



Coastal Protection and
Restoration Authority of Louisiana

*Elevation Survey Report For Coastal Reference Monitoring System,
and Secondary Monuments*
CRMS 0687



PREPARED BY: C & C TECHNOLOGIES INC.
DECEMBER 11, 2014

X 
DUSTIN F. CAIN, PLS
PROJECT MANAGER LAND SURVEY SERVICES



CORPORATE OFFICE: 730 E. Kaliste Saloom Road, Lafayette, LA 70508 U.S.A.

1. Project Description

1.1 Project Description

C & C Technologies, Inc. was contracted by the State of Louisiana, Coastal Protection and Restoration Authority (herein referred to as CPRA) to provide elevations at all CRMS sites and CWPPRA discrete monitoring stations listed in Appendix A of the Scope of Services provided by CPRA dated February 24, 2014.

Landowner information was provided to C & C Technologies, Inc. by CPRA in the Scope of Work under Appendix C – Landowner Contact Information. In accordance with the Scope of Work, C & C Technologies, Inc. contacted all landowners and secured the necessary permits/permissions for access throughout the survey.

2. Survey Methodology, Network Adjustment Methodology, and Control Survey

2.1 Survey Methodology

The field survey for this site was conducted on May 19, 2014. The purpose of this survey was to acquire elevations on the CRMS 0687 Continuous Recorder, Staff Gauge and Rod Surface Elevation Table (RSET) rod. Data collection was performed using a Leica Viva RTK GPS receiver and a Leica CS-15 with SmartWorx Data Collector using the Real-Time Kinematic (RTK) method. All data was recorded in State Plane Coordinate System, NAD 83 U.S. Feet, Louisiana South Zone (1702) and NAVD 88 U.S. Feet (Geoid 12a). The RTK base station was set up over Secondary Monument CS23-SM-01 using the published values on the DNR control sheet. The continuous recorder and staff gauge positions and relative differences were surveyed using a fixed height pole for the rover and manual tape pulls to all measurements to check for blunders and to achieve redundancy. The RSET consisted of a deep driven rod with a disk sleeve measured 0.50 feet down the said rod. The disk contains eight holes at equal distances around the rod and the #1 hole and #5 hole, which are opposite of one another, were surveyed in and averaged to get an accurate disk elevation (reference page 8 of 14). These numbers were also manually checked for blunders and to have redundancy in the field by tape measurements. RSET location was accessed by the end of walkway and the use of a 2"x6" board laid across from walkway to walkway so no existing marsh would be damaged. The survey was performed by Elvis Nguyen (Party Chief) and Stuart Chance (Instrument Man) on board an aluminum hull survey vessel owned and operated by C & C Technologies, Inc. and assistance of an airboat and airboat driver.

2.2 Network Adjustment

The program used for the network adjustment was Leica GeoOffice (LGO), version 8,2,0,0. All raw static and survey data is collected as a SmartWorx raw data file (.m00 extension). The static data is imported into LGO and checked to make sure that all five receivers have appropriate amount of overlapping time. The overlapping time is what allows for baselines between the control points to be calculated. A typical static session with five bases running simultaneously (reference page 8 of 14); in some instances only four bases were being used. A single overnight session was used when navigating to and from control daily was unreasonable, and two sessions were used otherwise. Dual sessions for a mini-network consisted of either

an 8 and 4 hour session or two 6 hours sessions. After all static data is imported into LGO, the precise ephemeris for each day the static was in session must be downloaded and imported in. The precise ephemeris is the final documented route of the satellites' orbits at the time of survey and is usually available 14-16 days after the collection of static data. After all of this data is uploaded into LGO, baselines between each control point within a particular mini-network can be calculated. Each mini-network must have static data time overlapping to connect to the next corresponding mini-network. This means that certain control points were occupied several times, each being tied to a different mini-network to ensure that the necessary static data is available to join them to the overall network (reference page 8 of 14). The static files corresponding to the chosen Continuously Operating Reference Station(s) (CORS) are downloaded for specific days to be used. The CORS used in the processing are as listed: TONY (Lafayette, LA), FSHS (Franklin, LA), CAMR (Cameron, LA), TXPT (Port Arthur, TX), TXOR (Orange, TX), and MCNE (Lake Charles, LA). Certain points were selected throughout the entirety of network to be used as anchors for the adjustment. The corresponding static data for the CORS were downloaded to overlap the data for the chosen points for processing. Each point then has a baseline created from each CORS, creating multiple redundant checks. This is similar to how NGS's Online Positioning User Service (OPUS) works, with the exception that OPUS uses only three CORS for its computations. After all the selected points are processed, then the processing of the mini-networks that correspond to them can begin. This is a timely process that involves the distribution of the error involved within each mini-network until certain tolerances are met. After this process is complete, a complete network adjustment is done to establish horizontal and vertical positions on all control within the network. After all the adjustments are made to the control, adjustments are made to the individual baselines corresponding to the control point and the CRMS site surveyed referenced to it. The geoid 12A is then applied to the survey data's adjusted positions to establish orthometric heights for the CRMS site and control.

2.3 Control Survey

The RTK base station was set up over Secondary Monument CS23-SM-01 using the published values on the DNR control sheet. The monument is said to be a 2" aluminum cap set on a 9/16" stainless steel rod driven to refusal and set in a 6" PVC sleeve filled with concrete. The unadjusted surveyed horizontal and vertical data is referenced to the positions listed in the table on page 11 of 14 titled "Unadjusted". Six days' worth of GPS static observations were performed with four other GPS receivers simultaneously to tie into a primary GPS network being established in accordance with CPRA's Contractor's Guide to Minimum Standards'. A RINEX (Receiver Independent Exchange) file was then created in LGO to process through OPUS as a secondary check to the network positions. The positions achieved through network adjustments developed in LGO compared to an averaged OPUS position differed by 0.00 feet in the X and 0.01 feet in the Y positions respectively, and 0.03 feet in the vertical, respectively, with LGO positions being lower in elevation (Compared using Geoid 12a). All positions listed in this report are based on the final values established through LGO network adjustments.



VICINITY MAP: Scale: 1" = 1000'
Station Name: CRMS 0687-CR-H01

Reproduced from 2013 CAMERON PARISH AERIAL

Location: Located in an unnamed canal approximately 4.03 miles South of Hackberry, LA in Cameron Parish, La.

Gauge Description: The gauge is a continuous recorder gauge attached to a 4"x4" treated wood post with a reference nail driven horizontally into the wood post.

Date of Survey: 5-19-2014

Continuous Recorder Gauge

NAD 83 Geodetic Position:

Lat. 29° 56' 21.036" N

Long. 93° 21' 28.494" W

UTM, NAD 83, Meters (Zone 15) Coordinates

N= 3,312,099.523 M

E= 465,458.790 M

NAD 83 Datum LSZ (1702) Feet

N= 529,038.04'

E= 2,639,631.24'

Elevation at Top of 4"x4" Post (NAVD 88) (Geoid 12A Height)

7.92 feet

Elevation at Top Shank of Nail (NAVD 88) (Geoid 12A Height)

2.39 feet



*Position Determined by using Real-Time Kinematic (RTK) Survey from CS23-SM-01 with a GPS Network Adjustment Value.
 Position Established by C & C Technologies, Inc. for the Louisiana Coastal Protection and Restoration Authority.*



VICINITY MAP: Scale: 1" = 1000'
Station Name: CRMS 0687-SG-H01

Reproduced from 2013 CAMERON PARISH AERIAL

Location: Located in an unnamed canal approximately 4.03 miles South of Hackberry, LA in Cameron Parish, La.

Gauge Description: The staff gauge is attached to a 4"x4" treated wood post. (There was no reference nail or evidence of nail at date of survey in 4x4 post.)

Date of Survey: 5-19-2014

Staff Gauge

NAD 83 Geodetic Position:

Lat. 29° 56' 21.026" N
 Long. 93° 21' 28.503" W

UTM, NAD 83, Meters (Zone 15) Coordinates

N= 3,312,099.196 M
 E= 465,458,539 M

NAD 83 Datum LSZ (1702) Feet

N= 529,036.98'
 E= 2,639,630.40'

Elevation at Top of 4"x4" Post (NAVD 88) (Geoid 12A Height)

5.76 feet

Elevation at Top Shank of Nail (NAVD 88) (Geoid 12A Height)

N/A feet



*Position Determined by using Real-Time Kinematic (RTK) Survey from CS23-SM-01 with a GPS Network Adjustment Value.
 Position Established by C & C Technologies, Inc. for the Louisiana Coastal Protection and Restoration Authority.*



VICINITY MAP: Scale: 1" = 1000'
Station Name: CRMS 0687-E01

Reproduced from 2013 CAMERON PARISH AERIAL

Location: Located near an unnamed canal approximately 4.06 miles South of Hackberry, LA in Cameron Parish, La.

Gauge Description: 9/16" stainless steel rod driven to refusal in a 6" PVC sleeve.
 Top of collar to top of rod distance: 0.50 feet.

Date of Survey: 5-19-2014

Deep Rod RSET

NAD 83 Geodetic Position:

Lat. 29° 56' 19.317" N

Long. 93° 21' 26.578" W

UTM, NAD 83, Meters (Zone 15) Coordinates

N= 3,312,046.448 M

E= 465,509.987 M

NAD 83 Datum LSZ (1702) Feet

N= 528,861.43'

E= 2,639,796.71'

Elevation at Top of RSET Rod (NAVD 88) (Geoid 12A Height)

2.58 feet



*Position Determined by using Real-Time Kinematic (RTK) Survey from CS23-SM-01 with a GPS Network Adjustment Value.
 Position Established by C & C Technologies, Inc. for the Louisiana Coastal Protection and Restoration Authority.*

Continuous Recorder and Staff Gauge Survey Data Sheet

Station	Date	Continuous Recorder Gauge				
		Top of Recorder Support Pole (4x4 Post, Cap of Pipe, etc.)	Top of Support Pole to Nail or Top of 1/4" Hole	Nail or Hole Elevation	Top of Recorder Support Pole to Top of Water Distance	Water Elevation
		(NAVD 88, Ft.)	(Ft.)	(NAVD 88, Ft.)	(Ft.)	(NAVD 88, Ft.)
CRMS0687-H01	5/19/2014	7.92	5.55	2.39	7.16	0.76

How to Obtain Readings for Each Continuous Recorder Gauge Column

- Top of Recorder Support Pole:** Obtained by using department approved surveying methods.
- Top of Support Pole to Nail or 1/4" Hole:** Obtained by physically measuring the distance between the two points.
- Nail or Hole Elevation:** Obtained by using the formula subtracting the two previous columns.
- Top of Recorder Support Pole to Top of Water Distance:** Obtained by measuring the distance between the two points.
- Water Elevation:** Obtained by using the formula: Top of Recorder Support Pole - Top of Recorder Support Pole to Top of Water Distance.

Station	Date	Staff Gauge						
		Existing Staff Gauge Reading (Upon Arrival)	Top of Staff Gauge Support Pole	Top of Staff Gauge Support Pole to Top of Water Distance	Water Elevation	Staff Gauge Reading (After Establishment or Adjustment)	Computed Difference (Water Elevation vs. Staff Gauge)	Correction Factor
			(NAVD 88, Ft.)	(Ft.)	(NAVD 88, Ft.)	(NAVD 88, Ft.)		
CRMS0687-H01	5/19/2014	1.42	5.76	5.00	0.76	N/A	N/A	

How to Obtain Readings for Each Staff Gauge Column

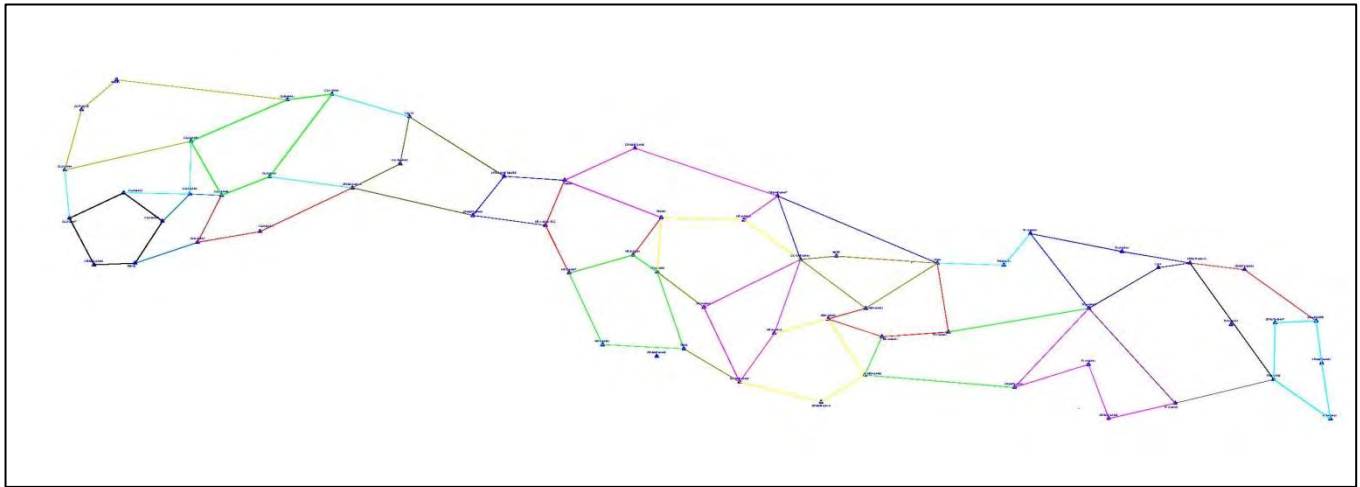
- Existing Staff Gauge Reading:** If a staff gauge is present at this location, obtain a reading before any adjustments are made.
- Top of Staff Gauge Support Pole:** Obtained by using department approved surveying methods.
- Top of Staff Gauge Pole to Top of Water Distance:** Obtained by physically measuring the distance between the two points.
- Water Elevation:** Obtained by subtracting the two previous readings (Top of Staff Gauge Support Pole and Top of Staff Gauge Support Pole to Top of Water Distance).
- Staff Gauge Reading:** Obtained by reading the staff gauge after it has been set to the datum.
- Computed Difference:** Obtained by subtracting the two previous readings (water elevation and Staff Gage Reading)
- Correction Factor:** Obtained by subtracting the Existing Staff Gauge Reading and the Staff Gauge Reading. The correction factor is used to correct all previously data collected.

ADJUSTED TO NETWORK SOLUTION				
STAFF GAUGE				
	Northing	Easting	Elevation (Geoid12A)	
Point Number	(NAD 83 LSZ (1702) Feet)	(NAD 83 LSZ (1702) Feet)	(NAVD88 Feet)	Notes
0687-1	529037.20	2639630.06	0.77	TOP WATER 11:44
0687-2	529037.32	2639630.20	2.18	3' MARK
0687-3	529036.98	2639630.40	5.76	TOP 4X4

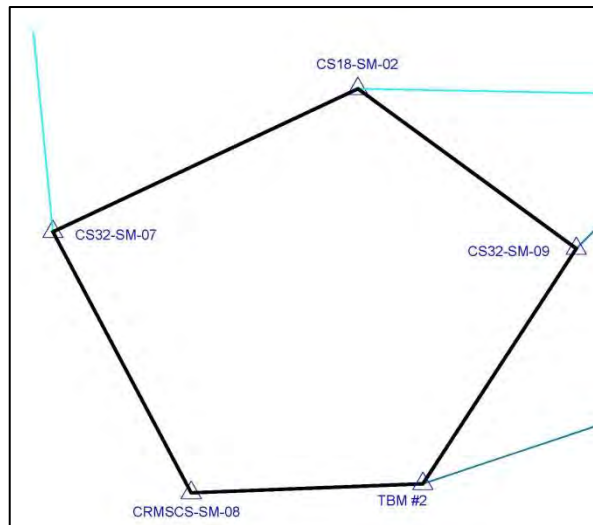
CONTINUOUS RECORDER				
	Northing	Easting	Elevation (Geoid12A)	
Point Number	(NAD 83 LSZ (1702) Feet)	(NAD 83 LSZ (1702) Feet)	(NAVD88 Feet)	Notes
0687-4	529037.19	2639630.06	0.78	TOP WATER 11:45
0687-5	529038.16	2639631.07	2.39	TOP OF NAIL
0687-6	529038.04	2639631.24	7.92	TOP 4X4

RSET Rod				
	Northing	Easting	Elevation (Geoid12A)	
Point Number	(NAD 83 LSZ (1702) Feet)	(NAD 83 LSZ (1702) Feet)	(NAVD88 Feet)	Notes
0687-7	528861.43	2639796.71	2.58	TOP RSET ROD
0687-8	528861.35	2639796.66	2.09	TOP COLLAR 1
0687-9	528861.50	2639796.70	2.12	TOP COLLAR 5
Note:	Adjustment from RAW data			
Δ	0.03	feet in X position		
Δ	-0.11	feet in Y position		
Δ	-0.88	feet in Z position		

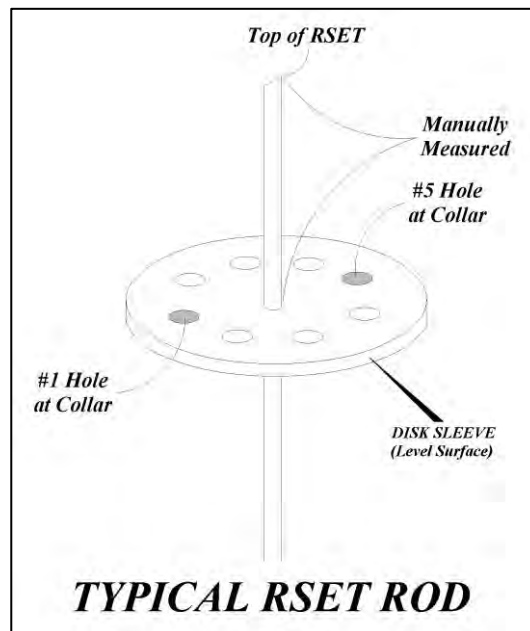
View of Entire Network



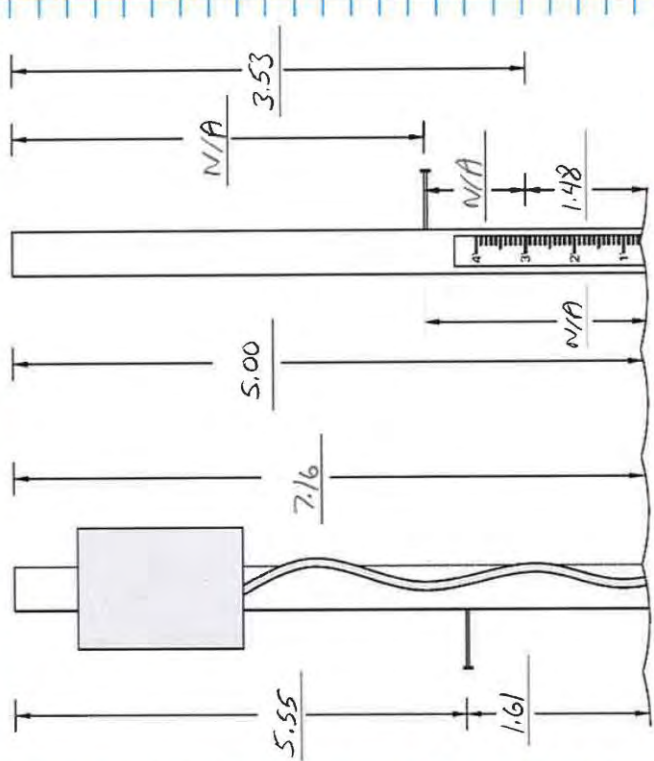
View of Typical Mini-Network



View of Typical RSET Rod



CRMS Project 2014				CRMS Project 2014			
Survey Party: E. Nguyen		Julian Day: 139		CRMS		0687-H01	
Date: 5-19-14		S. Chance		BASE @		CS 23-SM-01	
POINT #	ANT. HGT.	GAUGE READ	TIME	RTK ELEV.	RMKS		
0687-1	6.562	1.42	11:20	1.65	WATER SURFACE		
0687-3	2.62			6.64	TOP 4X4		
					NAIL SHANK		
0687-2	6.562			3.06	3.0' GAUGE		
0687-6	2.62			8.79	TOP 4X4		
0687-5	6.562			3.27	NAIL SHANK		
0687-4	6.562			1.65	WATER SURFACE		
0687-7	6.562			3.46	TOP R-SET		
0687-8	6.562			2.97	#1 HOLE		
0687-9	6.562			3.00	#5 HOLE		
<p>Comments: No nail in 4x4 w/ Tide Gauge. Also, no evidence of a nail hole where one would have been.</p>							



CRMS Project 2014		CRMS Project 2014			
CRMS:	0687-HOI	Recorded Top Nail	RTK Δ	Measured	Difference
Date:	5-19-14	Top W.S.	RTK Δ	Measured	Difference
Recorded Top 4x4 Elev.	6.64	Recorded Top Nail	RTK Δ	Measured	Difference
Recorded Top 4x4 Elev.	6.64	Top W.S.	RTK Δ	Measured	Difference
Recorded Top Nail	1.65	Top W.S.	RTK Δ	Measured	Difference
Recorded 3.0' Mark	3.06	Recorded Top 4x4	RTK Δ	Measured	Difference
Recorded 3.0' Mark	3.06	Recorded Top Nail	RTK Δ	Measured	Difference
Recorded 3.0' Mark	3.06	Top W.S.	RTK Δ	Measured	Difference
Recorded Top 4x4	8.79	Recorded Top Nail	RTK Δ	Measured	Difference
Recorded Top Nail	3.27	Recorded Top W.S.	RTK Δ	Measured	Difference
Recorded Top 4x4	8.79	Recorded Top W.S.	RTK Δ	Measured	Difference
Recorded Top R-Set	3.46	Recorded Collar	RTK Δ	Measured	Difference

Comments:

CRMS Project 2014

UNADJUSTED				
	Northing	Easting	Elevation (Geoid12A)	
Point Number	(NAD 83 LSZ (1702) Feet)	(NAD 83 LSZ (1702) Feet)	(NAVD88 Feet)	Notes
0687-1	529037.31	2639630.03	1.65	TOP WATER 11:44
0687-2	529037.43	2639630.17	3.06	3' MARK
0687-3	529037.09	2639630.37	6.64	TOP 4X4
0687-4	529037.30	2639630.03	1.66	TOP WATER 11:45
0687-5	529038.27	2639631.04	3.27	TOP OF NAIL
0687-6	529038.15	2639631.21	8.80	TOP 4X4
0687-7	528861.54	2639796.68	3.46	TOP RSET ROD
0687-8	528861.46	2639796.63	2.97	TOP COLLAR 1
0687-9	528861.61	2639796.67	3.00	TOP COLLAR 5
0658-10	572934.57	2562452.69	8.66	OTH #5-HOLE AT COLLAR
CONTROL CALLS				
CS23-SM-01	518286.36	2631372.09	1.92	

Note: Data from digital raw file collected by crew. Any minor discrepancies between the unadjusted raw data and field notes could be due to rounding by field crew.

USE THIS FORM IS USING FIXED HEIGHT TRIPODS GPS LOG SHEET

Job No. 140302 Operator GARY PUGHANNE
 Client C.P.R.A. Job Description C.R.M.S. SURVEY / STATIC
 Location LAT 29° 54' 33.164186" N LONG 93° 23' 00.168705" W

SESSION INFO

Station No. CS23-SM-01 (4 Characters) Julian Date 139 (3 Characters) Session No. 3 (1 Character)

Long Name CS23-SM-01

Monument Description 2" ALUMINUM CAP SET ON 9/16" S.S. ROD DRIVEN TO REFUSAL, SET TO A 6" PVC SLEEVE FILLED W/ CONCRETE

Receiver Type GS14 Receiver Serial No. 4795
 Antenna Type GS14 Ant. Serial No. 4795

Antenna Height Measurement is TRUE VERTICAL to Bottom of Antenna Mount if Using Fixed Height Tripod

Reading 1 NA Meters Fixed Hgt 2 Meter Tripod 2.000 Meters
 Reading 2 NA Meters Check Reading 6.562 Feet/Tenths
 Reading 3 NA Meters Note: Record all readings on log sheet prior to entering in receiver

Start Time 07:50 JD-139 Stop Time 09:47 JD-142 Session Time 73:57

Time	Pdop	Satellites in View

Time	Note any Power Failures, Weather Conditions, etc.
<u>0757</u>	<u>61° winds SE @ 3 MPH 100% Humidity</u>
<u>0947-JD142</u>	<u>77° winds SE @ 6 MPH, 79% Hum. Partly Cloudy</u>

USE BACK OF THIS SHEET TO MAKE STATION SKETCH, REFERENCE TIES & DESCRIPTION

FILE: CS231390.14o OP1404757490658

NGS OPUS SOLUTION REPORT

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All computed coordinate accuracies are listed as peak-to-peak values.
 For additional information: <http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: lance.richard@cctech.us DATE: July 07, 2014
 RINEX FILE: cs23139m.14o TIME: 18:26:07 UTC

SOFTWARE: page5 1209.04 master52.pl 022814 START: 2014/05/19 12:34:00
 EPHEMERIS: igs17931.eph [precise] STOP: 2014/05/20 12:59:00
 NAV FILE: brdc1390.14n OBS USED: 60273 / 62835 : 96%
 ANT NAME: LEIGS14 NONE # FIXED AMB: 144 / 253 : 57%
 ARP HEIGHT: 2.0001 OVERALL RMS: 0.016(m)

REF FRAME: NAD_83(2011) (EPOCH:2010.0000) IGS08 (EPOCH:2014.3809)

X:	-326555.269(m)	0.001(m)	-326556.038(m)	0.001(m)
Y:	-5523614.147(m)	0.016(m)	-5523612.664(m)	0.016(m)
Z:	3161640.812(m)	0.007(m)	3161640.628(m)	0.007(m)
LAT:	29 54 33.16331	0.004(m)	29 54 33.18137	0.004(m)
E LON:	266 36 59.83184	0.002(m)	266 36 59.79996	0.002(m)
W LON:	93 23 0.16816	0.002(m)	93 23 0.20004	0.002(m)
EL HGT:	-26.596(m)	0.017(m)	-27.932(m)	0.017(m)
ORTHO HGT:	0.330(m)	0.031(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 15)	SPC (1702 LA S)
Northing (Y) [meters]	3308787.121	157973.970
Easting (X) [meters]	462990.131	802043.830
Convergence [degrees]	-0.19116586	-1.02504937
Point Scale	0.99961690	0.99992702
Combined Factor	0.99962108	0.99993120

US NATIONAL GRID DESIGNATOR: 15RVP6299008787(NAD 83)

BASE STATIONS USED

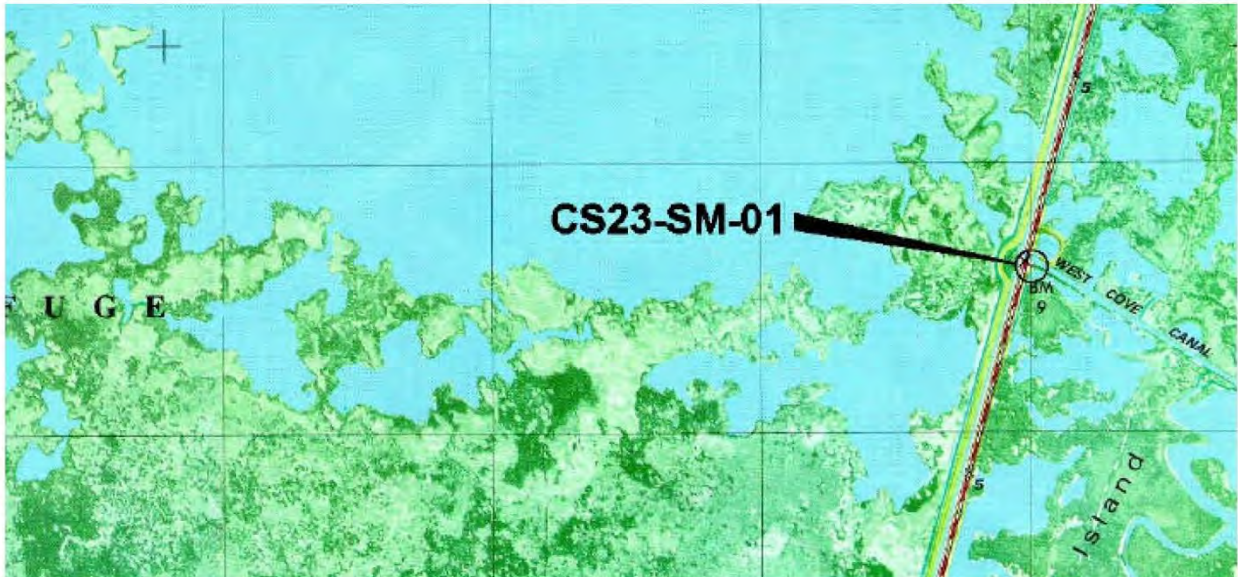
PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN4512	TXOR ORANGE CORS ARP	N300730.704	W0934913.450	48483.2
DK3579	CAMR CAMERON PARISH CT CORS ARP	N294754.577	W0931930.380	13503.2
DE8095	MCNE MCNEESE ST UNIV CORS ARP	N301050.022	W0931303.843	34058.9

NEAREST NGS PUBLISHED CONTROL POINT

AV0836	BROWN	N295515.386	W0932405.870	2192.2
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STATE PLANE COORDINATES - U.S. Survey Foot

	SPC (1702 LA S)
Northing (Y) [feet]	518286.267
Easting (X) [feet]	2631372.132
Convergence [degrees]	-1.02504937
Point Scale	0.99992702
Combined Factor	0.99993120



VICINITY MAP Scale: 1" = 2000'

Reproduced from USC&GS "BROWNS LAKE" Quadrangle

Station Name: CS23-SM-01

Monument Location: From St. Peters Catholic Church in the town of Hackberry, Louisiana, proceed south on La. Highway 27 for approximately 5.4 miles to a bridge crossing West Cove Canal at Hogg Island Gulley and the monument at left on east side of highway in a parking area.

Monument Description: 2" aluminum cap set on a 9/16" stainless steel rod driven to refusal and set in a 6" PVC sleeve filled with concrete.

Stamping: "HOGG RESET"

Set Date: October 2000

Monument Established By: John Chance Land Surveys, Inc

For: Louisiana Department of Natural Resources, CRD

Adjusted NAD 83 (1992) Geodetic Position

Lat. 29° 54' 33.163" N

Long. 93° 23' 00.168" W

Adjusted NAD 1983 Datum LSZ (1702) Feet

N= 518,286.57

E= 2,631,372.12

Adjusted NAVD88 Height(Geoid 12a)

Elevation = 1.04 ft / 0.317 m

Ellipsoid Height = -87.30 ft / -26.609 m

Geoid12a Height = -88.34 ft / -26.926m

Surveyed by:

John Chance Land Surveys, Inc.(2000)

Geoid 99 Elevation = 1.92 ft / 0.586 m

Ellipsoid Height = -86.66 ft / -26.413 m

Geoid 99 Height = -88.58 ft / -26.999 m



Note: Re-Surveyed and Re-Adjusted in May 2014