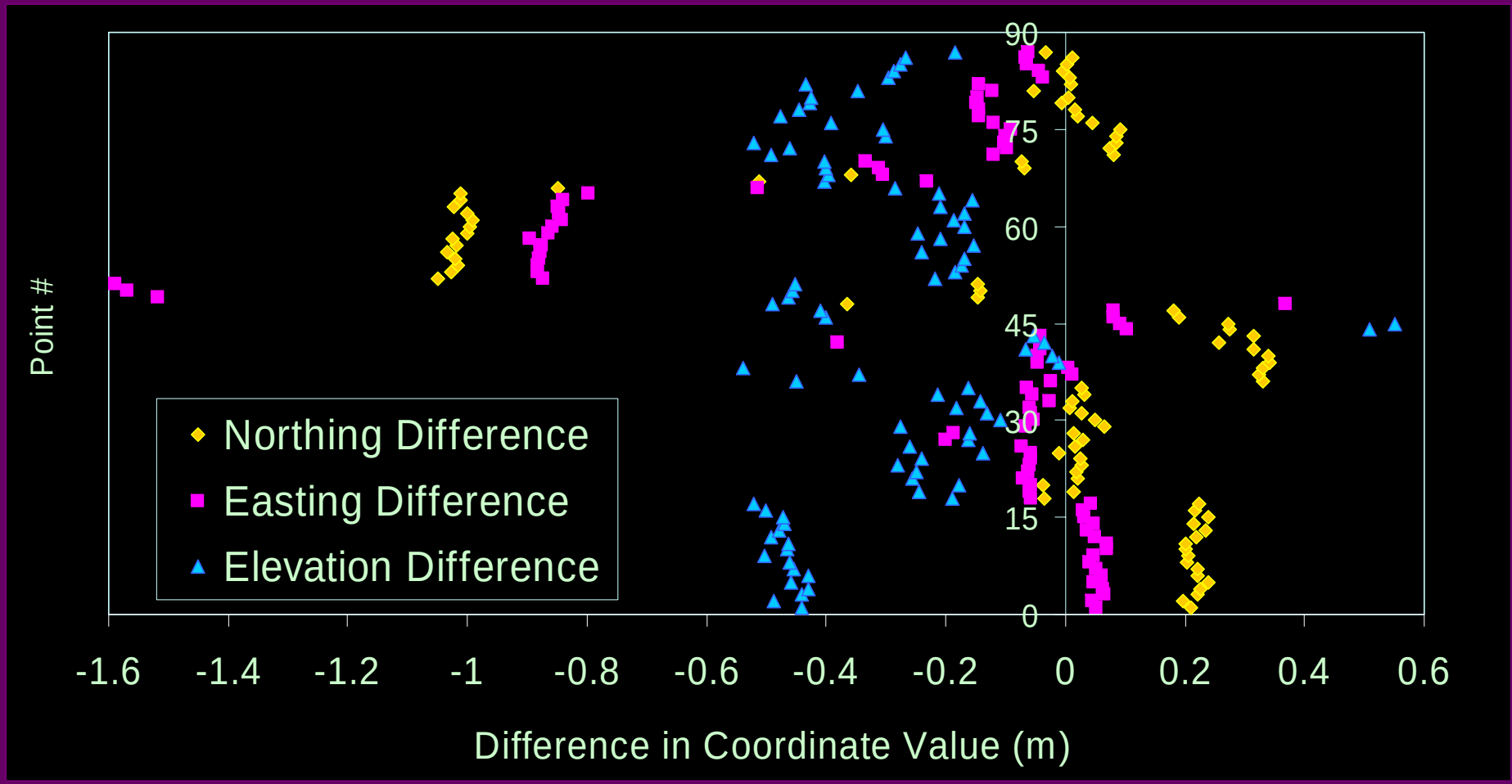
# Control Point Coordinate Datums

GCES Historical Control Point Datum

- State Plane Coordinate System
- NAD 27 Horizontal Reference Datum
- NGVD 29 Vertical Reference Datum
- Orthometric Height

GCMRC Contemporary Control Point Datum

- State Plane Coordinate System
- NAD 83 Horizontal Reference Datum
- NAVD 88 Vertical Reference Datum
- Ellipsoid Height



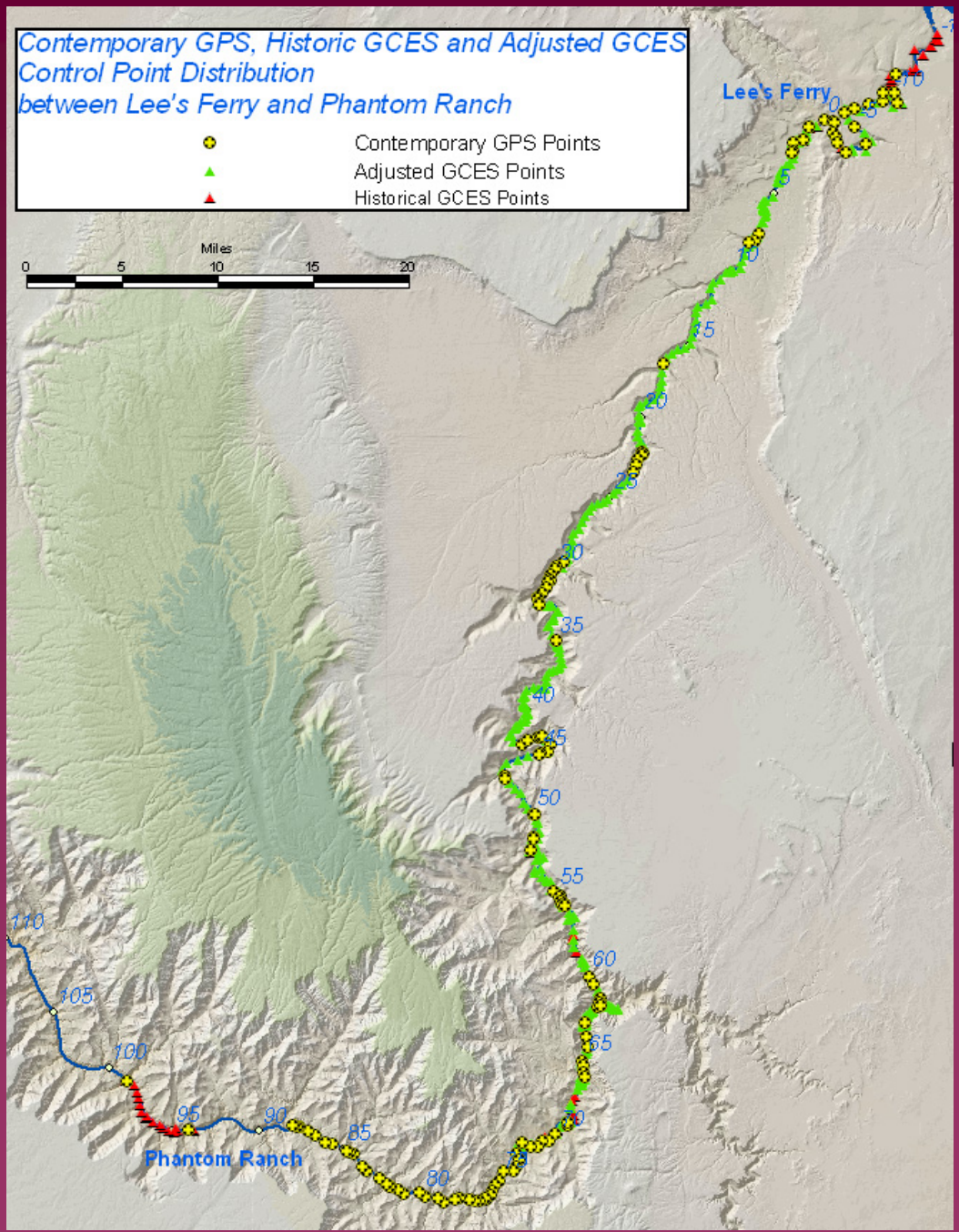

# Difference between GPS and GCES Coordinate Values for 87 Control Points

# Contemporary GPS and Historic GCES Coordinate Value Comparison

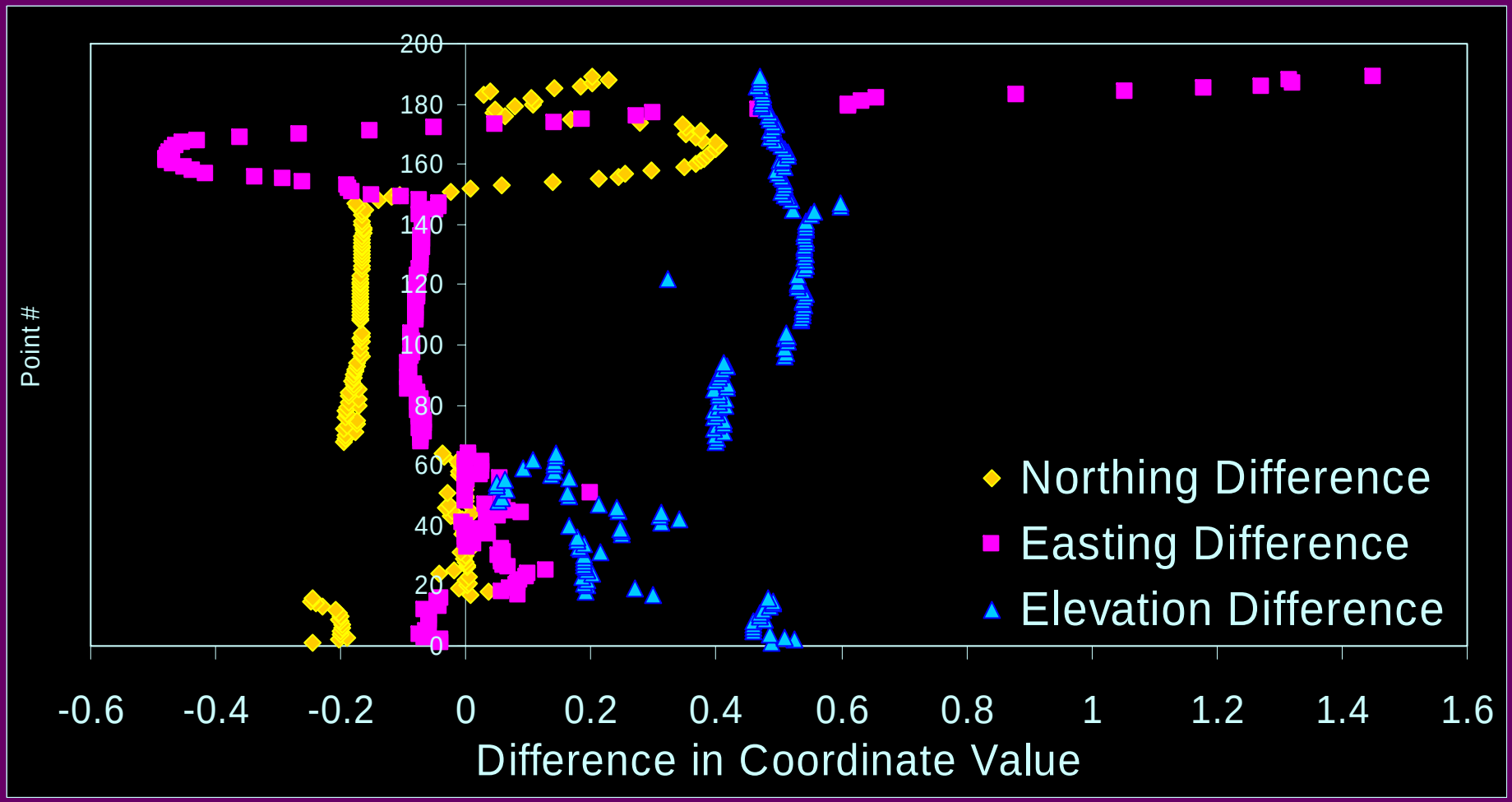
| | Northing | Easting | Elevation |
|---|---|---|---|
| Range of Difference Values | 1.390 m | 1.956 m | 1.091 m |
| Averaged Absolute Value of Difference | 0.569 m | 0.536 m | 0.625 m |
| Std. Dev. Of Difference | 0.441 m | 0.406 m | 0.191 m |

# Method for Converting GCES Control Point Coordinates to Contemporary Datum

- Adjusts conventional survey angle and distance measurements to specified control coordinates.
- Uses modern GPS derived coordinates.
- Uses historic GCES conventionally surveyed angle and distance measurements.
- Must have conventional survey measurements to control points with GPS derived coordinates.
- Can combine modern measurements with historic measurements to strengthen network.




# Distribution of Historic GCES Control Points Adjusted to current GPS coordinate values.




Difference between Historical and Adjusted GCES Coordinate Values for 176 Control Points

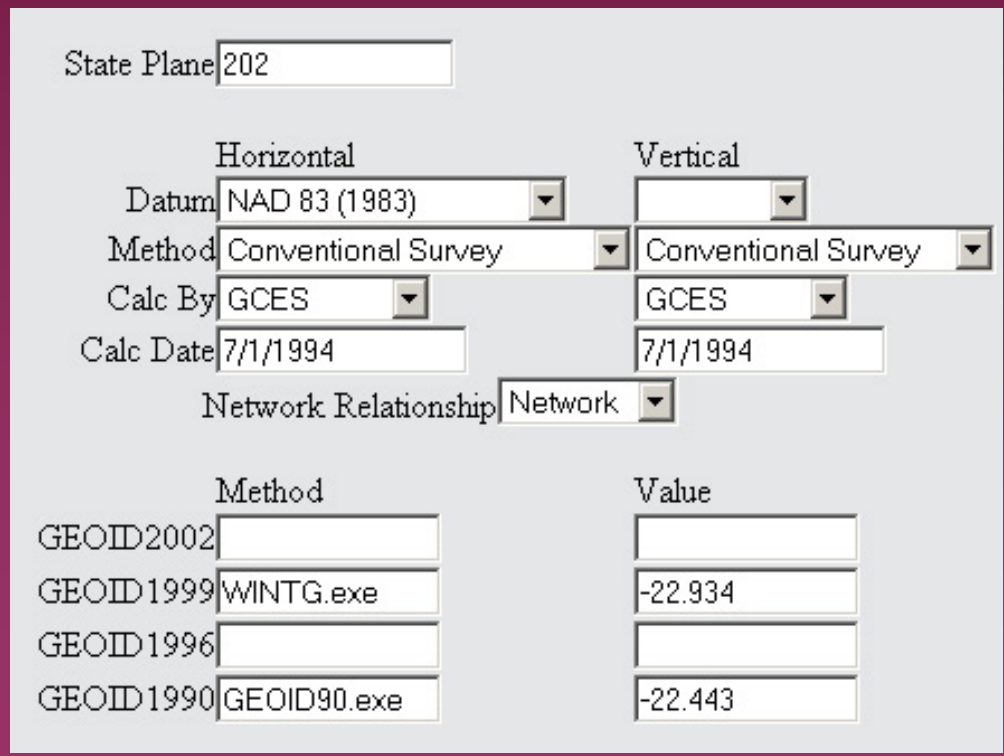
# Adjusted and Historic GCES Coordinate Value Comparison

| | Northing | Easting | Elevation |
|---|---|---|---|
| Range of Difference Values | 0.642 m<br>1.390 m | 1.926 m<br>1.956 m | 0.548 m<br>1.091 m |
| Averaged Absolute Value of Difference | 0.143 m<br>0.569 m | 0.163 m<br>0.536 m | 0.404 m<br>0.625 m |
| Std. Dev. Of Difference | 0.174 m<br>0.441 m | 0.304 m<br>0.406 m | 0.148 m<br>0.191 m |

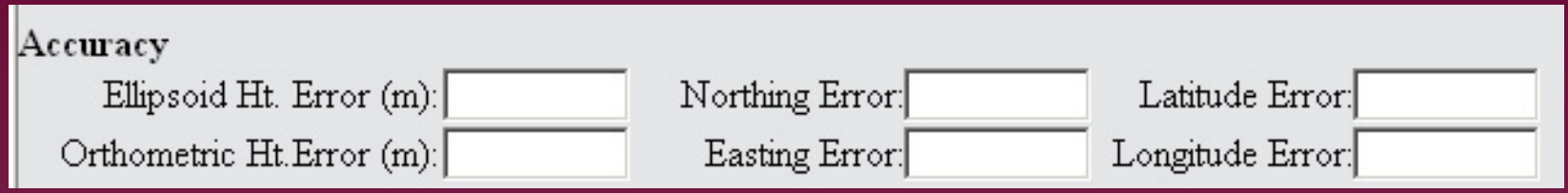
GPS Comparison Information

# Coordinate Metadata and Datum Information

- State Plane Coordinate Zone
- Method of deriving coordinate value
- Organization deriving coordinate value
- Network Relationship
  - Network
  - Local
  - Unknown
- Datum

# Accuracy

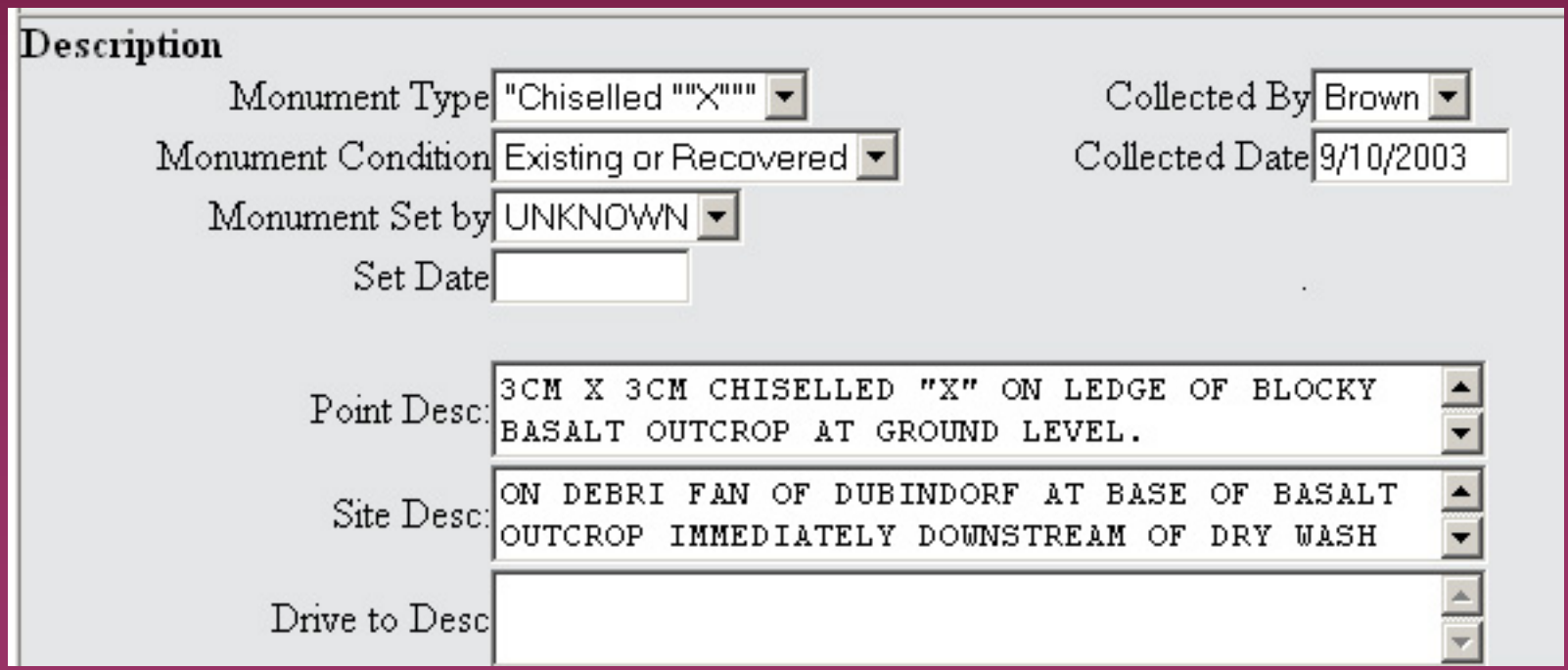



This section will change significantly

- Network Error for Northing, Easting, and Elevation
  - Error in relation to the entire network
  - Useful for remote sensing applications
- Local Error for Northing, Easting, and Elevation
  - Error in relation to survey work of nearest neighbors
  - Useful for error associated with site specific survey data collection (beach or hydro surveys)

# Description

- Monument Type
- Monument Condition
- Monument Set by
- Set Date
- Point Description
- Site Description



# Sample GCES Control Point Descriptions

| GCMRC Name | GCES Description |
|---|---|
| MC002131R | GS-F22bolt |
| MC043701L | Jeff's DS crack in rock |
| MC055671R | IVO ID PT |
| MC044914L | #356 US Willie's |

Descriptions associating a project or a person to a control point.

| | |
|---|---|
| GR064949R | BS1 Carbon x RL US end Carbon |
| GR123472L | Screw in lead 50m+\- DS Forster |

Description of point rock or location.

# Updated GCMRC Descriptions

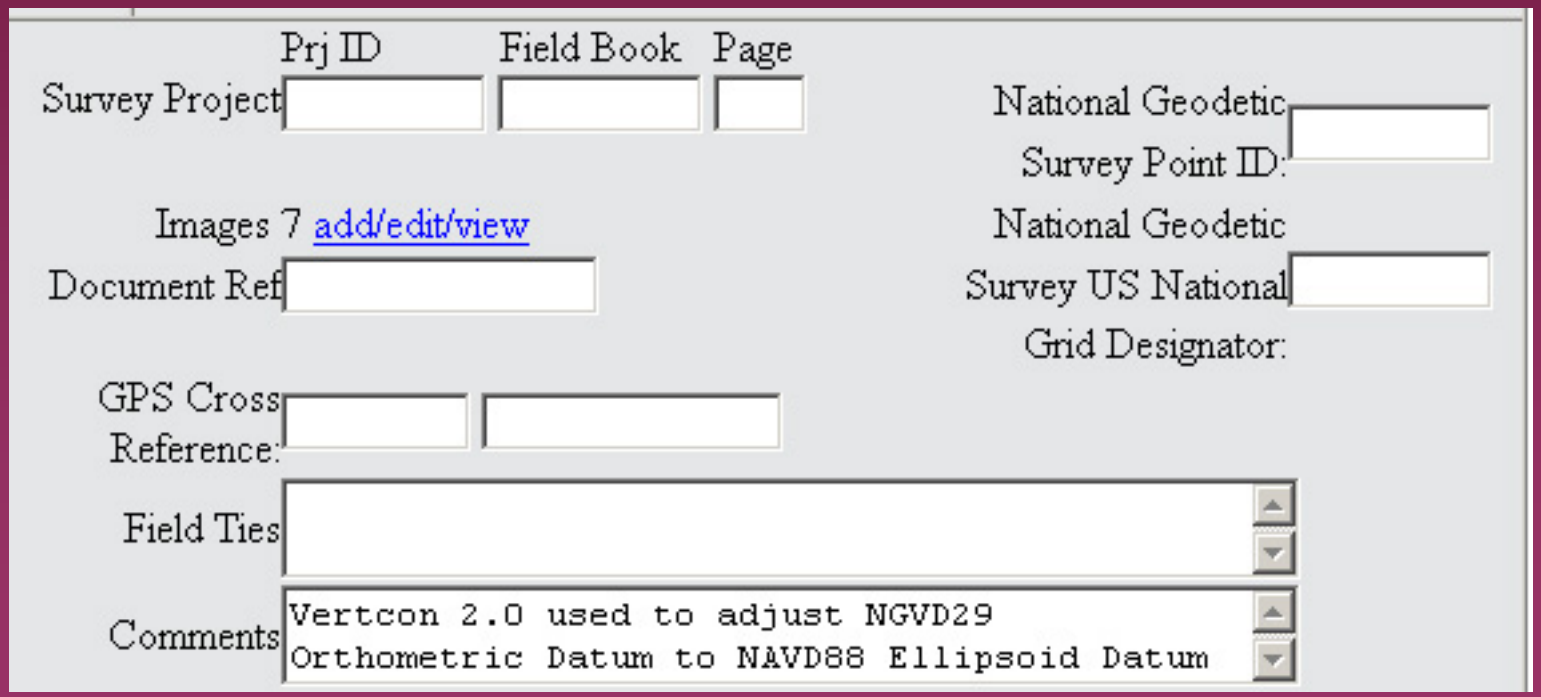
- Point Description
  - 3CM X 3CM CHISELLED "X" ON LEDGE OF BLOCKY BASALT OUTCROP AT GROUND LEVEL. APPROXIMATELY .75 METER EAST OF EDGE. VERY VISIBLE X. Fd X IN BASALT LEDGE DS GALLOWAY

- Site Description
  - ON DEBRI FAN OF DUBINDORF AT BASE OF BASALT OUTCROP IMMEDIATELY DOWNSTREAM OF DRY WASH THAT OUTPUTS AT TOP OF RAPID. ON RIVER SIDE OF PRONOUNCED TRAIL 25 METERS NORTH OF WASH AND 44 METERS EAST OF RIVER.

Written directions on how to find the point using distances and bearings to obvious landmarks.

# Description cont.

- Survey Project Point is associated with
- GPS Cross Reference
- Field Ties
- Comments
- Images



# Database Images

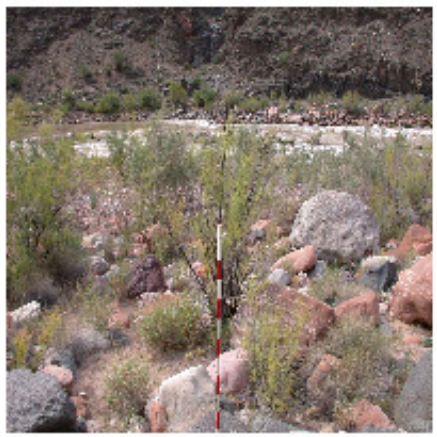
- Nadir images
- Oblique images

add new photo

*Point*
*Designation:* GR132266R
*Date Taken:* 9/10/2003
*Taken By:* K. BROWN
*Description:* NADIR

*Point*
*Designation:* GR132266R
*Date Taken:* 9/10/2003
*Taken By:* K. BROWN
*Description:* FROM DRY WASH TOWARD CONTROL POINT PHOTO TAKEN TOWARD 40 DEGREES

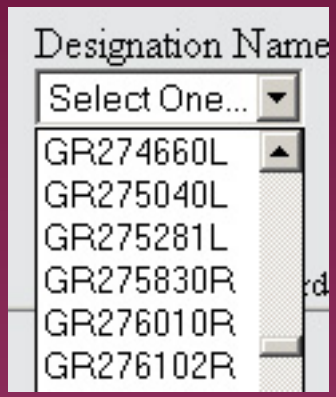
*Point*
*Designation:* GR132266R
*Date Taken:* 9/10/2003
*Taken By:* K BROWN
*Description:* TOWARD MOUTH OF DRY WASH PHOTO TAKEN TOWARD 135 DEGREES

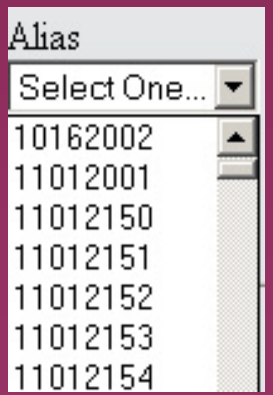


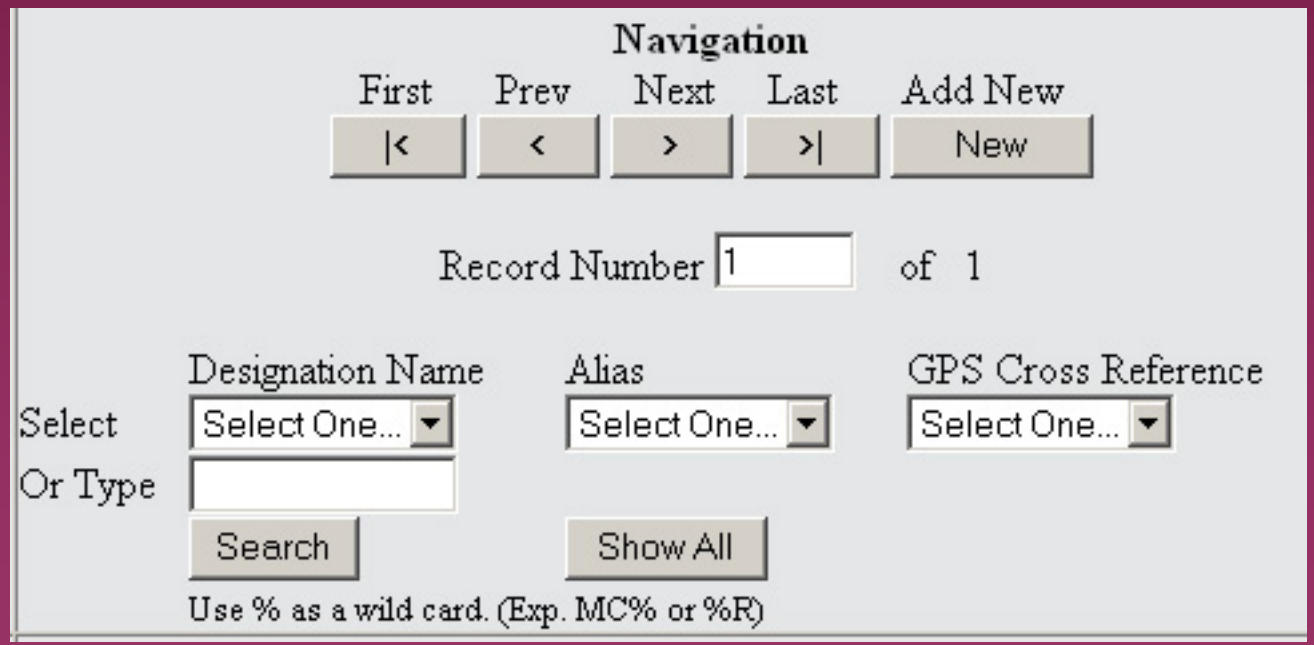
*Point*
*Designation:* GR132266R
*Date Taken:* 9/10/2003
*Taken By:* K BROWN
*Description:* ACROSS DEBRI FAN TOWARD HEAD OF RAPID PHOTO TAKEN TOWARD 255 DEGREES

# Database Navigation and Query

- GCMRC Name
- Point Alias (GCES Name)
- GPS Cross Reference
- Using Wild Card Characters
- River mile
- Project



# Database Products

- Printed Output of Control Point Information
- Printed Output of Control Point Images
- Printed Control Point Atlas on Aerial Photographs
- Digital Control Point Atlas
- Web Interface to access Control Point Database
- Other needed products

**Point Name (Designation):** GR132266R
**Point Alias:** 8513003,

**Station Mile:** 132.266 **Field Area:** Grand Canyon **Side Shot:** Yes
**Station River Offset** 77.155 **State** AZ **Traverse:** No
**River Side** Right **Hydro:** No
**GPS:** No

**Accuracy Convention:**

**USGS 15 Quad:** POWELL PLATEAU NW

**State Plane** 202

| | Horizontal | Vertical |
|---|---|---|
| **Datum** | NAD 83 (1983) | |
| **Method** | Conventional Survey | Conventional Survey |
| **Calc By** | GCES | GCES |
| **Calc Date** | 7/1/1994 | 7/1/1994 |
| **Network Relationship** | ******** | |

| Method | Value |
|---|---|
| GEOID2002 | |
| GEOID1999WINTG.exe | -22.934 |
| GEOID1996 | |
| GEOID1990GEOID90.exe | -22.443 |

**Coordinate**

**Northing Meters:** 592842.818
**Easting Meters:** 165122.114

**Ellipsoid Ht. (m)*:** 586.579
**Orthometric Ht. (m)*:** 608.18591
**Orthometric Ht. Datum:** 90

**Mapping Plane Scale Factor:** .9999287
**Ellipsoid (Elv.) Scale Factor:** .99991171

**N Latitude (dd mm ss.ss):** 36 20 39.33
**W Longitude (dd mm ss.ss):** 112 27 14.64

**N Latitude (dd.ddddd):** 36.3442583333333
**W Longitude (dd.ddddd):** 112.454066666667

**Hydro Azimuth:**
**Combined Grid Factor:** .9998404
**Convergence:** -0-19-06.56

**Accuracy**
**Ellipsoid Ht. Error (m):**
**Orthometric Ht.Error (m):**
**Northing Error:**
**Latitude Error:**
**Longitude Error:**

**Description**

**Monument Type** "Chiselled ""X"""
**Monument Condition** Existing or Recovered
**Monument Set by** UNKNOWN
**Set Date**

**Collected By** Brown
**Collected Date**

**Prj ID** **Field Book** **Page**
**Survey Project**
**Images** 7 edit/add/view
**Document Ref**

**National Geodetic Survey Point ID:**
**National Geodetic Survey US National Grid Designator:**

**Point Desc:** 3CM X 3CM CHISELLED "X" ON LEDGE OF BLOCKY BASALT OUTCROP AT GROUND LEVEL. APPROXIMATELY .75 METER EAST OF EDGE. VERY VISIBLE X. Fd X IN BASALT LEDGE DS GALLOWAY

**Site Desc:** ON DEBRI FAN OF DUBINDORF AT BASE OF BASALT OUTCROP IMMEDIATELY DOWNSTREAM OF DRY WASH THAT OUTPUTS AT TOP OF RAPID. ON RIVER SIDE OF PRONOUNCED TRAIL 25 METERS NORTH OF WASH AND 44 METERS EAST OF RIVER.

**Drive to Desc**

**Red Flag Desc**

**GPS Cross Reference:**

**Field Ties** *****

**Comments** Vertcon 2.0 used to adjust NGVD29 Orthometric Datum to NAVD88 Ellipsoid Datum

**Input Tracking by:** **Date:**
**Checked By:** Brown **Date:** 1/1/2003
**Input/Update**

*Orthometric Height was collected, Ellipsoid Height was calculated.

Printed Output


Point Designation GR132266R
Date Taken 9/10/2003
Taken By K. Brown
Description Scribed X
Compass Direction Nadir


Point Designation GR132266R
Date Taken 9/10/2003
Taken By K. Brown
Description From dry wash toward point - downstream
Compass Direction 40


# Sample of Atlas

**1:10,000 Scale for Reference**


1:1,000 Scale for Locating Control Point

Future direction of the Control Point Database is to compile and include control points used by contractors, cooperators and other researchers.

- To make available the most complete control point database possible.
- To eliminate establishing multiple control points within close proximity of each other.
- To facilitate and expedite updating or establishing coordinate values for contractors, cooperators and other researchers.


The End