

Stantec's Response to COGCC's RE Response #1

- 2017: Chevron completed a management of change (MOC) of the Rangely CS-47 site from AECOM to Stantec. During the MOC, Stantec received survey control files from AECOM.
 - The Control Point, established by AECOM, for CS-47 indicated an elevation of 5199.655 feet above mean sea level (ft amsl).
- May 2017: Stantec advances borings SB-1 through SB-6. Stantec set up survey equipment on AECOM's survey control (elevation 5199.655 ft amsl) and surveyed the SBs.
- May 2017: Stantec developed boring logs and used the survey collected in May 2017.
- October 2017: In preparation for additional site assessment activities and to QC the previous consultant's survey data, Stantec collected static survey data on the AECOM established control point and completed a survey check-in at a local NGS monument, LN0411, at the Rangely Municipal Building, see **Table 1**.

Table 1 – NGS Monument and Stantec's Check-In at Monument

	Northing	Easting	Elevation
Stantec	1291887.869	2076056.901	5228.143
NGS LN0411	1291887.930	2076056.810	5228.210
Difference	-0.061	0.091	-0.067

- After Stantec checked-in to LN0411, Stantec realized the AECOM data utilized the Dynamic Height versus the Ortho Height. NGS Data Sheet indicates a 4.8-foot vertical difference between Dynamic and Ortho Heights (the same observation Kris has in his response), see **Appendix A**.
 - Dynamic Height versus Ortho Height:
 - Dynamic height is a difference between two points measured normal (perpendicular) to gravity (established gravity at the 45th parallel). Elevations need to be adjusted for gravity at the Site in relation to the 45th parallel (initially established for water levels over a large area [i.e. the Great Lakes]). Data to calibrate the dynamic height continues to change and present-day data collectors are not equipped with gravity modifications based on location, therefore elevation calculations must be completed by hand.
 - Orthometric height is the height of a point above the geoid (equipotential surface of the earth; a model of the earth's shape). The difference between two points (not affected by gravity) is the ellipsoid height minus the geoid height. The geoid model is also changing as NGS gathers more data. Stantec updates our data collectors with the most recent models from NGS; Stantec currently uses the Geoid 12B model (released in 2012). NGS anticipates a new release in 2022 (using continuously collected data from the previous 10 years to redevelop the assumptions of the earth's shape). Data collectors automatically adjusts elevations with no hand calculations.
- October 2017: Stantec updated the vertical survey control to NAVD 88 Ortho Height (to reduce error and to not calculate elevations by hand); Control Point for CS-47 has an elevation of 5204.500 (difference of 4.845 feet)

- October 2017: Stantec resurveyed the site features, including the May 2017 SBs, see **Table 2**.
- Stantec did not update the boring logs with the adjusted Ortho Height data collected in November 2017.

Table 2 – Elevation Differences (Dynamic Height versus Ortho Height)

May 2017 Survey Data (dynamic height)			
Northing	Easting	Elevation	Description
1294717.207	2073626.483	5198.203	sb01
1294718.127	2073666.363	5197.837	sb02
1294733.799	2073646.118	5200.354	sb03
1294704.671	2073646.820	5199.365	sb04
1294718.339	2073681.035	5197.580	sb05
1294735.065	2073665.510	5197.668	sb06

November 2017 Survey Data (ortho height)			
Northing	Easting	Elevation	Description
1294717.131	2073626.204	5203.120	SB-1
1294718.180	2073666.636	5202.730	SB-2
1294733.722	2073646.48	5205.234	SB-3
1294704.652	2073647.224	5204.199	SB-4
1294718.313	2073681.393	5202.534	SB-5
1294735.221	2073665.779	5202.656	SB-6

Difference (ortho – dynamic)			
Northing (feet)	Easting (feet)	Elevation (feet)	Description
-0.076	-0.279	4.917	SB-1
0.053	0.273	4.893	SB-2
-0.077	0.362	4.880	SB-3
-0.019	0.404	4.834	SB-4
-0.026	0.358	4.954	SB-5
0.156	0.269	4.988	SB-6

average elevation change 4.911

Observations:

- According to the NGS Data Sheet, from Dynamic Height to Ortho Height, there is a 4.8-foot vertical change.
- On average, Stantec observed a 4.9-foot vertical change (approx. 1-inch more than NGS, due to slight soil changes at each soil boring).

Appendix A - NGS Data Sheet

The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.11

1 National Geodetic Survey, Retrieval Date = JANUARY 13, 2017

LN0411 *****

LN0411 DESIGNATION - V 419

LN0411 PID - LN0411

LN0411 STATE/COUNTY- CO/RIO BLANCO

LN0411 COUNTRY - US

LN0411 USGS QUAD - RANGELY (1972)

LN0411

LN0411 *CURRENT SURVEY CONTROL

LN0411

LN0411* NAD 83(2011) POSITION- 40 05 14.57864(N) 108 48 10.73871(W) NO CHECK

LN0411* NAD 83(2011) ELLIP HT- 1577.030 (meters) (06/27/12) NO CHECK

LN0411* NAD 83(2011) EPOCH - 2010.00

LN0411* [NAVD 88](#) ORTHO HEIGHT - 1593.561 (meters) 5228.21 (feet) ADJUSTED Stantec uses Ortho Height

LN0411

LN0411 GEOID HEIGHT - -16.537 (meters) GEOID12B

LN0411 NAD 83(2011) X - -1,575,369.821 (meters) COMP

LN0411 NAD 83(2011) Y - -4,626,828.831 (meters) COMP

LN0411 NAD 83(2011) Z - 4,086,428.979 (meters) COMP

LN0411 LAPLACE CORR - 1.35 (seconds) DEFLEC12B

LN0411 DYNAMIC HEIGHT - 1592.098 (meters) 5223.41 (feet) COMP AECOM used Dynamic Height

LN0411 MODELED GRAVITY - 979,652.1 (mgal) NAVD 88

LN0411

LN0411 VERT ORDER - FIRST CLASS II Vertical Difference = 4.8 feet

LN0411

LN0411 Network accuracy estimates per FGDC Geospatial Positioning Accuracy

LN0411 Standards:

LN0411 FGDC (95% conf, cm) Standard deviation (cm) CorrNE

LN0411 Horiz Ellip SD_N SD_E SD_h (unitless)

LN0411 -----

LN0411 NETWORK 1.30 2.55 0.56 0.50 1.30 0.09921871

LN0411 -----

LN0411 Click [here](#) for local accuracies and other accuracy information.

LN0411

LN0411

LN0411.The horizontal coordinates were established by GPS observations

LN0411.and adjusted by the National Geodetic Survey in June 2012.

LN0411

LN0411.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has

LN0411.been affixed to the stable North American tectonic plate. See

LN0411.[NA2011](#) for more information.

LN0411

LN0411.The horizontal coordinates are valid at the epoch date displayed above

LN0411.which is a decimal equivalence of Year/Month/Day.

LN0411

LN0411.No horizontal observational check was made to the station.

LN0411.

LN0411.The orthometric height was determined by differential leveling and

LN0411.adjusted by the NATIONAL GEODETIC SURVEY

LN0411.in June 1991.

LN0411

LN0411.Significant digits in the geoid height do not necessarily reflect accuracy.

LN0411.GEOID12B height accuracy estimate available [here](#).

LN0411

LN0411.The X, Y, and Z were computed from the position and the ellipsoidal ht.

LN0411

LN0411.The Laplace correction was computed from DEFLEC12B derived deflections.

LN0411

LN0411.The ellipsoidal height was determined by GPS observations

LN0411.and is referenced to NAD 83.

LN0411

LN0411.The dynamic height is computed by dividing the NAVD 88

LN0411.geopotential number by the normal gravity value computed on the

LN0411.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

LN0411.degrees latitude (g = 980.6199 gals.).

LN0411

LN0411.The modeled gravity was interpolated from observed gravity values.

LN0411

LN0411. The following values were computed from the NAD 83(2011) position.

LN0411

LN0411;

		North	East	Units	Scale Factor	Converg.
--	--	-------	------	-------	--------------	----------

LN0411;SPC CO N	-	393,768.229	632,783.382	MT	0.99996089	-2 08 03.0
-----------------	---	-------------	-------------	----	------------	------------

LN0411;SPC CO N	-	1,291,887.93	2,076,056.81	sFT	0.99996089	-2 08 03.0
-----------------	---	--------------	--------------	-----	------------	------------

horizontal data

LN0411;UTM 12	-	4,439,769.091	687,305.373	MT	1.00003191	+1 24 54.7
---------------	---	---------------	-------------	----	------------	------------

LN0411

LN0411! - Elev Factor x Scale Factor = Combined Factor

LN0411!SPC CO N - 0.99975266 x 0.99996089 = 0.99971356

LN0411!UTM 12 - 0.99975266 x 1.00003191 = 0.99978456

LN0411

LN0411_U.S. NATIONAL GRID SPATIAL ADDRESS: 12TXK8730539769(NAD 83)

LN0411

LN0411 SUPERSEDED SURVEY CONTROL

LN0411

LN0411 NAD 83(2007)- 40 05 14.57830(N) 108 48 10.73917(W) AD(2002.00) 1

LN0411 ELLIP H (05/01/09) 1577.058 (m) GP(2002.00) 4 1

LN0411 NAD 83(1992)- 40 05 14.57785(N) 108 48 10.73831(W) AD() 1

LN0411 ELLIP H (03/15/06) 1577.075 (m) GP() 4 1

LN0411 NAVD 88 1593.56 (m) 5228.2 (f) LEVELING 3

LN0411

LN0411.Superseded values are not recommended for survey control.

LN0411

LN0411.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LN0411.[See file dsdata.txt](#) to determine how the superseded data were derived.

LN0411

LN0411_MARKER: I = METAL ROD

LN0411_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)

LN0411_STAMPING: V 419 1984

LN0411_MARK LOGO: NGS

LN0411_PROJECTION: FLUSH

LN0411_MAGNETIC: I = MARKER IS A STEEL ROD

LN0411_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

LN0411_SATELLITE: THE SITE LOCATION WAS REPORTED AS NOT SUITABLE FOR

LN0411+SATELLITE: SATELLITE OBSERVATIONS - May 23, 2006

LN0411_ROD/PIPE-DEPTH: 14.1 meters

LN0411

LN0411	HISTORY	- Date	Condition	Report By
--------	---------	--------	-----------	-----------

LN0411	HISTORY	- 1984	MONUMENTED	NGS
--------	---------	--------	------------	-----

LN0411	HISTORY	- 20051115	GOOD	WOOLPT
--------	---------	------------	------	--------

LN0411	HISTORY	- 20060523	GOOD	GEOCAC
--------	---------	------------	------	--------

LN0411

LN0411 STATION DESCRIPTION

LN0411

LN0411'DESCRIBED BY NATIONAL GEODETIC SURVEY 1984

LN0411'IN RANGELY.

LN0411'IN RANGELY, AT THE JUNCTION OF WEST MAIN STREET AND SOUTH WHITE

LN0411'AVENUE, 82.9 M (272.0 FT) EAST OF THE CENTER OF THE AVENUE, 13.9 M

LN0411'(45.6 FT) SOUTH OF THE CENTERLINE OF MAIN STREET, 12.1 M (39.7 FT)

LN0411'NORTHWEST OF THE NORTHWEST CORNER OF THE RANGELY MUNICIPAL BUILDING,

LN0411'AND 0.3 M (1.0 FT) NORTH OF A DEDICATED MEMORIAL MARKER. NOTE--ACCESS

LN0411'TO DATUM POINT IS HAD THROUGH A 5-INCH LOGO CAP.

LN0411'THE MARK IS 0.1 M ABOVE THE STREET.

LN0411

LN0411 STATION RECOVERY (2005)

LN0411

LN0411'RECOVERY NOTE BY WOOLPERT CONSULTANTS 2005 (KCH)

LN0411'RECOVERY NOTE BY WOOLPERT, INC. 2005 (BAJ) RECOVERED AS DESCRIBED.

LN0411

LN0411 STATION RECOVERY (2006)

LN0411

LN0411'RECOVERY NOTE BY GEOCACHING 2006 (WD)

LN0411'RECOVERED IN GOOD CONDITION.

*** retrieval complete.

Elapsed Time = 00:00:02