

GNSS STATION INSTALLATION REPORT

NGS/CORS PERMANENT GNSS SITE

4-CHARACTER ID: TMG2

Reported By: Jim Normandeau

Date Reported: 12/12/2017



GENERAL INFORMATION

Project Name	NGS COORS cGNSS Installation
Site Descriptive Name	Table Mountain, Boulder, CO
Station Name (Long)	n/a
Station Name (Short)	n/a

GENERAL INFORMATION	
4-Character ID	TMG2
Station Type Code	cGNSS
Installed By (list all)	Jim Normandeau, Keith Williams
Owner of Station	NOAA/NGS CORS
Monument Type	DDBM
Monument Install Date	29-NOV-2017

UNAVCO CONTACTS	
Reporting Person	Jim Normandeau
Address	UNAVCO, 6350 Nautilus Dr., Boulder, CO, USA
Email	normandeau@unavco.org
On-Site Engineers	Jim Normandeau, Keith Williams
Primary Contact	Jim Normandeau
Address	UNAVCO, 6350 Nautilus Dr., Boulder, CO, USA

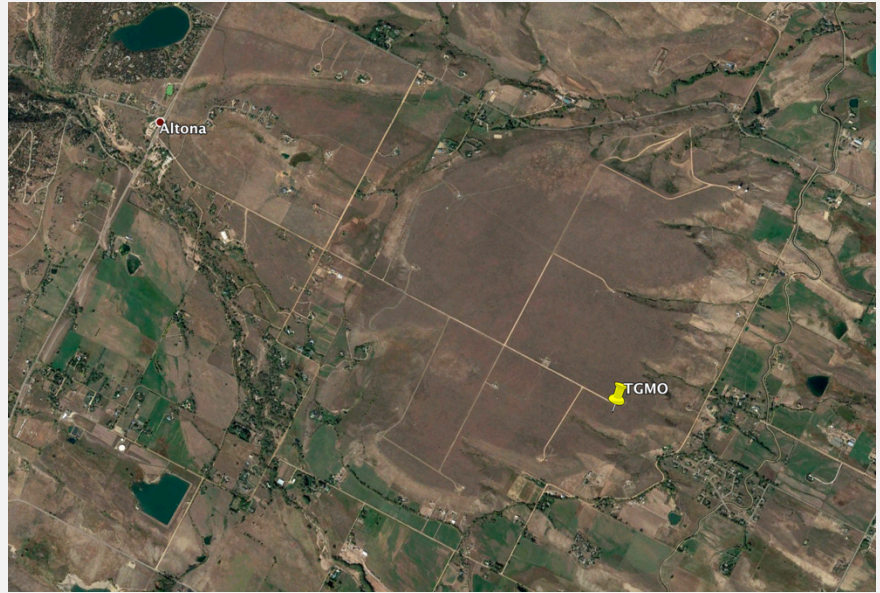
UNAVCO CONTACTS	
Email	normandeau@unavco.org
Maintenance Contact	Jim Normandeau
Email	<u>normandeau@unavco.org</u>
Data Management Contact	NOAA/NGS CORS
Address	
Email	

OTHER CONTACTS	
Landowner	U.S. Department of Commerce,
Address	325 Broadway St. Boulder, CO 80305-3328
Email	
Phone	
On-Site Contact	Francine Coloma
Address	Spatial Reference Systems Division / CORS Branch National Geodetic Survey / NOS / NOAA 325 Broadway St. Mail code E/NE42 Boulder, CO 80305-3328 USA

OTHER CONTACTS	
Phone	Tel: (303) 497-3692
Email	Francine.Coloma@noaa.gov
Notes	
Communications Provider	National Geodetic Survey / NOS / NOAA
Address	n/a
Phone	n/a
Email	n/a
STATION LOCATION DESCRIPTION	
Latitude	40° 7'47.99"N
Longitude	105°13'58.40"W
City	Boulder
State	CO
Country	USA

OTHER CONTACTS

Map of Site



Directions to Site

From: US Department-Commerce Personnel

325 Broadway, Boulder, CO 80305

Follow Broadway and US-36 W to Plateau Rd for 10 miles.

Take Right onto Plateau Rd. Site is approximately 2.1 mile to the East.

ACCESS INFORMATION

There is a security gate where you will need the 4 digit code to gain access.

Type of Permit

N/A

SITE INFORMATION

POWER

The system is AC powered with a battery backup. This system includes 2 100Ah gel cell batteries, breaker switches, equipment enclosure and all necessary power wiring and electrical surge protection.

MONUMENT INFORMATION

The geodetic monument is a deep drill braced type monument. The monument consists of 4 bracing legs welded to a center/vertical leg. Each leg is approximately 30 feet below the ground surface and grouted. A SCIGN type antenna mount was installed, leveled and aligned to true North.

EQUIPMENT ENCLOSURE

The GPS and telemetry equipment is located in an aluminum Type 2, 4-battery enclosure manufactured by SunWize. The enclosure is mounted on a 3" galvanized steel post. The enclosures use a MAPPS style key which is currently in the AC breaker box.

TELEMETRY AND RELAY

The GNSS receiver unit is online via a Ethernet connection provided by NOAA.

EQUIPMENT	
Receiver	
Make	Septentrio
Model	PolaRx5
Serial Number	3022424
UNAVCO ID	n/a
Date Installed	18-DEC-2017
Memory	8GB
Username/Password	None set
Session Programming	n/a – to be completed by NGS/CORS
IP/Subnet/Gateway	LAN: 192.168.61.100/255.255.255.0/192.168.61.1
GPS Antenna	
Make	Javad
Model	RingAnt-DM. p/n 01-570300-01
Serial Number	00446
Height (m)	0.0083

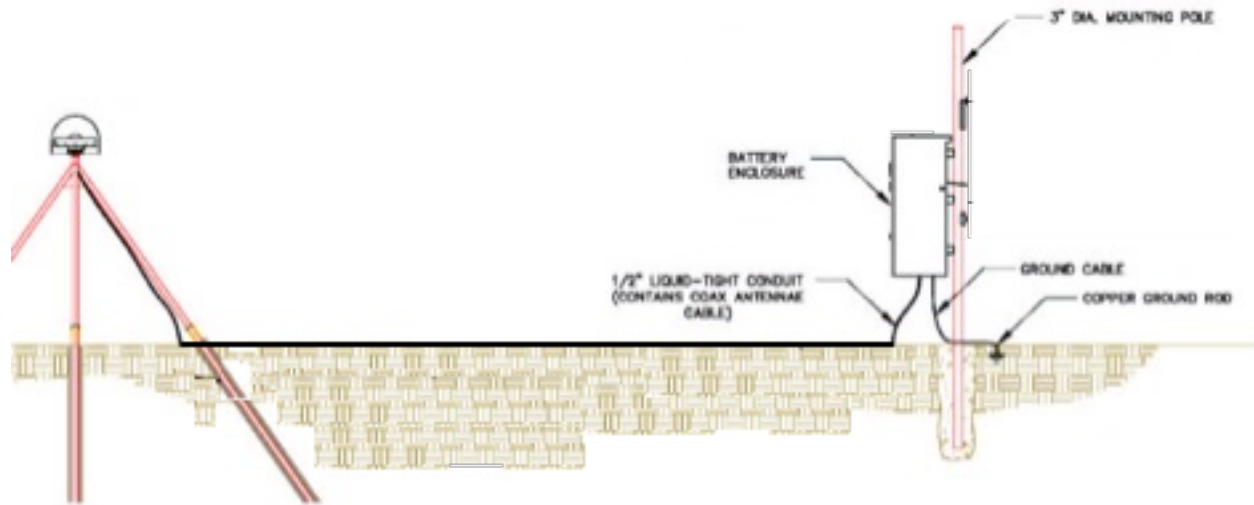
EQUIPMENT	
Orientation	Set to True North
Date Installed	18-DEC-2017
Radome	
Type	SCIGN
Serial Number	3162
Date Installed	18-DEC-17
SCIGN (Tall, Short, None)	SCIS
SCIGN Mount	
Date Installed	18-DEC-17
Serial Number	n/a
Telemetry	
Type	DSL
Date Installed	n/a
Serial Number	n/a
UNAVCO ID	n/a

EQUIPMENT	
IP/Subnet/Gateway	192.168.61.100/255.255.255.0/192.168.61.1
Detailed Description	There is a Ethernet connection to main building. The Ethernet cable runs through conduit and into equipment enclosure. There is a Ethernet switch in the equipment enclosure that serves both GPOS stations in the location.
GPS Antenna Cable	
Type	LMR-400 in Liquitite conduit
GPS End Connector	Straight N in to EMP protector. .5m pigtail antenna from EMP to receiver.
Antenna End Connector	90 degree N
Length	Appx. 35 m
Placement	In conduit.
Notes	GPS cable is connected to a EMP at the equipment box and a RF-58 N-TNC pigtail to the receiver.
Surge Protection	
GPS Receiver	<p>Huber Shuner EMP, mounted to equipment enclosure, connected to Antenna Cable and antenna cable pigtail.</p> <p>Ethernet surge protection.</p> <p>AC to DC converter has a 15 amp fuse.</p> <p>Three 10 amp breaker switches protect DC input, load and battery lines.</p>
Power System	AC power. AC power is a line from the main building in conduit.

EQUIPMENT	
GPS Site Grounding	Enclosures are grounded to 5 foot copper clad grounding rod driven near the post.

CONSTRUCTION DETAILS		
Drill Rig		
Geologic Conditions	See Appendix B.	
Monument Assembly	Standard DDBM	
Hole Information	Monument Leg	
	Vertical	Depth of Hole ¹
	North	40'
	Southeast	35'
	Southwest	35'
Enclosure/Enclosure Post	<ul style="list-style-type: none"> 5 feet tall 35 m Northeast of monument 	5'

CONSTRUCTION DETAILS



Appendix A: Site Photos

Site over view



Monument in North



Monument in East



Monument in South



Monument in West



Inside of equipment enclosure



GPS antenna:



Drilling operation photos:









Appendix B: Setting of Table Mountain, Boulder County, CO

Table Mountain is a plateau of approximately two square miles. It rises about 250 feet (~75 meters) above lands to the east and 100 feet (~30 meters) above lands west of the plateau. While it looks to be flat-topped, there is a gentle tilt of the surface of 0.85° (1 foot vertical in 66 feet horizontal) from SW to NE. It is the remnant of an erosional surface and an alluvial fan, called a pediment, which formed from an older alignment of Left Hand Creek when it exited the mountains west of Niwot/Nebo Road in glacial times. It is an example of inverted topography.

Underlying Geology:

The Laramide Orogeny (~65 mybp) uplifted the core of the modern Rocky Mountains, exposing Precambrian crystalline rocks and leaving overlying Paleozoic and Mesozoic sedimentary rocks exposed as the dipping outcrops (hogbacks) of the Front Range. There is some normal faulting. These are visible west of Table Mountain. The sedimentary rocks dip to the east an average of 20° into the Denver Basin (Figure 1). However, there are numerous folds and faults which can change local dips at outcrops. For example the Cretaceous Niobrara Formation outcropping near intersection of US 36 and Neva Road dip about 70° . The brown sandstone commonly used as building stone in the area (warehoused at intersection of US 36 and Plateau Road and at US 36 and CO 66) is the Permian Lyons Sandstone. The upper Cretaceous Laramie Formation, miles east of Table Mtn., was a major source of shallow coal. Its mining gave birth to cities like Erie, Lafayette and Louisville. There was Paleocene intrusive activity, as witnessed by the vertical Valmont Dike in east Boulder and some bedding-plane sills a mile west of US 36, just west of Table Mountain.

The upper Cretaceous Pierre Shale Formation immediately underlies the pediment material of Table Mountain; in particular the Middle Shale member and the Hygiene Sandstone member. The Hygiene member outcrops north of the Table Mountain north gate at Nelson Road. The Pierre Shale is an olive-gray shale with interbedded sandstone layers, locally with ironstone concretions and limestone concretions. It formed in the shallow seas of the Western Interior Seaway. It is a very thick formation (~8000 ft \approx 2400 m) and is internally mapped biostratigraphically. Numerous ammonites have been found, notably genera *Baculites*, *Inoceramus* and *Didymoceras* (Figure 2). Some were found along east and north edges of Table Mountain. Other plant and animal (e.g. clams) fossils have also been found. The ironstone may have formed in bogs or under the sea; and was the basis for some historical foundries (e.g. Eldorado Springs area).

The south edge of Table Mountain is over the north end of the Haystack Mountain Anticline; which runs southward to the Boulder Reservoir. Ironically, Haystack Mountain is not over any part of the anticline. This anticline is likely only in the Pierre Shale.

The Pierre Shale (named for city of Pierre, South Dakota) has low permeability (tight to water) in its buried state. However, exposed to weathering, its clays (bentonite) can swell significantly and it will erode easily. The shale under Table Mountain (probably the Hygiene Sandstone member) is protected from most weathering and remains stable. Whereas in surrounding areas, the shale, which was originally the uplands, has eroded to levels below Table Mountain (inverted topography).

Surficial Geology:

Left Hand Creek, and its tributary James Creek, drain the local mountains in a rough easterly direction (oddly oblique to major, mapped faults) at a latitude corresponding to Niwot or Nebo Road. When it reaches the valley west of the Front Range (Olde Stage Road corridor), it diverts north and exits mountains just west of Plateau Road (after merging with Geer Canyon Creek). It is believed the major drainage used to not divert and emptied into plains just north of old Ball Aerospace facility.

During melting of various glacial advances during the Pleistocene large amounts of rock and sediment (mostly of crystalline origin) were eroded from the mountains and transported eastward. The current creeks are mere vestiges of their glacial versions. As the creeks exited hard, crystalline rocks of

the mountains, they eroded the Pierre Shale and other local sedimentary rocks to a sub-planar surface (i.e. the pediment). Alluvial fans formed within the valleys of the paleo-topography generally east of the pediment (see Figure 1). The distributary channels in a fan shift (horizontally) frequently to dump their sediment load most easily. A thin layer (~10 to 30 feet thick) of these sediments were also left atop the pediment rocks. The resulting sediments are generally unsorted with respect to grain (or cobble) size. Although there will be limited areas of well sorted material, such as from a sandbar. During inter-glacials, when the semi-arid climate returned, calcium carbonate will precipitate out of stream or rain waters and will form a weak cement between the sand grains, called caliche. The resulting pediment is very porous and permeable and weakly cemented. Subsequent rain waters quickly drain through the material while eroding very little of it. As mentioned above, the pediments remains stable while weatherable rocks, which had formed the valley walls, erode, leaving the pediments as inverted topography. Other local pediments left as mesas include Table Mesa (NCAR) and Kohler Mesa (behind DOC facility) in Boulder, Table Top Mountain north of Hygiene and the flat areas north and west of Table Mountain. There are at least five pediment levels mapped locally. Haystack Mountain represents the highest and oldest level (Nebraskan glaciation). It is highest since the surrounding geology had yet to erode down. Table Mountain represents the second oldest level (Kansan glaciation). Note that the two Table Mountains east of Golden are capped with volcanic rock and are not pediments.

In May 1993 two wells were drilled at the Table Mountain Geophysical Observatory, which this author logged. Cuttings are available. The top 15 feet were dry sand and gravel. The next 10 feet were moist sand and gravel. These 25 feet are the pediment at this site. It is expected that the thickness of the pediment can vary ± 10 feet elsewhere on Table Mountain. The spring of 1993 had a lot of rain. The ten feet of moisture was a perched water-table, not always present on Table Mountain. Gravimeter readings were high that spring, reflecting the added mass of the ground water. Typically rain water (and snow melt) drain into the pediment, hit the aquiclude of the shale and move off horizontally coming out as temporary springs or going into perimeter canals. In the well from 25 feet to 36 feet, a brown, sandy shale was encountered. This may have been the bottom of the Hygiene Sandstone member or a weathered section of generic Pierre Shale. From 36 feet to the bottom of the well at 100 feet, dry Pierre Shale was encountered.

References:

Braddock, W.A., Houston, R.G., Colton, R.B. and Cole, J.C., 1988, Geologic Map of the Lyons Quadrangle, Boulder County, Colorado, USGS *Geologic Quadrangle Map GQ-1629*, scale 1:24,000.

Gutiérrez, M., 2005, *Climatic Geomorphology*, (English translation), Developments in Earth Surface Processes 8, (Elsevier: San Diego), 760 pp.

Scott, G.R. and Cobban, W.A., 1965, Geologic and Biostratigraphic Map of the Pierre Shale Between Jarre Creek and Loveland, Colorado, USGS *Miscellaneous Geologic Investigations Map I-438* and accompanying text, scale 1:48,000.

Trimble, D.E., 1975, Geologic Map of the Niwot Quadrangle, Boulder County, Colorado, USGS *Geologic Quadrangle Map GQ-1229*, scale 1:24,000.

Compiled by D. Winester, NOAA-NGS, August 2009.