

Glenn County GPS Subsidence Project – 2004

Project Report



Jim Frame, Frame Surveying & Mapping
609 A Street
Davis, CA 95616
jhframe@dcn.davis.ca.us

Don D'Onofrio, Geodetic Consultant
7228 Willowbank Way
Carmichael, CA 95608
dondonofrio@comcast.net

PROJECT REPORT

2004 GLENN COUNTY GPS SUBSIDENCE PROJECT

August 31, 2004

Introduction

A. Purpose

The purpose of the project is to provide a baseline survey against which future subsidence can be measured and monitored. The network designed for the project included a number of existing bench marks related to the North American Vertical Datum of 1988 (NAVD88) and a number of new stations established to provide uniform spacing throughout the eastern two-thirds of the county.

B. Time Period

The observations began on March 16, 2004. Unlike earlier projects, the local network stations were observed first followed by the Primary Base Station Network. Re-observations occurred over the next several weeks as more information became available and the original observations were examined.

Local network stations were observed on March 16–20 (Julian Days 76-79). Primary Base Stations were observed on March 22-24 (Julian Days 82-84). Re-observations were obtained on March 22 (JD 82), March 30 and April 1 (JD 90 and 92) and on April 28 (JD 119.) A complete observation schedule is included in **Appendix C**.

C. Points of Contact

Project Administrator – Lester Messina
Glenn County Agriculture Commissioner’s Office
P.O. Box 351
Willows, CA 95988
(530) 934-6501
wateradv@countyofglenn.net

Prime Contractor - Jim Frame
Frame Surveying & Mapping
609 A Street
Davis, CA 95616
(530) 756-8584
jhframe@dcn.davis.ca.us

Project Consultant - Don D’Onofrio
Geodetic Consultant
7228 Willowbank Way
Carmichael, CA 95608
(916) 944-7879
dondonofrio@comcast.net

D. Accuracy Standard

The project was conducted according to the National Geodetic Survey’s “Guidelines for Establishing GPS-Derived Ellipsoid Heights” NOAA TM NOS NGS-58, July, 1997, Zilkoski, Frakes & D’Onofrio. The 2-centimeter standard was followed for the project. There were three variations from the Guidelines: local network stations were occupied for 45 minutes; all adjacent station baselines were observed; and, one session was observed for 60 minutes. In the first two cases these procedures exceeded the Guidelines, in the last case the lines were somewhat longer than allowed due to geographic, transportation and topographic issues. So the sessions were lengthened somewhat.

E. Location

The project was observed almost entirely in Glenn County. Since there are no adjusted NAVD88 bench marks in the county, two NAVD88 marks in Butte County, immediately to the east of Glenn County, were included in the project. These were J 1434 (PID KS1942) and P 1430 (PID KS1922). Three CORS/CGPS sites outside the county were also included. These were Oroville (ORVB OROVILLE CORS – PID AI4496), Chico (CHICO 1 CORS ARP – PID AI1402) and Sutter Buttes (SUTTER BUTTES CORS ARP – PID AF9711). The Sutter Buttes site has been used in two previous Height Modernization surveys in Yolo County in 1999 and 2002.

Two stations (VIOLICH and EXT1) were established within about 200 meters of existing extensometers. It is assumed that a level tie will be made between each of these stations and their respective extensometers.

A copy of the project map is included in **Appendix B**.

F. Conditions Affecting Operations

All observations were obtained using fixed height (constant height) poles. However there were two different fixed heights. Most poles were 2.000 meters. Three poles, borrowed from Caltrans for the project, were 1.890 meters. These poles came equipped with an adapter bringing them to this height. See the following pictures. The pole height is 1.810 meters and the adapter is 0.080 meter.

On March 17 (JD 77) the antenna (S/N 0220046067) at station 1500 in Session 1 was blown over by severe winds into an irrigation canal. The receiver collected only 20 minutes of data. The antenna could not be used for further observations since it could not receive satellite signals. Station LOGAN was thus not occupied in Session 2 by that receiver. A spare antenna (S/N 0220003263) was substituted for Session 3 and was used for the remainder of the project. The baselines from station 1500 processed satisfactorily. The baselines from station LOGAN were made up during one of the re-observation sessions.



(Fixed Height Pole Adapter)



(Fixed Height Pole with Adapter)

On March 18 (JD 78) the observer set up over station WINSLOW NO 1 (a reference mark) instead of station WINSLOW. The reference mark was too close to a power pole and it was determined to use the station originally selected, station WINSLOW. All baselines from station WINSLOW were observed as part of the re-observations on March 22 (JD 82).

On March 18 (JD 78) the observer recovered station 208.65 USBR. The station fit the mileage indicated in the description. The observer used this station for all observations on March 18 and 19 (JD 78 and 79). The station selected was SR 94 CADWR. Station SR 94 was dropped from the project. The observer entered the 4-Ch ID SR94 into the receiver for the observations. All references to station SR 94 should be eliminated and 208.65 substituted.

There were eleven receivers used during the project: two Trimble 4700s, seven Trimble 4000 SSIs, one Trimble 4000 SSE and one Ashtech Z XII. There were two Micro-centered L1/L2 with Ground Plane (associated with the 4700s), seven Trimble Compact L1/L2 antennas with Ground Plane (associated with the SSIs), one Trimble with Ground Plane (associated with the SSE) and one Ashtech Permanent L1/L2 Geodetic antenna with an integral ground plane, model 700718(B).

The Trimble 4700 receivers were operated without data loggers. The receiver logged its serial number in lieu of the 4-Ch ID and had faulty session numbers. The 4-Ch IDs and session numbers were revised at the time of data downloading and the file names reflect the correct information.

There were no other significant conditions affecting operations.

G. Agency Participation

There were five primary agencies involved in the observation scenario. These included the California Department of Water Resources, the Glenn-Colusa Irrigation District, and the following Glenn County agencies: Agriculture Commissioner's Office, Air Pollution Department and Public Works Department. A private person representing the County Water Advisory Committee also participated in the observation phase of the project. Frame Surveying & Mapping provided observers during the project and the re-observations, as necessary.

The observing personnel were:

Lester Messina	Glenn County Agriculture Commissioner's Office
Ben Myhre	Glenn County Air Pollution Department
Ken Wright	Glenn County Public Works Department
Tomás Loera	Glenn-Colusa Irrigation District
Jon Picou	Glenn-Colusa Irrigation District
Judy Brown	Glenn County Water Advisory Committee
Jim West	California Department of Water Resources
Seth Lawrence	California Department of Water Resources
April Scholzen	California Department of Water Resources
Beth Liebenow	California Department of Water Resources
Nancy Snodgrass	California Department of Water Resources
Jim Frame	Frame Surveying & Mapping
Don D'Onofrio	Frame Surveying & Mapping

Once again the University of California Davis and Caltrans provided equipment for use in a Sacramento Valley subsidence project. UC Davis provided three sets of receivers, antennas and related equipment. Caltrans provided a receiver, antenna, batteries, fixed-height poles and Office Support Modules. The California Department of Water Resources provided five fully equipped observing teams.

H. Field Work

1. Chronology - We received notice to proceed with the observations from Glenn County. This was followed by approval from NGS to proceed with the project as a Height Modernization project. The county decided to begin the observations so they could be completed before water pumping began in the county. March 16 was selected as the starting date for the survey.

2. Instrumentation – Trimble 4000 SSi, Trimble 4000SSE, Trimble 4700 and Ashtech Z-XII receivers were used for observations during the project. Ashtech Z-XII3 receivers were operational at the three CORS/CGPS sites.

<u>Receiver Model and Ser. No.</u>	<u>Antenna Model and Ser. No.</u>	<u>Agency Supplying Receiver</u>
4000SSi – 3608A14594	Compact L1/L2 – 0220050361	UC Davis
4000SSi – 3608A14632	Compact L1/L2 – 0220050501	UC Davis
4000SSi – 3608A14631	Compact L1/L2 – 0220050490	UC Davis
4000SSi – 3429A06782	Compact L1/L2 – 0220004072	CA DWR
4000SSi – 3435A07613	Compact L1/L2 – 0220046067 (1)	CA DWR
	Compact L1/L2 – 0220003263 (2)	CA DWR
4000SSi – 3435A07618	Compact L1/L2 – 0220004054	CA DWR
4000SSi – 3647A17633	Permanent L1/L2- 0220024846	Frame
4000SSE – 3240A01547	Compact L1/L2 – 0220064123	Caltrans
4700 - 0220202606	Compact L1/L2 – 0220200693	CA DWR
4700 - 0220203616	Compact L1/L2 – 0220202428	CA DWR
Ashtech Z-XII – 03788	Ashtech 700718(B) – 10646	Frame

(1) Through Day 77, session 1.

(2) From Day 77, session 3.

3. Deviation from Instructions – The project was observed according to instructions.

I. Data Processing

Baseline processing was performed by Frame Surveying & Mapping using Trimble Geomatics Office software. Primary Base Station (long lines, long sessions) processing and all project data will be processed and adjusted by the California Spatial Reference Center. The final results will be reviewed and published by the National Geodetic Survey.

J. Statistics

1. Stations occupied – There were 58 stations occupied during the project. These included three CORS/CGPS sites (ORVB, SUTB and CHO1). A complete list of stations is included in **Appendix A**.

NSRS/CSRS horizontal stations	8
NSRS/CSRS vertical stations	23
NSRS/CSRS horizontal/vertical stations	4
Existing non-NSRS/CSRS stations	6
New stations set:	
Disks in concrete	25
Class A rod marks	4
Stations previously established by GPS (including CORS/CGPS)	8

2. Total observing days and sessions – There were ten observing days: three days for Primary Base Stations; four days for local network stations; and, three days (or portions) for re-observations. One local network session was observed on one of the Primary Base Station observing days (March 22, Day 82).

One of the Primary Base Station observing days was offset from the other two by four hours. There were six Primary Base Stations observed simultaneously with the three CORS/CGPS sites (CHO1, SUTB and ORVB).

There were 16 sessions involved in the local network station observations. All but two sessions were scheduled for 45 minutes. The other two sessions were scheduled for 60 minutes. These two sessions involved baselines that were somewhat longer than average due to topographic and logistical considerations.

There were 129 baselines observed in the project and processed to achieve the 2 centimeter standard. For these purposes a baseline is defined as a line connecting a station to its immediate neighboring stations. The baselines are indicated on the map in **Appendix B**.

All session schedules including re-observation schedules are included in **Appendix C**.

There were ten re-observation sessions involving from two to six receivers. Re-observation schedule #1 was scheduled since an observer in the original session went to the wrong station. A few baselines were re-observed to account for mis-identified antenna height measurements. There were two different types of constant height poles used as indicated in **F. Conditions Affecting Operations (above)**. The remaining re-observation schedules were the result of baselines exceeding the 2 centimeter criterion or were the result of issues related to the Trimble Geomatics Office (TGO) software. In the original baseline processing several baselines exceeded the 2 centimeter criterion and were scheduled for re-observation. Subsequent processing of some of these baselines indicated that the re-observations may have not been necessary. In one particular case the TGO software would not process baselines emanating from station WILDLIFE. These baselines were re-observed and the issue was resolved.

K. Comments and Recommendations:

Observers were visited throughout the course of the observing phase to ensure that project guidelines and safety procedures were being followed. Guidelines and safety procedures were discussed at the formal training session held the day before beginning observations. A copy of the project guidelines is included in **Appendix D**.

Data downloading was accomplished in an office provided by Glenn County. All observers came to the office daily (with a few exceptions) to download the data from that day's observations.

This was the first time several of the observers had been exposed to survey operations and the use of GPS equipment. They all demonstrated exemplary attitude and professionalism to the project.

The original Observation Logs and copies of the B-File (the digital file listing which stations were occupied by each observer and the specific equipment at the station) and the D-File (the digital station description file) will be forwarded to CSRC for use in processing and adjusting the data. These results and the related data and information will then be forwarded to NGS for review, publication and archiving.

A digital file of the data and baseline comparison results will also be forwarded along with a digital copy of the free adjustment prepared by Frame Surveying & Mapping.

Respectfully submitted,

Jim Frame
Frame Surveying & Mapping

Don D'Onofrio
Geodetic Consultant

Appendix A. Station List



(Photo: Jim West, CADWR, at station OWENS)

STATION	4-Ch ID	PID	LATITUDE	LONGITUDE	ELEVATION METERS
1500	1500	none	39 30 54.1	121 55 48.1	
11-227 CADH	1122	none	39 27 50.6	121 55 31.4	
296.66 USBR	2966	none	39 47 25.3	122 13 33.1	
60.64 USDI	6064	none	39 23 58.8	122 17 17.2	
A 1079	A107	KT0126	39 35 07.9	122 24 17.9	151.06
ADOBE	ADOB	none	39 23 26.7	121 57 00.6	
AGUIAR	AGUI	none	39 43 34.0	122 14 26.2	
ARTOIS	ARTO	none	39 37 27.2	122 12 16.6	
B 1079	B107	KT0737	39 36 40.7	122 31 42.9	215.44
BIG BUTTE	BIGB	none	39 27 51.3	121 52 14.0	
BIG W	BIGW	none	39 40 21.2	122 20 10.5	
C 200	C200	KT0343	39 24 22.6	122 11 32.3	28.72
CAPAY	CAPA	none	39 46 57.1	122 06 14.3	
CHEROKEE	CHER	none	39 40 05.5	122 15 10.6	
CREEK	CREE	none	39 43 53.2	122 24 47.1	
EXT1	EXT1	none	39 37 46.9	122 06 08.0	
FRENCH	FREN	none	39 34 57.1	122 14 58.5	
GLENN	GLEN	KT0178	39 31 17.92320	122 00 53.28847	29.63
GORDON	GORD	none	39 24 34.5	122 00 35.9	
H 285 USGS	H285	KT0120	39 33 07.4	122 21 25.5	104.78
HAMILTON	HAMI	KT1807	39 44 39.72932	122 01 14.03733	47.9
HOWARD	HOWA	none	39 25 12.5	121 53 52.4	
J 1434	J143	KS1942	39 36 58.3	121 40 55.2	62.697
JACINTO	JACI	none	39 34 56.8	122 00 36.0	
K 852	K852	KT0183	39 41 49.0	122 11 43.0	70.36
KAISER	KAIS	none			
L191	L191	none	39 34 55.3	122 07 20.3	
LARKINS	LARK	none	39 29 34.0	122 05 15.4	
LOGAN	LOGA	none	39 27 56.2	122 11 46.3	
MI 11.18	1118	none	39 39 35.1	122 01 36.9	
MINOR	MINO	none	39 27 52.0	122 08 12.0	
N 852	N852	KT0195	39 48 34.0	122 10 21.0	75.38
NORMAN 1	NORM	none	39 24 27.1	122 08 10.7	
ORLAND SOUTH BASE	ORLA	KT0189	39 46 06.53159	122 11 32.38240	81.5
OWENS	OWEN	none	39 27 55.8	122 14 55.5	
P 1430	P143	KS1922	39 50 25.15722	121 56 26.97101	58.684
P30W	P30W	none	39 39 10.0	122 09 04.3	
PETER	PETE	none	39 41 46.0	122 06 11.2	
PROVIDENT	PROV	none	39 31 18.7	122 05 19.1	
PUMP	PUMP	none	39 47 03.2	122 02 45.0	
Q 1078	Q107	KT0155	39 31 27.5	122 14 14.3	45.42
S 1067	S106	KT0814	39 43 11.3	122 32 58.4	276.19
208.56 USBR	2085	none	39 44 48.0	122 07 21.7	
U 1078	U107	KT0116	39 31 51.5	122 19 34.3	93.99
V 380 RESET	V380	KT0221	39 46 56.7	122 17 42.2	113
VIOLICH	VIOL	none	39 45 50	122 04 37	
W 215 AZ MK	W215	KT0827	39 47 44.9	122 32 47.9	207.15

WALKER	WALK	none	39 31 27.1	122 09 53.9	
WILDLIFE	WILD	none	39 42 45.7	121 57 48.9	
WILLOW	WILL	none	39 26 09.4	122 04 34.1	
WILSON	WILS	none	39 33 55.1	122 11 37.2	
WINSLOW	WINS	KT0803	39 39 48.62792	122 31 33.45368	200.04
Y 380	Y380	KT0225	39 45 46.0	122 20 14.6	141.06
Y 850	Y850	KT0507	39 23 33.1	122 14 53.9	36.34
Y 852	Y852	KT0518	39 27 25.9	122 01 03.5	27.37
CHICO 1 CORS ARP	CHO1	AI1402	39 25 57.48332	121 39 53.81026	45.19
ORVB OROVILLE CORS	ORVB	AI4496	39 33 16.64226	121 30 00.99091	367.8
SUTTER BUTTES CORS ARP	SUTB	AF9711	39 12 21.99441	121 49 14.10145	645.9

NOTE: The elevations listed are as published by the National Geodetic Survey and are subject to change as a result of this survey. The horizontal coordinates (latitude and longitude) will similarly be changed as a result of the survey and California's crustal motion issues.

Appendix B. Project Map



(Photo: Seth Lawrence, CADWR, at station 60.64 USDI.)

Appendix C. Project Observation Schedule



(Photo: Ben Myhre at Station FRENCH)

2004 GLENN COUNTY GPS SUBSIDENCE PROJECT PROJECT STATION SCHEDULE

DAY 1, TUESDAY, MARCH 16 (JD 76)

RECEIVER	SESSION 1	SESSION 2	SESSION 3	SESSION 4
START:	8:00AM	9:45AM	11:45AM	1:30PM
STOP:	8:45AM	10:30AM	12:30PM	2:15PM
DRW-1	OWEN	GLEN	GLEN	OWEN
DWR-2	6064	GORD	WALK	WALK
DWR-3	Y850	1122	JACI	Q107
DWR-4	LOGA	1500	1500	LOGA
DWR-5	C200	ADOB	L191	U107
GLENN-1	MINO	BIGB	PROV	MINO
GLENN-2	NORM	NORM	WILS	WILS
GLENN-3	WILL	WILL	EXT1	H285
GLENN-4	LARK	HOWA	LARK	LARK
GLENN-5	Y852	Y852	1118	FREN

SESSION 1

DAY 2, WEDNESDAY, MARCH 17 (JD 77)

RECEIVER	SESSION 1	SESSION 2	SESSION 3	SESSION 4
START:	8:00AM	9:45AM	11:45AM	1:30PM
STOP:	8:45AM	10:30AM	12:30PM	2:15PM
DRW-1	GLEN	OWEN	OWEN	GLEN
DWR-2	WALK	WALK	6064	GORD
DWR-3	JACI	Q107	Y850	1122
DWR-4	1500	LOGA	LOGA	1500
DWR-5	L191	U107	C200	ADOB
GLENN-1	PROV	MINO	MINO	BIGB
GLENN-2	WILS	WILS	NORM	NORM
GLENN-3	EXT1	H285	WILL	WILL
GLENN-4	LARK	LARK	LARK	HOWA
GLENN-5	1118	FREN	Y852	Y852

2004 GLENN COUNTY GPS SUBSIDENCE PROJECT PROJECT STATION SCHEDULE (CONT'D.)

DAY 3, THURSDAY, MARCH 18 (JD78)

****NOTE: SESSION 1 IS A 60 MINUTE SESSION.****

RECEIVER	SESSION 1	SESSION 2	SESSION 3	SESSION 4
START:	8:00AM	10:00AM	12:00PM	1:45PM
STOP:	9:00AM	10:45AM	12:45PM	2:45PM
DRW-1	S106	CHER	CHER	KAIS
DWR-2	Y380	P30W	P30W	PUMP
DWR-3	2966	L191	2966	WILD
DWR-4	A107	A107	SR94	SR94
DWR-5	B107	ARTO	N852	1118
GLENN-1	WINS	H285	K852	VIOL
GLENN-2	BIGW	BIGW	CAPA	CAPA
GLENN-3	V380	EXT1	ORLA	EXT1
GLENN-4	AGUI	WILS	AGUI	HAMI
GLENN-5	CREE	FREN	PETE	PETE
FRAME	W215			

DAY 4, FRIDAY, MARCH 19 (JD 79)

****NOTE: SESSION 3 IS A 60 MINUTE SESSION.****

RECEIVER	SESSION 1	SESSION 2	SESSION 3	SESSION 4
START:	8:00AM	9:45AM	11:45AM	1:45PM
STOP:	8:45AM	10:30AM	12:45PM	2:30PM
DRW-1	CHER	KAIS	S106	CHER
DWR-2	P30W	PUMP	Y380	P30W
DWR-3	2966	WILD	2966	L191
DWR-4	SR94	SR94	A107	A107
DWR-5	N852	1118	B107	ARTO
GLENN-1	K852	VIOL	WINS	H285
GLENN-2	CAPA	CAPA	BIGW	BIGW
GLENN-3	ORLA	EXT1	V380	EXT1
GLENN-4	AGUI	HAMI	AGUI	WILS
GLENN-5	PETE	PETE	CREE	FREN
FRAME			W215	

2004 GLENN COUNTY GPS SUBSIDENCE PROJECT

PRIMARY BASE STATION OBSERVING SCHEDULE

DATE	JULIAN DAY	START TIME (UTC)	STOP TIME (UTC)	PROJECT DAY
Mar. 22 (Mon.)	82	12:00pm (2000)	5:00pm (0100)	5
Mar. 23 (Tue.)	83	8:00am (1600)	1:00pm (2100)	6
Mar. 24 (Wed.)	84	8:00am (1600)	1:00pm (2100)	7

.....

STATION	4-Ch ID	OBSERVING AGENCY/UNIT
P 1430	P143	DWR-1
J 1434	J143	GLENN-1
1500	1500	GLENN-2
C 200	C200	GLENN-3
ORLAND SOUTH BASE	ORLA	GLENN-4
B 1079	B107	GLENN-5

**2004 GLENN COUNTY GPS
SUBSIDENCE PROJECT
RE-OBSERVATION SCHEDULE # 1**

DAY 5, MONDAY, MARCH 22 (JD 082)

RECEIVER	SESSION 1
START:	8:15AM
STOP:	9:30AM
GLENN 1	WINS
GLENN 2	B107
GLENN 3	CREE
GLENN 4	A107
GLENN 5	BIGW
D'ONOFRIO	S106

This is a make-up session for session 1, Day 3, March 18 (JD 078) when observer was set up over the wrong station.

**2004 GLENN COUNTY GPS
SUBSIDENCE PROJECT
RE-OBSERVATION SCHEDULE # 2**

DAY 1, TUESDAY, MARCH 30, (JD 90)

RECEIVER	SESSION 1	SESSION 2	SESSION 3	SESSION 4
START:	8:30AM	10:30AM	12:30PM	2:30PM
STOP:	9:30AM	11:30AM	1:30PM	3:30PM
GLENN 1	AGUI	LARK	JACI	WILD
GLENN 2	2966	MINO	L191	PETE
GLENN 3	V380	LOGA	WILS	KAIS
GLENN 4	CHER	WALK	EXT1	HAMI
FRAME	Y380	Q107	FREN	1118
D'ONOFRIO			P30W	

.....

DAY 2, THURSDAY, APRIL 1 (JD 92)

RECEIVER	SESSION 1	SESSION 2	SESSION 3
START:	8:30AM	10:30AM	12:30PM
STOP:	9:30AM	11:30AM	1:30PM
GLENN 1	1500	EXT1	
GLENN 2	GLEN	ARTO	
FRAME	OWEN	S106	B107 (tentative)
D'ONOFRIO	U107	W215	A107 (tentative)

**2004 GLENN COUNTY GPS
SUBSIDENCE PROJECT
RE-OBSERVATION SCHEDULE # 3**

DAY 3, WEDNESDAY, APRIL 28 (JD 119)

RECEIVER	SESSION 1	SESSION 2	SESSION 3
START:	8:30AM	10:15AM	12:15PM
STOP:	9:30AM	11:15AM	1:15PM
MESSINA	AGUI		
FRAME	V380	K852	A107
D'ONOFRIO	Y380	P30W	B107

Appendix D. Project Guidelines



(Photo: Tomás Loera, Glenn Colusa Irrigation District, at station LARKINS.)

2004 GLENN COUNTY GPS SUBSIDENCE PROJECT

OBSERVATION GUIDELINES

Session lengths:

Primary Base Stations: 5 hours per day.
Project Control Stations: 45 minutes.

Number of observations:

Primary Base Stations: Three (one day offset by four hours from the other two days).

Project Control Stations: Two (minimum) on two different days and at two different times of the day (minimum three hour difference).

Receiver defaults:

Observation epoch: 15 seconds.
Elevation cut-off: 10 degrees
Minimum no. of satellites: 1

Receiver issues:

Type: Dual-frequency, full-wavelength.
Manufacturer and model: Provide to project manager prior to observations.
Serial numbers: Provide prior to observations.

Antenna issues:

Type: Microstrip w/ground plane, or choke ring.
Manufacturer and model: Provide prior to observations.
Serial number: Provide prior to observations.

Observing issues:

Fixed-height poles will be used for all observations.

The fixed-height portion of the HI shall be the height from the mark to the **bottom** of the antenna pre-amplifier. The **constant** is the measurement from the bottom of the antenna to the L1 phase center.

Antennas shall be oriented to north (generally there is an arrow on the antenna ground plane).

Include the antenna cable length in the lower left section of the Observation Log.

All Observation Logs shall be filled out in ink.

A station rubbing will be made at every station occupation and taped to the Observation Log. Post-it notes work well for this purpose and will be supplied.

A supply of Observation Logs, with a sample, are included in the Observer's Handbook.

Note any unusual occurrences in the REMARKS section of the Observation Log. These might include battery problems, late arrival at the station, or anything that might have some effect on the quality of the data.

Sand bags, or equivalent, should be used on all adjustable tripod legs during each observation.

Session numbering:

All **Project Control Station** session occupations (45 or 60 minute sessions) will be entered as 1, 2, 3 or 4 according to the observation schedule.

All **Primary Base Station** session occupations (5 hour sessions) will be entered as session 0.

Note: A malfunction requiring a re-start of the session will require an increase in the receiver session. In this event, the issue can be resolved during data downloading.

Data downloading:

Two complete sets of data will be downloaded from each receiver daily.

Diskettes, CD-Rs, and labels:

Diskettes and/or CD-Rs will be supplied. Labels will be provided. Labels should include: Date, Julian Day and session (e.g., 177-1), 4-Ch ID and station name.

Safety:

Safety shall be of primary importance throughout the project! When conditions warrant, use emergency flashers, hard hats, traffic cones, safety vests, etc.

Equipment:

Some observers will be using equipment on loan from other agencies. Please treat this equipment with respect. The equipment represents a significant financial investment to these agencies.

Contacts:

Don D'Onofrio (916) 806-1697 (cell)
dondonofrio@comcast.net

Jim Frame (530) 400-2020 (cell)
jhframe@dcn.org

Lester Messina (530) 934-6501 (office in Willows)