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Volume 1

Waste Isolation Pilot Plant

Geotechnical Analysis Report For July 2010 – June 2011

U.S. Department of Energy

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FOREWORD AND ACKNOWLEDGMENTS

This report contains an assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the excavation of the principal underground access and experimental areas, the status was reported quarterly. Since 1987, when the initial construction phase was completed, reports have been published annually. This report presents and analyzes data collected from July 1, 2010, to June 30, 2011.

This Geotechnical Analysis Report (GAR) was written to meet the needs of several audiences. It satisfies requirements contained in the WIPP Hazardous Waste Facility Permit[1] (HWFP) and the Certification of Compliance[2] with Subparts B and C, Title 40 *Code of Federal Regulations* (CFR) Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes." It focuses on the geotechnical performance of the various components of the underground facility, including the shafts, shaft stations, access drifts, and waste disposal areas. The results of investigations of excavation effects and other geotechnical studies are also included.

The report compares the geotechnical performance of the repository to the design criteria. It describes the techniques that were used to acquire the data and the performance history of the instruments. The depth and breadth of the evaluation of the different components of the underground facility vary according to the types and quantities of data available and the complexity of the recorded geotechnical responses. Graphic documentation of data and tabular documentation of instrument history can be provided upon request.

This GAR was prepared by Washington TRU Solutions LLC (WTS) for the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO), in Carlsbad, New Mexico. Work was supported by the DOE under Contract No. DE-AC29-01AL66444.

[1] New Mexico Environment Department (NMED), 2010, Waste Isolation Pilot Plant Hazardous Waste Facility Permit, NM4890139088-TSDF, Santa Fe, NM

[2] U.S. Environmental Protection Agency, 1998, "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision," Federal Register, Vol. 63, No. 95, pp. 27354, May 18, 1998, Washington, DC

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bp	before present
bsc	below shaft collar
CAO	Carlsbad Area Office
CBFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH	contact-handled
cm	centimeter(s)
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
GAR	Geotechnical Analysis Report
GIS	geomechanical instrumentation system
HWFP	Hazardous Waste Facility Permit
in	inch(es)
km	kilometer(s)
kPa	kilopascal(s)
kVA	kilovolt ampere(s)
LANL	Los Alamos National Laboratory
lb	pound(s)
m	meter(s)
Ma	million years
MB	marker bed
μin	10^{-6} inch(es)
NMED	New Mexico Environment Department
OMB	orange marker bed
psi	pound(s) per square inch
RH	remote-handled

SPDV	Site and Preliminary Design Validation
TRU	transuranic
WIPP	Waste Isolation Pilot Plant
WTS	Washington TRU Solutions LLC
yr(s)	year(s)

1.0 INTRODUCTION

This Geotechnical Analysis Report (GAR) presents and interprets geotechnical data from the underground excavations at the Waste Isolation Pilot Plant (WIPP). The data, which are obtained as part of a regular monitoring program, are used to characterize conditions, to compare actual performance to the design assumptions, and to evaluate and forecast the performance of the underground excavations.

GARs have been available to the public since 1983. During the Site and Preliminary Design Validation (SPDV) Program, the architect/engineer for the project produced these reports quarterly to document the geomechanical performance during and immediately after early excavations of the underground facility. Since completion of the construction phase of the project in 1987, the management and operating contractor for the facility has prepared these reports annually. This report describes the performance and condition of selected areas from July 1, 2010, to June 30, 2011. It is divided into nine chapters.

Chapter 1 provides background information on WIPP, its mission, and the purpose and scope of the geomechanical monitoring program. Chapter 2 describes the local and regional geology of the WIPP site. Chapters 3 and 4 describe the geomechanical instrumentation in the shafts and shaft stations, present the data collected by that instrumentation, and provide interpretation of these data. Chapters 5 and 6 present the results of geomechanical monitoring in the two main portions of the WIPP underground (the access drifts and the waste disposal area). Chapter 7 discusses the results of the Geoscience Program, which include fracture mapping and observation hole observations. Chapter 8 summarizes the results of geomechanical monitoring and compares the current excavation performance to the design requirements. Chapter 9 lists references.

1.1 Location and Description

WIPP is located in southeastern New Mexico, 26 miles (42 kilometers [km]) east of Carlsbad (Figure 1-1). The surface facilities were built on the flat to gently rolling terrain that is characteristic of the Los Medaños area. The underground facility is being excavated approximately 2,150 feet (ft) (655 meters [m]) beneath the surface in the Salado Formation. Figure 1-2 shows a plan view of the underground configuration of WIPP as of June 30, 2011.

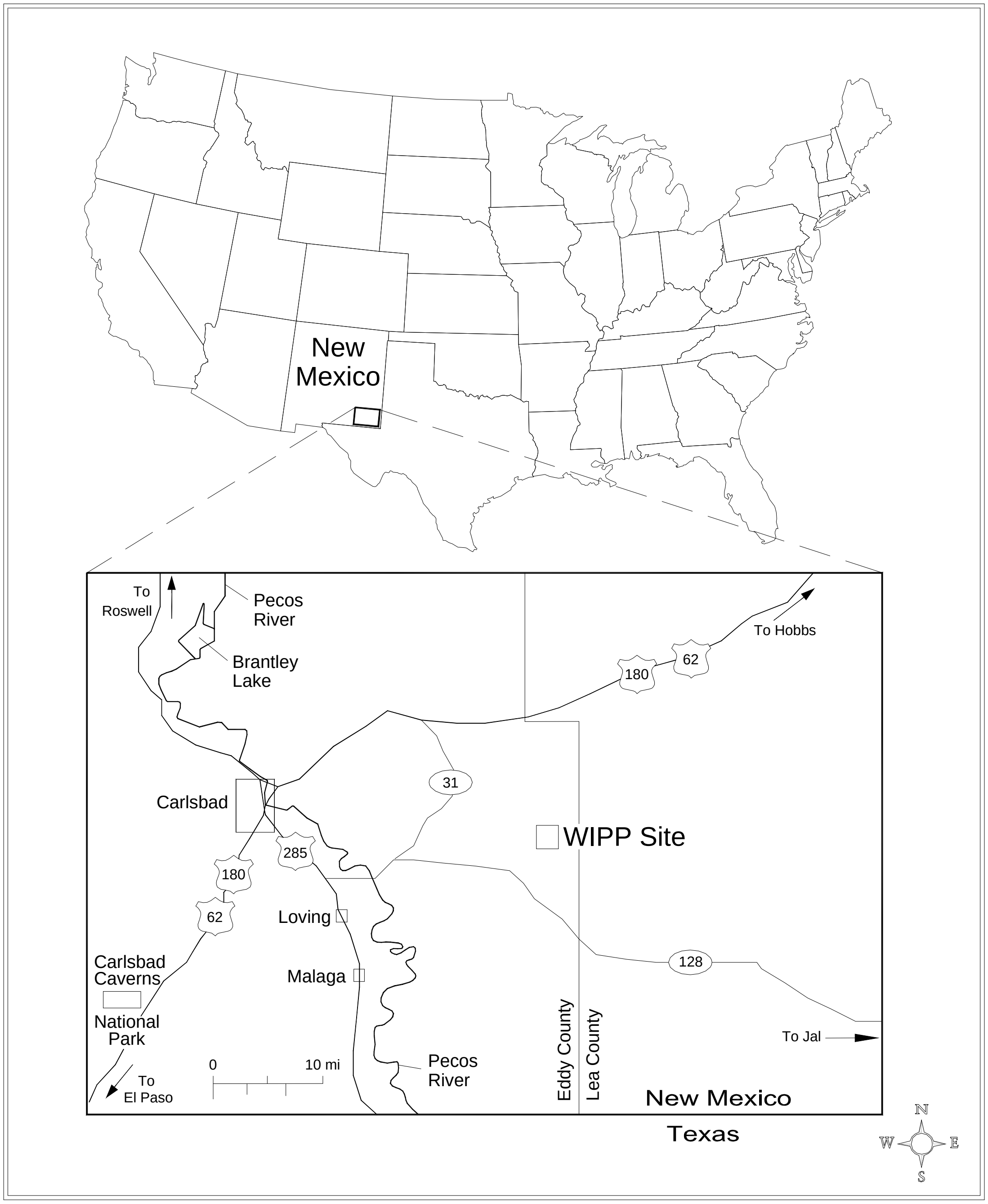

Figure 1-1 – WIPP Location

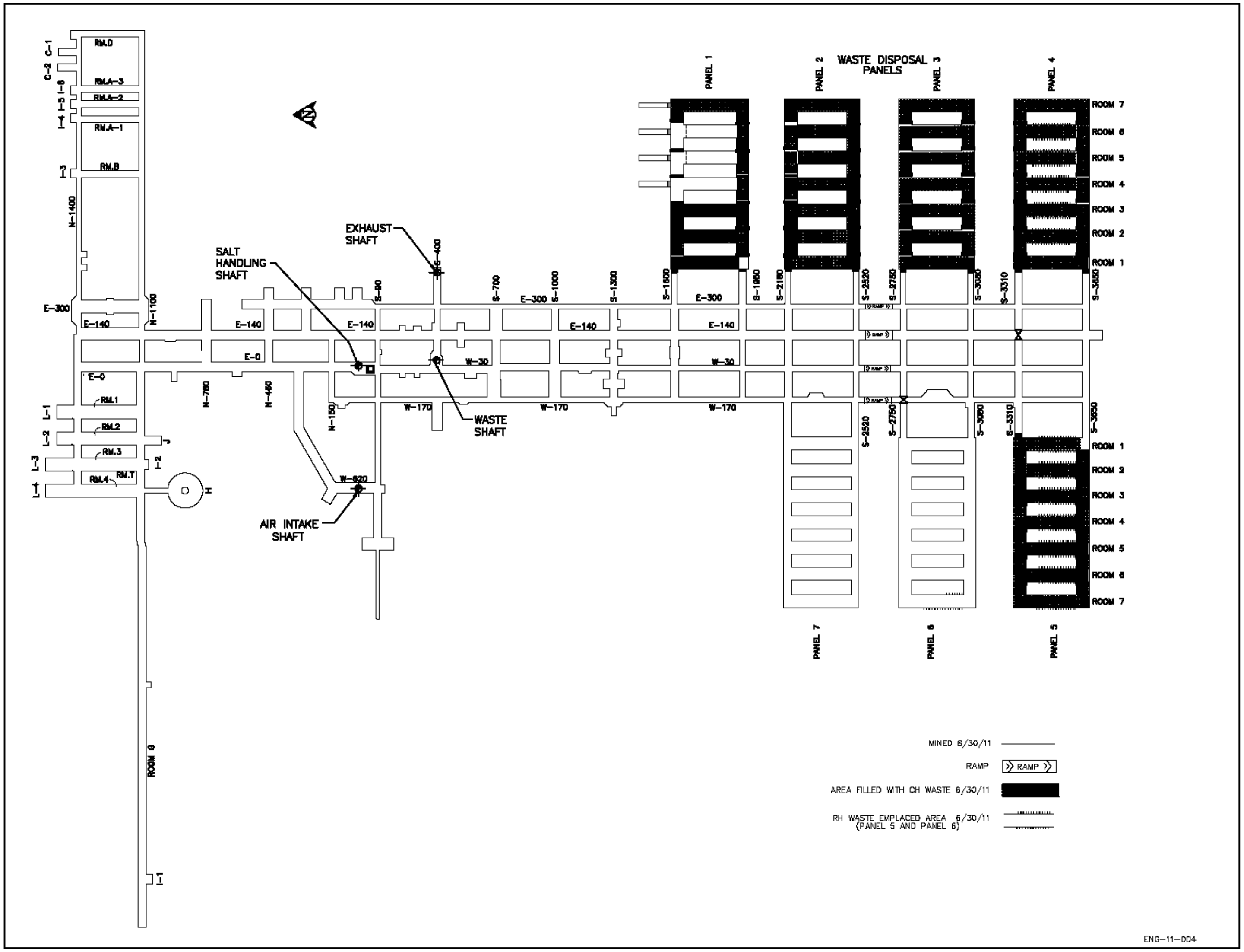

Figure 1-2 – Underground Mining and Waste Disposal Configuration as of June 30, 2011

1.2 Mission

In 1979 Congress authorized WIPP (Public Law 96-164, National Security and Military Applications of Nuclear Energy Authorization Act of 1980) to provide ". . . a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission." To fulfill this mission, the DOE constructed a full-scale facility to demonstrate both technical and operational principles of the permanent disposal of transuranic (TRU) and TRU mixed wastes. Technical aspects are those concerned with the design, construction, and performance of the subsurface excavations. Operational aspects refer to the receiving, handling, and emplacement of TRU wastes in the facility. The facility was first used for *in situ* studies and experiments without the use of radioactive waste. WIPP now receives handles, and permanently disposes of TRU waste and TRU mixed waste.

1.3 Development Status

To fulfill its mission, the DOE developed WIPP in a phased manner. The goal of the SPDV phase, begun in 1980, was to characterize the site and obtain *in situ* geotechnical data from underground excavations to determine whether site characteristics and in situ conditions were suitable for permanent disposal. During this phase, the Salt Shaft, a ventilation shaft, a drift to the southernmost extent of the proposed waste disposal area, a four-room experimental panel, and access drifts were excavated. Surface-based geological and hydrological investigations were also conducted. The data obtained from the SPDV investigations were reported in the "Summary of the Results of the Evaluation of the WIPP Site and Preliminary Design Validation Program" (DOE, 1983).

Based upon the favorable results of the SPDV investigations, additional activities were initiated in 1983. These included the construction of surface structures, conversion of the ventilation shaft for use as the Waste Shaft, excavation of the Exhaust Shaft, development of additional access drifts to the waste disposal area, excavation of the Air Intake Shaft, and excavation of additional experimental rooms to support research and development. Geotechnical data acquired during this phase were used to evaluate the performance of the excavations in the context of established design criteria (DOE, 1984). Results of these evaluations were reported in Geotechnical Field Data Reports (DOE, 1985; DOE, 1986a) and were summarized in the Design Validation Final Report (DOE, 1986b).

The Design Validation Final Report concluded that the facility, including waste disposal areas, could be developed and operated to fulfill the long-term mission of WIPP (DOE, 1986b). All available information validated the design of underground openings to safely accommodate the permanent disposal of waste under routine operating conditions.

Panel 1 mining began in 1986 and was completed in 1988. Panel 1 was intended to receive waste for an initial operations demonstration and pilot plant phase that was scheduled to start in October 1988; however, the demonstration and pilot plant phase was not put into effect because waste could not be emplaced until permits were acquired.

In October 1996, the DOE submitted to the U.S. Environmental Protection Agency (EPA) a compliance certification application in accordance with 40 CFR Parts 191 and 194, which addressed the long-term (10,000-year) performance criteria for the disposal system. On May 18, 1998, the EPA published the final certification that allowed for the receipt of TRU waste at WIPP. Immediately before this certification, the DOE Carlsbad Area Office (CAO) completed an Operational Readiness Review, which is required by the DOE before the start-up or a process change of any nuclear facility. As a result of the review, the CAO notified the Energy Secretary on April 1, 1998, that WIPP was operationally ready to receive waste. On March 26, 1999, the first shipment of TRU waste was received from Los Alamos National Laboratory (LANL). By the end of June 2011, many additional generator sites had shipped waste to WIPP. The cleanup of several small-quantity generator sites, as well as one large-quantity site (Rocky Flats Environmental Technology Site) is now complete.

Waste disposal in Panels 1, 2, 3, and 4 is complete. Panels 1, 2, and 3 contain only CH waste. The first RH waste shipment arrived January 24, 2007. Panel 4 was the first to receive both CH and RH waste. As of June 30, 2011, waste handling activities included RH disposal in Room 7 of Panel 6 and CH disposal in Room 1 of Panel 5. Mining of Panel 7 began April 24, 2010 and was ongoing as of June 30, 2011.

1.4 Purpose and Scope of Geomechanical Monitoring Program

As specified in the WIPP HWFP (NMED, 2010), the purpose of the geomechanical monitoring program is to obtain *in situ* data to support the continuous assessment of the design for underground facilities.

Specifically, the program provides for:

- Early detection of conditions that could affect operational safety.
- Evaluation of disposal room closure that ensures adequate access.
- Guidance for design modifications and remedial actions.
- Data for interpreting the behavior of underground openings, in comparison with the established design criteria.

Data taken by or input into the geomechanical instrumentation system (GIS) are evaluated and reported in this GAR. This annual report fulfills the requirements set forth in Part 4.6.1.2, Attachment A3, Section A2-5b (2) of the WIPP HWFP (NMED, 2010), and 40 CFR §191.14, "Assurance Requirements," implemented through the certification criteria, 40 CFR Part 194.

The Geomechanical Monitoring Program generates the data for four of the compliance monitoring parameters:

- Creep closure and stresses
- Extent of deformation
- Initiation of brittle deformation
- Displacement of deformation features

The instrumentation system for geomechanical monitoring provides data for routine evaluations of safety, stability, and performance of underground openings. *In situ* data are also used to model long-term disposal system performance. Changes resulting from excavations are monitored by routine inspections of selected observation hole arrays and fracture mapping to detect and quantify occurrences of discontinuities such as fractures and bed separations. Analysis of data indicating areas of potential instability allows timely corrective action before they could become safety issues. Other geoscience activities include geologic mapping and sampling, and seismic monitoring.

The GIS provides data that are collected, processed, and stored for analysis. The following subsections briefly describe the major components of the GIS.

1.4.1 Instrumentation

Instrumentation installed for measuring the geomechanical response of the shafts, drifts, and other underground openings includes convergence points, convergence meters, extensometers, rock bolt load cells, pressure cells, strain gauges, piezometers, and joint meters. Table 1-1 lists a summary of the specifications for geomechanical instrumentation.

Table 1-1 – Geomechanical Instrumentation System

Instrument Type	Measures	Range[1]	Resolution[1]
Sonic probe extensometer	Cumulative deformation	0–2 in	0.001 in
Convergence point (tape extensometer)	Cumulative deformation	2–50 ft	0.001 in
Wire convergence meter	Cumulative deformation	0–3.5 ft	0.001 in
Embedded strain gauge	Cumulative strain	0–3000 μin/in	1 μin/in
Spot-welded strain gauge	Cumulative strain	0–2500 μin/in	1 μin/in
Rock bolt load cell	Load	0–50 tons	40 lb
Earth pressure cell	Pressure	0–1000 psi	1 psi
Piezometer	Fluid pressure	0–500 psi	0.5 psi
Joint meter	Cumulative deformation	0–4 in	0.001 in
Vibrating wire extensometer	Cumulative deformation	0–4 in	0.001 in
Wire extensometer	Cumulative deformation	0–20 in	0.001 in
Linear potentiometric extensometer	Cumulative deformation	0–6 in	0.001 in

[1] Manual readout boxes for the instruments were manufactured to render measurements in U.S. customary units. Range and resolution measurement units have not been converted to metric units. Measurements from these instruments have been converted for presentation elsewhere in this report.

1.4.2 Data Acquisition

Geomechanical instruments are read either manually, using portable devices, or remotely by electronically polling the stations from the surface in accordance with approved operating procedures. Remotely read instruments are connected to one of the underground data loggers, and readings are collected by initiating the appropriate polling routine. Upon completion of a verification process, data are transferred to a computer database. Manual readout devices are taken to instrument locations underground. Data are recorded on data sheets and later entered into an electronic database.

The underground data acquisition system consists of instruments, polling devices, and a communications network. Instruments are connected to polling devices that are installed in electrical enclosures near the instrument locations. Polling devices are connected by a data link to a surface computer.

Whether acquired manually or remotely, geomechanical data are entered into the database files of the GIS data processing system. The data processing system consists of computer programs that are used to enter, reduce, and transfer the data to permanent storage files. Additional routines allow access to the permanent storage files for numerical analysis, tabular reporting, and graphical plotting. Copies of the instrumentation database and data plots are available upon request.[3]

[3] Instrumentation data and data plots are presented in "Geotechnical Analysis Report for July 2010-June 2011 Supporting Data" (DOE/WIPP-12-3484 Volume 2).
The document is available upon request from the National Technical Information Service. See page 3 for details and addresses.

1.4.3 Data Evaluation

Rounding and significant digits are used in the data tables of this document. The reference document is American Society for Testing and Materials (ASTM) document ASTM D 6026-06, "Standard Practice for Using Significant Digits in Geotechnical Data."[4]

Closure measurements are acquired manually from convergence point anchors and remotely from convergence meters. Data are presented in plots of closure versus time. Closure rate data are calculated and presented as part of the data analysis. Extensometers provide displacement data from instrumented rods or wires anchored at various depths. Plots show displacement versus time for individual anchors.

Displacement rate data from the hole collar to the deepest anchor are presented in the data analysis.

The annual closure rate is calculated as follows:

$$rate(inches/year) = (cfi_2 - cfi_1)/(date_2 - date_1) \times 365.25\, days/year$$
$$where\; cfi = the\; change\; from\; the\; initial\; reading\; (inches)$$
$$cfi_1 = cfi\; reading\; closest\; to\; the\; beginning\; of\; the\; reporting\; period$$
$$cfi_2 = cfi\; reading\; closest\; to\; the\; end\; of\; the\; reporting\; period$$

Comparisons between closure rates of the previous and current reporting periods are presented as percent changes in rate and are calculated as follows:

$$percent\; change\; in\; rate = ((Rate_{Current\;Period} - Rate_{Previous\;Period})/(Rate_{Previous\;Period})) \times 100\%$$

Rock bolt load cells are used to determine bolt support performance. Plots show load versus time for each instrumented bolt.

Earth pressure cells and strain gauges are used to determine the stresses and deformation in and around the shaft liners. Data are depicted in time-based plots.

Piezometers are used to measure the gauge pressure of groundwater and are installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Data are plotted as pressure versus time.

Joint meters, installed perpendicular to a crack, monitor the dilation of the crack with time. Data are presented as displacement versus time.

[4] Copyright by ASTM, Reproduction authorized per License Agreement with Washington TRU Solutions LLC.

1.4.4 Data Errors

GIS data are processed through a comprehensive database management system. Whether acquired manually or remotely, GIS data are processed and permanently stored according to approved procedures. On occasion, erroneous readings can occur. There are several possible explanations for erroneous readings, including the following:

- The measuring device was misread.
- The reading was recorded incorrectly.
- The measuring device was not functioning within specifications.

When a reading is believed to be erroneous, the suspect reading is evaluated, and, if necessary, a second reading is collected. If the second reading falls in line with the instrument trend, the first reading is discarded and the second reading is entered in the database. If the second reading and subsequent readings remain out of the instrument trend, the ground conditions in the vicinity of the instrument are assessed to determine the reason for the discrepancy. In addition, the reading frequency may be increased. This process to correct erroneous readings is documented, and the documentation is filed for future reference.

2.0 GEOLOGY

This chapter provides a summary of the stratigraphy of the WIPP region and the site. Readers desiring further geologic information may consult the "Geological Characterization Report, WIPP Site, Southeastern New Mexico" (Powers et al., 1978). This report was developed as a source document on the geology of the WIPP site for individuals, groups, or agencies seeking basic information on geologic history, hydrology, geochemistry, or detailed information, such as physical and chemical properties of repository rocks. A more recent survey of WIPP stratigraphy is included in Holt and Powers (1990).

2.1 Regional Stratigraphy

The stratigraphy in the vicinity of the WIPP site includes rocks of Permian (295 to 250 million years [Ma] before present [bp]), Triassic (250 to 203 Ma), and Quaternary (1.75 Ma to present) ages. The descriptions of formations provided in this section are given in order of deposition (oldest to youngest), beginning with the Castile Formation (Figure 2-1).

2.1.1 Permian

The Permian system in southwestern North America is divided into four series. The last of these, the Ochoan Series, contains the host rock in which the WIPP repository is located. The Ochoan Series is of mostly marine origin and consists of four formations: three evaporite formations (the Castile, the Salado, and the Rustler) and one redbeds formation (the Dewey Lake). The Ochoan evaporites overlie marine limestones and sandstones of the Guadalupian Series (Delaware Mountain Group). The younger redbeds represent a transition from the lower evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The Permian rocks are overlain by fluvial deposits of the Triassic and Quaternary periods.

2.1.1.1 Castile Formation

The Castile Formation, lowermost of the four Ochoan formations, is approximately 1,250 ft (380 m) thick in the WIPP vicinity. Lithologically, the Castile is the least complex of the evaporite formations and is composed chiefly of interbedded anhydrite and halite, with limestone present in minor amounts.

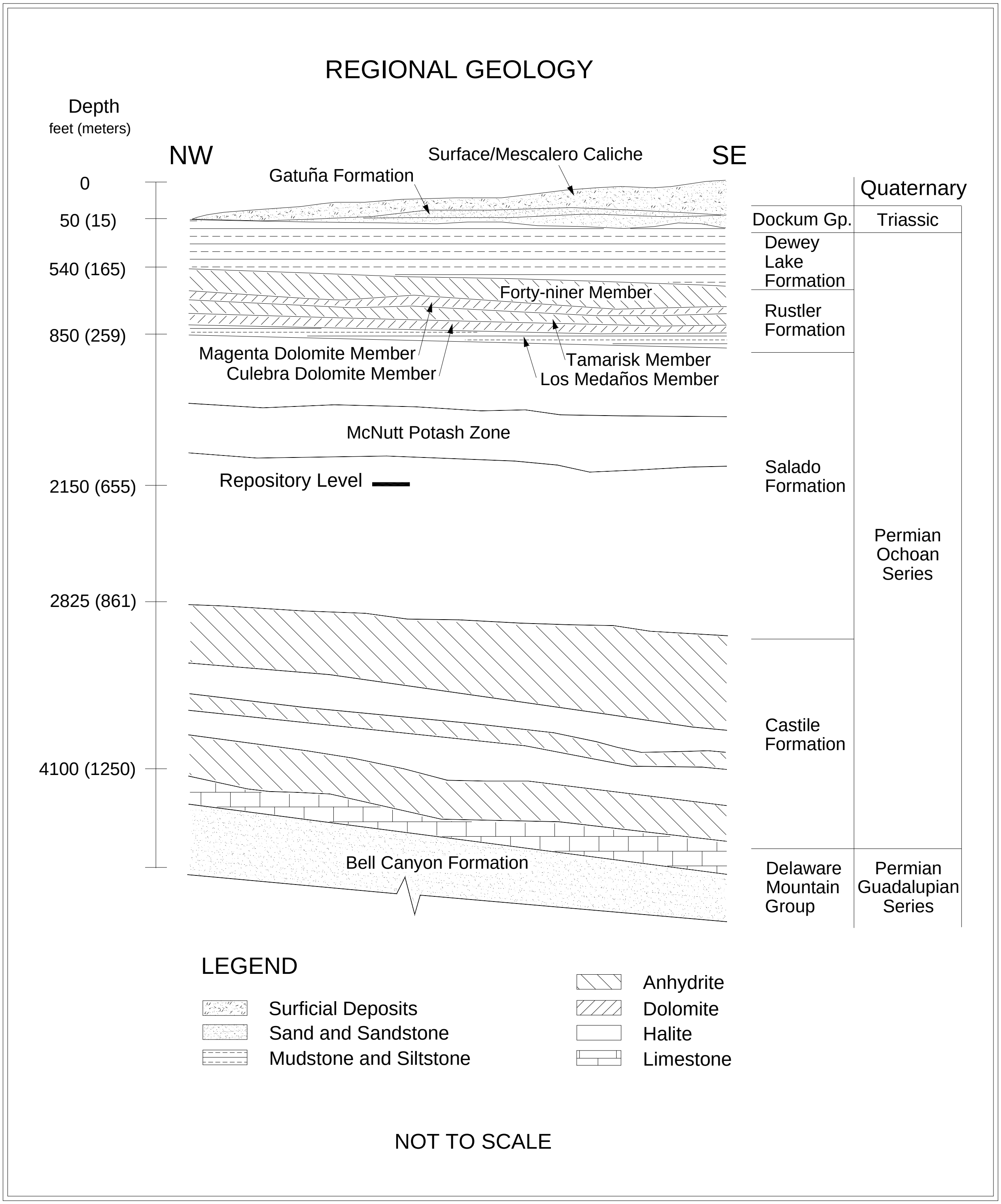

Figure 2-1 – Regional Geology

2.1.1.2 Salado Formation

The Salado Formation comprises nearly 2,000 ft (610 m) of evaporites, primarily halite. The formation is subdivided into three informal members: the unnamed lower member, the McNutt potash zone, and the unnamed upper member. Each member contains similar amounts of halite, anhydrite, and polyhalite and is differentiated on the basis of soluble potassium- and magnesium-bearing minerals. The WIPP disposal horizon is located within the unnamed lower member, 2,150 ft (655 m) below the surface.

2.1.1.3 Rustler Formation

The Rustler Formation is subdivided into five members, starting from its base: the Los Medaños Member, the Culebra Dolomite Member, the Tamarisk Member, the Magenta Dolomite Member, and the Forty-niner Member.

In the vicinity of the WIPP site, the Rustler is approximately 310 ft (95 m) thick and thickens to the east. The lower portion (Los Medaños Member) contains primarily fine sandstone to mudstone with lesser amounts of anhydrite, polyhalite, and halite. Bedded and burrowed siliciclastic sedimentary rocks with cross-bedding and fossil remains signify the transition from the strongly evaporitic environments of the Salado to the brackish lagoonal environments of the Rustler (Holt and Powers, 1990).

The upper portion of the Rustler contains interbeds of anhydrite, dolomite, and mudstone. The Culebra Dolomite member is generally brown, finely crystalline, and locally argillaceous. The Culebra contains rare to abundant vugs with variable gypsum and anhydrite filling and is the most transmissive hydrologic unit within the Rustler. The Tamarisk Member consists of lower and upper sulfate units separated by a unit that varies laterally from mudstone to mainly halite. The Magenta Dolomite Member is a gypsiferous dolomite with abundant primary sedimentary structures and well-developed algal features. The Forty-niner Member consists of lower and upper sulfate units separated by a mudstone that displays sedimentary features and bedding. East of the site area, halite correlates with the mudstone. The Culebra and Magenta Dolomite members are persistent and serve as important marker units.

2.1.1.4 Dewey Lake Redbeds

The Dewey Lake Redbeds is the uppermost of the Ochoan Series formations. Within the series, the Dewey Lake represents a transition from the lower marine evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The redbeds, approximately 475 ft (145 m) thick, consist of predominantly reddish-brown interbedded fine-grained sandstone, siltstone, and claystone. This formation is differentiated from others by its lithology and distinctive color (both of which are remarkably uniform), and by sedimentary structures, including horizontal- and cross-laminae and ripple marks. The redbeds also contain locally abundant greenish-gray reduction spots and gypsum-filled fractures. The formation thickens from west to east due to eastward dips and erosion to the west.

2.1.2 Triassic

The only Triassic rocks present in the WIPP region belong to the Dockum Group.

2.1.2.1 Dockum Group

The Dockum Group consists of fine-grained floodplain sediments and coarse alluvial debris of Triassic age. From a pinch-out near the center of the WIPP site it thickens eastward, forming an erosional wedge. Local subdivisions of the Dockum Group are the Santa Rosa Sandstone and the Chinle Formation; however, only the Santa Rosa occurs in the vicinity of the site. It consists primarily of poorly sorted sandstone with conglomerate lenses and thin mudstone partings and contains impressions and remnants of fossils. These rocks have more variegated hues than the underlying uniformly colored Dewey Lake.

2.1.3 Quaternary

Quaternary Period deposits include the Gatuña Formation, Mescalero Caliche, and surficial sediments.

2.1.3.1 Gatuña Formation, Mescalero Caliche, and Surficial Sediments

The Gatuña Formation (ranging in age from approximately 1.3 million to 600,000 years bp) (Powers and Holt, 1993) is a stream-laid deposit overlying the Dockum Group in the WIPP vicinity. At the site center, the formation consists of approximately 13 ft (4 m) of poorly consolidated sand, gravel, and silty clay. The Gatuña Formation is light red and mottled with dark stains. The unit contains abundant calcium carbonate, but is poorly cemented. Sedimentary structures are abundant (Powers and Holt, 1993, 1995).

The Mescalero Caliche (approximately 500,000 years bp) is approximately 4 ft (1.2 m) thick in the WIPP vicinity. The Mescalero is a hard, resistant soil horizon that lies beneath a cover of wind-blown sand. The horizon is petrocalcic (i.e., very strongly cemented with calcium carbonate). Petrocalcic horizons form slowly beneath a stable landscape at the average depth of infiltration of soil moisture and indicate stability and integrity of the land surface. Many of the surface buildings at WIPP are founded on top of the Mescalero Caliche.

Surficial sediments include sandy soils developed from eolian material and active dune areas. The Berino Series (a soil type) covers about 50 percent of the site and consists of deep sandy soils that developed from wind-worked material of mixed origin. Based on sample analyses, the Berino soil from the WIPP site formed 330,000 ± 75,000 years bp.

2.2 Underground Facility Stratigraphy

The WIPP disposal horizon lies near the midpoint of the Salado Formation. The Salado was deposited in a shallow saline lagoon environment, which progressed through numerous inundation and desiccation cycles that are reflected in the formation. An "ideal" cycle progresses upward as follows: a basal layer consisting predominantly of claystone, followed by a layer of sulfate, which is in turn followed by a layer of halite. The entire sequence is capped by a bed of argillaceous (clay-rich) halite accumulated during a period of mainly subaerial exposure.

A regional system used for numbering the more significant sulfate beds within the Salado designates these beds as marker beds (MBs), counted from MB100 near the top of the formation to MB144 near the base. The repository is located between MB138 and MB139 (Figure 2-2) within a sequence of laterally continuous depositional cycles as described above. Within this sequence, layers of clay and anhydrite that are locally designated (as shown) can have a significant impact on the geomechanical performance of the excavations. Clay layers provide surfaces along which slip and separation can occur, whereas anhydrites form brittle layers that do not deform plastically.

In the vicinity of WIPP, the stratigraphy is fairly continuous and uniform. Beds generally dip toward the south-southeast at a slope of approximately 3 percent.

2.2.1 Disposal Horizon Stratigraphy of Panels 1, 2, 7, and 8

This disposal horizon contains Panels 1, 2, 7, and 8, all the shaft areas, the shop areas, the SPDV areas (which are now closed), and all the access drifts north of S-2620. Farther south, the four main entries rise in a ramp that starts at S-2620 and ends at S 2740. Panel 7 is currently being excavated, and Panel 8 has not yet been excavated.

Most underground excavations are located within this disposal horizon (Figure 2-2). In it, the Orange Marker Bed (OMB) lies near the middle of the rib (i.e., the excavation wall). The OMB is a laterally consistent unit of moderate to light reddish-orange translucent halite about 6 inches (in) (15 centimeters [cm]) thick that is used as a point of reference during excavation.

MB139 lies approximately 11.5 ft (3.5 m) below the OMB. MB139 is a 20 to 32 in (50-to-80 cm) thick layer of polyhalitic anhydrite. The top of the anhydrite undulates up to 15 in (38 cm), while the bottom is sub-horizontal and is underlain by Clay E.

Above MB139 is a unit of halite that terminates at the base of the OMB. Within this unit, polyhalite is locally abundant and decreases upward, while argillaceous material increases upward.

Above the OMB, a thin band of argillaceous halite gives way to a thick sequence of clear halite that becomes increasingly argillaceous upward and is capped by Clay F. This constitutes a thin layer occasionally interrupted by partings and breaks and is readily visible in the upper ribs. Above Clay F, another sequence of halite begins that, as in lower sequences, becomes increasingly argillaceous upward. This sequence terminates at the Clay G/Anhydrite "b" interface, approximately 6.5 ft (2 m) above the roof of most disposal horizon excavations, forming a roof beam that typically acts as a structural unit. The roof of some disposal horizon excavations (e.g., the E-140 drift between S-1000 and 1950), has been excavated to the upper contact of Anhydrite "b." In this case, a roof beam is formed by the next depositional sequence beginning with Anhydrite "b" and progressing upward to the Clay H/Anhydrite "a" interface, approximately 6.5 ft (2 m) above the upper contact of Anhydrite "b."

2.2.2 Disposal Horizon Stratigraphy of Panels 3, 4, 5, and 6

Field observations and computer modeling indicated that moving the disposal horizon stratigraphically upward (so that the roof was located at Clay G) would improve long-term ground conditions and provide a more stable roof configuration without significantly impacting repository performance. In 2000, the decision was made to implement this change by moving the mining horizon up approximately six feet. Subsequently, in 2000 and 2001, ramps were mined in the W 170, W 30, E 140, and E 300 drifts between S 2620 and S 2750 (Figure 1-2). As a result, the disposal horizon for Panels 3, 4, 5, and 6, and the associated connecting drifts lies above the horizon for the other panels (Figure 2-3).

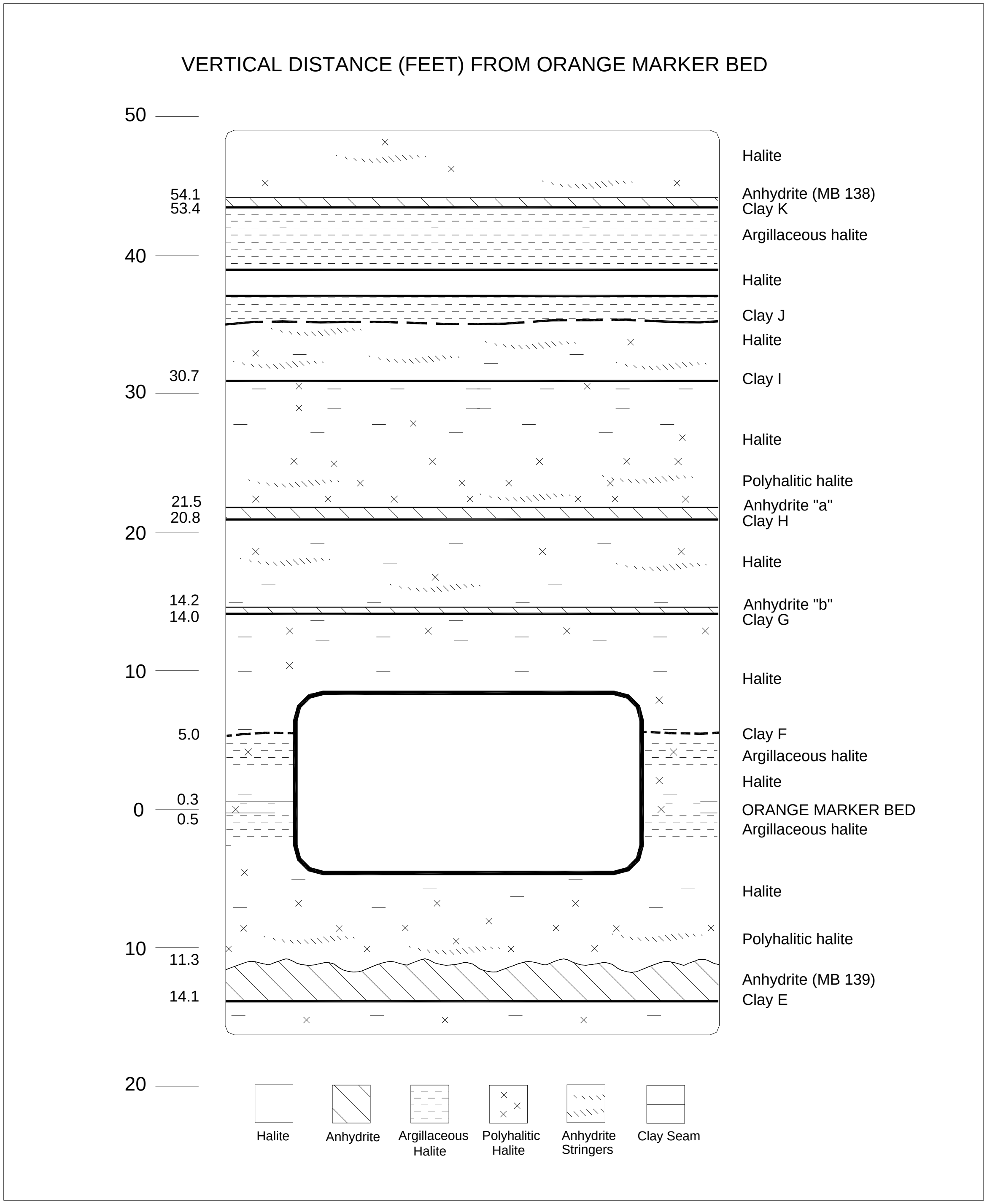

Figure 2-2 – Repository Level Stratigraphy of Panels 1, 2, 7, and 8

In this horizon (see Figure 2-3), the OMB lies at or below the floor. MB139 lies about 12 ft (3.7 m) below the floor. The roof lies at or slightly above Anhydrite "b." Clay G/ Anhydrite "b" is used as the mining reference during excavation of this disposal horizon.

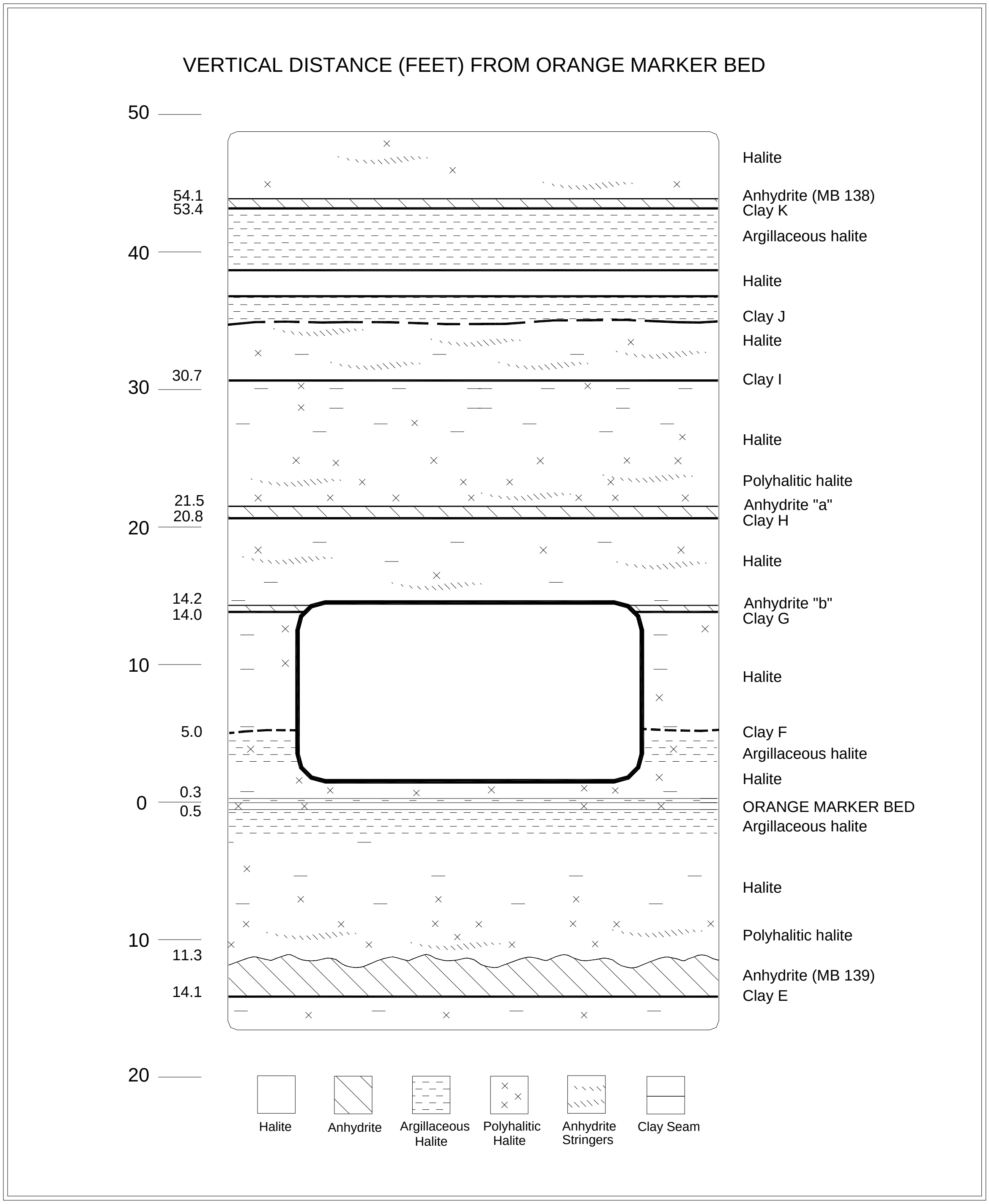

Figure 2-3 – Repository Level Stratigraphy of Panels 3, 4, 5, and 6

2.2.3 Northeast Area Stratigraphy

All of the Northeast Area, a former experimental area, is now deactivated and closed to access. These excavations lie at a higher stratigraphic level than the disposal excavations. Floors are at Anhydrite "b." As in the lower units, the halite intervals between the clay seams/anhydrite beds contain relatively pure halite that becomes increasingly argillaceous upward. Above clay I, two more halite intervals complete the underground facility stratigraphy. Clay J, at the top of the first of these intervals, may consist of a distinct seam or merely an argillaceous zone. Clay K tops the second interval and is overlain by MB138.

3.0 PERFORMANCE OF SHAFTS AND KEYS

Four shafts connect the surface with the underground. They are the Salt Shaft, which is used primarily for removing excavated salt from the underground and for transporting personnel and material; the Waste Shaft, which is used primarily for transporting TRU waste to the underground and for transporting personnel and materials; the Exhaust Shaft, which is used to exhaust the ventilation air from the underground; and the Air Intake Shaft, which is the primary source of fresh air ventilation to the underground. This chapter describes the geomechanical performance of these shafts.

Although through the years much of the instrumentation installed in the shafts has failed, there are no plans to replace it. The project has a good understanding of the expected movements in the shafts. Monitoring results up to the point of instrument failure did not indicate unusual shaft movements or displacements. Continued periodic visual inspections confirm the expected shaft performance and provide necessary observations to evaluate shaft performance. Replacement of failed instrumentation will not provide significant additional information.

3.1 Salt Shaft

The first construction activity undertaken during the SPDV Program was the excavation of the Exploratory Shaft. This shaft was subsequently referred to as the Construction and Salt Shaft and is currently designated the Salt Shaft (see Figure 1-2). The shaft was drilled from July 4 to October 24, 1981, and geologically mapped in the spring of 1982 (DOE, 1983). Figure 3-1 presents the stratigraphy in the shaft.

The Salt Shaft is lined from the surface to 846 ft (258 m) with steel casing having an inside diameter of 10 ft (3-m). The thickness of the steel liner (including external stiffener rings) increases from 0.62 in (1.6 cm) at the top to 1.5 in (3.8 cm) at the key. Cement grout was placed between the liner and the rock face. The 10-ft (3-m) diameter extends through the concrete shaft key to 880 ft (268 m). The shaft key is a 37.5 ft (11.4-m) long, reinforced-concrete structure that begins 3.5 ft (1.07 m) above the bottom of the steel liner. From the key to the bottom at 2,298 ft (700 m), the shaft has a nominal diameter of 12 ft (4 m).

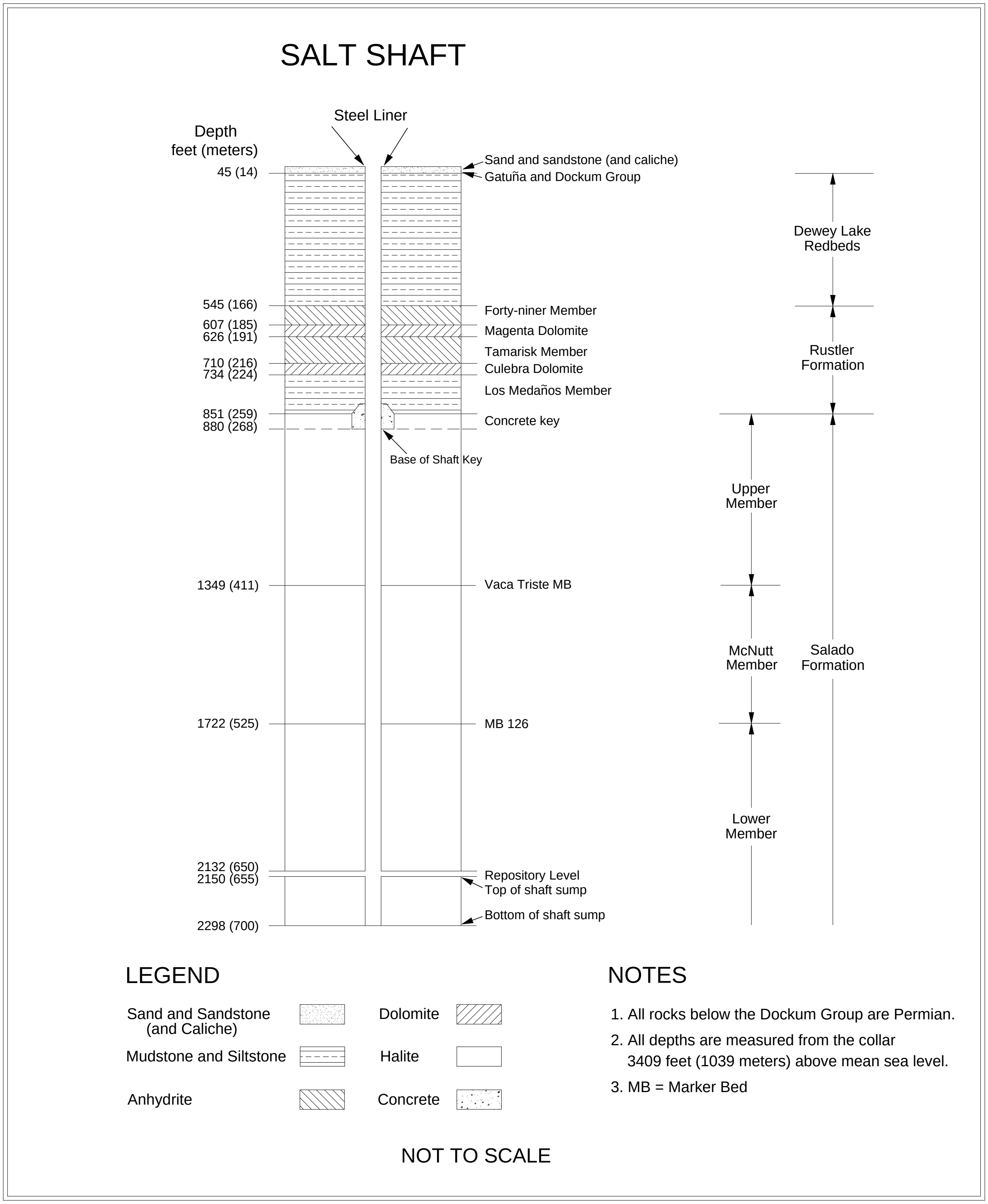

Figure 3-1 – Salt Shaft Stratigraphy

Wire mesh anchored by rock bolts is installed in sections of the lower shaft as a safety screen to contain rock fragments that may become detached. The shaft extends approximately 140 ft (43 m) below the repository horizon in order to accommodate the skip loading equipment and a sump.

3.1.1 Shaft Observations

Underground operations personnel conduct weekly visual inspections. These inspections are performed principally to assess the condition of the hoisting and mechanical systems, but they also include examining the shaft walls for water seepage, loose rock, or sloughing. Visual inspections during this reporting period found that the shaft remained in satisfactory condition. Only routine ground control activities were required.

3.1.2 Instrumentation

Geomechanical instruments (radial convergence points, extensometers, and piezometers) were installed at various levels in the shaft from April through July of 1982 (Figure 3-2). In the shaft key, instruments included strain gauges, pressure cells, and piezometers. Radial convergence points were installed prior to outfitting. Upon completion of shaft outfitting, no more readings were taken. Figure 3-2 and Figure 3-3 show the instrument locations.

Ten of the 12 piezometers continue to provide data. The fluid pressures recorded at the end of this reporting period range from approximately 60 pounds per square inch (psi) (414 kilopascals [kPa]) at the 802-ft (244-m) level in the Los Medaños Member to 188 psi 1,296 kPa) at the 691-ft (211-m) level in the Magenta Dolomite Member. The recorded pressures for this reporting period are generally consistent with the readings from the previous reporting period. The fluid pressure on the shaft liner will continue to be monitored on a regular basis.

Four earth pressure cells were installed in the key section during concrete emplacement at the 860-ft (262-m) level. These instruments measure the normal stress between the concrete key and the Salado Formation as salt creep loads up the key structure. Three of the four earth pressure cells continue to provide data. These instruments have indicated essentially no contact pressure since their installation (readings resemble instrument drift at a zero pressure). The maximum contact pressure recorded by the instruments for this reporting period is 7 psi (48 kPa).

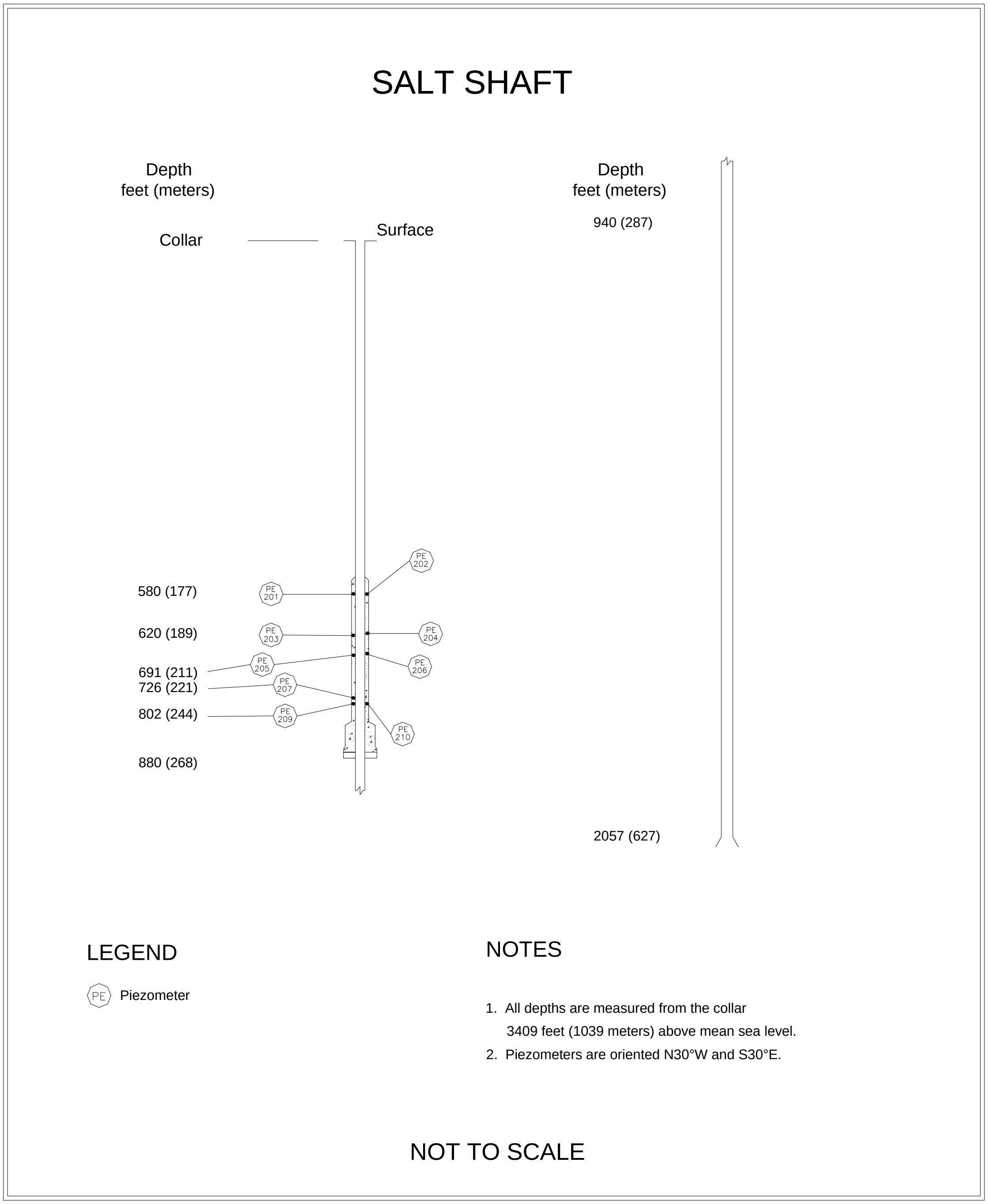

Figure 3-2 – Salt Shaft Instrumentation (Without Shaft Key)

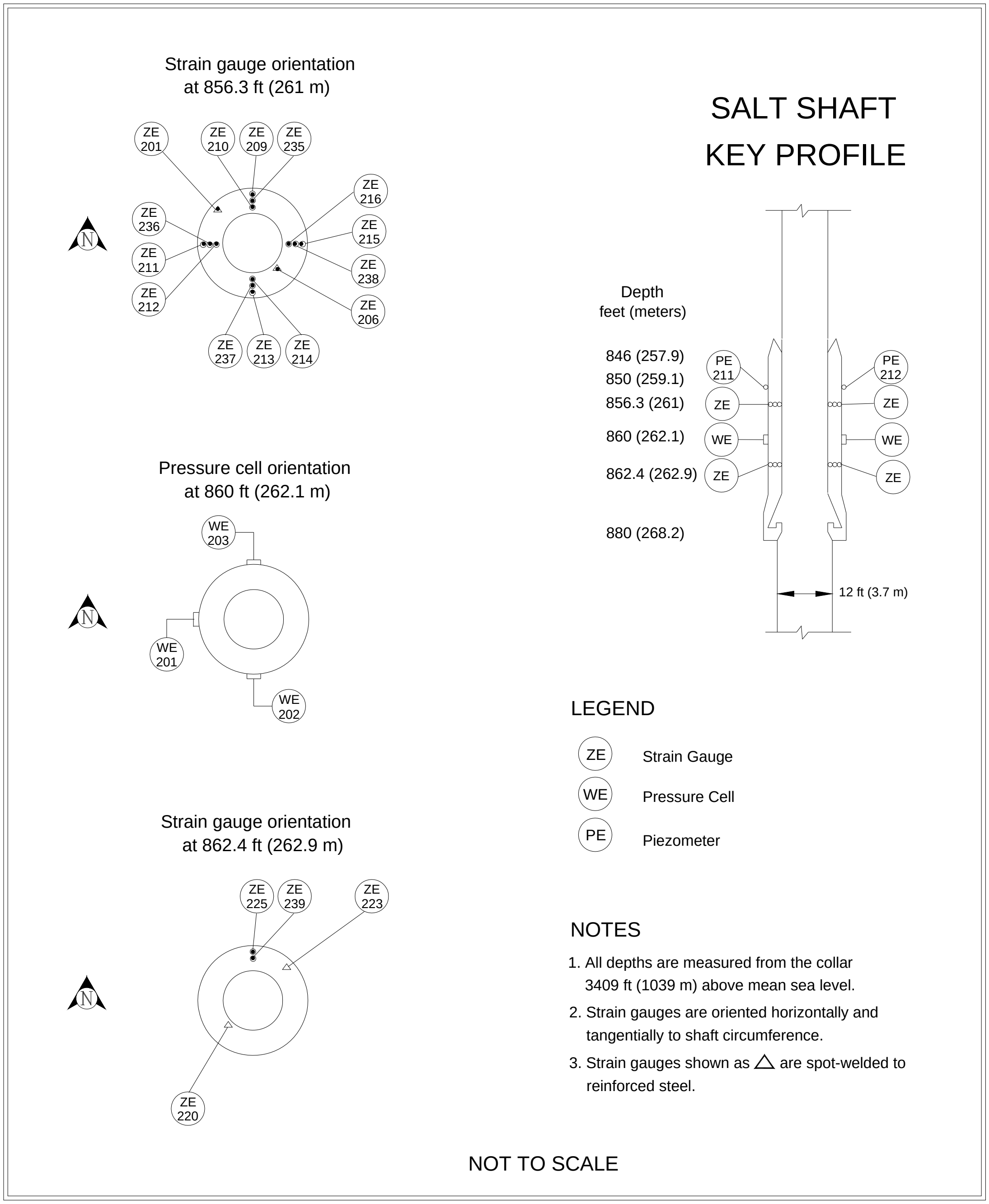

Figure 3-3 – Salt Shaft Key Instrumentation

Sixteen spot-welded and twenty-four embedment strain gauges were installed on and in the shaft key concrete at both the 856.3-ft (261-m) level and at the 862.4-ft (263-m) level. Four spot-welded strain gauges are still functioning at these levels. Strains at the 856.3-ft (261-m) level were 653 and 746 microstrain. Strains at the 862.4 ft (263 m) level were 705 and 906 microstrain. Fourteen embedment strain gauges are still functioning. The strains at the 856.3-ft (261-m) level ranged from -891 to 998 microstrain. The strains from the two embedment strain gauges at the 862.4 ft (263-m) level were 271 to 391 microstrain. The strains recorded by the spot-welded strain gauges and the embedment strain gauges during this reporting period are very similar to the strains recorded by these instruments at the end of the previous reporting period.

3.2 Waste Shaft

As part of the SPDV Program, a 6-ft (2-m) diameter ventilation shaft, now referred to as the Waste Shaft, was excavated from December 1981 through February 1982 (see Figure 1-2). This shaft, in combination with the Salt Shaft, provided a two-shaft underground air circulation system. From October 11, 1983, to June 11, 1984, the shaft was enlarged to a diameter of 20 to 23 ft (6 to 7 m) and lined above the key. Stratigraphic mapping (Figure 3-4) was conducted during shaft enlargement from December 9, 1983, to June 5, 1984 (Holt and Powers, 1984).

The Waste Shaft is lined with non-reinforced concrete having a 19 ft (6 m) inside diameter from the surface to the top of the key at 837 ft (255 m). Liner thickness increases from 10 in (25 cm) at the surface to 20 in (51 cm) at the key. The key is 63 ft (19 m) long and 4.25 ft (1.3 m) thick and is constructed of reinforced concrete. The bottom of the key is 900 ft (274 m) below the surface. The diameter of the shaft is 20 ft (6 m) at the bottom of the key and increases to 23 ft (7 m) just above the shaft station. The shaft below the key is lined with wire mesh anchored by rock bolts. The diameter of 23 ft (7 m) extends to a depth of approximately 2,286 ft (697 m), with the shaft sump comprising the lower 119 ft (36 m) of that interval.

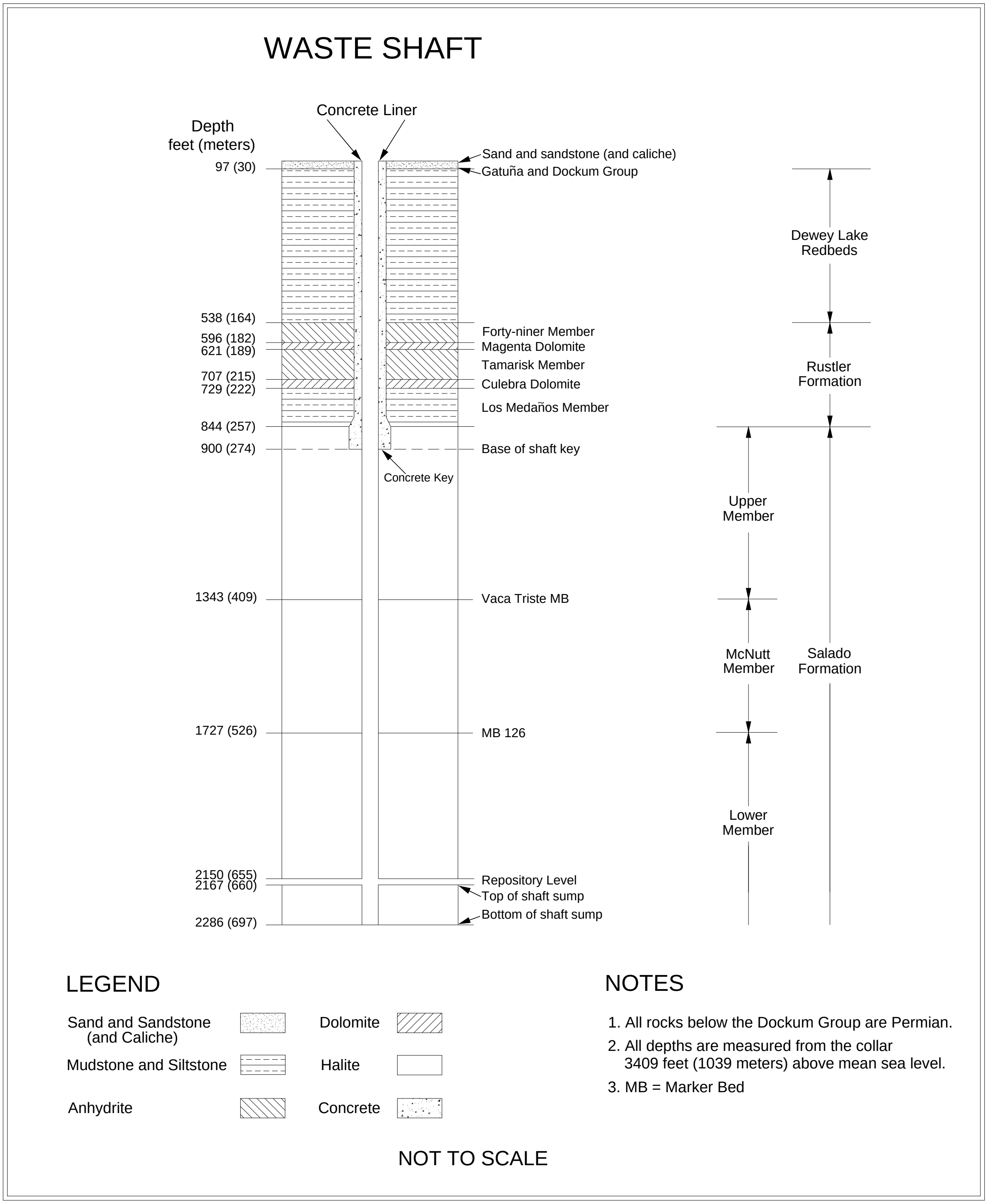

Figure 3-4 – Waste Shaft Stratigraphy

3.2.1 Shaft Observations

Underground operations personnel conduct weekly visual inspections, principally to assess the condition of the hoisting and mechanical systems, but also include observation of the shaft walls for water seepage, loose rock, or sloughing. The visual inspections found that the shaft was in satisfactory condition. No ground control activities other than routine maintenance were required.

3.2.2 Instrumentation

Radial convergence points, extensometers, piezometers, and earth pressure cells were installed in the Waste Shaft between August 27 and September 10, 1984. Radial convergence points were installed prior to the outfitting. Upon completion of shaft outfitting, no more radial convergence readings were taken. Figure 3-5 and Figure 3-6 show the instrument locations.

Nine multi-position extensometers were installed in arrays 1,071 ft (326 m), 1,566 ft (477 m), and 2,059 ft (628 m) below the surface as shown in Figure 3-5. Each array consists of three extensometers. No extensometer data have been collected in recent years due to the malfunction of the data acquisition equipment. Since the type of extensometers installed in the shaft over 27 years ago is no longer manufactured, remote data acquisition equipment for these extensometers is also unavailable.

Twelve piezometers were installed in the lined section of the Waste Shaft on September 7 and 8, 1984, to monitor fluid pressure behind the shaft liner and the key section. Data continue to be received from 4 piezometers. The maximum recorded fluid pressure during this reporting period was 138 psi (951 kPa) at the 717-ft (219-m) level. The pressure readings during this reporting period were consistent with the readings from the previous reporting period with a mean change in pressures of 5 psi (34 kPa).

Four earth pressure cells were installed in the key section of the Waste Shaft during concrete emplacement between March 23 and April 3, 1984. One is still working. Earth pressure cells measure the normal stress between the concrete key and the Salado Formation as salt creep loads the key structure. The contact pressure recorded by the instrument during this reporting period was 118 psi (814 kPa) at the 866 ft (264 m) level.

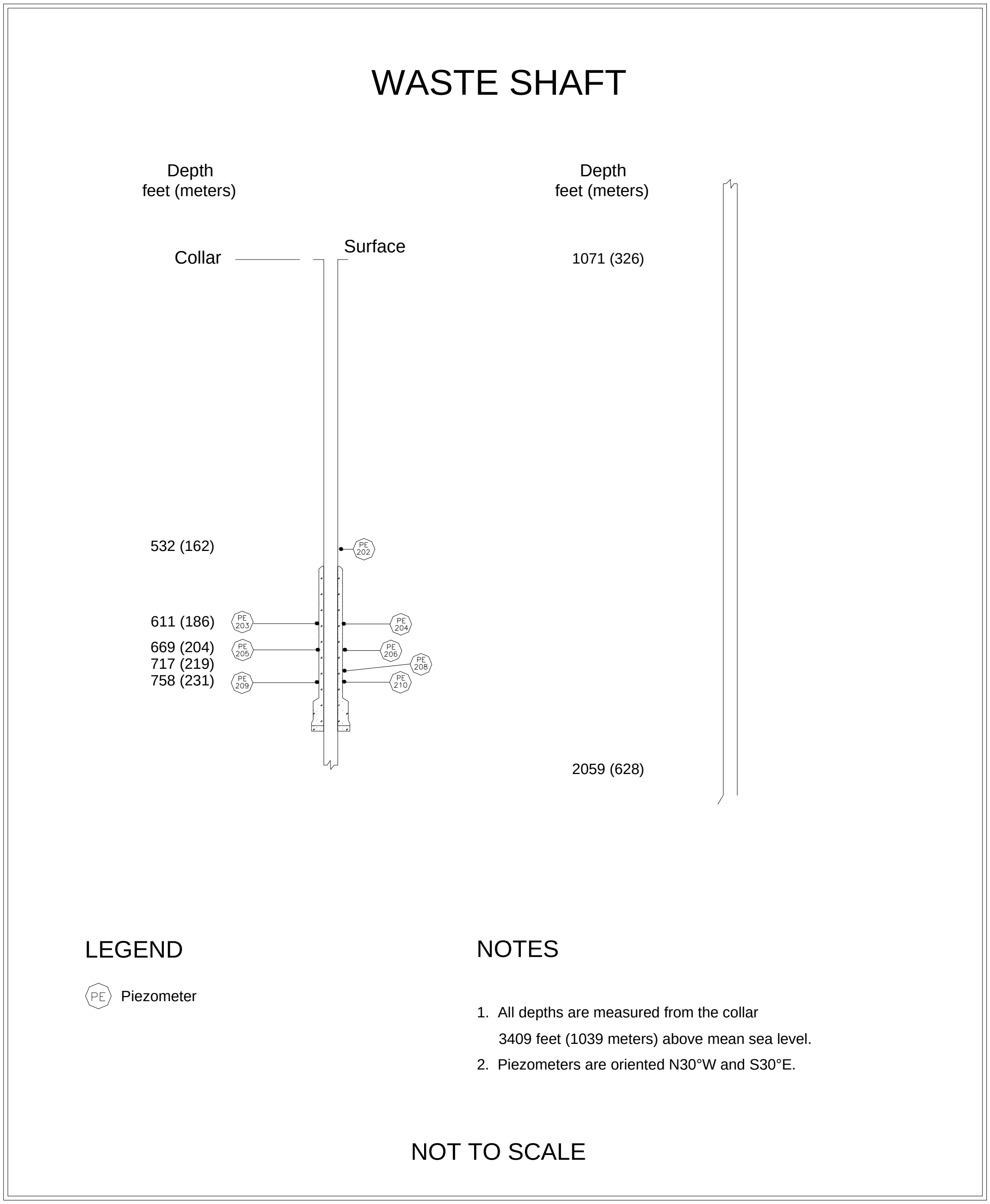

Figure 3-5 – Waste Shaft Instrumentation (Without Shaft Key)

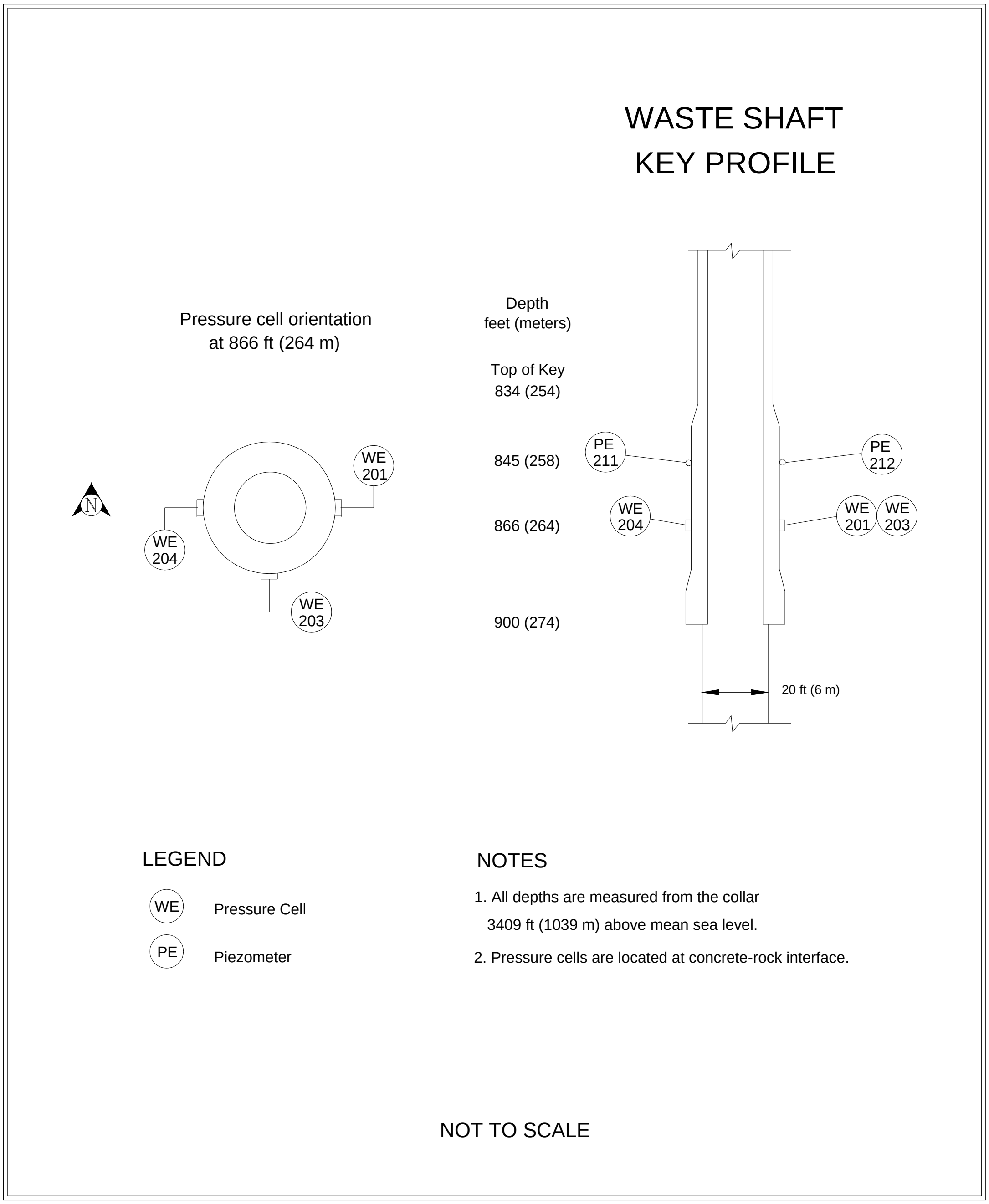

Figure 3-6 – Waste Shaft Key Instrumentation

3.3 Exhaust Shaft

The Exhaust Shaft was drilled from September 22, 1983, to November 29, 1984, to establish a route from the underground to the surface for exhaust air (Figure 1-2). Stratigraphic mapping was conducted from July 16, 1984, to January 18, 1985 (DOE, 1986c). Figure 3-7 illustrates the shaft stratigraphy.

The Exhaust Shaft is lined with non-reinforced concrete from the surface to the top of the shaft key at 844 ft (257 m). The liner thickness increases from 10 to 16 in (25 to 41 cm) over that interval. The key is 63 ft (19 m) long and 3.5 ft (1 m) thick. The shaft diameter below the key is 15 ft (5 m), and the interval below the key is lined with wire mesh anchored by rock bolts. The shaft terminates at the facility horizon, approximately 2,150 ft (655 m) deep. This shaft has no sump.

3.3.1 Exhaust Shaft Observations

Quarterly video inspections were conducted according to approved WIPP procedures. Inspections were performed to evaluate the condition and to verify the integrity of the shaft. The shaft was examined for cracks, corrosion, salt buildup, seeps, and debris. In addition, inspections examined the condition of anchors, brackets, and down-hole equipment. Between July 2010 and June 2011, four quarterly shaft inspections were conducted on August 4, 2010; November 17, 2010; February 16, 2011; and May 18, 2011.

3.3.1.1 Video Camera

Video inspections use a custom-designed vertical-drop color camera in an aerodynamic housing, suspended by a dual-armored cable, with pan, tilt, and zoom capability. The cable contains five copper conductors and two multi-mode optical fibers. It is reeled out by a winch mounted in a control van. Inspections are recorded electronically.

3.3.1.2 Shaft Inspection Observations

Quarterly video inspection observations concentrate on four major areas: air monitoring components, shaft liner, shaft walls, and equipment support and cabling. The air monitoring components consist of one air-velocity and three air-monitoring devices as shown in Figure 3-8. The video inspection includes examination of each device, including the transport assembly, guide tubes, the sample intake, and the support brackets that extend from Station "A" above the shaft to the shaft collar. Air monitoring components extend from the collar 21 ft into the shaft. Video inspections indicate that the air-sampling components can accumulate salt buildup of up to several inches thick.

The Exhaust Shaft liner is examined for cracks, seepage, and general shaft stability. Currently, there are three principal zones of seepage in the shaft. The first is about 50 to 55 ft below the shaft collar (bsc). The second is about 60 to 65 ft bsc. The third is about 75 to 80 ft bsc, as shown in Figure 3-9. Monitoring of seepage horizons started before 1995. Water entering the shaft through these cracks is believed to originate from a perched aquifer at the base of the Santa Rosa Formation that is being recharged as the result of surface modifications at the site. The fluid level in the Santa Rosa near the shaft is about 46 to 47 ft below the surface. Based on examination of inspection videos, the flow rate into the shaft during this reporting period is estimated at about 1 to 1 1/2 gallons per minute, most of which is carried out of the shaft by the exhaust air. Seepage cracks are confined primarily to the eastern side of the shaft wall.

When fluid was detected seeping into the shaft, a catch basin was designed and installed at the base of the Exhaust Shaft to intercept water and prevent it from draining into the Waste Shaft Sump. Fluid was removed from the catch basin from March 1996 through October 2005 as needed. The catch basin was damaged in 2004 by fallen debris, either salt or instrumentation cables or both. A new catch basin was fabricated and installed in December 2004. This basin was damaged in August 2005, most likely the result of fallen debris. An interception well system was installed between November 2005 and March 2006 to replace the catch basin. Interception wells were drilled down-gradient in S-400 between E-140 and E 300 (Figure 3-10). The interception well system initially consisted of four 30-ft deep 9-7/8-in diameter fluid collection holes with a submersible pump and pressure transducer in each. Fluid is pumped from each hole to a series of storage containers in S-550. A data-acquisition system monitors the fluid level in each hole, turning the pump on and off between set limits as needed.

Between February 2 and 6, 2008, two additional fluid collection holes, OH631 and OH632, were drilled in S-400 to improve the total volume of fluid recovered by the interception well system. They replaced OH613 and OH614 which generated little fluid. As with the previous four holes, the additional holes were drilled at 9-7/8-inch diameter to a total depth of 30 feet. Pumps were pulled from OH613 and OH614 and installed in OH631 and OH632. Figure 3-10 shows the location of the interception wells system and the 500-gallons storage containers.

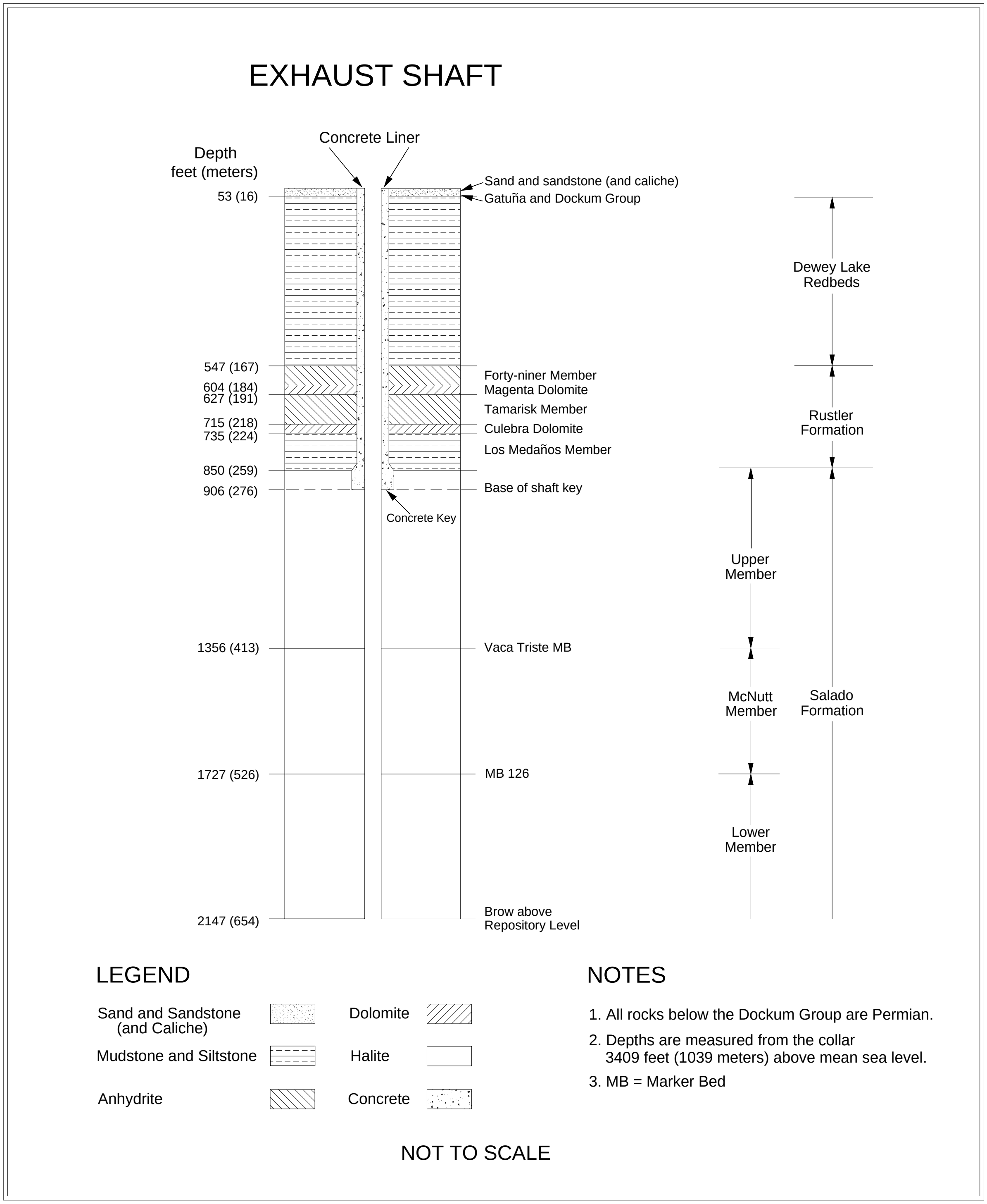

Figure 3-7 – Exhaust Shaft Stratigraphy

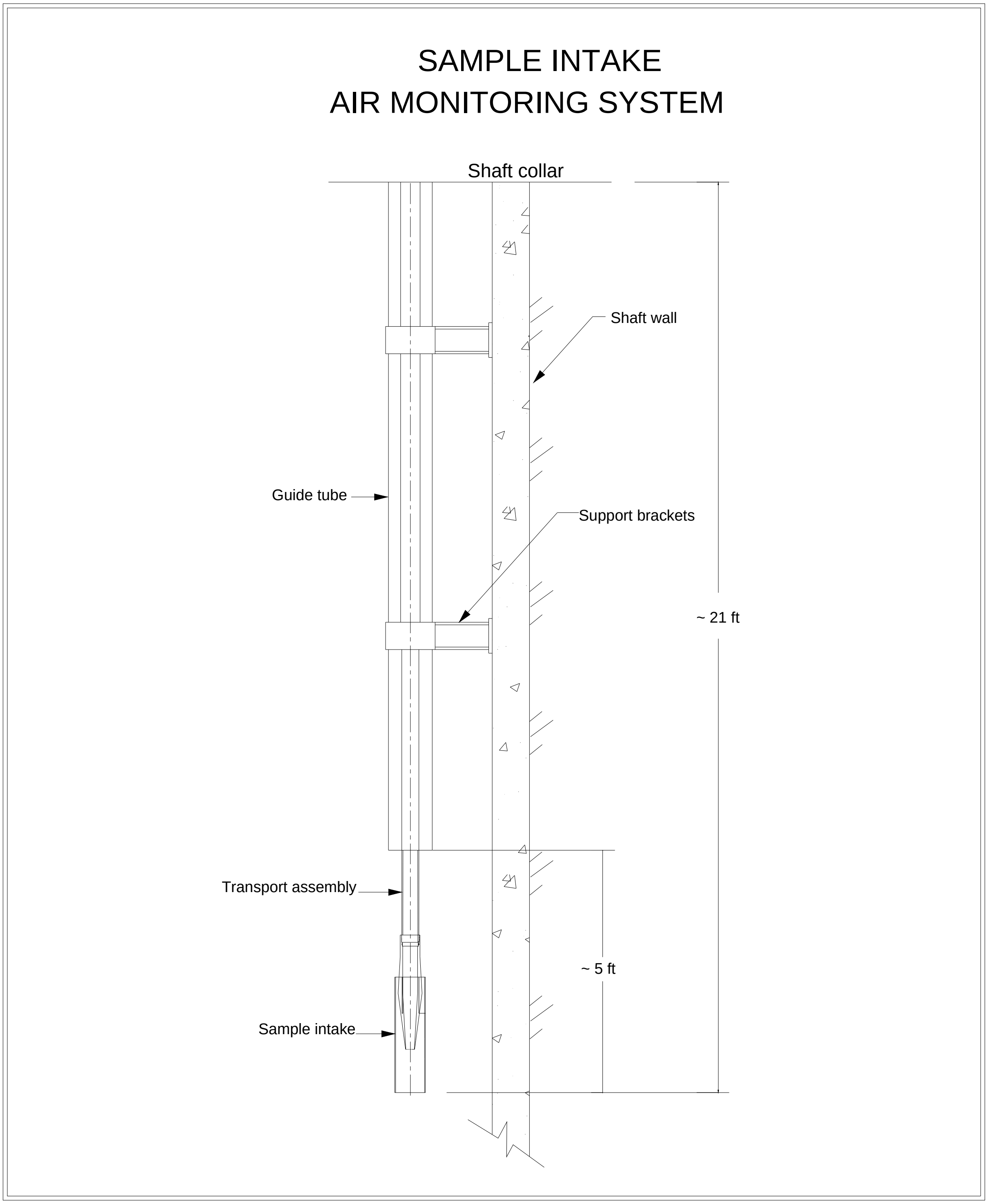

Figure 3-8 – Sample Intake of Exhaust Shaft Air Monitoring System

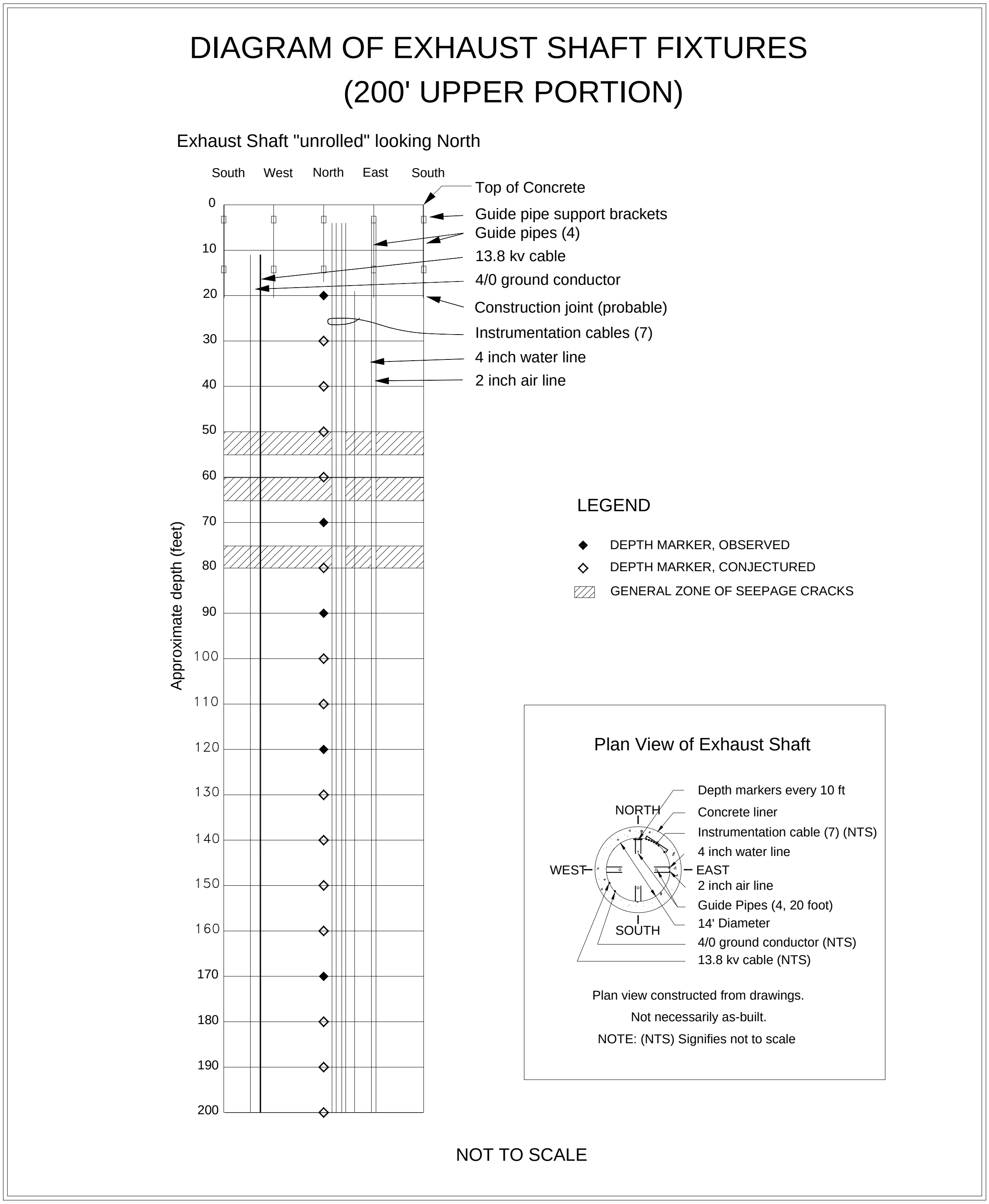

Figure 3-9 – Diagram of Exhaust Shaft Fixtures and Seepage Zones (Upper 200 ft)

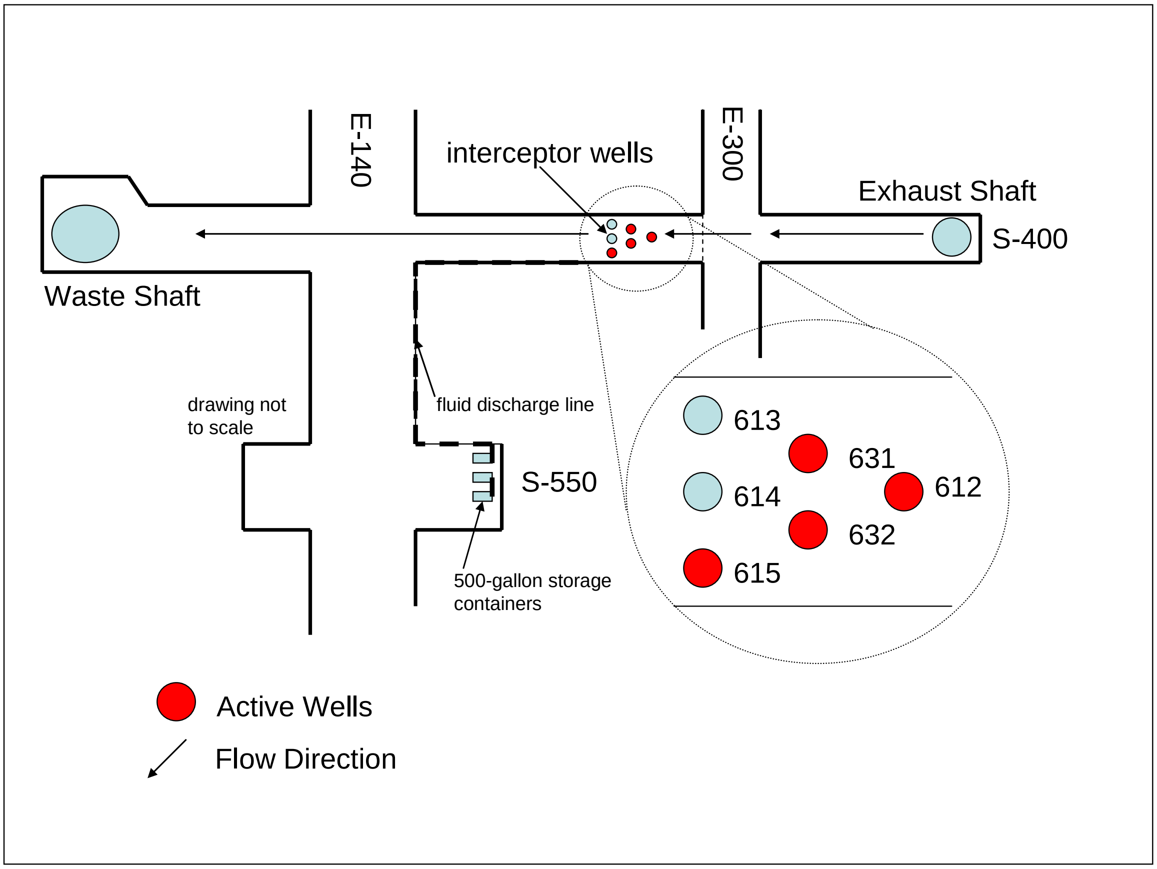

Figure 3-10 – Location of Interception Wells and Storage Containers

Table 3-1 and Figure 3-11 present the volume of fluid removed from the catch basin from July 1997 through June 2006, and by the interception well system from July 2006 through June 2011. The largest reported volumes are typically associated with periods of reduced ventilation and increased humidity. For a discussion of the factors affecting the quantity of fluid produced in the Exhaust Shaft, refer to DOE/WIPP 00-2000, *Brine Generation Study*.

The shaft walls were examined for salt buildup, cracks, moisture, and encrustations, with particular attention paid to power cables, instrument cables, air lines and water-lines, and the three water rings at the base of the Magenta and Culebra members of the Rustler Formation and the bottom of the shaft key. The condition of the shaft wall varies depending on airflow, humidity, temperature, and underground mining activities. During this reporting period, significant mining activity continued in Panel 7. The principal areas in the shaft with significant salt buildup were the three water rings at the Magenta, the Culebra, and the key, and along upper portions of the shaft generally associated with power cables, support brackets, instrument cables, and the air lines and water-lines.

Though the Magenta and Culebra water rings are encrusted with salt buildup, no water appears to originate from the liner or water rings. Most of the seepage was observed along the east face of the shaft wall near the instrumentation cables and the air lines and water-lines in the upper section of the shaft. Though the presence of water is an inconvenience requiring periodic disposal, at this time it does not appear to have created any hazard or affected the structural integrity of the shaft. However, brine increases the probability of corrosion and deterioration of utility hangers and brackets. There are no visible signs of dissolution of the salt below the key.

The video inspections also focused on the installed utilities and support brackets. These include a 13.8 kVA power cable that is no longer active and the grounding cable on the west wall of the shaft, the instrumentation cables on the northeast wall of the shaft, and the 4 in. air-line and the 2-in. water-line on the east wall of the shaft.

Sporadic salt buildup continues on all cables. The long-term implication of salt buildup is increased loading on cables and cable hangers, accompanied by intermittent falls of debris. The 4-in. compressed air-line and the 2-in. water-line extend from the surface to the bottom of the shaft. At present, neither line is being used. The integrity of the brackets holding the air-line and water-line was difficult to assess because of salt buildup; however, there was no indication that the brackets were broken. Instrumentation cable breaks were observed in the shaft; however, most of these breaks affected abandoned cables, with negligible impact on shaft monitoring and operations.

Table 3-1 – Water Removed from the Exhaust Shaft Catch Basin and the Interception Well System

July 1997 – June 1998		July 1998 – June 1999		July 1999 – June 2000		July 2000 – June 2001		July 2001 – June 2002		July 2002 – June 2003	
Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons
7/18/1997	275	7/1/1998	770	7/19/1999	110	7/3/2000	220	7/31/2001	165	7/2/2002	165
7/28/1997	660	7/7/1998	330	12/13/1999	165	7/15/2000	110	8/21/2001	1,595	7/8/2002	440
8/1/1997	550	7/14/1998	220	2/21/2000	110	9/18/2000	330	9/13/2001	330	7/9/2002	495
8/4/1997	715	7/16/1998	275	5/16/2000	715	10/24/2000	110	10/15/2001	770	7/10/2002	660
8/8/1997	770	7/23/1998	165	6/7/2000	165	3/7/2001	110	10/30/2001	220	7/30/2002	220
8/11/1997	660	7/24/1998	220	6/12/2000	275	3/21/2001	165	4/29/2002	275	9/17/2002	165
8/15/1997	475	7/27/1998	825	6/19/2000	440	4/10/2001	220	6/11/2002	550	9/24/2002	330 Sludge
8/18/1997	330	7/28/1998	330	6/22/2000	330	4/17/2001	220	6/22/2002	330	3/25/2003	220 Sludge
8/22/1997	330	8/3/1998	495	6/30/2000	165	4/24/2001	110	**TOTAL**	**4,235**	5/27/2003	55
8/25/1997	1045	8/10/1998	1265	**TOTAL**	**2,475**	5/22/2001	110			6/3/2003	220
8/25/1997	110 Sludge	8/21/1998	330			5/22/2001	440 Sludge			6/25/2003	330
9/2/1997	220	8/24/1998	990			6/12/2001	1100			**TOTAL**	**3,300**
9/15/1997	605	8/27/1998	1155			6/13/2001	110				
9/22/1997	550	9/1/1998	330			6/13/2001	110				
10/13/1997	825	10/5/1998	385			**TOTAL**	**3,465**				
10/20/1997	220	10/26/1998	660								
11/3/1997	275	11/23/1998	110								
11/10/1997	385	2/1/1999	385								
11/17/1997	385	2/10/1999	110								
11/24/1997	330	5/4/1999	330								
12/10/1997	440	5/11/1999	110								
12/12/1997	550	5/24/1999	605								
1/2/1998	220	5/26/1999	165								
1/12/1998	605	5/28/1999	165								
2/2/1998	660	6/1/1999	165								
2/16/1998	605	6/4/1999	165								
3/16/1998	605	6/10/1999	165								
5/4/1998	660	6/10/1999	165 Sludge								
5/11/1998	550	6/16/1999	165								

Table 3-1 – Water Removed from the Exhaust Shaft Catch Basin and the Interception Well System (Continued)

July 1997 – June 1998		July 1998 – June 1999		July 1999 – June 2000		July 2000 – June 2001		July 2001 – June 2002		July 2002 – June 2003	
Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons
5/18/1998	495	6/21/1999	1,705								
5/20/1998	110	6/23/1999	275								
6/1/1998	330	6/30/1999	605								
6/10/1998	90	**TOTAL**	**14,135**								
6/15/1998	385										
6/22/1998	165										
TOTAL	**16,185**										
July 2003 - June 2004		**July 2004 - June 2005**		**July 2005 - June 2006**		**July 2006 - June 2007**		**July 2007 - June 2008**		**July 2008 - June 2009**	
Date	Gallons	Date	Gallons	Date	Date	Gallons	Gallons	Date	Gallons	Date	Gallons
7/8/2003	605	11/29/2004	660 sludge	8/1/2005	1,100	7/11/2006	250	7/11/2007	200	7/31/2008	225
7/9/2003	550	12/6/2004	275 sludge	8/15/2005	880	8/16/2006	420	7/20/2007	400	8/31/2008	50
7/17/2003	165	1/3/2005	440	10/10/2005	715	8/17/2006	400	7/29/2007	420	9/30/2008	115
8/12/2003	275	1/4/2005	220	3/16/2006	55	9/1/2006	420	7/29/2007	410	11/30/2008	65
10/14/2003	165	1/10/2005	385	5/30/2006	400	9/7/2006	420	8/4/2007	410	1/31/2009	65
10/20/2003	440	5/16/2005	660	**TOTAL**	**3,150**	9/18/2007	840	8/14/2007	1000	5/31/2009	927
10/21/2003	330	6/1/2005	660			11/10/2006	150	8/15/2007	820	6/30/2009	425
11/23/2003	220	6/6/2005	220			11/15/2006	400	9/5/2007	820		
11/23/2003	660 sludge	6/20/2005	440			1/30/2007	310	11/8/2007	150		
TOTAL	**3,410**	6/27/2005	220			5/11/2007	75	11/9/2007	110		
		TOTAL	**4,180**			6/20/2007	200	12/4/2007	150		
						TOTAL	**3,885**	6/11/2008	750		
								TOTAL	**5,640**	**TOTAL**	**1,872**

Table 3-1 - Water Removed from the Exhaust Shaft Catch Basin and the Interception Well System (Continued)

July 2009 - June 2010		July 2010- June 2011		July 2011 - June 2012		July 2012 - June 2013		July 2013- June 2014		July 2014 - June 2015	
Date	**Gallons**	Date	**Gallons**								
7/2/2009	870	7/3/2010	950								
9/19/2009	180	7/7/2010	790								
1/26/2010	50	7/8/2010	875								
5/3/2010	450	7/16/10	475								
		7/18/2010	390								
		7/23/2010	475								
		3/3/2011	80								
		6/29/11	165								
TOTAL	**1,550**		4,200								

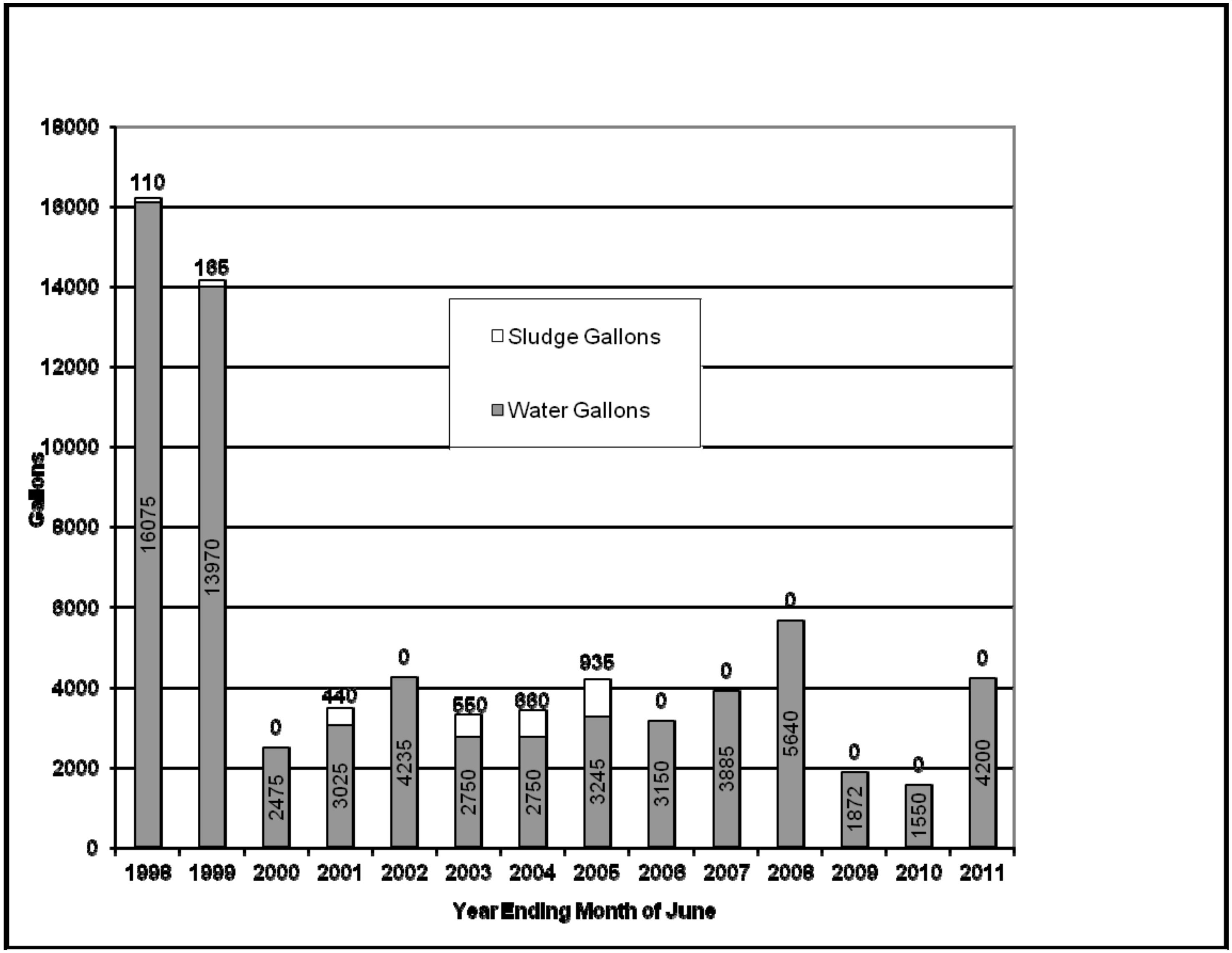

Figure 3-11 – Water Removed from the Exhaust Shaft Catch Basin and the Interception Well System

3.3.2 Instrumentation

The Exhaust Shaft was equipped with geomechanical instrumentation in two stages. Earth pressure cells were installed behind the liner key in November 1984. Piezometers and nine multi-position extensometers were installed during November and December 1985. Figure 3-12 and Figure 3-13 show the instrument locations.

Eight piezometers remain in working condition. The fluid pressure readings from the working piezometers at the end of the reporting period range from -3 psi (-21 kPa) at 544 ft (166 m) to 141 psi (972 kPa) at 721 ft (220 m). Maximum pressure readings from the working piezometers during this reporting period were consistent with maximum readings from the previous reporting period.

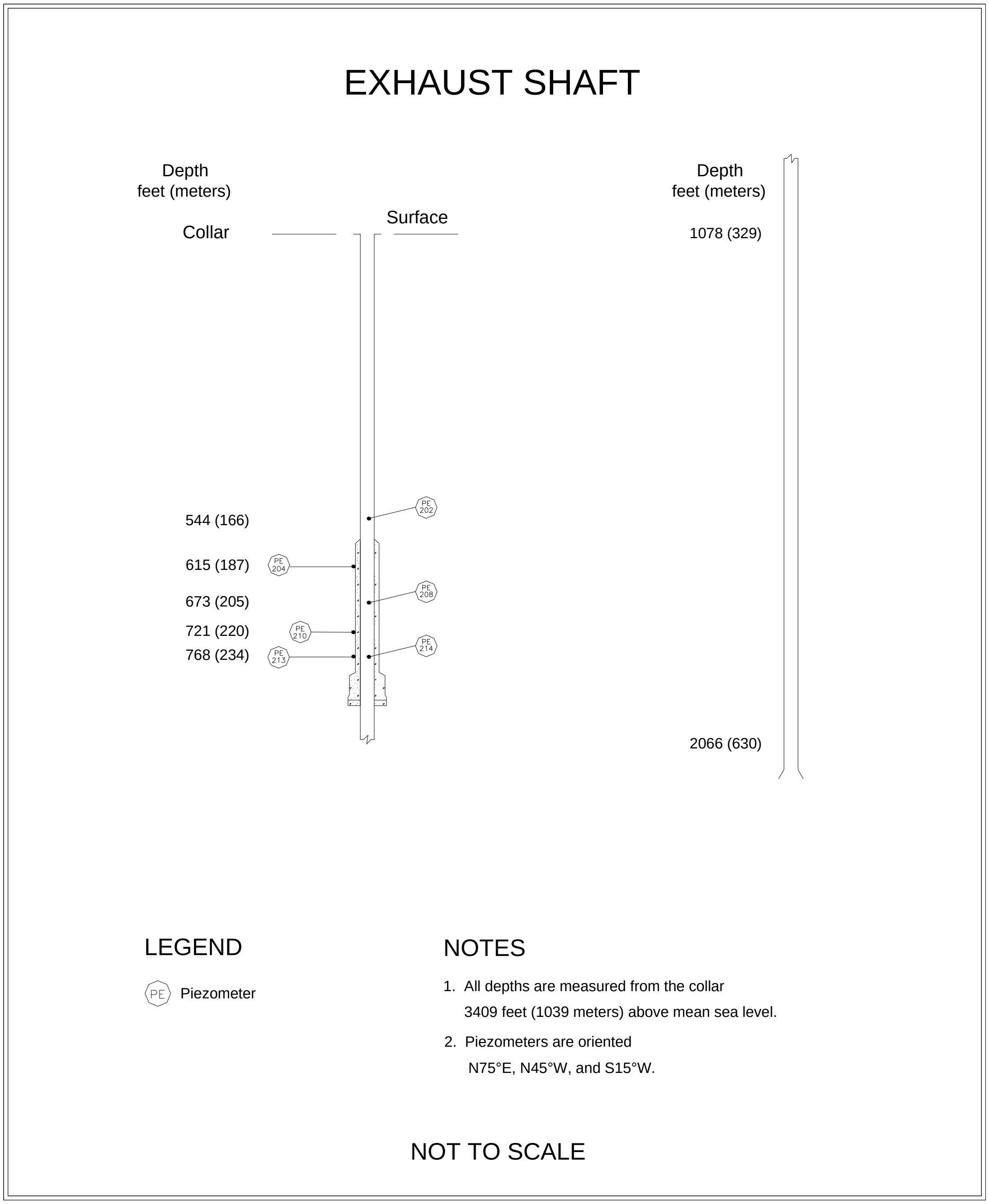

Figure 3-12 – Exhaust Shaft Instrumentation (Without Shaft Key)

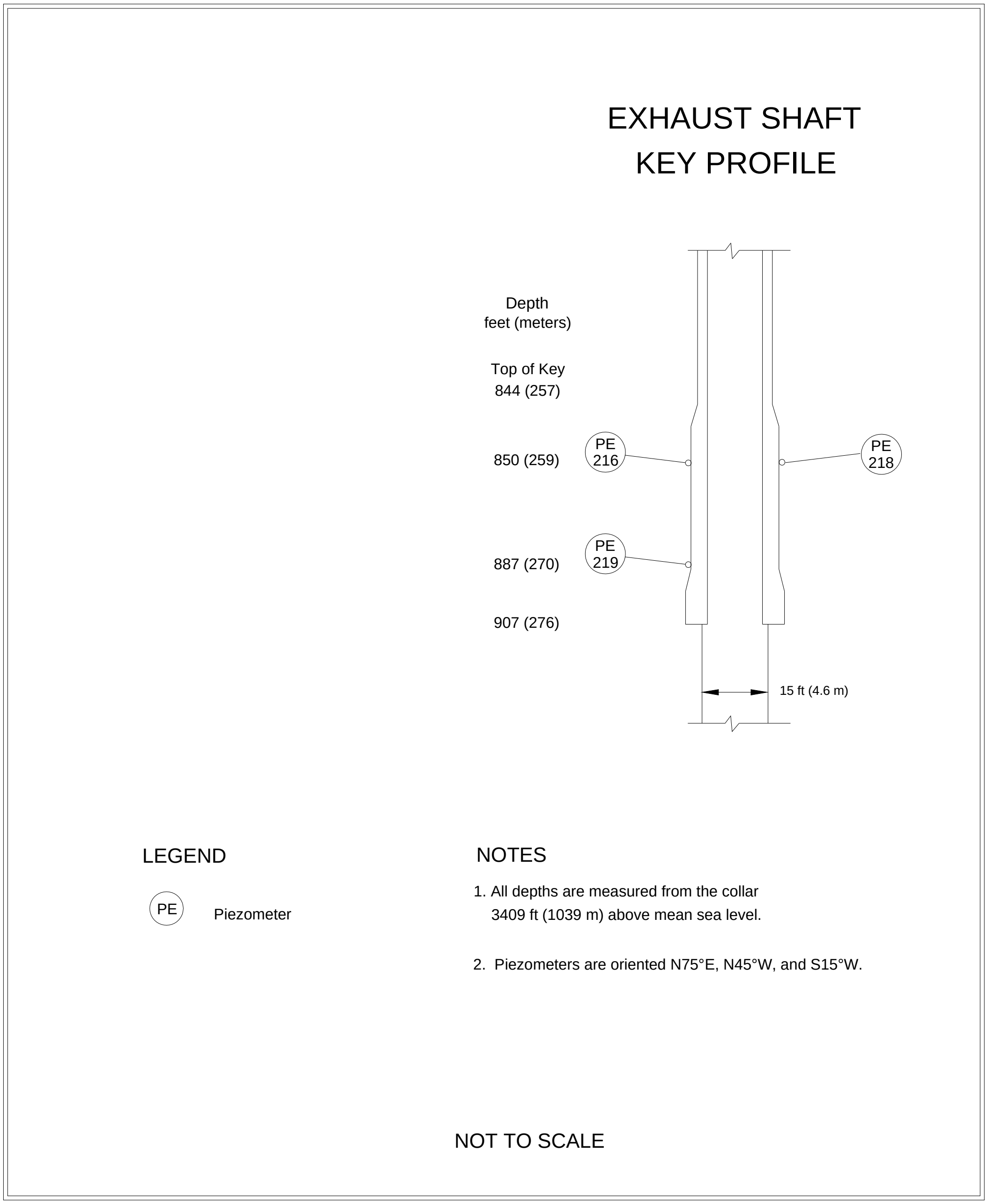

Figure 3-13 – Exhaust Shaft Key Instrumentation

3.4 Air Intake Shaft

The Air Intake Shaft was drilled from December 4, 1987, to August 31, 1988, to establish a primary route for surface air to enter the repository (see Figure 1-2). The stratigraphy was mapped from September 14, 1988, to November 14, 1989 (Holt and Powers, 1990). Figure 3-14 summarizes the shaft stratigraphy.

The Air Intake Shaft is lined with non-reinforced concrete from the surface to the bottom of the shaft key at 903 ft (275 m). The key is 81 ft (25 m) long with an inside diameter of 16 ft (5 m). The shaft diameter below the key is 20 ft (6 m), and the shaft below the key is unlined to the facility horizon at 2,150 ft (655 m). The shaft walls are bolted and meshed from just below the key all the way down to the shaft station. This shaft has no sump.

3.4.1 Shaft Performance

Weekly visual inspections were performed on the Air Intake Shaft during this reporting period, and the shaft was found to be in satisfactory condition. No ground control activities other than routine maintenance were required during this reporting period.

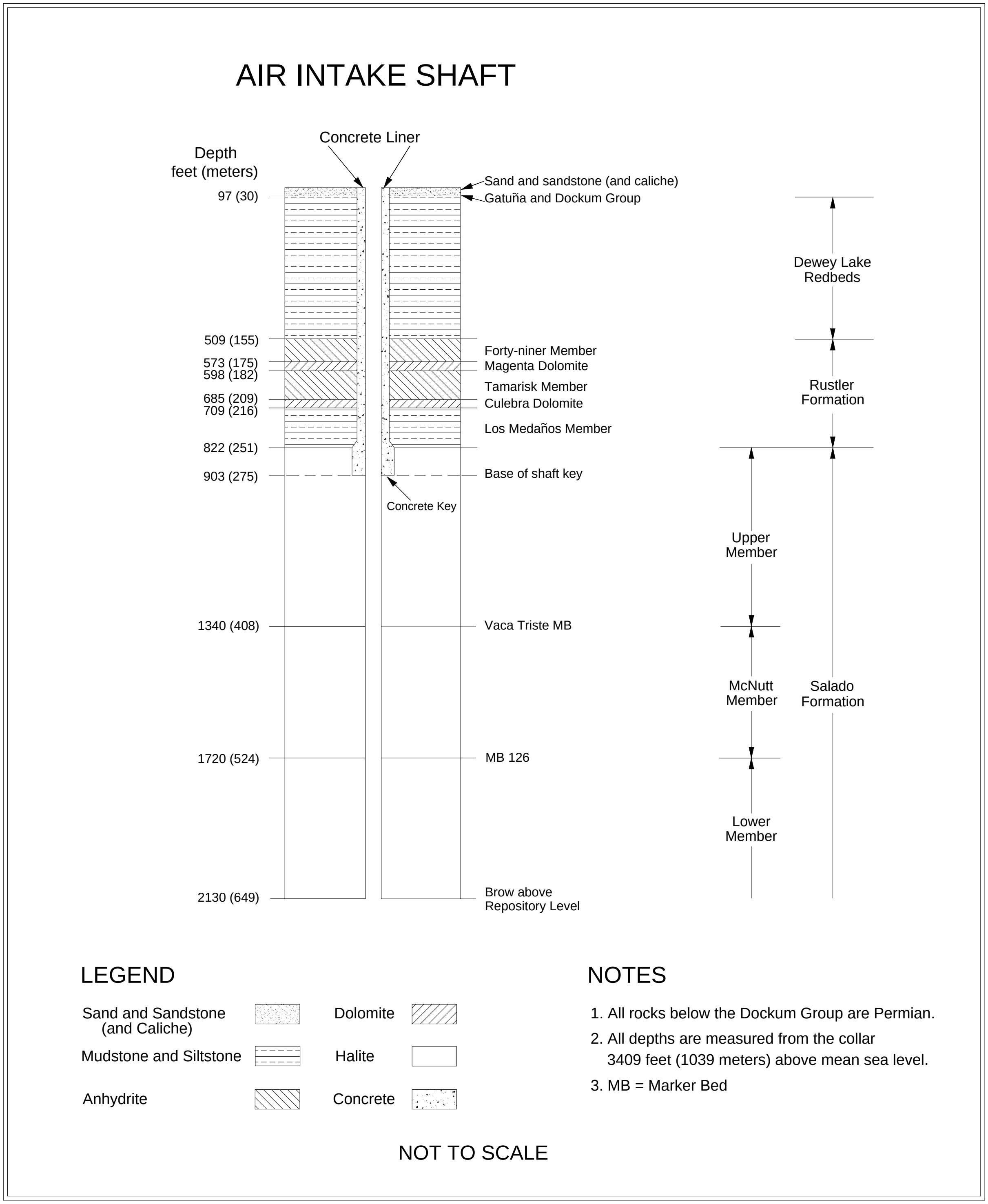

Figure 3-14 – Air Intake Shaft Stratigraphy

4.0 PERFORMANCE OF SHAFT STATIONS

This chapter describes the instrumentation and geomechanical performance of the shaft stations at the base of the Salt Shaft, the Waste Shaft, and the Air Intake Shaft. The Exhaust Shaft does not have an enlarged shaft station; therefore, it is not included in this chapter.

4.1 Salt Shaft Station

The Salt Shaft Station was excavated by drilling and blasting between May 2 and June 3, 1982. In 1987 the station was enlarged by removing the roof beam up to Anhydrite "b" between S-90 and N-20 using a mechanical scaler. In 1995, the remaining roof beam at the north end of the station was also removed up to Anhydrite "b." The station area south of the shaft is 90 ft (27.5 m) long and 32 to 38 ft (10 to 12 m) wide. The height of the station south of the shaft is 18 ft (5.5 m). The station dimensions north of the shaft are approximately 30 ft (9 m) long, 32 to 35 ft (10 to 11 m) wide, and 18 ft (5.5 m) high. The shaft extends approximately 140 ft (43 m) below the facility horizon to accommodate the skip loading equipment and a sump. Figure 4-1 shows a cross section of the station.

4.1.1 Modifications to Excavation and Ground Control Activities

No significant modifications were performed in the Salt Shaft Station during this reporting period. Ground control activities were limited to routine maintenance.

4.1.2 Instrumentation

Geomechanical instrumentation was installed in the Salt Shaft Station between June 1982 and February 1983, with subsequent re-installation of extensometers and convergence points as necessary. Figure 4-2 shows the instrument locations after the roof beam was taken down.

Five vertical convergence point arrays are currently monitored. Table 4-1 summarizes the vertical closure rates in the Salt Shaft Station from July 2010 through June 2011. Salt Shaft Station vertical closure rates indicate that the rates are slightly higher than during the previous reporting period.

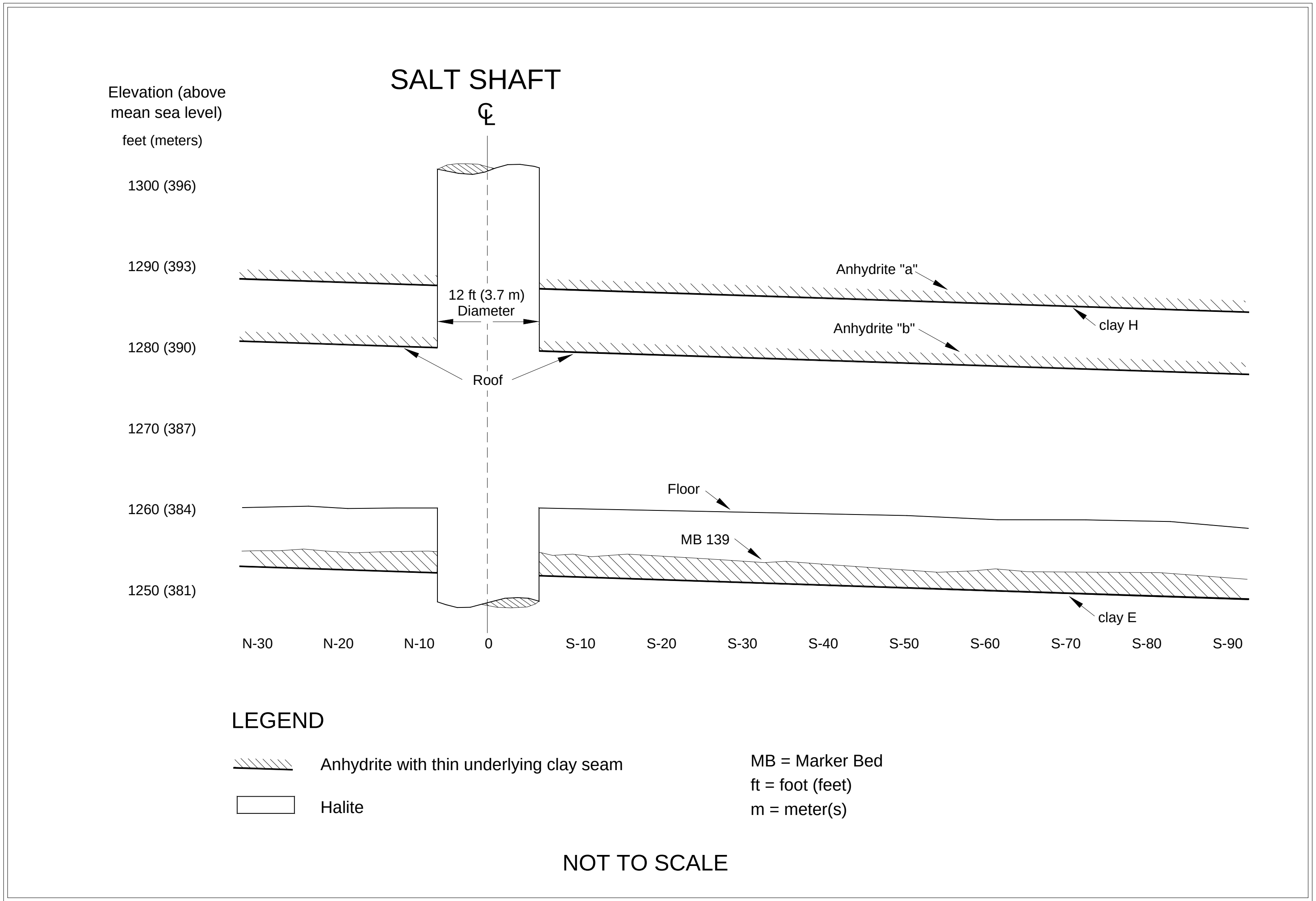

Figure 4-1 – Salt Shaft Station Stratigraphy

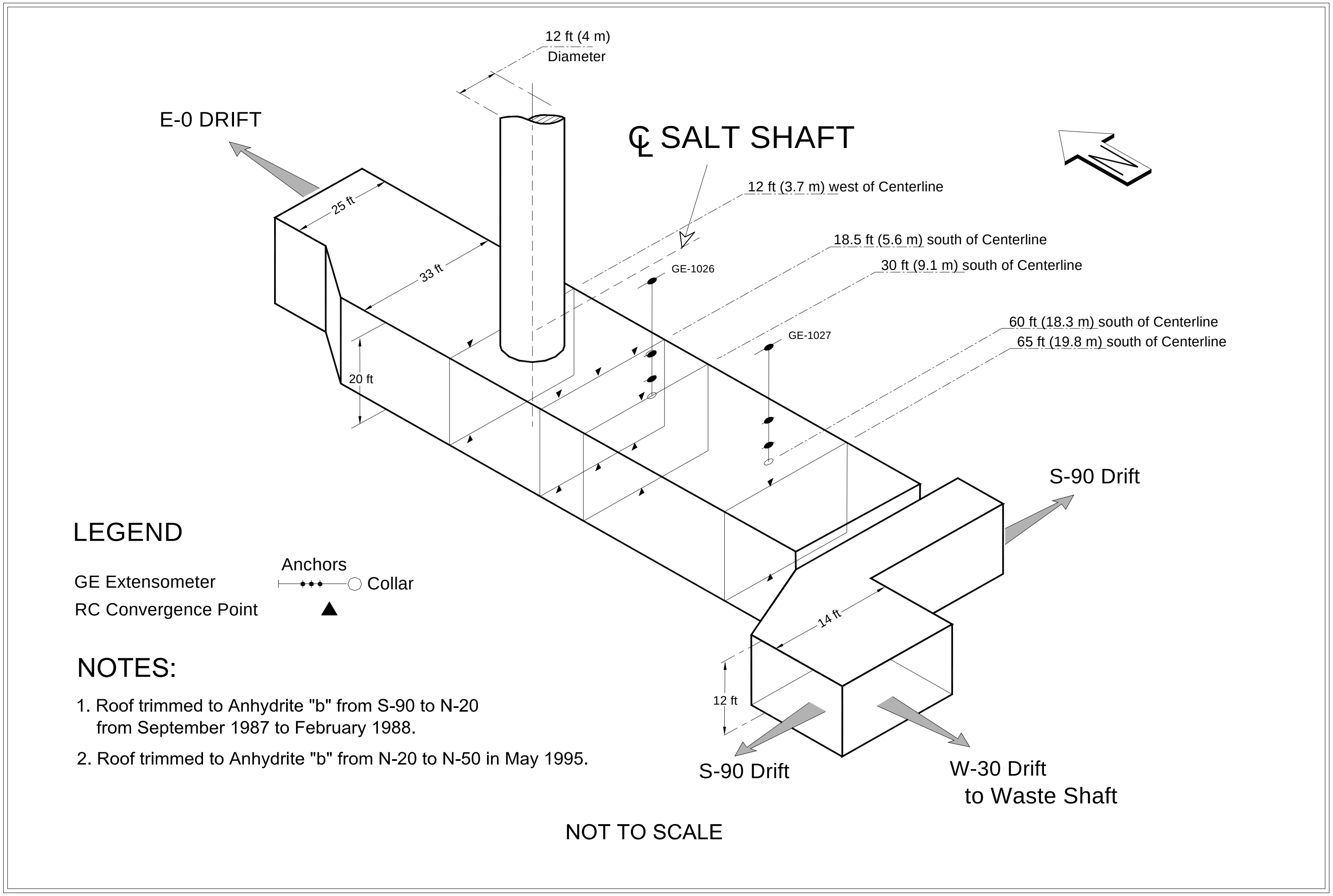

Figure 4-2 – Salt Shaft Station Instrumentation after Roof Beam Excavation

Table 4-1 – Vertical Closure Rates in the Salt Shaft Station

Location	Chord[1]	Last Reading	Total Cumulative Displacement in (cm.)	Closure Rate 2010 to 2011 in/yr (cm/yr)	Closure Rate 2009 to 2010 in/yr (cm/yr)	Rate Change Percent
E-0, S-18	A-E	06/29/11	38.033 (96.60)	1.85 (4.70)	1.37 (3.48)	35%
E-0, S-18	B-D	06/29/11	39.407 (100.09)	2.01 (5.11)	1.52 (3.86)	32%
E-0, S-18	F-H	06/29/11	24.741 (62.84)	1.26 (3.20)	0.92 (2.34)	37%
E-0, S-30	A-C	06/29/11	52.805 (134.12)	1.88 (4.78)	1.40 (3.56)	34%
E-0, S-65	A-C	05/04/11	45.416 (115.36)	1.17 (2.97)	1.11 (2.82)	5%

[1] Chord is defined in Section 5.3

4.2 Waste Shaft Station

The Waste Shaft Station was initially excavated with a continuous miner as a ventilation connection to a 6-ft (2-m) diameter exhaust shaft in November 1982. In 1984, the station was enlarged to a height of 15 to 20 ft (4.5 to 6 m) and a width of 20 to 30 ft (6 to 9 m). The station is approximately 150 ft (46 m) long. In 1988, the station walls were trimmed, and concrete was placed on the floor. Since 1988, the Waste Shaft Station has undergone five major floor renovations. A 53-ft (16-m)-long section of the reinforced concrete was removed in February 1991, in 1995 an additional 30-ft (9-m) section was removed, and in 2000 floor maintenance included trimming of the floor and reinstallation of the rails supported by segmented concrete panels on a crushed rock backfill. The roof of the Waste Shaft station was mined up to Clay G in December 2008 to assure adequate operational clearance. 12-ft resin-anchored roof bolts and chain link were installed for ground support. Figure 4-3 shows a cross-section of the Waste Shaft Station.

4.2.1 Modifications to Excavation and Ground Control Activities

No modifications were made during this reporting period.

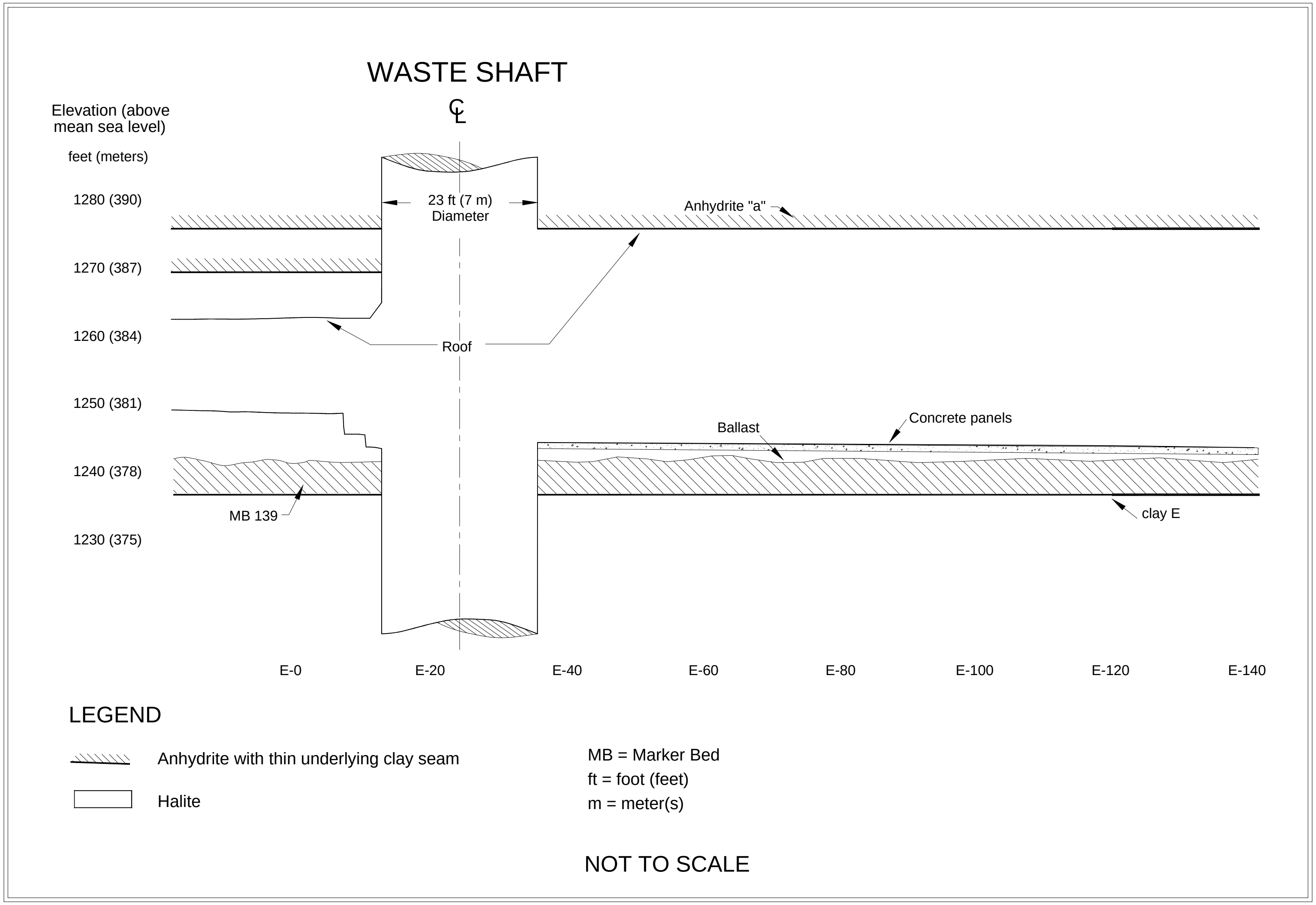

Figure 4-3 – Waste Shaft Station Stratigraphy

4.2.2 Instrumentation

Instruments were initially installed in the Waste Shaft Station between November 12 and December 2, 1982. Figure 4-4 illustrates the locations after enlargement. Two extensometers in the Waste Shaft Station are currently being monitored. In addition, horizontal convergence is being monitored at E-32 and E-85.

Table 4-2 summarizes the recent history of the roof extensometers in the Waste Shaft Station. Extensometer 51X-GE-00268 (W-30) is installed in a hole drilled into the roof of the station. Extensometer 51X-GE-00404-2 is located at approximately S400-E32.

Table 4-3 summarizes the annual closure rates calculated from convergence point data for this reporting period. The data indicate that the horizontal closure rates at both E-32 and E-85 have not changed significantly from the previous reporting period.

Table 4-2 – Summary of Roof Extensometers in Waste Shaft Station

Instrument	Location	Last Reading	Collar Displacement Relative to Deepest Anchor in (cm)	Displacement Rate 2010 to 2011 in/yr (cm/yr)	Displacement Rate 2009 to 2010 in/yr (cm/yr)	Rate Change Percent
51X-GE-00268	S-400, W-30	05/04/11	10.805 (27.44)	0.11 (0.28)	0.27 (0.69)	-59%
51X-GE-00404-2[1]	WASTE STATION	06/27/11	0.283 (0.72)	0.27 (0.69)	0.29 (0.74)	-7%

[1] 2009-2010 rate from the previous installation (51X-GE-00404)

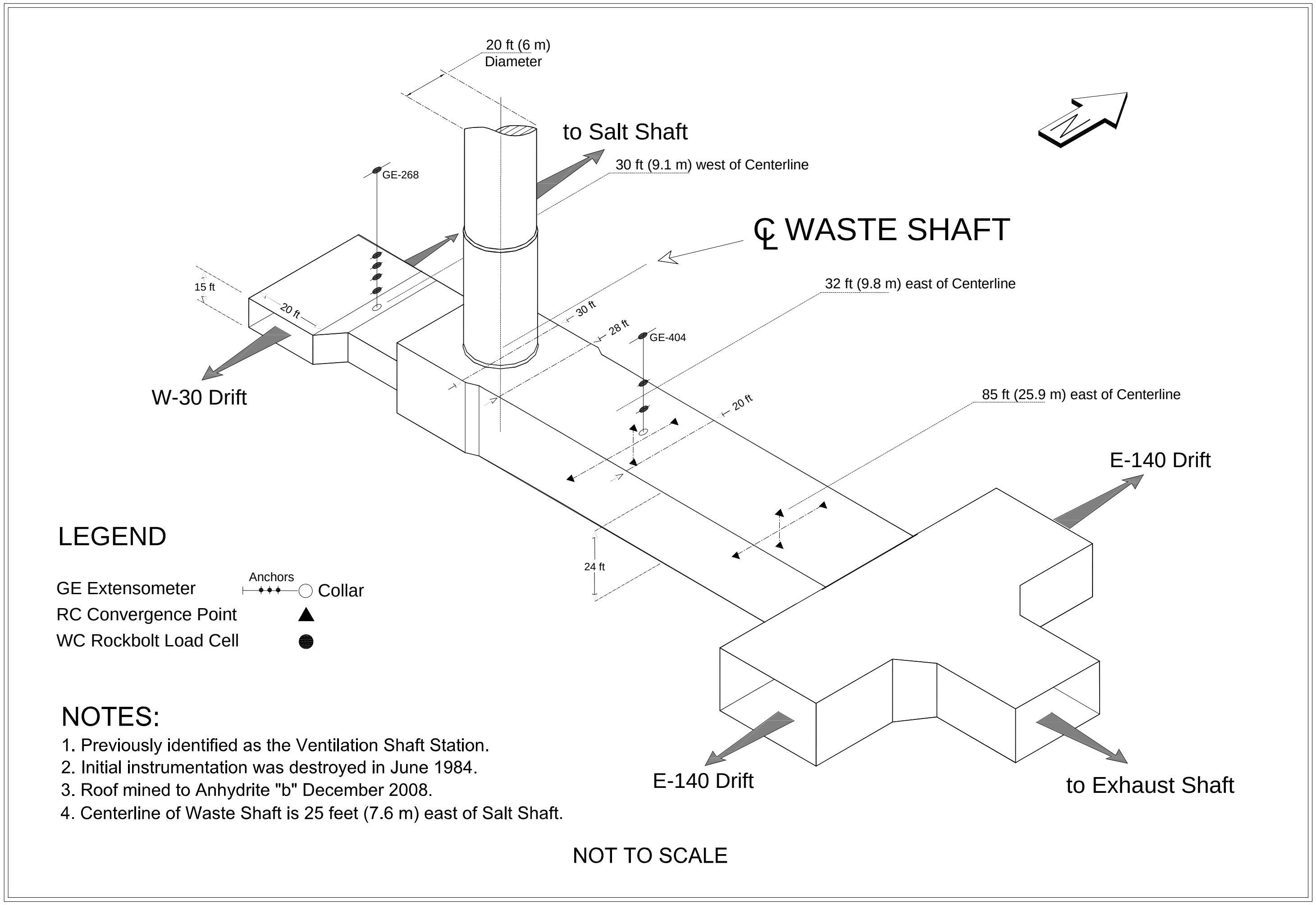

Figure 4-4 – Waste Shaft Station Instrumentation after Raising the Roof

Table 4-3 – Closure Rates in the Waste Shaft Station

Location	Chord[1]	Last Reading	Cumulative Displacement in (cm)	Closure Rate 2010 to 2011 in/yr (cm/yr)	Closure Rate 2009 to 2010 in/yr (cm/yr)	Rate change Percent
S-400, E-32	B-D	6/16/2011	2.918 (7.41)	1.26 (3.20)	1.17 (2.97)	8%
S-400, E-85	B-D	6/16/2011	2.963 (7.53)	1.32 (3.35)	1.16 (2.95)	14%

[1] Chord is defined in Section 5.3

4.3 Air Intake Shaft Station

The Air Intake Shaft Station was excavated in late 1987 and early 1988, using a continuous miner. The Air Intake Shaft is furnished with a work platform and a small cage that can be raised and lowered to perform routine ground maintenance. The principal purpose of that equipment is to provide emergency access.

4.3.1 Modifications to Excavation and Ground Control Activities

The AIS station was not significantly modified during this reporting period. Ground control activities were limited to routine maintenance.

4.3.2 Instrumentation

Radial convergence point and extensometer instrumentation data near the Air Intake Shaft Station are presented in Chapter 5.0 as part of the discussion on the performance of the access drifts. Twenty rock bolt load cells installed in the Air Intake Shaft Station area are monitored regularly.

5.0 PERFORMANCE OF ACCESS DRIFTS

This chapter describes the geomechanical performance of the underground access drifts. The Waste Disposal Area is discussed in Chapter 6.0. Four major north-south drifts in the WIPP underground are intersected by shorter east-west cross-drifts. Drift dimensions range from 13 ft (4 m) to 21 ft (6.4 m) high and from 14 ft (4.3 m) to 33 ft (9.2 m) wide.

5.1 Modifications to Excavation and Ground Control Activities

Trimming, scaling, and floor milling activities were performed as necessary in many areas. Table 5-1 summarizes these activities. It also summarizes ground control activities (e.g., rock bolting and installing wire mesh) in various locations in the access drifts.

5.2 Instrumentation

This section discusses instrumentation details and locations for each instrumentation type.

5.2.1 Extensometers

Twenty-eight extensometers are currently being monitored in the access drifts.

5.2.2 Convergence Points

Convergence points installed during this reporting period were limited to the replacement of arrays in previously mined areas and the installation of new monitoring arrays in newly mined areas. Replacement convergence points were installed in 84 locations throughout the WIPP underground access drifts. Horizontal and vertical convergence point arrays were installed at various locations. Most of these installations were located in E-140 and W-30, where floor trimming activities removed the existing points. Convergence points within the access drifts are read manually at least every two months, with more frequent monitoring in some areas. Table 5-2 lists the replacement convergence points that were installed during this reporting period.

Table 5-1 – Summary of Modifications and Ground Control Activities in the Access Drifts July 1, 2010 through June 30, 2011

Location	Work Activity
E300 N250 to S90 (Maintenance Shop)	Installed bolts and mesh
E300 overcasts at S2520 and S2750	Replaced broken 12 ft resin anchored bolts and installed bolts and mesh on exposed salt
E140, S400 to S3650 (Waste Transport Route)	Replaced broken 12 ft resin anchored bolts
E140, S380, S400, S700	Installed 12 ft resin anchored bolts and mesh on brows
E140, S400 to S700	Installed 12 ft resin anchored bolt pattern
E140, S400 to S700	Installed bolts and mesh on ribs
E140, S875 to S920	Spot bolted on ribline
E140, N460 to N780	Installed 12 ft resin anchored bolts
E140, N780 and N1100	Installed 12 ft resin anchored bolts
E140, N1120	Installed 12 ft and 18 ft pull test bolts
E0, N780 to N1100	Installed 12 ft resin anchored bolts
E0, N1120	Installed 12 ft and 18 ft pull test bolts
W30, S700 to S3080	Installed bolts and mesh on ribs
W30, S3080 to S3650	Installed 12 ft resin anchored bolts
W170, N100	Spot bolted the Fuel Bay
W170, S2750 to S3080	Replaced broken 12 ft resin anchored bolts
W170, S1600 to S3650	Installed bolts and mesh on ribs
W170, S1950 to S3650	Installed 12 ft resin anchored bolts
N300, E0 to AIS	Replaced broken 12 ft resin anchored bolts
S700, E140 to E300	Spot bolted
S1950, W30 to E140	Installed 12 ft resin anchored bolt pattern and installed bolts and mesh on ribs
S2750, E140 to W170	Installed 12 ft resin anchored bolts
S2750, E140 to W170	Replaced broken 12 ft resin anchored bolts
S3080, W30 to W170	Replaced broken bolts and plates
S3080, W30 to E140	Installed 12 ft resin anchored bolt pattern
S3080, E300 to Panel 3 Closure	Installed 12 ft resin anchored bolts and installed bolts and mesh
S3310, W30 to W170	Installed 12 ft resin anchored bolts

Table 5-2 – New and Replace Convergence Points Installed in the Access Drifts July 1, 2010 through June 30, 2011

Location	New/Replaced	Field Tag[1]	Chord[2]	Date Installed
E0-N225	R	E0-N0225-2	B-D	07/27/10
E0-N300	R	E0-N300-6	A-C	01/11/11
E140-S460	R	E140-S460-6	A-C	02/24/11
E140-S550	R	E140-S550-6	A-C	02/24/11
E140-S700	R	E140-S700-8	A-D	02/24/11
E140-S1225	R	E140-S1225-3	H-F	08/10/10
E140-S1378	R	E140-S1378-3	A-E	07/28/10
E140-S1378	R	E140-S1378-3	B-D	07/28/10
E140-S1378	R	E140-S1378-3	H-F	08/03/10
E140-S1450/1456	R	E140-S1450-5	A-G	07/28/10
E140-S1450/1456	R	E140-S1450-3	L-H	07/28/10
E140-S1450/1456	R	E140-S1450-3	B-F	07/28/10
E140-S1450/1456	R	E140-S1450-3	I-E	10/07/10
E140-S1534	R	E140-S1534-4	B-D	08/03/10
E140-S1534	R	E140-S1534-3	A-E	08/03/10
E140-S1534	R	E140-S1534-3	H-F	08/03/10
E140-S1600	R	E140-S1600-6	A-C	08/03/10
E140-S1687	R	E140-S1687-3	B-D	08/03/10
E140-S1687	R	E140-S1687-3	A-E	08/03/10
E140-S1687	R	E140-S1687-3	H-F	08/03/10
E140-S1775	R	E140-S1775-3	A-G	08/16/10
E140-S1775	R	E140-S1775-4	B-F	08/16/10
E140-S1775	R	E140-S1775-3	L-H	08/16/10
E140-S1862	R	E140-S1862-3	A-E	08/16/10
E140-S1862	R	E140-S1862-3	B-D	08/16/10
E140-S1862	R	E140-S1862-3	H-F	08/16/10
E140-S1950	R	E140-S1950-6	A-C	08/17/10
E140-S2007	R	E140-S2007-6	A-C	08/17/10
E140-S2065	R	E140-S2065-5	A-C	08/17/10
E140-S2122	R	E140-S2122-4	A-C	08/17/10
E140-S2275	R	E140-S2275-4	A-C	08/17/10
E140-S2350	R	E140-S2350-5	A-C	08/17/10
E140-S2425	R	E140-S2425-4	A-C	08/17/10
E140-S2520	R	E140-S2520-3	A-C	08/17/10
E140-S2750	R	E140-S2750-3	A-C	09/28/10
E300-S700	R	E300-S700-2	A-C	03/02/11
E300-S850	R	E300-S850-2	B-D	03/01/11
E300-S850	R	E300-S850-2	A-E	03/01/11
E300-S850	R	E300-S850-2	H-F	03/01/11
E300-S1000	R	E300-S1000-2	A-C	03/02/11
E300-S1150	R	E300-S1150-4	A-E	03/02/11
E300-S1150	R	E300-S1150-4	H-F	03/02/11
E300-S1150	R	E300-S1150-4	B-D	03/02/11
E300-S1300	R	E300-S1300-2	A-C	03/02/11
E300-S1450	R	E300-S1450-2	A-C	03/02/11
E300-S1687	R	E300-S1687-2	A-C	03/07/11
E300-S1775	R	E300-S1775-2	A-C	03/07/11
E300-S1862	R	E300-S1862-2	A-C	03/07/11
E300-S2065	R	E300-S2065-2	A-C	03/07/11

Table 5-2 – New and Replace Convergence Points Installed in the Access Drifts July 1, 2010 through June 30, 2011

Location	New/Replaced	Field Tag[1]	Chord[2]	Date Installed
E300-S2275	R	E300-S2275-2	A-C	03/07/11
E300-S2350	R	E300-S2350-2	A-C	03/07/11
E300-S2425	R	E300-S2425-2	A-C	03/07/11
E300-S2634	R	E300-S2634-2	A-C	03/07/11
E300-S2833	R	E300-S2833-2	A-C	03/07/11
E300-S2916	R	E300-S2916-4	A-C	03/07/11
E300-S2998	R	E300-S2998-4	A-C	03/07/11
N780-E220	R	N780-E220-2	A-C	02/24/11
S1950-E311	R	S1950-E311-7	A-C	08/26/10
S2180-W100	R	S2180-W100-3	A-C	10/26/10
S2520-W100	R	S2520-W100-2	B-D	10/26/10
S2750-E55	R	S2750-E55-2	A-C	07/27/10
S2750-W93	R	S2750-W93-2	A-C	07/27/10
S3080-E55	R	S3080-E0055-2	A-C	03/07/11
W170-S2998	R	W170-S2998-2	B-D	08/26/10
W30-S1000	R	W30-S1000-5	A-C	10/20/10
W30-S2067	R	W30-S2067-2	A-C	07/12/10
W30-S2067	R	W30-S2067-3	B-D	07/12/10
W30-S2180	R	W30-S2180-3	A-C	07/12/10
W30-S2275	R	W30-S2275-3	A-C	07/15/10
W30-S2275	R	W30-S2275-2	B-D	07/15/10
W30-S2350	R	W30-S2350-2	B-D	07/12/10
W30-S2350	R	W30-S2350-3	A-C	07/12/10
W30-S2425	R	W30-S2425-3	A-C	07/19/10
W30-S2425	R	W30-S2425-2	B-D	07/19/10
W30-S2520	R	W30-S2520-3	A-C	07/21/10
W30-S2685	R	W30-S2685-3	A-C	07/21/10
W30-S2685	R	W30-S2685-3	B-D	07/21/10
W30-S2750	R	W30-S2750-2	A-C	07/21/10
W30-S2833	R	W30-S2833-2	A-C	07/21/10
W30-S2833	R	W30-S2833-2	B-D	07/21/10
W30-S2833	R	W30-S2833-3	A-C	12/03/10
W30-S2916	R	W30-S2916-2	B-D	07/21/10
W30-S2998	R	W30-S2998-2	B-D	07/27/10
W30-S700	R	W30-S700-5	A-C	07/27/10

N = New installation.
R = Replacement installation (i.e., instrument replaces older instrument that has failed or has been mined out).
[1] This column is a combination of the convergence point location followed by a "-X," where X represents the reinstallation number, when applicable.
[2] A unique letter is assigned to each convergence array element around a particular opening. Chord refers to a particular array pair. The various array lettering schemes are shown in Figure 5-1.

5.3 Analysis of Convergence Point and Extensometer Data

Convergence point data are obtained by measuring the change in distance between fixed points anchored into the rock across an opening, either from rib to rib or from roof to floor. The measurement end-points constitute a "chord." Figure 5-1 shows typical convergence point array configurations along with typical chord designations. Extensometer data are obtained by measuring the displacement from the reference head anchor (collar) to each fixed anchor of the extensometer. These measurements are made, at a minimum, every two months throughout the WIPP underground, except when convergence points are not accessible. Convergence rates and extensometer displacement rates indicate how an excavation is performing; rates that decrease or are relatively constant typify stable excavations, whereas increasing rates may indicate some type of developing instability or may be the response to nearby mining.

Where possible, annual closure rates were calculated from convergence point array data gathered in the access drifts. A complete tabulation of these convergence point data and calculated closure rates is presented in the supporting data document for this report. Locations with increases in annual vertical closure rates of greater than 10 percent are shown in Table 5-3.

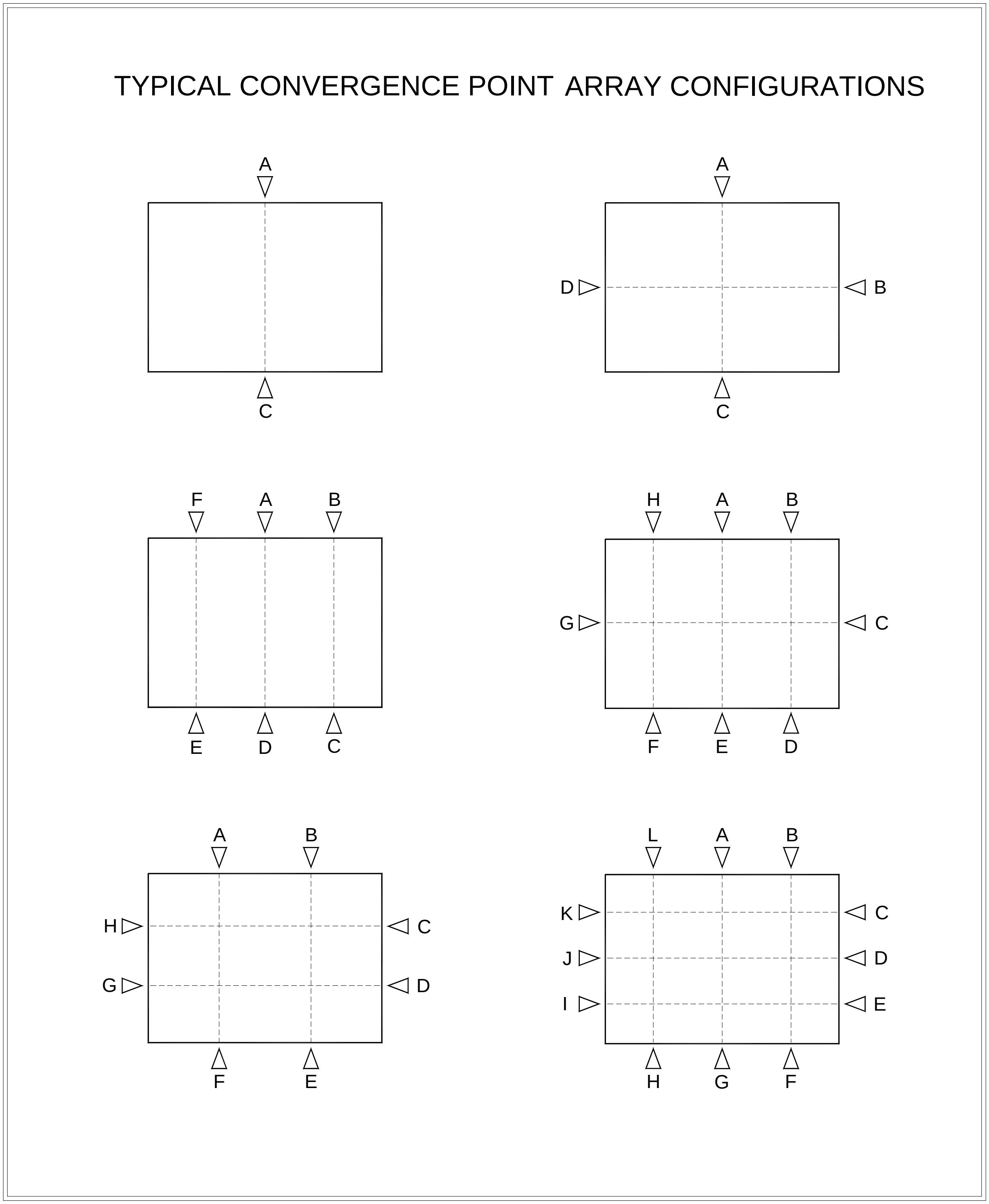

Figure 5-1 – Typical Convergence Point Array Configurations Showing Anchor Designations

Extensometer displacement rates and convergence rates are routinely plotted against time, and comparisons are made through time to identify any acceleration. Annual convergence rates are calculated by determining the difference between the first and last readings of the reporting period and dividing the difference by the time between the two readings (in years) (see Section 1.4.3). Instruments that indicate acceleration are analyzed to determine the significance of the acceleration. Factors considered during the analysis include magnitude of the respective rates, percentage increase, convergence history, and any recent excavation in the vicinity.

Twenty-eight extensometers continue to be monitored at various locations in the access drifts. Where displacement data were available, annual displacement rates were calculated for each active installation and compared to the annual displacement rates from the previous reporting period. Approximately 50 percent of the instruments are installed in the E 140 drift to monitor the waste transport route. Many of the E-140 extensometers indicate movement in the roof beam that may be attributed to shallow fracturing and the effects of anhydrite stringer separations in the roof. Lateral deformation in the roof beam may influence the extensometer readings, causing an increase in the measured displacement. Although the extensometer data indicate continued deformation and breakup of the lower beam, the roof bolt anchorage zone remains competent.

Closure rates are variable from year to year; however, locations that exhibit rate increases by more than ten percent are assessed in detail. Further analysis of the convergence rate accelerations has shown many of them to be minor and generally related to roof beam fracturing. Other areas had closure rate increases that can be directly attributed to drift widening and floor trims.

The closure rates observed in E-140 from S-1025 to S-2833 are in an area where the roof beam has been mined to Clay G. The rate of increase in this area may be attributed to roof beam separations formed along shallow anhydrite stringers in the roof. These separations result in the formation of thin roof beams that can easily be deformed toward the opening. Tensile fractures generally develop on the roof surface in areas of maximum deformation.

The rate increases observed in other areas may be attributable to various causes. Rate increases in W-30 and W-170 between S-2750 and S-3080 may be attributed to gradual deterioration of the roof beam along anhydrite stringers. Increases in E300 from S700 to S3080 are the result of floor mining completed during the holiday maintenance outage from December 2010 to January 2011.

Table 5-3 – Greater than 10 Percent Increases in Annual Vertical Convergence From July 1, 2010 to June 30, 2011

Location	Chord	Last Reading Date	Cumulative Displacement Inches (cm)	Closure Rate 2010 to 2011 in/yr (cm/yr)	Closure Rate 2009 to 2010 in/yr (cm/yr)	Rate Change Percent
E0-N1110	A-C	06/29/11	45.9 (116.7)	1.8 (4.6)	1.3 (3.3)	38%
E0-N1266	A-C	06/29/11	56.1 (142.4)	2.2 (5.6)	1.9 (4.8)	16%
E0-N225	A-C	06/29/11	17.7 (44.9)	2.0 (5.1)	1.6 (4.1)	25%
E0-N460	A-C	06/29/11	40.7 (103.4)	2.4 (6.1)	1.5 (3.8)	60%
E0-N562	A-C	05/04/11	14.8 (37.6)	2.0 (5.1)	1.8 (4.6)	11%
E0-N80	A-C	06/29/11	17.8 (45.2)	2.0 (5.1)	1.7 (4.3)	18%
E0-N80	A-C	06/29/11	34.8 (88.3)	2.0 (5.1)	1.7 (4.3)	18%
E0-N780	A-C	06/29/11	37.2 (94.4)	2.3 (5.8)	1.7 (4.3)	35%
E0-N940	A-C	06/29/11	64.8 (164.7)	3.2 (8.1)	2.3 (5.8)	39%
SH SHAFT-S18	A-E	06/29/11	38.0 (96.6)	1.9 (4.8)	1.4 (3.6)	36%
SH SHAFT-S30	A-C	06/29/11	52.8 (134.1)	1.9 (4.8)	1.4 (3.6)	36%
E140 -N1100	A-C	05/11/11	10.3 (26.2)	1.7 (4.3)	1.3 (3.3)	31%
E140-N1420	A-C	05/12/11	27.8 (70.7)	1.7 (4.3)	1.4 (3.6)	21%
E140-N220	A-C	05/11/11	37.5 (95.3)	2.5 (6.4)	2.1 (5.3)	19%
E140-N355	A-C	05/11/11	17.9 (45.4)	2.2 (5.6)	1.9 (4.8)	16%
E140-N460	A-C	05/11/11	39.8 (101.2)	2.3 (5.8)	1.9 (4.8)	21%
E140-N5	A-C	05/12/11	42.5 (107.9)	2.3 (5.8)	2.1 (5.3)	10%
E140-N626	A-C	05/11/11	57.0 (144.7)	3.4 (8.6)	3.1 (7.9)	10%
E140-N780	A-C	05/11/11	55.3 (140.5)	2.9 (7.4)	2.2 (5.6)	32%
E140-S1300	A-C	06/15/11	35.2 (89.5)	1.7 (4.3)	1.4 (3.6)	21%
E140-S2634	A-C	06/15/11	47.8 (121.4)	6.5 (16.5)	5.4 (13.7)	20%
E140-S2833	A-C	06/15/11	31.5 (80.1)	5.0 (12.7)	4.0 (10.2)	25%
E140-S2998	A-C	06/15/11	35.9 (91.3)	3.9 (9.9)	3.4 (8.6)	15%
E140-S3080	A-C	06/15/11	23.4 (59.3)	3.3 (8.4)	2.6 (6.6)	27%
E140-S3295	A-C	06/14/11	13.4 (34.0)	2.5 (6.4)	2.1 (5.3)	19%
E140-S3325	A-C	06/14/11	13.1 (33.2)	2.4 (6.1)	2.0 (5.1)	20%
E140-S3480	A-C	06/14/11	23.4 (59.4)	4.0 (10.2)	3.6 (9.1)	11%
E140-S3565	A-C	06/14/11	18.0 (45.7)	2.9 (7.4)	2.6 (6.6)	12%
E140-S3650	A-C	06/08/11	11.4 (28.9)	2.1 (5.3)	1.7 (4.3)	24%
E140-S90	A-C	06/16/11	25.4 (64.5)	1.6 (4.1)	1.4 (3.6)	14%
E300-N170	A-E	06/22/11	30.3 (77.1)	1.8 (4.6)	1.5 (3.8)	20%
E300-N250	A-C	06/22/11	36.6 (93.0)	1.7 (4.3)	1.5 (3.8)	13%
E300-N45	A-E	06/22/11	30.4 (77.1)	1.5 (3.8)	1.3 (3.3)	15%
E300-S250	A-C	06/23/11	12.9 (32.9)	0.7 (1.8)	0.5 (1.3)	40%
E300-S3480	A-C	11/19/10	8.7 (22.0)	2.4 (6.1)	2.0 (5.1)	20%
E300-S45	A-E	06/22/11	24.6 (62.6)	1.4 (3.6)	1.1 (2.8)	27%
E300-S90	A-C	06/23/11	18.1 (46.0)	0.9 (2.3)	0.6 (1.5)	50%
N1420-E300	A-C	05/12/11	10.0 (25.3)	1.9 (4.8)	1.5 (3.8)	27%
N215-W500	A-C	05/10/11	28.8 (73.2)	1.3 (3.3)	1.2 (3.0)	8%
N215-W620	A-C	05/10/11	24.0 (60.9)	1.0 (2.5)	0.8 (2.0)	25%
N250-E220	A-E	06/22/11	35.8 (90.9)	2.6 (6.6)	2.3 (5.8)	13%
N780-E70	A-C	06/29/11	11.5 (29.3)	1.4 (3.6)	1.2 (3.0)	17%

Table 5-3 – Greater than 10 Percent Increases in Annual Vertical Convergence From July 1, 2010 to June 30, 2011

Location	Chord	Last Reading Date	Cumulative Displacement Inches (cm)	Closure Rate 2010 to 2011 in/yr (cm/yr)	Closure Rate 2009 to 2010 in/yr (cm/yr)	Rate Change Percent
S1000-E120	A-C	05/26/11	15.4 (39.2)	1.2 (3.0)	0.9 (2.3)	33%
S1000-E0160	A-C	05/26/11	3.0 (7.6)	1.0 (2.5)	0.7 (1.8)	43%
S1000-E58	A-C	05/26/11	23.3 (59.2)	1.4 (3.6)	1.1 (2.8)	27%
S1000-W98	A-C	05/26/11	32.2 (81.7)	2.0 (5.1)	1.8 (4.6)	11%
S1300-E120	A-C	05/26/11	13.9 (35.4)	1.1 (2.8)	0.8 (2.0)	38%
S1300-E160	A-C	05/26/11	21.4 (54.4)	2.0 (5.1)	1.5 (3.8)	33%
S1300-E24	A-C	05/26/11	21.4 (54.3)	1.4 (3.6)	1.2 (3.0)	17%
S1300-W100	A-C	05/26/11	34.7 (88.1)	2.3 (5.8)	1.9 (4.8)	21%
S1600-E110	A-C	05/26/11	14.8 (37.7)	1.1 (2.8)	0.9 (2.3)	22%
S1600-E170	A-C	05/26/11	16.2 (41.2)	1.2 (3.0)	0.9 (2.3)	33%
S1600-E170	A-C	05/26/11	16.2 (41.2)	1.2 (3.0)	0.9 (2.3)	33%
S1600-E357	A-C	05/25/11	23.0 (58.5)	1.1 (2.8)	0.8 (2.0)	38%
S1600-E382	A-C	05/25/11	22.8 (58.0)	1.0 (2.5)	0.7 (1.8)	43%
S1600-E453	A-C	05/25/11	4.4 (11.1)	0.7 (1.8)	0.6 (1.5)	17%
S1950-E113	A-C	05/26/11	12.0 (30.4)	1.3 (3.3)	0.7 (1.8)	86%
S1950-E281	A-C	05/25/11	20.6 (52.3)	1.3 (3.3)	1.0 (2.5)	30%
S1950-E284	A-C	05/25/11	20.9 (53.1)	1.4 (3.6)	1.0 (2.5)	40%
S1950-E332	A-C	05/25/11	37.2 (94.5)	1.7 (4.3)	1.5 (3.8)	13%
S1950-E357	A-C	05/25/11	43.4 (110.2)	2.3 (5.8)	2.0 (5.1)	15%
S1950-E382	A-C	05/25/11	46.4 (117.8)	2.7 (6.9)	2.3 (5.8)	17%
S1950-E432	A-C	05/25/11	48.9 (124.2)	3.4 (8.6)	1.9 (4.8)	79%
S2180-E220	A-C	06/07/11	14.2 (36.1)	1.6 (4.1)	1.3 (3.3)	23%
S2180-E220	A-C	06/07/11	14.2 (36.1)	1.6 (4.1)	1.3 (3.3)	23%
S2180-E410	A-C	06/07/11	13.9 (35.4)	1.5 (3.8)	1.2 (3.0)	25%
S2180-E410	A-C	06/07/11	13.9 (35.4)	1.5 (3.8)	1.2 (3.0)	25%
S2180-E55	A-C	06/07/11	15.2 (38.7)	2.1 (5.3)	1.8 (4.6)	17%
S2520-E220	A-C	06/07/11	18.7 (47.4)	1.8 (4.6)	1.5 (3.8)	20%
S2520-E410	A-C	06/07/11	28.9 (73.3)	3.5 (8.9)	3.0 (7.6)	17%
S2750-E220	A-C	06/07/11	21.4 (54.3)	3.1 (7.9)	2.0 (5.1)	55%
S2750-E410	A-C	06/07/11	21.1 (53.6)	4.5 (11.4)	3.0 (7.6)	50%
S3080-E220	A-C	06/06/11	17.2 (43.6)	2.8 (7.1)	2.2 (5.6)	27%
S3080-E55	A-C	01/04/11	17.2 (43.6)	2.8 (7.1)	2.1 (5.3)	33%
S3080-W100	A-C	06/07/11	21.2 (53.9)	4.5 (11.4)	3.4 (8.6)	32%
S3310-E220	A-C	06/08/11	22.4 (56.9)	5.8 (14.7)	3.2 (8.1)	81%
S3310-W285	A-C	06/07/11	7.9 (20.1)	2.2 (5.6)	1.7 (4.3)	29%
S3650-E55	A-C	06/07/11	7.5 (19.0)	1.8 (4.6)	1.6 (4.1)	13%
S3650-W100	A-C	06/07/11	11.2 (28.4)	2.6 (6.6)	1.8 (4.6)	44%
S700-E180	A-C	05/26/11	9.6 (24.4)	2.0 (5.1)	1.7 (4.3)	18%
S700-E205	A-C	05/26/11	26.9 (68.4)	2.0 (5.1)	1.7 (4.3)	18%
S700-W98	A-C	05/26/11	23.7 (60.1)	1.8 (4.6)	1.4 (3.6)	29%
S90-W590	A-C	06/02/11	13.2 (33.6)	0.7 (1.8)	0.6 (1.5)	17%
W170-N150	A-C	06/02/11	10.4 (26.4)	0.7 (1.8)	0.5 (1.3)	40%
W170-S1445	A-C	06/01/11	15.9 (40.3)	1.6 (4.1)	1.3 (3.3)	23%
W170-S1779	A-C	06/01/11	19.4 (49.2)	1.6 (4.1)	1.2 (3.0)	33%

Table 5-3 – Greater than 10 Percent Increases in Annual Vertical Convergence From July 1, 2010 to June 30, 2011

Location	Chord	Last Reading Date	Cumulative Displacement Inches (cm)	Closure Rate 2010 to 2011 in/yr (cm/yr)	Closure Rate 2009 to 2010 in/yr (cm/yr)	Rate Change Percent
W170-S1950	A-C	06/01/11	16.5 (41.8)	1.4 (3.6)	1.0 (2.5)	40%
W170-S2060	A-C	06/01/11	17.7 (45.0)	1.5 (3.8)	1.1 (2.8)	36%
W170-S2180	A-C	06/28/11	22.6 (57.5)	2.7 (6.9)	1.3 (3.3)	108%
W170-S2275	A-C	06/27/11	13.6 (34.6)	2.0 (5.1)	1.2 (3.0)	67%
W170-S232	A-C	06/01/11	11.9 (30.2)	0.6 (1.5)	0.5 (1.3)	20%
W170-S2350	A-C	06/27/11	18.0 (45.8)	2.7 (6.9)	1.7 (4.3)	59%
W170-S2425	A-C	06/27/11	16.0 (40.5)	2.2 (5.6)	1.5 (3.8)	47%
W170-S2520	A-C	06/27/11	20.0 (50.9)	3.2 (8.1)	1.7 (4.3)	88%
W170-S2833	A-C	06/27/11	25.1 (63.7)	6.1 (15.5)	5.1 (13.0)	20%
W170-S2916	A-C	06/27/11	24.3 (61.7)	3.9 (9.9)	3.0 (7.6)	30%
W170-S3195	A-C	06/27/11	19.5 (49.6)	3.6 (9.1)	2.9 (7.4)	24%
W170-S3565	A-C	06/30/11	11.2 (28.6)	2.1 (5.3)	1.9 (4.8)	11%
W170-S3650	A-C	06/07/11	11.9 (30.3)	1.9 (4.8)	1.6 (4.1)	19%
W170-S400	A-C	06/01/11	14.5 (36.9)	0.8 (2.0)	0.6 (1.5)	33%
W30-S120	A-C	06/29/11	24.9 (63.1)	1.0 (2.5)	0.9 (2.3)	11%
W30-S250	A-C	06/29/11	32.1 (81.4)	1.4 (3.6)	1.1 (2.8)	27%
W30-S2916	A-C	06/27/11	32.5 (82.6)	7.2 (18.3)	5.2 (13.2)	38%
W30-S2998	A-C	06/27/11	17.3 (43.9)	3.9 (9.9)	2.7 (6.9)	44%
W30-S3195	A-C	06/27/11	16.6 (42.1)	2.4 (6.1)	2.0 (5.1)	20%
W30-S3310	A-C	06/27/11	15.4 (39.2)	1.8 (4.6)	1.6 (4.1)	13%
W30-S3480	A-C	06/30/11	12.8 (32.5)	2.7 (6.9)	2.3 (5.8)	17%
W30-S3565	A-C	06/30/11	9.2 (23.4)	1.6 (4.1)	1.4 (3.6)	14%
W30-S3650	A-C	06/07/11	10.0 (25.4)	2.0 (5.1)	1.6 (4.1)	25%
W30-S400	A-C	06/29/11	22.8 (58.0)	1.2 (3.0)	0.8 (2.0)	50%

5.4 Excavation Performance

Approximately 500 readings are collected and assessed regularly from convergence point arrays throughout the WIPP underground. Convergence rates continue to vary seasonally, typically increasing during the warmer and more humid summer months and decreasing during the cooler and drier winter months.

The performance of the access drift excavations during this reporting period was within acceptable criteria. "Acceptable criteria" means that a drift remains accessible, and the ground can be controlled by routine maintenance. Standard remedial ground control in some areas was required to maintain the performance of the excavations. The drifts remain stable and controlled. Most of the annualized rates remain steady, indicating stability. In some locations, where the rates are high, nearby mining activity or gradual deterioration of the roof beam along anhydrite stringers is most likely the cause. Where necessary, additional ground control measures have been or will be installed.

6.0 PERFORMANCE OF WASTE DISPOSAL AREA

The Waste Disposal Area as of June 30, 2011, consisted of Panels 1, 2, 3, 4, 5, and 6. Panels 1, 2, 3, and 4 were closed during previous reporting periods. Waste disposal in Panels 5 and 6 was ongoing. Panel 7 mining was under way.

6.1 History

Excavation of Panel 1 began in May 1986 with the mining of the access entries. Initially, the disposal rooms and drifts were developed as pilot drifts that were later excavated to nominal operational dimensions of 13 ft (4 m) high, 33 ft (10 m) wide, and 300 ft (91 m) long. Room 1 was completed to these dimensions in August 1986, and pilot drifts for Rooms 2 and 3 were excavated in January and February 1987. Rooms 2 and 3 were completed in February and March 1988, and Rooms 4 through 7 were completed in May 1988. Four short access drifts designed to lead to smaller test alcoves were excavated north off the S-1600 drift and Rooms 4-7 in June 1989. Only the access drifts to the alcoves were completed; the alcoves themselves were not excavated. Panel 1 waste emplacement (in Rooms 1, 2, 3, 7, adjacent areas of S 1600, and all of S-1950) was completed during a prior reporting period, and the panel is closed to all access. The Panel 1 access entries, S-1600 and S-1950, which extend from the E-300 drift to the isolation walls, remain open, and the instrumentation in this area continues to be maintained and monitored.

Excavation of the Panel 2 waste disposal area began in September 1999 with the mining of access entries. Initially, the disposal rooms and drifts were developed as pilot drifts that were trimmed to finished dimensions. Room 1 was completed in January 2000, and pilot drifts for Rooms 2 and 3 were excavated in February 2000. Pilot drifts were completed for Rooms 4 through 6 in April 2000. The pilot drift for Room 7 was excavated in May 2000. All the rooms were excavated to final dimensions by August 2000. Waste emplacement in Panel 2 was completed during a prior reporting period, and the panel is closed to all access. The Panel 2 access entries, S-2150 and S-2520, which extend from the E-300 drift to the isolation walls, remain open, and the instrumentation in this area continues to be maintained and monitored.

Excavation of Panel 3 waste disposal rooms began in May 2002 with the mining of access entries to Panel 3. As with Panel 2, initially, the disposal rooms and drifts were developed as pilot drifts that were trimmed to finished dimensions. All the rooms were excavated to final dimensions by the end of March 2004. Waste emplacement in Panel 3 was completed in February 2007. Substantial barriers and bulkheads were installed in the exhaust and intake drifts of Panel 3 to prevent access into the panel and to isolate it from the ventilation circuit.

Panel 4 access drift mining began in January 2005. The disposal rooms were initially developed as pilot drifts and were later trimmed to final dimensions. Mining was completed by June 2006. Waste emplacement in Panel 4 was completed in March 2009. Substantial barriers and bulkheads were installed in the exhaust and intake drifts of Panel 4 to prevent access into the panel and to isolate it from the ventilation circuit.

Waste was being emplaced in Panel 5, Room 7 and in Panel 6, Room 7.

Panel 7 mining activities were underway.

6.2 Modifications to Excavations and Ground Control Activities

Routine maintenance and ground control activities in the form of trimming, scaling, rock bolt replacement, and installing wire mesh were performed on ribs, floor, and roof throughout accessible areas of the disposal panels. Table 6-1 summarizes the ground control activities performed in the disposal panels during this reporting period.

6.3 Instrumentation

There were no changes to the Panel 6 instrumentation layout. Convergence monitoring continued in all accessible areas up to the time that the waste stack front passed the instrument location. Remote monitoring of extensometers continues.

Schematics of the geotechnical instrumentation layout in Panels 3, 4, 5, and 6 are shown in Figure 6-1 through Figure 6-3.

Table 6-1 – Summary of Modifications and Ground Control Activities in the Waste Disposal Area from July 1, 2010 to June 30, 2011

Location	Work Performed
Panel 5	Tension fracture bolted with 12 ft resin-anchored bolts

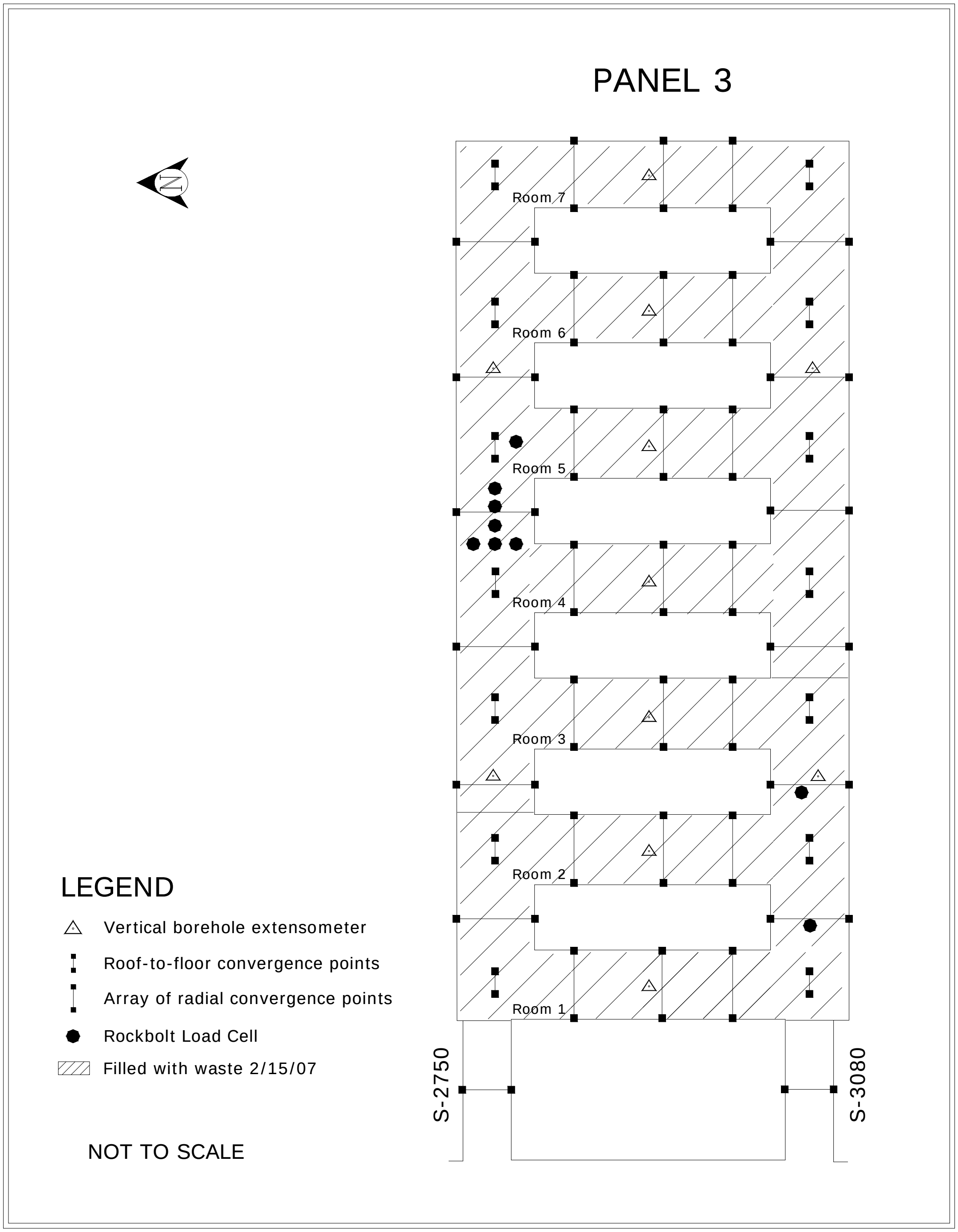

Figure 6-1 – Location of Panel 3 Geotechnical Instruments

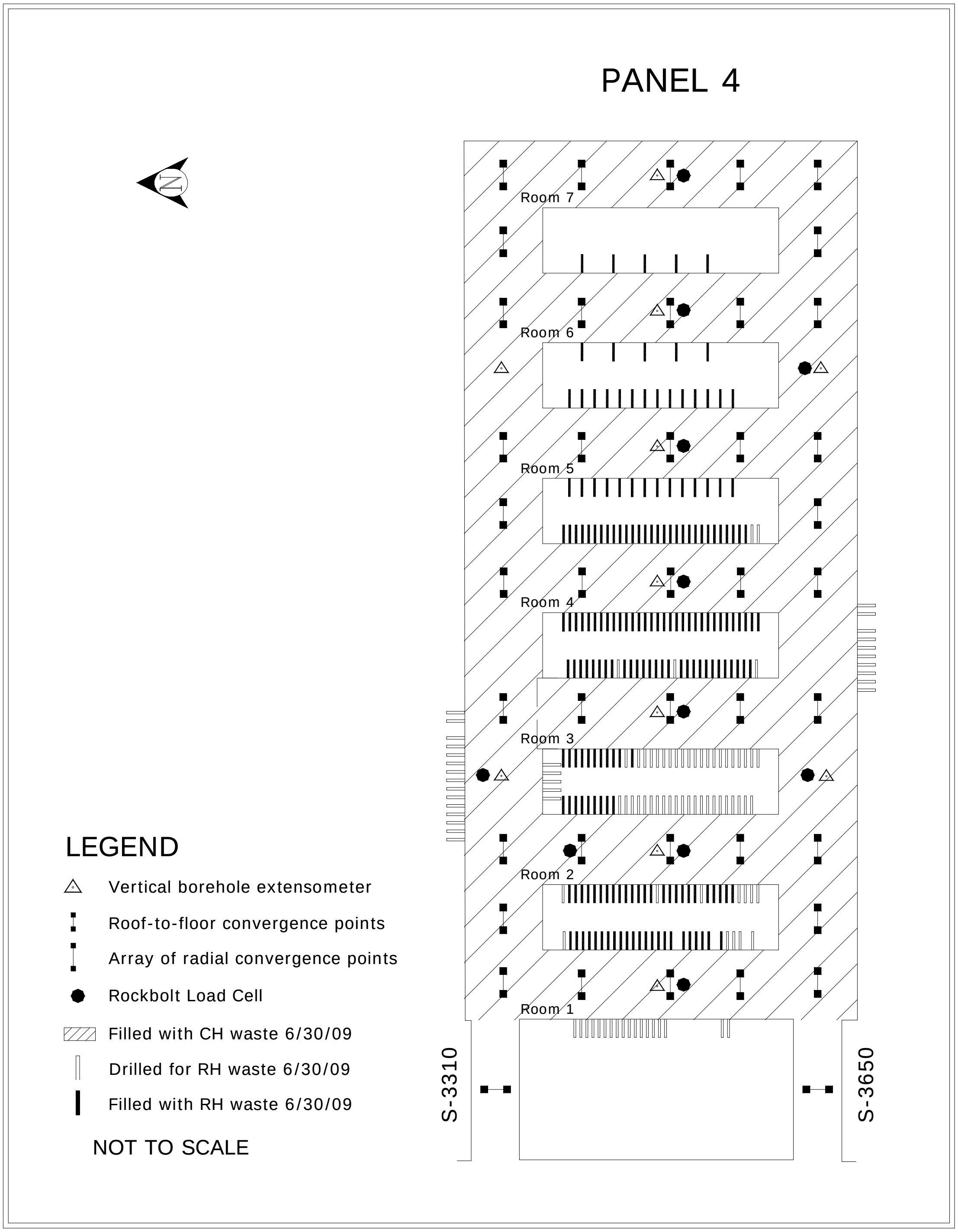

Figure 6-2 – Location of Panel 4 Geotechnical Instruments

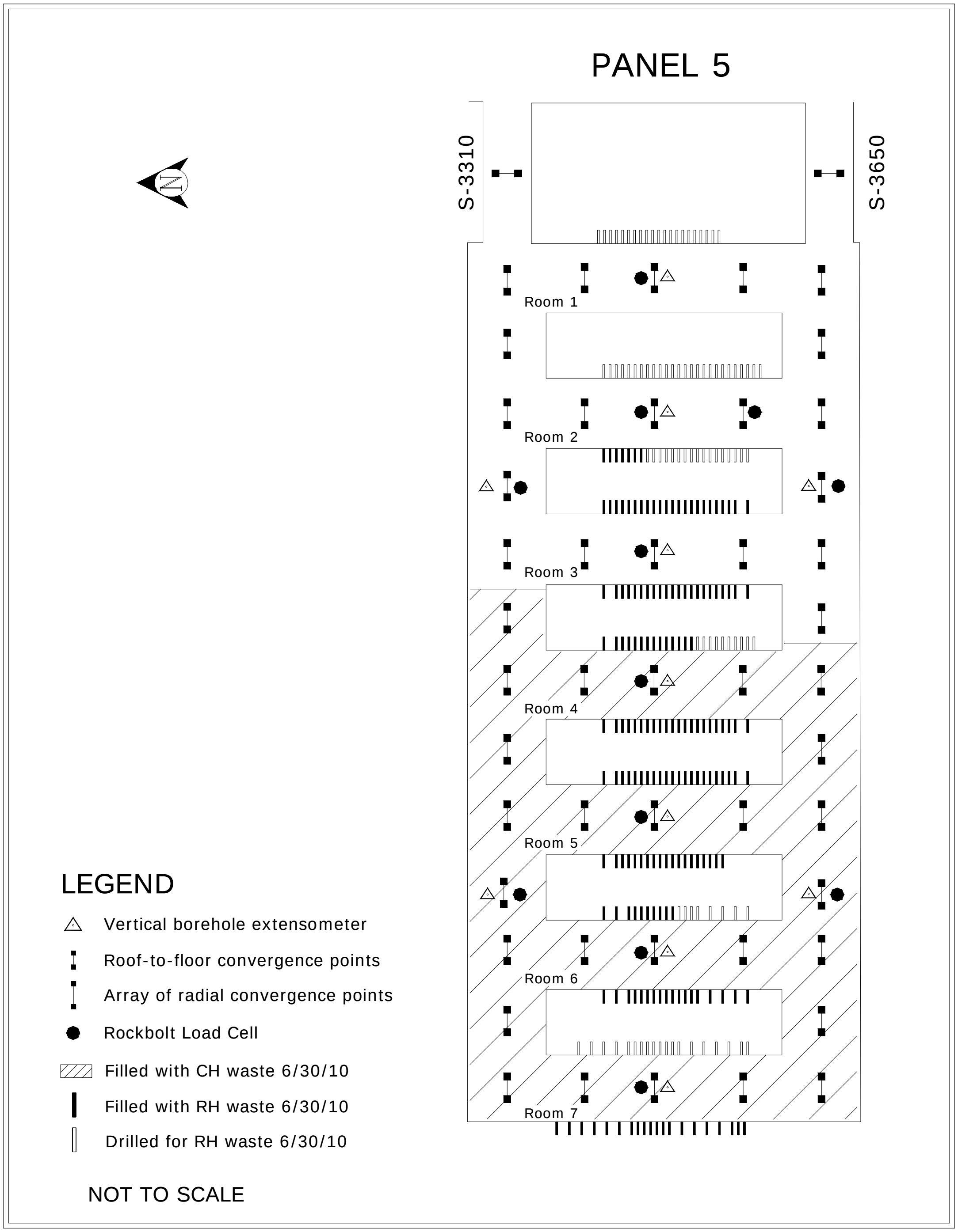

Figure 6-3 – Location of Panel 5 Geotechnical Instruments

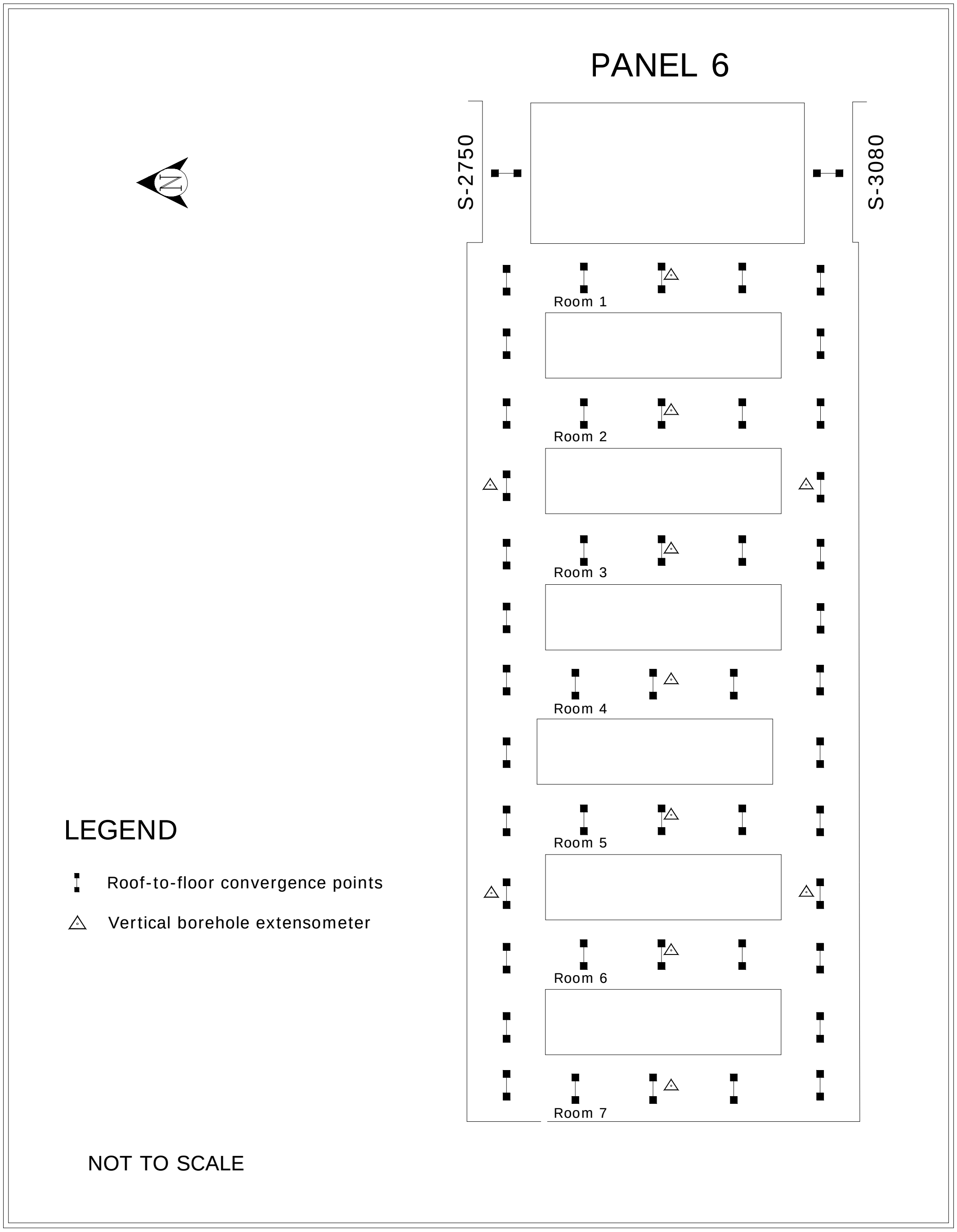

Figure 6-4 – Location of Panel 6 Geotechnical Instruments

6.4 Excavation Performance

Waste handling activities in Panels 1-5 have been completed, and geotechnical monitoring inside these panels has been discontinued. Extensometers in Panel 4 continue to be read remotely until the loss of communication with instruments behind the panel closure.

In accessible underground areas, horizontal and vertical convergence rates, calculated at the center of each of the rooms, were compared between this and the previous reporting period. Generally, convergence rates have declined from initial post-mining levels. Localized increases occur with seasonal creep trends, the presence of continuous anhydrite stringers, and coincident with adjacent mining activities. These increases are addressed, where necessary, with additional ground support selected for conditions prevailing at the specific location of installation.

6.5 Analysis of Extensometer and Convergence Point Data

Geotechnical instrumentation is installed in each disposal room and at select locations in the panel access drifts. As anticipated, these installations showed a general decrease in room closure rate and roof beam deformation with time. At some locations, deformation rates increased as roof sag and roof beam deterioration developed. Supplemental ground control support was installed in these areas and has subsequently reduced the observed rates.

Although Panels 1 through 4 are closed, convergence monitoring continues in the panel entries between E-300 and the explosion isolation walls (Panels 1 and 2) and substantial and isolation barriers (Panels 3 and 4). The exception is the Panel 4 intake drift (S3650) which is closed to access due to elevated VOC levels. The monitoring results indicate a steady long-term trend.

Panel 5 convergence monitoring indicated a stabilized rate in accessible locations until closure.

Panel 6 convergence data rates appear to remain elevated after floor trimming, particularly in the northern and eastern portions of the panel. Designed ground support consists of 5 foot-long resin anchored rock bolts, which provide a stiffening effect to the lower portion of the roof beam. Observation holes indicate that larger separations along anhydrite stringers are occurring above the anchorage zone, where the stress has been redirected. 12 ft resin anchored rock bolts were installed during this reporting period to counter the beam expansion along anhydrite stringers, and convergence monitoring indicates some success with this approach.

Panel 7 mining activities were underway at the end of this reporting period. No stable data was yet available for those areas.

7.0 GEOSCIENCE PROGRAM

The Geoscience Program confirms the suitability of the site through the collection of various geologic data and excavation characteristics from the underground. These include the inspection of open observation holes for fractures (separations) and offsets (lateral displacements) in roof beams and the mapping of fracture development on roof surfaces. Data collected through these activities support the design and evaluation of ground support systems.

During this reporting period, the following activities were performed:

- Observation hole inspections
- Fracture mapping

Fracture development in the roof is primarily caused by the concentration of compressive stresses in the roof beam and is influenced by the size and shape of the excavation and the stratigraphy in the immediate vicinity of the opening. In a thick roof beam, pillar deformations induce lateral compressive stresses into the immediate roof and floor. With time, the buildup of stress causes differential movement along stratigraphic boundaries. This differential movement is identified as offsets in observation holes and by the bends in failed rock bolts. Large strains associated with lateral movements can induce fracturing in the roof, which is frequently seen near the ribs; however, this process may take a long time (years) to develop.

At the upper repository horizon, clay or anhydrite stringers exert significant influence over the effective thickness of the roof beam. The presence of these stringers causes the roof beam to behave as a series of thin independent beams. Little or no tensile support is provided across the stringer interface. As horizontal end-loading continues, each beam can deflect downward causing a tensile fracture to develop along the bottom of the beam. These tensile fractures can develop in relatively new excavations soon after separation occurs along the stringer interface.

The location and initiation of interface separation is also influenced by the dip of the rock layers. The roofs and floors of the disposal panels are mined level through the sloping beds. At some locations, this may result in a significant difference in roof beam thickness from one side of the excavation to the other. Areas with the thinnest beam are the most likely to develop separations and subsequent fracturing.

7.1 Observation Hole Inspections

Geotechnical observation holes are drilled at various locations throughout the underground facility. A location may contain one or more holes arranged in an array. These holes are drilled to depths that allow the monitoring of fracture development and offsetting and are inspected for the development of those features. Roof observation holes usually extend up past clays G and H (Figure 7-1 and Figure 7-2).

The clay seams nearest the excavation surfaces define the immediate roof beam. The roof beam is bounded by Clay G in most of the access drifts and Panels 1 and 2. Some areas, such as the Salt Shaft Station, portions of the E-0 and E-140 drifts, the south mains south of S-2620, and Panels 3, 4, 5, and 6 are excavated to Clay G and so have roof beams bounded by Clay H.

The offset in an observation hole is determined by visually estimating the degree of occlusion. The direction of offset along clay seams is observed as the movement of the strata nearer to the observer relative to the strata farther away. Typically, the nearer strata move toward the center of the excavation (Figure 7-3 and Figure 7-4). Based on previous observations in the underground, the magnitude of offset is usually greater in holes located near ribs than in those located along excavation centerlines. Offsetting along the clay layers is observable until total offset is reached or visibility is obstructed by intervening offsets at other clay seams or fractures.

Observation holes are inspected for fractures, using an aluminum rod with a flattened steel wire probe attached to one end perpendicular to the rod (referred to as a "scratch rod"). Fractures and clay seams are located by moving the probe along the inside of the hole until it is snagged in one of these features. Depth to each feature is recorded, as is the magnitude of separations encountered. A fiber scope camera is occasionally used in addition to the scratch rod to visually document features of interest in a hole.

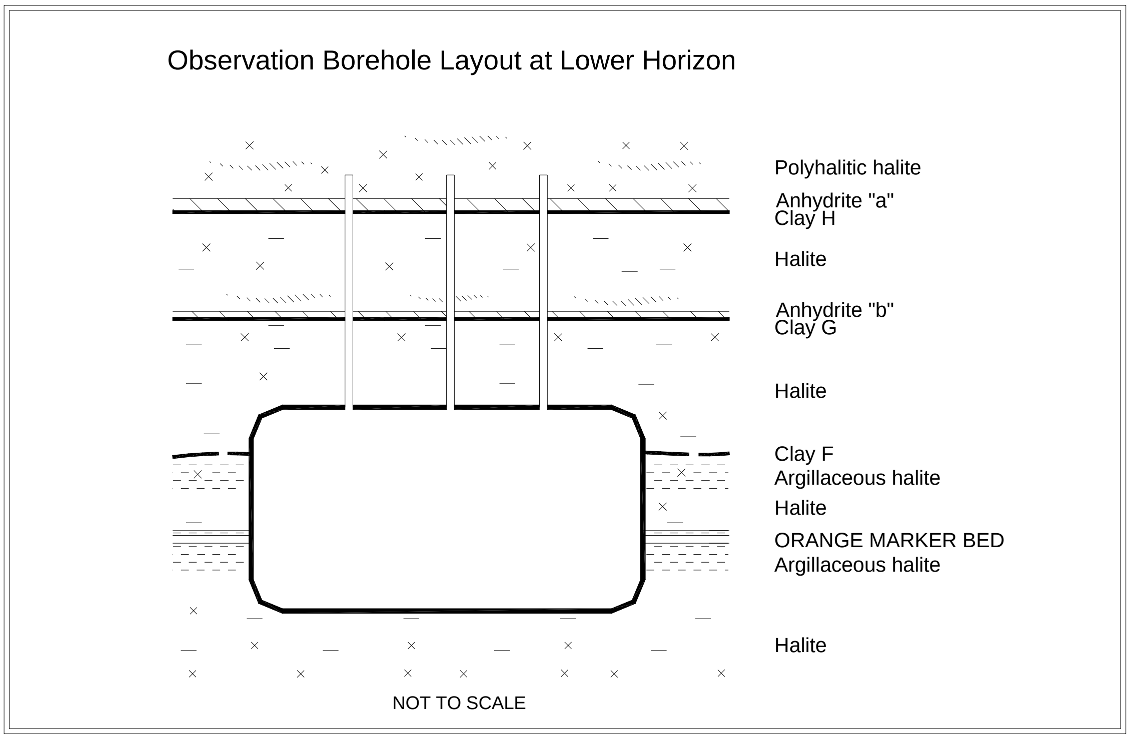

Figure 7-1 – Example of Observation Hole Layout at Lower Horizon

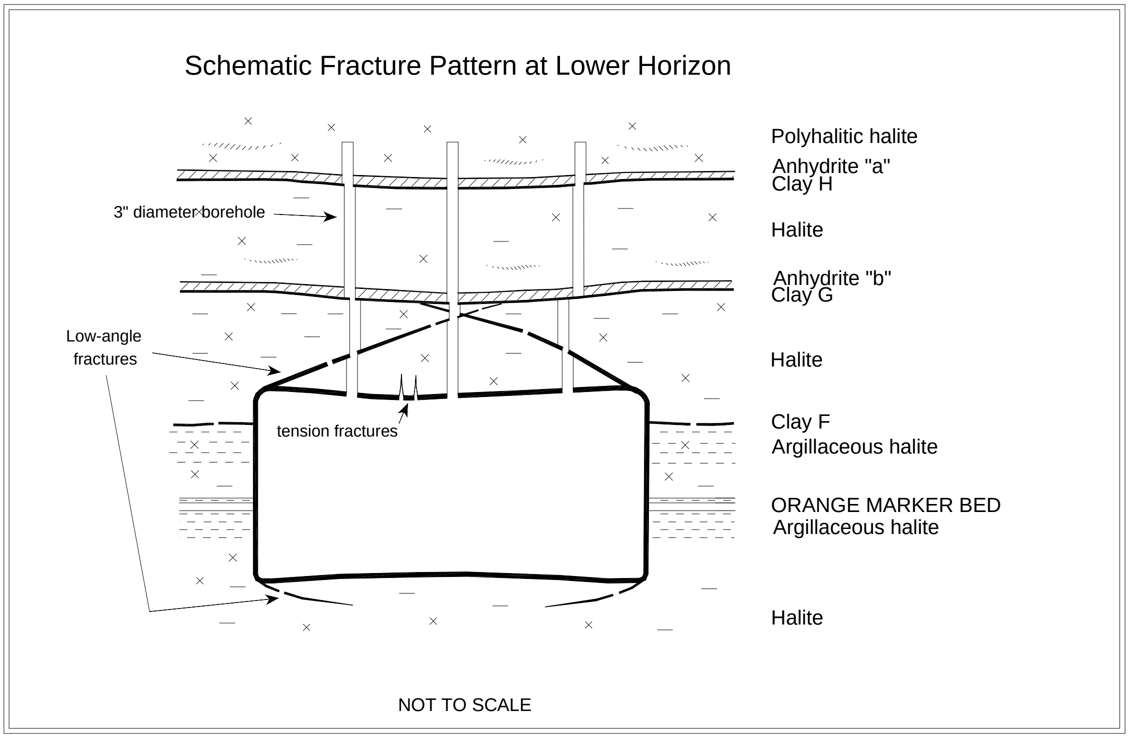

Figure 7-2 – Example of Observation Hole Layout at Upper Horizon

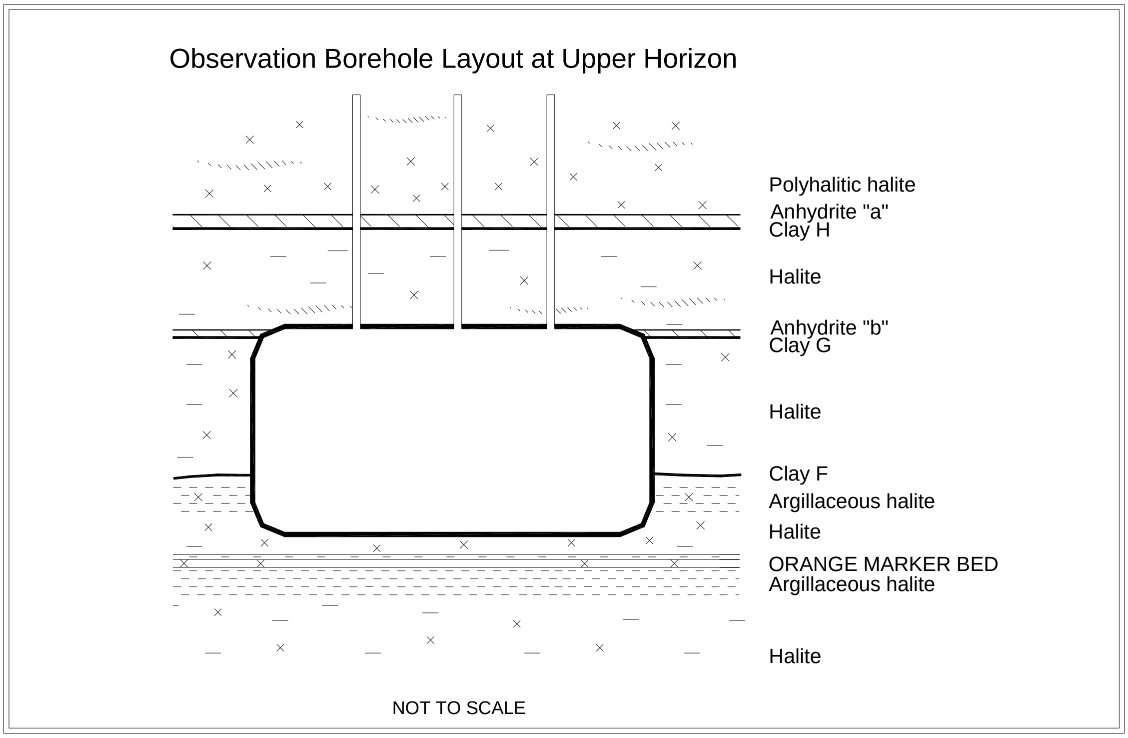

Figure 7-3 – Typical Fracture Patterns at Lower Horizon

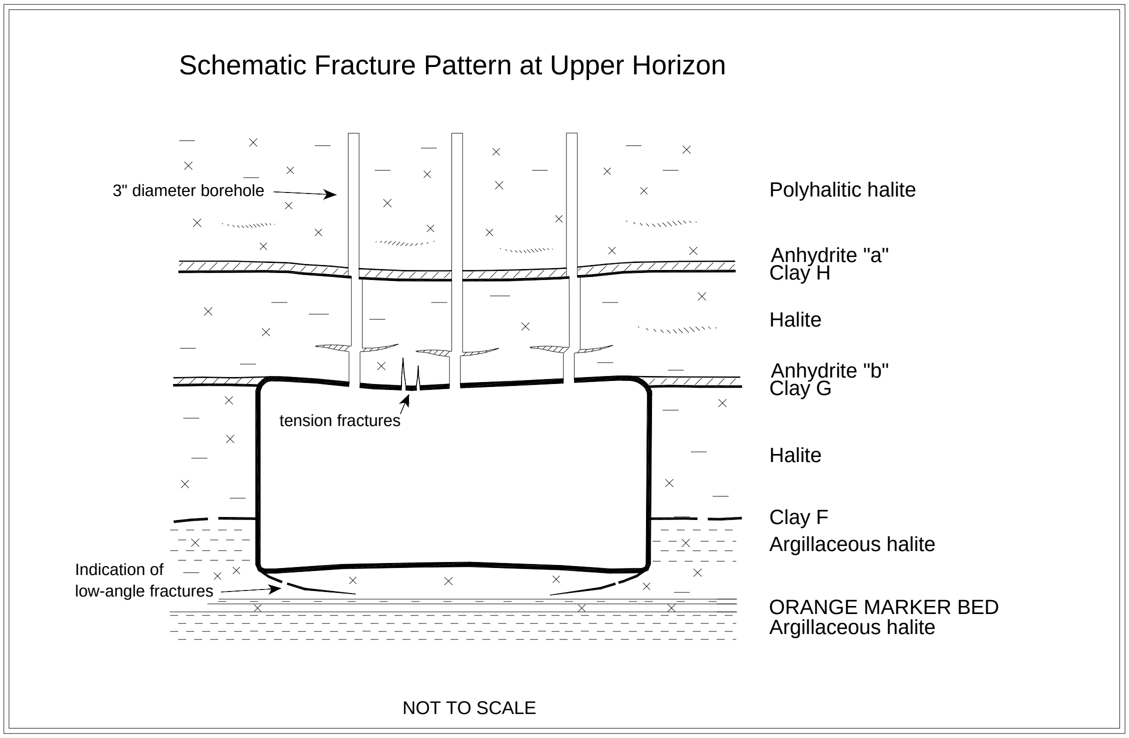

Figure 7-4 – Typical Fracture Patterns at Upper Horizon

The separation and offset data observed in accessible observation holes in the back are presented in the supporting data document for this report. Forty-seven accessible holes were monitored in Panel 5, and 47 in Panel 6. In Panel 6, the greatest separations were associated with Clay H and Anhydrite "a." Nineteen holes in Panel 6 had fractures associated with anhydrite stringers in the lower portion (first 3 feet) of the roof beam. Thirty-eight of 47 holes in Panel 6 and sixteen of the 47 holes in Panel 7 showed some offset.

7.2 Fracture Mapping

Routine mapping documents the progression of fractures in the roof exposed on the excavation surfaces of the drifts and rooms in the underground repository. The fracture surveys are generally performed on an annual basis, and the fracture maps are updated. The fracture maps facilitate the analysis of strain in the immediate roof-beam, because they document the development and propagation of fractures through time. The supporting data document contains fracture maps for Panels 6 and 7. During this reporting period, fractures were mapped in Panels 6 and 7.

8.0 SUMMARY

At the inception of WIPP, criteria were developed that address the design requirements (DOE, 1984). They pertained to all aspects of the mined facility and its operation as a pilot plant for the demonstration of technical and operational methods for permanent disposal of contact-handled and remote-handled TRU waste. In 1994, as the WIPP focus moved toward the permanent disposal of TRU waste, these design requirements were reassessed and replaced by a new set of requirements called system design descriptions. Table 8-1 shows the comparison of these design requirements with conditions actually observed in the underground from July 2010 through June 2011.

Normal drift and room maintenance continued during this reporting period with rib, roof, and floor scaling and trimming in various locations, and rock bolts and wire mesh installed as needed. Supplemental ground control systems consisting of resin-anchored bolts were installed in select locations. Some of these supplemental systems also included roof mats.

New geomechanical instrumentation was installed in Panel 7 and its access drifts, as well as in various locations throughout the repository to replace mined-out instruments. Monitoring no longer continues in non-accessible areas except in Panel 4. All accessible areas of the underground are connected to data-loggers or are monitored manually.

The *in situ* performance of the excavations generally continues to satisfy the appropriate design criteria, although specific areas are being identified where deterioration resulting from ageing must be addressed through routine maintenance and installation of engineered systems. This deterioration has been identified through the analysis of data acquired from geomechanical instrumentation and the Geoscience Program. If the planned life of some of the openings needs to be extended, changing the geometry of the access drifts (removing unstable roof beam or rib spalls, or milling the floor for added clearance), or additional ground control (roof removal, installing bolts, mesh, or straps) may be necessary. The ground conditions in the waste disposal area and associated waste transport routes continue to slowly deteriorate; however, routine ground control installations and maintenance continue to allow safe access in the underground facility.

In addition to underground instrumentation, qualitative assessments of fracture development are documented through mapping the underground repository and inspecting the observation holes. The information acquired from these programs provides early detection of ground deterioration, contributes to the understanding of the dynamic geomechanical processes in the WIPP underground, and aids in the design of effective ground control and support systems.

Table 8-1 – Comparison of Excavation Performance to System Design Requirements

Requirement	Comments
"The lining shall be designed for a hydrostatic pressure. . . ."	Water pressure observed on piezometers located behind the shaft liners remains below design levels.
"The key shall be designed to resist the lateral pressure generated by salt creep."	Geomechanical data from the Waste Shaft indicate that the shaft key is minimally loaded and is structurally stable. Visual inspections of all shaft keys do not indicate any deterioration due to creep loading.
"The key shall be designed to retain the rock formation and will be provided with chemical seal rings and a water collection ring with drains to prevent water from flowing down the unlined shaft from the lining above."	Shaft inspection observations and instrumentation show no indication of instability due to salt dissolution. No water has been observed flowing along the rock-liner interface.
"The underground waste disposal facilities shall be designed to provide space and adequate access for the underground equipment and temporary storage space to support underground operations."	Geomechanical instrument data and visual observations indicate that the current design provides adequate access and storage and disposal space. Ground control maintenance is performed as necessary to maintain access.
"Entries and subentries to the underground disposal area and the experimental areas shall be provided and sized for personnel safety, adequate air flow, and space for equipment."	Deformation of excavation remains within the required limits. Normal periodic maintenance consisting of rock bolting, wire meshing, trimming, and scaling continue throughout the repository. Areas such as the waste transport route undergo periodic floor trims in order to maintain adequate operating height.
"Geomechanical instrumentation shall be provided to measure the cumulative deformation of the rock mass surrounding mined drifts. . . ."	Geotechnical instrumentation is operated and maintained to meet this requirement. This annual report provides a summary and analysis of the geomechanical data.

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Supporting Data

MAY 2012

Waste Isolation Pilot Plant

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Geosciences Program

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1.0 Introduction

This report is a compilation of geotechnical data presented as plots for each active instrument installed in the underground at the Waste Isolation Pilot Plant (WIPP) through June 30, 2011. A summary of the geotechnical analyses that were performed using the enclosed data is provided in Volume 1 of the Geotechnical Analysis Report (GAR).

1.1 Instrumentation

Geomechanical instrument data included in this report reflect the measurements of the geomechanical response of the underground and shafts. The instruments consist of convergence points, borehole extensometers, rockbolt load cells, pressure cells, strain gages, piezometers, and joint meters.

Closure measurements are taken at convergence points. Rock displacement is calculated by measuring the distance between two opposing points. Displacement is monitored over time and is plotted as closure versus time. Annual rates of closure are calculated for the convergence data and are compared with annual closure rates from previous reporting periods.

Borehole extensometers are used to determine the absolute movements of the ground around the openings. With these instruments, rods or wires are placed into a hole and anchored at various depths. The displacement at the extensometer head (located near the excavation face) is measured relative to each of the fixed anchors. These data are used in the extensometer *displacement* plots presented here. As part of the post-processing of acquired extensometer data a *relative displacement* value is calculated. The deepest anchor is assumed to be fixed in undisturbed ground and a displacement for the remaining anchors relative to the deepest anchor is calculated. Annual rates of collar displacement are calculated for each extensometer and are compared with the annual displacement rate reported during the previous reporting period.

Rockbolt load cells are used to determine the ground loading and the effectiveness of rockbolts. Plots consist of load versus time for each instrumented bolt.

Earth pressure cells and strain gages are used in and around the shaft liners to determine their loads. These are also depicted in time-based plots. Monitoring of these instruments indicates whether there is any stress buildup in the shaft lining systems.

Piezometers are used to measure the gauge pressure of groundwater. They have been installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Plots from piezometers are presented as pressure versus time.

Joint meters are installed perpendicular to a crack and monitor any changes in separation of the crack which may occur over time.

1.2 Data Plot Explanation

Data are presented in graphical form for ease in interpretation. Time-based plots are used in this report. Each plot generally consists of a legend in the upper right-hand corner that gives the array name and specific location of the instrument or point evaluated. The legend ties the graphical cross-sectional representation of the drift or shaft typically presented in the lower right-hand corner to the symbols on the curve in the graph. For extensometers, each anchor is designated with an alpha character "A" closest to the collar and "B," "C," "D," or "E" for the furthest point from the collar (the deepest anchor). For convergence points, the horizontal and vertical sections of the drift are referred to as chords. Breaks in the graph for convergence data and a numeric designator added to the legend typically indicate that the convergence point was lost due to normal mine maintenance activities and later reinstalled.

1.3 Report Organization

Chapter 1.0 provides an introduction to this Supporting Data volume of the GAR. Chapter 2.0 provides instrument data analysis for the Salt Handling Shaft, Waste Shaft, and Exhaust Shaft followed by data plots for the extensometers, piezometers, earth pressure cells, spot welded strain gages, and embedment strain gages installed in the shafts. Chapter 3.0 provides instrument data analysis for the Salt Handling Shaft Station and Waste Shaft Station, an instrument data summary only for the area immediately surrounding the Air Intake Shaft, and data plots for extensometers, convergence points, and rockbolt load cells for all three locations. Chapter 4.0 provides instrument data analysis for the access drifts followed by data plots for the extensometers, convergence points, joint meters and rock bolt load cells. Chapter 5.0 provides instrument data analysis for the Waste Disposal Area followed by data plots for the extensometers, rock bolt load cells and convergence points. Chapter 6.0 provides geologic data collected through the mapping of fractures, stratigraphic mapping and the observed displacements in vertical boreholes.

2.0 Instrumentation Summary for Shafts

Instrumentation data analysis for three of the four shafts at the WIPP follows. Table 2-1 presents data and analysis of the Salt Shaft. Plots of the instrument data are presented as Figures 2-1 through 2-12.

Table 2-2 presents data and analysis of the Waste Shaft. Plots of the instrument data are presented as Figures 2-13 through 2-16.

Table 2-3 presents data and analysis of the Exhaust Shaft. Plots of the instrument data are presented as Figures 2-17 through 2-23.

Table 2-1
Salt Handling Shaft Data Analysis

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Pressure Readings (psi)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X-PE-00201	580	2-1	08/02/10	79	04/05/10	99	-20	
37X-PE-00202	580	2-1	08/02/10	86	04/05/10	107	-21	
37X-PE-00203	620	2-2	08/02/10	154	04/05/10	231	-77	
37X-PE-00204	620	2-2	08/02/10	157	04/05/10	188	-31	
37X-PE-00205	691	2-3	06/06/11	188	06/03/10	188	0	
37X-PE-00206	691	2-3	06/06/11	182	06/03/10	183	-1	
37X-PE-00209	802	2-4	09/07/10	61	08/03/09	64	-3	
37X-PE-00210	802	2-4	09/07/10	60	09/01/09	65	-5	
37X-PE-00211	850	2-5	06/06/11	91	06/03/10	105	-14	
37X-PE-00212	850	2-5	06/06/11	108	06/03/10	122	-14	

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Pressure Readings (psi)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X- WE-00201	860	2-6	08/02/10	-7	09/01/09	-6	-1	
37X- WE-00202	860	2-6	08/02/10	-25	07/06/09	-24	-1	
37X- WE-00203	860	2-6	04/04/11	7	04/05/10	7	0	

Salt Handling Shaft Data Analysis

Table 2-1 (Continued)
Salt Handling Shaft Data Analysis

SPOT WELDED STRAIN GAGES

Field Tag	Level Feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Strain Readings (με)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Strain Readings (με)	Change in Maximum Strain From Previous Year (με)	Comments
37X-ZE-00201	856.3	2-7	09/07/10	746	09/01/09	747	-1	
37X-ZE-00206	856.3	2-7	08/02/10	653	08/03/09	646	7	
37X-ZE-00220	862.4	2-8	10/04/10	906	09/01/09	893	13	
37X-ZE-00223	862.4	2-8	08/02/10	705	08/03/09	696	9	

EMBEDMENT STRAIN GAGES

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Strain Readings (με)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Strain Readings (με)	Change in Maximum Strain From Previous Year (με)	Comments
37X-ZE-00209	856.3	2-9	03/08/11	-540	01/19/10	-552	12	
37X-ZE-00210	856.3	2-9	08/02/10	998	08/03/09	994	4	
37X-ZE-00211	856.3	2-9	06/06/11	338	09/01/09	333	5	
37X-ZE-00212	856.3	2-9	02/07/11	-891	02/01/10	-818	-73	
37X-ZE-00213	856.3	2-9	06/06/11	376	07/06/09	365	11	
37X-ZE-00214	856.3	2-9	06/06/11	106	02/01/10	-83	189	
37X-ZE-00215	856.3	2-9	06/06/11	131	07/06/09	119	12	
37X-ZE-00216	856.3	2-9	06/06/11	660	06/03/10	629	31	
37X-ZE-00225	862.4	2-10	06/06/11	271	09/01/09	256	15	
37X-ZE-00235	856.3	2-11	02/07/11	-413	01/19/10	-420	7	
37X-ZE-00236	856.3	2-11	02/07/11	-145	08/03/09	107	-252	
37X-ZE-00237	856.3	2-11	06/06/11	124	06/03/10	115	9	
37X-ZE-00238	856.3	2-11	06/06/11	545	06/03/10	525	20	
37X-ZE-00239	862.4	2-12	09/07/10	391	09/01/09	383	8	

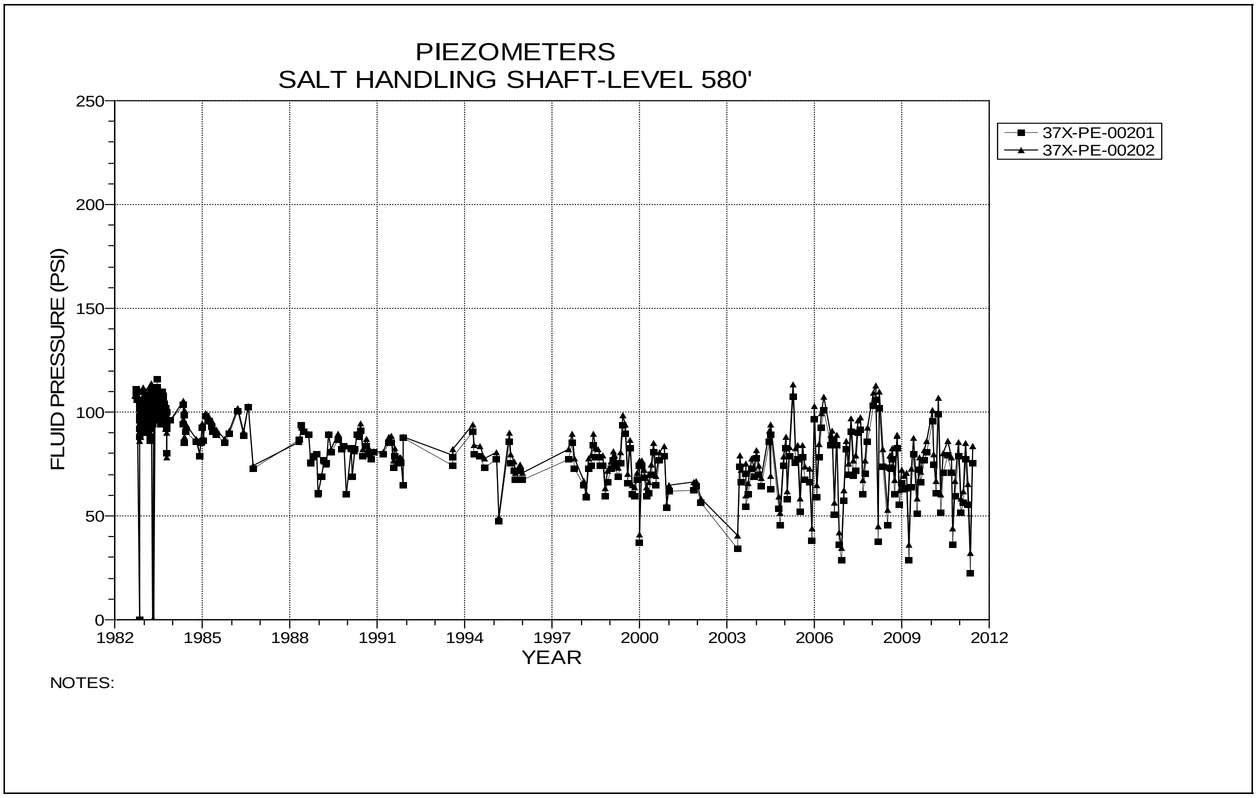


Figure 2-1 Piezometers 37X-PE-00201 and 37X-PE-00202
Salt Handling Shaft – Level 580 at the Forty-niner Member

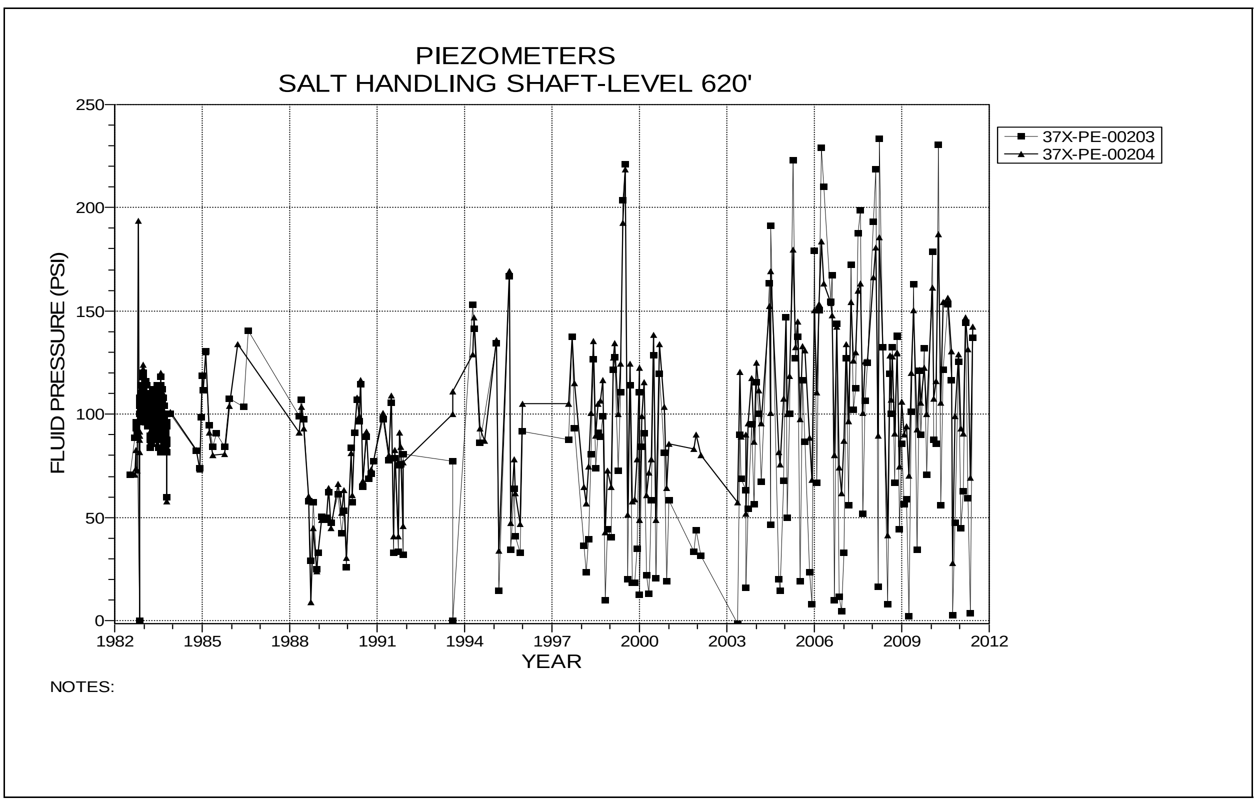


Figure 2-2 Piezometers 37X-PE-00203 and 37X-PE-00204
Salt Handling Shaft – Level 620 at the Magenta Dolomite Member

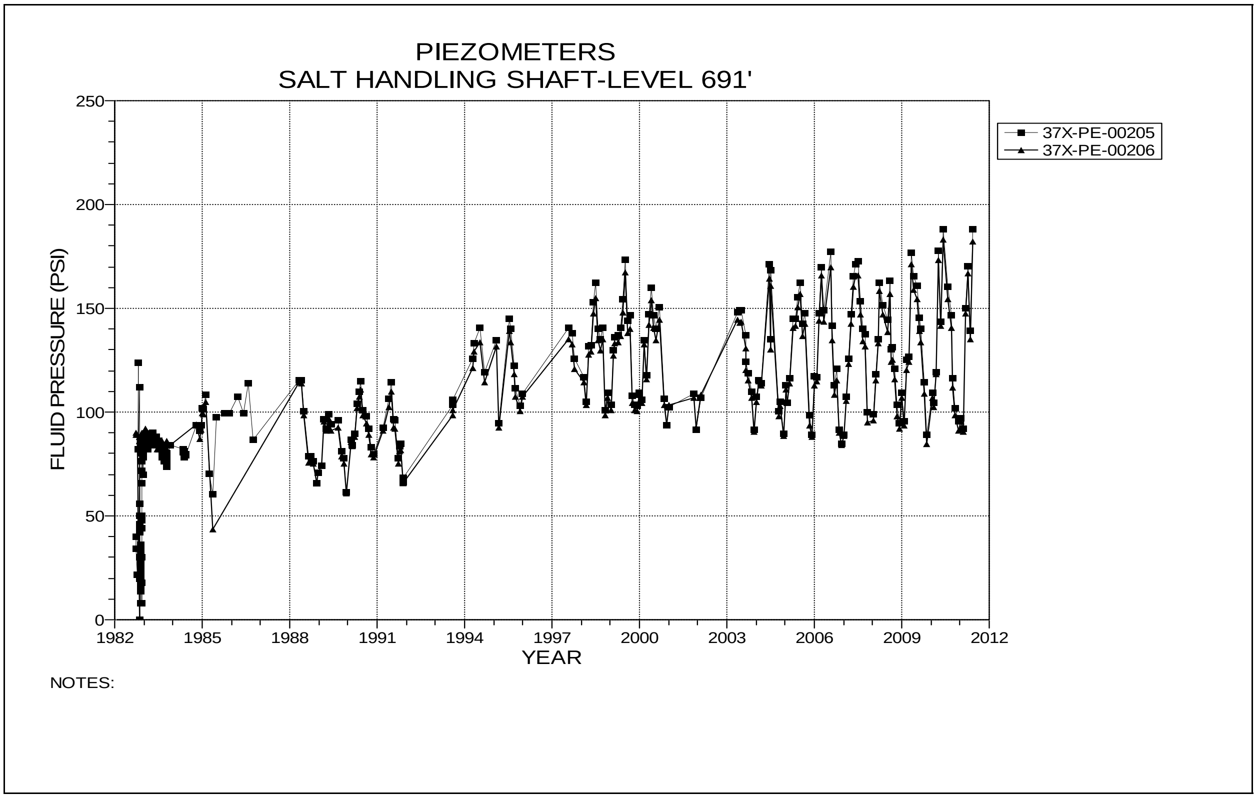


Figure 2-3 Piezometers 37X-PE-00205 and 37X-PE-00206
Salt Handling Shaft – Level 691 at the Tamarisk Member

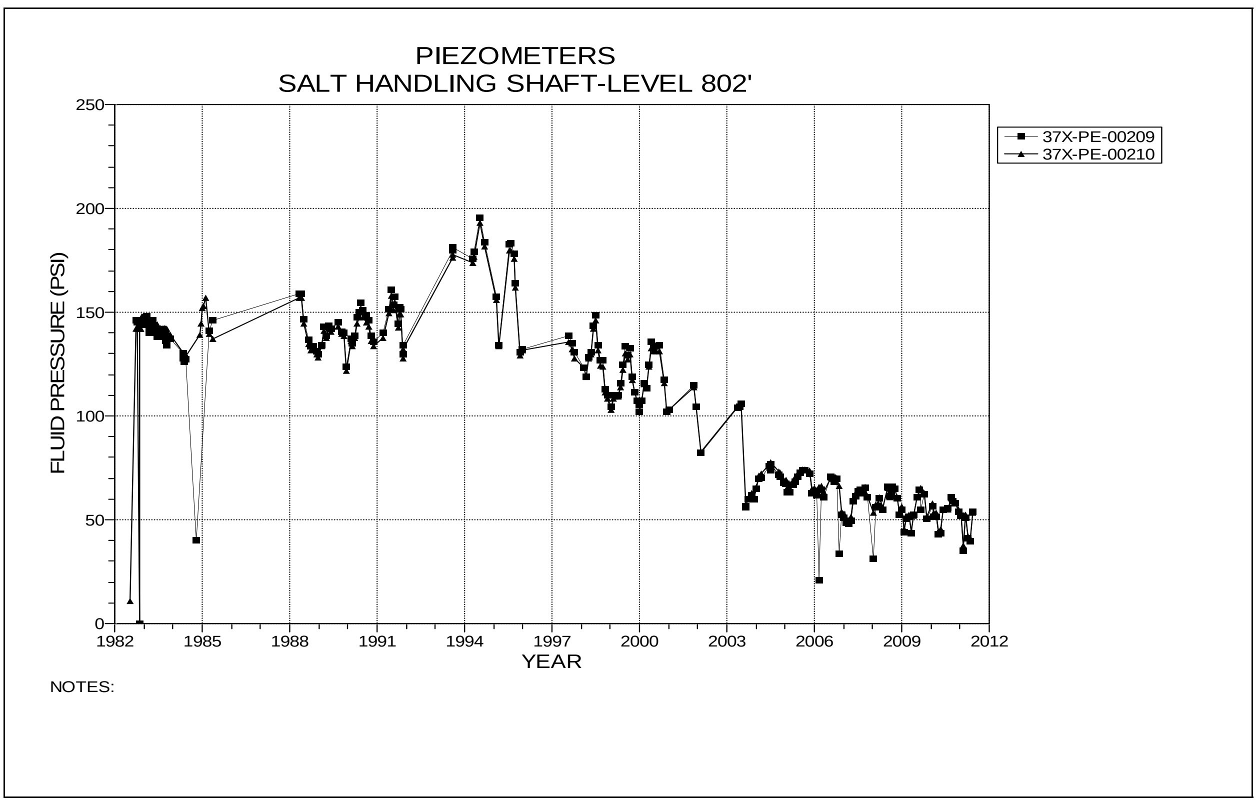


Figure 2-4 Piezometers 37X-PE-00209 and 37X-PE-00210
Salt Handling Shaft – Level 802 at the Los Medaños Member

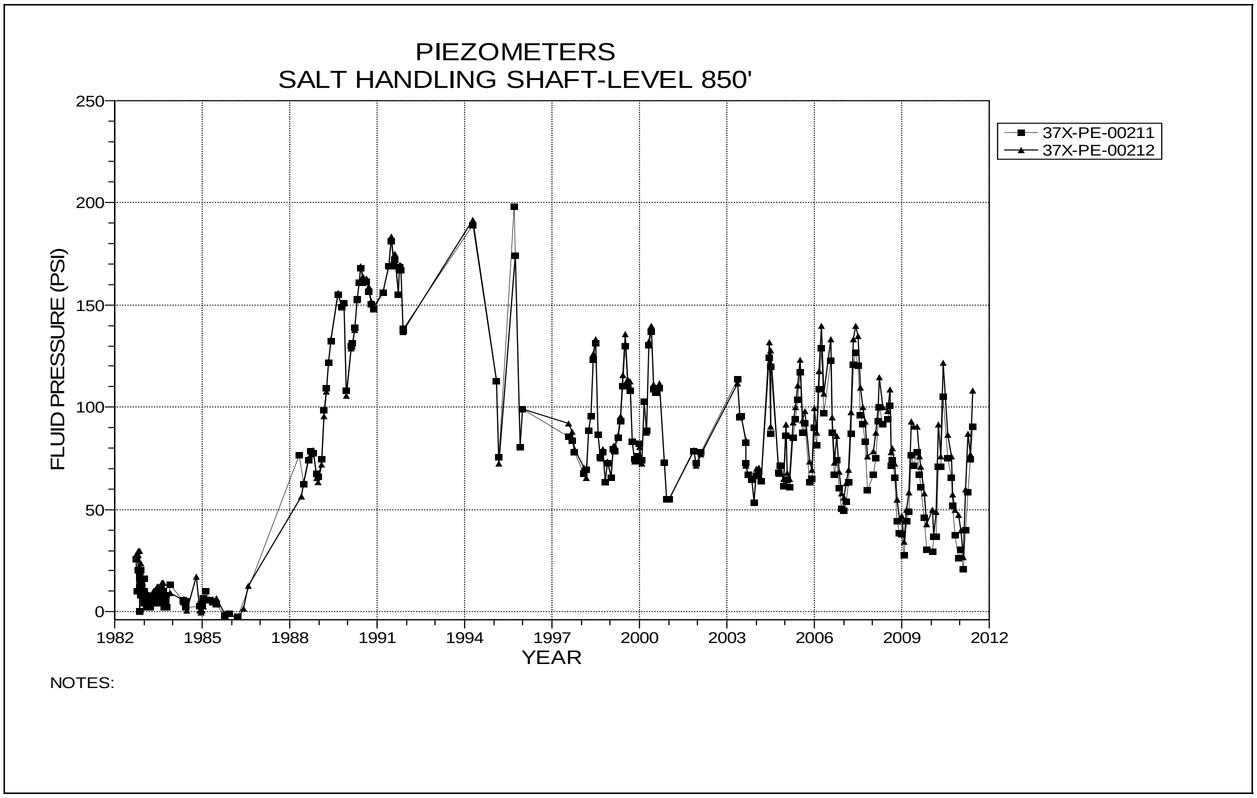


Figure 2-5 Piezometers 37X-PE-00211 and 37X-PE-00212
Salt Handling Shaft – Level 850 at the Rustler-Salado Contact

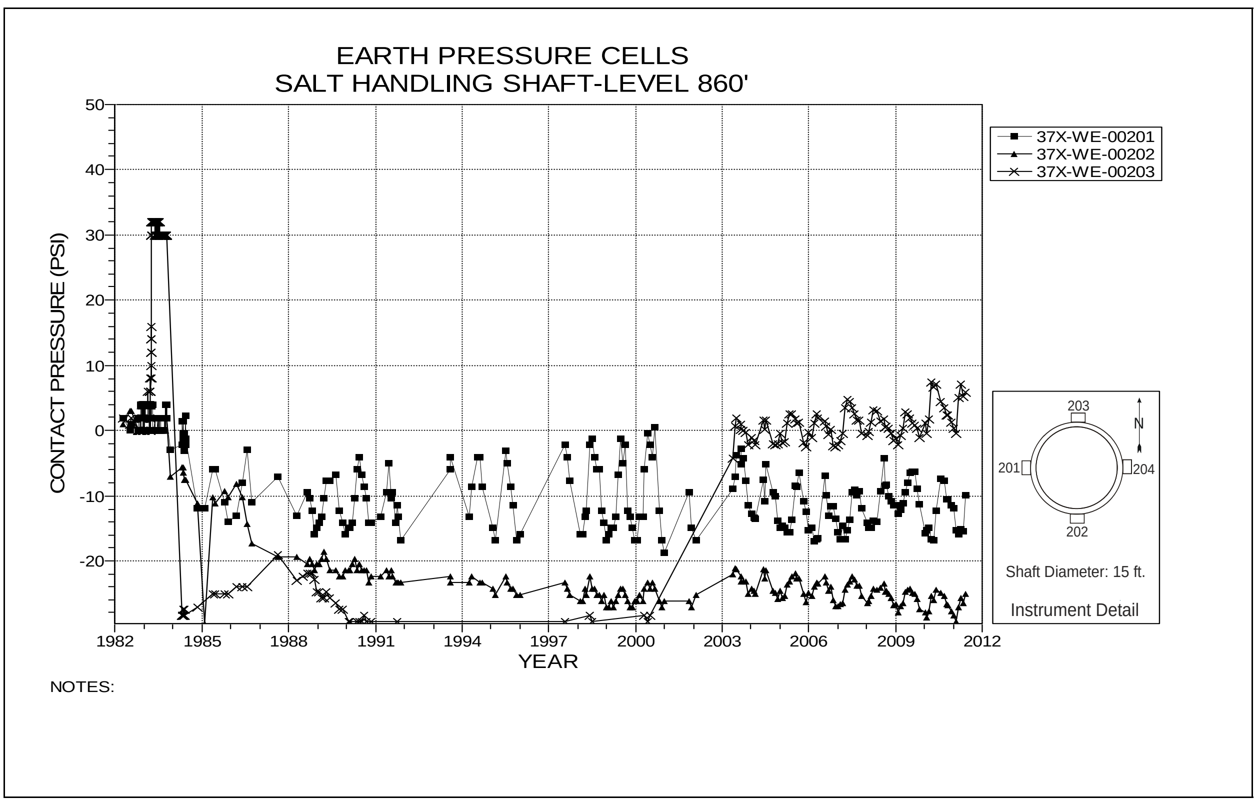


Figure 2-6 Earth Pressure Cells Behind Shaft Key
Salt Handling Shaft Key – Level 860

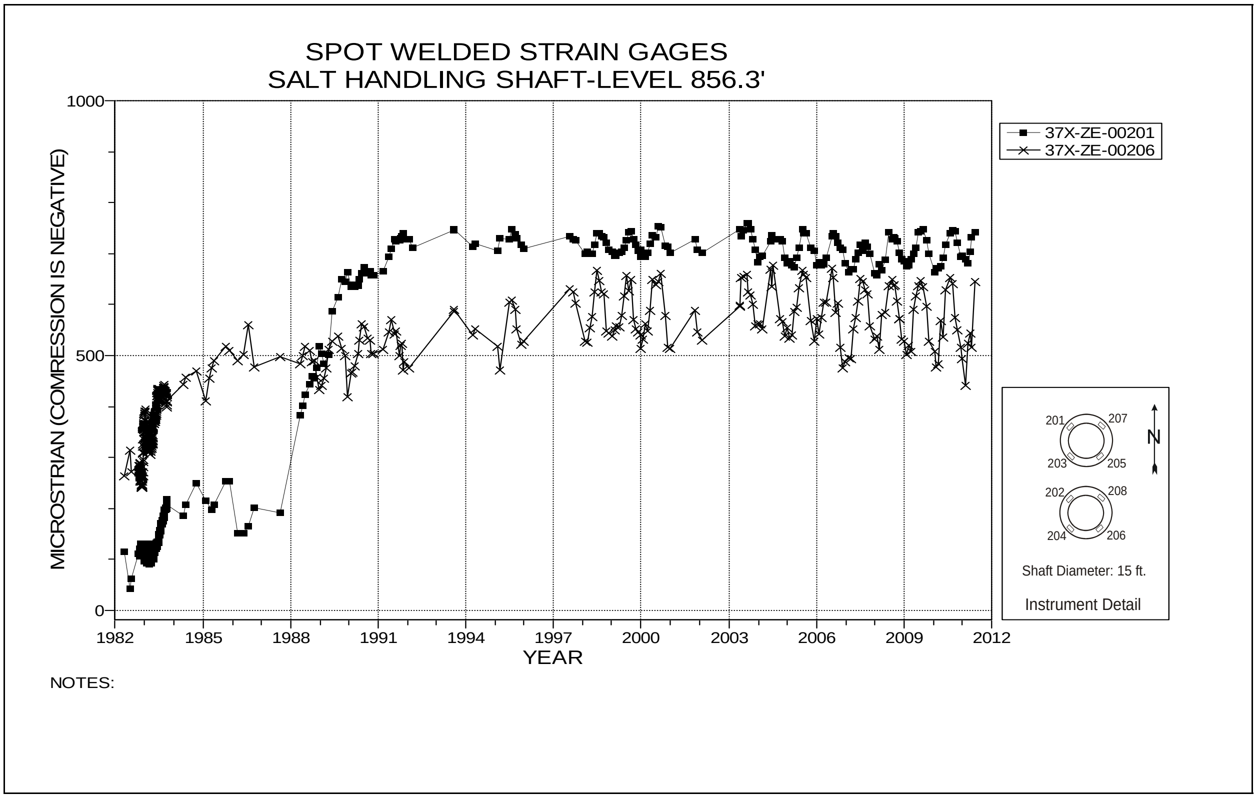


Figure 2-7 Spot-Welded Strain Gages
Salt Handling Shaft Key – Level 856.3

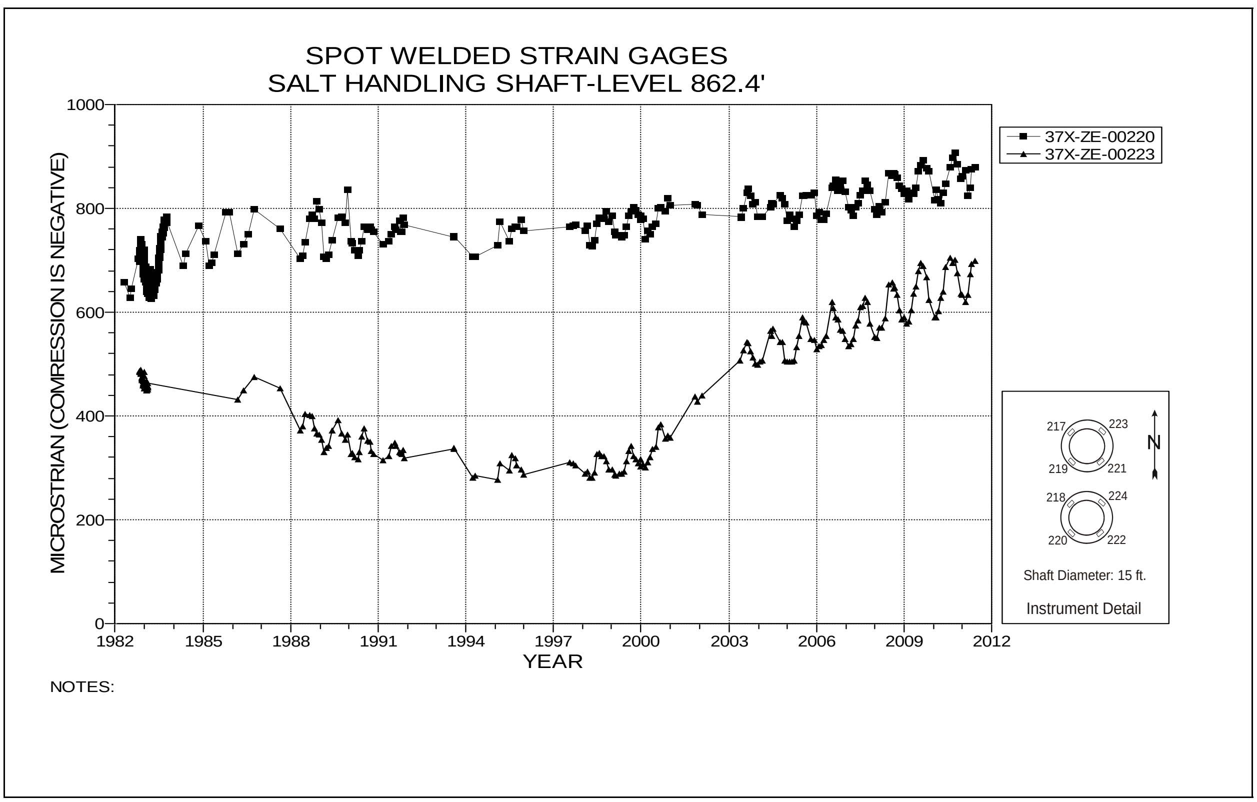


Figure 2-8 Spot-Welded Strain Gages
Salt Handling Shaft Key – Level 862.4

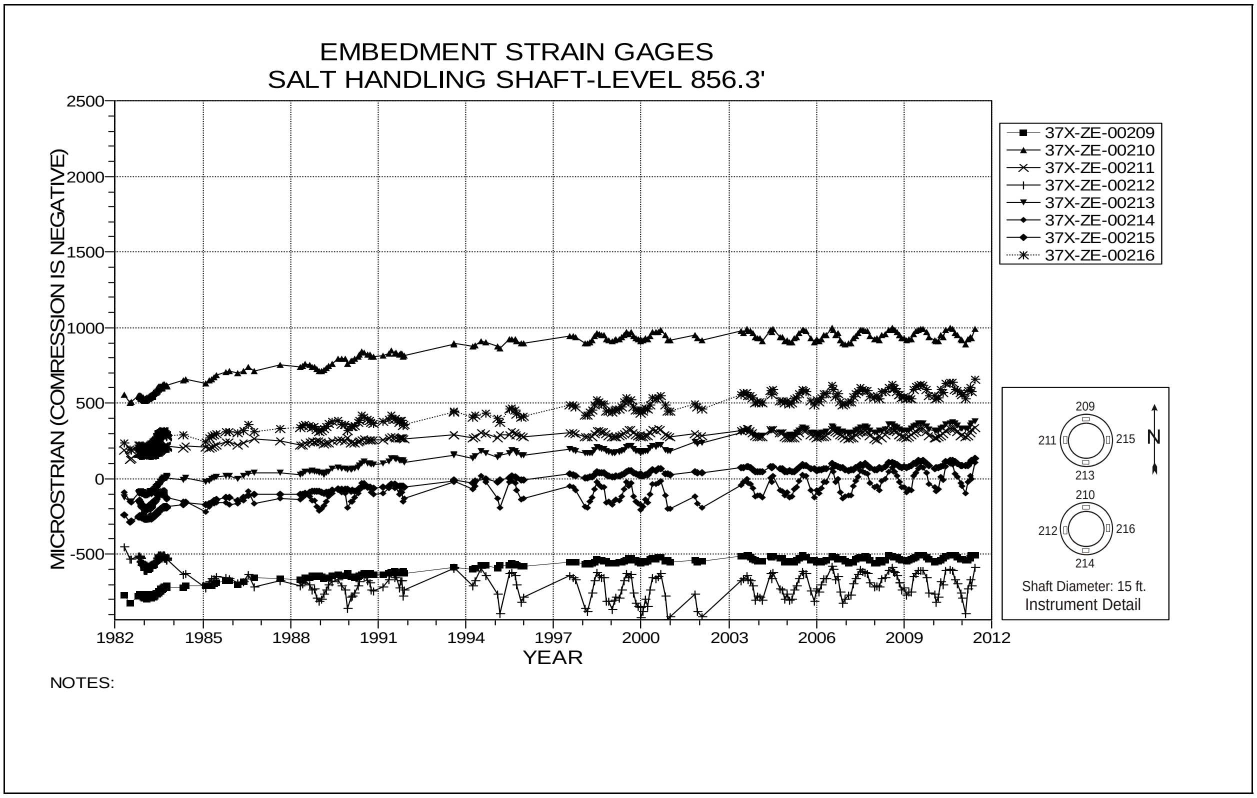


Figure 2-9 Embedment Strain Gages
Salt Handling Shaft Key – Level 856.3

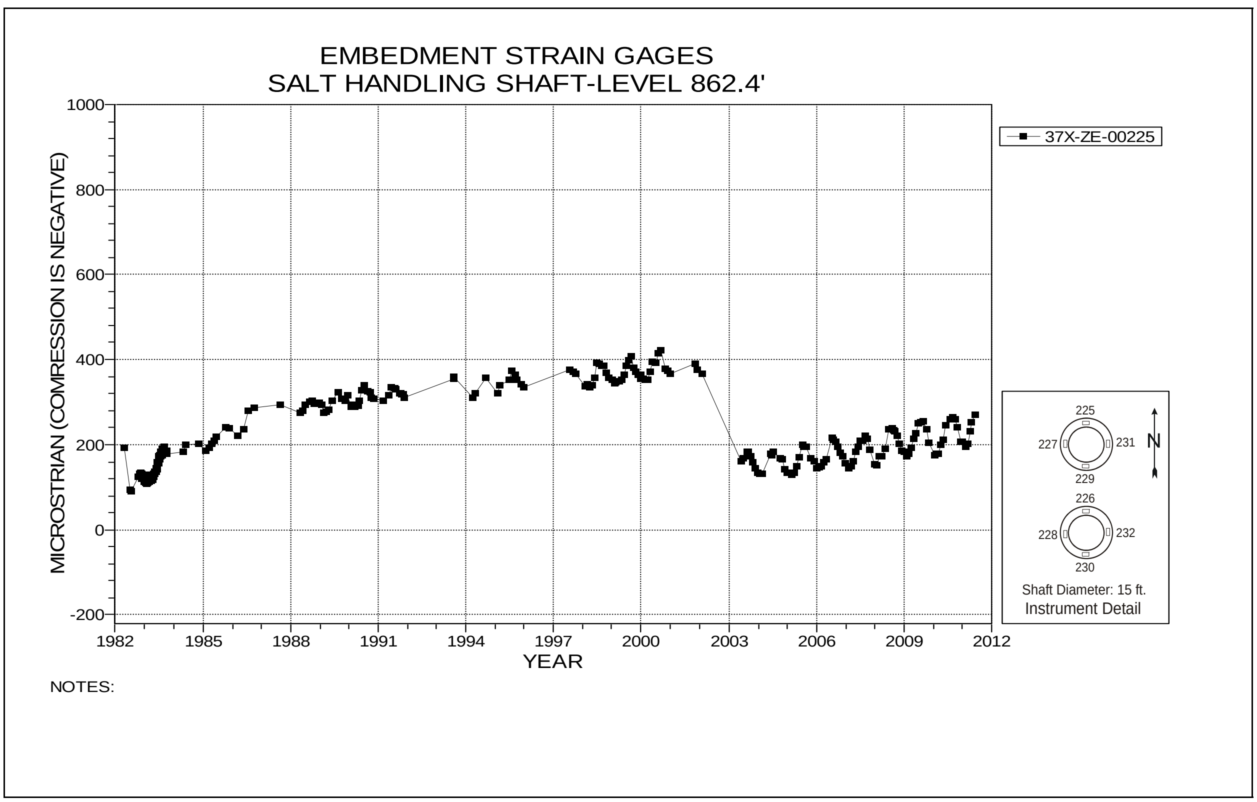


Figure 2-10 Embedment Strain Gage
Salt Handling Shaft Key Level 862.4

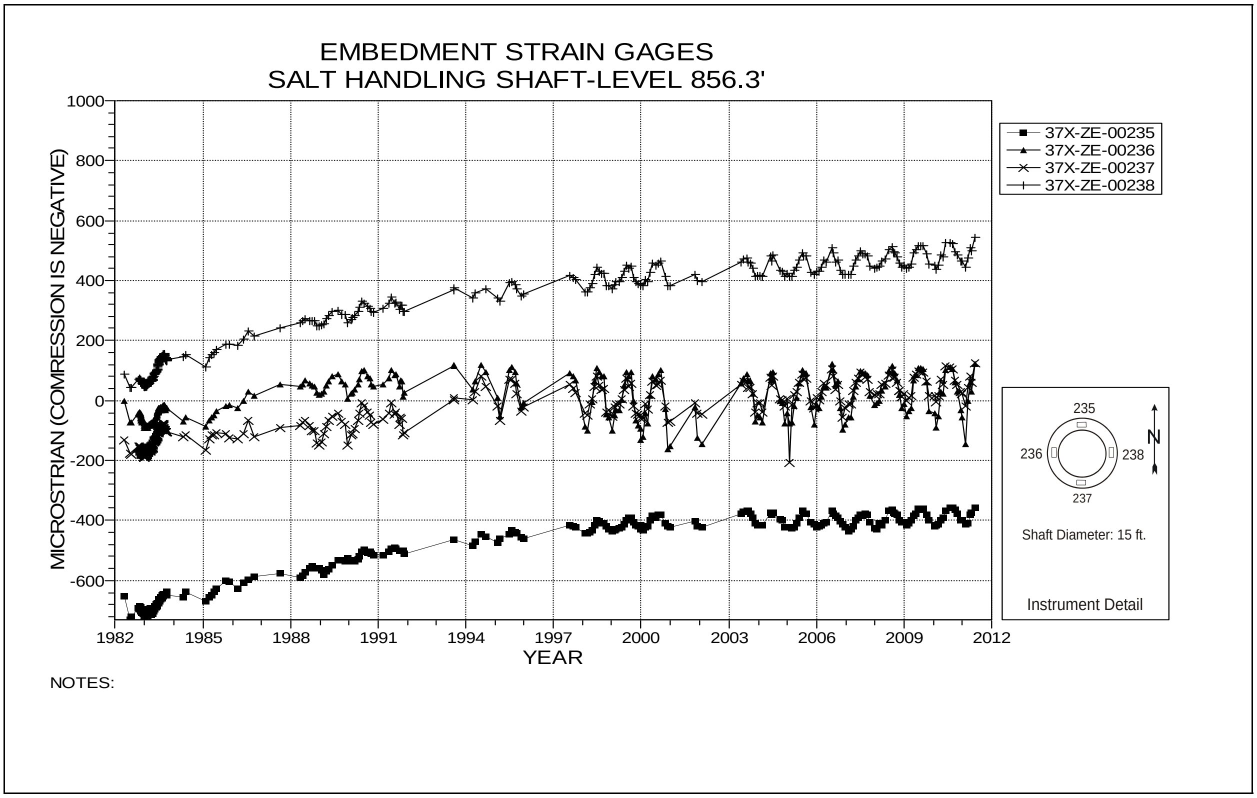


Figure 2-11 Embedment Strain Gages
Salt Handling Shaft Key Level 856.3

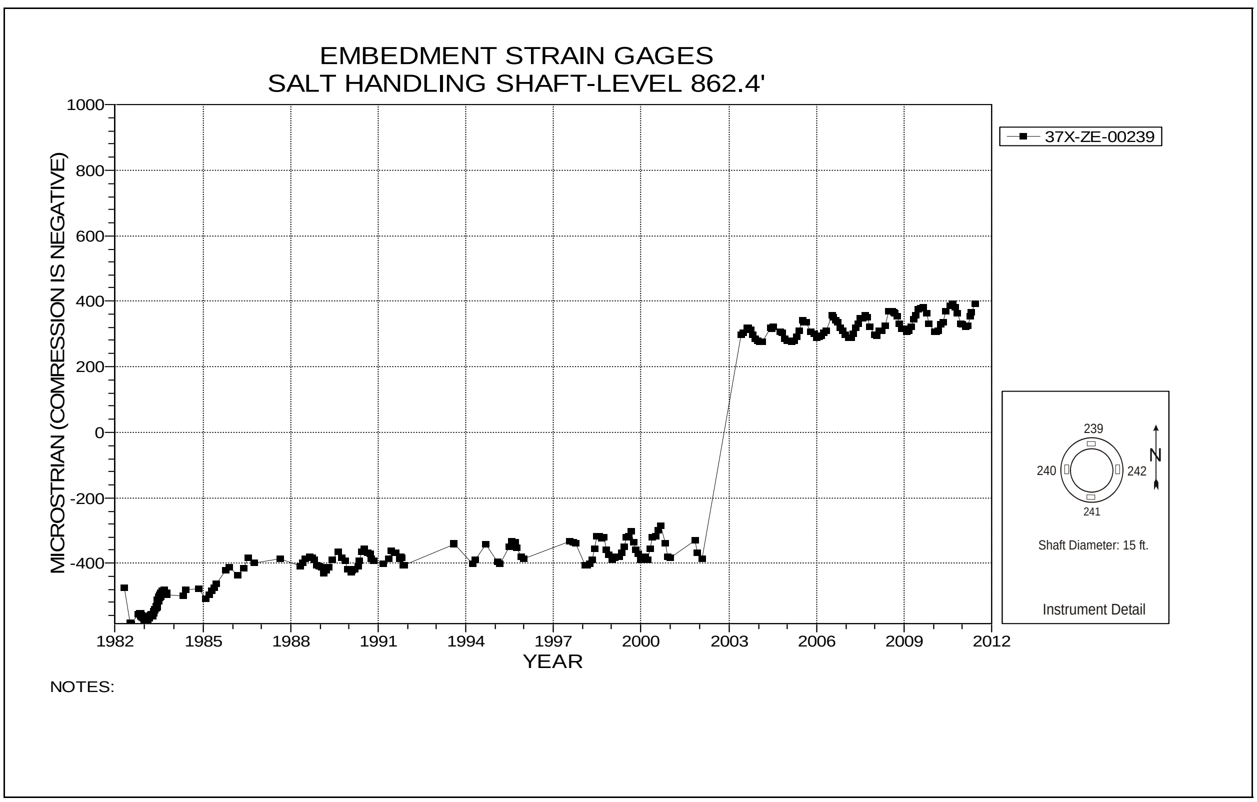


Figure 2-12 Embedment Strain Gage
Salt Handling Shaft Key – Level 862

Table 2-2
Waste Shaft Data Analysis

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Pressure Readings (psi)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Pressure Reading (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X-PE-00208	717	2-13	07/16/10	138	06/16/10	145	-7	
31X-PE-00209	758	2-14	08/09/10	52	06/16/10	51	1	
31X-PE-00211	845	2-15	07/16/10	60	09/25/09	67	-7	
31X-PE-00212	845	2-15	8/9/2010	68	07/29/09	72	-4	

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Pressure Readings (psi)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Pressure Reading (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X- WE-00203	866	2-16	06/16/11	118	08/27/09	125	-7	

Table 2- Waste Shaft Data Analysis

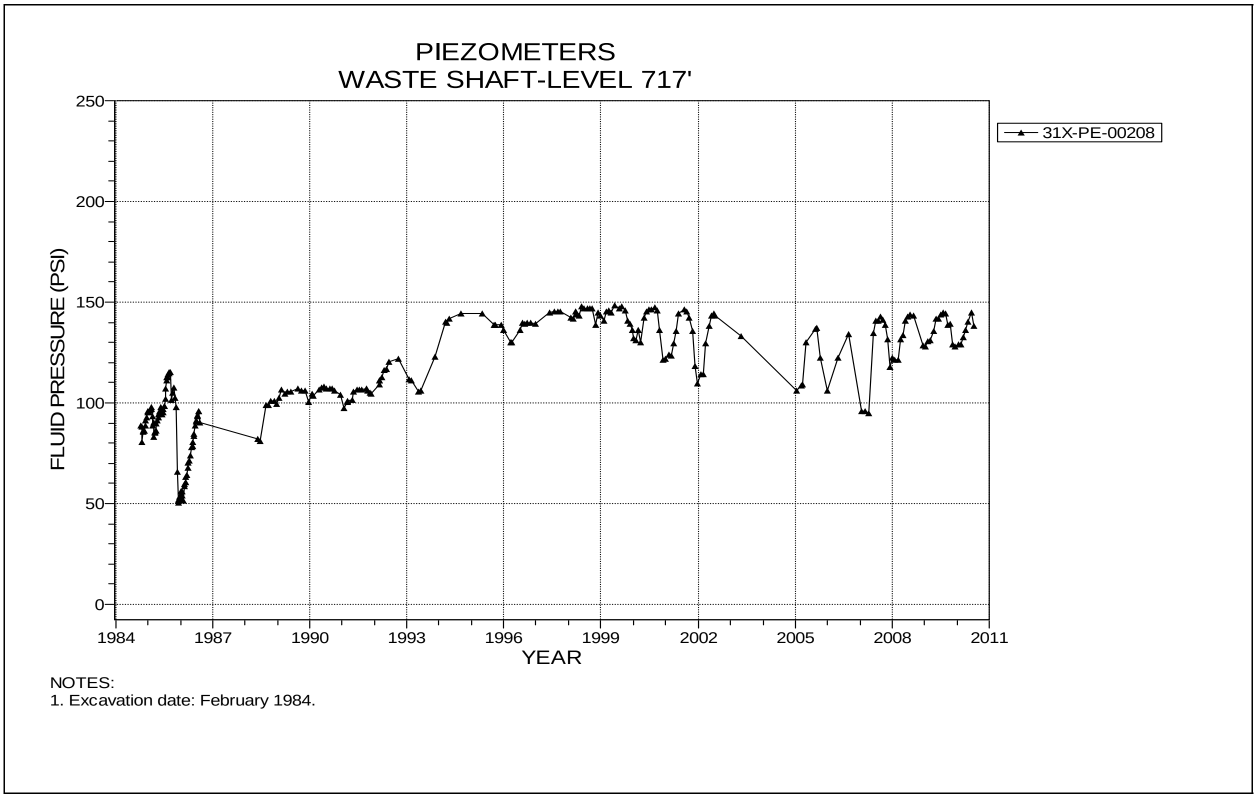


Figure 2-13 Piezometer 31X-PE-00208
Waste Shaft – Level 717 at the Culebra Dolomite Member

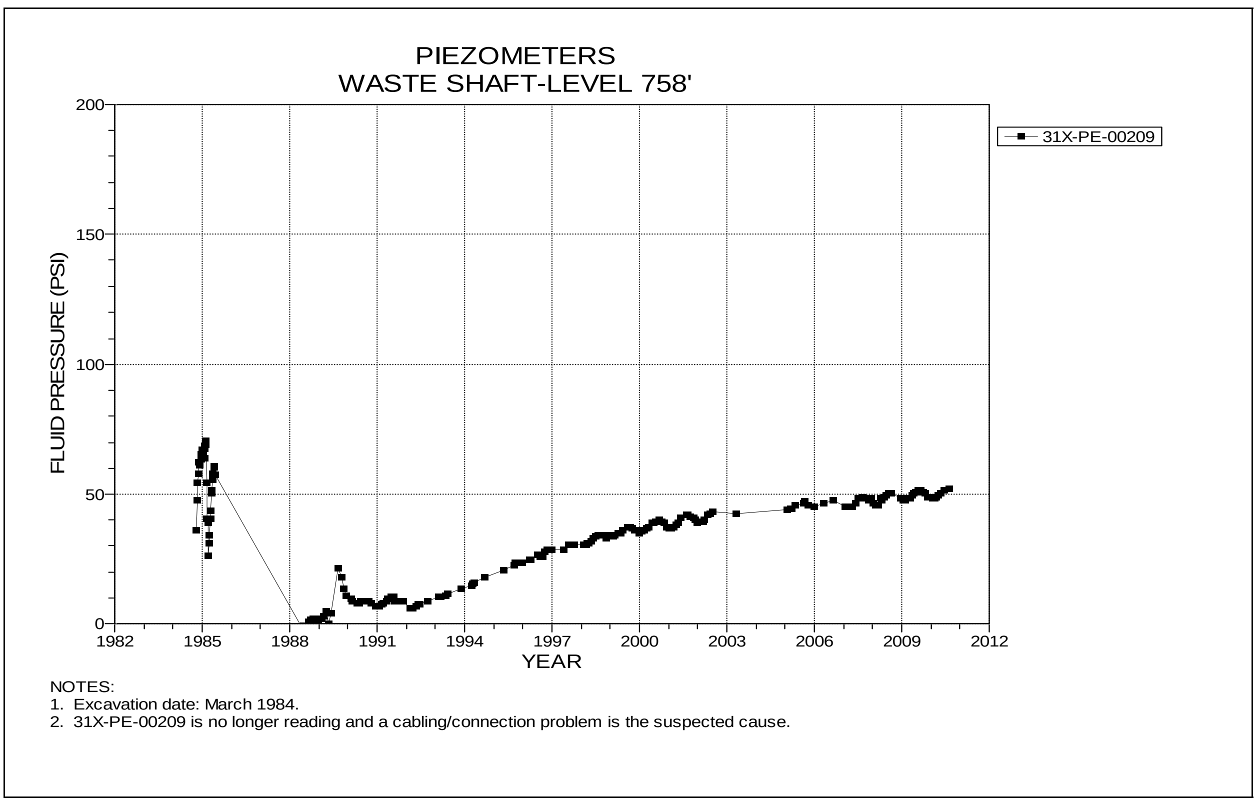
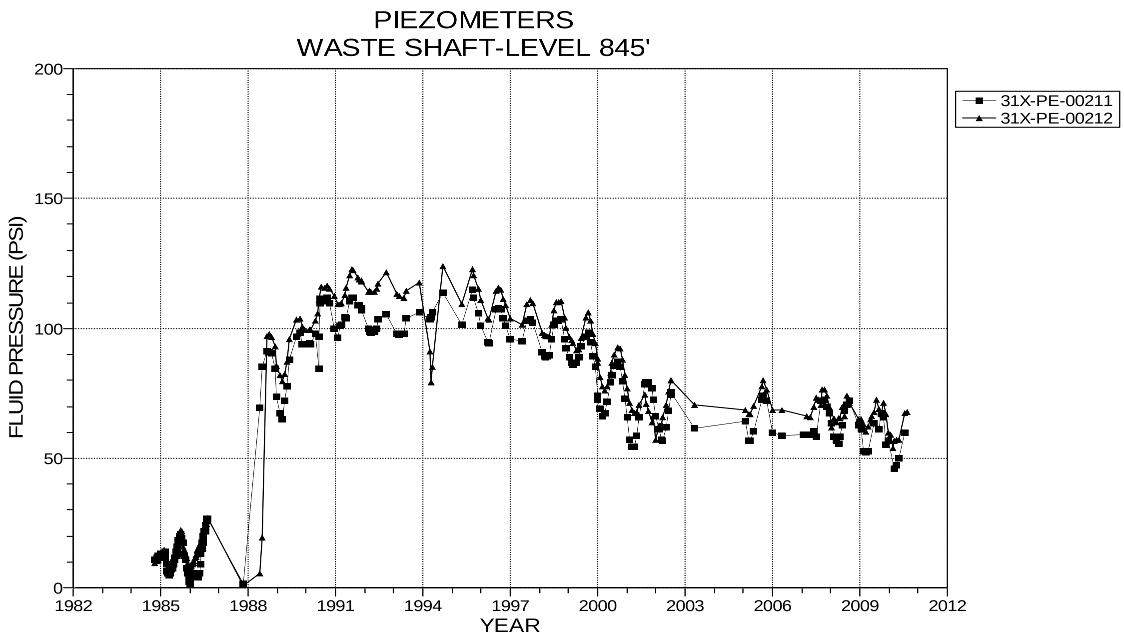
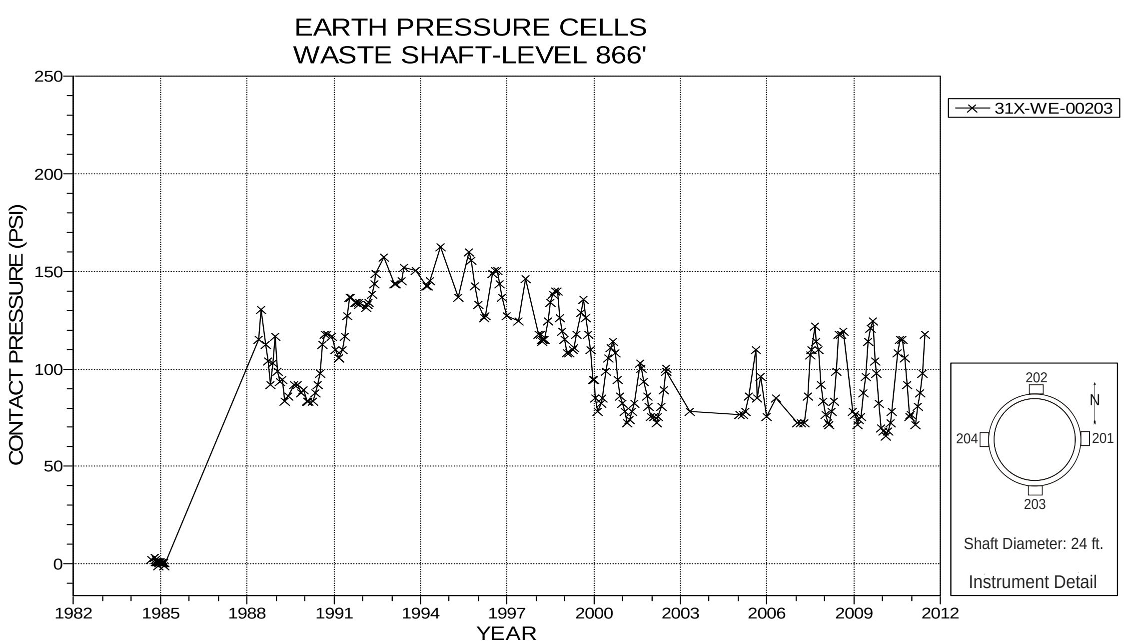


Figure 2-14 Piezometer 31X-PE-00209 Waste Shaft – Level 758 at the Los Medaños Member



NOTES:
1. Excavation date: March 1984.
2. Instruments are no longer reading; probably due to an electrical connection.

Figure 2-15 Piezometers 31X-PE-00211 and 31X-PE-00212
Waste Shaft – Level 845 at the Rustler-Salado Contact



NOTES:
1. Excavation date: March 1984.
2. 31X-WE-00201, 202 & 204 are no longer reading, suspect cabling/connection problem.

Figure 2-16 Earth Pressure Cell 31X-WE-00203
Waste Shaft Key – Level 866

Table 2-3
Exhaust Shaft Data Analysis

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2010-2011 Max. Reading	2010-2011 Maximum Pressure Readings (psi)	Date of 2009-2010 Max. Reading	2009-2010 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
35X-PE-00202	544	2-17	06/06/11	-3	06/03/10	-3	0	
35X-PE-00204	615	2-18	06/06/11	125	10/05/09	126	-1	
35X-PE-00208	673	2-19	06/06/11	5	09/01/09	6	-1	
35X-PE-00210	721	2-20	06/06/11	141	09/01/09	141	0	
35X-PE-00213	768	2-21	06/06/11	8	09/01/09	9	-1	
35X-PE-00214	768	2-21	06/06/11	6	08/03/09	7	-1	
35X-PE-00218	850	2-22	05/02/11	46	01/04/10	27	19	
35X-PE-00219	887	2.23	06/06/11	25	10/05/09	27	-2	

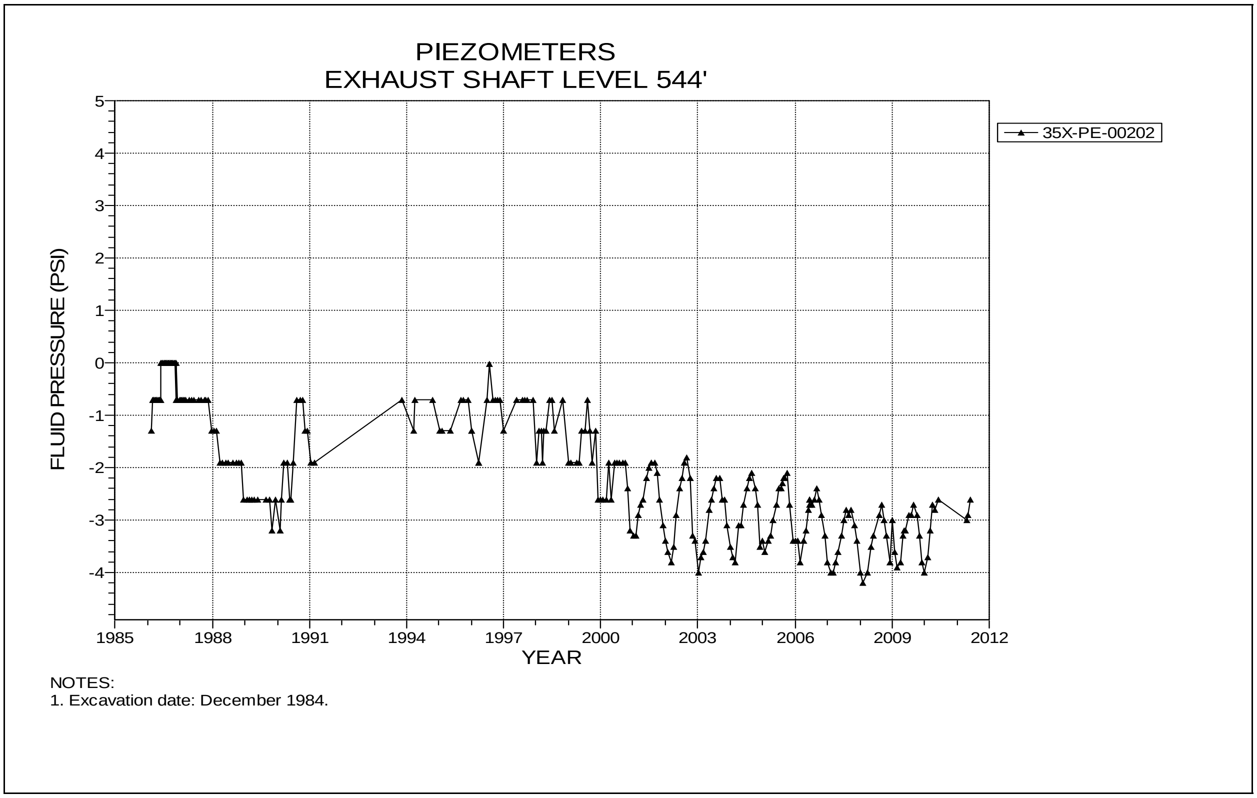


Figure 2-15 Piezometer 35X-PE-00202
Exhaust Shaft – Level 544 at the Base of Dewey Lake Redbeds

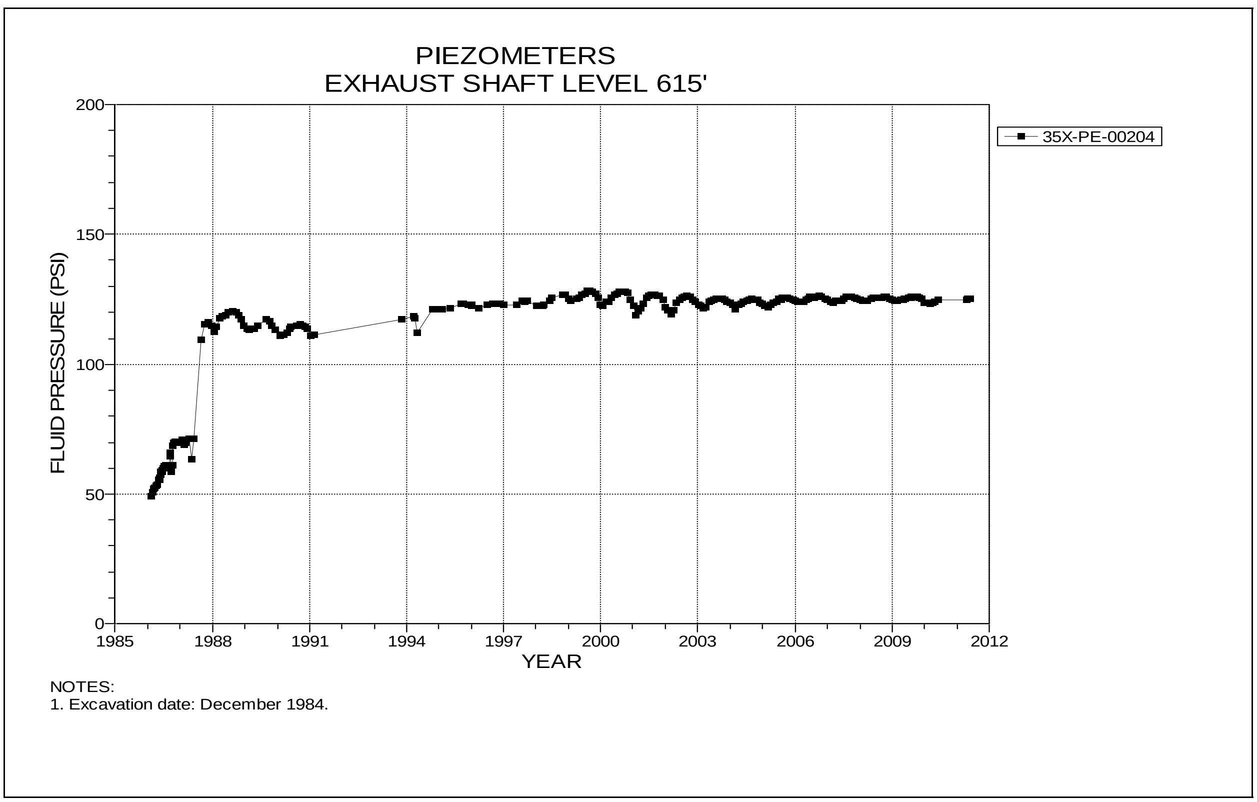


Figure 2- 16 Piezometer 35X-PE-00204
Exhaust Shaft – Level 615 at the Magenta Dolomite Member

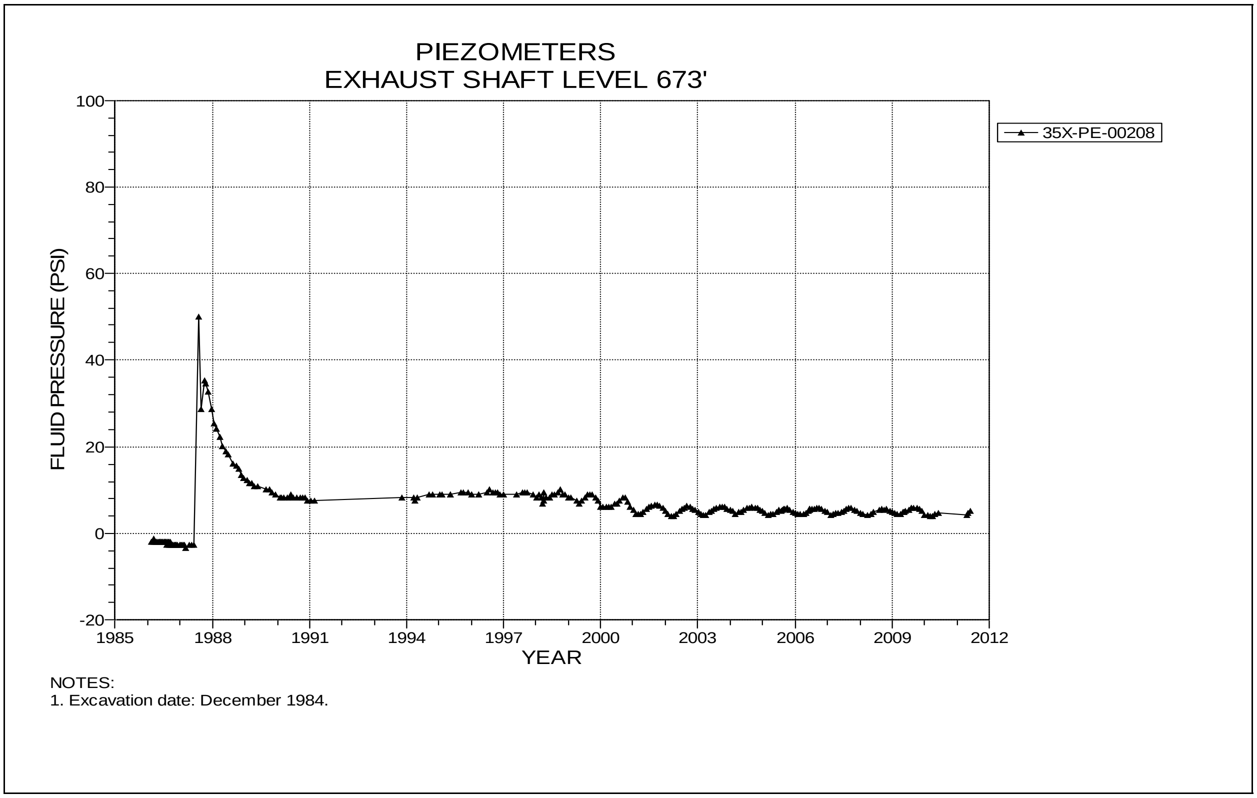


Figure 2-17 Piezometer 35X-PE-00208
Exhaust Shaft – Level 673 at the Tamarisk Member

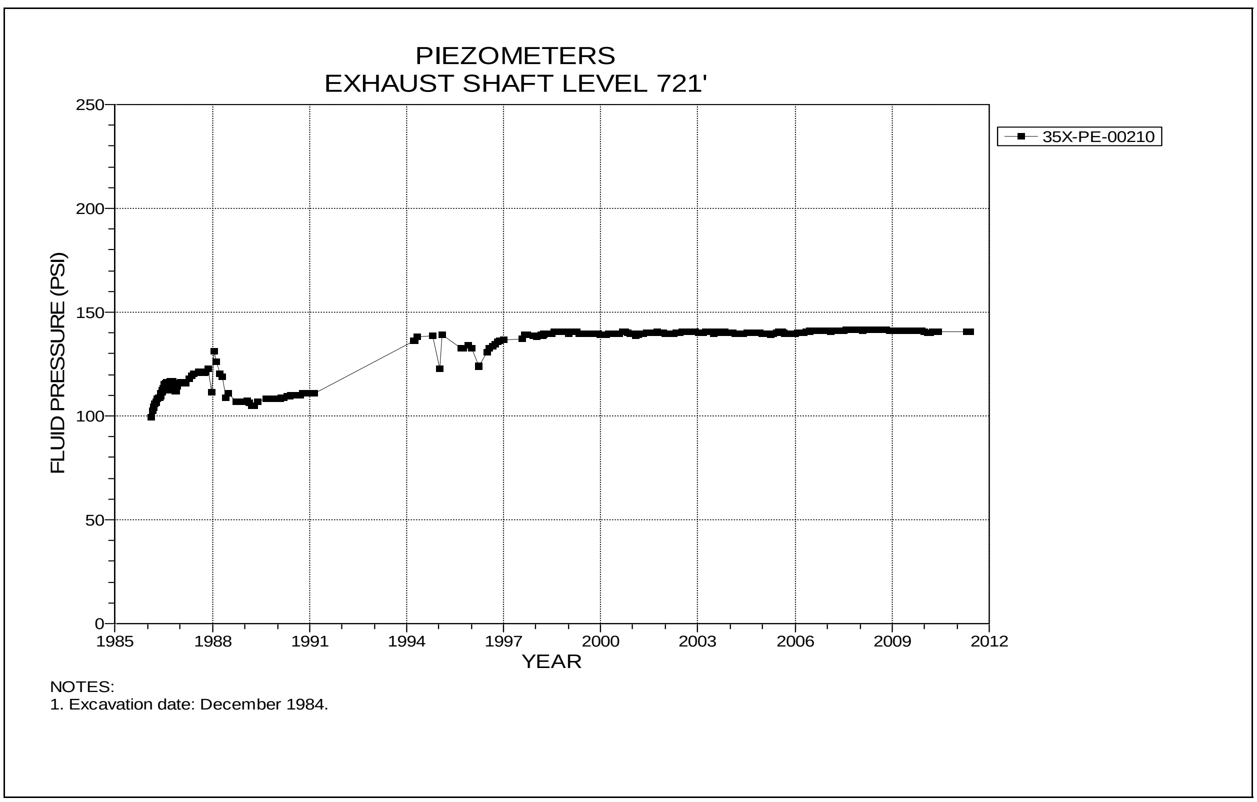


Figure 2-20 Piezometer 35X-PE-00210
Exhaust Shaft – Level 721 at the Culebra Dolomite Member

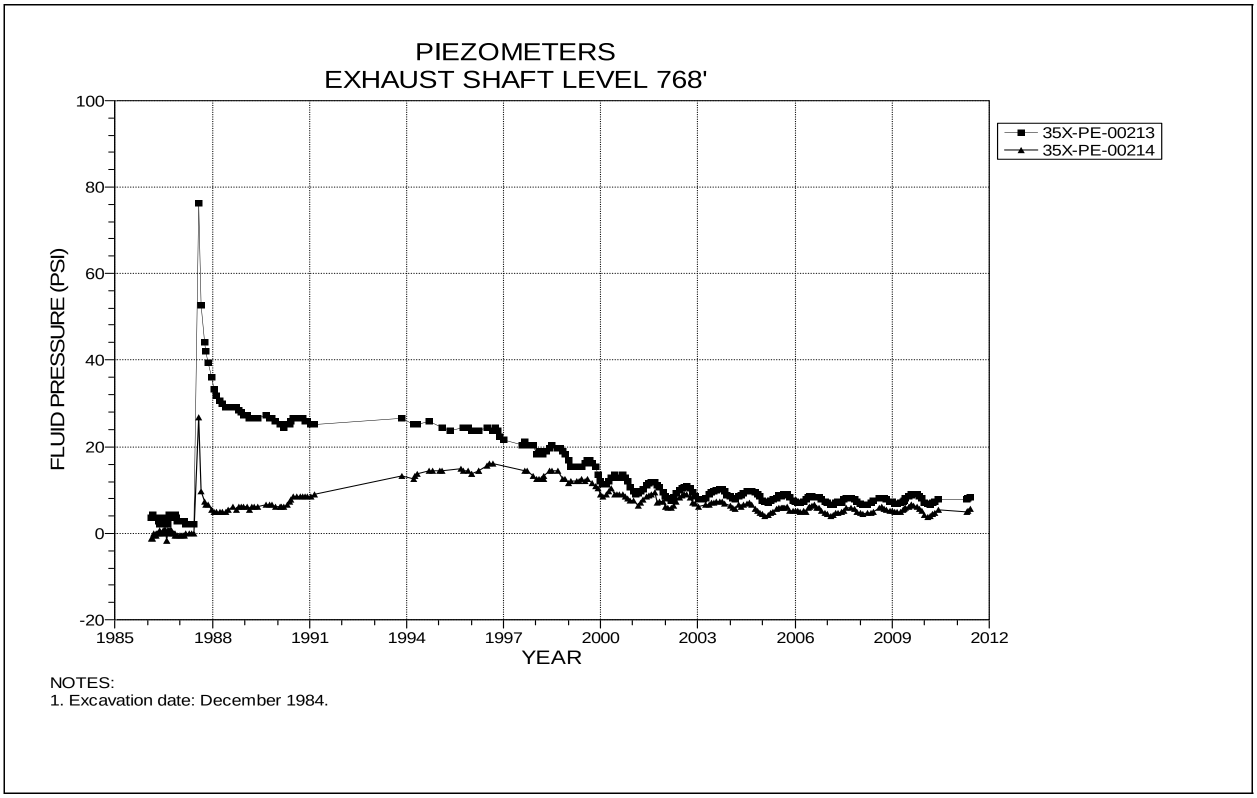


Figure 2-21 Piezometers 35X-PE-00213 and 35X-PE-00214
Exhaust Shaft – Level 768 at the Los Medaños Member

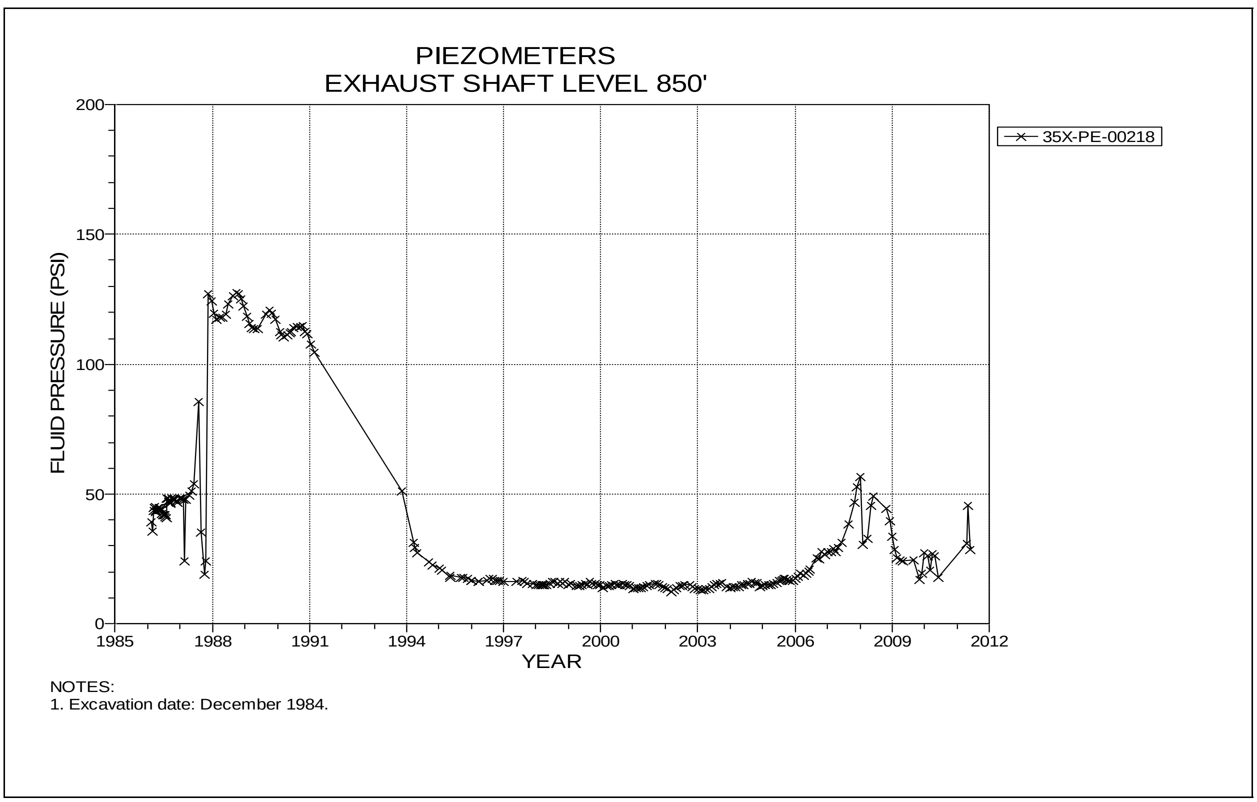


Figure 2-22 Piezometer 35X-PE-00218
Exhaust Shaft – Level 850 at the Rustler-Salado Contact

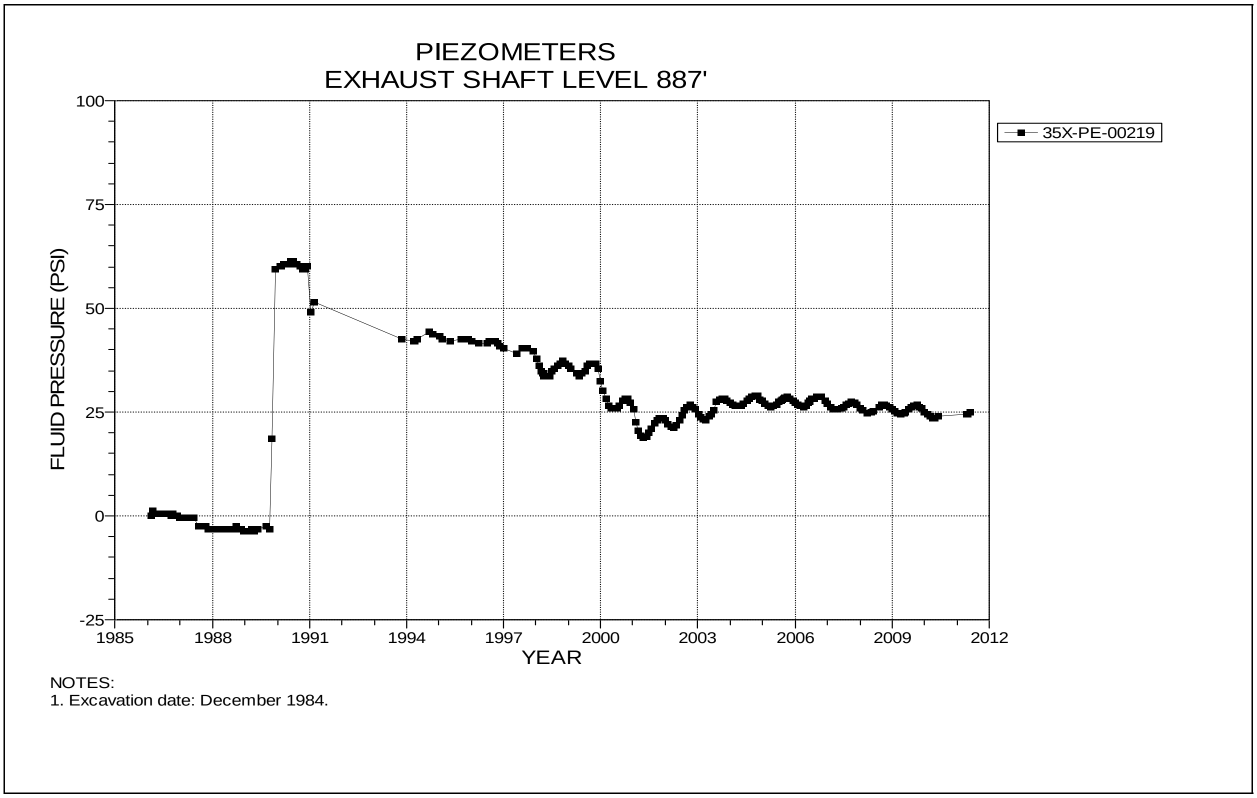


Figure 2-23 Piezometer 35X-PE-00219
Exhaust Shaft – Level 887 below the Lower Chemical Seal

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3.0 Instrumentation Summary for Shaft Stations

Instrumentation data analysis for the Salt Handling Shaft Station, Waste Shaft Station, and the area around the Air Intake Shaft follow. Table 3-1 presents data analyses for each of the Salt Handling Shaft Station instruments. Figures 3-1 through 3-3 present plots of the instrumentation data for the Salt Handling Shaft Station.

Table 3-2 presents data and analysis for the Waste Shaft Station. Plots from the instrumentation in the Waste Shaft Station are presented as Figures 3-4 through 3-7.

Table 3-3 and Figures 3-8 through 3-13 present the data from rock bolt load cells and borehole extensometers located in the immediate area around the Air Intake Shaft.

Table 3-1
Salt Handling Shaft Station Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010-2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
E0-S18-6 A-E	E0 Drift-S18	3-1	06/29/11	20.516	38.033	1.85	1.37	35%	
E0-S18-4 B-D	E0 Drift-S18	3-1a	06/29/11	22.389	39.407	2.01	1.52	32%	
E0-S18-4 H-F	E0 Drift-S18	3-1a	06/29/11	13.925	24.741	1.26	0.92	37%	
E0-S30-5 A-C	E0 Drift-S30	3-2	06/29/11	21.236	52.805	1.88	1.40	34%	
E0-S65-3 A-C	E0 Drift-S65	3-3	05/04/11	15.102	45.416	1.17	1.11	5%	

Table 3- Salt Handling Shaft Station Data Analysis

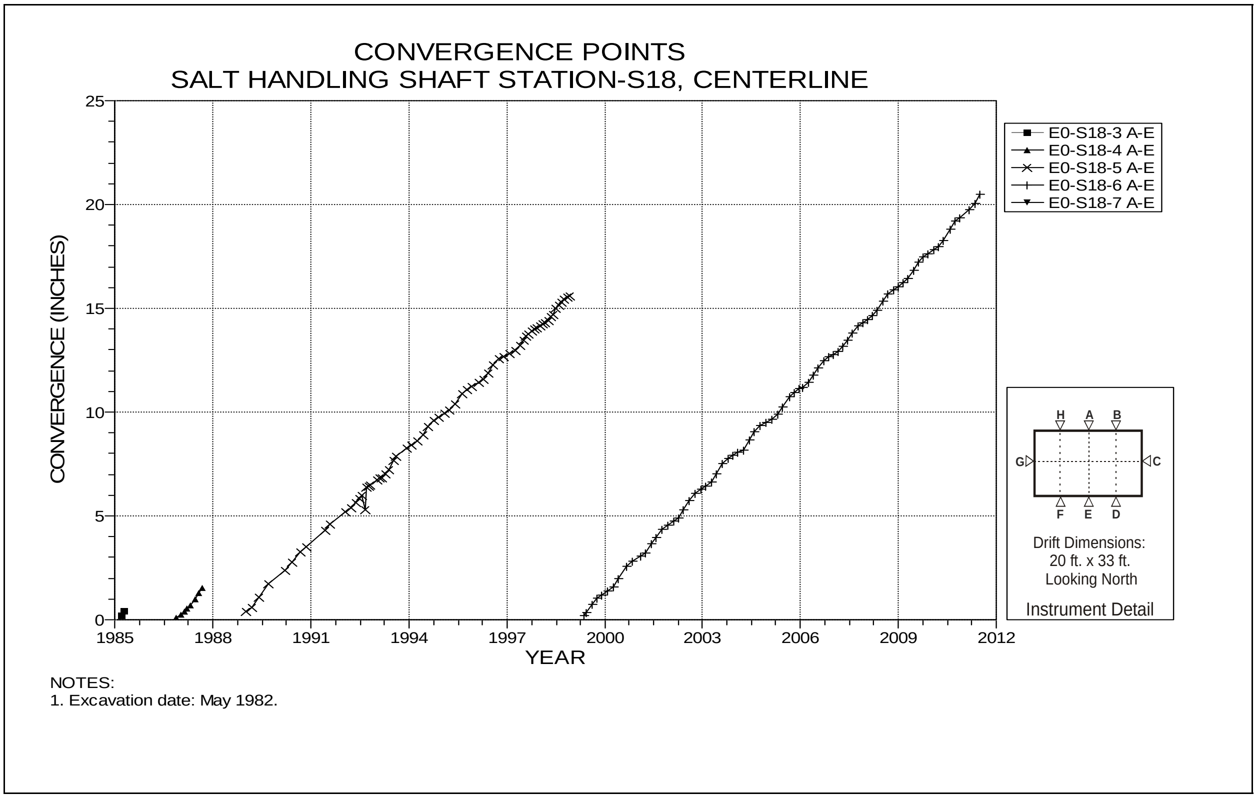


Figure 3-1 Convergence Point Array
Salt Handling Shaft Station at S18 – Centerline

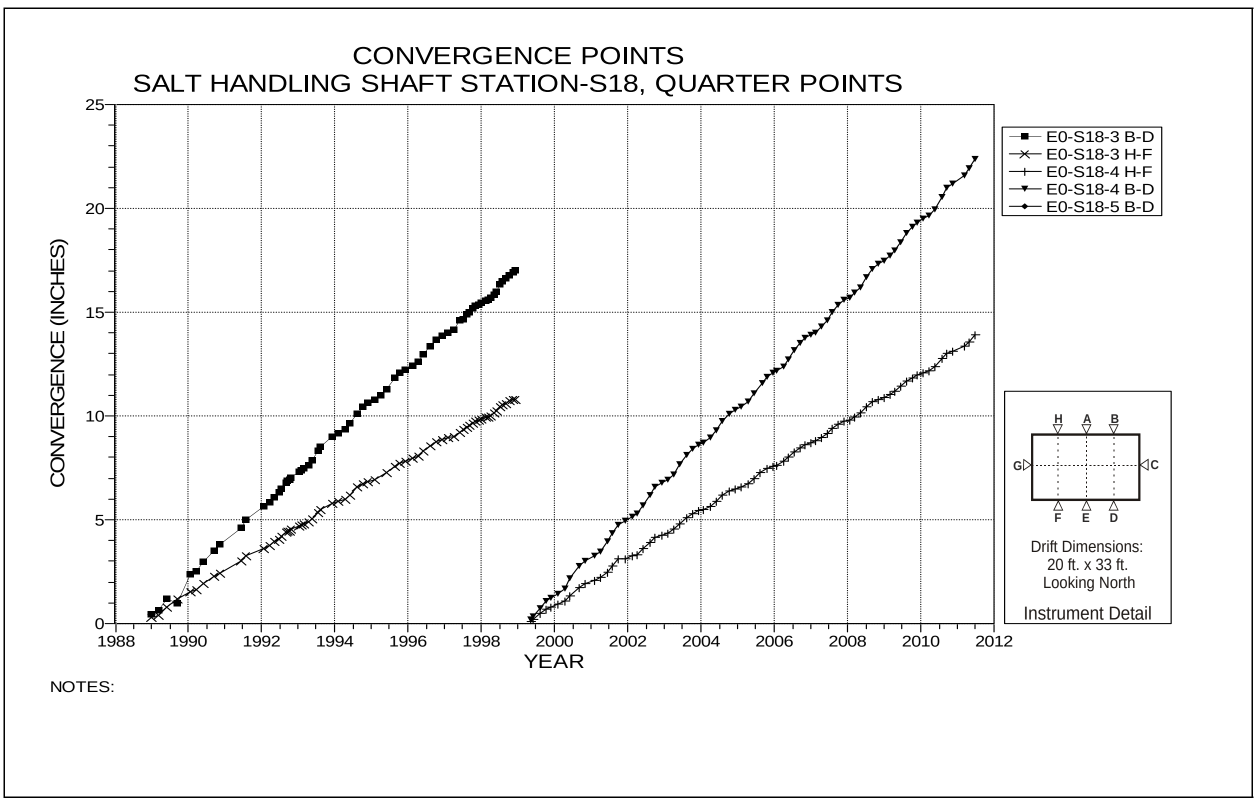


Figure 3-1a Convergence Point Array
Salt Handling Shaft Station at S18 – Quarter-Points

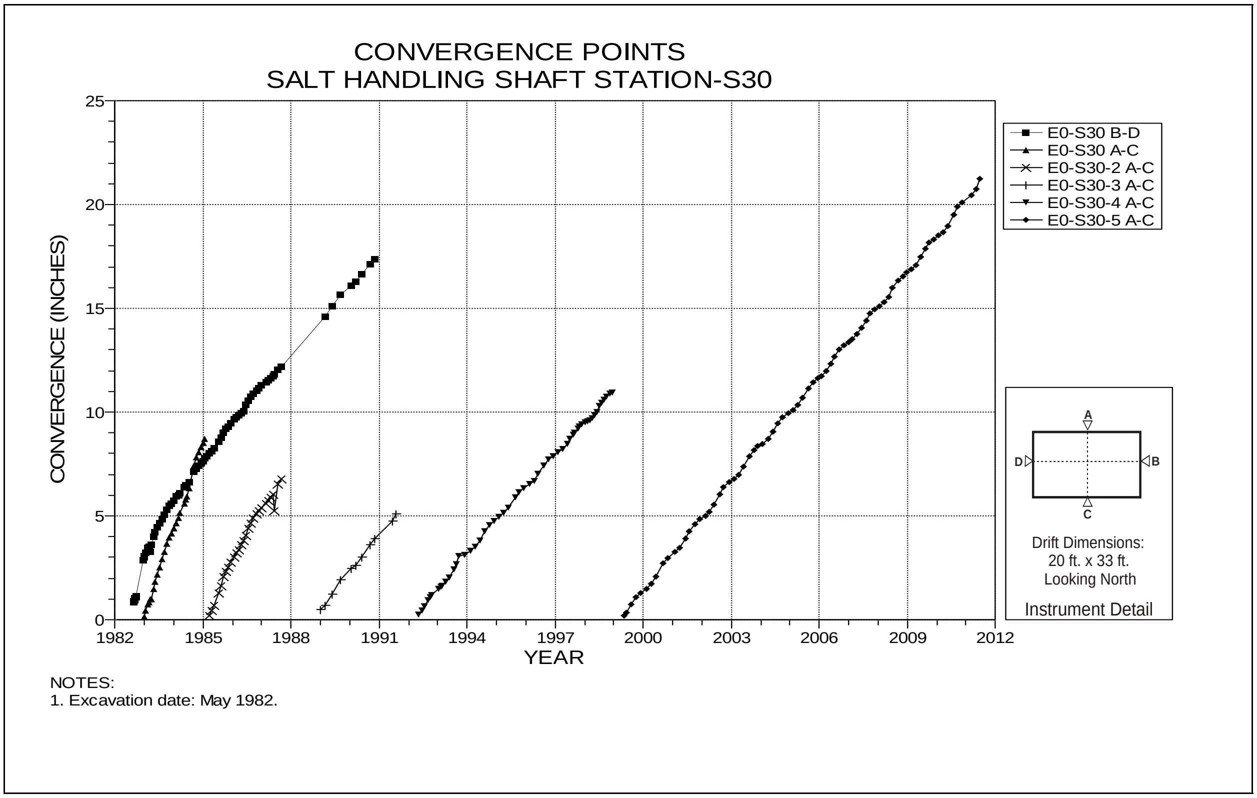


Figure 3-2 Convergence Point Array
Salt Handling Shaft Station at S30 – Roof to Floor

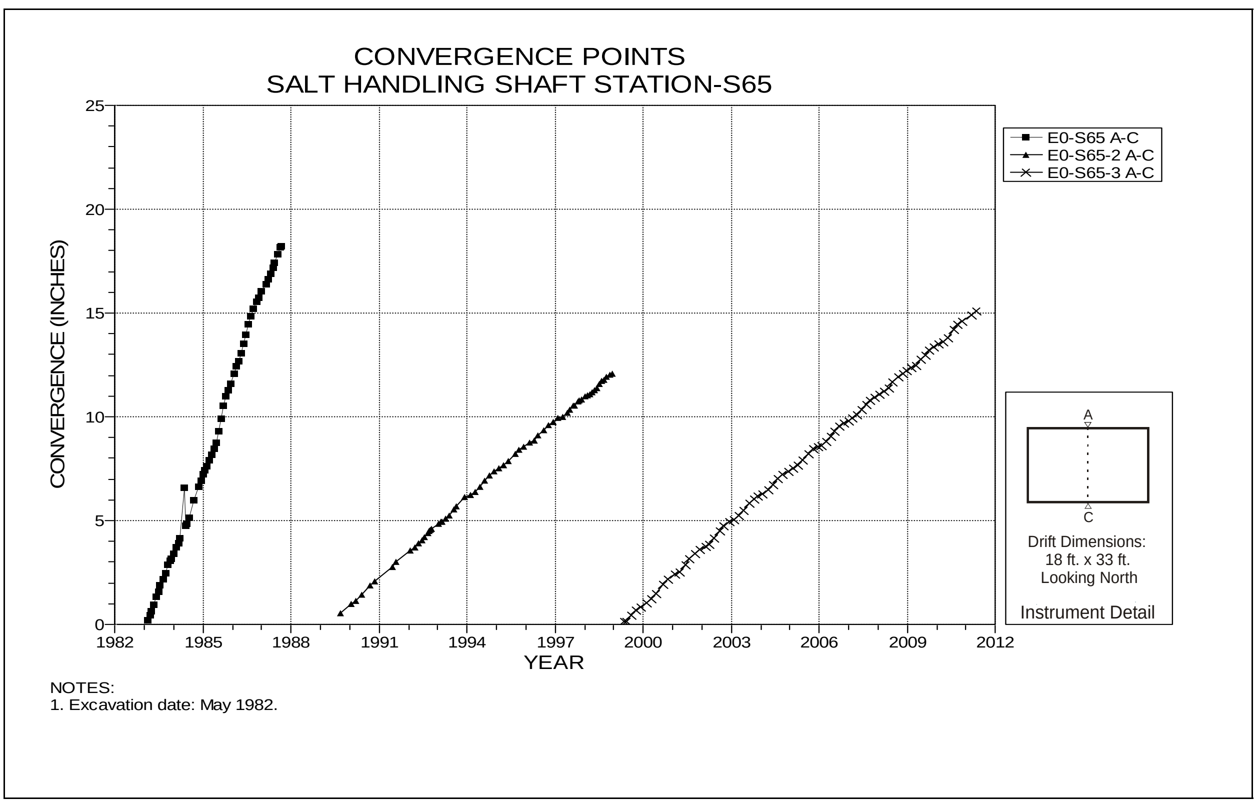


Figure 3-3 Convergence Point Array
Salt Handling Shaft Station at S65 – Roof to Floor

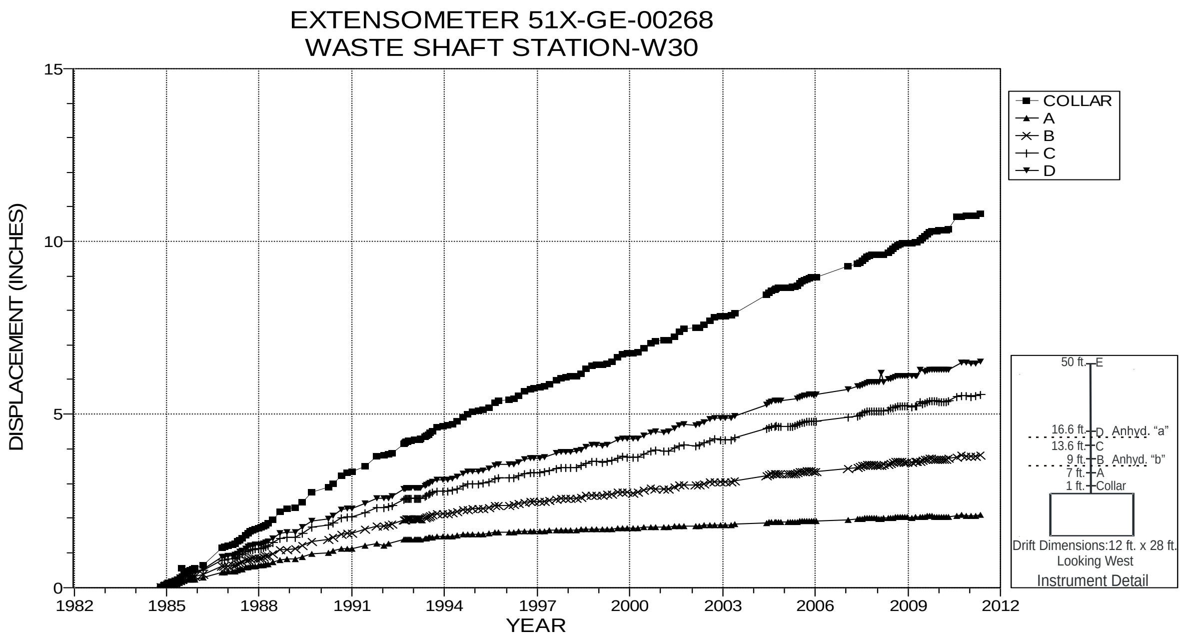
Table 3-2
Waste Shaft Station Data Analysis

EXTENSOMETERS

Fieldtag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2010 to 2011 (in/year)	Displacement Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-GE-00268	W30 Drift-S400 Roof	3-4	05/04/11	10.805	0.105	0.27	-61%	
51X-GE-00404-2	Waste Station Roof	3-5	06/27/11	0.283	0.265	0.29	-9%	

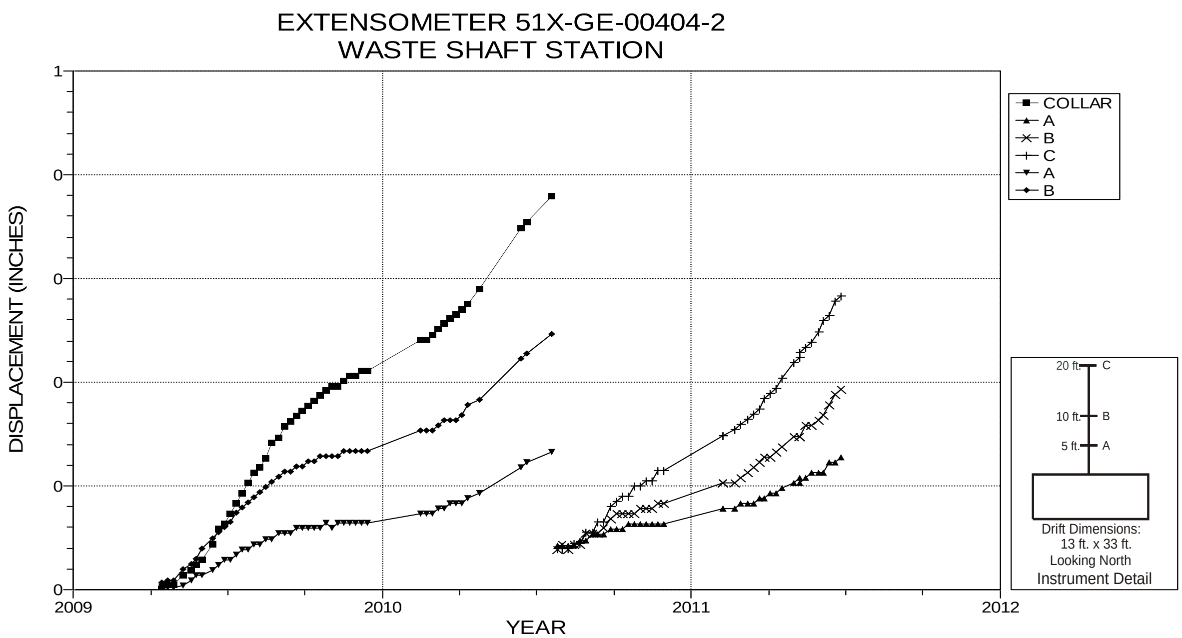
CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010-2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
S400-E32-2 B-D	S400-E32	3-6	06/16/11	2.918	2.918	1.26	1.17	8%	
S400-E85 B-D	S400-E85	3-7	06/16/11	2.963	2.918	1.32	1.16	14%	



NOTES:
1. Excavation date: November 1982.

Figure 3-4 Extensometer 51X-GE-00268
Waste Shaft Station at W30 – Roof



NOTES:
1. Excavation date: November 1982.
2. Extensometer was replaced July 2010.

Figure 3-5 Extensometer 51X-GE-00404-2
Waste Shaft Station – Roof

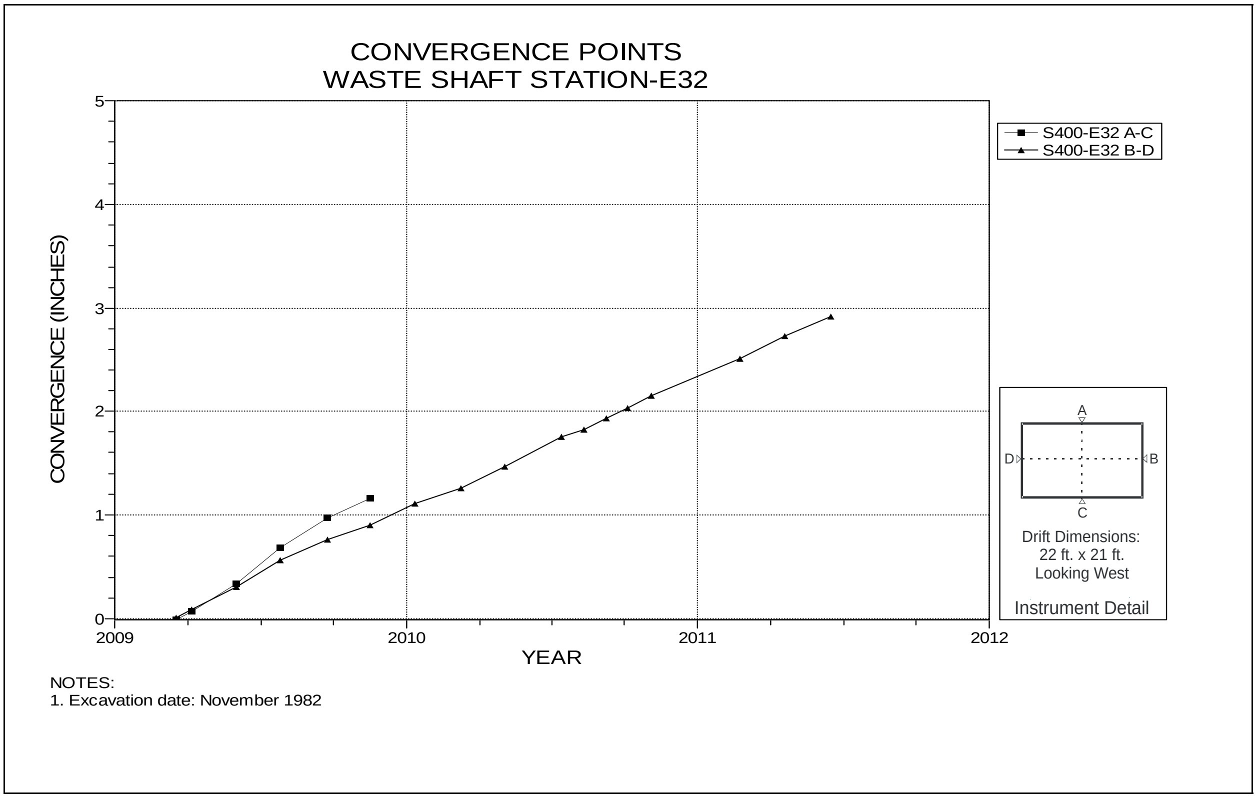


Figure 3-6 Convergence Point Array
Waste Shaft Station at E32 – All Chords

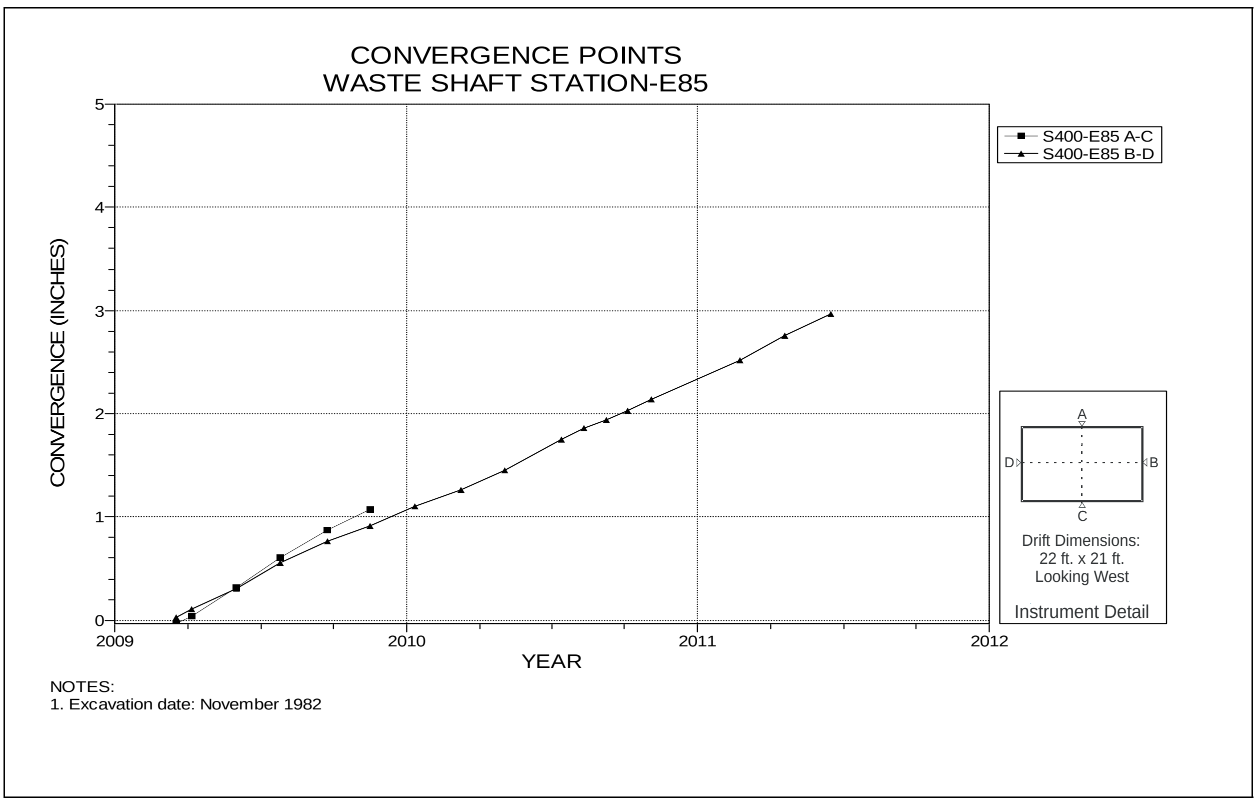


Figure 3-7 Convergence Point Array
Waste Shaft Station at E85 – All Chords

Table 3-3
Air Intake Shaft Station Data Analysis

EXTENSOMETERS

Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (Inches)	Displacement Rate 2010 to 2011 in/year	Displacement Rate 2009 to 2010 in/year	Rate Change Percent	Comments
41X-GE-00122	S65-W620 Roof	3-8	06/27/11	4.079	0.33	0.29	14%	
41X-GE-00123	N93-W620 Roof	3-9	06/27/11	5.084	0.01	0.35	-97%	Anchor @ max. range.

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X-WG-00236	AIS Station Brow – South	3-10	01/19/93	06/27/11	61.6	
51X-WG-00237	AIS Station Brow – South	3-10	01/19/93	06/27/11	1.8	
51X-WG-00238	AIS Station Brow – South	3-10	01/19/93	06/27/11	2.6	
51X-WG-00239	AIS Station Brow – South	3-10	01/19/93	06/27/11	28.0	
51X-WG-00240	AIS Station Brow – South	3-10	01/19/93	06/27/11	4.8	
51X-WG-00241	AIS Station Brow – South	3-11	01/19/93	06/27/11	66.3	
51X-WG-00242	AIS Station Brow – South	3-11	01/19/93	06/27/11	12.5	
51X-WG-00243	AIS Station Brow – South	3-11	01/19/93	06/27/11	9.3	
51X-WG-00244	AIS Station Brow – South	3-11	12/24/94	06/27/11	23.7	
51X-WG-00245	AIS Station Brow – South	3-11	01/19/93	06/27/11	0.8	
51X-WG-00246	AIS Station Brow – North	3-12	01/19/93	06/27/11	54.8	
51X-WG-00247	AIS Station Brow – North	3-12	01/19/93	06/27/11	58.4	
51X-WG-00248	AIS Station Brow – North	3-12	01/19/93	06/27/11	9.4	
51X-WG-00249	AIS Station Brow – North	3-12	01/19/93	06/27/11	36.8	
51X-WG-00250	AIS Station Brow – North	3-12	12/24/94	06/27/11	18.0	
51X-WG-00251	AIS Station Brow – North	3-13	01/19/93	06/27/11	36.9	
51X-WG-00252	AIS Station Brow – North	3-13	01/19/93	06/27/11	0.3	
51X-WG-00253	AIS Station Brow – North	3-13	01/19/93	06/27/11	55.8	
51X-WG-00254	AIS Station Brow – North	3-13	01/19/93	06/27/11	12.9	
51X-WG-00255	AIS Station Brow – North	3-13	01/19/93	06/27/11	34.0	

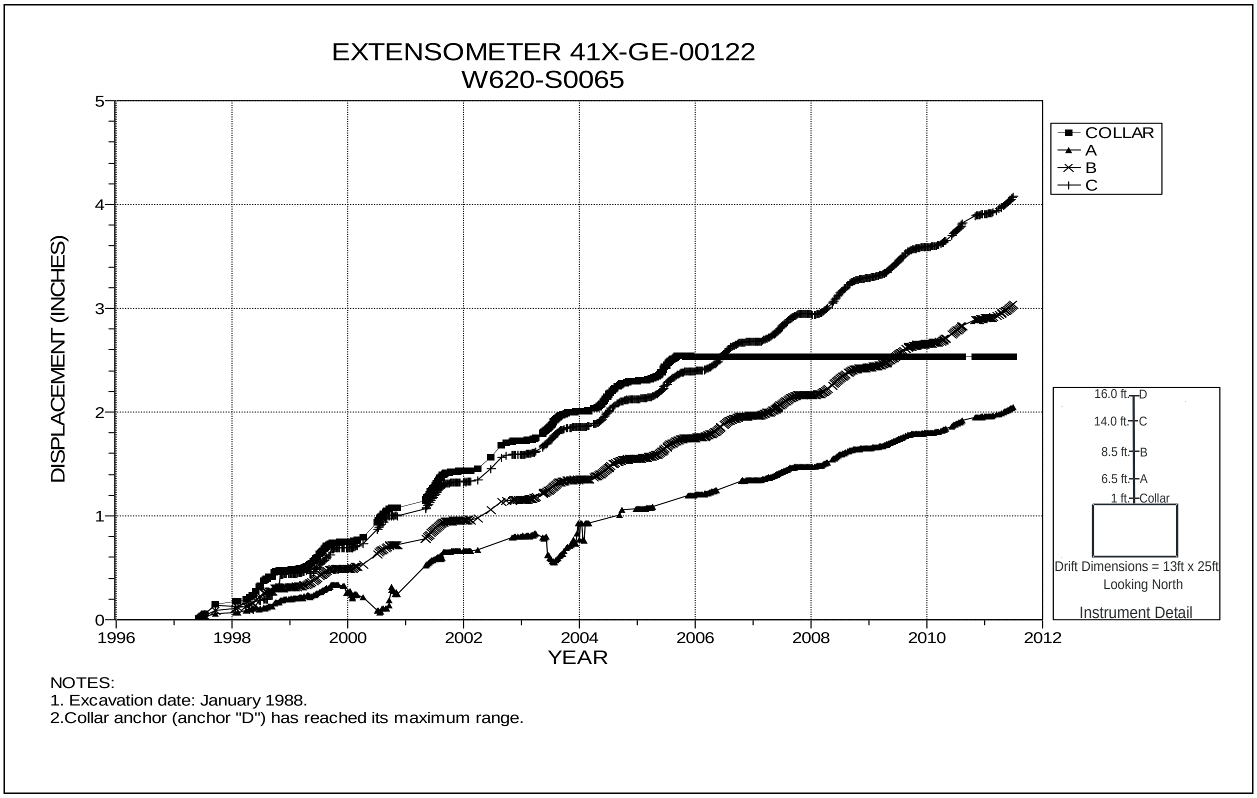


Figure 3-8 Extensometer 41X-GE-00122
Air Intake Shaft Station at S65 – Roof

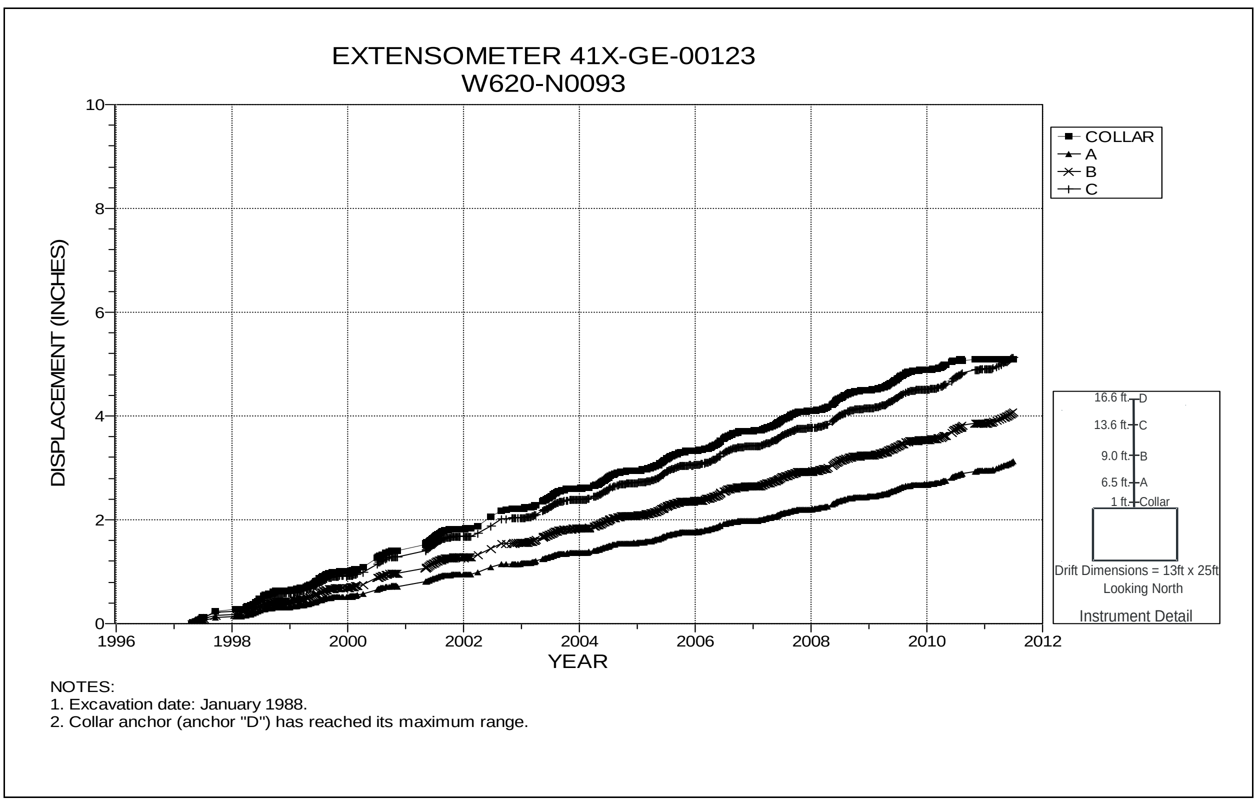


Figure 3-9 Extensometer 41X-GE-00123
Air Intake Shaft Station at N93 – Roof

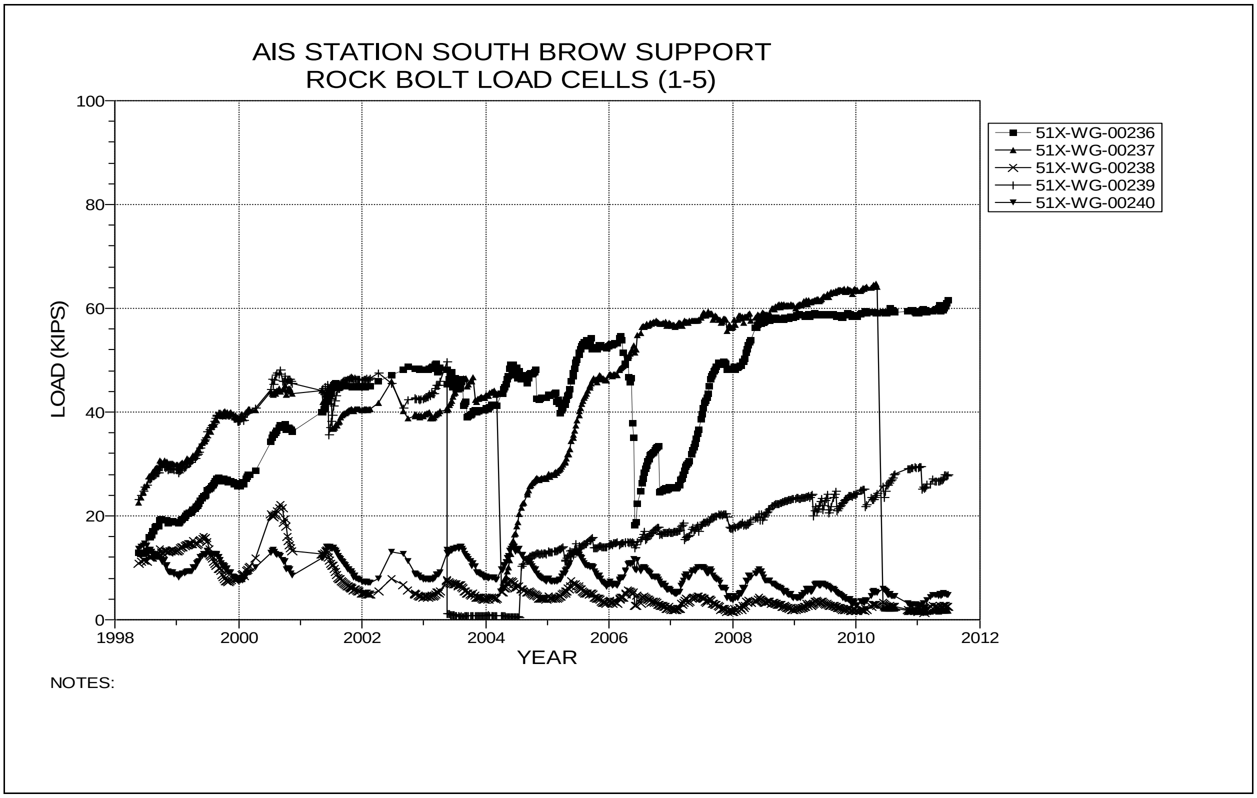


Figure 3-10 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 1

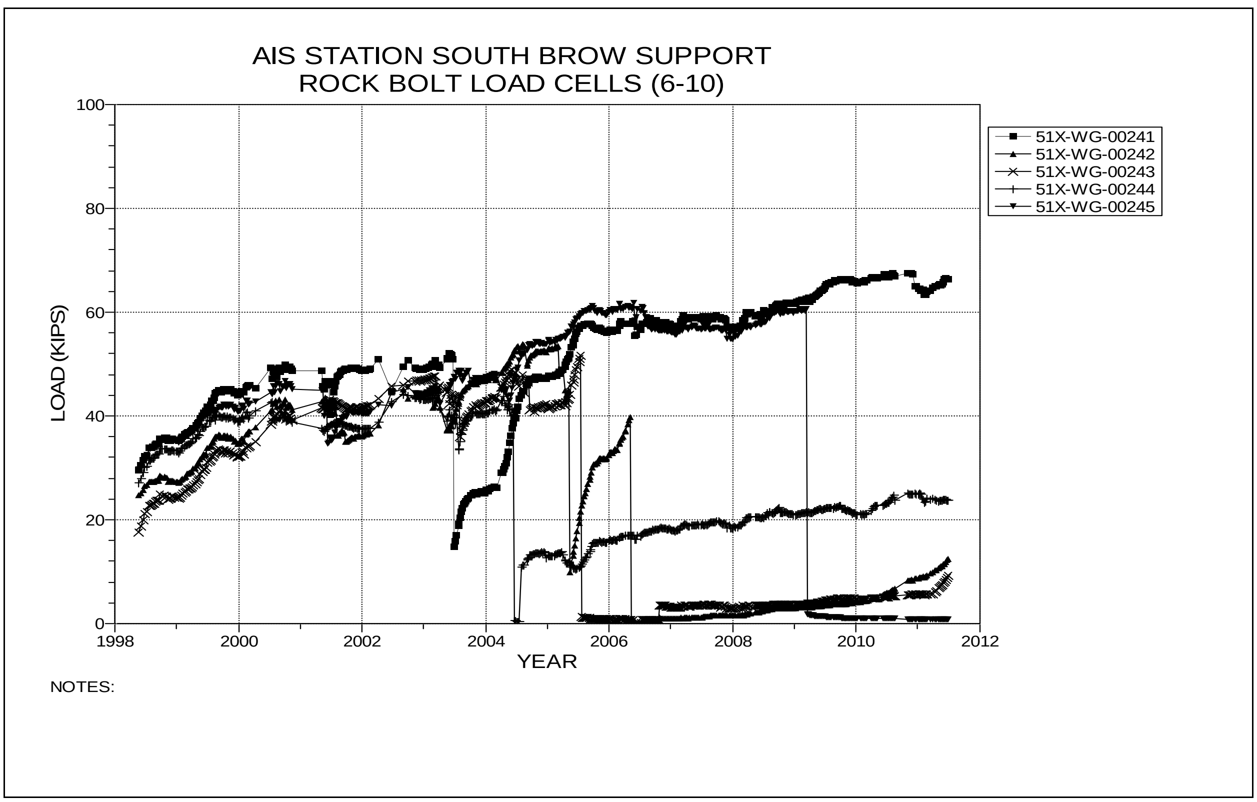


Figure 3-11 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 2

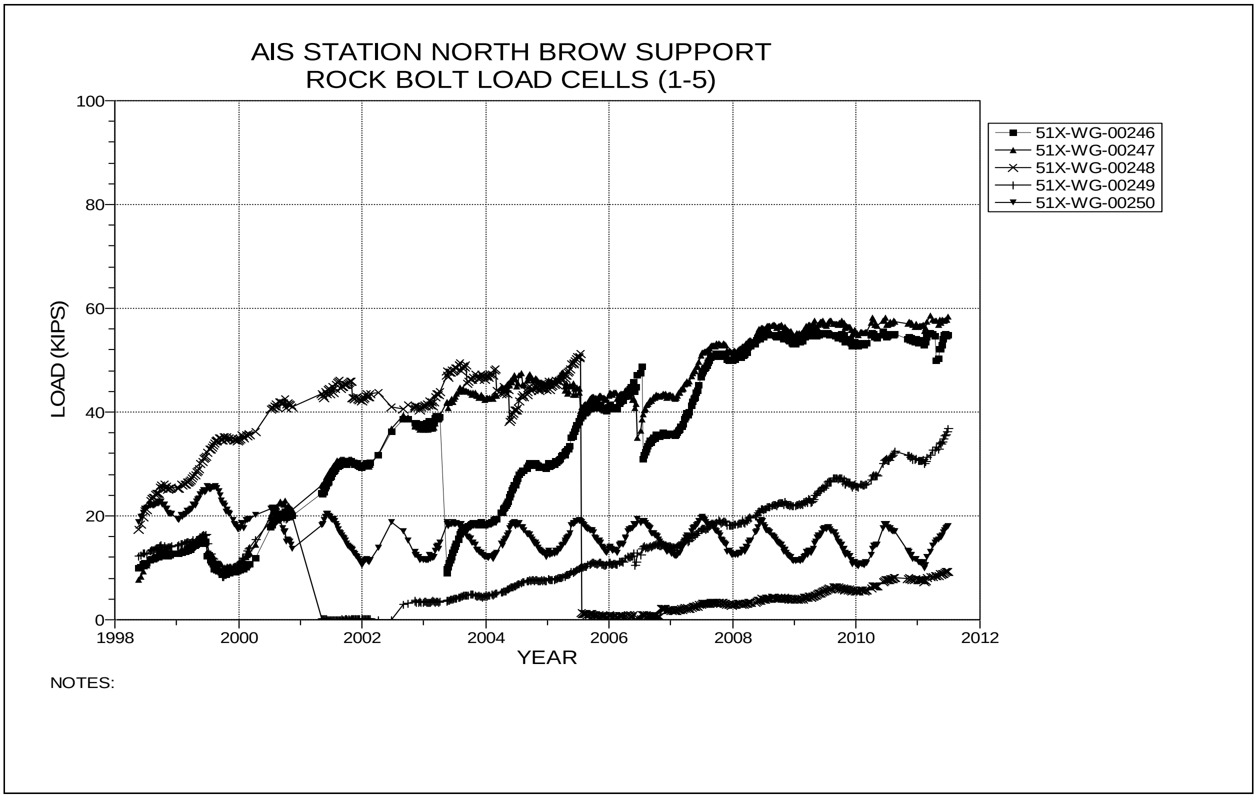


Figure 3-12 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 1

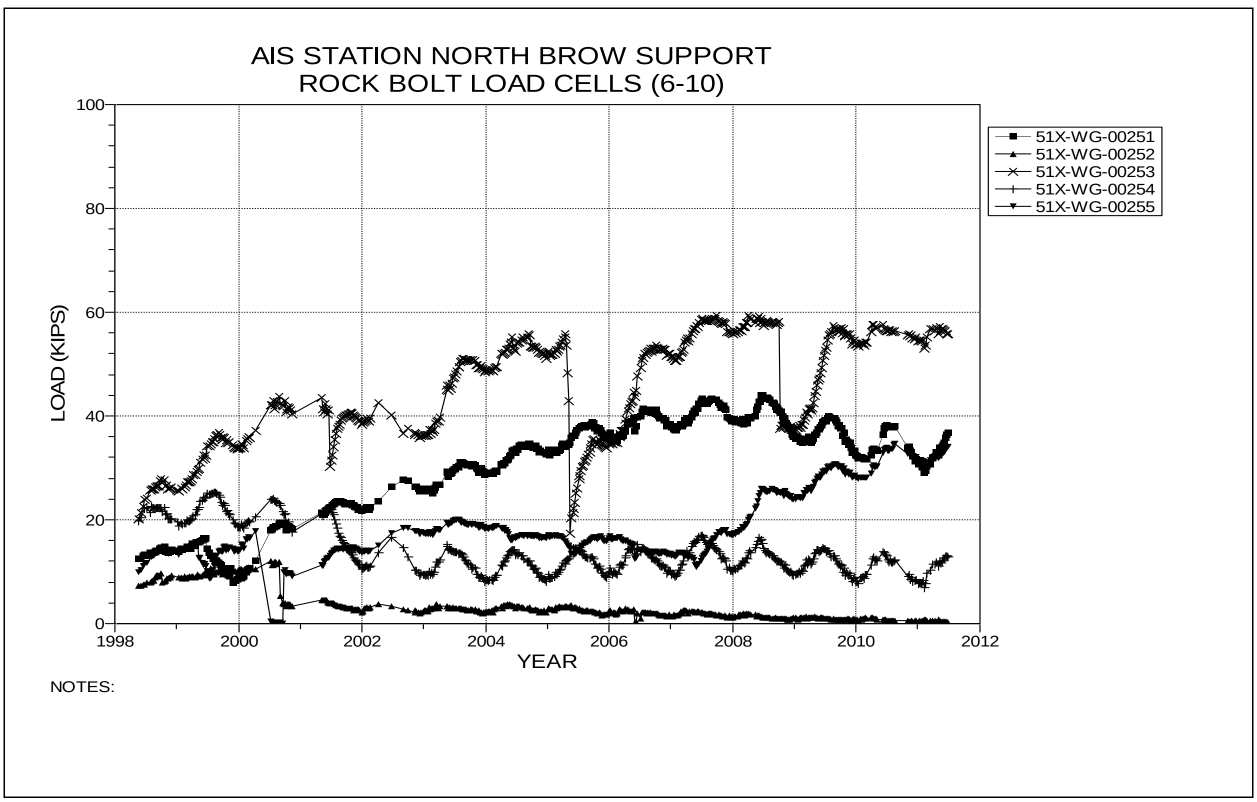


Figure 3-12 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 2

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4.0 Instrumentation Summary for the Access Drifts

This chapter presents the instrumentation data and data analyses for the access drifts throughout the WIPP underground. Table 4-1 provides the results of analyses performed on the instrument data including displacement, convergence rates, and rock bolt loading.

Figures 4-1 through 4-26 present data from borehole extensometers installed in the access drifts while Figures 4-27 through 4-251 present the convergence point data. Figure 4-252 through 4-261 presents data from joint meters installed at the S1950/E300 overcast and the access drifts. Figure 4-262 through 4-268 presents the data from rock bolt load cells installed in the E140 drift, the adjacent brows in E140-S1300 and at the E140-S1300 east brow.

Table 4-1 Access Drifts Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2010 to 2011 (in/year)	Displacement Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-GE-00361	E0-N1266	Roof	4-1	06/27/11	9.246	0.96	1.01	-5%	
51X-GE-00352	E0-N940	Roof	4-2	06/27/11	5.443	1.44	1.04	38%	
51X-GE-00353	E0-N626	Roof	4-3	06/27/11	5.025	1.08	0.71	52%	
51X-GE-00355	E0-N300	Roof	4-4	06/27/11	4.658	0.58	0.49	18%	
51X-GE-00364	E140-N1266	Roof	4-5	11/29/10	4.579	0.69	0.66	5%	
51X-GE-00372	E140-S146	Roof	4-6	06/27/11	3.384	0.50	0.56	-11%	
51X-GE-00472	E140-S1000	Roof	4-7	06/15/11	5.285	0.40	0.04	900%	
51X-GE-00464	E140-S1025	Roof	4-8	06/15/11	4.535	0.40	0.15	167%	
51X-GE-00333	E140-S1075	Roof	4-9	06/27/11	6.516	0.34	0.64	-47%	
51X-GE-00465	E140-S1300	Roof	4-10	06/15/11	2.988	0.28	0.10	180%	
51X-GE-00335	E140-S1300	Roof	4-11	05/16/11	4.574	0.21	0.27	-22%	
51X-GE-00492	E140-S2750	Roof	4-12	06/15/11	3.233	0.33	0.24	38%	
51X-GE-00367-2	E140-S2916	Roof	4-13	06/27/11	8.159	2.08	1.04	100%	
51X-GE-00396	E140-S3493	Roof	4-14	06/27/11	4.757	1.66	1.38	20%	
51X-GE-00373	E300-N1341	Roof	4-15	06/27/11	3.905	1.00	0.70	43%	
51X-GE-00388	E300-N1266	Roof	4-16	06/27/11	2.783	0.60	0.54	11%	
51X-GE-00374	E300-N1186	Roof	4-17	06/27/11	4.660	0.57	0.46	24%	
51X-GE-00481	N300-W10 Brow	Roof	4-18	08/02/10	2.813	N/A	0.17	N/A	Instrument out of range.
51X-GE-00474	S1000-E120 Brow	Roof	4-19	05/26/11	1.302	0.08	0.01	700%	
51X-GE-00473	S1000-E160 Brow	Roof	4-20	05/26/11	1.093	0.06	0.01	500%	
51X-GE-00462	S1300-E120 Brow	Roof	4-21	05/26/11	0.743	0.05	0.02	150%	
51X-GE-00463	S1300-E160 Brow	Roof	4-22	05/26/11	4.576	0.56	0.22	155%	
51X-GE-00442	S1600-E120 Brow	Roof	4-23	05/26/11	1.058	0.07	-0.02	-450%	
51X-GE-00490	W30-S2750	Roof	4-24	06/30/11	3.133	0.67	0.46	46%	
51X-GE-00415	W170-S2998	Roof	4-25	06/27/11	4.104	3.51	3.23	9%	
41X-GE-00124	W519-N190	Roof	4-26	06/27/11	5.021	0.37	0.37	0%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
E300-N250-3 A-C	E300-N250	4-27	06/22/11	7.654	36.608	1.68	1.50	12%	
E300-N170-2 A-E	E300-N170	4-28	06/22/11	7.847	30.341	1.79	1.55	15%	
E300-N170-2 H-F	E300-N170	4-28	06/22/11	7.197	27.257	1.68	1.42	18%	
E300-N170-2 C-G	E300-N170	4-28	06/22/11	8.809	23.653	1.45	1.23	18%	
E300-N45 A-E	E300-N45	4-29	06/22/11	30.366	30.366	1.47	1.26	17%	
E300-N45 H-F	E300-N45	4-29	06/22/11	27.200	27.200	1.36	1.12	21%	
E300-N45 C-G	E300-N45	4-29	06/22/11	22.372	22.372	1.29	1.09	18%	
E300-S45-2 A-E	E300-S45	4-30	06/22/11	24.630	24.630	1.36	1.15	18%	
E300-S45-2 B-D	E300-S45	4-30	06/22/11	22.019	22.019	1.66	1.40	19%	
E300-S45-2 H-F	E300-S45	4-30	06/22/11	21.233	21.233	1.12	0.96	17%	
E300-S45 C-G	E300-S45	4-30	06/22/11	18.699	18.699	0.98	0.73	34%	
E300-S90 A-C	E300-S90	4-31	06/23/11	18.099	18.099	0.85	0.62	37%	
E300-S250-2 A-C	E300-S250	4-32	06/23/11	8.551	12.936	0.69	0.55	25%	
E300-S250-2 B-D	E300-S250	4-32	06/23/11	9.192	13.238	0.73	0.55	33%	
E300-S700-2 A-C	E300-S700	4-33	06/23/11	0.579	20.309	1.81	0.56	223%	
E300-S850-2 A-E	E300-S850	4-34	06/23/11	0.225	11.526	0.56	0.38	47%	
E300-S850 B-D	E300-S850	4-34	11/19/10	11.301	11.301	0.35	0.38	-8%	
E300-S850-2 H-F	E300-S850	4-34	06/23/11	0.221	10.684	0.63	0.37	70%	
E300-S850-2 C-G	E300-S850	4-34	06/23/11	8.352	17.630	1.01	0.55	84%	
E300-S1000-2 A-C	E300-S1000	4-35	06/23/11	0.381	19.926	1.29	0.58	122%	
E300-S1150-4 A-E	E300-S1150	4-36	06/23/11	1.095	18.174	3.32	0.56	493%	
E300-S1150-4 B-D	E300-S1150	4-37	06/23/11	0.327	12.432	1.04	0.41	154%	
E300-S1150-4 H-F	E300-S1150	4-37	06/23/11	0.375	12.131	1.10	0.45	144%	
E300-S1150-2 C-G	E300-S1150	4-38	06/23/11	10.140	20.596	1.45	0.66	120%	
E300-S1300-2 A-C	E300-S1300	4-39	06/23/11	0.763	14.297	2.50	0.64	291%	
E300-S1450-2 A-C	E300-S1450	4-40	06/23/11	0.686	9.668	2.15	0.61	252%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
E300-S1450 B-D	E300-S1450	4-40	06/23/11	11.520	11.520	1.65	0.71	132%	
E300-S1687-2 A-C	E300-S1687	4-41	06/23/11	0.432	10.289	1.46	0.78	87%	
E300-S1687 B-D	E300-S1687	4-41	06/23/11	11.415	11.415	1.42	0.78	82%	
E300-S1775-2 A-C	E300-S1775	4-42	06/23/11	0.541	9.336	1.81	0.68	166%	
E300-S1775 B-D	E300-S1775	4-42	06/23/11	11.637	11.637	1.49	0.76	96%	
E300-S1862-2 A-C	E300-S1862	4-43	06/23/11	0.682	10.135	2.38	0.74	222%	
E300-S1862 B-D	E300-S1862	4-43	06/23/11	12.615	12.615	1.78	0.84	112%	
E300-S2065-2 A-C	E300-S2065	4-44	06/23/11	0.591	11.702	1.94	0.90	116%	
E300-S2065 B-D	E300-S2065	4-44	06/23/11	16.215	16.215	2.27	1.14	99%	
E300-S2275-2 A-C	E300-S2275	4-45	06/23/11	1.115	14.541	3.79	1.06	258%	
E300-S2275 B-D	E300-S2275	4-45	06/23/11	19.030	19.030	2.60	1.46	78%	
E300-S2350-2 A-C	E300-S2350	4-46	06/23/11	1.545	17.109	5.06	1.22	315%	
E300-S2350 B-D	E300-S2350	4-46	06/23/11	19.679	19.679	2.58	1.44	79%	
E300-S2425-2 A-C	E300-S2425	4-47	06/23/11	1.325	17.547	4.35	1.37	218%	
E300-S2425 B-D	E300-S2425	4-47	06/23/11	19.761	19.761	2.45	1.36	80%	
E300-S2634-2 A-C	E300-S2634	4-48	06/23/11	0.714	14.099	2.44	1.60	53%	
E300-S2634 B-D	E300-S2634	4-48	06/23/11	14.742	14.742	2.38	1.49	60%	
E300-S2833-2 A-C	E300-S2833	4-49	06/23/11	0.576	16.868	1.95	2.11	-8%	
E300-S2833 B-D	E300-S2833	4-49	06/23/11	15.334	15.334	2.37	1.52	56%	
E300-S2916-4 A-C	E300-S2916	4-50	06/23/11	0.650	25.720	2.24	2.06	9%	
E300-S2916 B-D	E300-S2916	4-50	06/23/11	17.116	17.116	2.48	1.67	49%	
E300-S2998-4 A-C	E300-S2998	4-51	06/23/11	1.232	35.982	4.49	2.67	68%	
E300-S2998 B-D	E300-S2998	4-51	06/23/11	16.727	16.727	2.49	1.79	39%	
E300-S3195 A-C	E300-S3195	4-52	04/27/11	18.512	18.512	2.88	2.73	5%	
E300-S3195 B-D	E300-S3195	4-52	04/27/11	15.591	15.591	1.83	1.55	18%	
E300-S3480 A-C	E300-S3480	4-53	11/19/10	8.676	8.676	2.39	2.01	19%	
E300-S3480 B-D	E300-S3480	4-53	11/19/10	6.571	6.571	1.75	1.58	11%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
E140-N1420-2 A-C	E140-N1420	4-54	05/12/11	11.357	27.827	1.67	1.43	17%	
E140-N1266-4 B-D	E140-N1266	4-55	05/12/11	8.591	30.596	1.34	1.11	21%	
E140-N1266-3 A-C	E140-N1266	4-55	05/12/11	17.195	54.950	2.44	2.26	8%	
E140-N1100-2 A-C	E140 -N1100	4-56	05/11/11	10.331	30.054	1.66	1.28	30%	
E140-N940-2 A-C	E140-N940	4-57	05/11/11	20.588	49.987	3.55	3.25	9%	
E140-N940-2 B-D	E140-N940	4-57	05/11/11	8.336	8.336	1.31	1.11	18%	
E140-N780-2 A-C	E140-N780	4-58	05/11/11	23.553	55.310	2.88	2.24	29%	
E140-N686-2 A-C	E140-N686	4-59	05/11/11	19.456	32.595	2.80	2.41	16%	
E140-N686-2 B-D	E140-N686	4-59	05/11/11	12.402	21.236	1.58	1.38	14%	
E140-N626-3 A-C	E140-N626	4-60	05/11/11	24.381	56.951	3.42	3.09	11%	
E140-N626-4 B-D	E140-N626	4-60	05/11/11	12.401	33.708	1.61	1.32	22%	
E140-N562-2 A-C	E140-N562	4-61	05/11/11	17.930	29.747	2.51	2.35	7%	
E140-N562-2 B-D	E140-N562	4-61	05/11/11	12.917	21.113	1.70	1.47	16%	
E140-N460-3 A-C	E140-N460	4-62	05/11/11	19.057	39.888	2.27	1.90	19%	
E140-N355-2 A-C	E140-N355	4-63	05/11/11	9.336	17.880	2.20	1.94	13%	
E140-N355 B-D	E140-N355	4-63	05/11/11	15.368	15.368	1.73	1.50	15%	
E140-N220-3 A-C	E140-N220	4-64	05/11/11	11.727	37.526	2.50	2.15	16%	
E140-N150-4 A-C	E140-N150	4-65	05/12/11	8.935	27.993	1.73	1.69	2%	
E140-N5-6 A-C	E140-N5	4-66	05/12/11	10.652	42.494	2.33	2.07	13%	
E140-N5-3 B-D	E140-N5	4-66	05/12/11	16.047	31.288	1.25	1.06	18%	
E140-S90-4 A-C	E140-S90	4-67	06/16/11	7.678	25.391	1.60	1.40	14%	
E140-S262-4 A-C	E140-S262	4-68	06/16/11	13.626	34.537	2.26	2.17	4%	
E140-S262-3 B-D	E140-S262	4-68	06/16/11	19.827	21.180	1.20	1.05	14%	
E140-S460-2 B-D	E140-S460	4-69	06/16/11	25.764	31.708	1.30	0.99	31%	
E140-S460-6 A-C	E140-S460	4-69	06/16/11	0.686	51.422	2.24	1.81	24%	
E140-S550-6 A-C	E140-S550	4-70	06/16/11	0.666	42.633	2.16	1.42	52%	
E140-S550-4 B-D	E140-S550	4-70	06/16/11	27.893	36.535	1.66	1.16	43%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
E140-S700-8 A-D	E140-S700	4-71	06/15/11	0.849	30.889	2.82	1.69	67%	
E140-S700-6 B-C	E140-S0700	4-72	06/15/11	2.673	32.705	2.69	2.05	31%	
E140-S700-6 E-F	E140-S0700	4-73	06/15/11	1.608	21.605	1.61	0.98	64%	
E140-S850-9 A-C	E140-S0850	4-74	06/15/11	2.516	54.029	2.58	2.27	14%	
E140-S850-4 B-D	E140-S850	4-75	06/15/11	18.395	34.342	1.34	1.16	16%	
E140-S1000-3 A-C	E140-S1000	4-76	06/15/11	1.885	37.533	1.857	1.31	42%	
E140-S1025-4 A-C	E140-S1025	4-77	06/15/11	1.988	24.165	1.99	1.46	36%	
E140-S1075-4 A-E	E140-S1075	4-78	06/15/11	2.536	24.766	2.55	1.82	40%	
E140-S1075-4 B-D	E140-S1075	4-79	06/15/11	1.237	20.146	1.25	1.13	11%	
E140-S1075-4 F-H	E140-S1075	4-79	06/15/11	1.743	18.602	1.75	1.24	41%	
E140-S1075-2 C-G	E140-S1075	4-80	06/15/11	16.666	17.488	1.45	1.25	16%	
E140-S1150-4 A-G	E140-S1150	4-81	06/15/11	4.351	62.381	4.40	3.52	25%	
E140-S1150-5 L-H	E140-S1150	4-82	06/15/11	2.305	22.498	2.31	1.91	21%	
E140-S1150-2 D-J	E140-S1150	4-83	06/15/11	18.000	29.907	1.61	1.39	16%	
E140-S1150 C-K	E140-S1150	4-83	06/15/11	17.072	17.072	1.39	1.23	13%	
E140-S1150-2 E-I	E140-S1150	4-83	06/15/11	16.336	17.197	1.49	1.28	16%	
E140-S1225-4 A-E	E140-S1225	4-84	06/15/11	3.619	30.316	3.57	2.55	40%	
E140-S1225-2 C-G	E140-S1225	4-84	06/15/11	23.179	24.086	2.35	2.15	9%	
E140-S1225-3 B-D	E140-S1225	4-85	06/15/11	3.303	30.404	3.29	2.45	34%	
E140-S1225-3 H-F	E140-S1225	4-85	06/15/11	1.946	21.380	2.34	1.70	38%	
E140-S1300-4 A-C	E140-S1300	4-86	06/15/11	18.654	25.081	1.65	1.40	18%	
E140-S1378-3 A-E	E140-S1375	4-87	06/15/11	2.597	37.034	2.93	2.15	36%	
E140-S1378-3 B-D	E140-S1375	4-88	06/15/11	1.496	18.904	1.70	1.34	27%	
E140-S1378-3 H-F	E140-S1375	4-88	06/15/11	2.123	31.664	2.60	2.34	11%	
E140-S1378 C-G	E140-S1375	4-89	06/15/11	20.353	20.353	1.70	1.50	13%	
E140-S1450-5 A-G	E140-S1450/1456	4-90	06/15/11	3.667	75.037	4.09	3.78	8%	
E140-S1450-3 B-F	E140-S1450/1456	4-91	06/15/11	2.786	42.770	3.13	2.59	21%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
E140-S1450-3 L-H	E140-S1450/1456	4-91	06/15/11	2.815	37.083	3.15	2.81	12%	
E140-S1456-2 D-J	E140-S1456	4-92	06/15/11	21.573	42.868	1.99	1.74	14%	
E140-S1456 K-C	E140-S1456	4-93	06/15/11	19.438	19.438	1.53	1.39	10%	
E140-S1450-3 I-E	E140-S1450/1456	4-93	06/15/11	1.051	19.143	1.53	1.31	17%	
E140-S1534-3 A-E	E140-S1534	4-94	06/15/11	2.644	48.807	3.06	2.97	3%	
E140-S1534-2 C-G	E140-S1534	4-94	06/15/11	19.201	20.672	1.68	1.47	14%	
E140-S1534-4 B-D	E140-S1534	4-95	06/15/11	1.989	30.864	2.31	2.26	2%	
E140-S1534-3 H-F	E140-S1534	4-95	06/15/11	2.219	33.778	2.58	2.17	19%	
E140-S1600-6 A-C	E140-S1600	4-96	06/15/11	1.756	38.493	2.03	1.82	12%	
E140-S1687-3 A-E	E140-S1687	4-97	06/15/11	3.293	43.549	3.81	3.56	7%	
E140-S1687-3 B-D	E140-S1687	4-97	06/15/11	2.136	32.997	2.51	2.65	-5%	
E140-S1687 C-G	E140-S1687	4-97	06/15/11	21.253	21.253	1.93	1.60	21%	
E140-S1687-3 H-F	E140-S1687	4-97	06/15/11	2.234	32.291	2.61	3.19	-18%	
E140-S1775-3 A-G	E140-S1775	4-98	06/15/11	3.599	61.657	4.35	4.10	6%	
E140-S1775-4 B-F	E140-S1775	4-98	06/15/11	3.275	51.363	3.96	3.62	9%	
E140-S1775-3 L-H	E140-S1775	4-98	06/15/11	2.031	29.014	2.31	2.19	5%	
E140-S1775 C-K	E140-S1775	4-99	06/15/11	20.505	20.505	1.71	1.44	19%	
E140-S1775-2 D-J	E140-S1775	4-99	06/15/11	21.442	22.693	2.15	1.75	23%	
E140-S1775-3 I-E	E140-S1775	4-99	06/15/11	7.327	21.548	2.13	1.60	33%	
E140-S1862-3 A-E	E140-S1862	4-100	06/15/11	3.294	46.977	3.96	3.82	4%	
E140-S1862-3 C-G	E140-S1862	4-100	06/15/11	14.913	21.218	2.09	1.66	26%	
E140-S1862-3 B-D	E140-S1862	4-101	06/15/11	3.255	42.344	3.96	3.48	14%	
E140-S1862-3 H-F	E140-S1862	4-101	06/15/11	1.676	23.135	2.06	1.88	10%	
E140-S1950-6 A-C	E140-S1950	4-102	06/15/11	2.703	50.887	3.22	2.47	30%	
E140-S2007-6 A-C	E140-S2007	4-103	06/15/11	3.482	37.434	4.15	3.21	29%	
E140-S2065-5 A-C	E140-S2065	4-104	06/15/11	4.404	44.767	5.26	4.15	27%	
E140-S2065-2 B-D	E140-S2065	4-104	06/15/11	14.948	21.596	2.17	1.74	25%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
E140-S2122-4 A-C	E14-S2122	4-105	06/15/11	4.016	42.534	4.80	3.81	26%	
E140-S2275-4 A-C	E140-S2275	4-106	06/15/11	6.130	69.781	7.40	6.90	7%	
E140-S2275 B-D	E140-S2275	4-106	06/15/11	23.149	23.149	2.46	1.95	26%	
E140-S2350-5 A-C	E140-S2350	4-107	06/15/11	6.180	73.254	7.39	6.94	6%	
E140-S2350-2 B-D	E140-S2350	4-107	06/15/11	24.389	31.280	2.61	2.11	24%	
E140-S2425-4 A-C	E140-S2425	4-108	06/15/11	5.136	49.024	6.16	5.71	8%	
E140-S2425 B-D	E140-S2425	4-108	06/15/11	24.016	24.016	2.63	2.10	25%	
E140-S2520-3 A-C	E140-S2520	4-109	06/15/11	3.108	35.129	3.69	2.89	28%	
E140-S2634 A-C	E140-S2634	4-110	06/15/11	47.779	47.779	6.47	5.42	19%	
E140-S2634 B-D	E140-S2634	4-110	06/15/11	18.059	18.059	2.56	2.02	27%	
E140-S2750-3 A-C	E140-S2750	4-111	06/15/11	2.036	21.207	2.82	2.37	19%	
E140-S2833-3 A-C	E140-S2833	4-112	06/15/11	10.728	31.527	4.99	4.04	24%	
E140-S2833 B-D	E140-S2833	4-112	06/15/11	15.963	15.963	2.26	1.79	26%	
E140-S2915-3 A-C	E140-S2915	4-113	06/15/11	8.935	35.151	3.65	3.50	4%	
E140-S2915 B-D	E140-S2915	4-113	06/15/11	17.348	17.348	2.37	1.94	22%	
E140-S2998-3 A-C	E140-S2998	4-114	06/15/11	8.780	35.935	3.88	3.43	13%	
E140-S2998 B-D	E140-S2998	4-114	06/15/11	16.026	16.026	2.07	1.74	19%	
E140-S3080-2 A-C	E140-S3080	4-115	06/15/11	7.214	23.353	3.27	2.58	27%	
E140-S3195-2 A-C	E140-S3195	4-116	06/14/11	8.792	35.047	3.76	3.47	8%	
E140-S3195 B-D	E140-S3195	4-116	06/14/11	15.961	15.961	1.99	1.66	20%	
E140-S3295-2 A-C	E140-S3295	4-117	06/14/11	5.685	13.390	2.47	2.15	15%	
E140-S3325 A-C	E140-S3325	4-118	06/14/11	13.077	13.077	2.36	2.01	17%	
E140-S3395-2 A-C	E140-S3395	4-119	06/14/11	8.733	23.891	3.70	3.47	7%	
E140-S3395 B-D	E140-S3395	4-119	06/14/11	10.920	10.920	1.76	1.55	14%	
E140-S3480-2 A-C	E140-S3480	4-120	06/14/11	9.081	23.381	3.99	3.59	11%	
E140-S3480 B-D	E140-S3480	4-120	06/14/11	11.219	11.219	1.77	1.60	11%	
E140-S3565-2 A-C	E140-S3565	4-121	06/14/11	6.666	17.994	2.93	2.61	12%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
E140-S3565 B-D	E140-S3565	4-121	06/14/11	10.602	10.602	1.80	1.55	16%	
E140-S3650-2 A-C	E140-S3650	4-122	06/08/11	4.757	11.377	2.08	1.74	20%	
E0-N1266-4 A-C	E0-N1266	4-123	06/29/11	19.151	56.058	2.17	1.94	12%	
E0-N1110-5 A-C	E0-N1110	4-124	06/29/11	11.519	45.943	1.81	1.30	39%	
E0-N940-5 A-C	E0-N940	4-125	06/29/11	16.774	64.826	3.18	2.26	41%	
E0-N780-2 A-C	E0-N780	4-126	06/29/11	16.738	37.160	2.27	1.67	36%	
E0-N686 B-D	E0-N686	4-127	03/08/11	11.873	11.873	1.26	1.24	2%	
E0-N686 A-C	E0-N686	4-127	03/08/11	19.062	19.062	2.05	2.11	-3%	
E0-N626-4 A-C	E0-N626	4-128	05/04/11	18.086	59.045	2.02	1.91	6%	
E0-N562 A-C	E0-N562	4-129	05/04/11	14.802	14.802	1.99	1.78	12%	
E0-N562 B-D	E0-N562	4-129	05/04/11	12.902	12.902	1.65	1.42	16%	
E0-N460-3 A-C	E0-N460	4-130	06/29/11	20.679	40.768	2.39	1.52	57%	
E0-N300-6 A-C	E0-N290	4-131	06/29/11	1.160	52.205	2.78	1.52	83%	
E0-N225-2 A-C	E0-N225	4-132	06/29/11	17.617	17.664	2.02	1.60	26%	
E0-N225-2 B-D	E0-N225	4-132	06/29/11	1.527	13.832	1.63	1.60	2%	
E0-N75 A-C	E0-N80	4-133	06/29/11	17.798	17.798	1.96	1.68	17%	
E0-N75 B-D	E0-N80	4-133	06/29/11	12.476	12.476	1.40	1.13	24%	
W30-S120-2 A-C	W30-S120	4-134	06/29/11	4.865	24.859	1.03	0.88	17%	
W30-S250-5 A-C	W30-S250	4-135	06/29/11	5.832	32.065	1.37	1.08	27%	
W30-S250-5 B-D	W30-S250	4-135	06/29/11	16.652	27.606	1.14	0.84	36%	
W30-S400-2 A-C	W30-S400	4-136	06/29/11	4.990	22.818	1.17	0.77	52%	
W30-S500 B-D	W30-S500	4-137	06/29/11	26.118	26.118	1.05	0.92	14%	
W30-S500-2 A-C	W30-S500	4-137	06/29/11	4.995	27.505	1.11	1.01	10%	
W30-S700-5 A-C	W30-S700	4-138	06/29/11	2.269	36.546	2.23	1.35	65%	
W30-S850-4 A-E	W30-S0850	4-139	06/28/11	3.096	24.588	2.97	1.07	178%	
W30-S850-4 B-D	W30-S0850	4-140	06/28/11	1.518	17.348	1.49	1.02	46%	
W30-S850-3 H-F	W30-S0850	4-140	06/28/11	2.240	17.808	2.14	0.70	206%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
W30-S850-3 C-G	W30-S0850	4-141	06/28/11	1.594	24.832	1.59	1.05	51%	
W30-S1000-5 A-C	W30-S1000	4-142	06/28/11	1.053	39.232	1.98	N/A	N/A	Insufficient data
W30-S1150-2 A-C	W30-S1150	4-143	06/28/11	3.590	5.091	3.47	N/A	N/A	
W30-S1300-2 A-C	W30-S1300	4-144	06/28/11	2.328	23.566	2.25	N/A	N/A	
W30-S1453-2 A-C	W30-S1453	4-145	06/28/11	2.792	16.859	2.74	N/A	N/A	
W30-S1453-3 B-D	W30-S1453	4-145	06/28/11	1.629	15.591	1.63	N/A	N/A	
W30-S1600-3 A-C	W30-S1600	4-146	06/28/11	2.644	21.774	2.58	N/A	N/A	
W30-S1775-2 A-C	W30-S1775	4-147	06/28/11	4.525	15.022	4.50	N/A	N/A	
W30-S1775-3 B-D	W30-S1775	4-147	06/28/11	2.019	14.695	1.97	N/A	N/A	
W30-S1950-2 A-C	W30-S1950	4-148	06/28/11	3.458	23.906	3.41	1.35	153%	
W30-S2067-2 A-C	W30-S2067	4-149	06/28/11	3.518	20.367	3.65	1.61	127%	
W30-S2067-3 B-D	W30-S2067	4-149	06/28/11	2.267	17.582	2.35	N/A	N/A	
W30-S2275-3 A-C	W30-S2275	4-150	06/28/11	6.893	17.927	7.24	N/A	N/A	
W30-S2275-2 B-D	W30-S2275	4-150	06/28/11	2.430	13.610	2.57	N/A	N/A	
W30-S2350-3 A-C	W30-S2350	4-151	06/28/11	5.536	17.129	5.72	N/A	N/A	
W30-S2350-2 B-D	W30-S2350	4-151	06/28/11	2.674	15.169	2.74	N/A	N/A	
W30-S2425-3 A-C	W30-S2425	4-152	06/28/11	3.970	16.841	4.22	N/A	N/A	
W30-S2425-2 B-D	W30-S2425	4-152	06/28/11	2.608	16.092	2.76	N/A	N/A	
W30-S2520-3 A-C	W30-S2520	4-153	06/28/11	2.865	22.023	3.07	2.03	51%	
W30-S2685-3 A-C	W30-S2685	4-154	06/27/11	2.475	21.365	2.66	2.84	-6%	
W30-S2685-3 B-D	W30-S2685	4-154	06/27/11	2.216	16.486	2.38	1.59	50%	
W30-S2750-2 A-C	W30-S2750	4-155	06/27/11	2.378	14.728	2.56	1.75	46%	
W30-S2833-3 A-C	W30-S2833	4-156	06/27/11	2.164	17.837	3.83	3.11	23%	
W30-S2833-2 B-D	W30-S2833	4-156	06/27/11	2.392	14.398	2.59	2.07	25%	
W30-S2916 A-C	W30-S2916	4-157	06/27/11	32.535	32.535	7.25	5.16	41%	
W30-S2916-2 B-D	W30-S2916	4-157	06/27/11	2.021	12.405	2.19	1.64	34%	
W30-S2998 A-C	W30-S2998	4-158	06/27/11	17.267	17.267	3.86	2.74	41%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
W30-S2998-2 B-D	W30-S2998	4-158	06/27/11	1.719	12.436	1.89	1.61	17%	
W30-S3080 A-C	W30-S3080	4-159	06/27/11	22.040	22.040	2.17	2.24	-3%	
W30-S3195 A-C	W30-S3195	4-160	06/27/11	16.578	16.578	2.41	2.03	19%	
W30-S3195 B-D	W30-S3195	4-160	06/27/11	12.707	12.707	1.61	1.42	13%	
W30-S3310 A-C	W30-S3310	4-161	06/27/11	15.432	15.432	1.82	1.64	11%	
W30-S3395 A-C	W30-S3395	4-162	06/27/11	10.828	10.828	1.86	1.71	9%	
W30-S3395 B-D	W30-S3395	4-162	06/27/11	9.039	9.039	1.52	1.35	13%	
W30-S3480 A-C	W30-S3480	4-163	06/30/11	12.797	12.797	2.72	2.25	21%	
W30-S3480 B-D	W30-S3480	4-163	06/30/11	8.806	8.806	1.45	1.30	12%	
W30-S3565-2 A-C	W30-S3565	4-164	06/30/11	3.405	9.230	1.64	1.37	20%	
W30-S3565 B-D	W30-S3565	4-164	06/30/11	8.868	8.868	1.44	1.31	10%	
W30-S3650-2 A-C	W30-S3650	4-165	06/07/11	4.351	10.003	1.96	1.59	23%	
W170-N150-3 A-C	W170-N150	4-166	06/02/11	2.056	10.408	0.68	0.49	39%	
W170-S5 A-C	W170-S5	4-167	06/02/11	14.708	14.708	0.42	0.58	-28%	
W170-S5-2 B-D	W170-S5	4-167	06/02/11	9.133	16.899	0.58	0.70	-17%	
W170-S90-3 A-C	W170-S90	4-168	06/02/11	8.381	15.583	0.86	0.81	6%	
W170-S232-2 A-C	W170-S232	4-169	06/01/11	6.311	11.900	0.60	0.53	13%	
W170-S232-2 B-D	W170-S232	4-169	06/01/11	9.590	12.232	0.64	0.53	21%	
W170-S400 A-C	W170-S400	4-170	06/01/11	14.511	14.511	0.76	0.62	23%	
W170-S560-4 A-C	W170-S560	4-171	06/01/11	2.107	12.926	0.62	0.63	-2%	
W170-S560-3 B-D	W170-S560	4-171	06/01/11	1.206	14.034	0.747	0.66	13%	
W170-S700-2 A-C	W170-S700	4-172	06/01/11	2.576	22.369	0.65	0.75	-13%	
W170-S850-7 A-E	W170-S850	4-173	06/01/11	2.171	19.160	0.60	0.70	-14%	
W170-S850-6 B-D	W170-S850	4-174	06/01/11	1.872	14.612	0.53	0.60	-12%	
W170-S850-7 H-F	W170-S850	4-175	06/01/11	1.557	13.178	0.36	0.51	-29%	
W170-S850-3 C-G	W170-S850	4-176	06/01/11	11.229	22.042	0.66	0.82	-20%	
W170-S1000-3 A-C	W170-S1000	4-177	06/01/11	3.137	26.050	0.96	0.92	4%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
W170-S1150-4 A-E	W170-S1150	4-178	06/01/11	2.558	22.987	0.73	0.82	-11%	
W170-S1150-4 B-D	W170-S1150	4-178	06/01/11	2.049	16.246	0.59	0.66	-11%	
W170-S1150-2 H-F	W170-S1150	4-178	06/01/11	2.041	15.447	0.57	0.65	-12%	
W170-S1150-2 C-G	W170-S1150	4-179	06/01/11	12.633	24.210	0.89	0.96	-7%	
W170-S1300-4 A-C	W170-S1300	4-180	06/01/11	5.794	26.752	1.69	1.71	-1%	
W170-S1445-4 A-C	W170-S1445	4-181	06/01/11	4.572	15.864	1.56	1.34	16%	
W170-S1445-2 B-D	W170-S1445	4-181	06/01/11	11.851	14.509	1.15	0.98	17%	
W170-S1600-4 A-C	W170-S1600	4-182	06/01/11	3.366	18.131	1.55	1.45	7%	
W170-S1779-3 A-C	W170-S1779	4-183	06/01/11	4.417	19.388	1.55	1.25	24%	
W170-S1779-2 B-D	W170-S1779	4-183	06/01/11	14.216	17.351	1.47	1.17	26%	
W170-S1950-3 A-C	W170-S1950	4-184	06/01/11	3.281	16.462	1.37	1.01	36%	
W170-S2060-2 A-C	W170-S2060	4-185	06/01/11	12.168	17.701	1.55	1.06	46%	
W170-S2060-2 B-D	W170-S2060	4-185	06/01/11	15.324	18.648	2.01	1.29	56%	
W170-S2180-2 A-C	W170-S2180	4-186	06/28/11	16.630	22.620	2.66	1.31	103%	
W170-S2275 A-C	W170-S2275	4-187	06/27/11	13.609	13.609	2.02	1.22	66%	
W170-S2275 B-D	W170-S2275	4-187	06/27/11	15.245	15.245	2.53	1.44	76%	
W170-S2350 A-C	W170-S2350	4-188	06/27/11	18.018	18.018	2.65	1.70	56%	
W170-S2350 B-D	W170-S2350	4-188	06/27/11	15.352	15.352	2.40	1.31	83%	
W170-S2425 A-C	W170-S2425	4-189	06/27/11	15.959	15.959	2.22	1.53	45%	
W170-S2425 B-D	W170-S2425	4-189	06/27/11	17.100	17.100	2.70	1.80	50%	
W170-S2520 A-C	W170-S2520	4-190	06/27/11	20.036	20.036	3.16	1.72	84%	
W170-S2685-2 A-C	W170-S2685	4-191	06/30/11	20.326	22.172	2.09	2.08	0%	
W170-S2685-2 B-D	W170-S2685	4-191	06/30/11	15.934	17.797	2.45	1.82	35%	
W170-S2833 A-C	W170-S2833	4-192	06/27/11	25.063	25.063	6.09	5.08	20%	
W170-S2833 B-D	W170-S2833	4-192	06/27/11	14.960	14.960	3.03	2.40	26%	
W170-S2916 A-C	W170-S2916	4-193	06/27/11	24.282	24.282	3.86	3.03	27%	
W170-S2916 B-D	W170-S2916	4-193	06/27/11	14.355	14.355	2.56	2.10	22%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
W170-S2998 A-C	W170-S2998	4-194	06/27/11	31.589	31.589	6.62	6.31	5%	
W170-S2998-2 B-D	W170-S2998	4-194	06/27/11	2.632	15.325	3.07	2.60	18%	
W170-S3080 A-C	W170-S3080	4-195	06/27/11	20.406	20.406	3.57	3.24	10%	
W170-S3195 A-C	W170-S3195	4-196	06/27/11	19.540	19.540	3.57	2.87	24%	
W170-S3195 B-D	W170-S3195	4-196	06/27/11	13.785	13.785	2.02	1.82	11%	
W170-S3310 A-C	W170-S3310	4-197	06/27/11	17.863	17.863	2.30	2.10	10%	
W170-S3395 A-C	W170-S3395	4-198	06/27/11	16.616	16.616	3.67	4.19	-12%	
W170-S3395 B-D	W170-S3395	4-198	06/27/11	10.257	10.257	1.94	1.83	6%	
W170-S3480 A-C	W170-S3480	4-199	06/27/11	18.036	18.036	3.60	4.25	-15%	
W170-S3480 B-D	W170-S3480	4-199	06/27/11	13.358	13.358	2.33	2.27	3%	
W170-S3565 A-C	W170-S3565	4-200	06/30/11	11.243	11.243	2.07	1.86	11%	
W170-S3565 B-D	W170-S3565	4-200	06/30/11	9.489	9.489	1.53	1.47	4%	
W170-S3650-2 A-C	W170-S3650	4-201	06/07/11	4.288	11.933	1.90	1.61	18%	
N780-E70 A-C	N780-E70	4-202	06/29/11	11.516	11.516	1.43	1.24	15%	
N780-E70 B-D	N780-E70	4-202	06/29/11	11.455	11.455	1.43	1.23	16%	
N460-E70-3 A-C	N460-E70	4-203	06/29/11	13.540	29.986	1.51	1.38	9%	
N460-E70-2 B-D	N460-E70	4-203	06/29/11	14.669	26.367	1.56	1.42	10%	
N300-W170-2 A-C	N300-W170	4-204	05/10/11	12.575	34.835	1.55	1.41	10%	
N300-W170-2 B-D	N300-W170	4-204	05/10/11	15.533	23.728	1.28	1.09	17%	
N250-E220-2 A-E	N250-E220	4-205	06/22/11	12.174	35.801	2.58	2.27	14%	
N250-E220-2 B-D	N250-E220	4-205	06/22/11	8.440	33.382	1.79	1.60	12%	
N250-E220-2 H-F	N250-E220	4-205	06/22/11	7.341	25.766	1.55	1.33	17%	
N250-E220 C-G	N250-E220	4-205	06/22/11	24.623	24.623	1.56	1.29	21%	
N215-W500-2 A-C	N215-W500	4-206	05/10/11	10.503	28.832	1.33	1.19	12%	
N215-W500-2 B-D	N215-W500	4-206	05/10/11	11.883	18.701	0.95	0.74	28%	
N215-W620-2 A-C	N215-W620	4-207	05/10/11	7.767	23.985	1.04	0.85	22%	
N140-E90-2 A-C	N140-E90	4-208	05/12/11	2.447	16.584	0.70	0.77	-9%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
N140-E90 B-D	N140-E90	4-208	05/12/11	17.870	17.870	0.86	0.79	9%	
S90-W120 A-C	S90-W120	4-209	06/02/11	7.399	7.399	0.63	0.63	0%	
S90-W120 B-D	S90-W120	4-209	06/01/11	7.894	7.894	0.71	0.68	4%	
S90-W400-2 A-C	S90-W400	4-210	06/02/11	4.055	17.404	0.47	0.63	-25%	
S90-W400-2 B-D	S90-W400	4-210	06/02/11	8.964	16.858	0.47	0.61	-23%	
S90-W590-2 A-C	S90-W590	4-211	06/02/11	3.912	13.241	0.65	0.56	16%	
S90-W590-2 B-D	S90-W590	4-211	06/02/11	8.553	12.360	0.61	0.51	20%	
S90-W620 A-C	S90-W620	4-212	06/02/11	24.941	24.941	1.22	1.15	6%	
S90-W770 A-C	S90-W770	4-213	06/02/11	17.304	17.304	0.94	0.87	8%	
S90-W770-3 B-D	S90-W770	4-213	06/02/11	2.512	15.833	0.94	0.82	15%	
S90-W905 A-C	S90-W905	4-214	06/02/11	13.760	13.760	1.19	1.24	-4%	
S105-W920 A-C	S105-W920	4-215	06/02/11	2.876	2.876	1.127	1.17	-4%	
CORE-W10 A-C	Core Storage W10	4-216	06/02/11	21.942	21.942	0.92	0.83	11%	
CORE-W20 A-C	Core Storage W20	4-216	06/02/11	20.755	20.755	0.93	0.84	11%	
CORE-W30 A-C	Core Storage W30	4-216	06/02/11	21.851	21.851	1.11	0.94	18%	
CORE-W51 A-C	Core Storage W51	4-216	06/02/11	25.218	25.218	1.38	1.26	10%	
CORE-W62 A-C	Core Storage W62	4-216	06/02/11	26.437	26.437	1.46	1.37	7%	
CORE-W73 A-C	Core Storage W73	4-216	06/02/11	26.691	26.691	1.46	1.36	7%	
CORE-W117 A-C	Core Storage W117	4-216	06/02/11	23.200	23.200	1.14	1.10	4%	
CORE-W133 A-C	Core Storage W133	4-216	06/02/11	19.452	19.452	0.89	0.85	5%	
S700-E205-3 A-C	S700-E205	4-217	05/26/11	9.490	26.919	2.04	1.70	20%	
S700-E180 A-C	S700-E180	4-218	05/26/11	9.609	9.609	2.05	1.73	18%	
S700-E180 B-D	S700-E180	4-218	05/26/11	5.651	5.651	1.25	0.93	34%	
S700-E55-2 A-C	S700-E55	4-219	05/26/11	1.982	6.116	2.14	0.85	152%	
S700-E55-2 B-D	S700-E55	4-219	05/26/11	1.325	5.467	1.42	0.83	71%	
S700-W98-2 A-C	S700-W98	4-220	05/26/11	9.175	23.657	1.80	1.45	24%	
S1000-E58-4 A-C	S1000-E58	4-221	05/26/11	7.858	23.324	1.43	1.14	25%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
S1000-E58-2 B-D	S1000-E58	4-221	05/26/11	17.317	18.861	1.24	0.91	36%	
S1000-W98-2 A-C	S1000-W98	4-222	05/26/11	13.428	32.176	1.99	1.79	11%	
S1000-E120-3 A-C	S1000-E120	4-223	05/26/11	7.009	15.449	1.17	0.91	29%	
S1000-E160 -3 A-C	S1000-E160	4-224	05/26/11	2.984	11.194	0.96	0.72	33%	
S1300-E24 A-C	S1300-E24	4-225	05/26/11	21.392	21.392	1.35	1.15	17%	
S1300-E120 A-C	S1300-E120	4-226	05/26/11	13.940	13.940	1.06	0.82	29%	
S1300-E160 A-C	S1300-E160	4-227	05/26/11	21.407	21.407	2.00	1.45	38%	
S1300-W100-3 A-C	S1300-W100	4-228	05/26/11	10.677	34.680	2.35	1.93	22%	
S1600-E110 A-C	S1600-E110	4-229	05/26/11	14.834	14.834	1.12	0.86	30%	
S1600-E170 A-C	S1600-E170	4-230	05/26/11	16.208	16.208	1.21	0.94	29%	
S1950-E113-4 A-C	S1950-E113	4-231	05/26/11	8.106	11.982	1.31	0.71	85%	
S1950-E281-3 A-C	S1950-E281	4-232	05/25/11	14.066	20.608	1.34	0.99	35%	
S1950-E284-3 A-C	S1950-E284	4-233	05/25/11	14.310	20.922	1.39	1.03	35%	
S2180-E55-3 A-C	S2180-E55	4-234	06/07/11	4.388	15.235	2.13	1.81	18%	
S2180-E55 B-D	S2180-E55	4-234	06/07/11	13.767	13.767	2.00	1.66	20%	
S2180-E220 A-C	S2180-E220	4-235	06/07/11	14.213	14.213	1.64	1.32	24%	
S2180-E220 B-D	S2180-E220	4-235	06/07/11	15.510	15.510	1.96	1.47	33%	
S2180-W100-3 A-C	S2180-W100	4-236	06/07/11	1.941	20.124	3.12	2.31	35%	
S2180-W100-2 B-D	S2180-W100	4-236	06/07/11	12.597	12.738	2.33	1.35	73%	
S2520-E220 A-C	S2520-E220	4-237	06/07/11	18.650	18.650	1.78	1.49	19%	
S2520-E220 B-D	S2520-E220	4-237	06/07/11	19.179	19.179	2.073	1.53	36%	
S2520-W100 A-C	S2520-W100	4-238	06/07/11	18.89	18.89	2.489	1.78	40%	
S2520-W100-2 B-D	S2520-W100	4-238	06/06/11	1.550	17.173	2.63	1.94	36%	
S2750-E55-2 A-C	S2750-E55	4-239	06/07/11	2.734	19.415	3.06	3.55	-14%	
S2750-E55 B-D	S2750-E55	4-239	06/07/11	14.750	14.750	2.72	1.91	42%	
S2750-E220 A-C	S2750-E220	4-240	06/07/11	21.397	21.397	3.12	2.03	54%	
S2750-E220 B-D	S2750-E220	4-240	06/07/11	13.767	13.767	2.04	1.53	33%	

Table 4-1 (Continued) Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
S2750-E410 A-C	S2750-E410	4-241	06/07/11	21.118	21.118	4.46	2.97	50%	
S2750-E410 B-D	S2750-E410	4-241	06/07/11	15.321	15.321	2.37	1.90	25%	
S2750-W93-2 A-C	S2750-W93	4-242	06/07/11	6.241	24.709	7.08	3.91	81%	
S2750-W93 B-D	S2750-W93	4-242	06/07/11	12.078	12.078	2.52	1.52	66%	
S3080-E55-2 A-C	S3080-E55	4-243	06/07/11	0.688	17.872	2.92	2.14	36%	
S3080-E55-2 B-D	S3080-E55	4-243	06/07/11	10.426	12.085	1.66	1.34	24%	
S3080-E220-2 A-C	S3080-E220	4-244	06/06/11	14.470	17.175	2.75	2.20	25%	
S3080-E220 B-D	S3080-E220	4-244	06/06/11	13.760	13.760	1.83	1.46	25%	
S3080-W100 A-C	S3080-W100	4-245	06/07/11	21.226	21.226	4.54	3.41	33%	
S3080-W100 B-D	S3080-W100	4-245	06/07/11	13.680	13.680	2.24	1.91	17%	
S3310-E55 A-C	S3310-E55	4-246	06/07/11	18.257	18.257	2.32	2.26	3%	
S3310-E55 B-D	S3310-E55	4-246	06/07/11	13.395	13.395	1.80	1.44	25%	
S3310-E220 A-C	S3310-E220	4-247	06/08/11	22.396	22.396	5.79	3.18	82%	
S3310-E220 B-D	S3310-E220	4-247	06/08/11	15.623	15.623	1.90	1.62	17%	
S3310-W100-3 A-C	S3310-W100	4-248	06/07/11	14.579	16.347	3.19	3.60	-11%	
S3310-W100 B-D	S3310-W100	4-248	06/07/11	14.002	14.002	1.94	1.68	15%	
S3650-E55-2 A-C	S3650-E55	4-249	06/07/11	4.138	7.471	1.82	1.58	15%	
S3650-E220-2 A-C	S3650-E220	4-250	06/07/11	4.345	7.702	1.95	2.08	-6%	
S3650-W100-2 A-C	S3650-W100	4-251	06/07/11	5.154	11.171	2.59	1.78	46%	
S3650-W100 B-D	S3650-W100	4-251	06/07/11	8.989	8.989	1.66	1.42	17%	

[1] N/A – Insufficient data available to perform the calculation. This is usually due to the inability to read the instruments because of activities such as: temporary removal of instrument due to floor, rib or back trimming; locations blocked by equipment or waste disposal, etc.

Table 4-1 (Continued) Access Drifts Data Analysis

JOINT METERS

Field Tag	Location	Figure Number	Date Of Last Reading	Cumulative Displacement (inches)	Dilation Rate 2010 to 2011 (in/year)	Dilation Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-CG-02706	S1950-E300	4-252	06/16/11	1.750	0.16	0.10	60%	
51X-CG-02707	S1950-E300	4-252	06/16/11	1.764	0.17	0.08	113%	
51X-CG-02713	E140-S2964	4-253	06/16/11	0.326	-0.26	-0.25	4%	
51X-CG-02715-2	W30-S2920	4-254	6/7/2011	0.298	1.06	0.76	39%	
51X-CG-02714-2	W30-S2932	4-255	6/7/2011	1.006	3.54	0.89	298%	
51X-CG-02716	W170-S2678	4-256	06/06/11	0.195	0.15	0.07	114%	
51X-CG-02717	W170-S2687	4-257	06/06/11	0.858	0.28	0.82	-66%	
51X-CG-02876-2	E140-S1505	4-258	06/16/11	0.056	0.02	0.03	-33%	
51X-CG-02883-2	E140-S1529	4-259	06/16/11	0.348	0.16	0.33	-52%	
51X-CG-02885-2	E140-S1545	4-260	06/16/11	0.587	0.29	0.32	-9%	
51X-CG-02875-2	E140-S1795	4-261	06/16/11	0.220	0.13	0.13	0%	

Table 4-1 (Continued) Access Drifts Data Analysis

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (klps)	Comments
51X-WG-00214	E140-S910 East Rib	4-262	06/26/97	06/27/11	49.5	
51X-WG-00215-2	E140-S910	4-262	10/21/09	06/27/11	43.6	
51X-WG-00216	E140-S910 East Rib	4-262	06/26/97	06/27/11	45.4	
51X-WG-00217	E140-S910 West Rib	4-262	06/26/97	06/27/11	1.4	
51X-WG-00218	E140-S775	4-263	06/26/97	06/27/11	0.8	
51X-WG-00219	E140-S975	4-263	06/26/97	06/27/11	39.4	
51X-WG-00220	E140-S1023	4-263	10/23/96	06/27/11	59.5	
51X-WG-00221	S1300-E120	4-264	10/23/96	06/27/11	4.2	
51X-WG-00222	S1300-E160	4-264	10/23/96	06/27/11	44.9	
51X-WG-00223	S1600-E150	4-265	02/18/96	06/06/11	5.5	
51X-WG-00293	E140-S1550	4-266	03/17/04	06/16/11	53.0	
51X-WG-00294	E140-S1775	4-267	03/17/04	06/16/11	52.8	
51X-WG-00295-2	E140-S2916	4-268	03/18/10	06/30/11	29.3	
51X-WG-00296-2	E140-S2916	4-268	03/18/10	06/30/11	45.6	

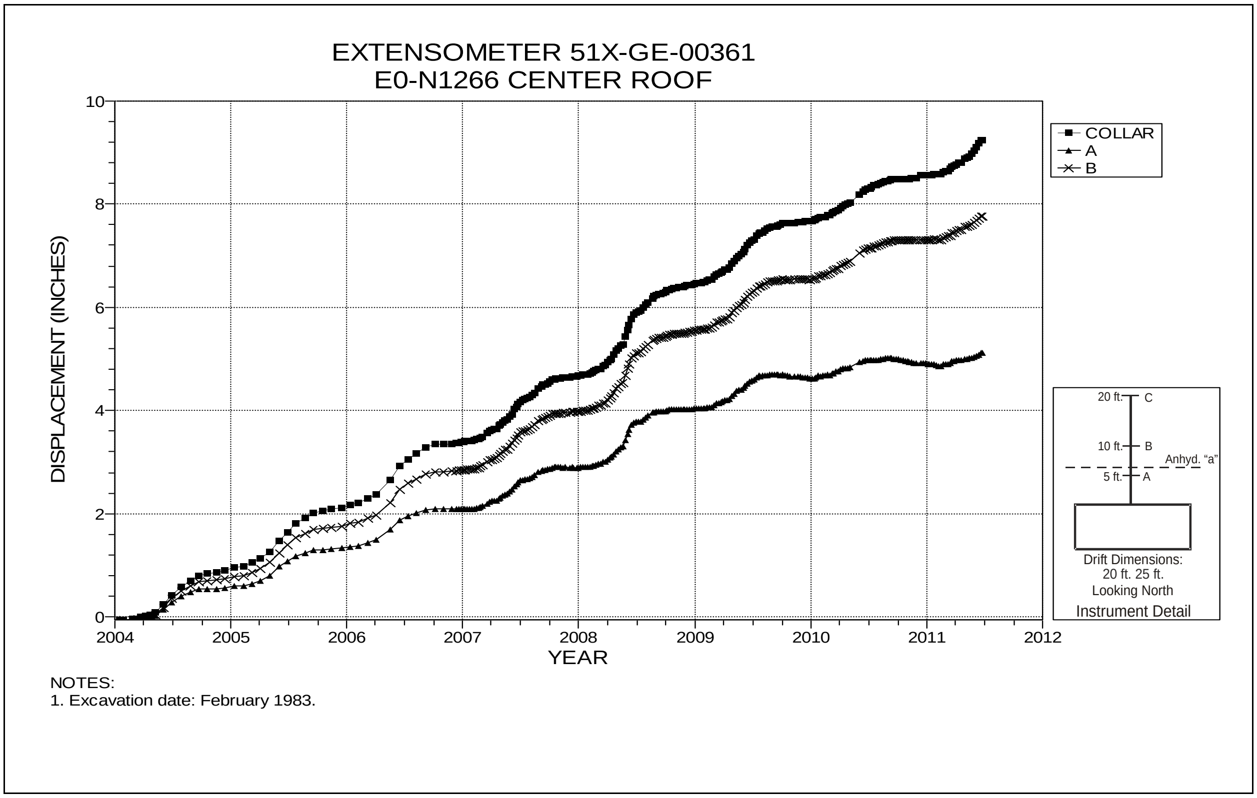


Figure 4-1 Extensometer 51X-GE-00361
E0 N1266 – Roof

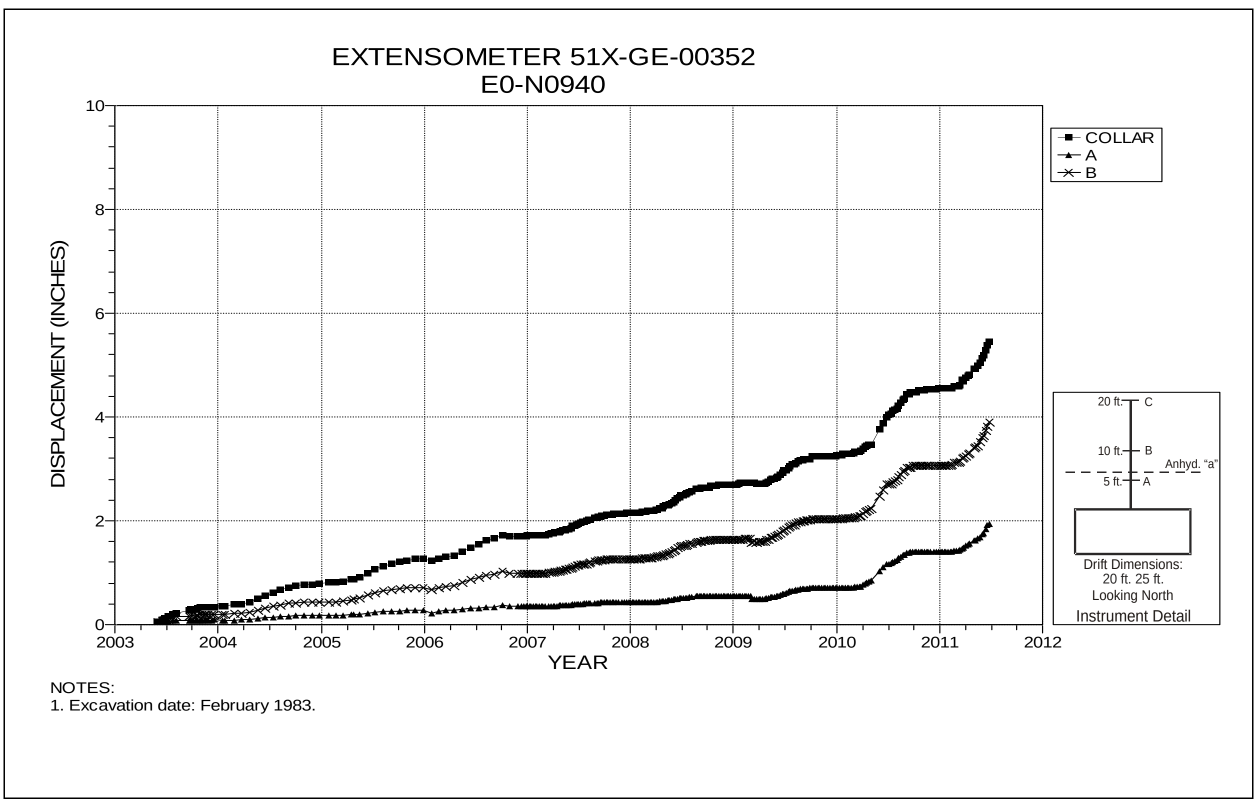
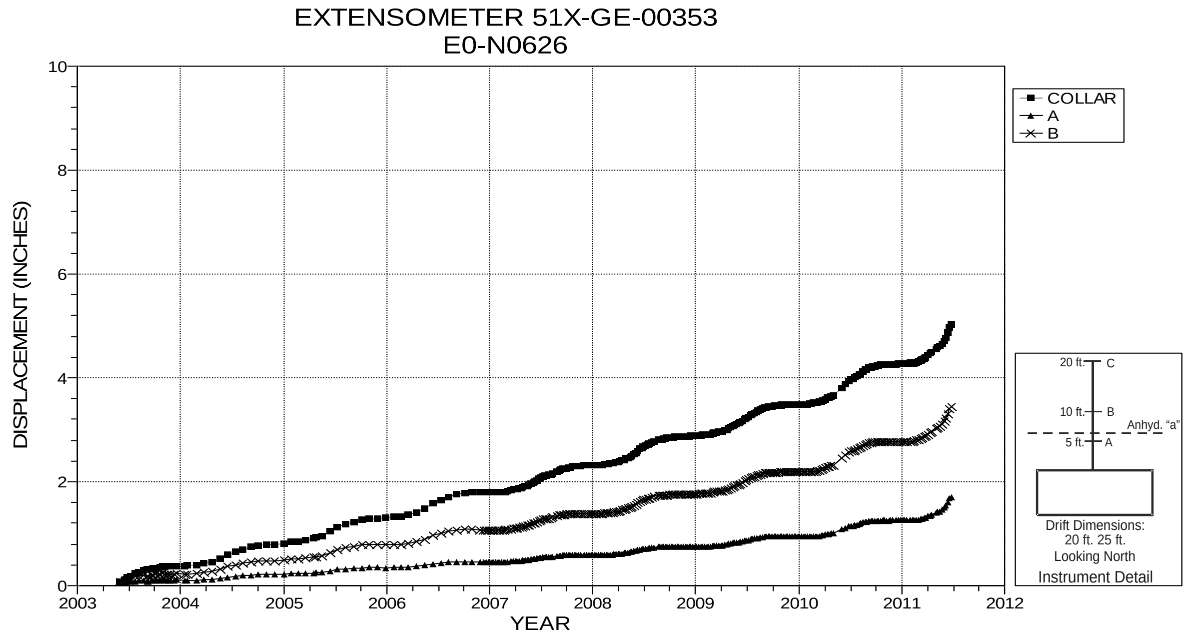
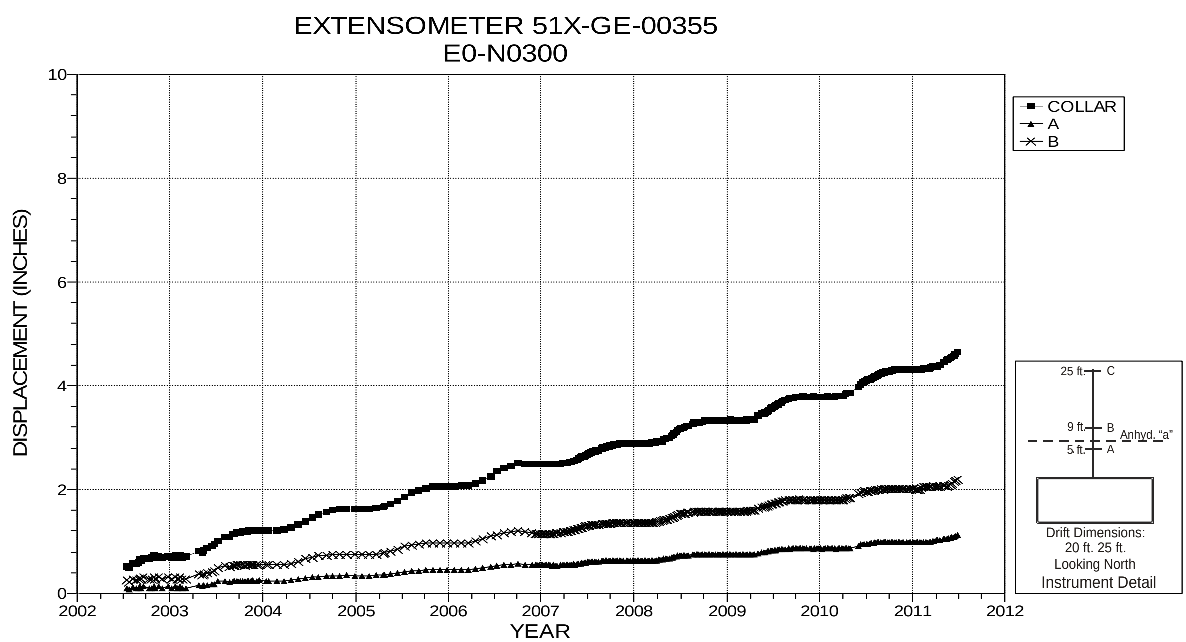


Figure 4-2 Extensometer 51X-GE-00352
E0 N940 – Roof



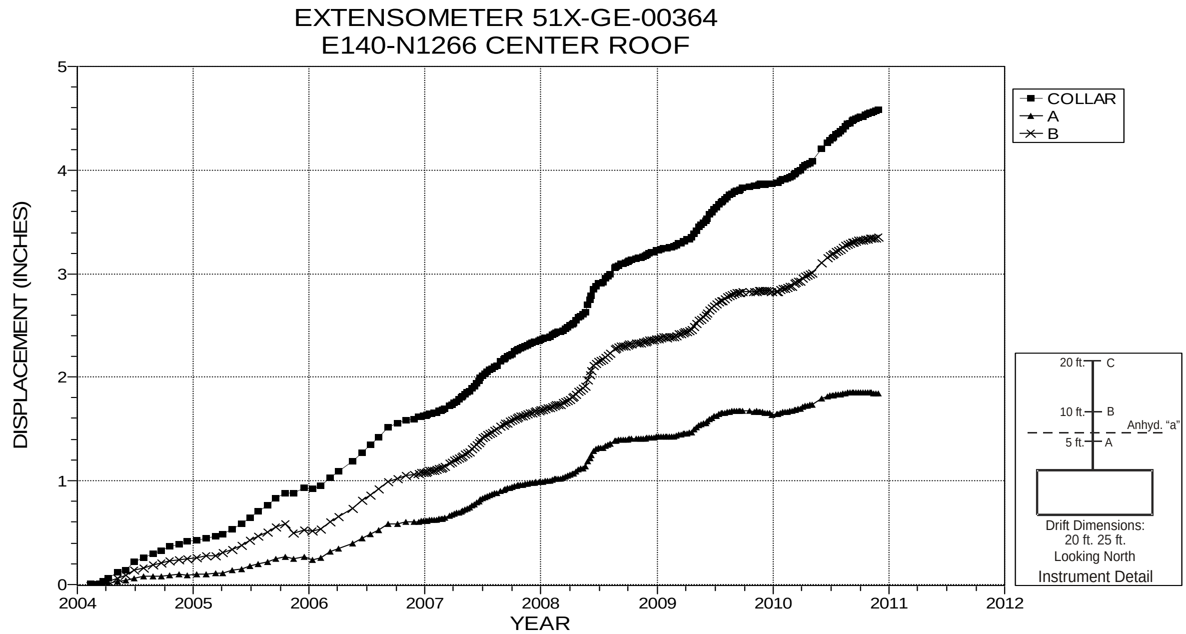
NOTES:
1. Excavation date: February 1983.

Figure 4-3 Extensometer 51X-GE-00353
E0 N626 – Roof



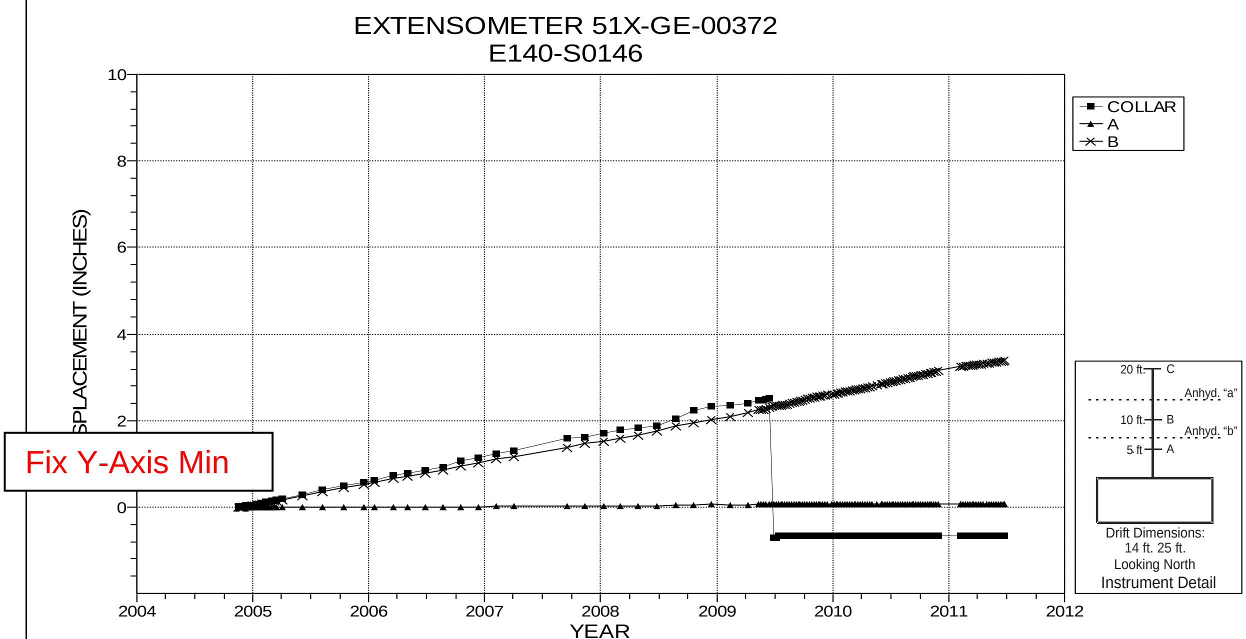
NOTES:
1. Excavation date: December 1982.

Figure 4-4 Extensometer 51X-GE-00355
E0 N300 – Roof



NOTES:
1. Excavation date: February 1983.
2. Instrument readings resumed after the end of this reporting period.

Figure 4-5 Extensometer 51X-GE-00364
E140 N1266 – Roof



NOTES:
1. Excavation date: November 1982.
2. The mechanical connection to the "Collar" anchor has been lost.

Figure 4-6 Extensometer 51X-GE-00372
E140 S146 – Roof

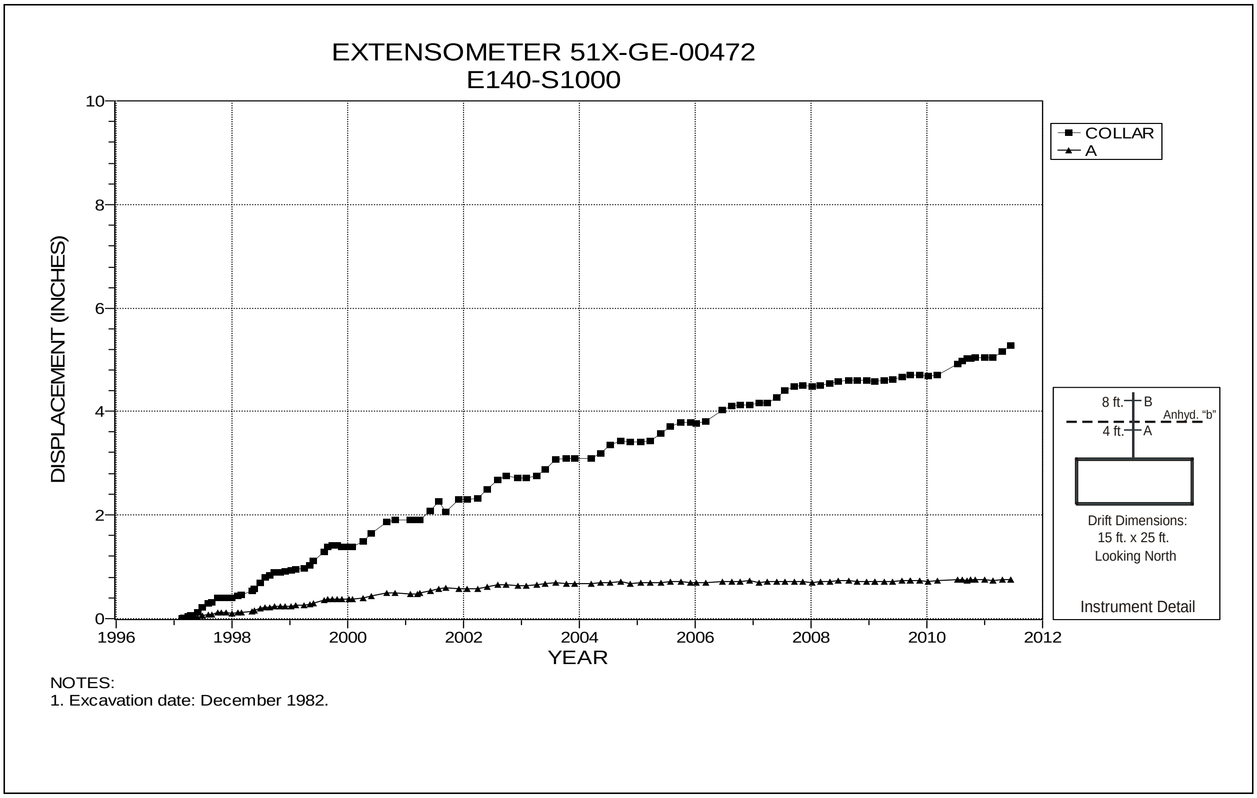


Figure 4-7 Extensometer 51X-GE-00472
E140 S1000 – Roof

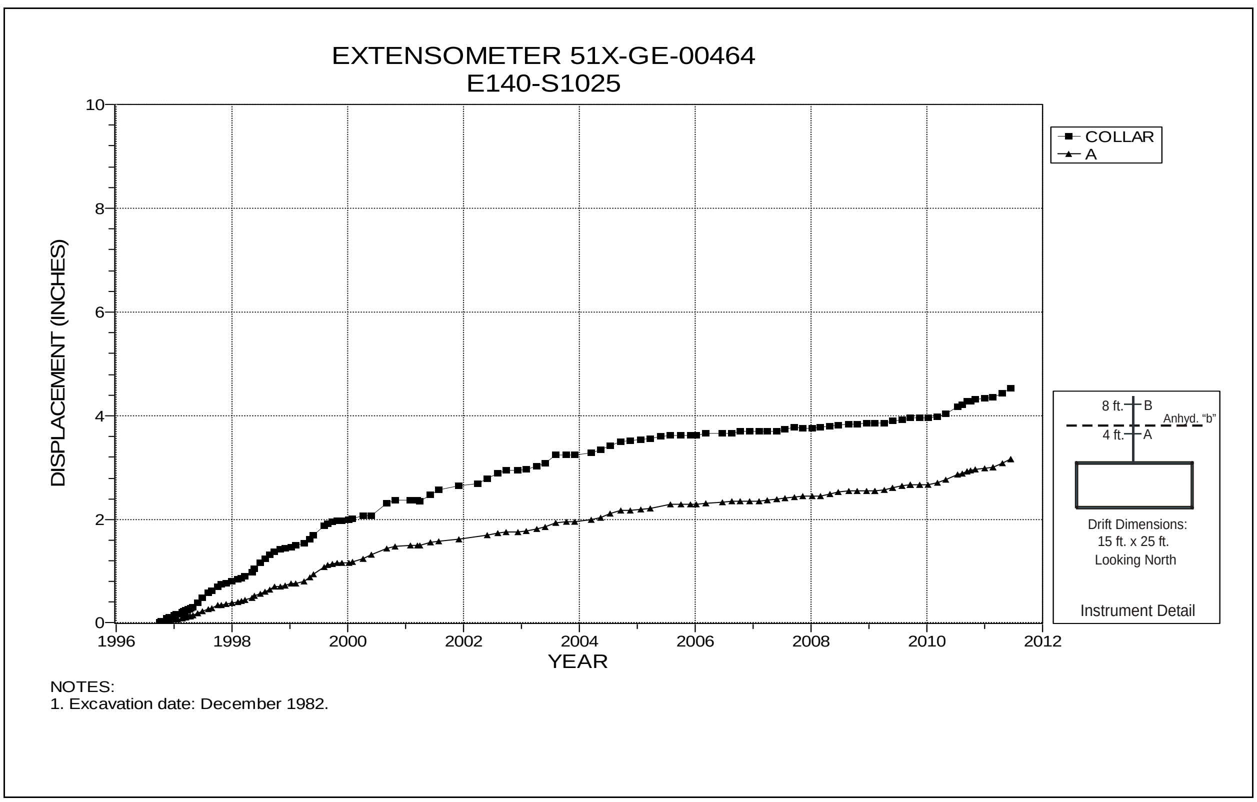
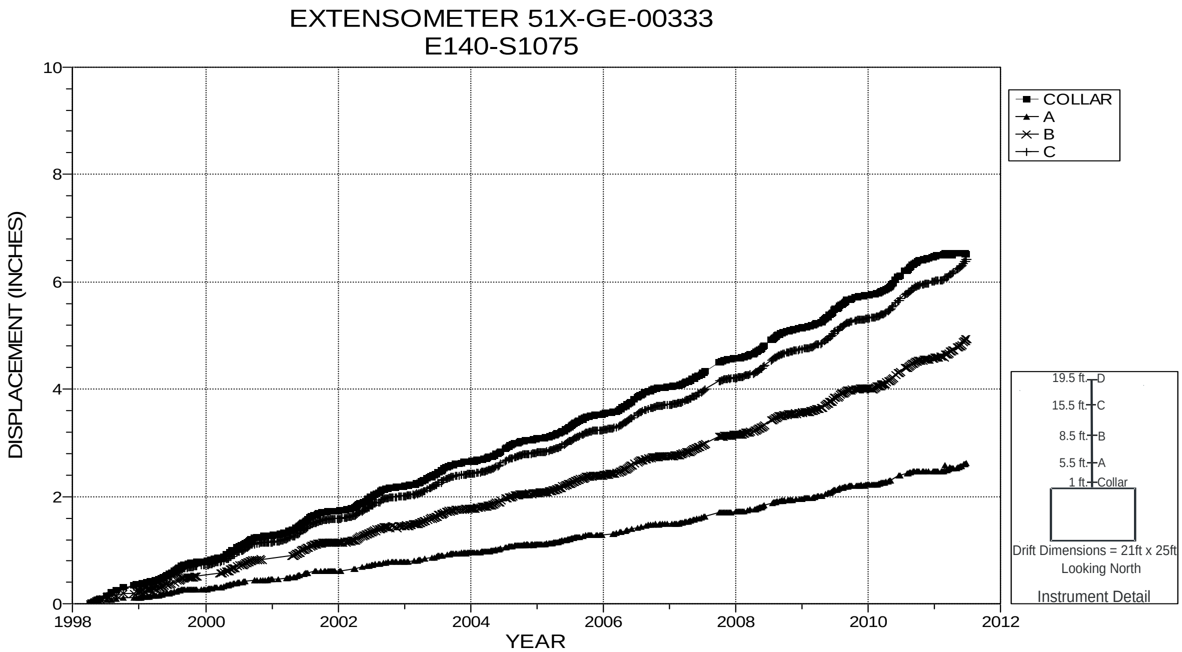
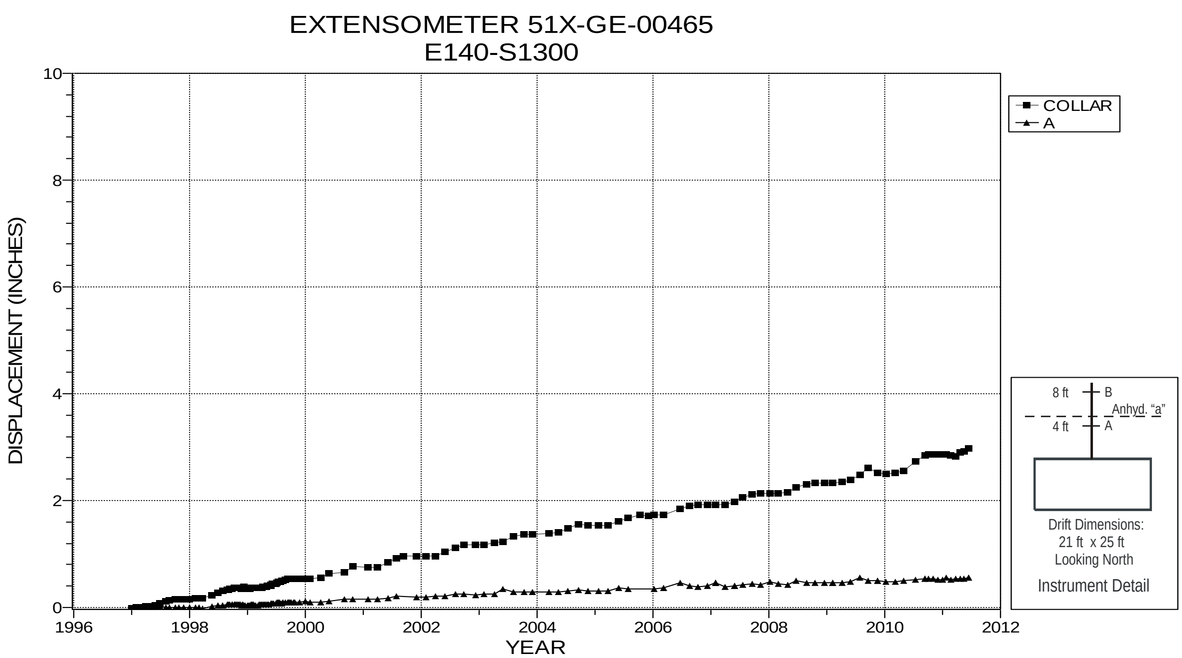


Figure 4-8 Extensometer 51X-GE-00464
E140 S1025 – Roof



NOTES:
1. Excavation date: December 1982.
2. Collar anchor (anchor "D") has reached its maximum range.

Figure 4-9 Extensometer 51X-GE-00333
E140 S1075 – Roof



NOTES:
1. Excavation date: December 1982.

Figure 4-10 Extensometer 51X-GE-00465
E140 S1300 – Roof

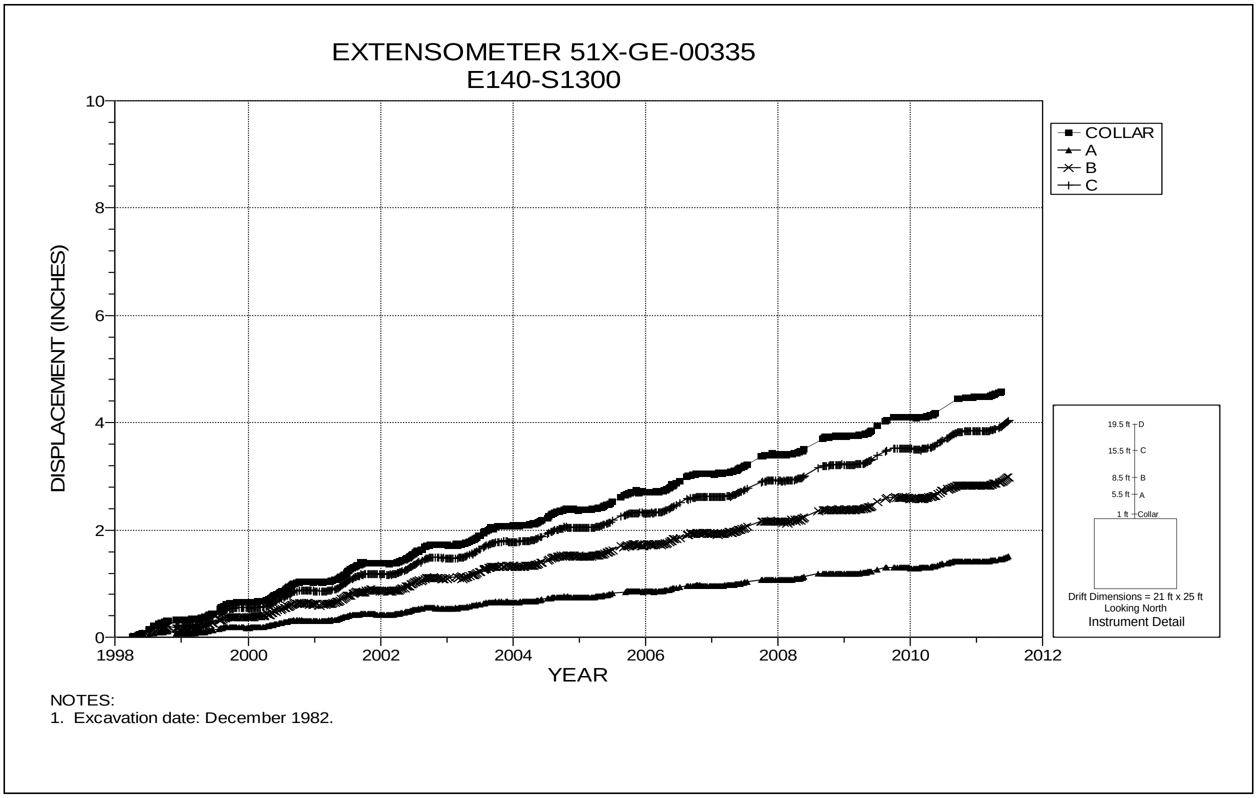


Figure 4-11 Extensometer 51X-GE-00335
E140 S1300 – Roof

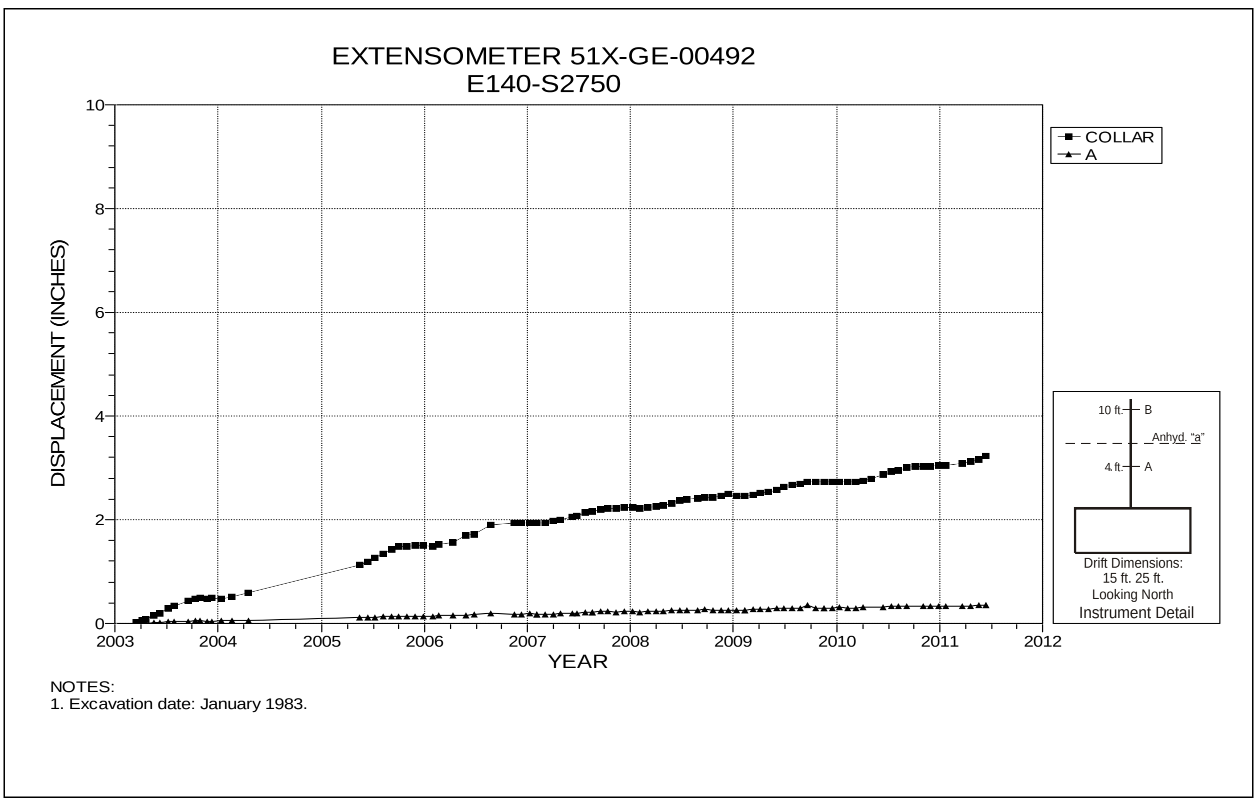


Figure 4-12 Extensometer 51X-GE-00492
E140 S2750 – Roof

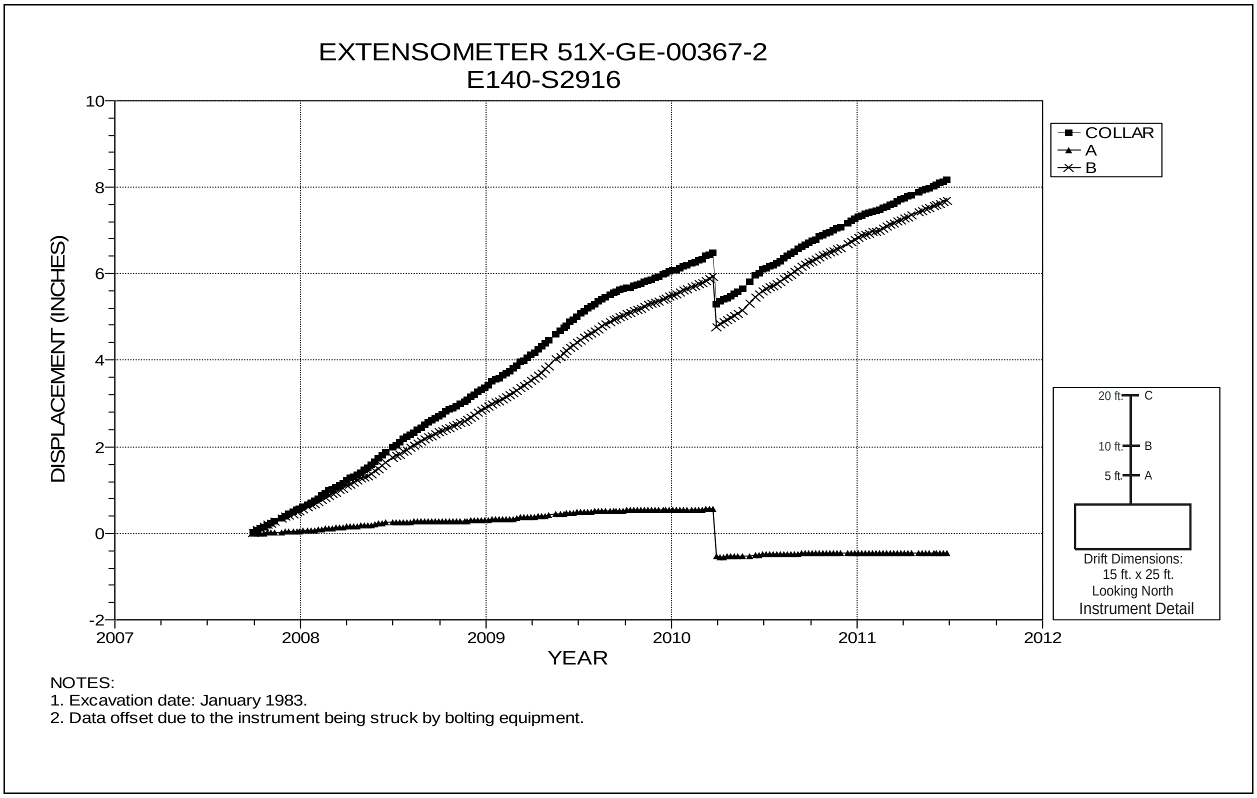


Figure 4-13 Extensometer 51X-GE-00367-2
E140 S2916 – Roof

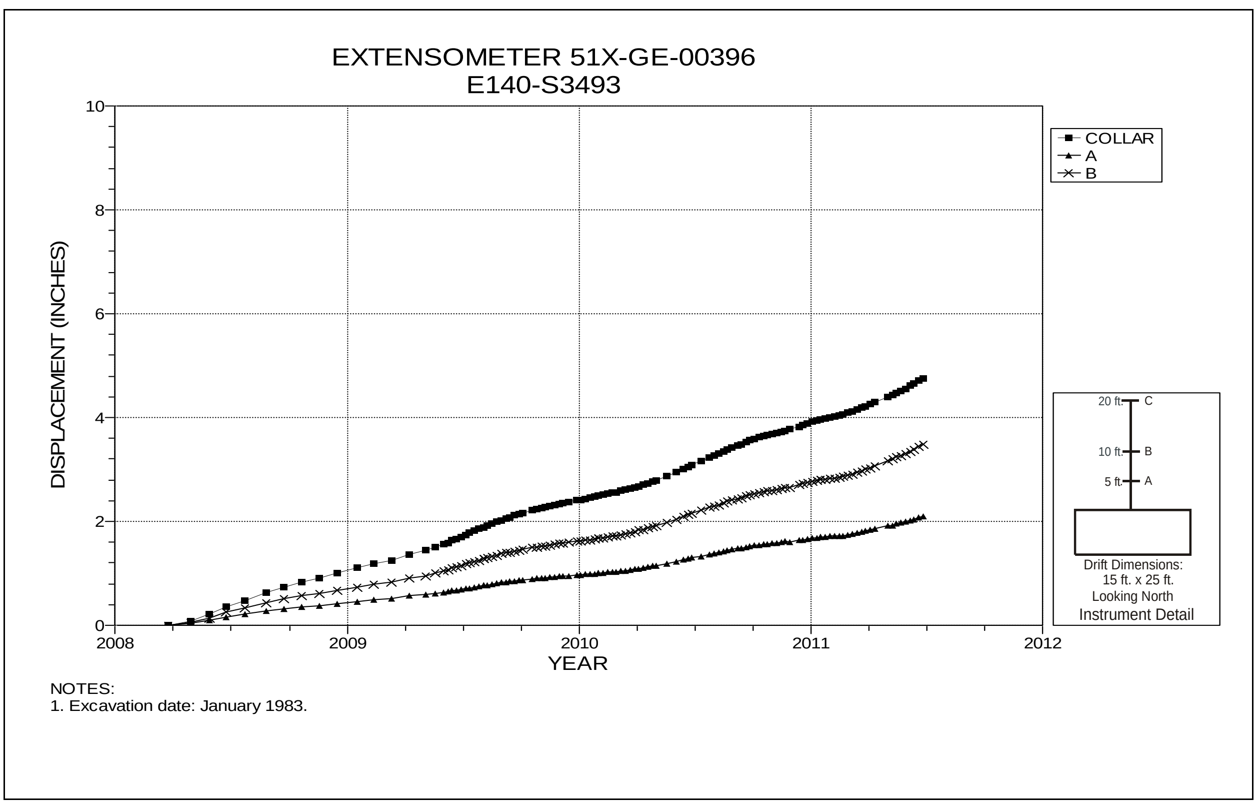


Figure 4-14 Extensometer 51X-GE-00396
E140 S3493 – Roof

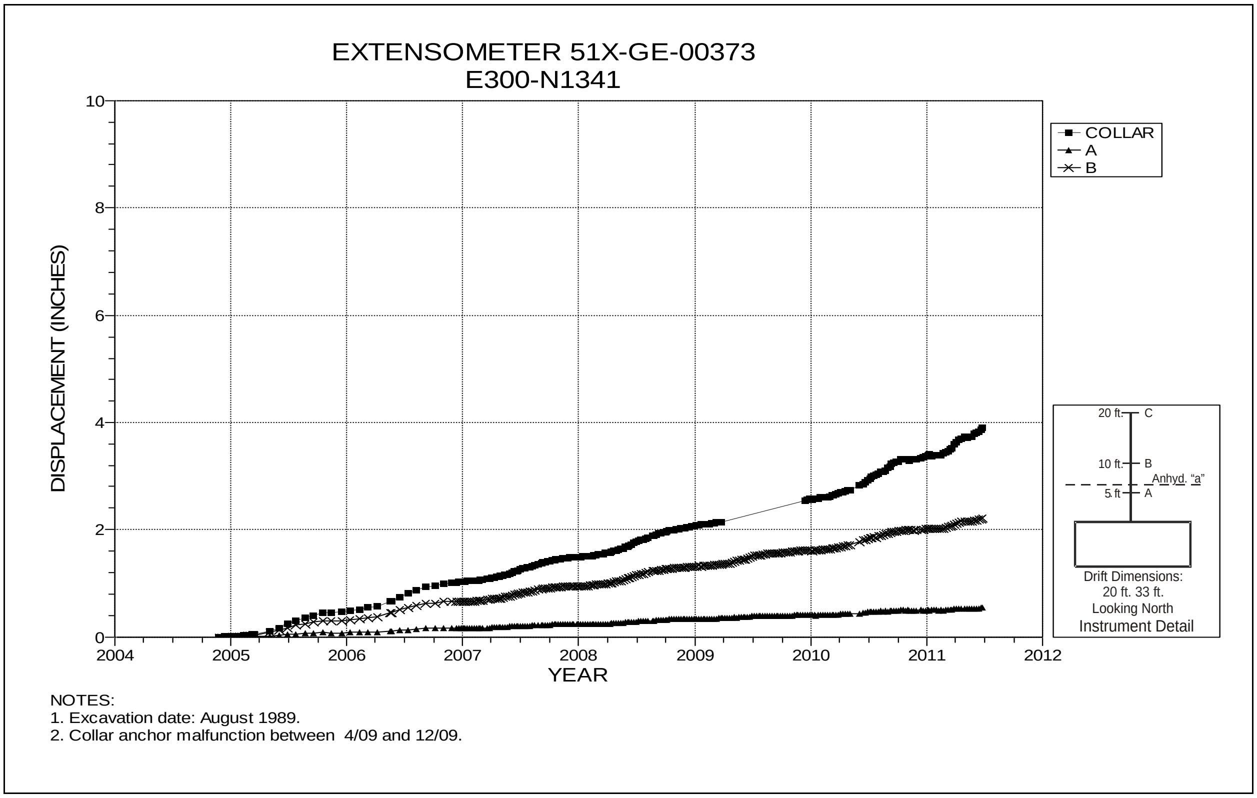


Figure 4-15 Extensometer 51X-GE-00373
E300 N1341 – Roof

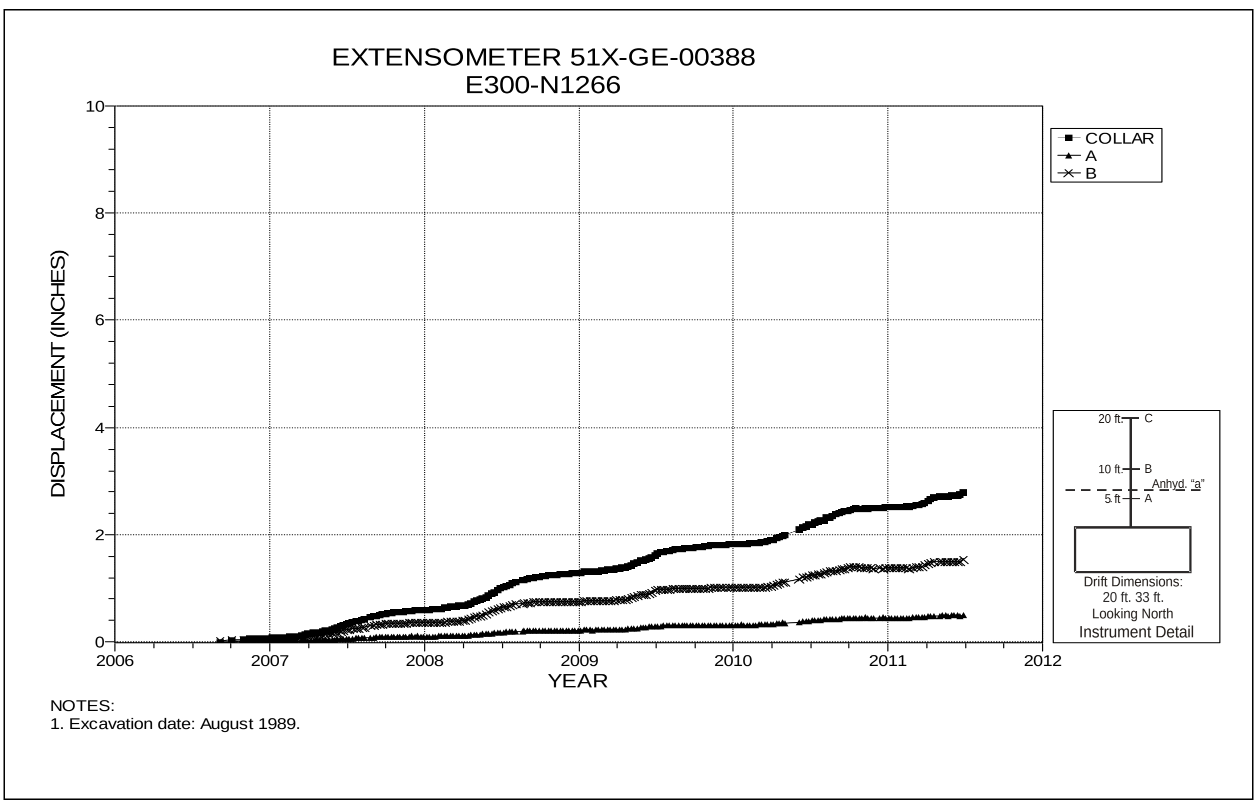
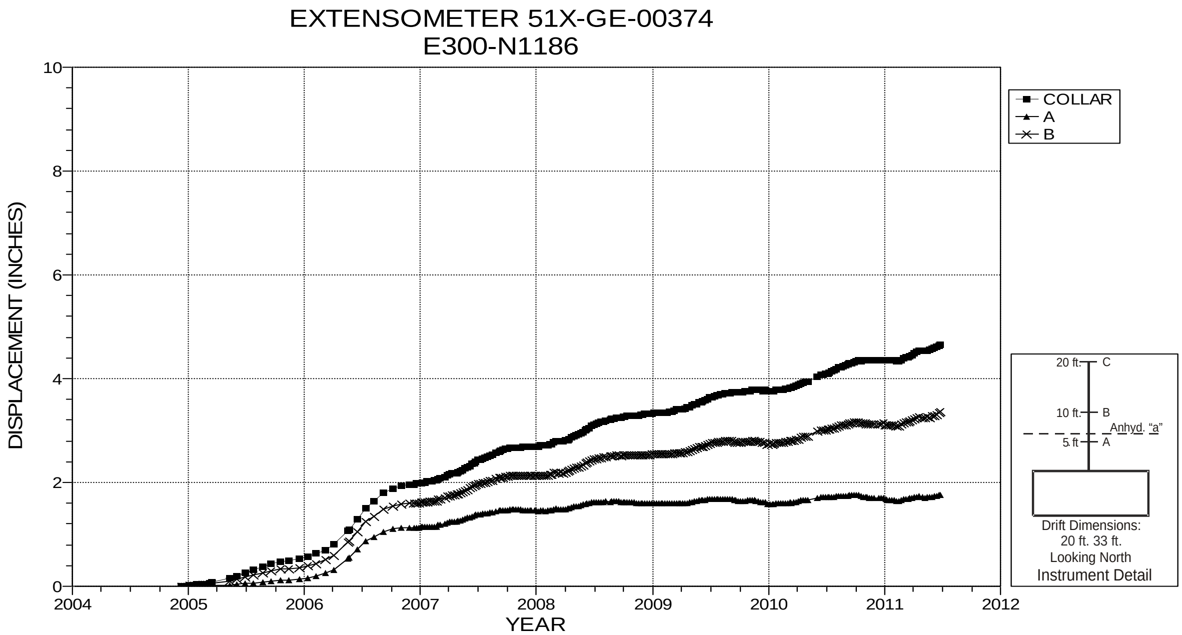
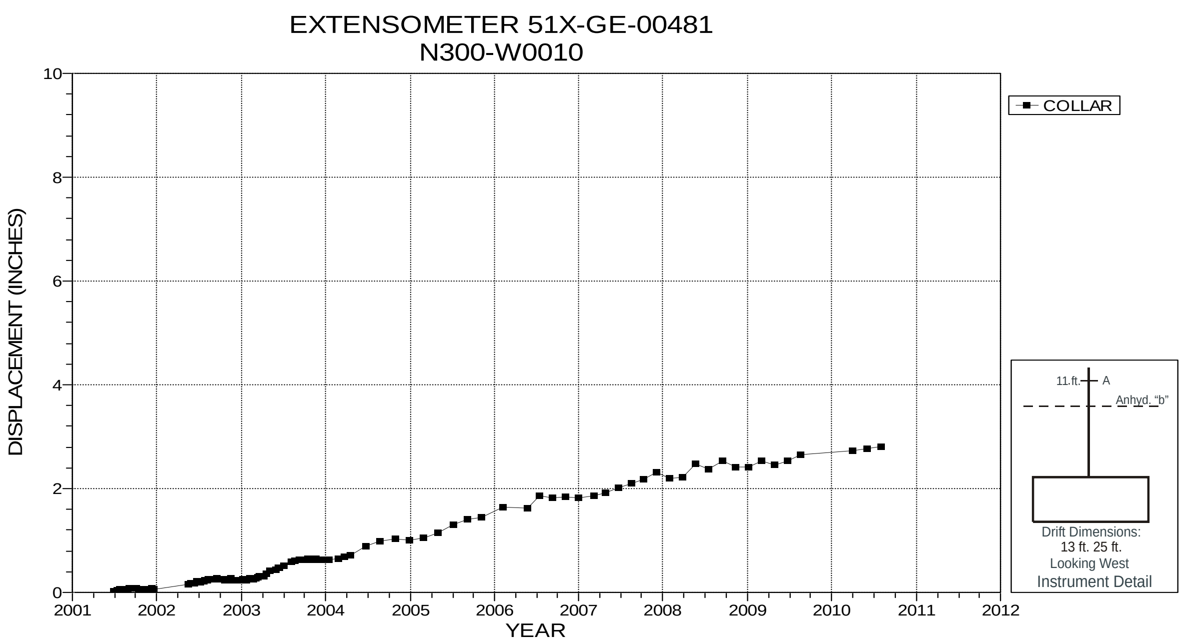


Figure 4-16 Extensometer 51X-GE-00388
E300 N1266 – Roof



NOTES:
1. Excavation date: August 1989.

Figure 4-17 Extensometer 51X-GE-00374
E300 N1186 – Roof



NOTES:
1. Excavation date: October 1987.
2. This instrument is no longer being read due to being struck by a haul truck.

Figure 4-18Extensometer 51X-GE-00481
N300 W10 – Roof

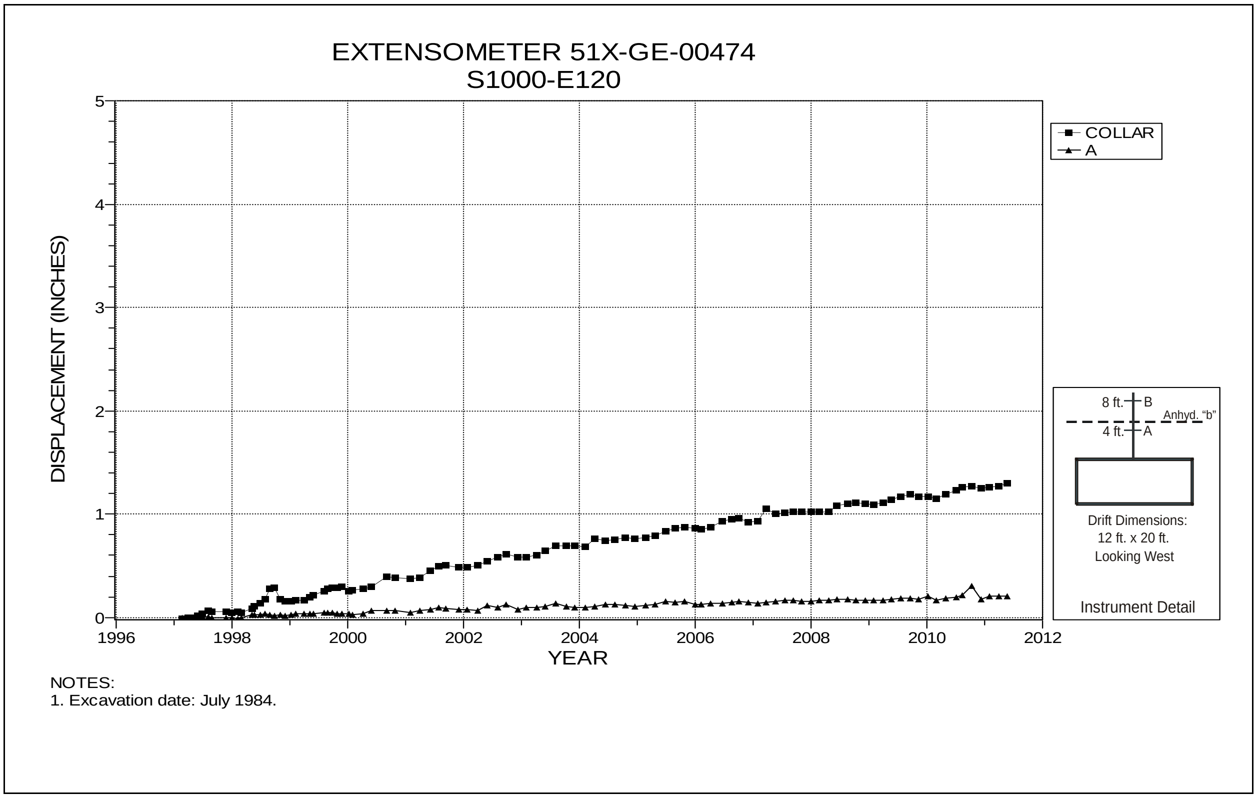


Figure 4-19 Extensometer 51X-GE-00474
S1000 E120 – Roof

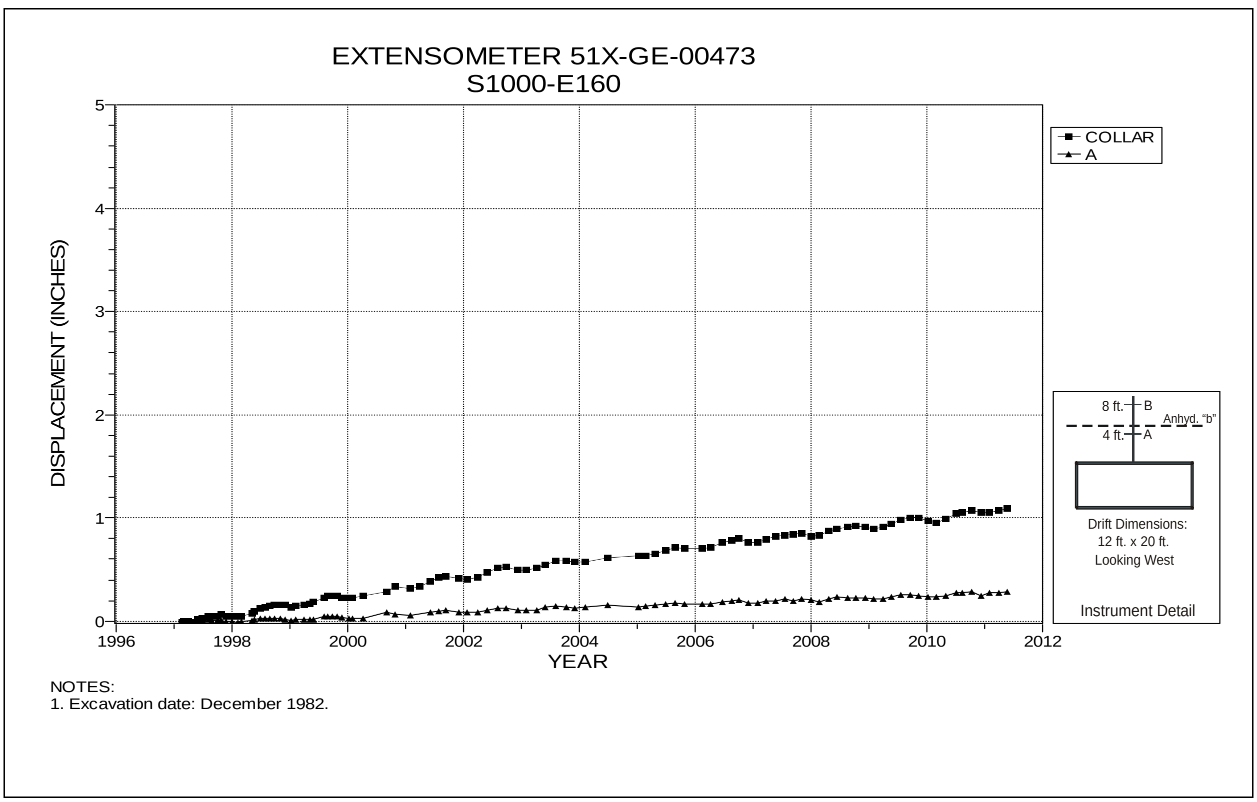
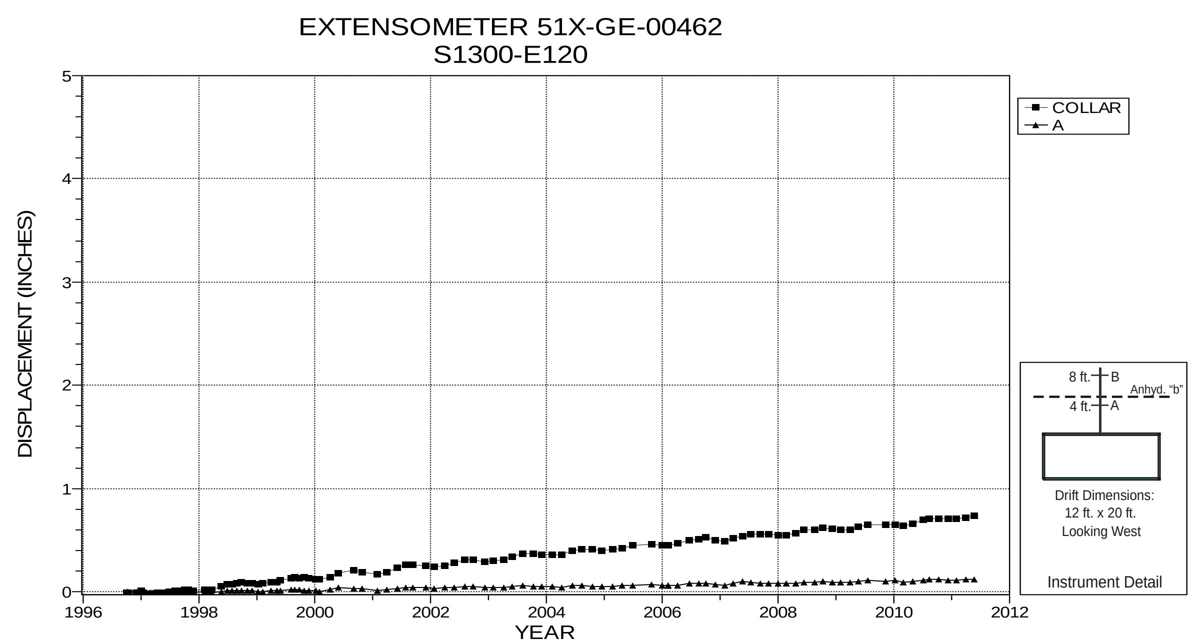
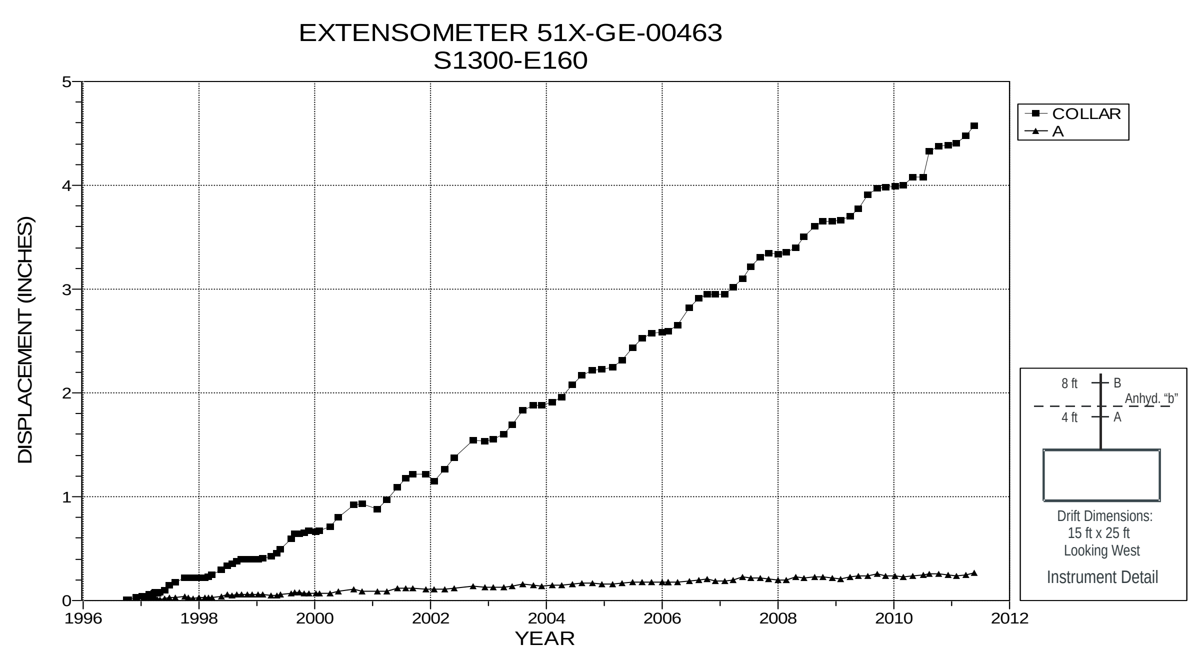


Figure 4-20 Extensometer 51X-GE-00473
S1000 E160 – Roof



NOTES:
1. Excavation date: August 1984.

Figure 4-21 Extensometer 51X-GE-00462
S1300 E120 – Roof



NOTES:
1. Excavation date: June 1984.

Figure 4-22 Extensometer 51X-GE-00463
S1300 E160 – Roof

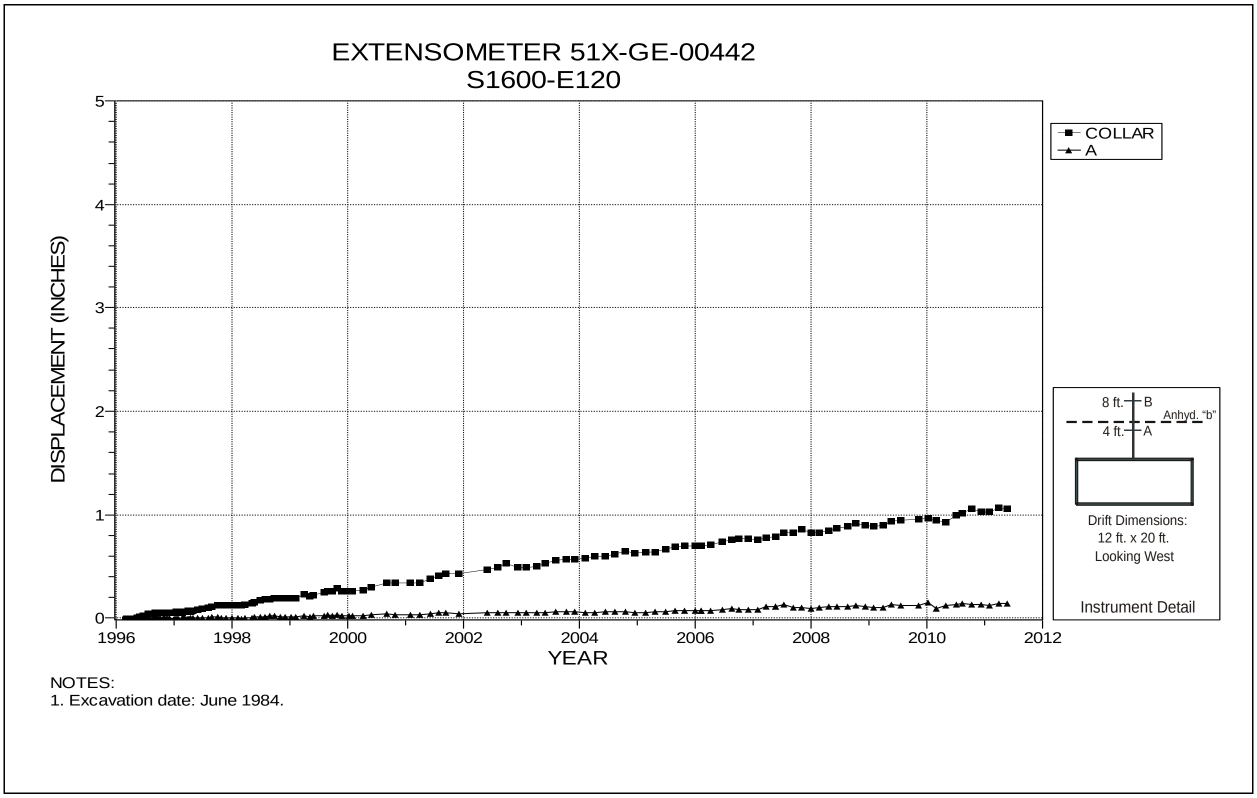


Figure 4-23 Extensometer 51X-GE-00442
S1600 E120 – Roof

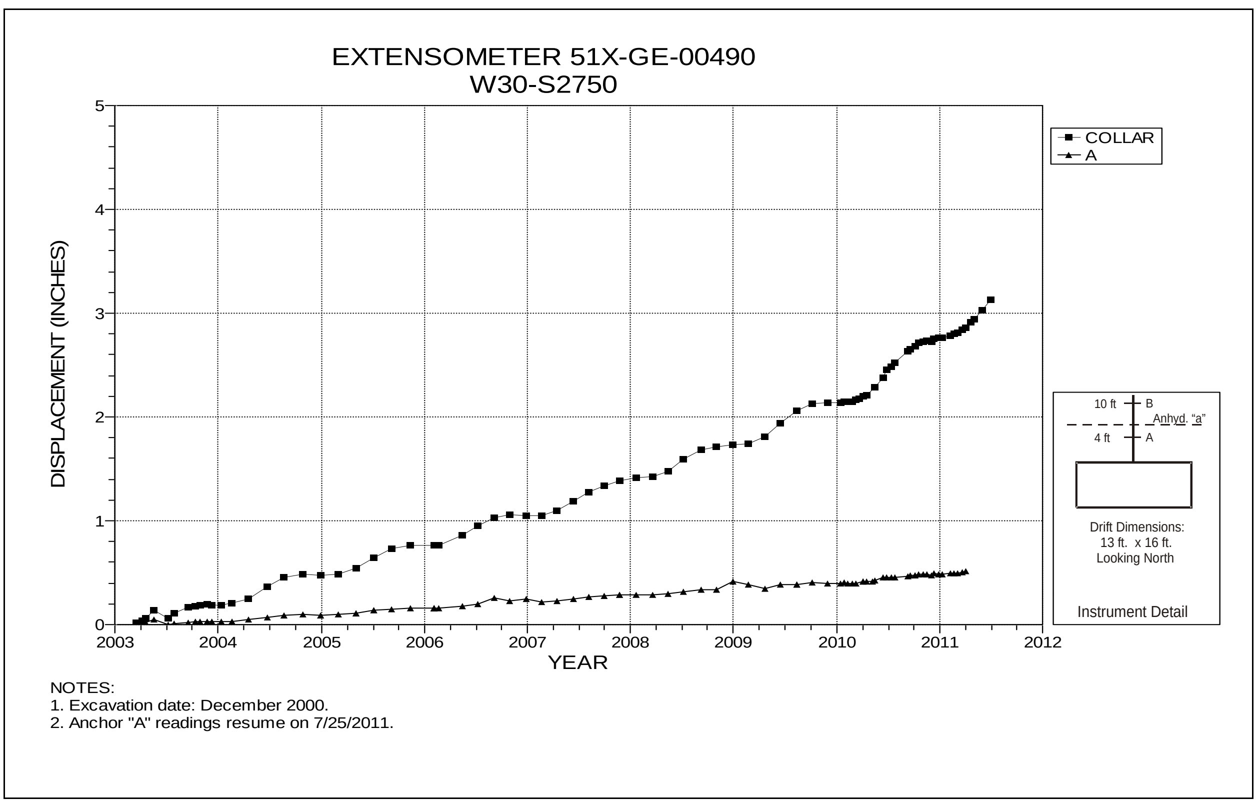
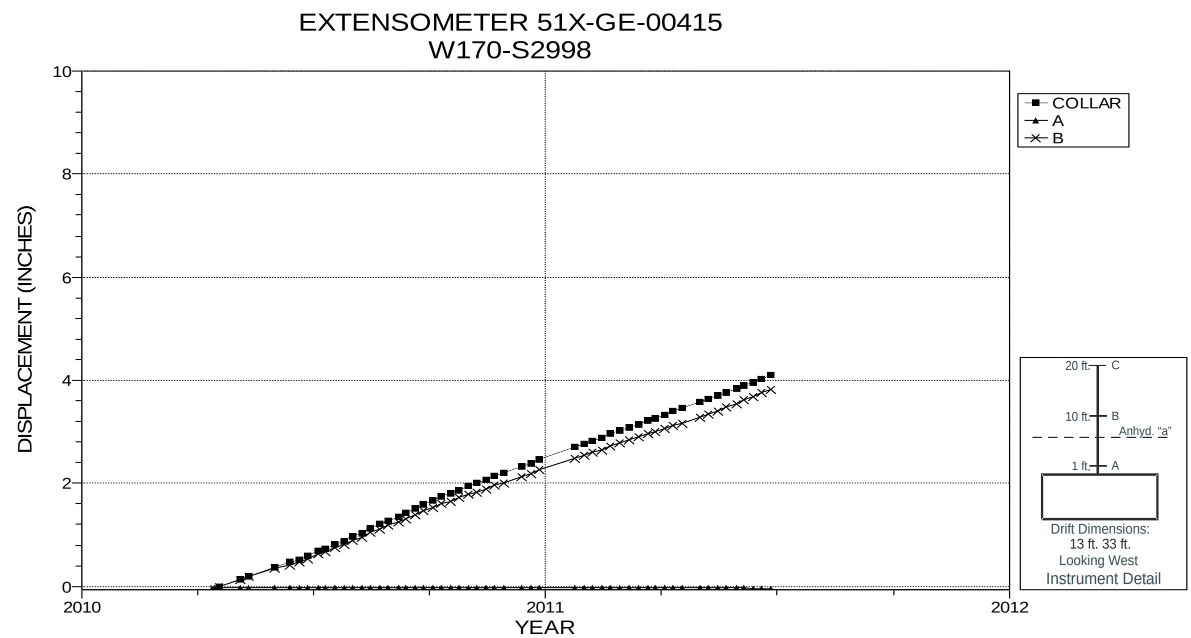
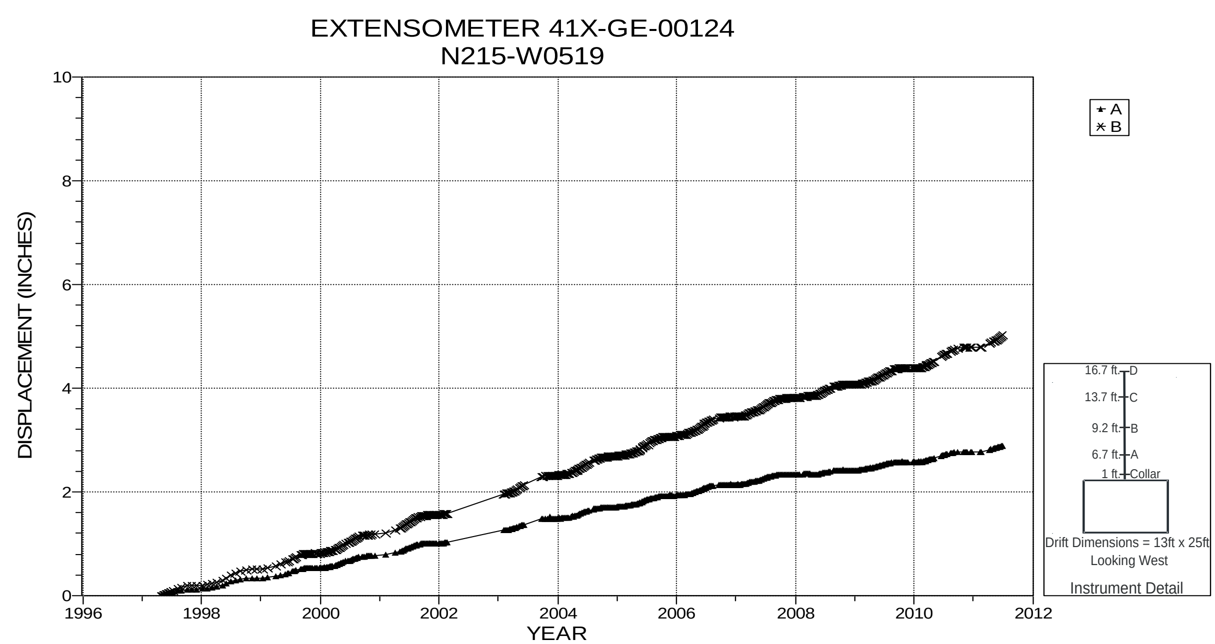


Figure 4-24 Extensometer 51X-GE-00490
W30 S2750 – Roof



NOTES:
1. Excavation date: August 2001.

Figure 4-25 Extensometer 51X-GE-00415
W170 S2998 – Roof



NOTES:
1. Excavation date: January 1988.
2. Anchors "C" and "D" have reached their maximum range
and have been removed from this plot for clarity.

Figure 4-26 Extensometer 41X-GE-00124
W519 N190 – Roof

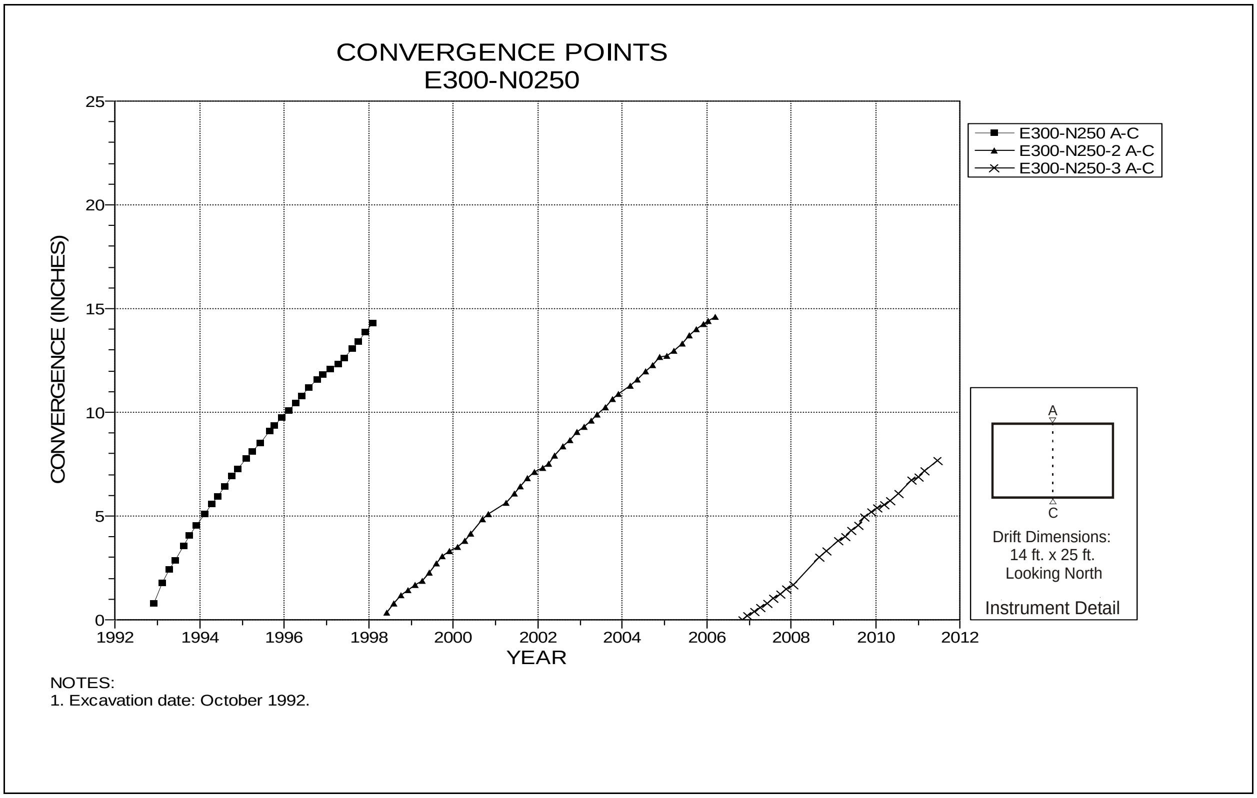


Figure 4-27 Convergence Point Array
E300 Shop N250 – Roof to Floor

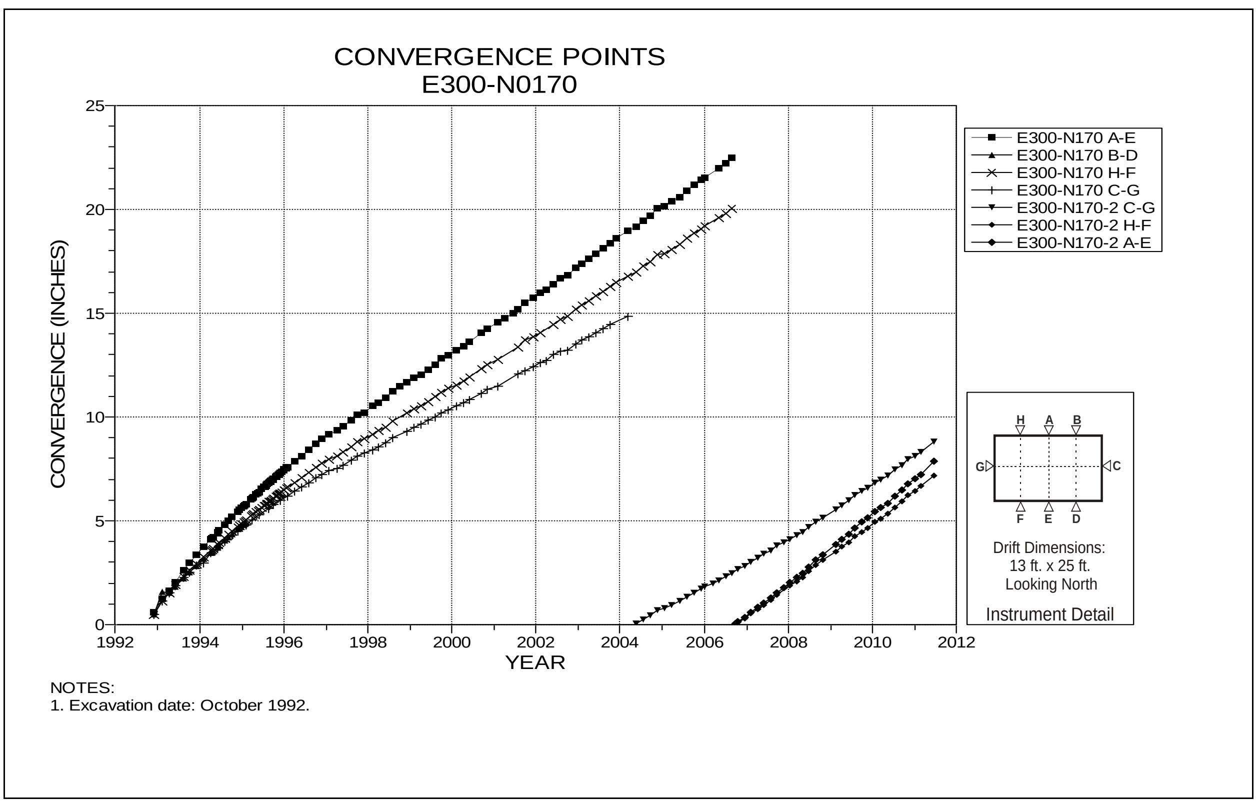


Figure 4-28 Convergence Point Array E300 Shop
N170 – All Chords

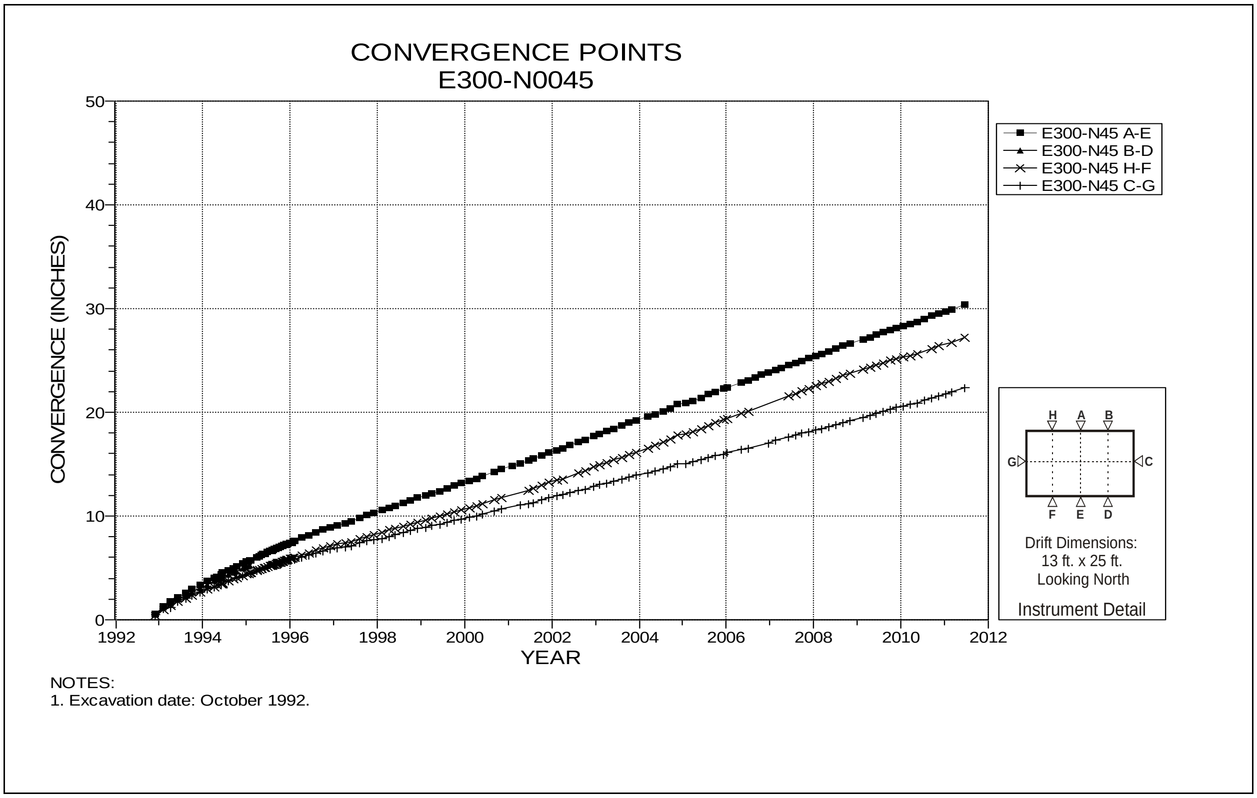


Figure 4-29 Convergence Point Array
E300 Shop N45 – All Chords

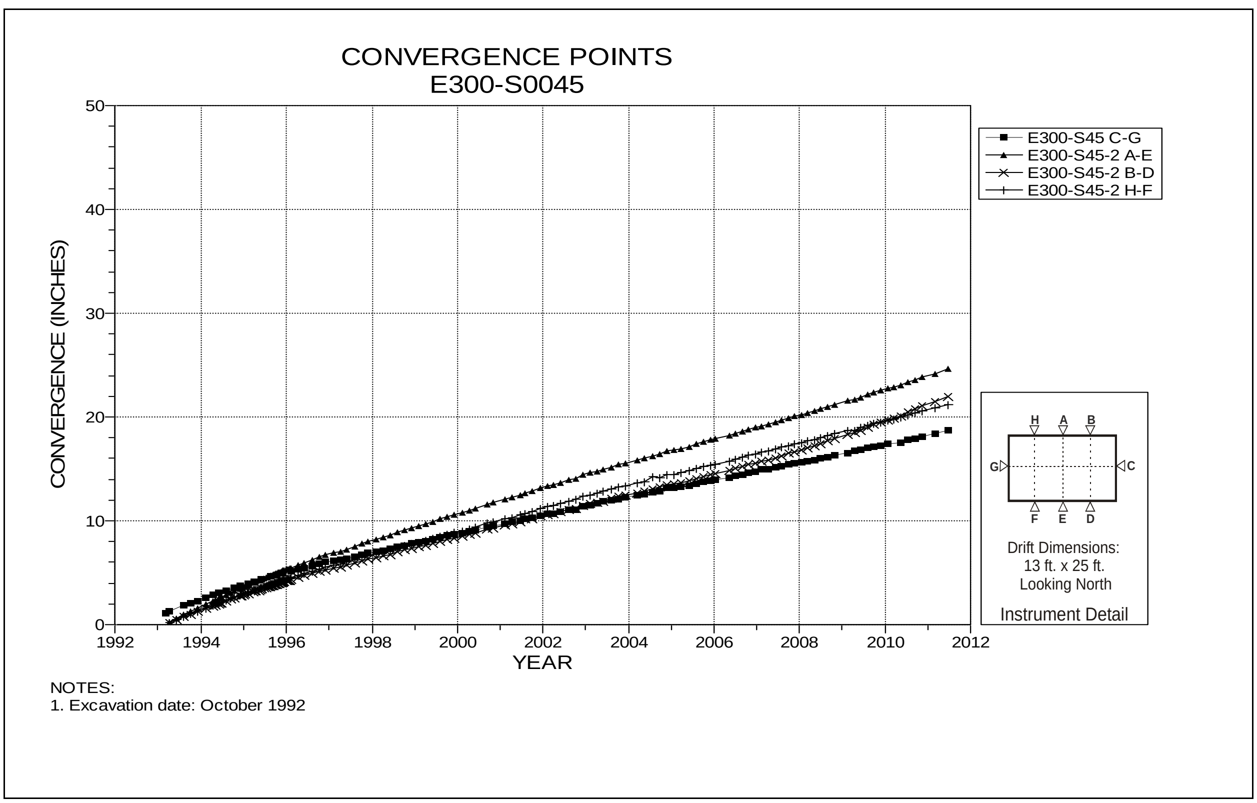


Figure 4-30 Convergence Point Array
E300 Shop S45 – All Chords

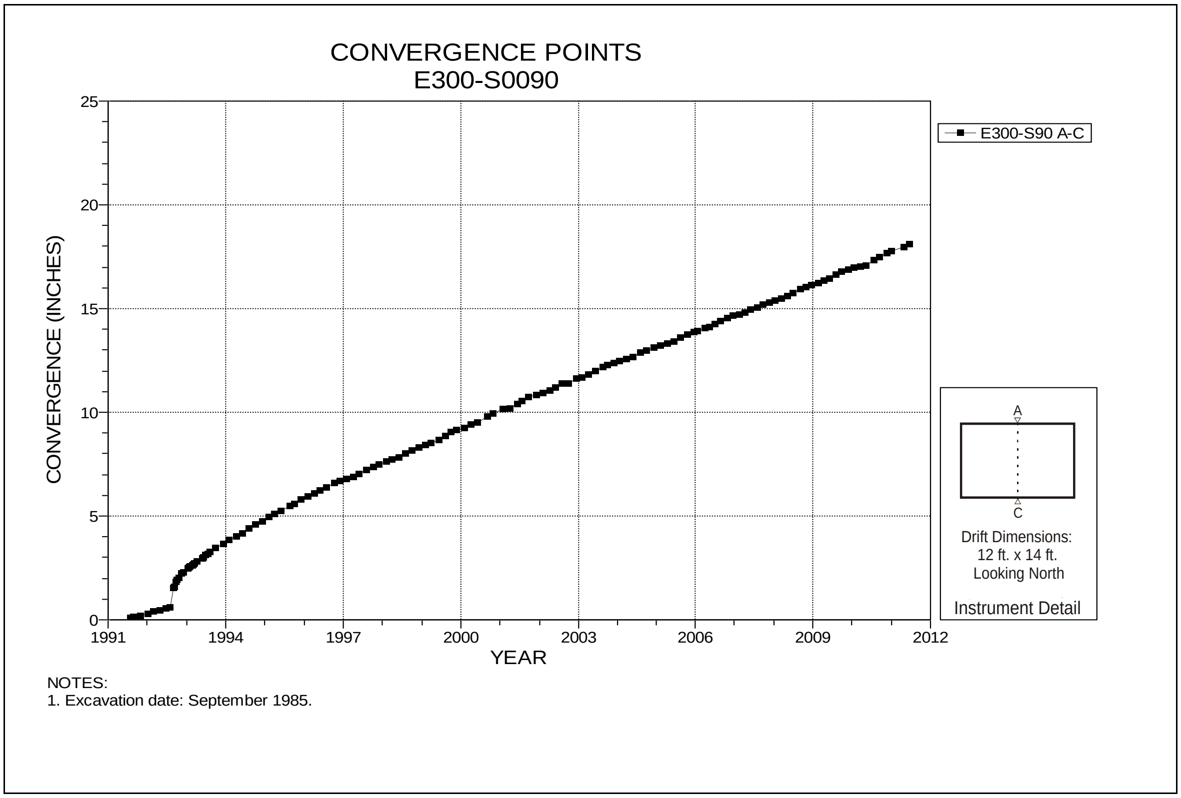


Figure 4-31 Convergence Point Array
E300 S90 – Roof to Floor

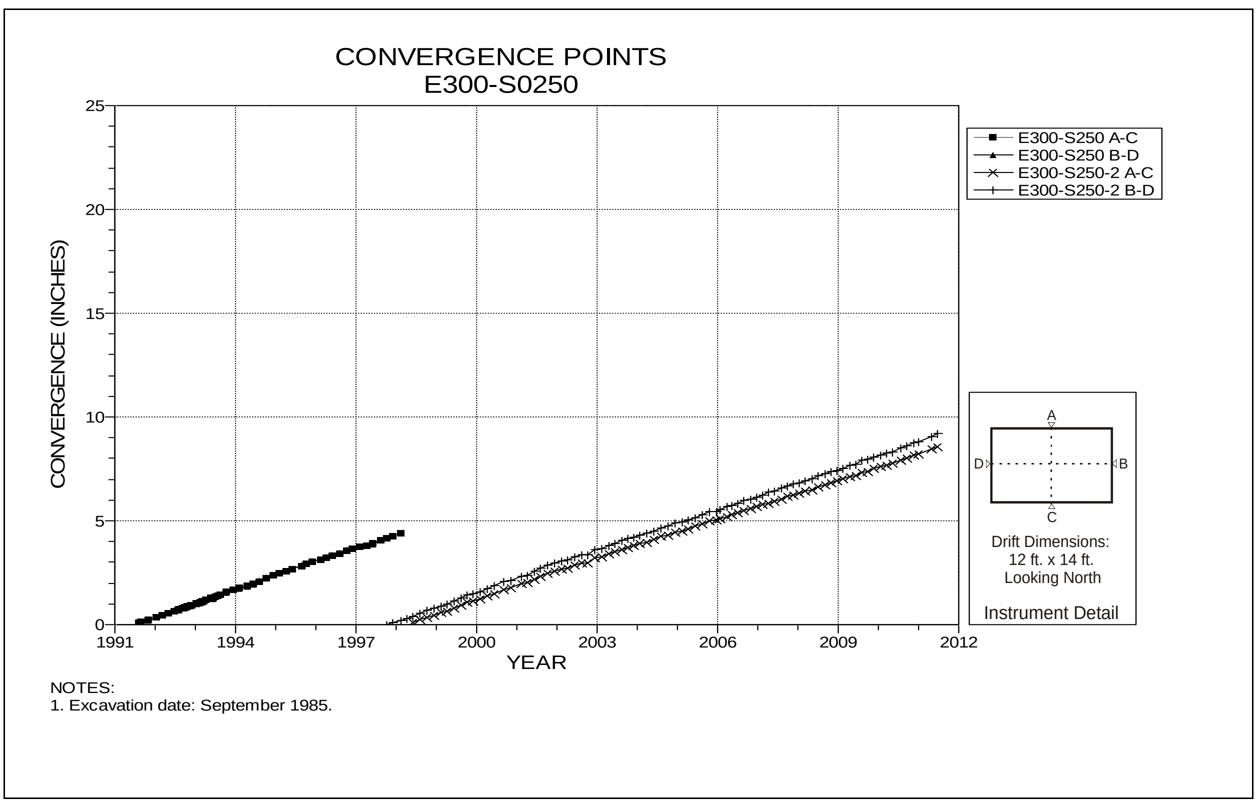


Figure 4-32 Convergence Point Array
E300 S250 – All Chords

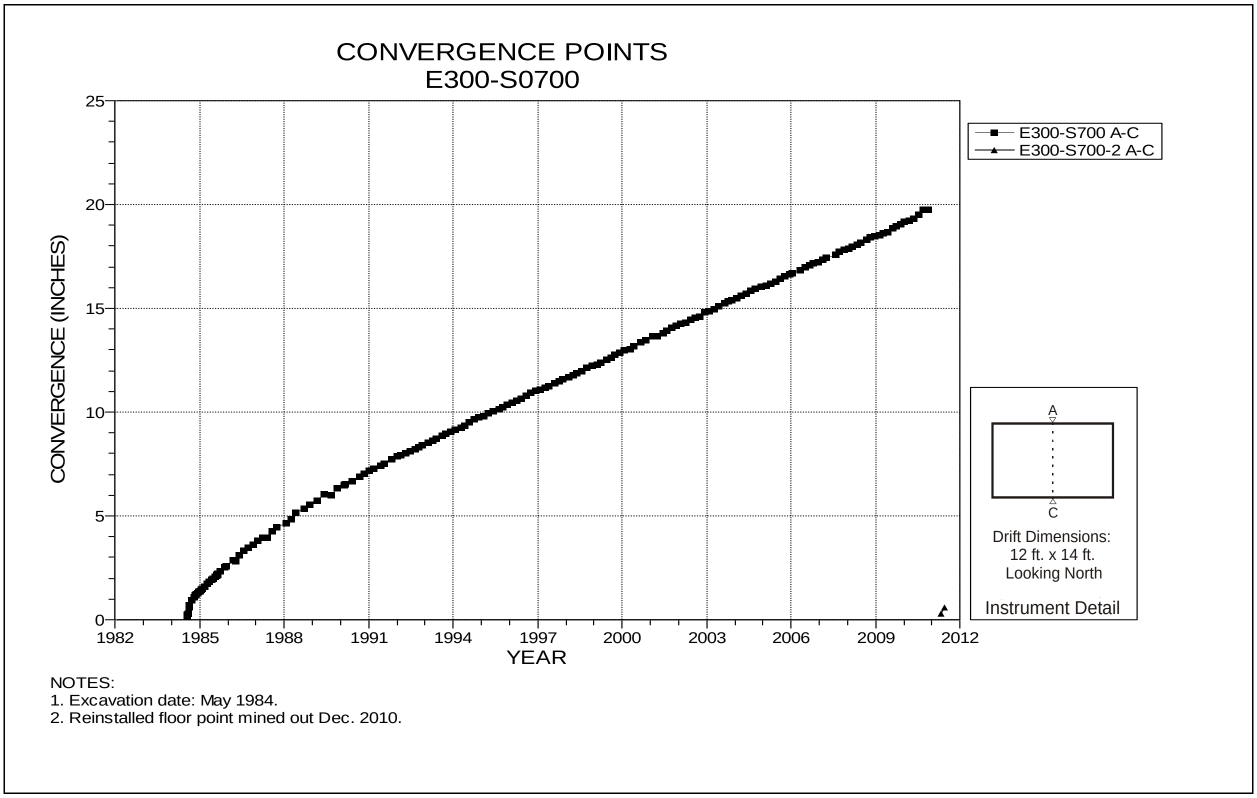


Figure 4-33 Convergence Point Array
E300 S700 – Roof to Floor

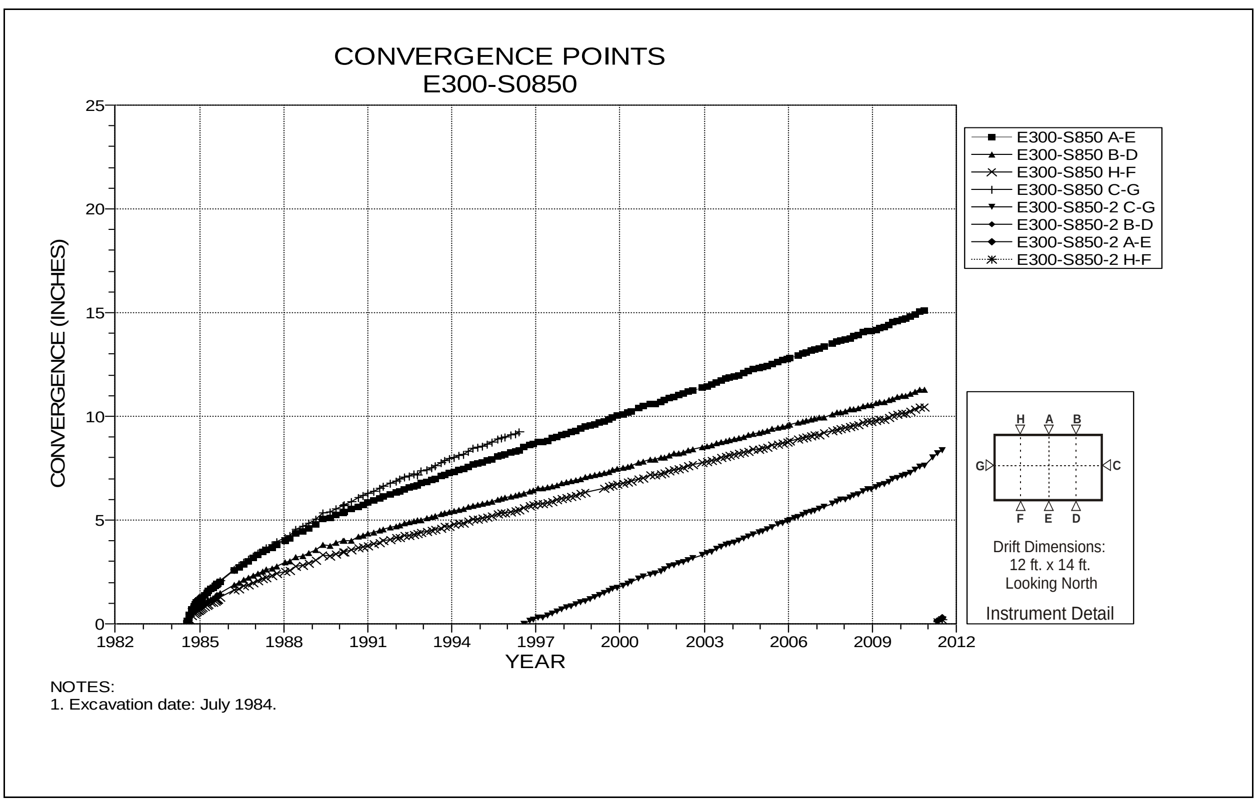


Figure 4-34 Convergence Point Array
E300 S850 – All Chords

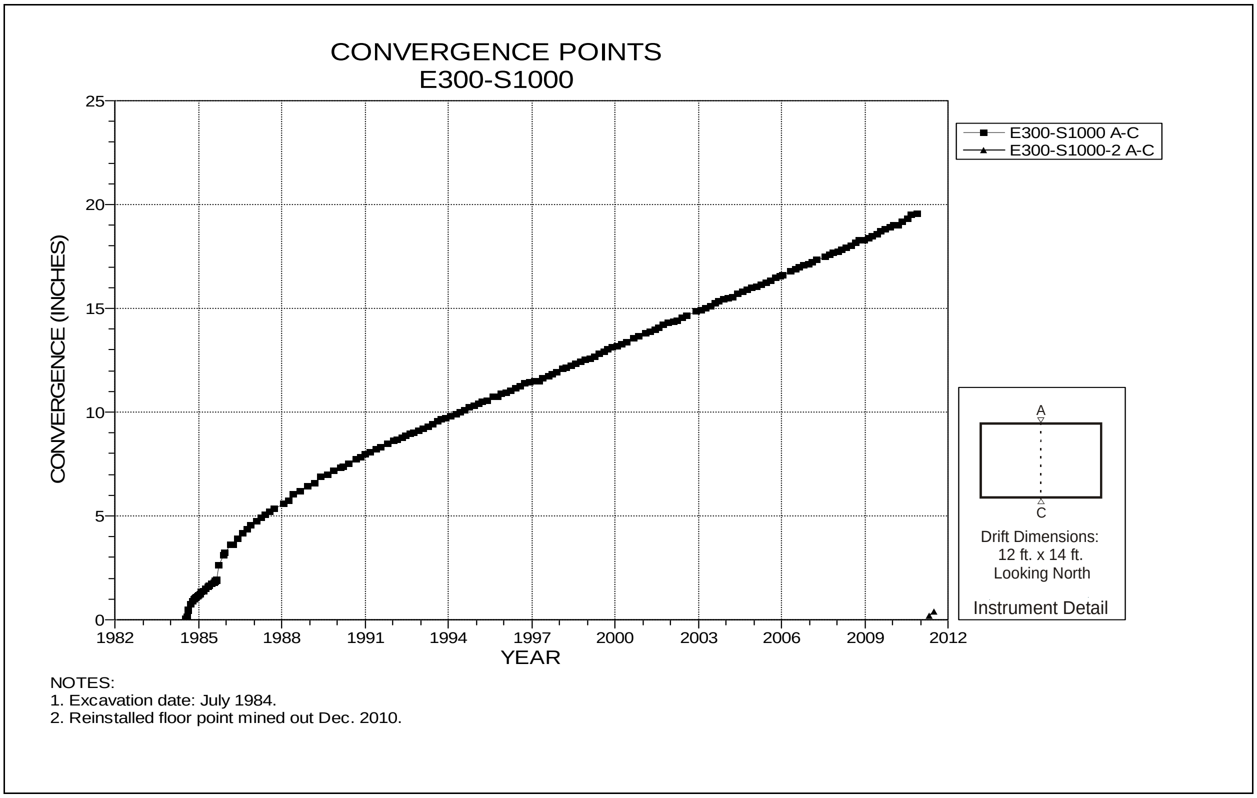


Figure 4-35 Convergence Point Array
E300 S1000 – Roof to Floor

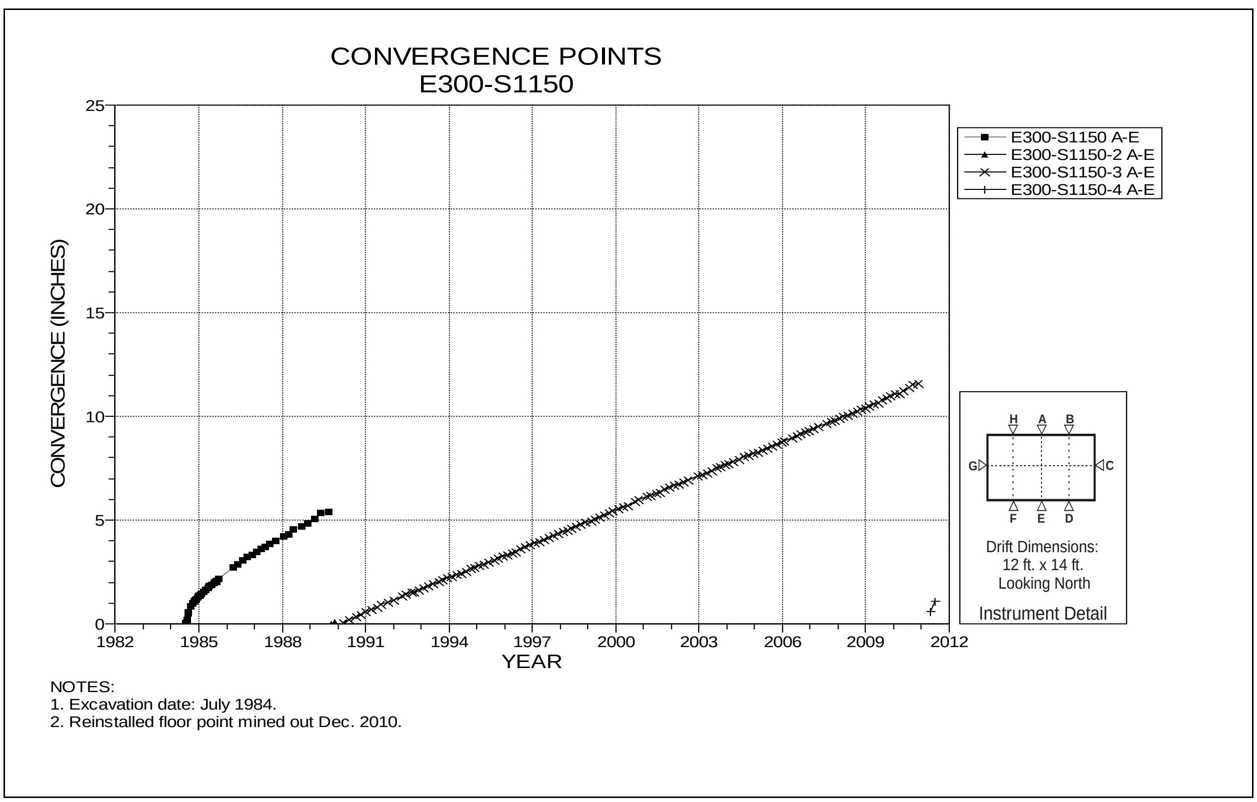


Figure 4-36 Convergence Point Array
E300 S1150 – Roof to Floor

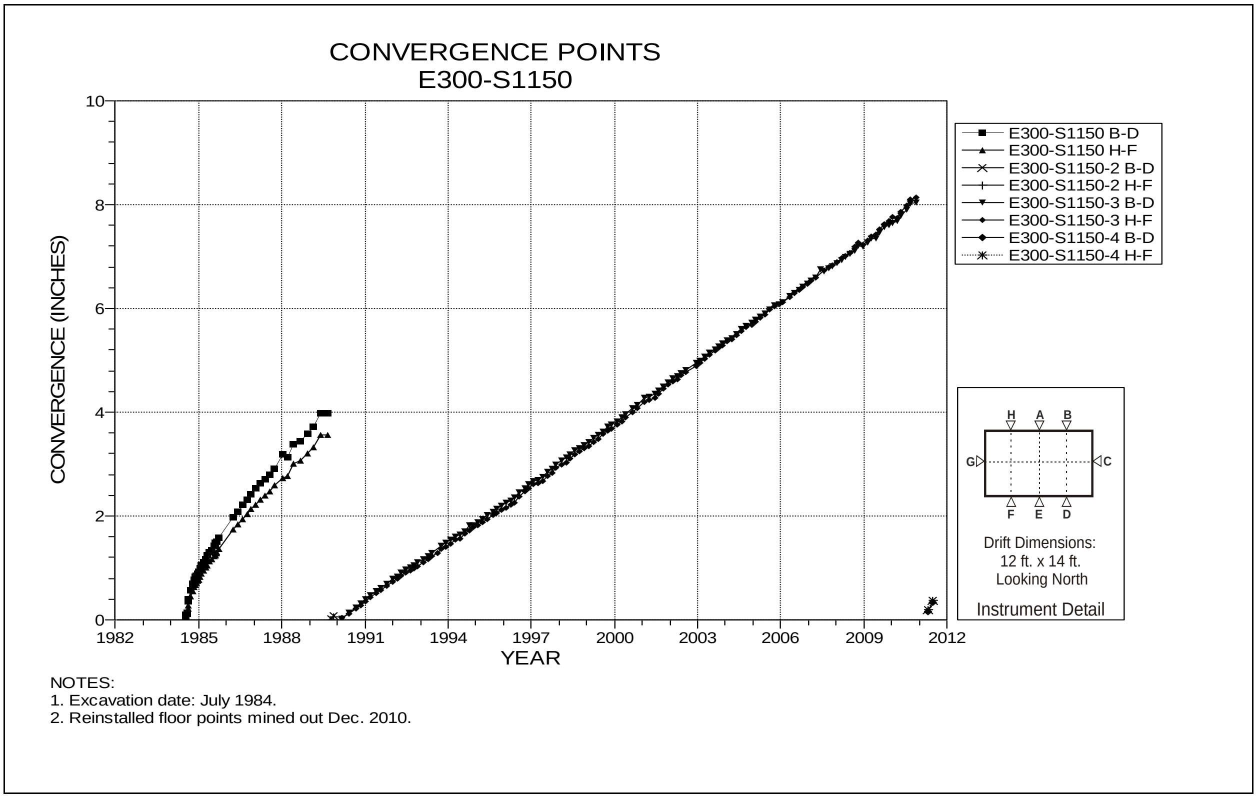


Figure 4-37 Convergence Point Array
E300 S1150 – Quarter-Points

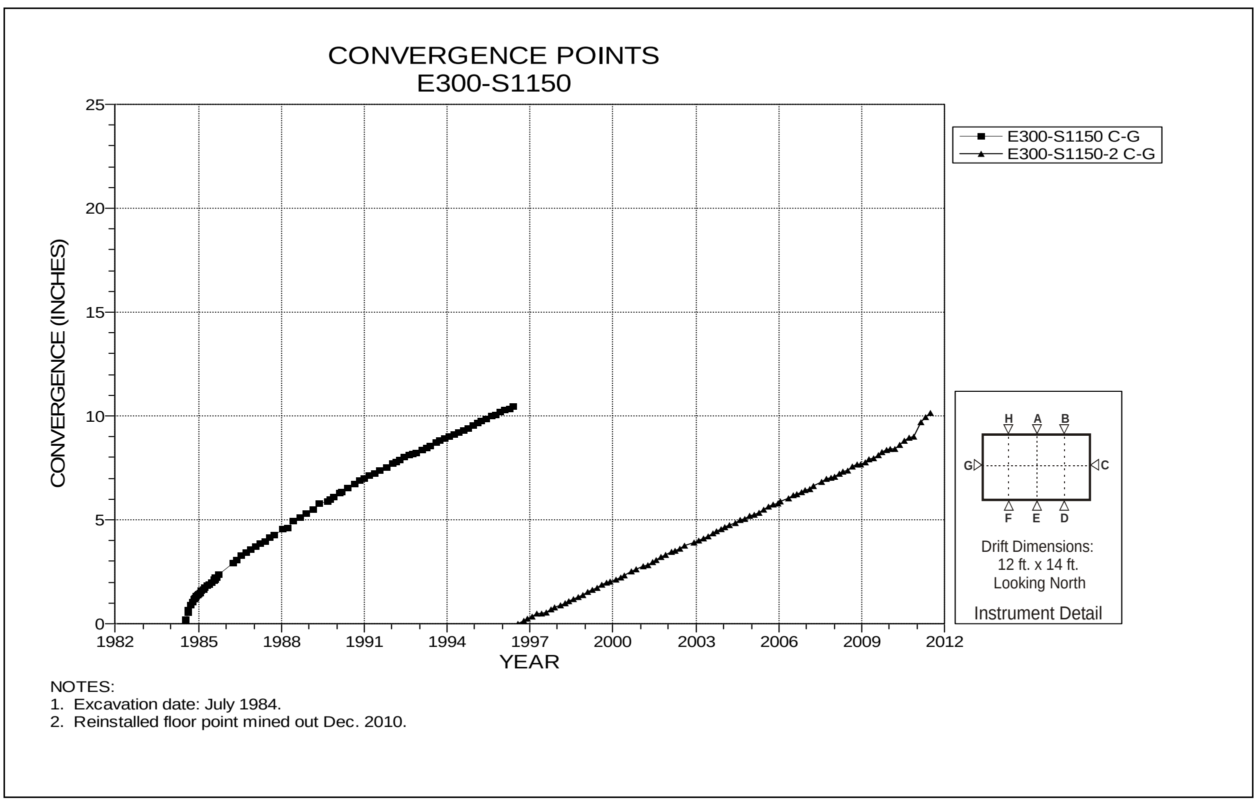


Figure 4-38 Convergence Point Array
E300 S1150 – Rib to Rib

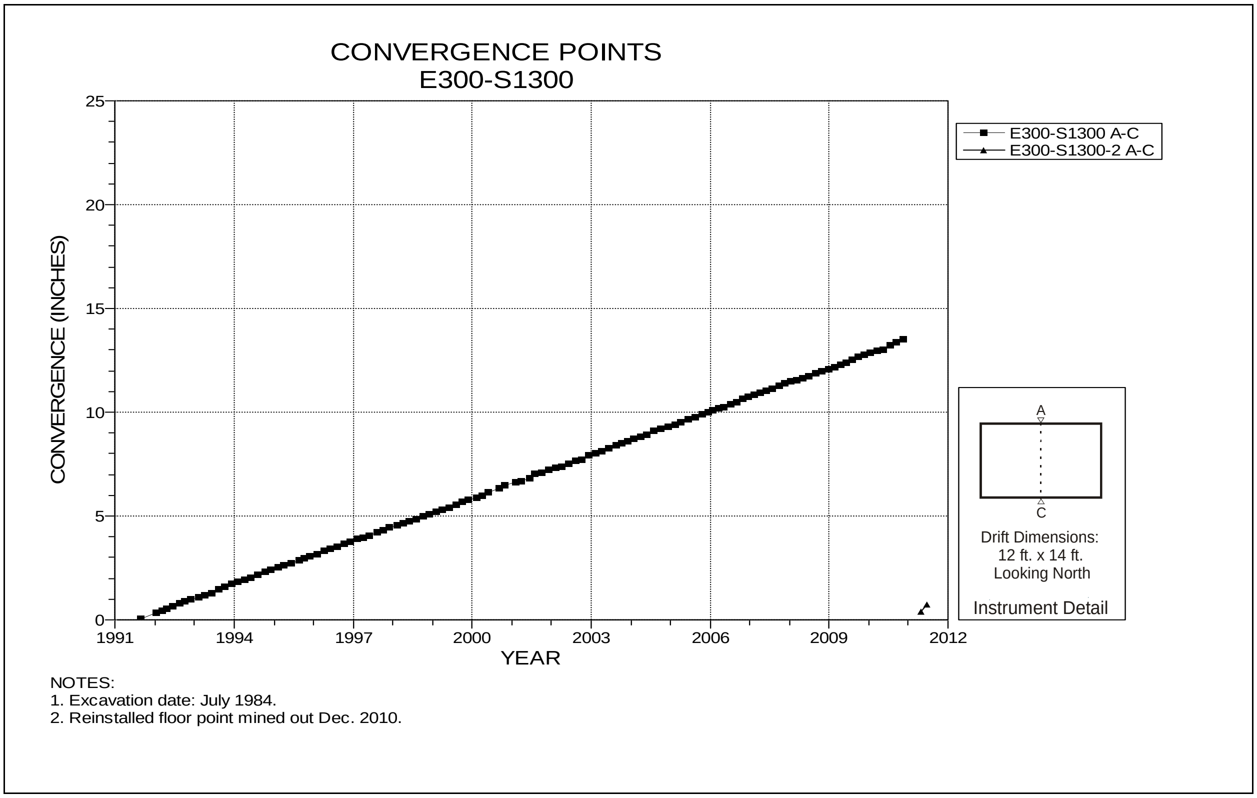


Figure 4-39 Convergence Point Array
E300 S1300 – Roof to Floor

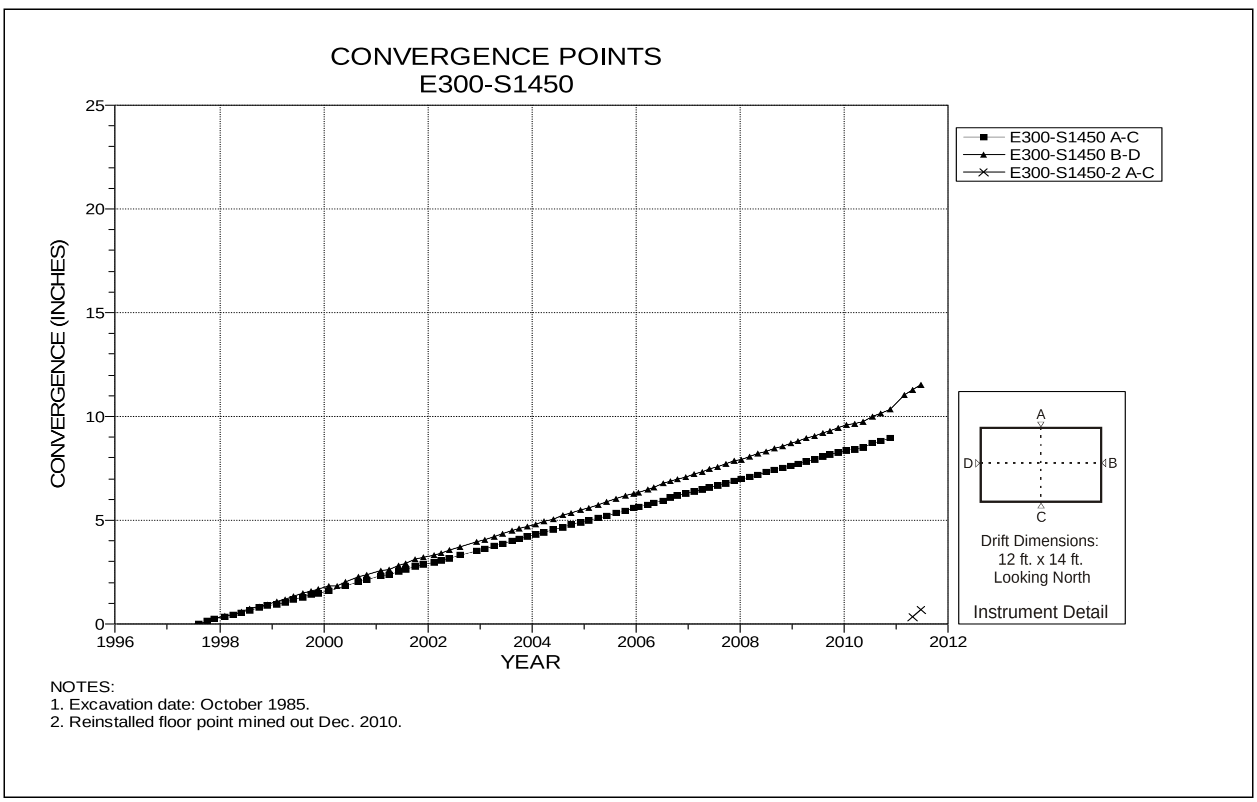


Figure 4-40 Convergence Point Array
E300 S1450 – All Chords

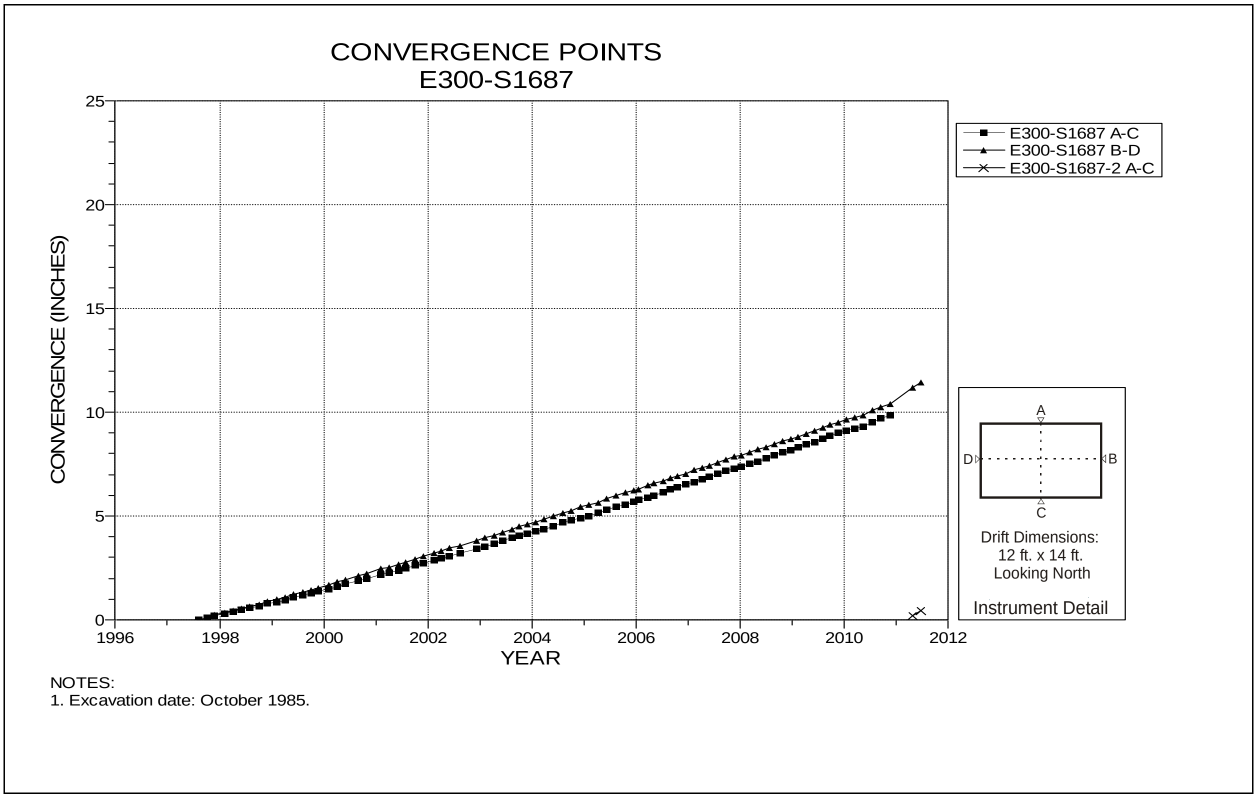


Figure 4-41 Convergence Point Array
E300 S1687 – All Chords

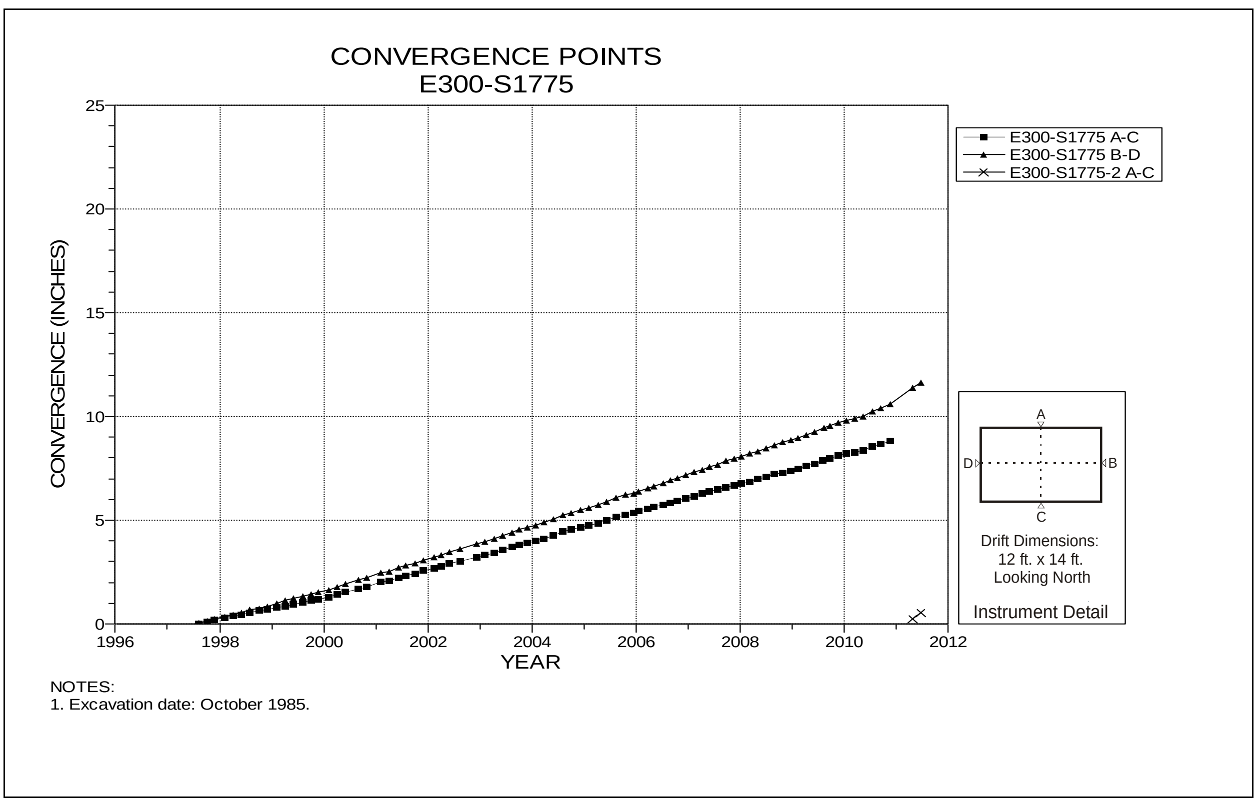


Figure 4-42 Convergence Point Array
E300 S1775 – All Chords

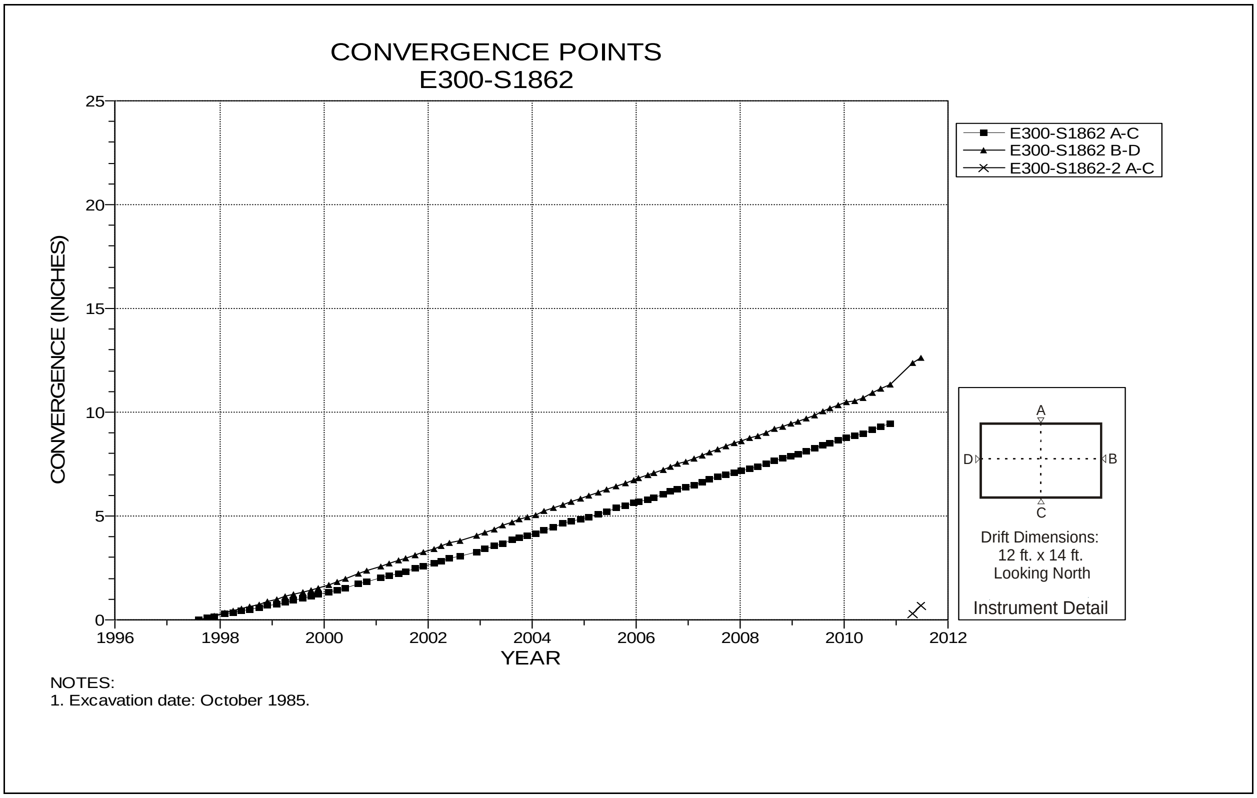


Figure 4-43 Convergence Point Array
E300 S1862 – All Chords

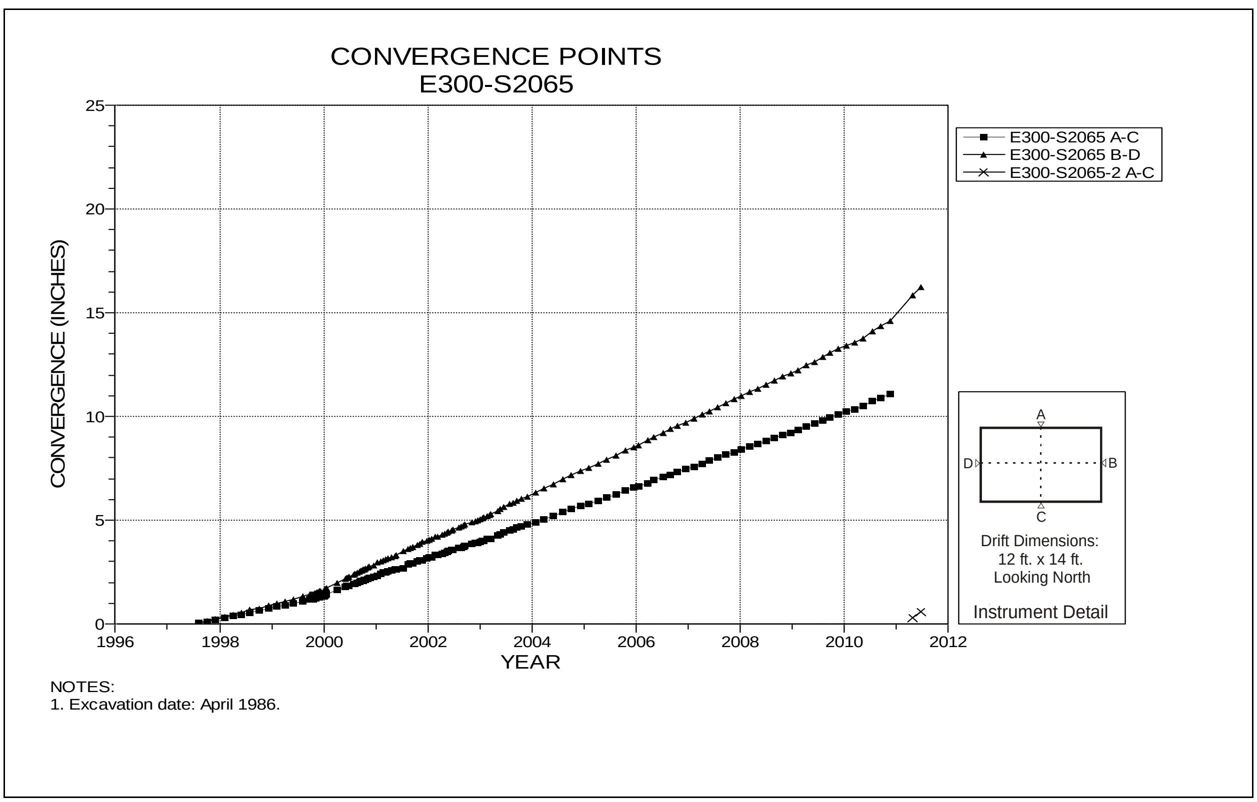


Figure 4-44 Convergence Point Array
E300 S2065 – All Chords

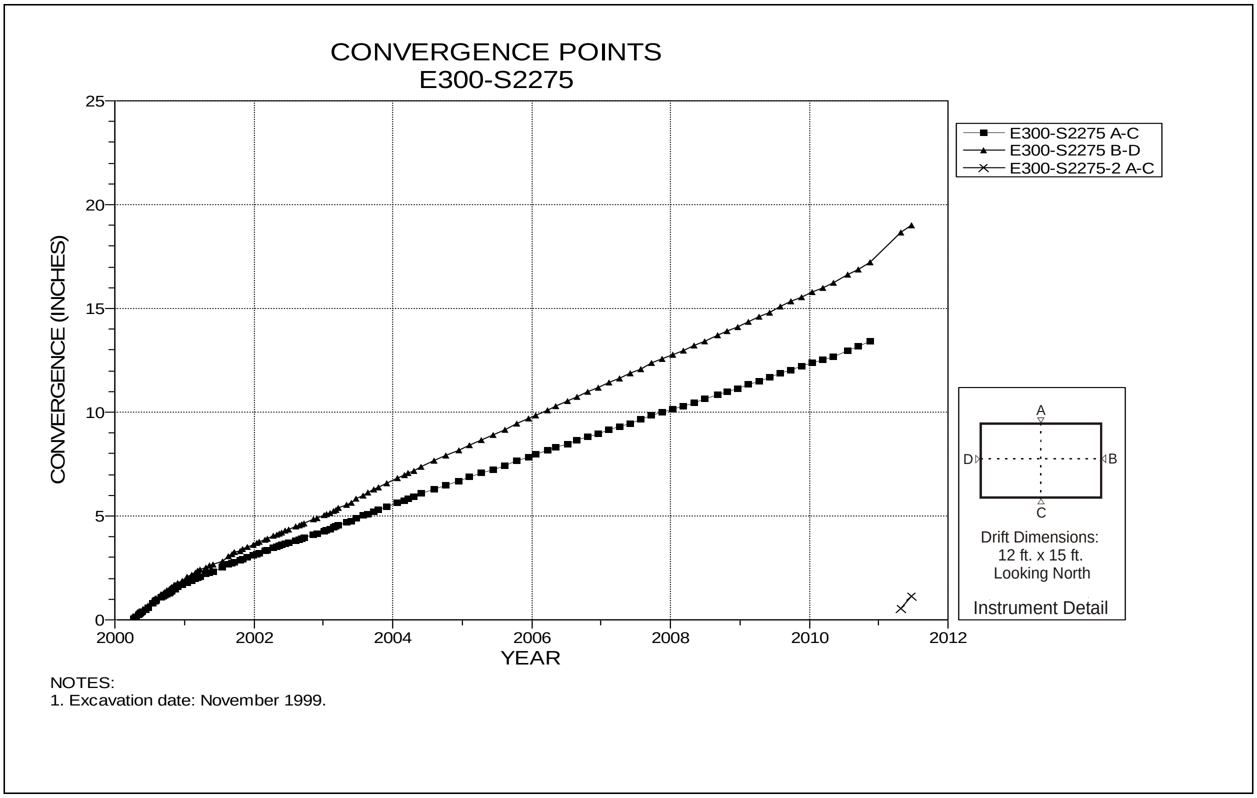


Figure 4-45 Convergence Point Array
E300 S2275 – All Chords

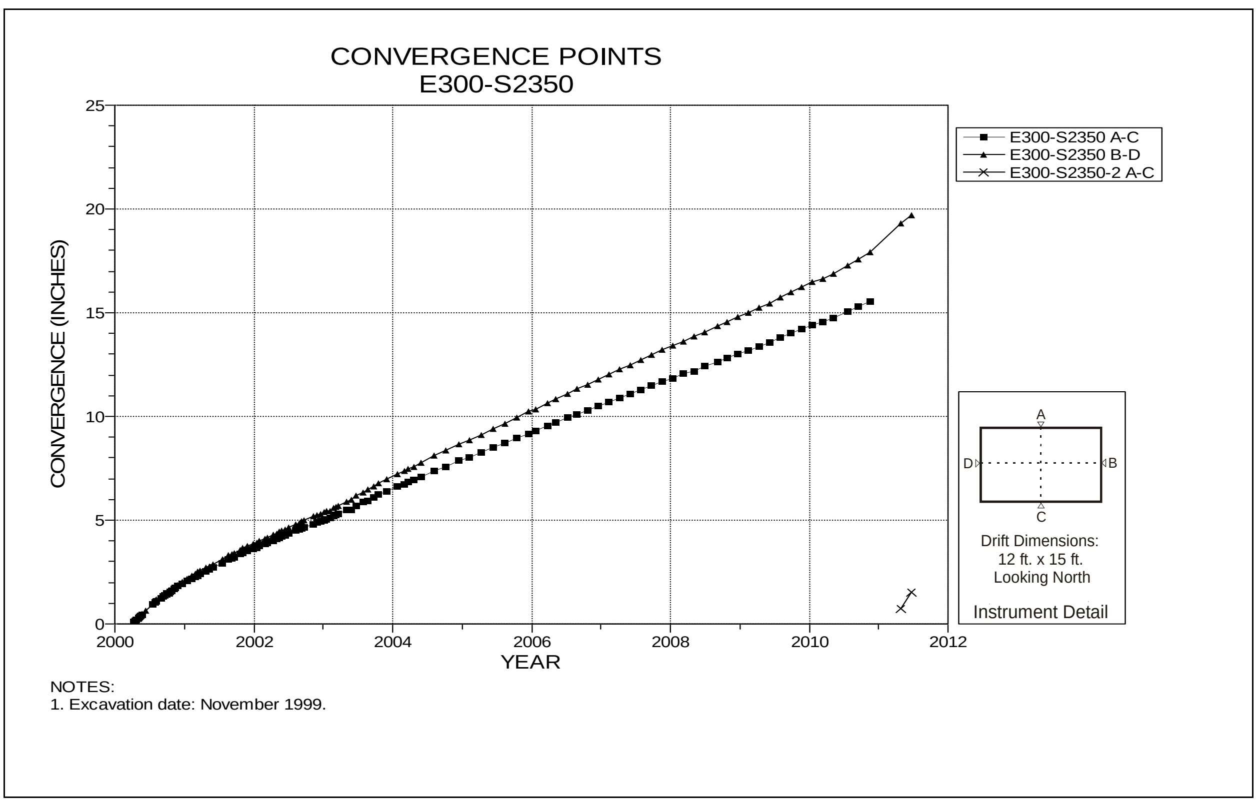


Figure 4-46 Convergence Point Array
E300 S2350 – All Chords

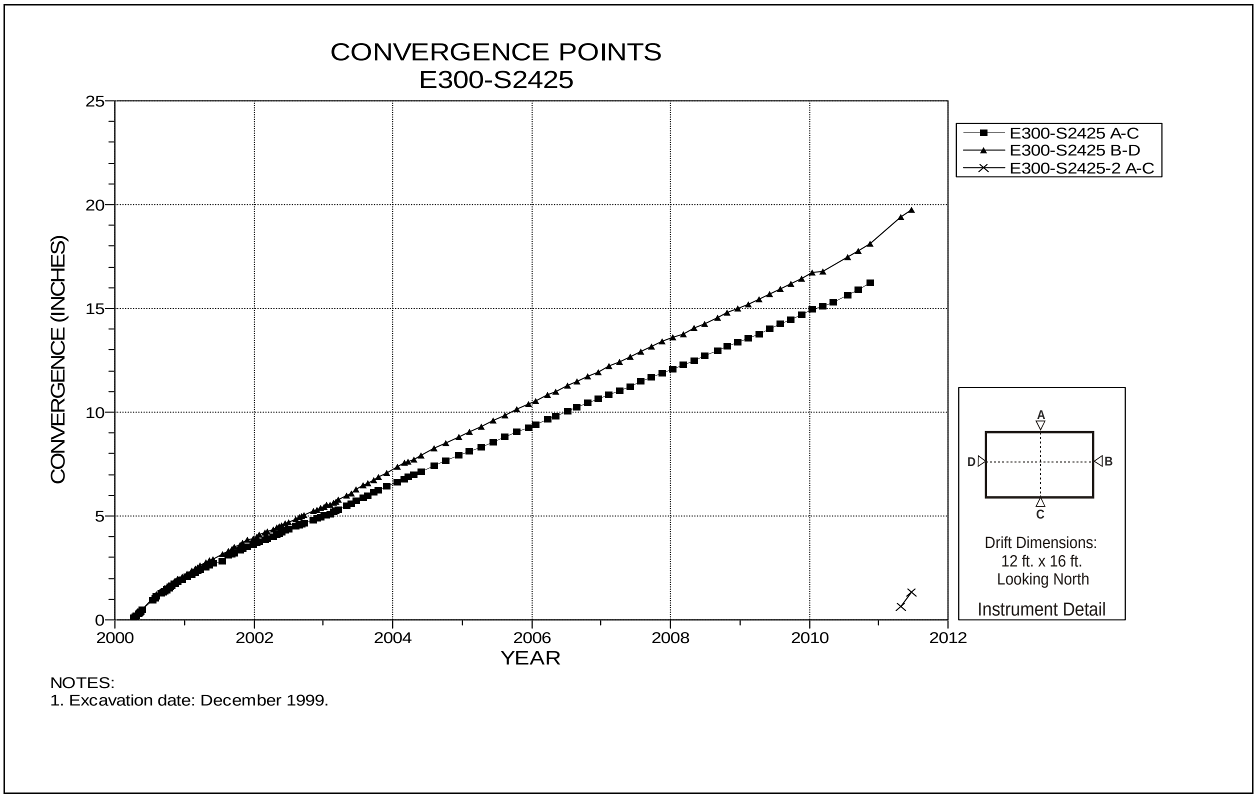


Figure 4-47 Convergence Point Array
E300 S2425 – All Chords

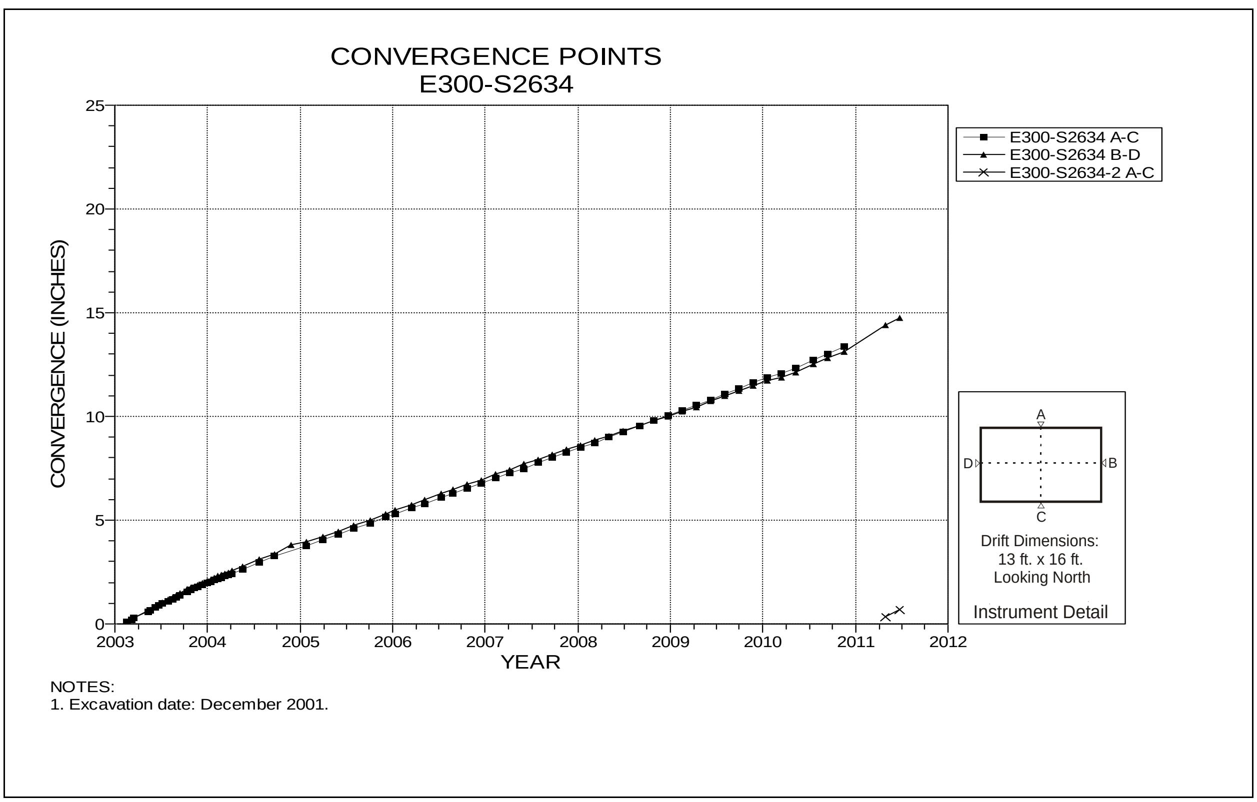


Figure 4-48 Convergence Point Array
E300 S2634 – All Chords

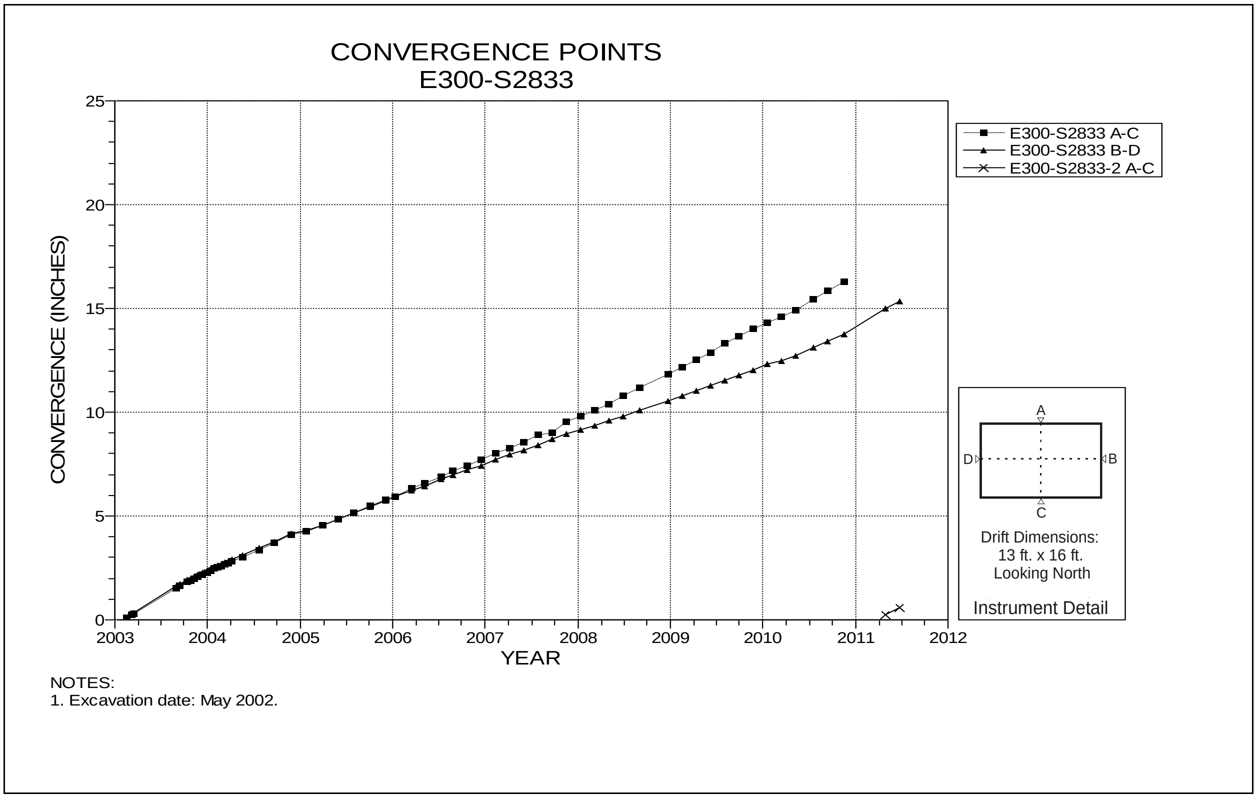


Figure 4-49 Convergence Point Array
E300 S2833 – All Chords

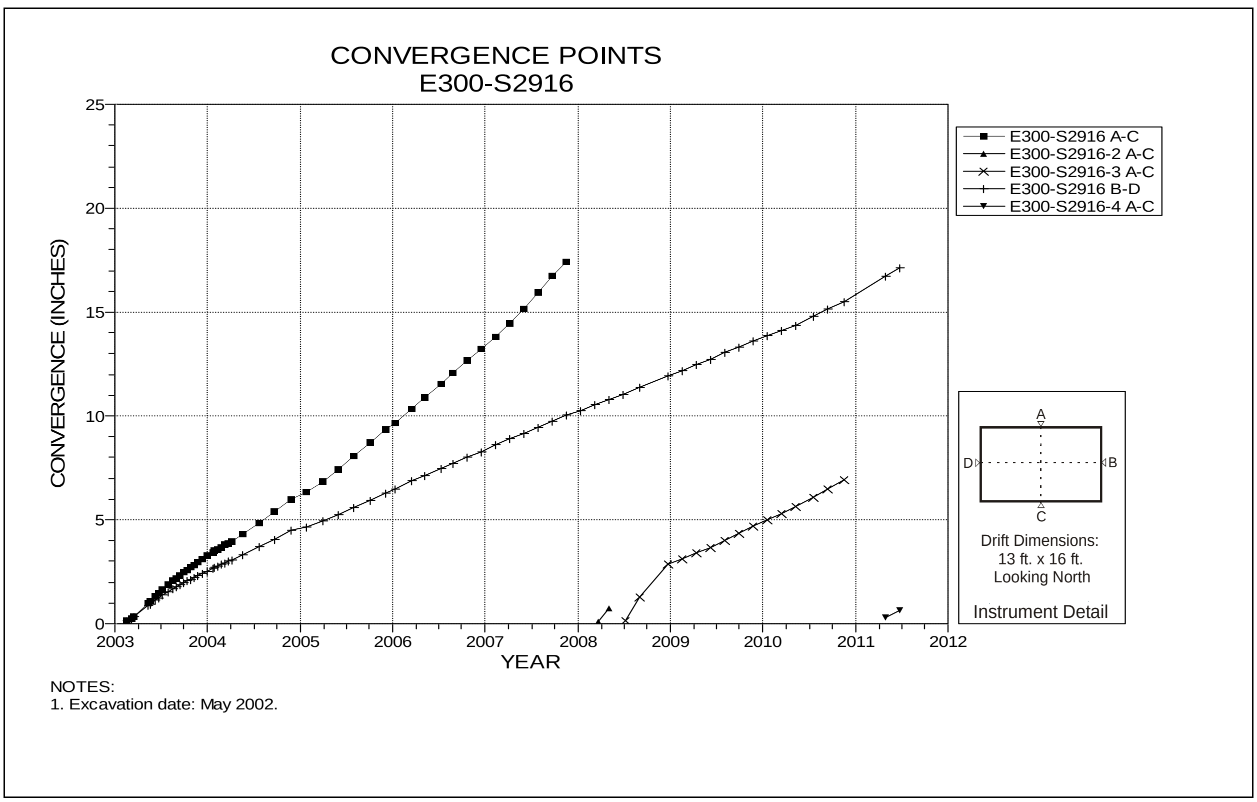


Figure 4-50 Convergence Point Array
E300 S2916 – All Chords

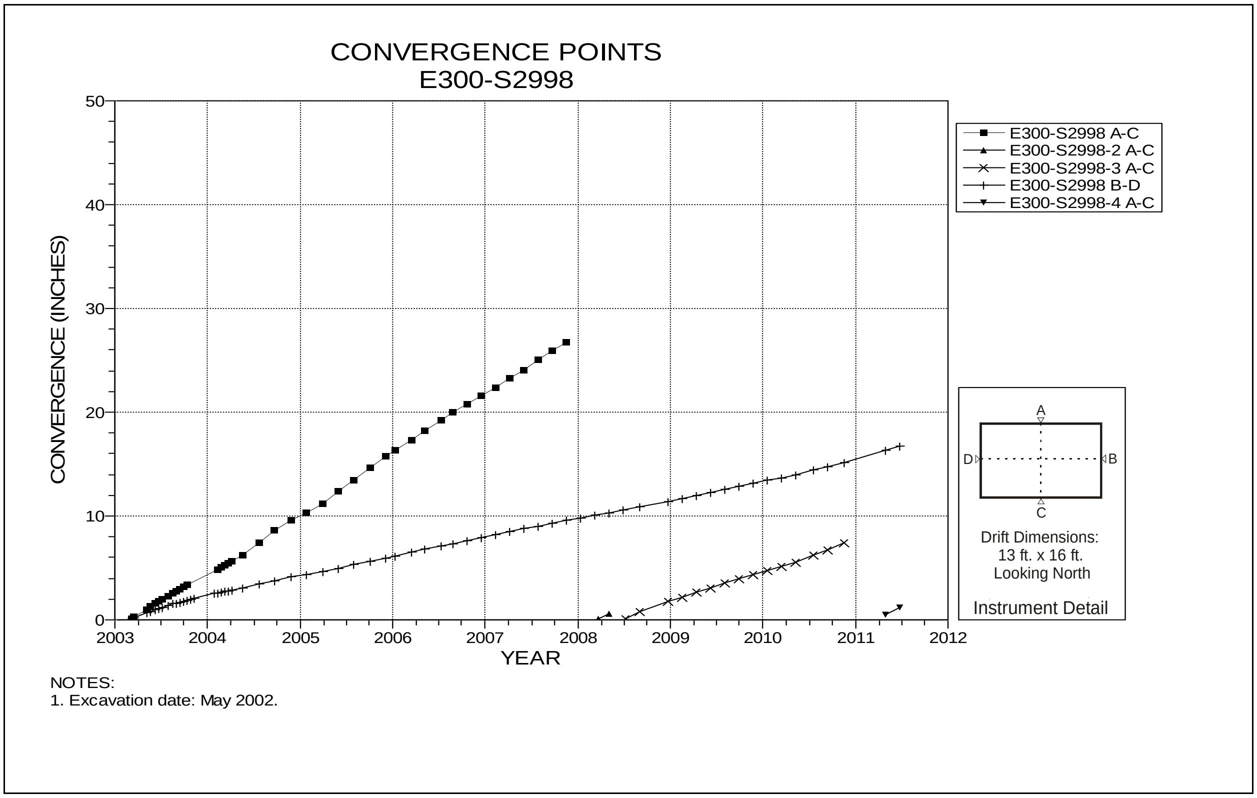


Figure 4-51 Convergence Point Array
E300 S2998 – All Chords

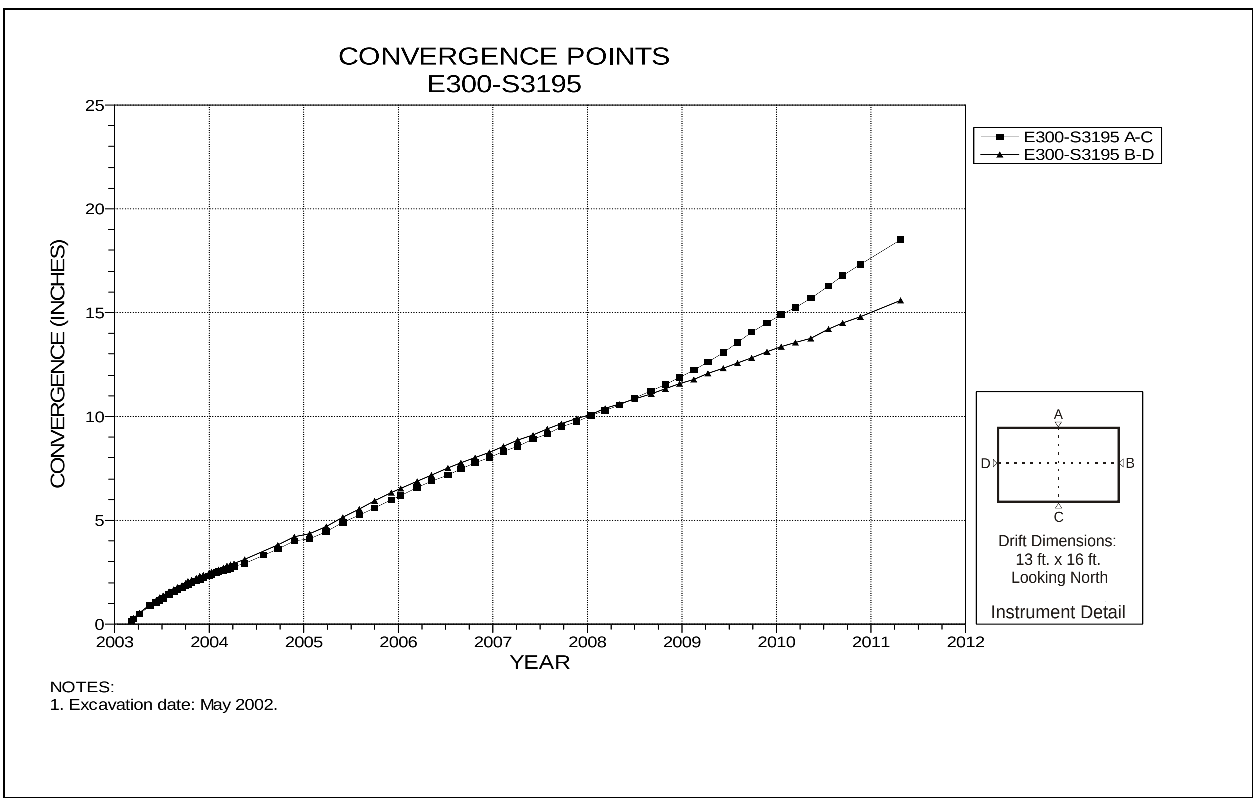
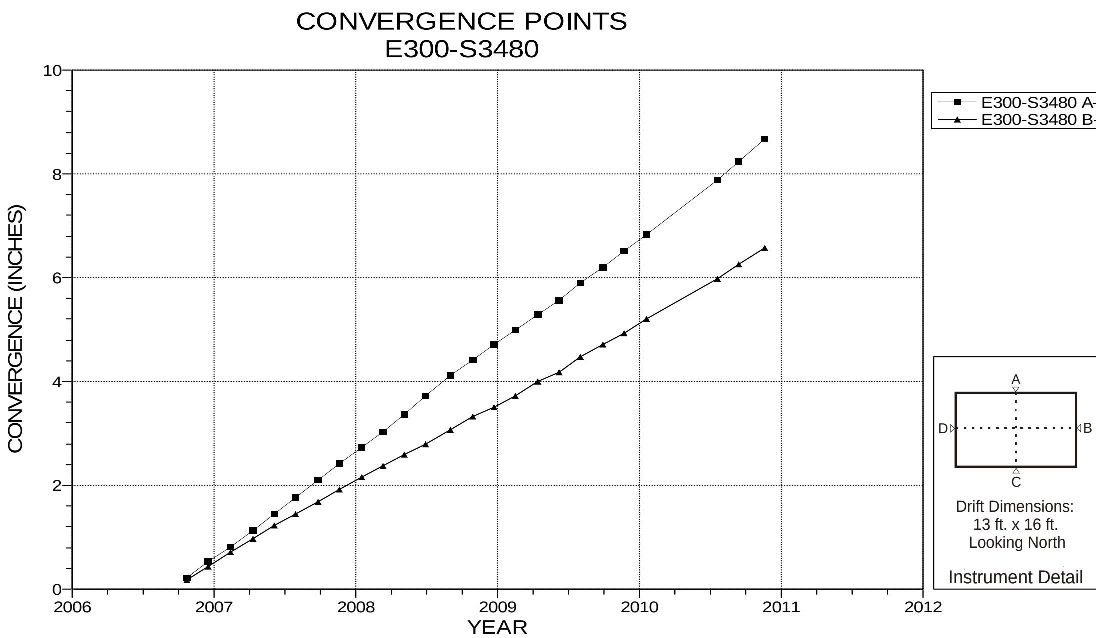
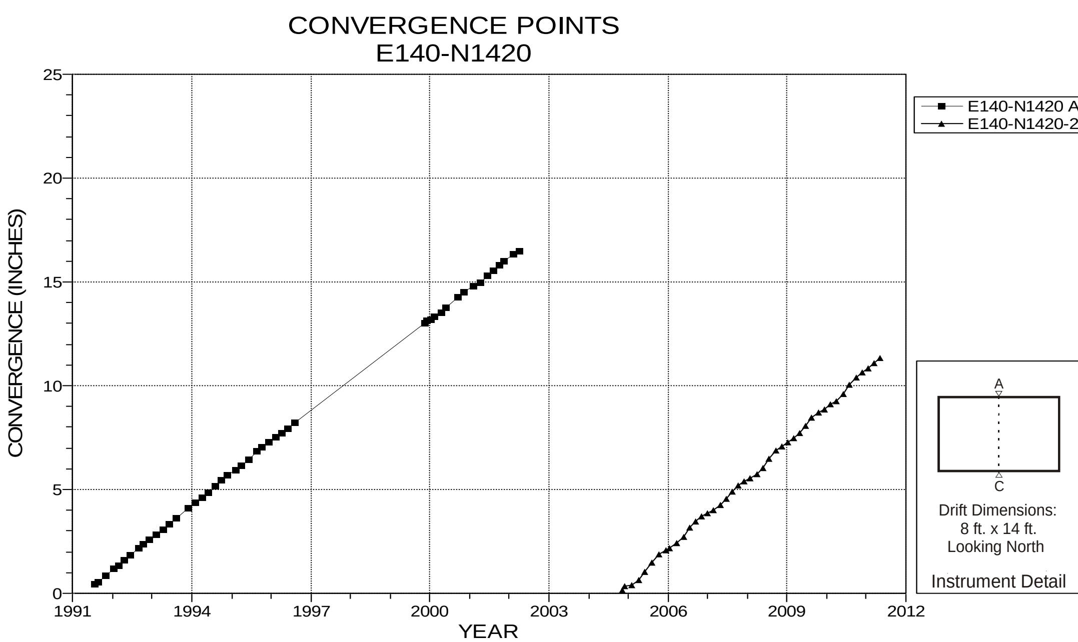


Figure 4-52 Convergence Point Array
E300 S3195 – All Chords



NOTES:
1. Excavation date: October 2002.
2. This area was inaccessible for instrument reading from early 2011 until July 2011.

Figure 4-53 Convergence Point Array
E300 S3480 – All Chords



NOTES:
1. Excavation date: February 1983.
2. Inaccessible from August 1996 to November 1999.

Figure 4-54 Convergence Point Array
E140 N1420 – Roof to Floor

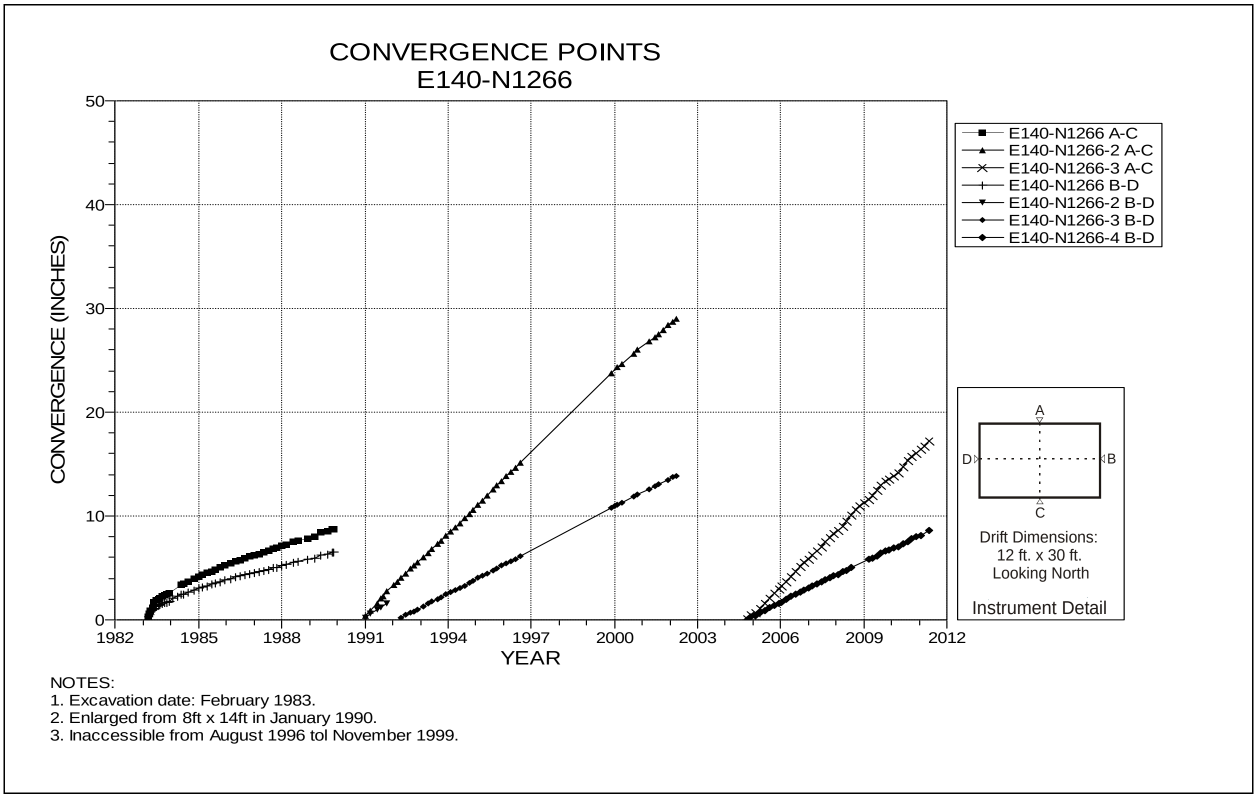


Figure 4-55 Convergence Point Array
E140 N1266 – All Chords

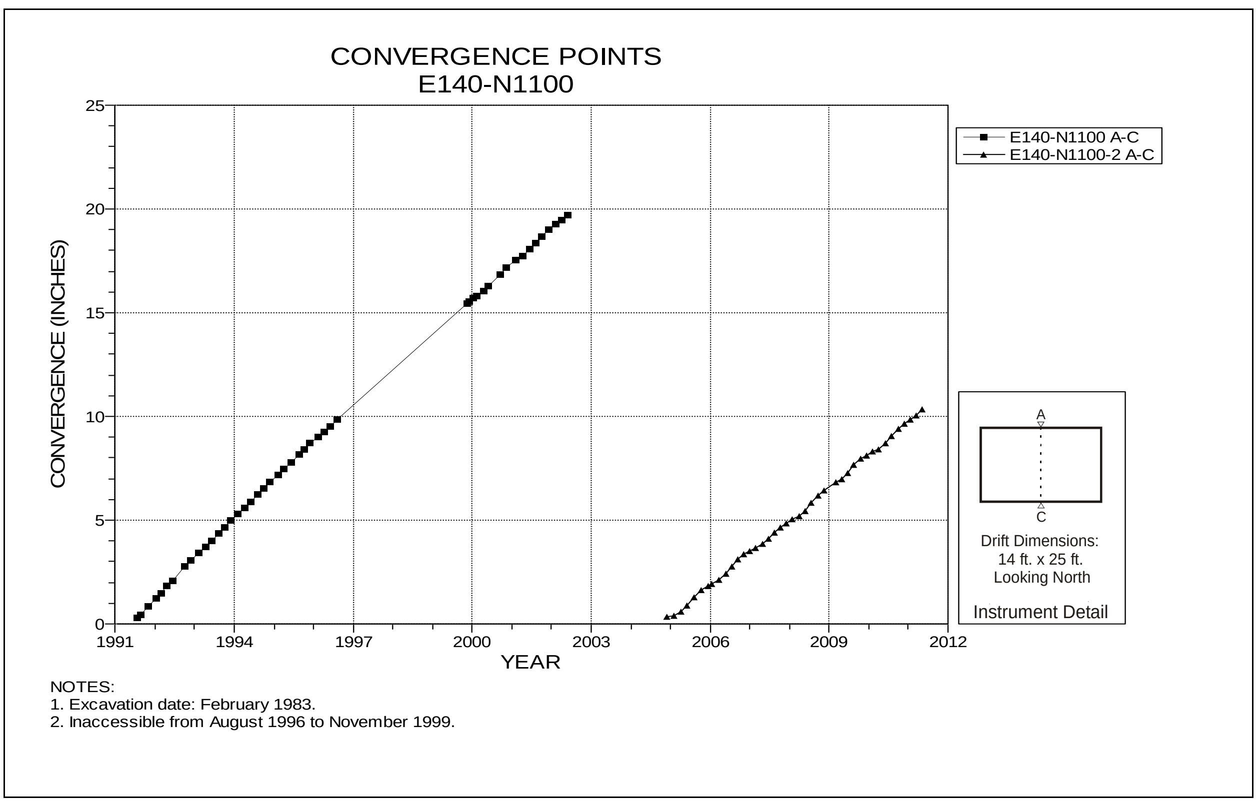


Figure 4-56 Convergence Point Array
E140 N1100 – Roof to Floor

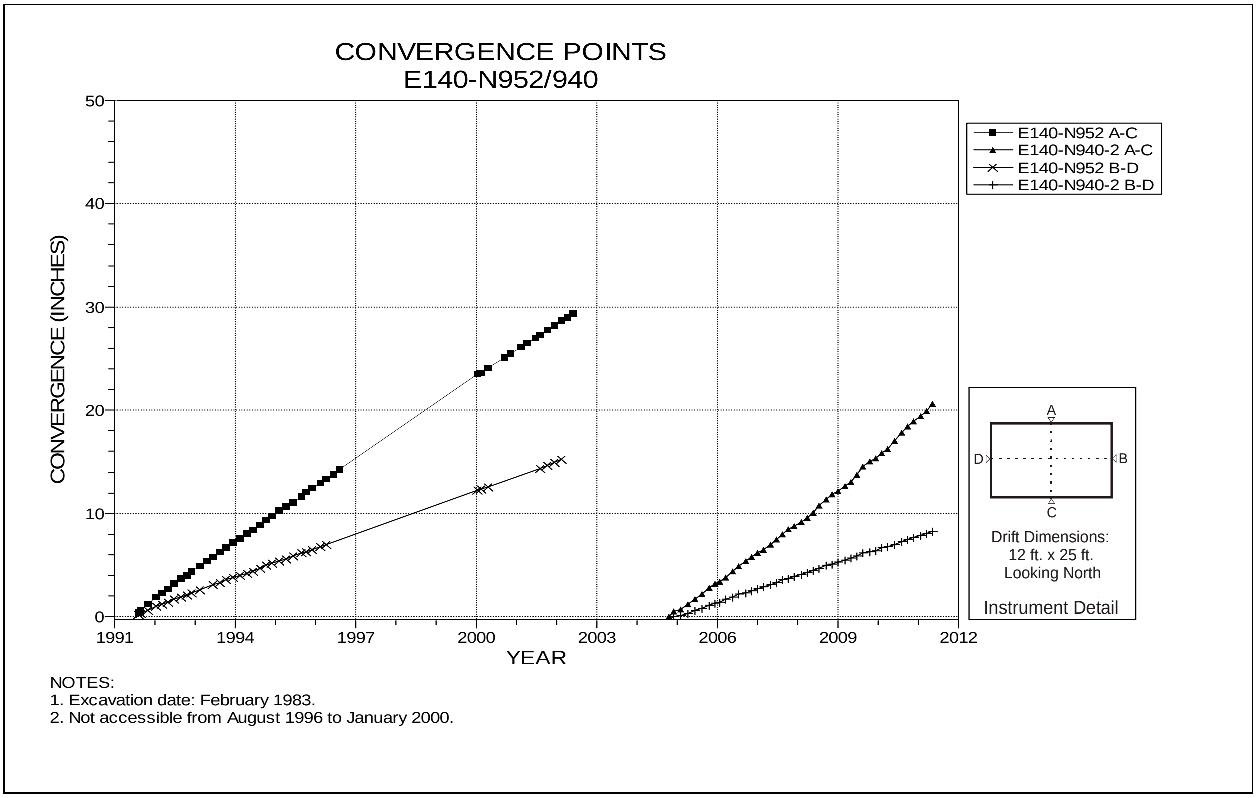


Figure 4-57 Convergence Point Array
E140 N952/940 – All Chords

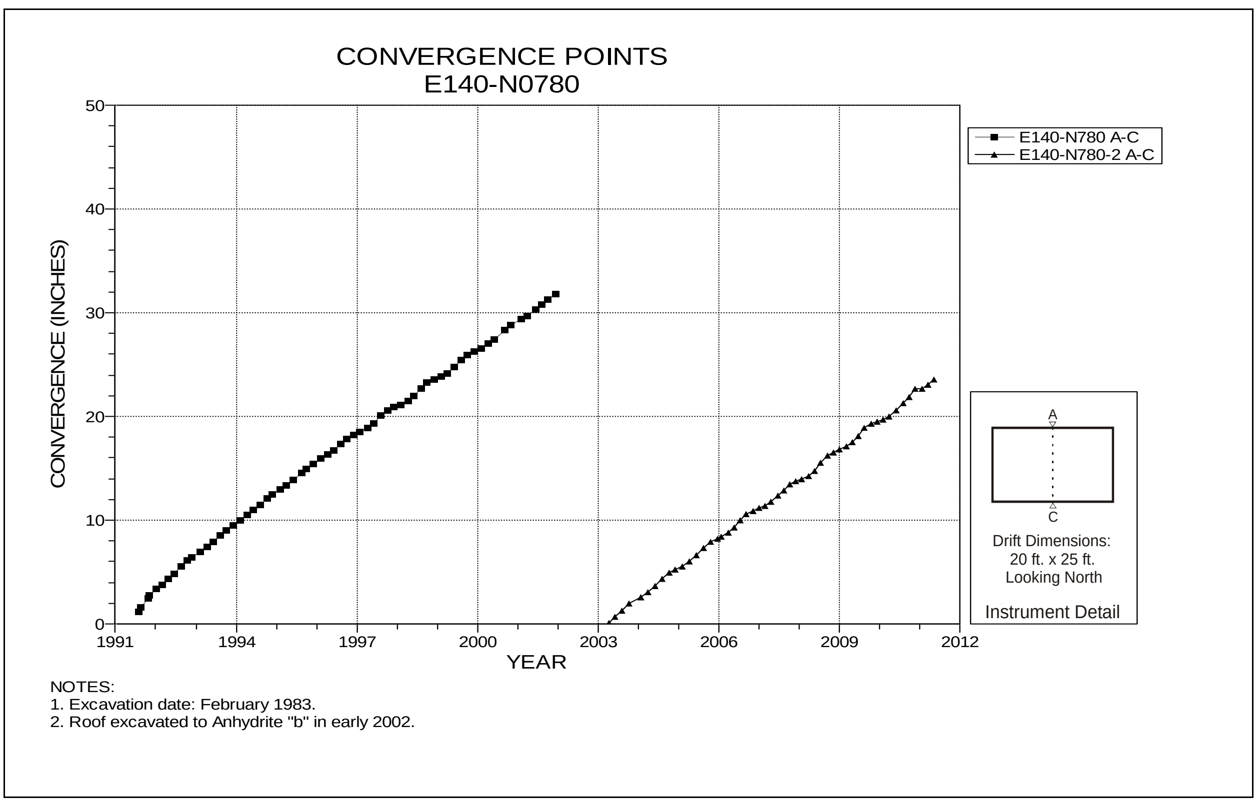


Figure 4-58 Convergence Point Array
E140 N780 – Roof to Floor

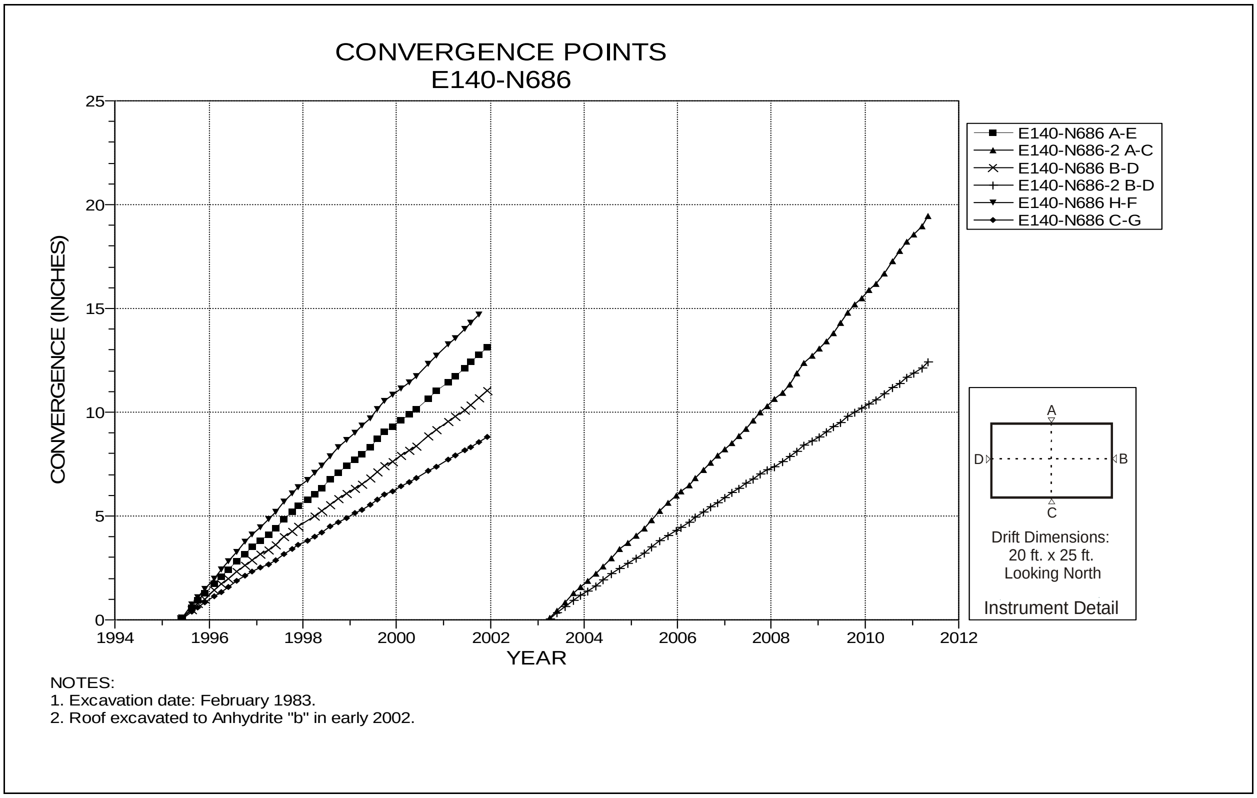


Figure 4-59 Convergence Point Array
E140 N686 – All Chords

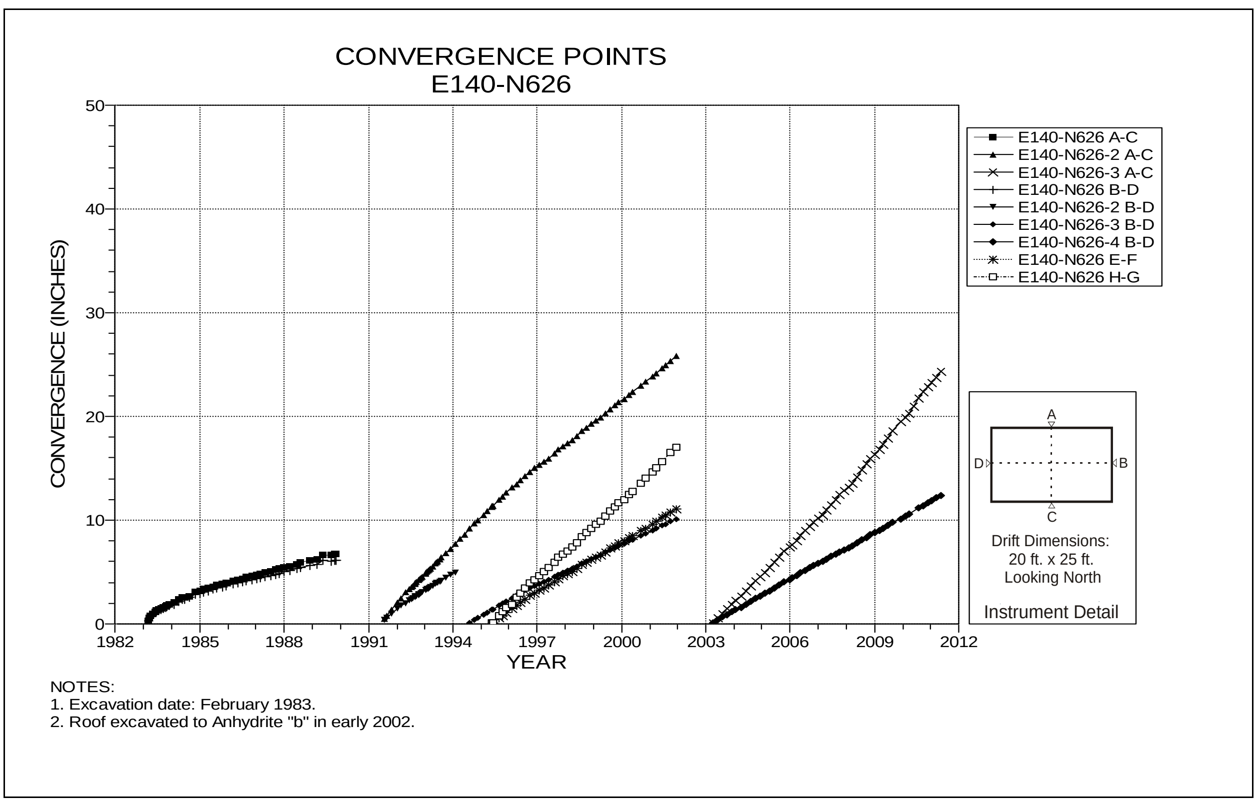


Figure 4-60 Convergence Point Array
E140 N626 – All Chords

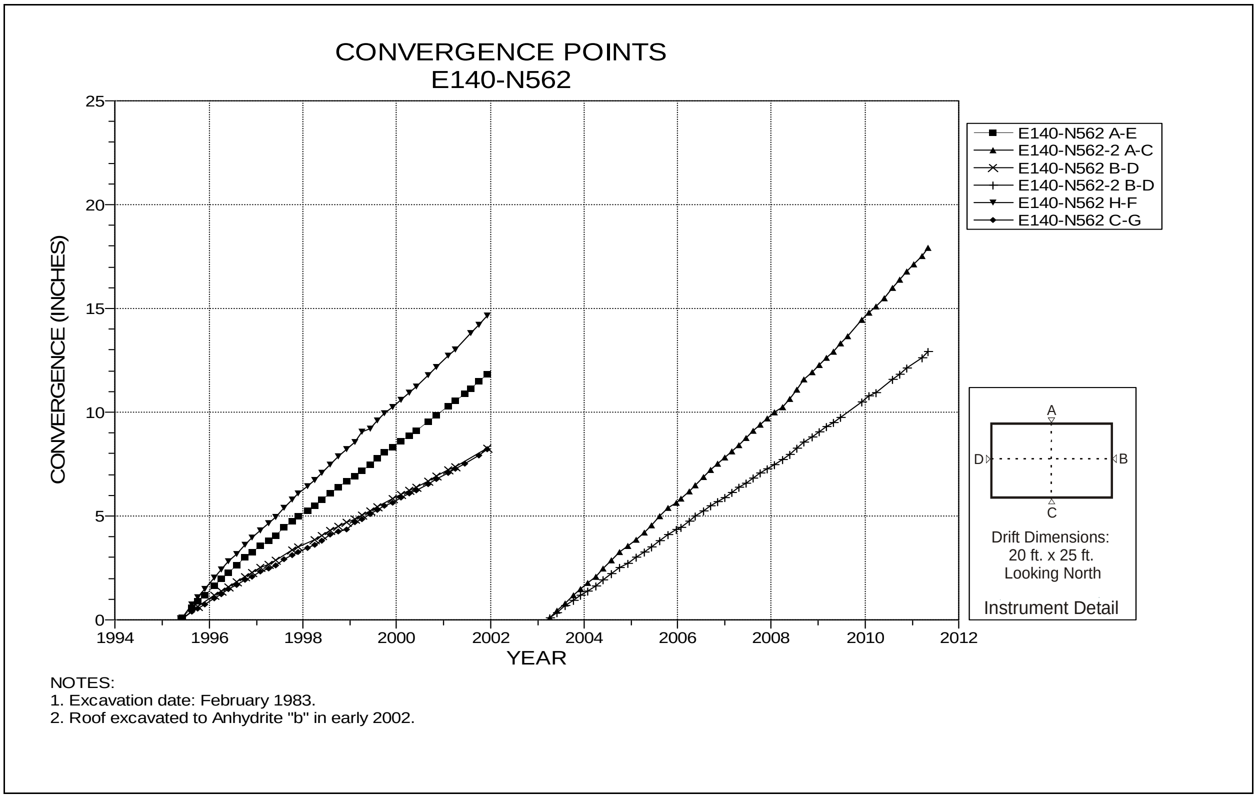


Figure 4-61 Convergence Point Array
E140 N562 – All Chords

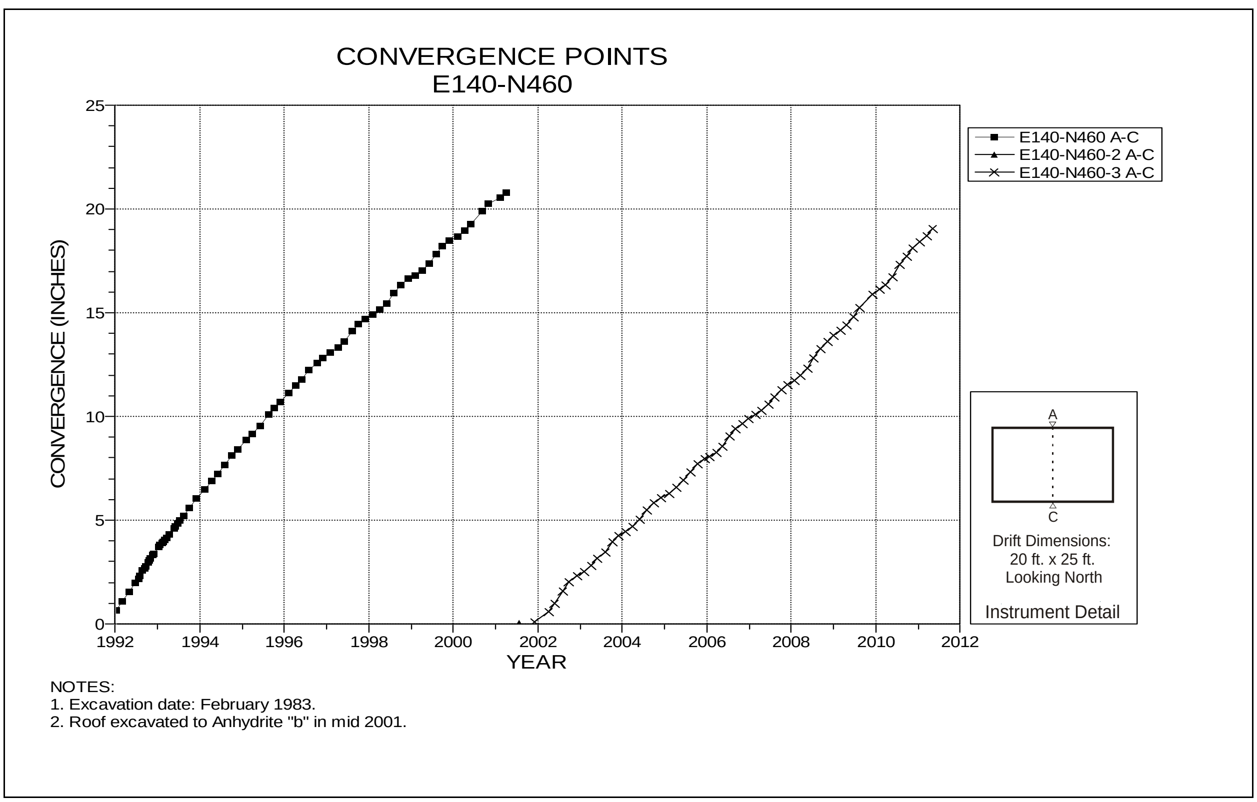


Figure 4-62 Convergence Point Array
E140 N460 – Roof to Floor

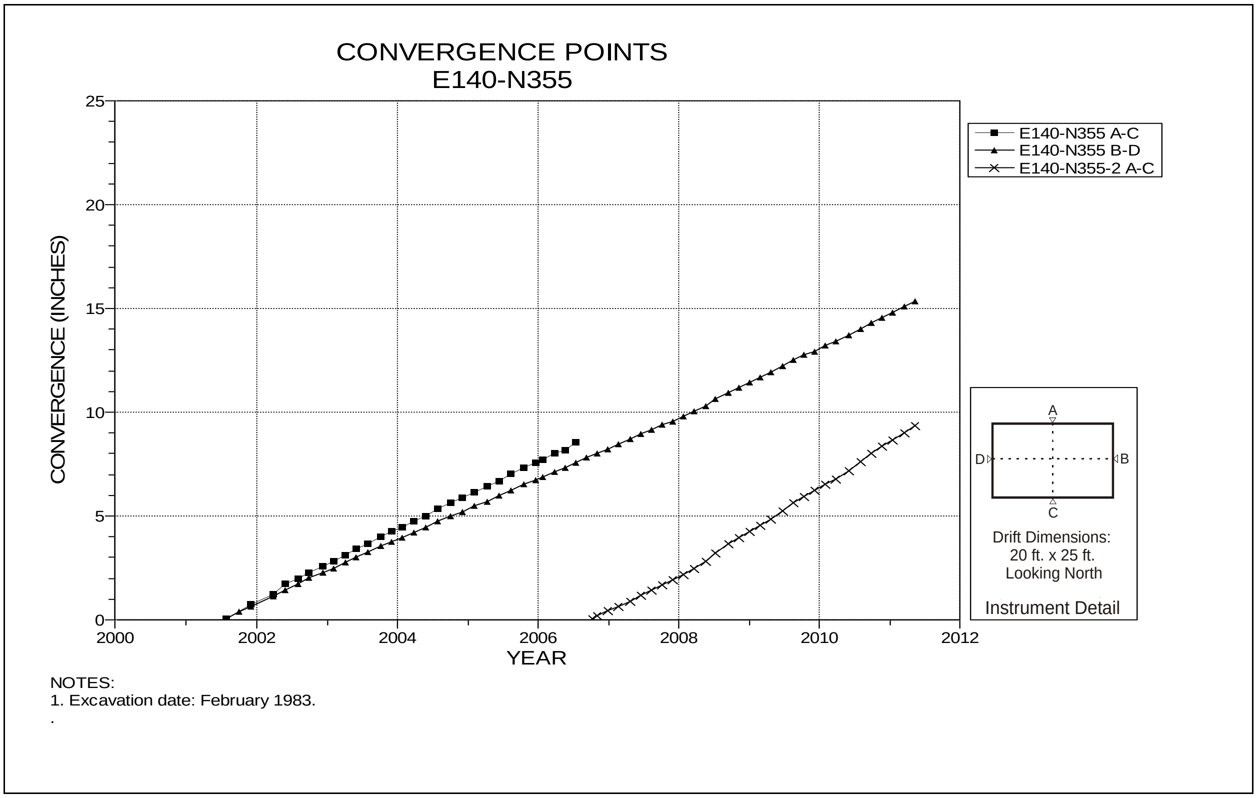


Figure 4-63 Convergence Point Array
E140 N355 – All Chords

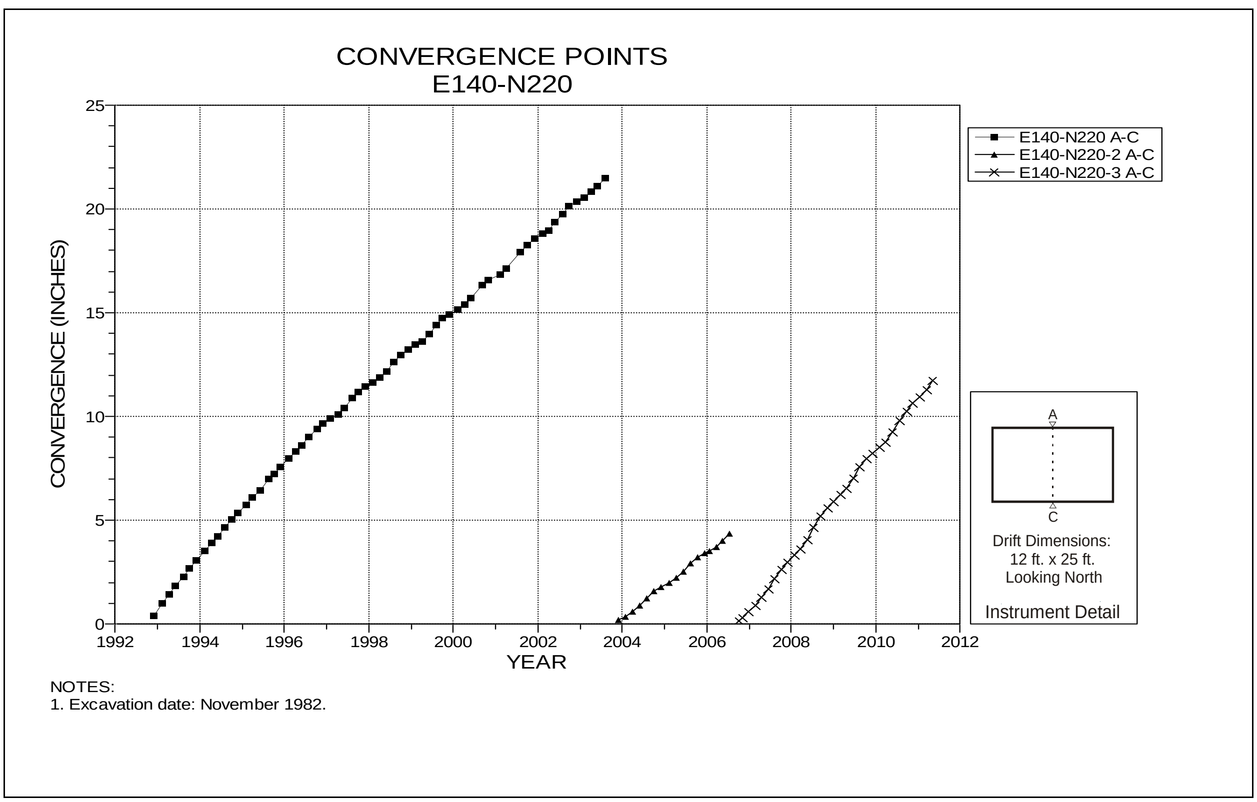


Figure 4-64 Convergence Point Array
E140 N220 – Roof to Floor

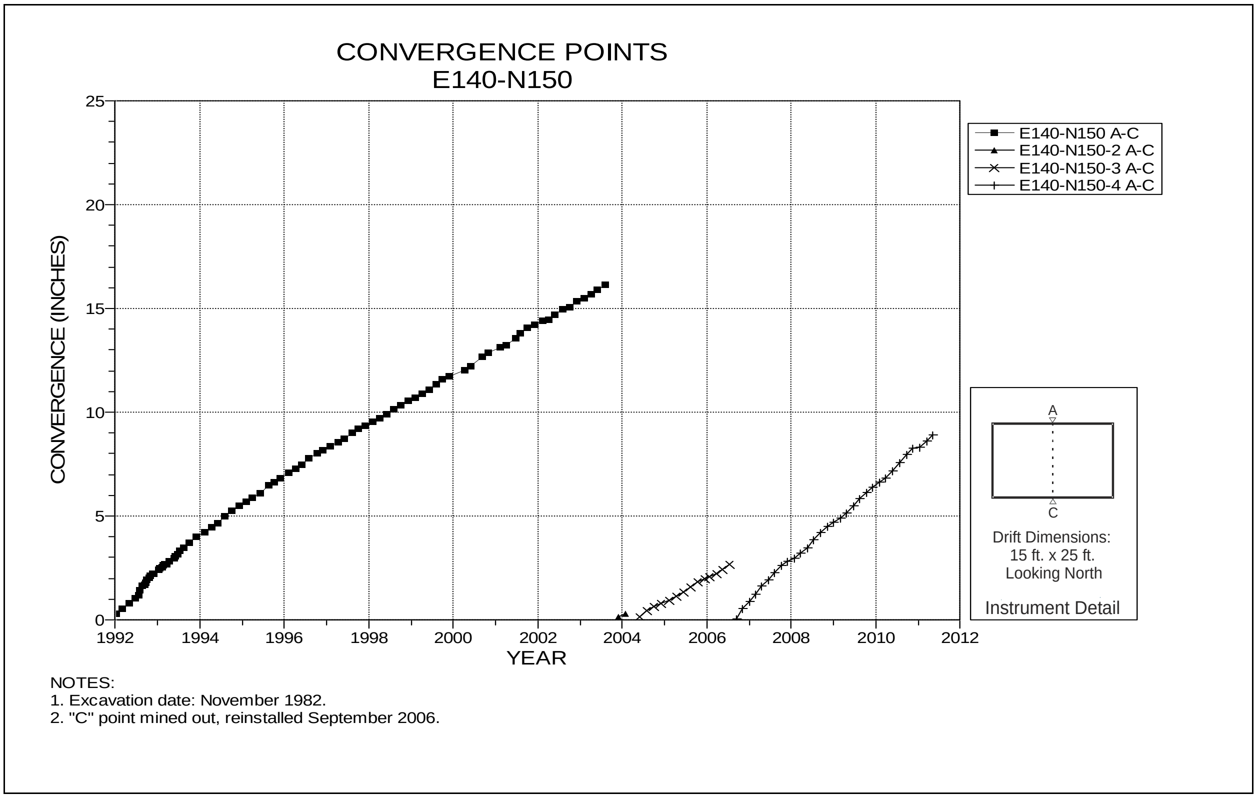


Figure 4-65 Convergence Point Array
E140 N150 – Roof to Floor

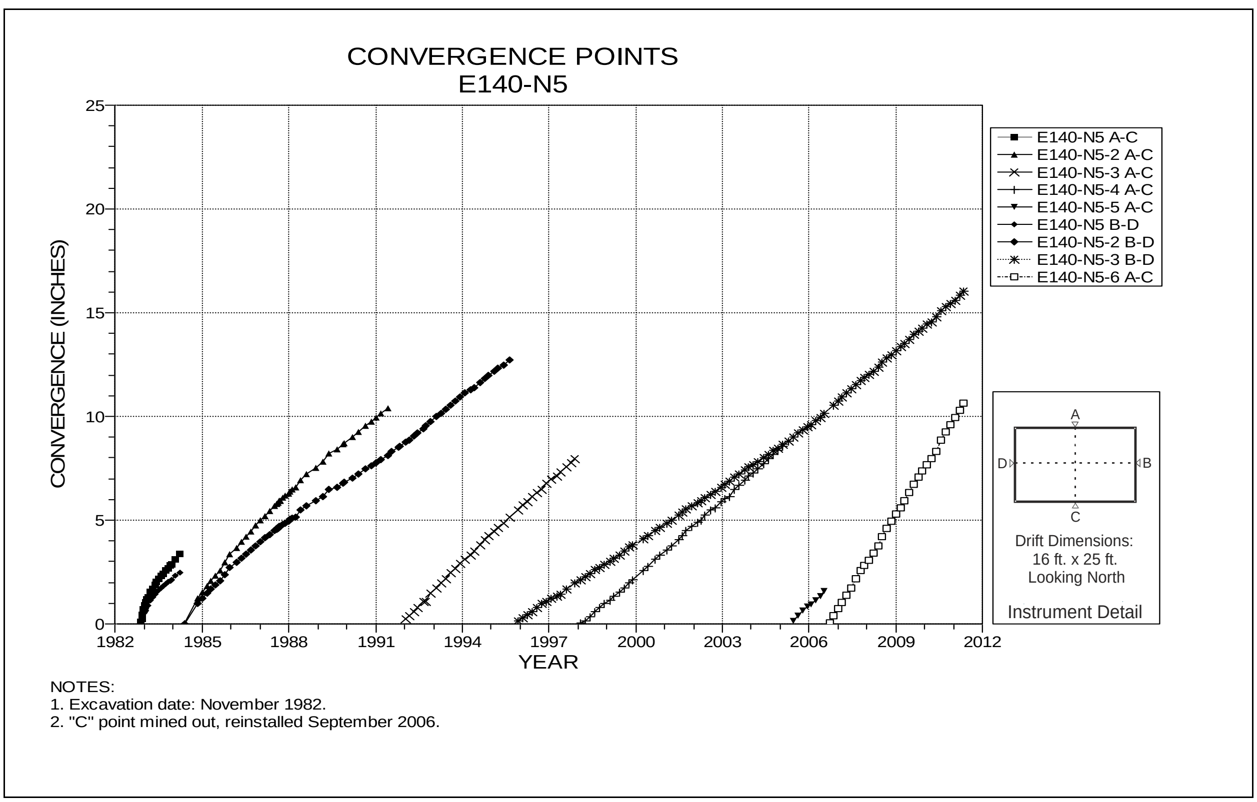


Figure 4-66 Convergence Point Array
E140 N5 – All Chords

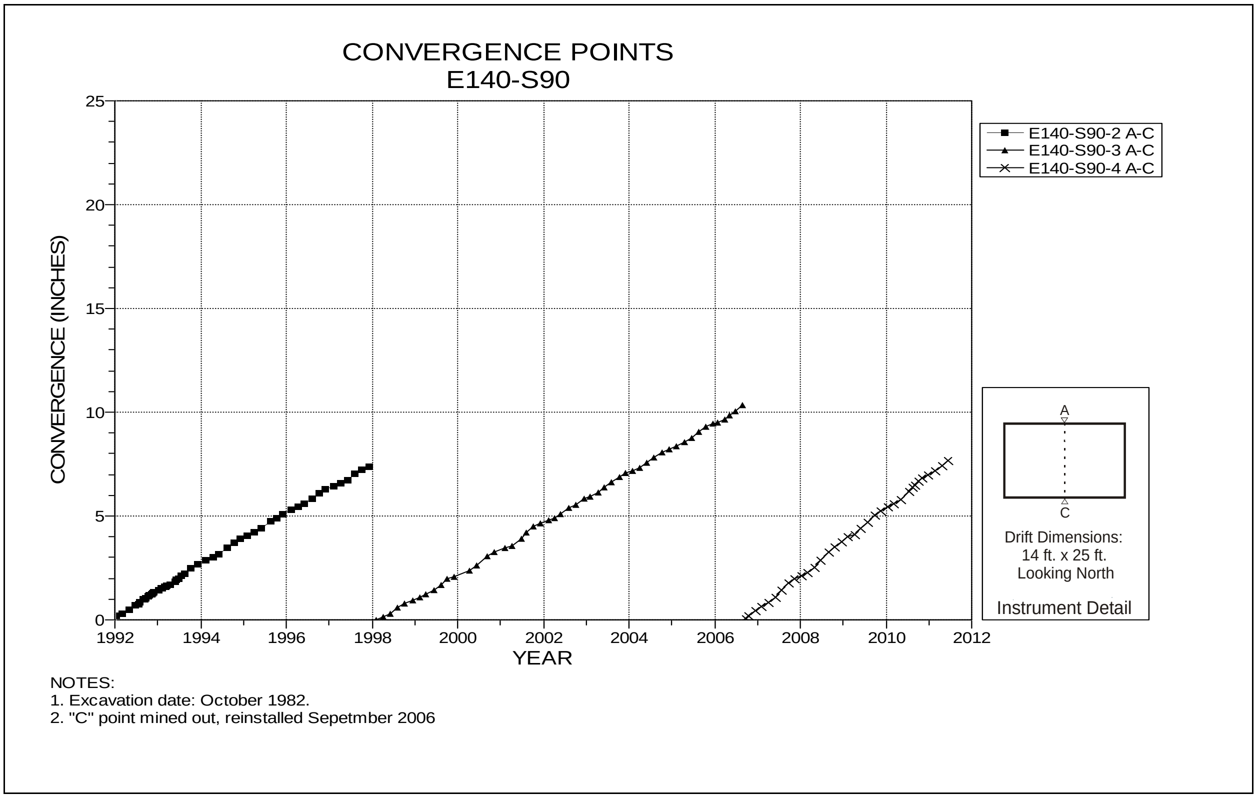


Figure 4-67 Convergence Point Array
E140 S90 – Roof to Floor

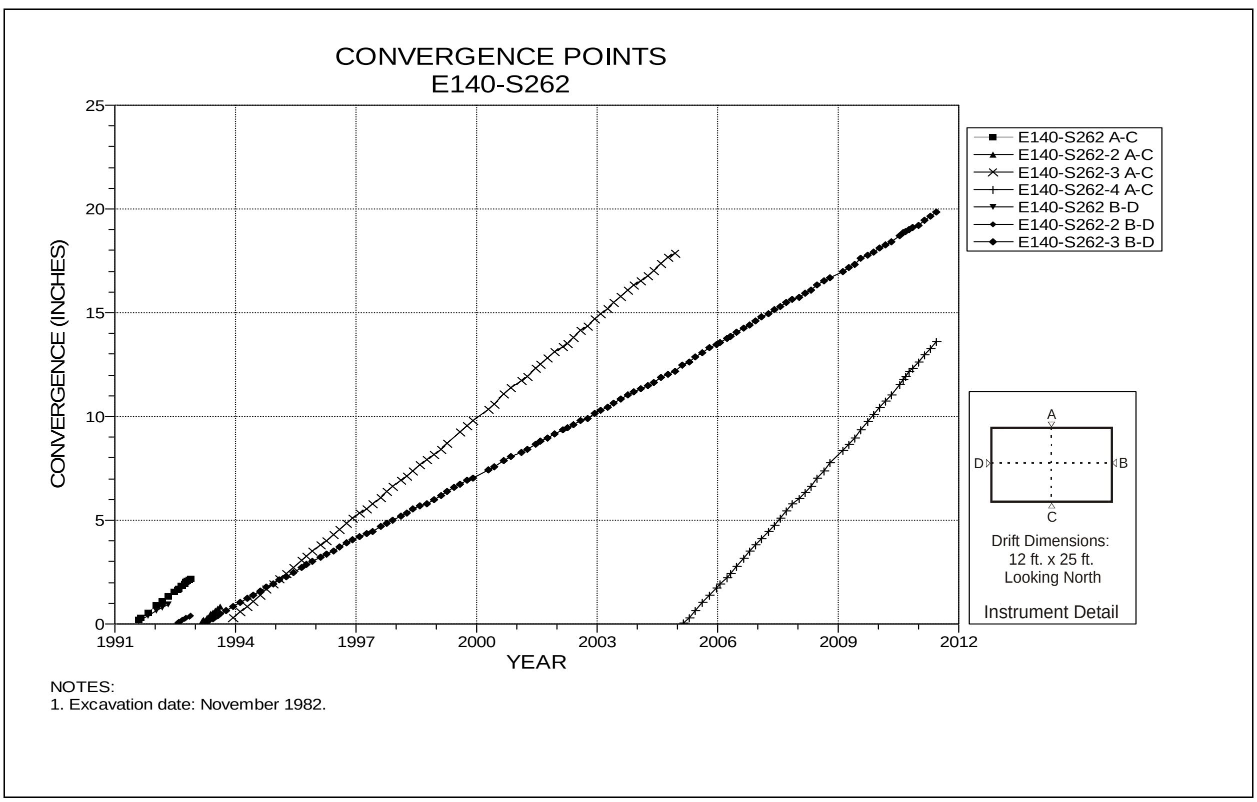


Figure 4-68 Convergence Point Array
E140 S262 – All Chords

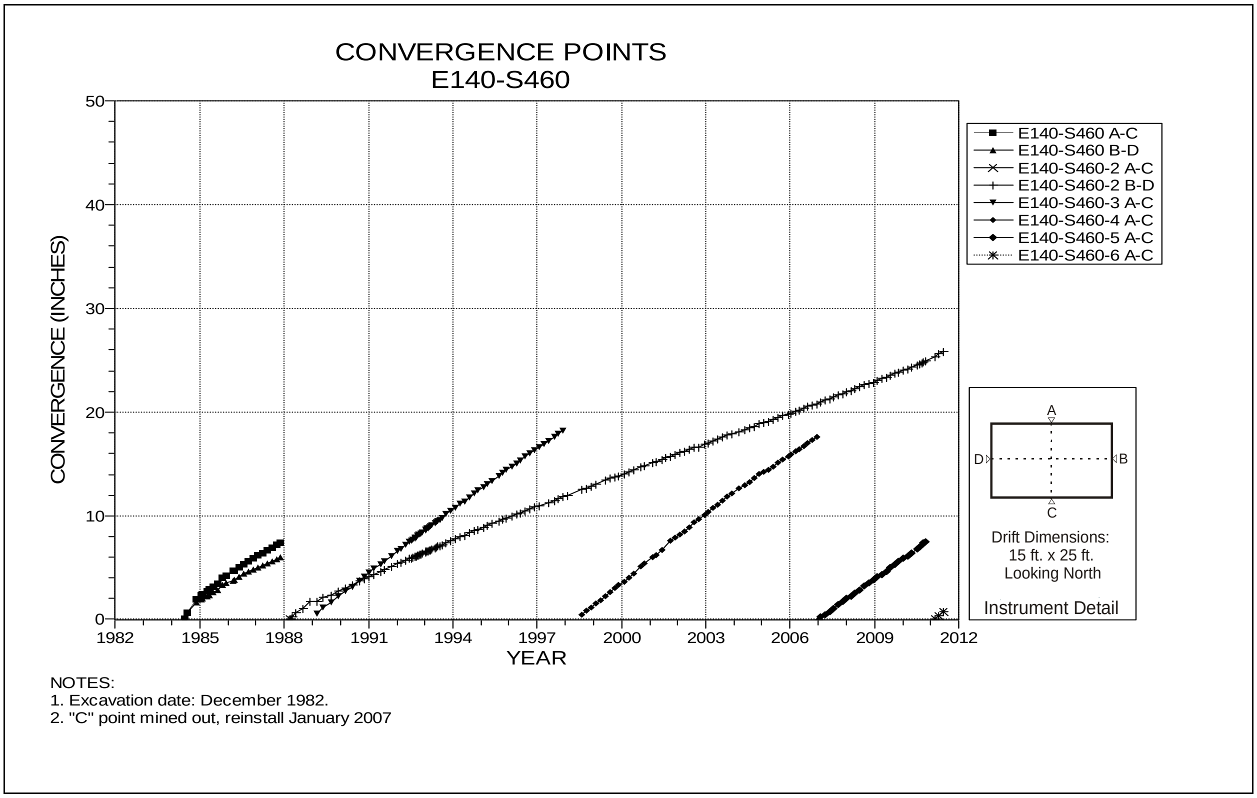


Figure 4-69 Convergence Point Array
E140 S460 – All Chords

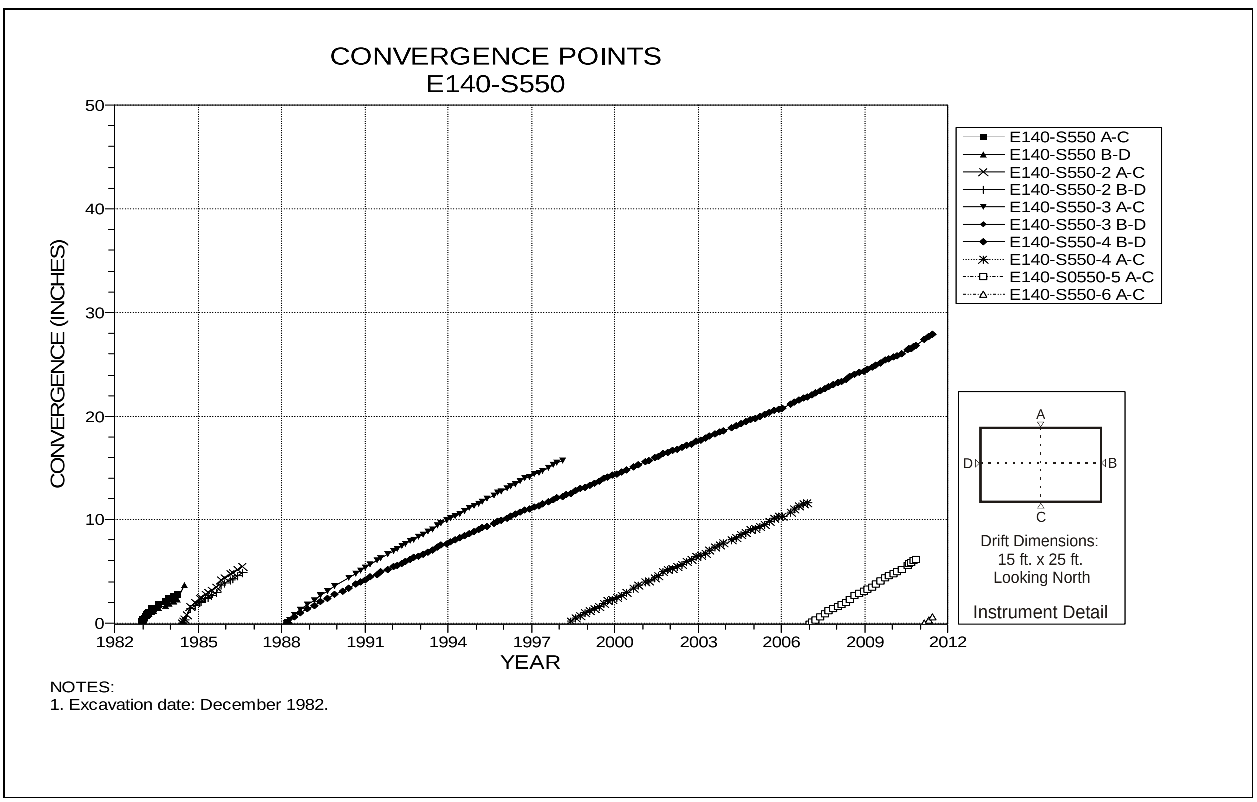


Figure 4-70 Convergence Point Array
E140 S550 – All Chords

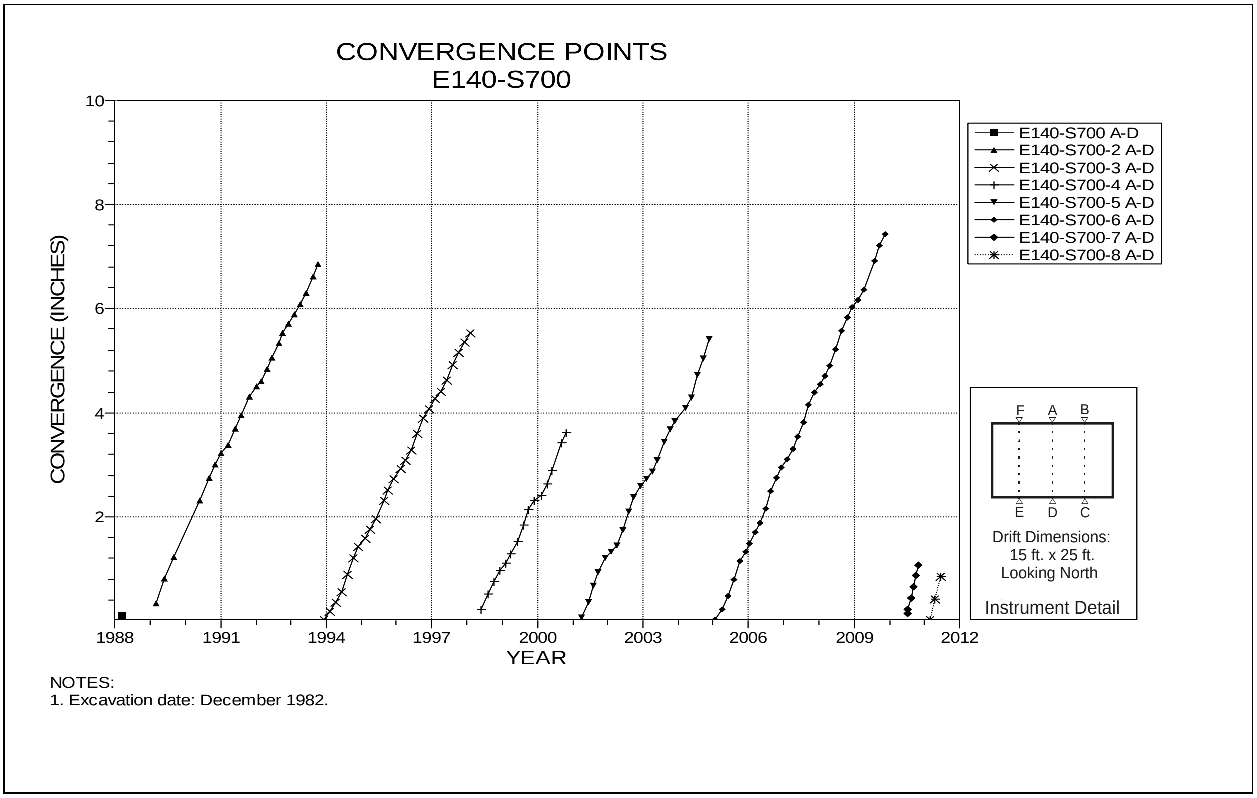


Figure 4-71 Convergence Point Array
E140 S700 – Roof to Floor – Centerline

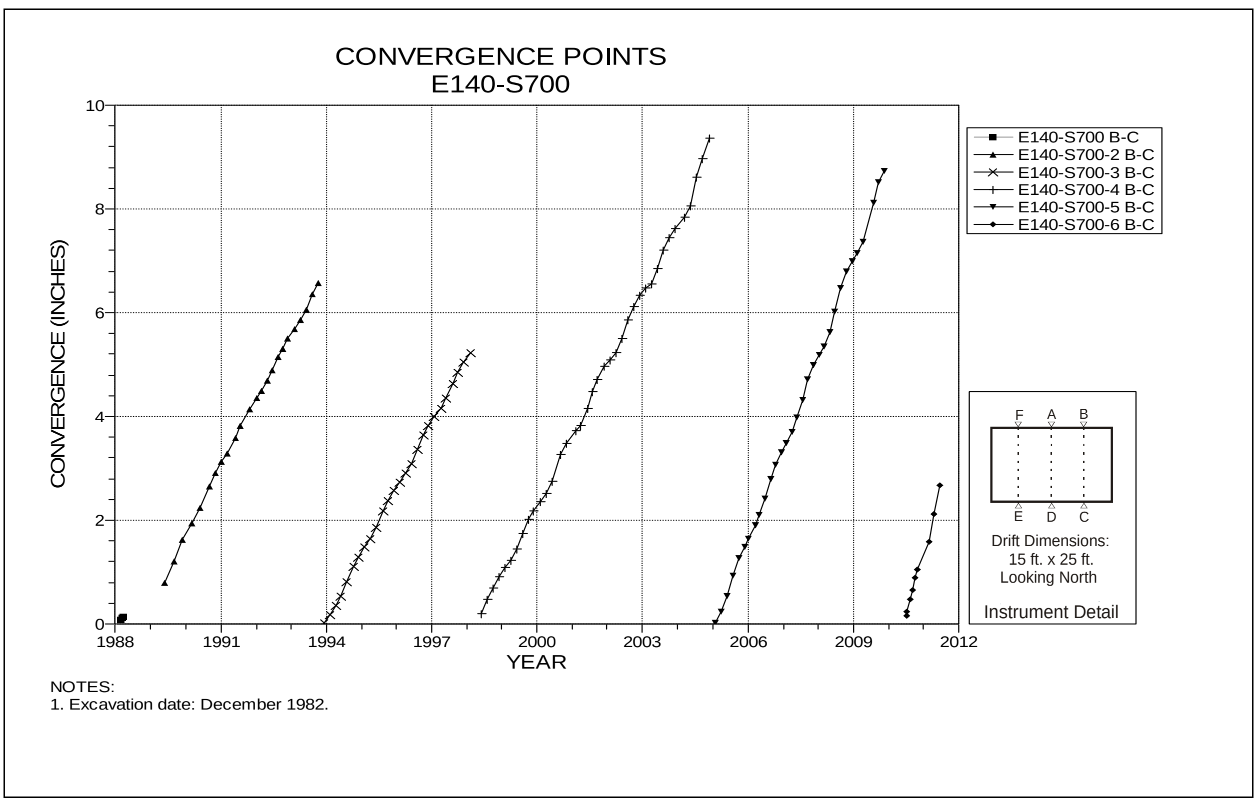


Figure 4-72 Convergence Point Array
E140 S700 – Roof to Floor – Quarter Point

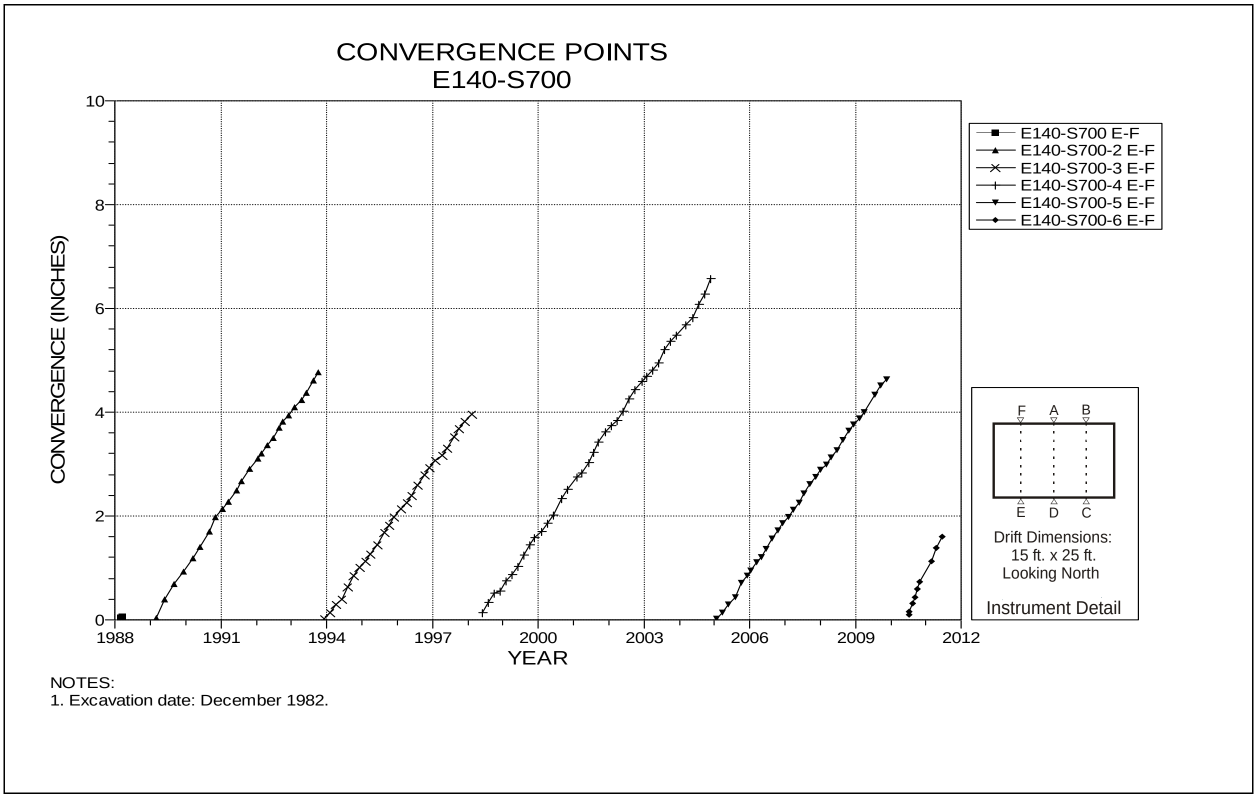


Figure 4-73 Convergence Point Array
E140 S700 – Roof to Floor – Quarter Point

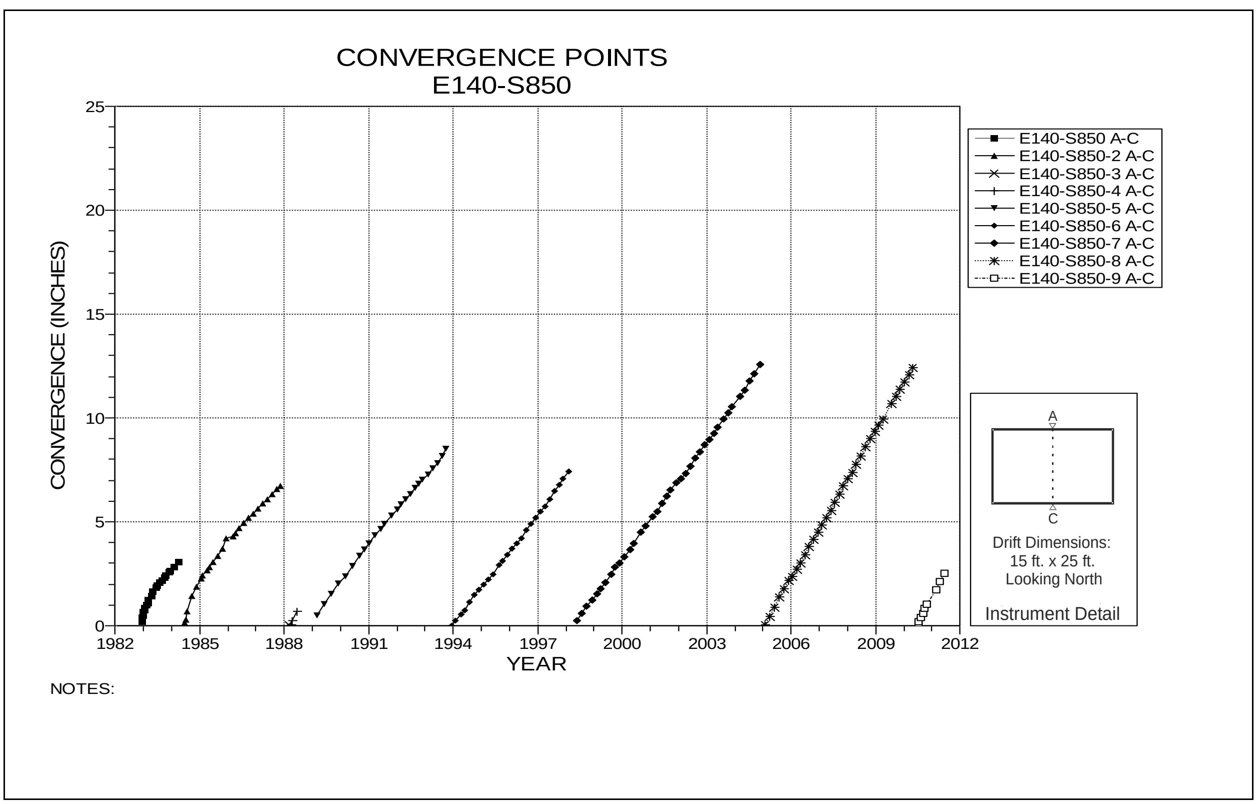


Figure 4-74 Convergence Point Array
E140 S850 – Roof to Floor

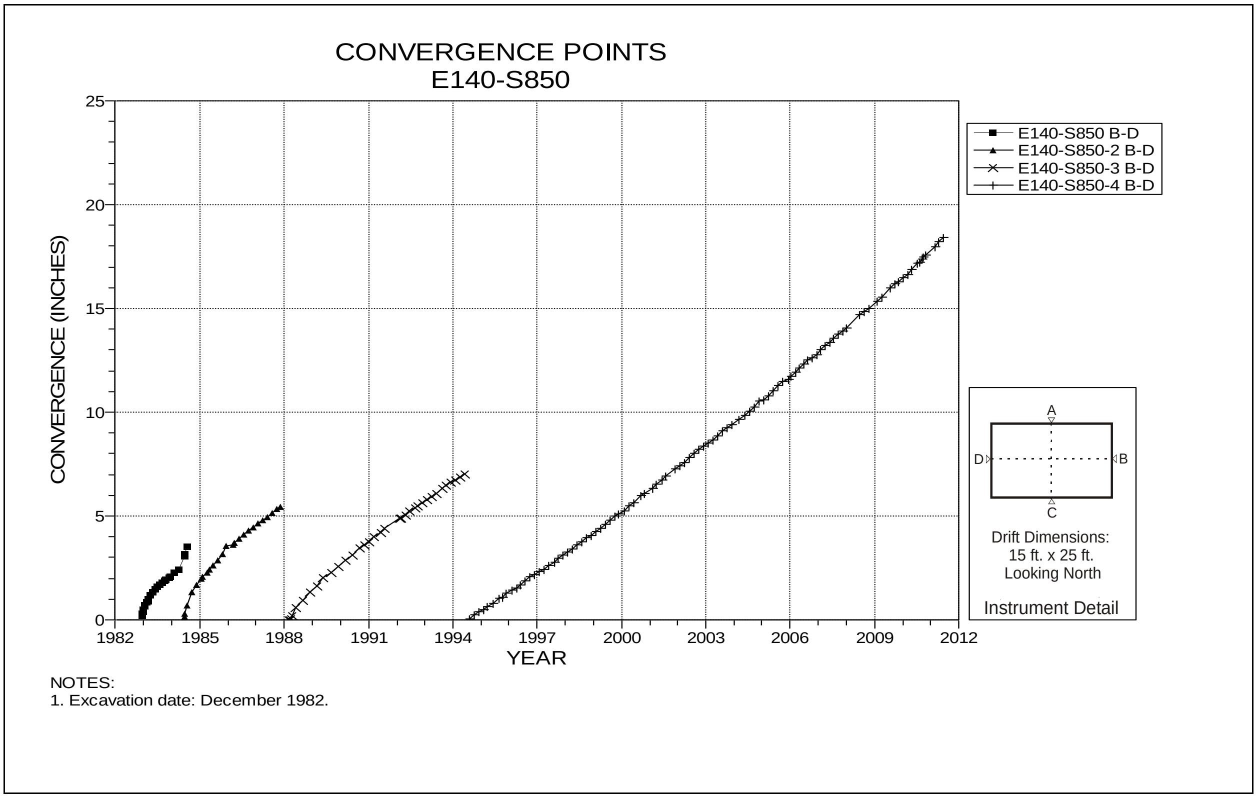


Figure 4-75 Convergence Point Array
E140 S850 – Rib to Rib

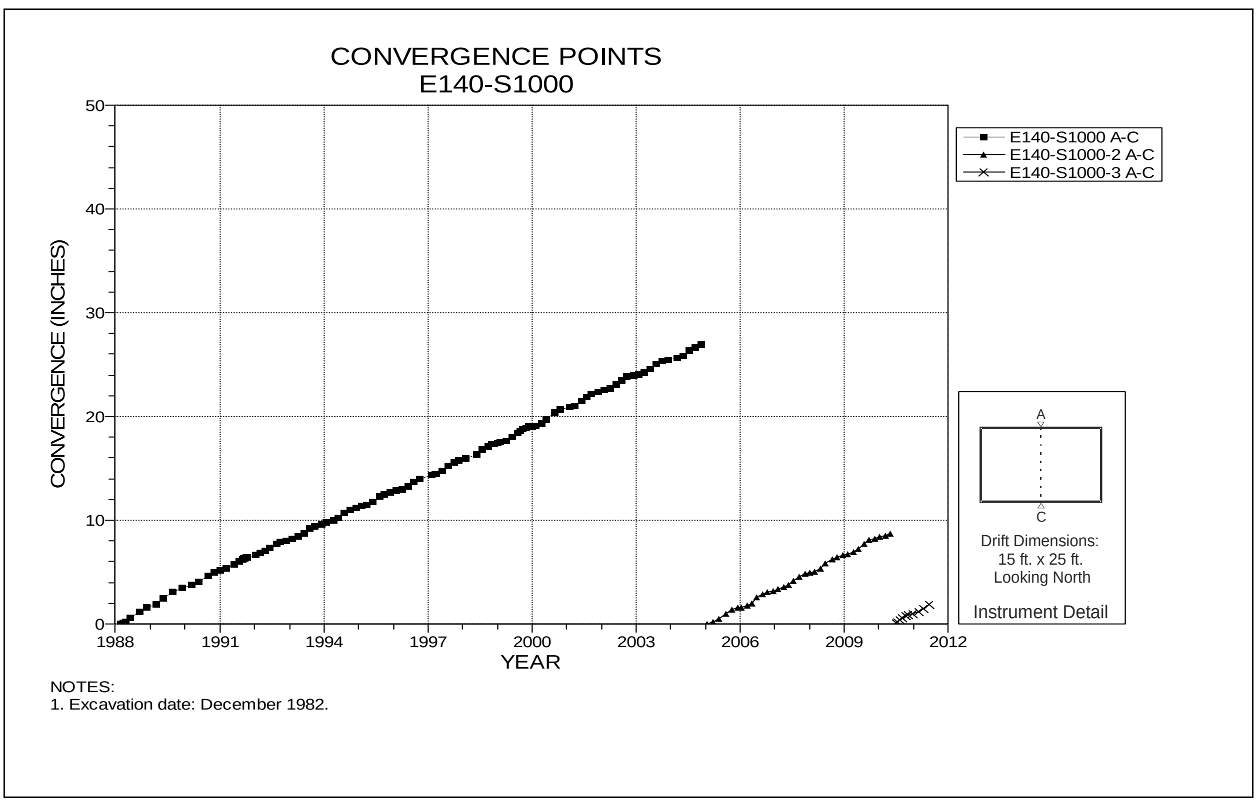


Figure 4-76 Convergence Point Array
E140 S1000 – Roof to Floor

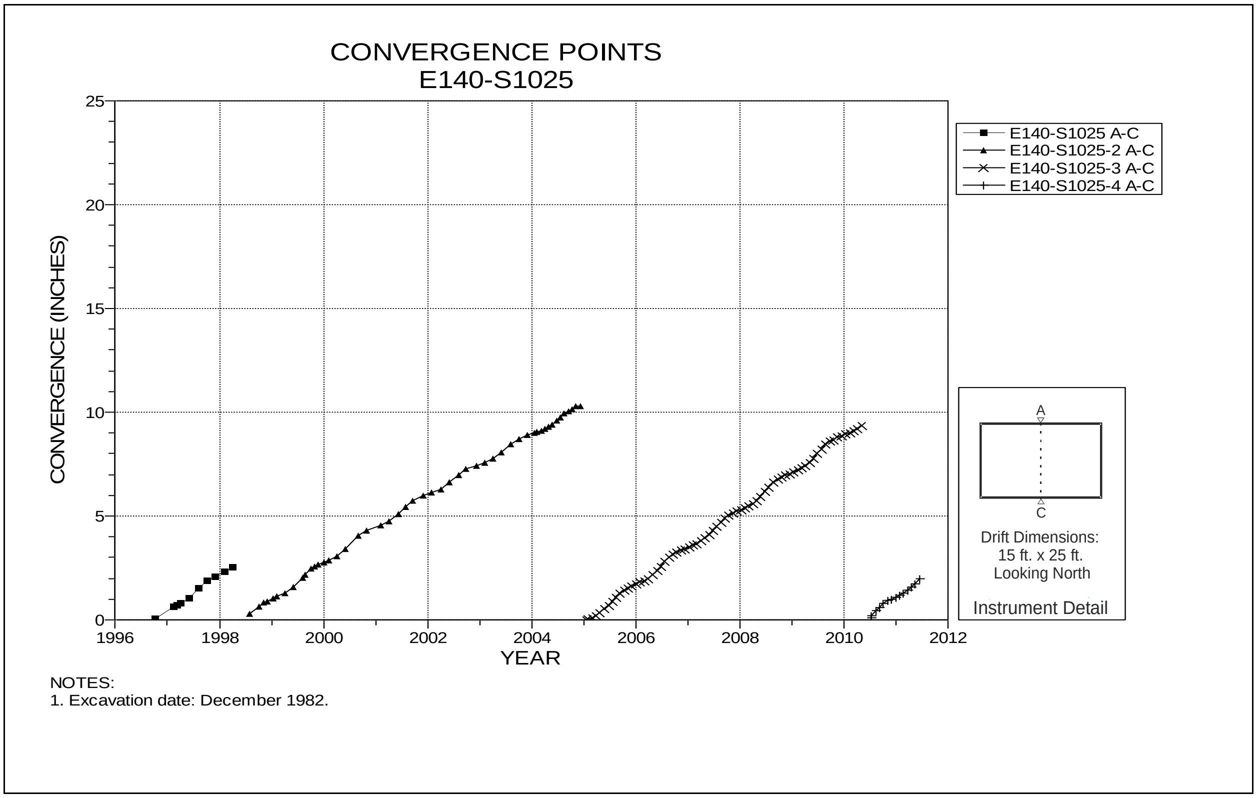


Figure 4-77 Convergence Point Array
E140 S1025 – Roof to Floor

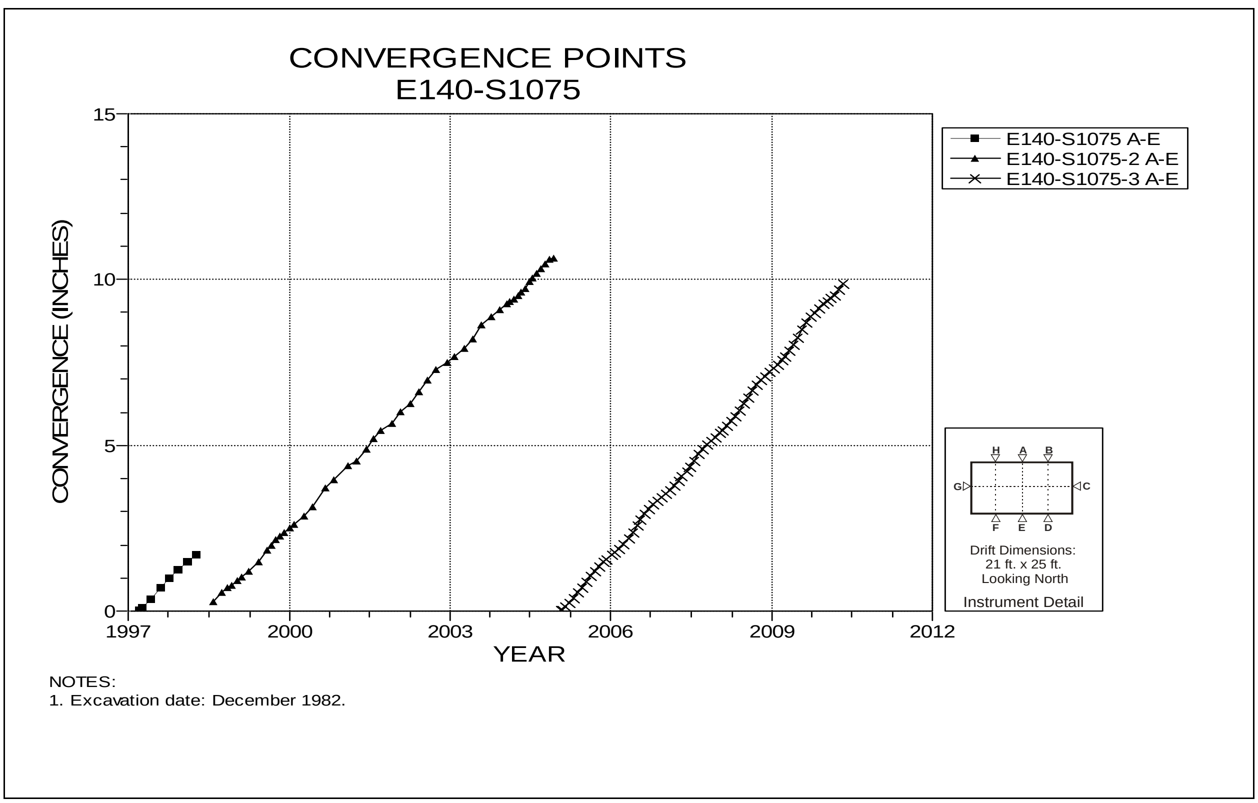


Figure 4-78 Convergence Point Array
E140 S1075 – Roof to Floor

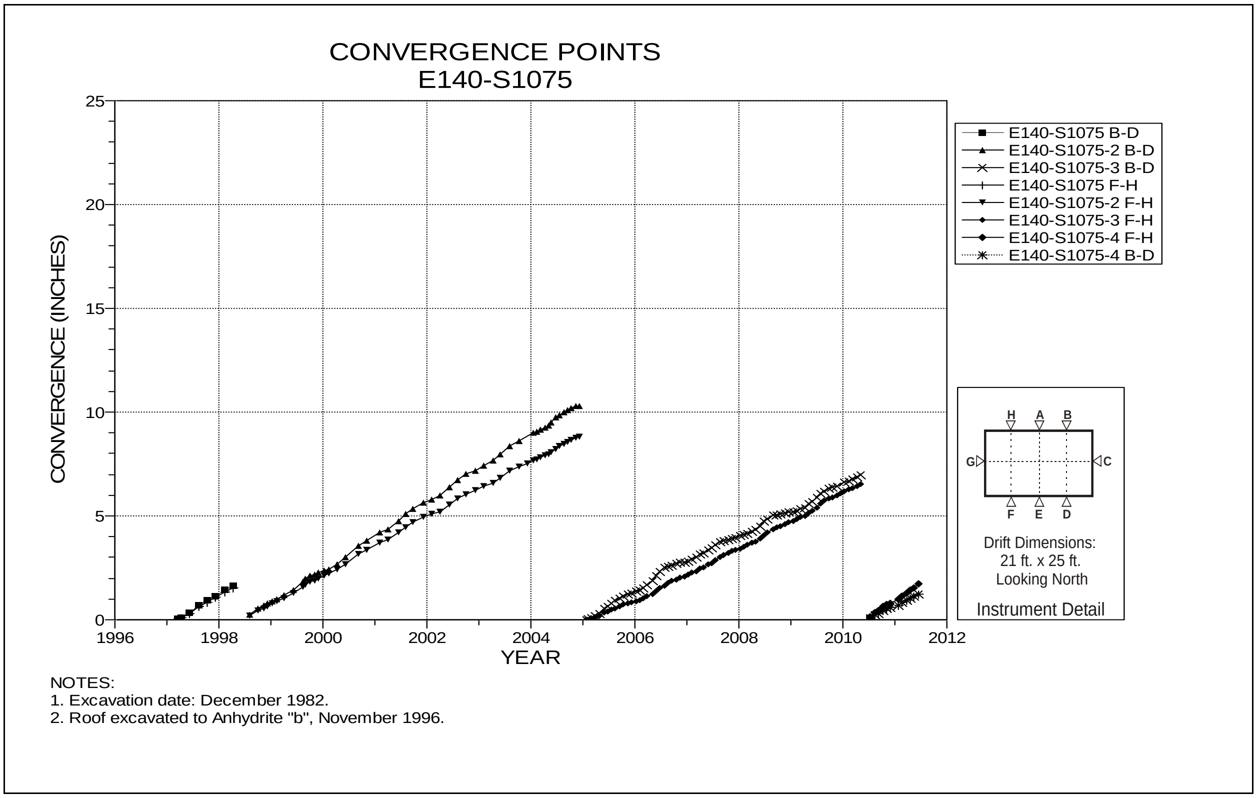


Figure 4-79 Convergence Point Array
E140 S1075 – Roof to Floor – Quarter Points

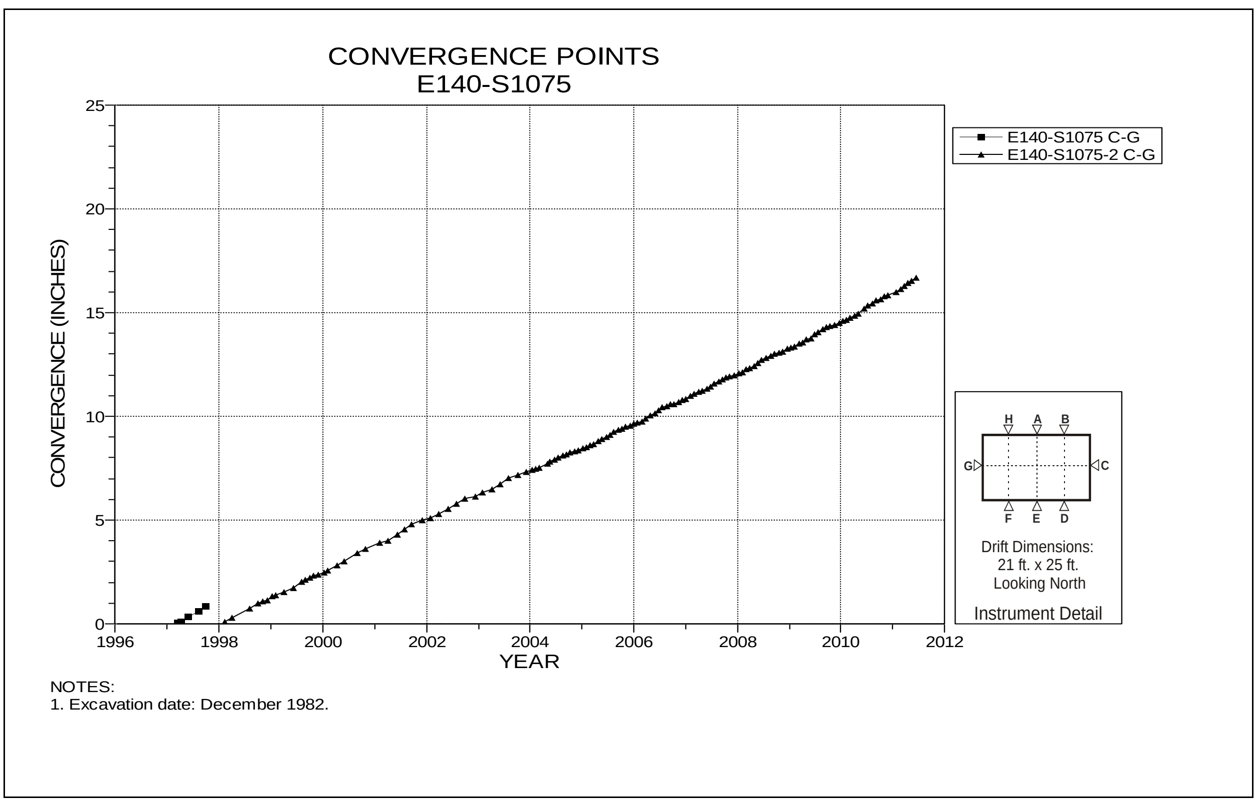


Figure 4-80 Convergence Point Array
E140 S1075 – Rib to Rib

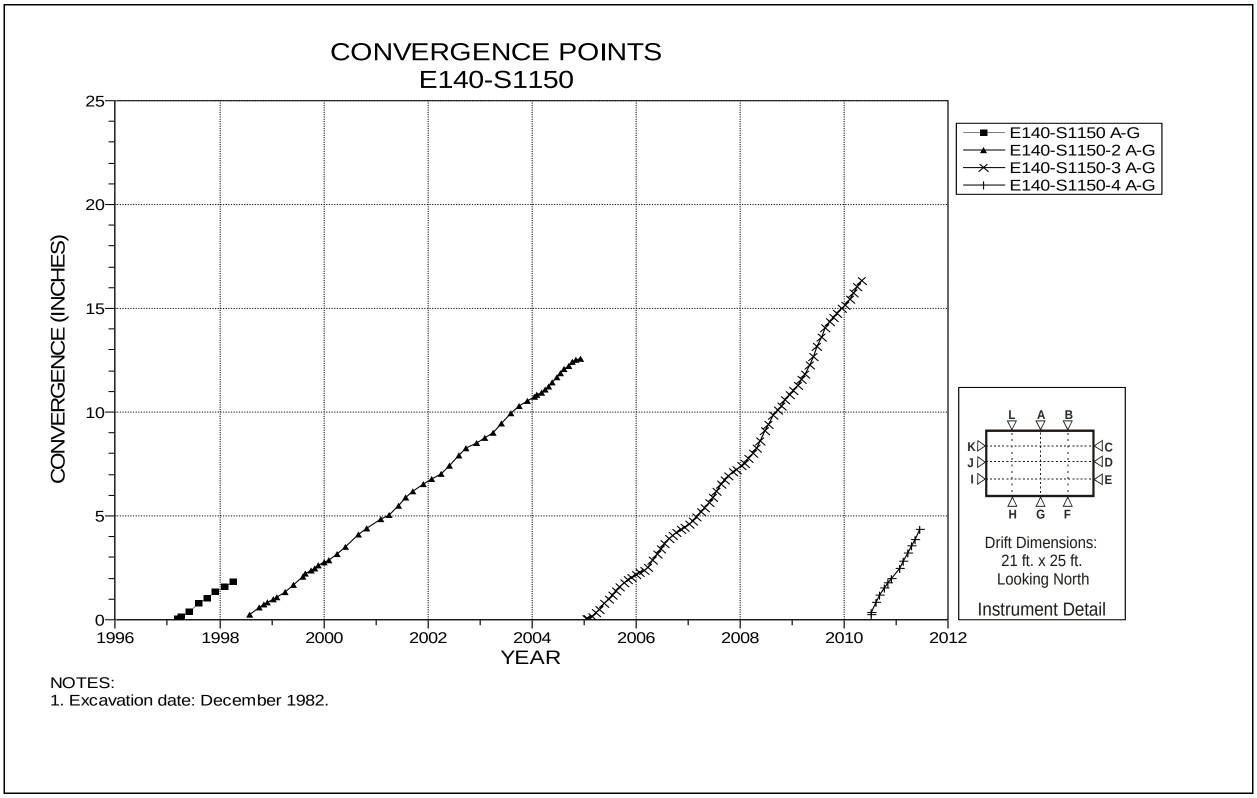


Figure 4-81 Convergence Point Array
E140 S1150 – Roof to Floor

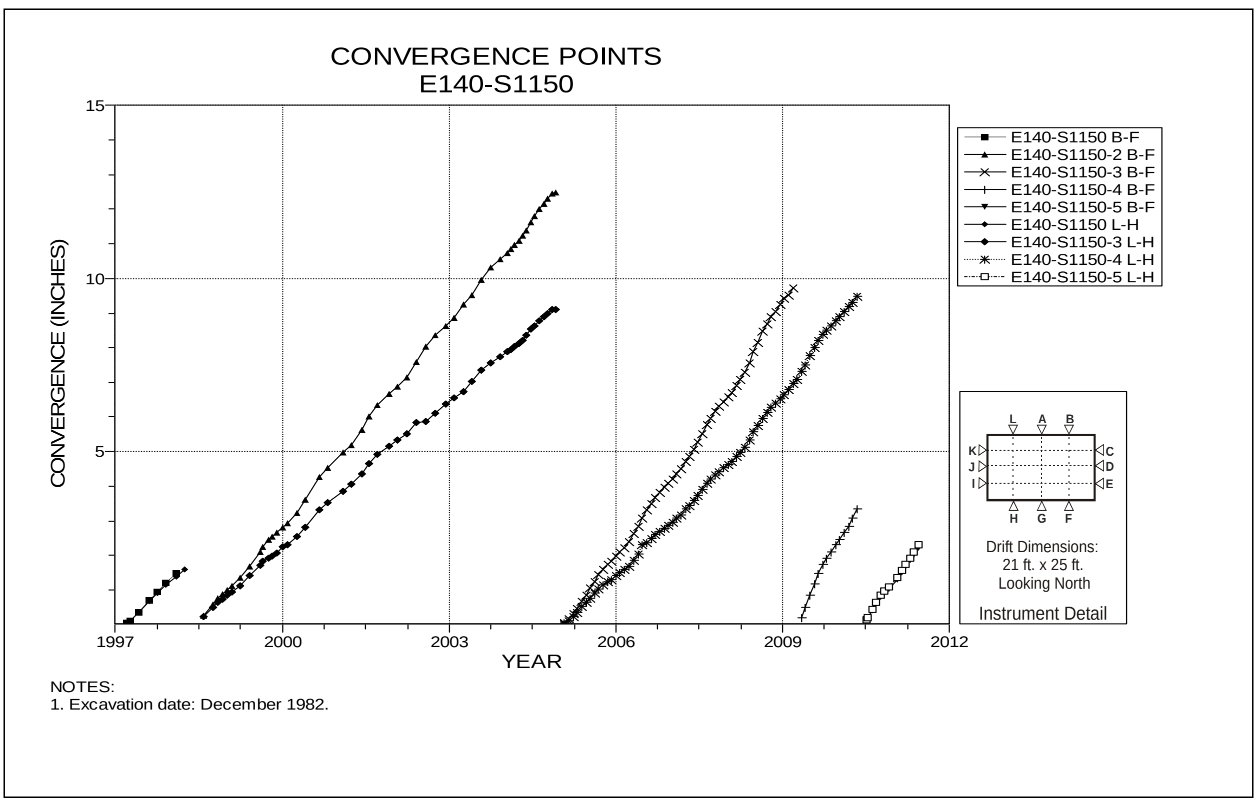


Figure 4-82 Convergence Point Array
E140 S1150 – Roof to Floor – Quarter Points

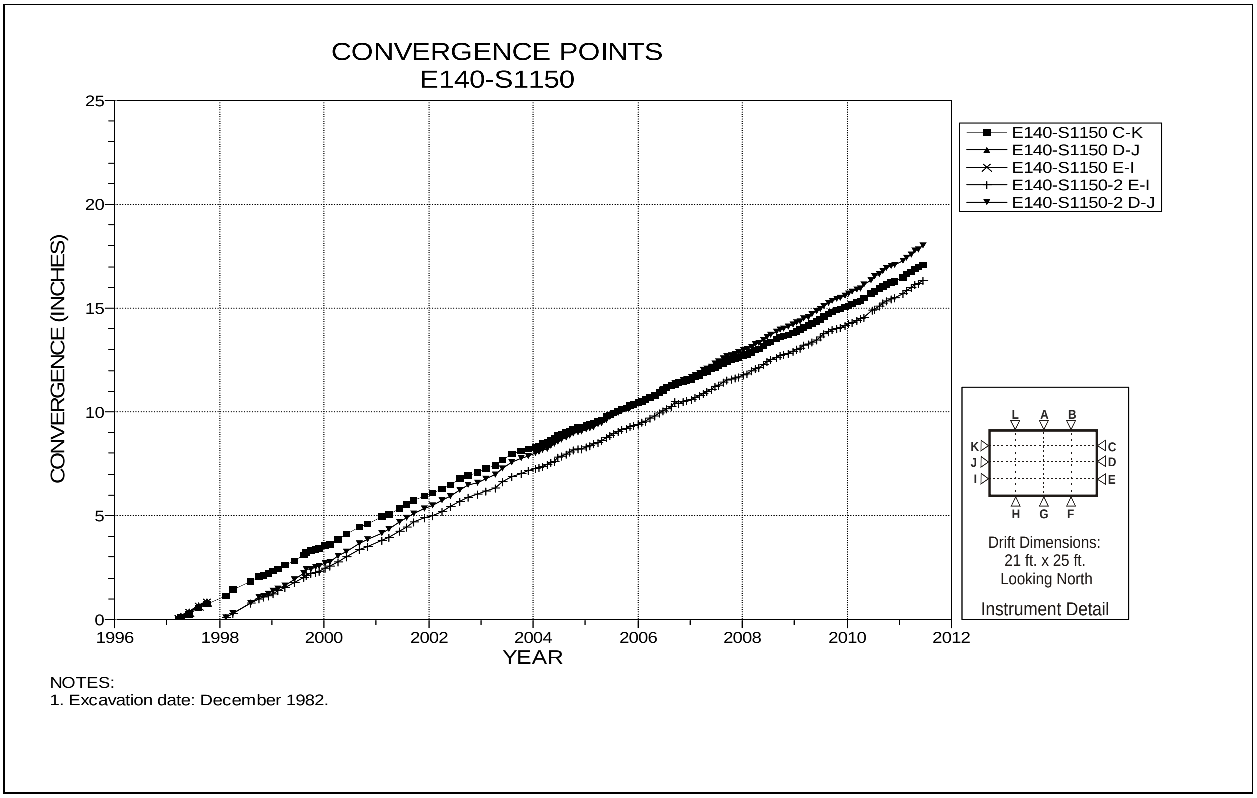


Figure 4-83 Convergence Point Array
E140 S1150 – Rib to Rib – Quarter Points

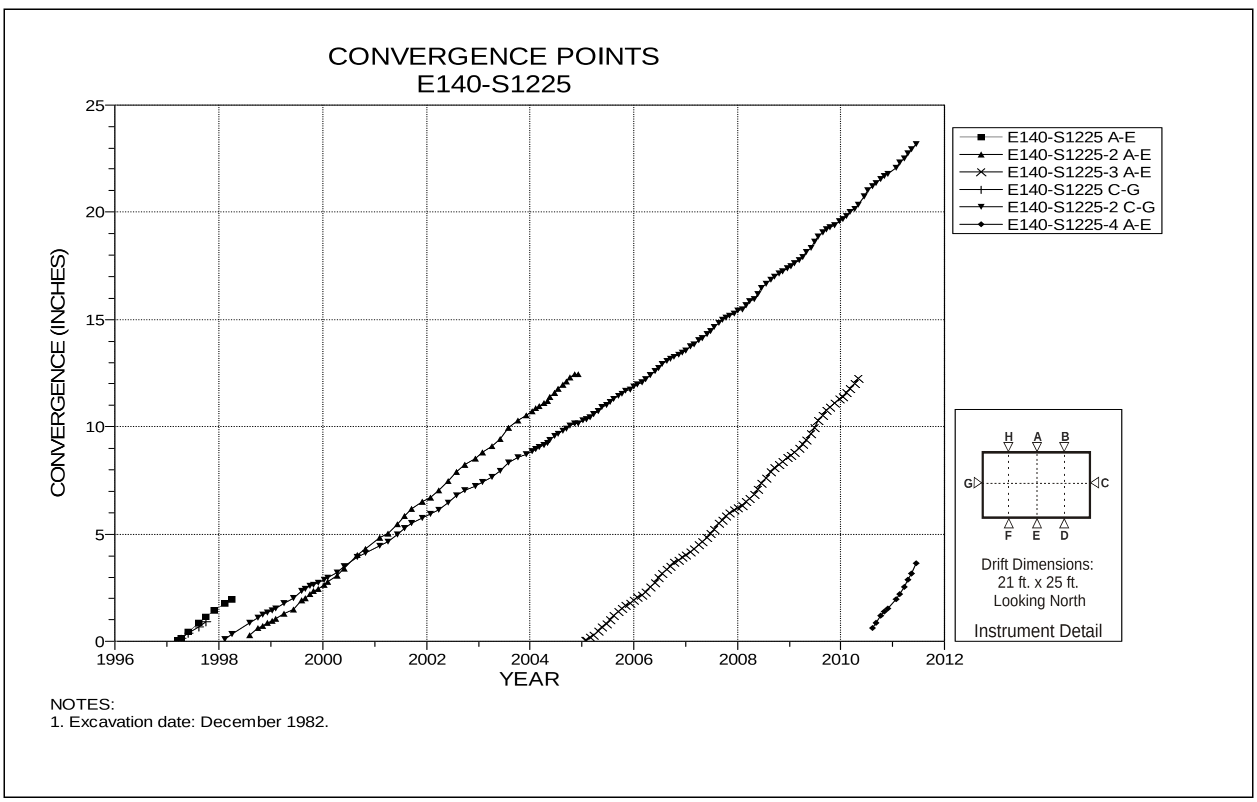


Figure 4-84 Convergence Point Array
E140 S1225 – Roof to Floor

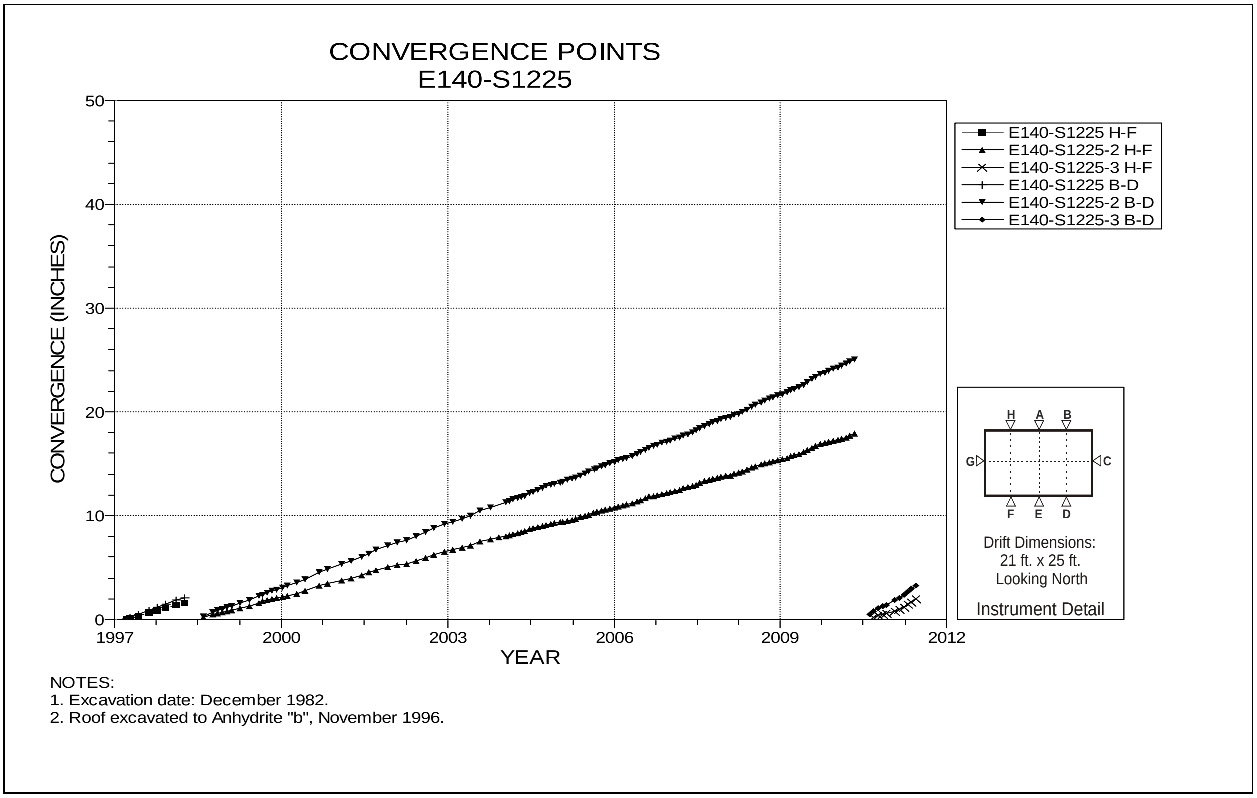


Figure 4-85 Convergence Point Array
E140 S1225 – Roof to Floor – Quarter Points

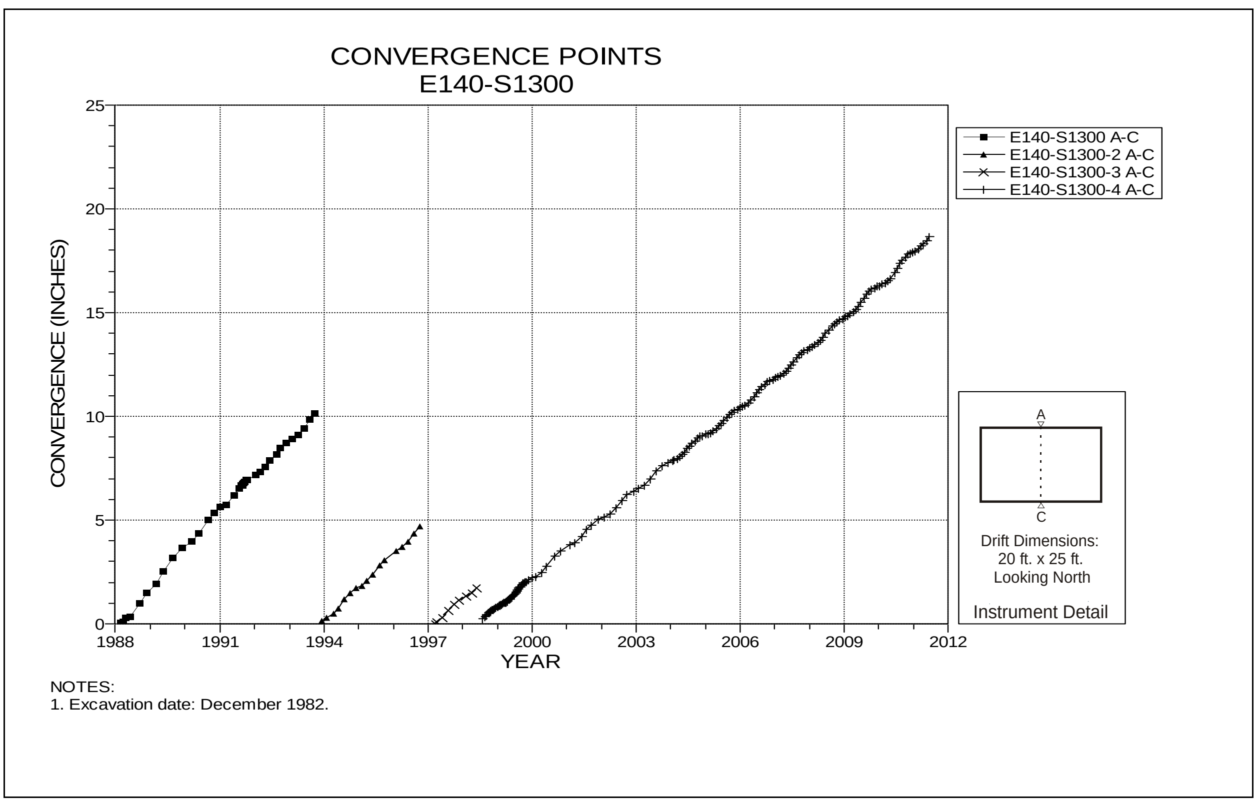


Figure 4-86 Convergence Point Array
E140 S1300 – Roof to Floor

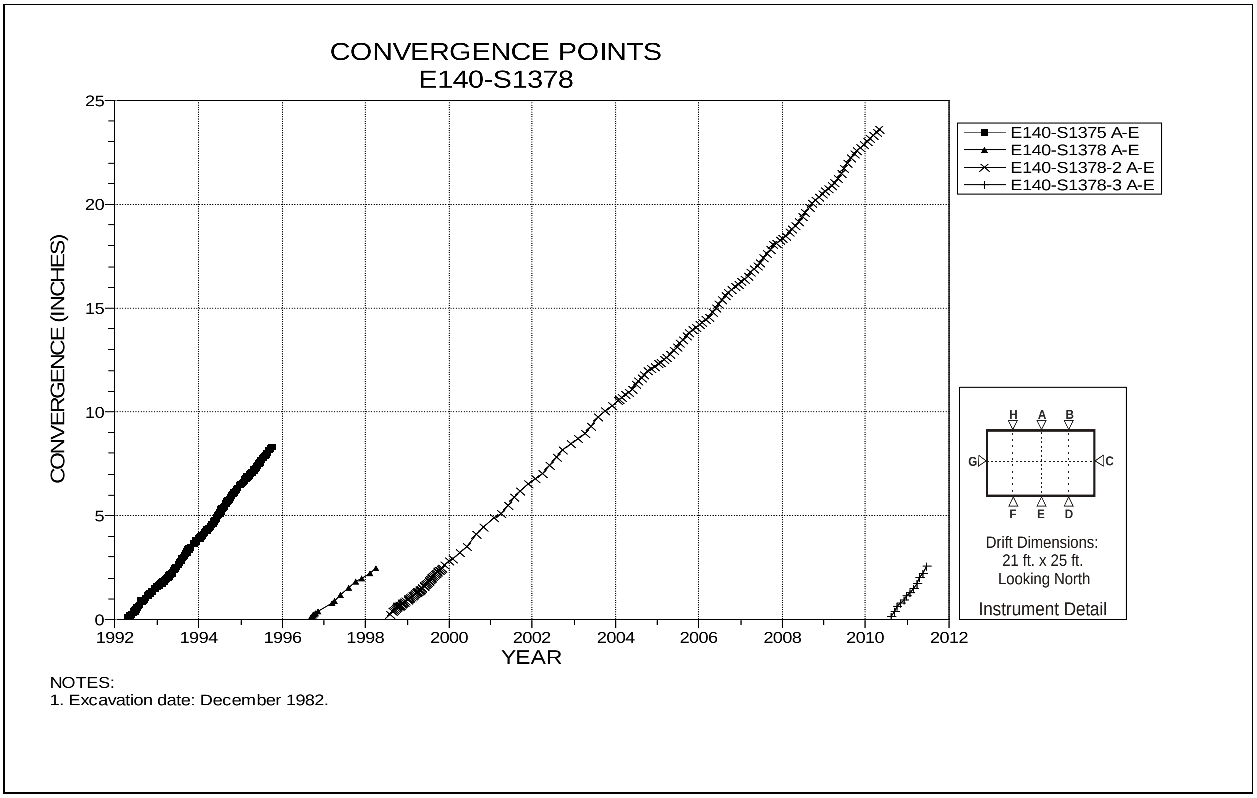


Figure 4-87 Convergence Point Array
E140 S1378 – Roof to Floor

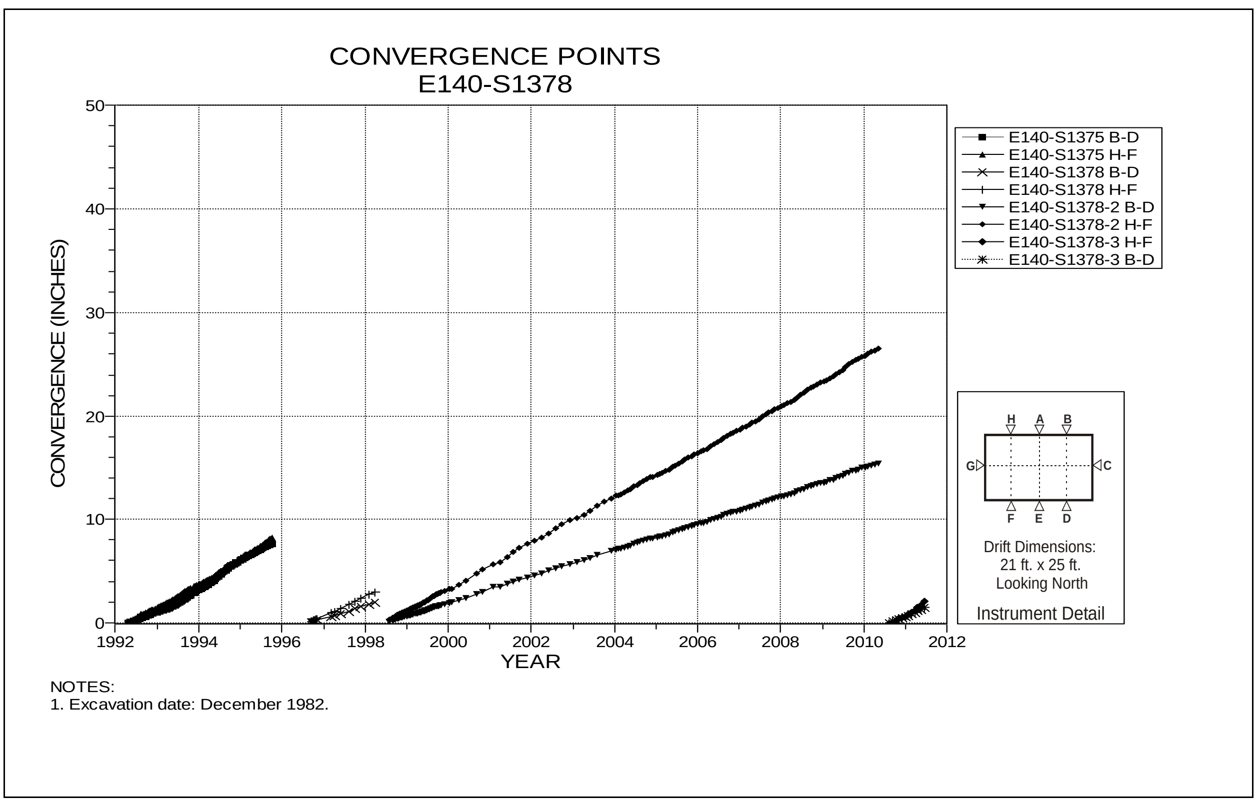


Figure 4-88 Convergence Point Array
E140 S1378 – Roof to Floor – Quarter Points

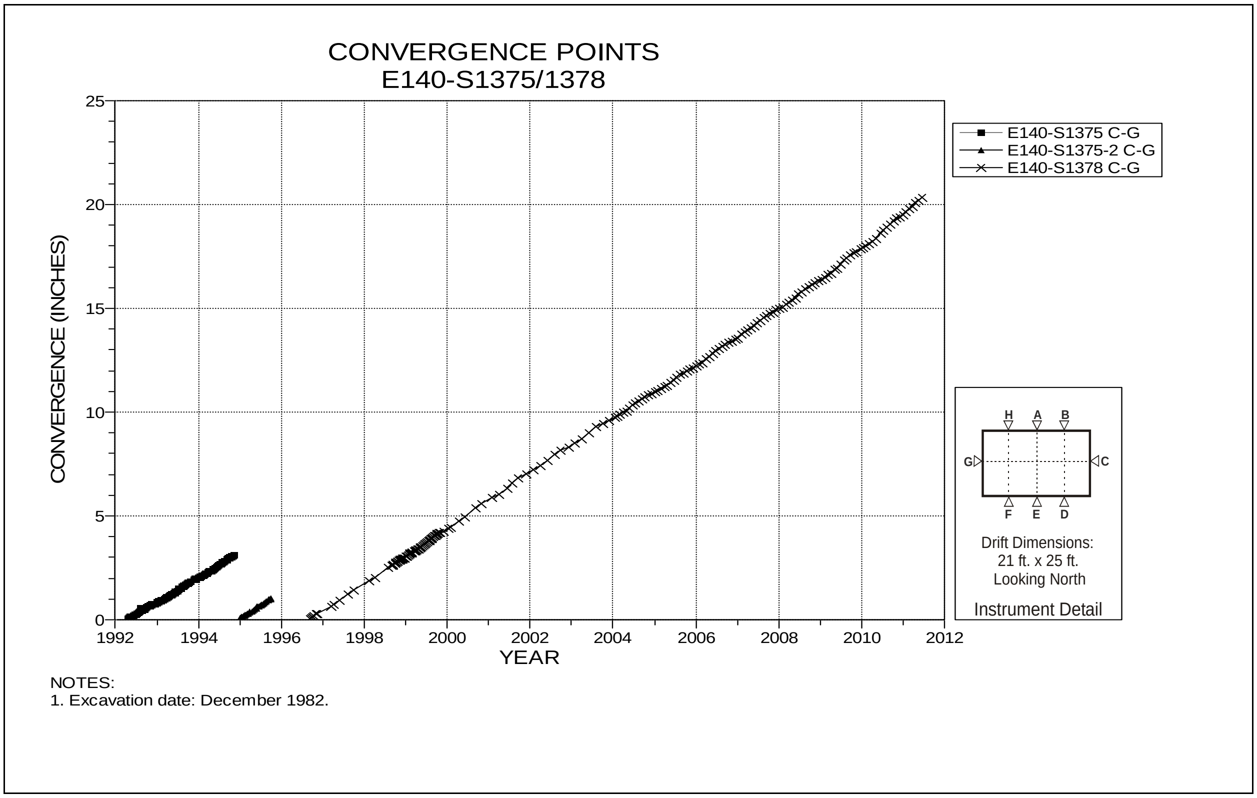


Figure 4-89 Convergence Point Array
E140 S1375/1378 – Rib to Rib

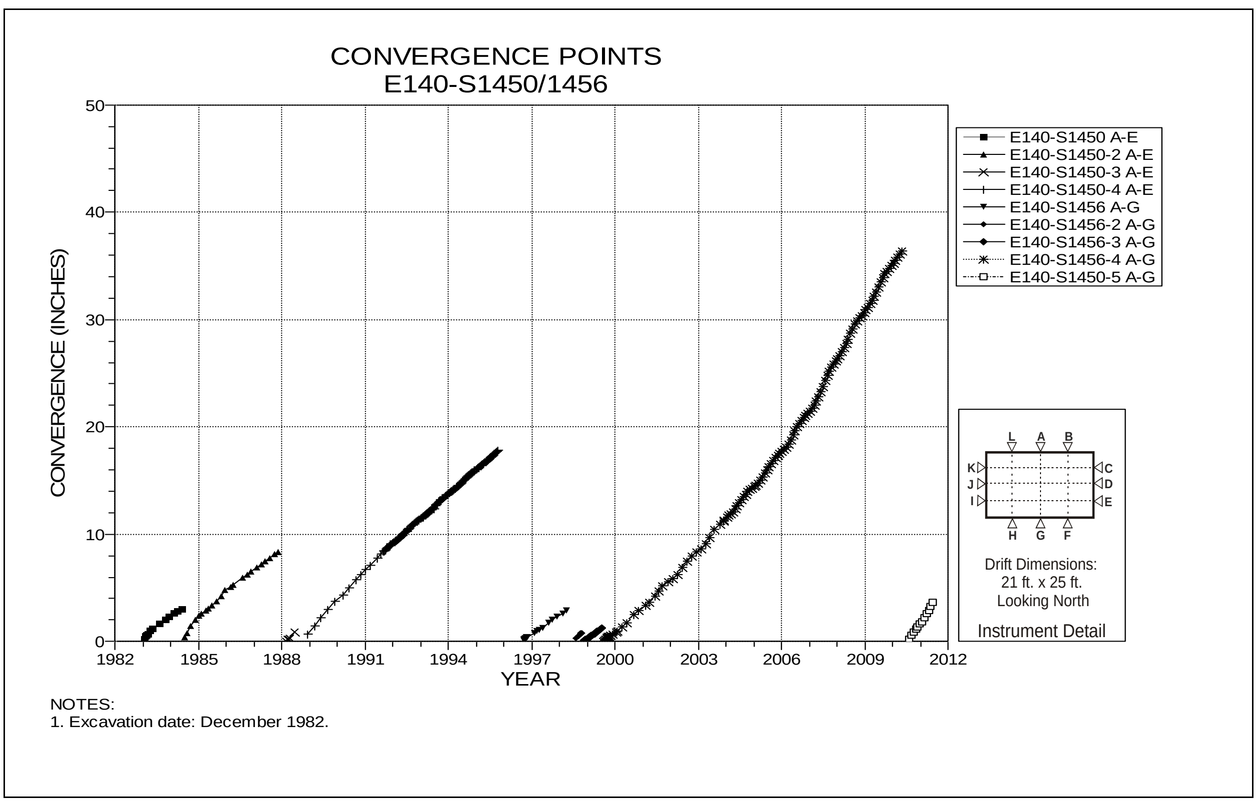


Figure 4-90 Convergence Point Array
E140 S1450/1456 – Roof to Floor

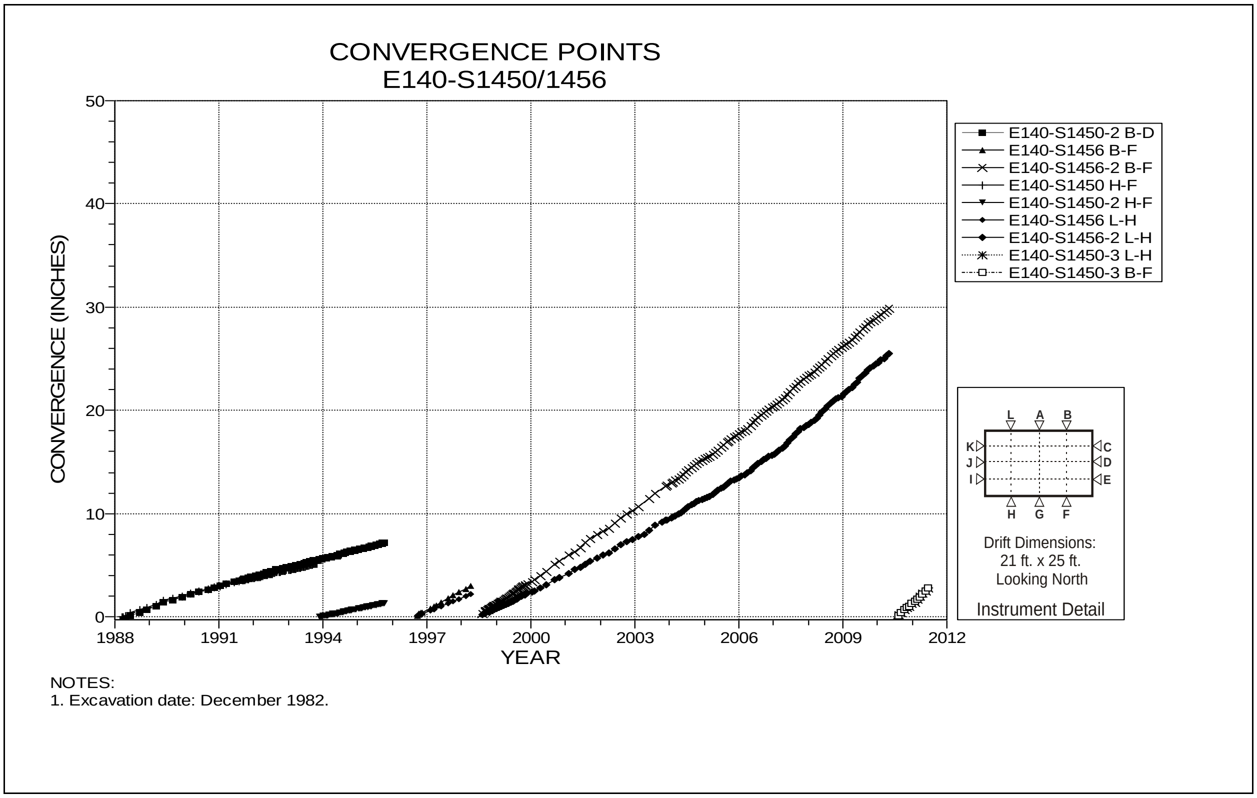


Figure 4-91 Convergence Point Array
E140 S1450/S1456 – Roof to Floor – Quarter Points

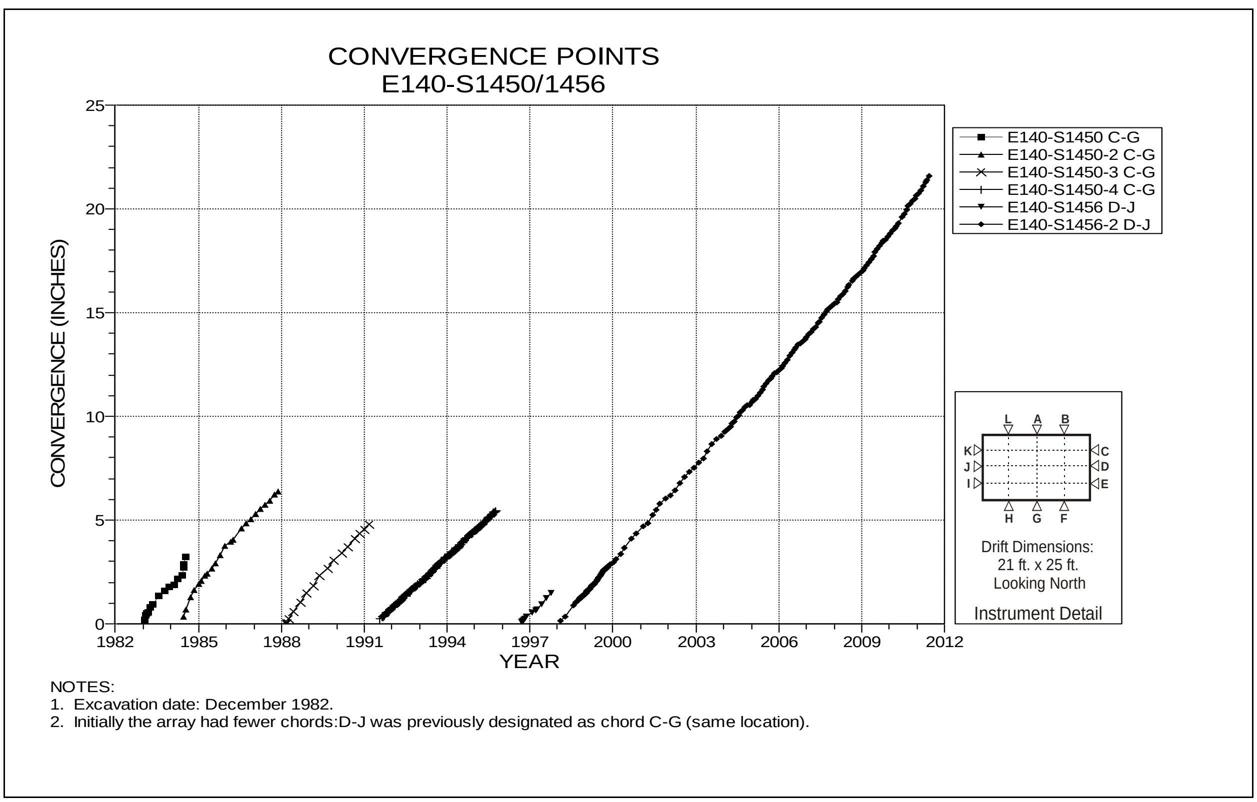


Figure 4-92 Convergence Point Array
E140 S1450/S1456 – Rib to Rib – Midheight

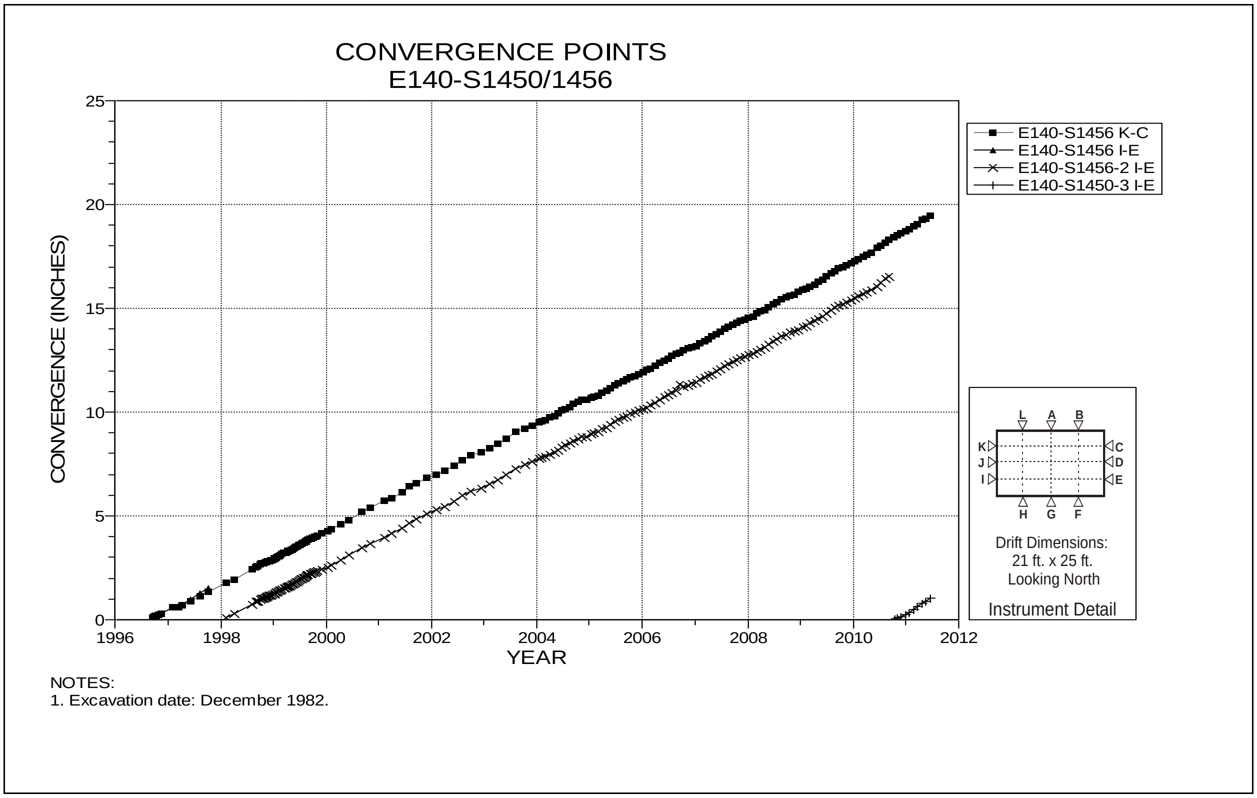


Figure 4-93 Convergence Point Array
E140 S1450/S1456 – Rib to Rib

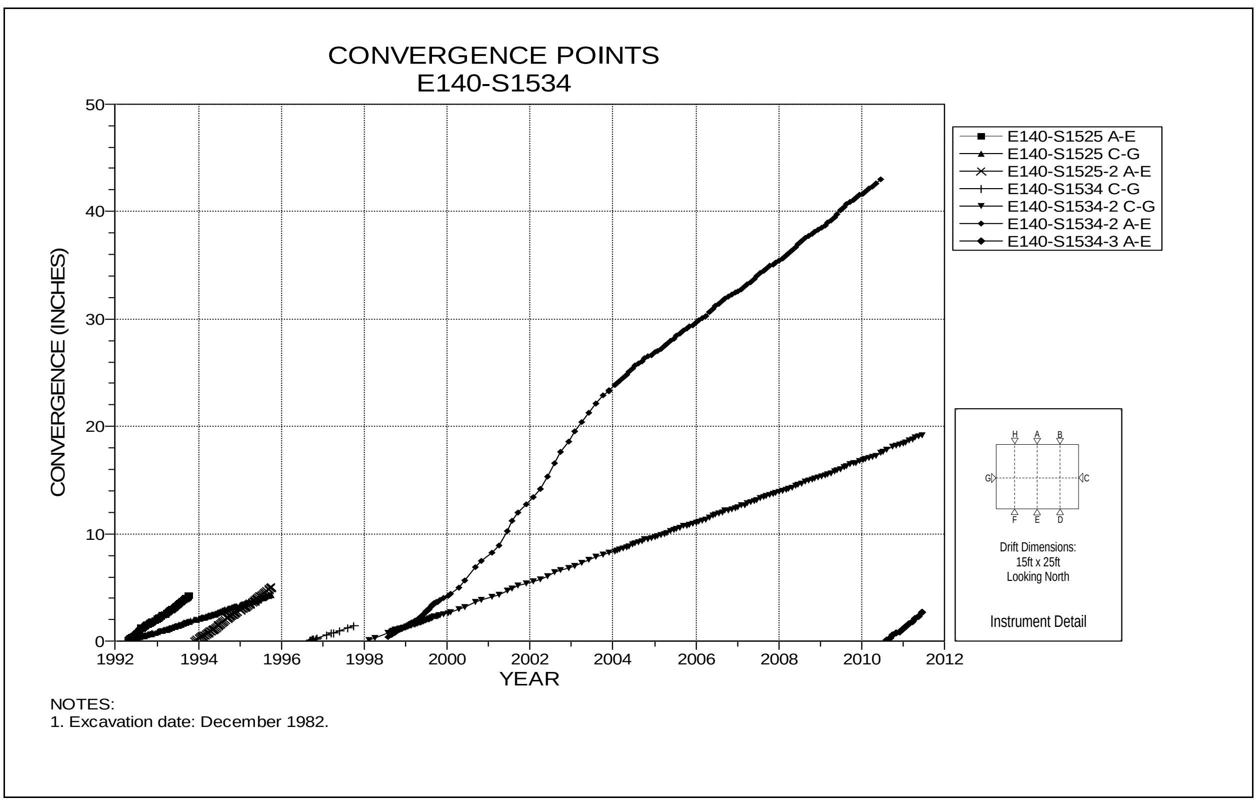


Figure 94 Convergence Point Array
E140 S1534 – Roof to Floor – Rib to Rib

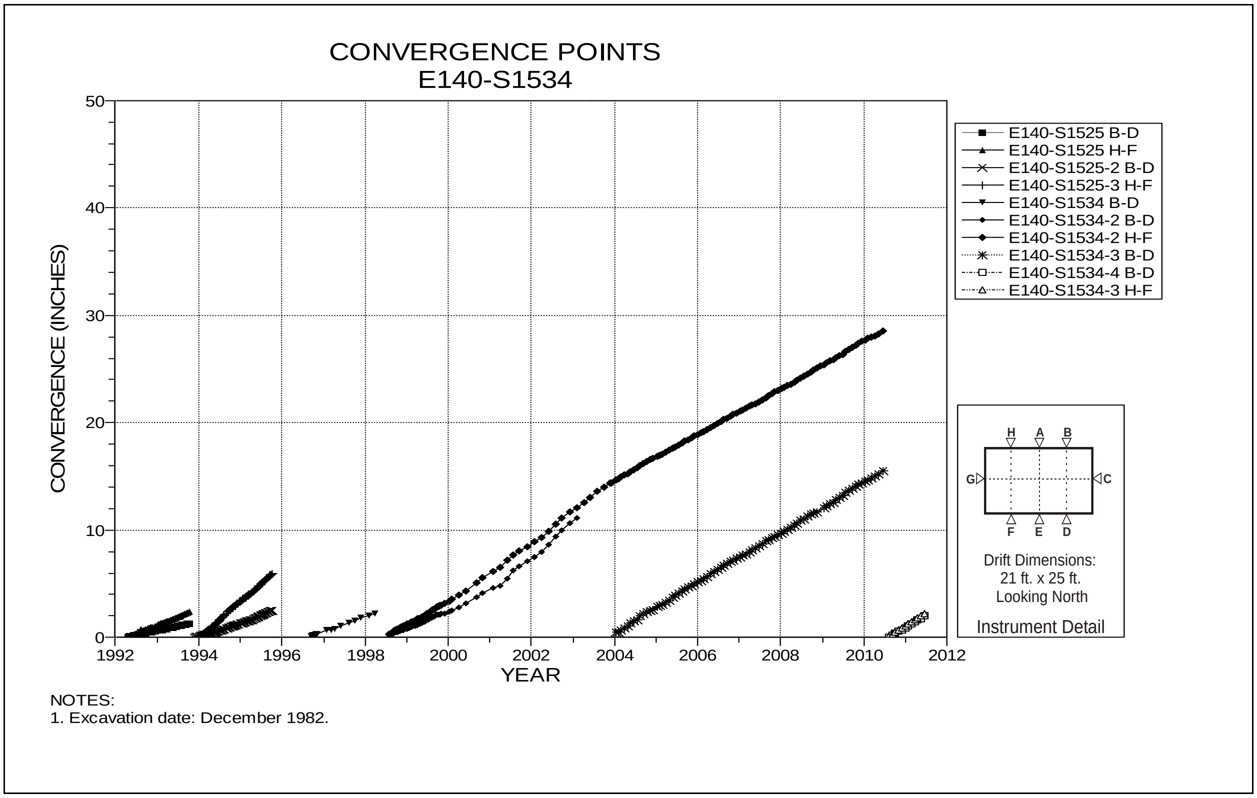


Figure 4-95 Convergence Point Array
E140 S1534 – Roof to Floor – Quarter Points

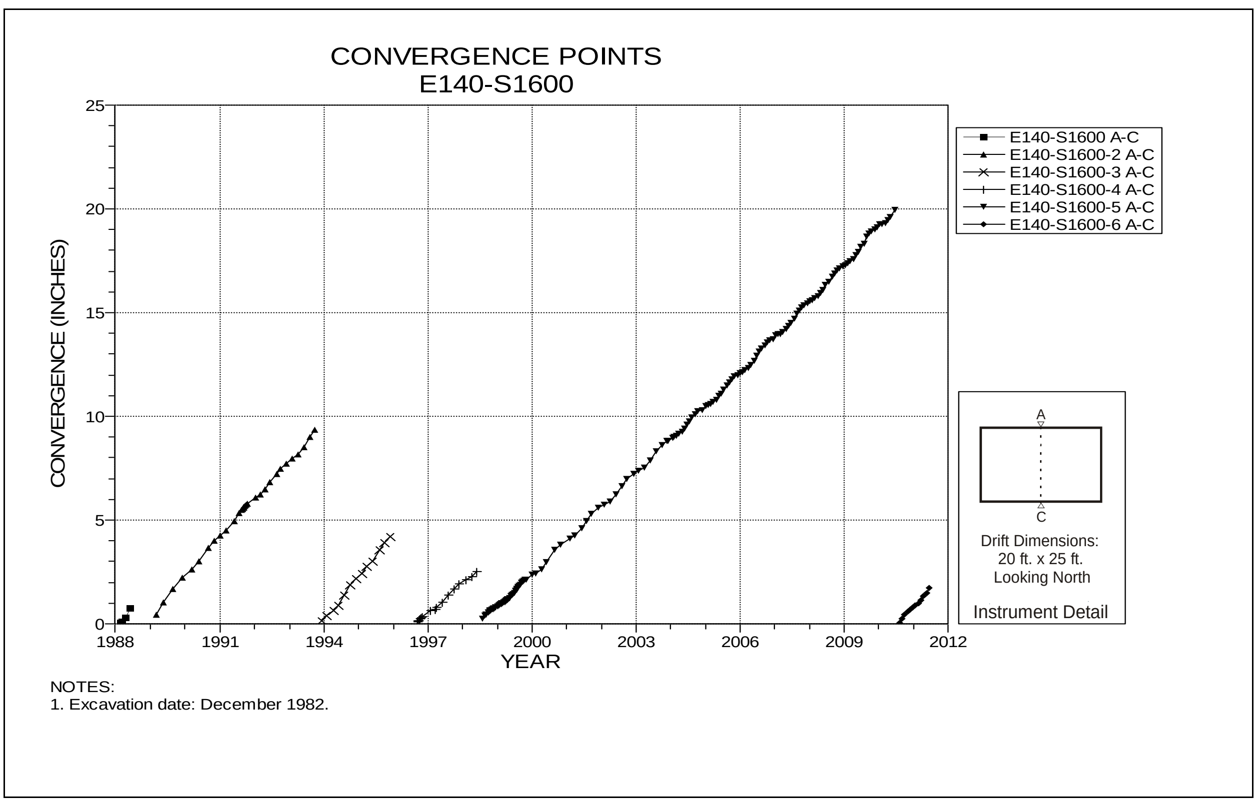


Figure 4-96 Convergence Point Array
E140 S1600 – Roof to Floor

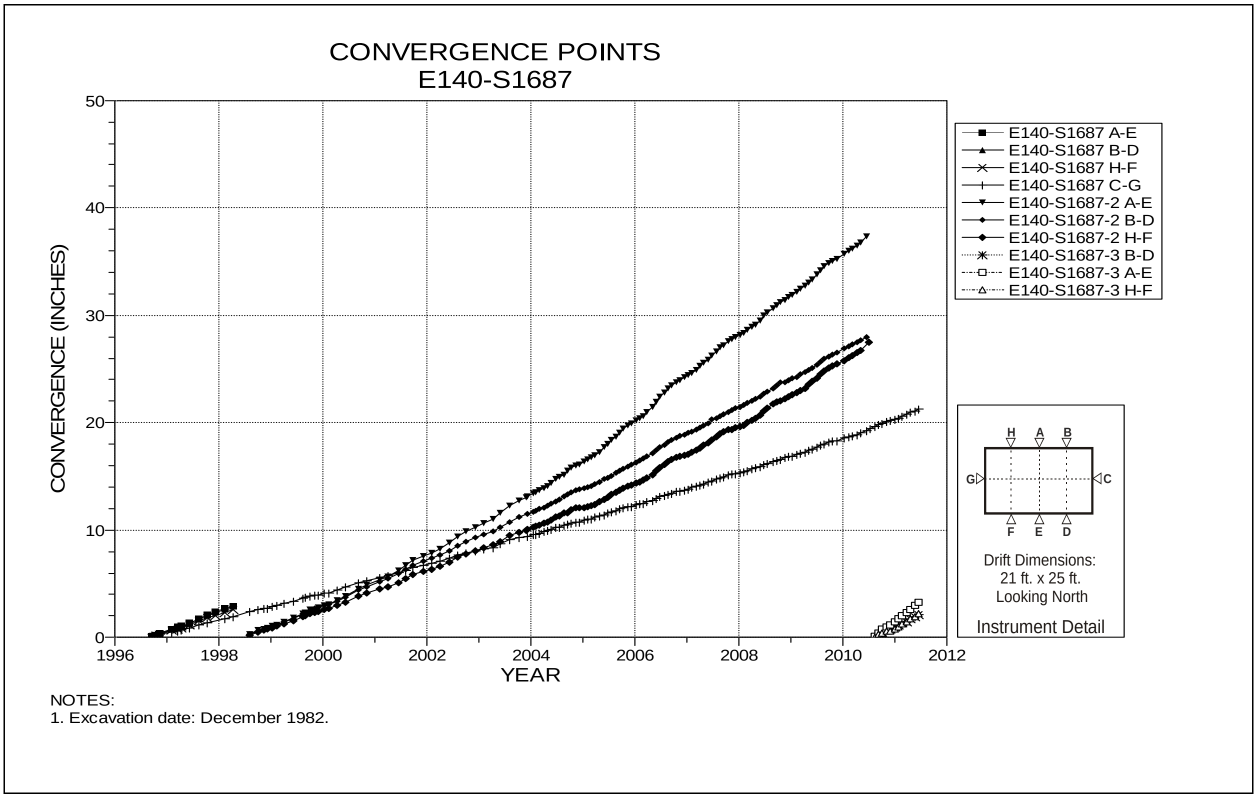


Figure 4-97 Convergence Point Array
E140 S1687 – All Chords

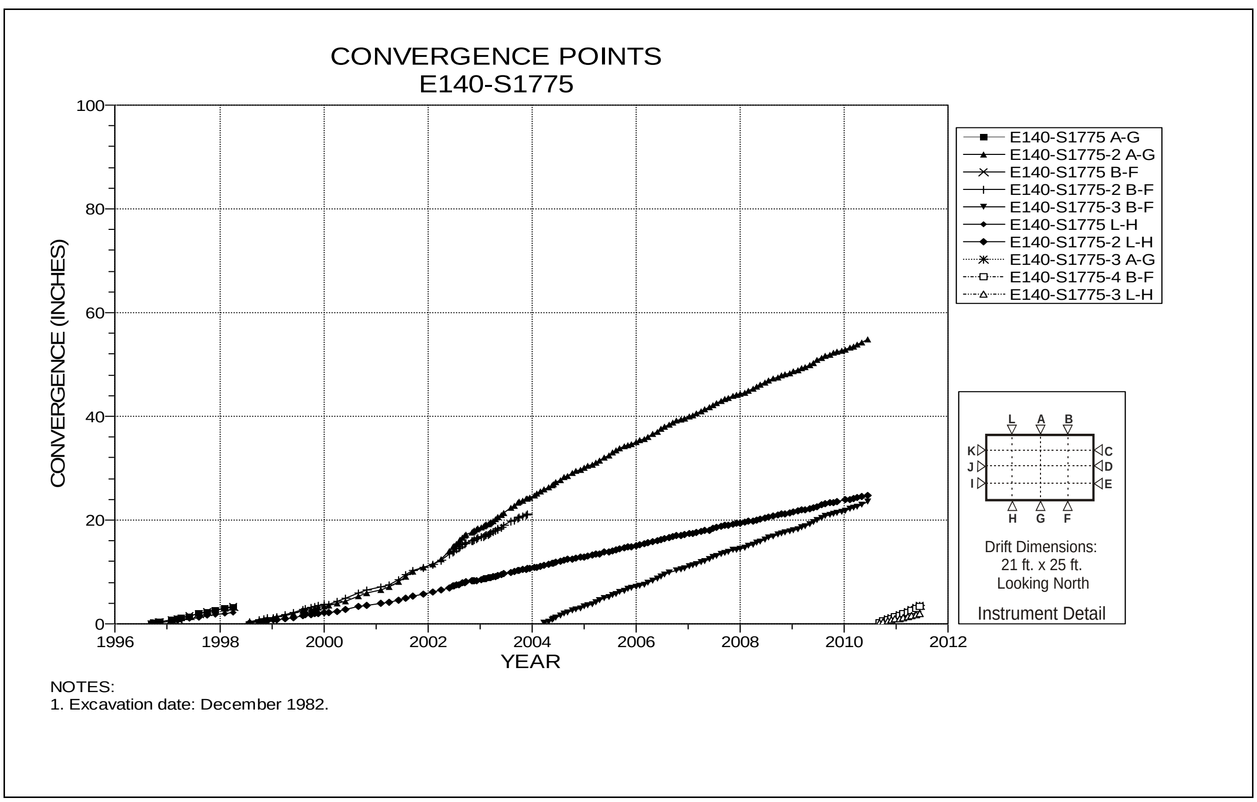


Figure 4-98 Convergence Point Array
E140 S1775 – Roof to Floor – Quarter Points

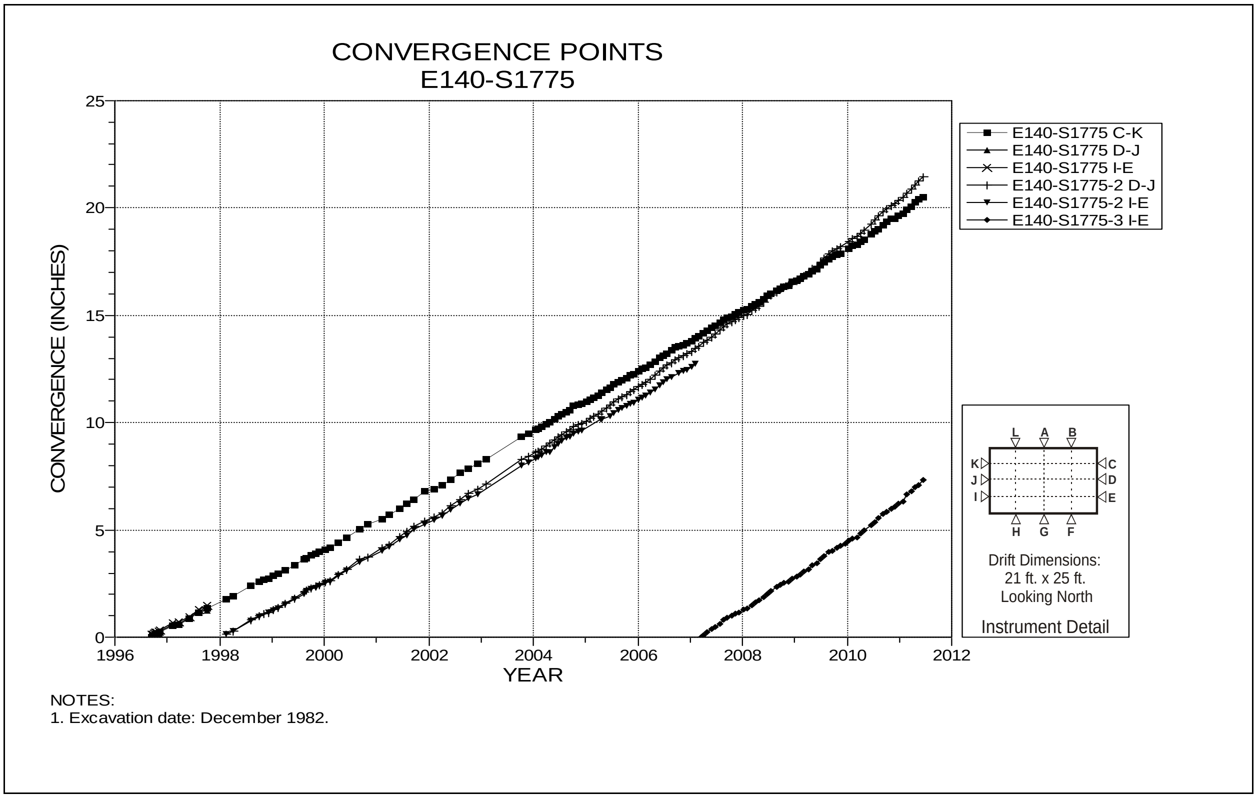


Figure 4-99 Convergence Point Array
E140 S1775 – Rib to Rib

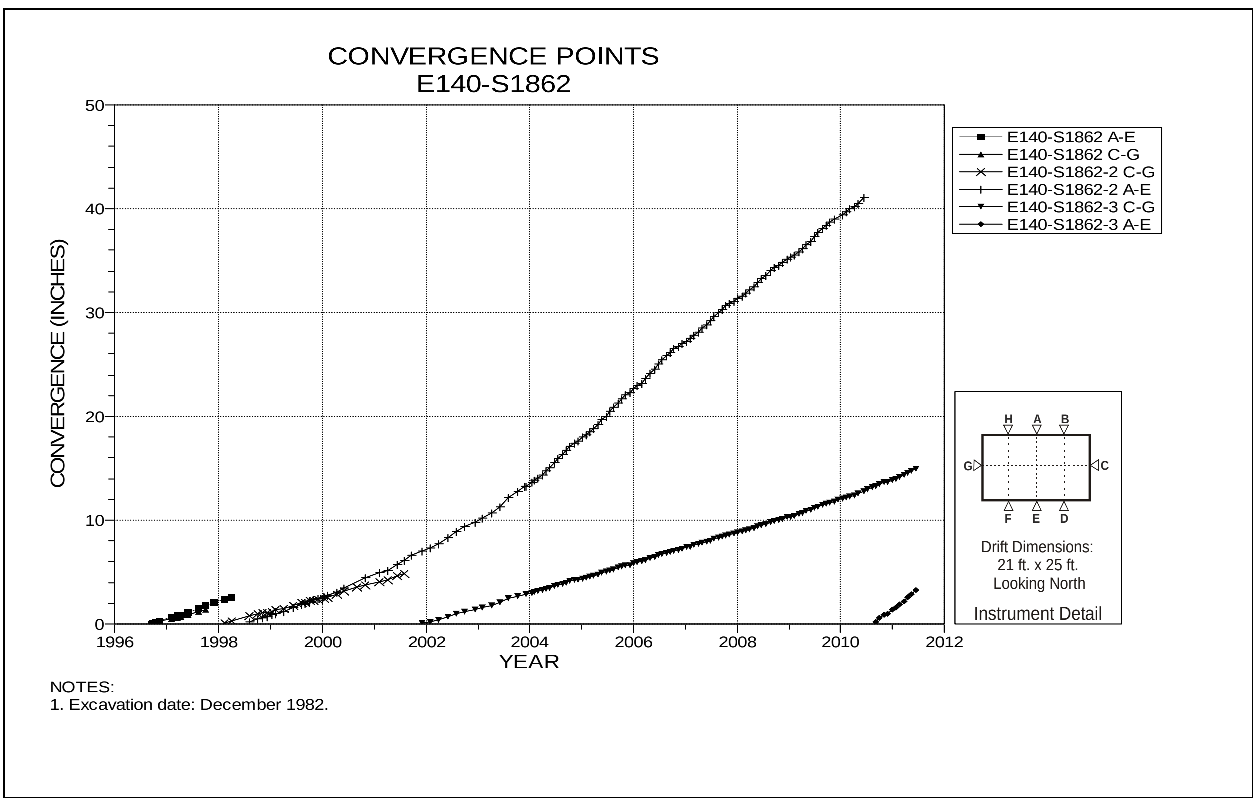


Figure 4-100 Convergence Point Array
E140 S1862 – Centerline Roof to Floor – Rib to Rib

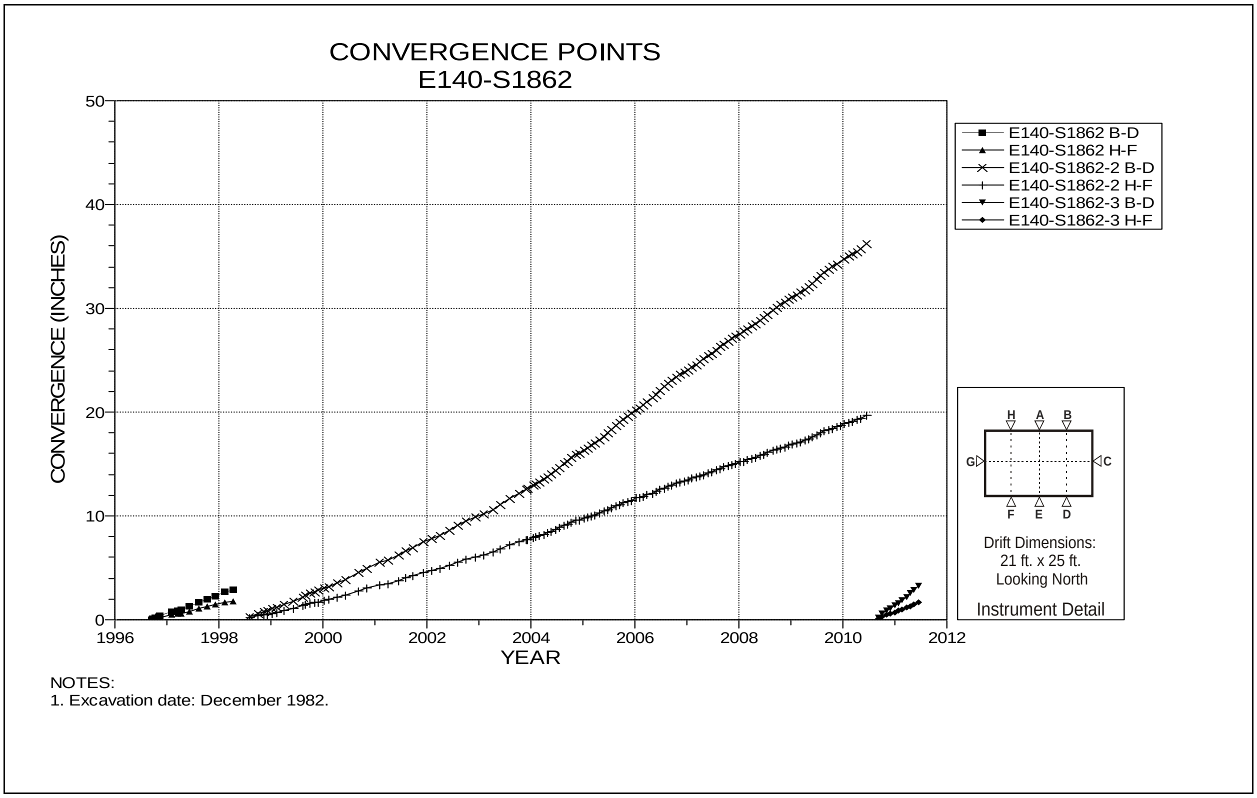


Figure 4-101 Convergence Point Array
E140 S1862 – Roof to Floor – Quarter Points

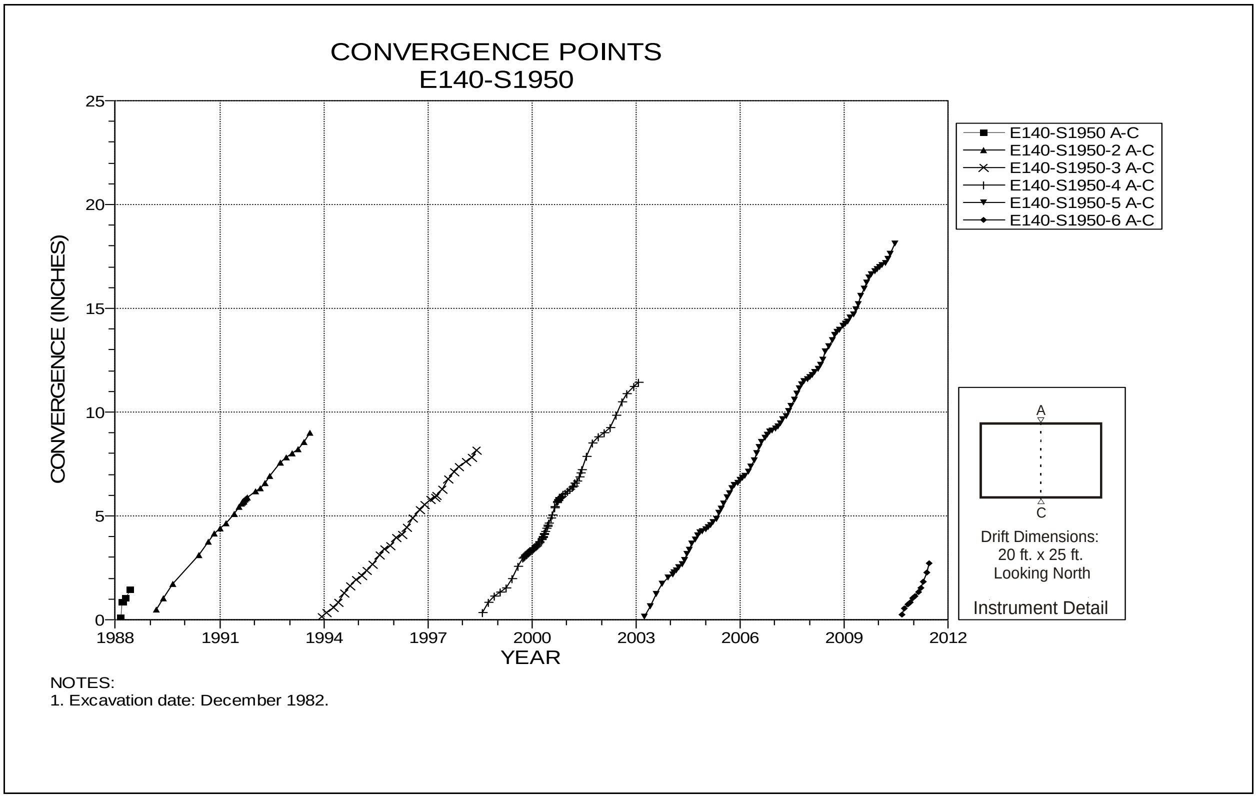


Figure 4-102 Convergence Point Array
E140 S1950 – Roof to Floor

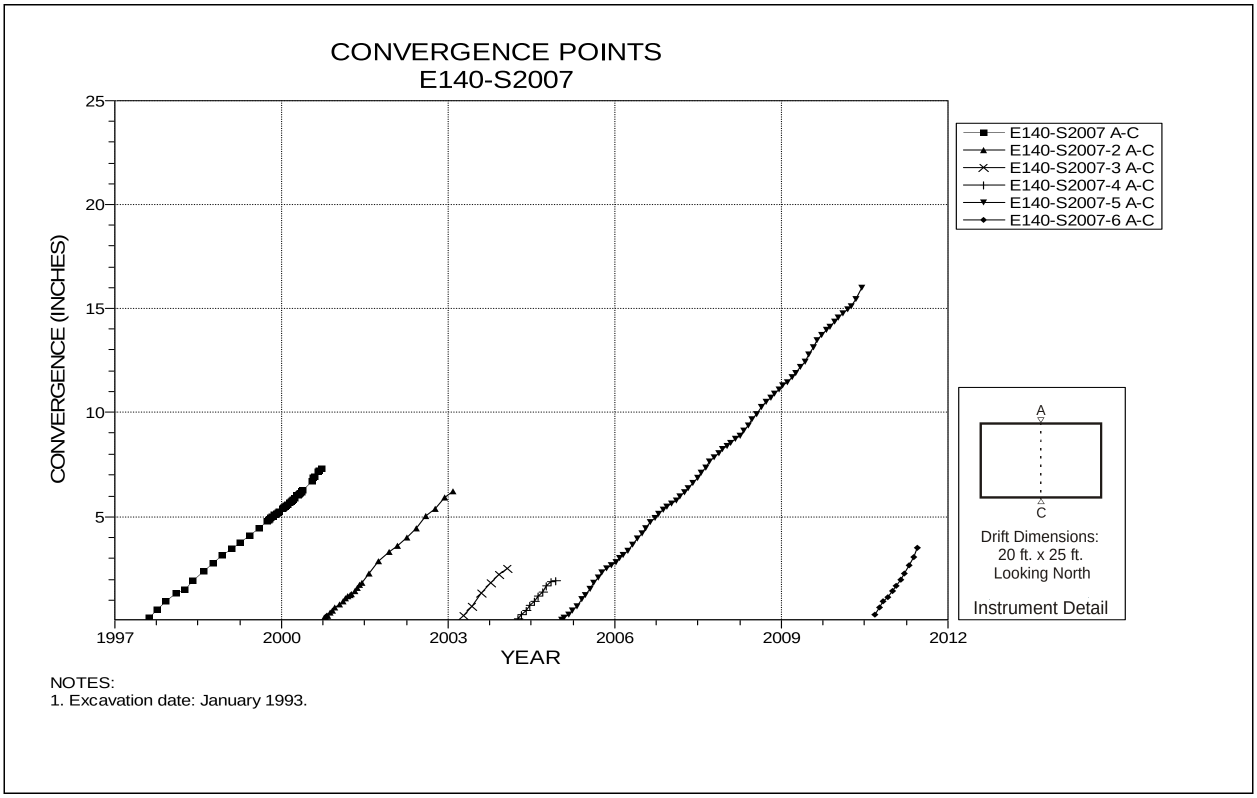


Figure 4-103 Convergence Point Array
E140 S2007 – Roof to Floor

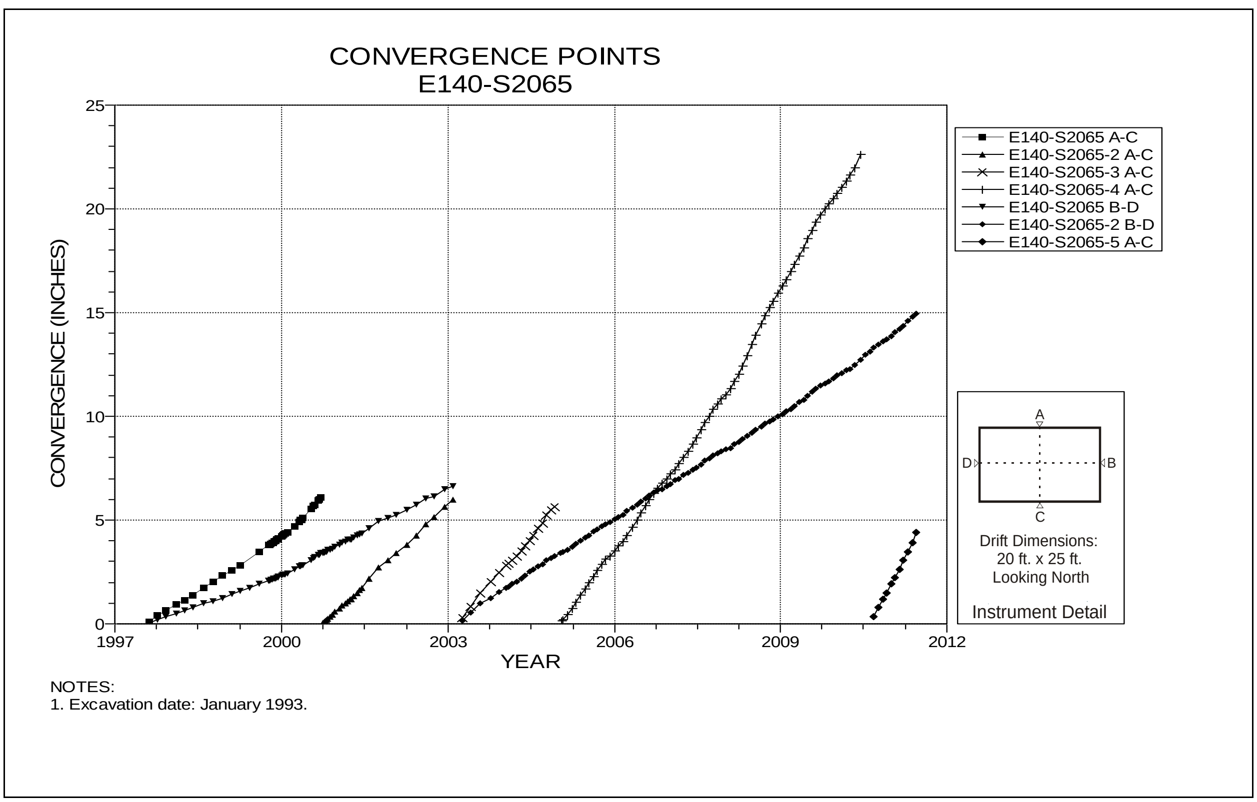


Figure 4-104 Convergence Point Array
E140 S2065 – All Chords

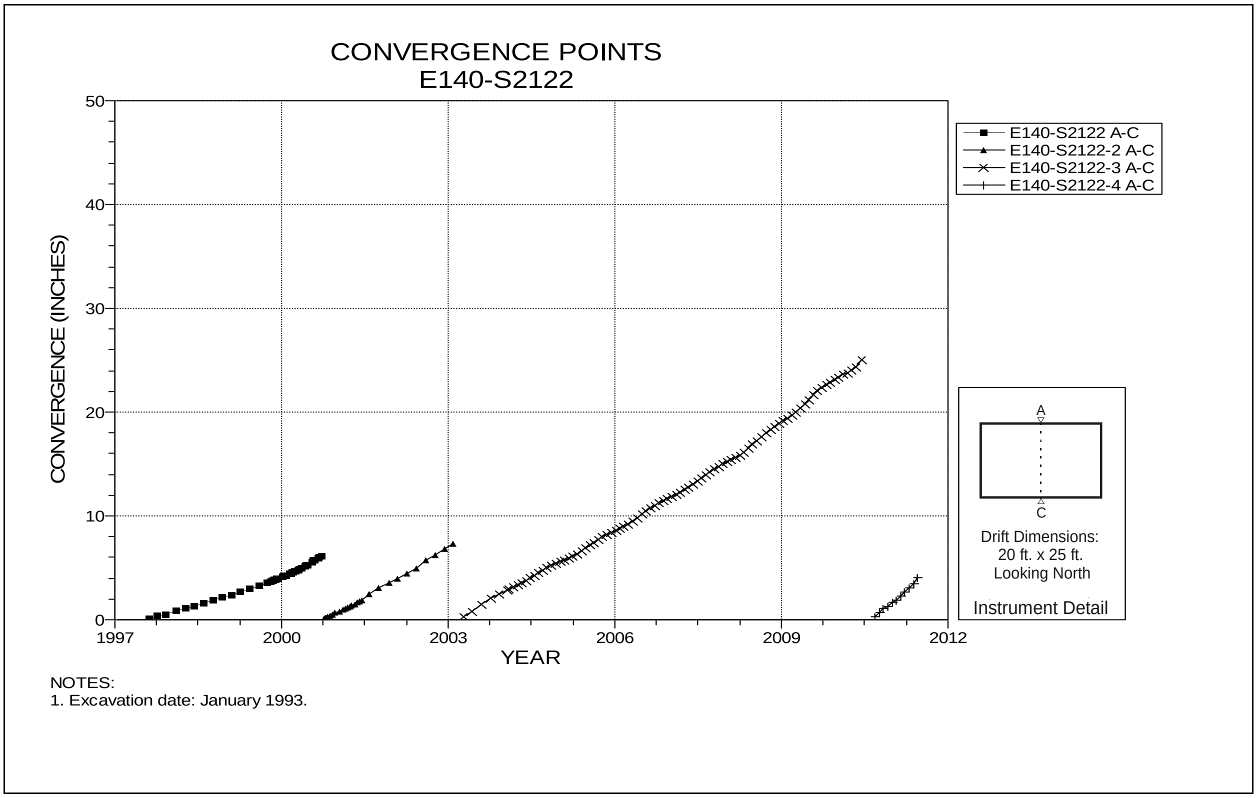


Figure 4-105 Convergence Point Array
E140 S2122 – Roof to Floor

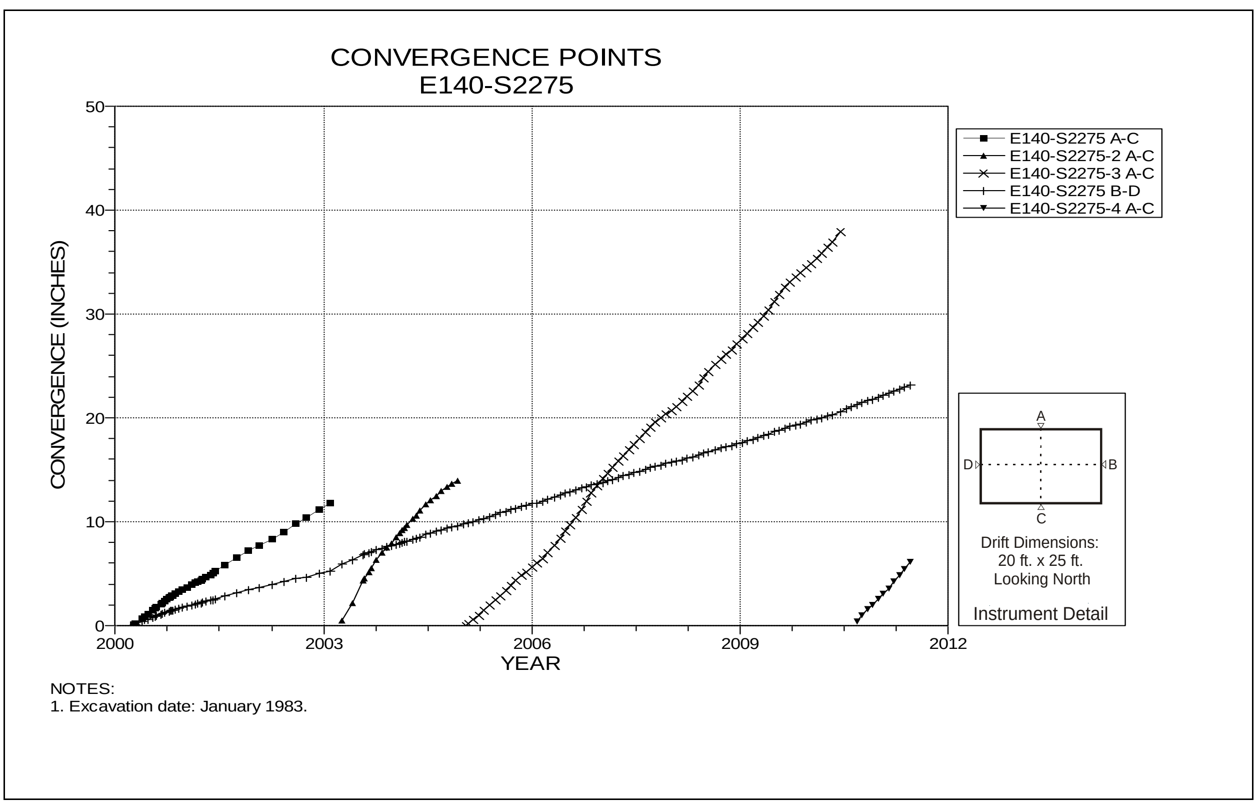


Figure 4-106 Convergence Point Array
E140 S2275 – All Chords

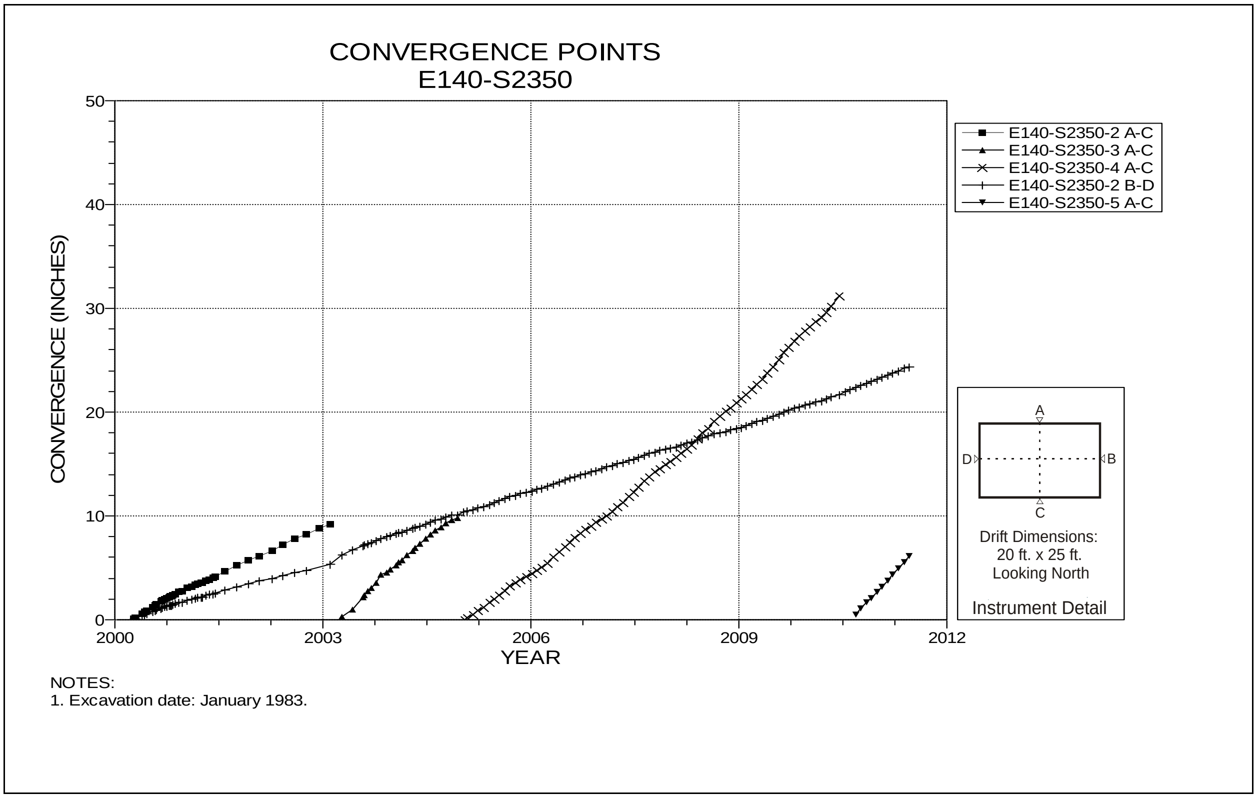


Figure 4-107 Convergence Point Array
E140 S2350 – All Chords

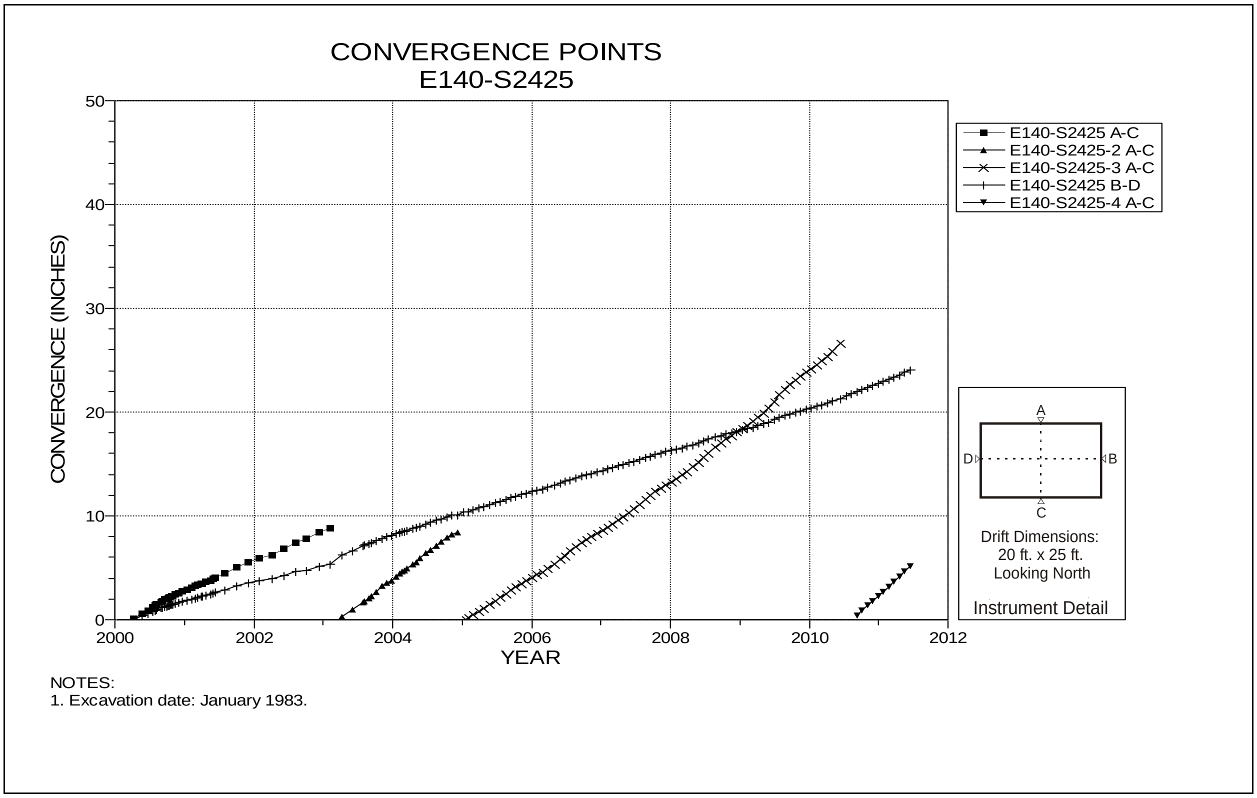


Figure 4-108 Convergence Point Array
E140 S2425 – All Chords

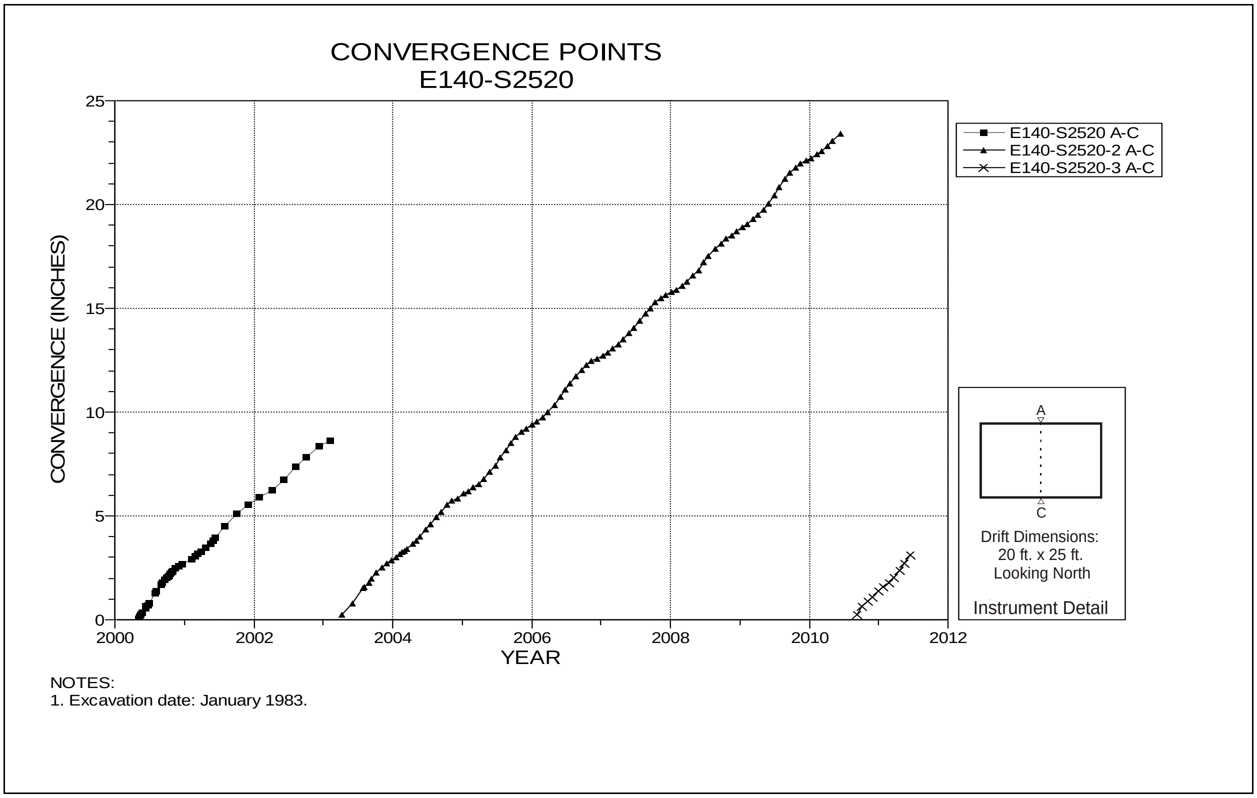


Figure 4-109 Convergence Point Array
E140 S2520 – Roof to Floor

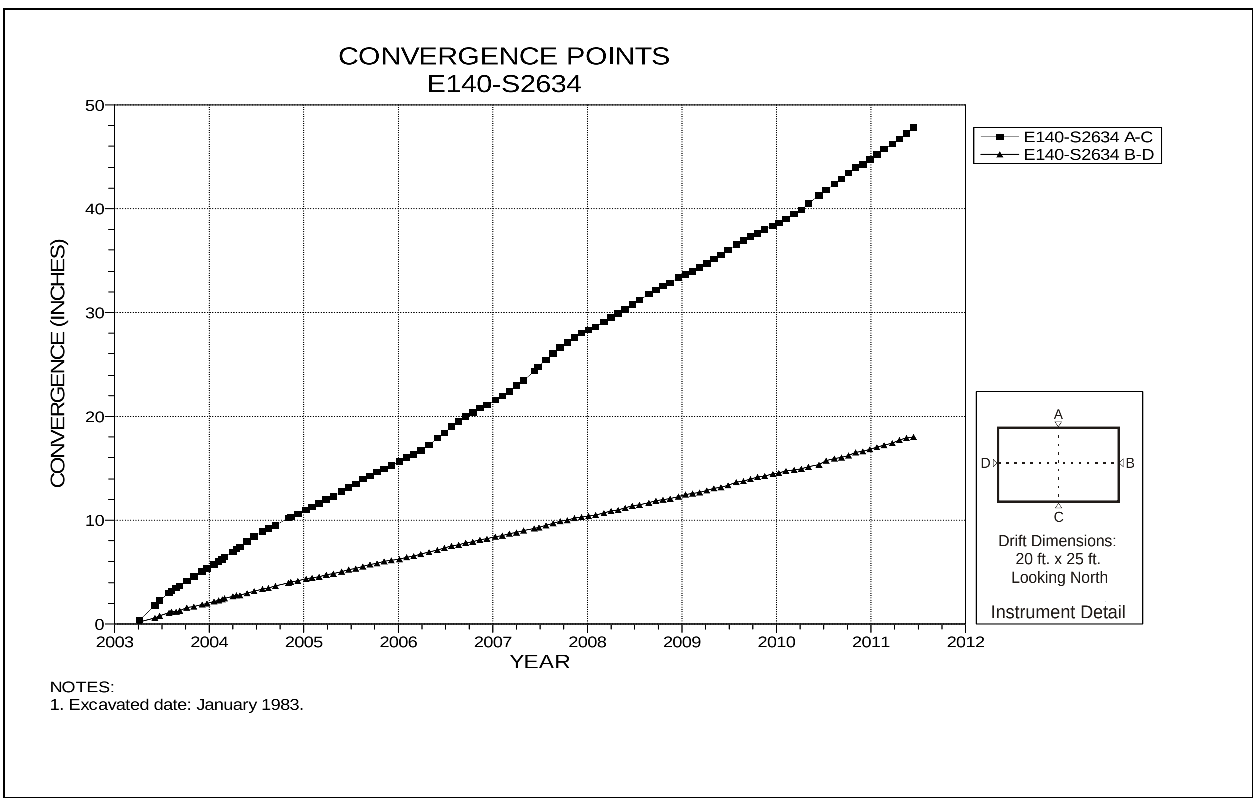


Figure 4-110 Convergence Point Array
E140 S2634 – All Chords

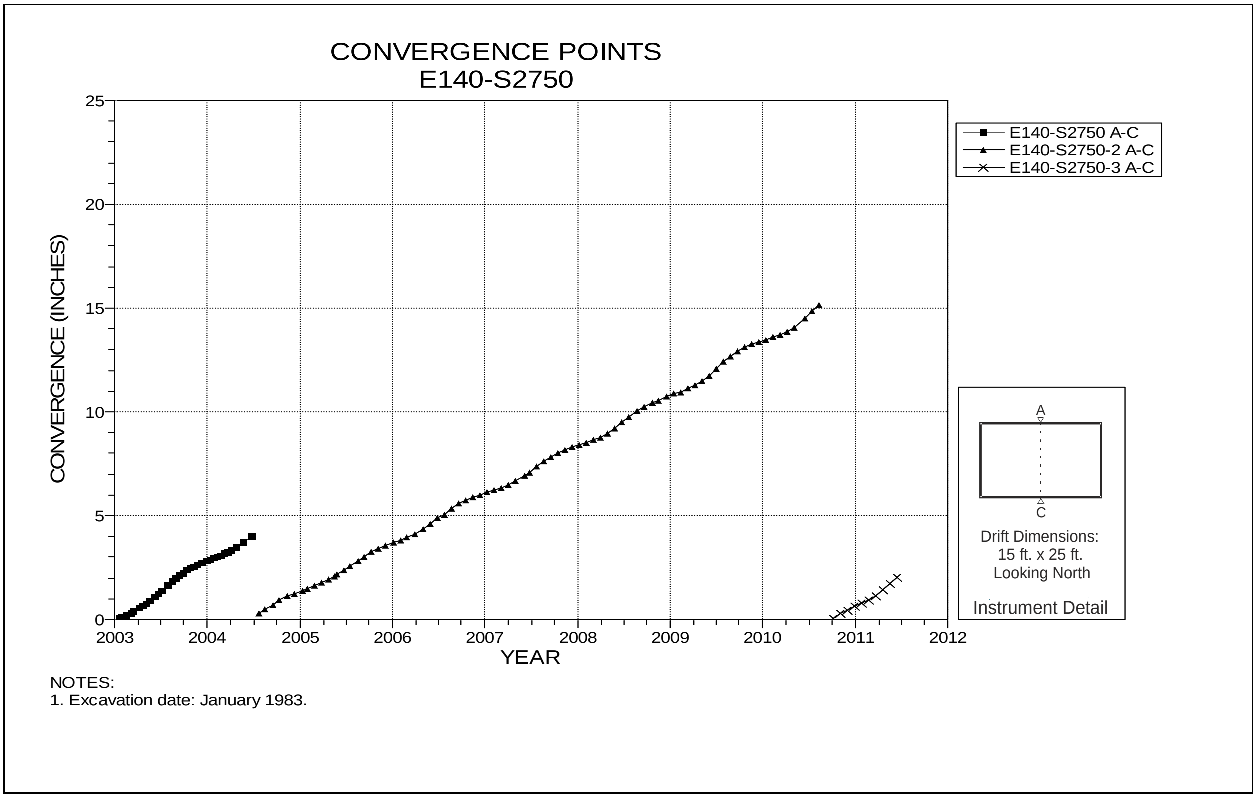


Figure 4-111 Convergence Point Array
E140 S2750 – Roof to Floor

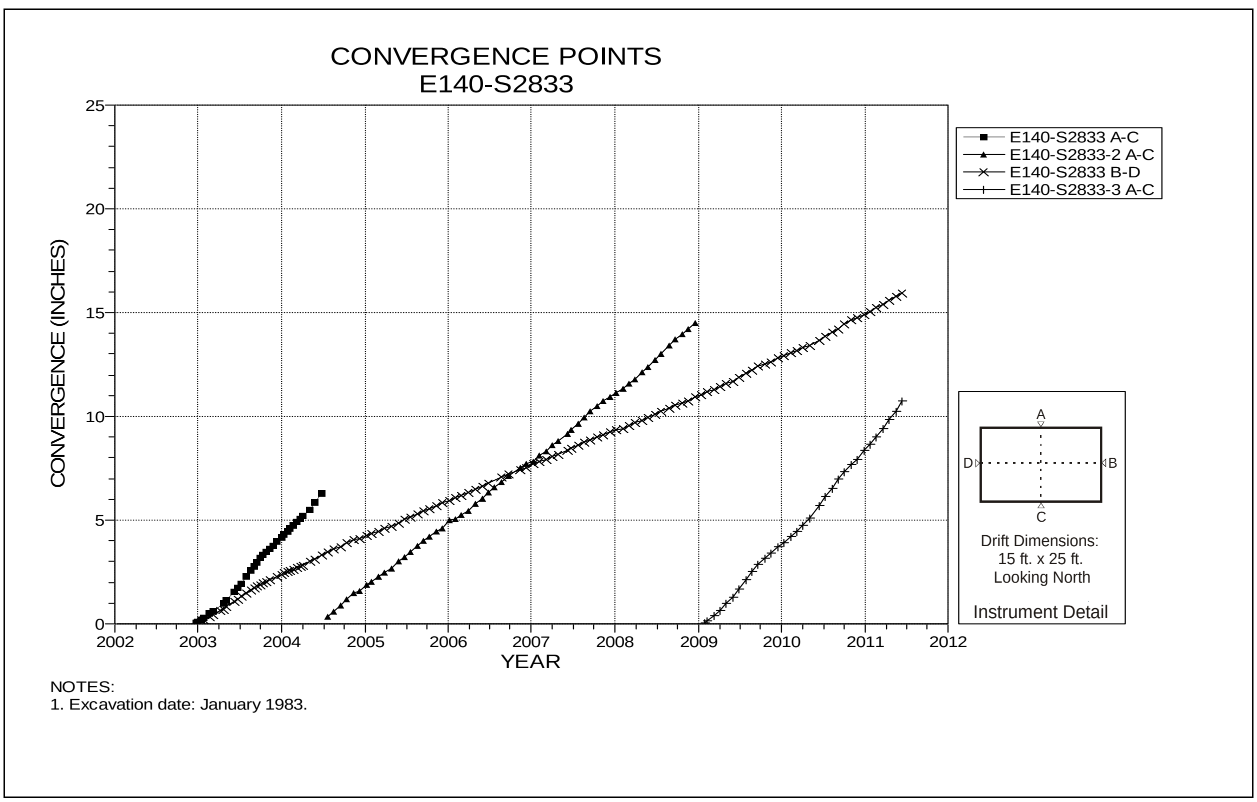


Figure 4-112 Convergence Point Array
E140 S2833 – All Chords

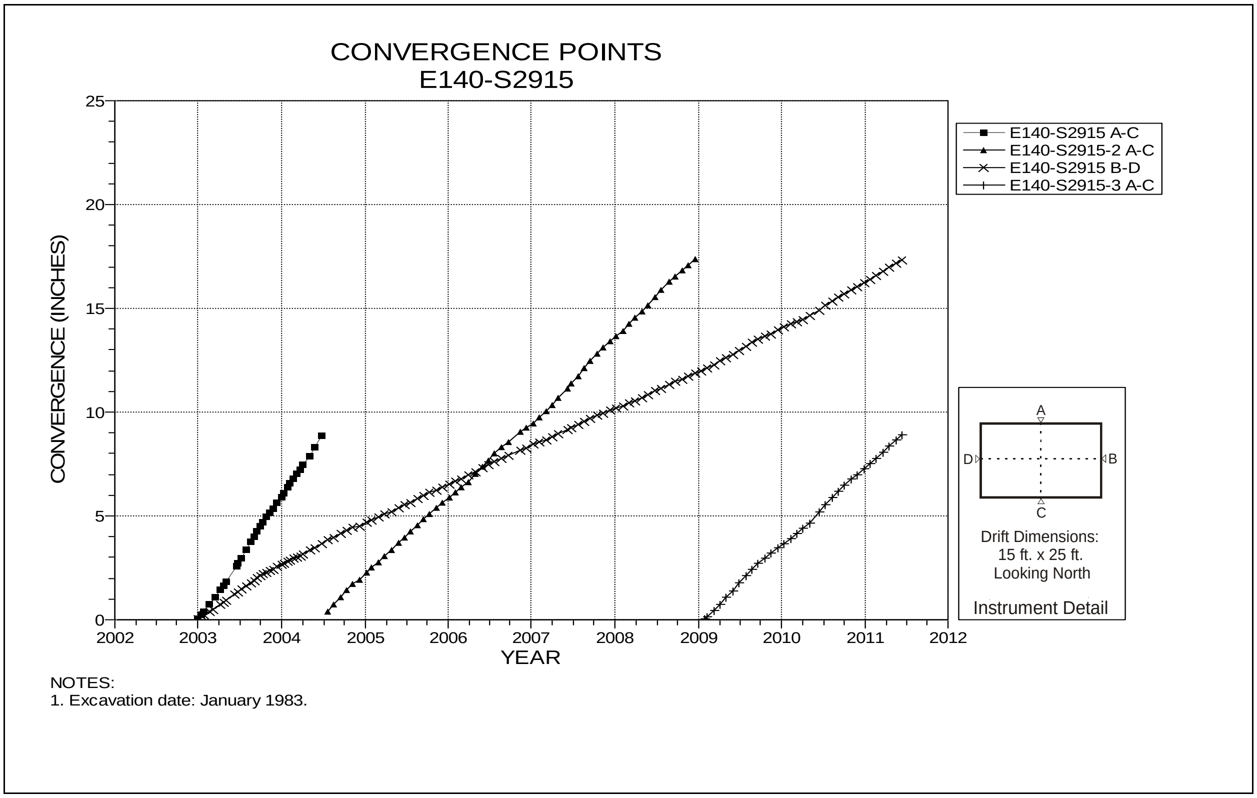


Figure 4-113 Convergence Point Array
E140 S2915 – All Chords

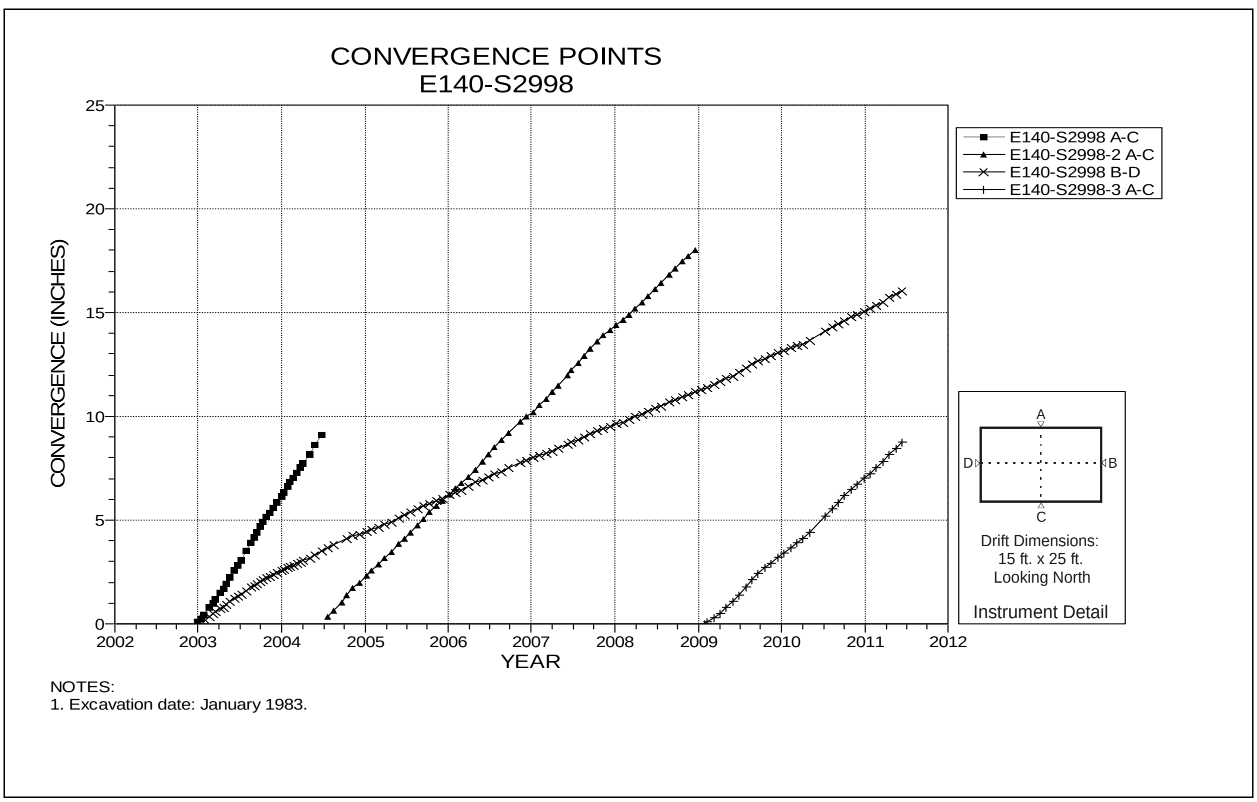


Figure 4-114 Convergence Point Array
E140 S2998 – All Chords

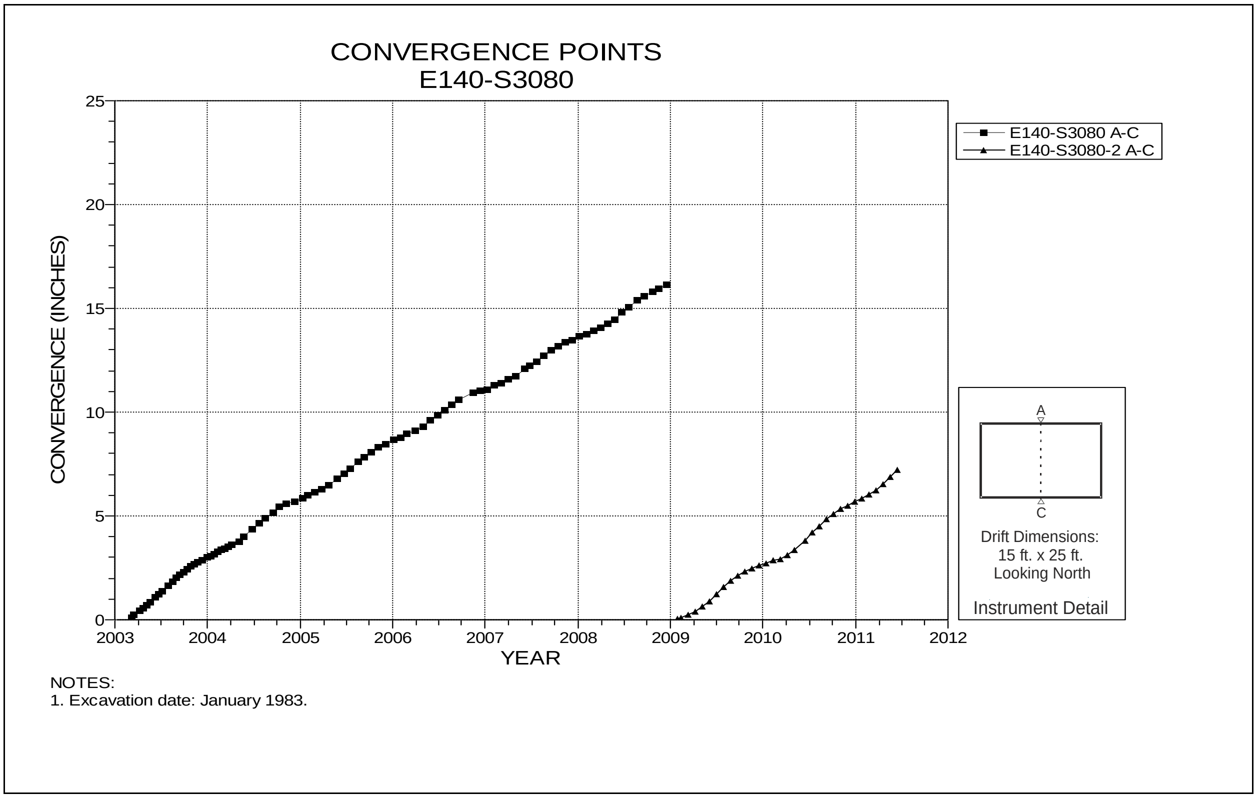


Figure 4-115 Convergence Point Array
E140 S3080 – Roof to Floor

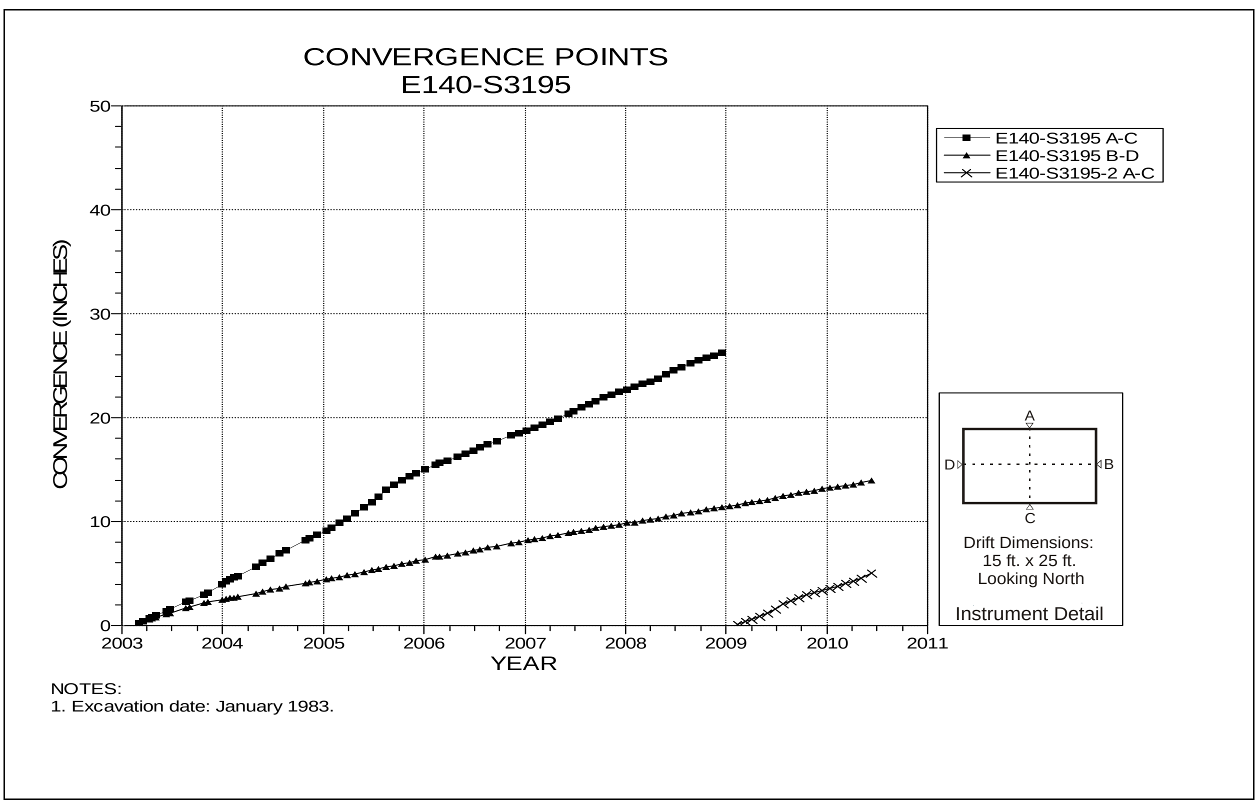


Figure 4-116 Convergence Point Array
E140 S3195 – All Chords

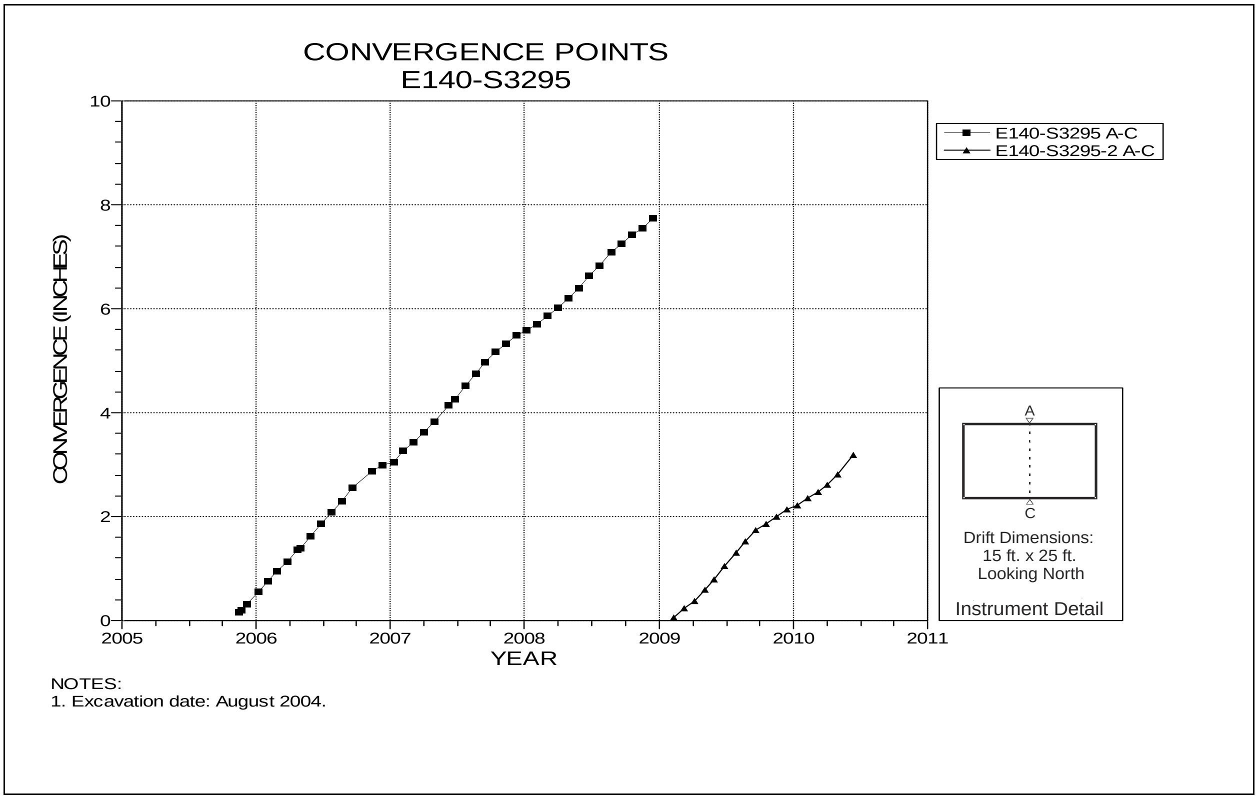


Figure 4-117 Convergence Point Array
E140 S3295 – Roof to Floor

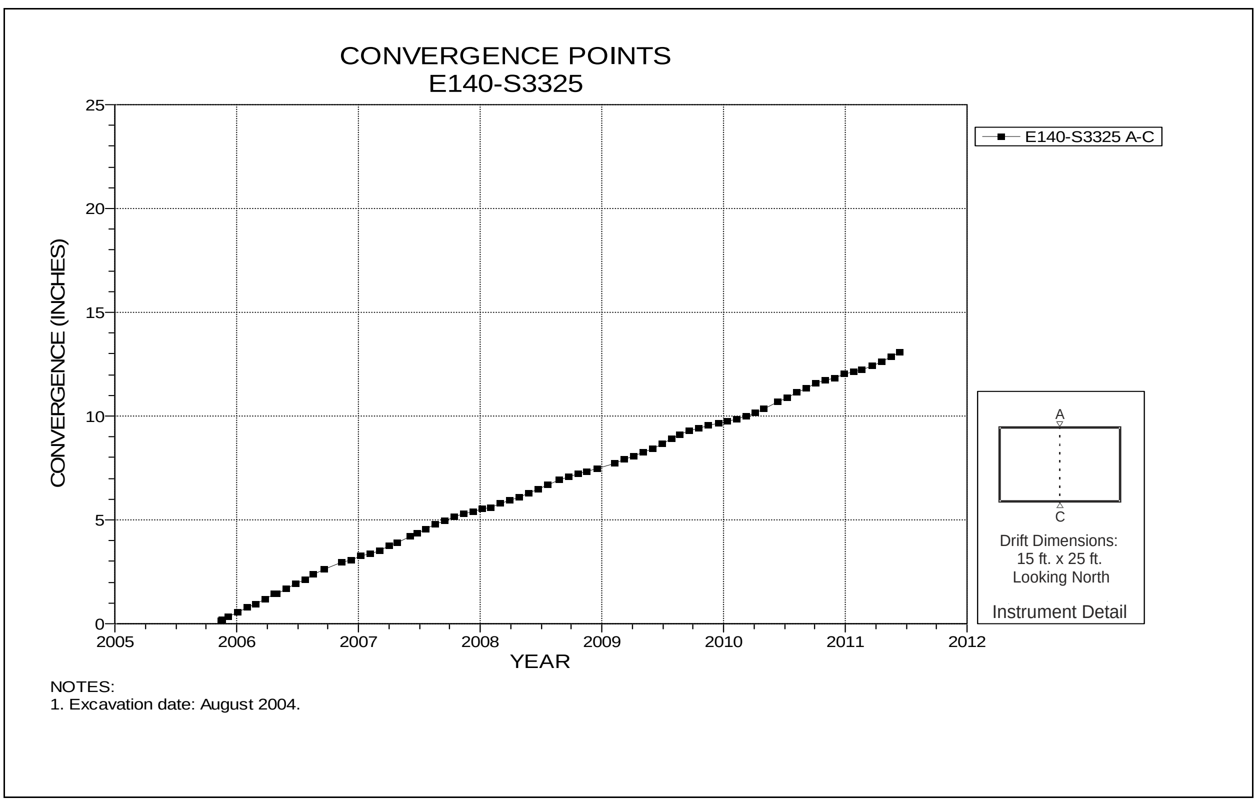


Figure 4-118 Convergence Point Array
E140 S3325 – Roof to Floor

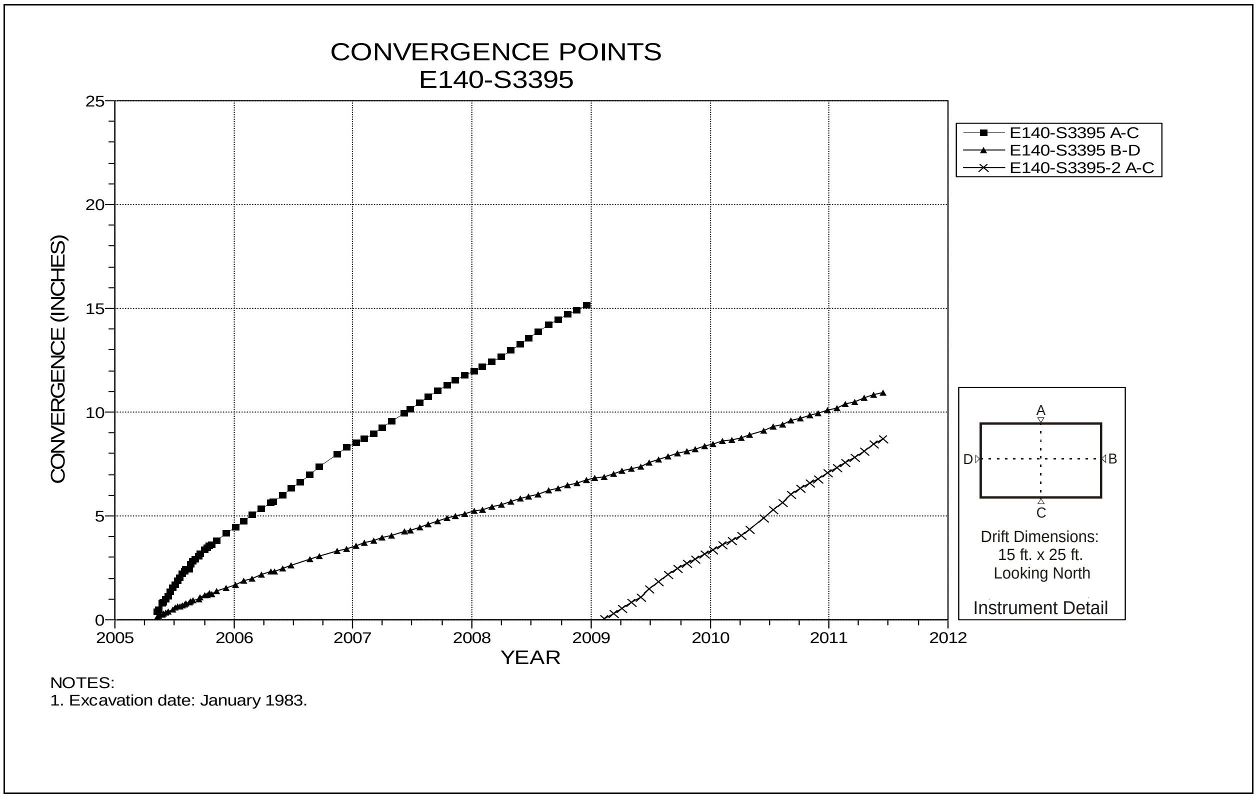


Figure 4-119 Convergence Point Array
E140 S3395 – All Chords

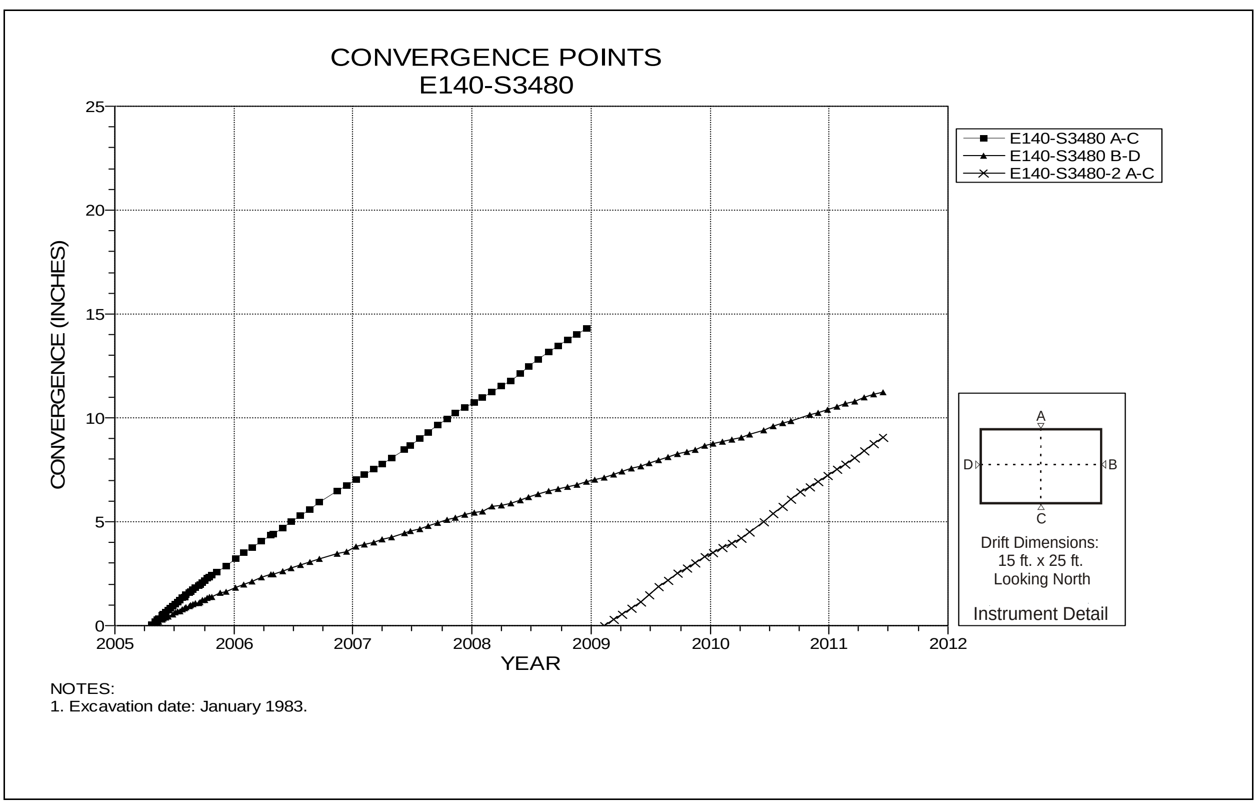


Figure 4-120 Convergence Point Array
E140 S3480 – All Chords

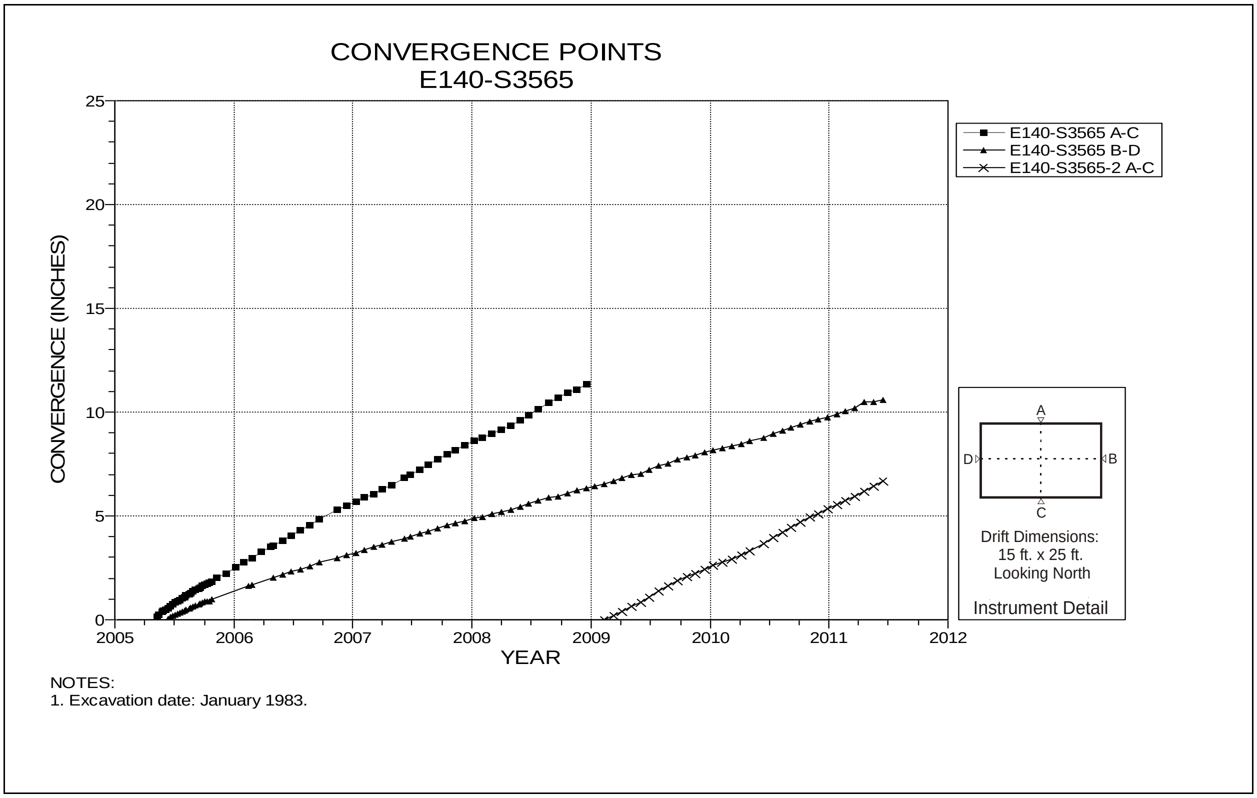


Figure 4-121 Convergence Point Array
E140 S3565 – All Chords

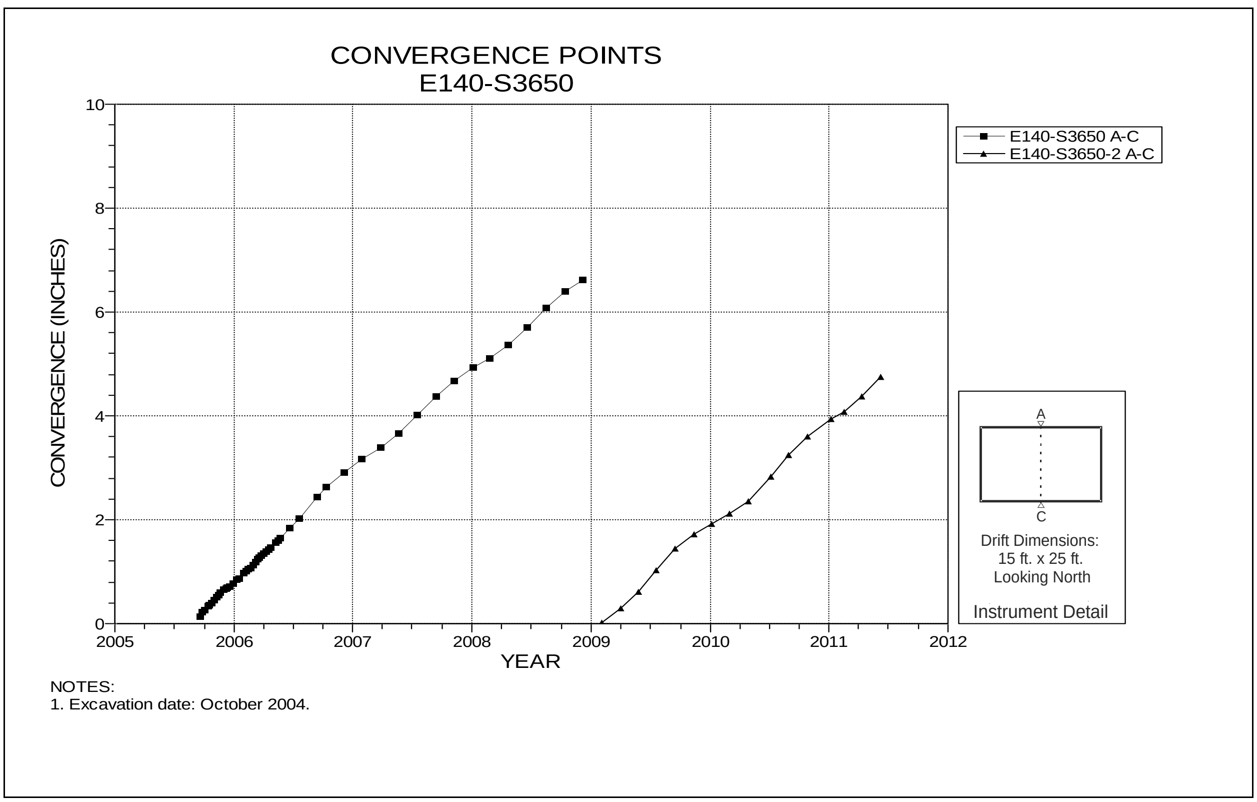


Figure 4-122 Convergence Point Array
E140 S3650– Roof to Floor

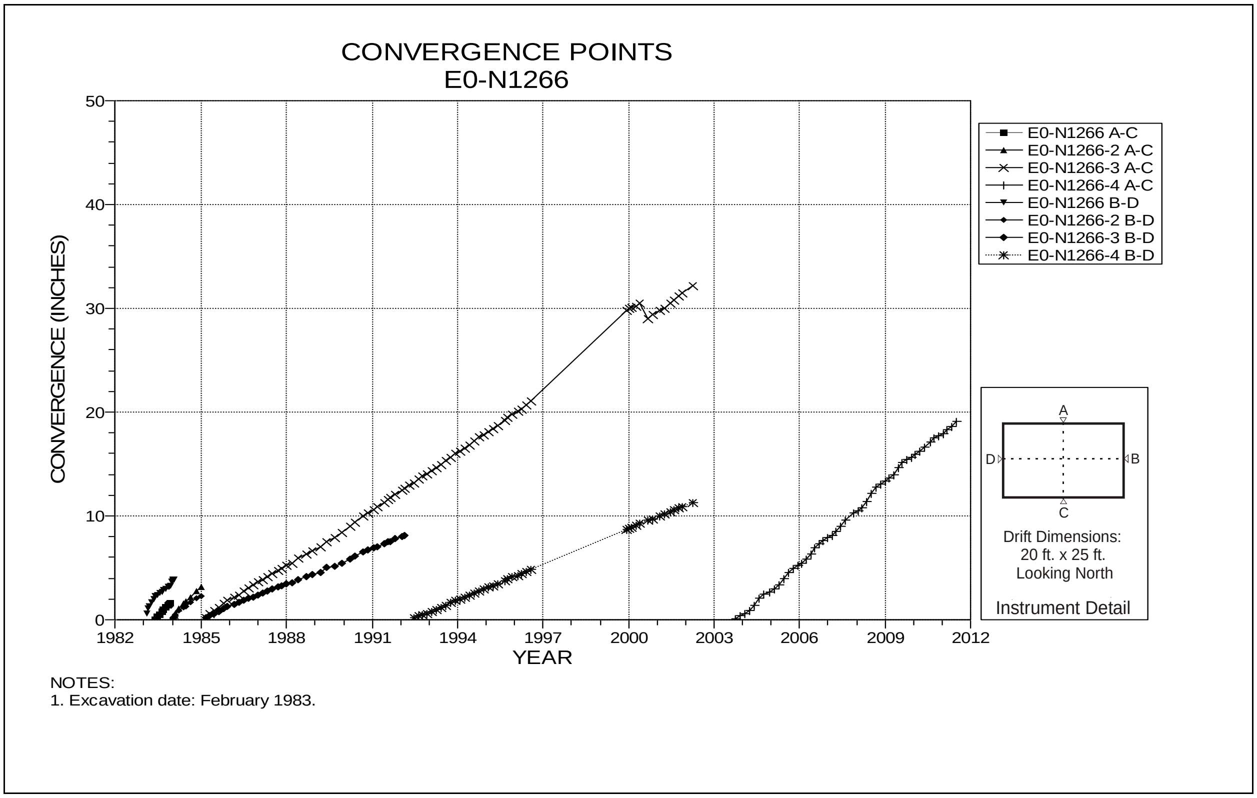


Figure 4-123 Convergence Point Array
E0 N1266 – All Chords

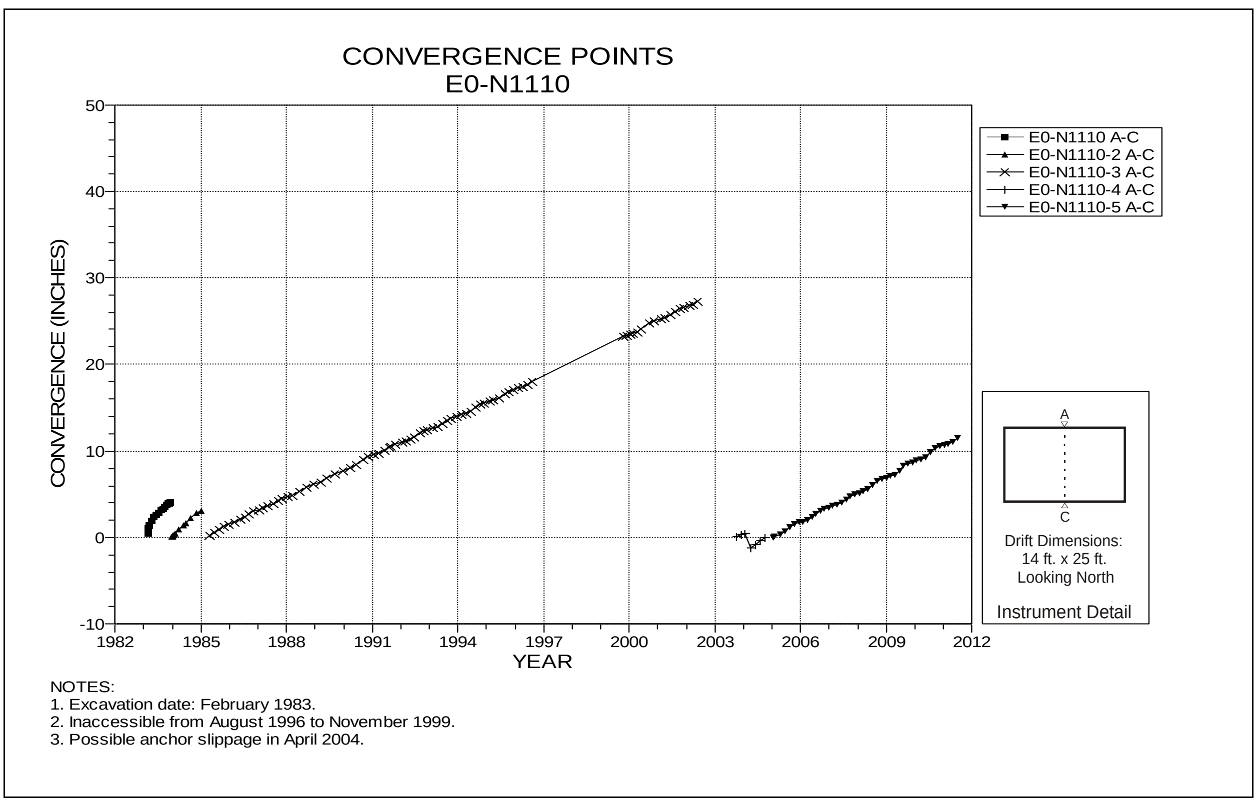


Figure 4-124 Convergence Point Array
E0 N1100 – Roof to Floor

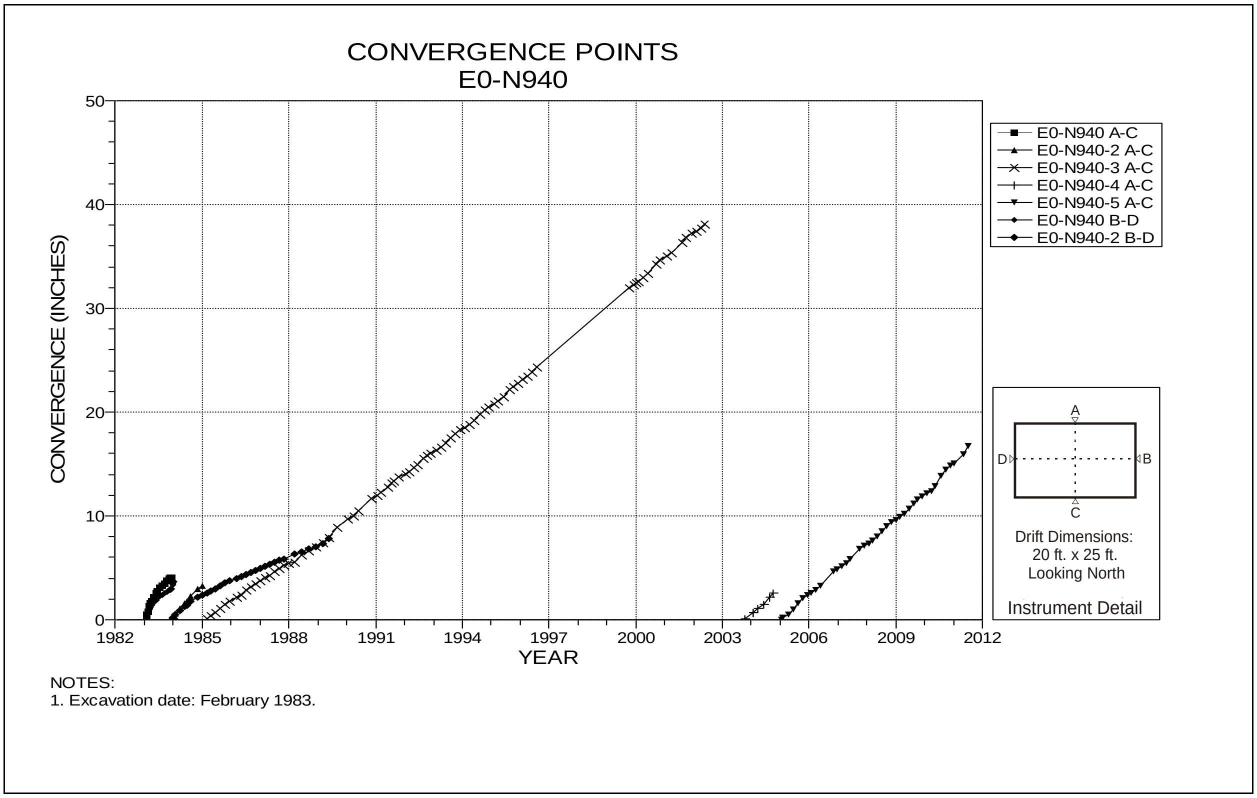


Figure 4-125 Convergence Point Array
E0 N940 – All Chords

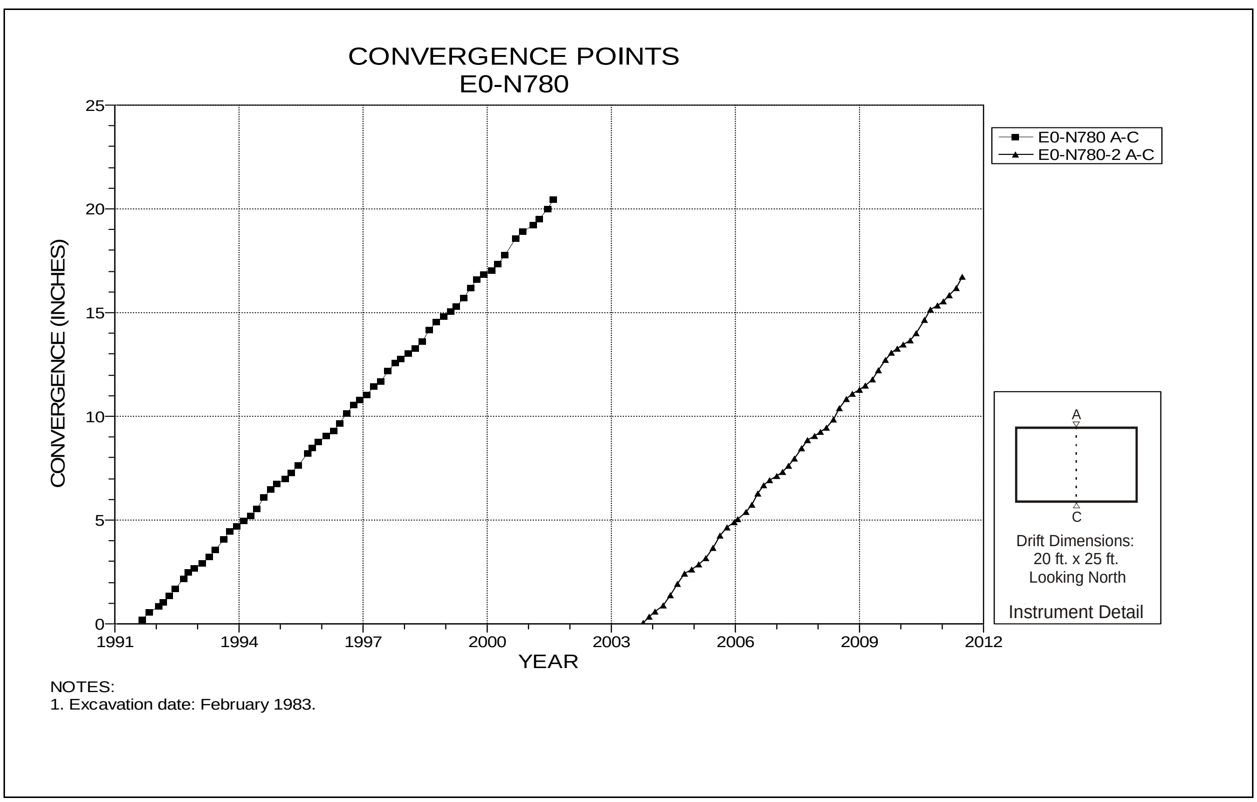


Figure 4-126 Convergence Point Array
E0 N780 – Roof to Floor

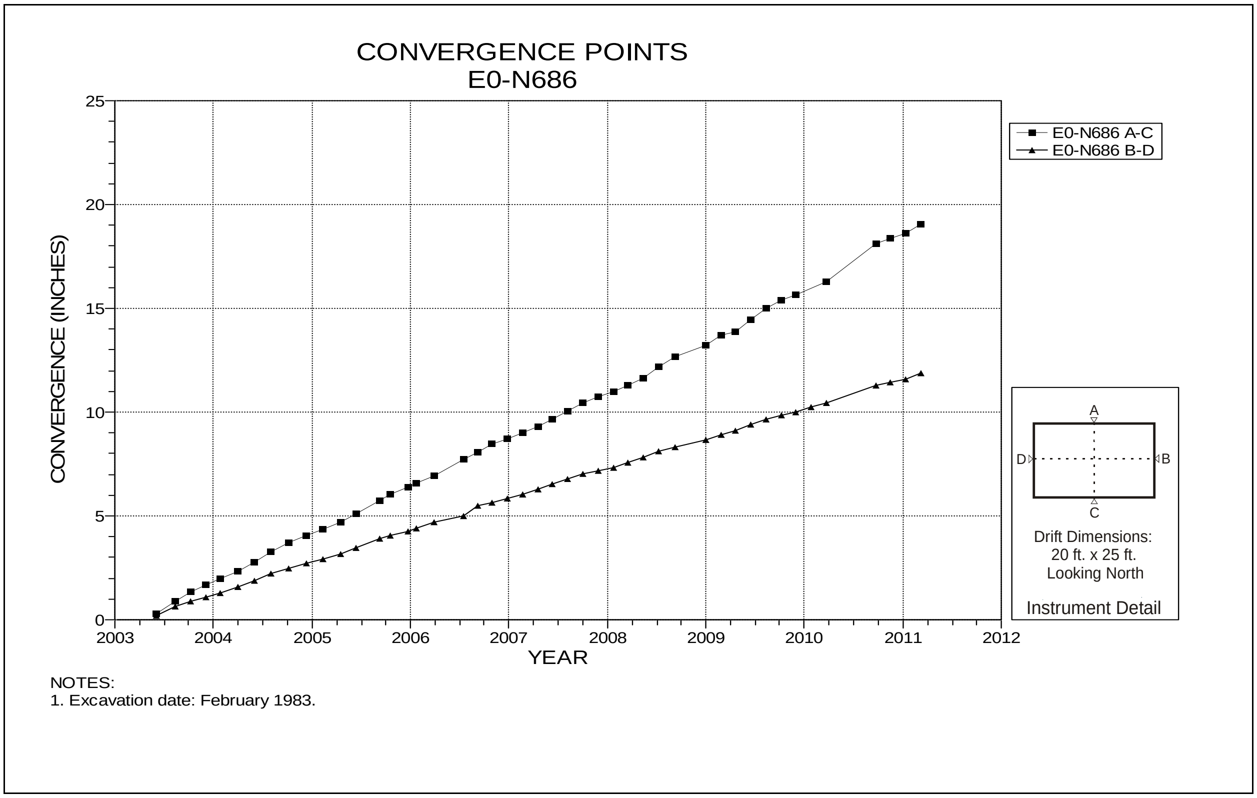


Figure 4-127 Convergence Point Array
E0 N686 – All Chords

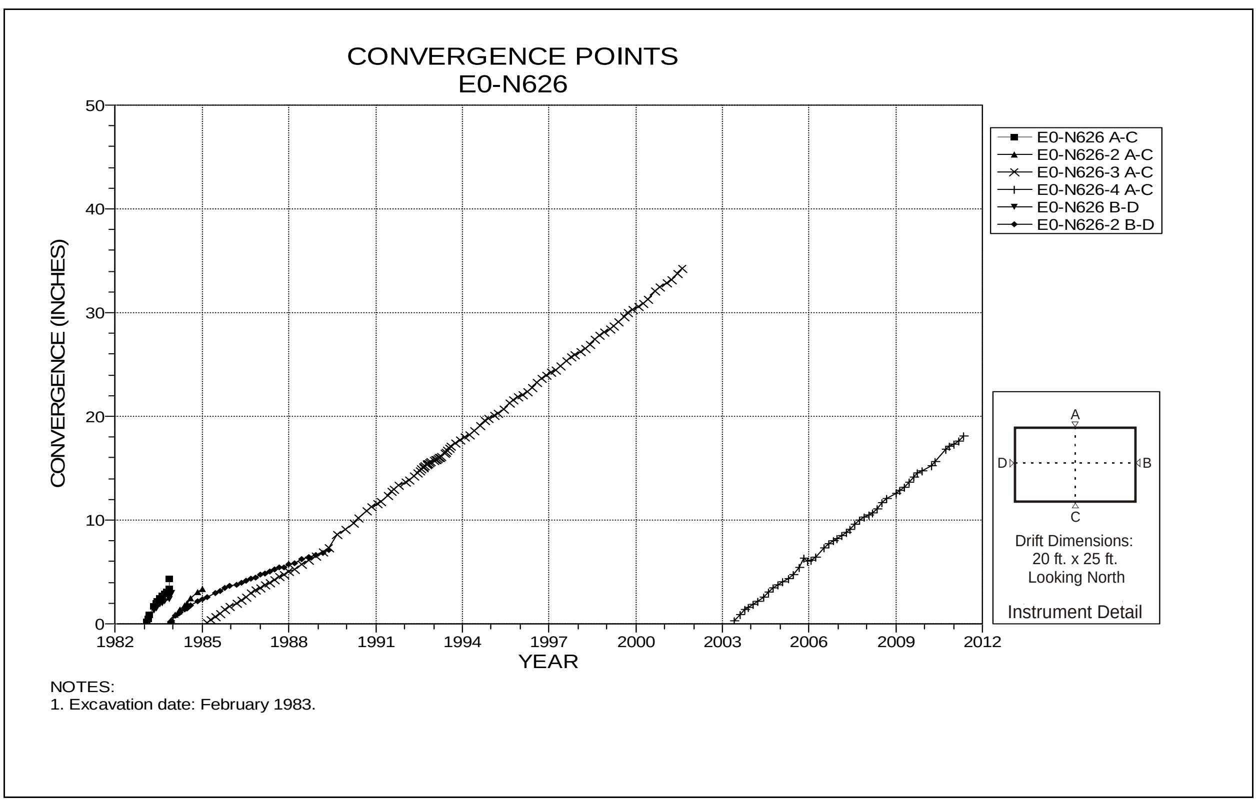


Figure 4-128 Convergence Point Array
E0 N626 – All Chords

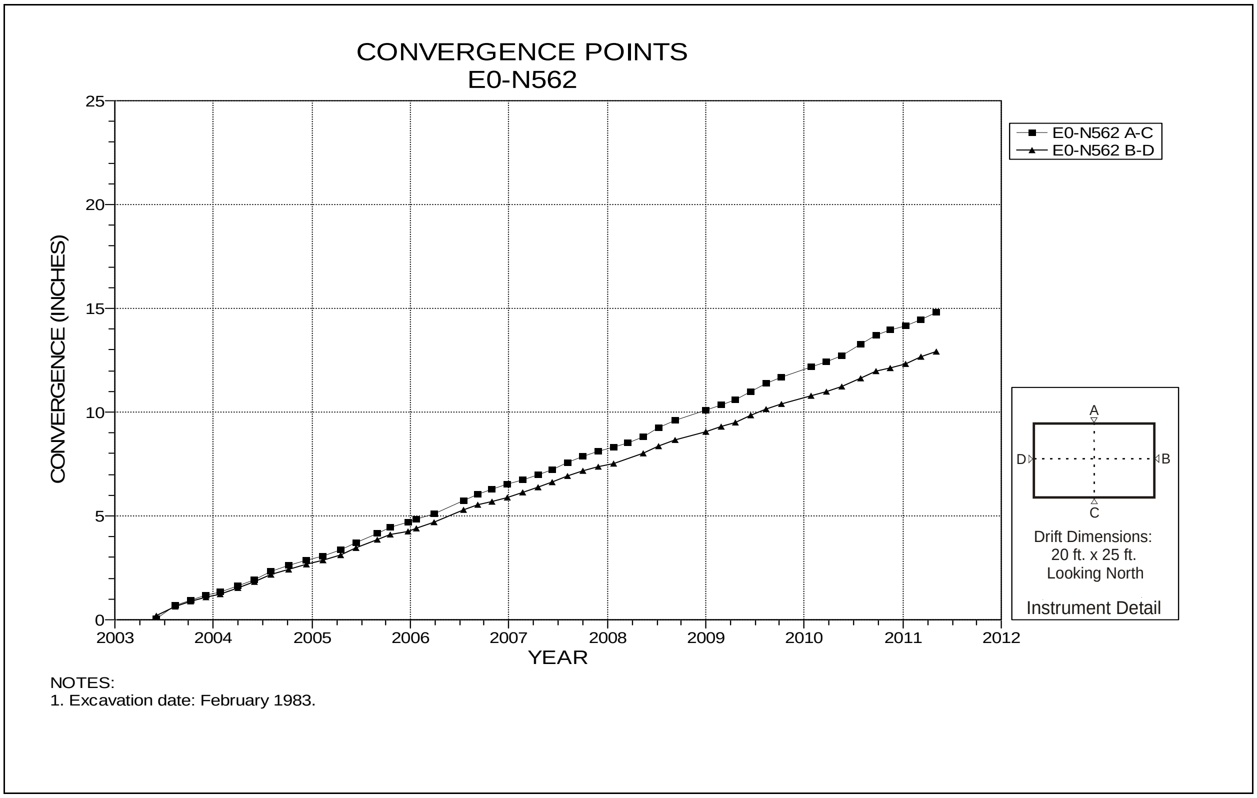


Figure 4-129 Convergence Point Array
E0 N562 – All Chords

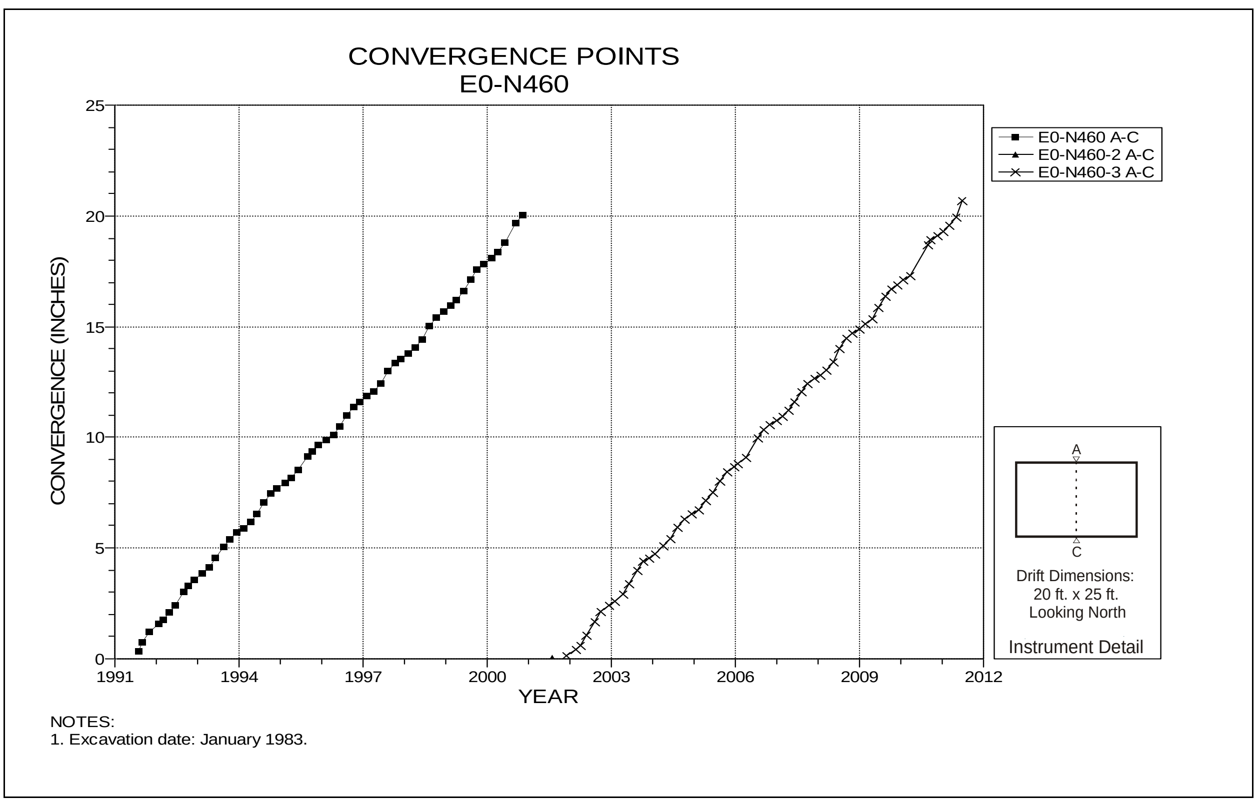


Figure 4-130 Convergence Point Array
E0 N460 – Roof to Floor

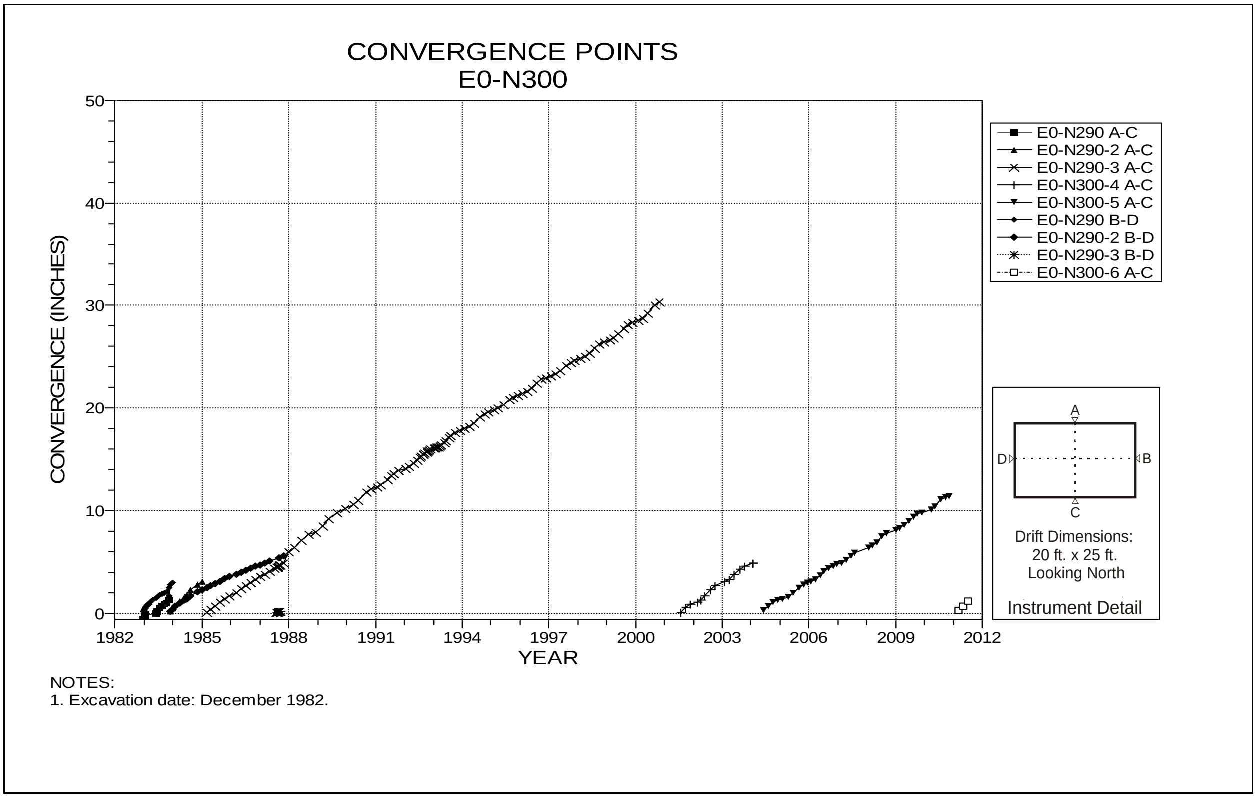


Figure 4-131 Convergence Point Array
E0 N300 – All Chords

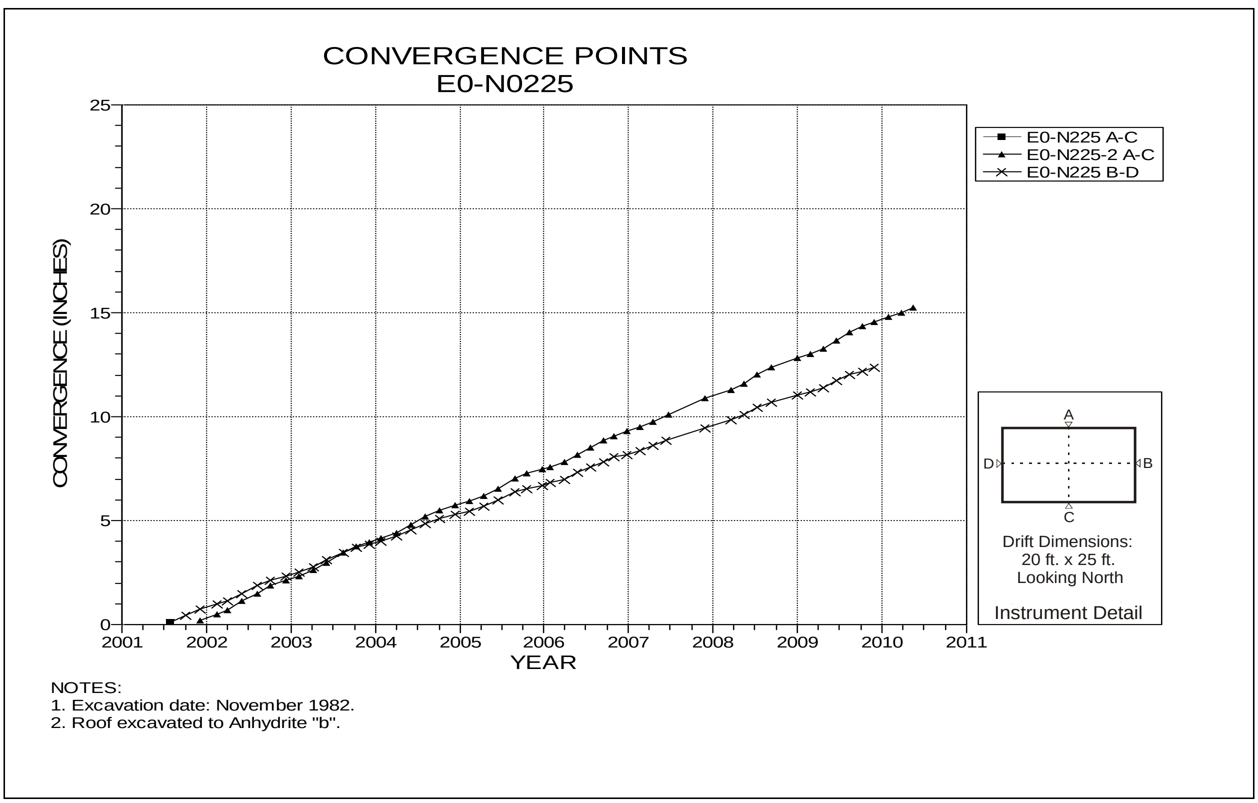


Figure 4-132 Convergence Point Array
E0 N225 – All Chords

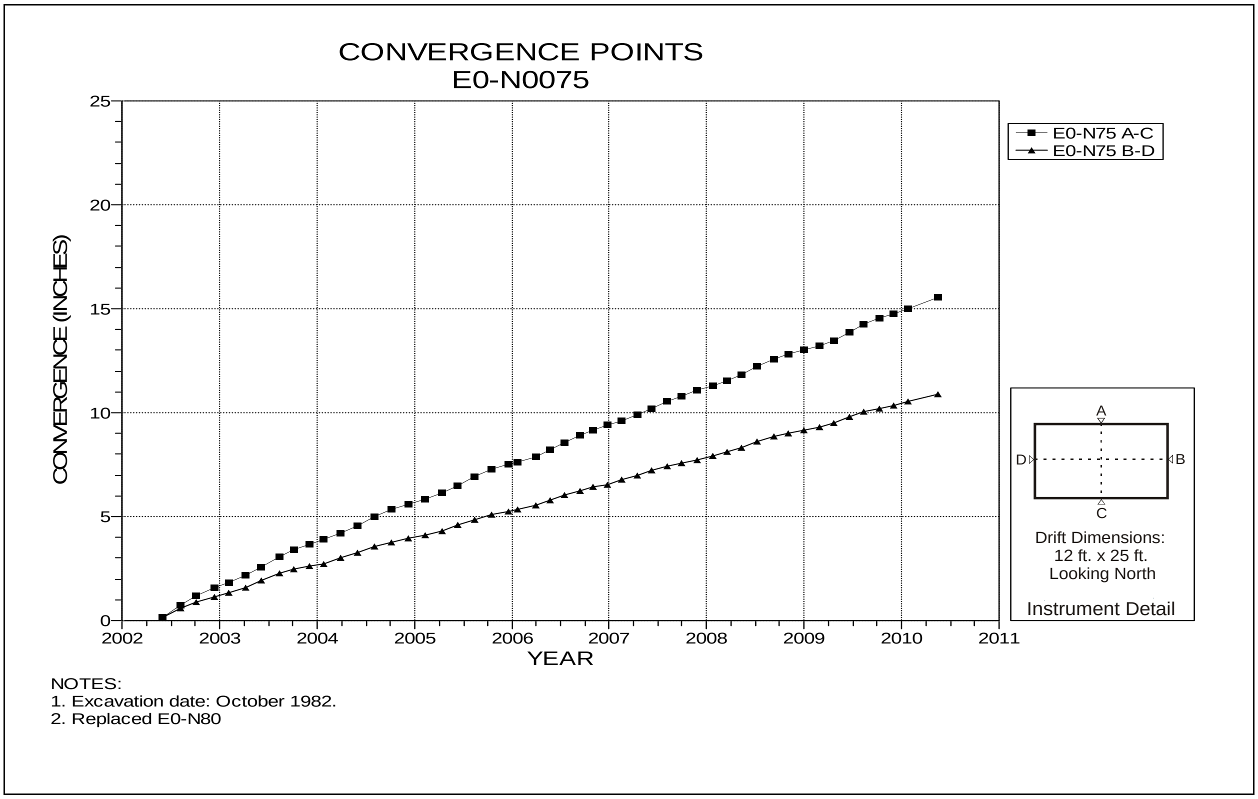


Figure 4-133 Convergence Point Array
E0 N75 – All Chords

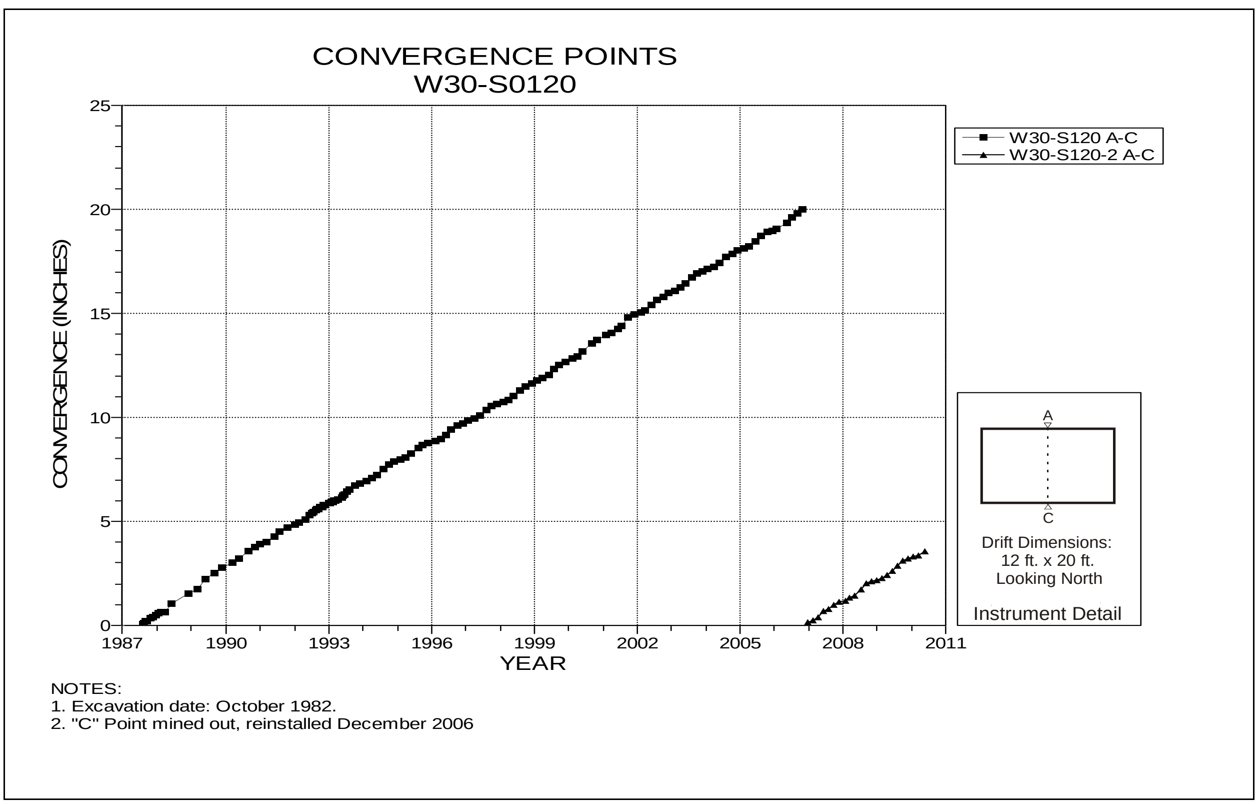


Figure 4-134 Convergence Point Array
W30 S120 – Roof to Floor

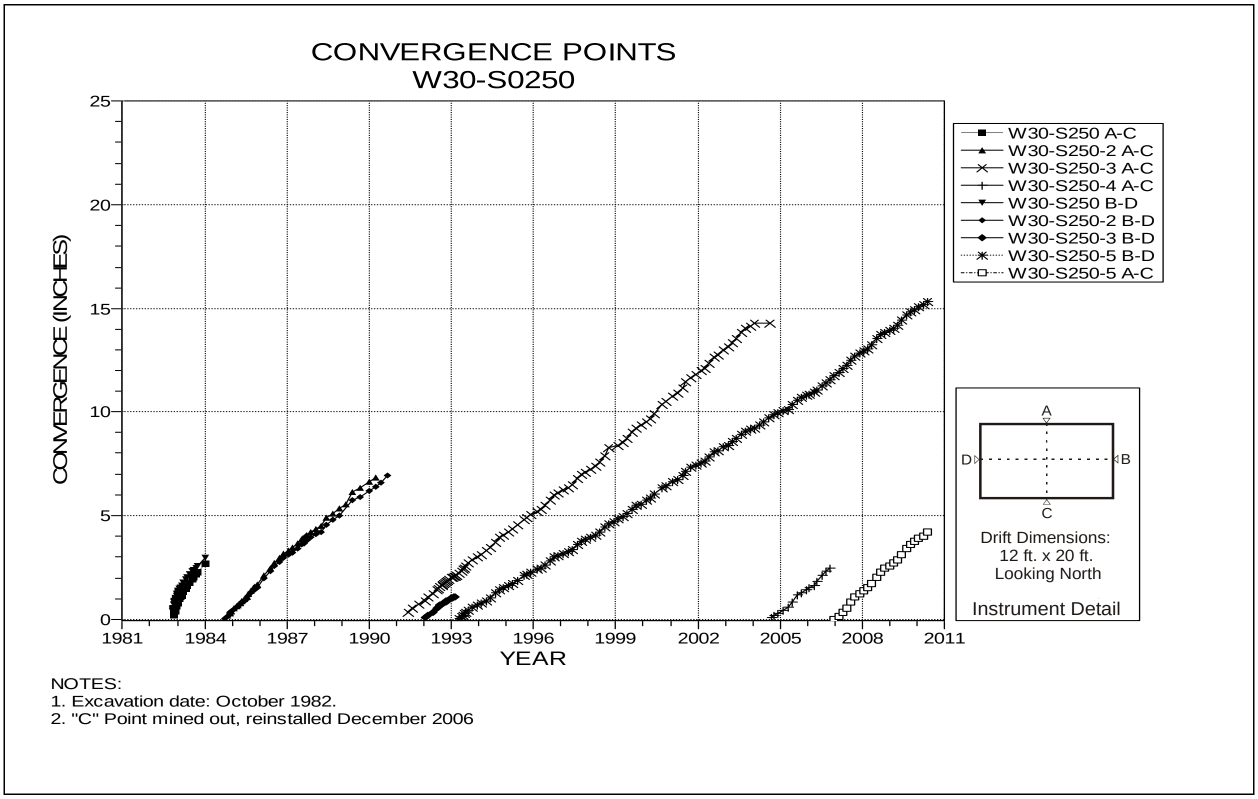


Figure 4-135 Convergence Point Array
W30 S250 – All Chords

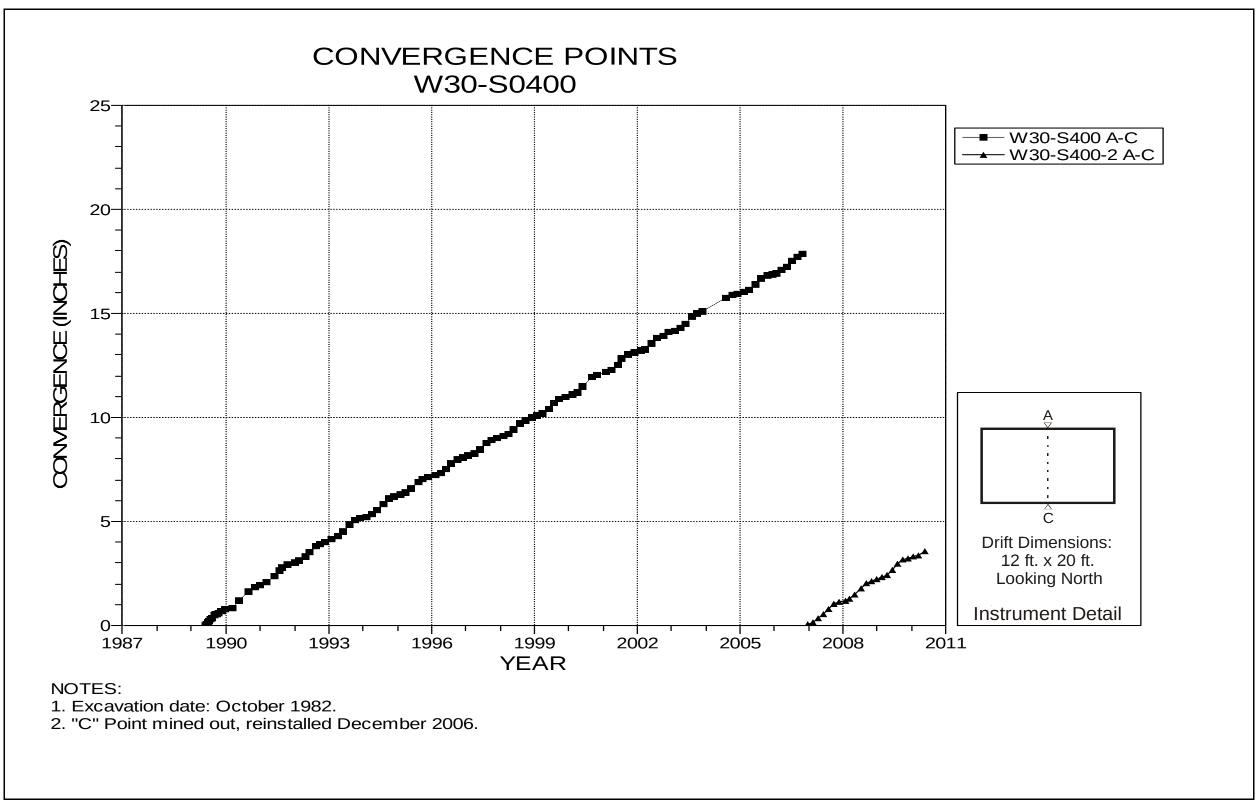


Figure 4-136 Convergence Point Array
W30 S400 – Roof to Floor

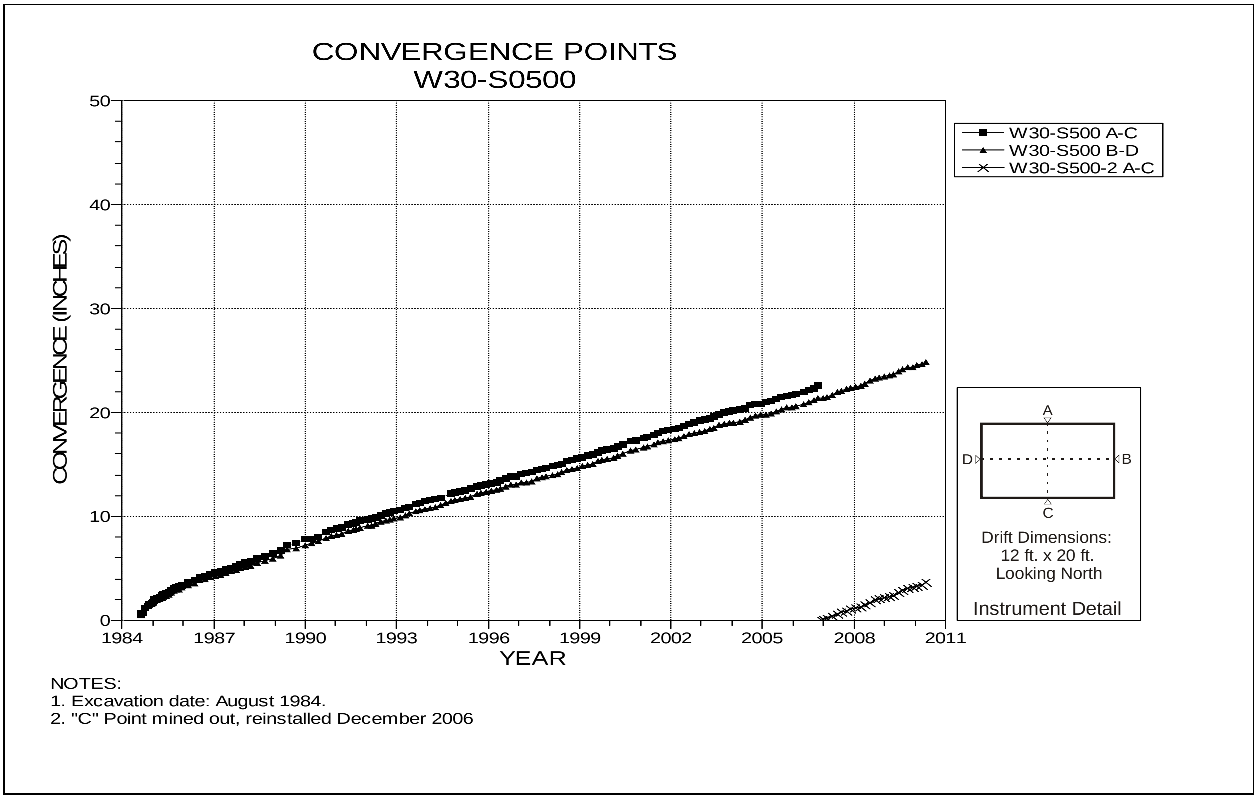


Figure 4-137 Convergence Point Array
W30 S500 – All Chords

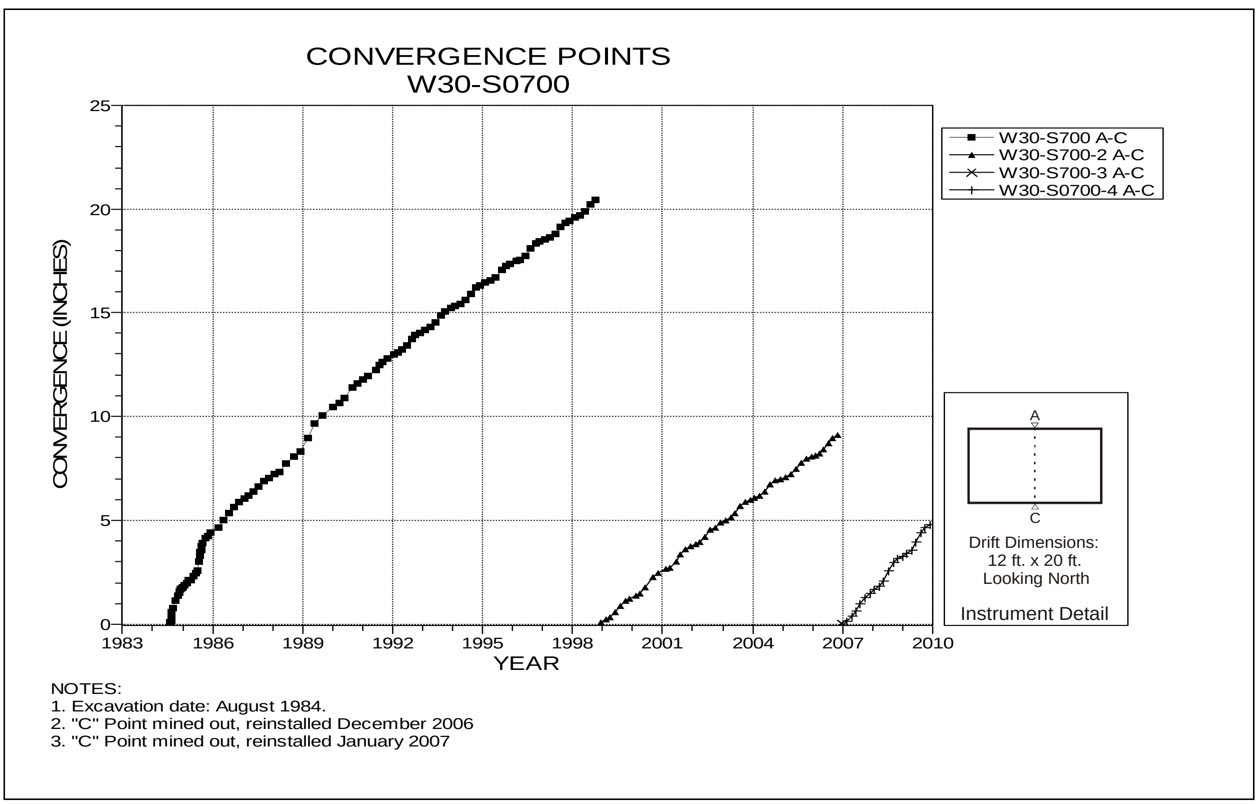


Figure 4-78 Convergence Point Array
W30 S700 – Roof to Floor

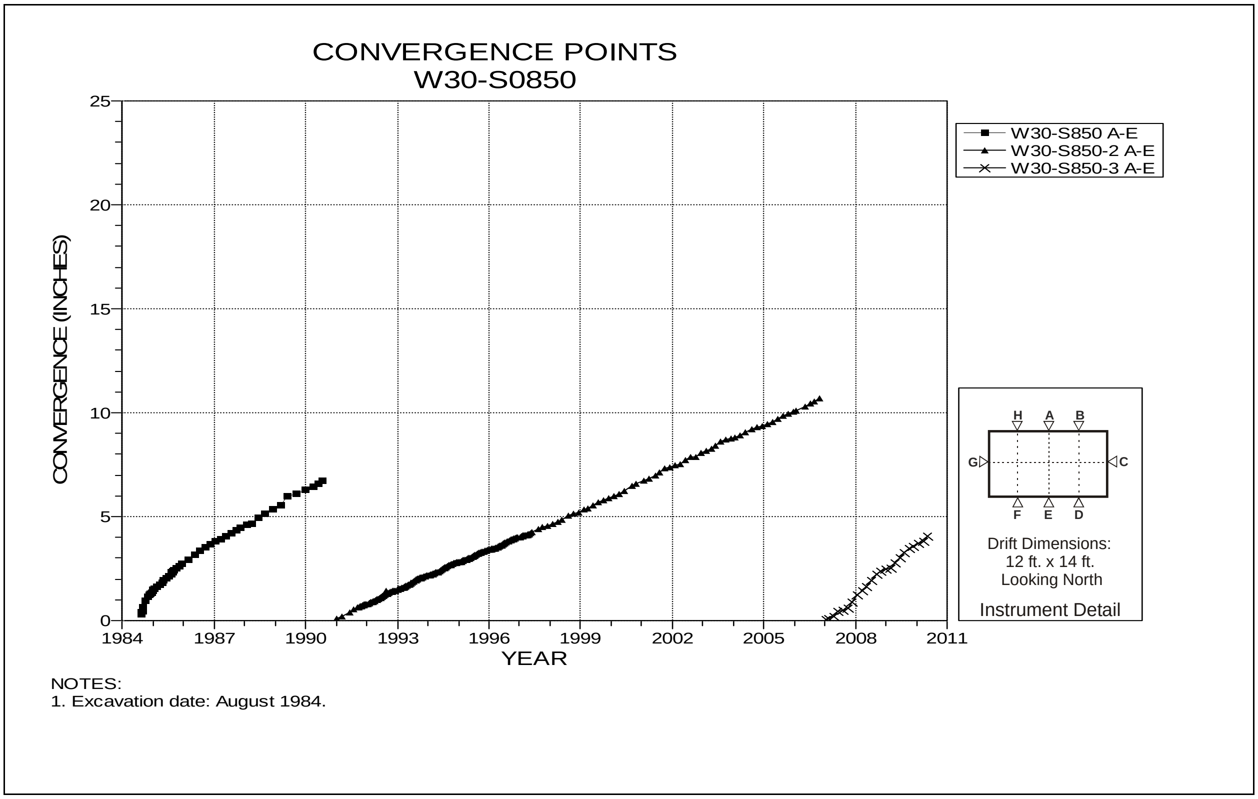


Figure 4-139 Convergence Point Array
W30 S850 – Roof to Floor – Centerline

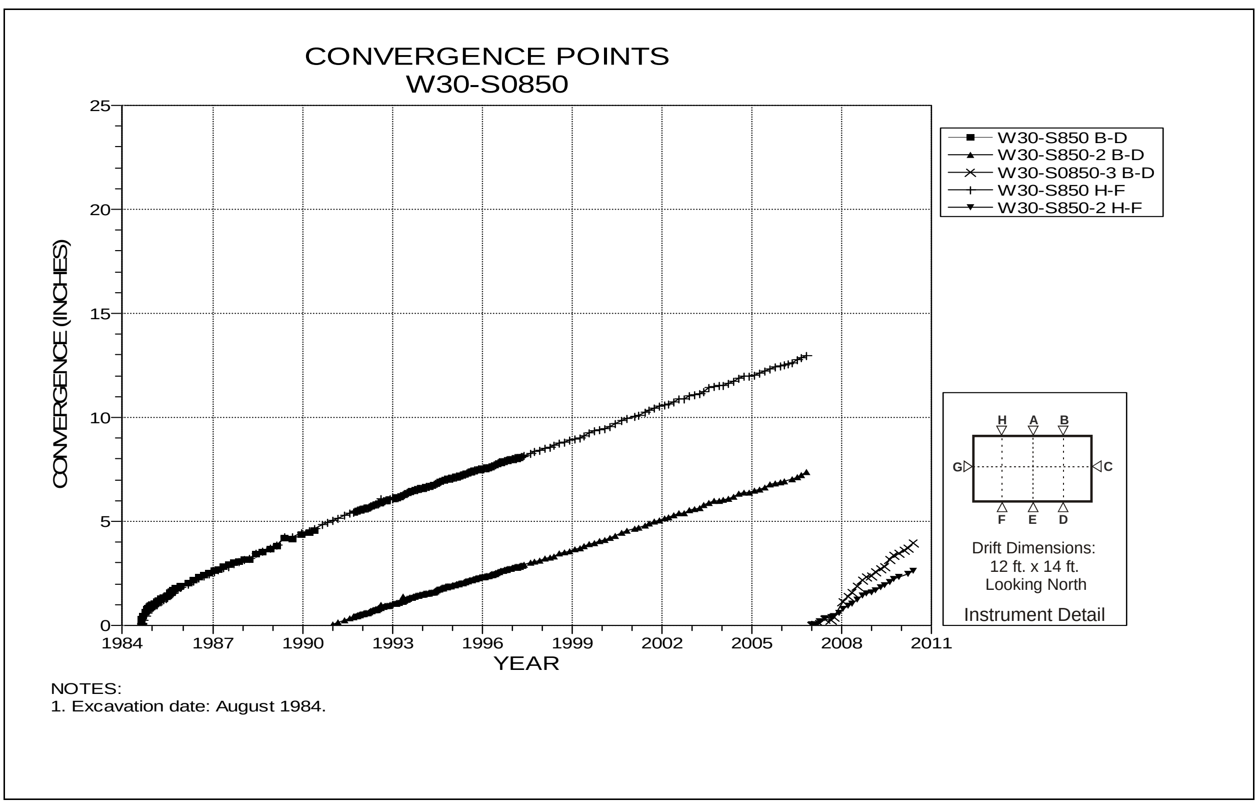


Figure 4-140 Convergence Point Array
W30 S850 – Roof to Floor – Quarter Points

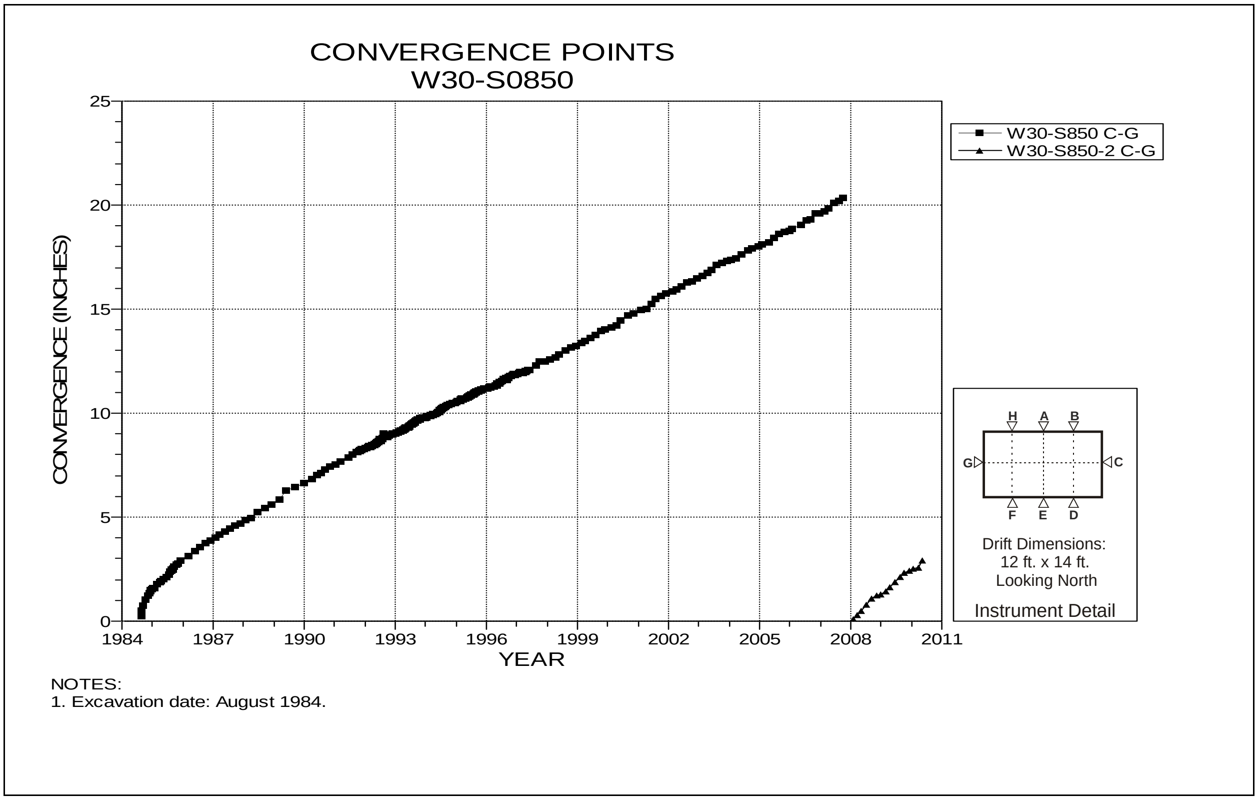


Figure 4-141 Convergence Point Array
W30 S850 – Rib to Rib

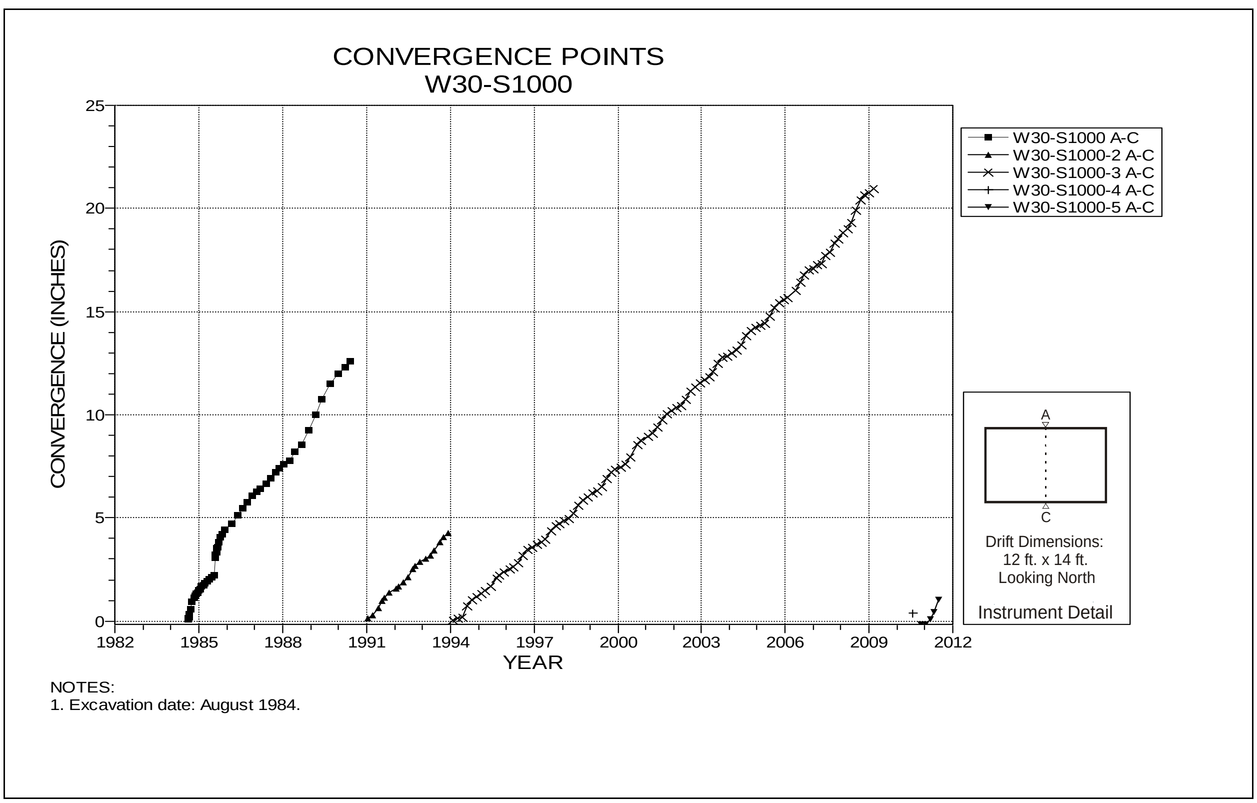


Figure 4-142 Convergence Point Array
W30 S1000 – Roof to Floor]

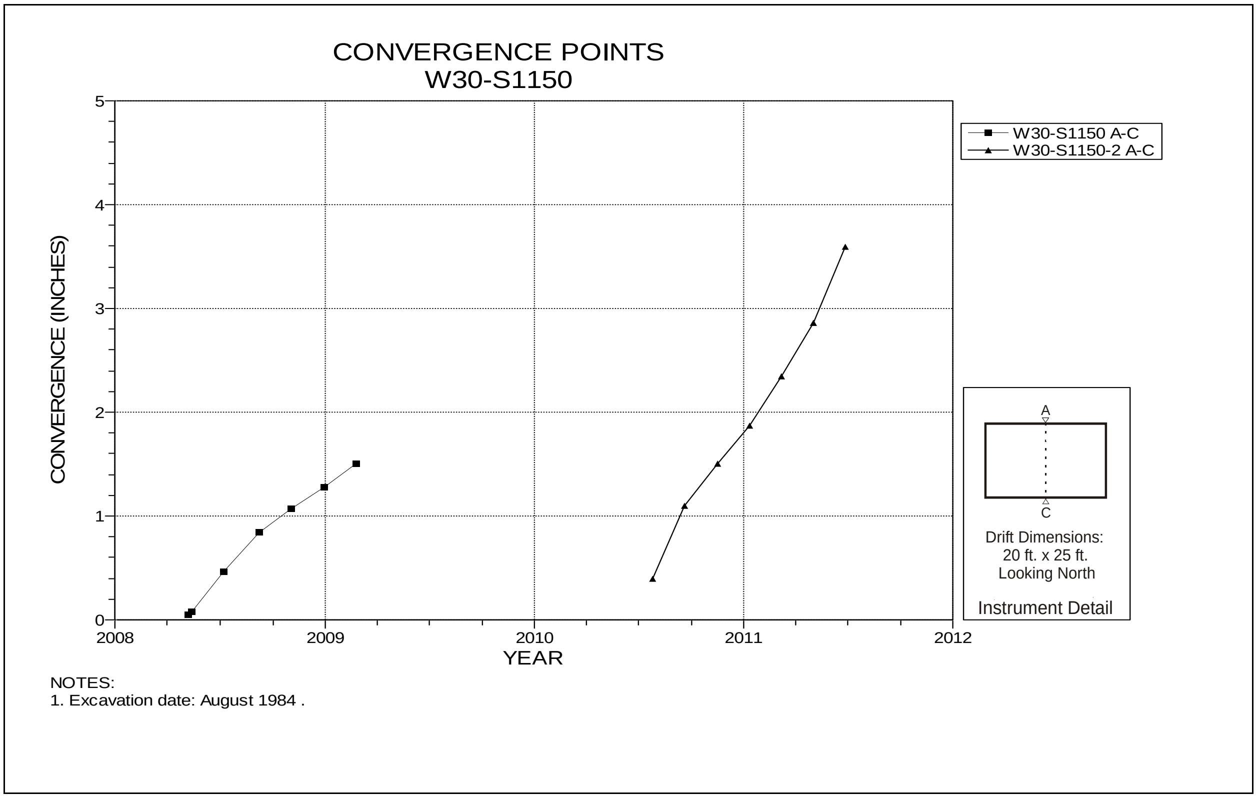


Figure 4-143 Convergence Point Array
W30 S1150 – Roof to Floor

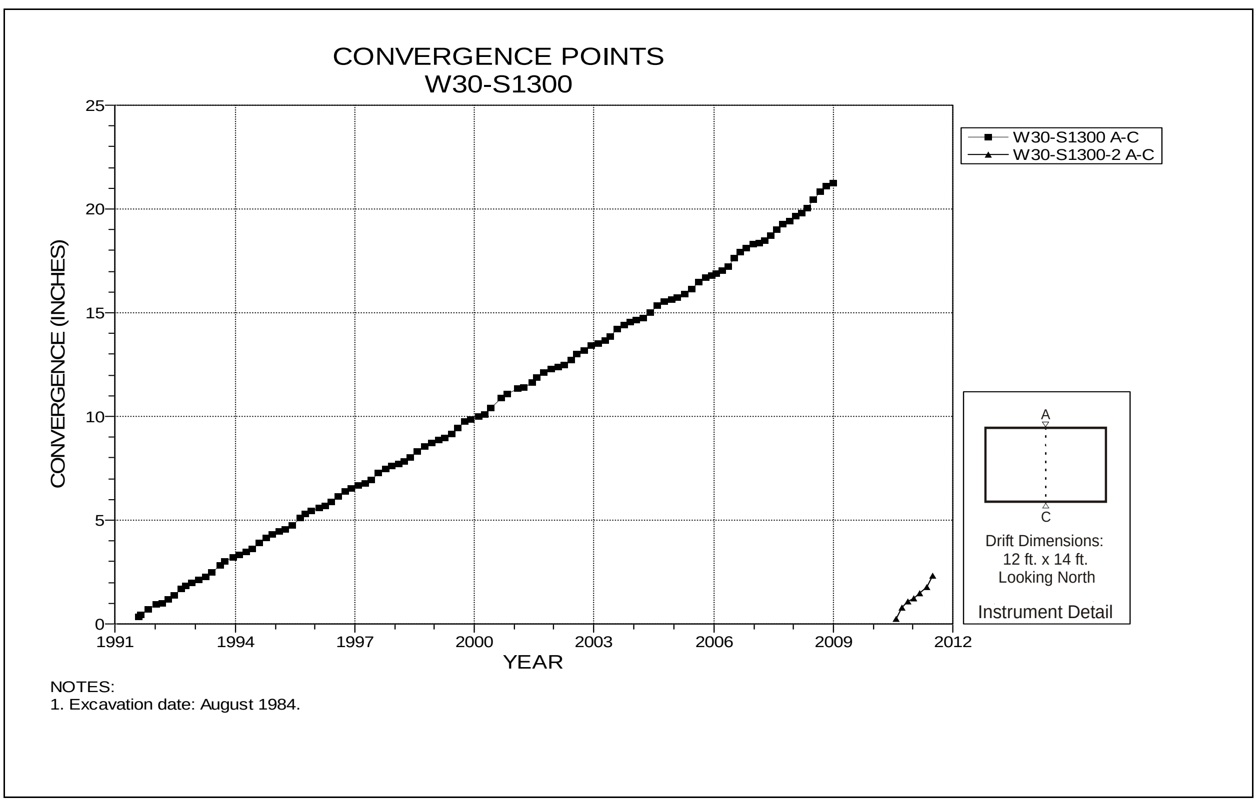


Figure 4-144 Convergence Point Array
W30 S1300 – Roof to Floor

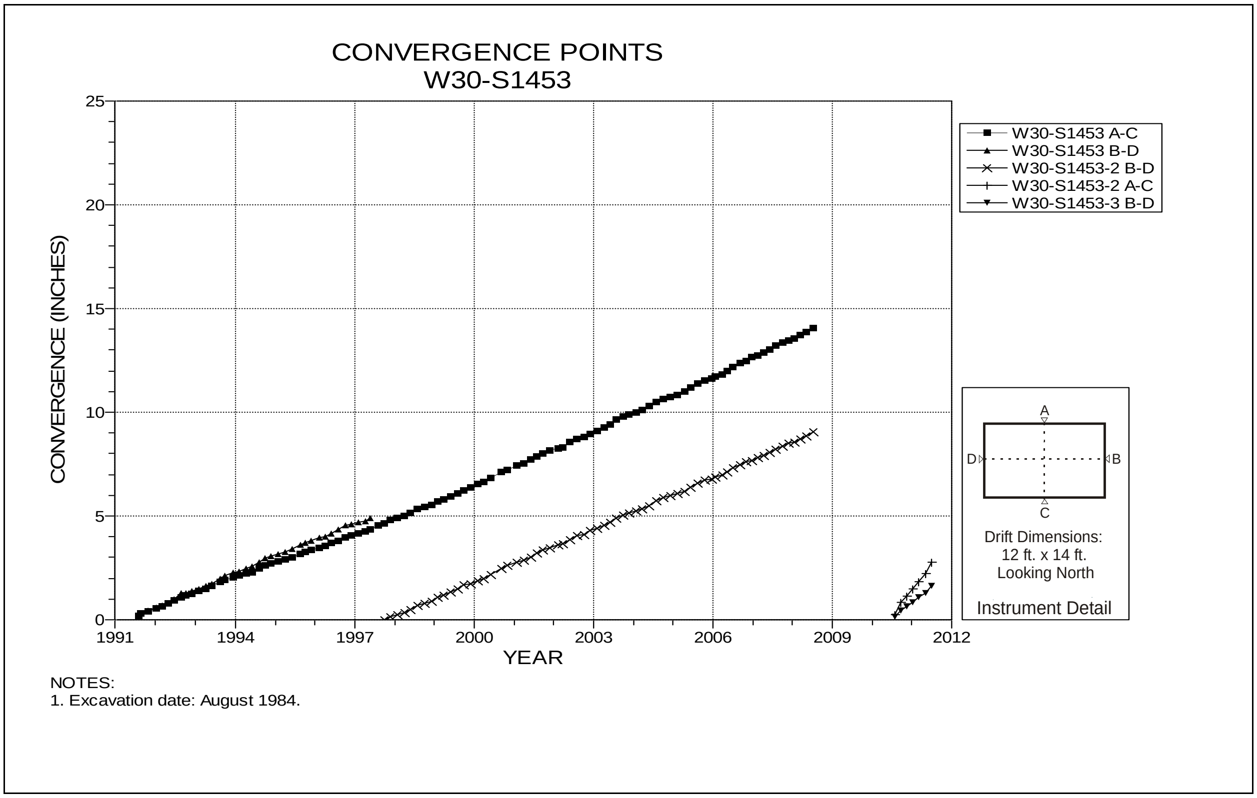


Figure 4-145 Convergence Point Array
W30 S1453 – All Chords

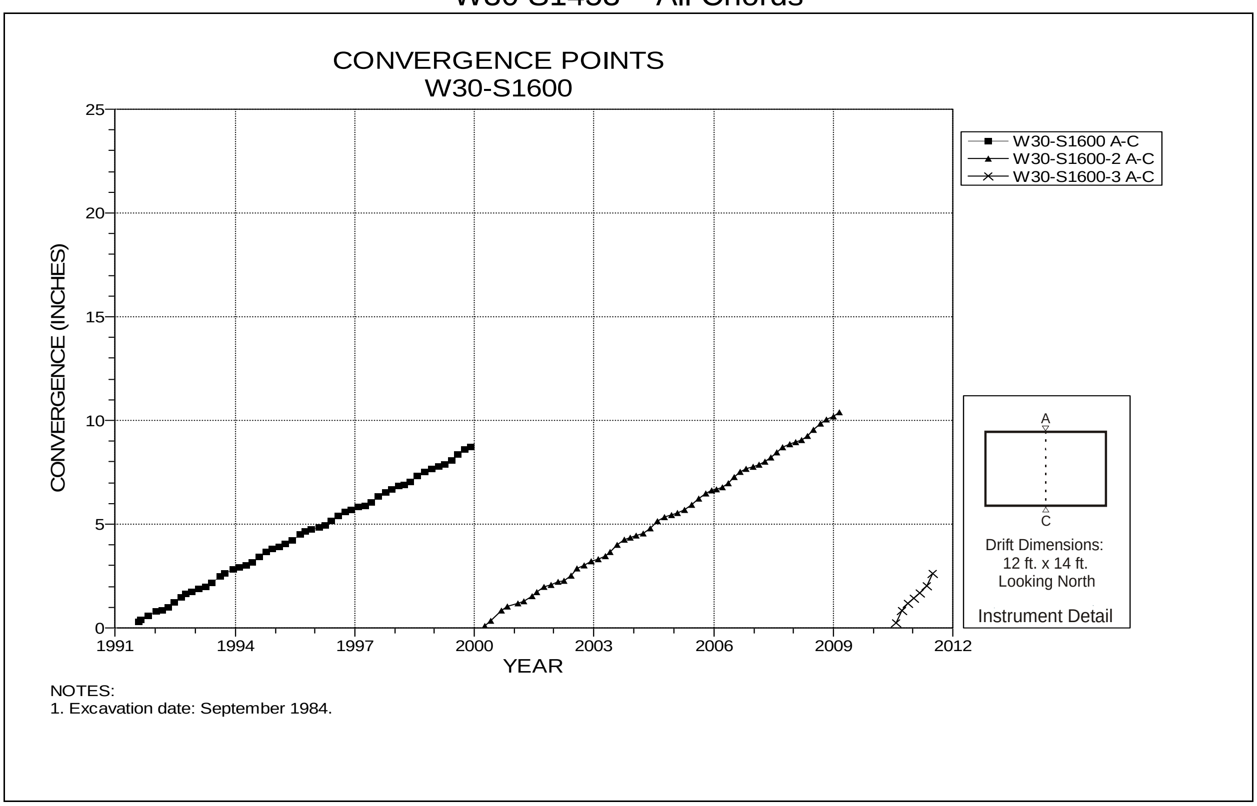


Figure 4-146 Convergence Point Array
W30 S1600 – Roof to Floor

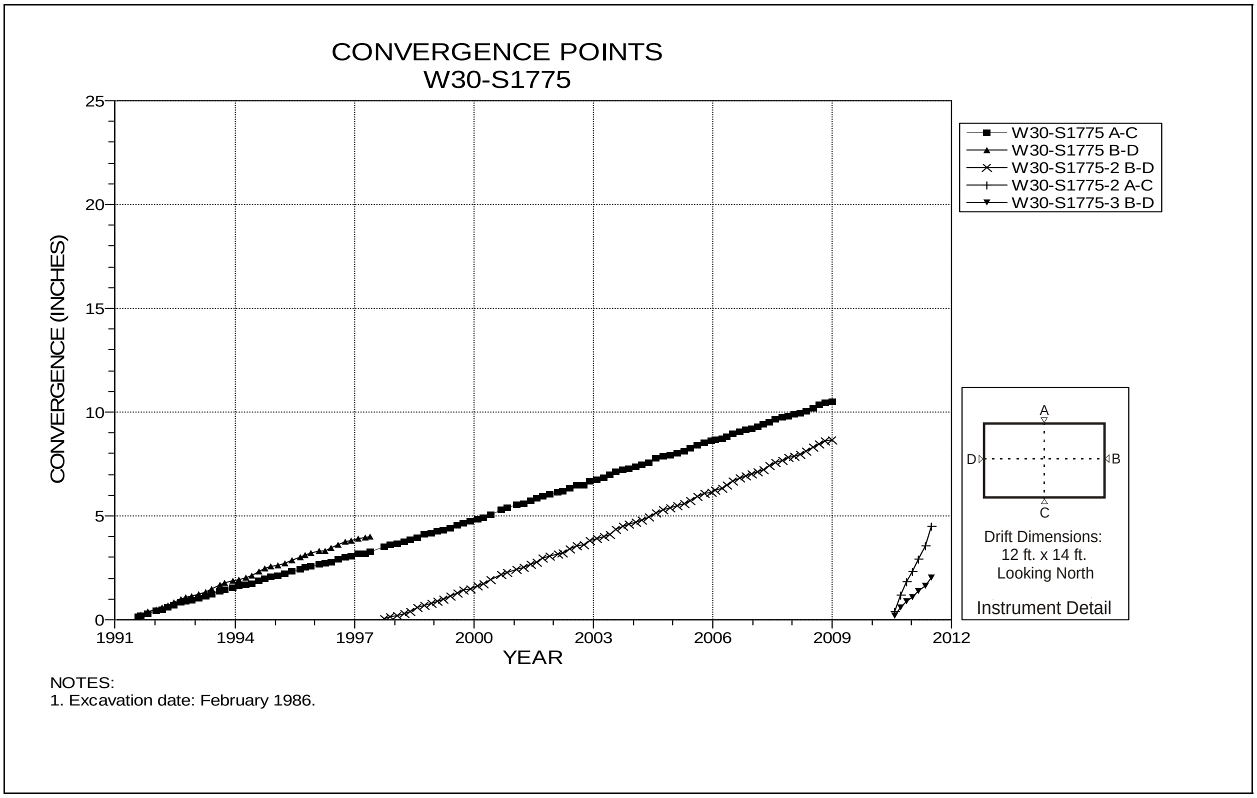


Figure 4-147 Convergence Point Array
W30 S1775 – All Chords

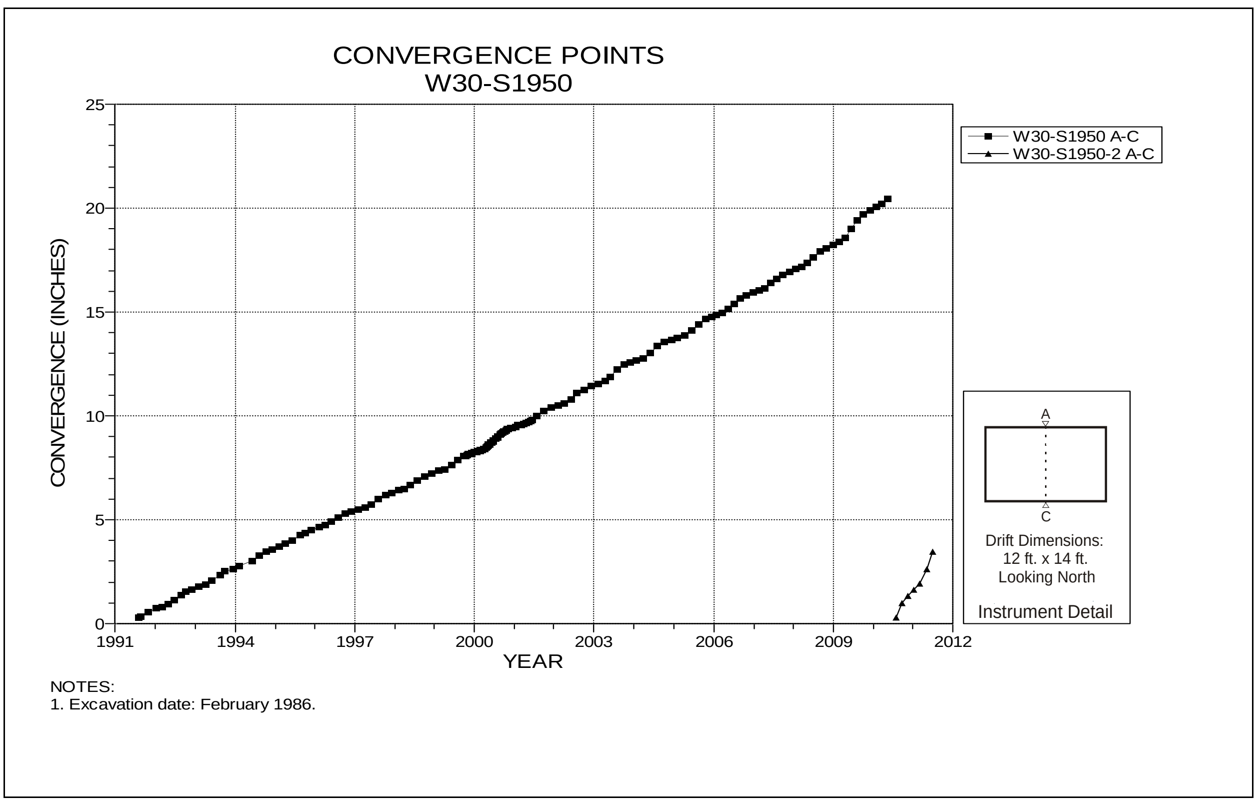


Figure 4-148 Convergence Point Array
W30 S1950 – Roof to Floor

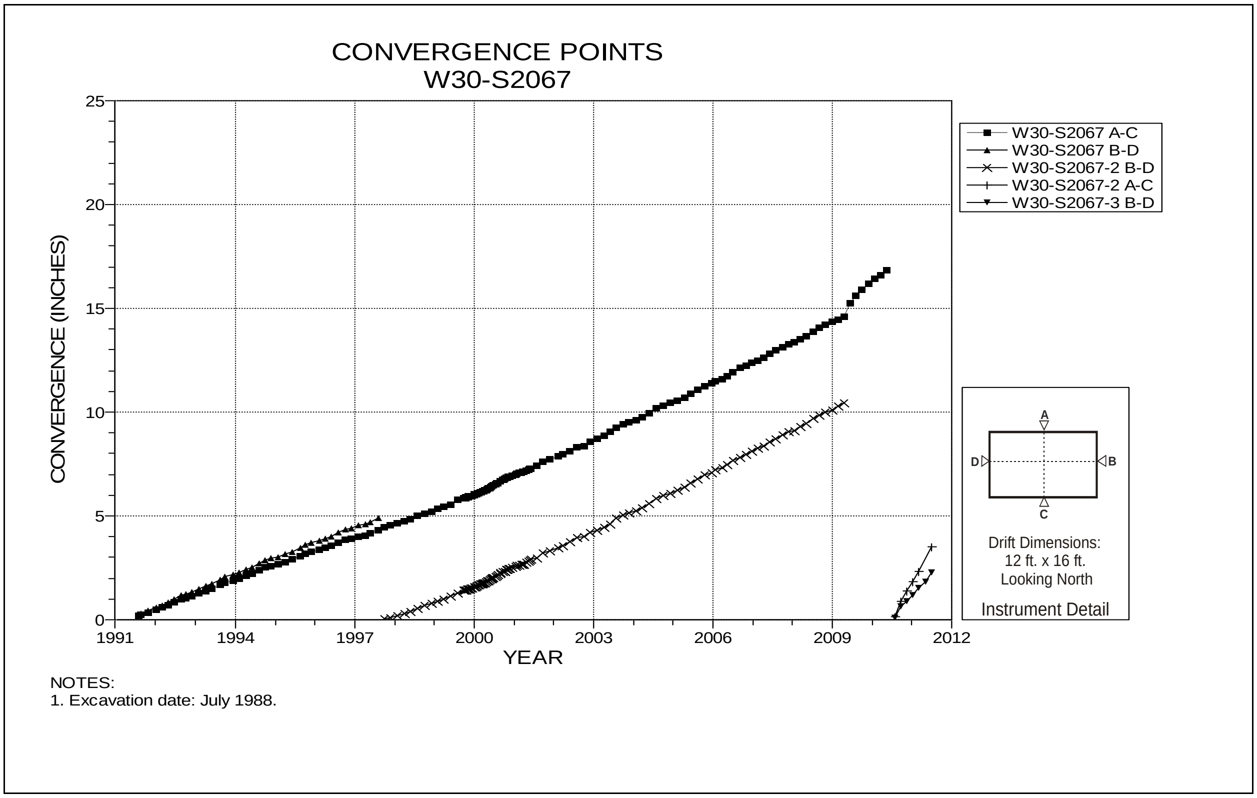


Figure 4-149 Convergence Point Array
W30 S2067 – All Chords

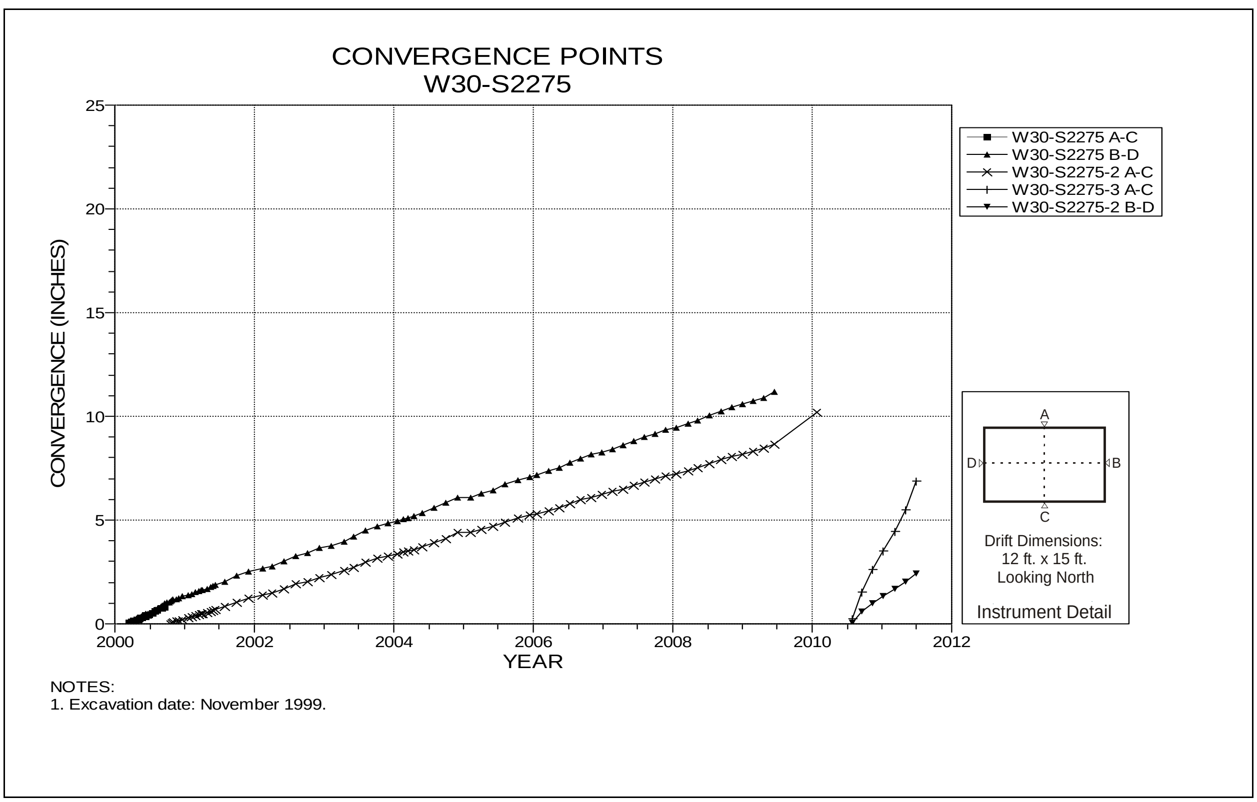


Figure 4-150 Convergence Point Array
W30 S2275 – All Chords

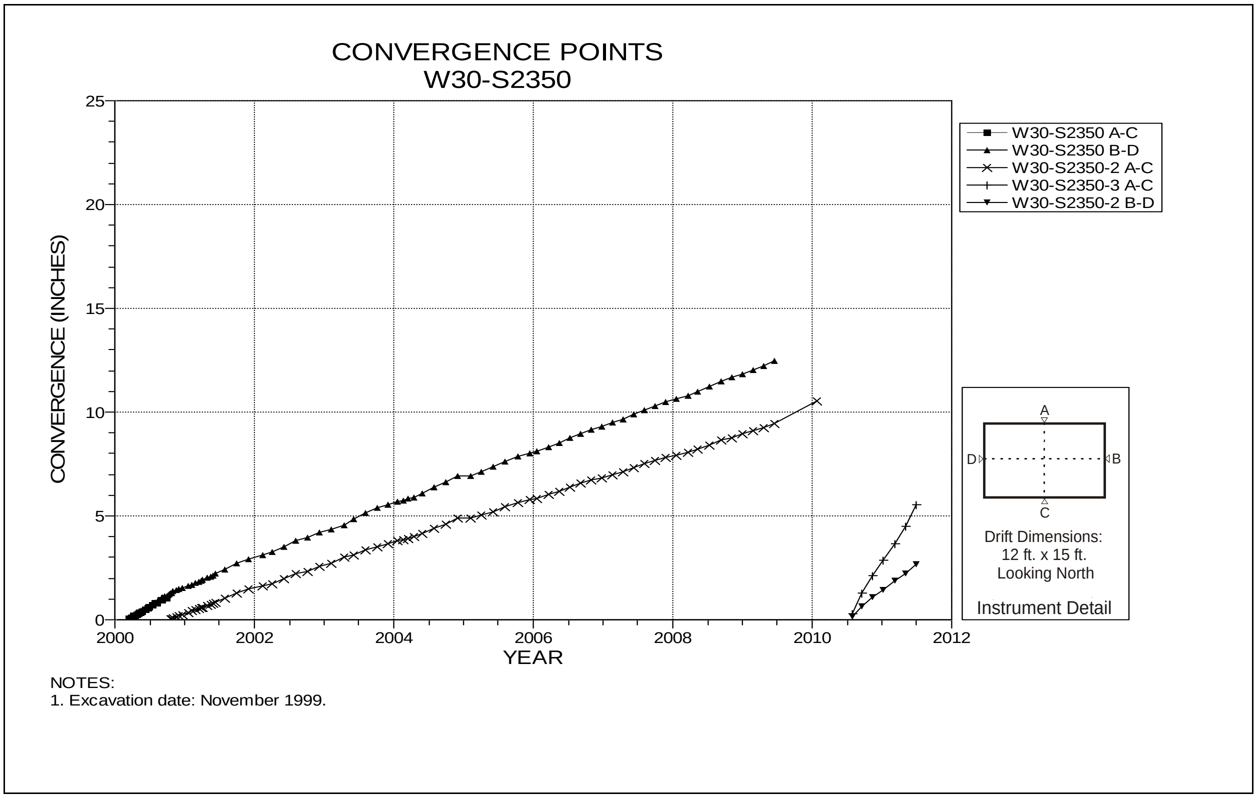


Figure 4-151 Convergence Point Array
W30 S2350 – All Chords

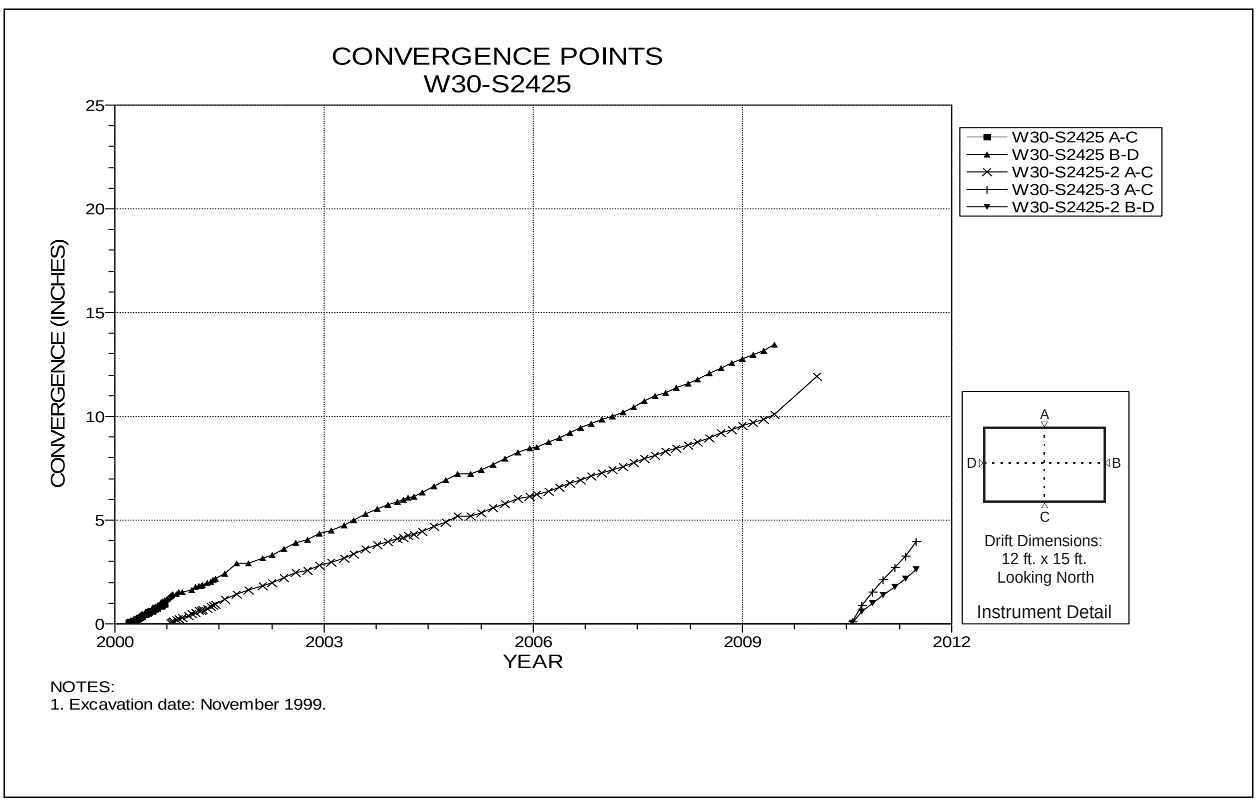


Figure 4-152 Convergence Point Array
W30 S2425 – All Chords

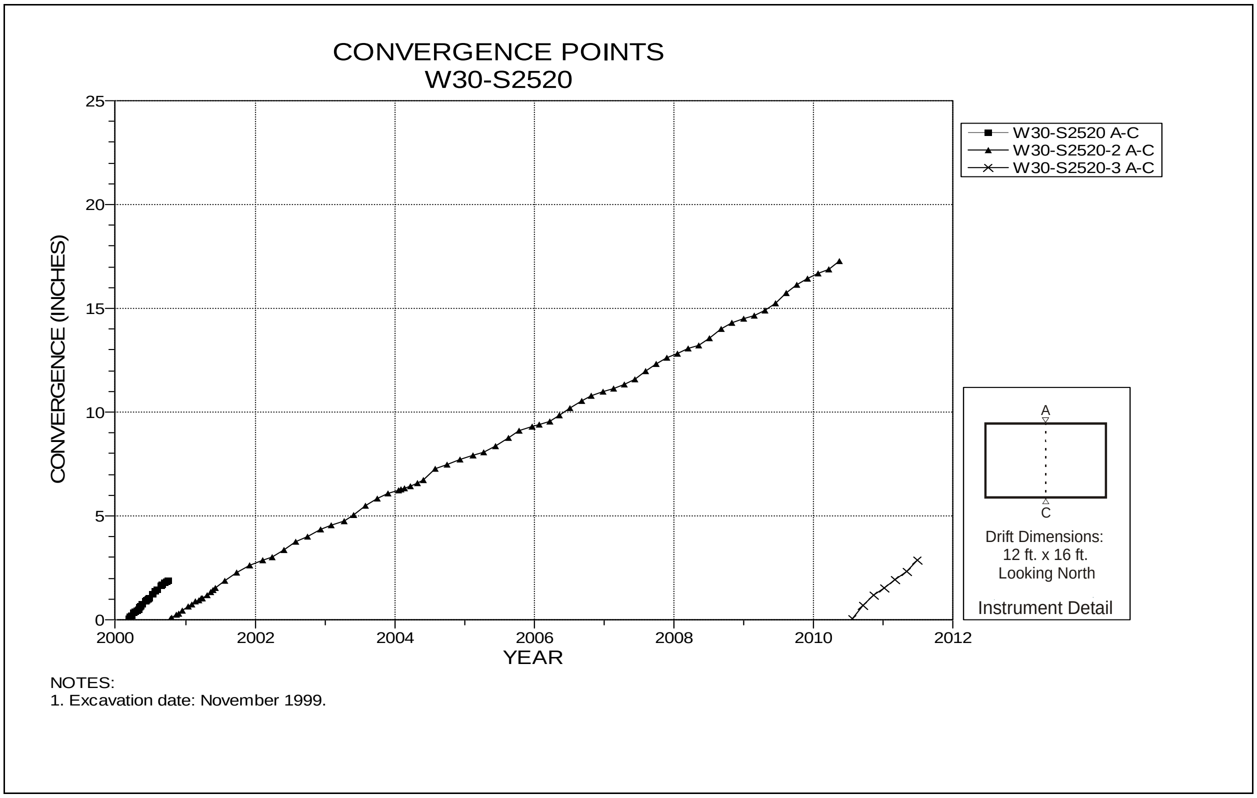


Figure 4-153 Convergence Point Array
W30 S2520 – Roof to Floor

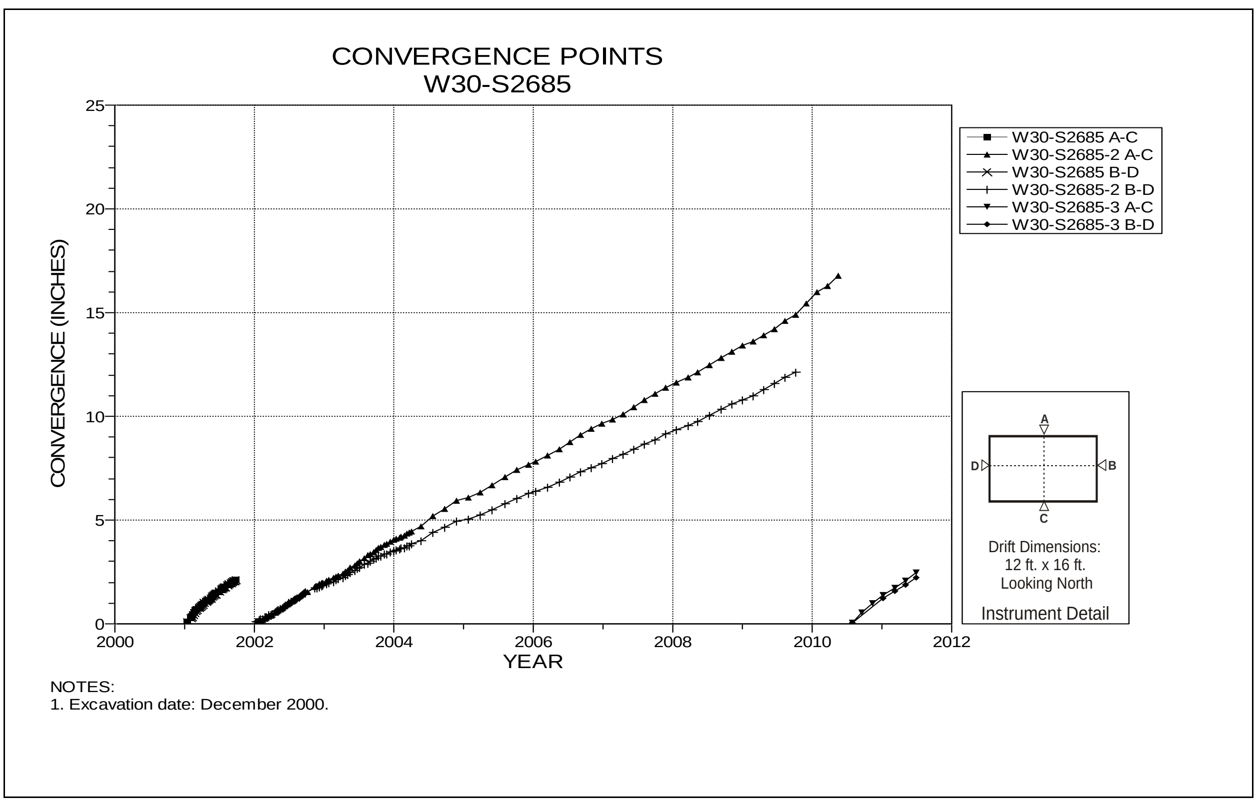


Figure 4-154 Convergence Point Array
W30 S2685 – All Chords

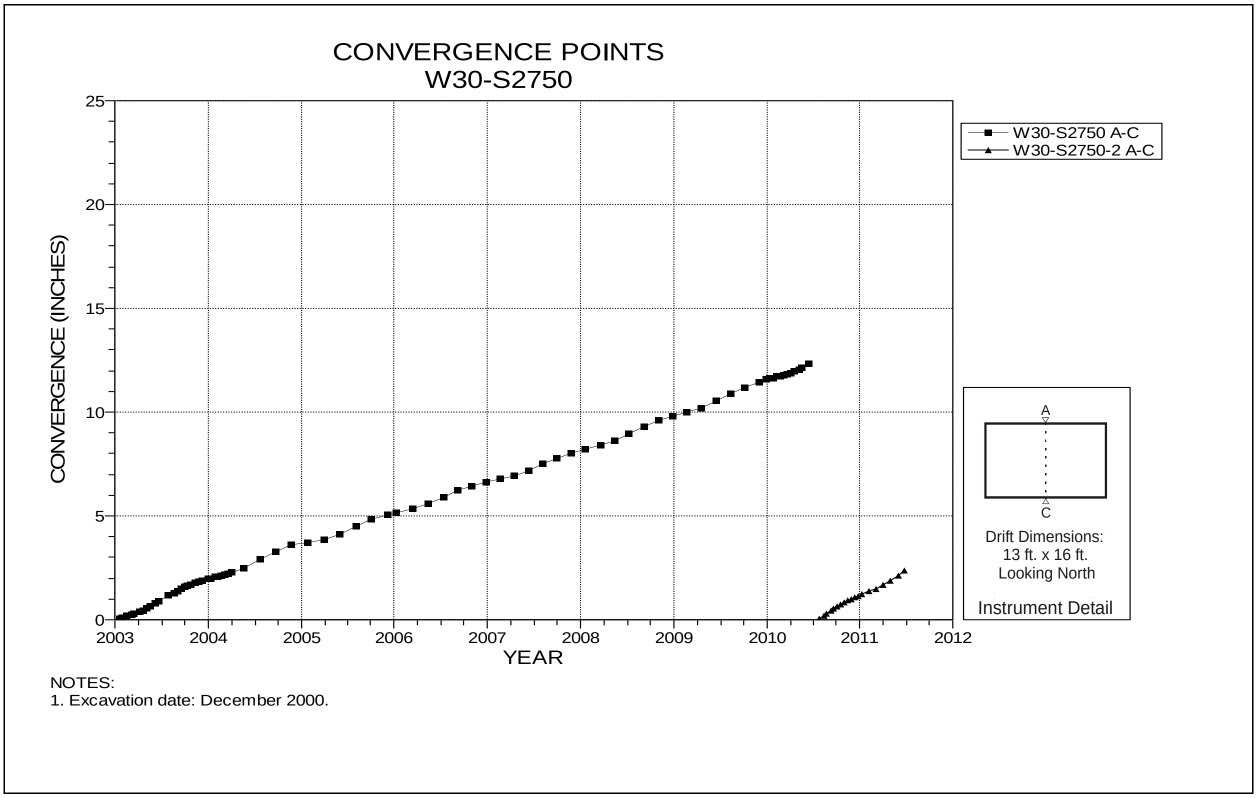


Figure 4-155 Convergence Point Array
W30 S2750 – Roof to Floor

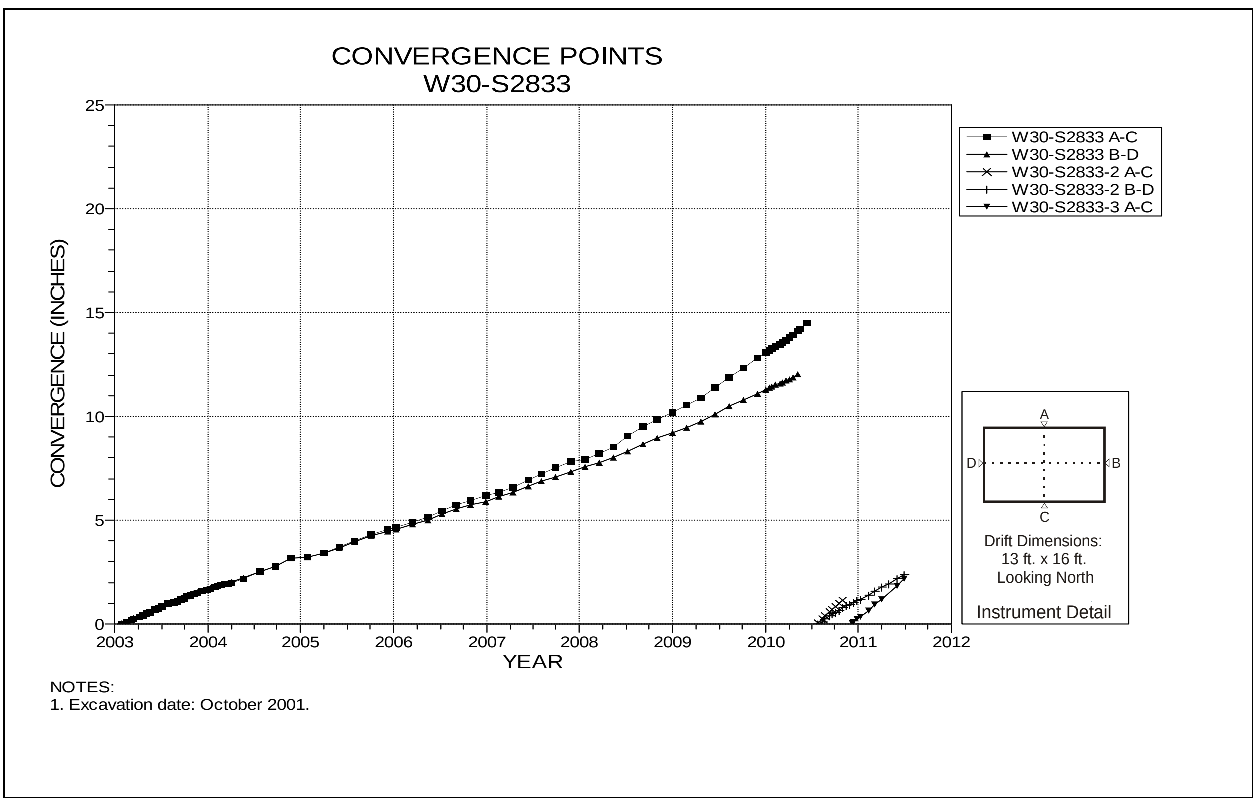


Figure 4-156 Convergence Point Array
W30 S2833 – All Chords

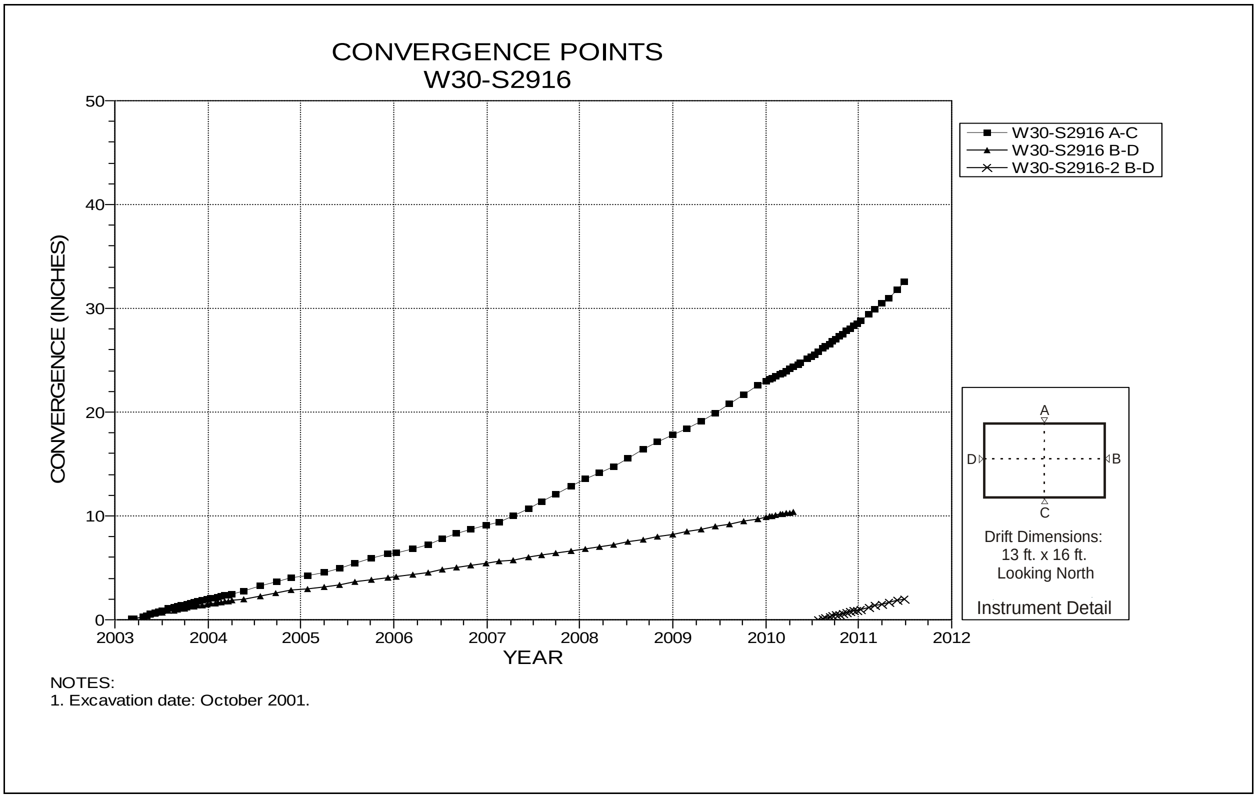


Figure 4-157 Convergence Point Array
W30 S2916 – All Chords

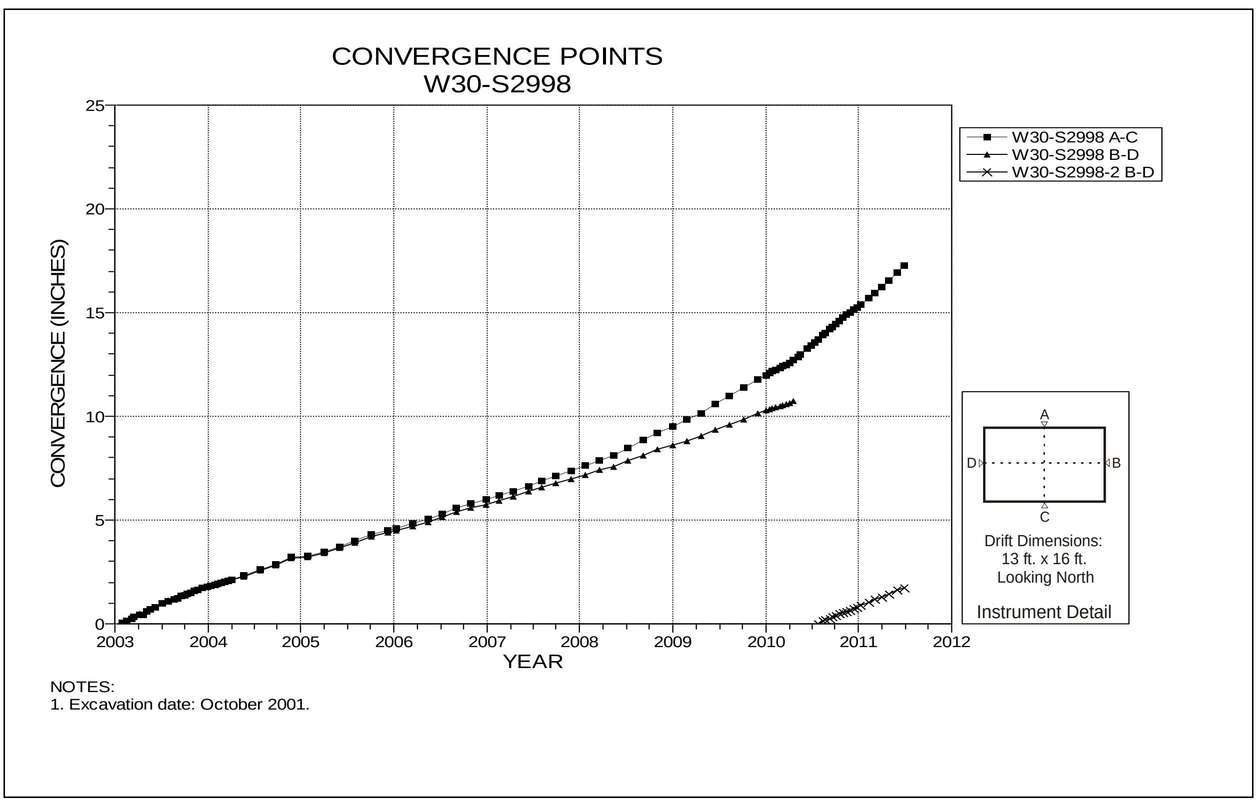


Figure 4-158 Convergence Point Array
W30 S2998 – All Chords

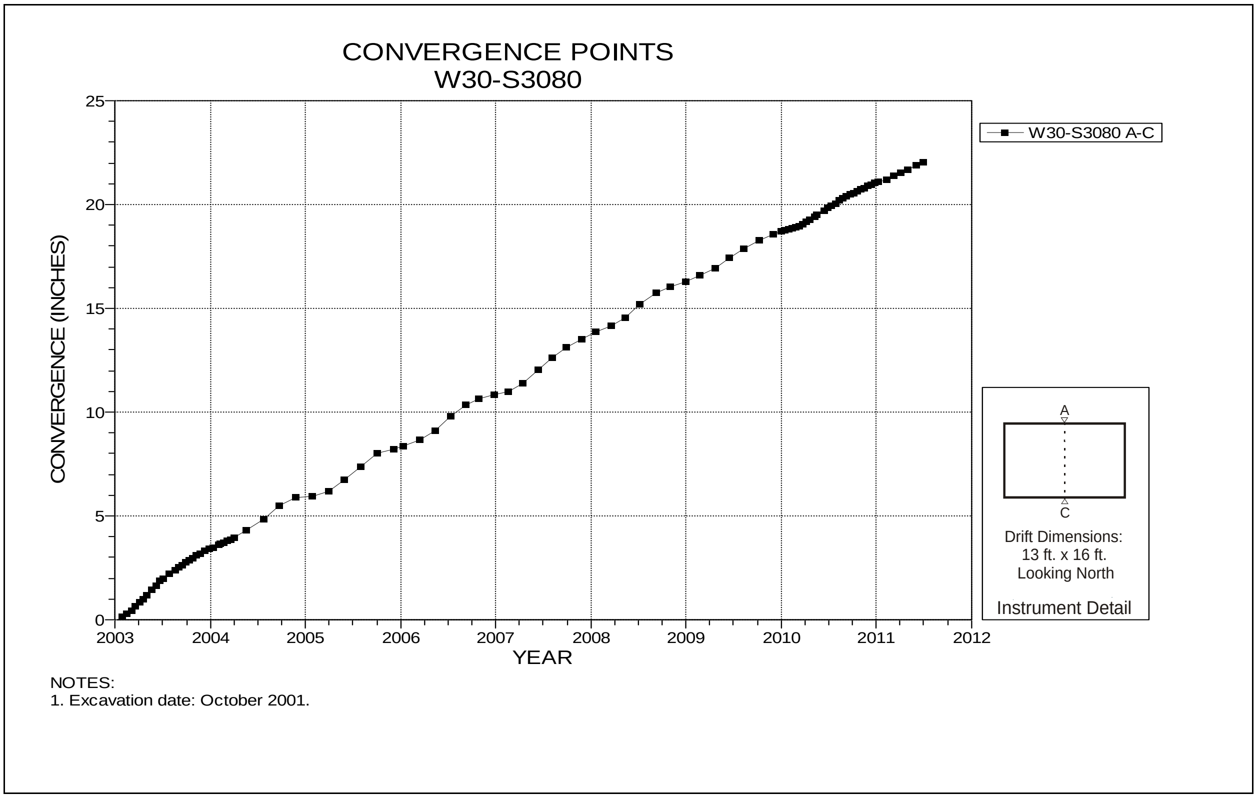


Figure 4-159 Convergence Point Array
W30 S3080 Drift – Roof to Floor

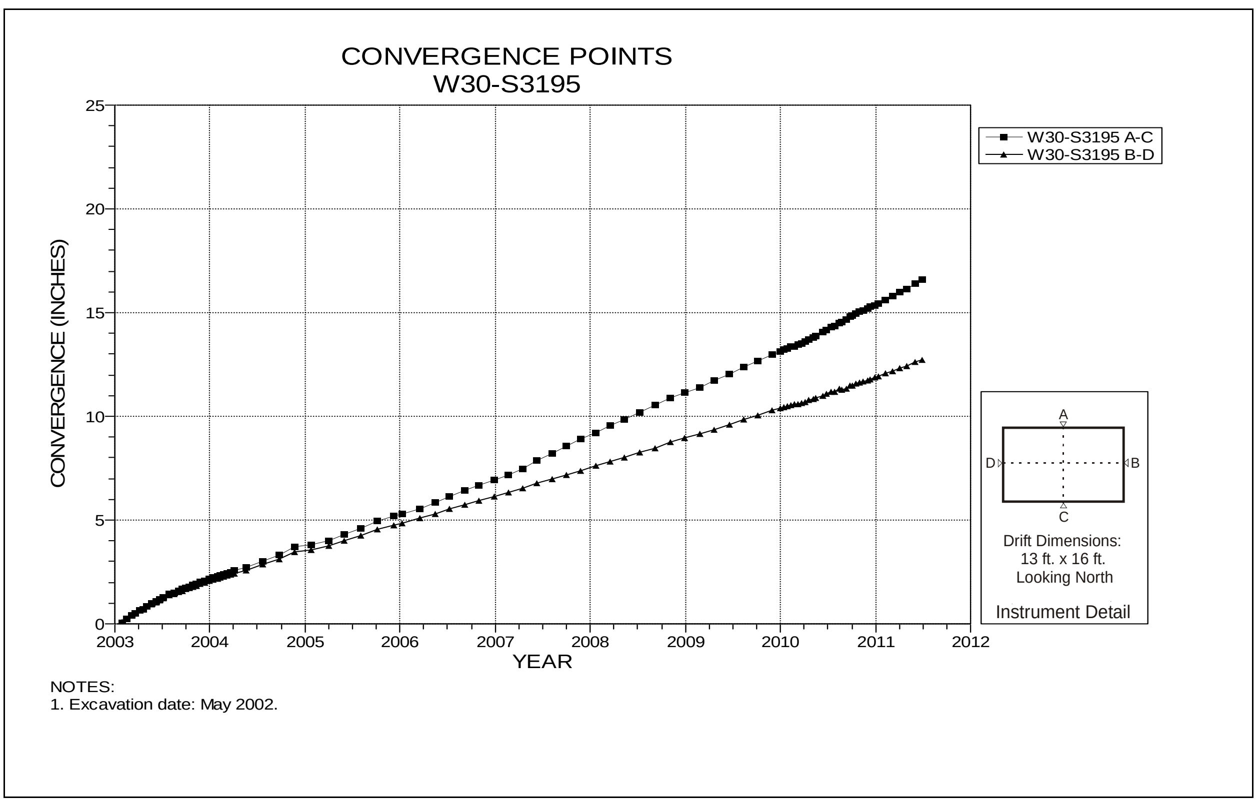


Figure 4-160 Convergence Point Array
W30 S3195 – All Chords

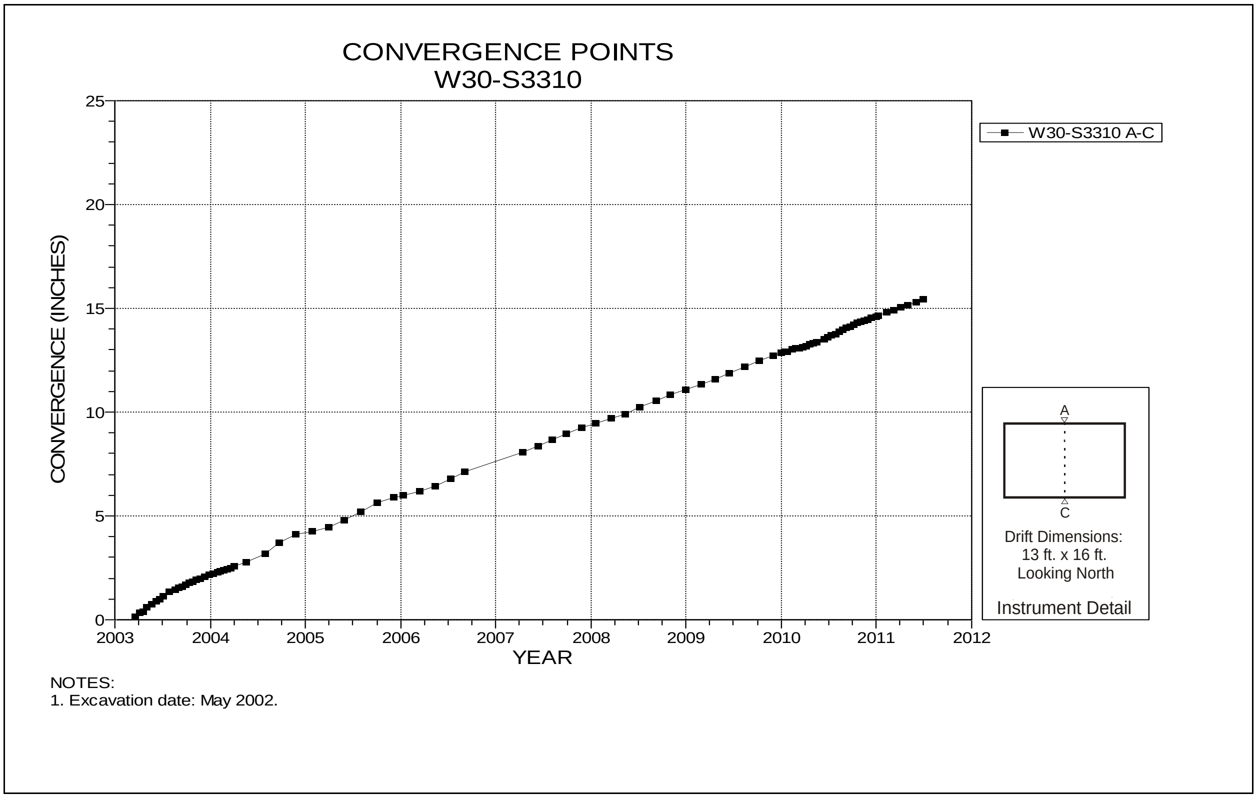


Figure 4-161 Convergence Point Array
W30 S3310 – Roof to Floor

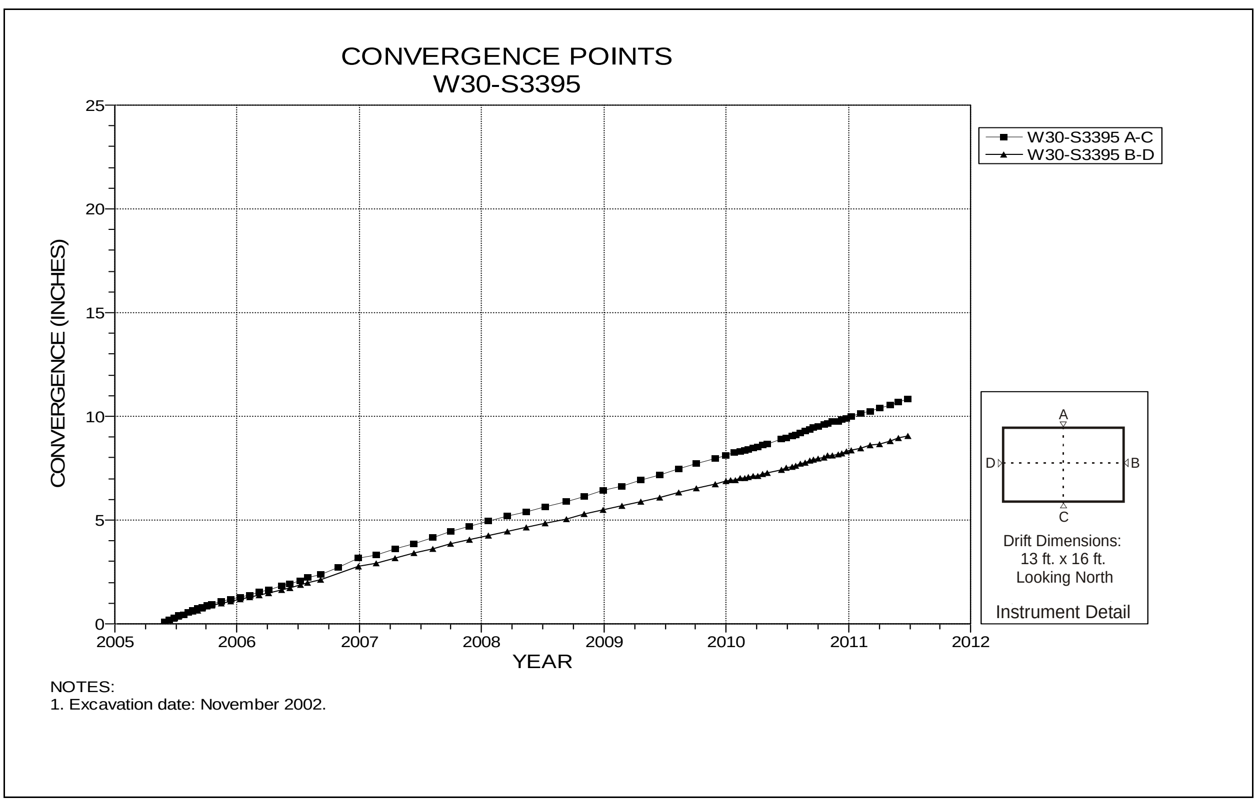


Figure 4-162 Convergence Point Array
W30 S3395 – All Chords

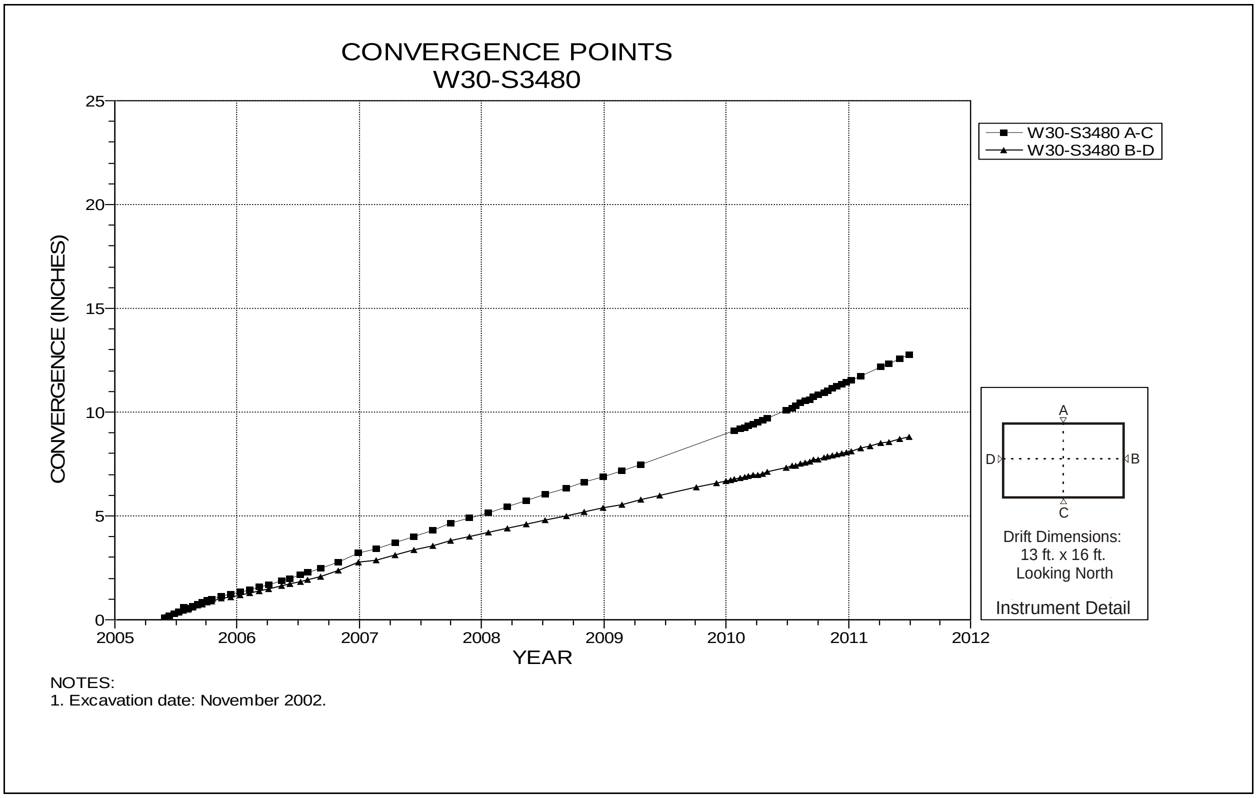


Figure 4-163 Convergence Point Array
W30 S3480 – All Chords

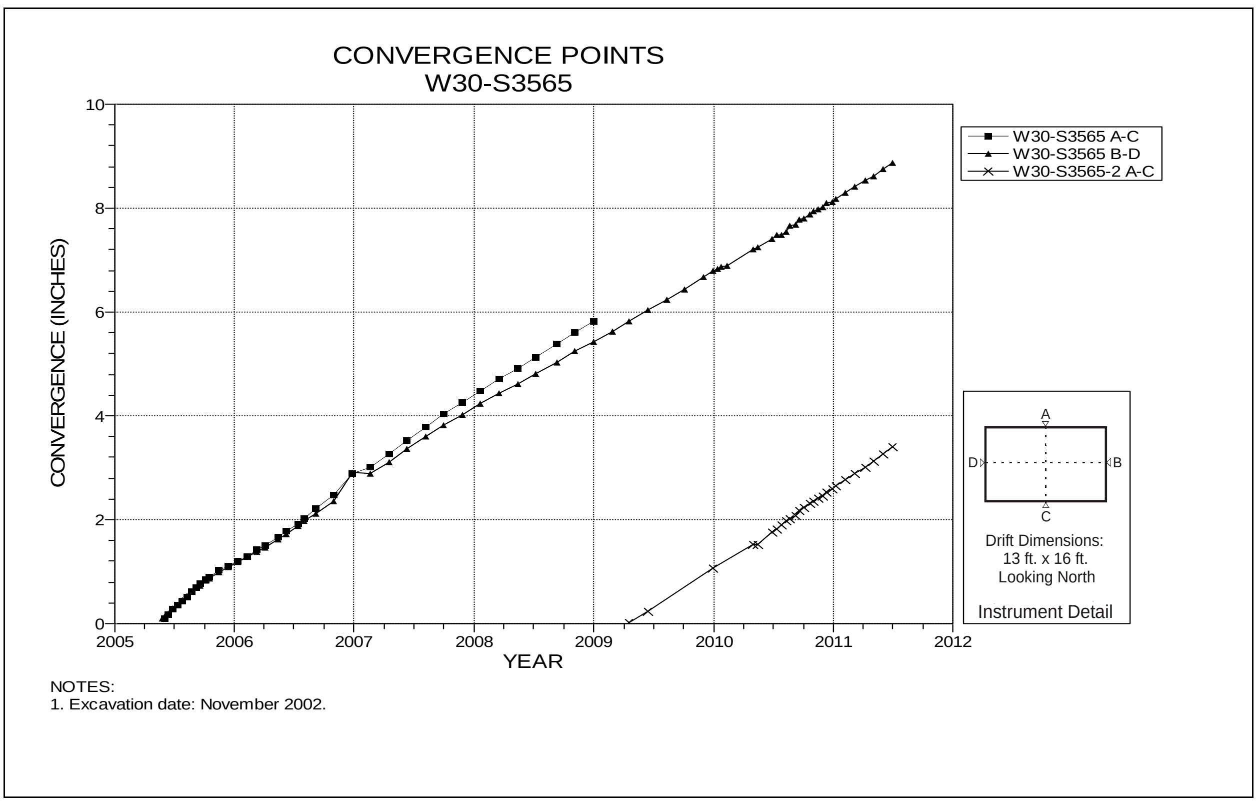


Figure 4-164 Convergence Point Array
W30 S3565 – All Chords

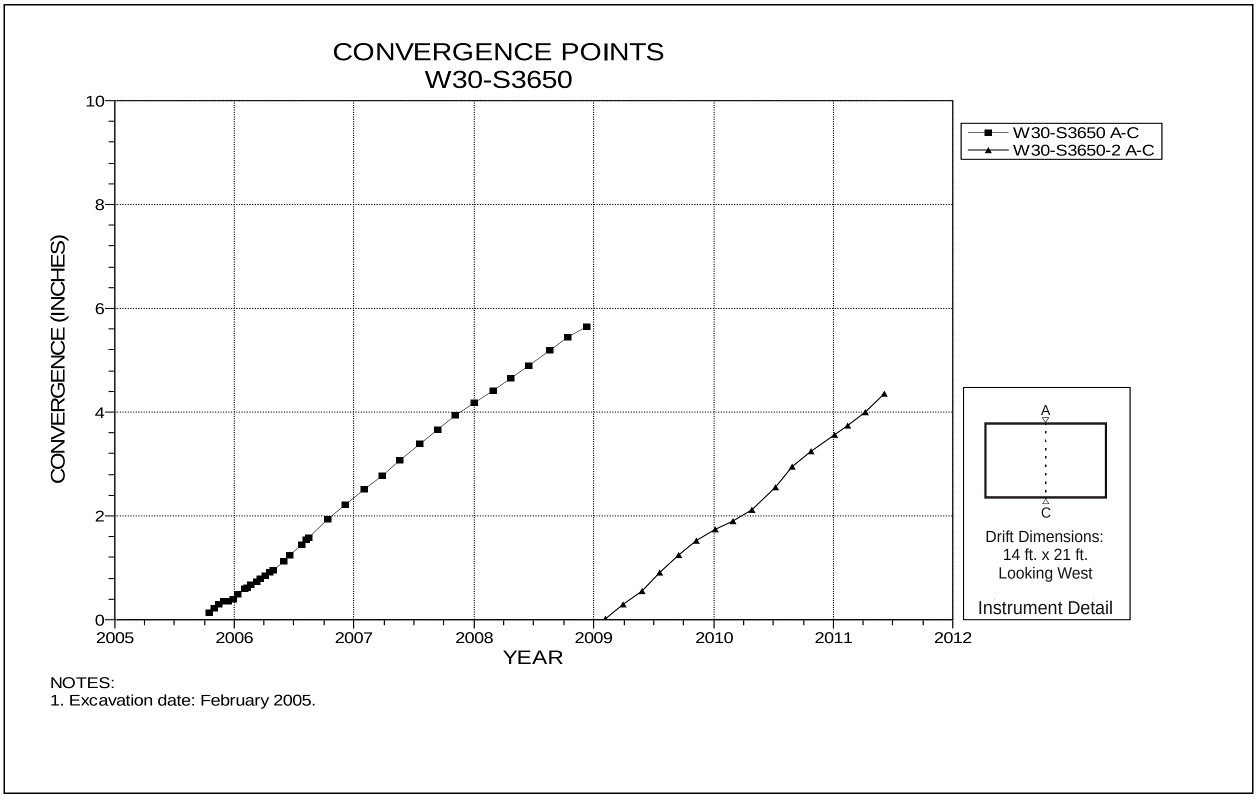


Figure 4-165 Convergence Point Array
W30 S3560 – Roof to Floor

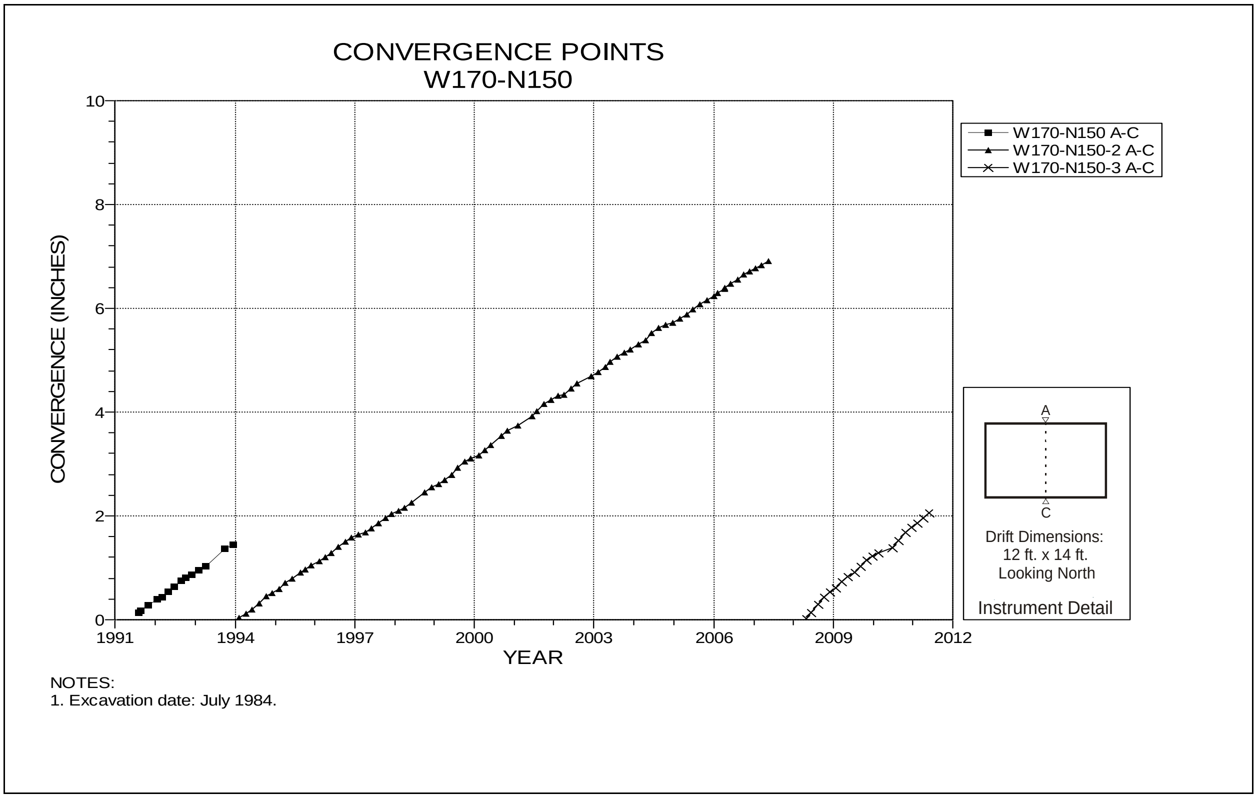


Figure 4-166 Convergence Point Array
W170 N150 – Roof to Floor

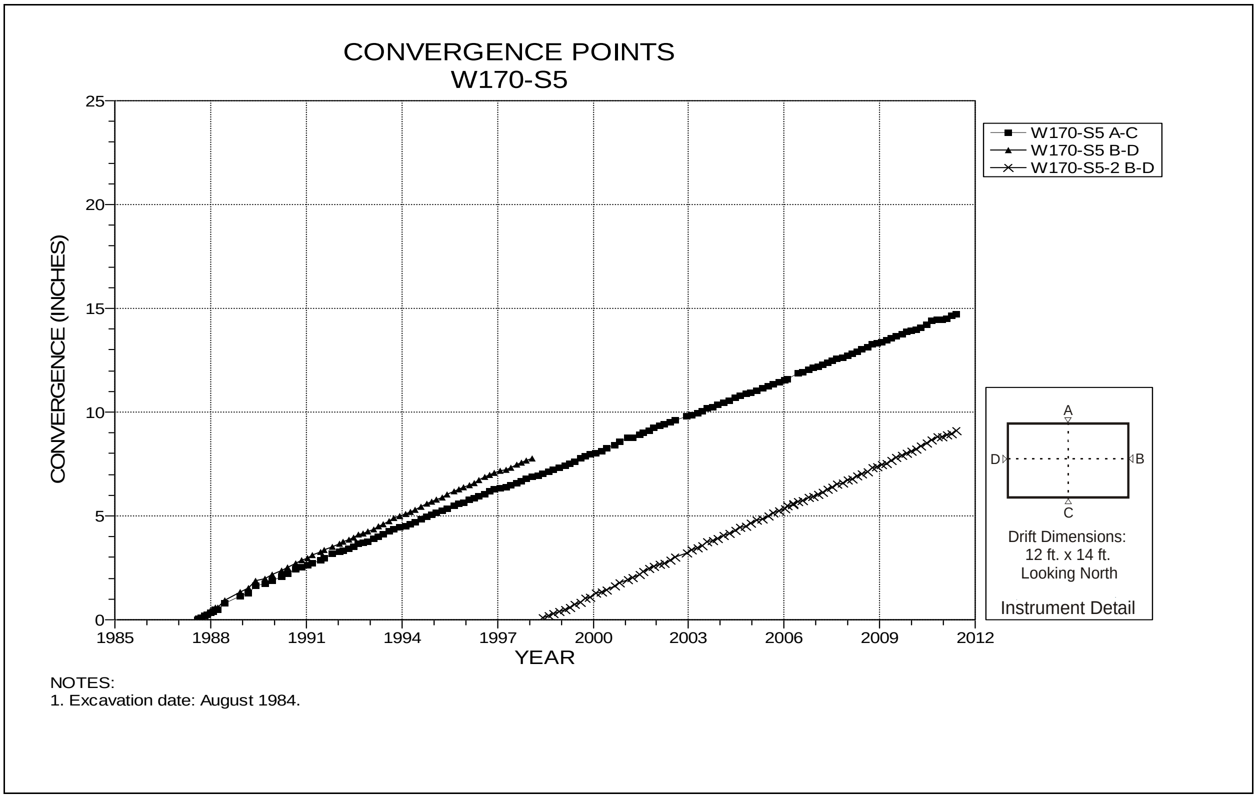


Figure 4-167 Convergence Point Array
W170 S5 – All Chords

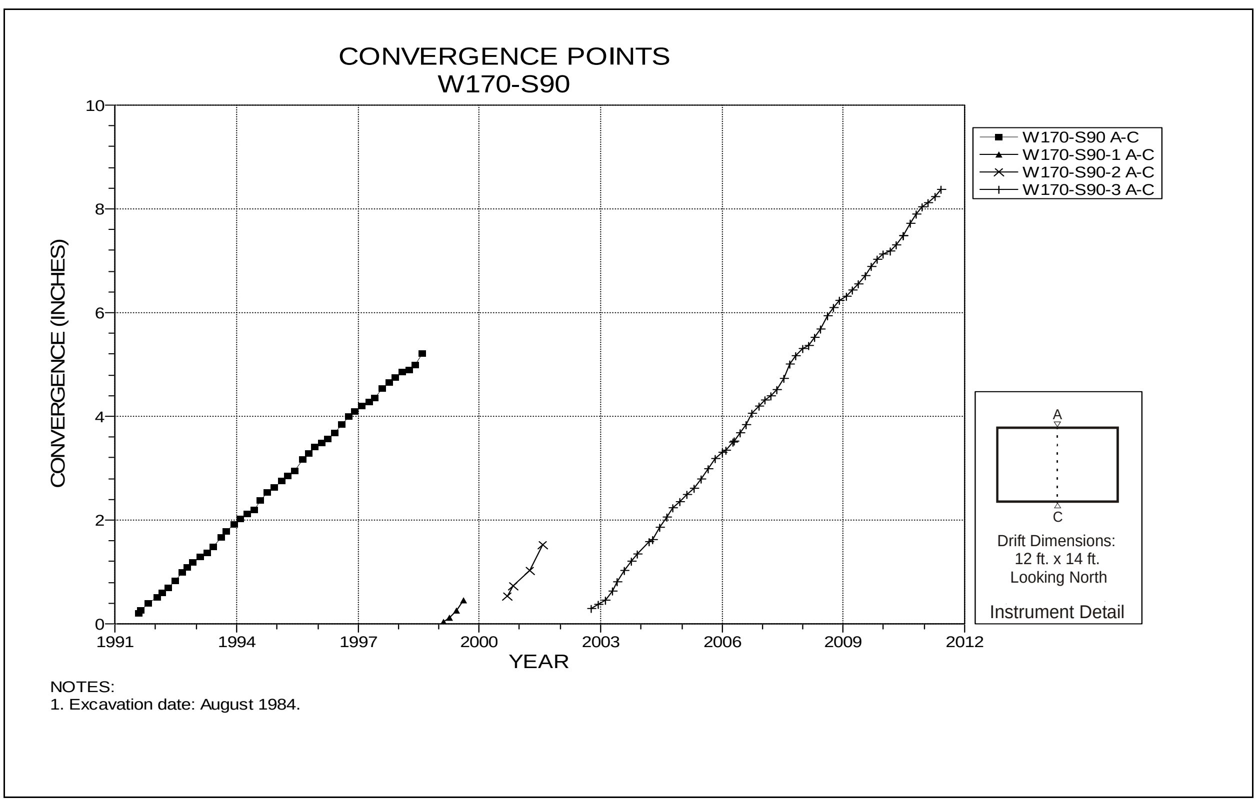


Figure 4-168 Convergence Point Array
W170 S90 – Roof to Floor

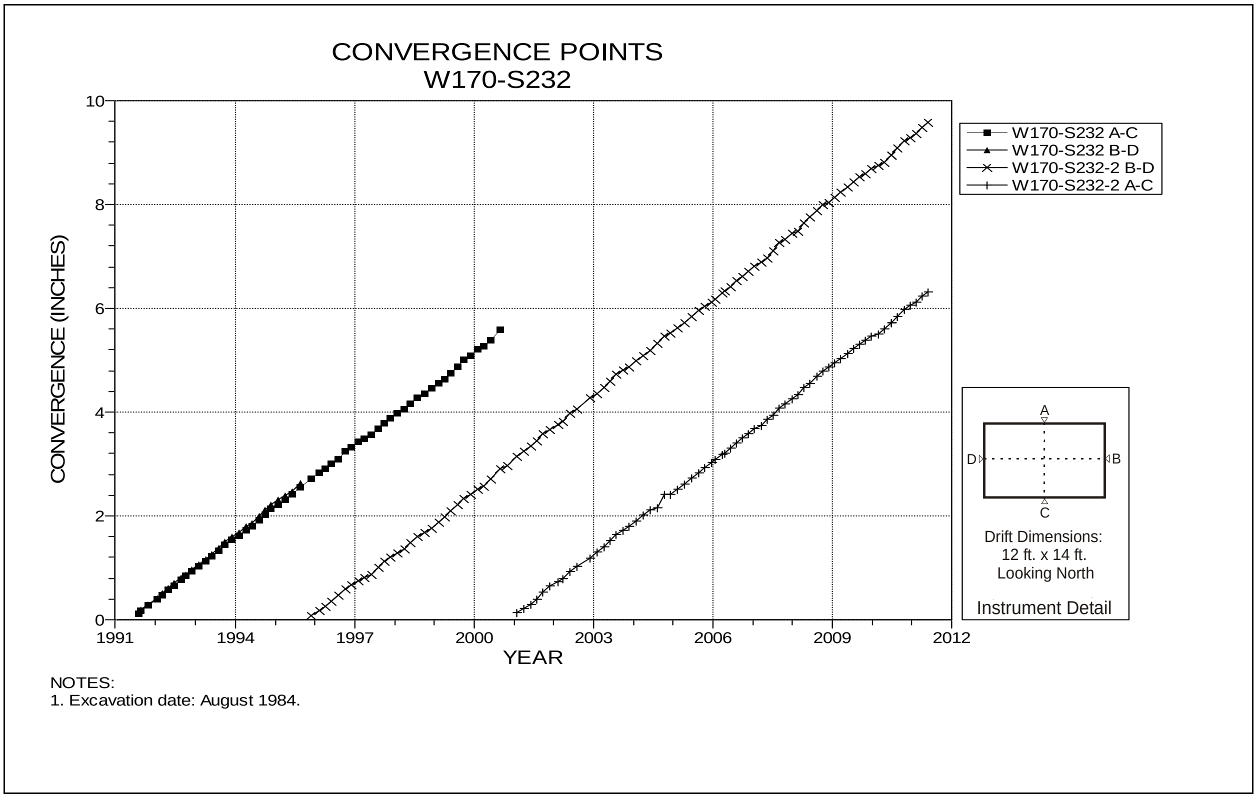


Figure 4-169 Convergence Point Array
W170 S232 – All Chords

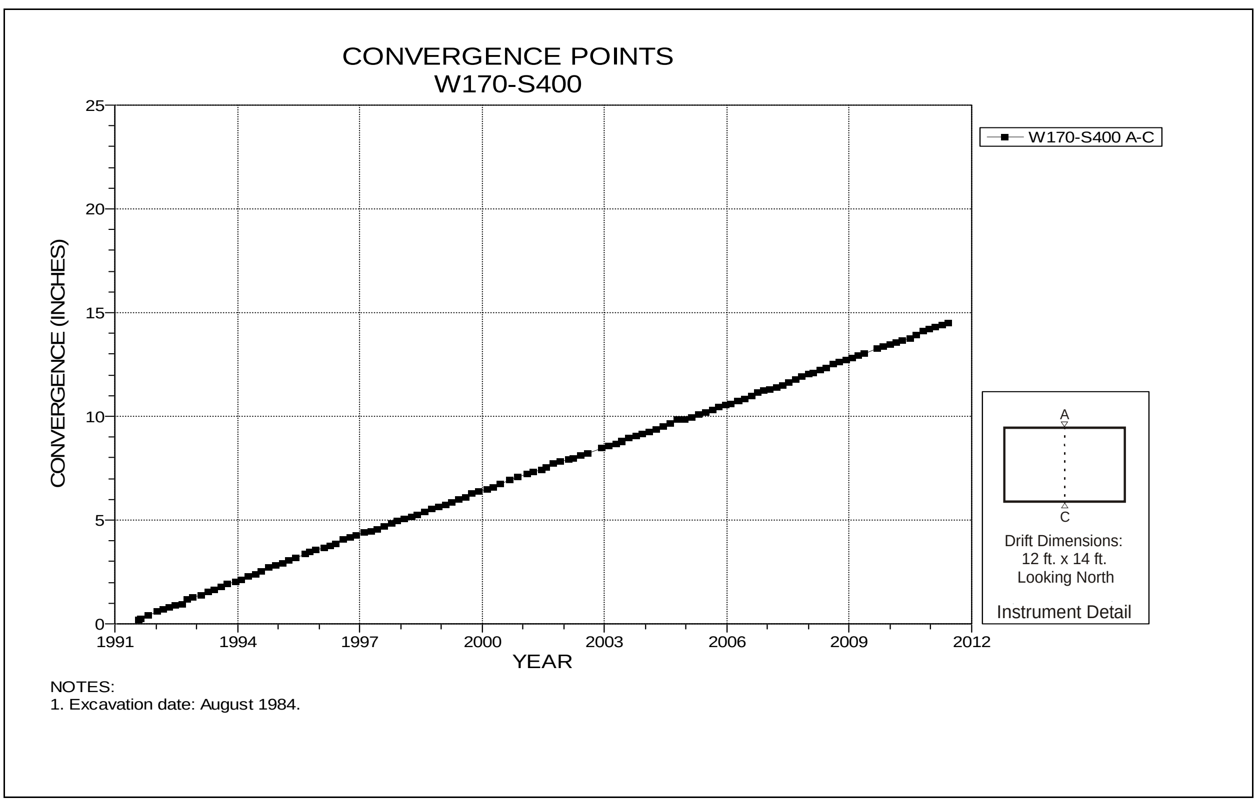


Figure 4-170 Convergence Point Array
W170 S400 – Roof to Floor

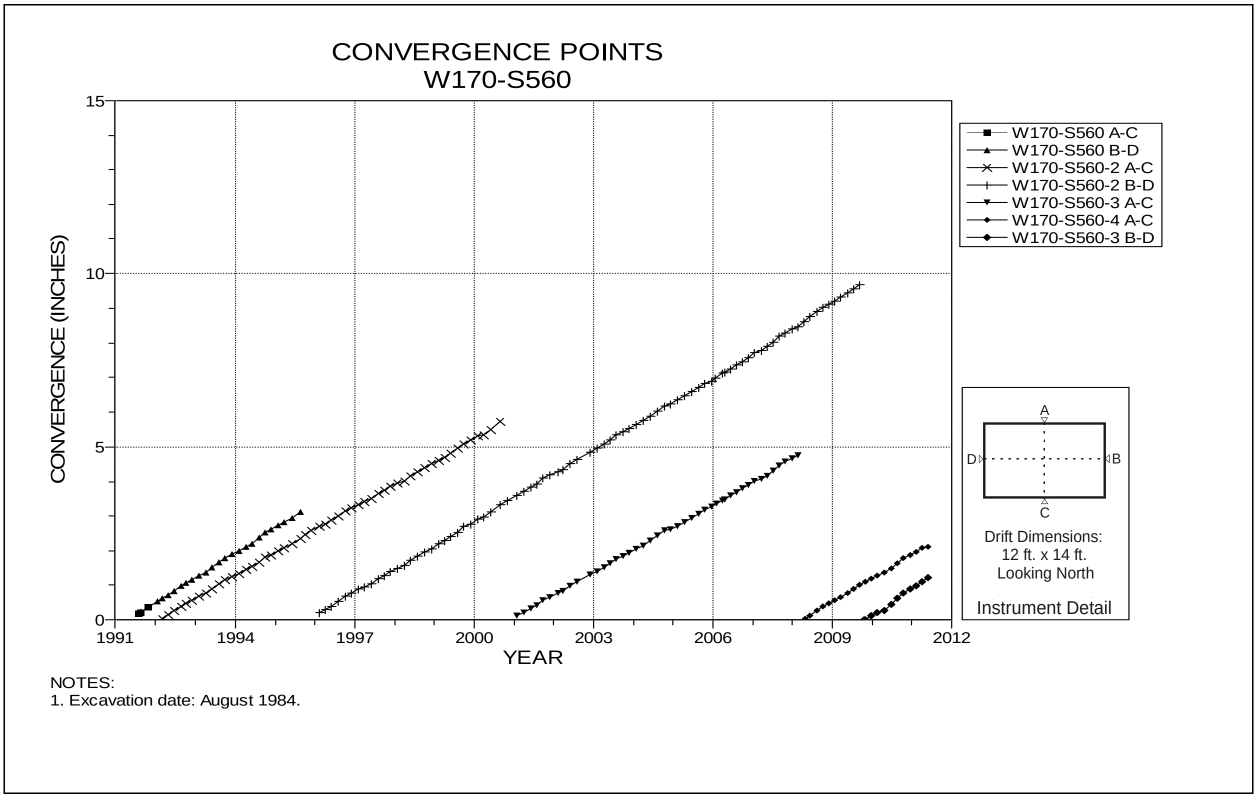


Figure 4-171 Convergence Point Array
W170 S560 – All Chords

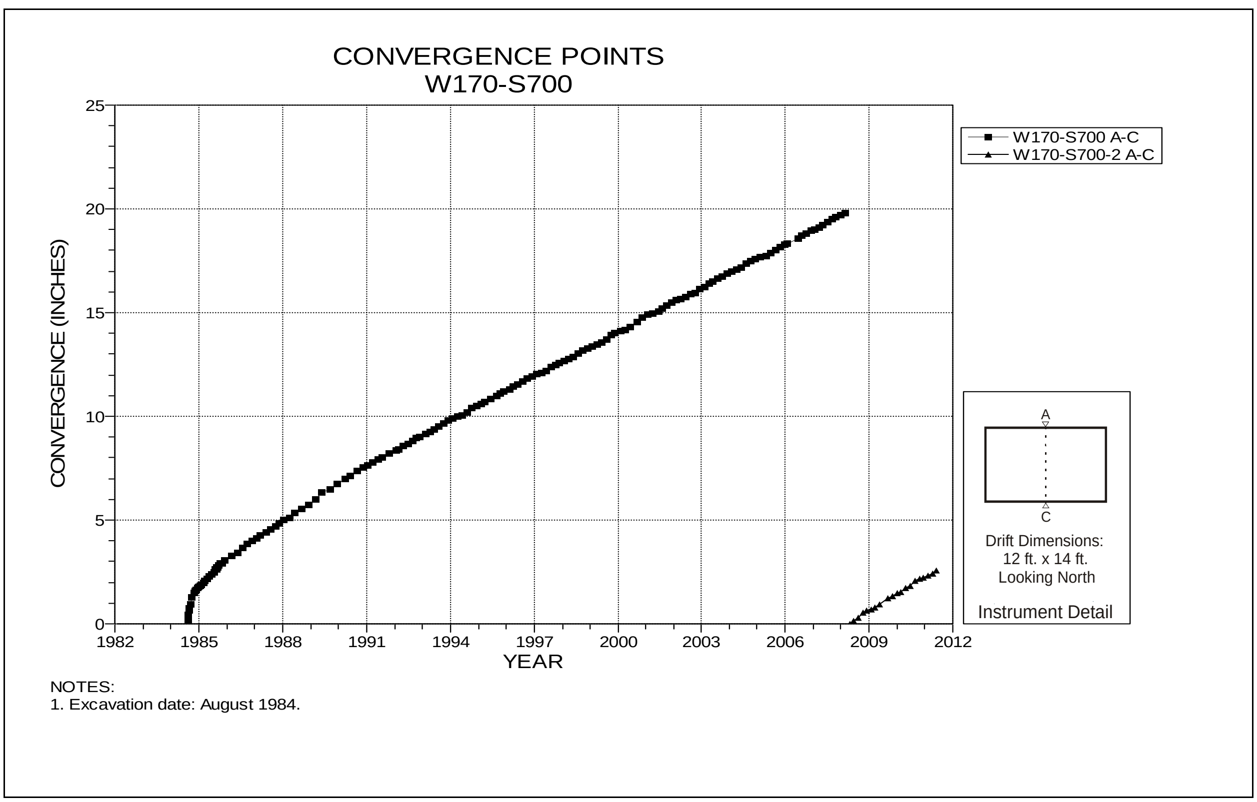


Figure 4-172 Convergence Point Array
W170 S700 – Roof to Floor

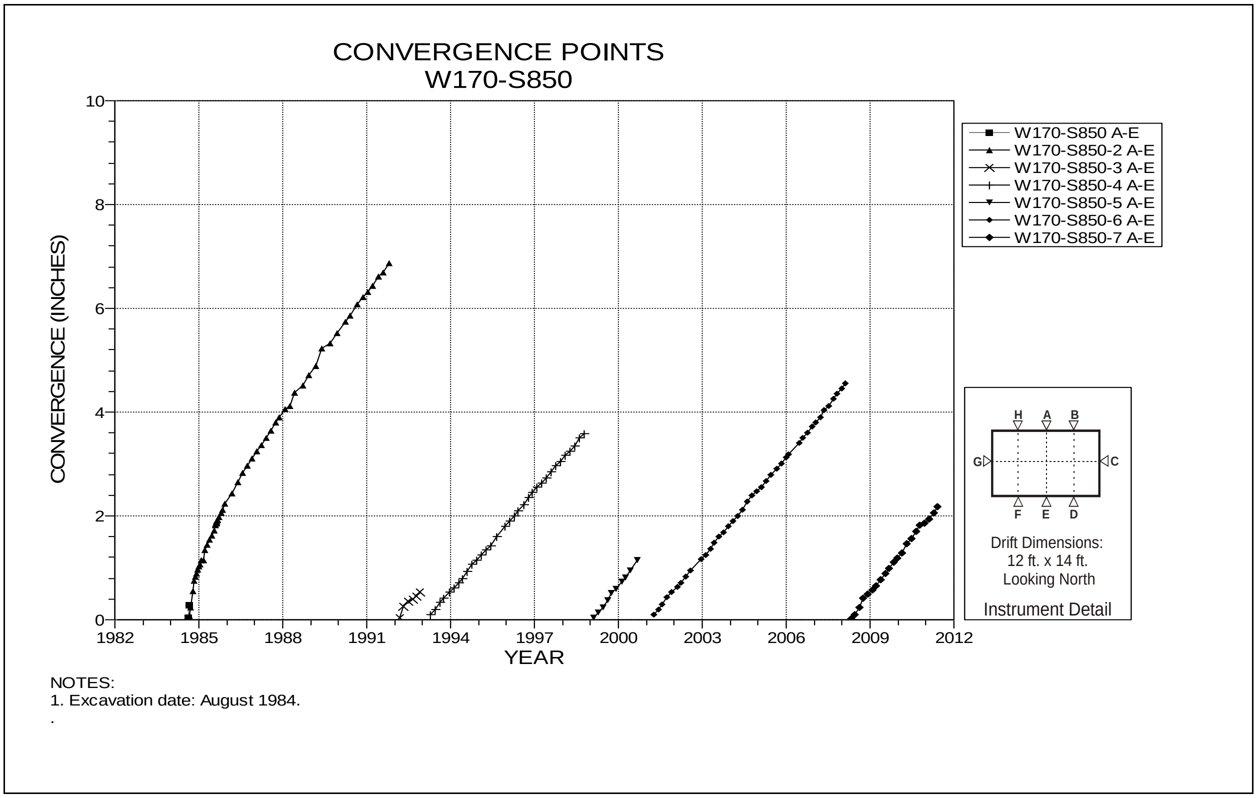


Figure4 -173 Convergence Point Array
W170 S850 – Roof to Floor – Centerline

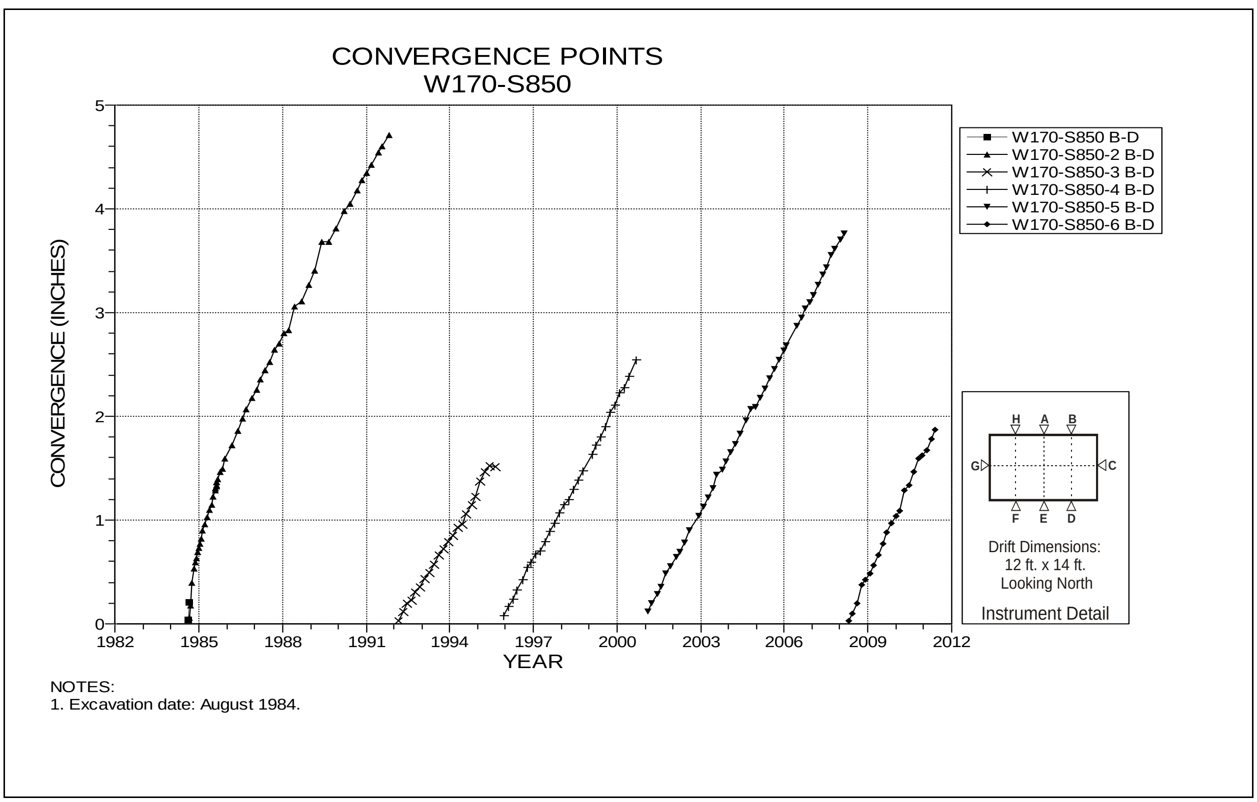


Figure 4-174 Convergence Point Array
W170 S850 – Roof to Floor – East Quarter Point

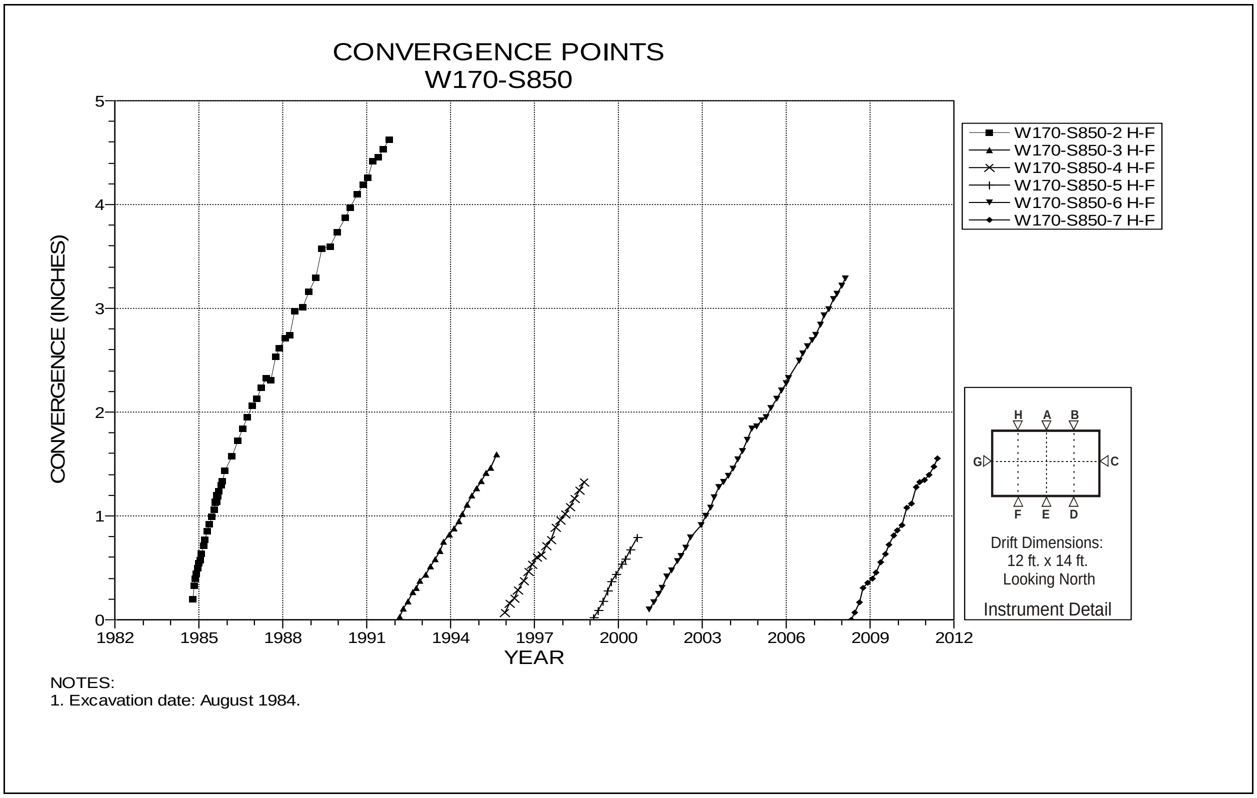


Figure 4-175 Convergence Point Array
W170 S850 – Roof to Floor – West Quarter Point

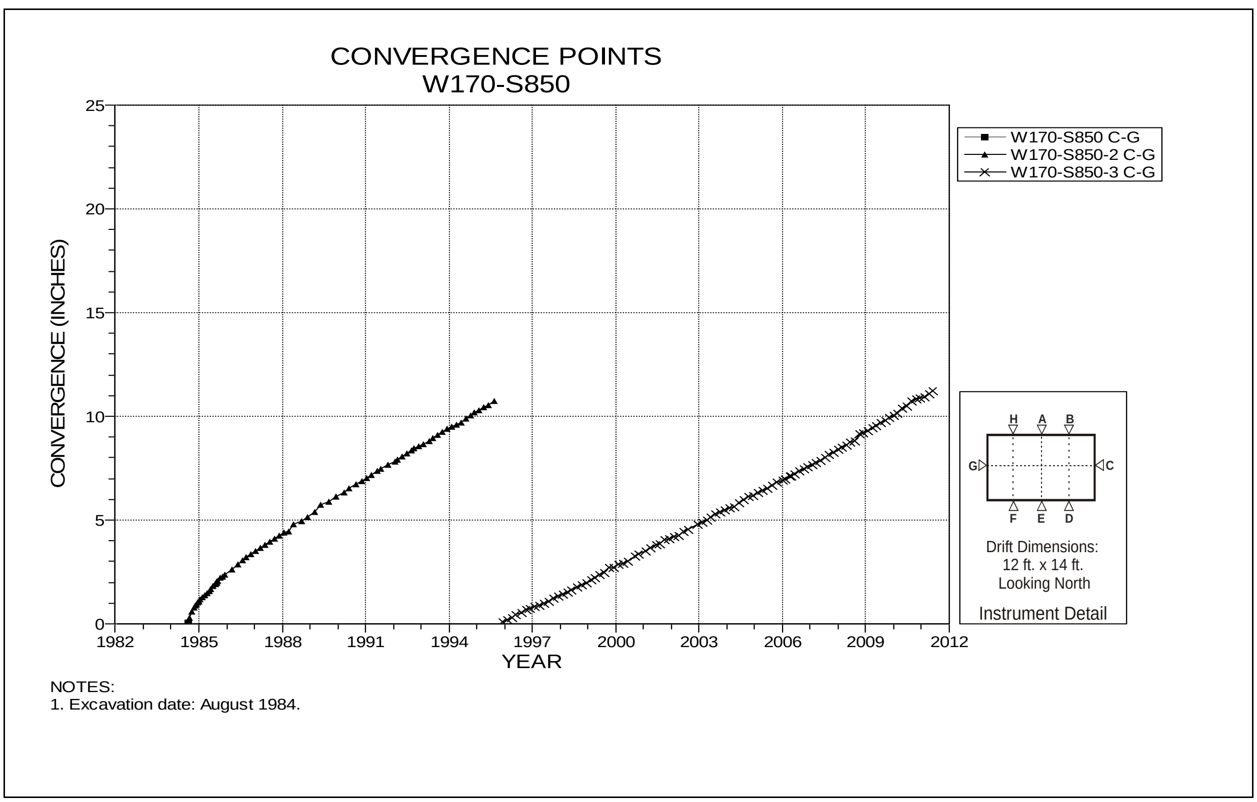


Figure 4-176 Convergence Point Array
W170 S850 – Rib to Rib

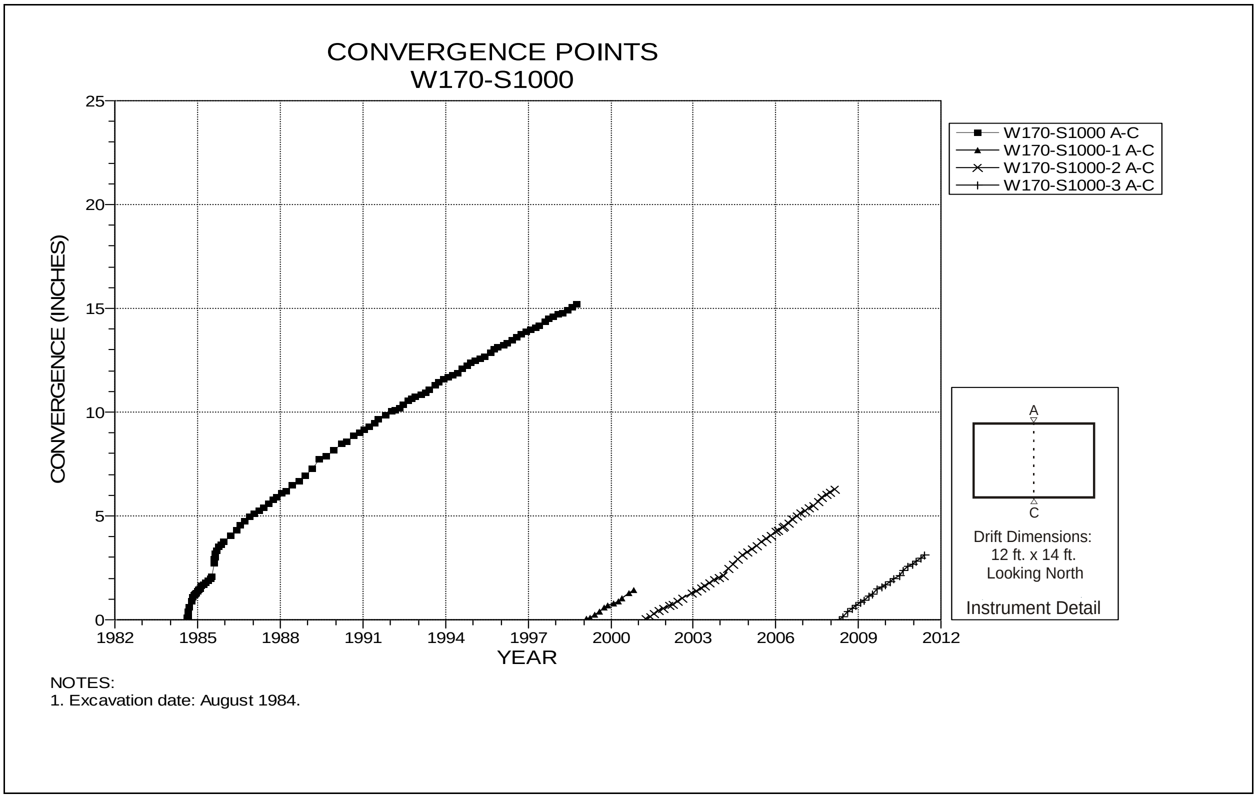


Figure 4-177 Convergence Point Array
W170 S1000 – Roof to Floor

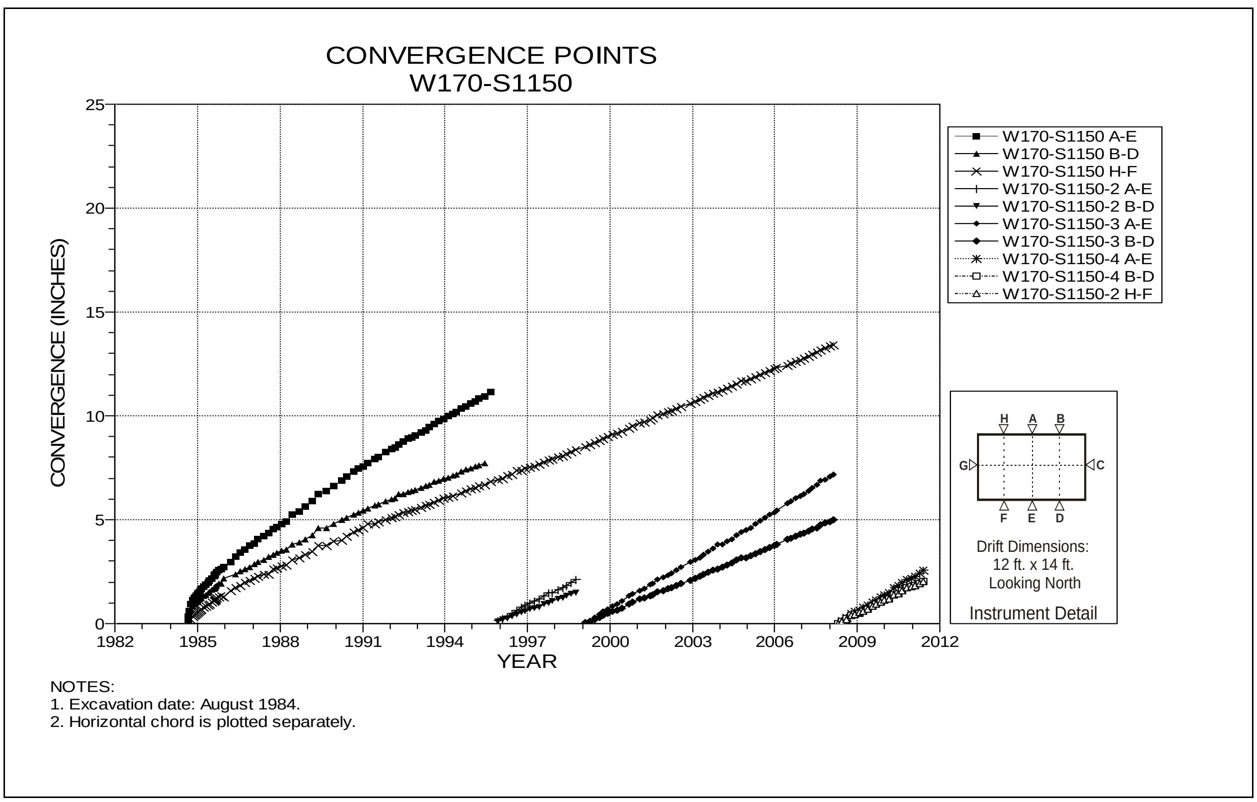


Figure 4-178 Convergence Point Array
W170 S1150 – Roof to Floor – Quarter Points

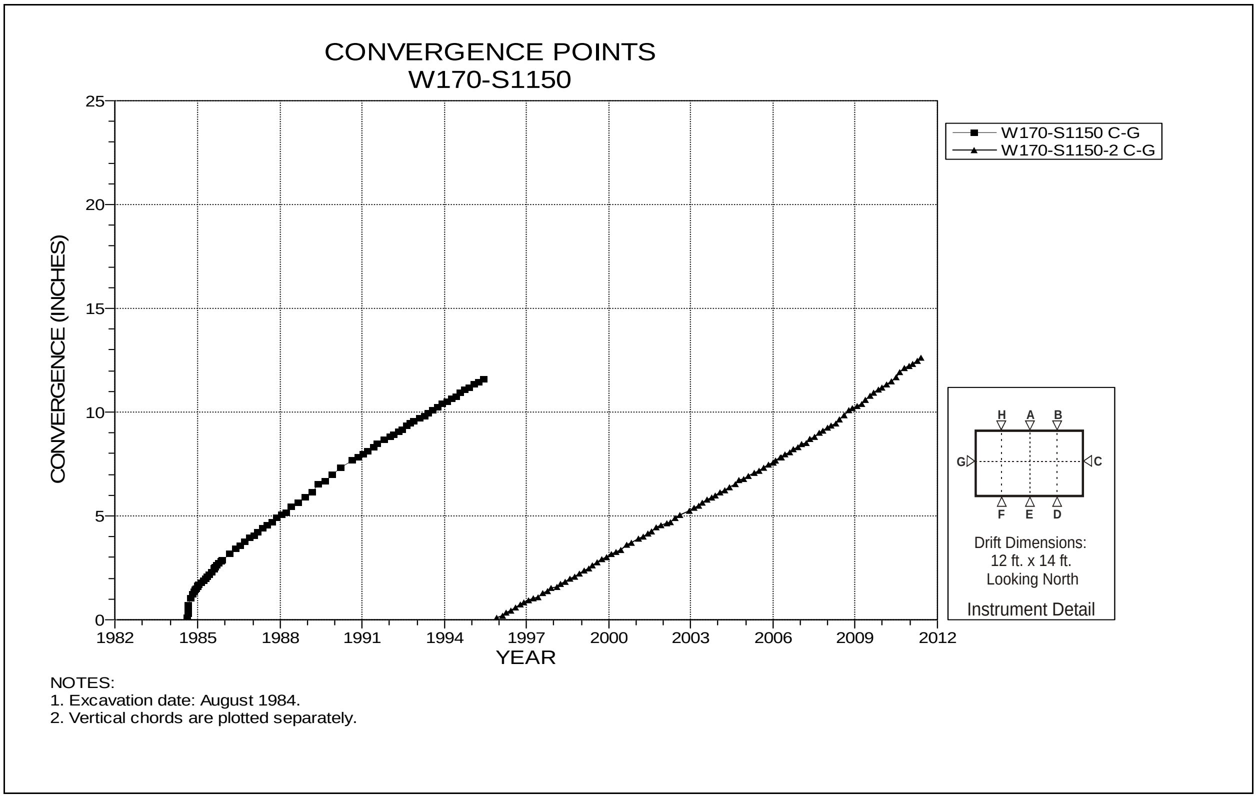


Figure 4-179 Convergence Point Array
W170 S1150 – Rib to Rib

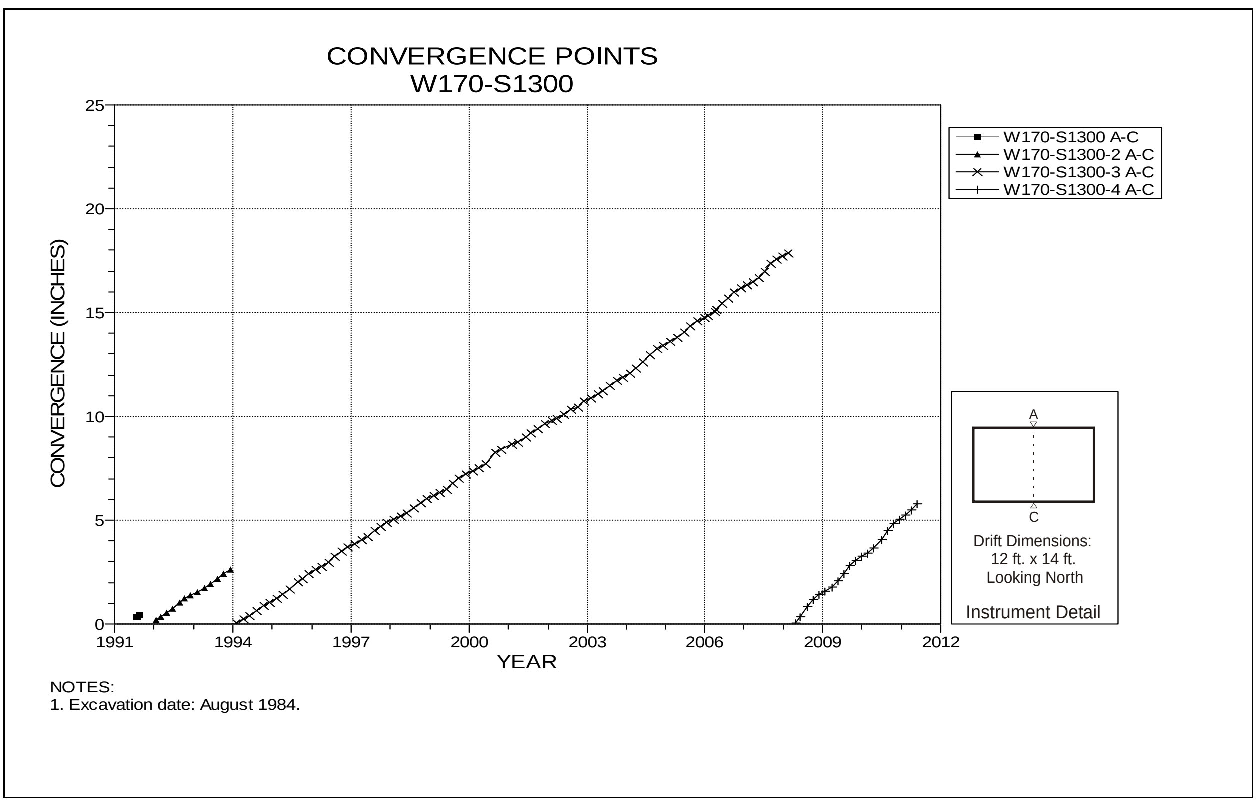


Figure 4-180 Convergence Point Array
W170 S1300 – Roof to Floor

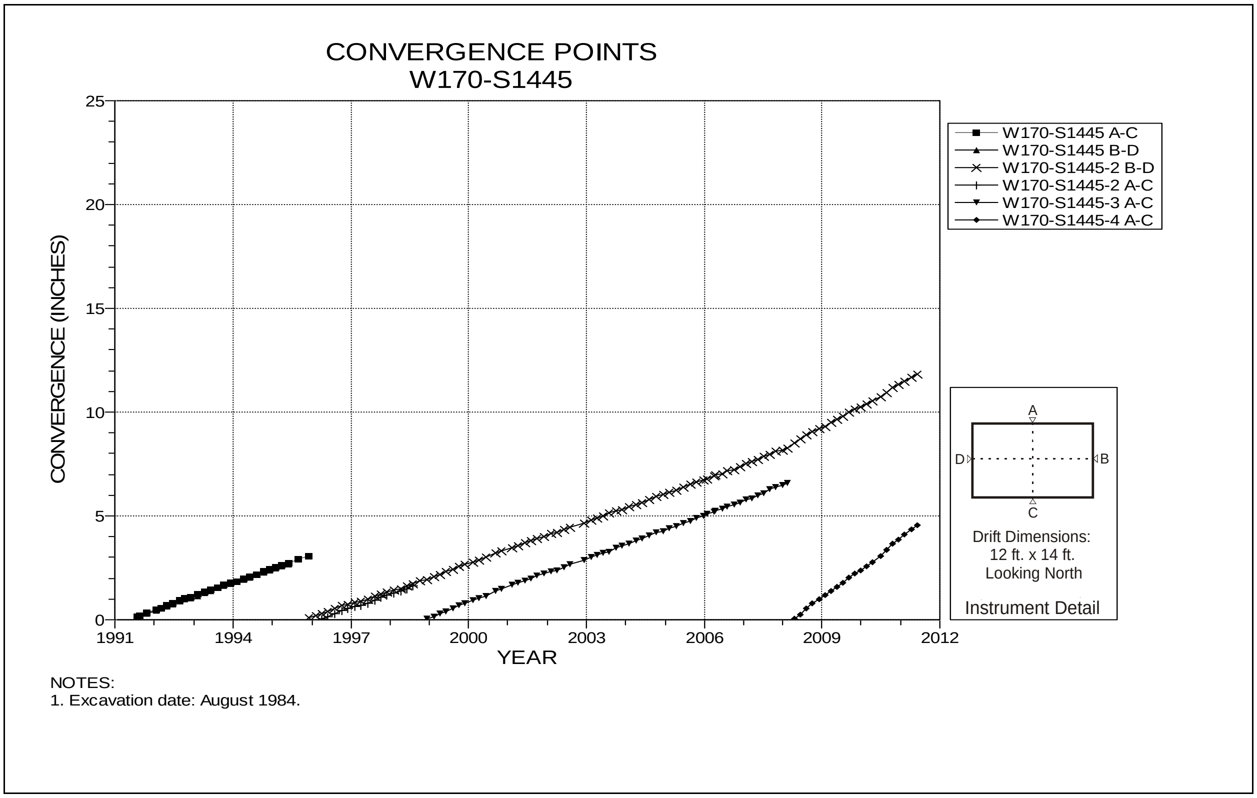


Figure 4-181 Convergence Point Array
W170 S1445 – All Chords

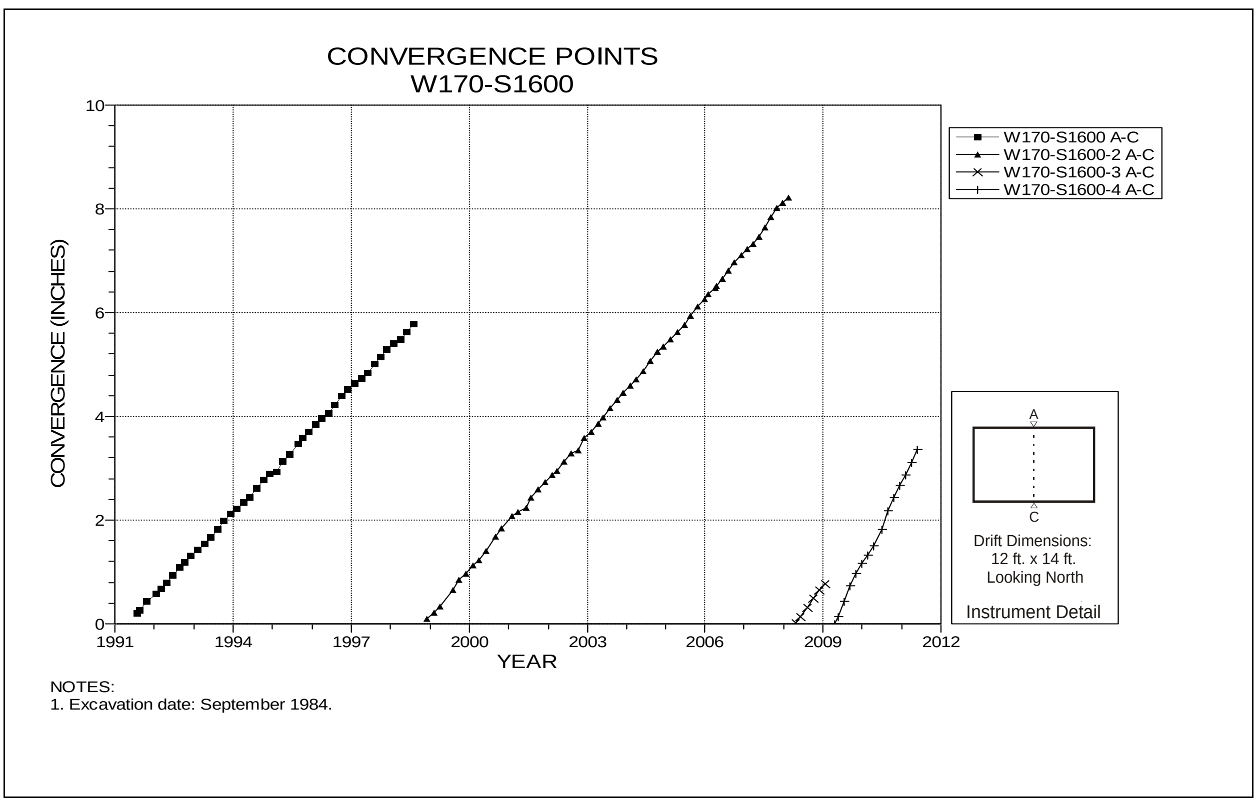


Figure 4-182 Convergence Point Array
W170 S1600 – Roof to Floor

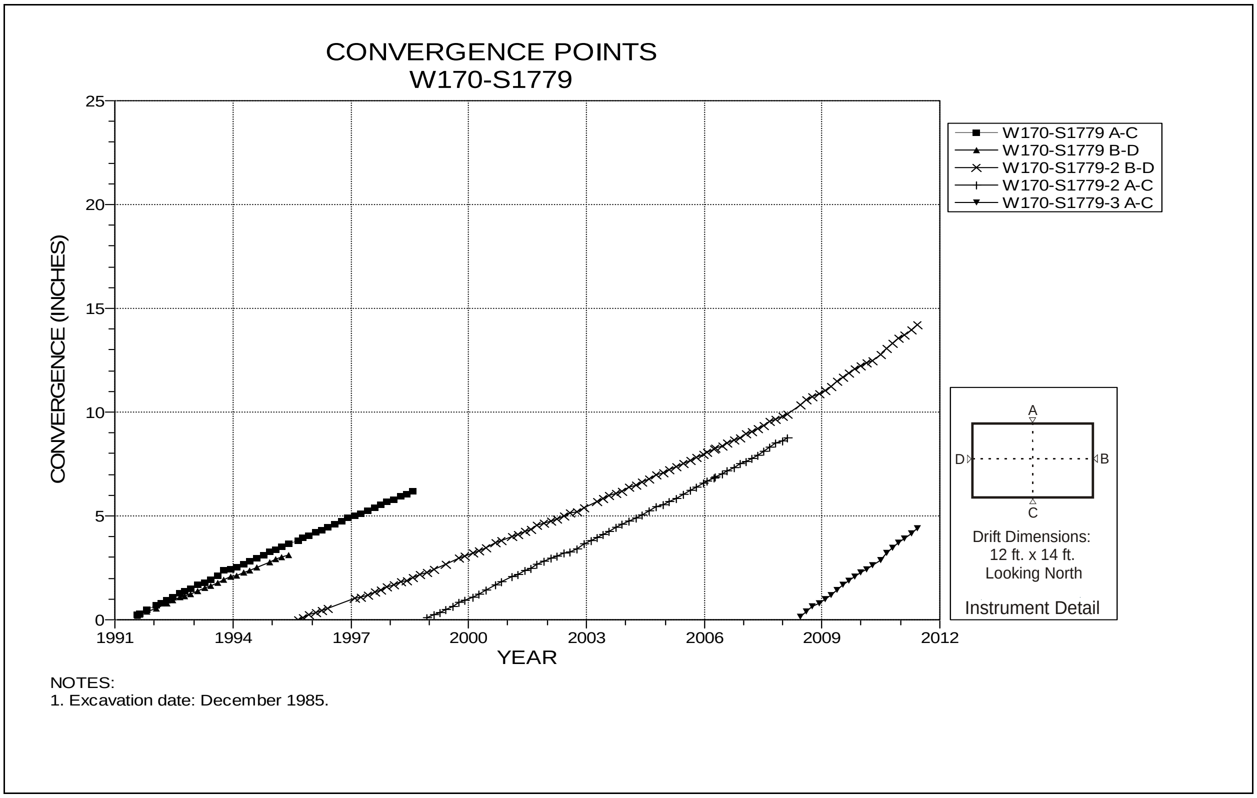


Figure 4-183 Convergence Point Array
W170 S1779 – All Chords

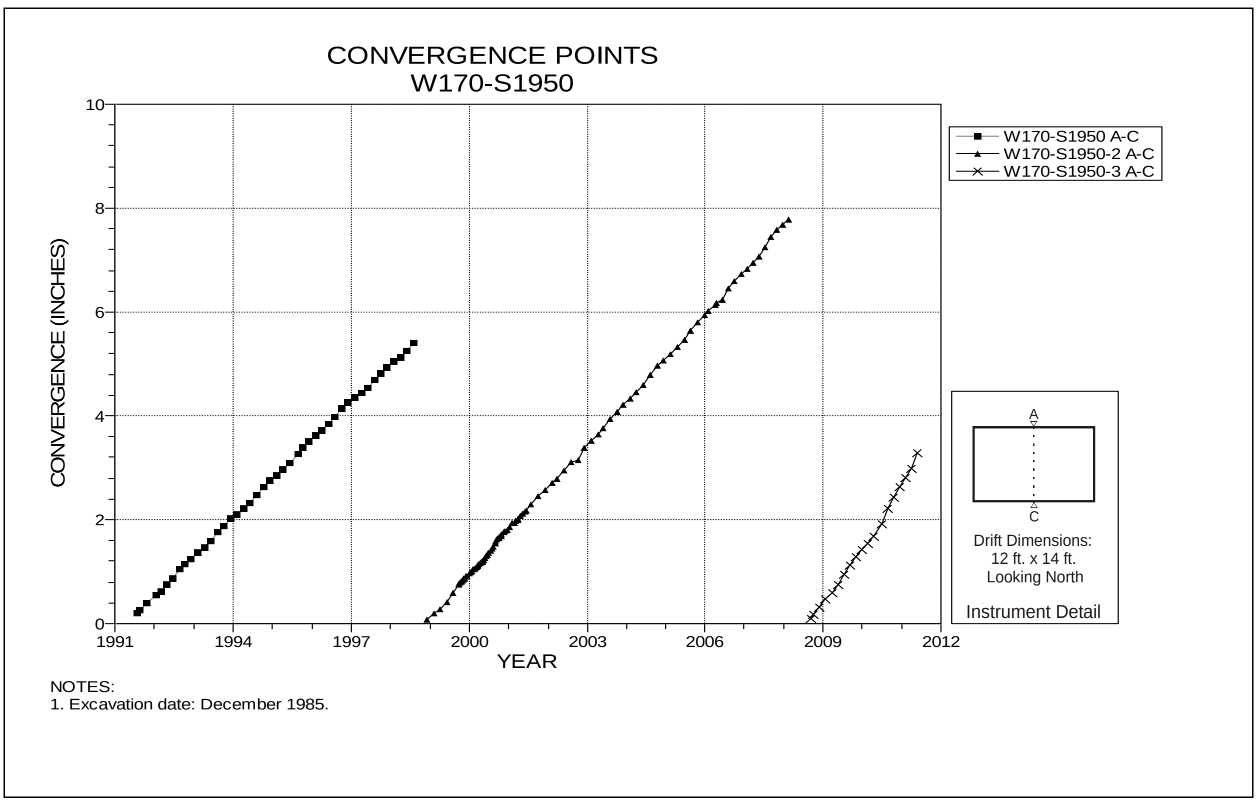


Figure 4-184 Convergence Point Array
W170 S1950 – Roof to Floor

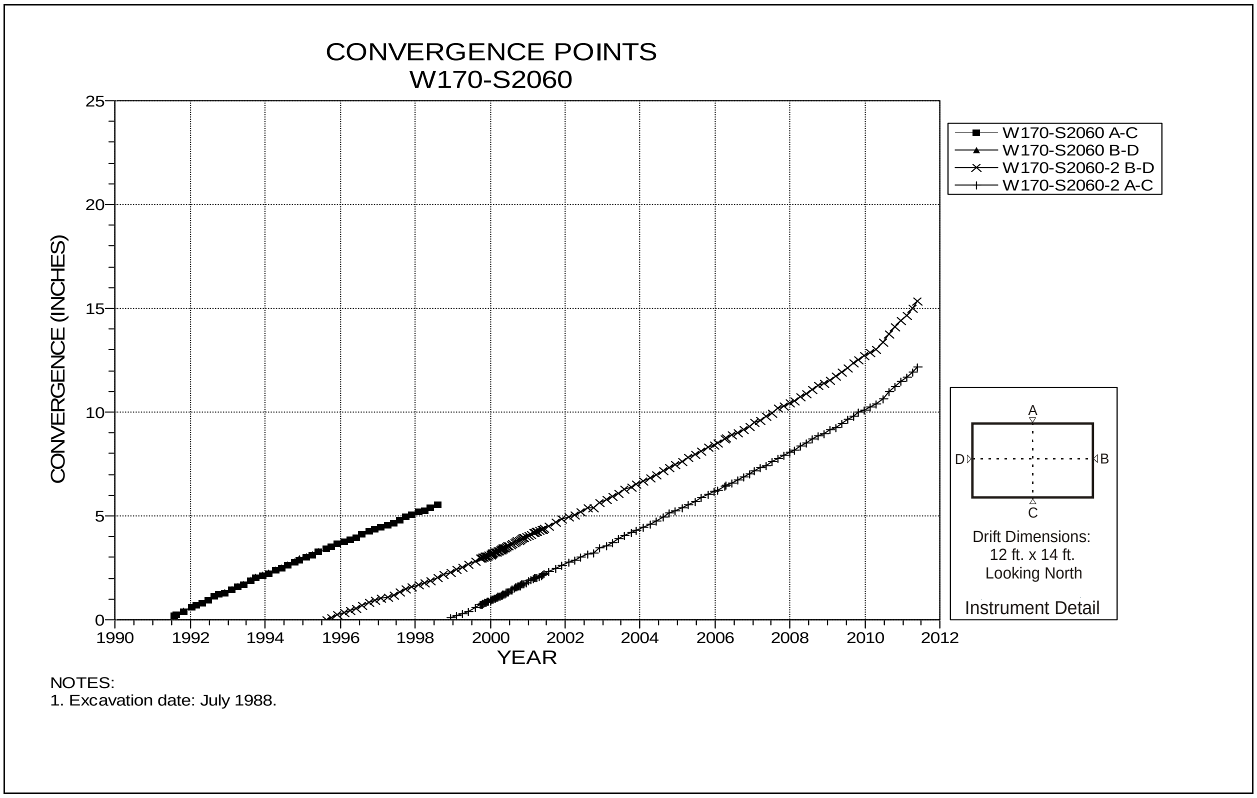


Figure 4-185 Convergence Point Array
W170 S2060 – All Chords

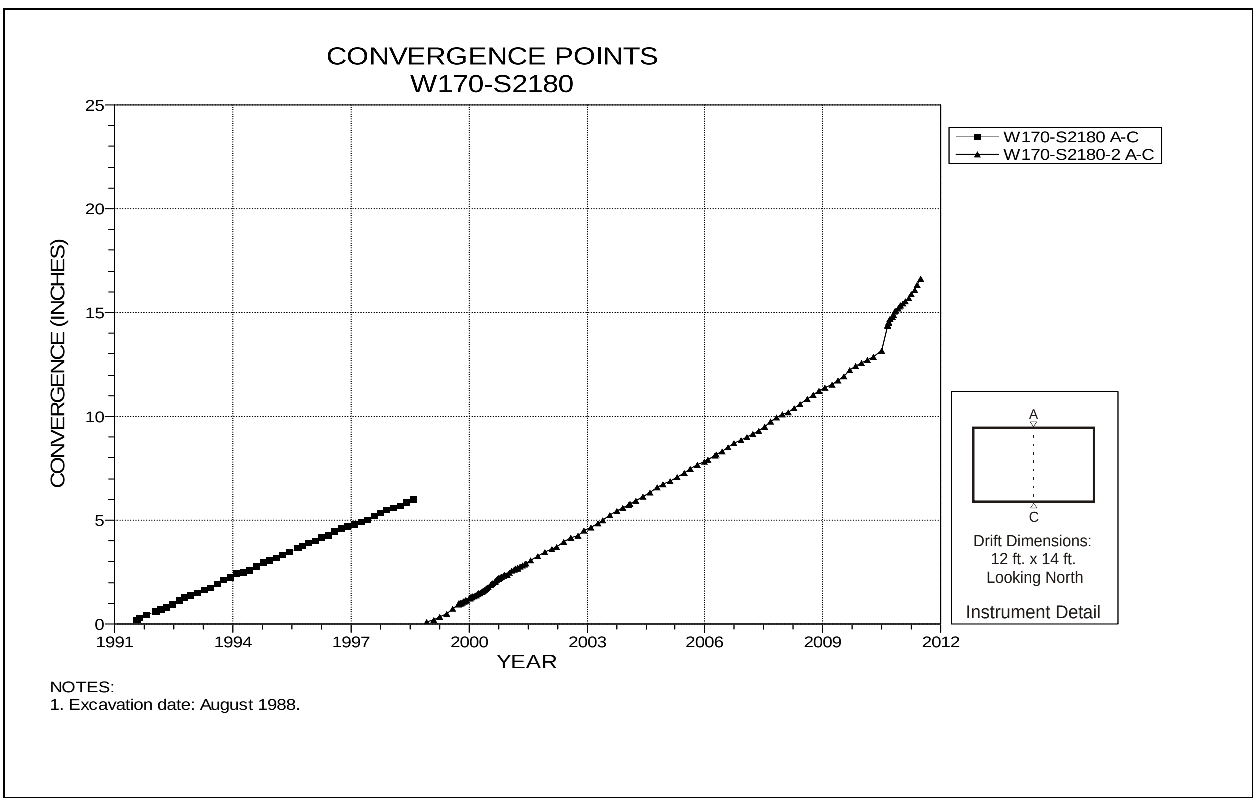


Figure 4-186 Convergence Point Array
W170 S2180 – Roof to Floor

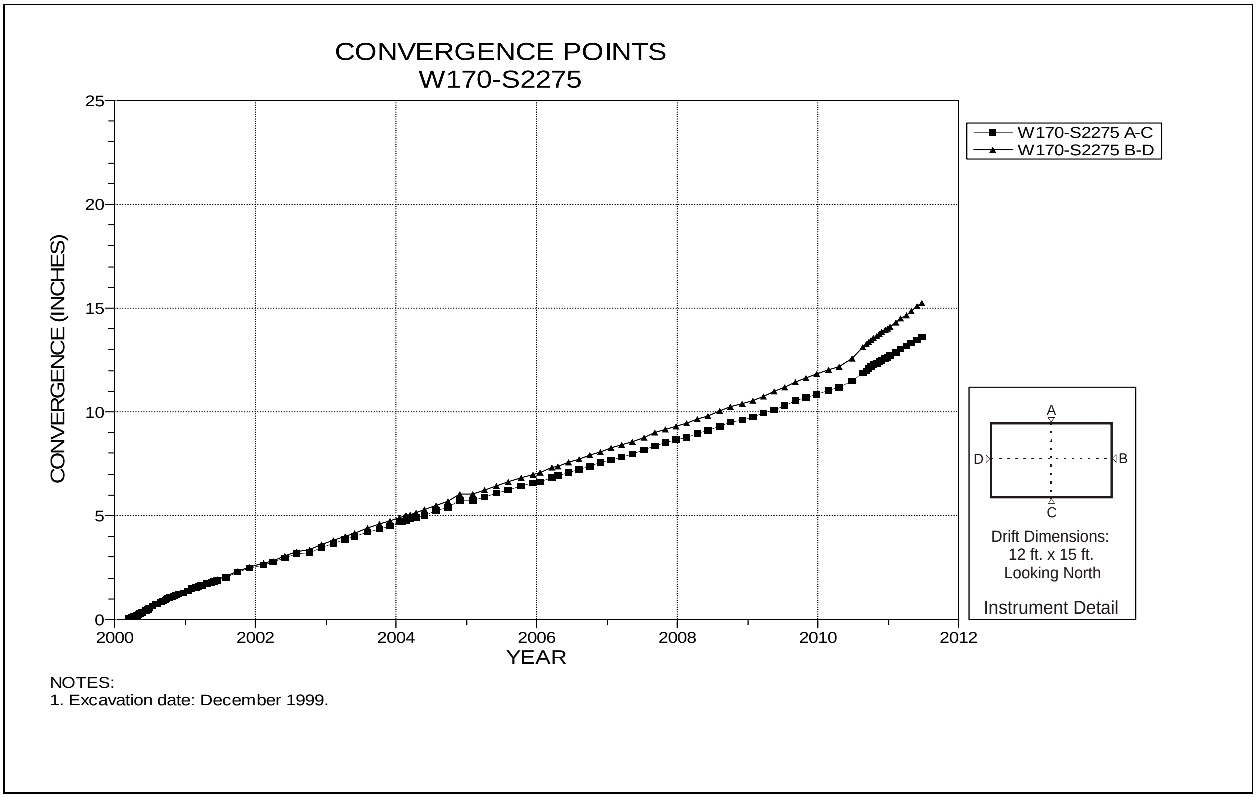


Figure 4-187 Convergence Point Array
W170 S2275 – All Chords

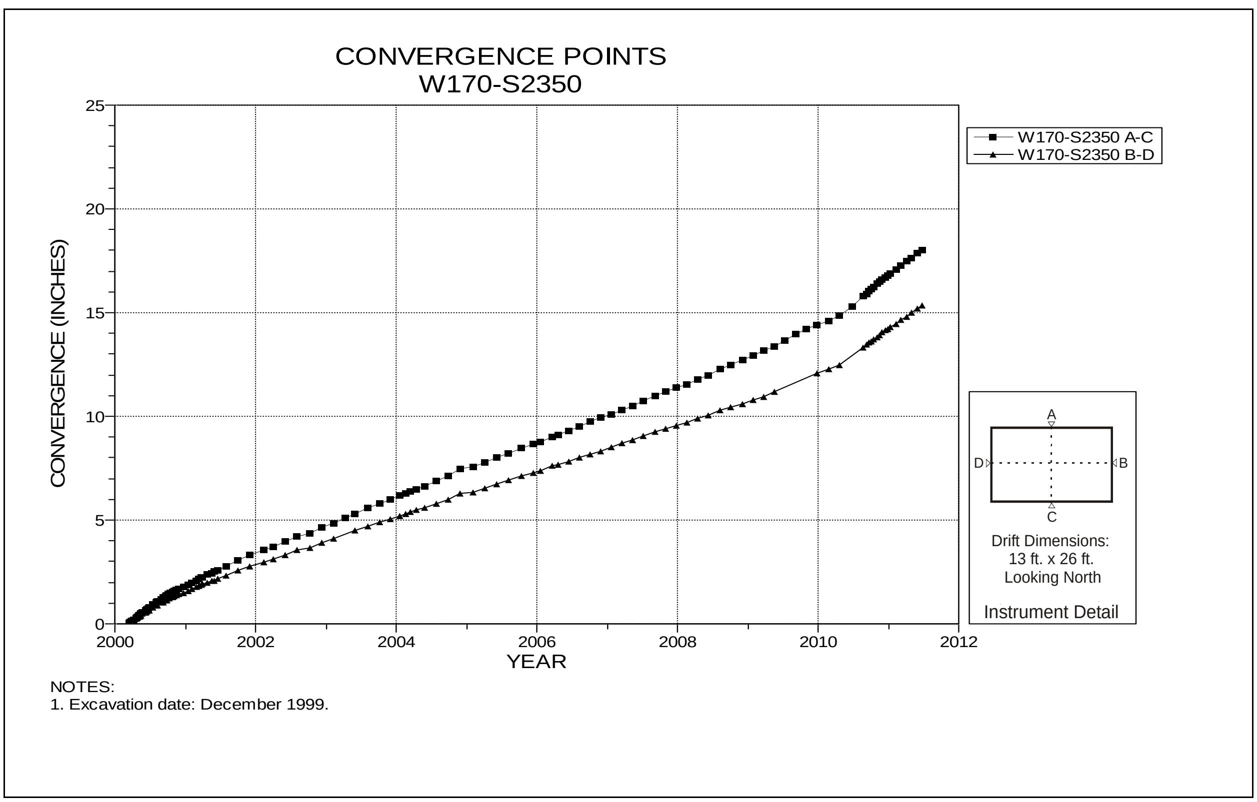


Figure 4-188 Convergence Point Array
W170 S2350 – All Chords

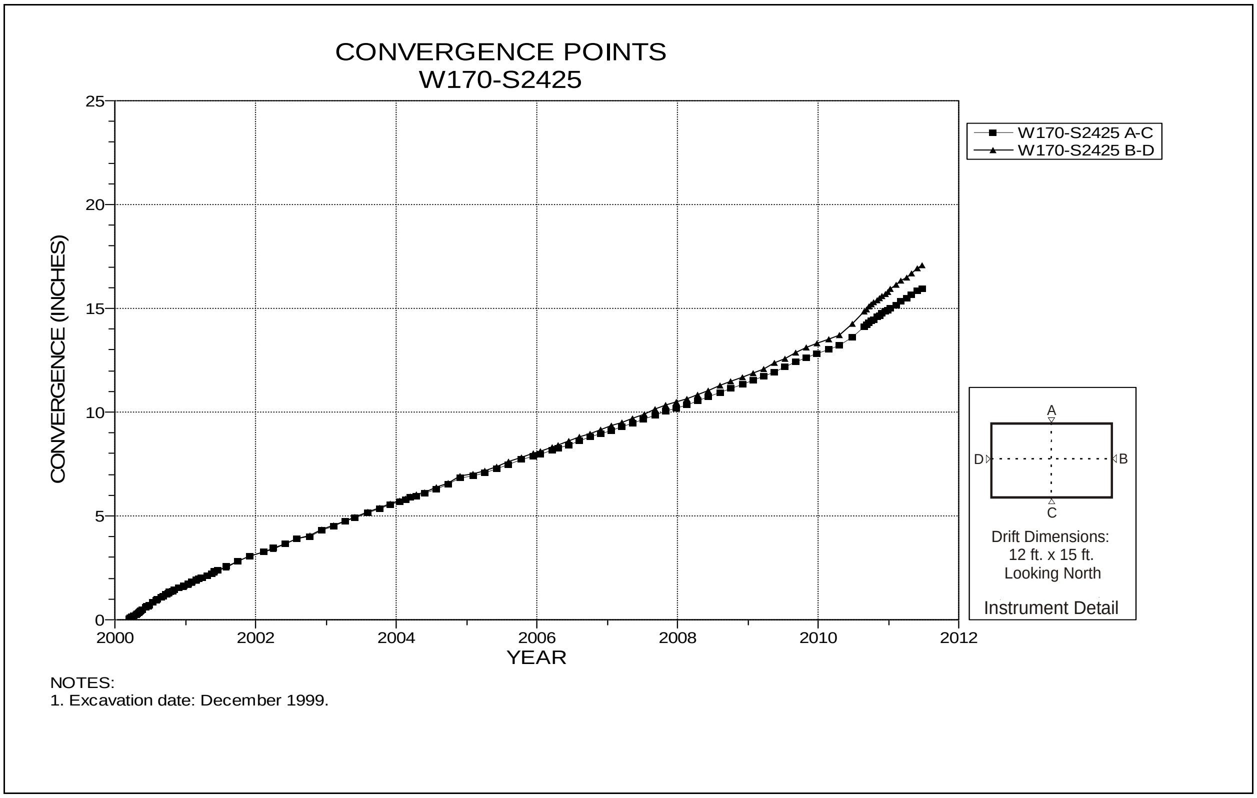


Figure 4-189 Convergence Point Array
W170 S2425 – All Chords

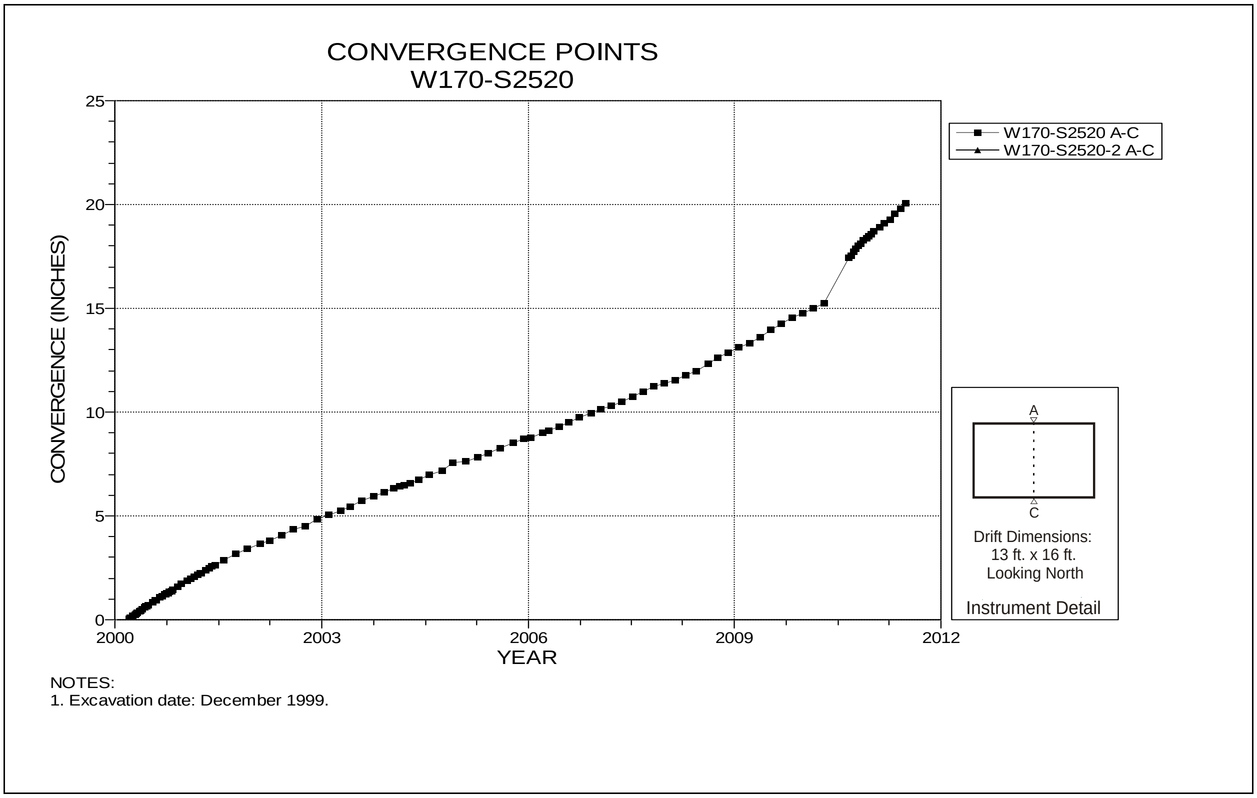


Figure 4-190 Convergence Point Array
W170 S2520 – Roof to Floor

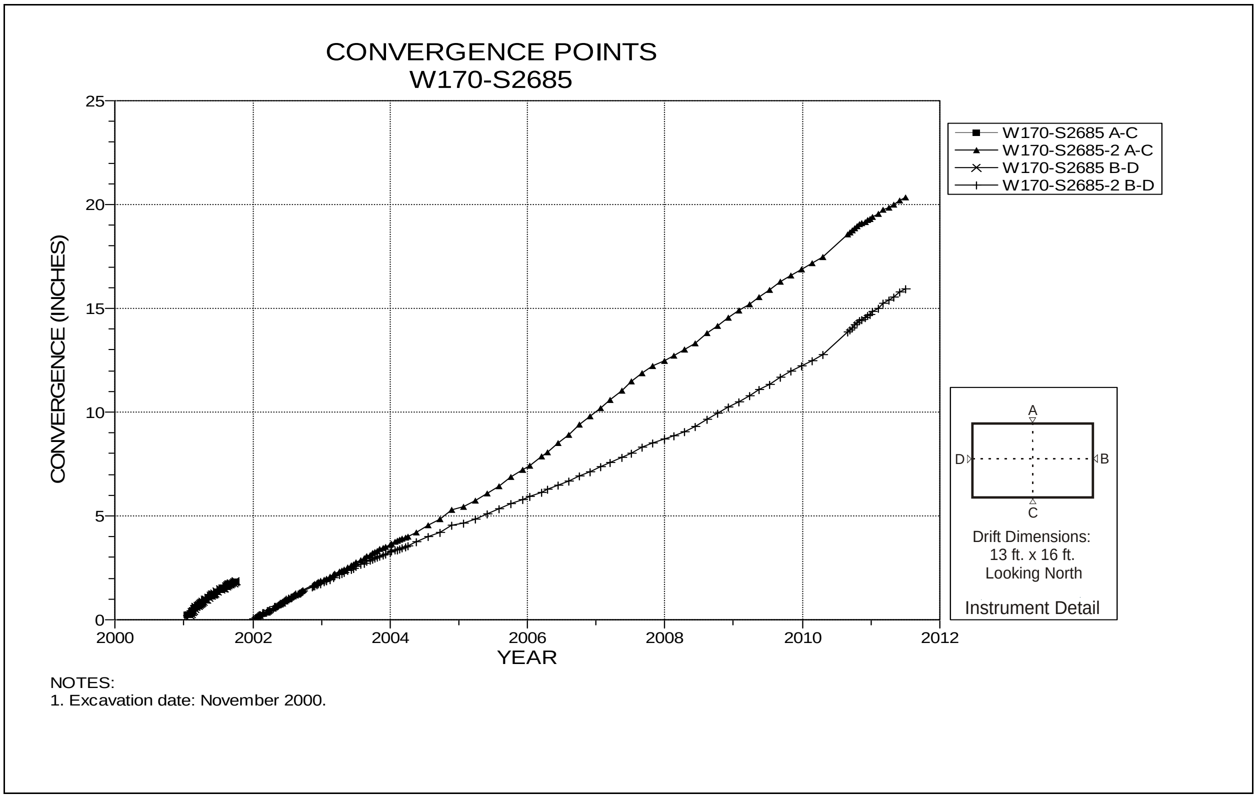


Figure 4-191 Convergence Point Array
W170 S2685 – All Chords

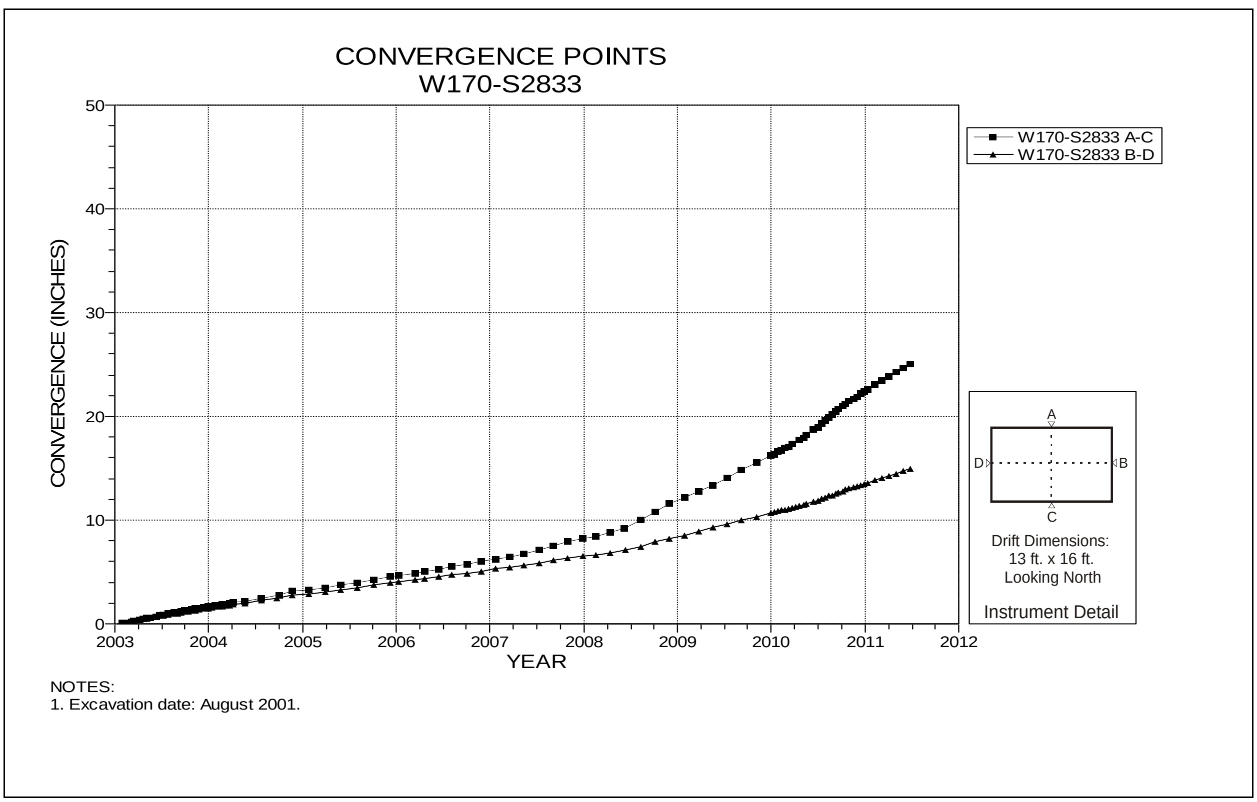


Figure 4-192 Convergence Point Array
W170 S2833 – All Chords

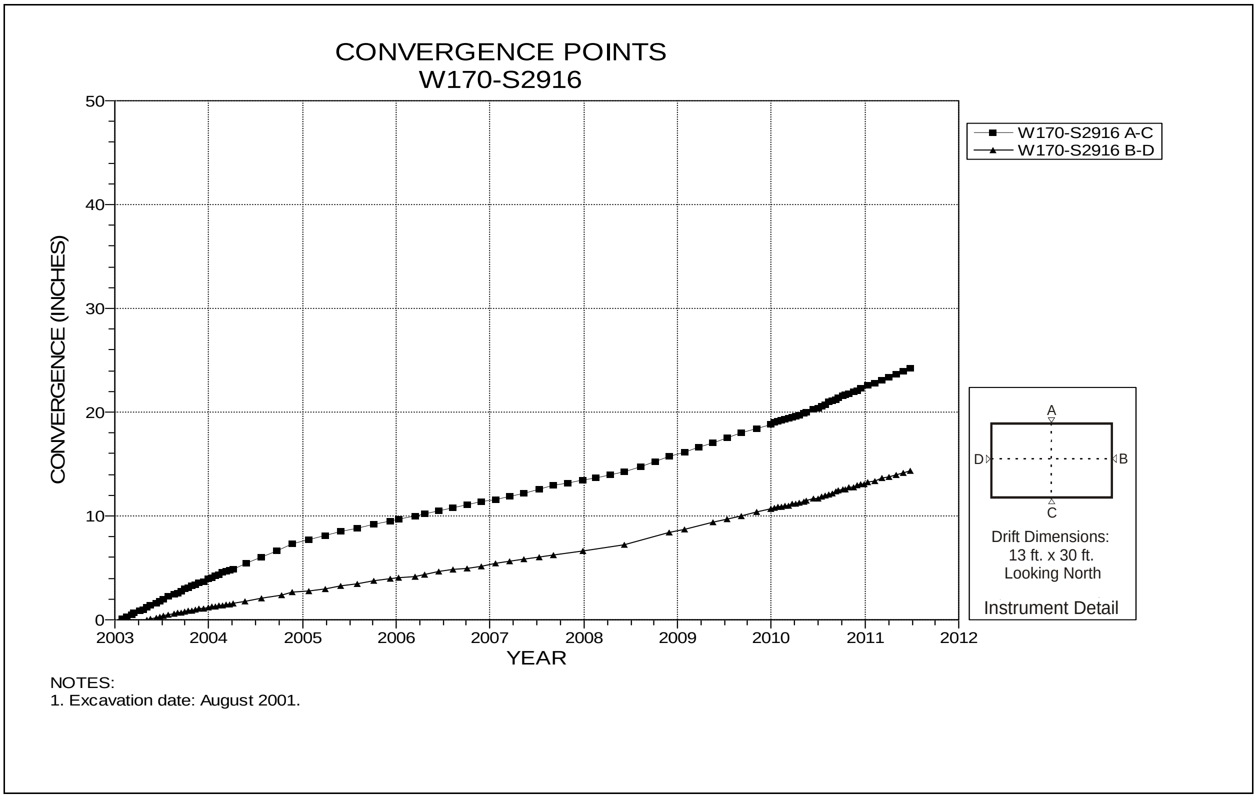


Figure 4-193 Convergence Point Array
W170 S2916 – All Chords

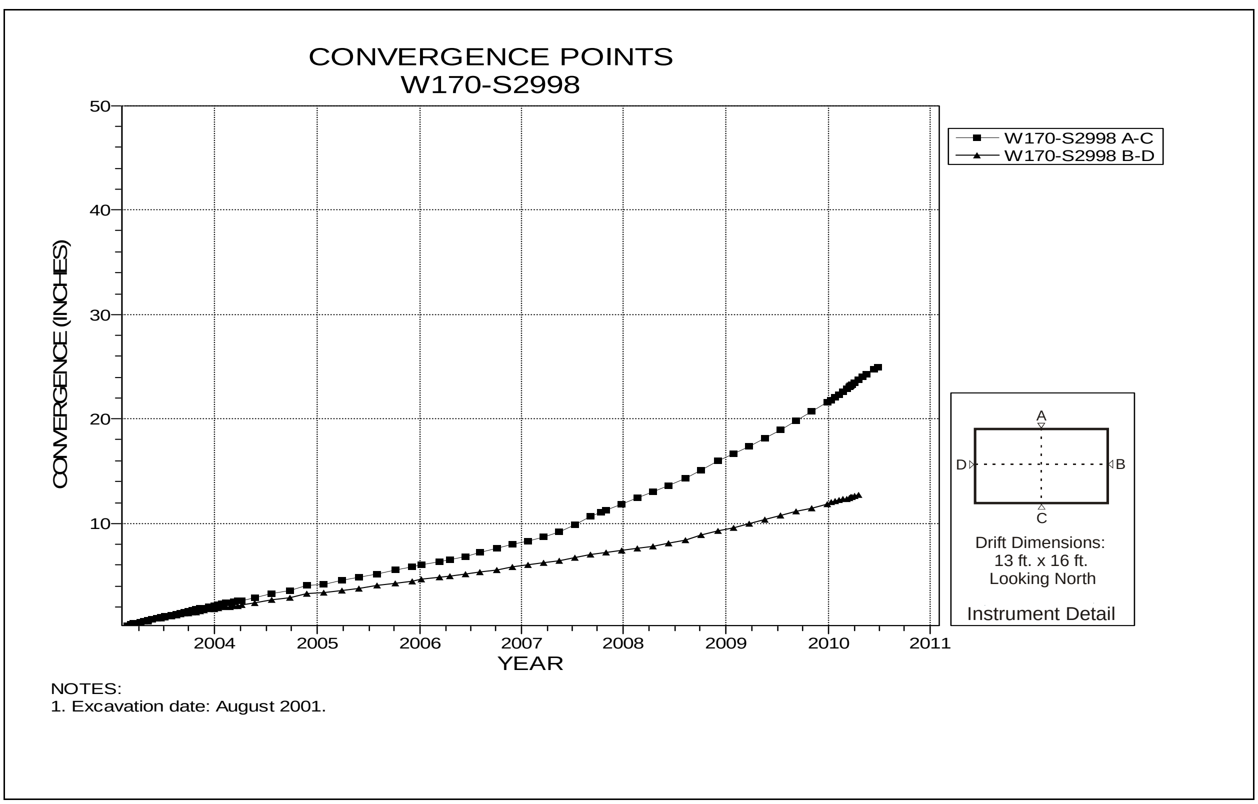


Figure 4-194 Convergence Point Array
W170 S2998 – All Chords

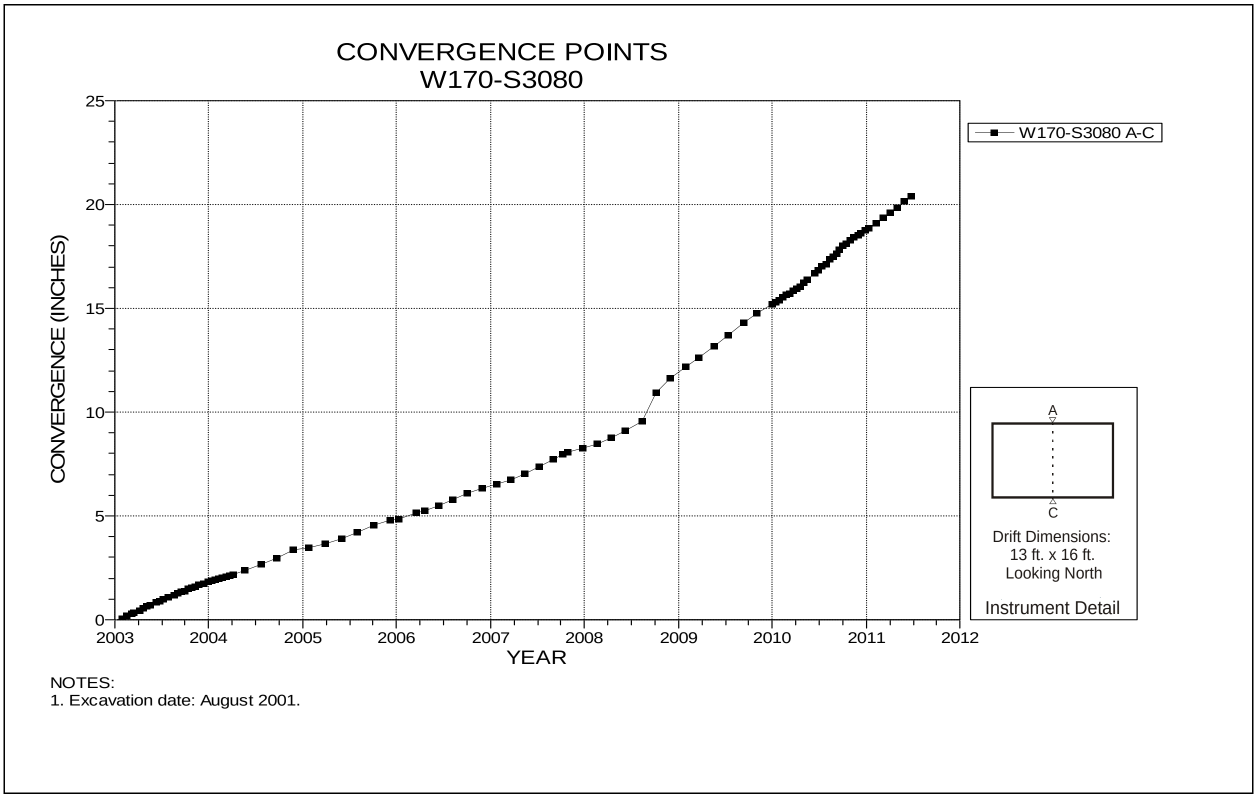


Figure 4-195 Convergence Point Array
W170 S3080 – Roof to Floor

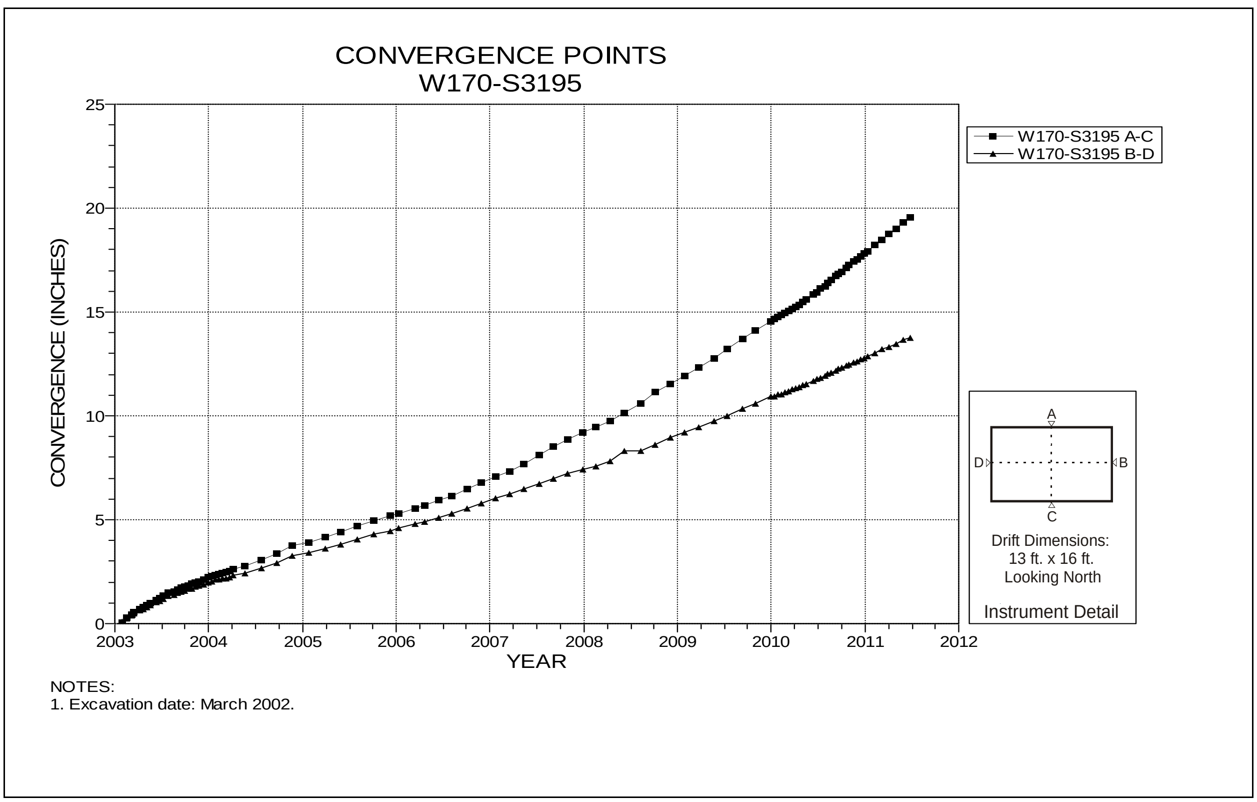


Figure 4-196 Convergence Point Array
W170 S3195 – All Chords

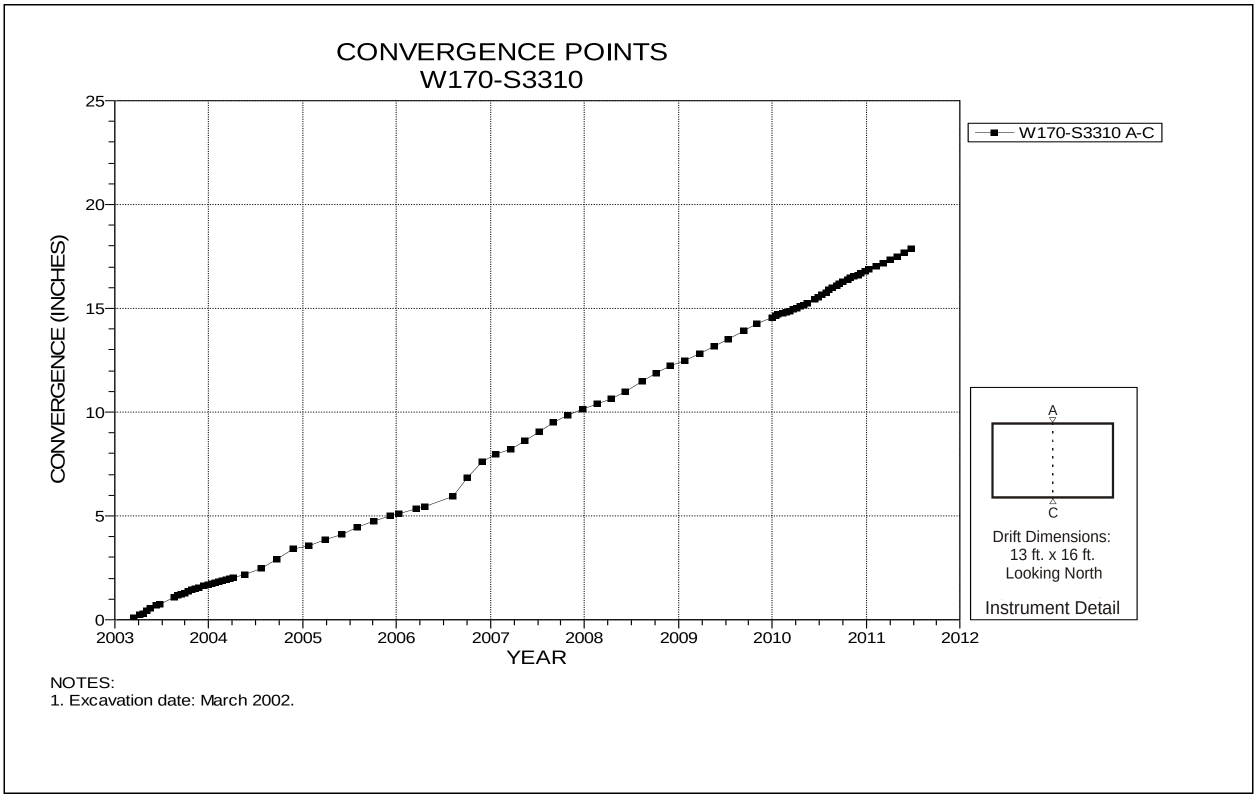


Figure 4-197 Convergence Point Array
W170 S3310 – Roof to Floor

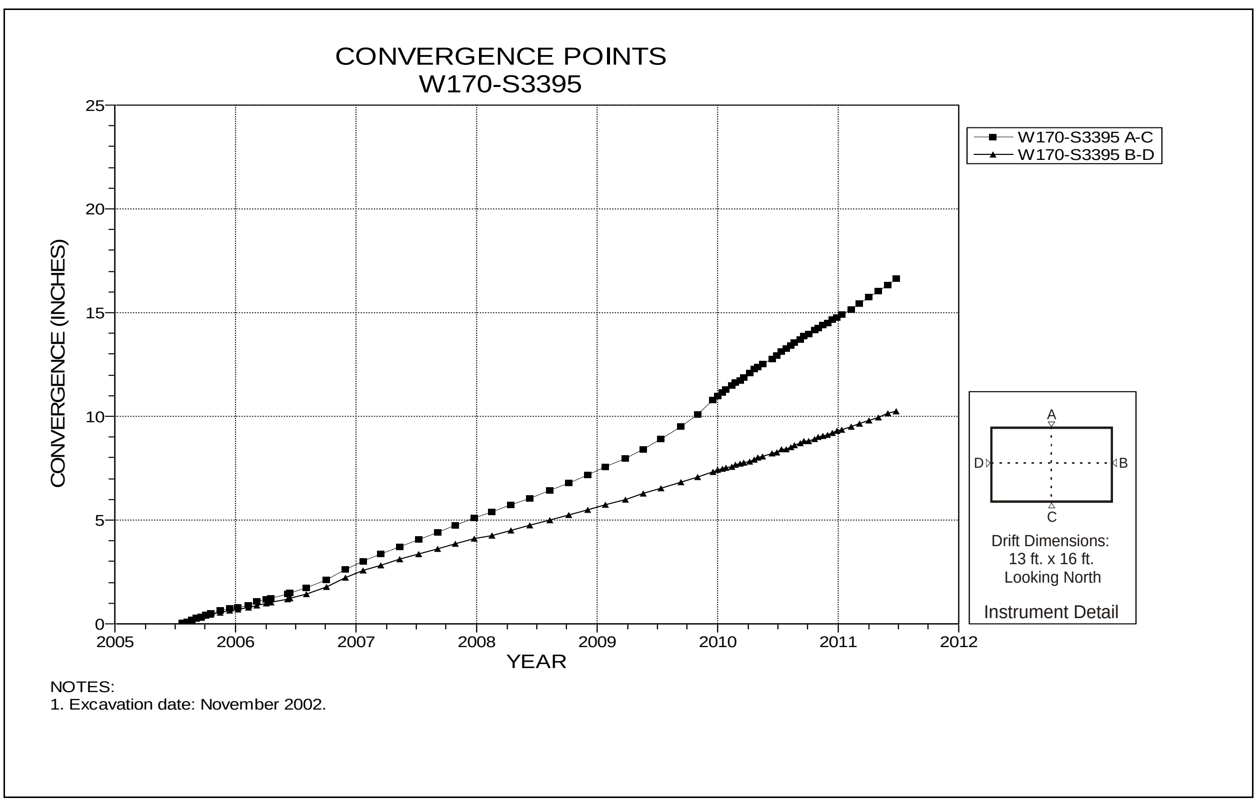


Figure 4-198 Convergence Point Array
W170 S3395 – All Chords

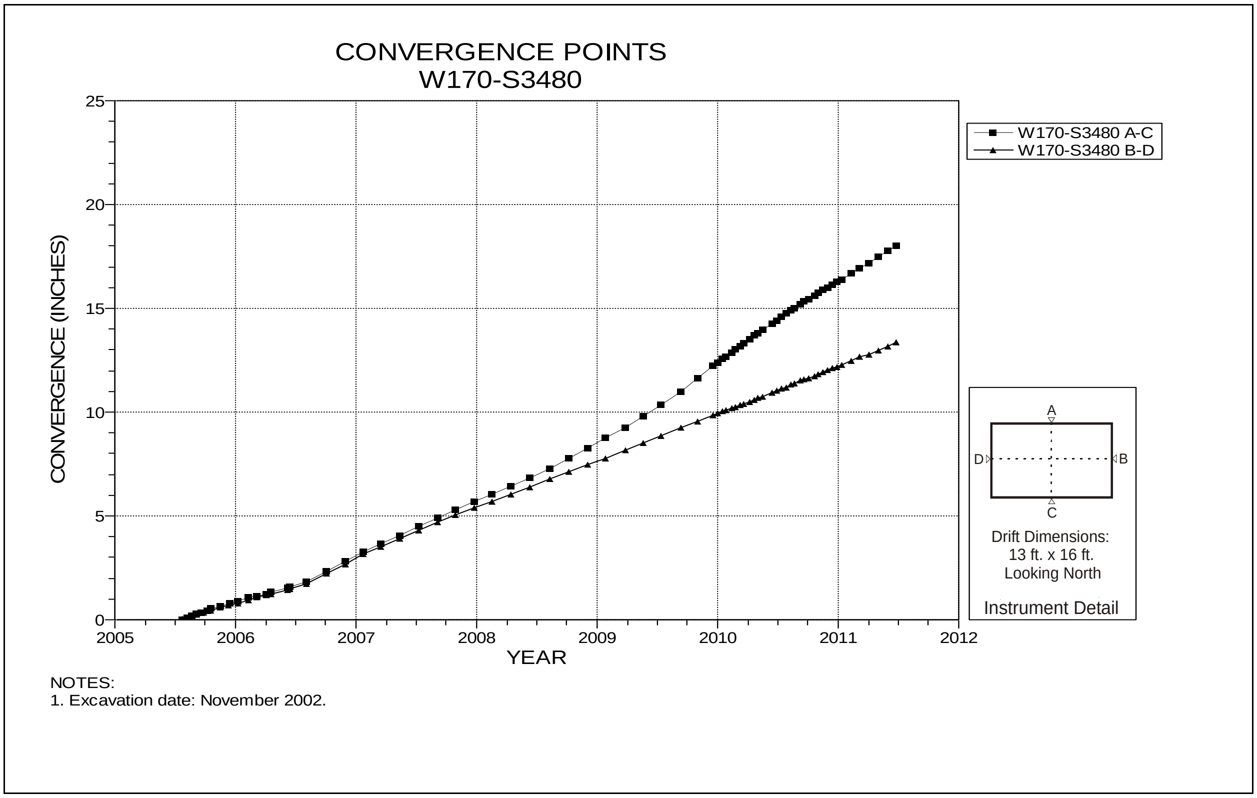


Figure 4-199 Convergence Point Array
W170 S3480 – All Chords

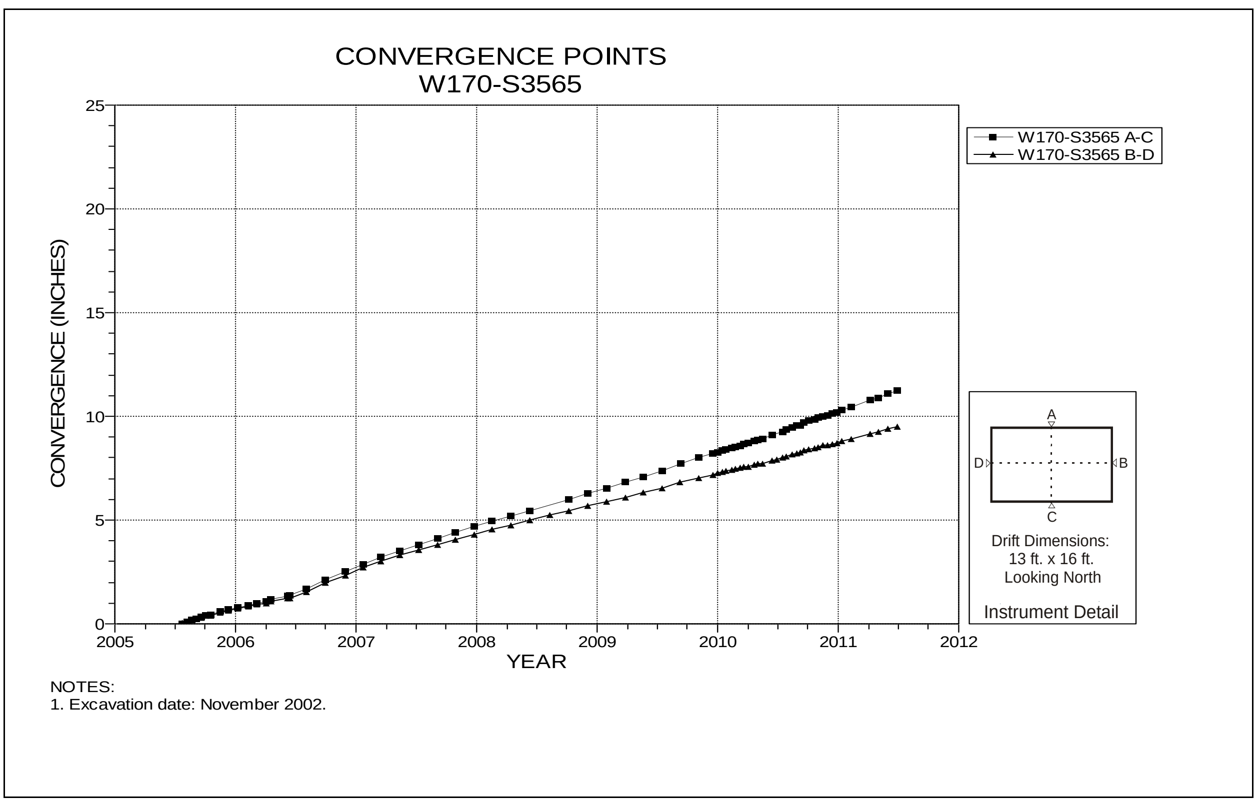


Figure 4-200 Convergence Point Array
W170 S3565 – All Chords

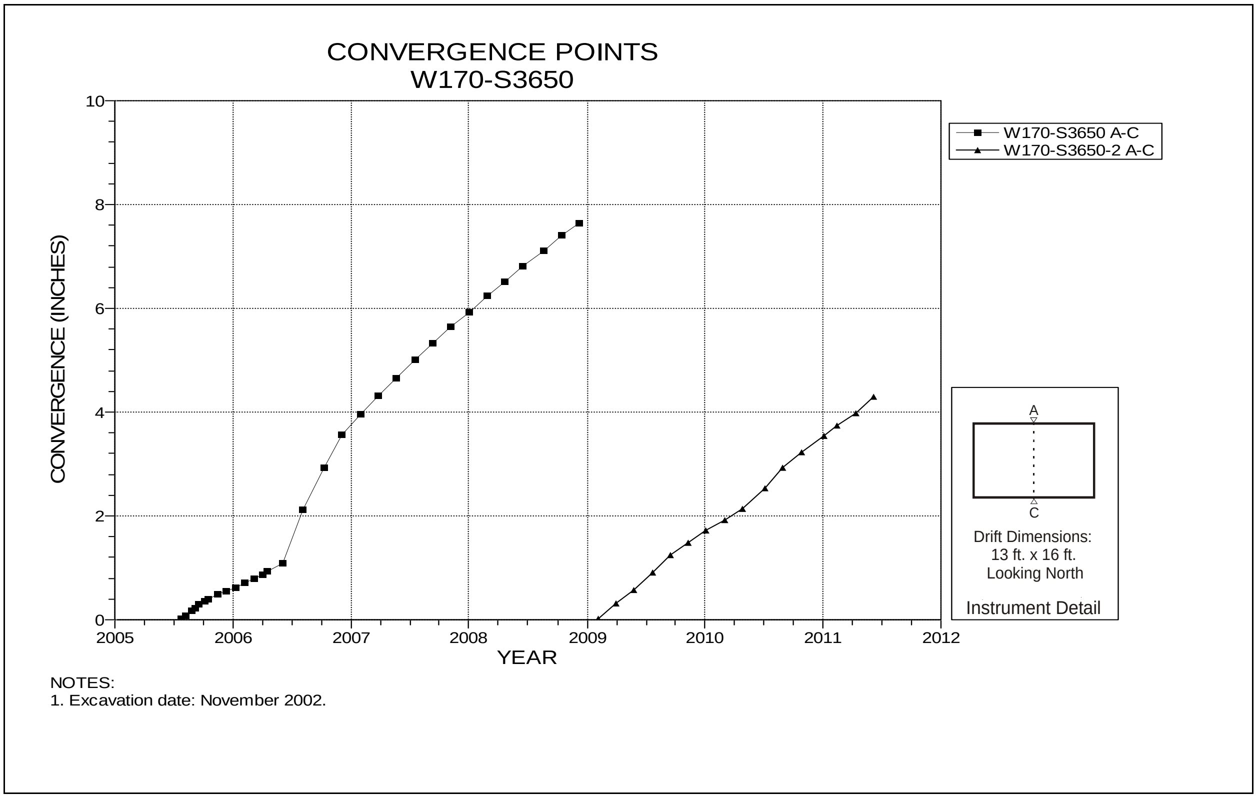


Figure 4-201 Convergence Point Array
W170 S3650 – Roof to Floor

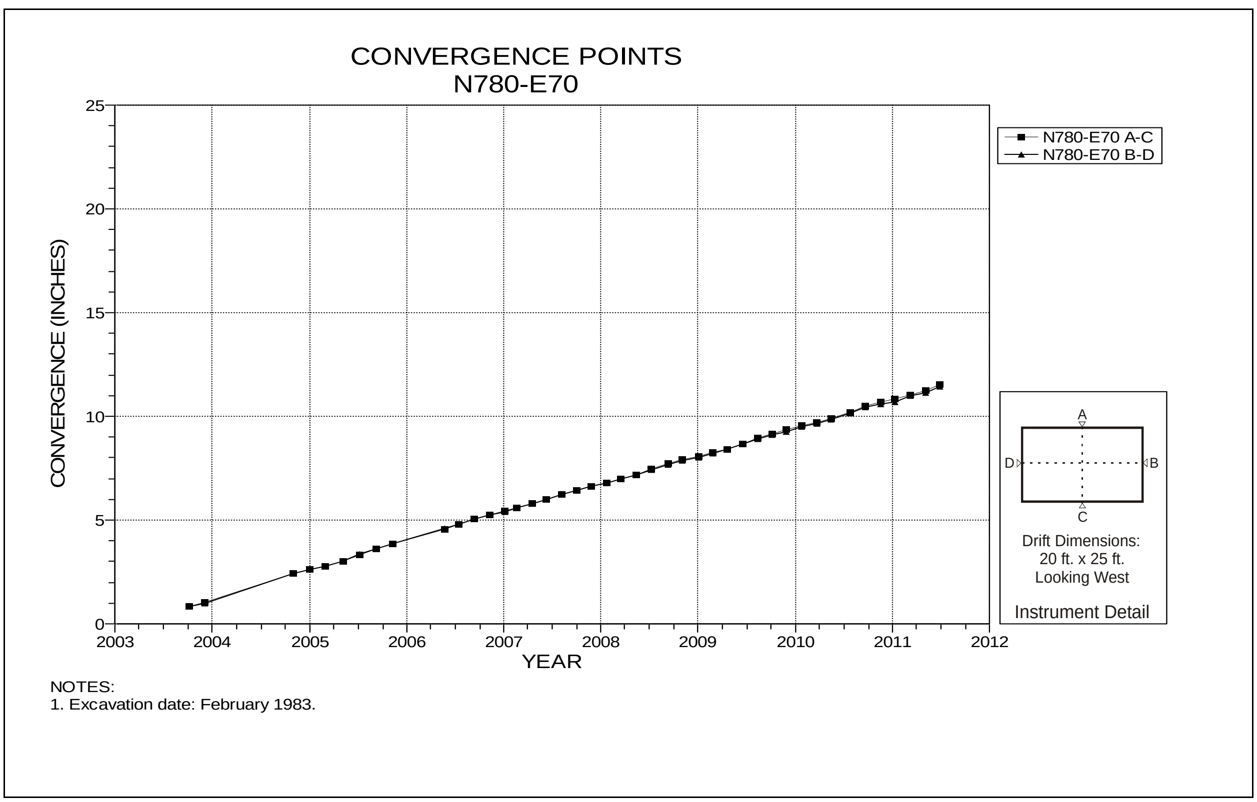


Figure 4-202 Convergence Point Array
N780 E70 – All Chords

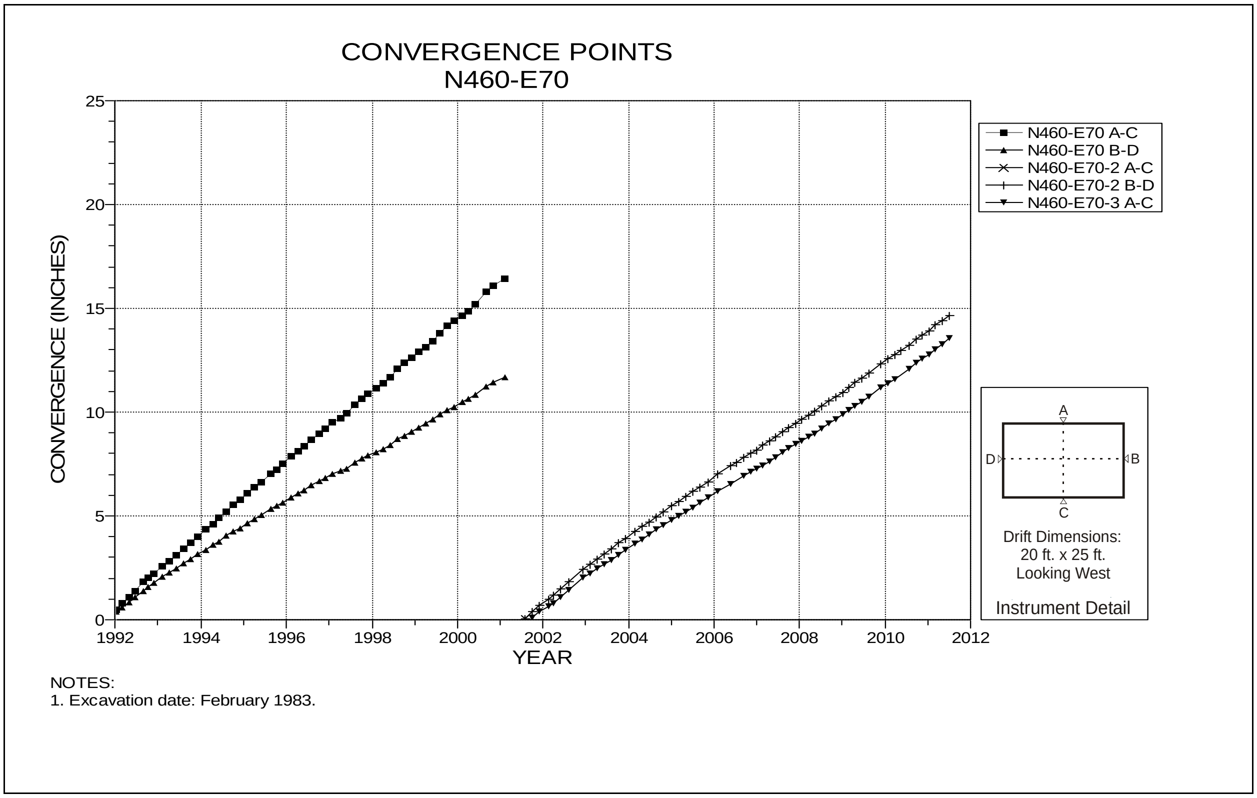


Figure 4-203 Convergence Point Array
N460 E70 – All Chords

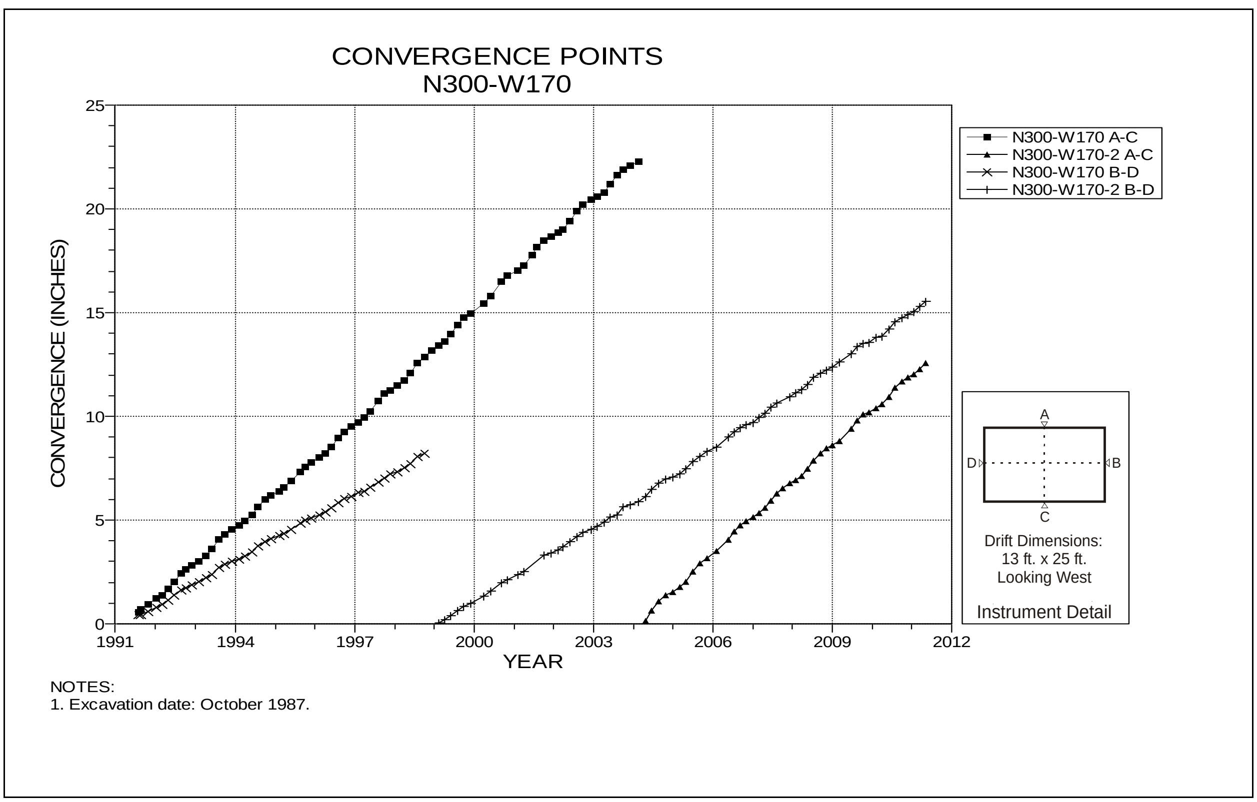
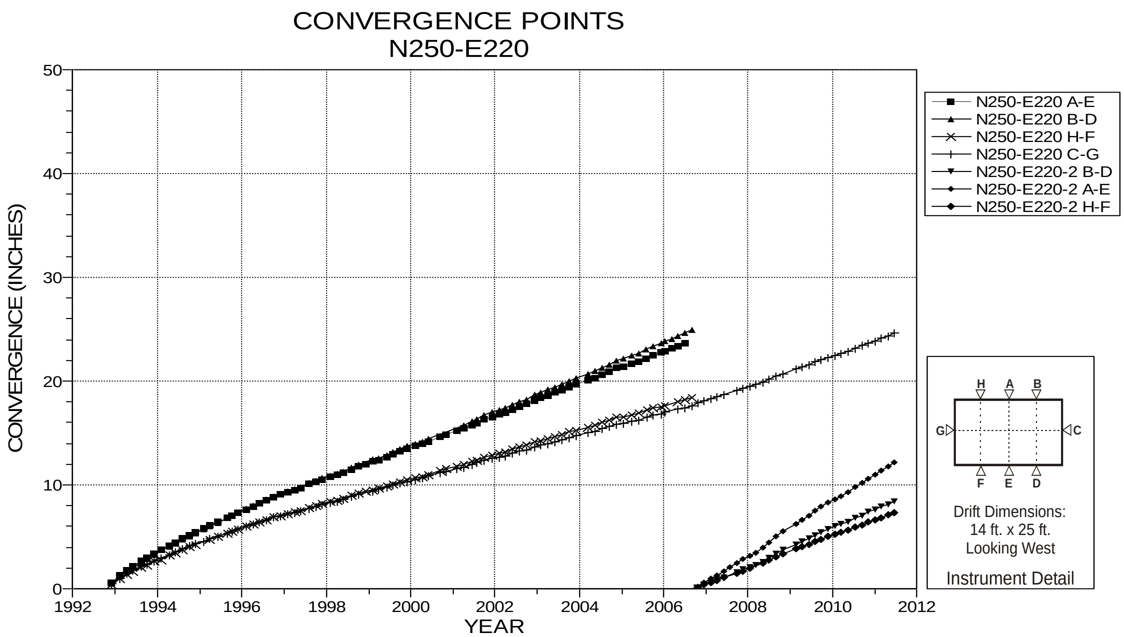
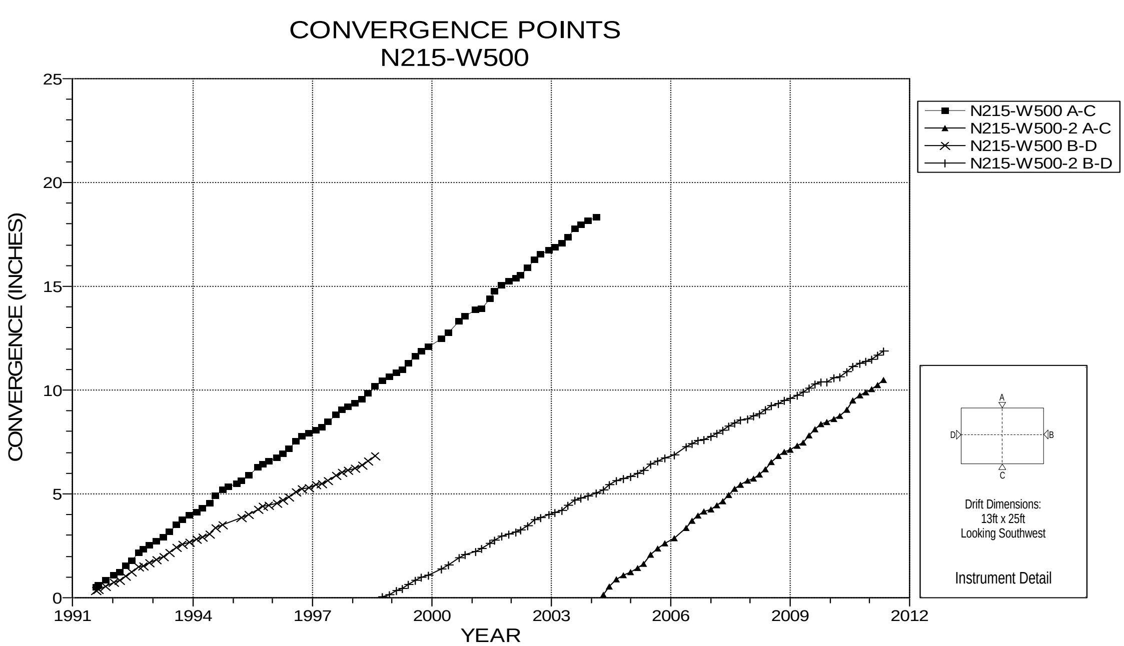


Figure 4-204 Convergence Point Array
N300 W170 – All Chords



NOTES:
1. Excavation date: October 1992.
2. Reinstalled "D", "E" and "F" points on 9-27-2006.

Figure 4-205 Convergence Point Array
N250 E220 – All Chords



NOTES:
1. Excavation date: December 1987.

Figure 4-206 Convergence Point Array
N215 W500 – All Chords

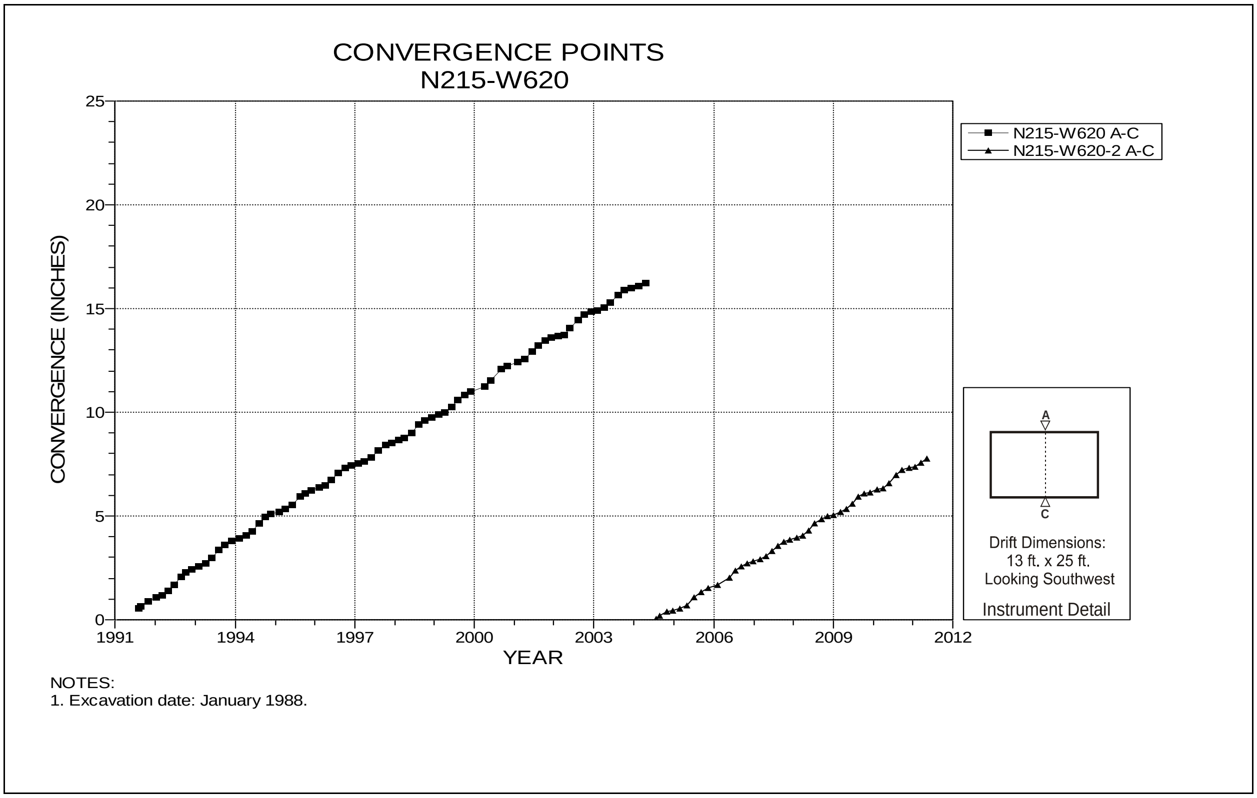


Figure 4-207 Convergence Point Array N215 W620 – Roof to Floor

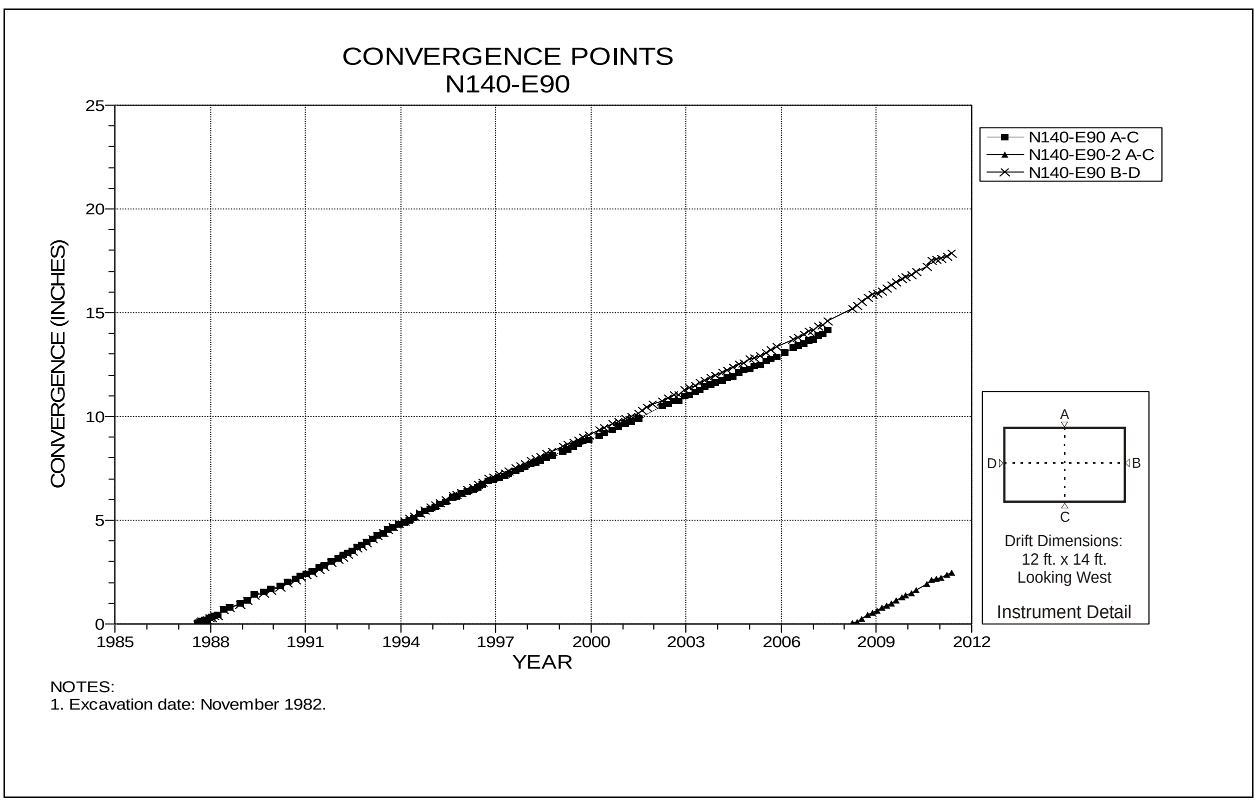


Figure 4-208 Convergence Point Array
N140 E90 – All Chords

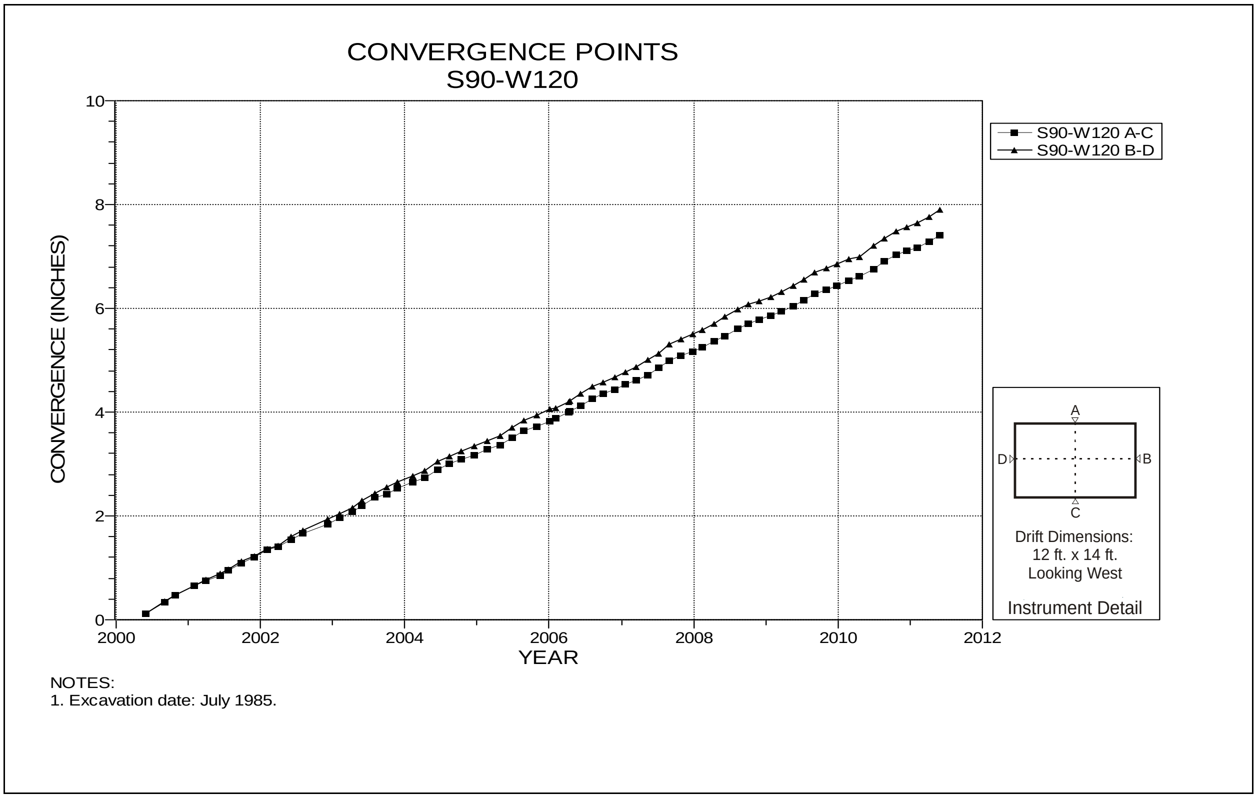


Figure 4-209 Convergence Point Array
S90 W120 – All Chords

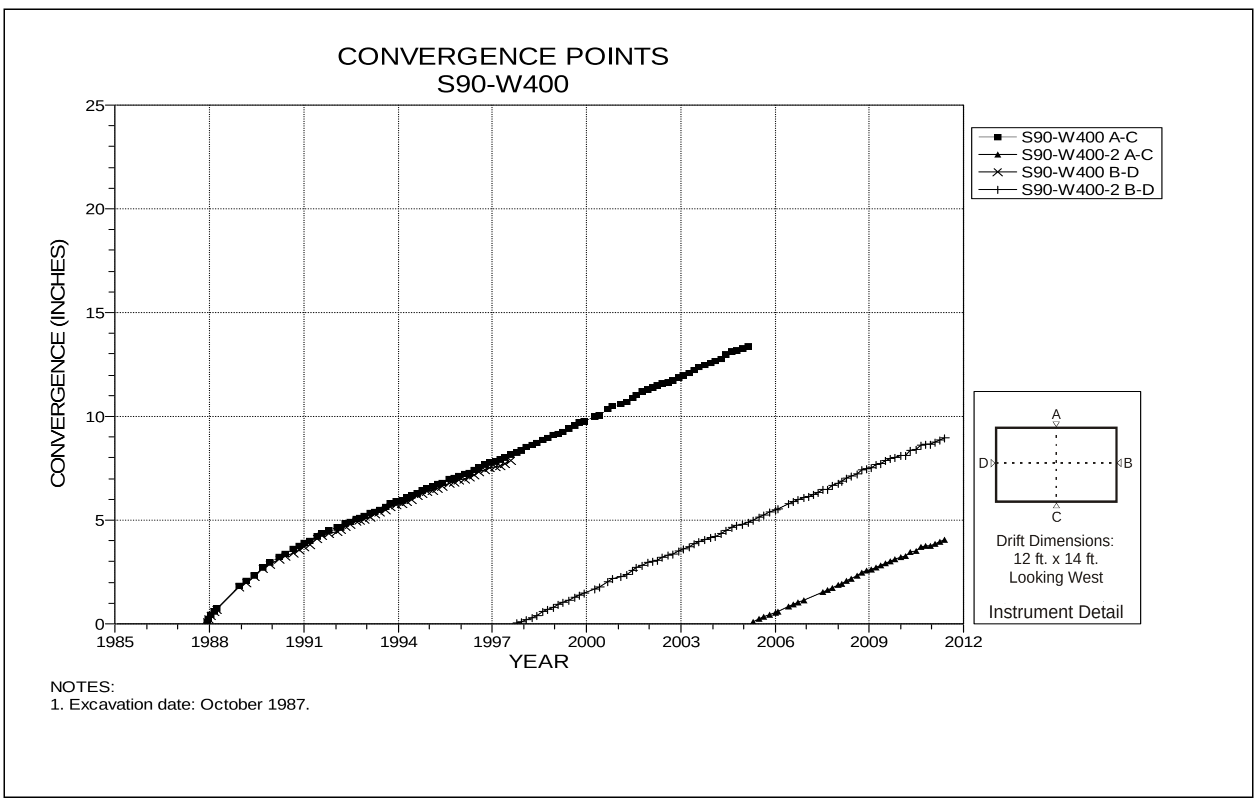


Figure 4-210 Convergence Point Array
S90 W400 – All Chords

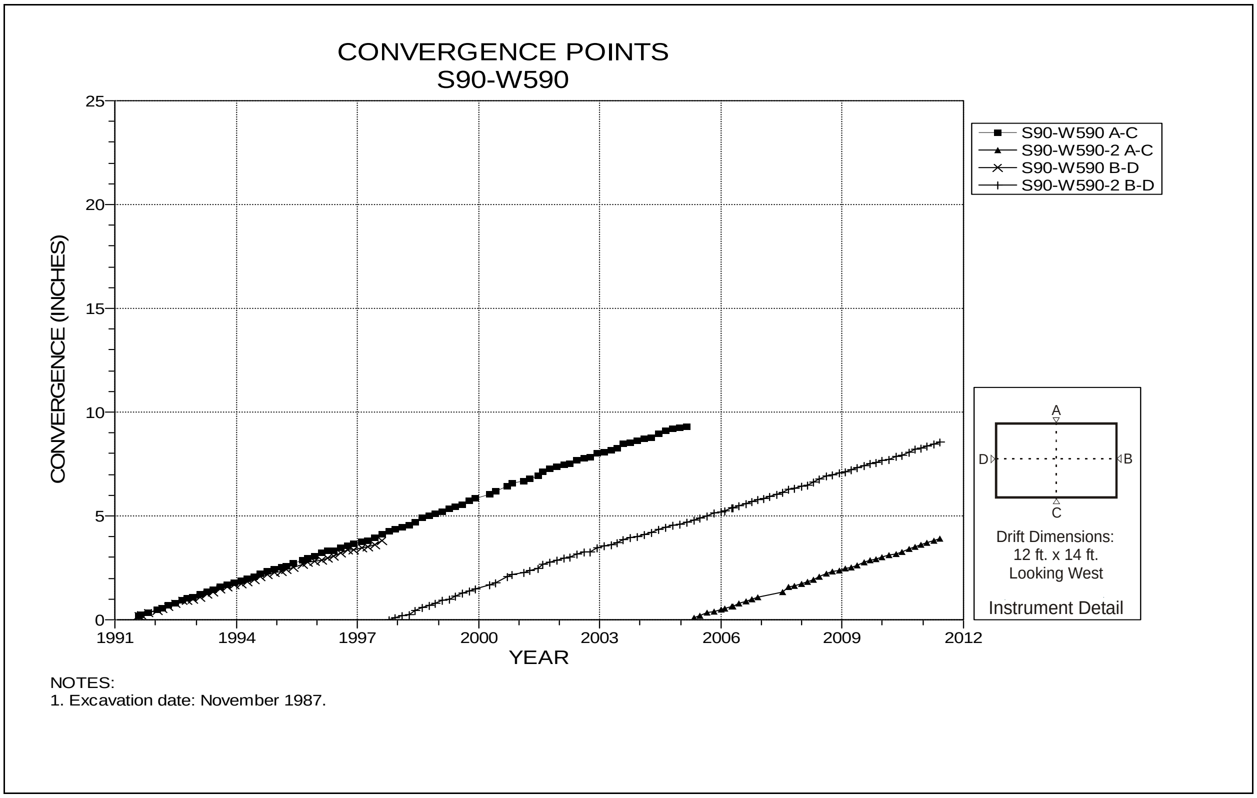


Figure 4-211 Convergence Point Array
S90 W590 – All Chords

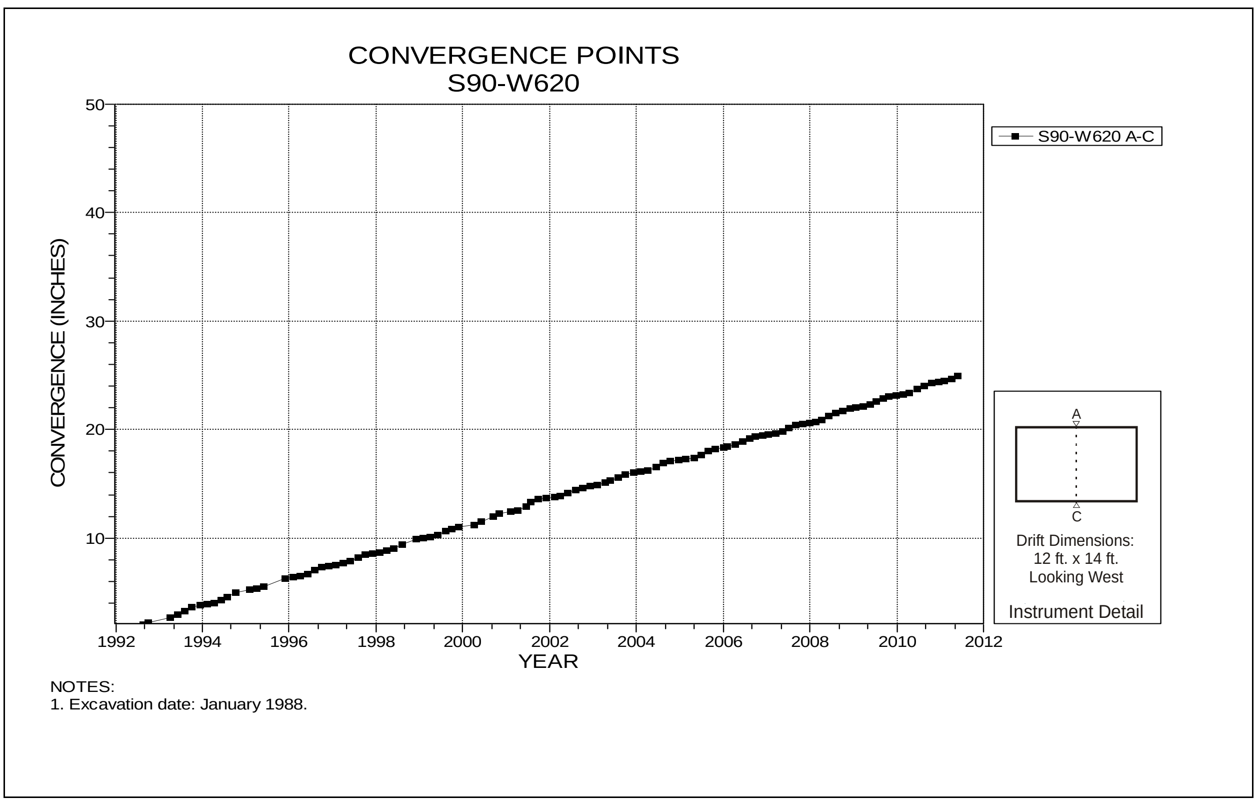


Figure 4-212 Convergence Point Array
S90 W620 – Roof to Floor

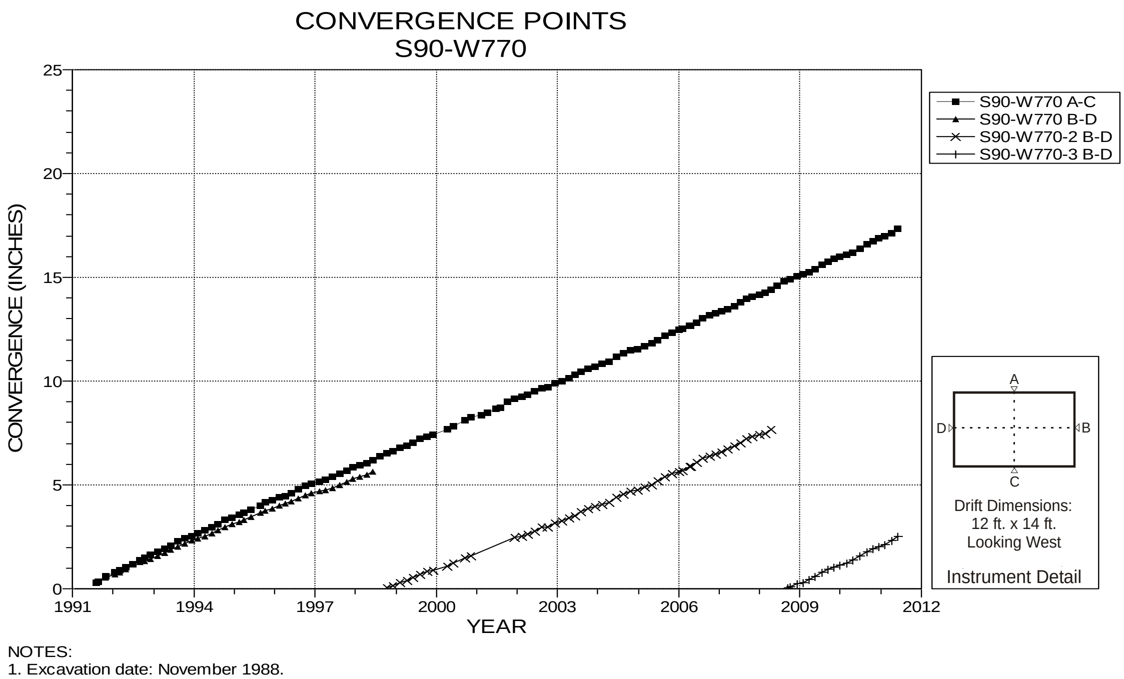


Figure 4-213 Convergence Point Array
S90 W770 – All Chords

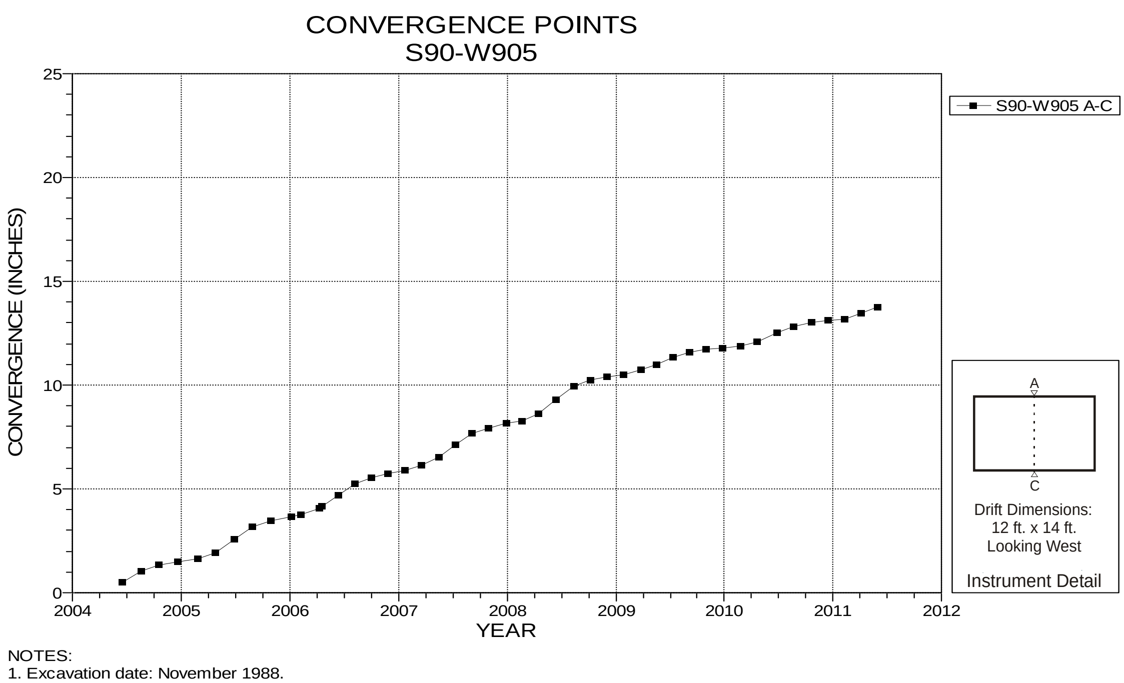


Figure 4-214 Convergence Point Array
S90 W905 – Roof to Floor

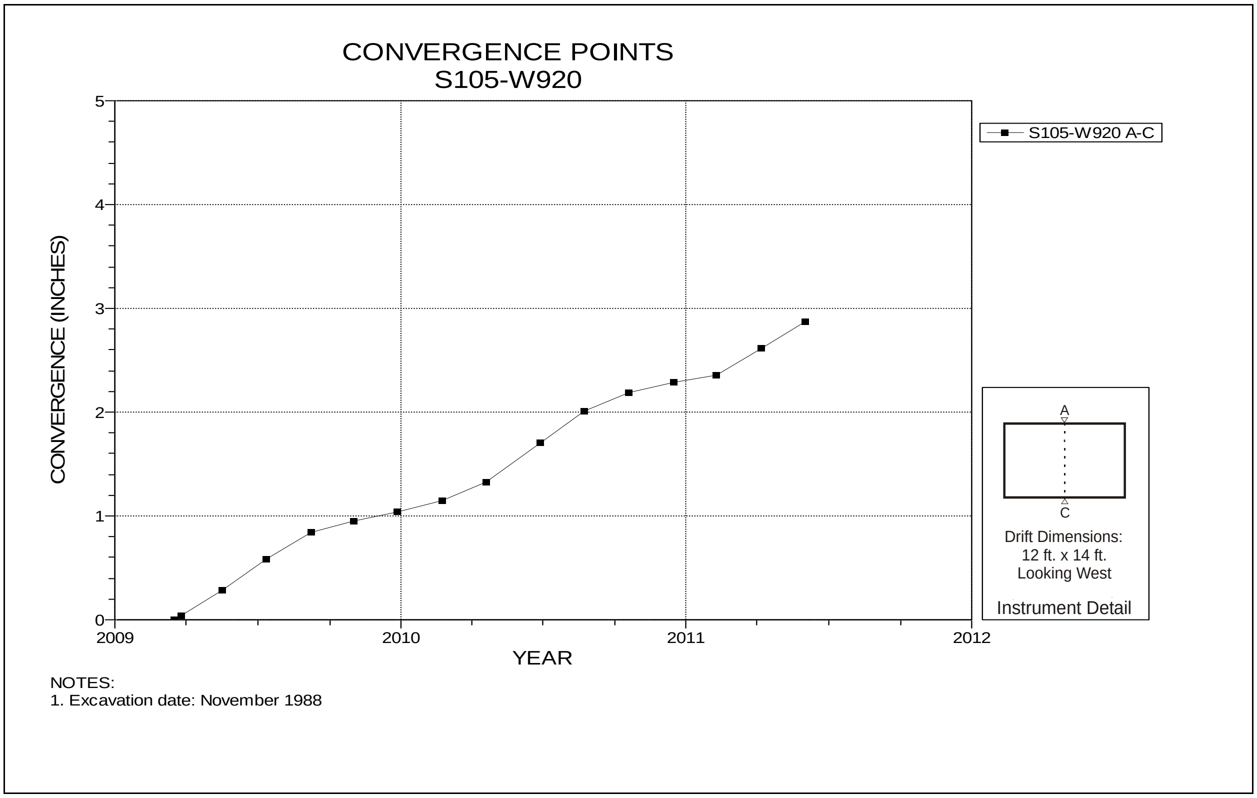


Figure 4-215 Convergence Point Array
S105 W920 – Roof to Floor

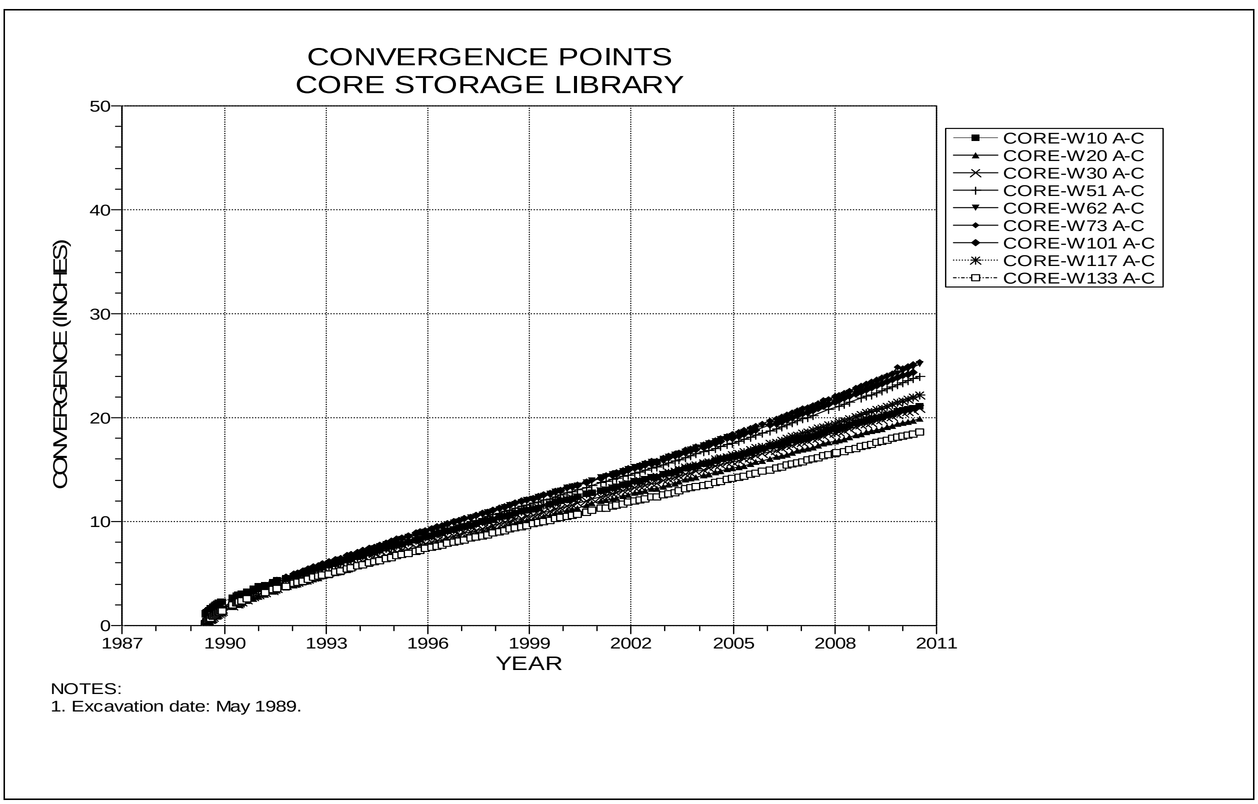


Figure 4-216 Convergence Point Array
S400 Core Storage Library – All Chords

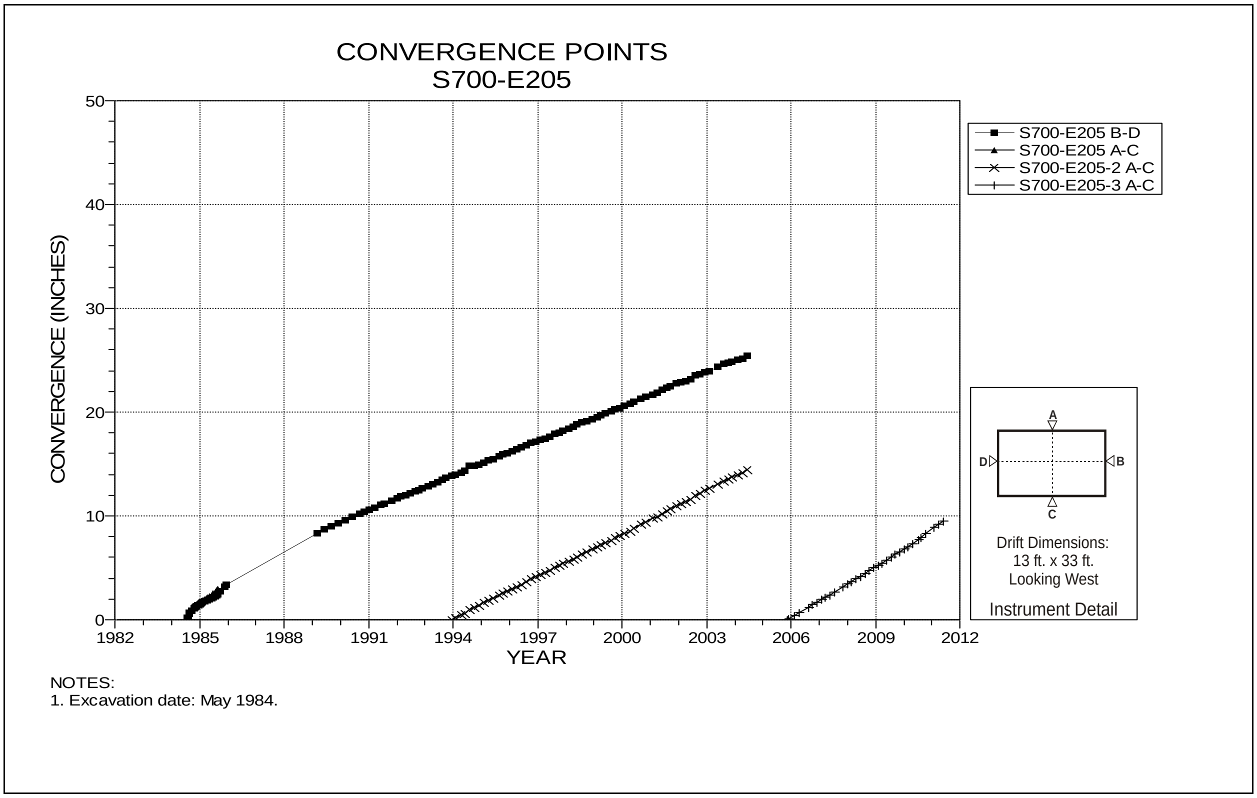


Figure 4-217 Convergence Point Array
S700 E205 – All Chords

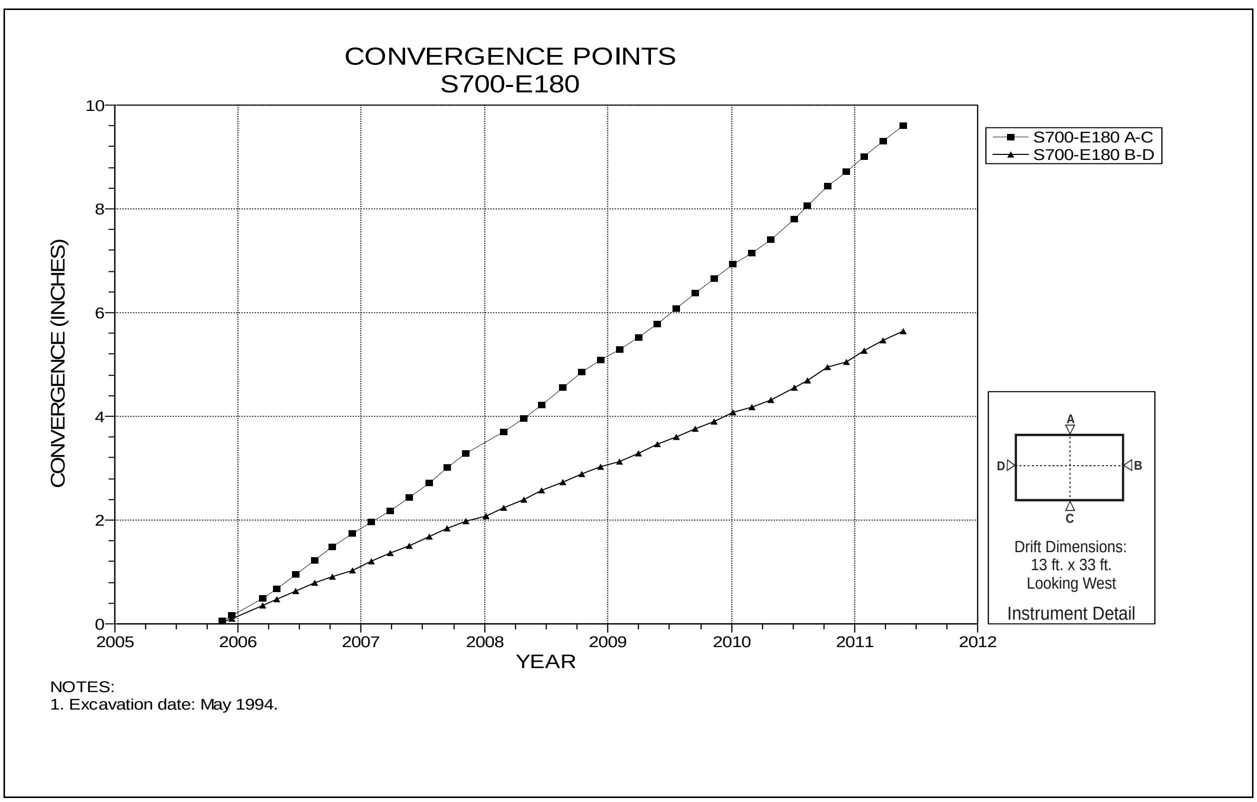


Figure 4-218 Convergence Point Array
S700 E180 – All Chords

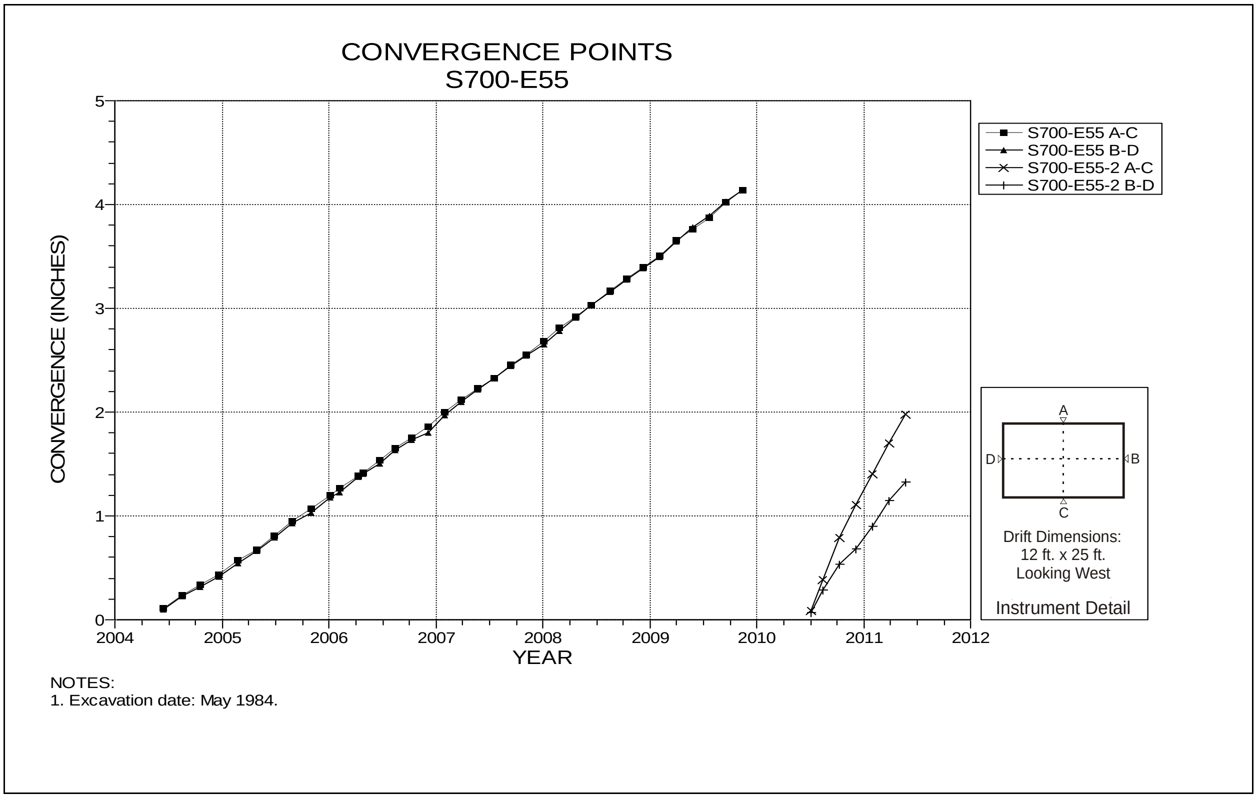


Figure 4-219 Convergence Point Array
S700 E55 – All Chords

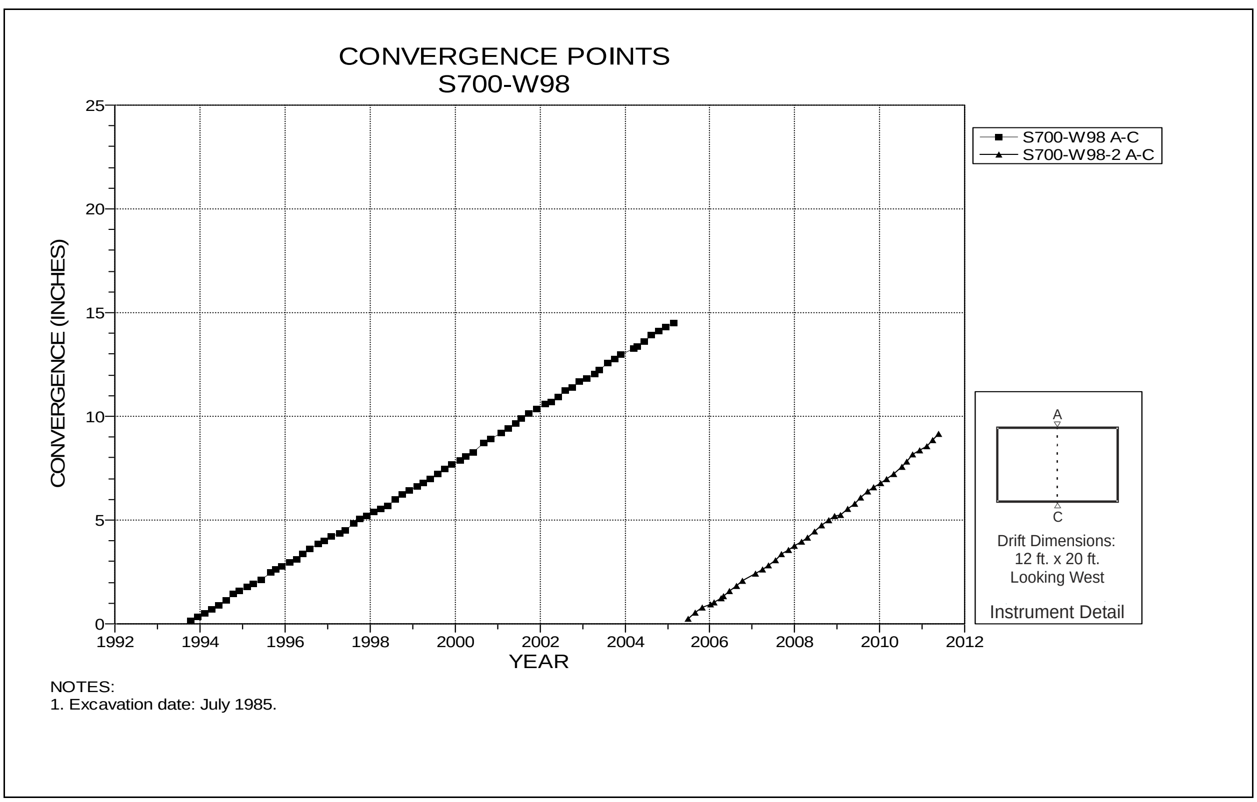


Figure 4-220 Convergence Point Array
S700 W98 – Roof to Floor

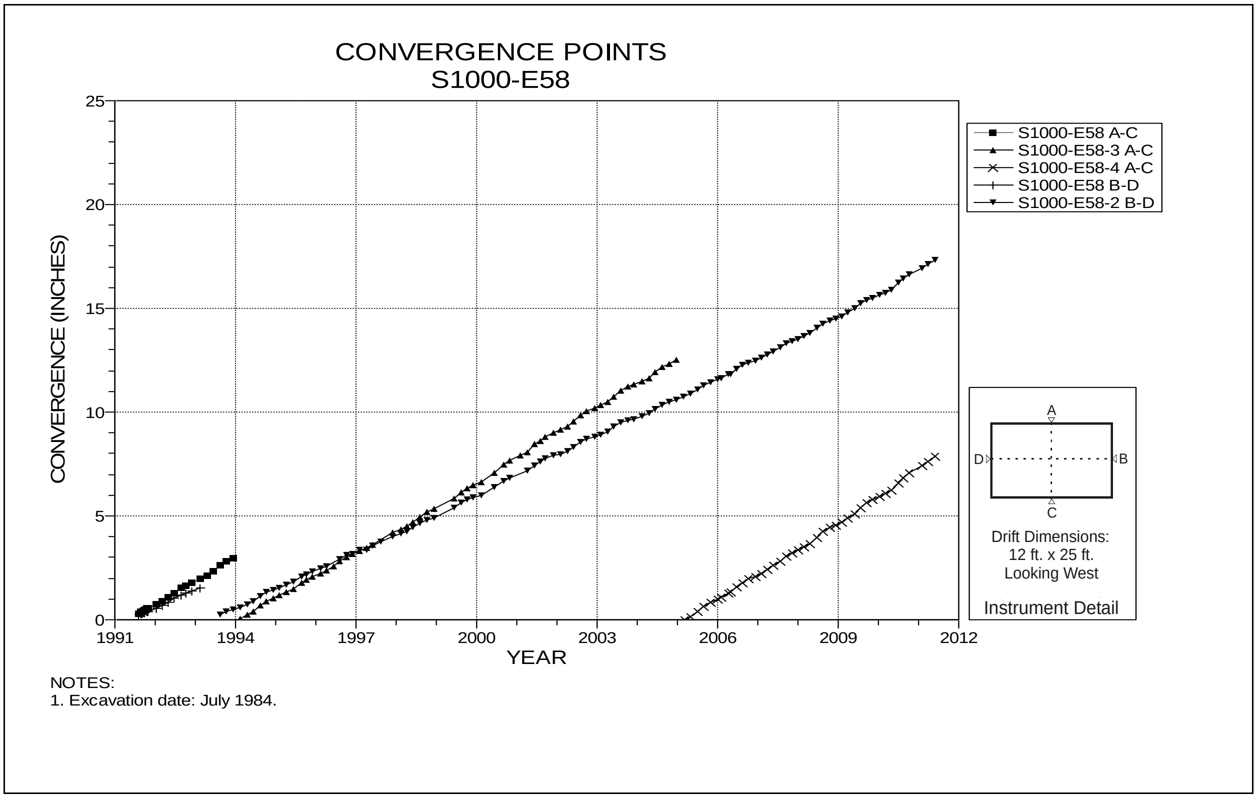


Figure 4-221 Convergence Point Array
S1000 E58 – All Chords

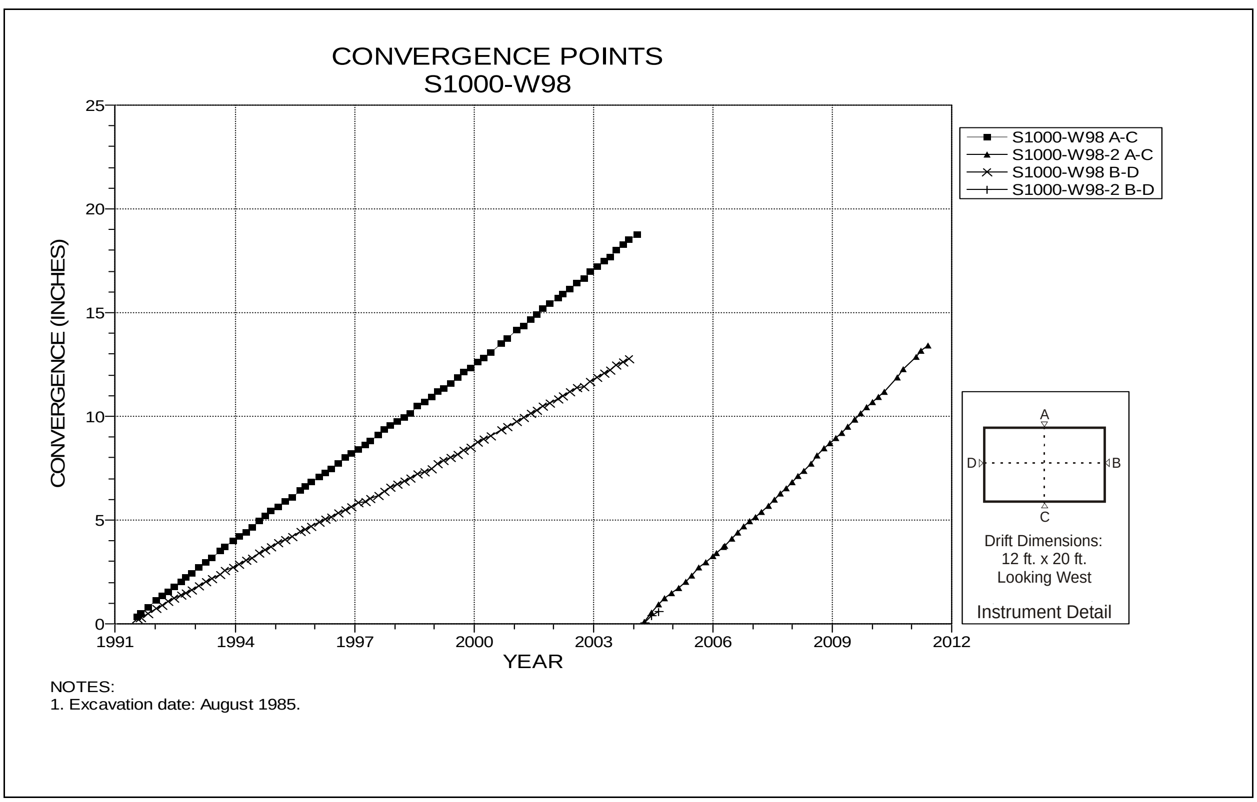


Figure 4-222 Convergence Point Array
S1000 W98 – All Chords

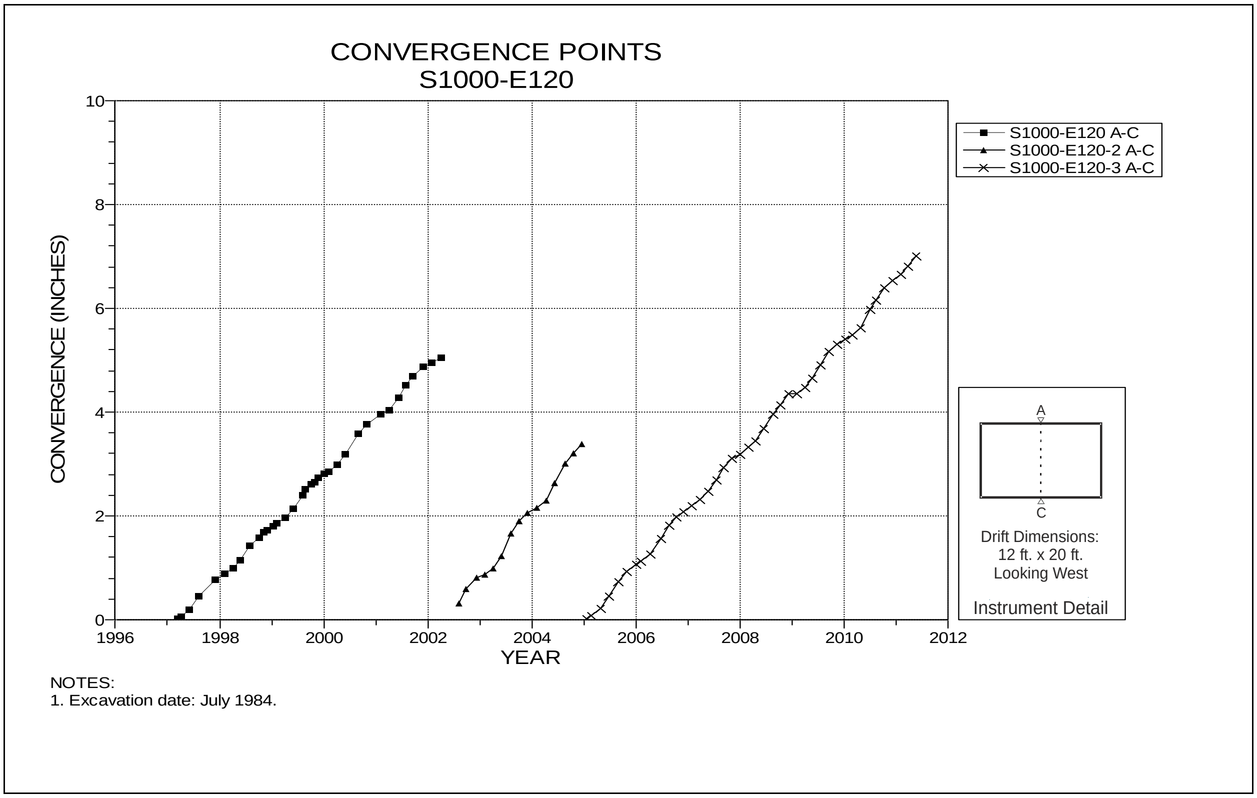


Figure 4-223 Convergence Point Array
S1000 E120 – Roof to Floor

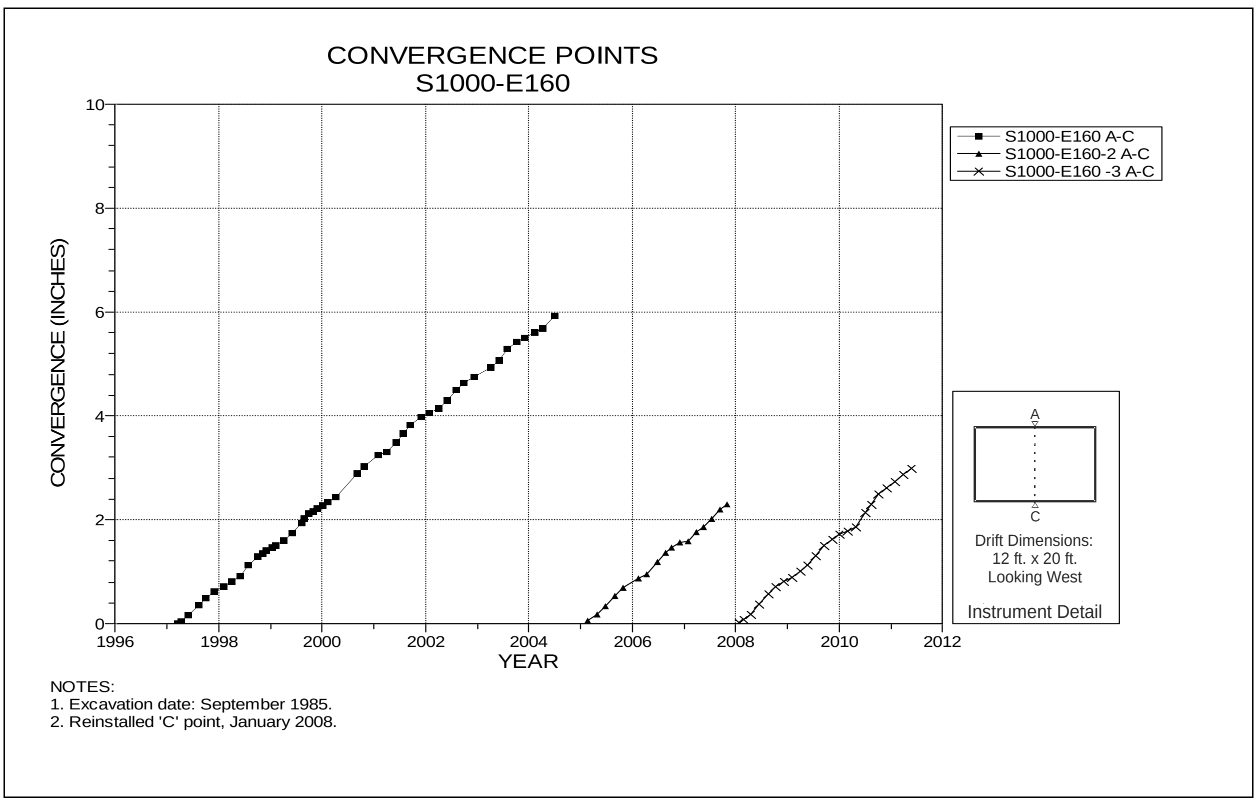


Figure 4-224 Convergence Point Array
S1000 E160 – Roof to Floor

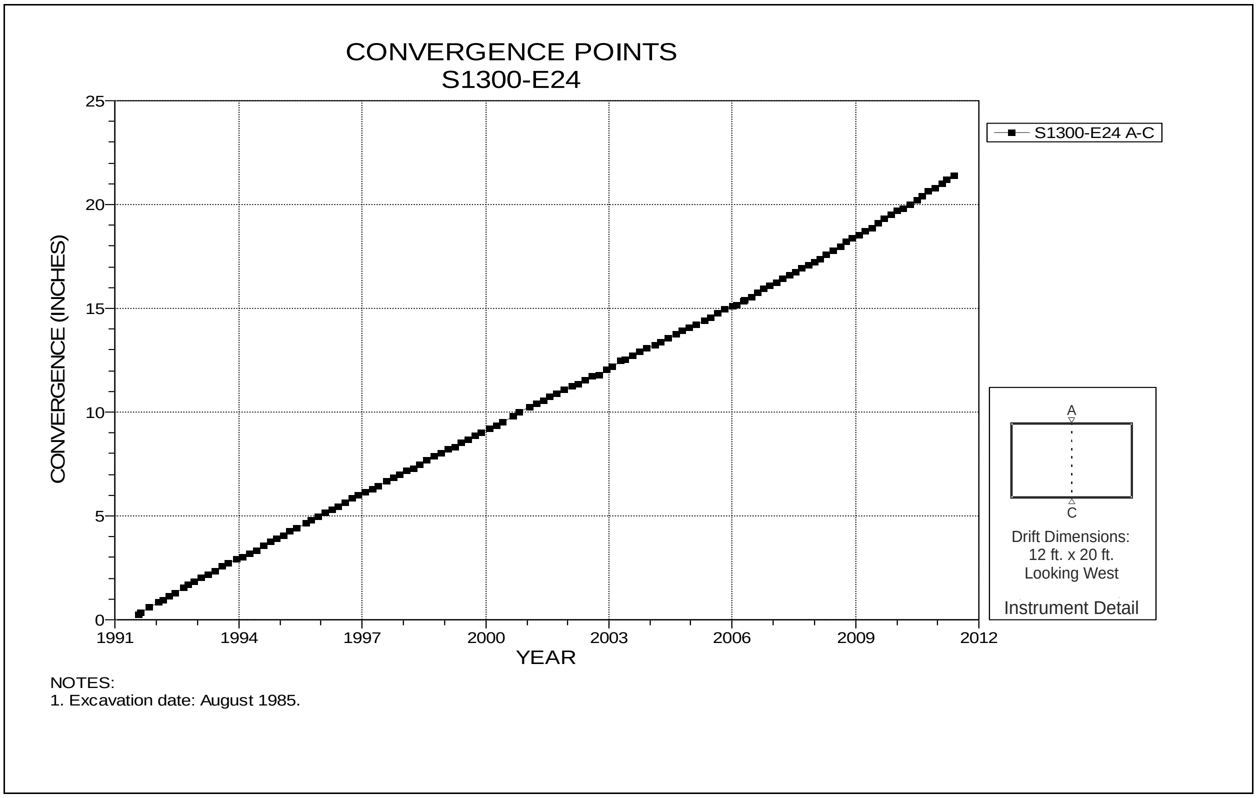


Figure 4-225 Convergence Point Array
S1300 E24 – Roof to Floor

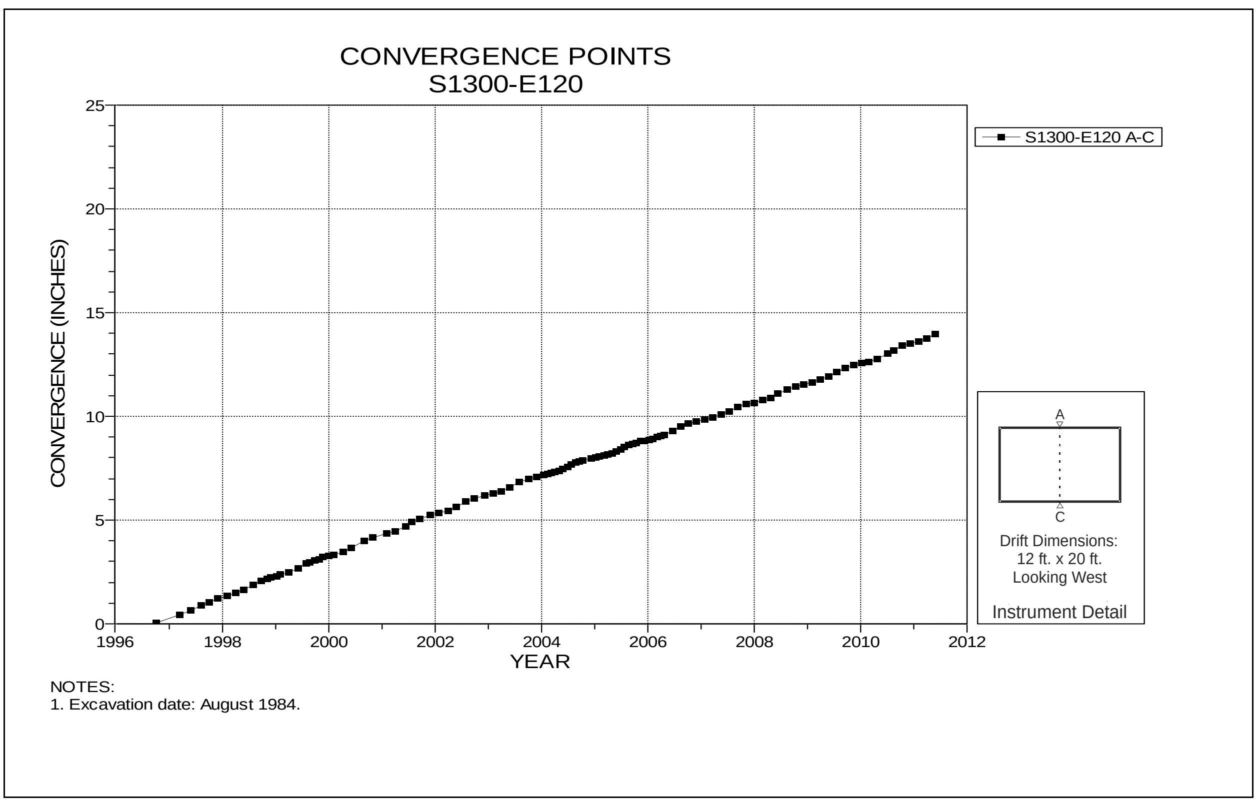


Figure 4-226 Convergence Point Array
S1300 E120 – Roof to Floor

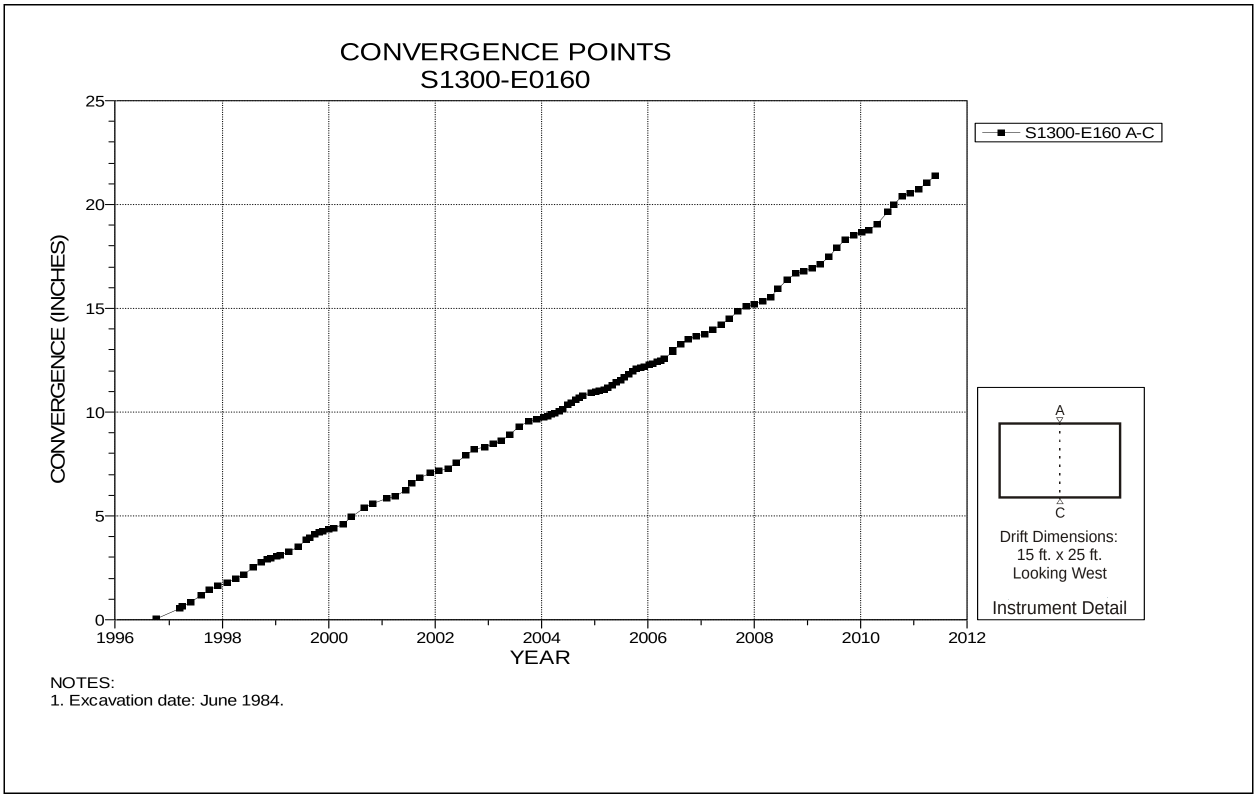


Figure 4-227 Convergence Point Array
S1300 E160 – Roof to Floor

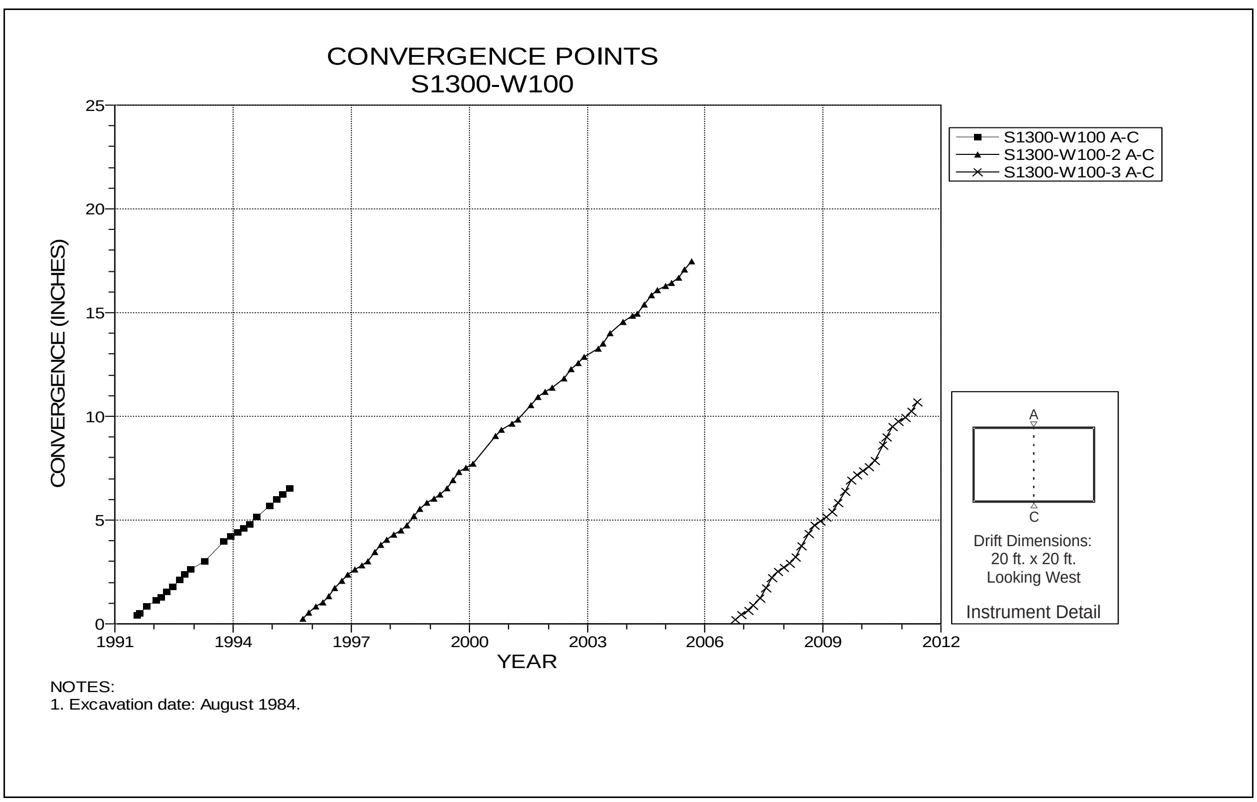


Figure 4-228 Convergence Point Array
S1300 W100 – Roof to Floor

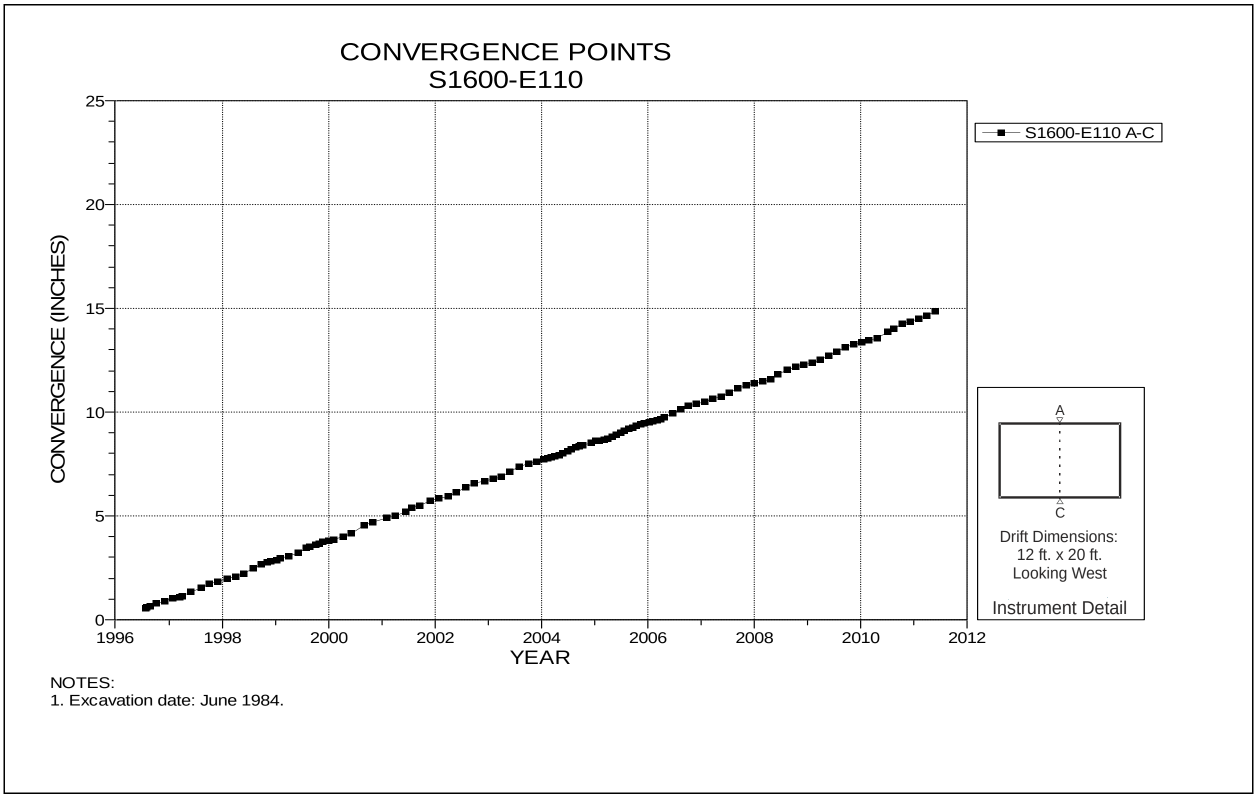


Figure 4-229 Convergence Point Array
S1600 E110 – Roof to Floor

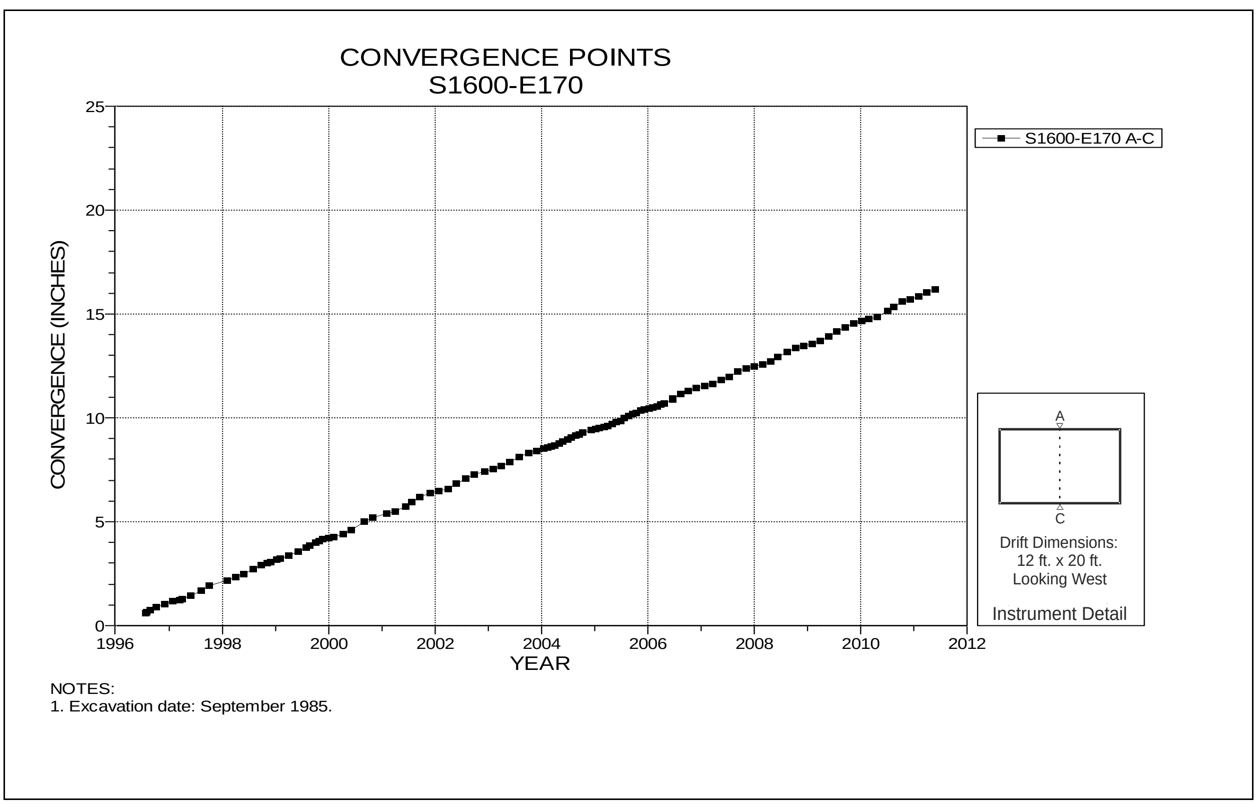


Figure 4-230 Convergence Point Array
S1600 E170 – Roof to Floor

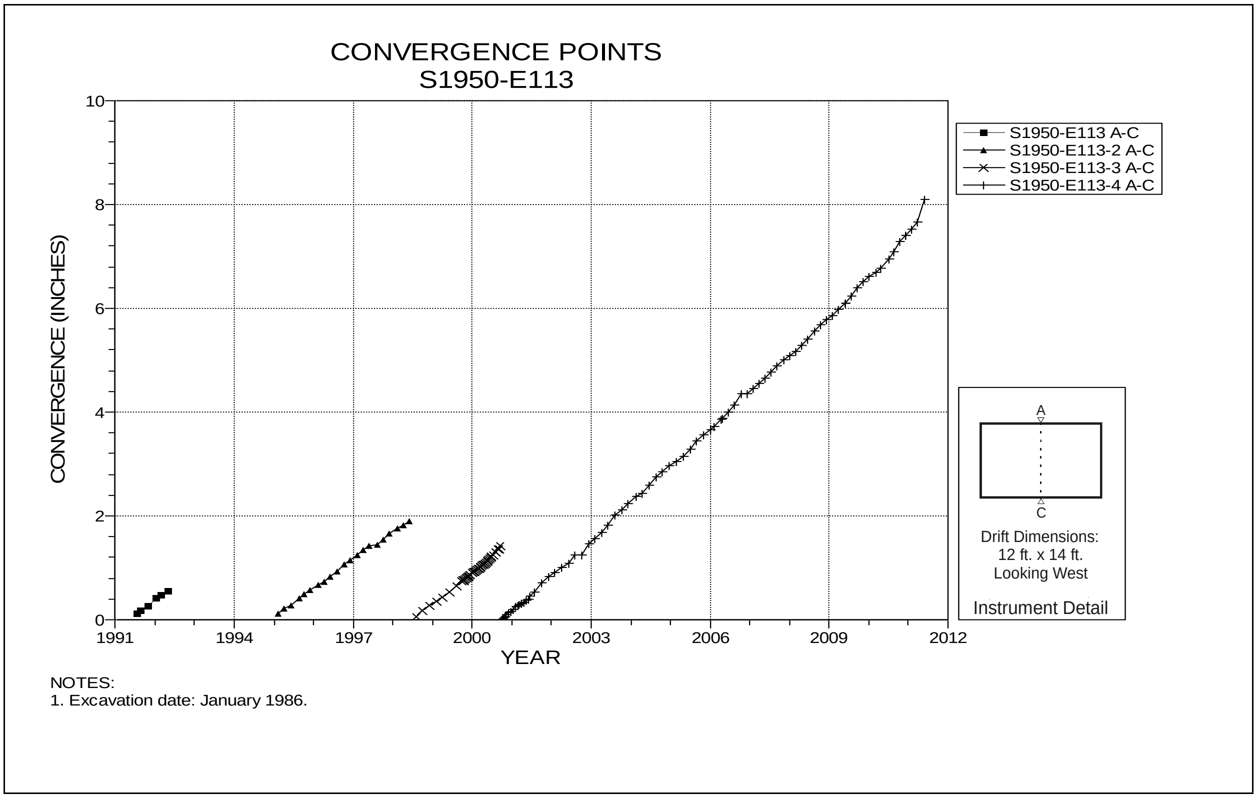


Figure 4-231 Convergence Point Array
S1950 E113 – Roof to Floor

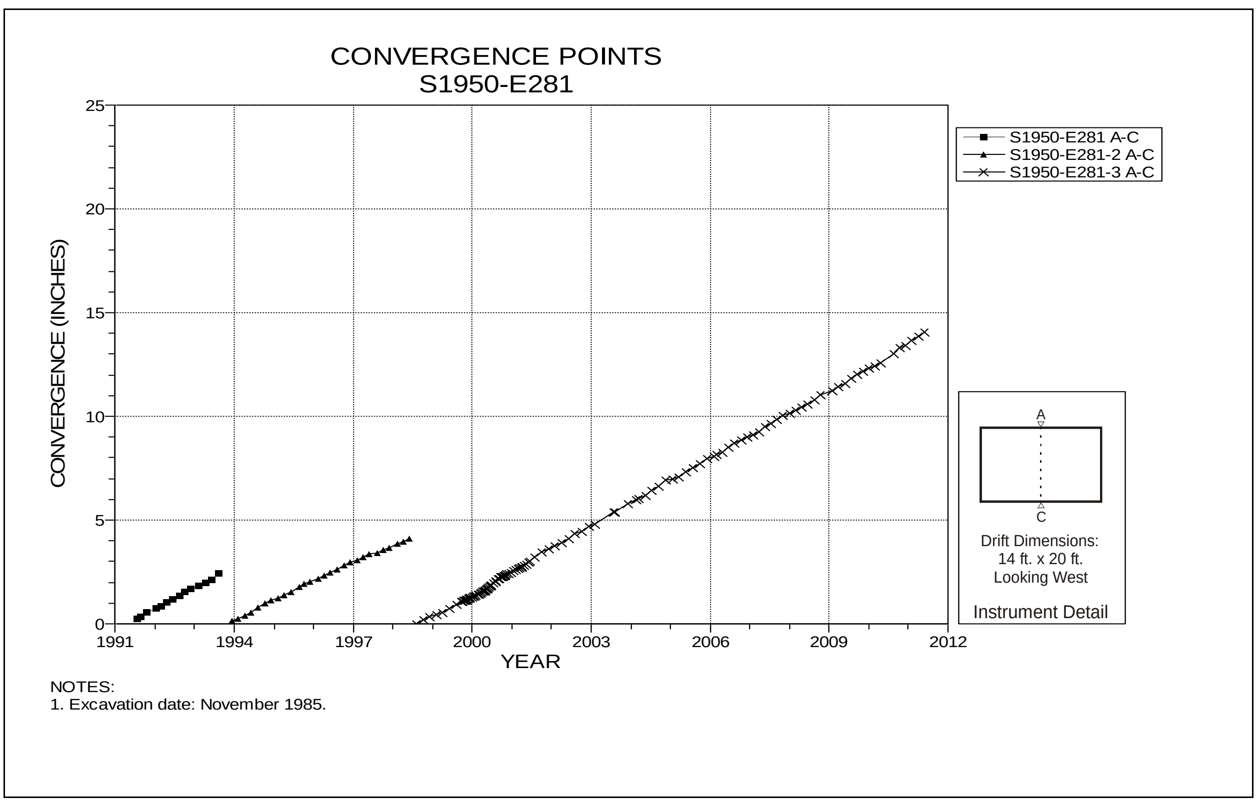


Figure 4-232 Convergence Point Array
S1950 E281 – Roof to Floor

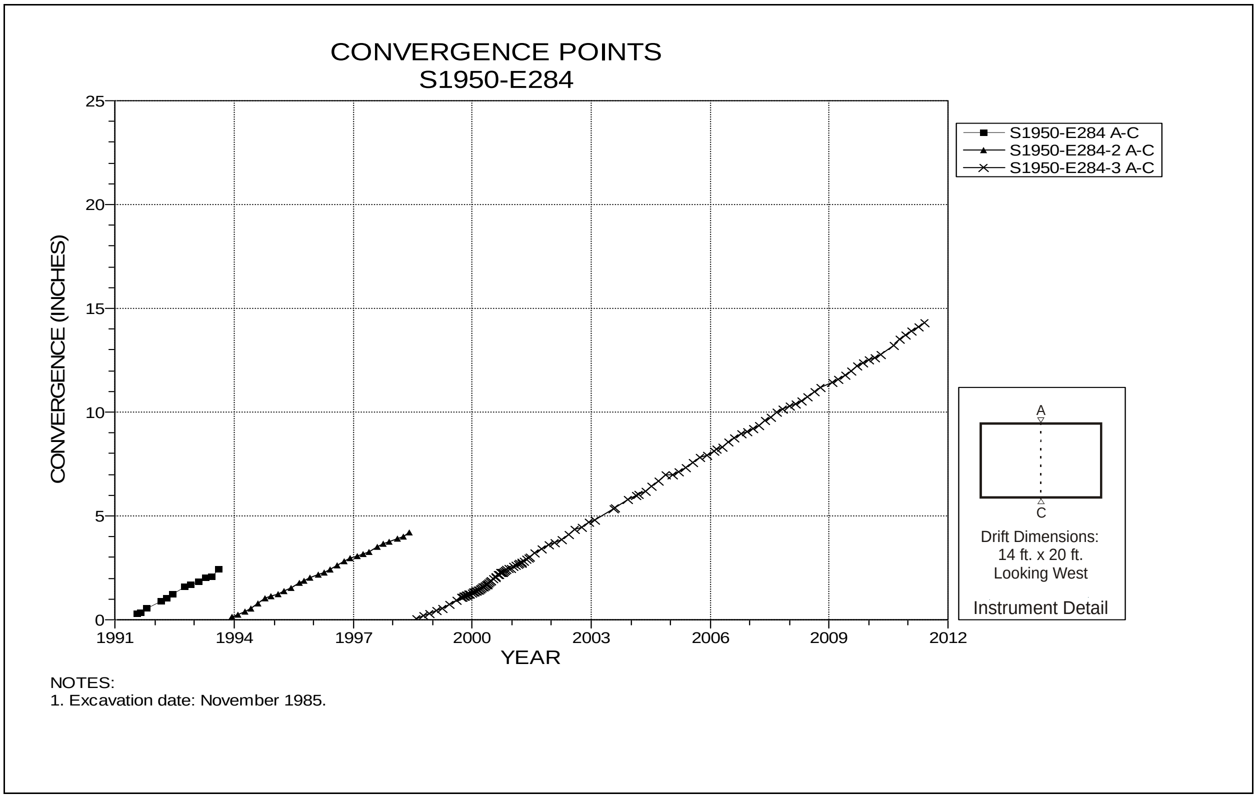


Figure 4-233 Convergence Point Array
S1950 E284 – Roof to Floor

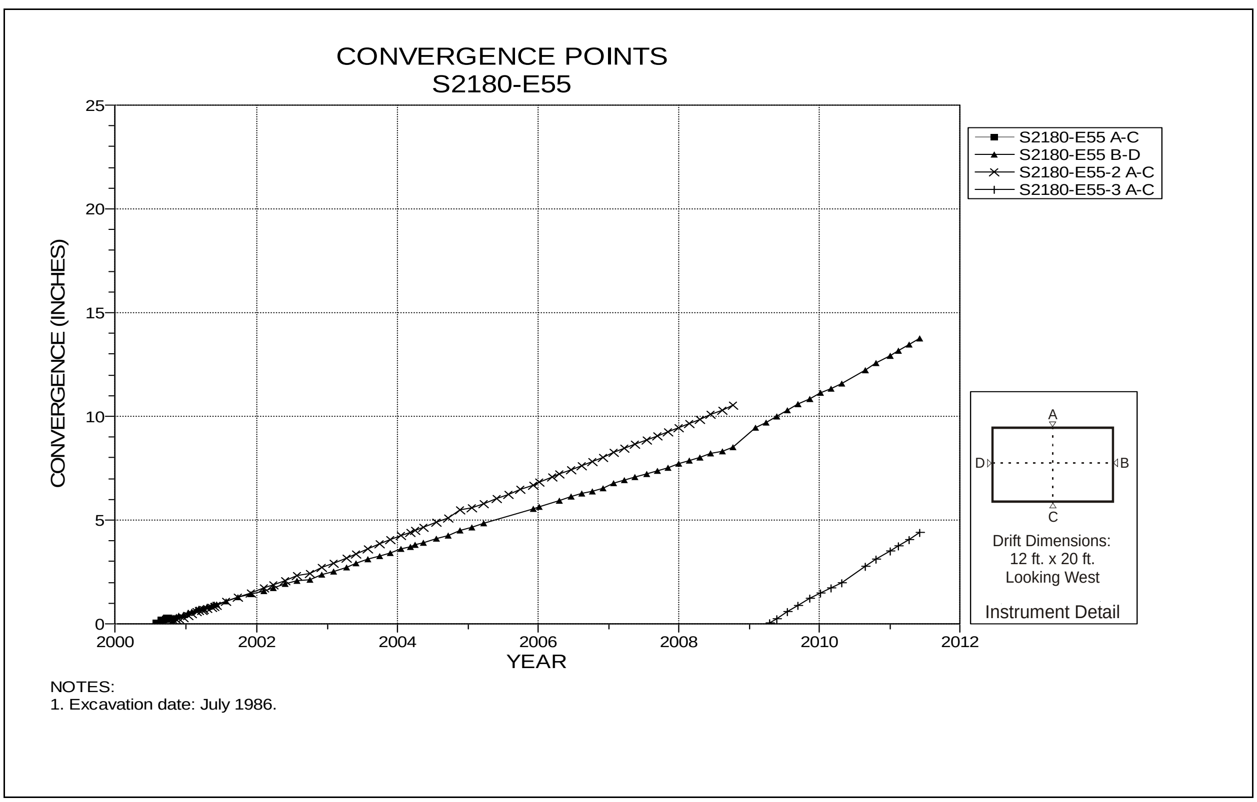


Figure 4-234 Convergence Point Array
S2180 E55 – All Chords

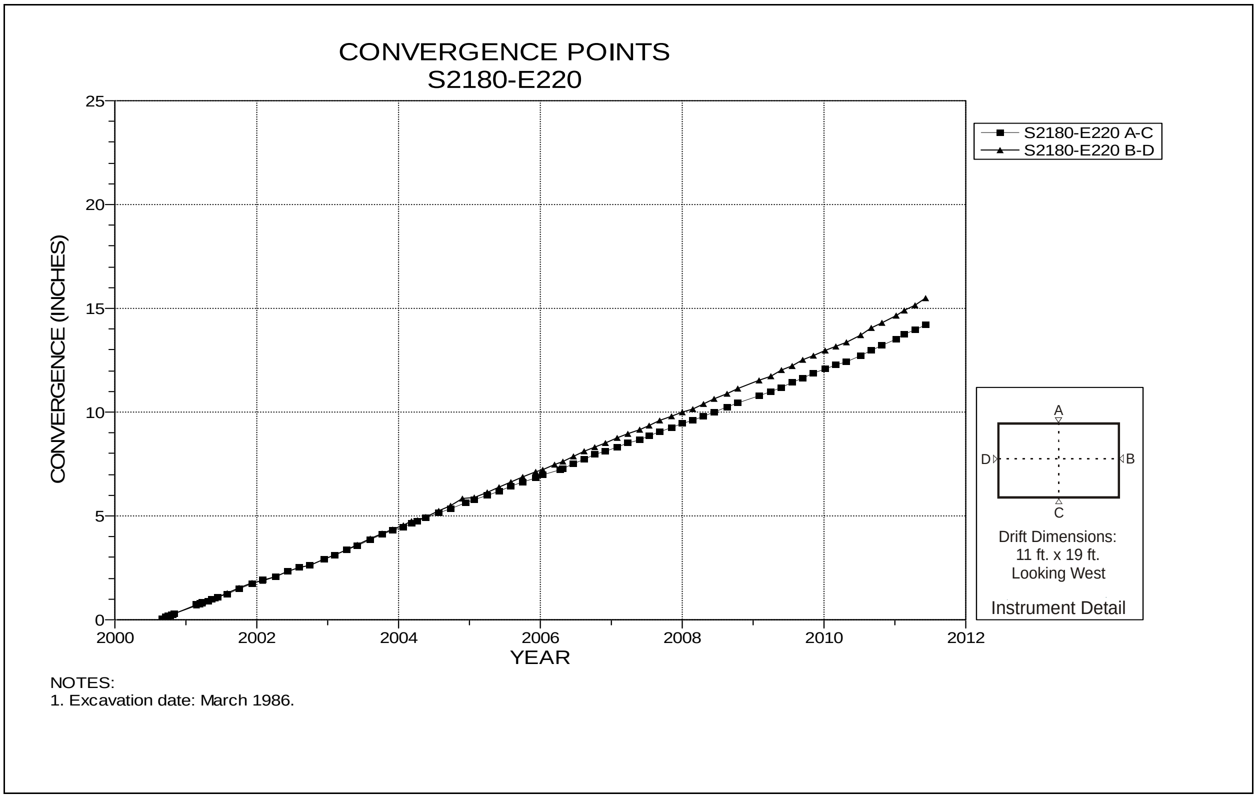


Figure 4-235 Convergence Point Array
S2180 E220 – All Chords

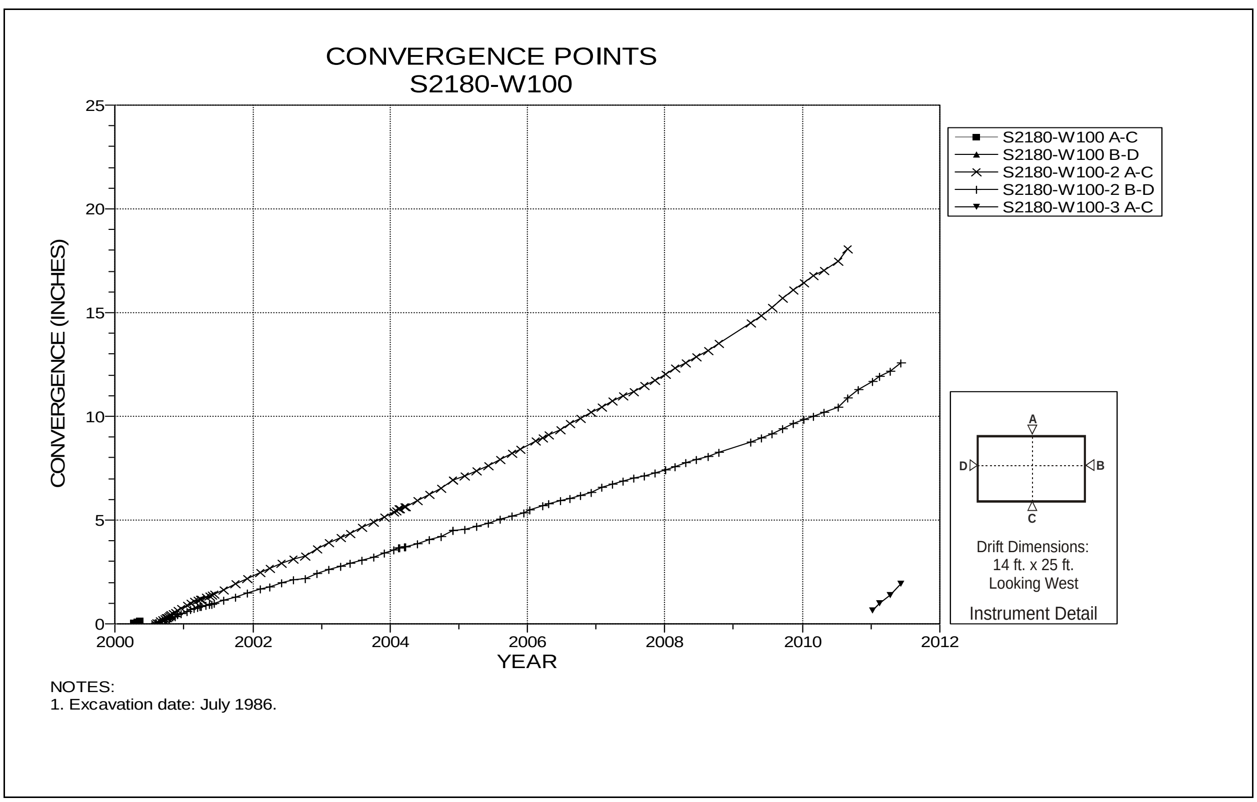


Figure 4-236 Convergence Point Array
S2180 W100 – All Chords

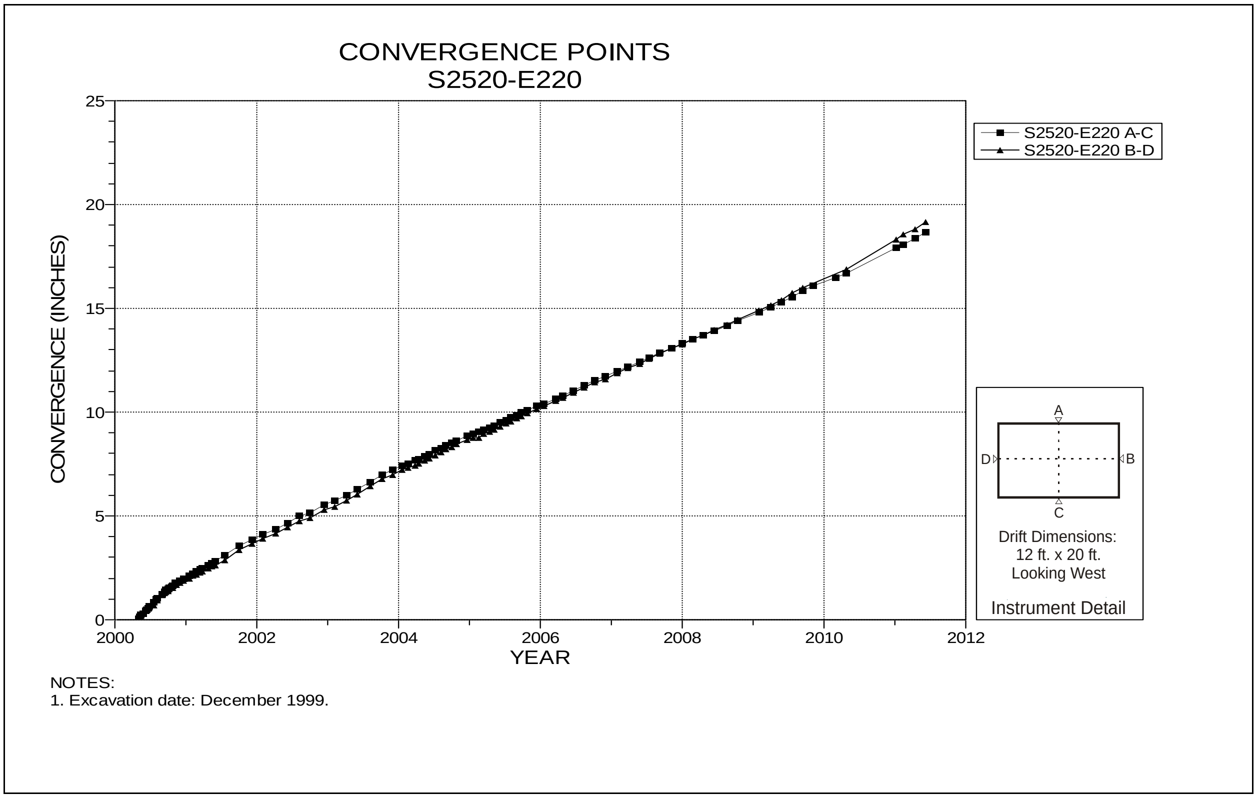


Figure 4-237 Convergence Point Array
S2520 E220 – All Chords

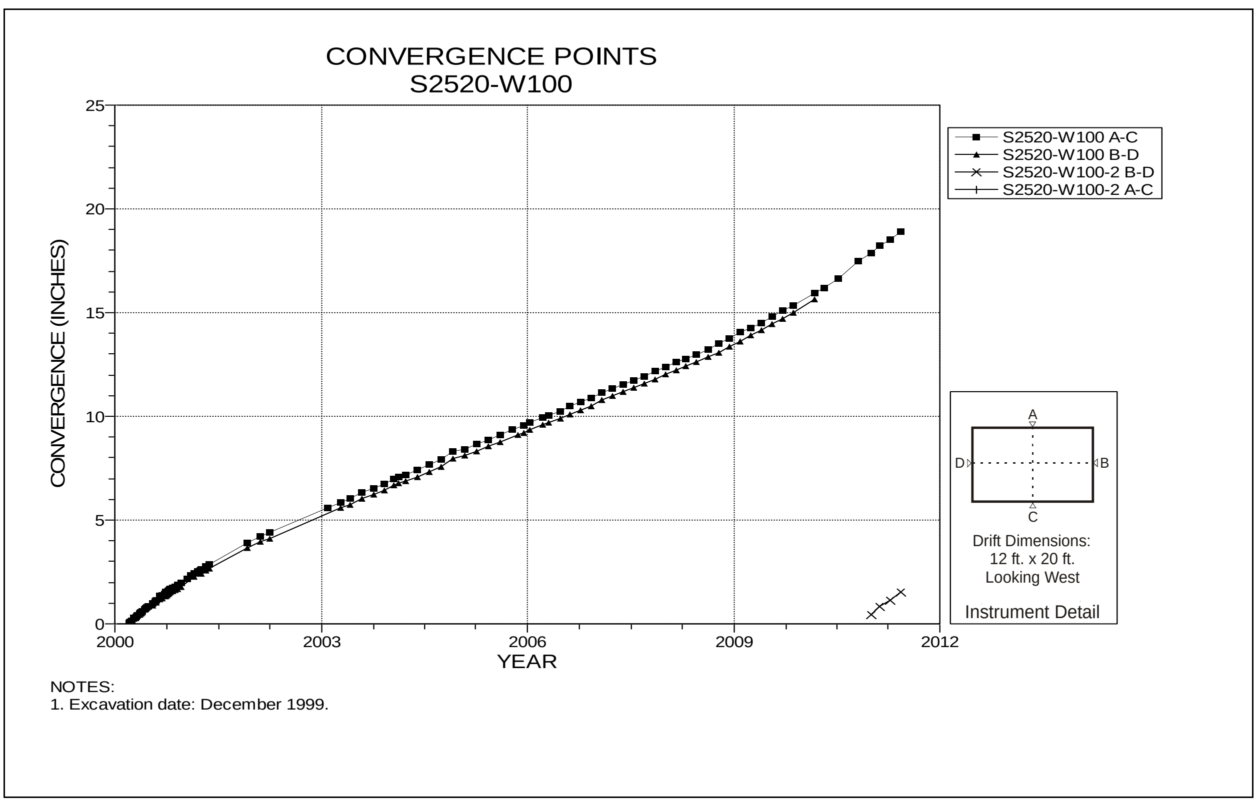
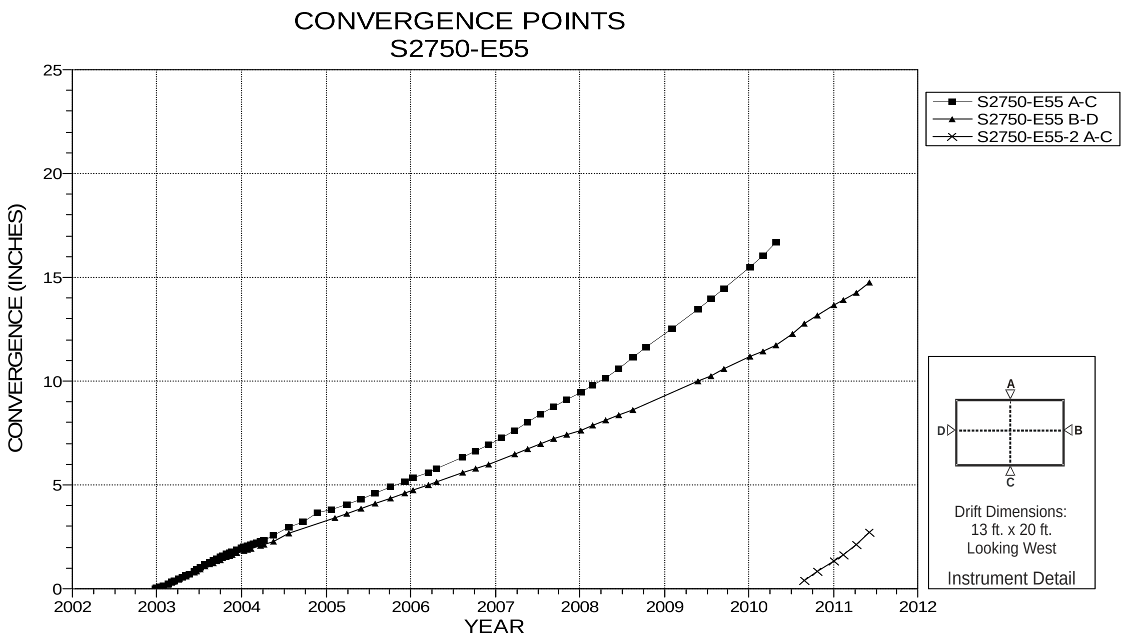
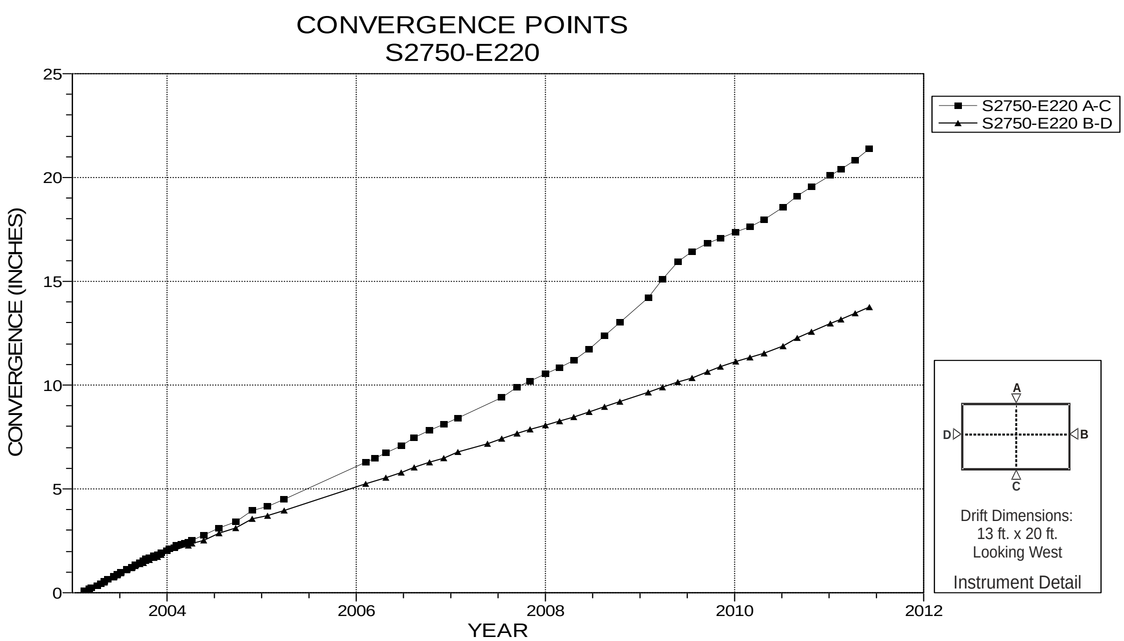


Figure 4-238 Convergence Point Array
S2520 W100 – All Chords



NOTES:
1. Excavation date: February 2001.

Figure 4-239 Convergence Point Array
S2750 E55 – All Chords



NOTES:
1. Excavation date: April 2001.

Figure 4-240 Convergence Point Array
S2750 E220 – All Chords

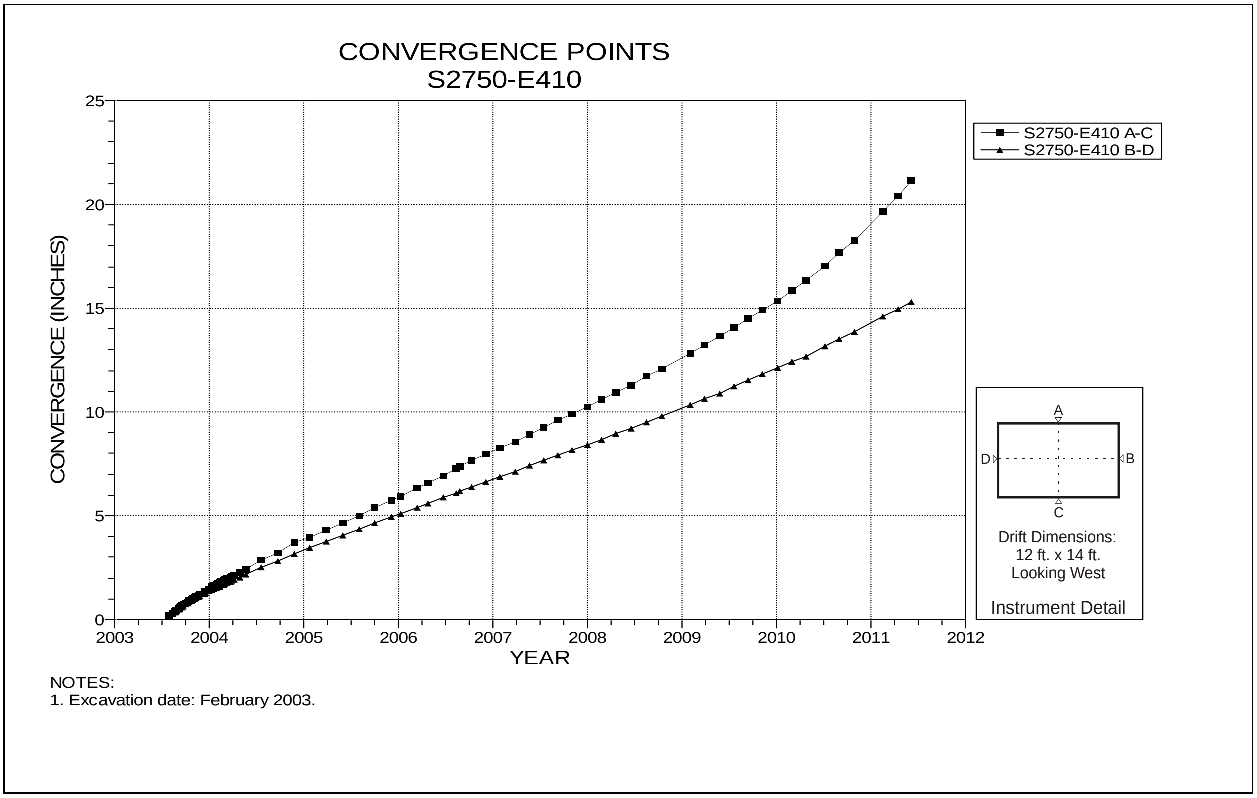


Figure 4-241 Convergence Point Array
S2750 E410 – All Chords

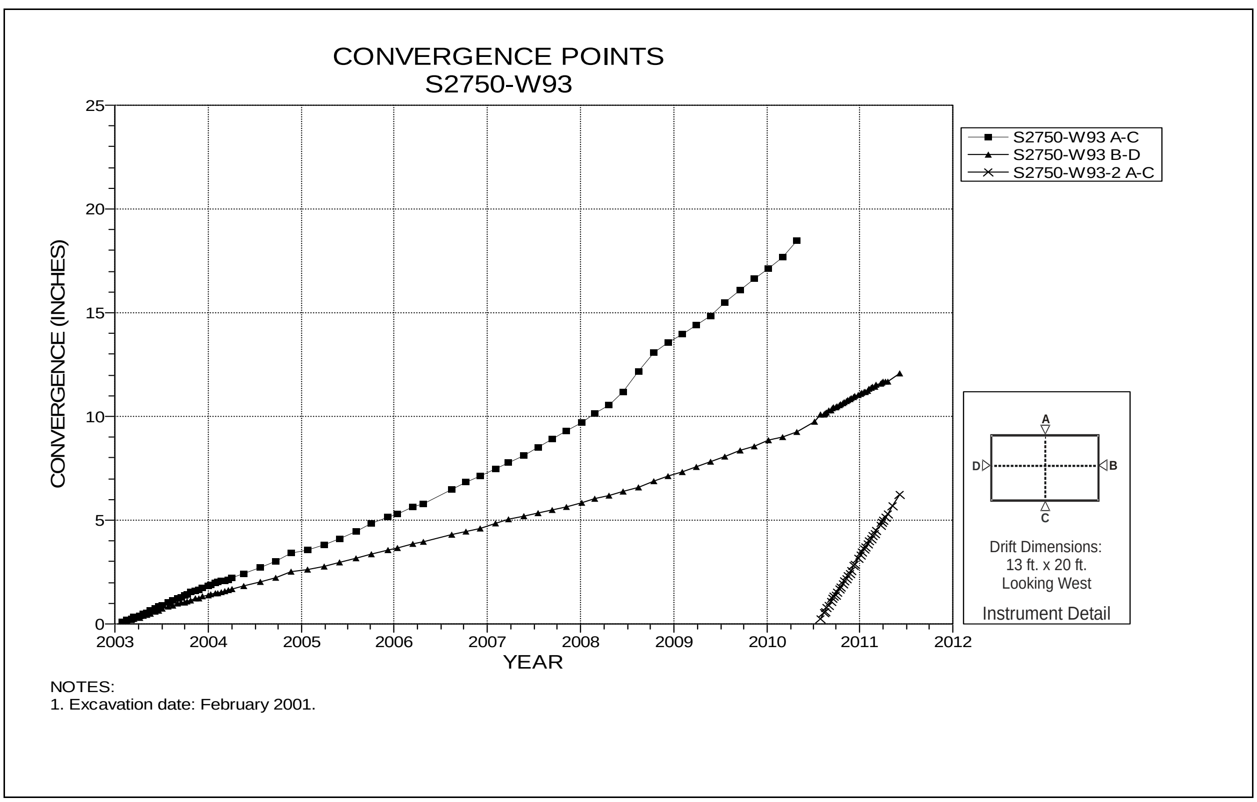


Figure 4-242 Convergence Point Array
S2750 W93 – All Chords

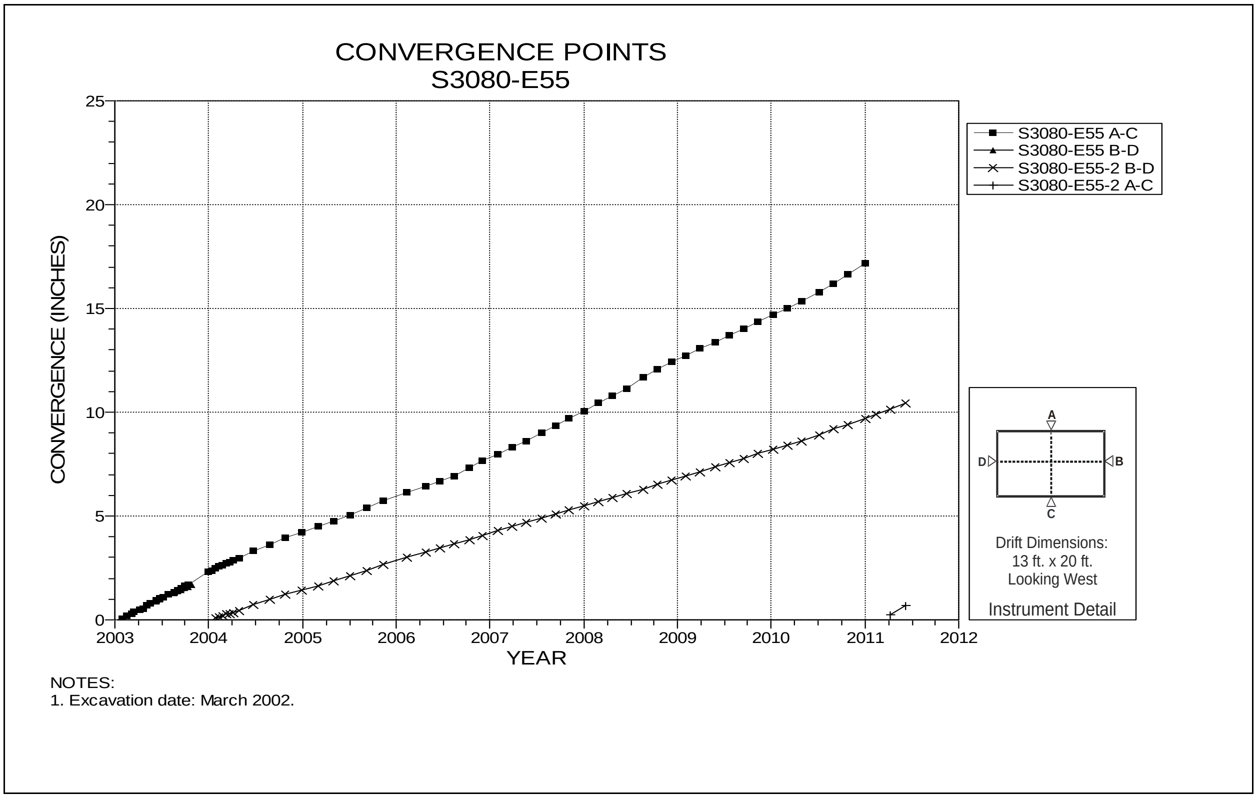


Figure 4-243 Convergence Point Array
S3080 E55 – All Chords

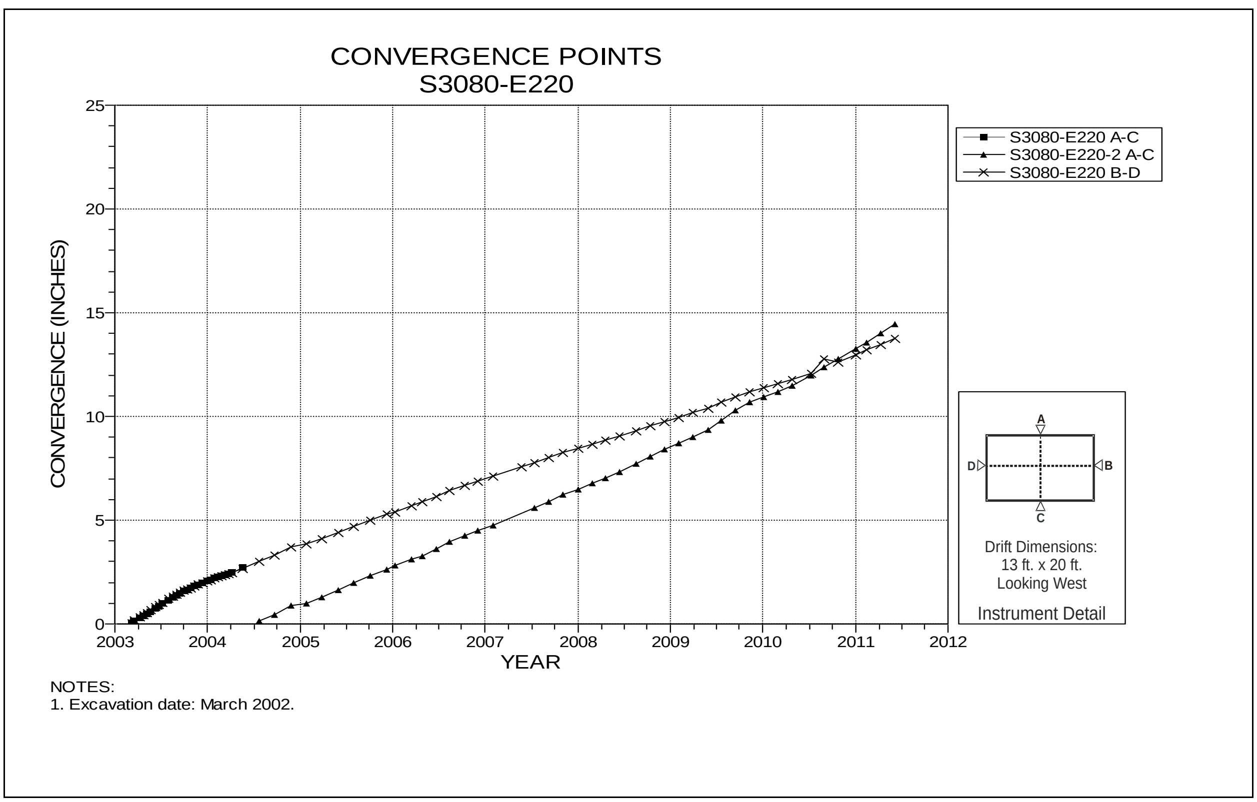


Figure 4-244 Convergence Point Array
S3080 E220 – All Chords

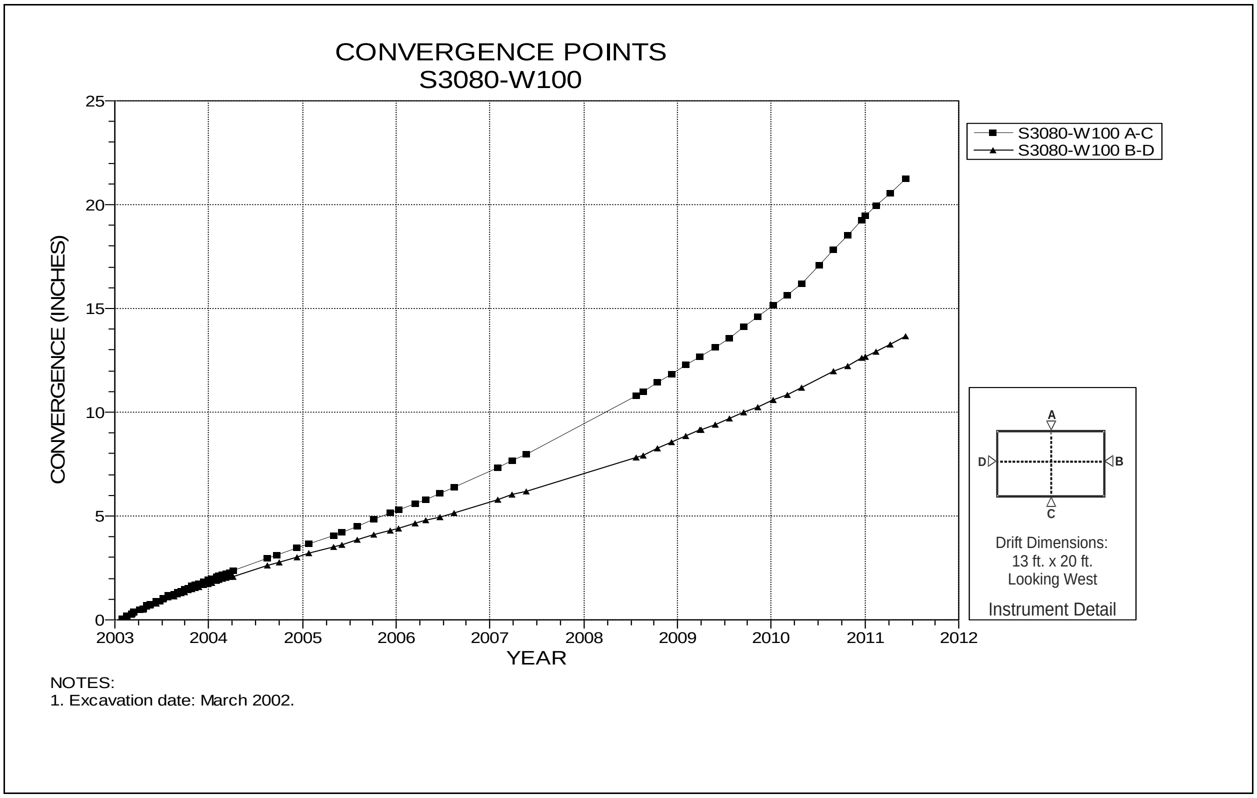


Figure 4-245 Convergence Point Array
S3080 W100 – All Chords

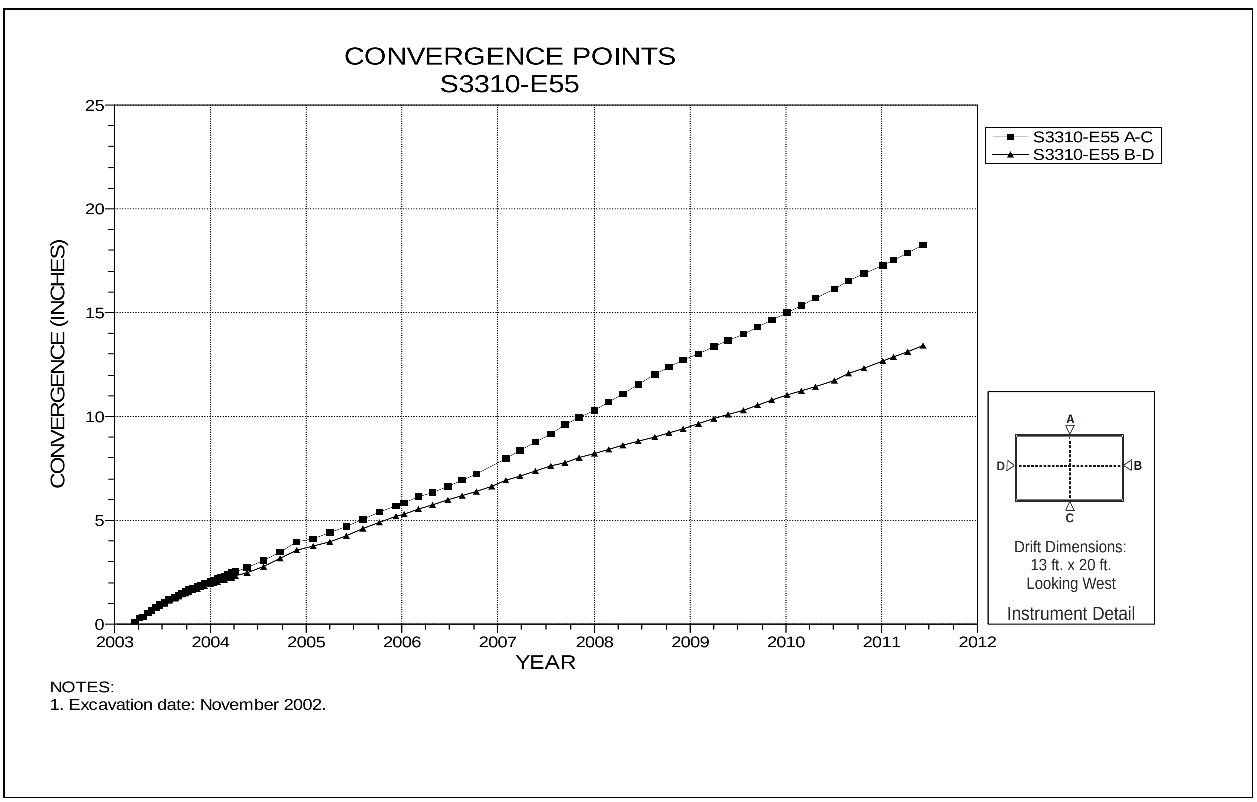


Figure 4-246 Convergence Point Array
S3310 E55 – All Chords

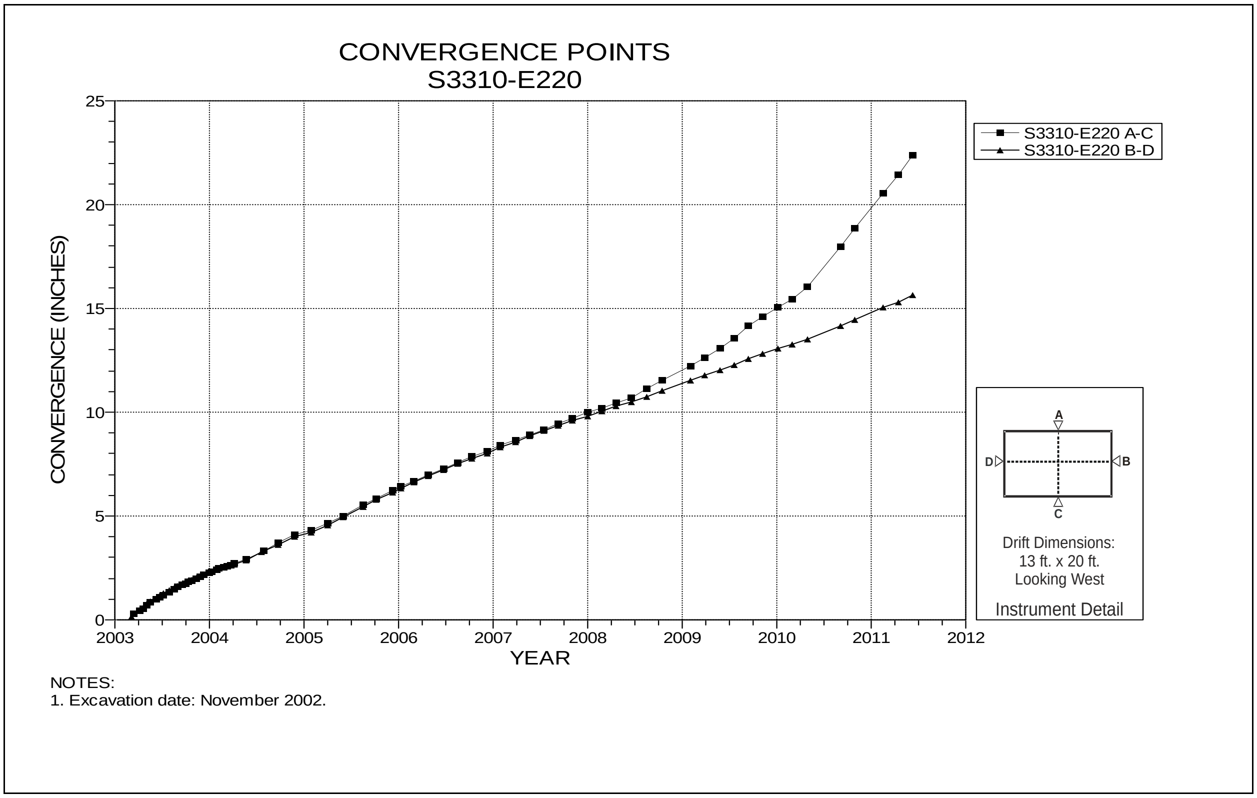


Figure 4-247 Convergence Point Array
S3310 E220 – All Chords

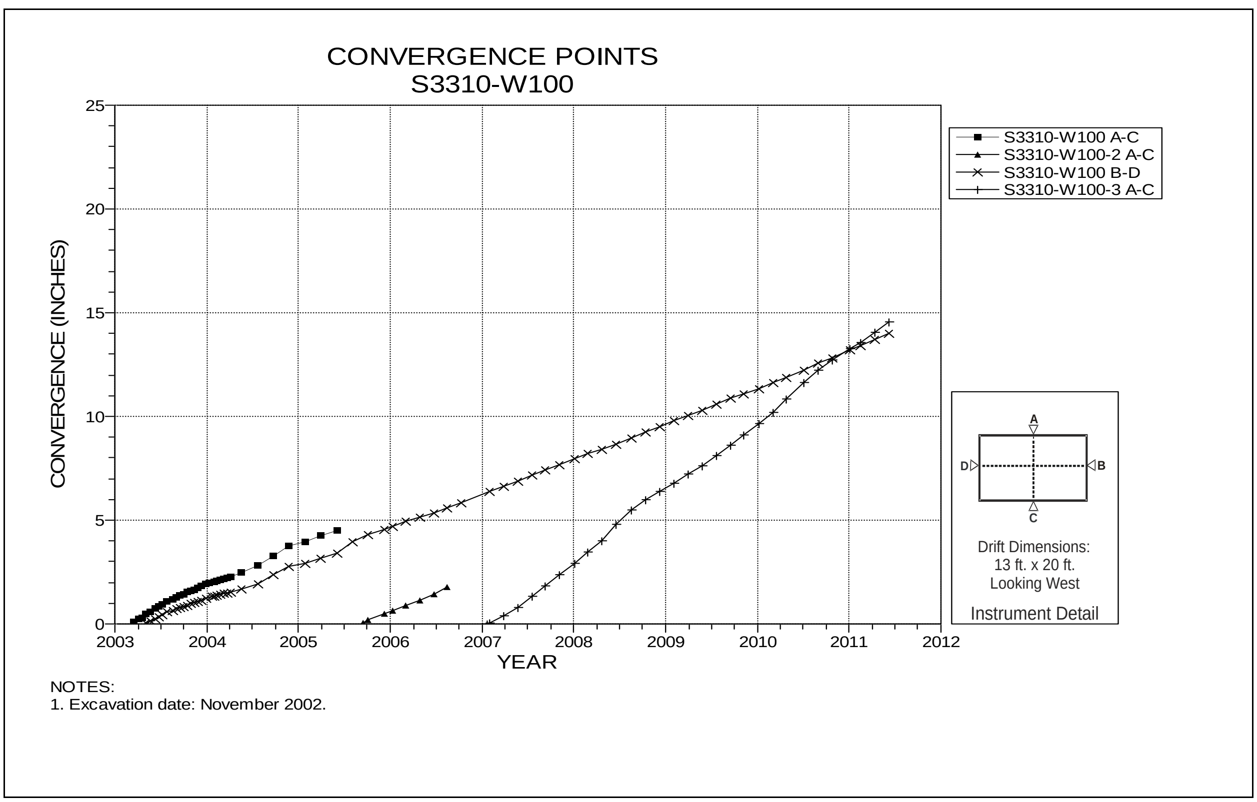


Figure 4-248 Convergence Point Array
S3310 W100 – All Chords

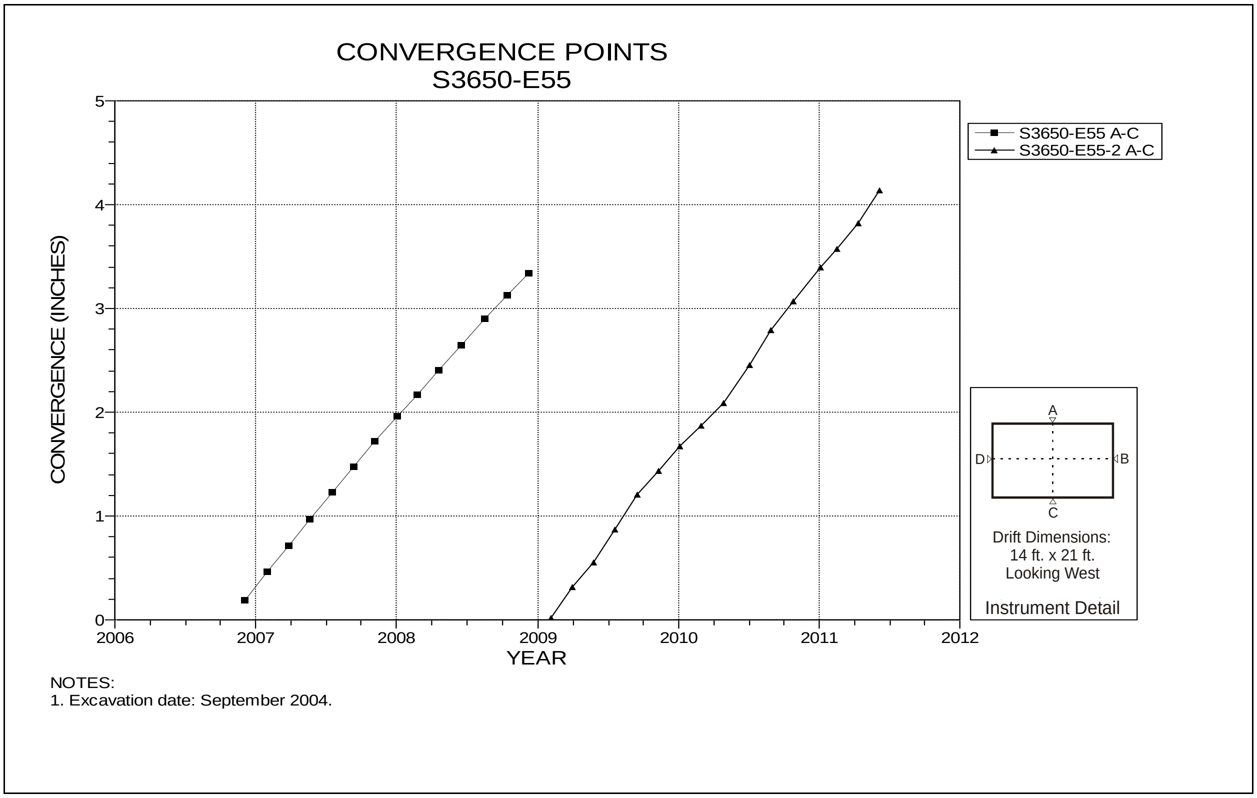


Figure 4-249 Convergence Point Array
S3650 E55 – Roof to Floor

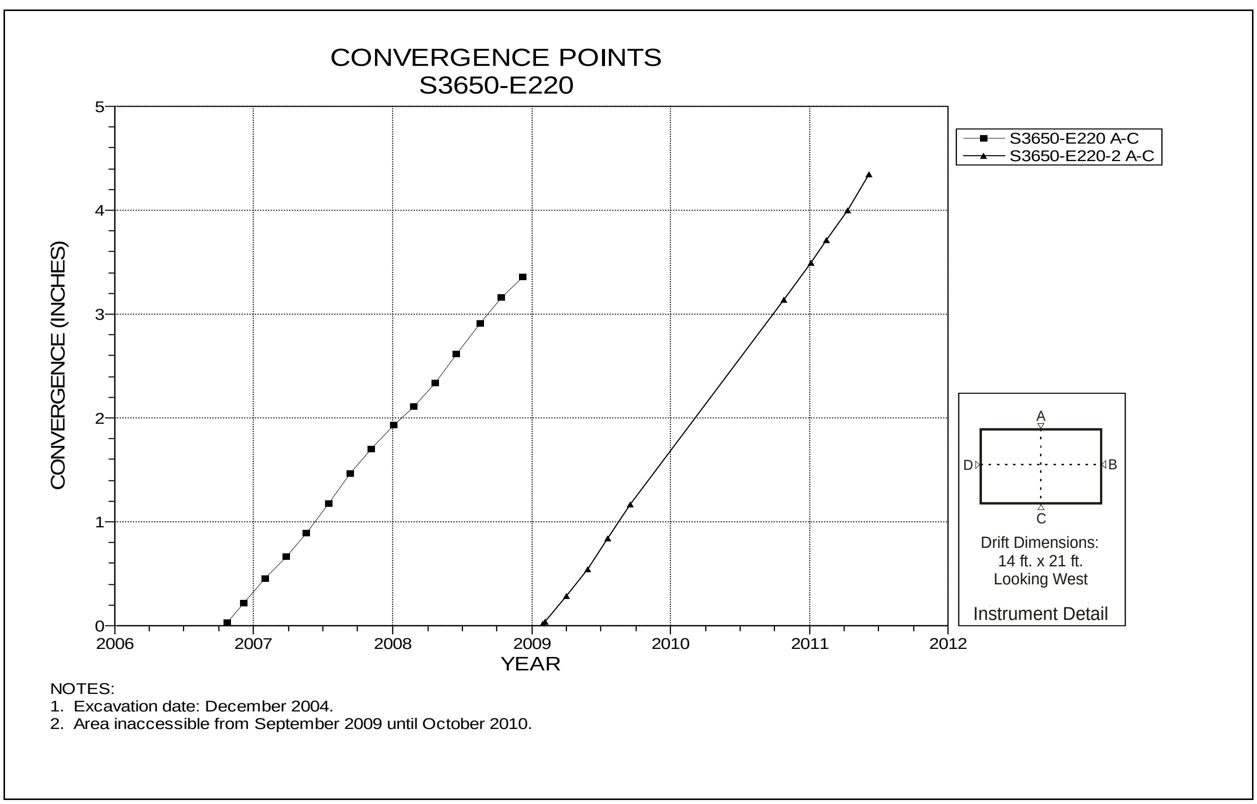


Figure 4-250 Convergence Point Array
S3650 E220 – Roof to Floor

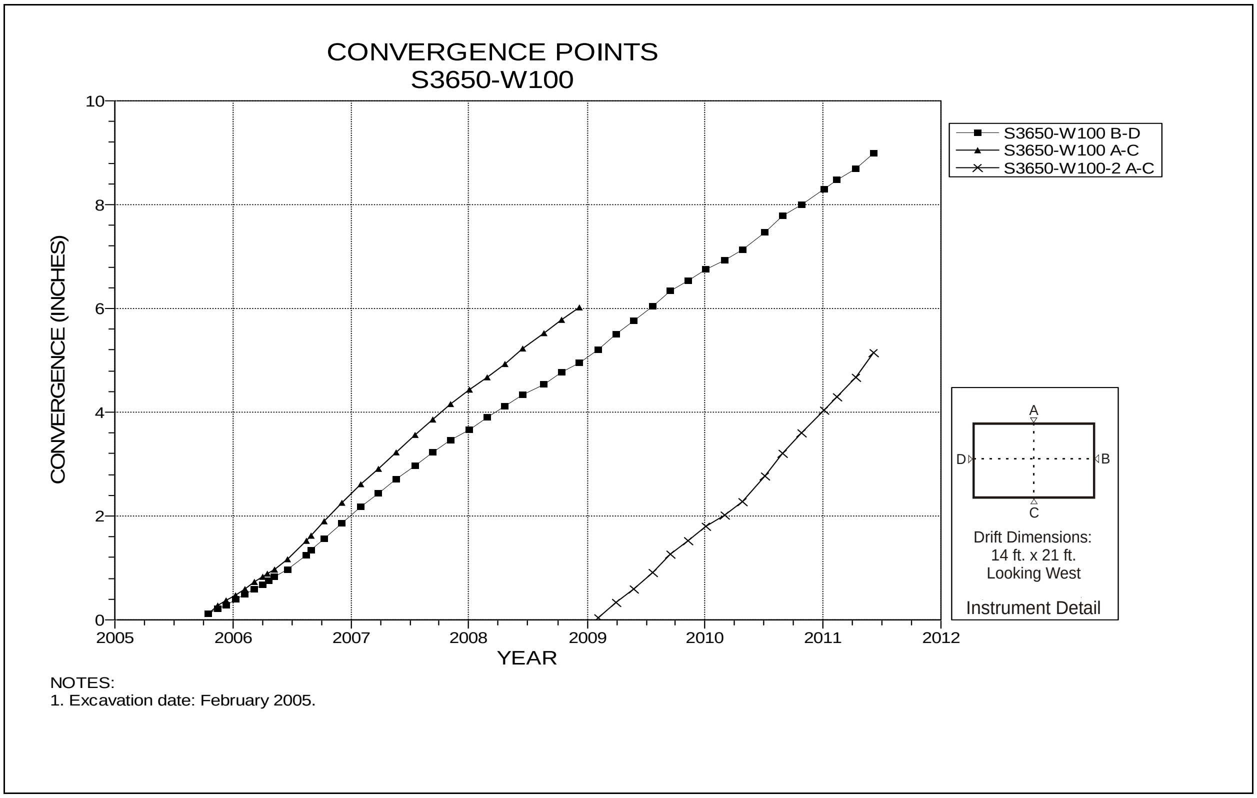


Figure 4-251 Convergence Point Array
S3650 W100 – All Chords

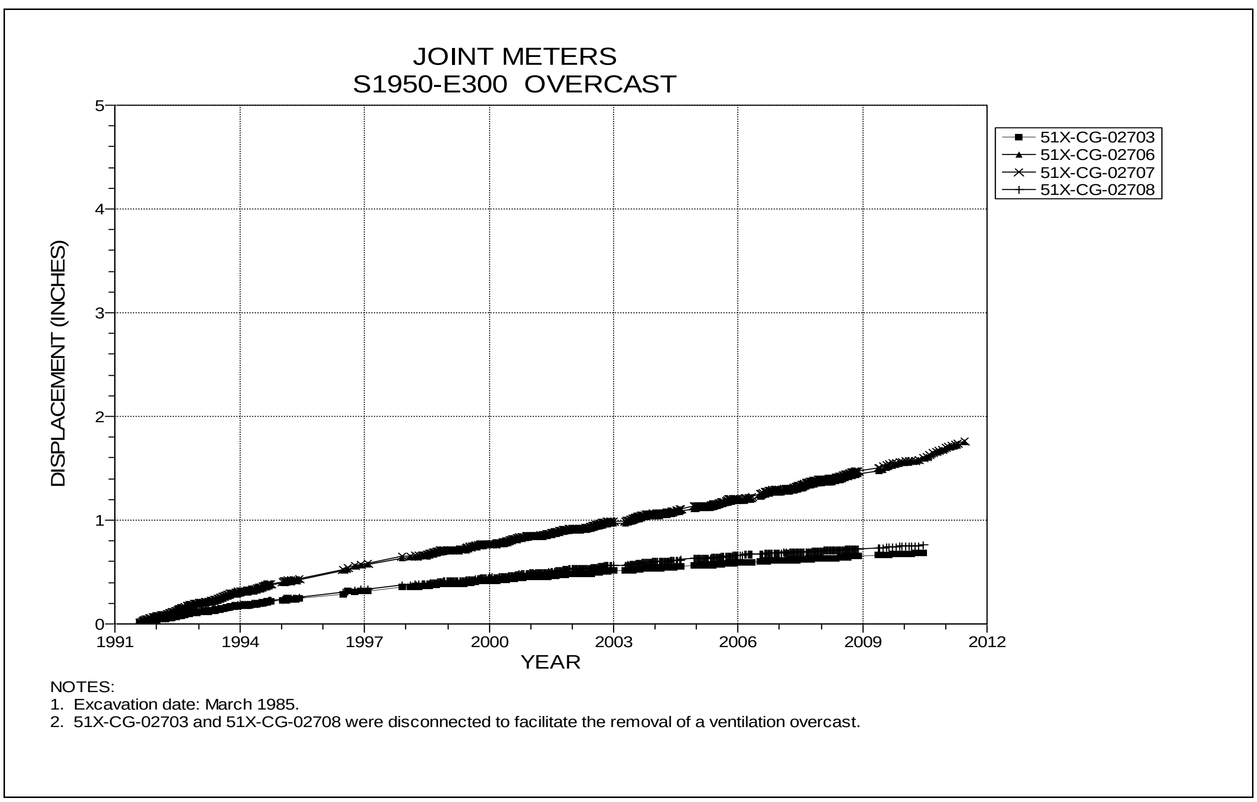


Figure 4-252 Joint Meters
S1950 E300 Overcast

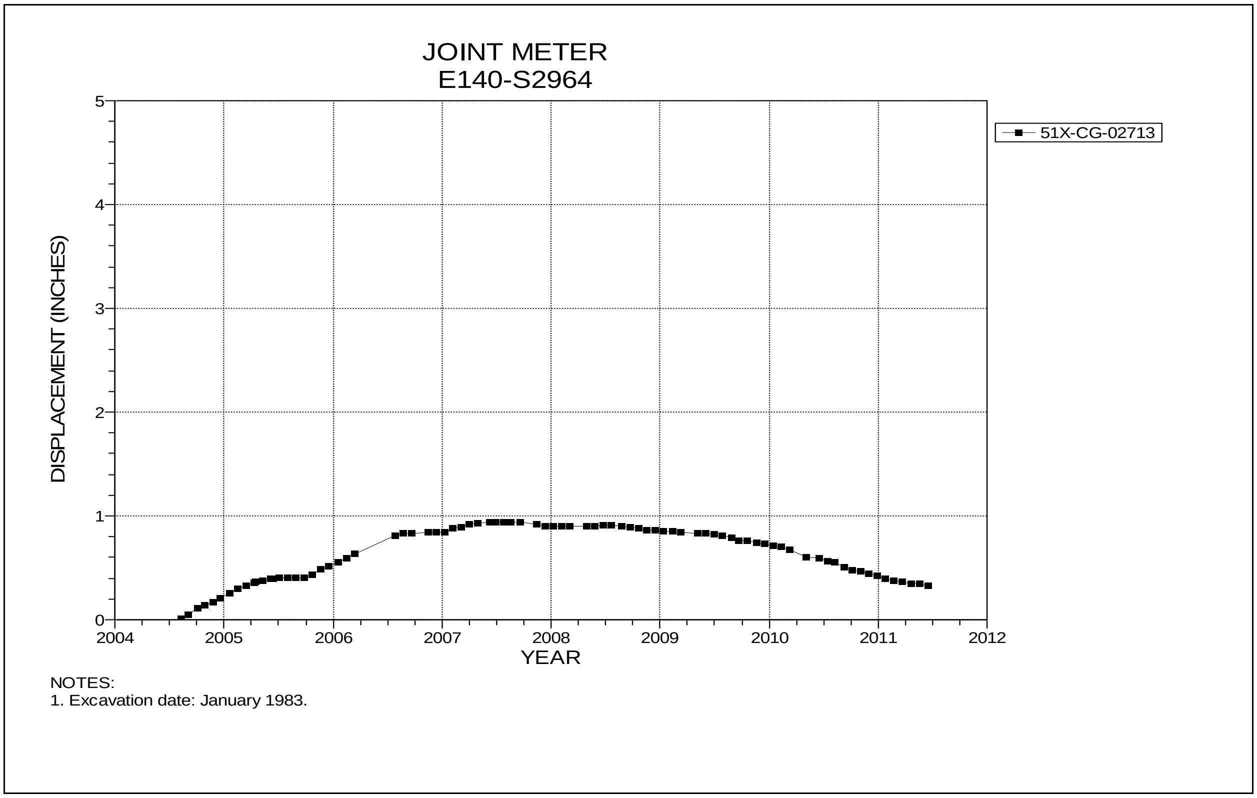


Figure 4-253 Joint Meter
E140 S2964

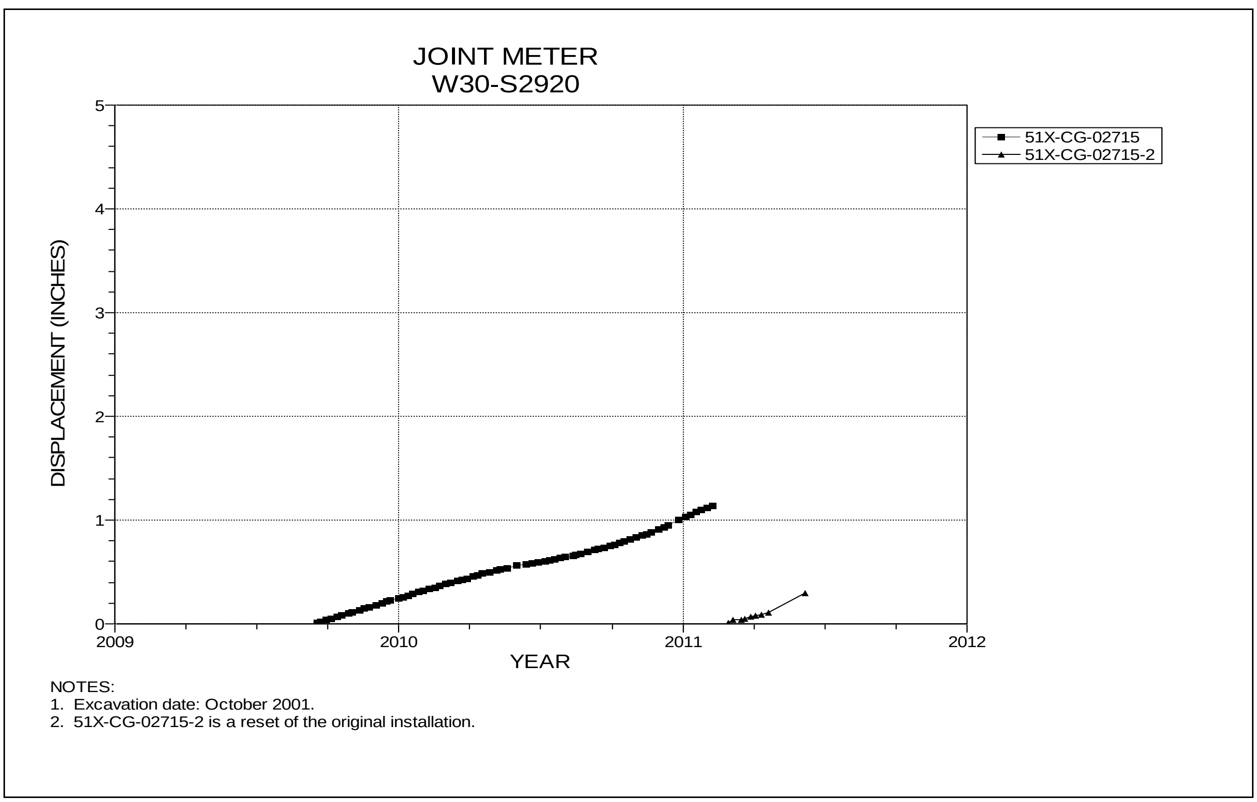


Figure 4-254 Joint Meter W30-S2920

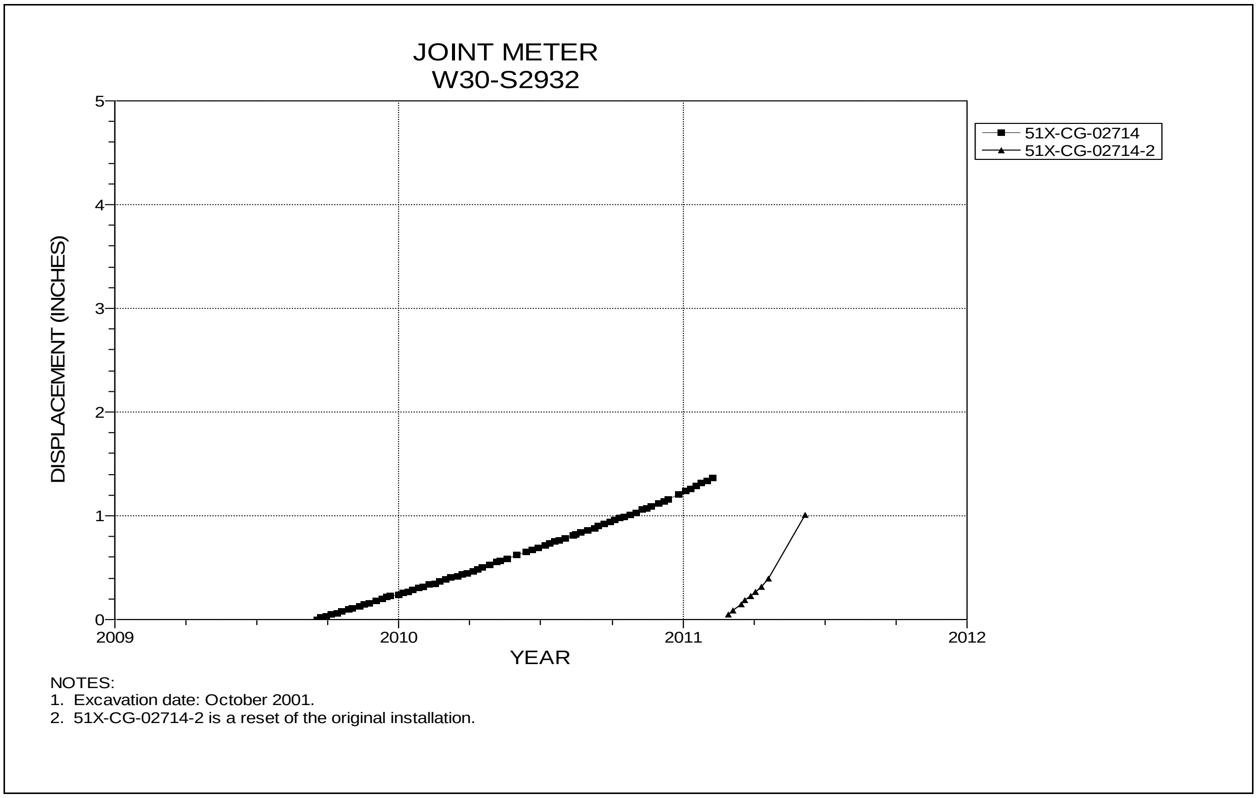


Figure 4-255 Joint Meter
W30-S2932

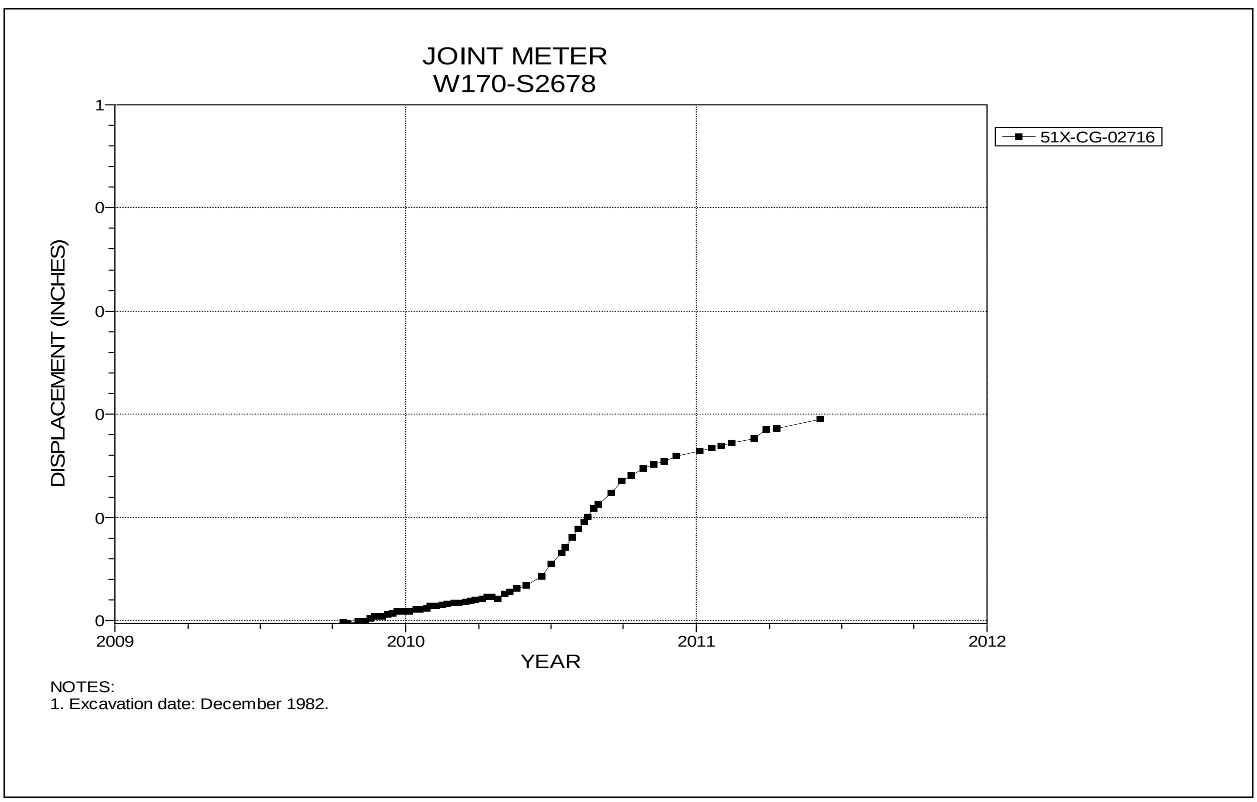


Figure 4-256 Joint Meter
W170-S2678

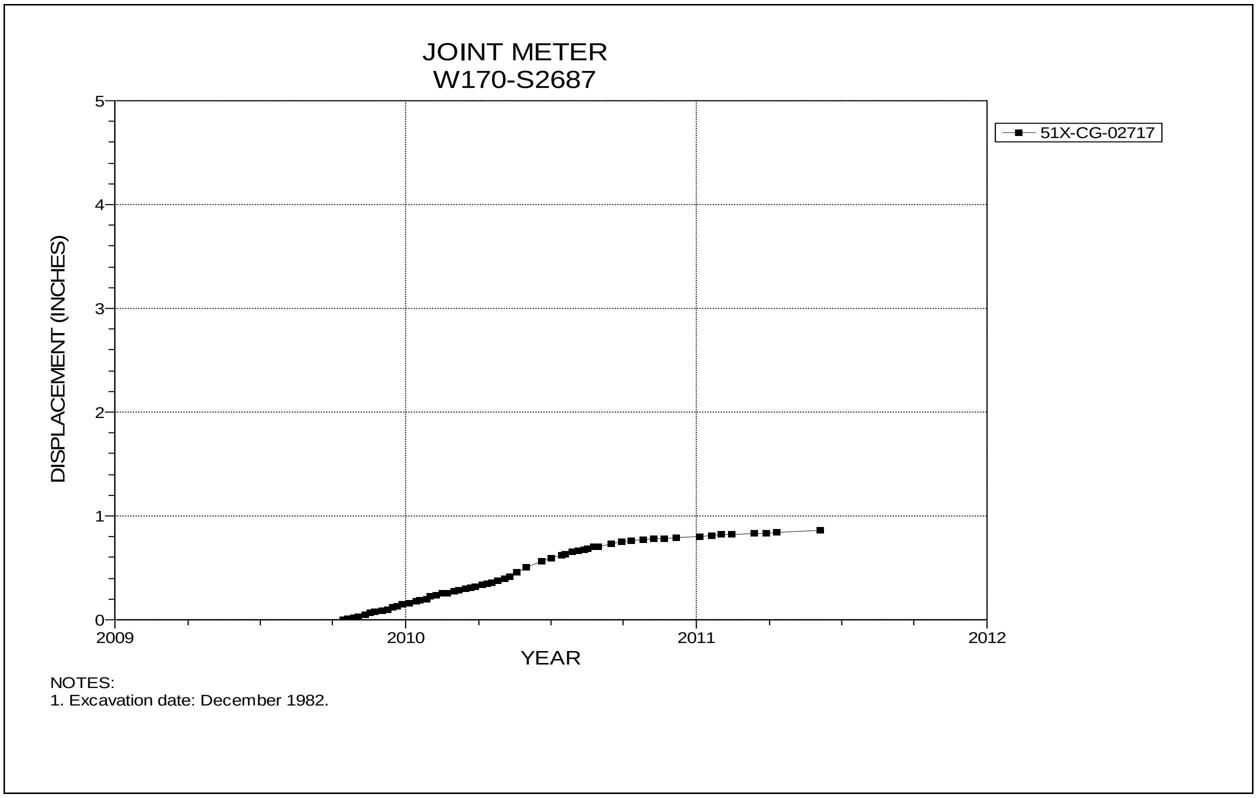


Figure 4-257 Joint Meter
W170-S2687

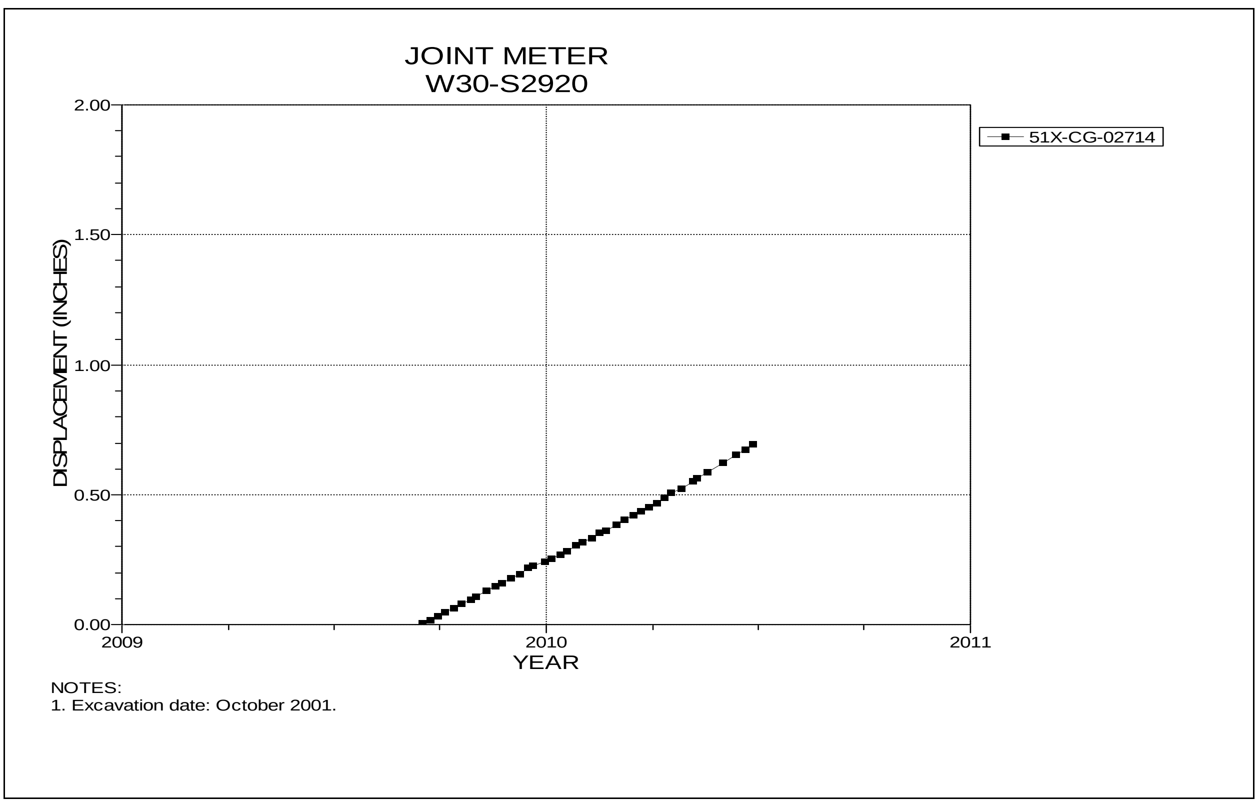


Figure 4-258 Joint Meter E140-S1505

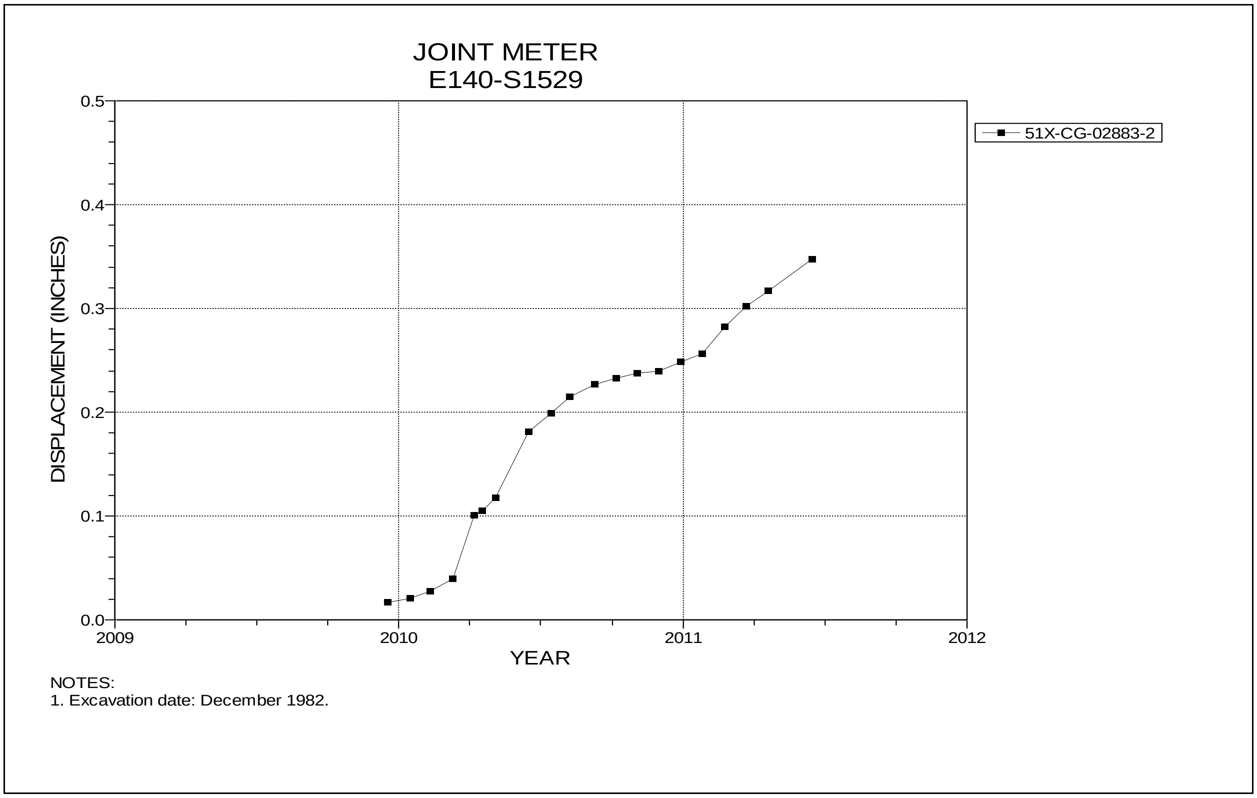


Figure 4-259 Joint Meter
E140-S1529

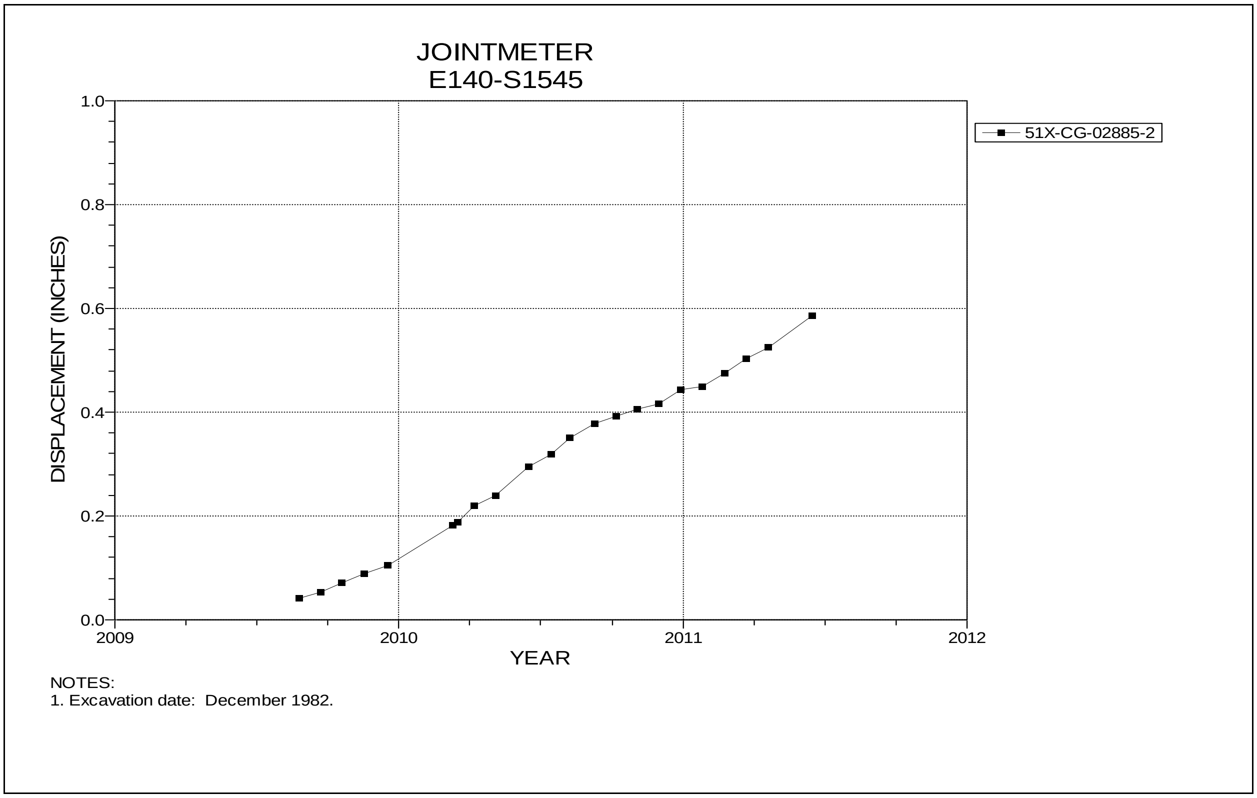


Figure 4-260 Joint Meter
E140-S1795

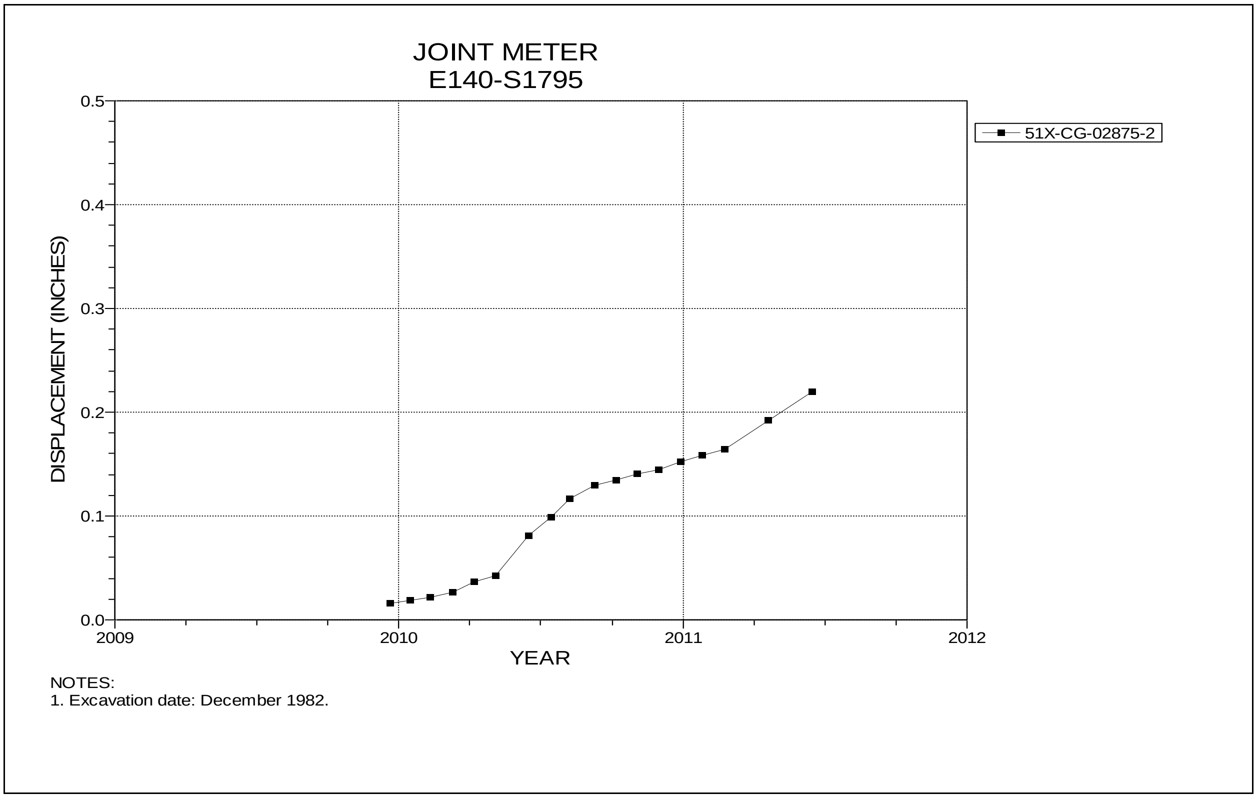


Figure 4-261 Joint Meter
E140-S1545

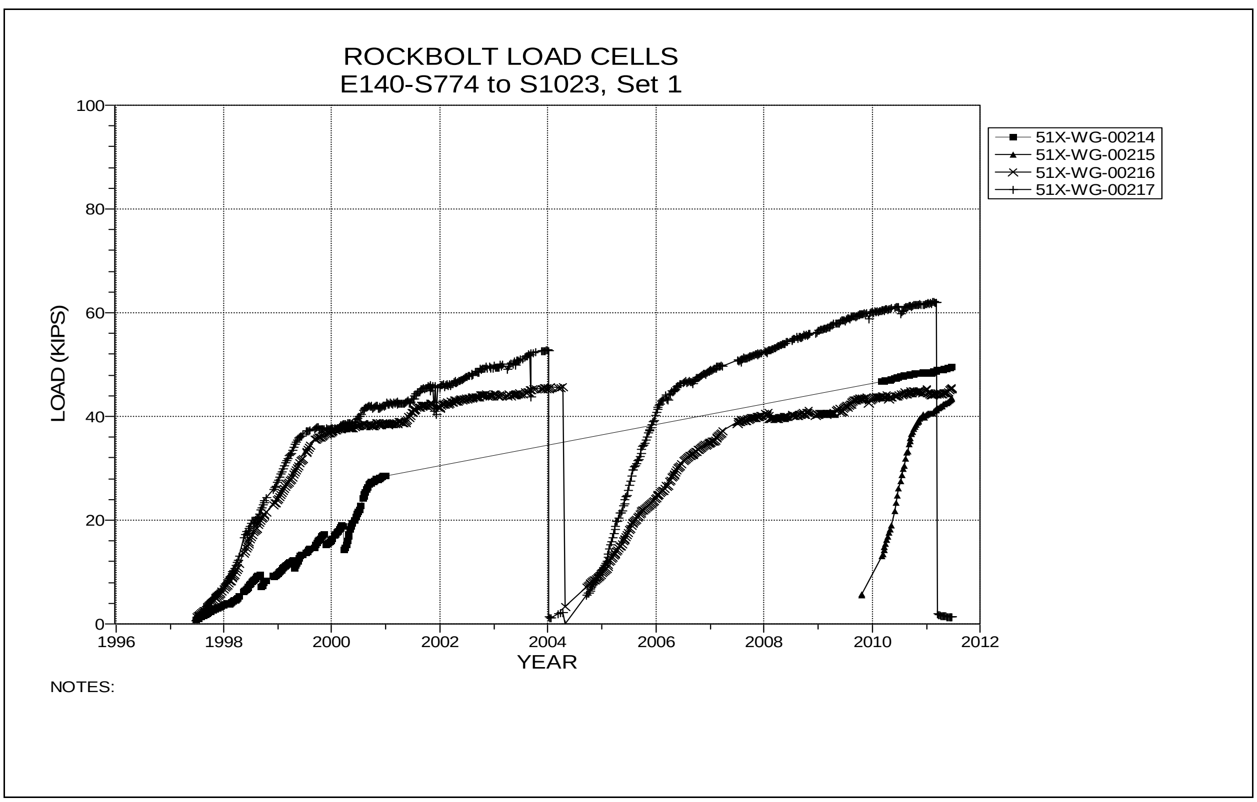


Figure 4-262 Rock Bolt Load Cells
E140 S901 to S910

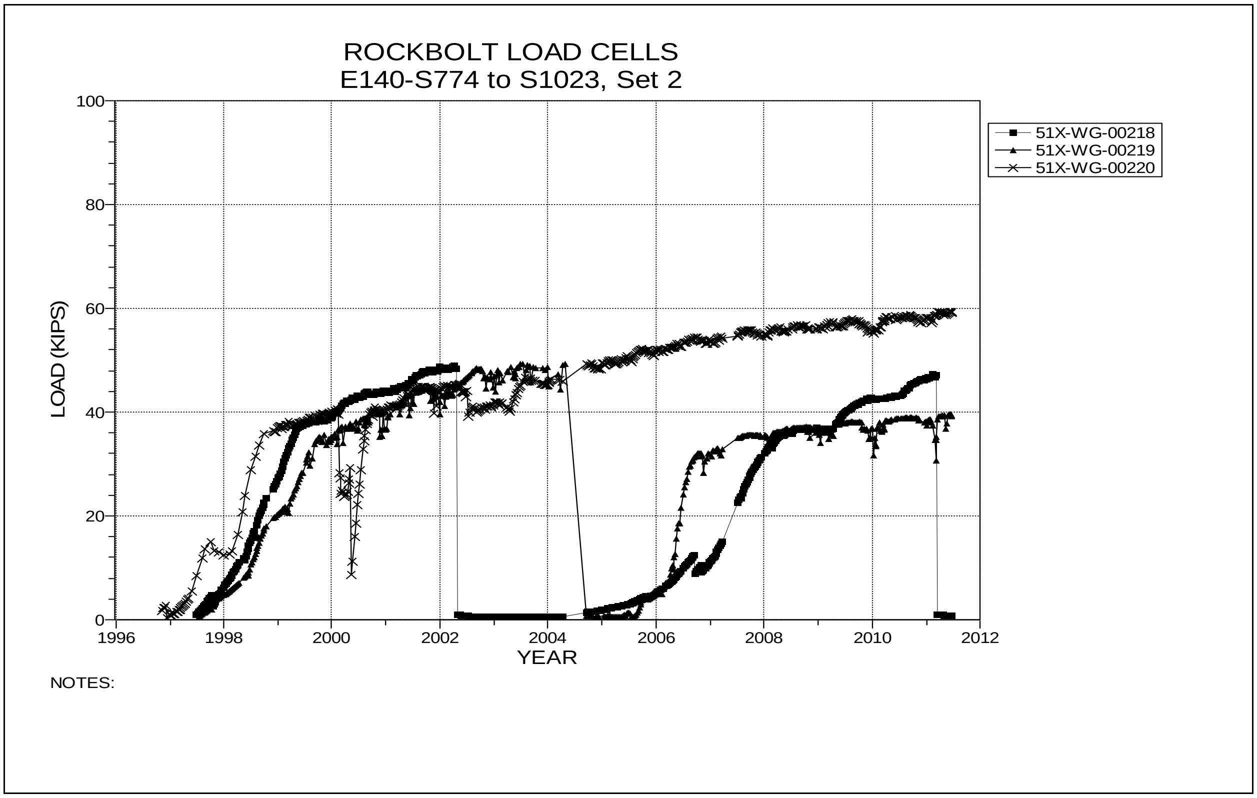


Figure 4-263 Rock Bolt Load Cells
E140 S775 to S1023

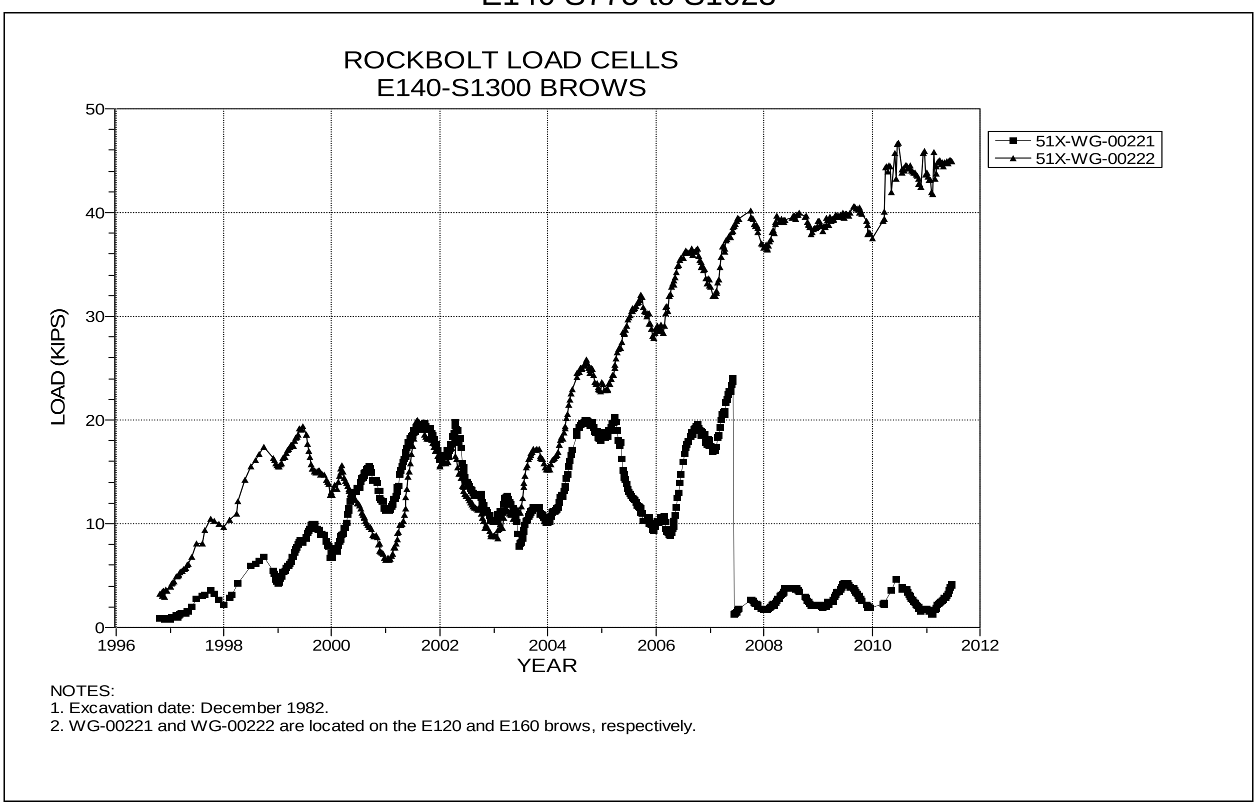


Figure 4-264 Rock Bolt Load Cells
E140-S1300 Brows

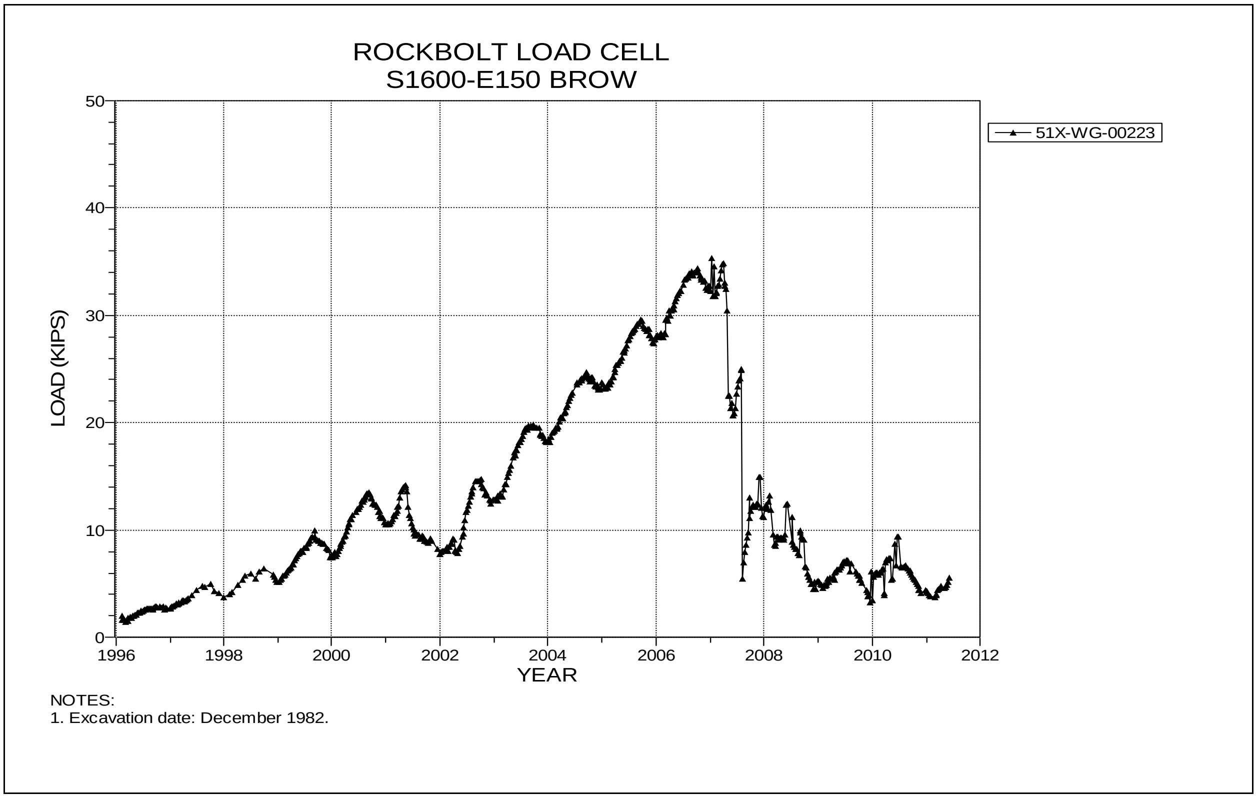


Figure 4-265 Rock Bolt Load Cell
S1600-E150 – Brow

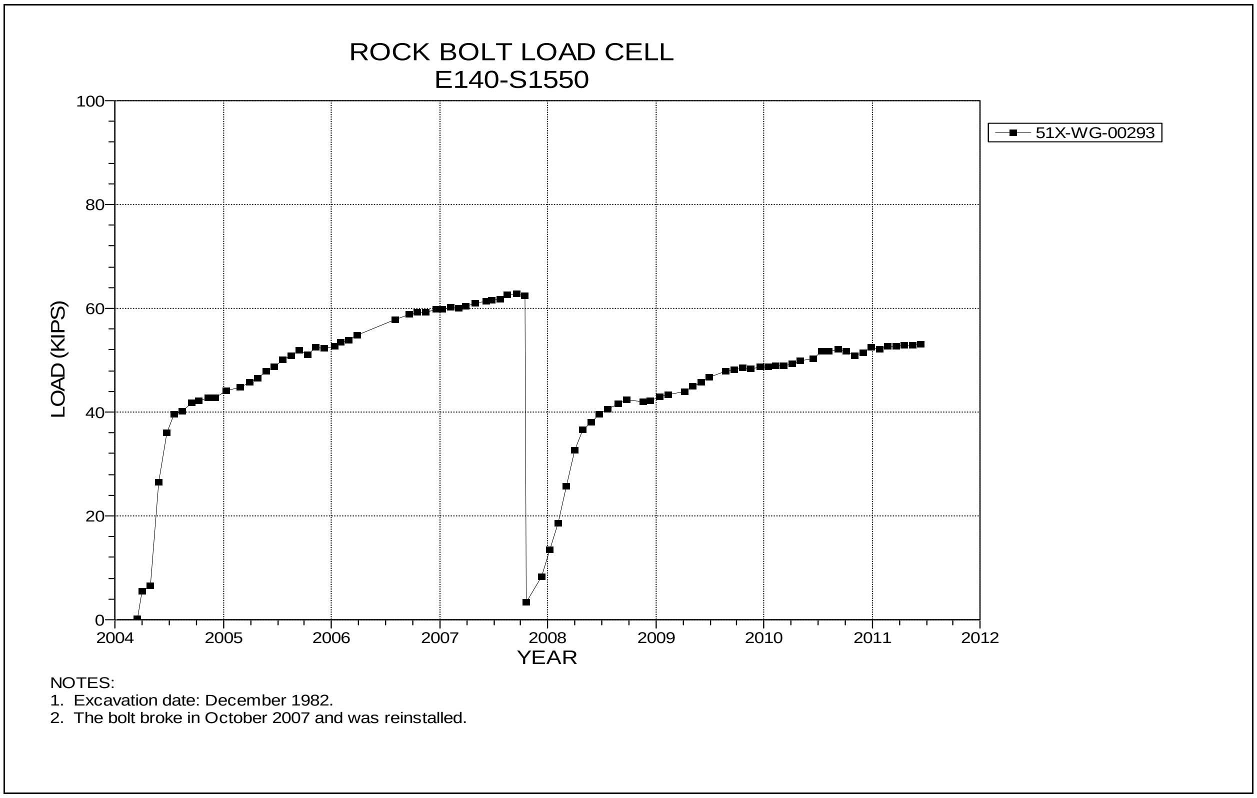
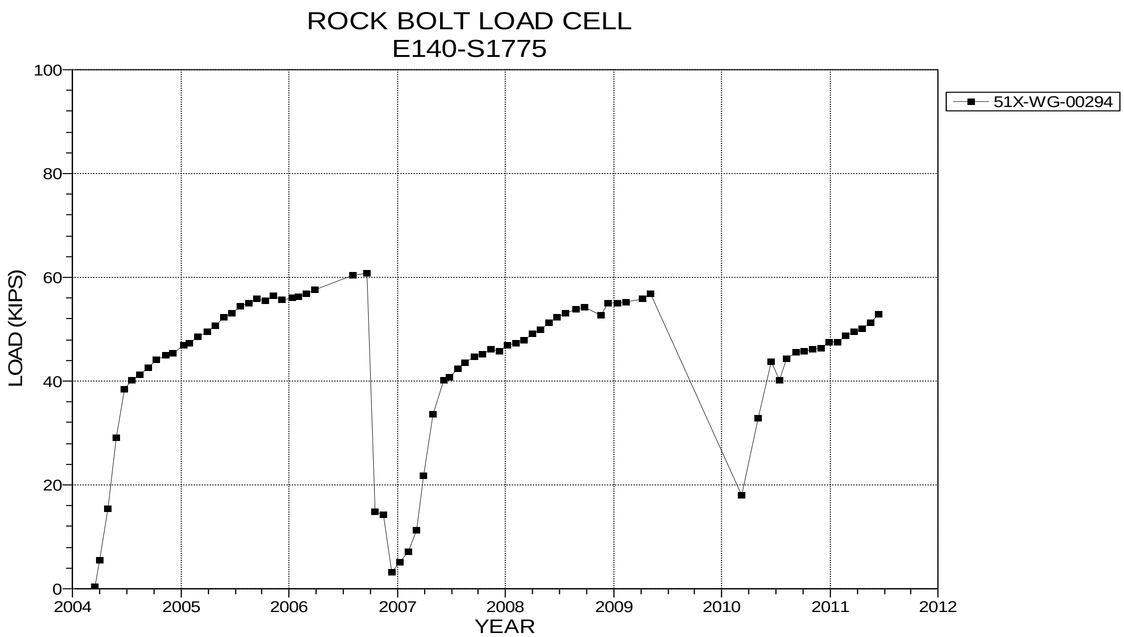
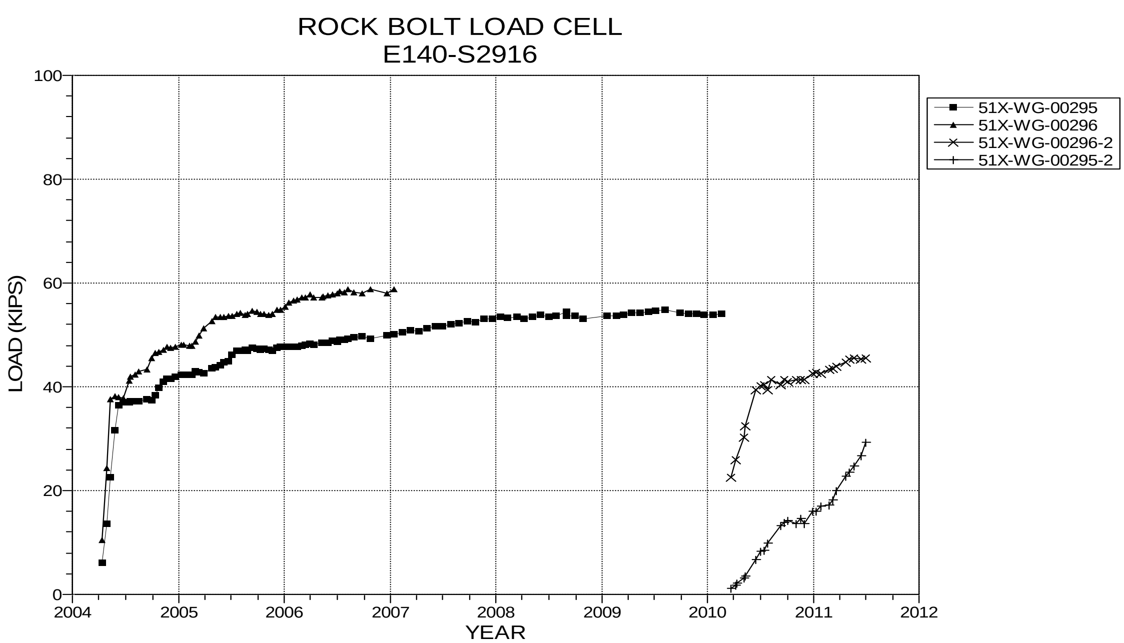


Figure 4-266 Rock Bolt Load Cell
E140 S1550



NOTES:
1. Excavation date: December 1982.
2. Load cell was reinstalled in October 2006 and March 2010 due to bolt failures.

Figure 4-267 Rock Bolt Load Cell
E140 S1550



NOTES:
1. Excavation date: January 1983.
2. Both load cells were reinstalled on replacement bolts in March 2010.

Figure 4-268 Rock Bolt Load Cells
E140 S2916

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5.0 Instrumentation Summary for the Waste Disposal Area

This chapter presents a summary of the data collected from instruments located in the Waste Disposal Area at the WIPP. Table 5-1 presents data and analysis of the access drifts associated with Panel 1. Plots of the instrument data are presented as Figures 5-1 through 5-14.

Table 5-2 presents data and analysis of the access drifts associated with Panel 2. Plots of the instrument data are presented as Figures 5-15 and 5-16.

Panel 3 data and analysis are presented on Table 5-3. Plots of the instrument data are presented as Figures 5-17 through 5-18.

Table 5-4 presents data and analysis of Panel 4. Plots of the instrument data are presented as Figures 5-19 through 5-26.

Table 5-5 presents data and analysis of Panel 5. Plots of the instrument data are presented as Figures 5-27 through 5-63.

Table 5-6 presents data and analysis of Panel 6. Plots of the instrument data are presented as Figures 5-64 through 5-123.

Table 5-7 presents data and analysis of Panel 7. Plots of the instrument data are presented as Figures 5-124 through 5-172.

Table 5-1
Panel 1 Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
S1600-E311-2 A-C	S1600-E311	5-1	05/25/11	15.782	21.229	0.80	0.74	8%	
S1600-E332-3 A-C	S1600-E332	5-2	05/25/11	15.127	19.554	0.90	0.85	6%	
S1600-E357-2 A-C	S1600-E357	5-3	05/25/11	17.621	23.019	1.07	0.77	39%	
S1600-E382-2 A-C	S1600-E382	5-4	05/25/11	17.446	22.826	0.98	0.74	32%	
S1600-E407-2 A-G	S1600-E407	5-5	05/25/11	19.354	24.796	1.22	0.92	33%	
S1600-E407-2 B-F	S1600-E407	5-5	05/25/11	17.919	22.925	1.12	0.82	37%	
S1600-E407-2 H-L	S1600-E407	5-5	05/25/11	18.928	23.993	1.29	0.87	48%	
S1600-E432-2 A-C	S1600-E432	5-6	05/25/11	22.444	29.203	1.54	1.43	8%	
S1600-E453 A-C	S1600-E453	5-7	05/25/11	4.352	4.352	0.70	0.58	21%	
S1600-E453 B-D	S1600-E453	5-7	05/25/11	4.137	4.137	0.68	0.45	51%	
S1950-E311-7 A-C	S1950-E311	5-8	05/25/11	1.114	30.505	1.46	1.16	26%	
S1950-E311-3 B-D	S1950-E311	5-8	05/25/11	16.201	29.202	1.57	1.32	19%	
S1950-E332-4 A-C	S1950-E332	5-9	05/25/11	18.594	37.196	1.70	1.48	15%	
S1950-E332-4 B-D	S1950-E332	5-9	05/25/11	13.999	31.945	1.76	1.48	19%	
S1950-E357-7 A-C	S1950-E357	5-10	05/25/11	23.591	43.755	2.28	2.04	12%	
S1950-E357-4 B-D	S1950-E357	5-10	05/25/11	14.970	33.429	1.78	1.59	12%	
S1950-E382-5 A-C	S1950-E382	5-11	05/25/11	27.762	46.397	2.73	2.26	21%	
S1950-E382-3 B-D	S1950-E382	5-11	05/25/11	21.803	36.185	2.14	1.61	33%	
S1950-E407-4 A-G	S1950-E407	5-12	05/25/11	27.467	49.291	2.62	2.27	15%	
S1950-E407-3 H-L	S1950-E407	5-12	05/25/11	27.060	47.792	2.40	2.03	18%	
S1950-E407-3 D-J	S1950-E407	5-13	05/25/11	22.793	36.970	1.96	1.69	16%	
S1950-E432-3 A-C	S1950-E432	5-14	05/25/11	27.106	48.901	3.41	1.95	75%	
S1950-E432-3 B-D	S1950-E432	5-14	05/25/11	21.283	35.684	1.71	1.60	7%	

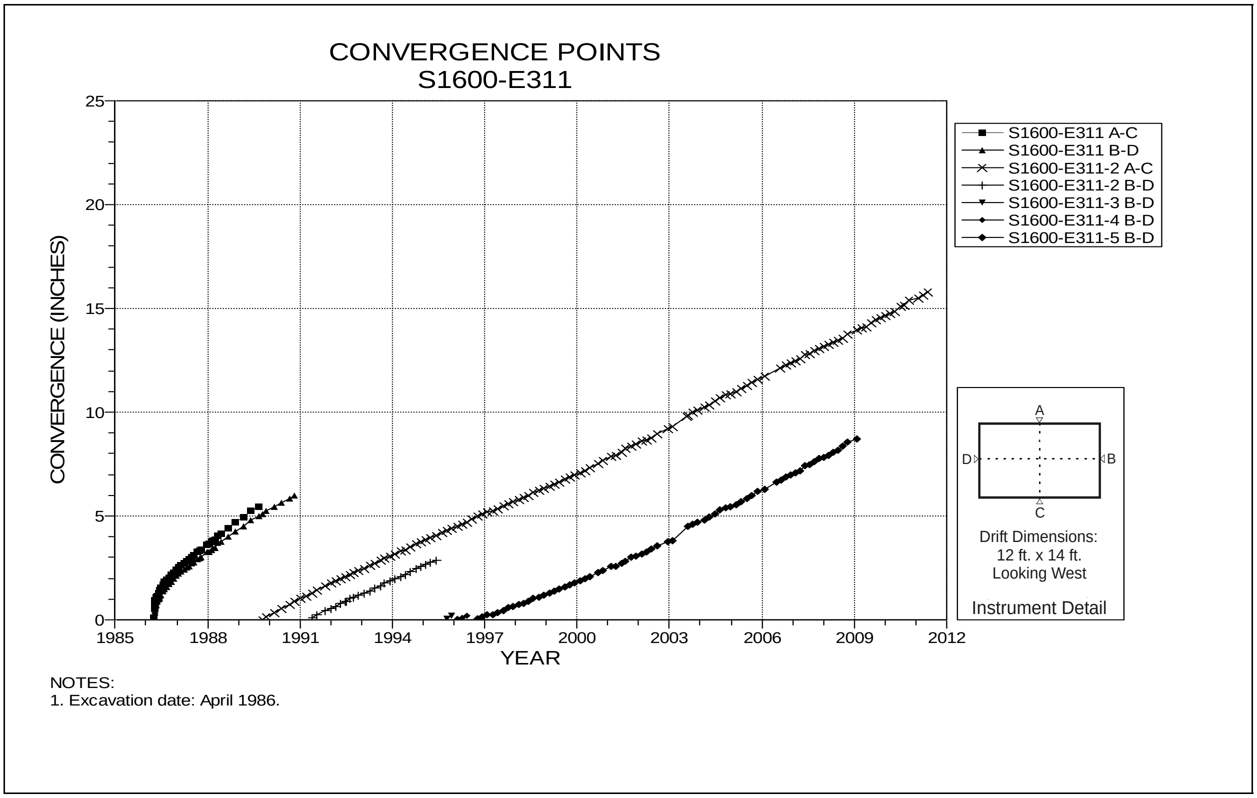


Figure 5-1 Convergence Point Array
S1600 E311 – All Chords

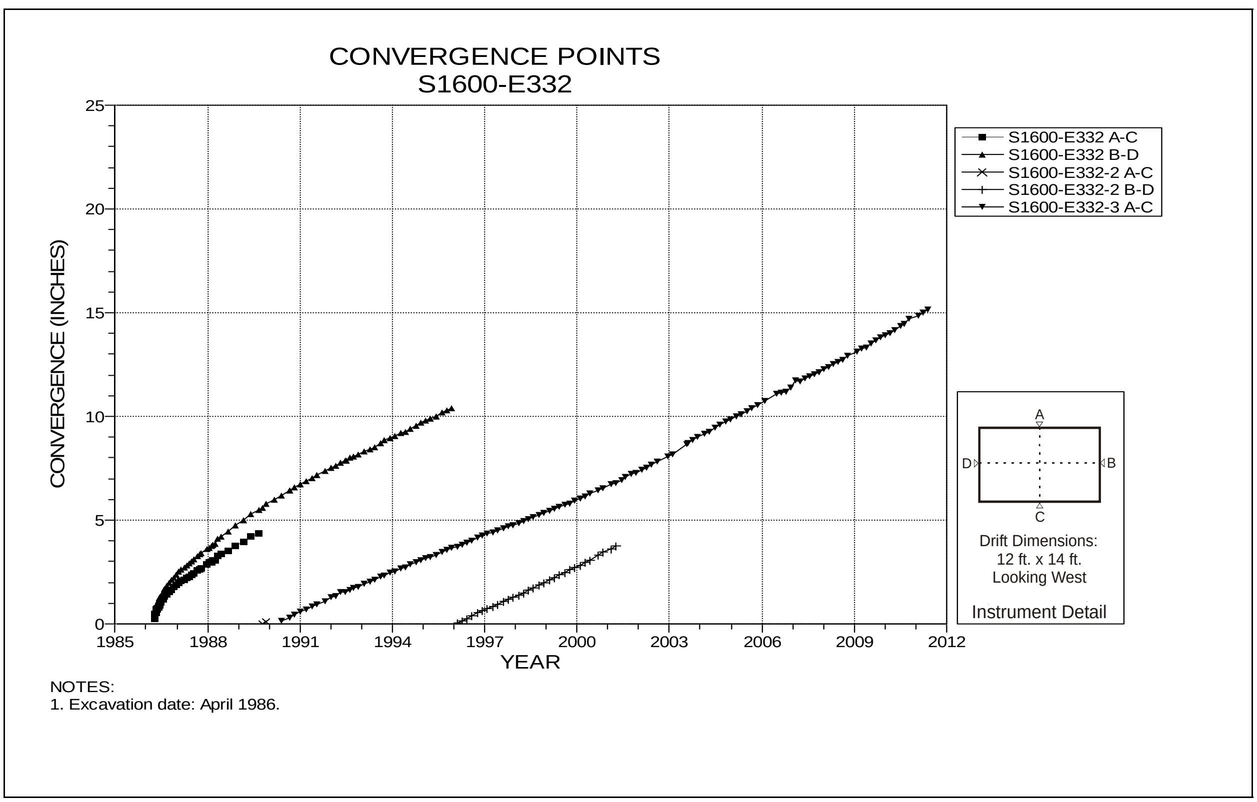


Figure 5-2 Convergence Point Array
S1600 E332 – All Chords

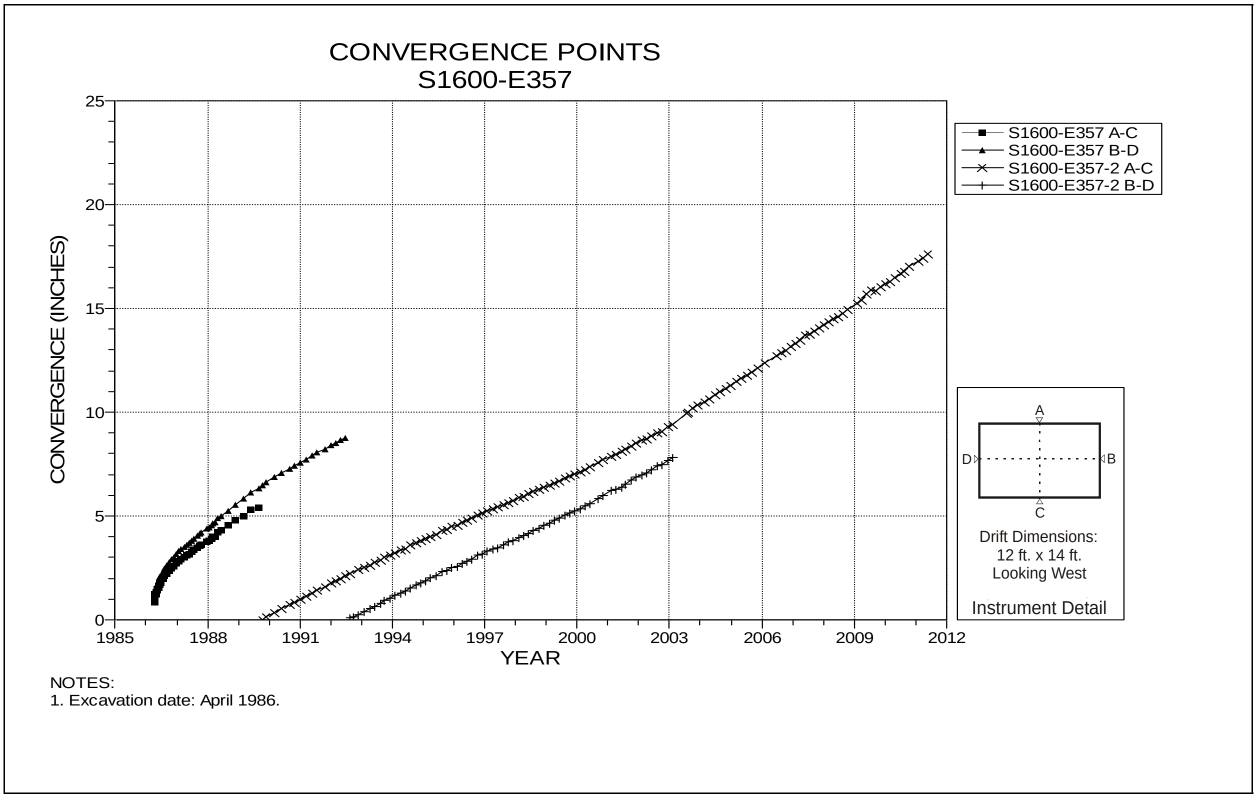


Figure 5-3 Convergence Point Array
S1600 E357 – All Chords

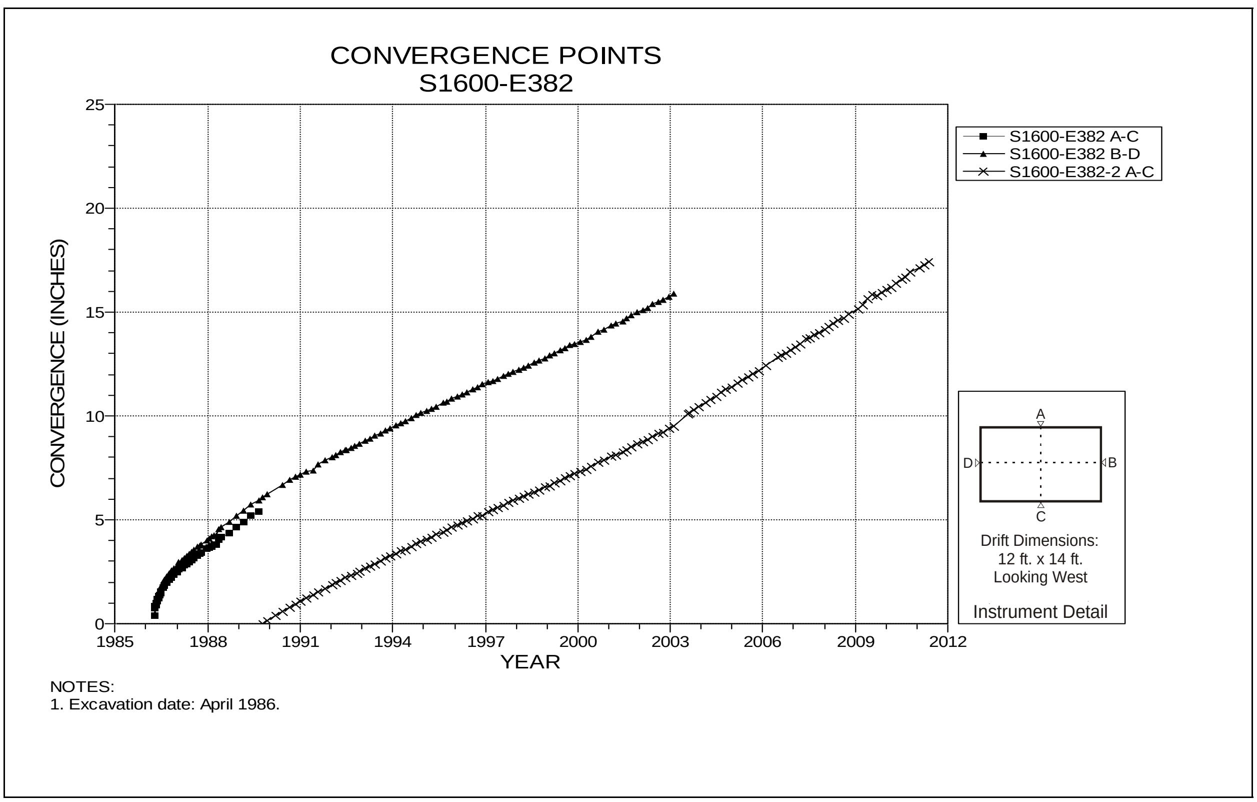


Figure 5-4 Convergence Point Array
S1600 E382 – All Chords

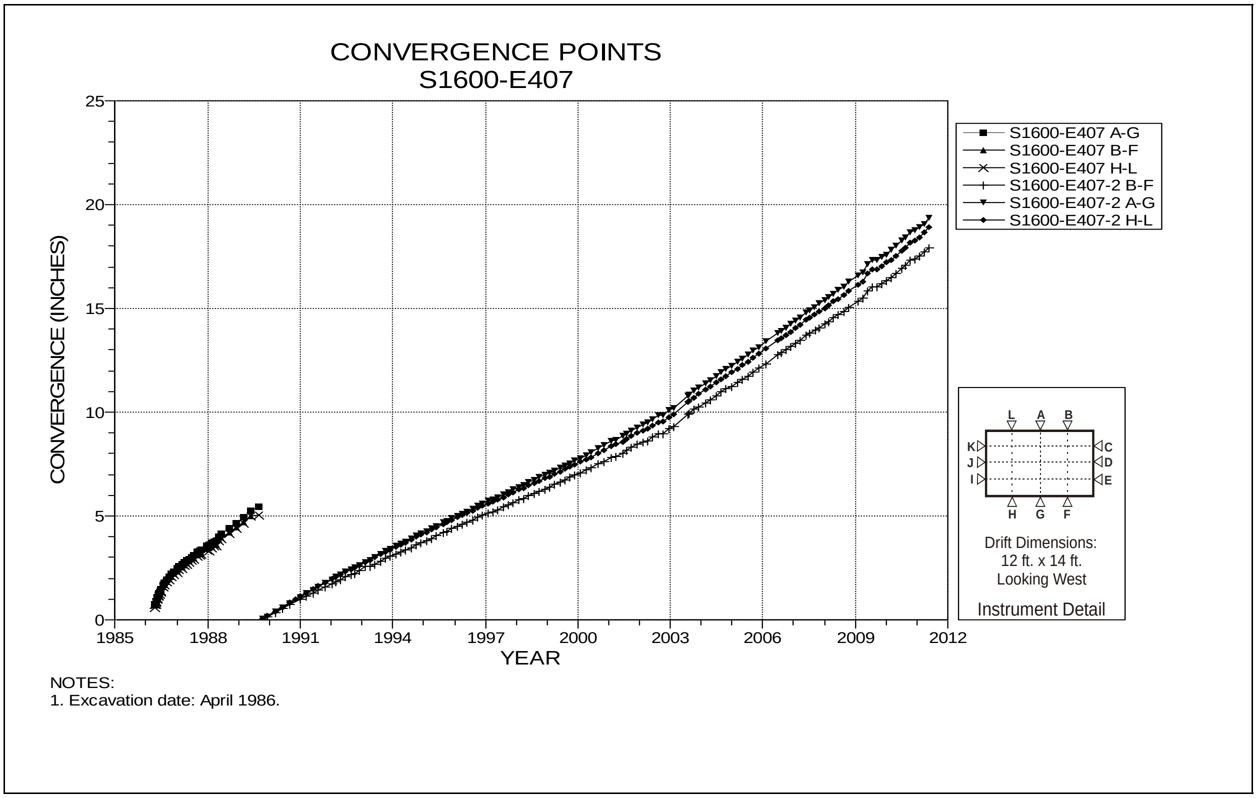


Figure 5-5 Convergence Point Array
S1600 E407 – All Vertical Chords

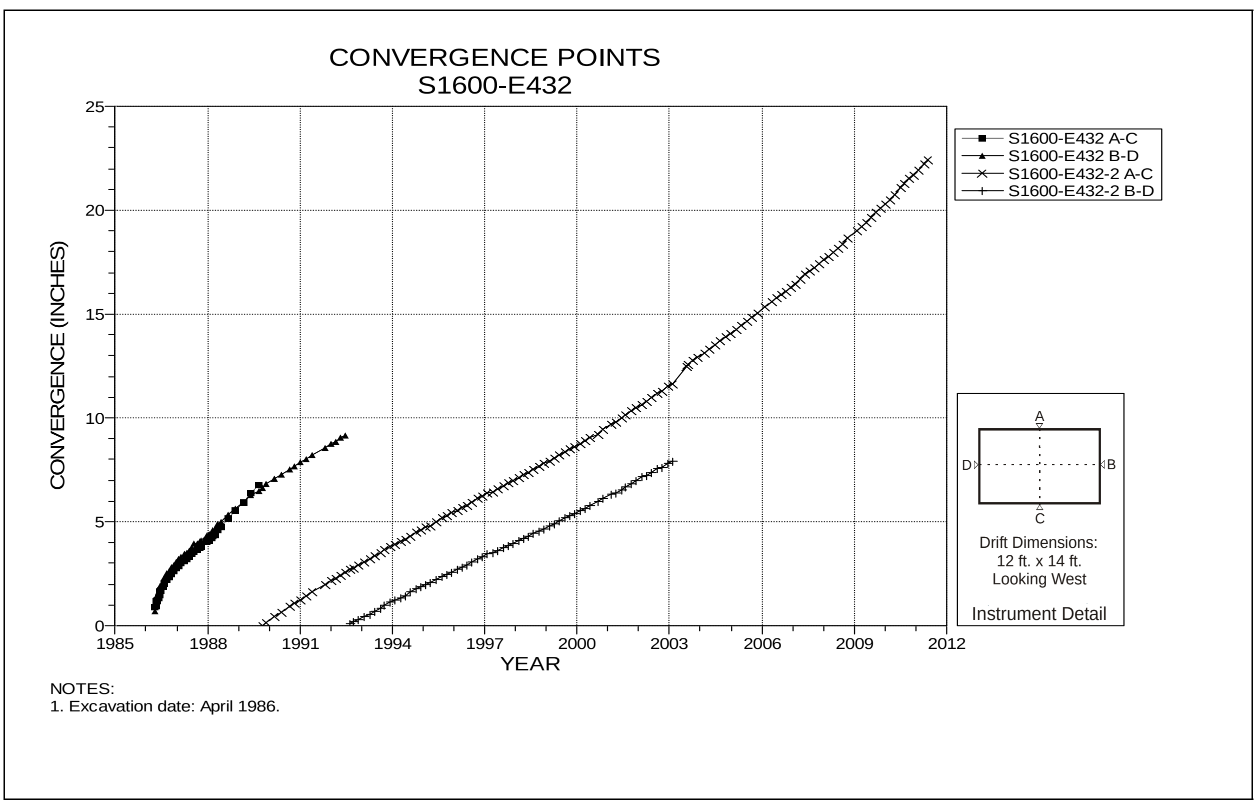


Figure 5-6 Convergence Point Array
S1600 E432 – All Chords

Working Copy

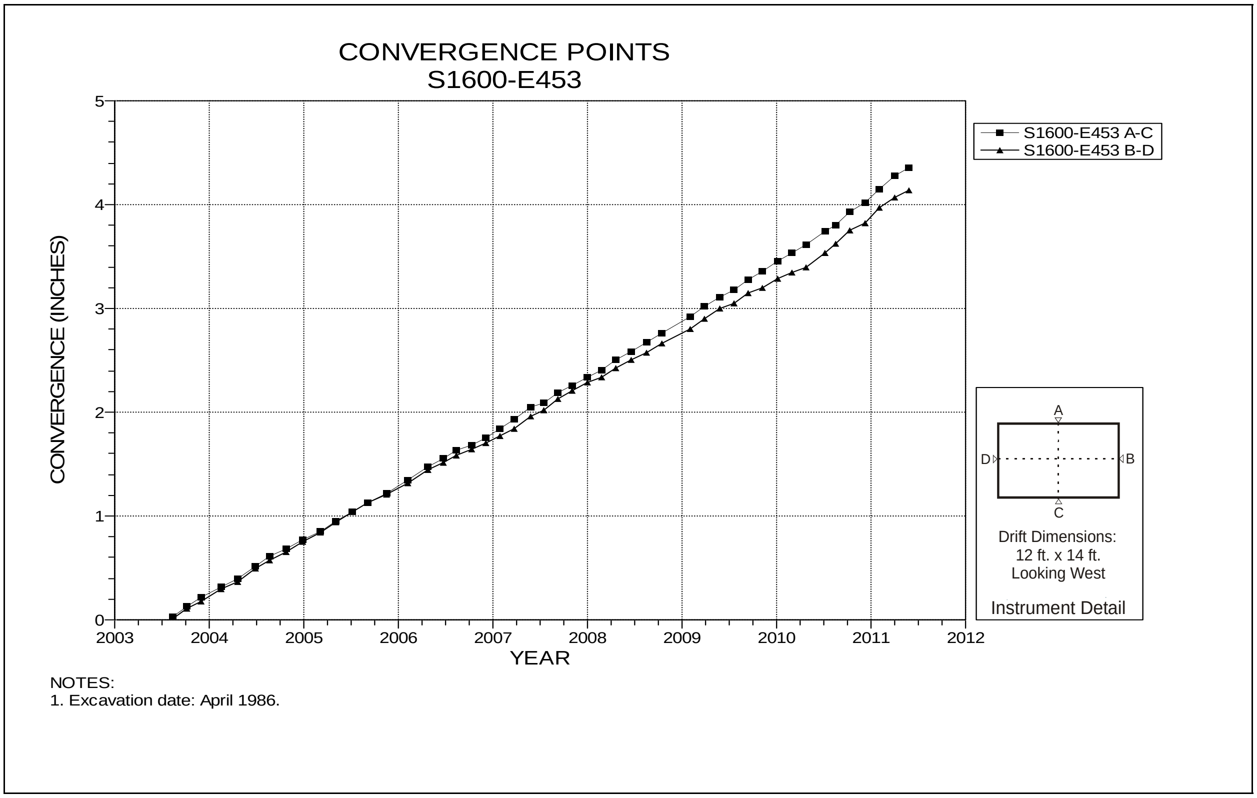


Figure 5-7 Convergence Point Array
S1600 E453 – All Chords

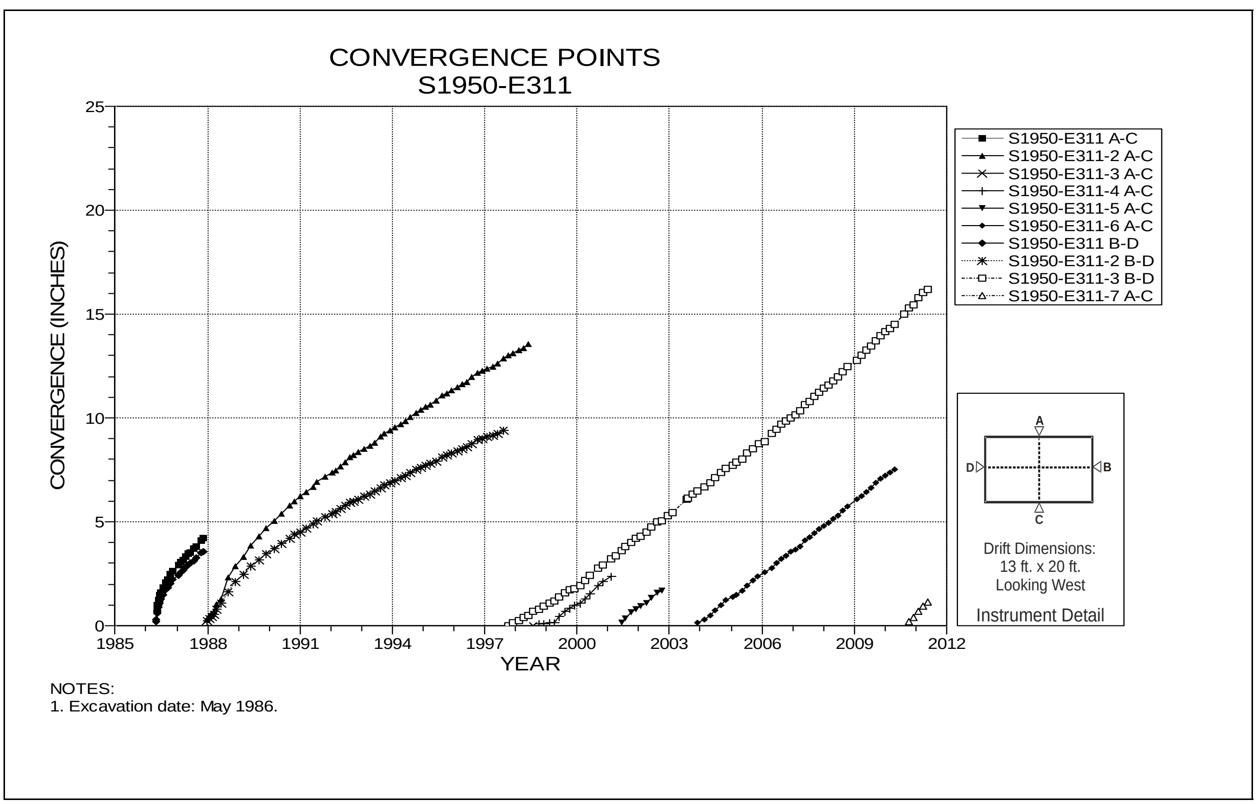
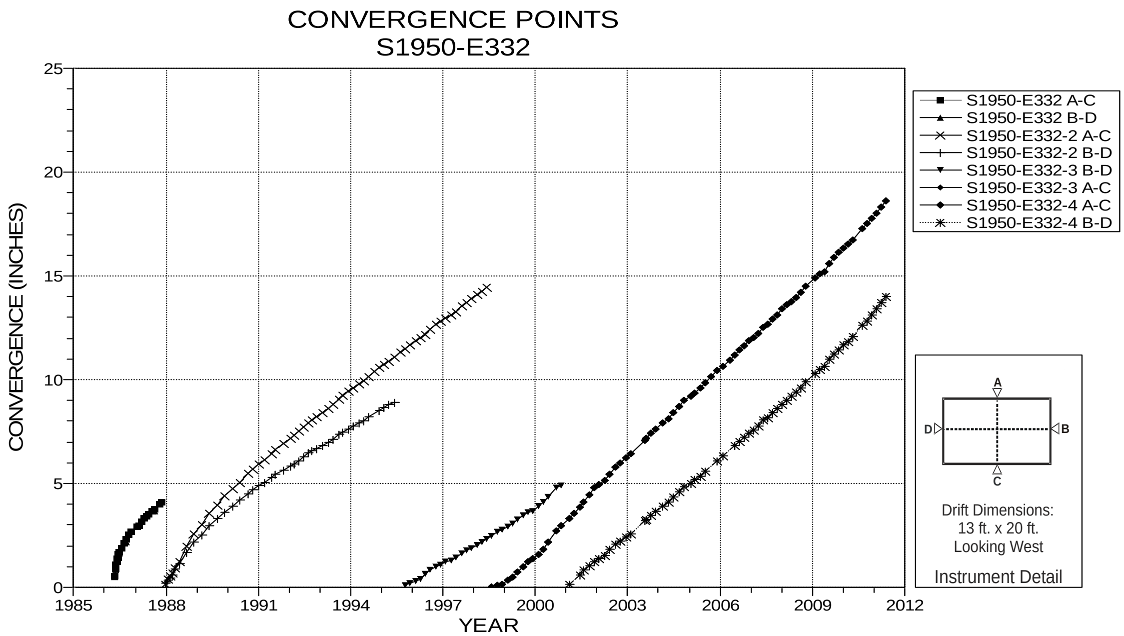
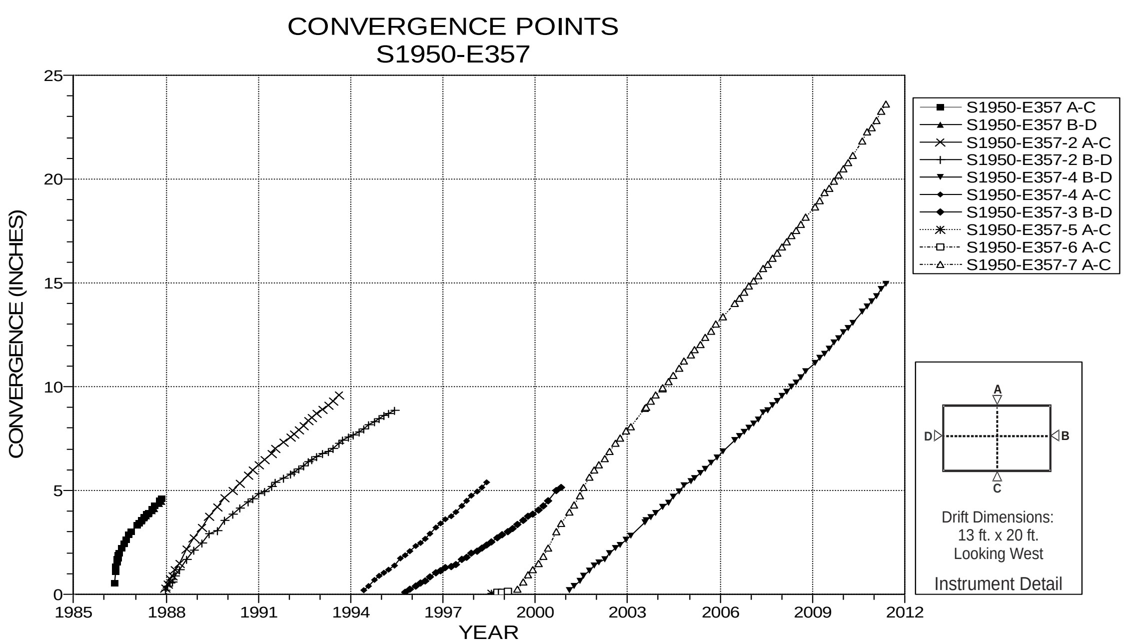


Figure 5-8 Convergence Point Array
S1950 E311 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 5-9 Convergence Point Array
S1950 E332 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 5-10 Convergence Point Array
S1950 E357 – All Chords

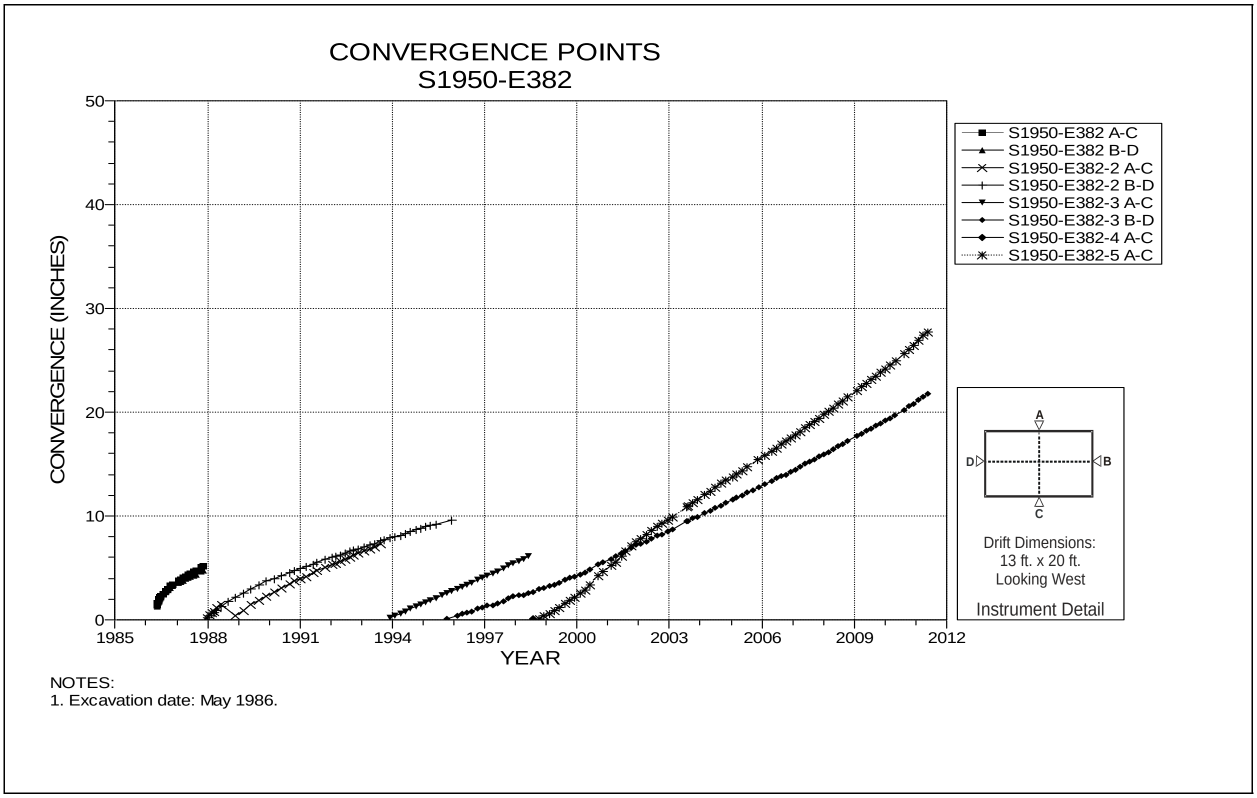


Figure 5-11 Convergence Point Array
S1950 E382 – All Chords

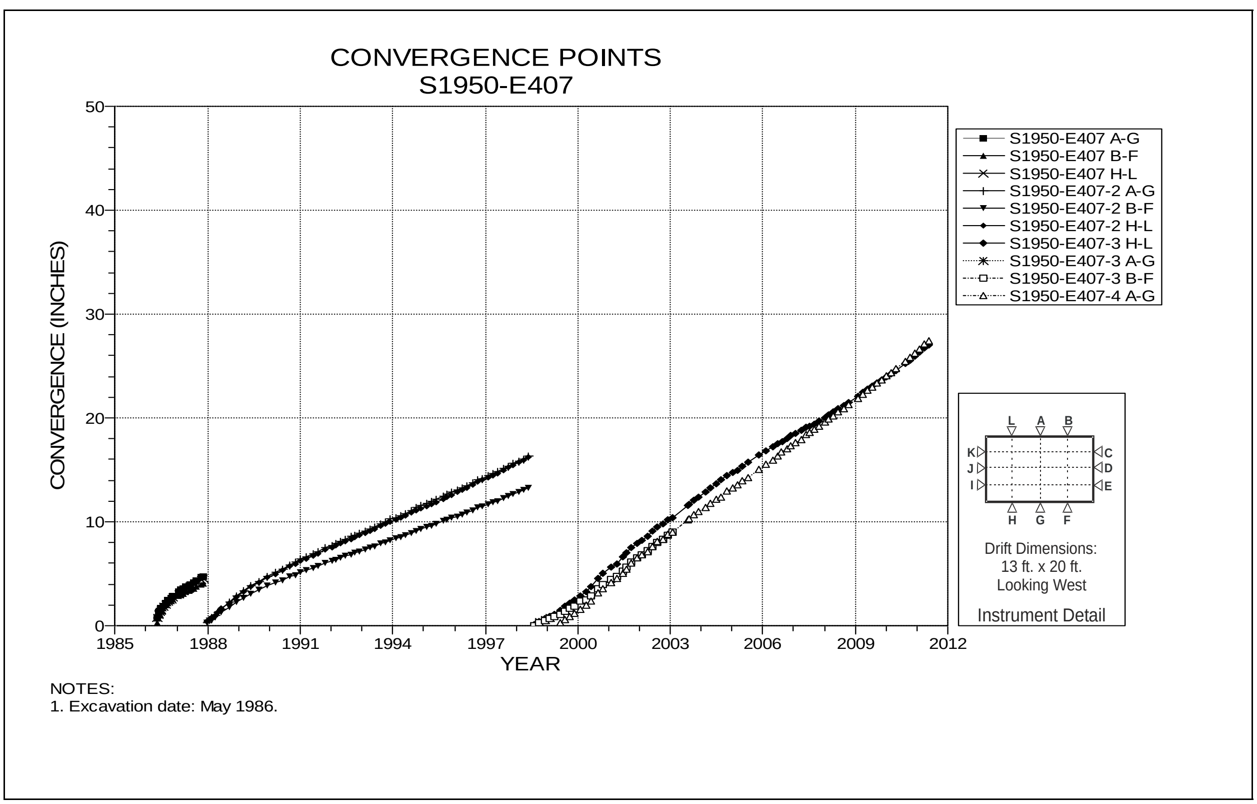


Figure 5-12 Convergence Point Array
S1950 E407 – Roof to Floor

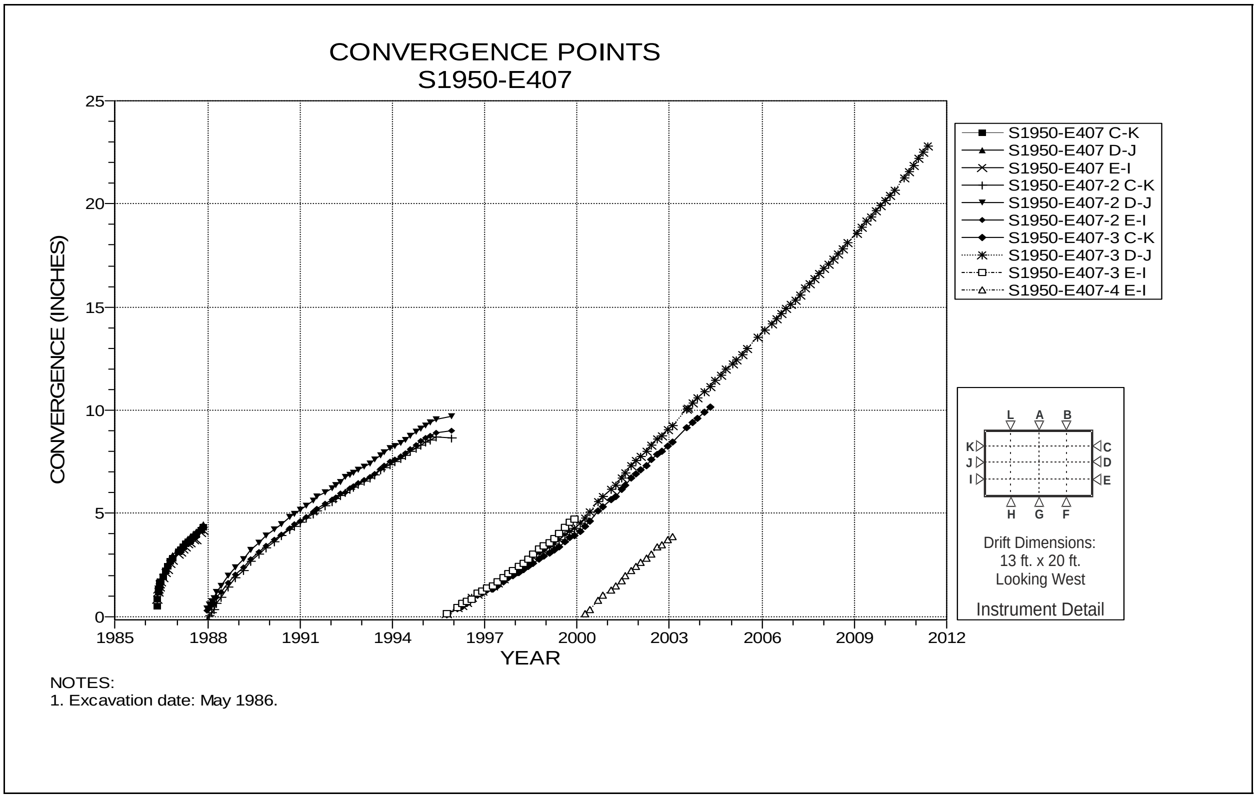


Figure 5-13 Convergence Point Array
S1950 E407 – Rib to Rib

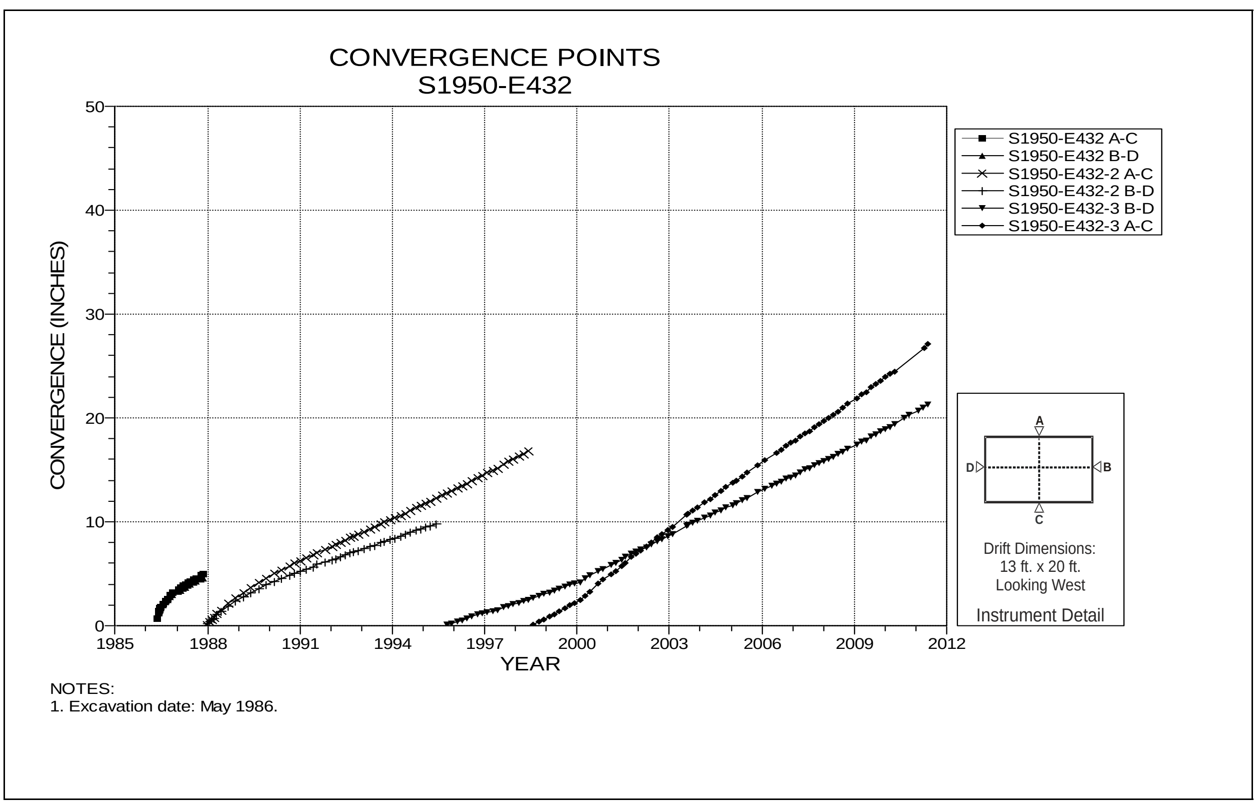


Figure 5-14 Convergence Point Array
S1950 E432 – All Chords

Table 5-2
Panel 2 Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S2180-E410-2 A-C	S2180-E410	5-15	06/07/11	9.136	13.933	1.51	1.23	23%	
S2180-E410 B-D	S2180-E410	5-15	06/07/11	17.692	17.692	2.19	1.70	29%	
S2520-E410-3 A-C	S2520-E410	5-16	06/07/11	20.740	28.876	3.53	3.04	16%	

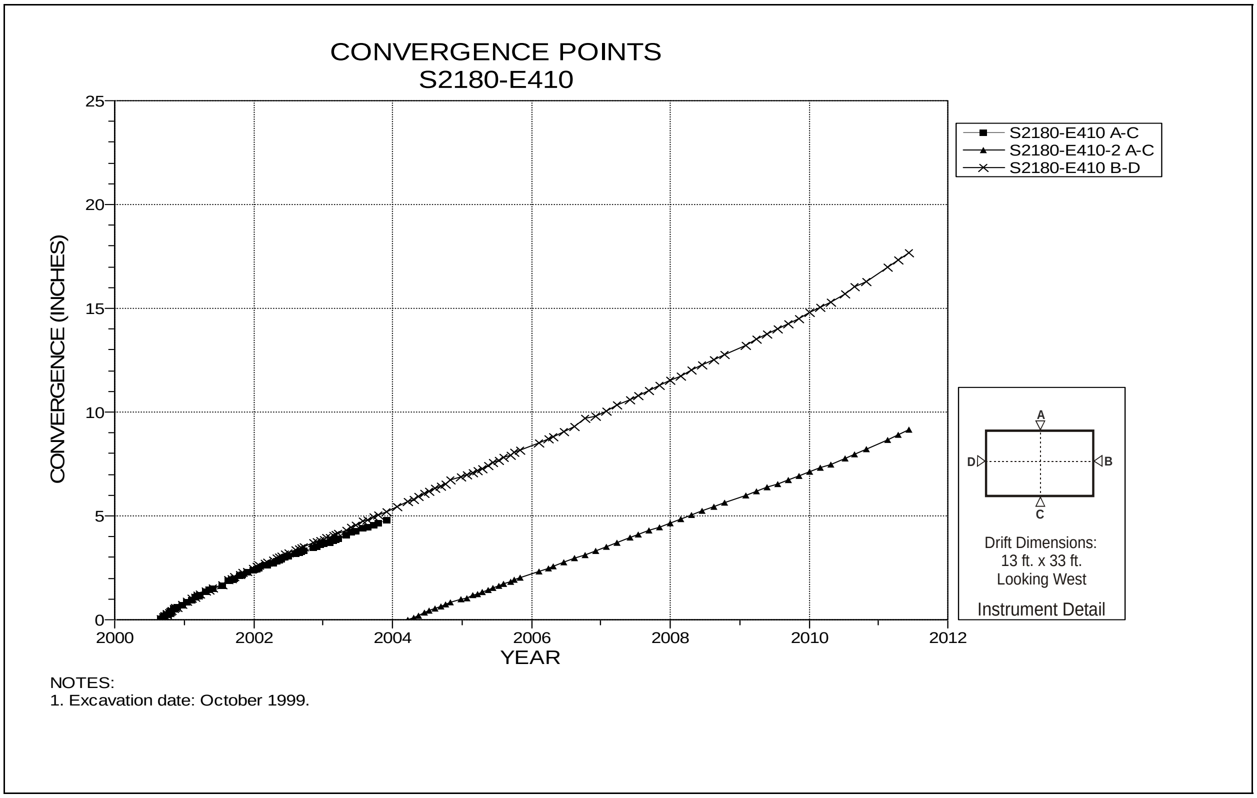


Figure 5-15 Convergence Point Array
S2180 E410 – All Chords

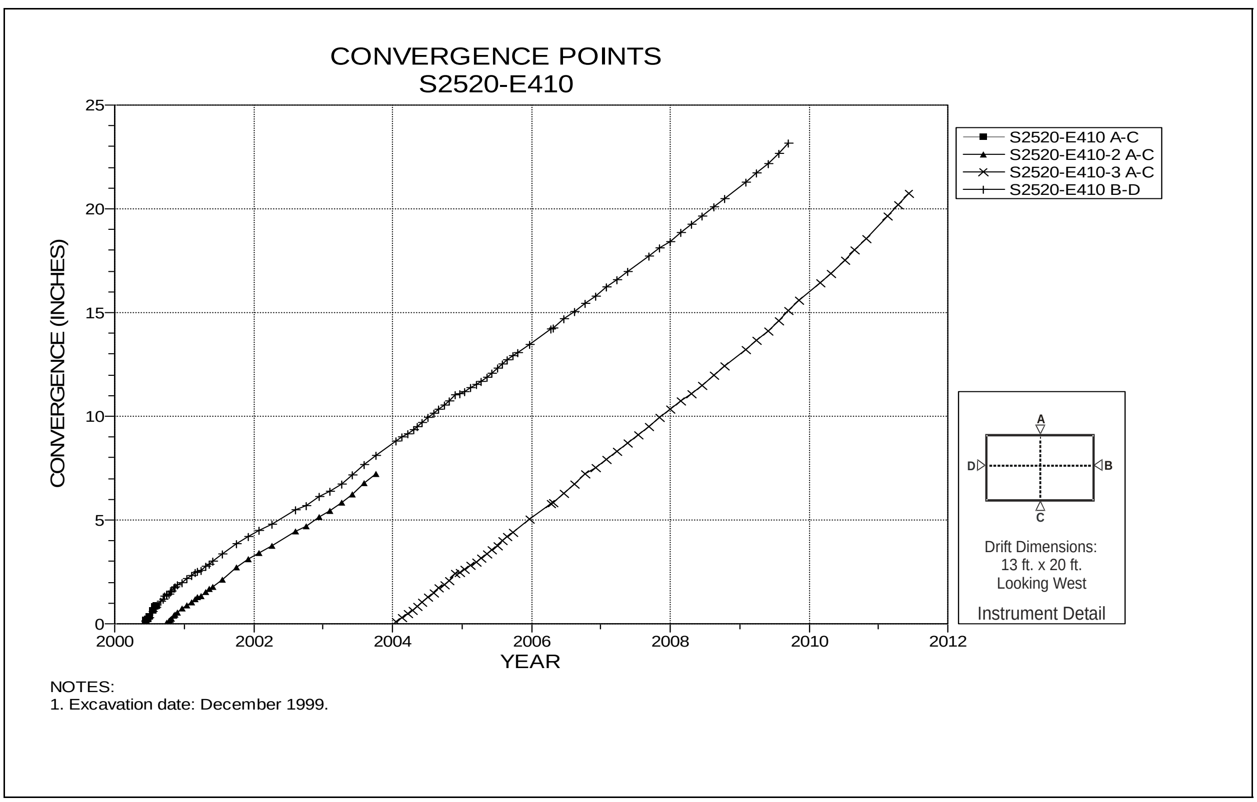


Figure 5-16 Convergence Point Array
S2520 E410 – All Chords

Table 5-3
Panel 3 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S2750-E410 A-C	S2750-E410	5-17	06/07/11	21.118	21.118	4.46	2.97	50%	
S2750-E410 B-D	S2750-E410	5-17	06/07/11	15.321	15.321	2.37	1.90	25%	
S3080-E410-2 A-C	S3080-E410	5-18	06/06/11	21.990	24.503	4.25	4.07	4%	
S3080-E410 B-D	S3080-E410	5-18	05/23/11	18.080	18.080	2.60	2.17	20%	

Table 5- Panel 3 Data Analysis

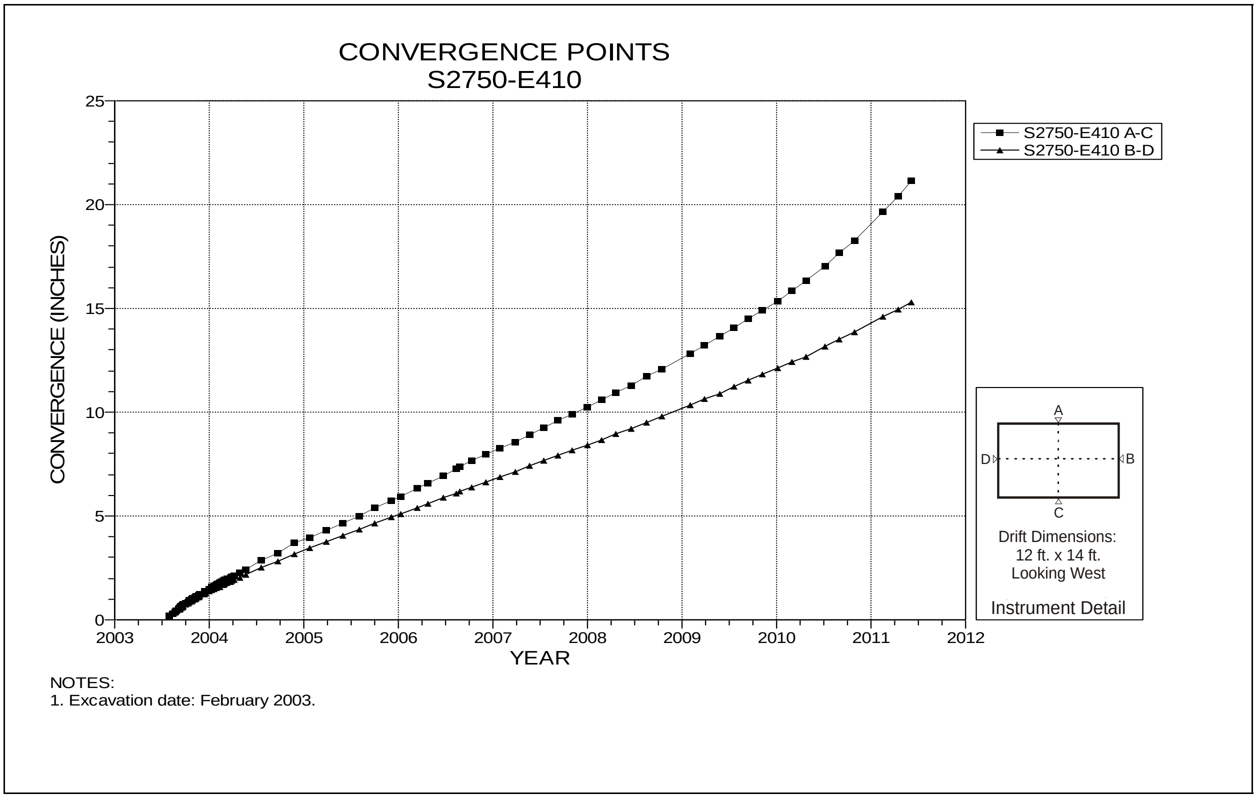


Figure 5-17 Convergence Point Array
S2750 E410 – All Chords

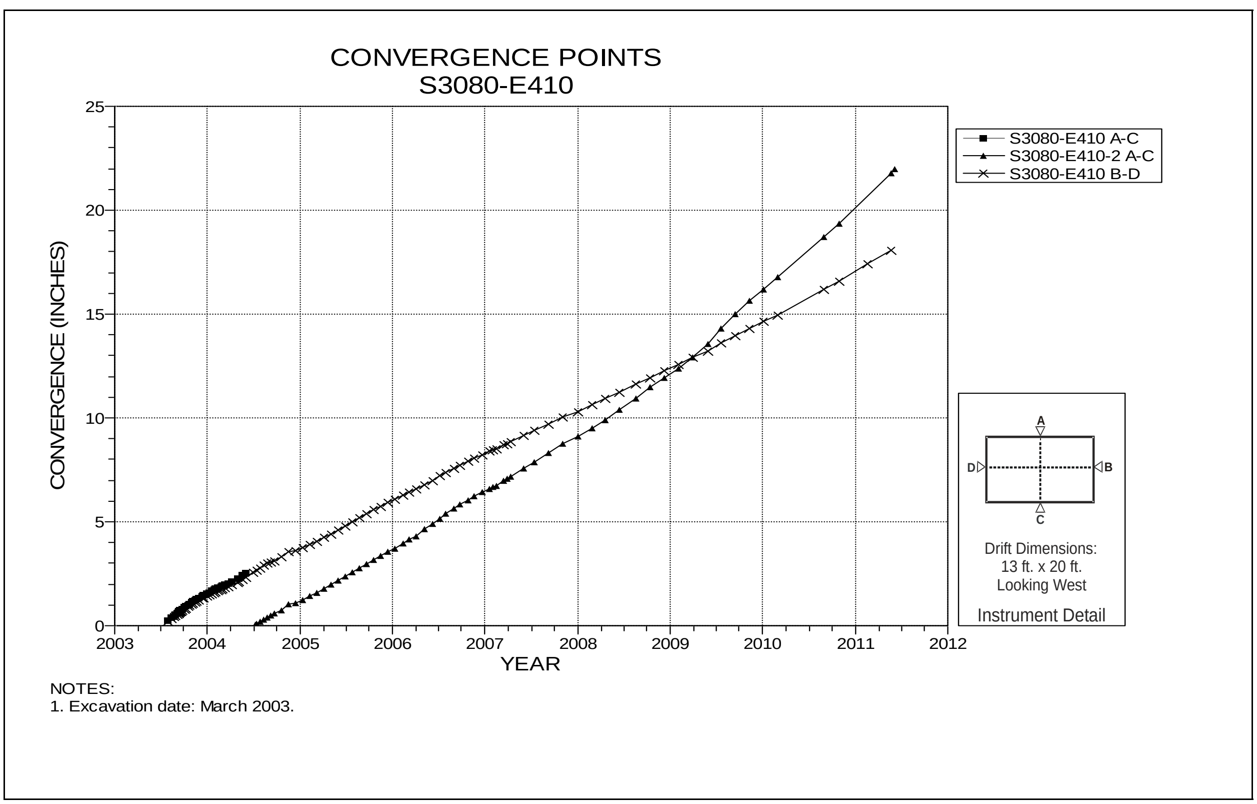


Figure 5-18 Convergence Point Array
S3080 E410 – All Chords

Table 5-4 Panel 4 Data Analysis

EXTENSOMETERS

Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2010 to 2011 (in/year)	Displacement Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-GE-00378	Panel 4 Room 2 – Center Roof	5-19	08/26/10	10.814	3.20	2.37	35%	
51X-GE-00380	Panel 4 Room 4 – Center Roof	5-20	08/26/10	13.485	4.90	3.99	23%	Rate calculated on anchor B.
51X-GE-00381	Panel 4 Room 6 – Center Roof	5-21	08/26/10	10.325	3.95	2.62	51%	
51X-GE-00382	Panel 4 Room 7 – Center Roof	5-22	08/26/10	7.843	2.45	1.85	32%	
51X-GE-00384	S3310-E1125	5-23	08/26/10	12.295	8.50	4.29	98%	
51X-GE-00386	S3650- E725	5-24	08/26/10	8.258	3.27	2.44	34%	
51X-GE-00385	S3650-E1125	5-25	08/26/10	9.696	3.63	2.87	26%	

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S3310-E410 A-C	S3310-E410	5-26	4/14/2011	11.640	11.640	N/A	1.61	N/A	Accessible for one reading this period.

able 5- Panel 4 Data Analysis

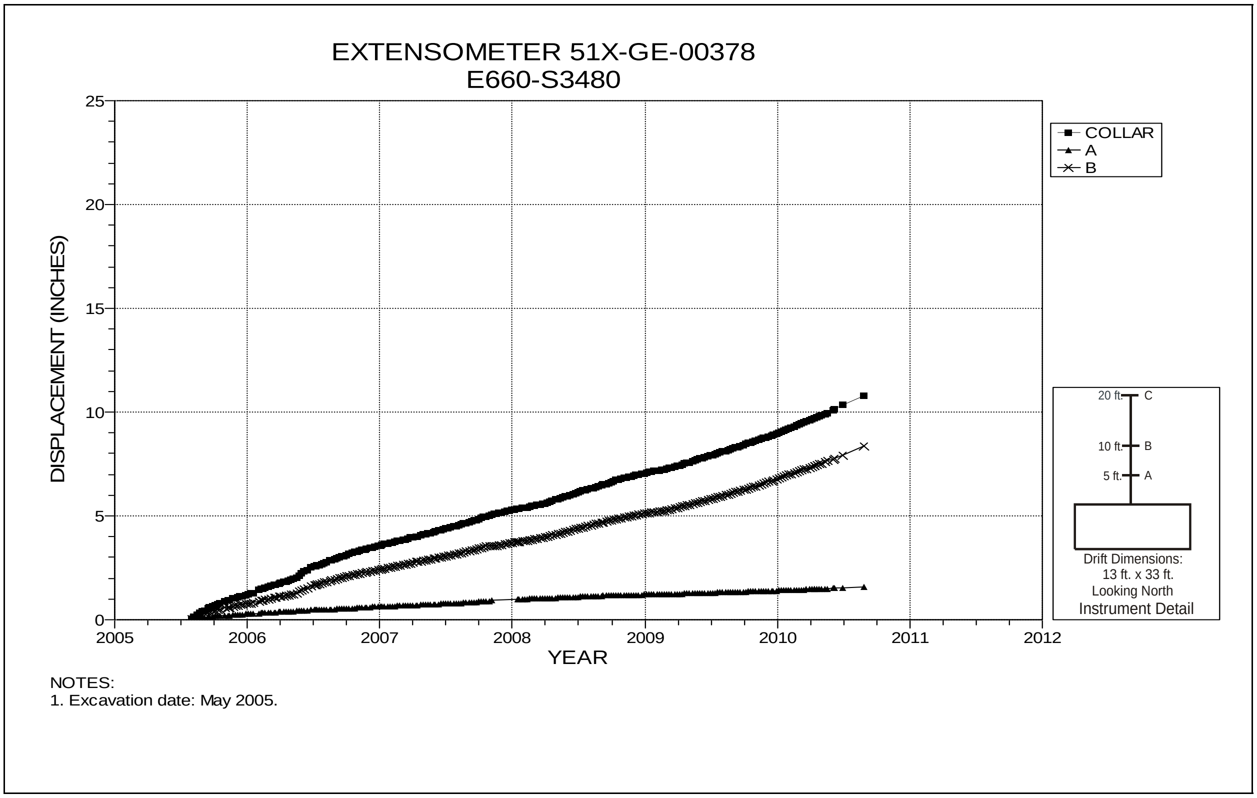


Figure 5-19 Extensometer 51X-GE-00378
Panel 4 Room 2 at E660 S3480 – Room Center – Roof

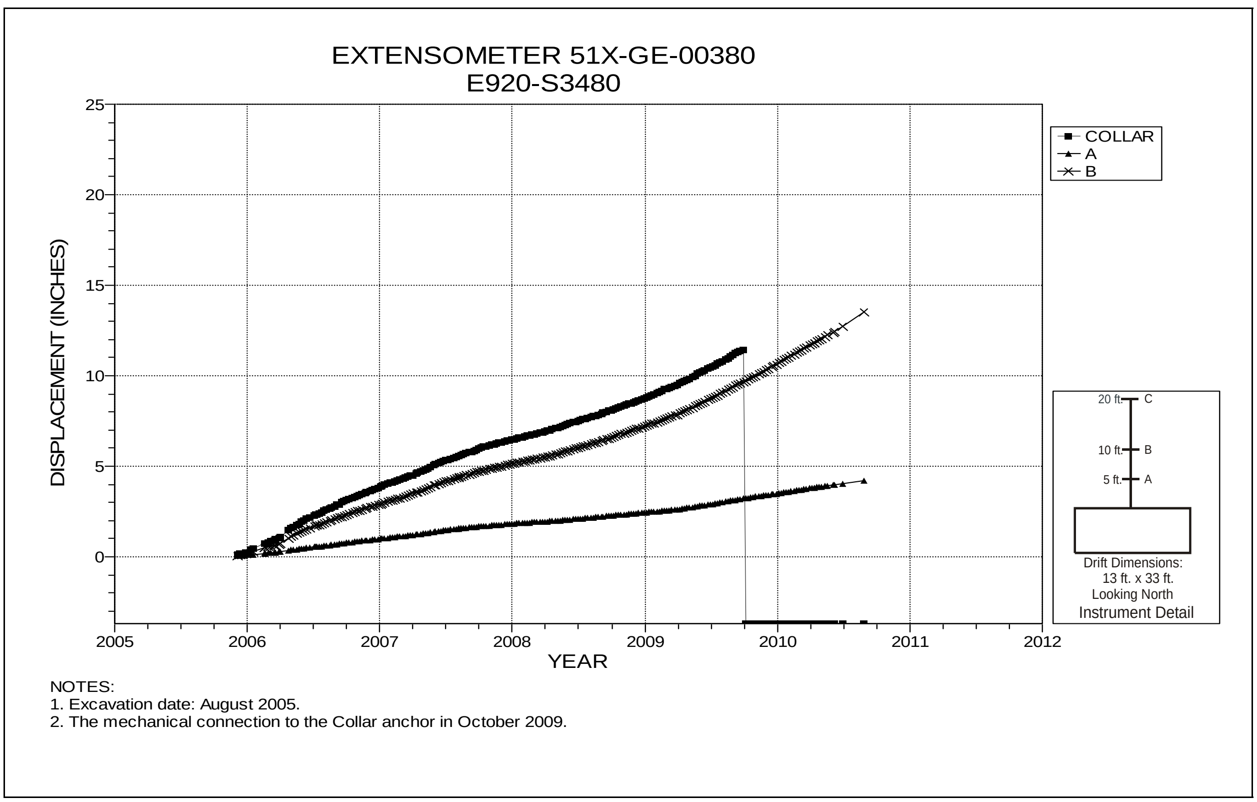


Figure 5-20 Extensometer 51X-GE-00380
Room 4, Panel 4 at E920 S3480 – Room Center – Roof

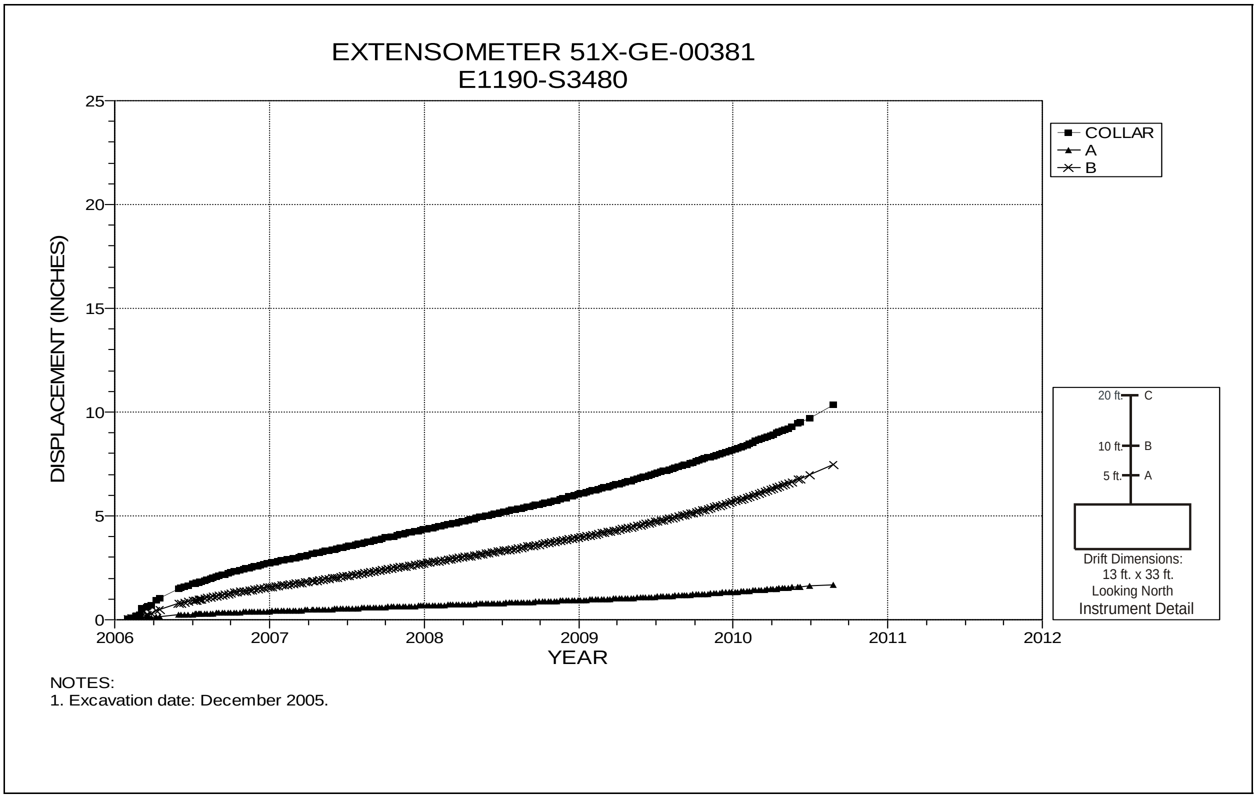


Figure 5-21 Extensometer 51X-GE-00381
Panel 4 Room 6 at E1190 S3480 – Room Center – Roof

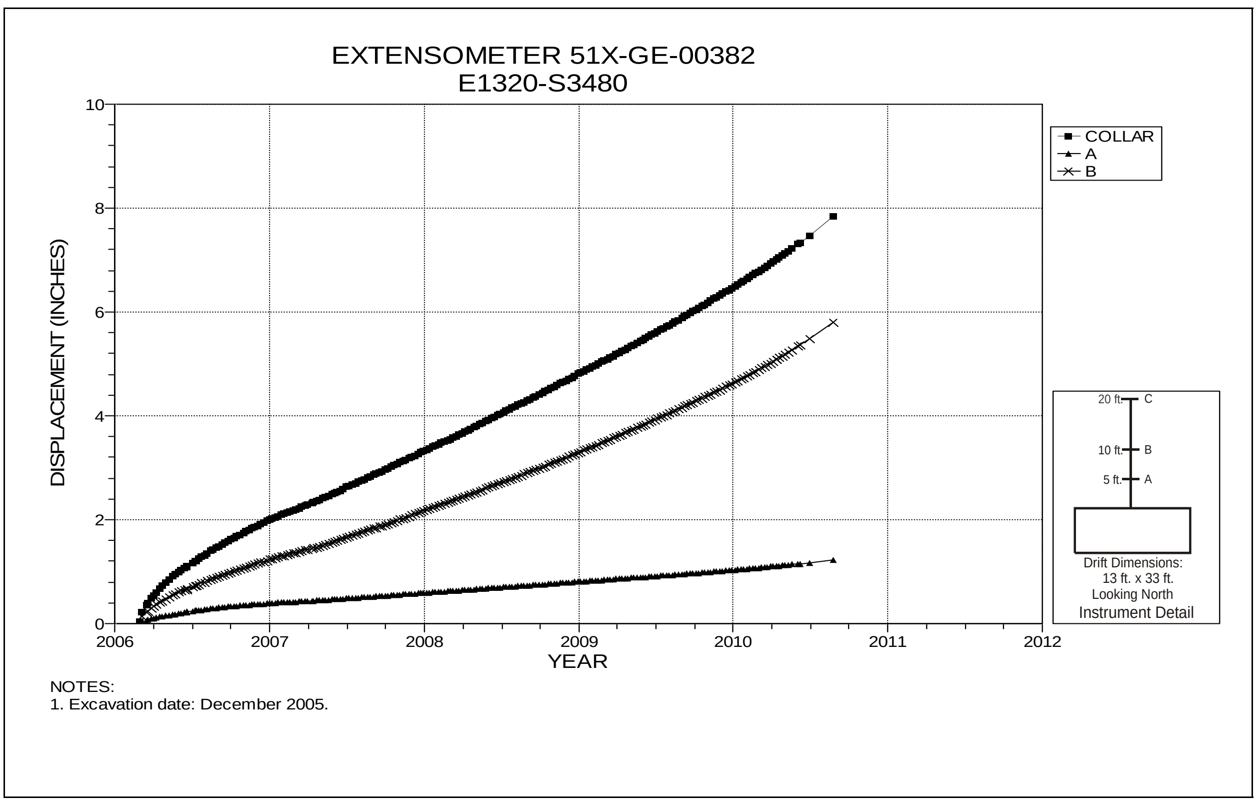


Figure 5-22 Extensometer 51X-GE-00382
Panel 4 Room 7, at E1320 S3480 – Room Center – Roof

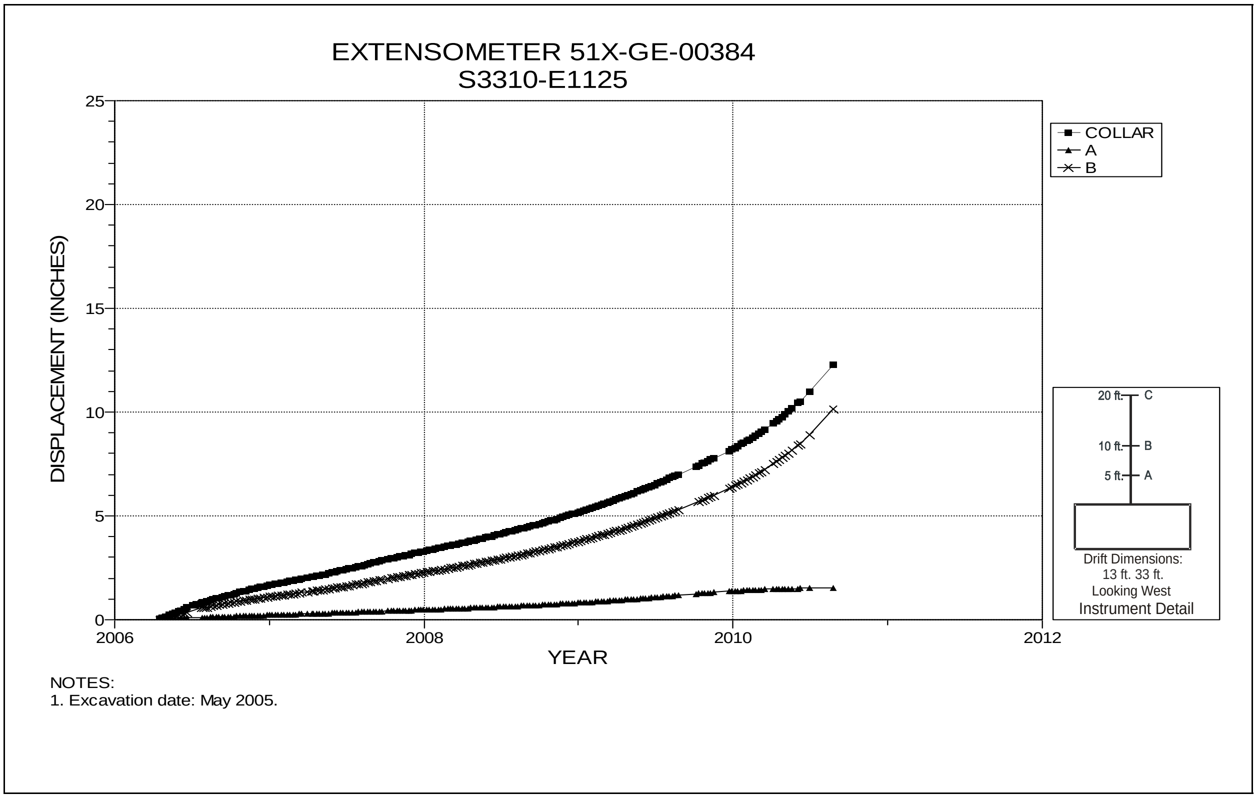


Figure 5-23 Extensometer 51X-GE-00384
S3310 E1125 – Roof

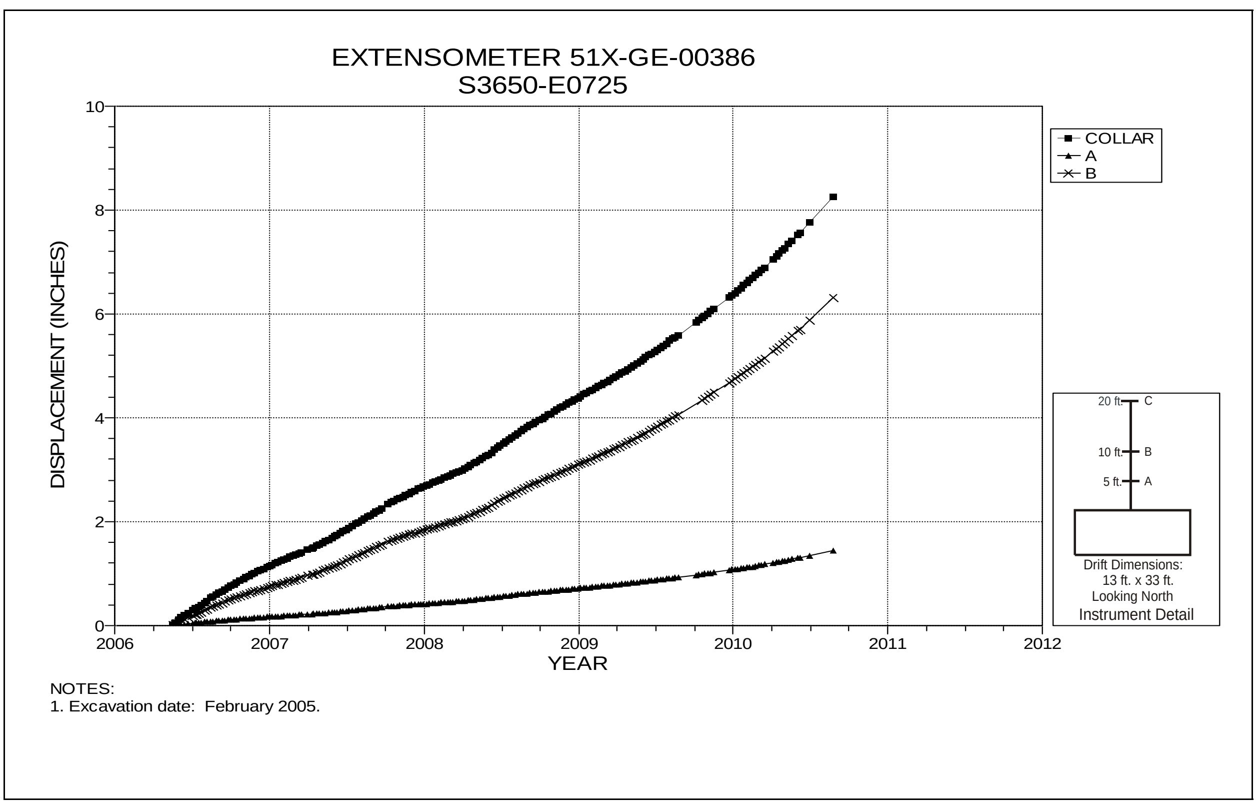


Figure 5-24 Extensometer 51X-GE-00386
S3650 E725 – Roof

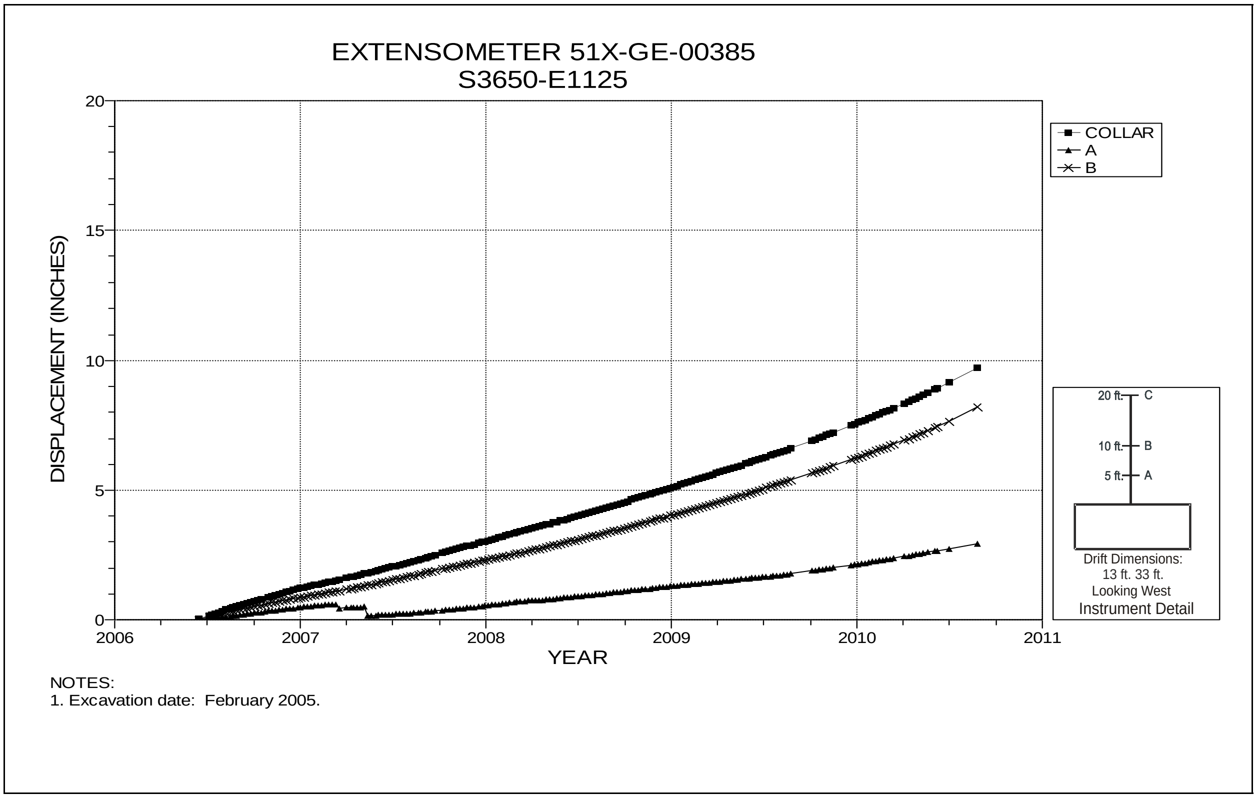


Figure 5-25 Extensometer 51X-GE-00385
S3650 E1125 – Roof

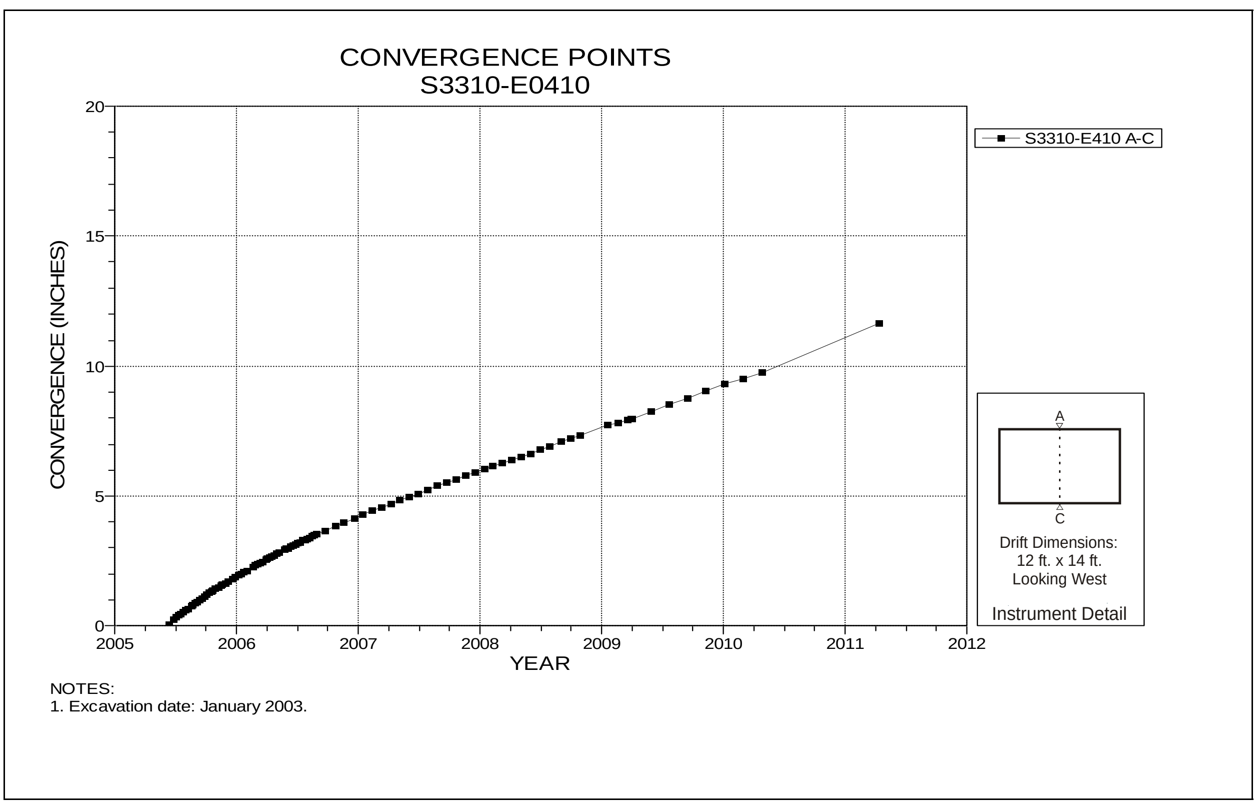


Figure 5-26 Convergence Point Array
S3310 E410 – Roof to Floor

Table 5-5 Panel 5 Data Analysis

EXTENSOMETERS

Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2010 to 2011 (in/year)	Displacement Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-GE-00400	S3310-W585	5-27	06/27/11	8.539	3.77	2.65	42%	
51X-GE-00397	S3310-W985	5-28	06/27/11	5.640	2.18	1.88	16%	
51X-GE-00389	W390-S3480	5-29	06/27/11	11.742	4.38	2.67	64%	
51X-GE-00390	W520-S3480	5-30	06/27/11	10.286	2.87	2.12	35%	
51X-GE-00391-2	W660-S3480	5-31	06/27/11	5.194	3.21	2.07	55%	
51X-GE-00392	W790-S3480	5-32	06/27/11	4.750	1.95	1.35	44%	Rates calculated on anchor B.
51X-GE-00393	W920-S3480	5-33	06/27/11	3.731	1.33	0.97	37%	
51X-GE-00394	W1050-S3480	5-34	06/27/11	3.295	0.93	0.94	-1%	
51X-GE-00395	W1190-S3480	5-35	06/27/11	3.353	0.88	0.98	-10%	
51X-GE-00398-2	S3650-W585	5-36	06/27/11	2.369	1.80	1.28	41%	5
51X-GE-00399	S3650-W985	5-37	06/27/11	3.283	1.00	0.96	4%	

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X-WG-00323	S3310-W590	5-38	02/13/08	07/06/10	33.2	
51X-WG-00321	W390-S3480	5-39	01/22/08	08/02/10	1.2	
51X-WG-00322	W520-S3480	5-40	01/22/08	02/17/11	39.9	
51X-WG-00320	W660-S3480	5-41	12/05/07	08/31/10	31.2	
51X-WG-00319	S3650-W585	5-42	10/18/07	09/27/10	30.2	

Table 5-5 (Continued) Panel 5 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)[1]	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
S3310-W285 A-C	S3310-W285	5-43	06/07/11	7.906	7.906	2.19	1.73	27%	
S3310-W390-2 A-C	S3310-W390	5-44	03/16/11	11.754	14.216	3.66	3.24	13%	
S3310-W460 A-C	S3310-W460	5-45	10/25/10	12.372	12.372	4.83	3.84	26%	
S3310-W520-2 A-C	S3310-W520	5-46	10/25/10	15.760	20.060	6.42	5.17	24%	
S3310-W590-2 A-C	S3310-W590	5-47	07/06/10	13.245	16.323	N/A	5.40	N/A	
S3310-W660-2 A-C	S3310-W660	5-48	08/02/10	13.365	17.094	6.05	4.80	26%	
W390-S3395-2 A-C	W390-S3395	5-49	05/09/11	27.037	28.663	6.07	5.74	6%	
W390-S3480-2 A-C	W390-S3480	5-50	05/09/11	24.217	25.408	6.13	4.88	26%	
W390-S3565-2 A-C	W390-S3565	5-51	06/07/11	18.270	19.179	3.64	3.14	16%	
W520-S3395-2 A-C	W520-S3395	5-52	11/22/10	13.314	17.625	5.06	4.11	23%	
W520-S3480-2 A-C	W520-S3480	5-53	02/14/11	15.012	19.504	4.89	4.24	15%	
W520-S3565-2 A-C	W520-S3565	5-54	03/16/11	11.523	15.800	3.31	3.02	10%	
W660-S3395-2 A-C	W660-S3395	5-55	08/02/10	8.678	13.216	4.21	3.27	29%	
W660-S3480-2 A-C	W660-S3480	5-56	08/31/10	11.196	16.032	5.56	4.24	31%	
W660-S3565-2 A-C	W660-S3565	5-57	09/27/10	8.858	13.533	3.62	3.23	12%	
S3650-W285-2 A-C	S3650-W285	5-58	05/09/11	4.907	7.348	2.56	1.81	41%	
S3650-W390-2 A-C	S3650-W390	5-59	06/07/11	17.096	18.669	3.52	2.98	18%	
S3650-W456-3 A-C	S3650-W456	5-60	04/11/11	12.897	17.654	4.00	3.31	21%	
S3650-W520-2 A-C	S3650-W520	5-61	03/16/11	11.690	19.444	3.86	3.43	13%	
S3650-W585-2 A-C	S3650-W585	5-62	09/27/10	9.075	16.753	3.83	3.19	20%	
S3650-W660-2 A-C	S3650-W660	5-63	09/27/10	9.476	15.190	3.96	3.12	27%	

Working Copy

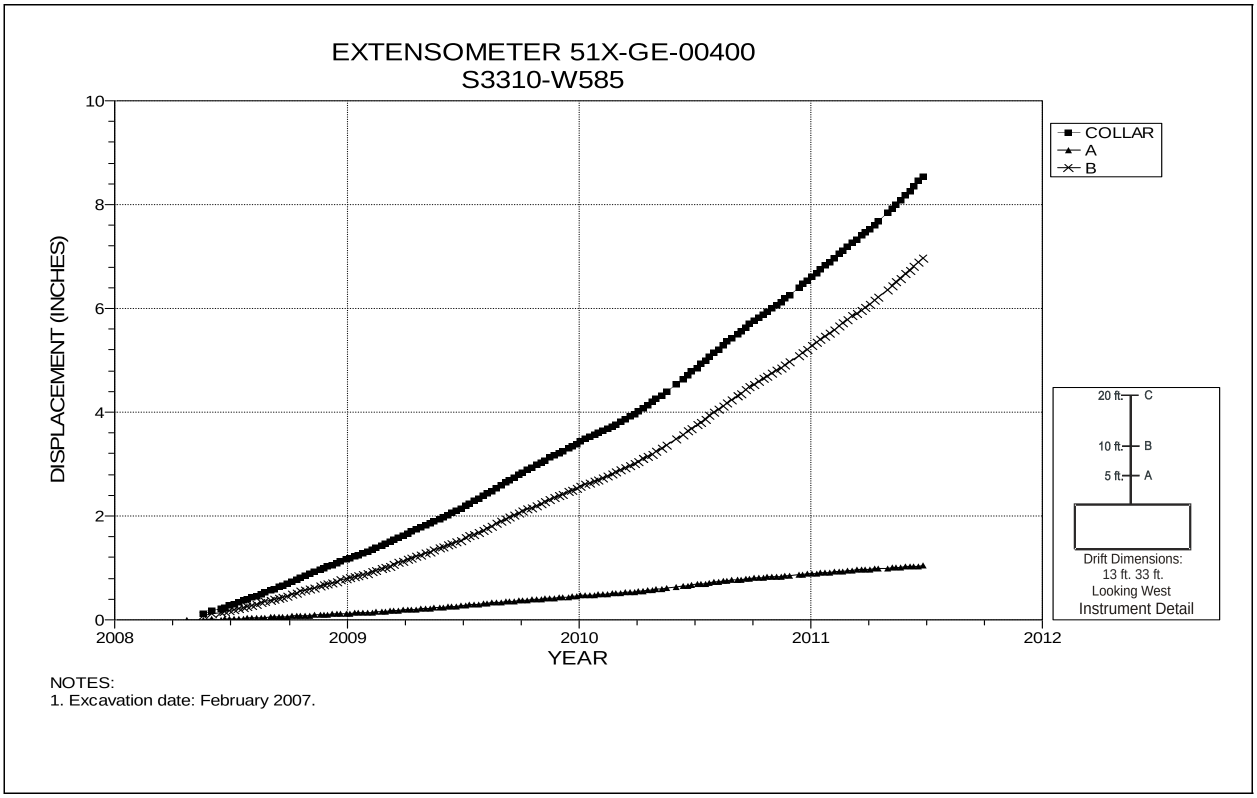


Figure 5-27 Extensometer 51X-GE-00400
S3310 W585 – Roof

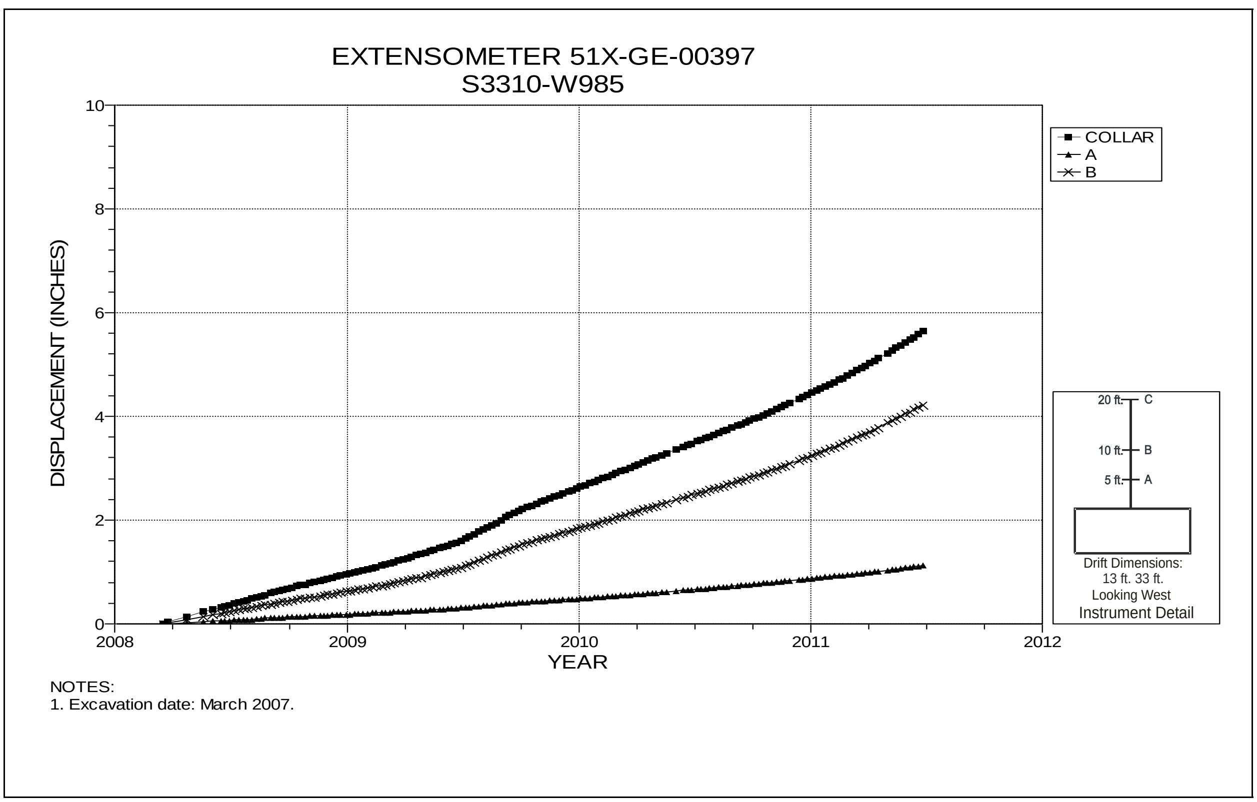


Figure 5-28 Extensometer 51X-GE-00397
S3310 W985 – Roof

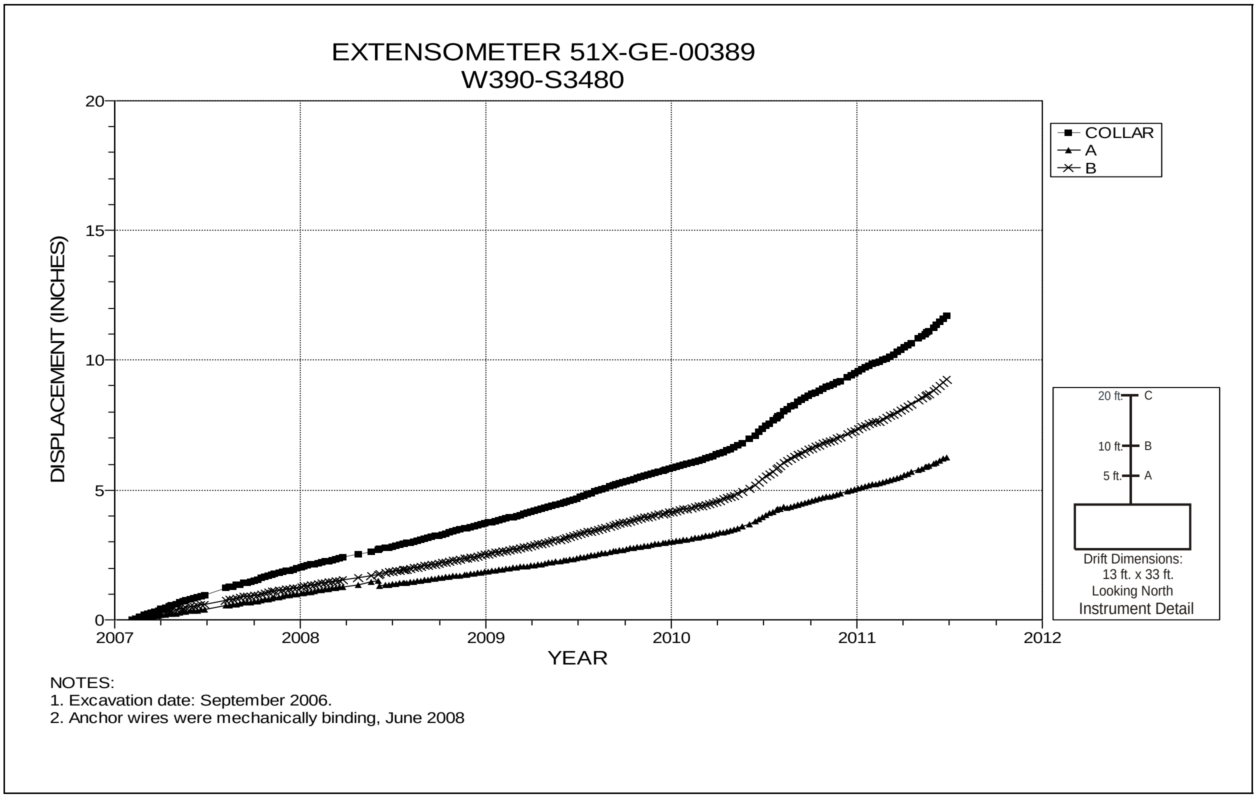


Figure 5-29 Extensometer 51X-GE-00389
Room 1, Panel 5 at W390 S3480 – Room Center – Roof

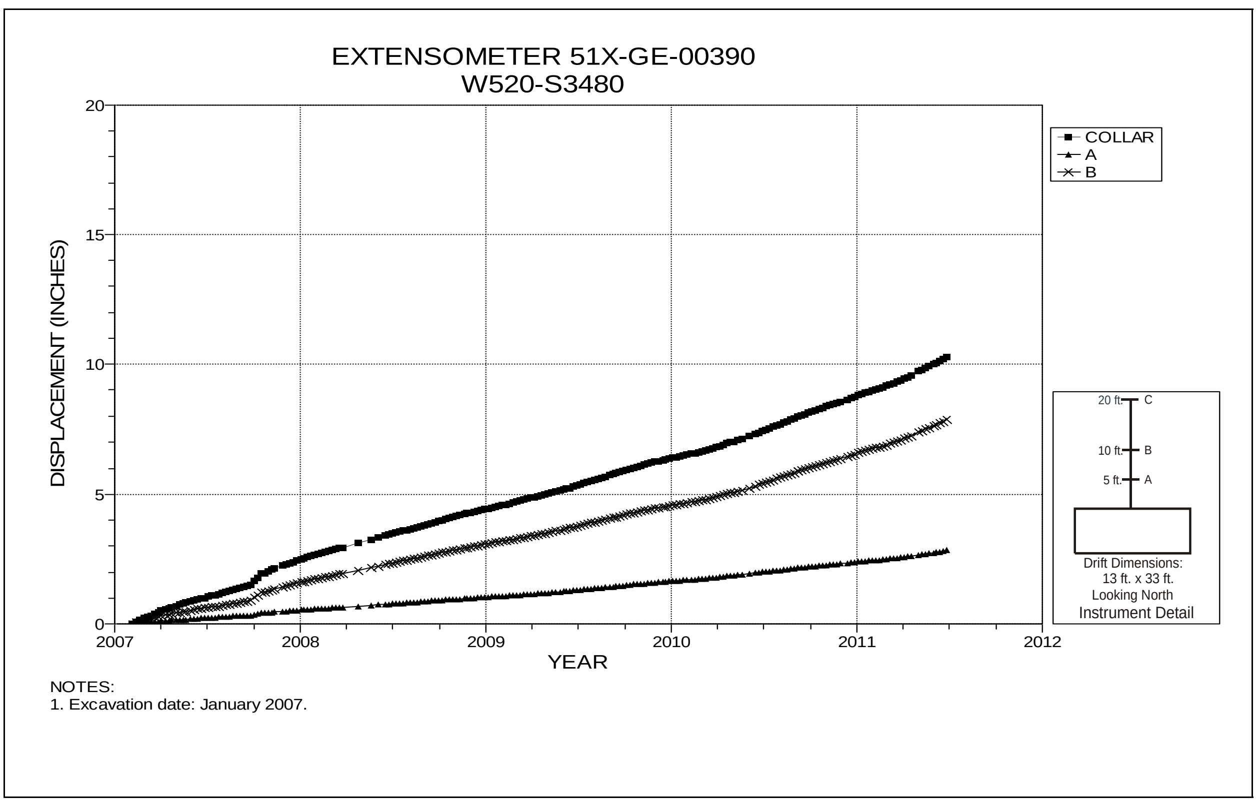
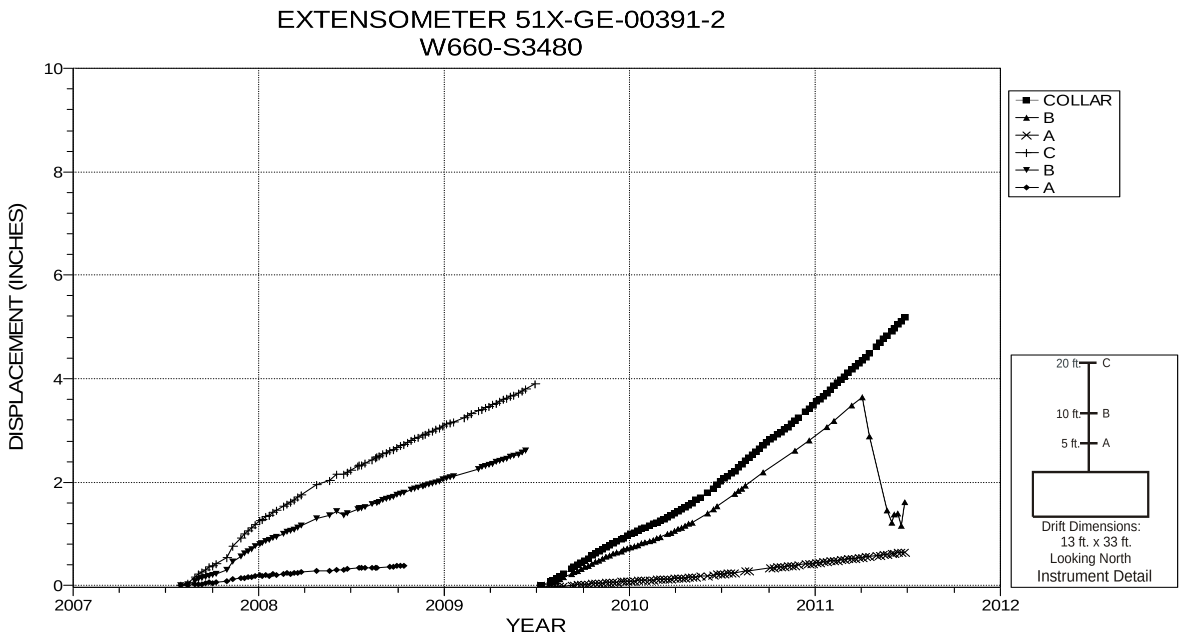
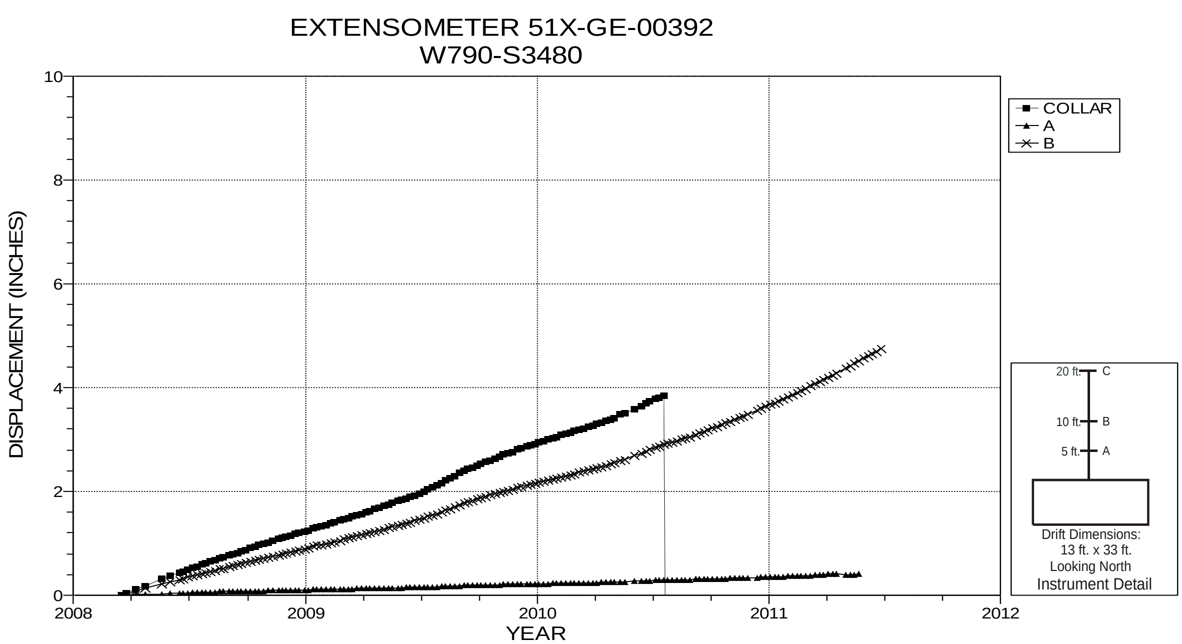


Figure 5-30 Extensometer 51X-GE-00390
Room 2, Panel 5 at W520 S3480 – Room Center – Roof



NOTES:
1. Excavation date: February 2007.
2. 51-GE-00391 was replaced in July, 2009.
3. Anchor B malfunctioned in April 2011.

Figure 5-31 Extensometer 51X-GE-00391-2
Room 3, Panel 5 at W660 S3480 – Room Center – Roof



NOTES:
1. Excavation date: April 2007.
2. Collar anchor's mechanical was lost in mid 2010.
3. The mechanical connection to anchor A failed in May 2011.

Figure 5-32 Extensometer 51X-GE-00392
Room 4, Panel 5 at W790 S3480 – Room Center – Roof

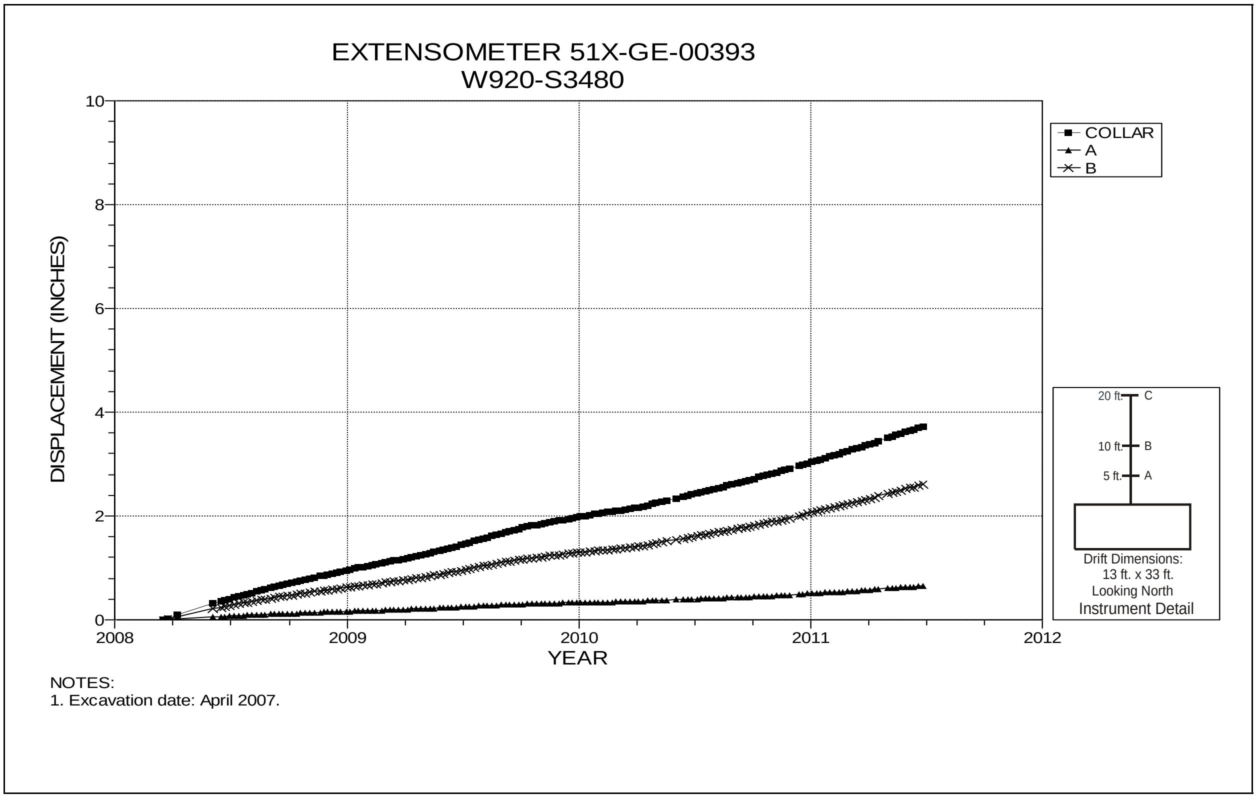


Figure 5-33 Extensometer 51X-GE-00393
Room 5, Panel 5 at W920 S3480 – Room Center – Roof

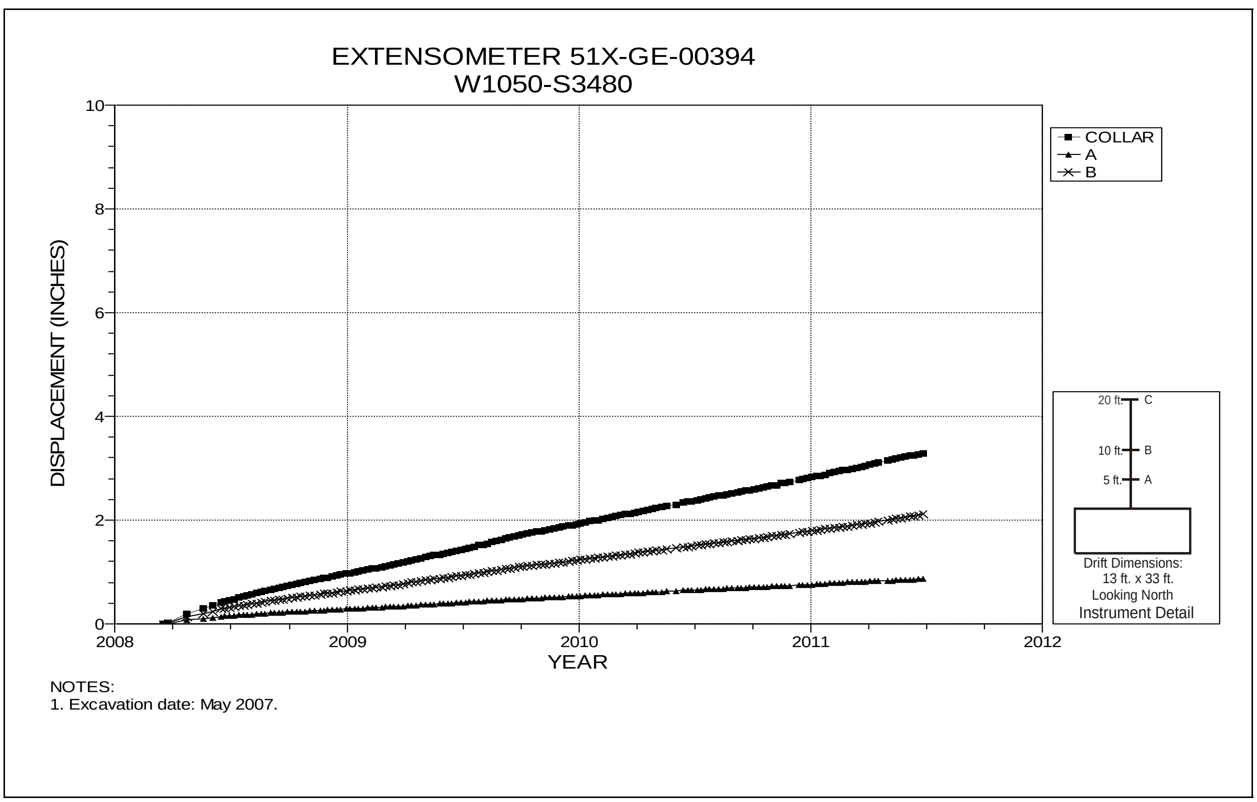


Figure 5-34 Extensometer 51X-GE-00394
Room 6, Panel 5 at W1050 S3480 – Room Center – Roof

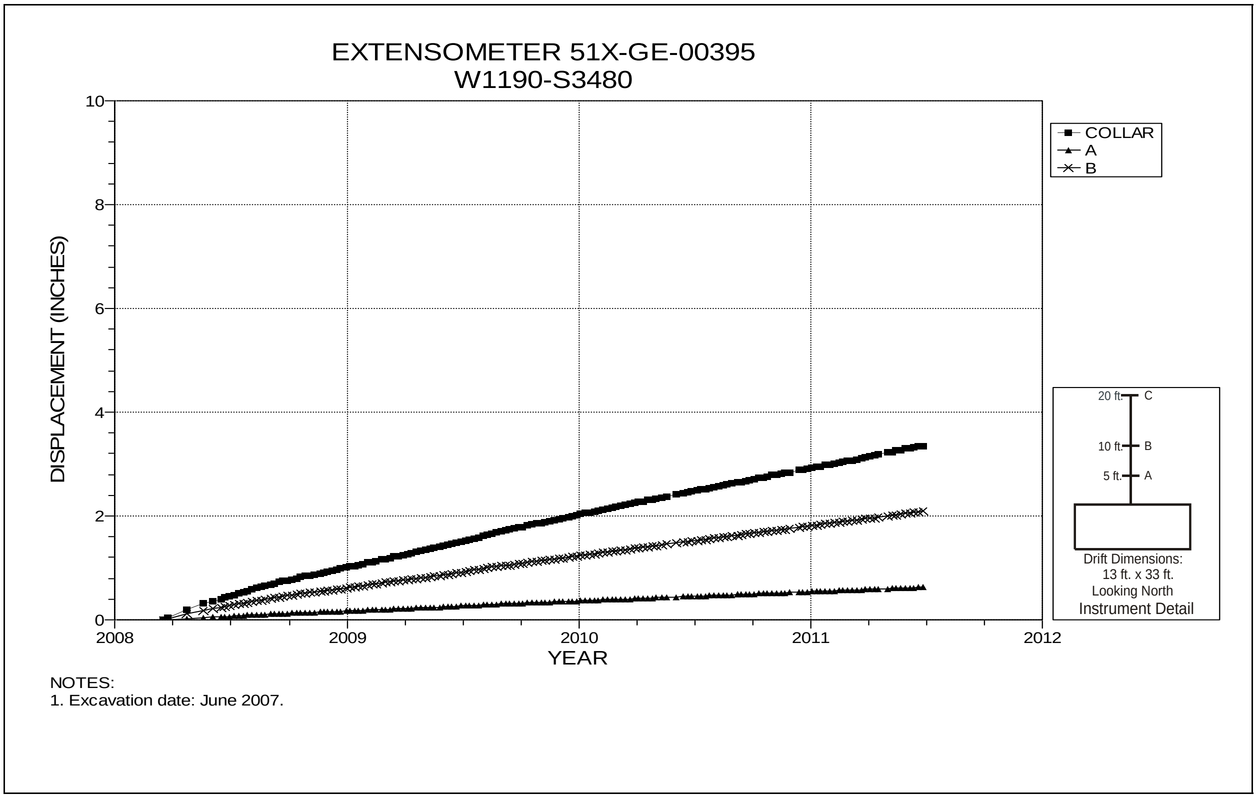


Figure 5-35 Extensometer 51X-GE-00395
Room 7, Panel 5 at W1190 S3480 – Room Center – Roof

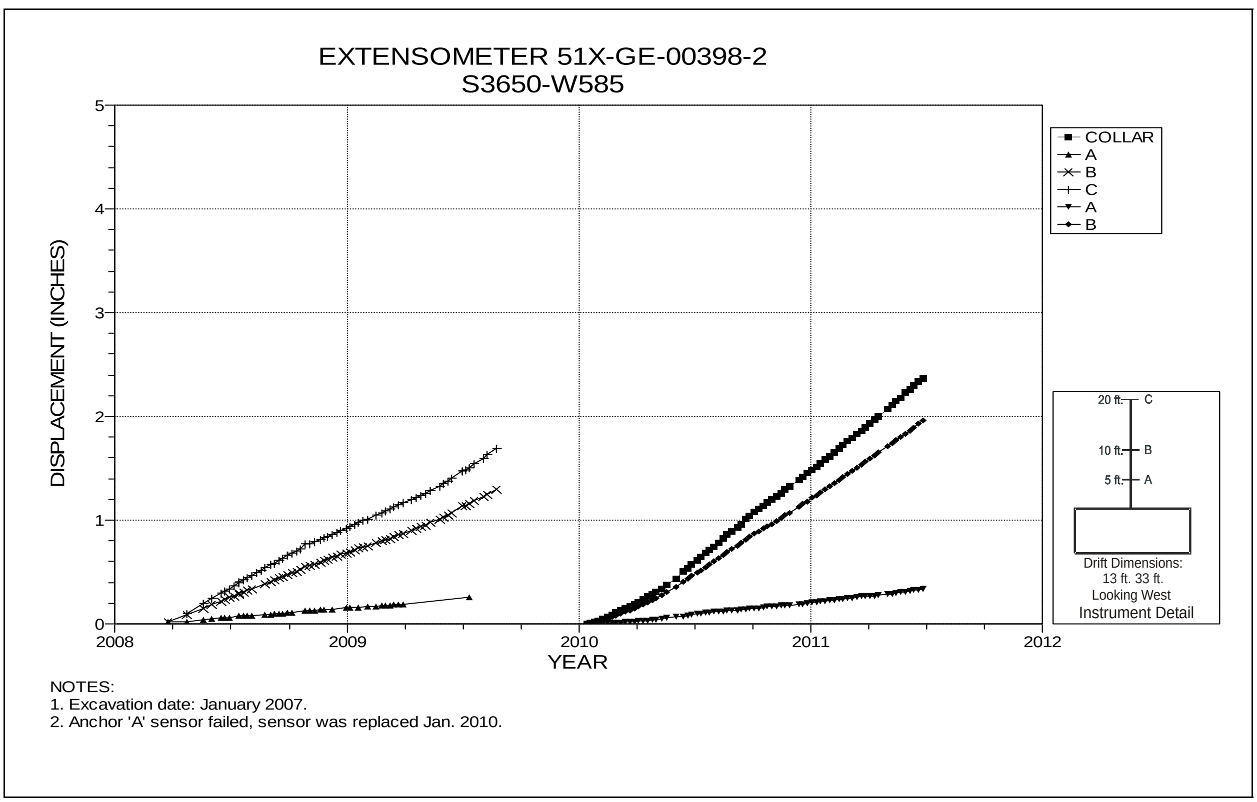


Figure 5-36 Extensometer 51X-GE-00398
S3650 W585 – Roof

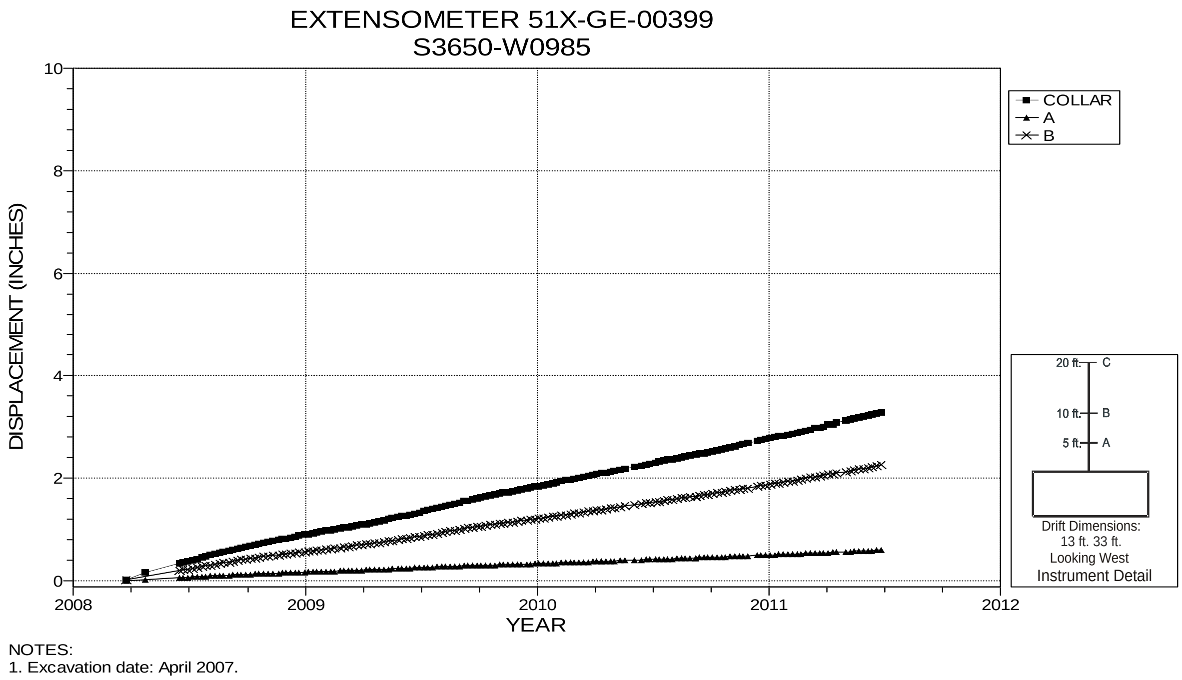


Figure 5-37 Extensometer 51X-GE-00399
S3650 W985 – Roof

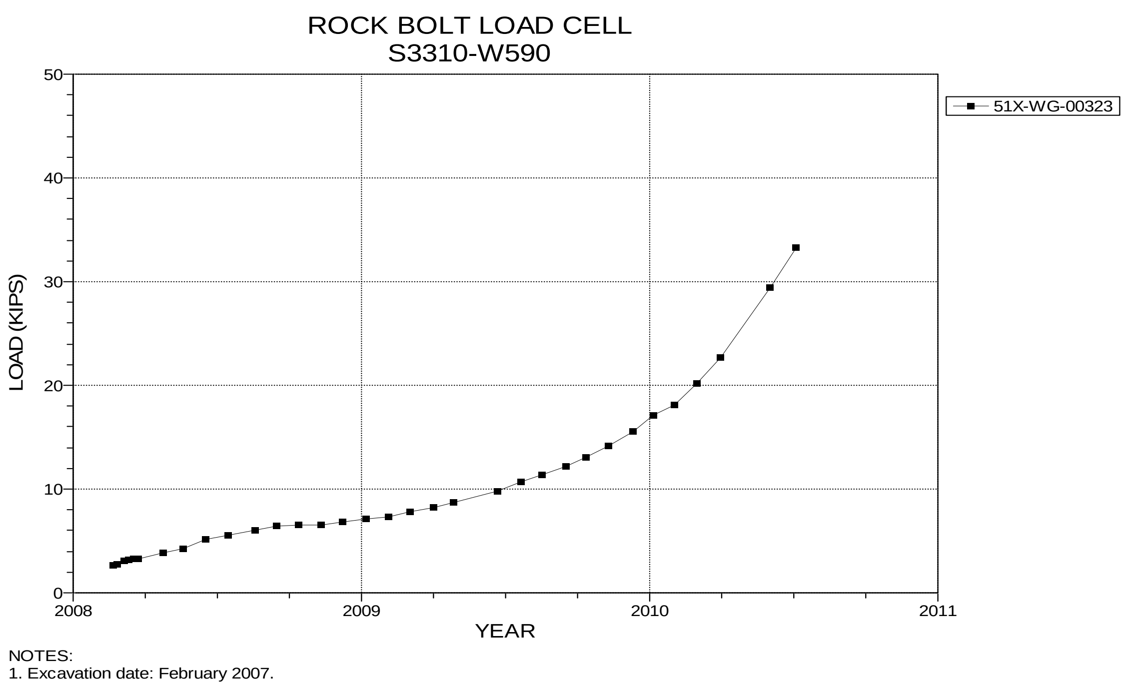


Figure 5-38 Rock Bolt Load Cell 51X-WG-00323
S3310 W590

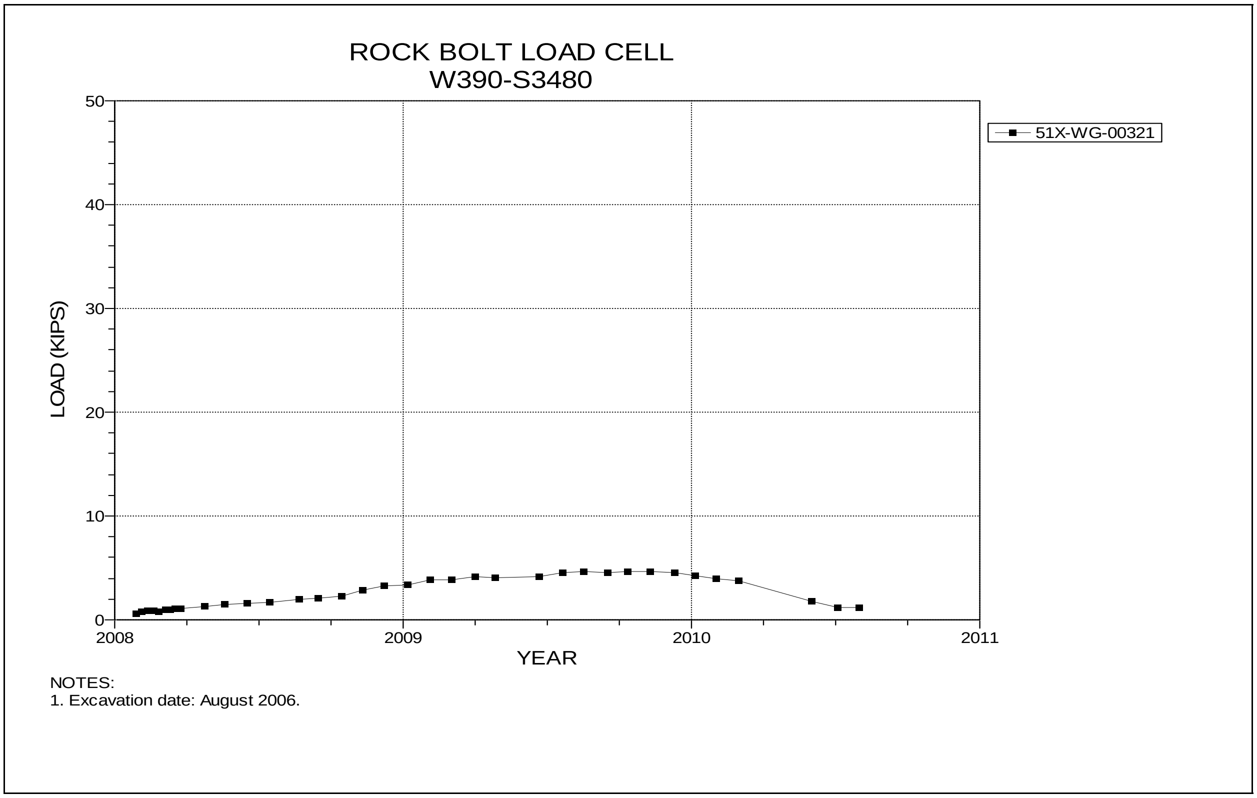


Figure 5-39 Rock Bolt Load Cell 51X-WG-00321
Room 1, Panel 5 at W390 S3480

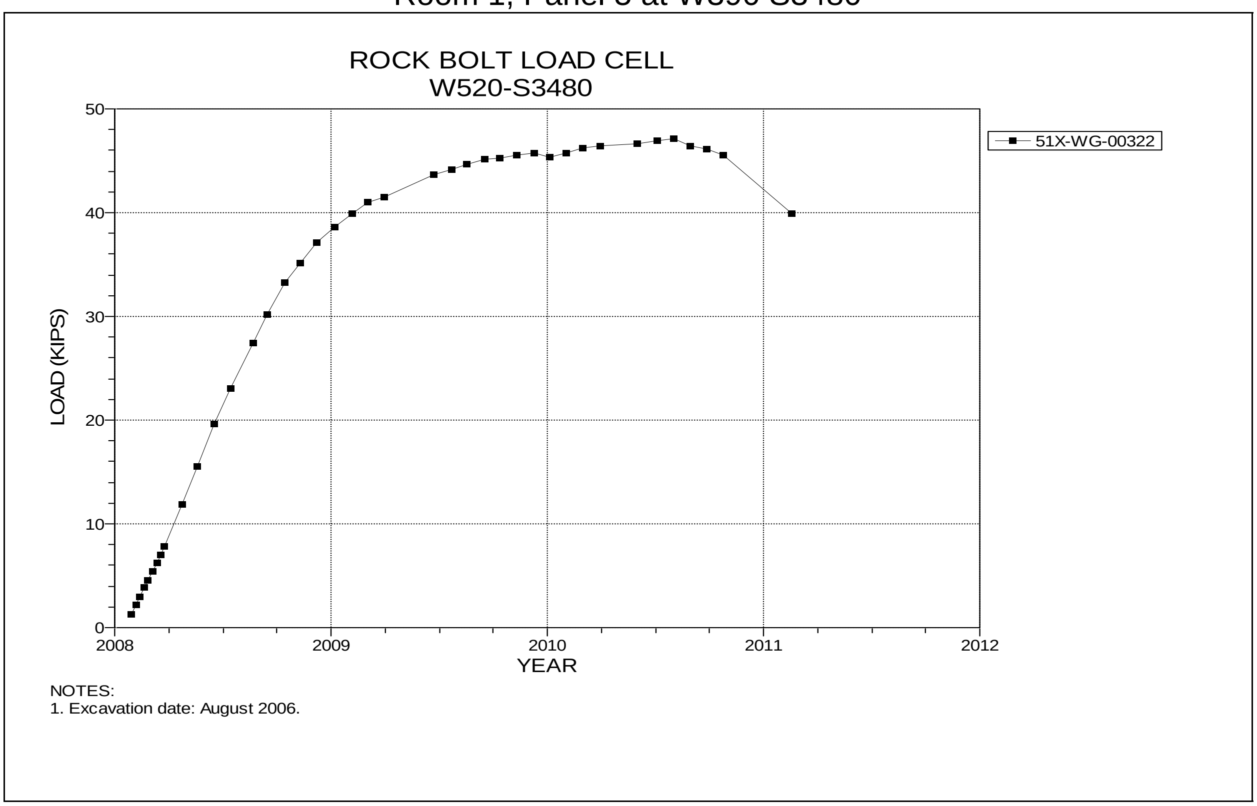


Figure 5-40 Rock Bolt Load Cell 51X-WG-00322
Room 2, Panel 5 at W520 S3480

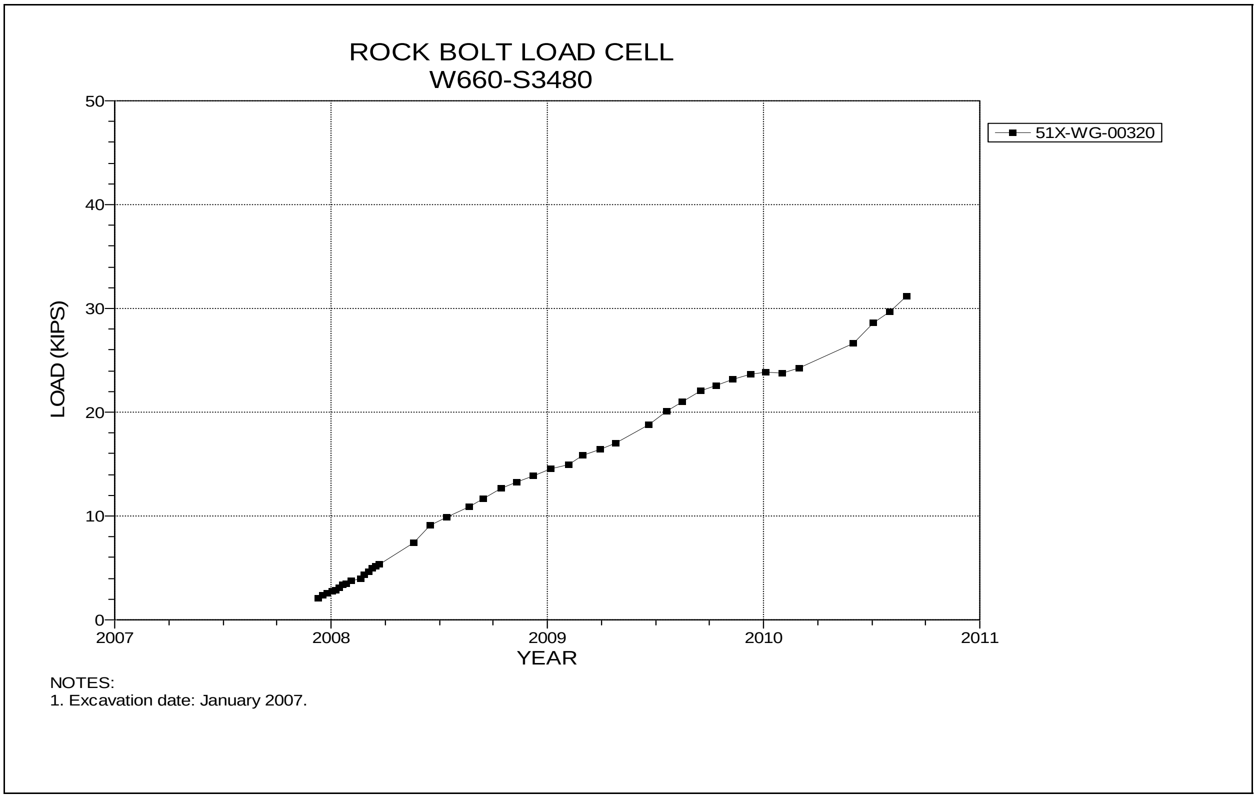


Figure 5-41 Rock Bolt Load Cell 51X-WG-00320
Room 3, Panel 5 at W660 S3480

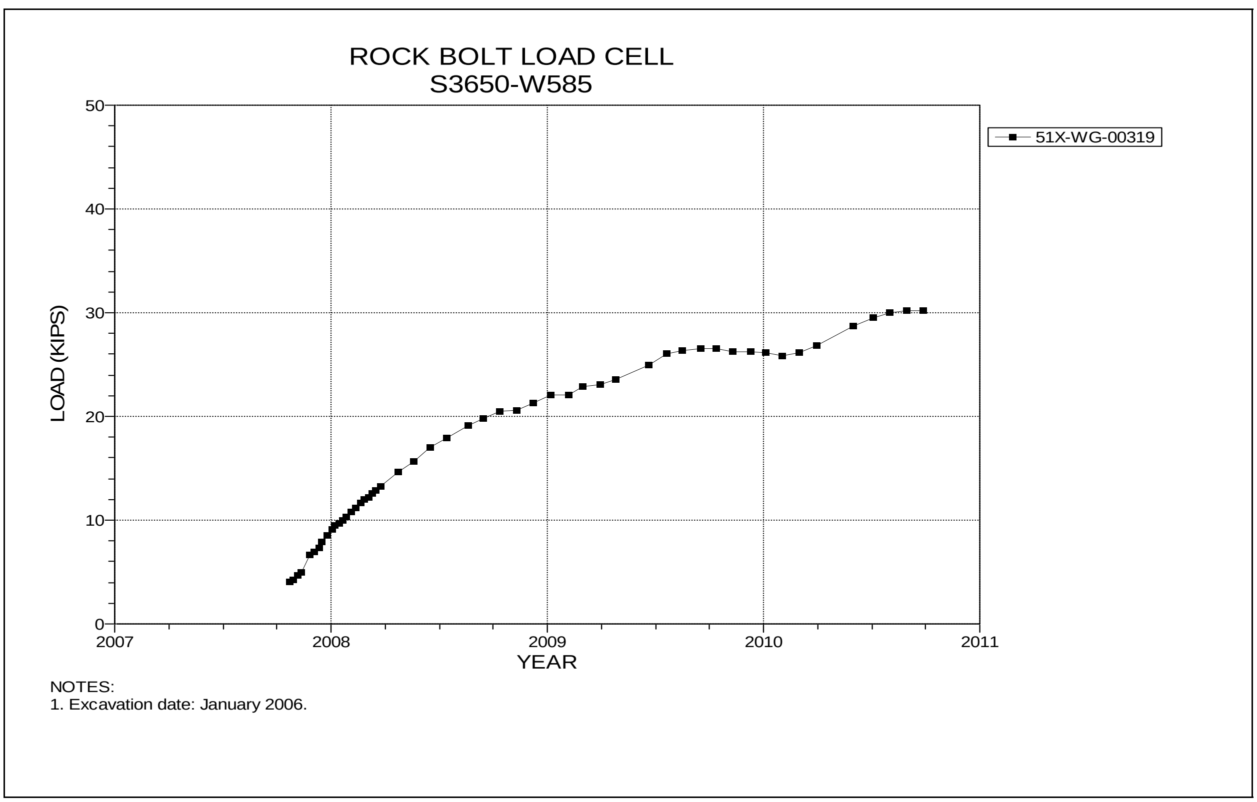


Figure 5-42 Rock Bolt Load Cell 51X-WG-00319
S3650-W585

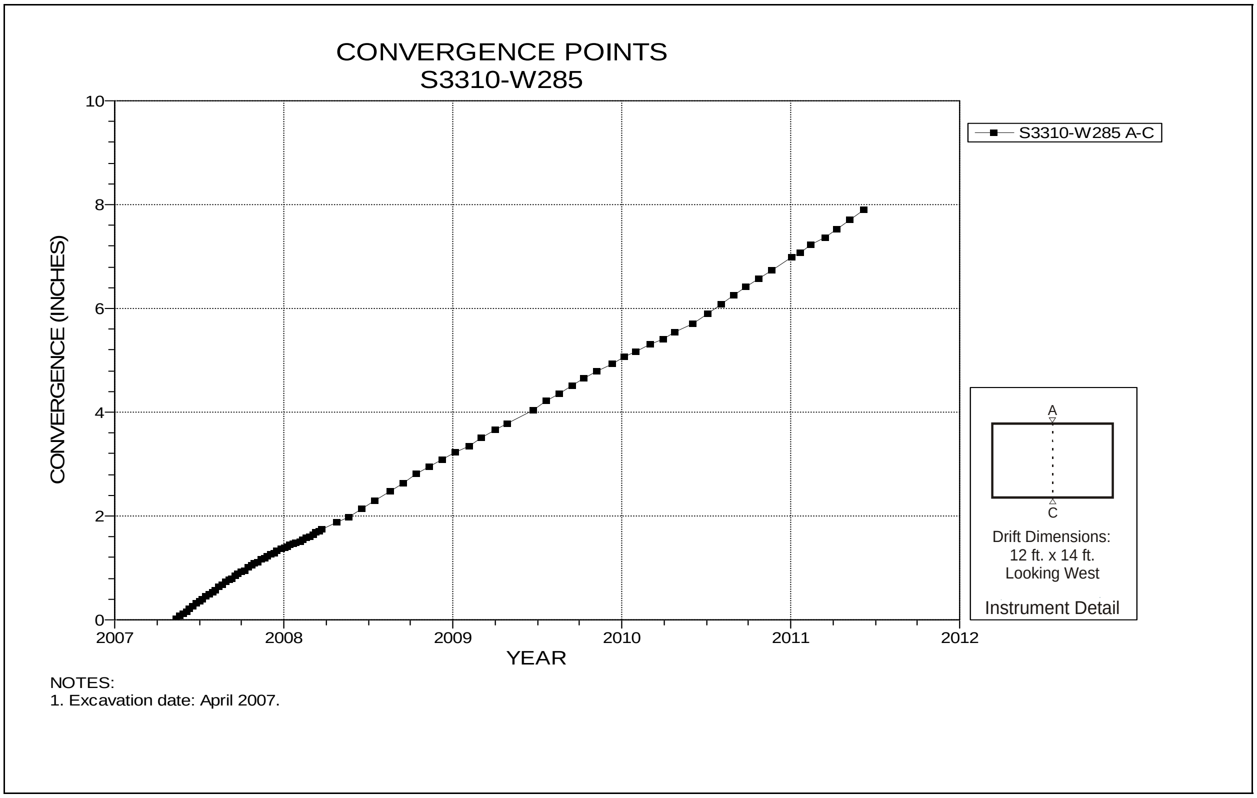


Figure 5-43 Convergence Point Array
S3310 W285 – Roof to Floor

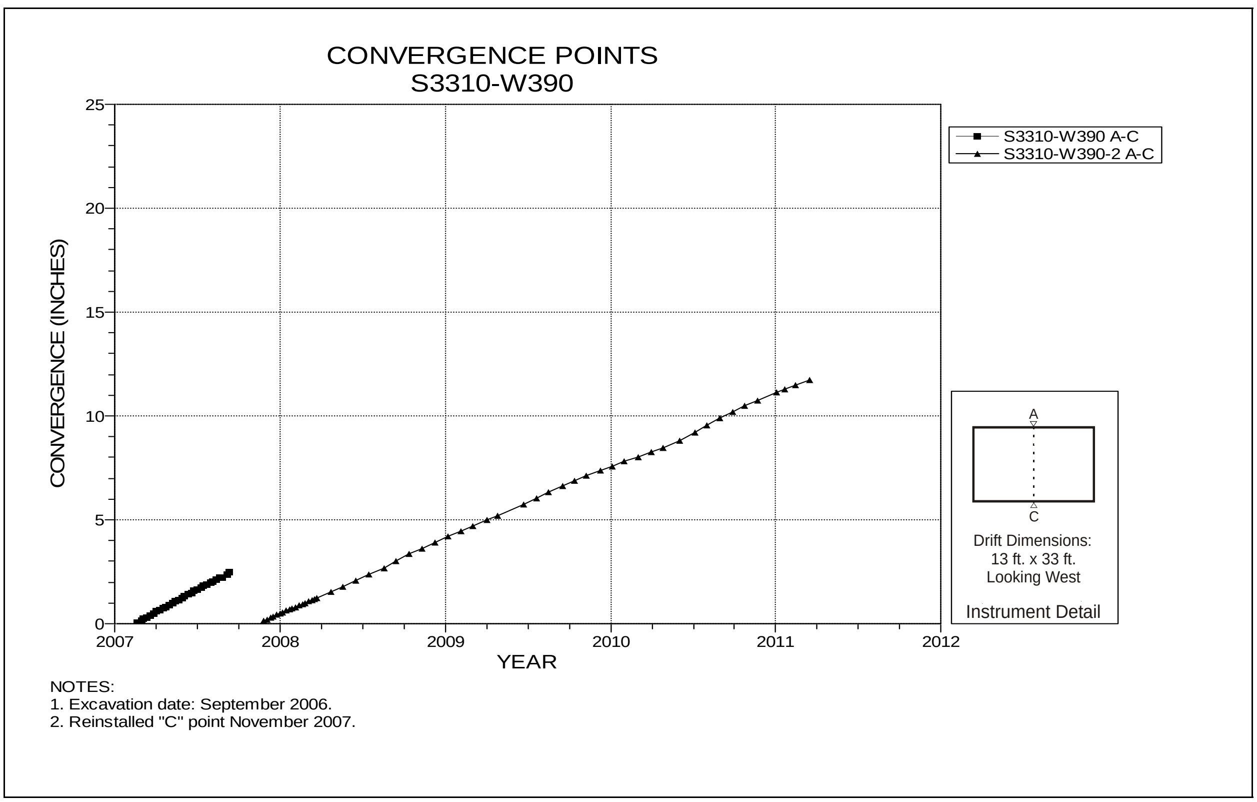


Figure 5-44 Convergence Point Array
S3310 W390 Intersection (Room 1, Panel 5) – Roof to Floor

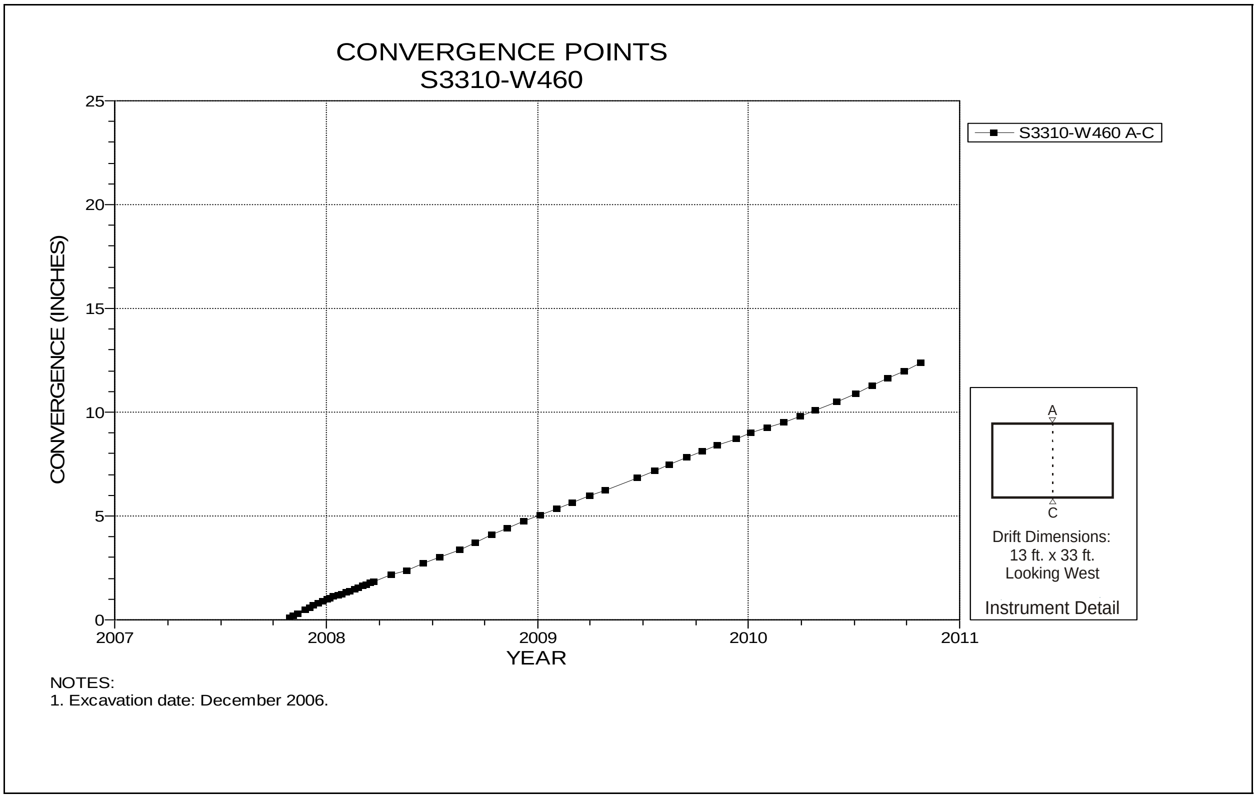


Figure 5-45 Convergence Point Array
S3310 W460 – Roof to Floor

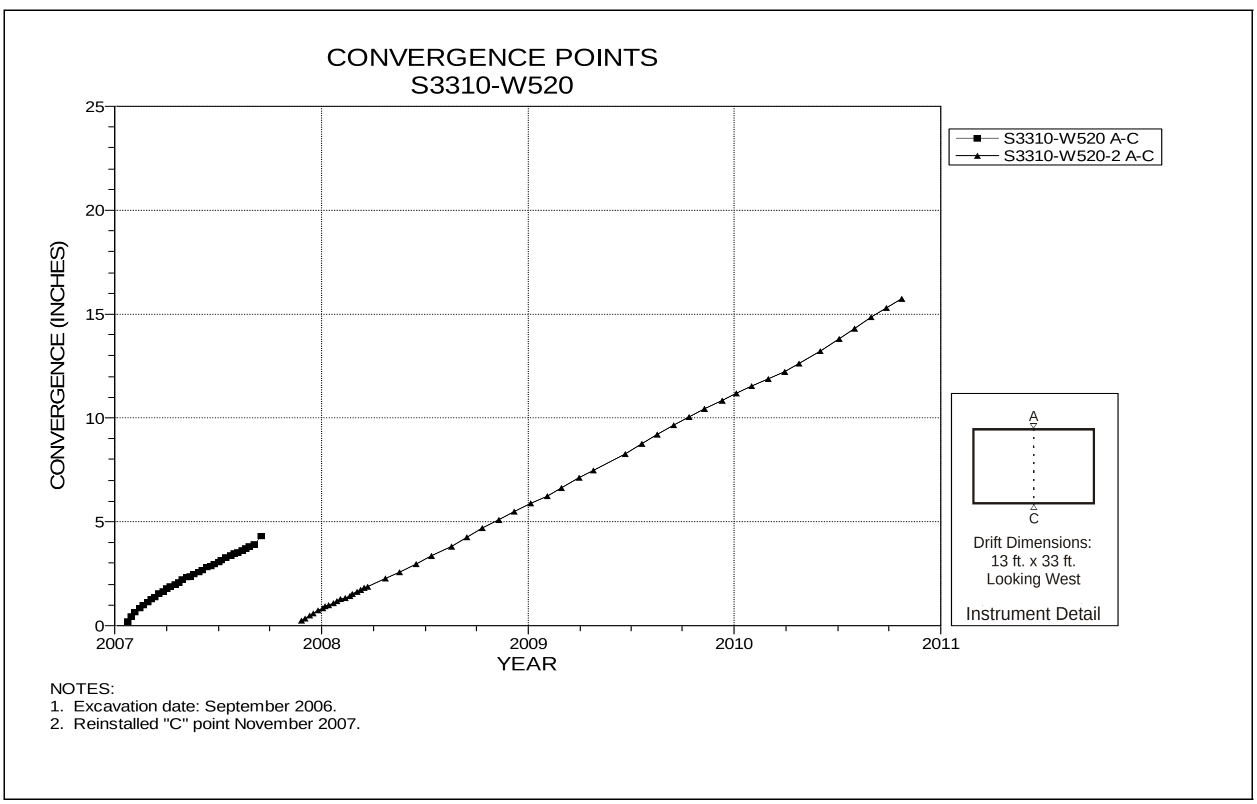


Figure 5-46 Convergence Point Array
S3310 W520 Intersection (Room 2, Panel 5) – Roof to Floor

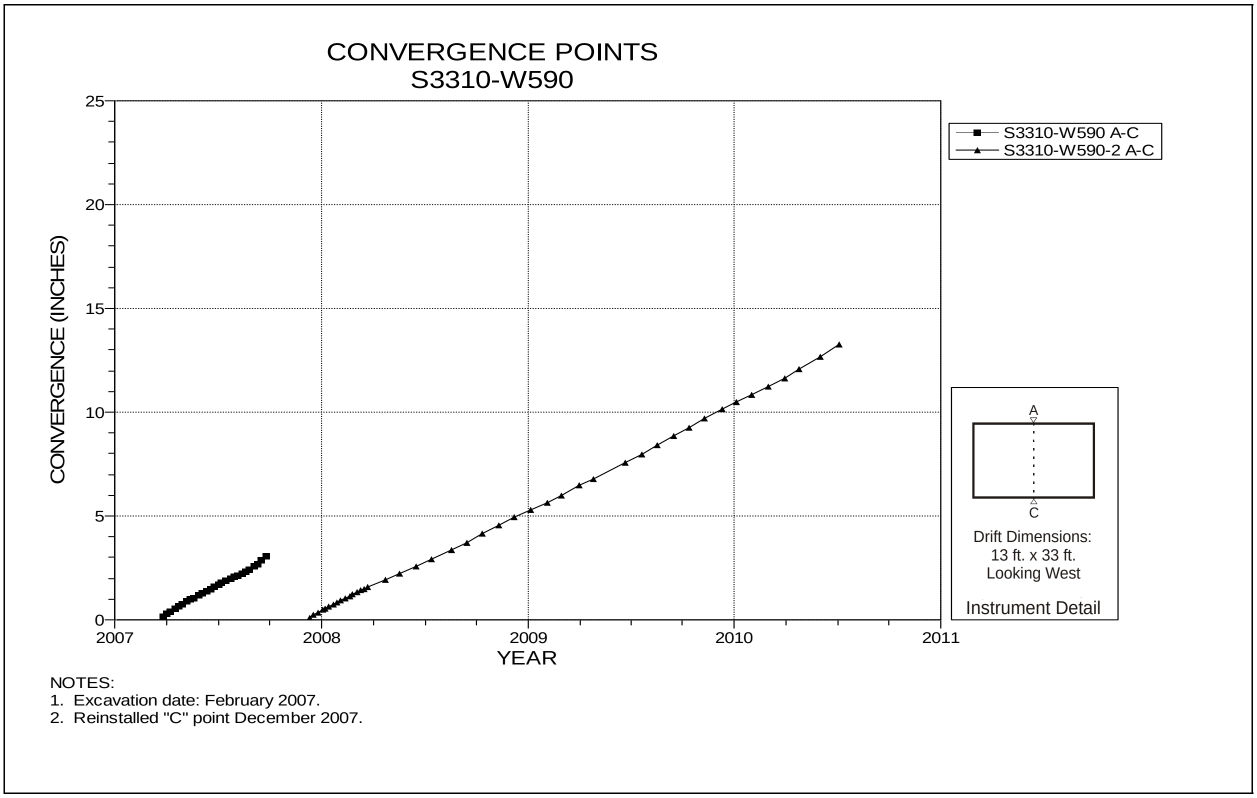


Figure 5-47 Convergence Point Array
S3310 W590 – Roof to Floor

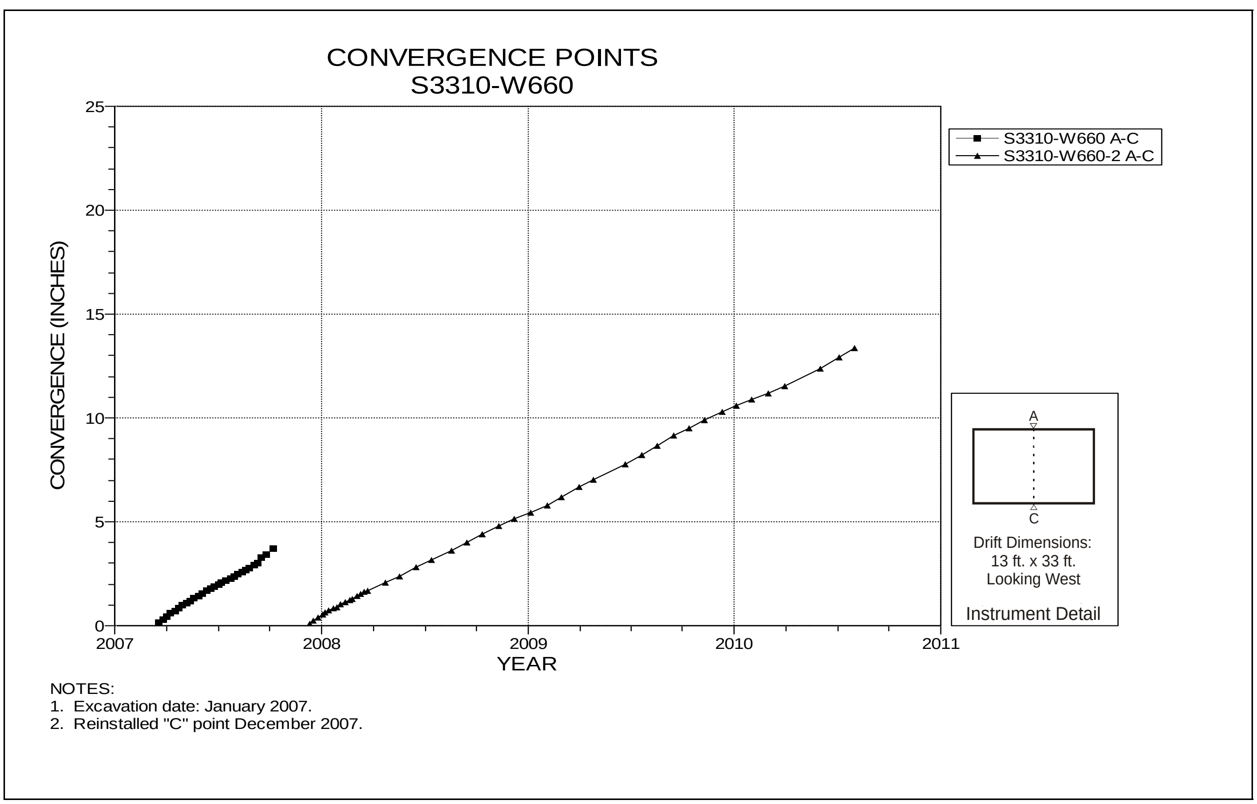


Figure 5-48 Convergence Point Array
S3310 W660 Intersection (Room 3, Panel 5) – Roof to Floor

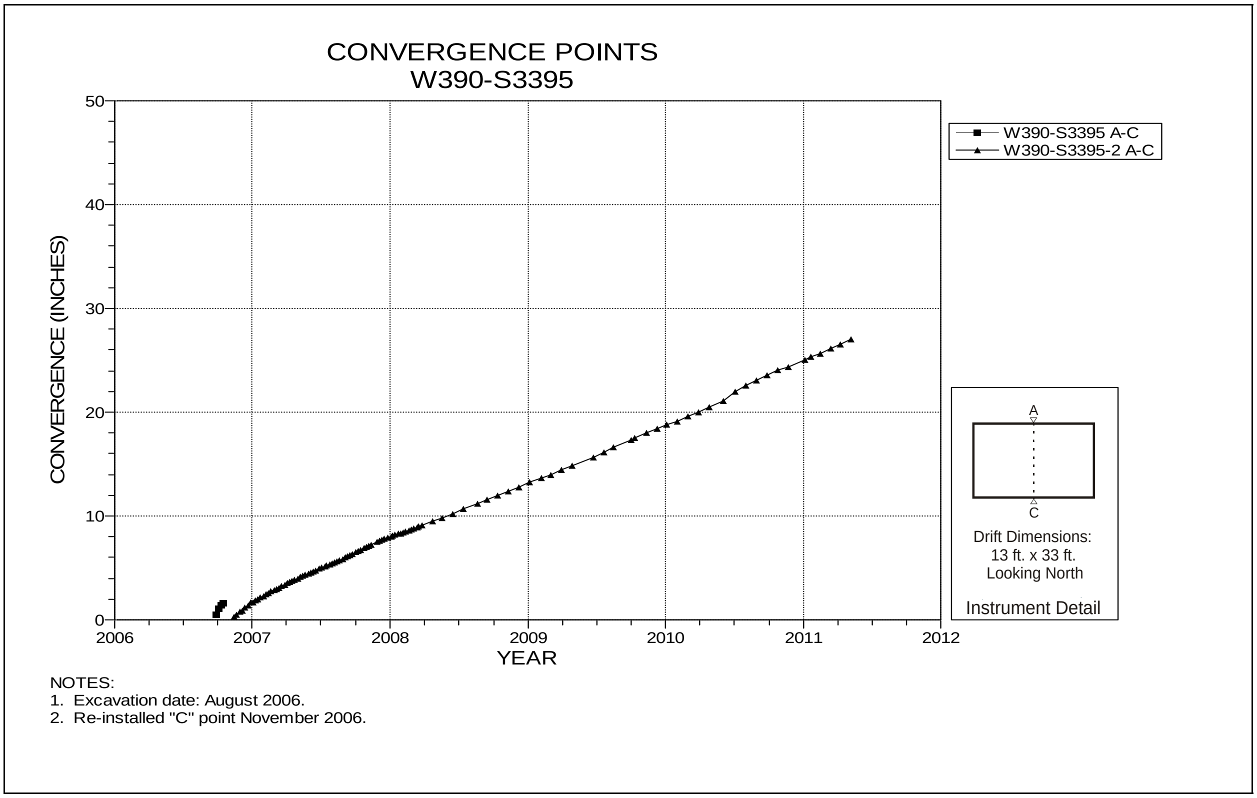


Figure 5-49 Convergence Point Array
Room 1, Panel 5 at W390 S3395 – Roof to Floor

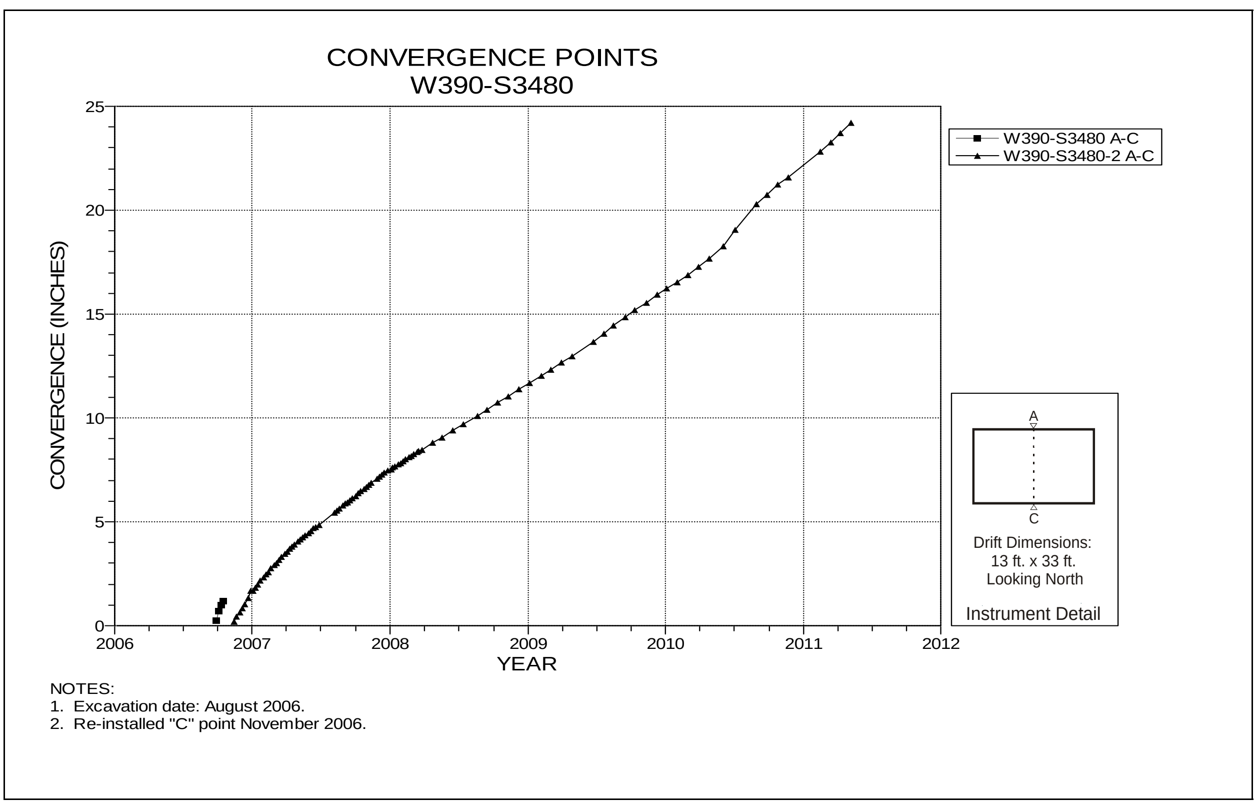


Figure 5-50 Convergence Point Array
Room 1, Panel 5 at W390 S3480 – Room Center – Roof to Floor

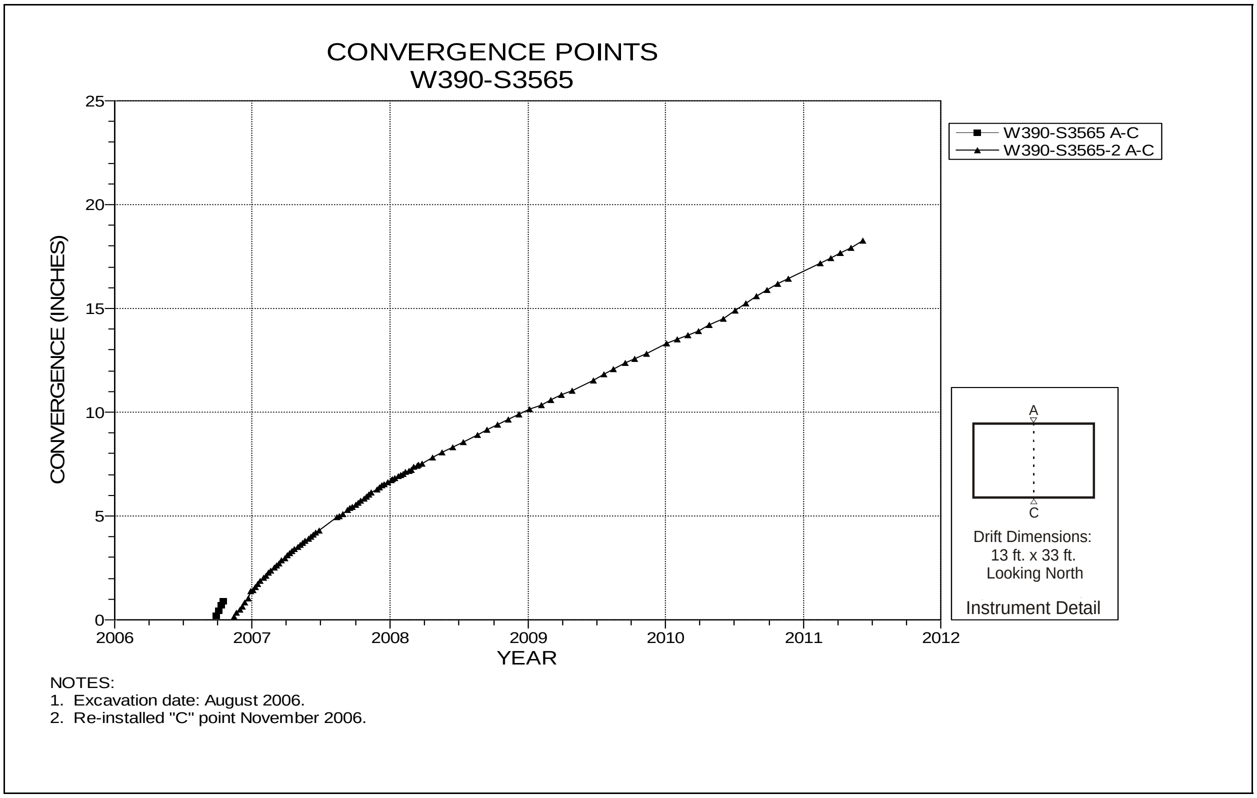


Figure 5-51 Convergence Point Array
Room 1, Panel 5 at W390 S3565 – Roof to Floor

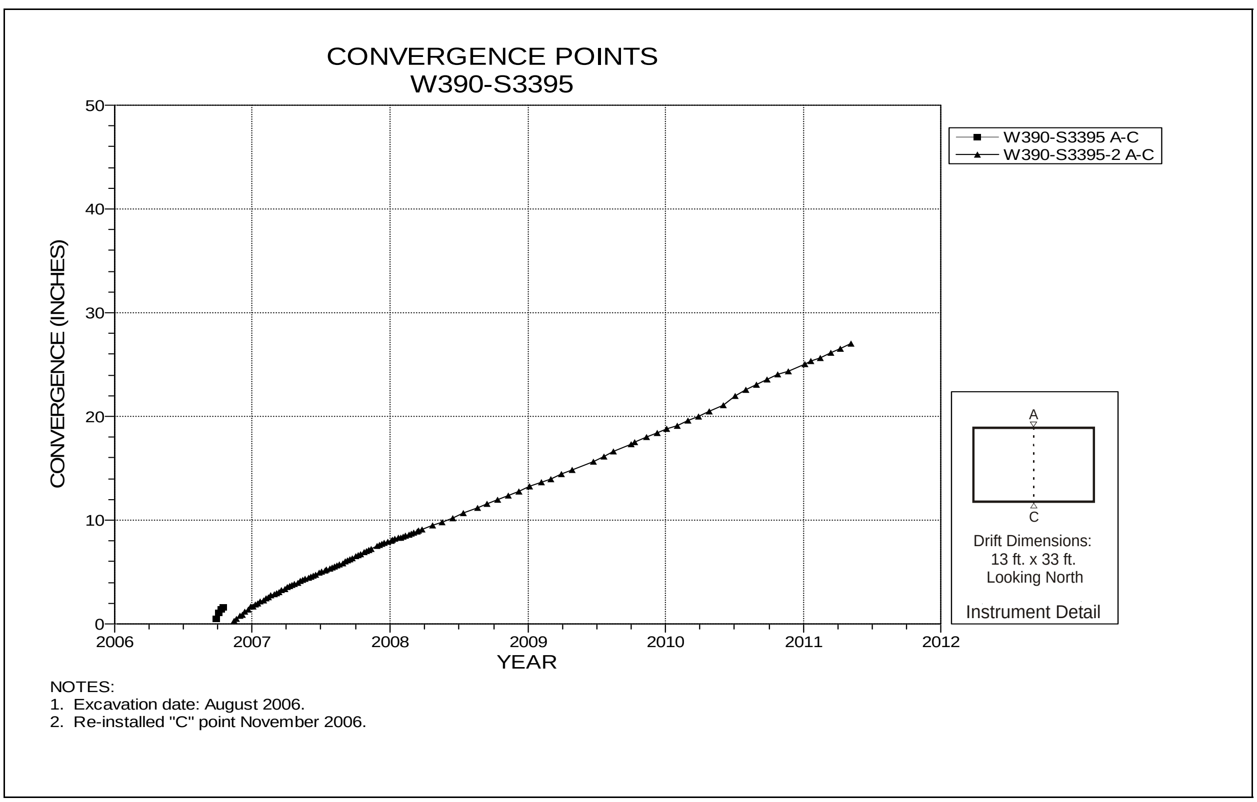


Figure 5-52 Convergence Point Array
Room 2, Panel 5 at W520 S3395 – Roof to Floor

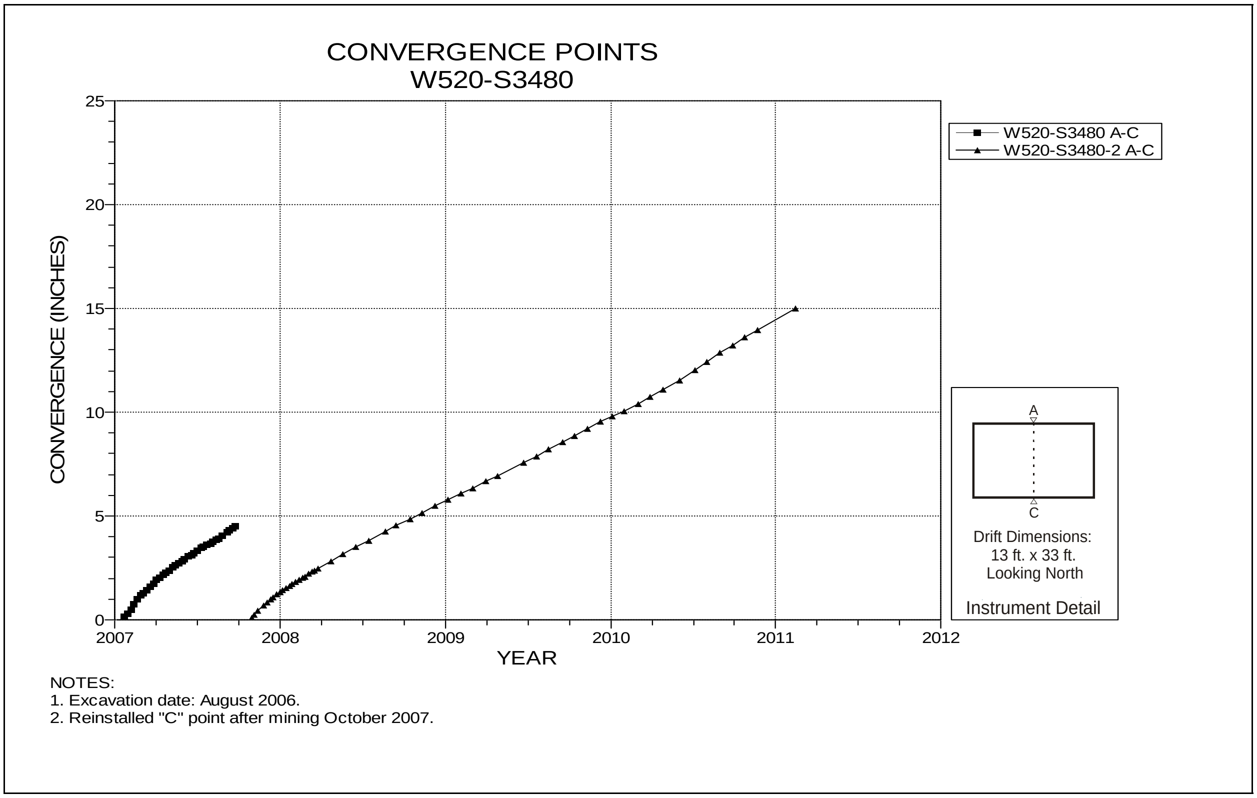


Figure 5-53 Convergence Point Array
Room 2, Panel 5 at W520 S3480 – Room Center – Roof to Floor

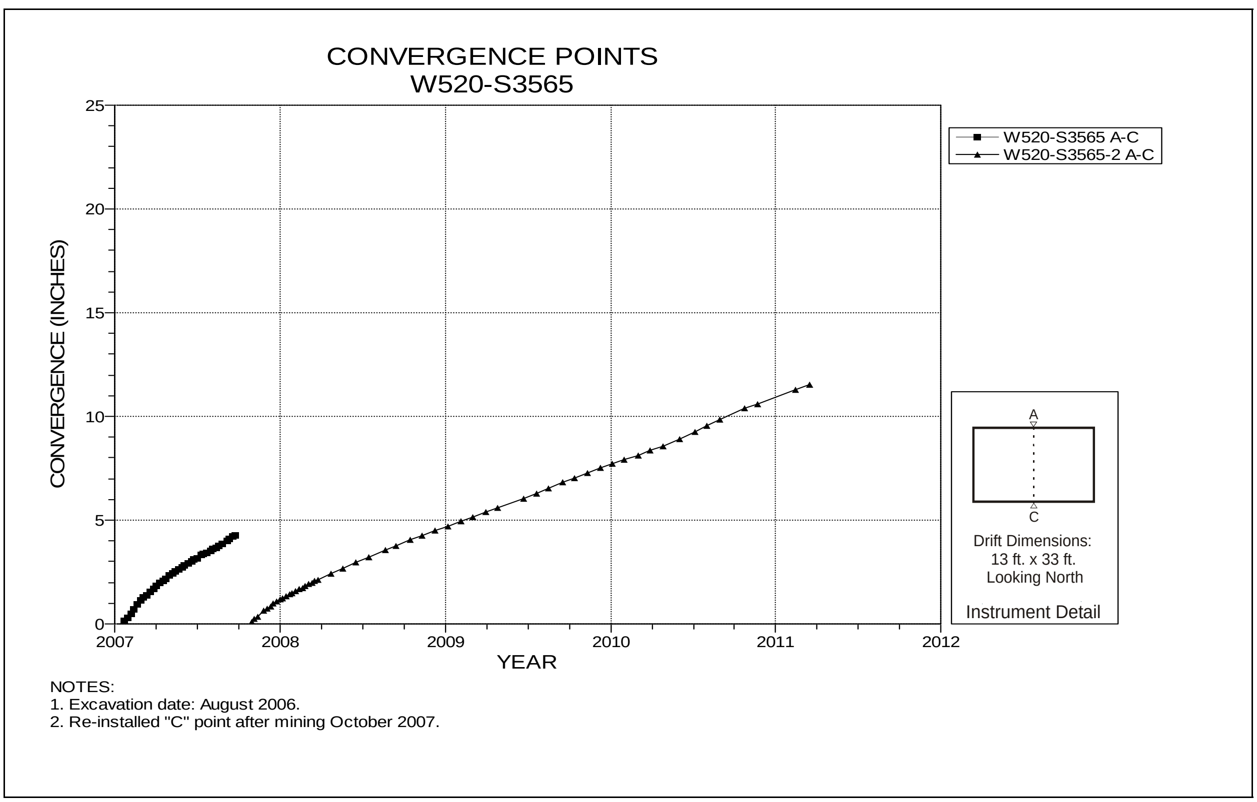


Figure 5-54 Convergence Point Array
Room 2, Panel 5 at W520 S3565 – Roof to Floor

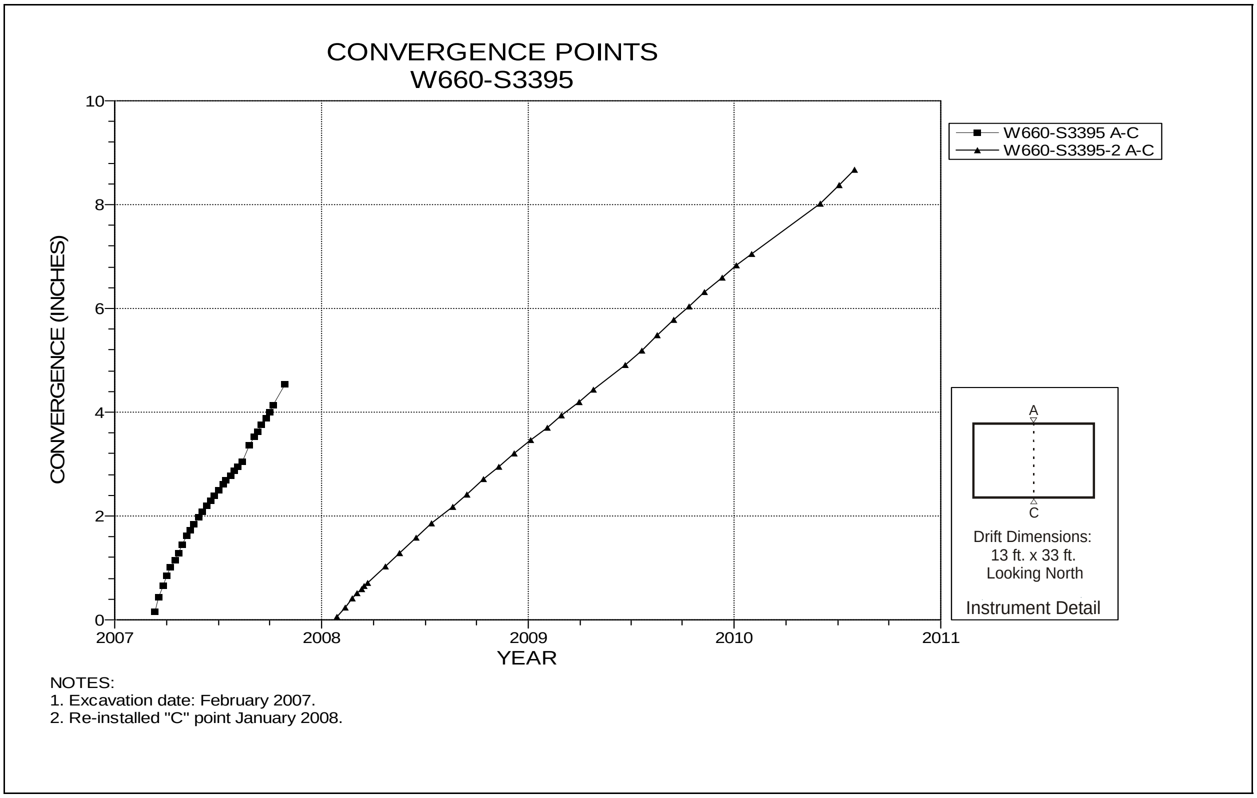


Figure 5-55 Convergence Point Array
Room 3, Panel 5 at W660 S3395 – Roof to Floor

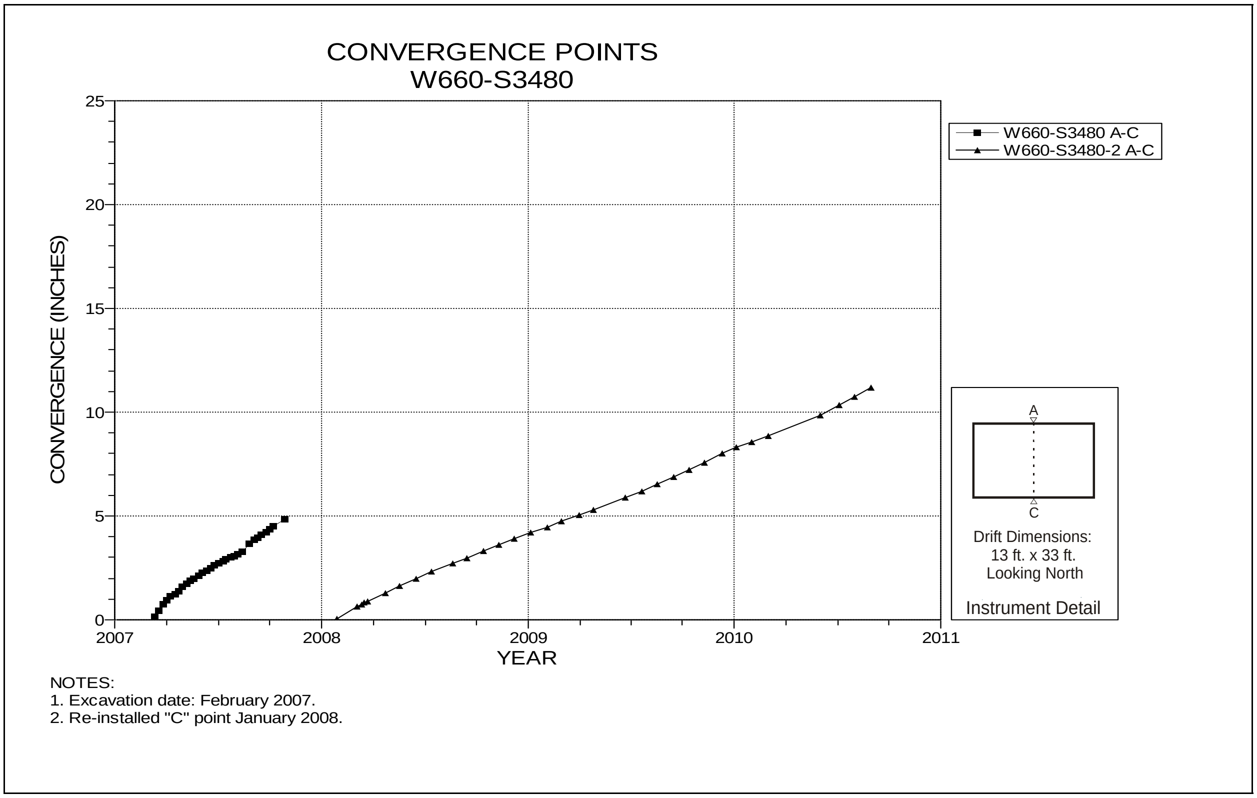


Figure 5-56 Convergence Point Array
Room 3, Panel 5 at W660 S3480 – Room Center – Roof to Floor

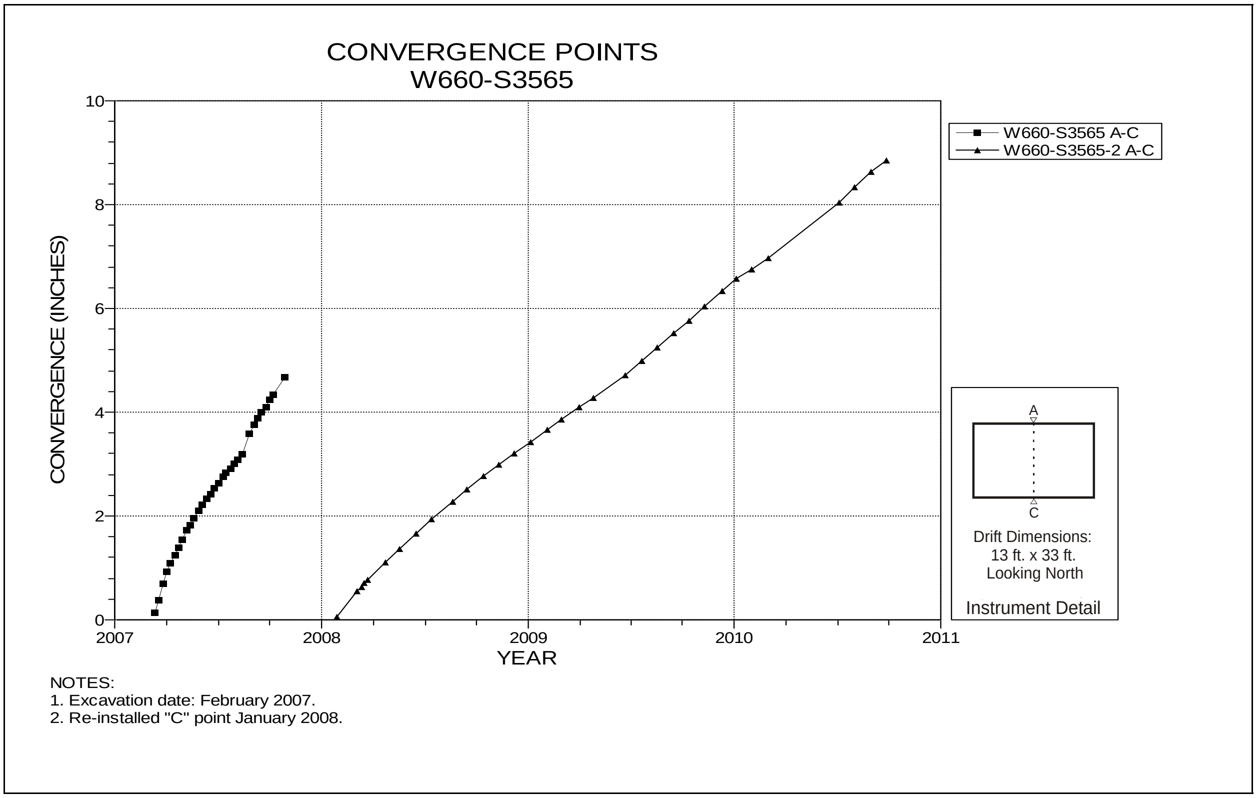


Figure 5-57 Convergence Point Array
Room 3, Panel 5 at W660 S3565 – Roof to Floor

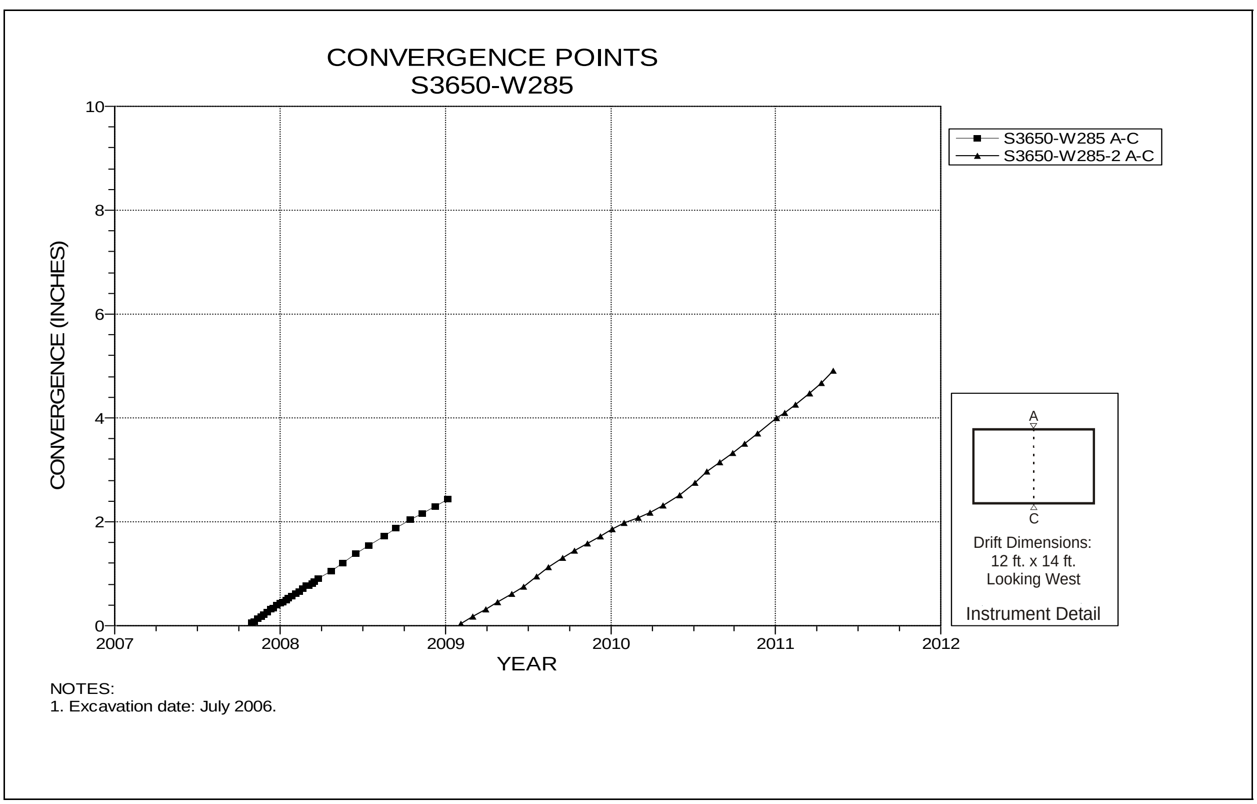


Figure 5-58 Convergence Point Array
S3650 W285 – Roof to Floor

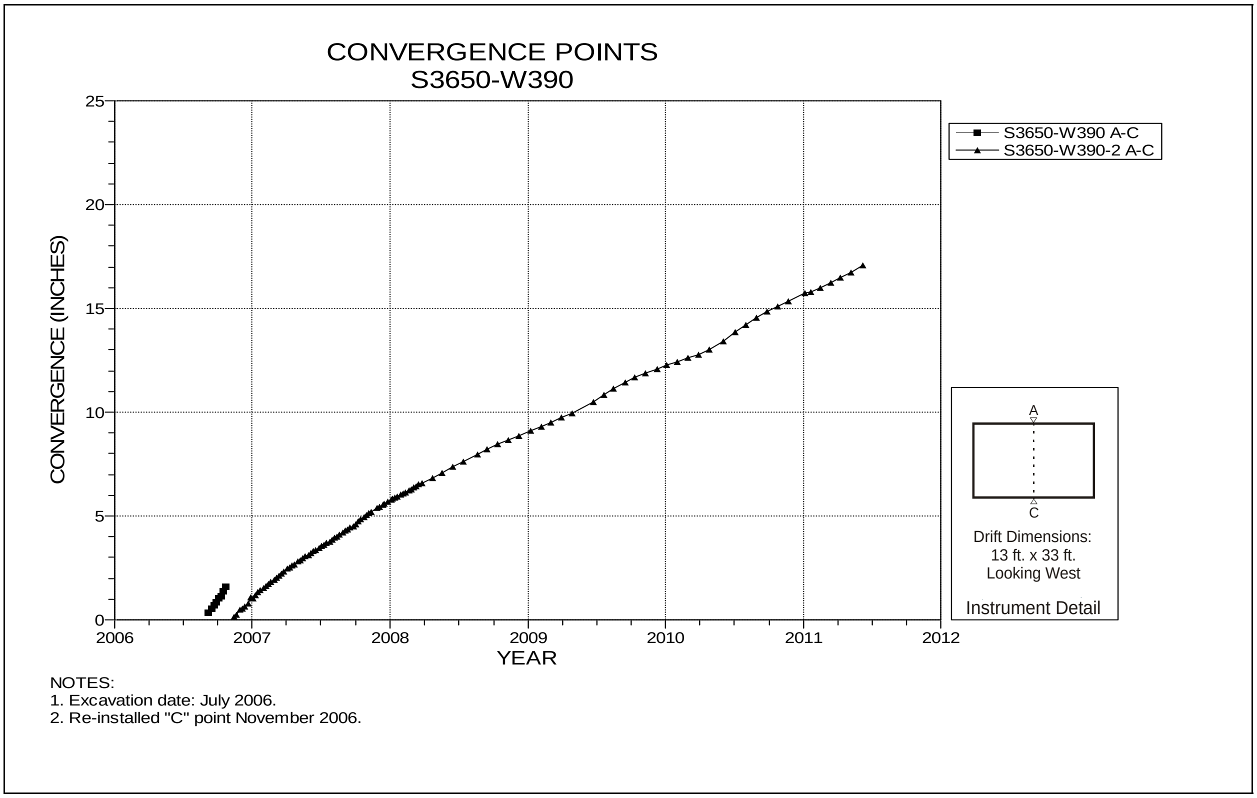


Figure 5-59 Convergence Point Array
S3650 W390 Intersection (Room 1, Panel 5) – Roof to Floor

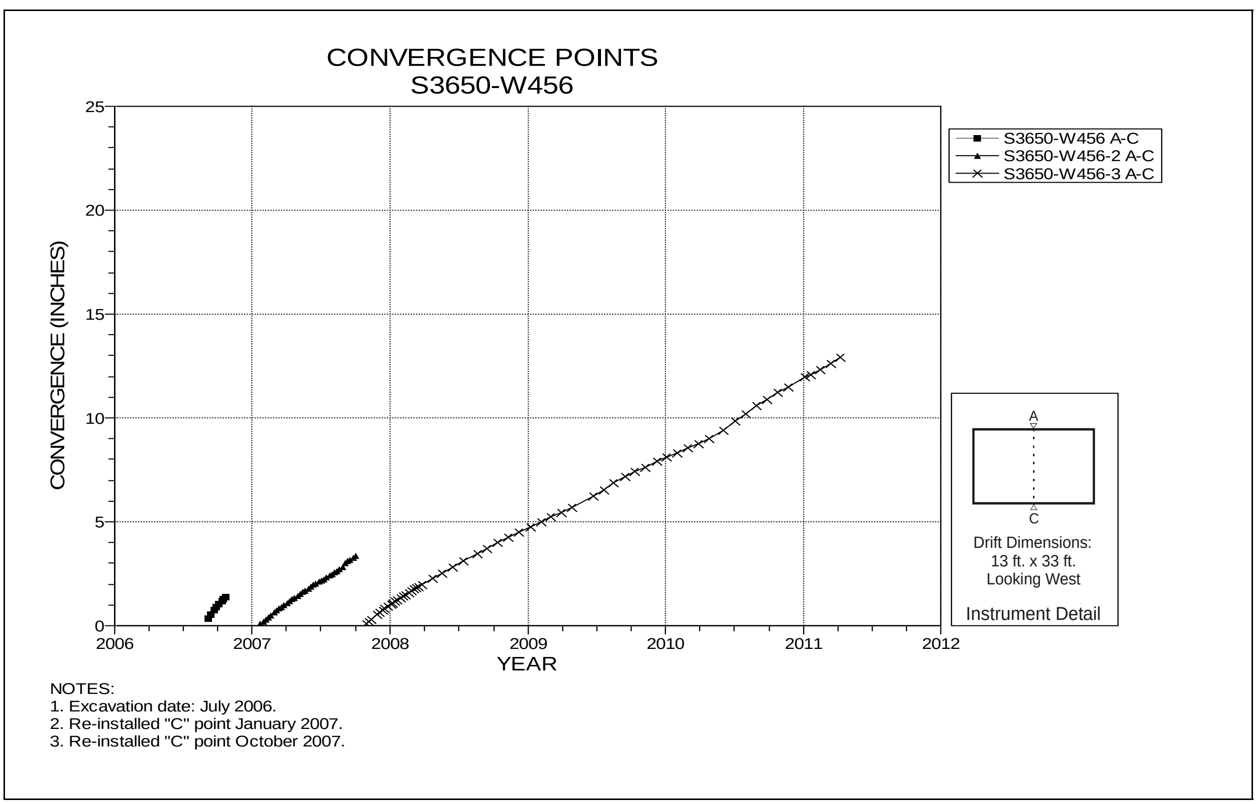


Figure 5-60 Convergence Point Array
S3650 W456 – Roof to Floor

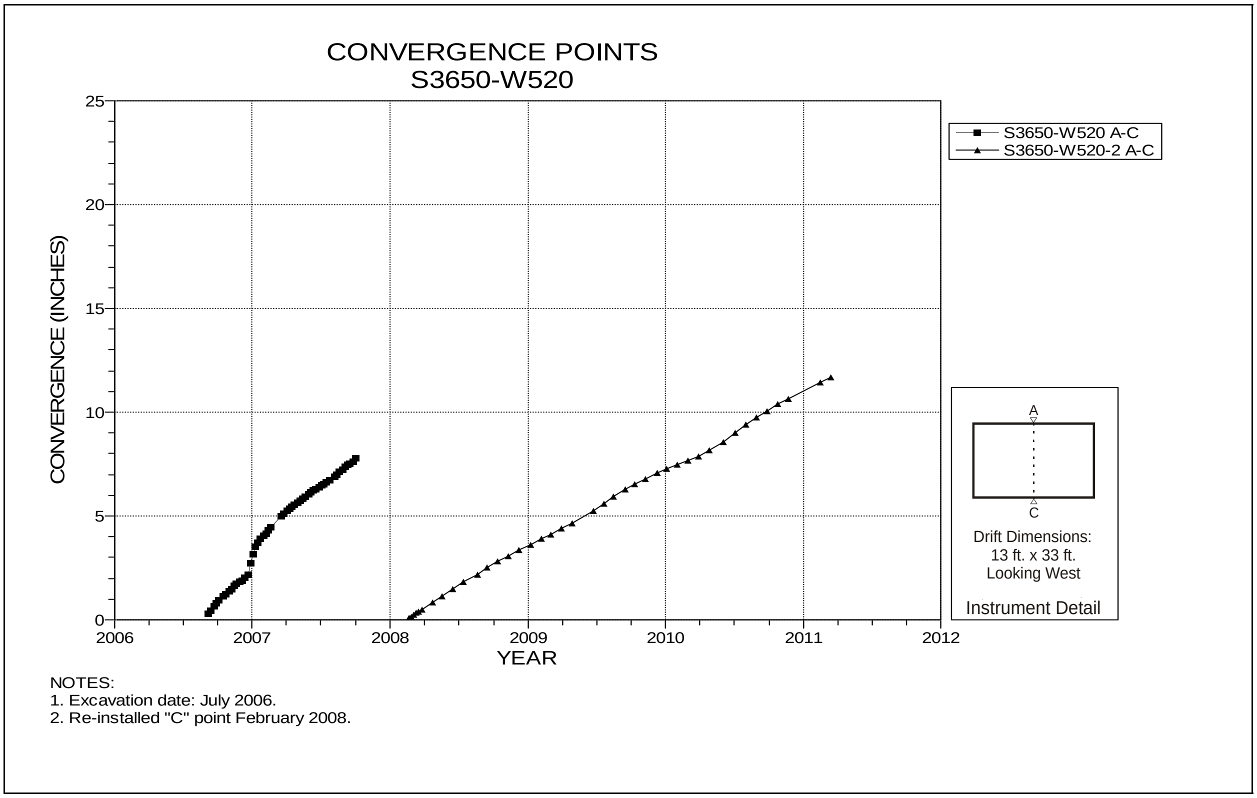


Figure 5-61 Convergence Point Array
S3650 W520 Intersection (Room 2, Panel 5) – Roof to Floor

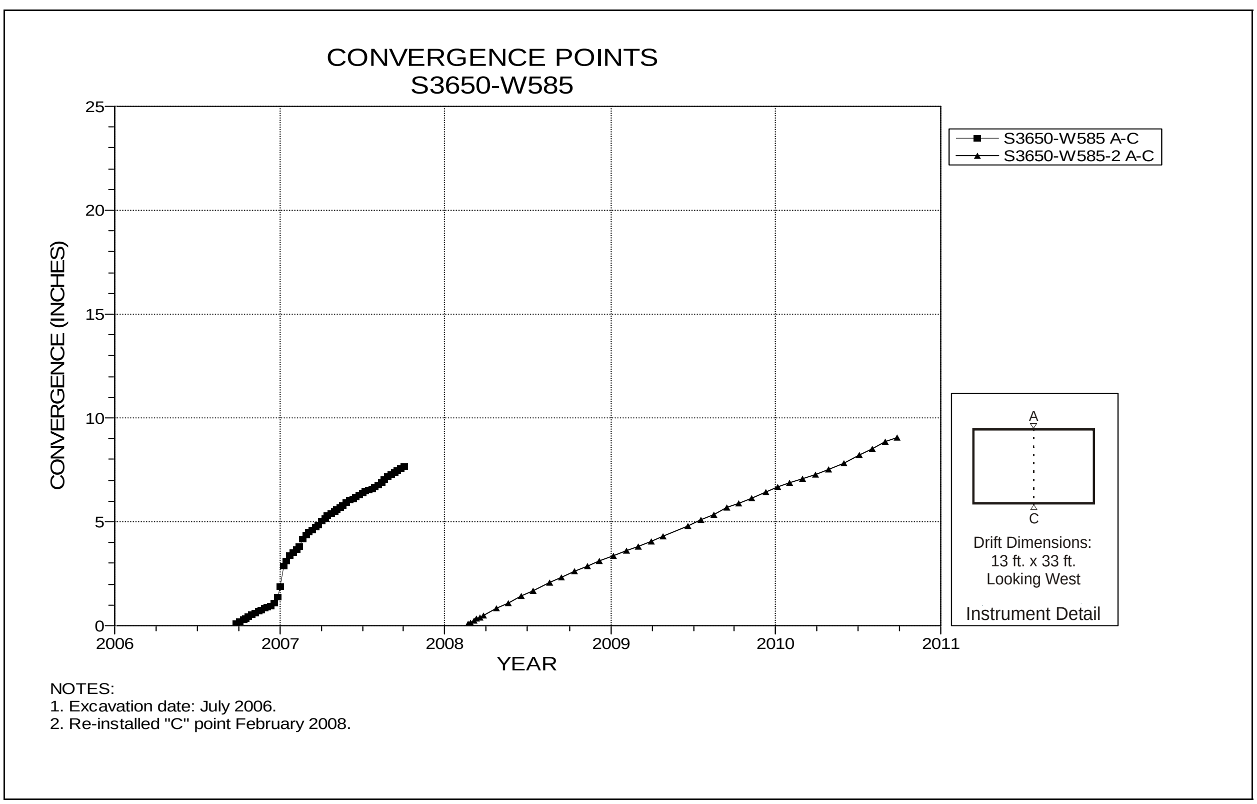


Figure 5-62 Convergence Point Array
S3650 W585 – Roof to Floor

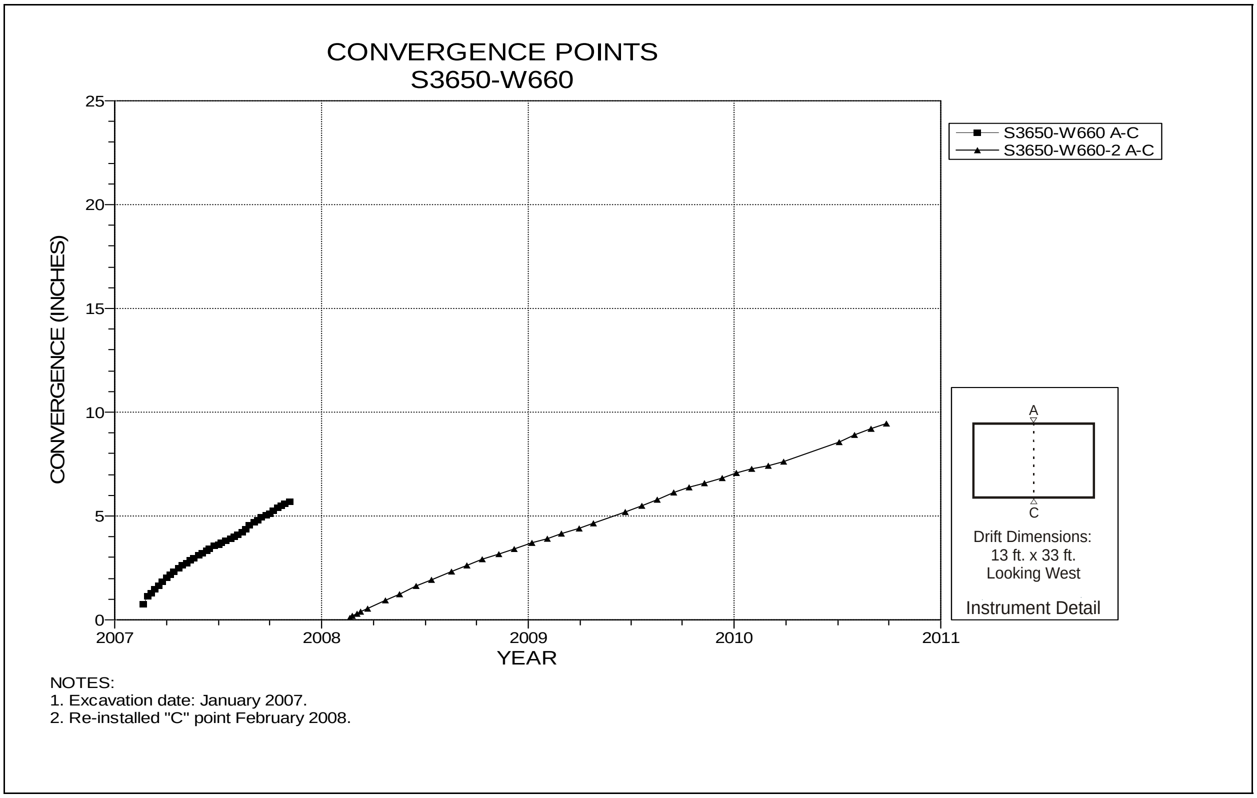


Figure 5-63 Convergence Point Array
S3650 W660 Intersection (Room 3, Panel 5) – Roof to Floor

Table 5-6 Panel 6 Data Analysis

EXTENSOMETERS

Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2010 to 2011 (in/year)	Displacement Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
51X-GE-00413-2	S2750-W585	5-64	06/27/11	1.357	3.13	4.06	-23%	
51X-GE-00414	S2750-W985	5-65	06/27/11	1.712	1.56	1.23	27%	
51X-GE-00403	W390-S2916	5-66	06/27/11	11.004	5.66	3.87	46%	
51X-GE-00405	W520-S2916	5-67	06/27/11	6.961	3.85	3.10	24%	
51X-GE-00406	W660-S2916	5-68	06/27/11	4.597	2.51	2.81	-11%	
51X-GE-00407	W790-S2916	5-69	06/27/11	3.952	1.99	2.70	-26%	
51X-GE-00408-2	W920-S2916	5-70	06/27/11	1.494	1.57	1.79	-22%	
51X-GE-00409	W1050-S2916	5-71	06/27/11	3.100	1.85	3.10	-40%	
51X-GE-00410	W1190-S2916	5-72	06/27/11	2.274	1.67	2.16	-23%	
51X-GE-00411	S3080-W585	5-73	06/27/11	4.997	4.07	4.59	-11%	
51X-GE-00412	S3080-W985	5-74	06/27/11	2.289	1.82	1.83	-1%	

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S2750-W285-2 A-C	S2750-W285	5-75	06/20/11	6.621	11.302	6.45	7.14	-10%	
S2750-W390-2 A-C	S2750-W390	5-76	06/20/11	6.341	13.467	6.02	7.95	-24%	
S2750-W460-2 A-C	S2750-W460	5-77	06/21/11	8.583	14.609	8.39	9.62	-13%	
S2750-W520-2 A-C	S2750-W520	5-78	06/21/11	6.843	13.559	6.61	7.63	-13%	
S2750-W590-2 A-C	S2750-W590	5-79	06/21/11	7.560	11.262	7.38	8.08	-9%	
S2750-W660-2 A-C	S2750-W660	5-80	06/21/11	7.184	11.274	6.99	7.83	-11%	
S2750-W725-2 A-C	S2750-W725	5-81	06/21/11	7.240	11.520	7.10	7.91	-10%	
S2750-W790-2 A-C	S2750-W790	5-82	06/21/11	6.930	11.383	6.74	7.06	-5%	
S2750-W855-2 A-C	S2750-W855	5-83	06/21/11	6.303	7.988	6.26	5.32	18%	
S2750-W920-2 A-C	S2750-W920	5-84	06/20/11	6.341	8.265	6.31	5.97	6%	

Table 5-6 (continued) Panel 6 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
S2750-W985-2 A-C	S2750-W985	5-85	06/20/11	5.131	7.041	5.11	4.79	7%	
S2750-W1050-2 A-C	S2750-W1050	5-86	06/20/11	5.128	7.111	5.10	5.48	-7%	
S2750-W1120-2 A-C	S2750-W1120	5-87	06/20/11	4.404	5.020	4.19	3.65	15%	
S2750-W1190-2 A-C	S2750-W1190	5-88	06/20/11	4.860	5.883	3.50	3.74	-6%	
W390-S2833-2 A-C	W390-S2833	5-89	06/20/11	9.769	17.298	9.32	12.13	-23%	
W390-S2916-2 A-C	W390-S2916	5-90	06/20/11	8.913	18.126	8.52	11.00	-23%	
W390-S2998-2 A-C	W390-S2998	5-91	06/20/11	6.308	15.361	5.88	9.78	-40%	
W520-S2833-2 A-C	W520-S2833	5-92	06/21/11	5.399	11.407	5.12	6.94	-26%	
W520-S2916-2 A-C	W520-S2916	5-93	06/21/11	6.917	13.020	6.65	8.12	-18%	
W520-S2998-2 A-C	W520-S2998	5-94	06/21/11	5.113	10.823	4.85	6.78	-28%	
W660-S2833-2 A-C	W660-S2833	5-95	06/21/11	5.656	9.950	5.55	6.70	-17%	
W660-S2916-2 A-C	W660-S2916	5-96	06/21/11	5.608	10.670	5.50	7.51	-27%	
W660-S2998-2 A-C	W660-S2998	5-97	06/21/11	5.450	10.240	5.34	6.29	-15%	
W790-S2833-2 A-C	W790-S2833	5-98	06/21/11	5.607	10.915	5.50	6.62	-17%	
W790-S2916-2 A-C	W790-S2916	5-99	06/21/11	5.199	10.463	5.08	6.57	-23%	
W790-S2998-2 A-C	W790-S2998	5-100	06/21/11	4.838	9.944	4.69	6.57	-29%	
W920-S2833-2 A-C	W920-S2833	5-101	06/20/11	4.736	8.422	4.67	7.85	-41%	
W920-S2916-2 A-C	W920-S2916	5-102	06/20/11	4.790	8.567	4.70	5.40	-13%	
W920-S2998-2 A-C	W920-S2998	5-103	06/20/11	4.195	7.780	4.09	5.36	-24%	
W1050-S2833-2 A-C	W1050-S2833	5-104	06/20/11	4.087	5.029	3.94	5.03	-22%	
W1050-S2916-2 A-C	W1050-S2916	5-105	06/20/11	5.004	6.046	4.94	6.25	-21%	
W1050-S2998-2 A-C	W1050-S2998	5-106	06/20/11	4.002	4.948	3.93	4.67	-16%	
W1190-S2833-2 A-C	W1190-S2833	5-107	06/20/11	5.933	7.361	4.11	4.96	-17%	
W1190-S2916-2 A-C	W1190-S2916	5-108	06/20/11	4.602	6.132	4.51	5.84	-23%	
W1190-S2998-2 A-C	W1190-S2998	5-109	03/30/11	3.335	4.860	4.20	5.03	-17%	
S3080-W285-2 A-C	S3080-W285	5-110	06/20/11	2.944	6.911	2.84	2.92	-3%	
S3080-W390-2 A-C	S3080-W390	5-111	06/20/11	5.046	13.244	4.76	6.66	-29%	
S3080-W460-2 A-C	S3080-W460	5-112	06/20/11	5.819	13.853	5.73	5.68	1%	

Table 5-6 ((Continued)) Panel 6 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S3080-W520-2 A-C	S3080-W520	5-113	06/20/11	6.364	14.835	6.01	8.20	-27%	
S3080-W585-2 A-C	S3080-W585	5-114	06/20/11	7.284	16.462	6.96	8.64	-19%	
S3080-W660-2 A-C	S3080-W660	5-115	06/20/11	6.392	13.516	6.07	6.82	-11%	
S3080-W725-2 A-C	S3080-W725	5-116	06/20/11	6.012	6.012	5.74	6.33	-9%	
S3080-W790-2 A-C	S3080-W790	5-117	06/20/11	6.456	12.193	6.21	6.98	-11%	
S3080-W855-2 A-C	S3080-W855	5-118	06/20/11	5.605	5.605	5.73	7.29	-21%	
S3080-W920-2 A-C	S3080-W920	5-119	06/20/11	5.153	5.153	5.52	8.37	-34%	
S3080-W985-2 A-C	S3080-W985	5-120	06/20/11	4.647	4.647	4.73	7.07	33%	
S3080-W1050-2 A-C	S3080-W1050	5-121	06/20/11	4.507	6.105	4.31	5.32	-19%	
S3080-W1120-2 A-C	S3080-W1120	5-122	02/28/11	2.710	4.053	3.79	4.55	-17%	
S3080-W1190-2 A-C	S3080-W1190	5-123	02/28/11	2.300	3.528	3.22	4.88	-34%	

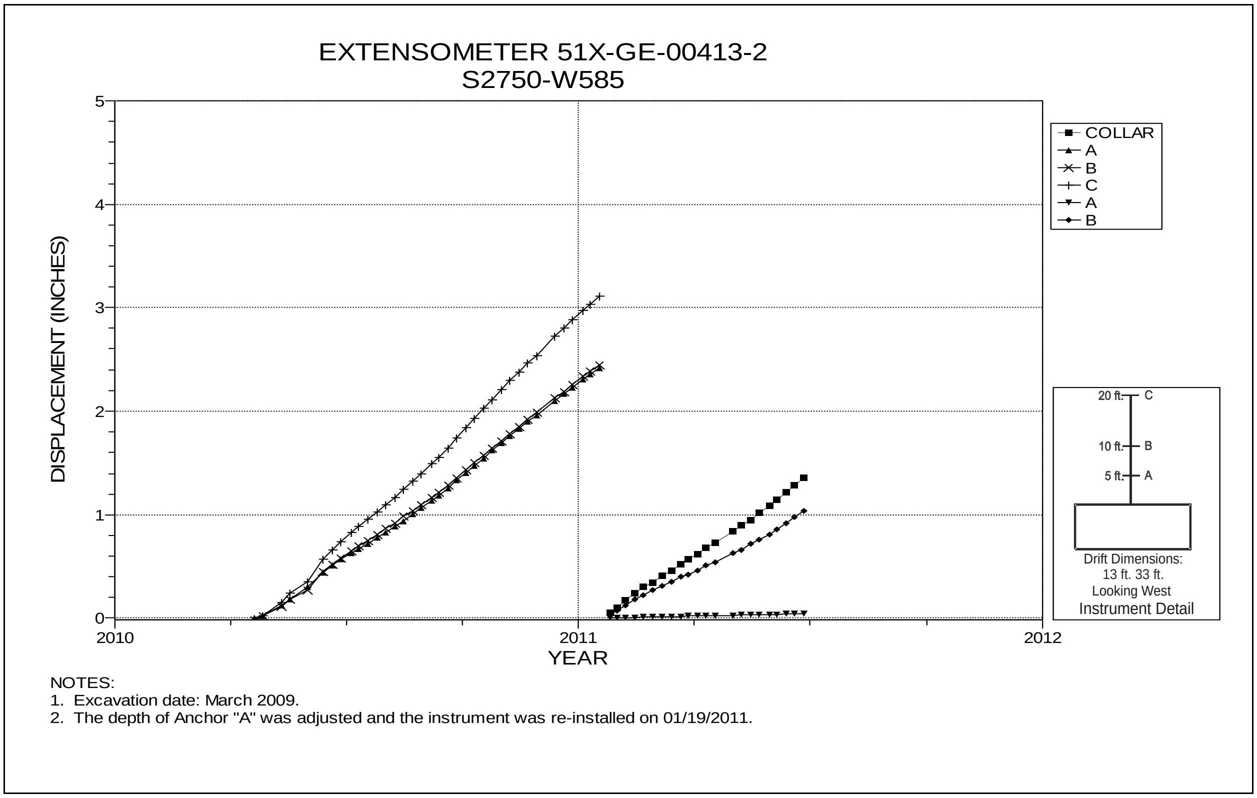


Figure 5-64 Extensometer 51X-GE-00413-2
S2750 W585 – Roof

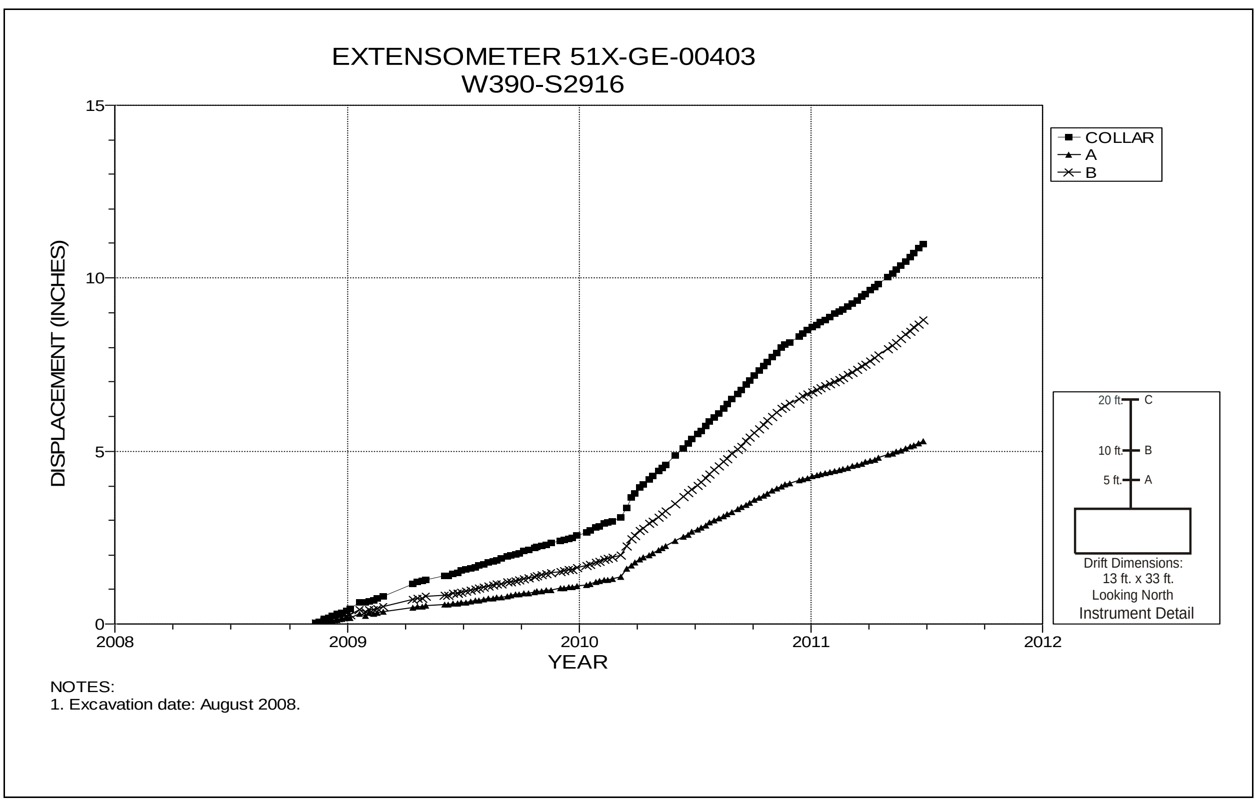


Figure 5-65 Extensometer 51X-GE-00414
S2750 W985 – Roof

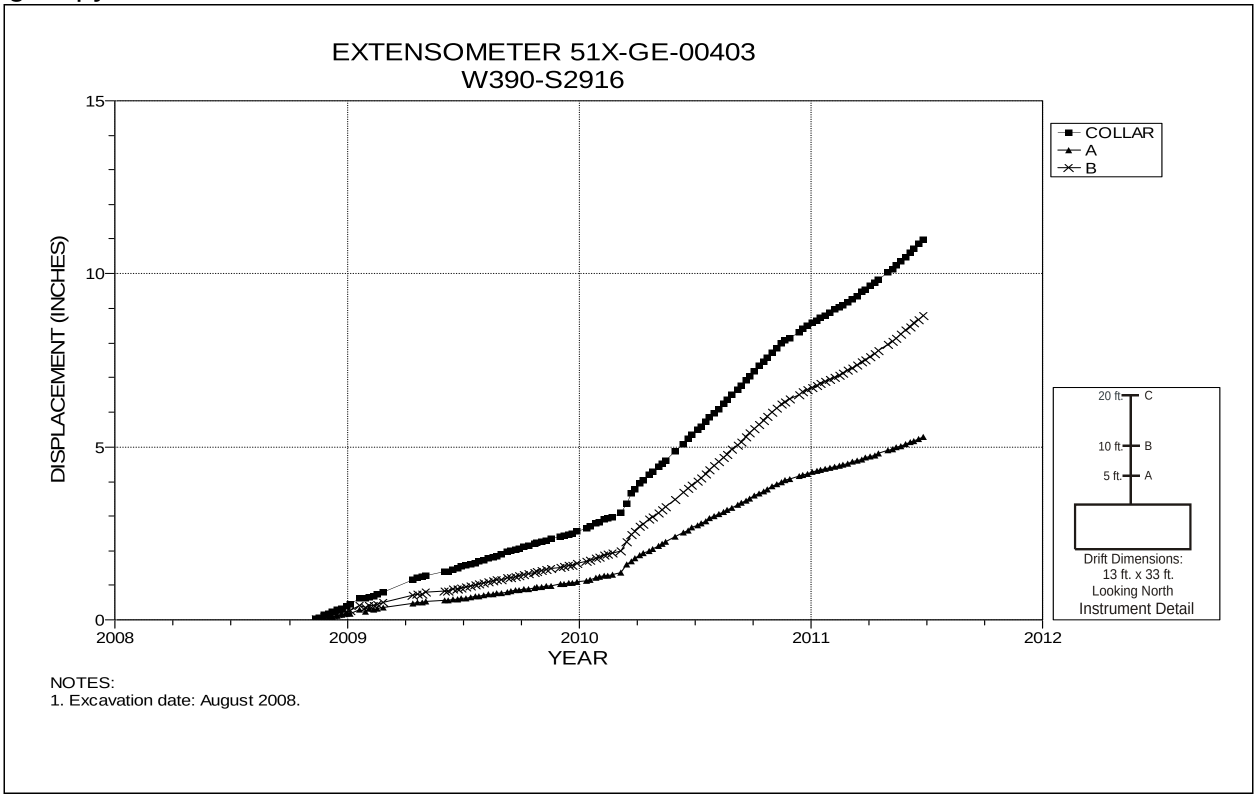


Figure 5-66 Extensometer 51X-GE-00403
Room 1, Panel 6 at W390 S2916 – Roof

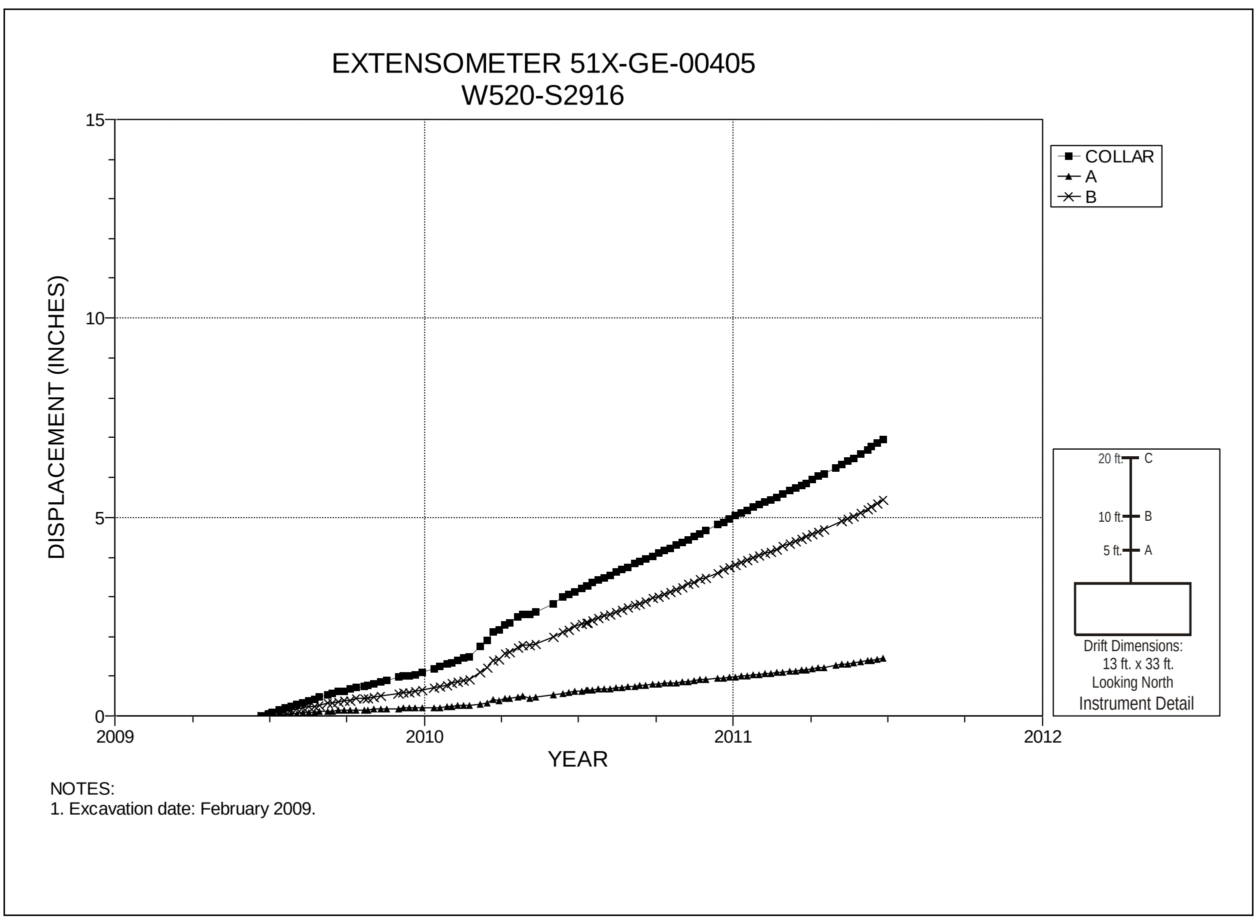


Figure 5-67 Extensometer 51X-GE-00405
Room 2, Panel 6 at W520 S2916 – Room Center – Roof

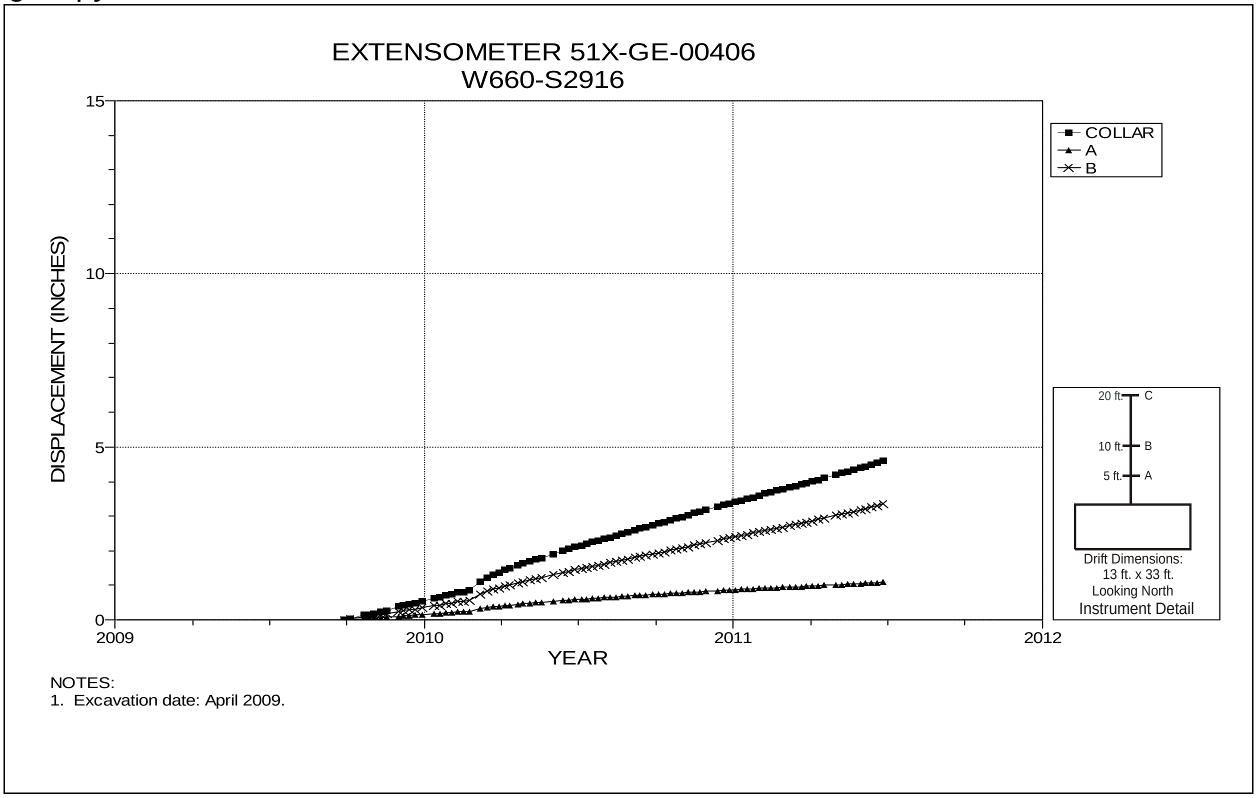


Figure 5-68 Extensometer 51X-GE-00406
Room 3, Panel 6 at W660 S2916– Room Center – Roof

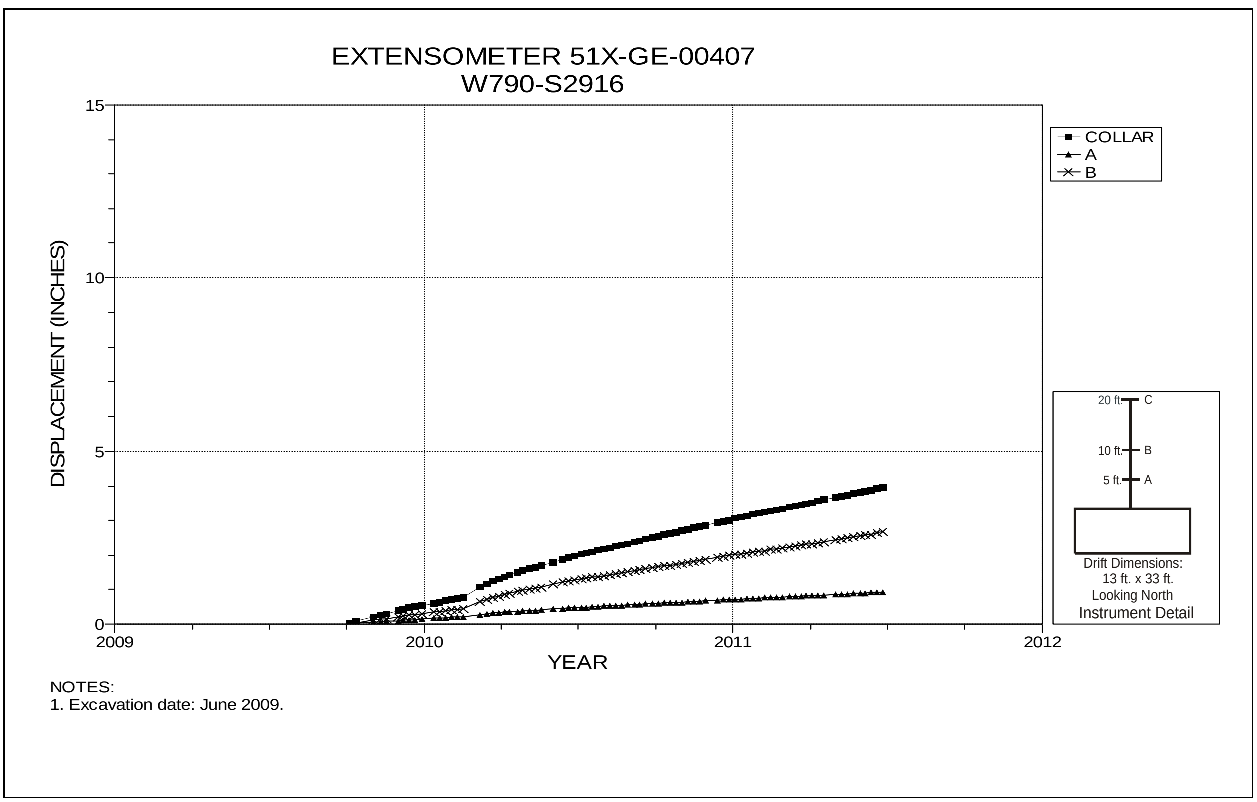


Figure 5-69 Extensometer 51X-GE-00407
Room 4, Panel 6 at W790 S2916 – Room Center – Roof

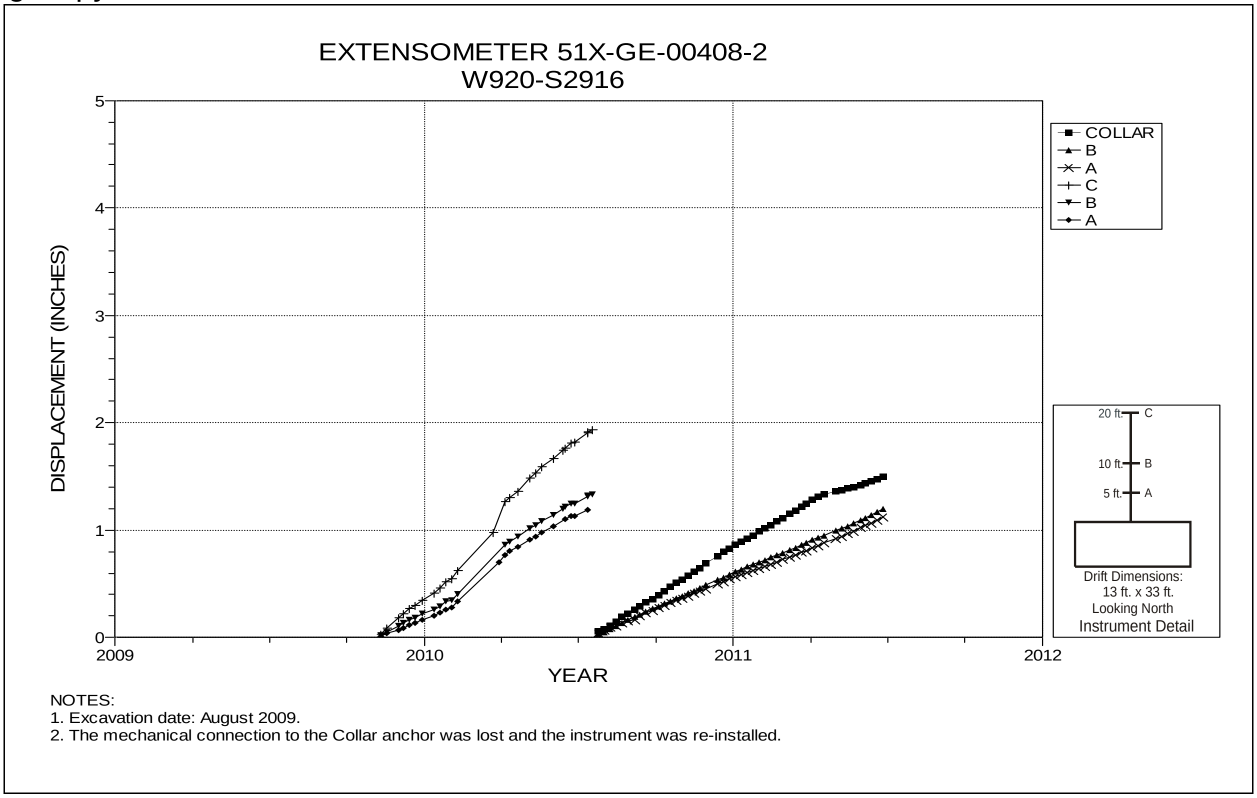


Figure 5-70 Extensometer 51X-GE-00408-2
Room 5, Panel 6 at W920 S2916– Room Center – Roof

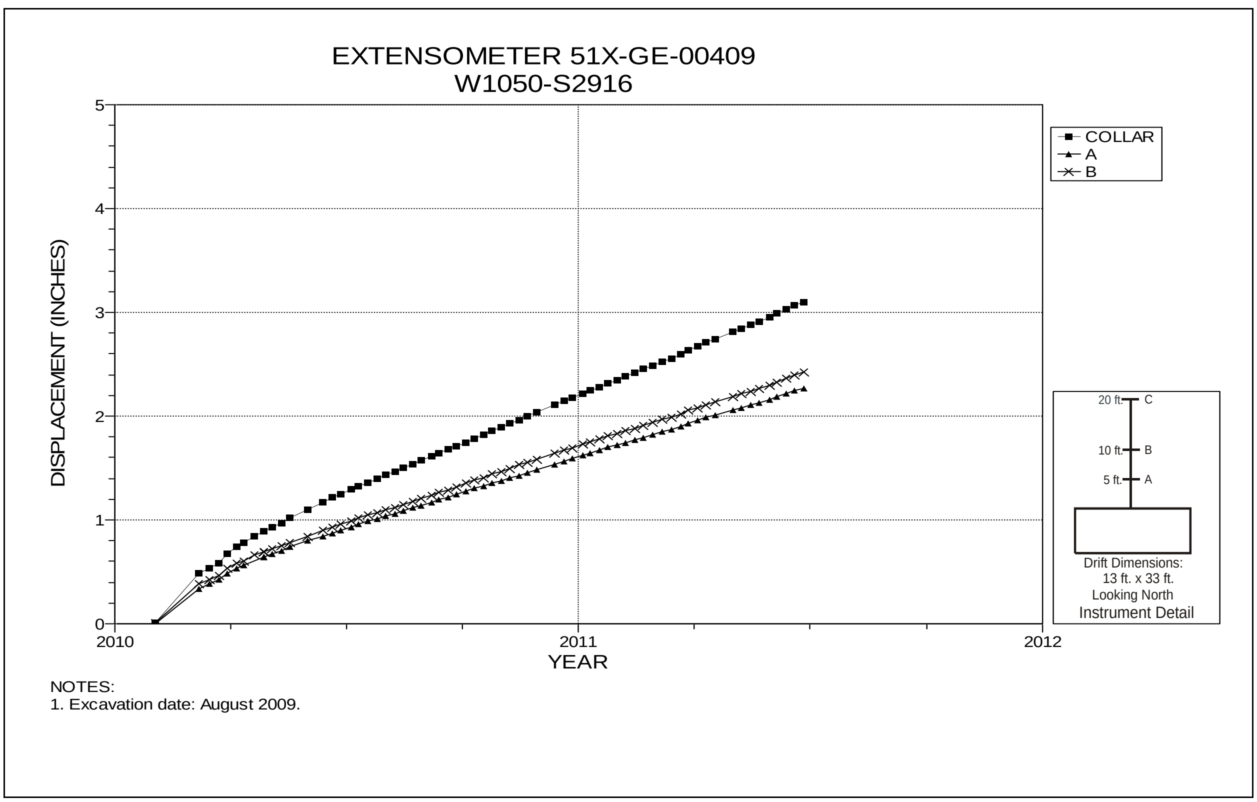


Figure 5-71 Extensometer 51X-GE-00409
Room 6, Panel 6 at W1050 S2916– Room Center – Roof

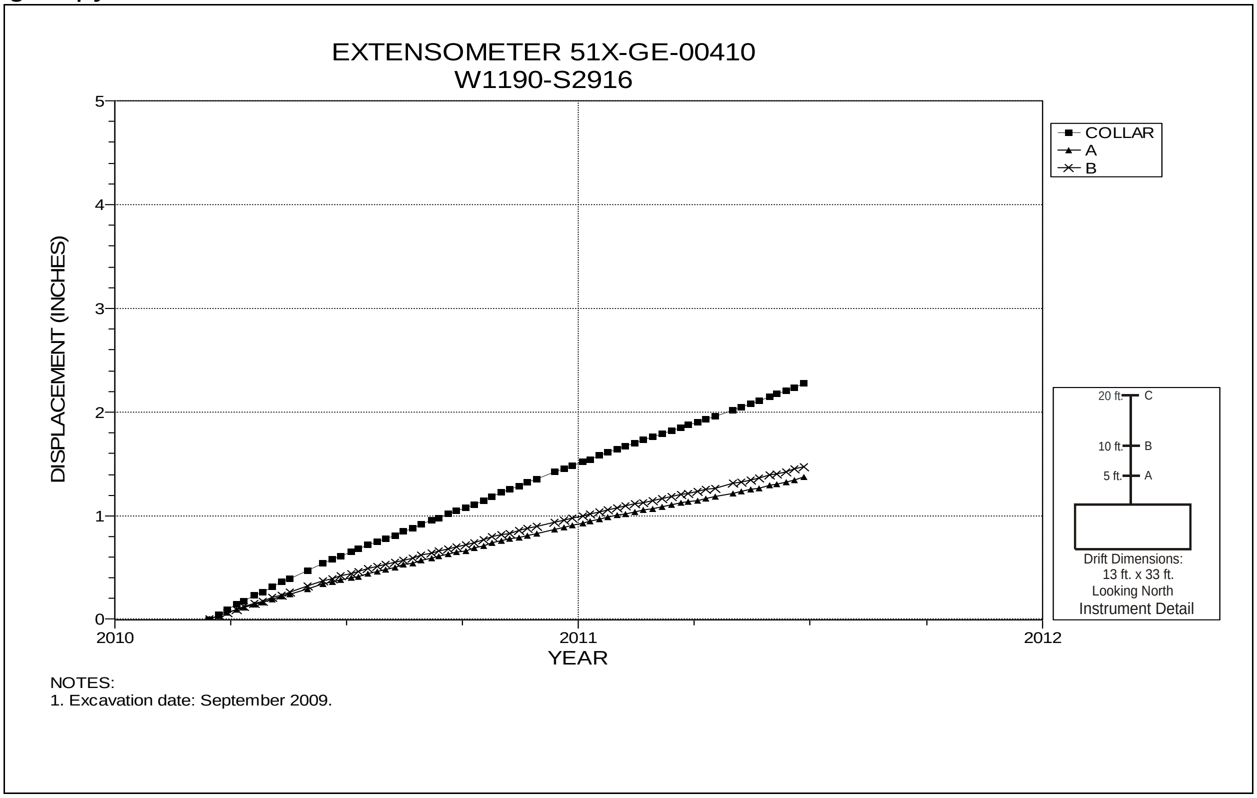


Figure 5-72 Extensometer 51X-GE-00410
Room 7, Panel 6 at W1190 S2916– Room Center – Roof

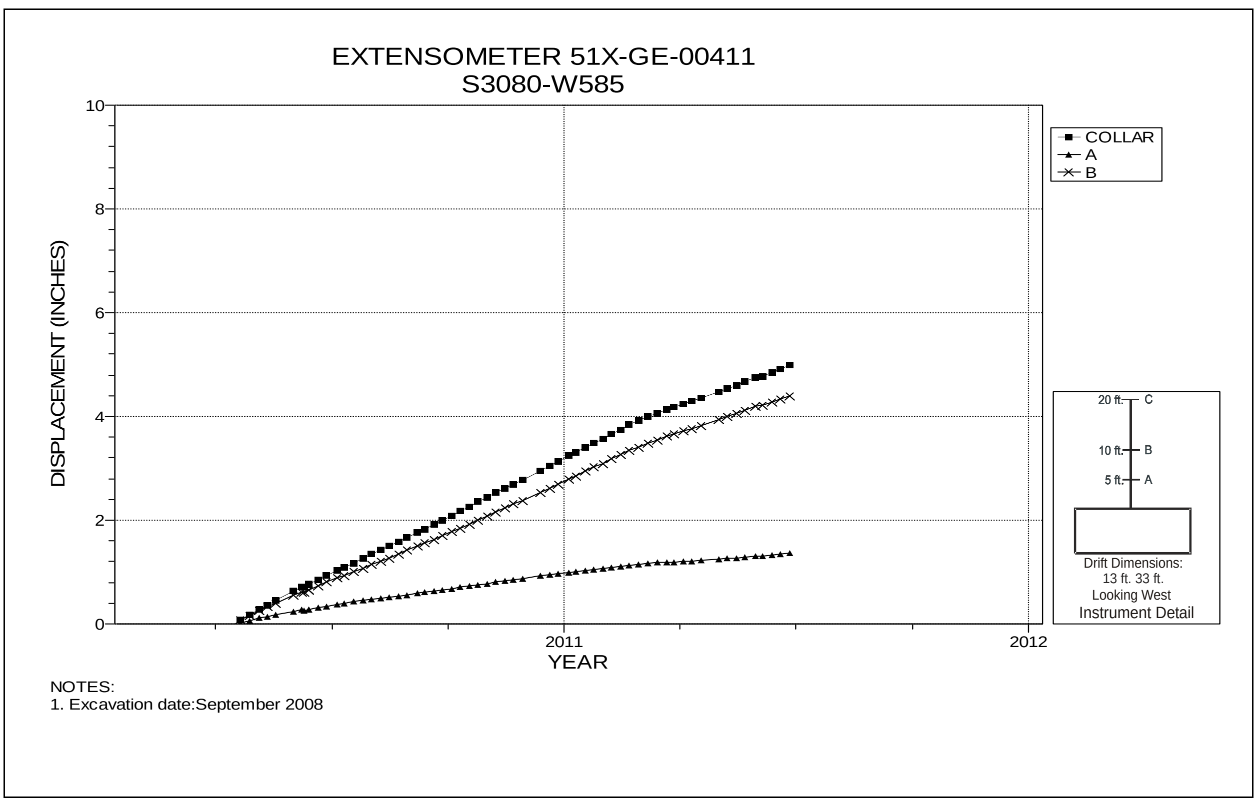


Figure 5-73 Extensometer 51X-GE-00411
S3080 W585 – Roof

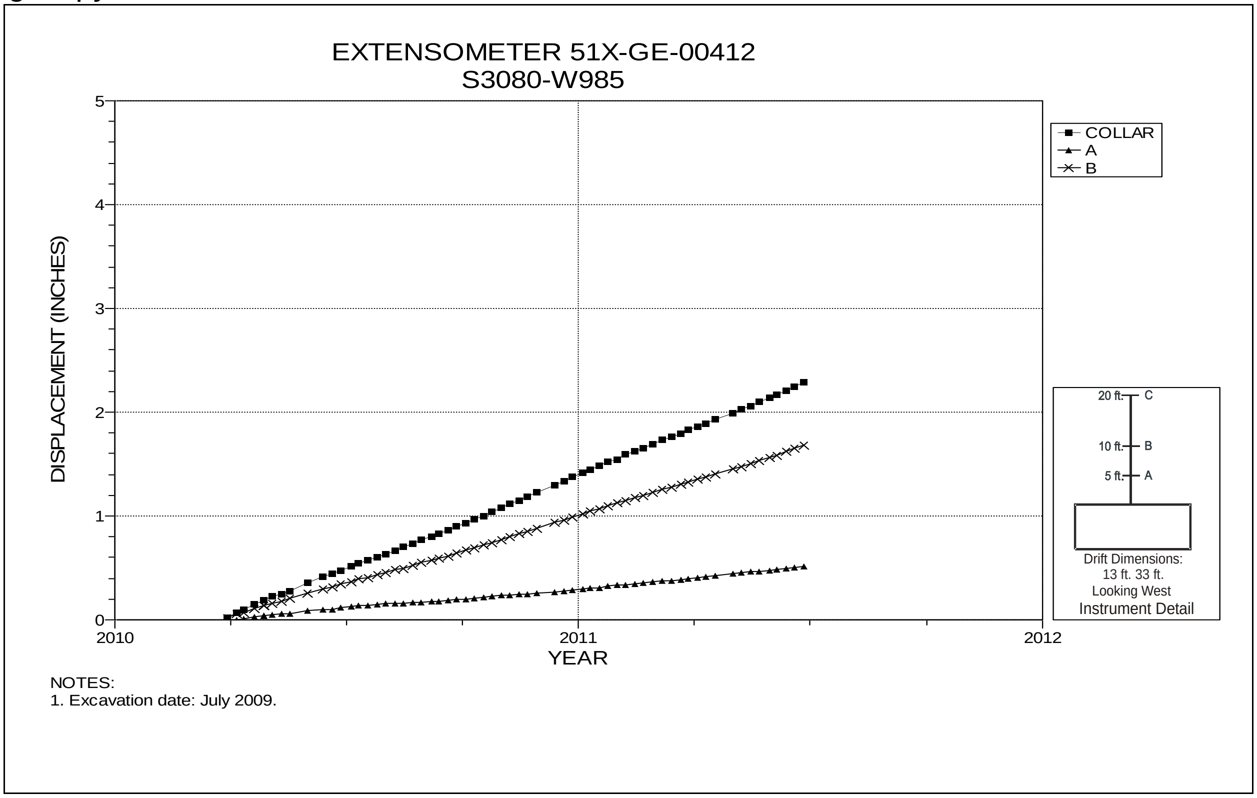


Figure 5-74 Extensometer 51X-GE-00412
S3080 W985 – Roof

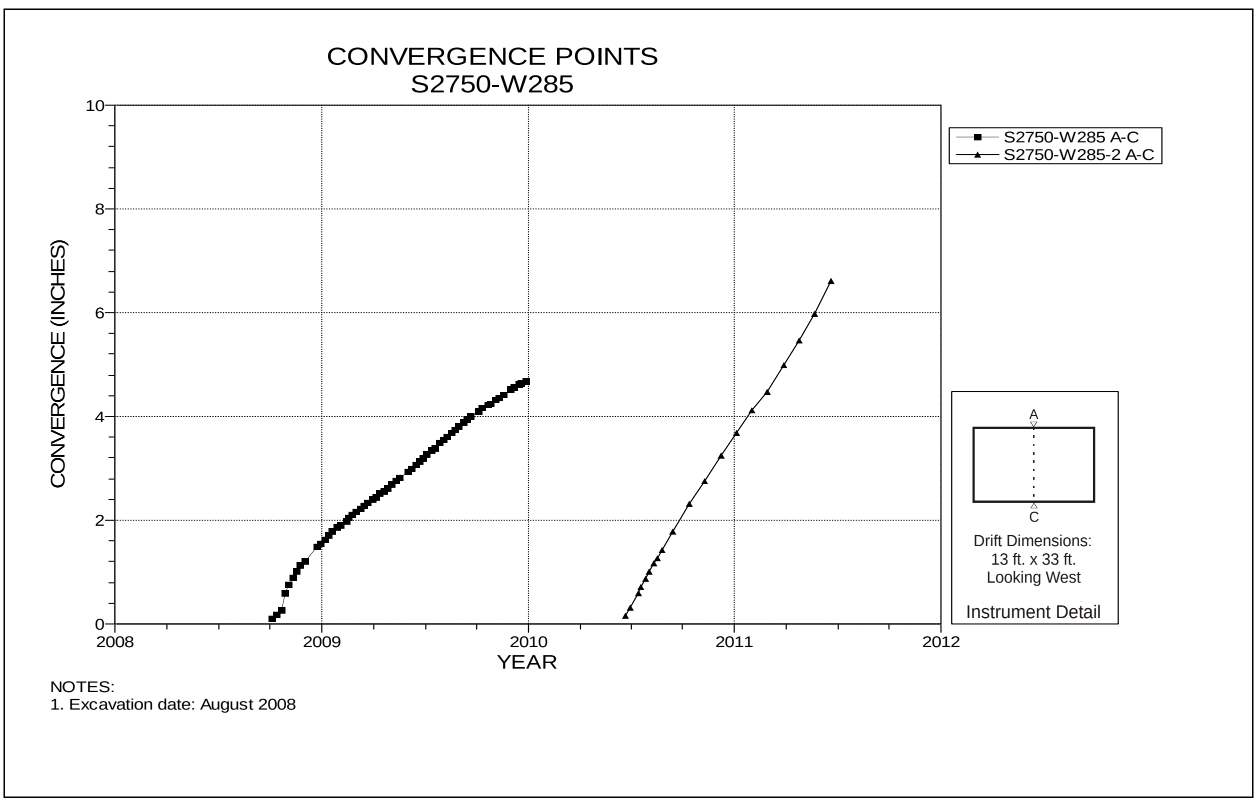


Figure 5-75 Convergence Point Array
S2750 W285 – Roof to Floor

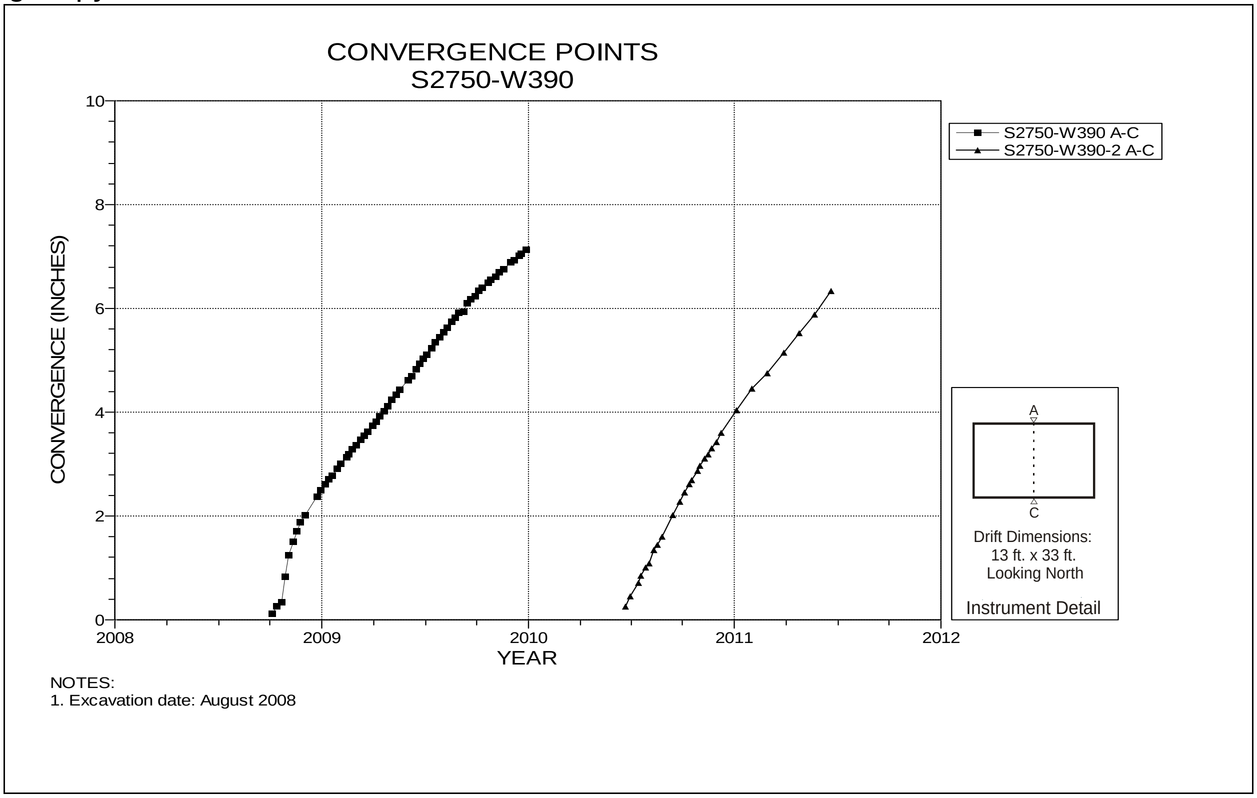


Figure 5-76 Convergence Point Array
S2750 W390 Intersection (Room 1, Panel 6) – Roof to Floor

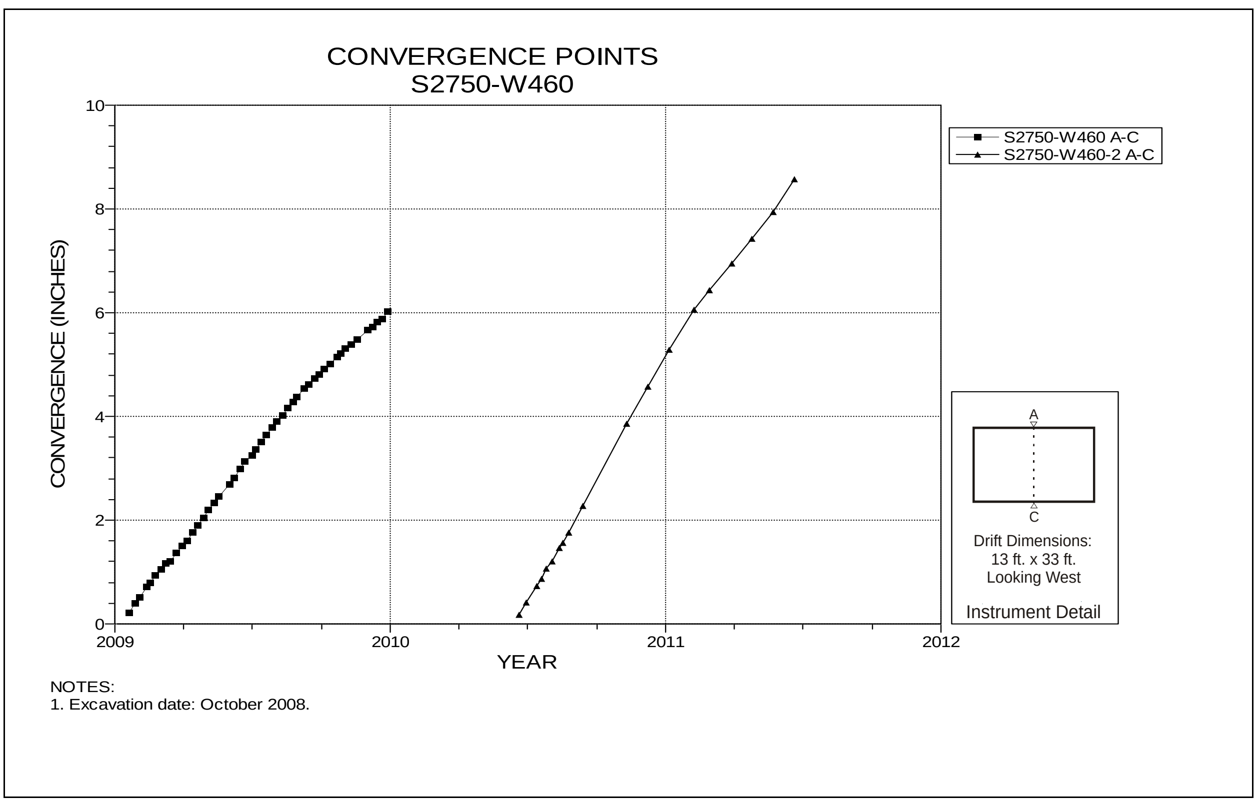


Figure 5-77 Convergence Point Array
S2750 W460 – Roof to Floor

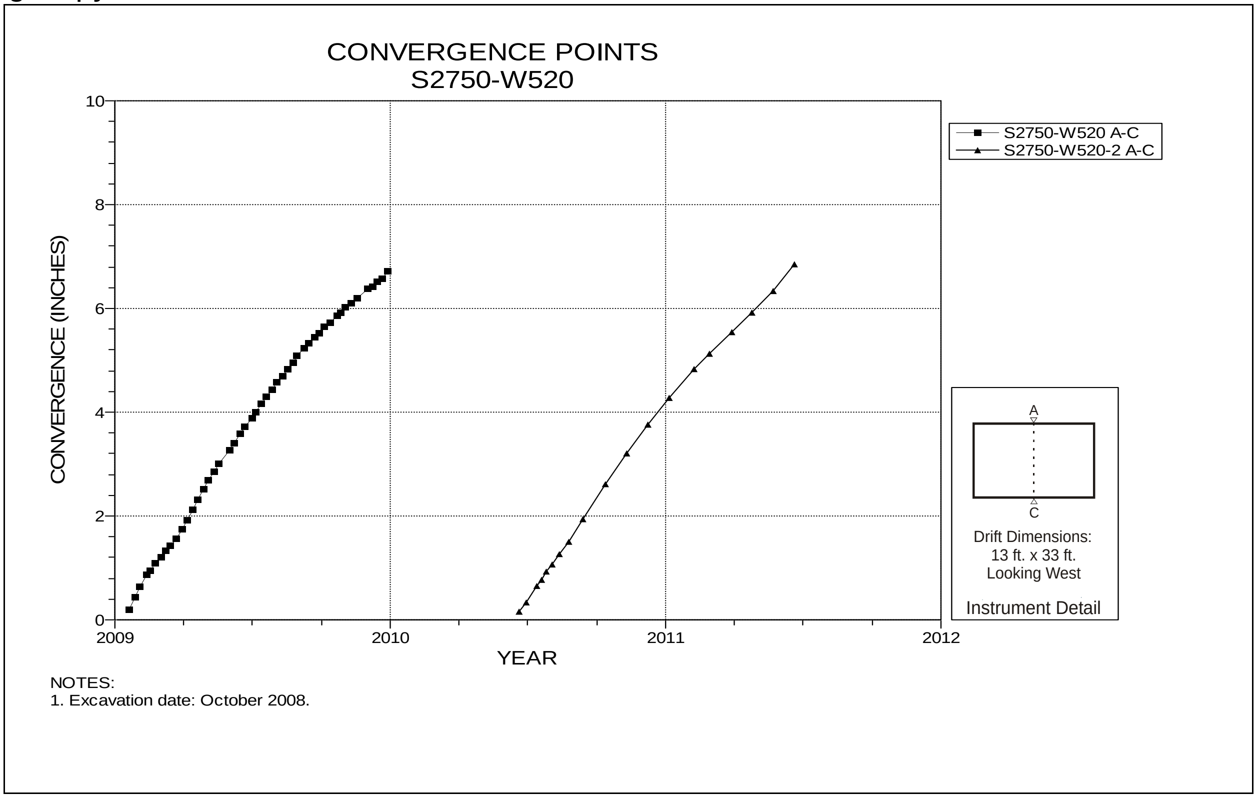


Figure 5-78 Convergence Point Array
S2750 W520 Intersection (Room 2, Panel 6) – Roof to Floor

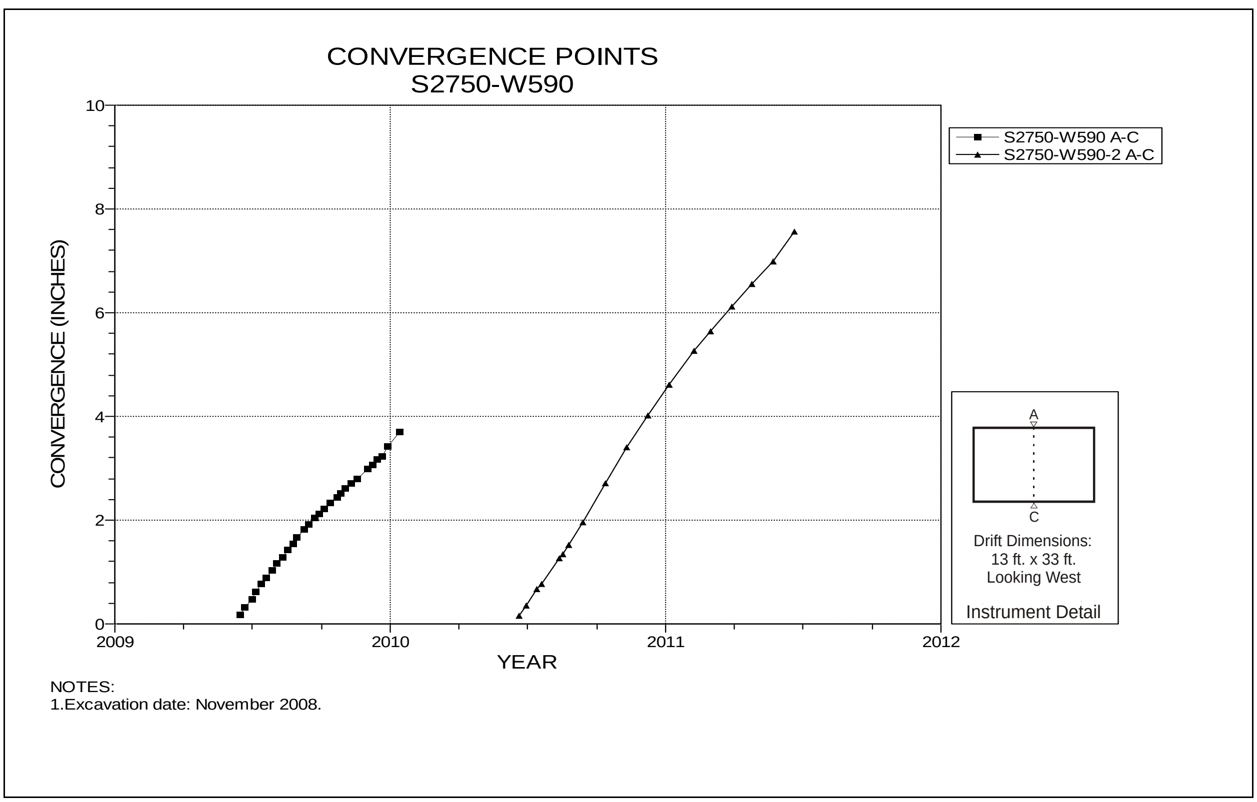


Figure 5-79 Convergence Point Array
S2750 W590 – Roof to Floor

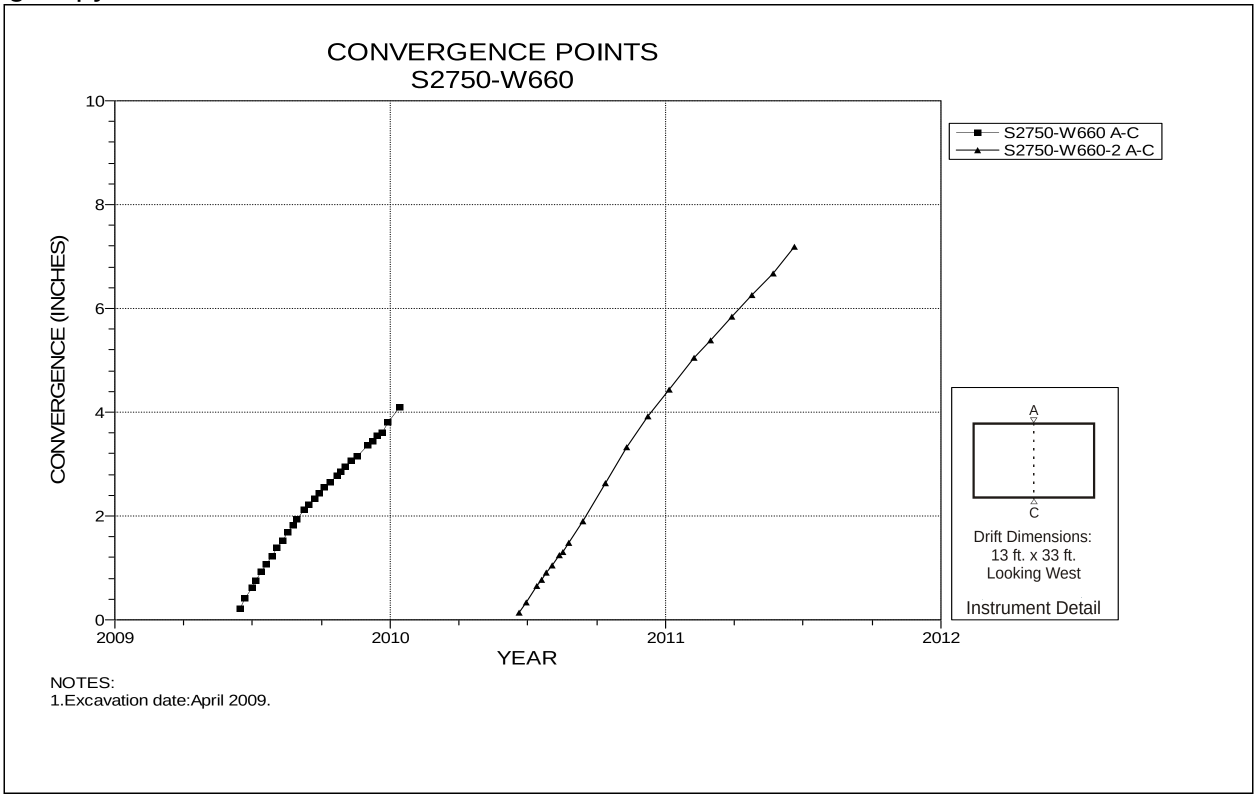


Figure 5-80 Convergence Point Array
S2750 W660 Intersection (Room 3 Panel 6) – Roof to Floor

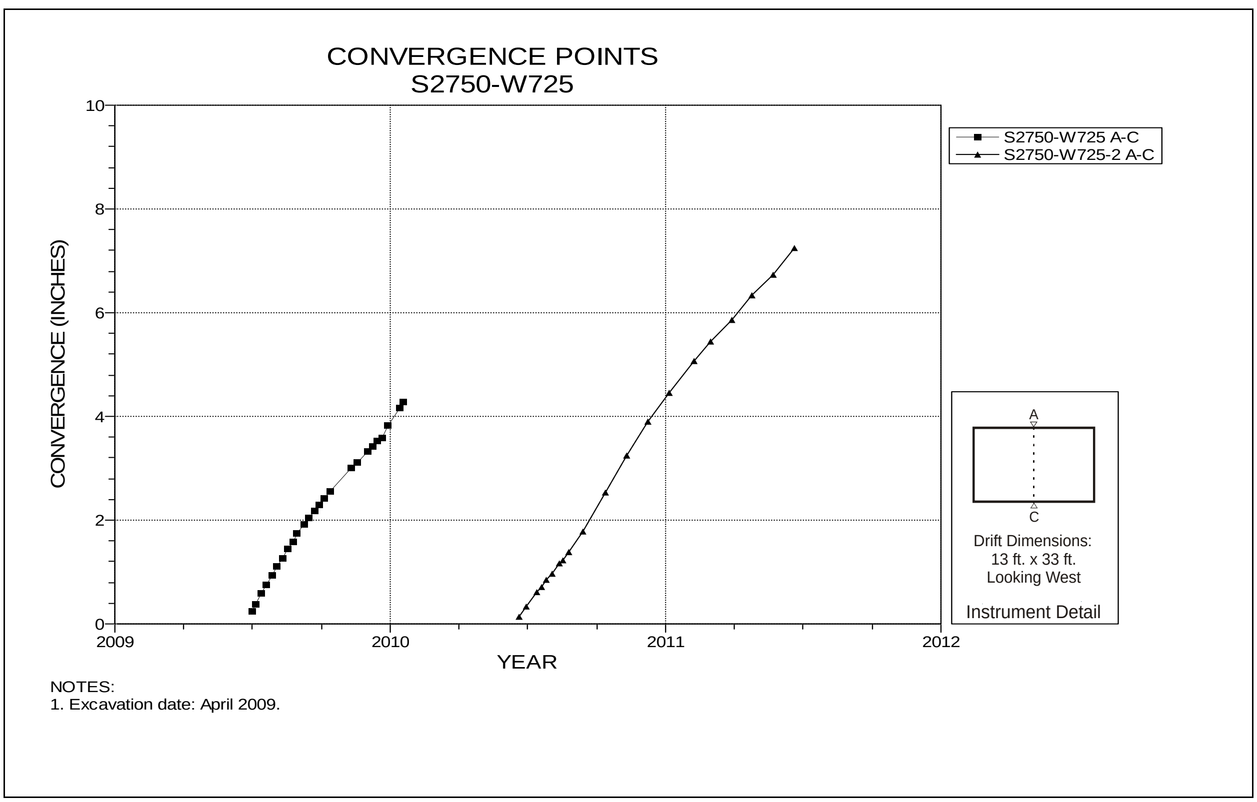


Figure 5-81 Convergence Point Array
S2750 W725 – Roof to Floor

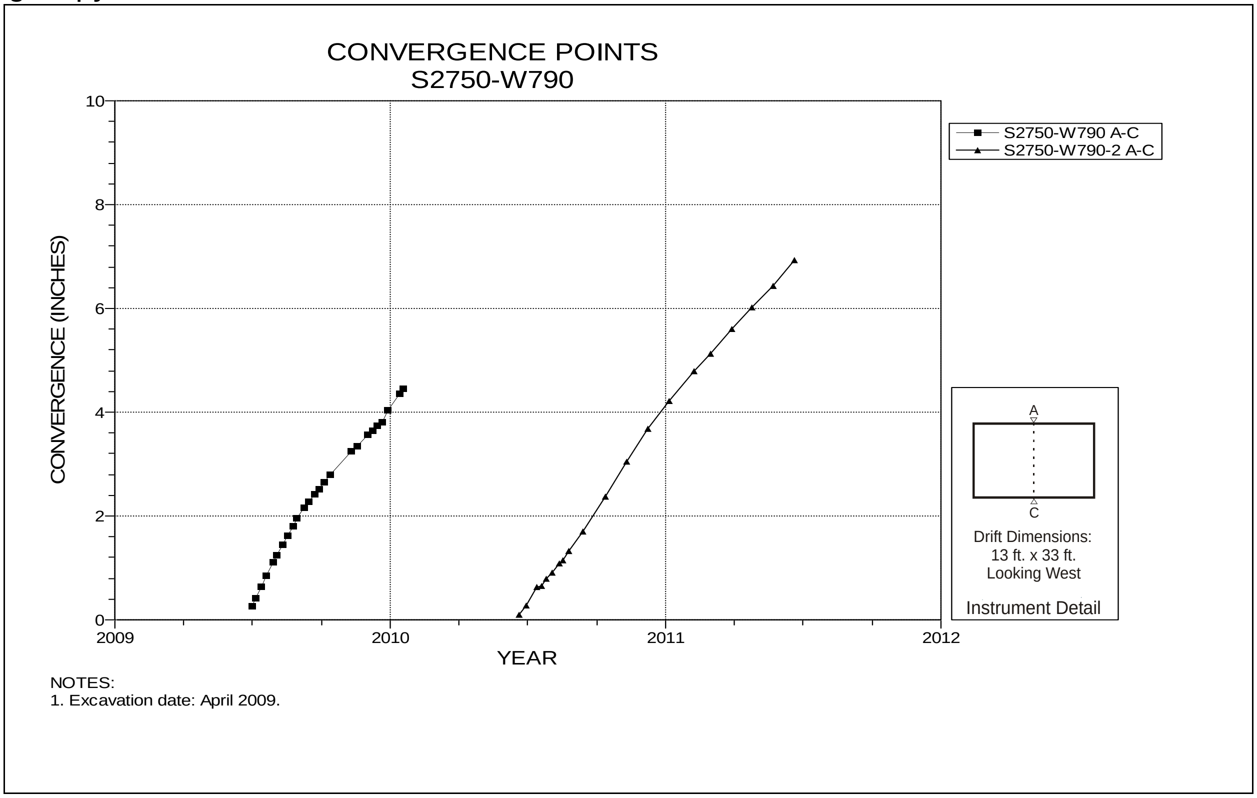


Figure 5-82 Convergence Point Array
S2750 W790 Intersection (Room 4, Panel 6) – Roof to Floor

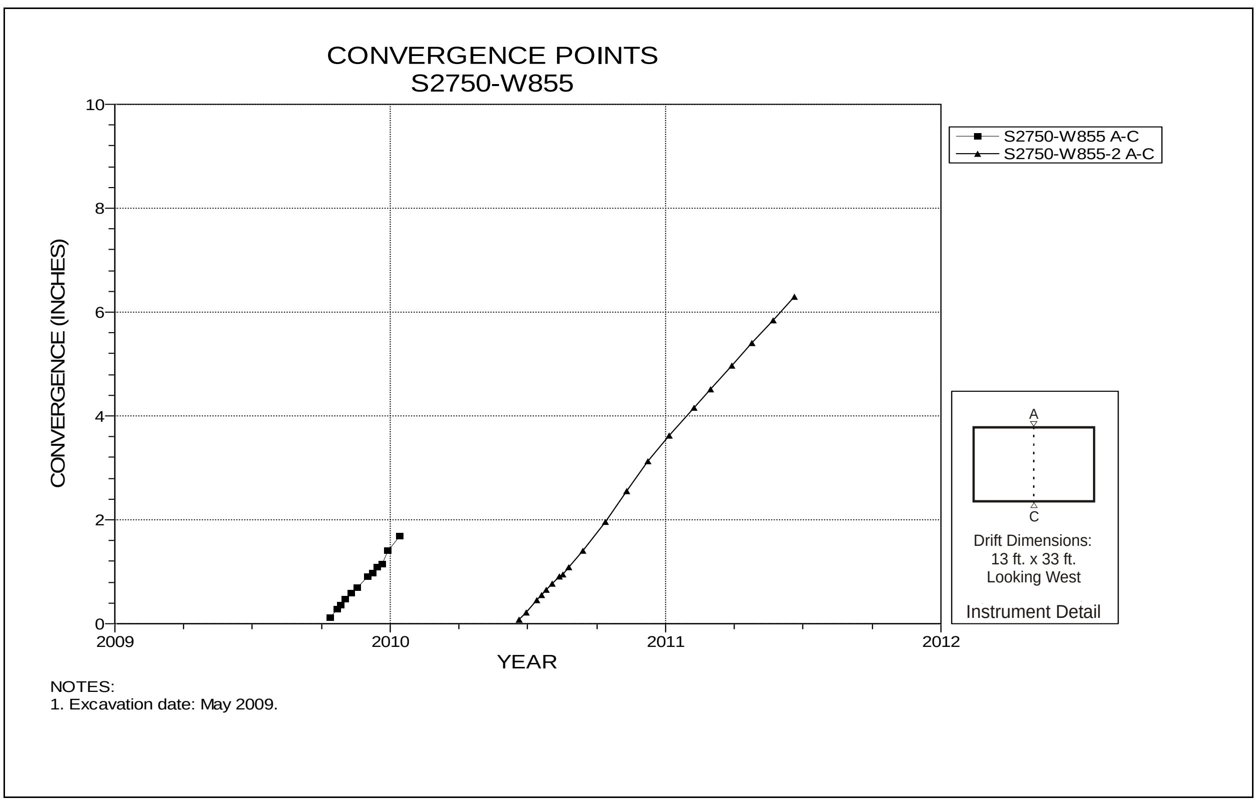


Figure 5-83 Convergence Point Array
S2750 W885 – Roof to Floor

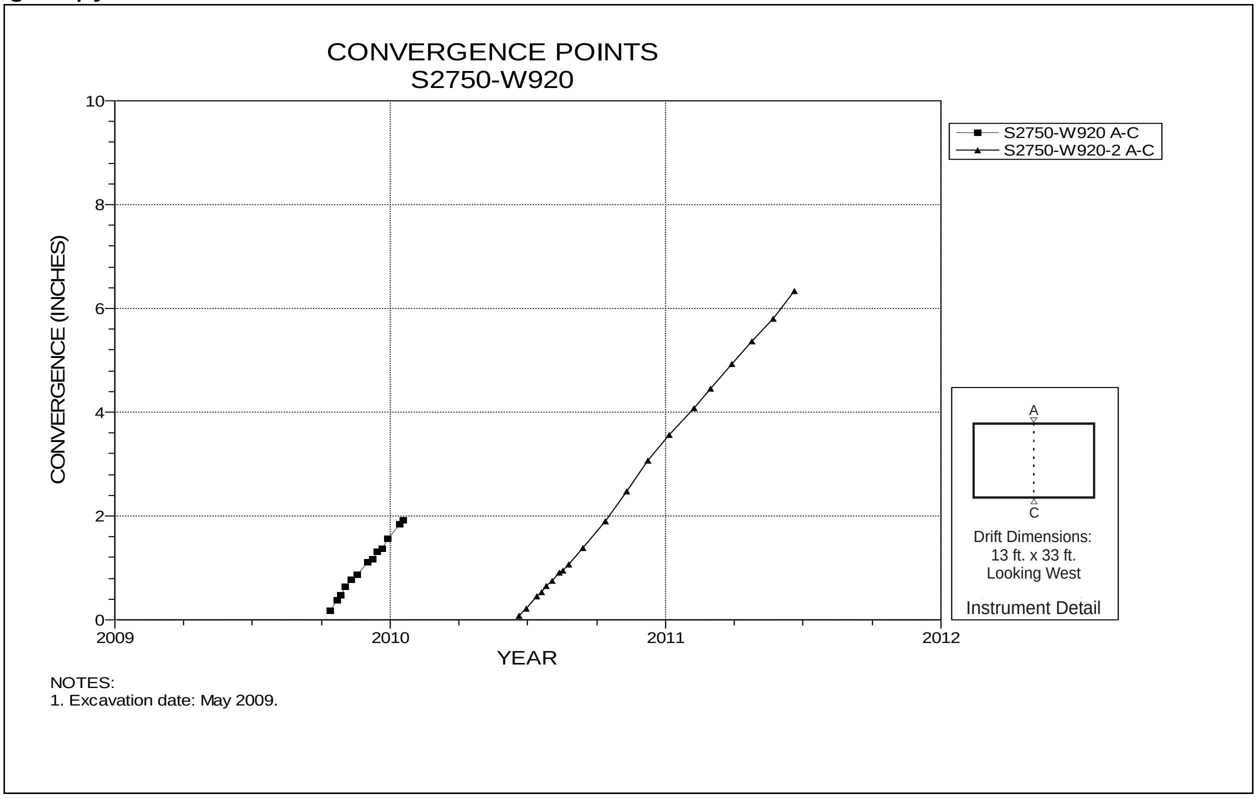


Figure 5-84 Convergence Point Array
S2750 W920 Intersection (Room 5, Panel 6) – Roof to Floor

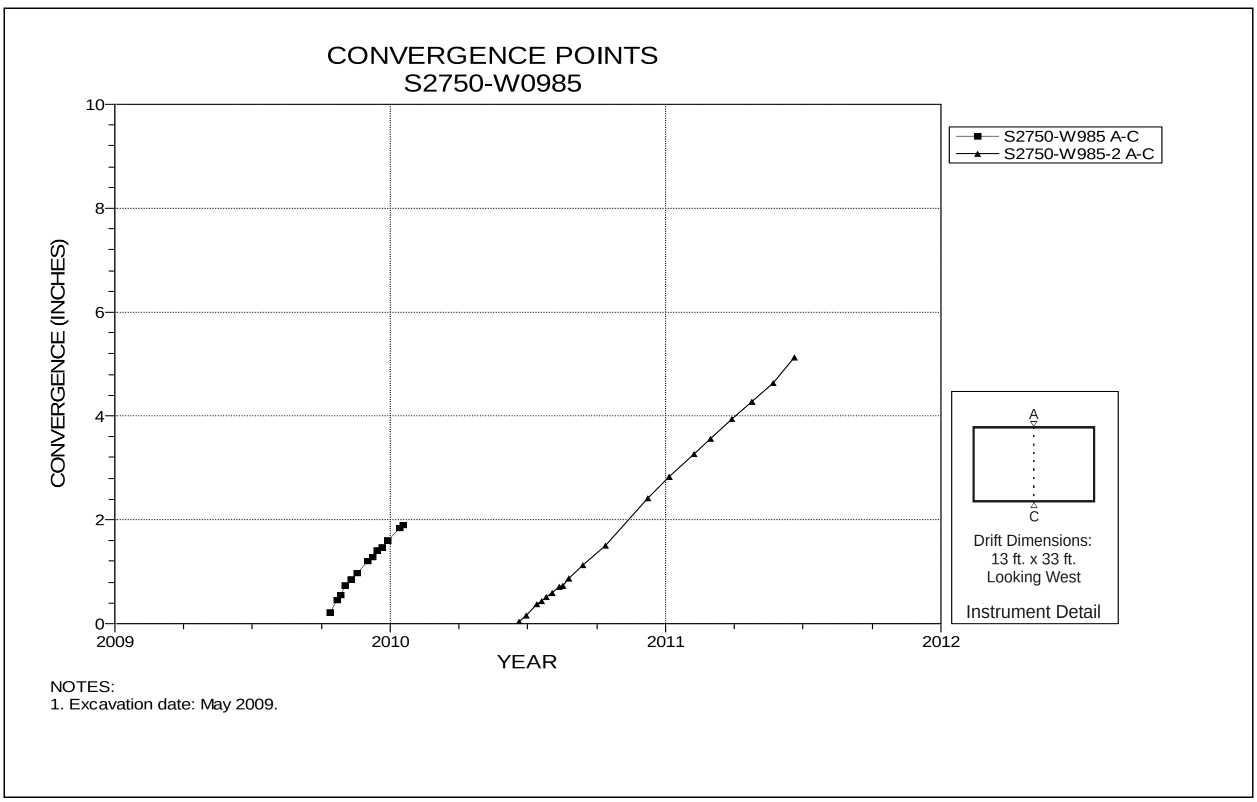


Figure 5-85 Convergence Point Array
S2750 W985 – Roof to Floor

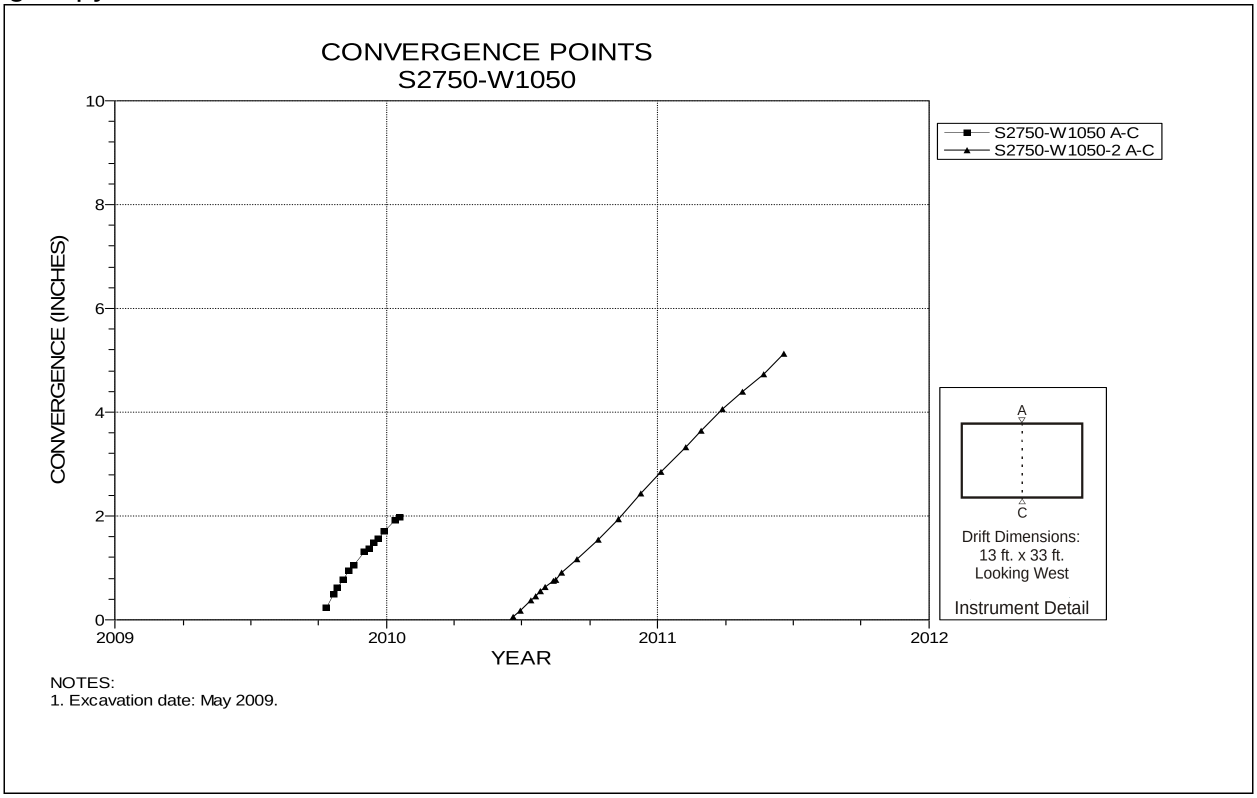


Figure 5-86 Convergence Point Array
S2750 W1050 Intersection (Room 6, Panel 6) – Roof to Floor

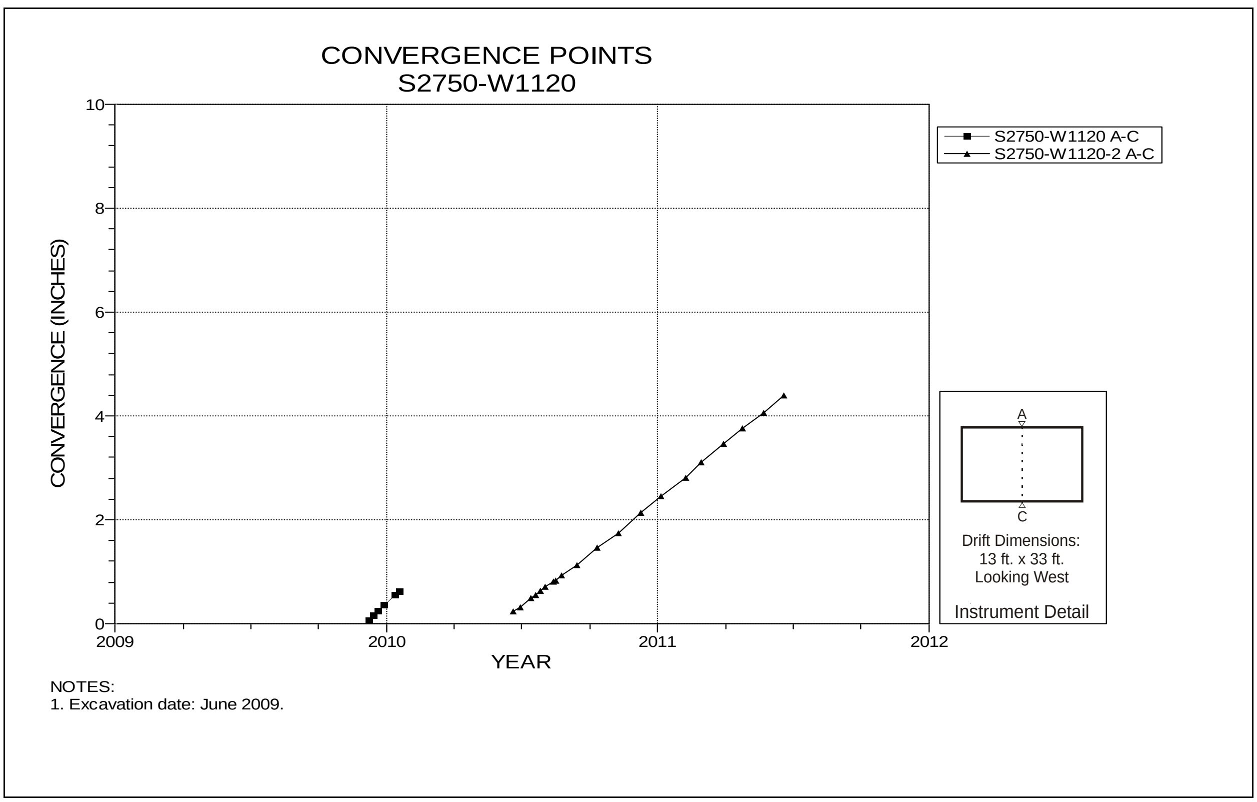


Figure 5-87 Convergence Point Array
S2750 W1120 – Roof to Floor

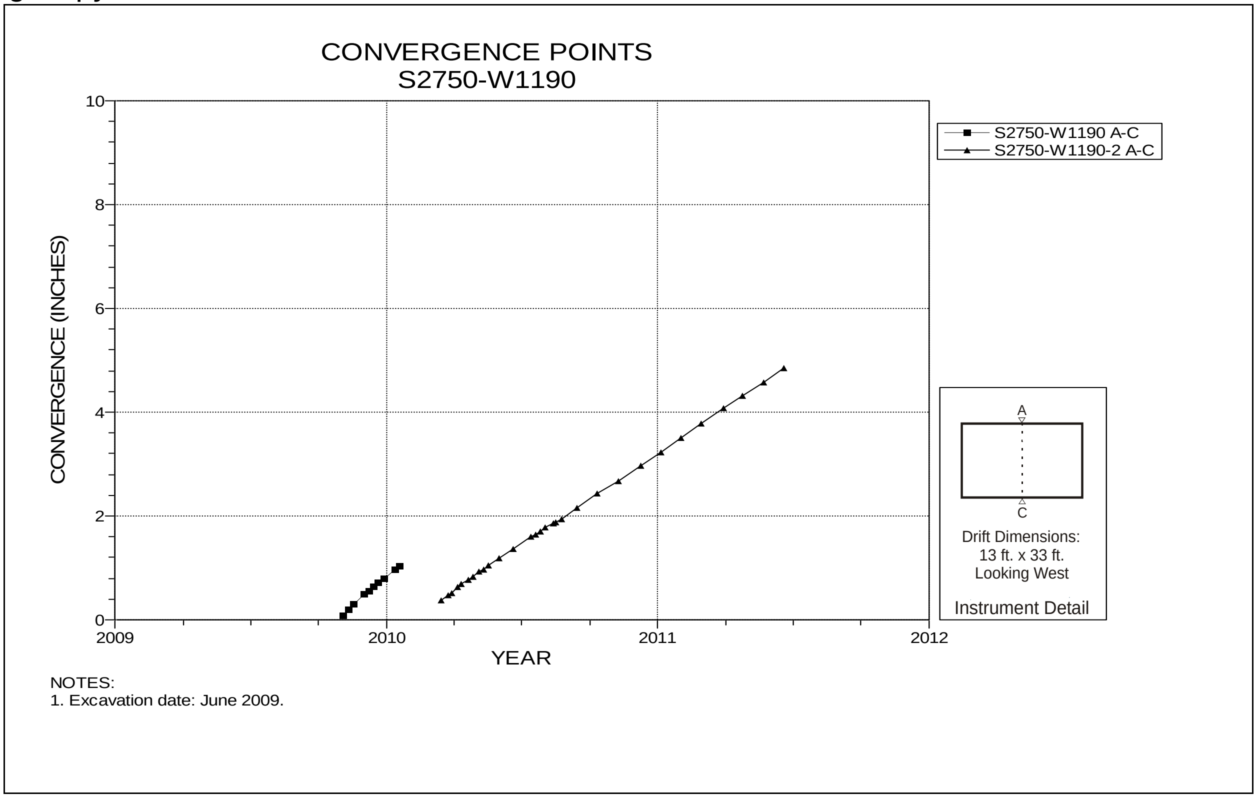


Figure 5-88 Convergence Point Array
S2750 W1190 Intersection (Room 7, Panel 6) – Roof to Floor

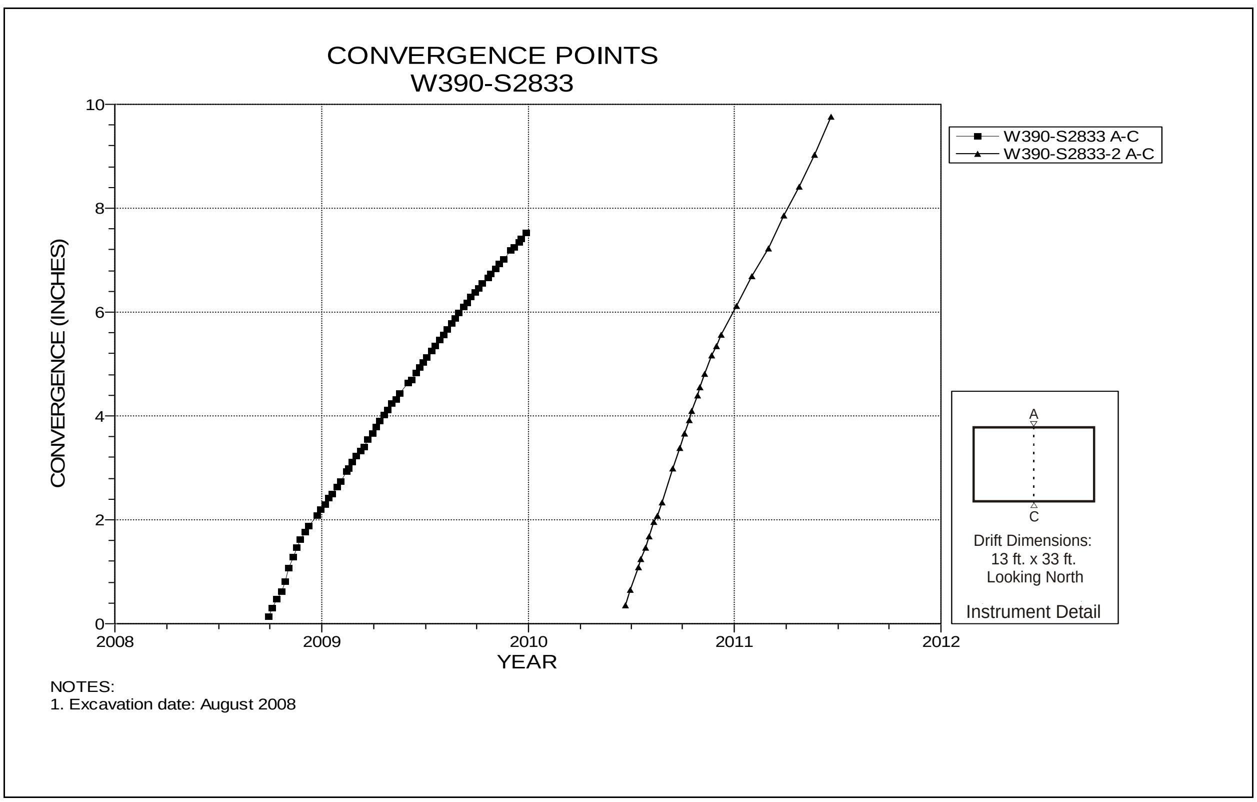


Figure 5-89 Convergence Point Array
Room 1, Panel 6 at W390 W2833 – Roof to Floor

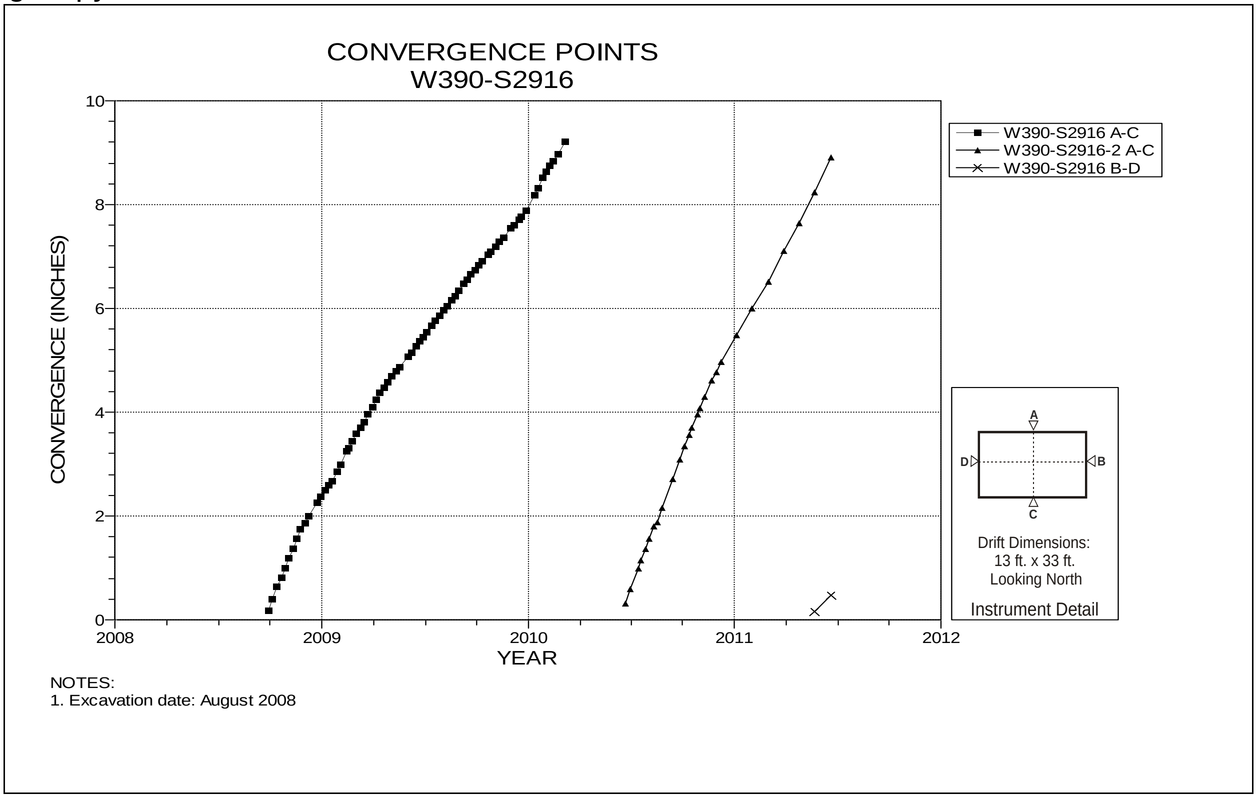


Figure 5-90 Convergence Point Array
Room 1, Panel 6 at W390 S2916– Room Center – Roof to Floor

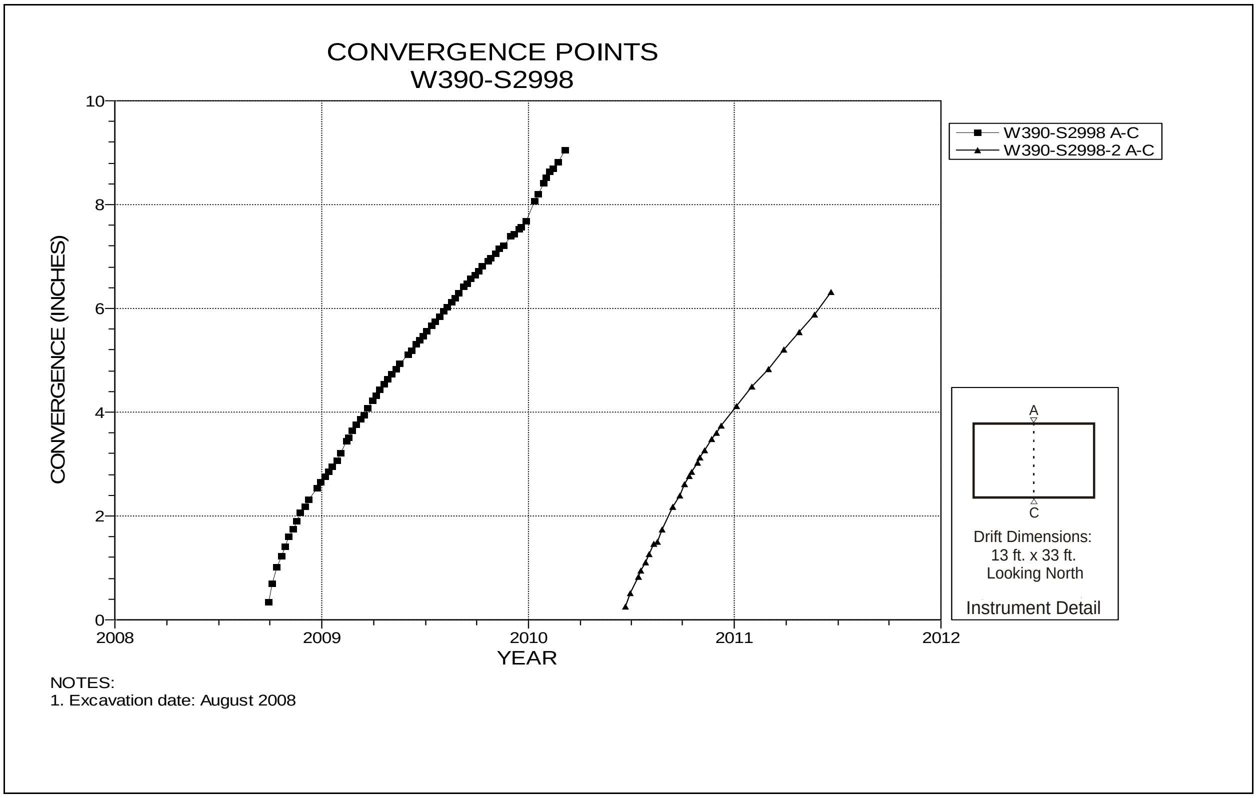


Figure 5-91 Convergence Point Array
Room 1, Panel 6 at W390 S2998 – Roof to Floor

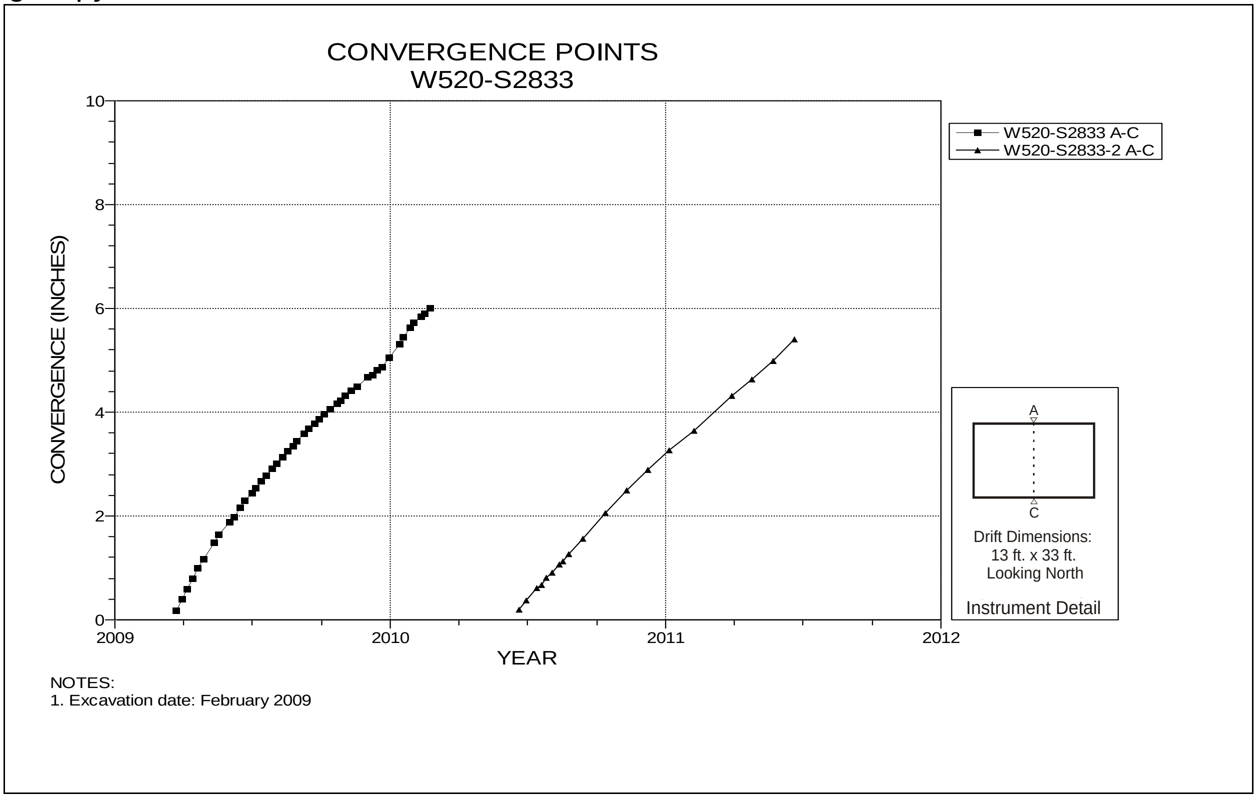


Figure 5-92 Convergence Point Array
Room 2, Panel 6 at W520 S2833 – Roof to Floor

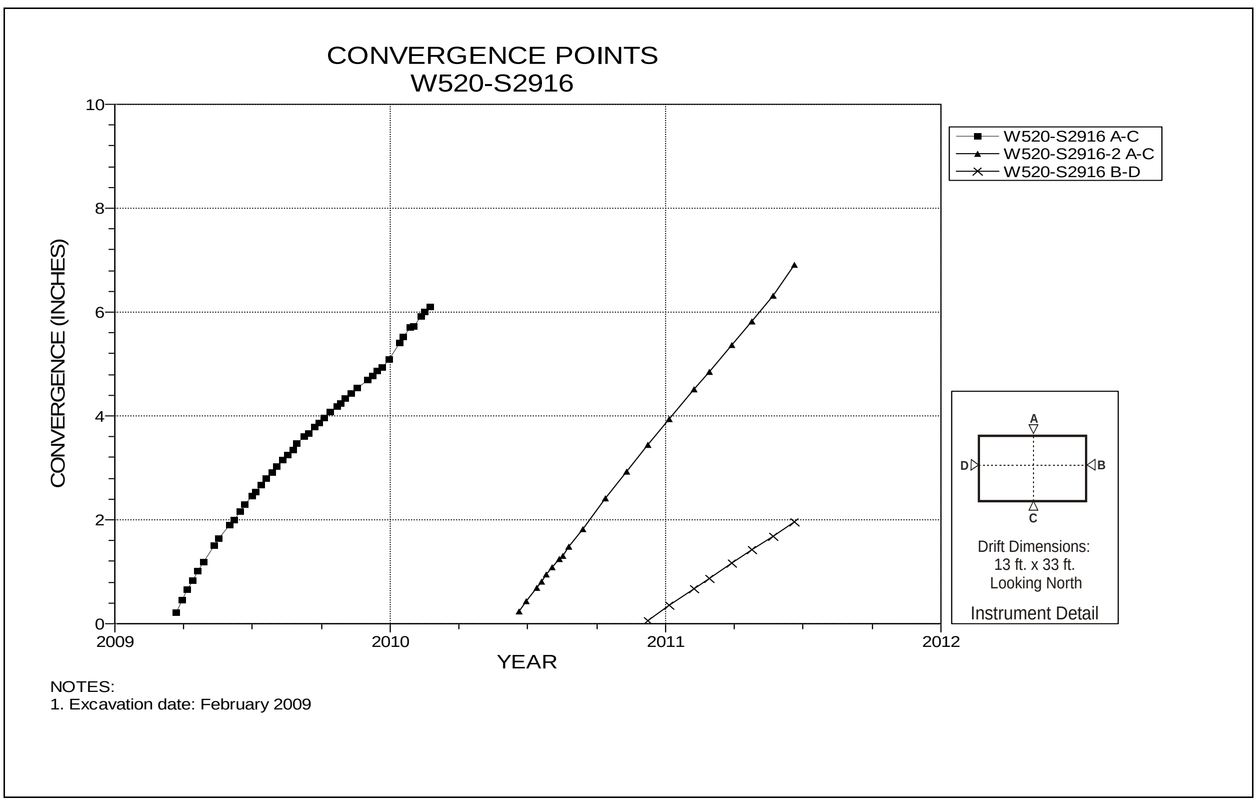


Figure 5-93 Convergence Point Array
Room 2, Panel 6 at W520 S2916– Room Center – Roof to Floor

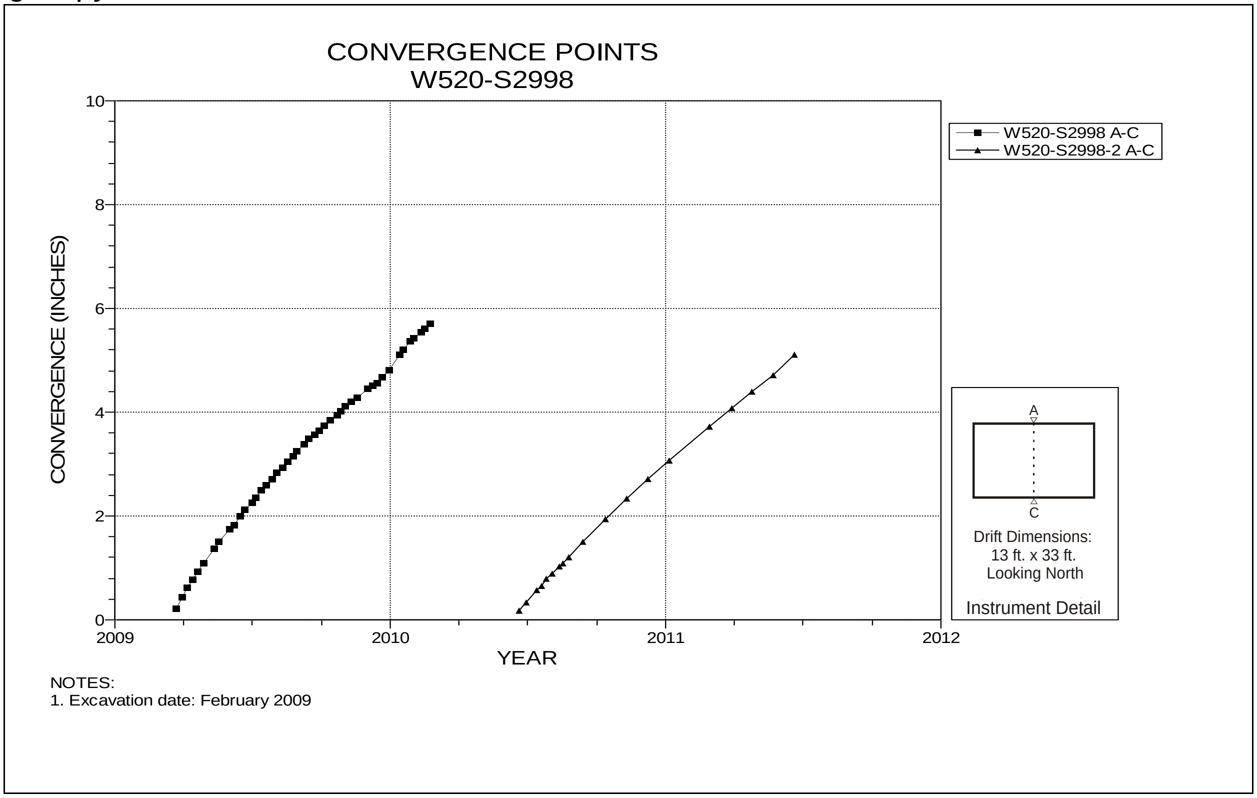


Figure 5-94 Convergence Point Array
Room 2, Panel 6 at W520 S2998 – Roof to Floor

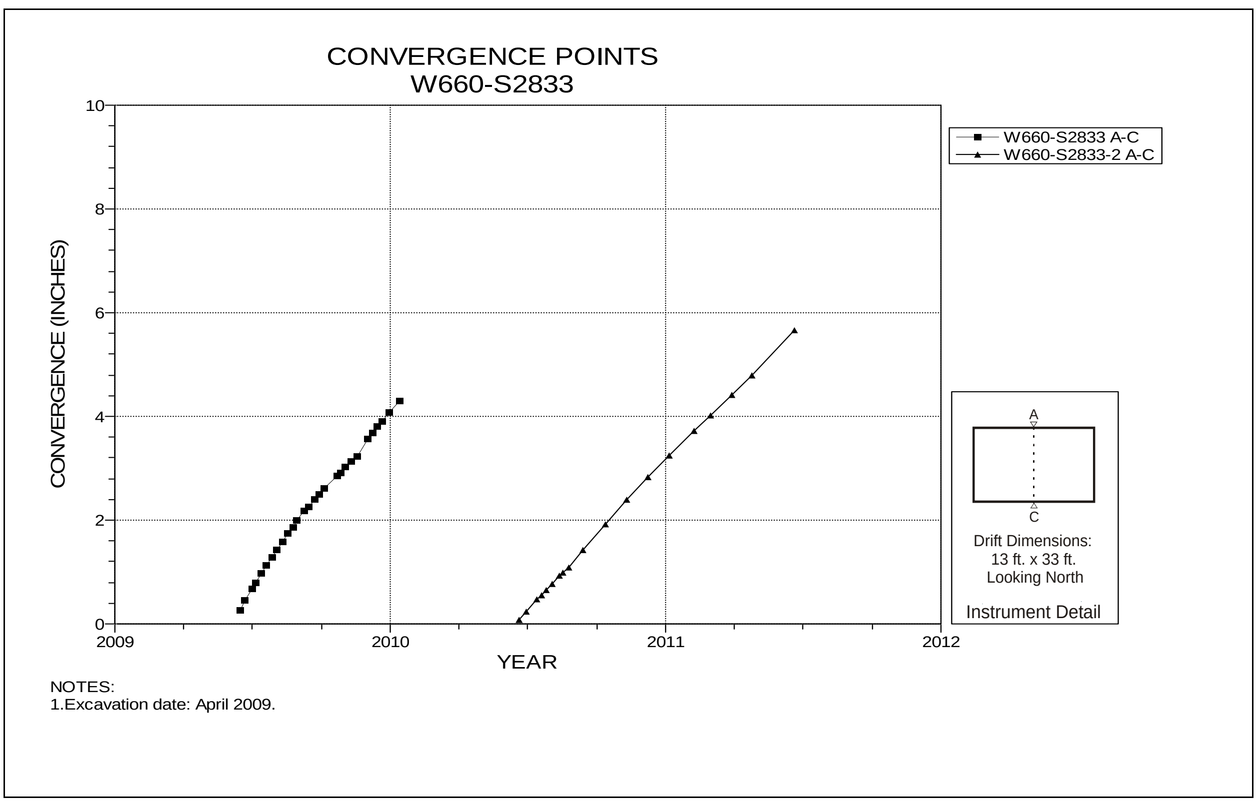


Figure 5-95 Convergence Point Array
Room 3, Panel 6 at W660 S2833 – Roof to Floor

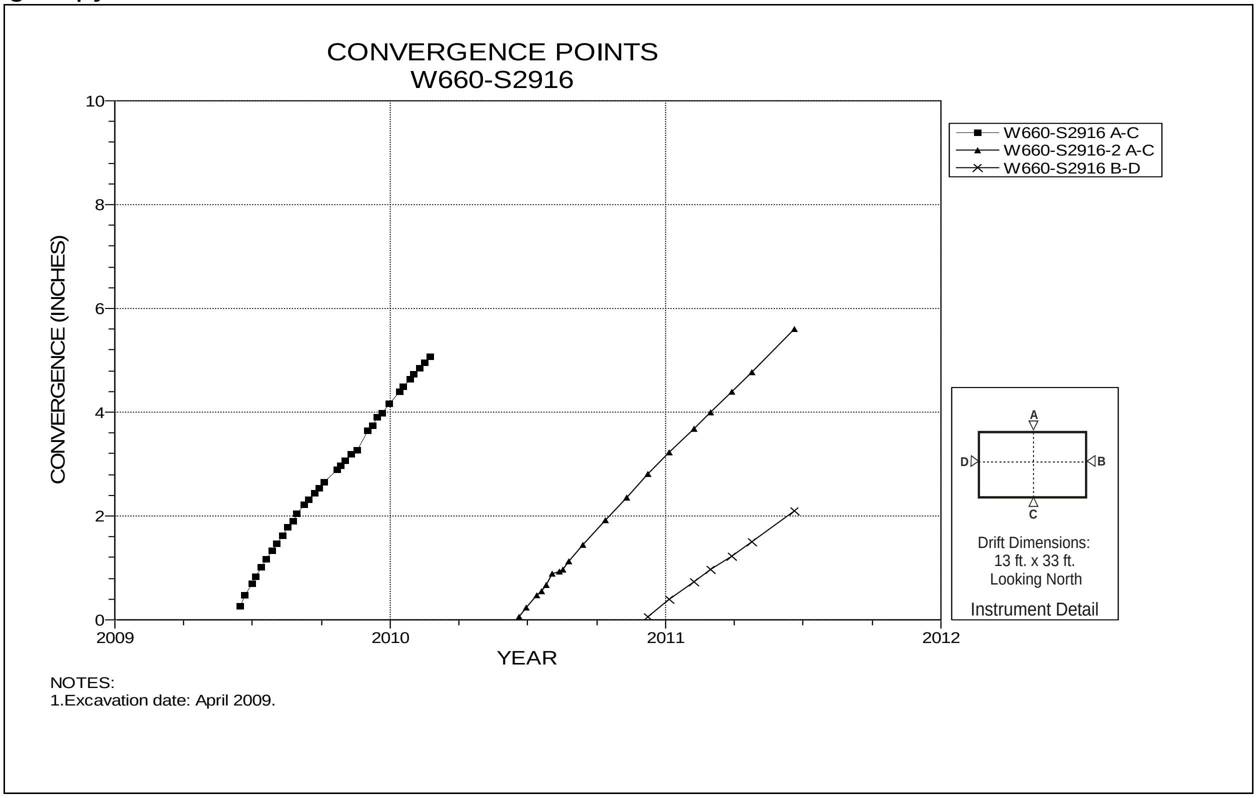


Figure 5-96 Convergence Point Array
Room 3, Panel 6 at W660 S2916– Room Center – Roof to Floor

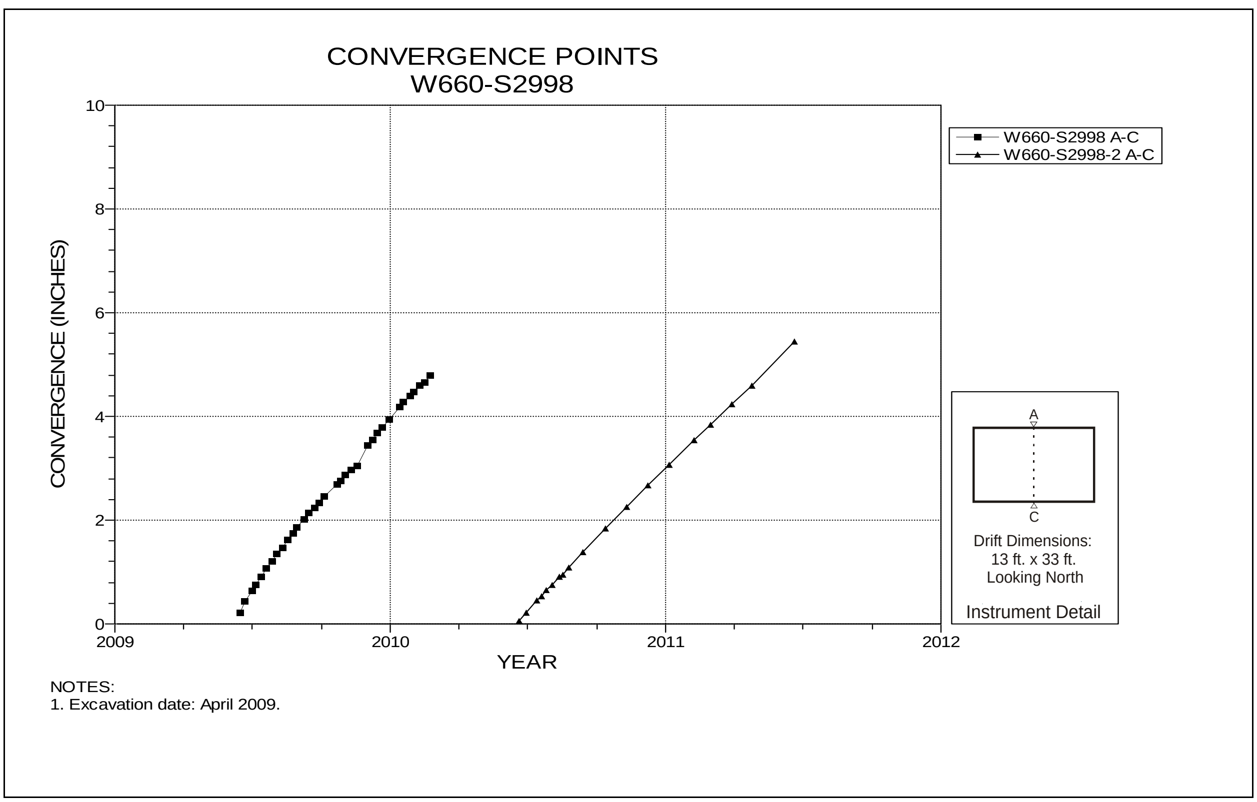


Figure 5-97 Convergence Point Array
Room 3, Panel 6 at W660 S2998 – Roof to Floor

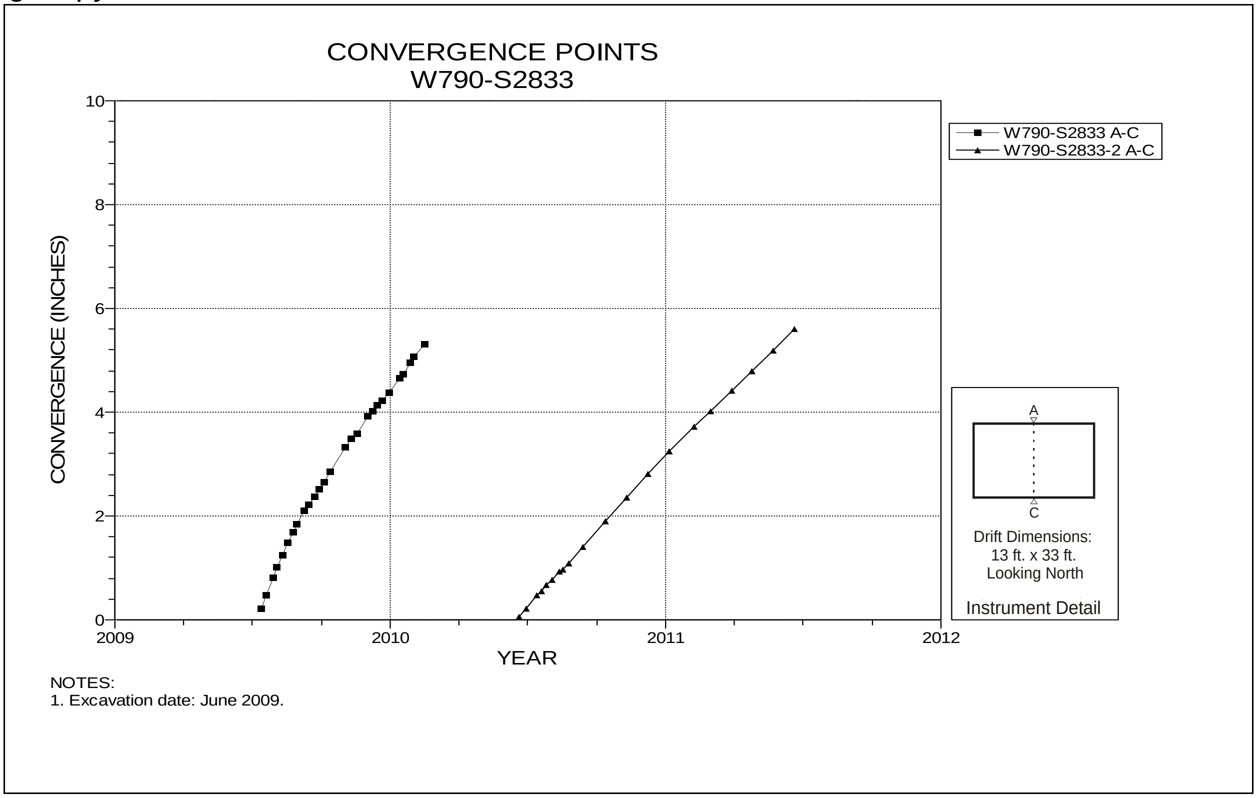


Figure 5-98 Convergence Point Array
Room 4, Panel 6 at W790 S2833 – Roof to Floor

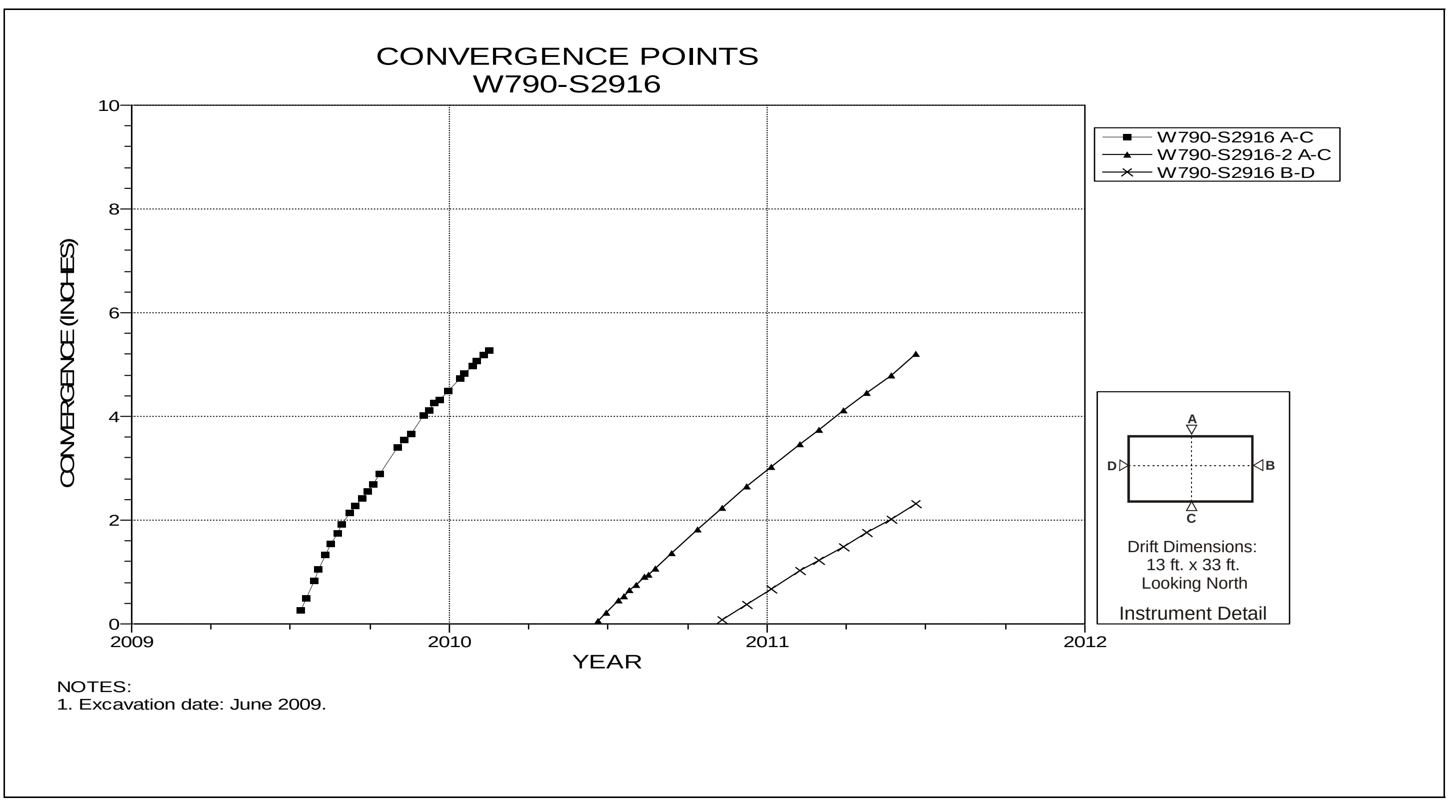


Figure 5-99 Convergence Point Array
Room 4, Panel 6 at W790 S2916– Room Center – Roof to Floor

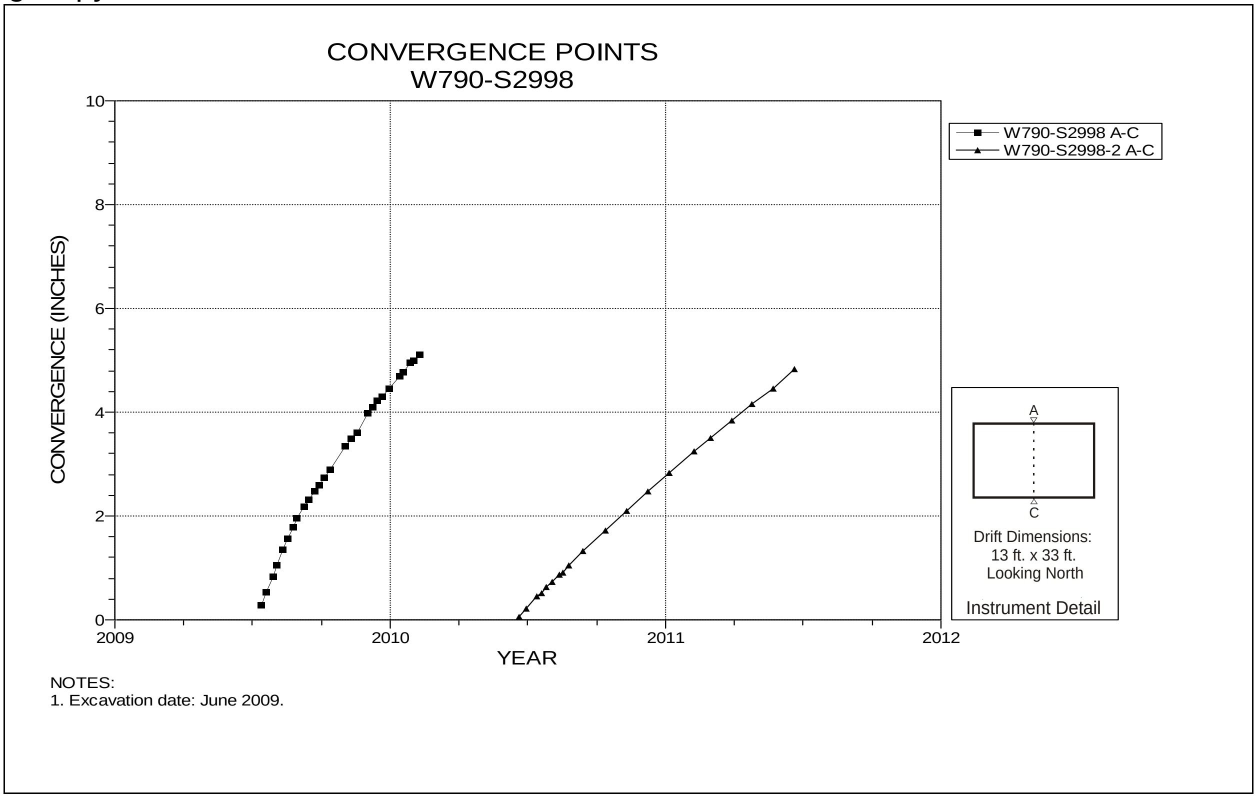


Figure 5-100 Convergence Point Array
Room 4, Panel 6 at W790 S2998 – Roof to Floor

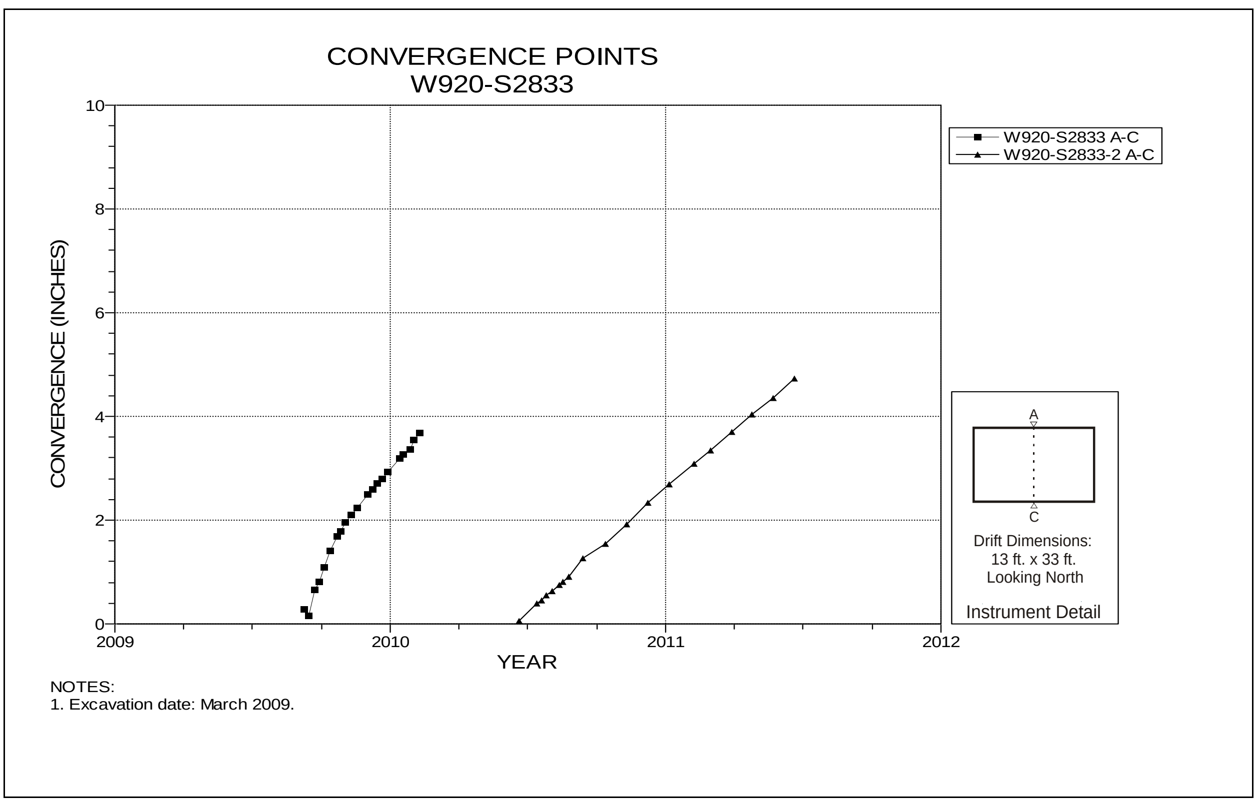
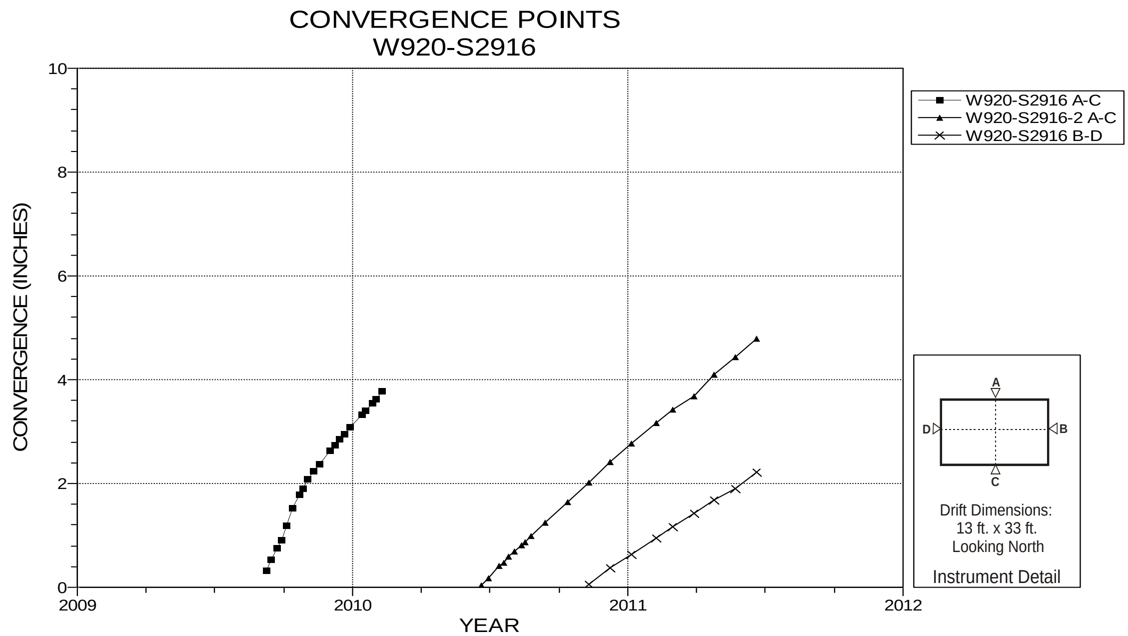
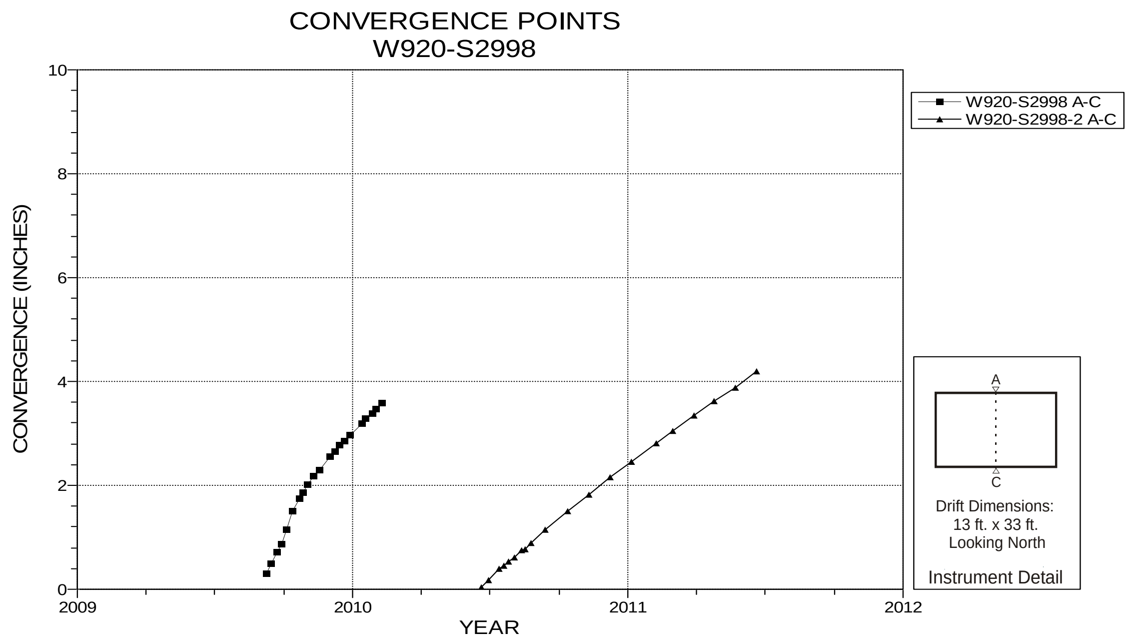


Figure 5-101 Convergence Point Array
Room 5, Panel 6 at W920 S2833 – Roof to Floor



NOTES:
1. Excavation date: June 2009.

Figure 5-102 Convergence Point Array
Room 5, Panel 6 at W920 S2916– Room Center – Roof to Floor



NOTES:
1. Excavation date: August 2009.

Figure 5-103 Convergence Point Array
Room 5, Panel 6 at W920 S2998 – Roof to Floor

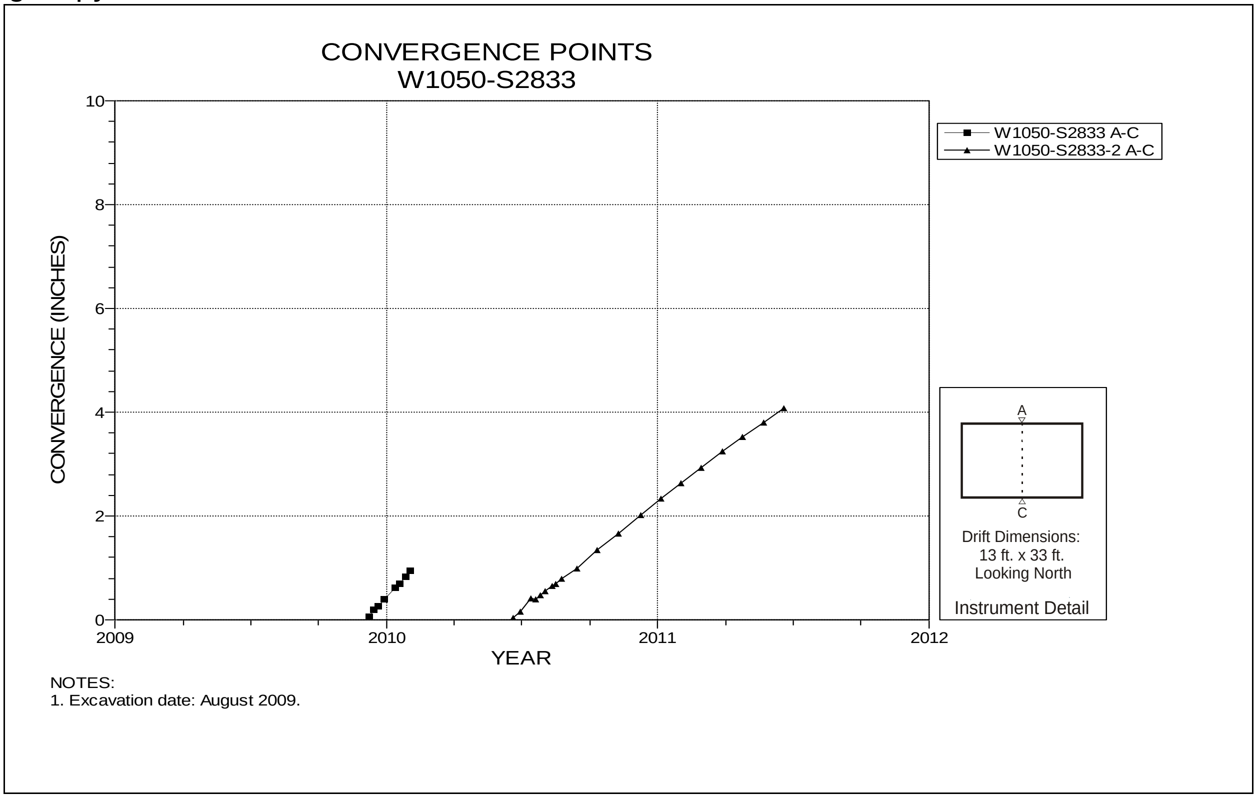


Figure 5-104 Convergence Point Array
Room 6, Panel 6 at W1050 S2833 – Roof to Floor

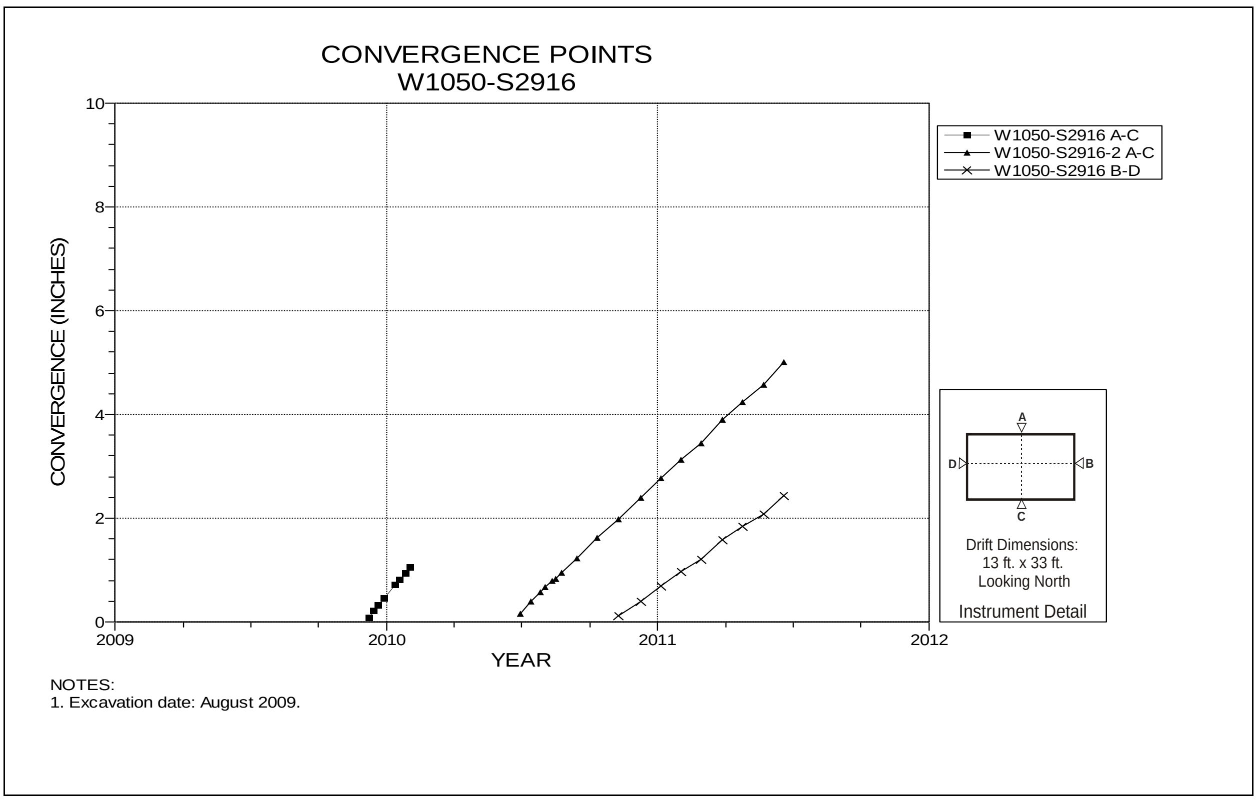


Figure 5-105 Convergence Point Array
Room 6, Panel 6 at W1050 S2916– Room Center – Roof to Floor

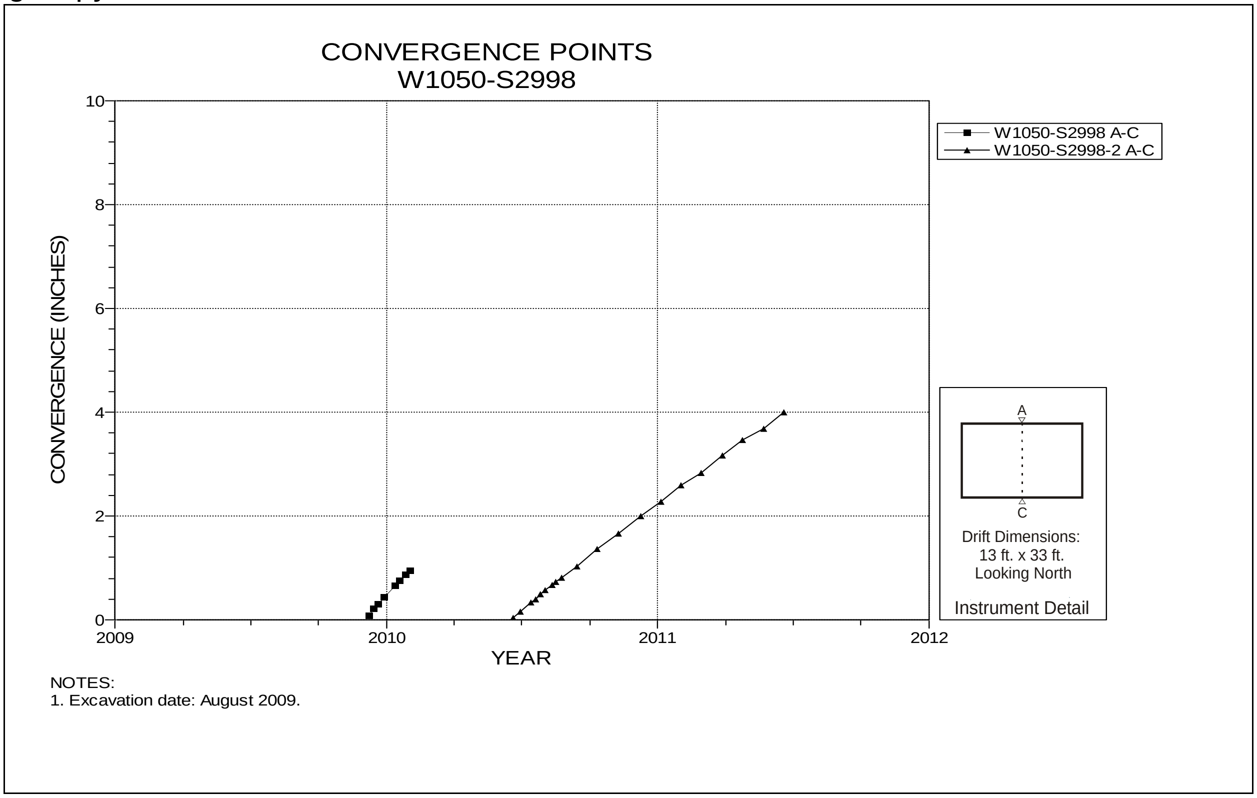


Figure 5-106 Convergence Point Array
Room 6, Panel 6 at W1050 S2998 – Roof to Floor

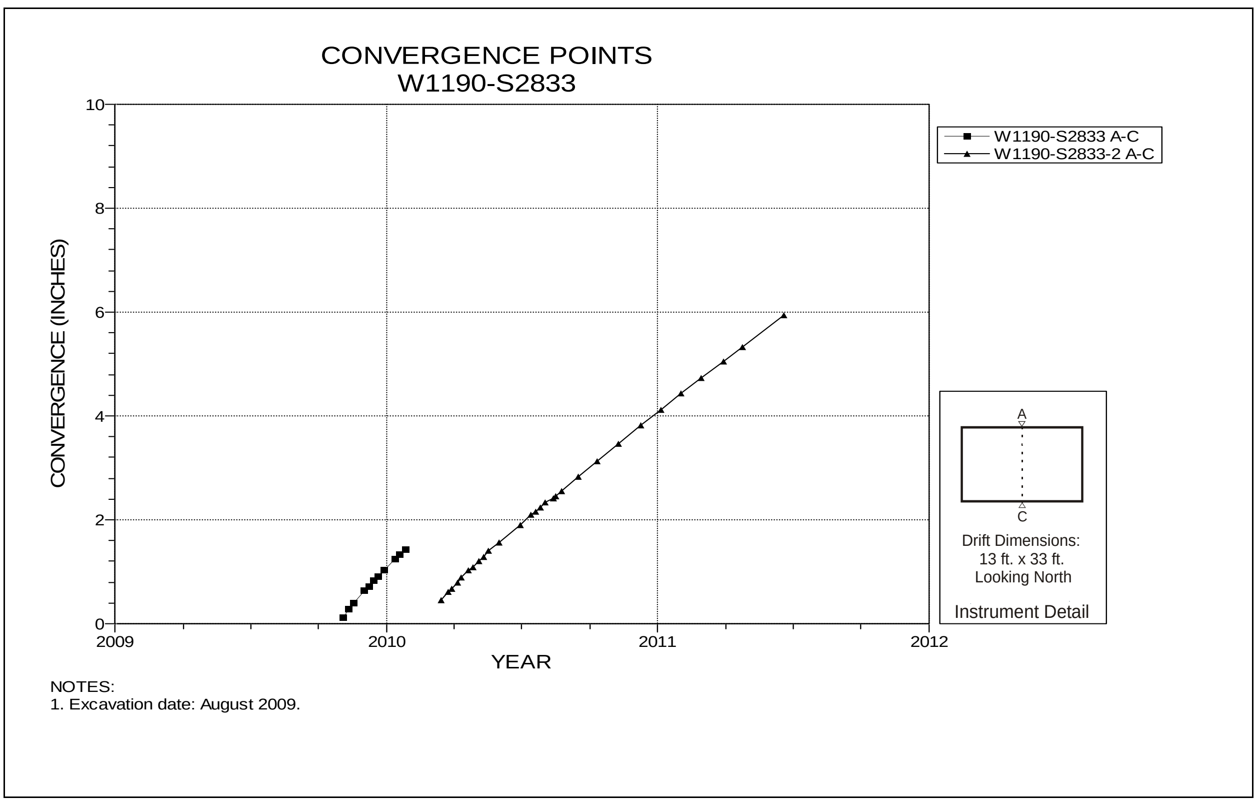
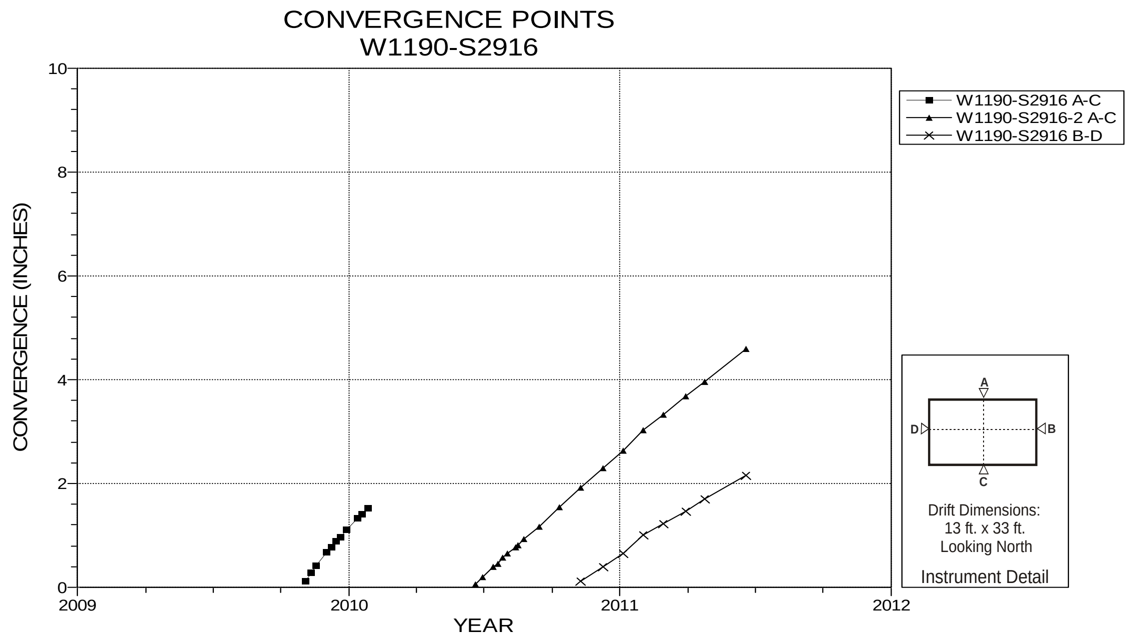
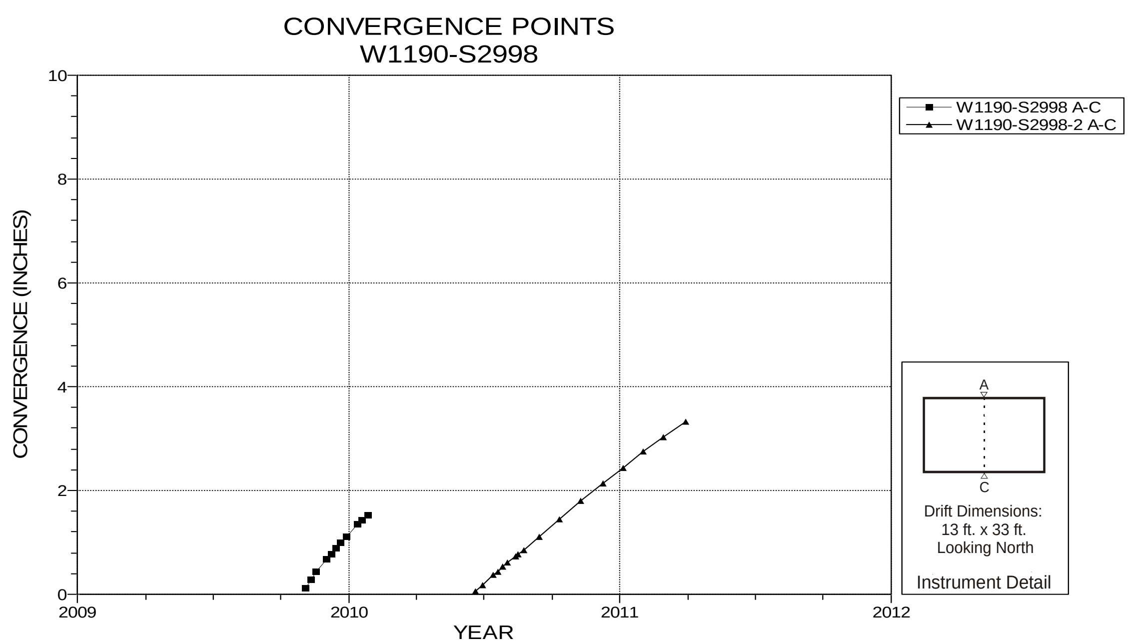


Figure 5-107 Convergence Point Array
Room 7, Panel 6 at W1190 S2833 – Roof to Floor



NOTES:
1. Excavation date: September 2009.

Figure 5-108 Convergence Point Array
Room 7, Panel 6 at W1190 S2916– Room Center – Roof to Floor



NOTES:
1. Excavation date: September 2009.

Figure 5-109 Convergence Point Array
Room 7, Panel 6 at W1190 S2998 – Roof to Floor

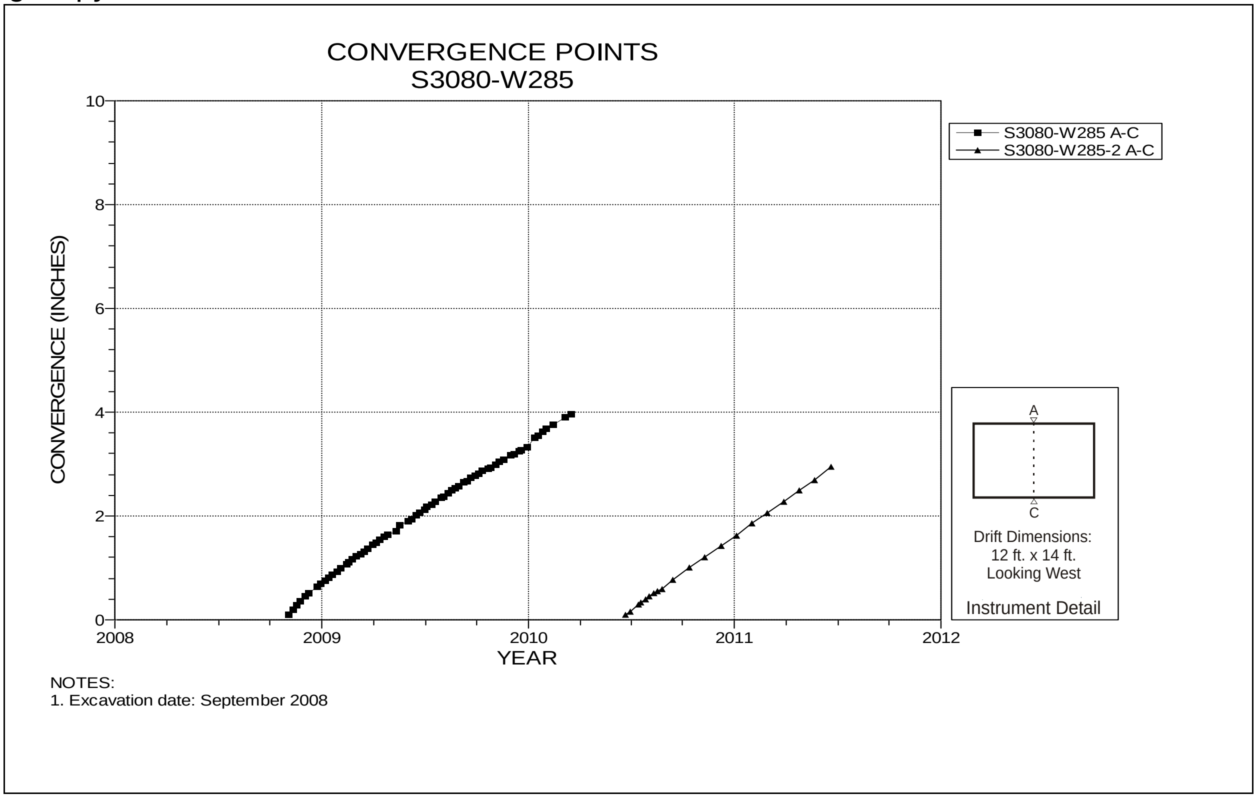


Figure 5-110 Convergence Point Array
S3080 W285 – Roof to Floor

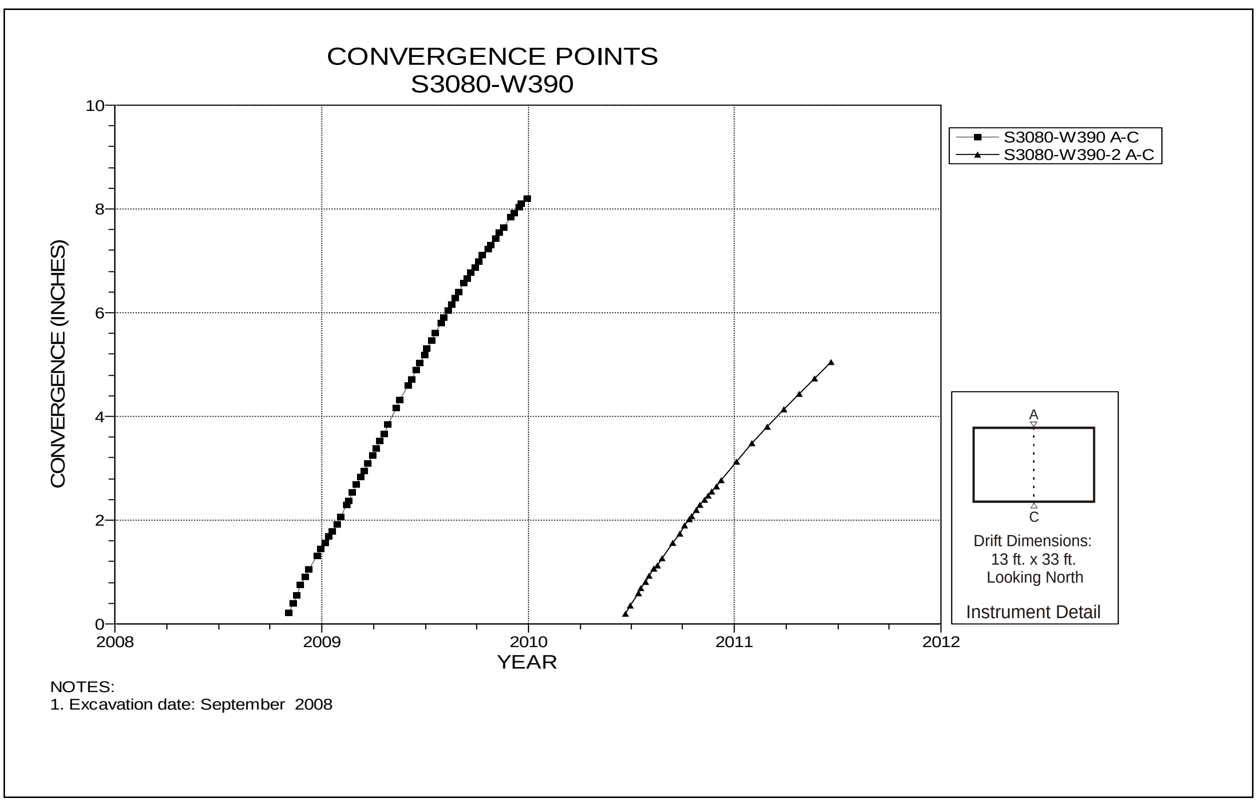


Figure 5-111 Convergence Point Array
S3080 W390 Intersection (Room 1, Panel 6) – Roof to Floor

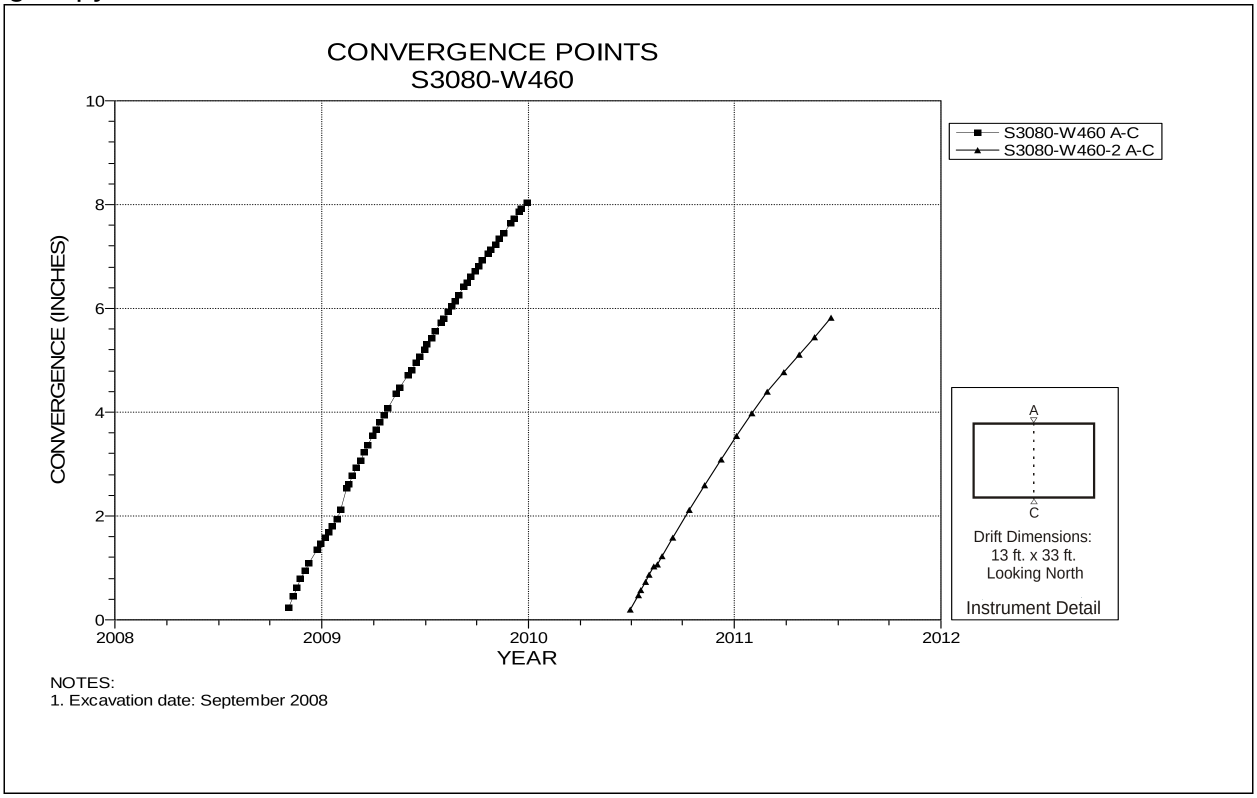


Figure 5-112 Convergence Point Array
S3080 W460 – Roof to Floor

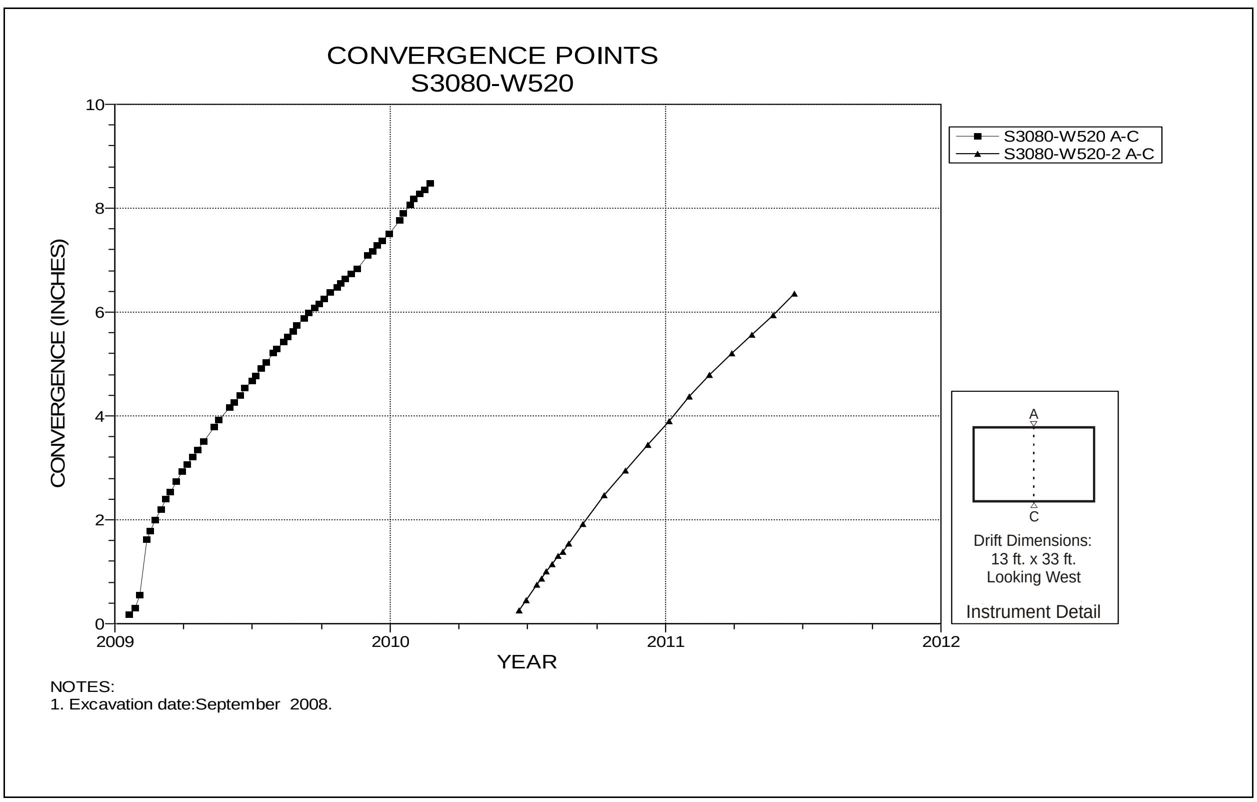


Figure 5-113 Convergence Point Array
S3080 W520 Intersection (Room 2, Panel 6)– Roof to Floor

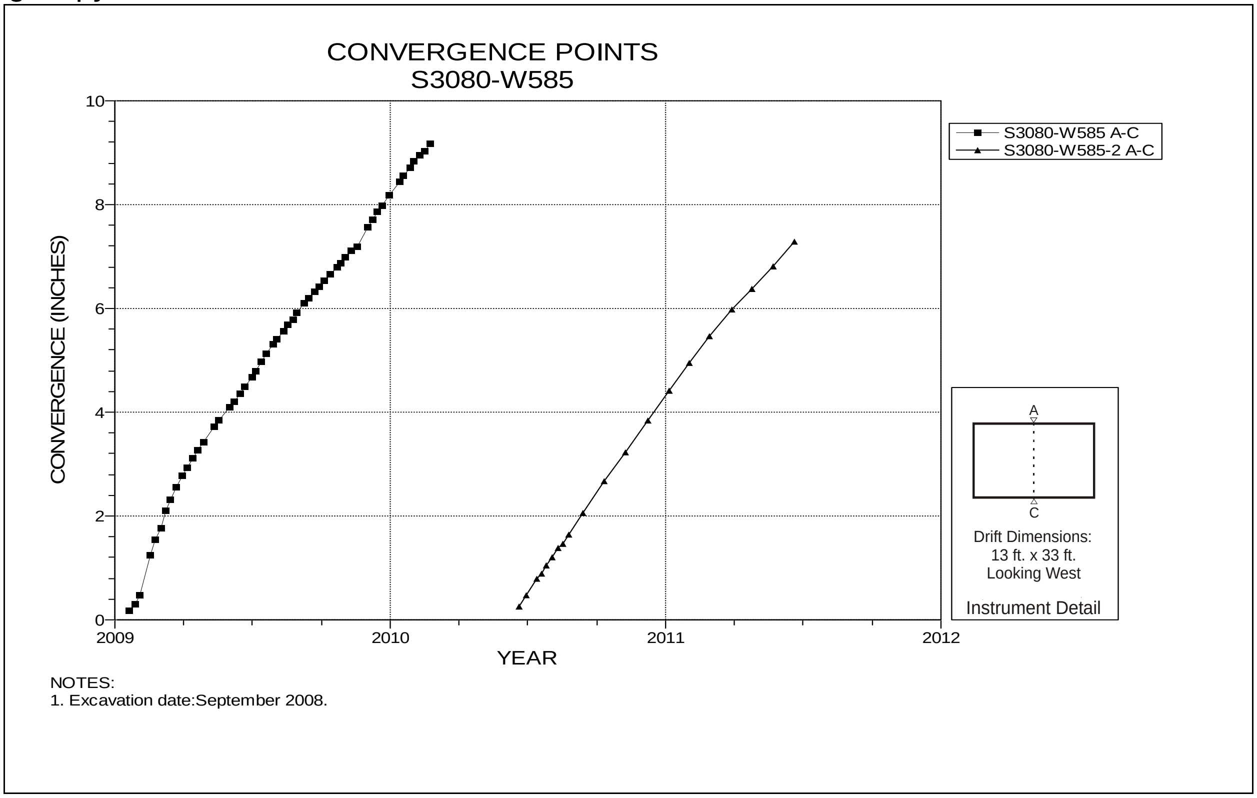


Figure 5-114 Convergence Point Array
S3080 W585 – Roof to Floor

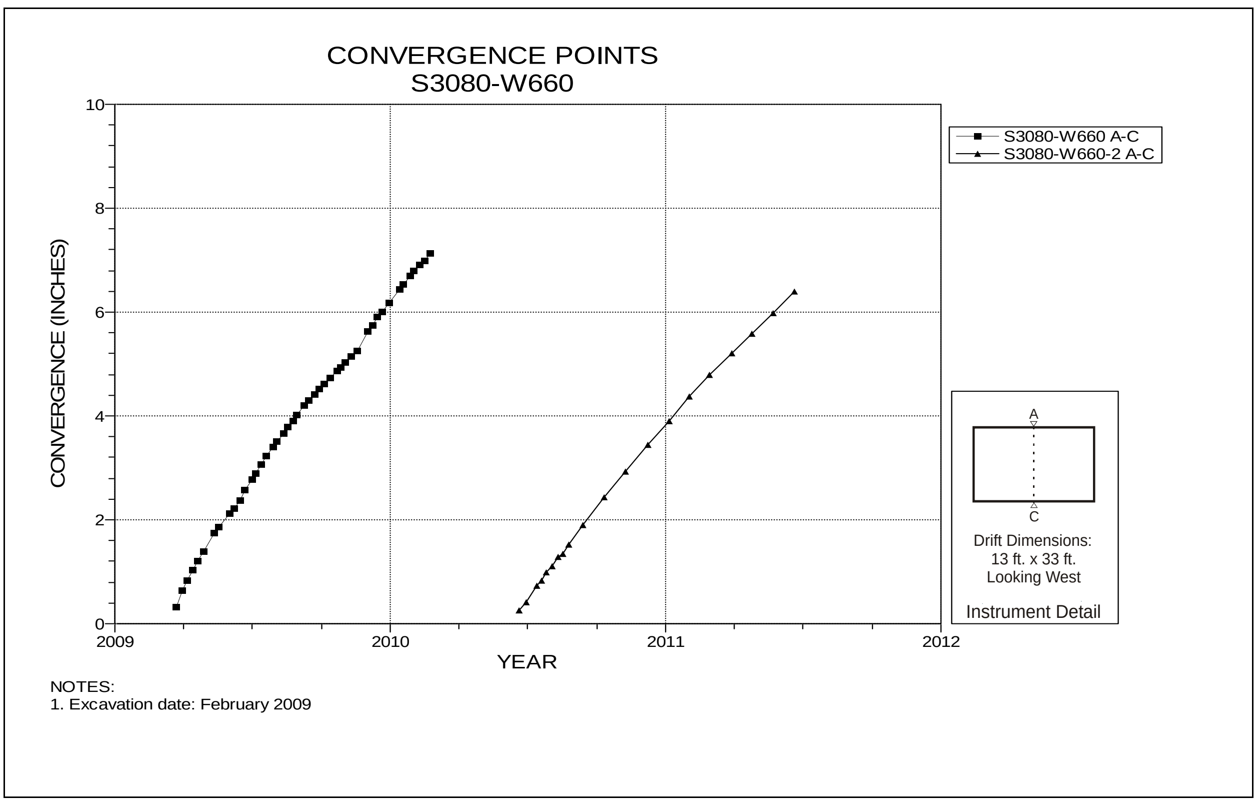


Figure 5-115 Convergence Point Array
S3080 W660 Intersection (Room 3, Panel 6) – Roof to Floor

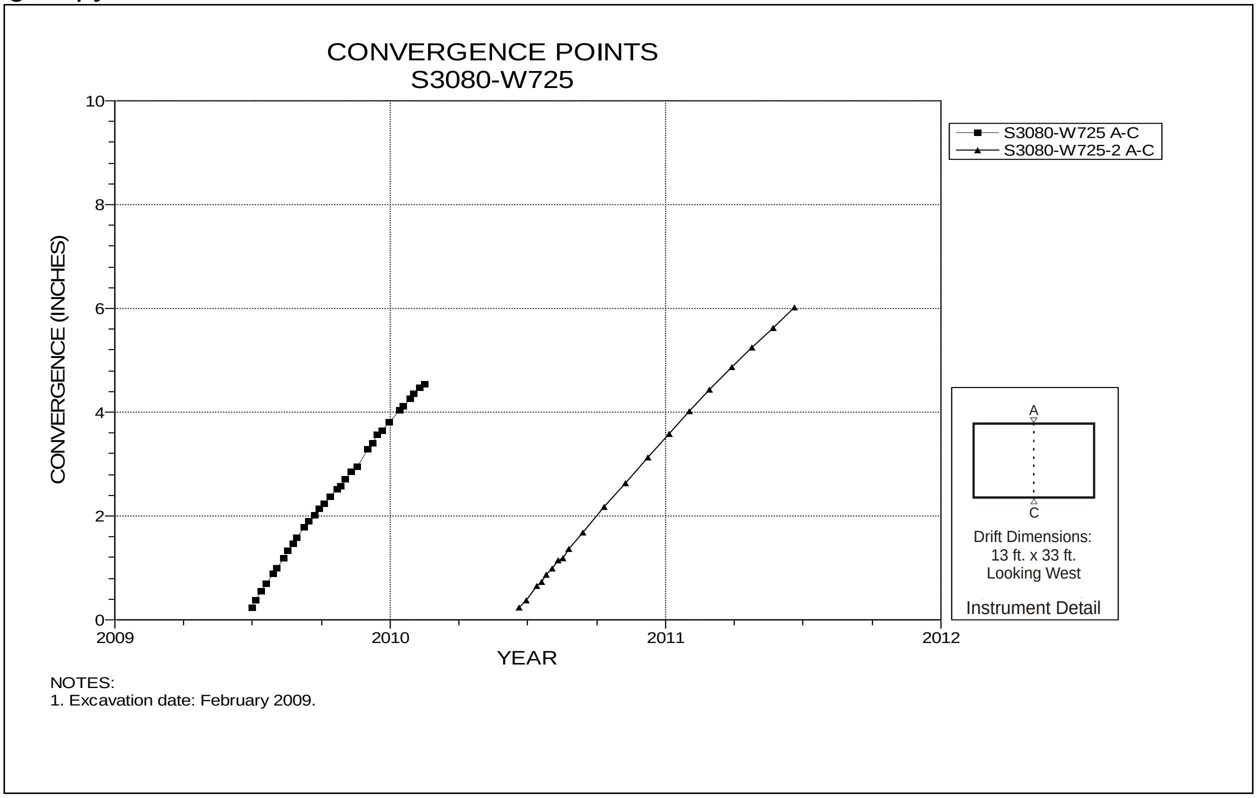


Figure 5-116 Convergence Point Array
S3080 W725 – Roof to Floor

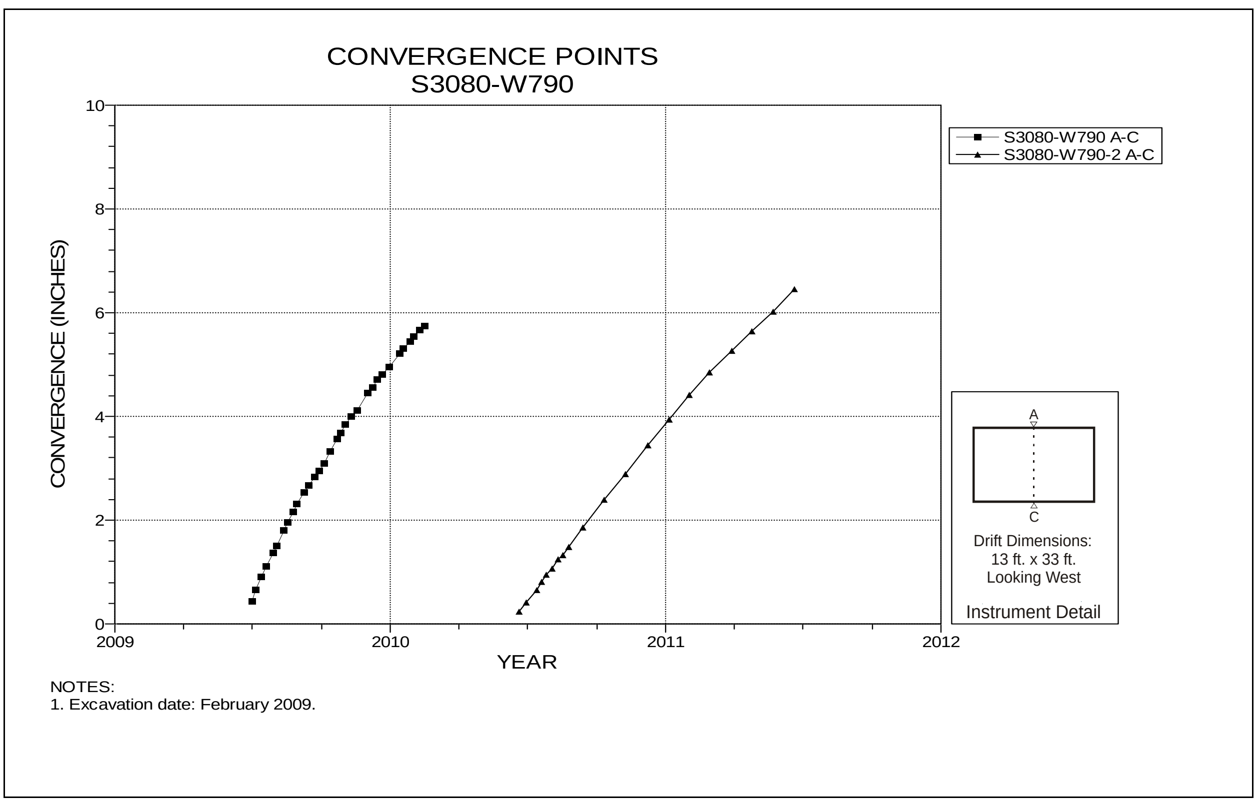


Figure 5-117 Convergence Point Array
S3080 W790 Intersection (Room 4, Panel 6) – Roof to Floor

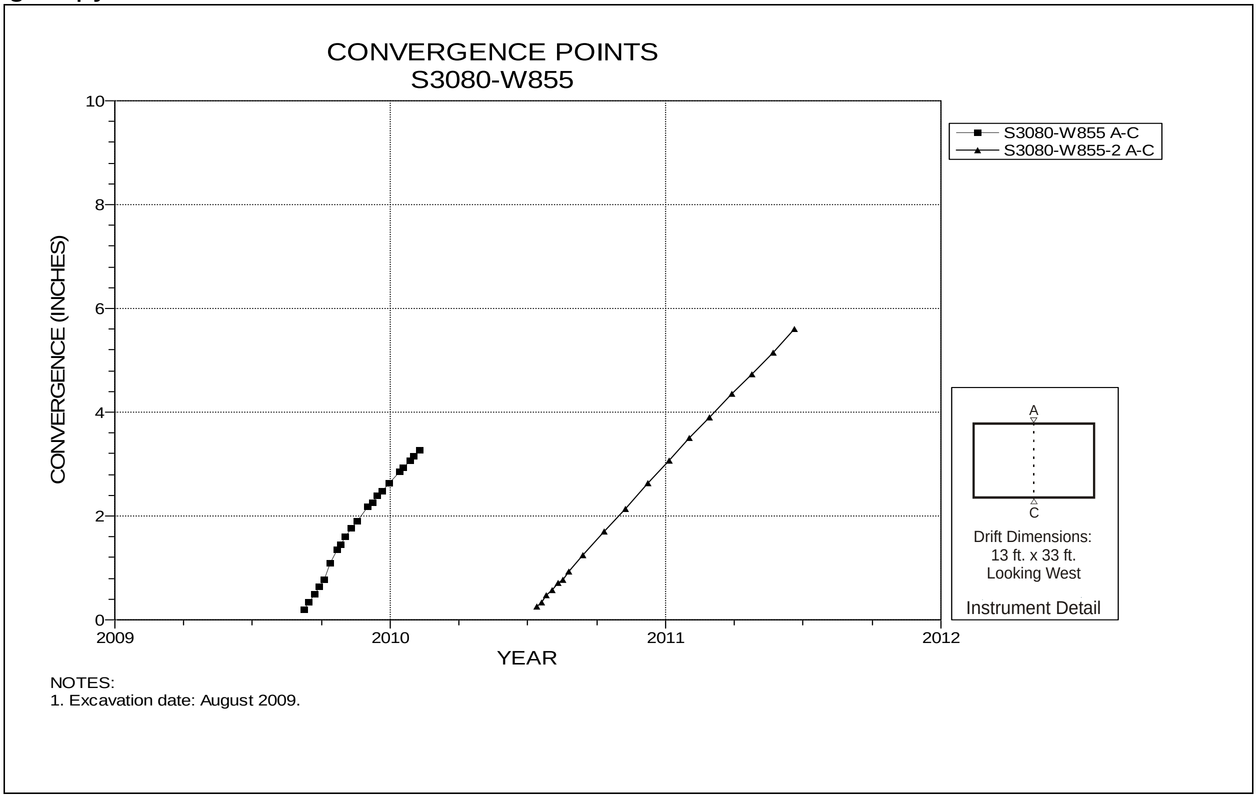


Figure 5-118 Convergence Point Array
S3080 W855 – Roof to Floor

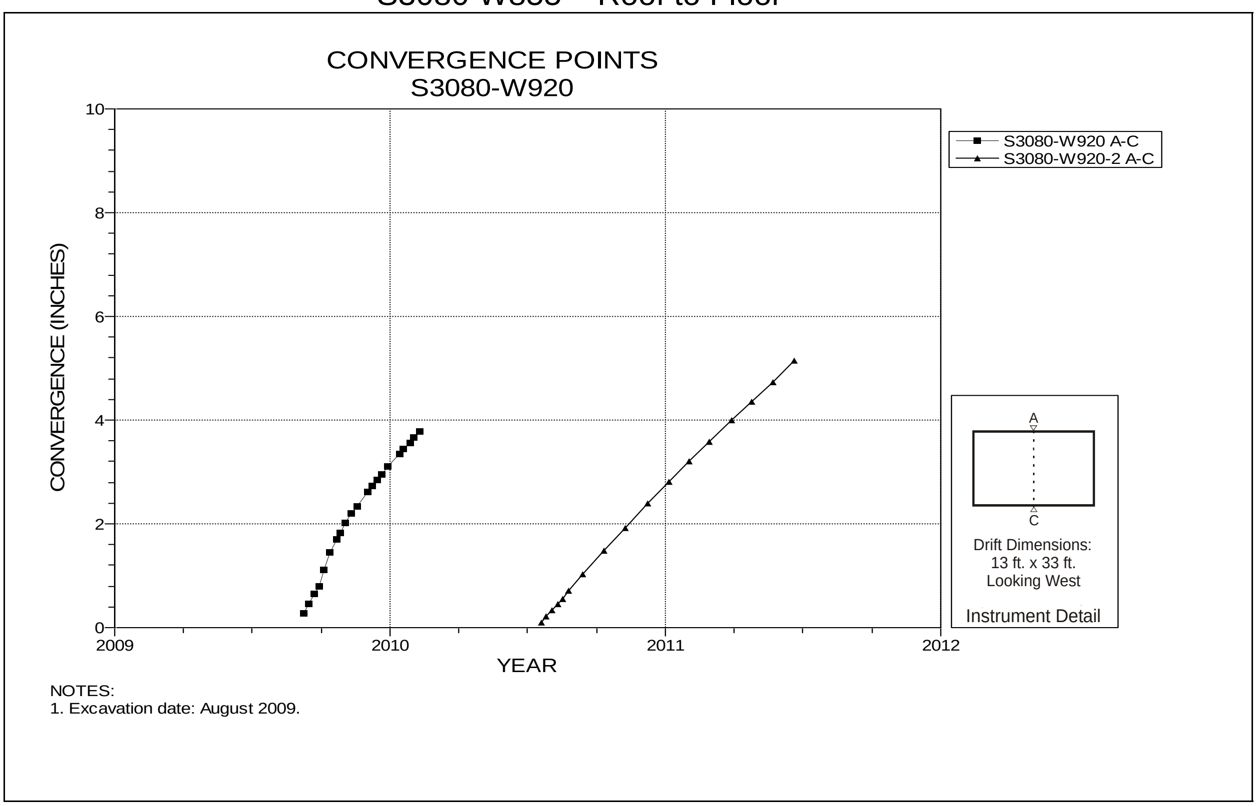


Figure 5-119 Convergence Point Array
S3080 W920 Intersection (Room 5, Panel 6) – Roof to Floor

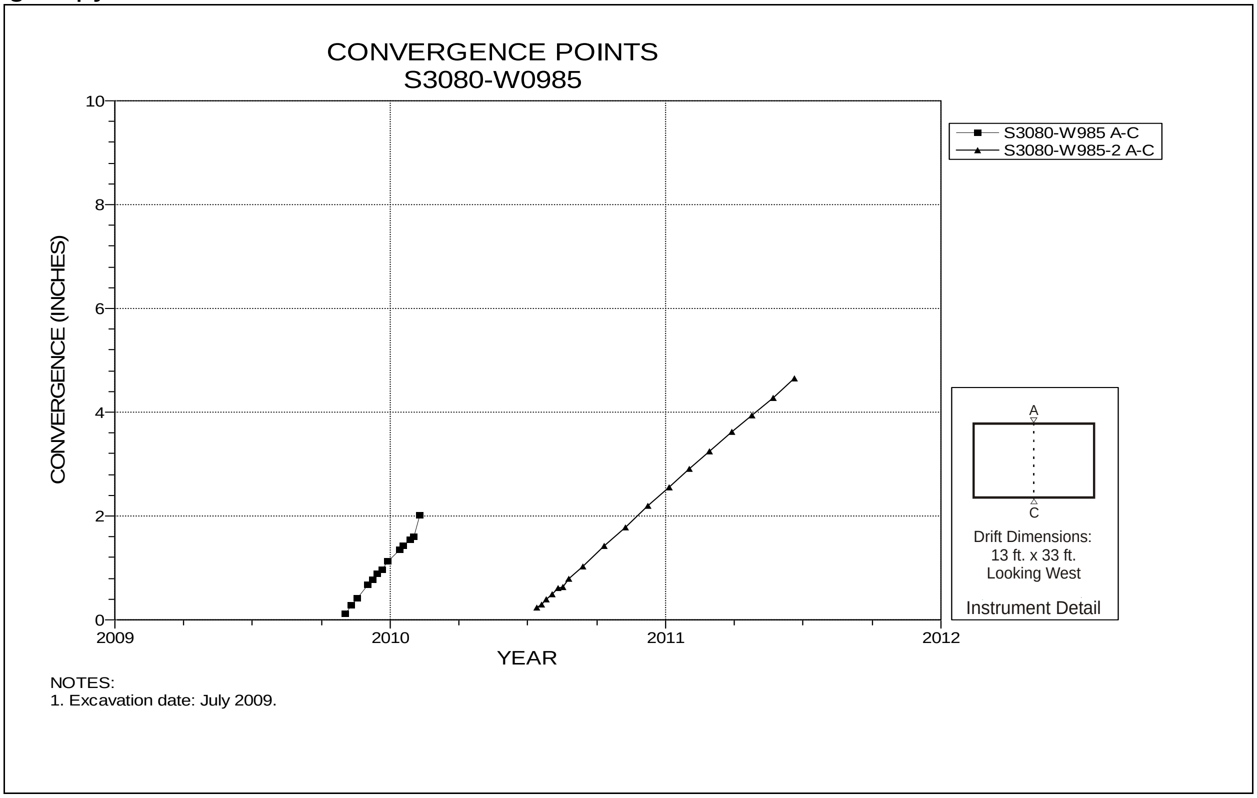


Figure 5-120 Convergence Point Array
S3080 W985 – Roof to Floor

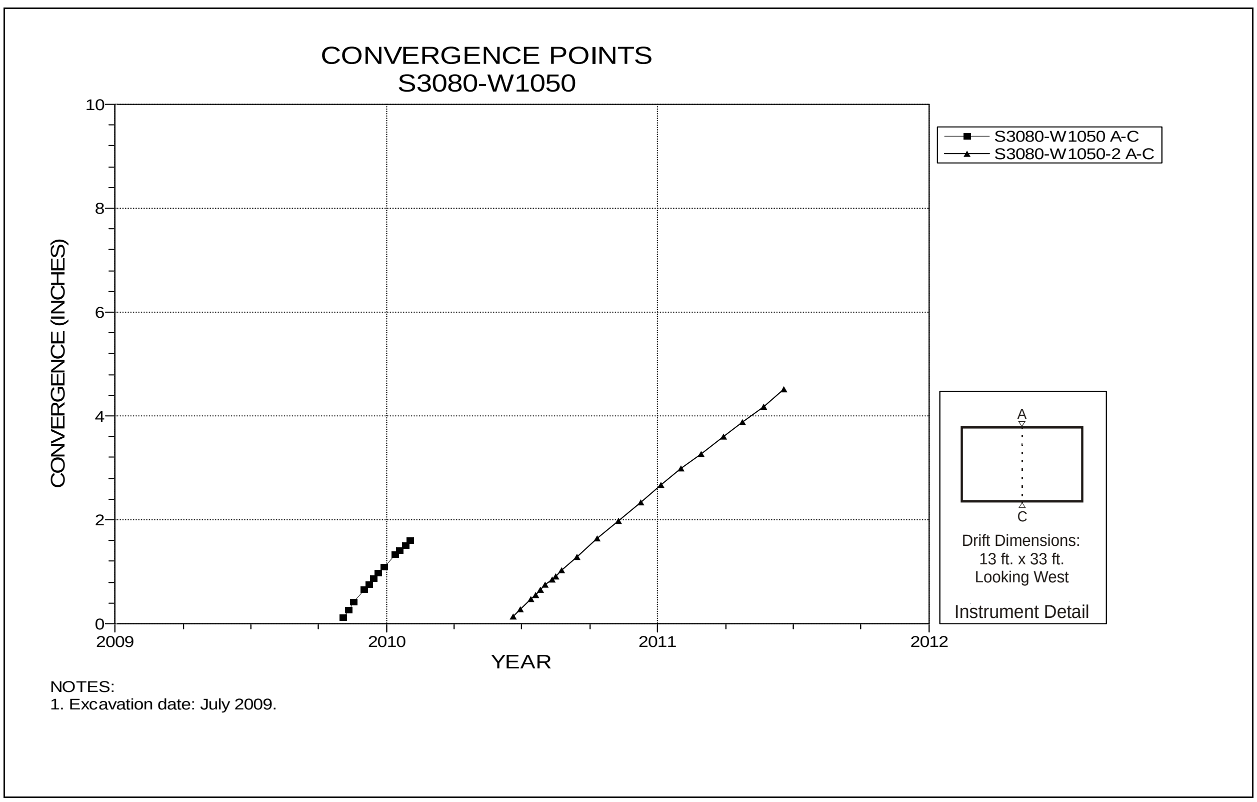


Figure 5-121 Convergence Point Array
S3080 W1050 Intersection (Room 6, Panel 6) – Roof to Floor

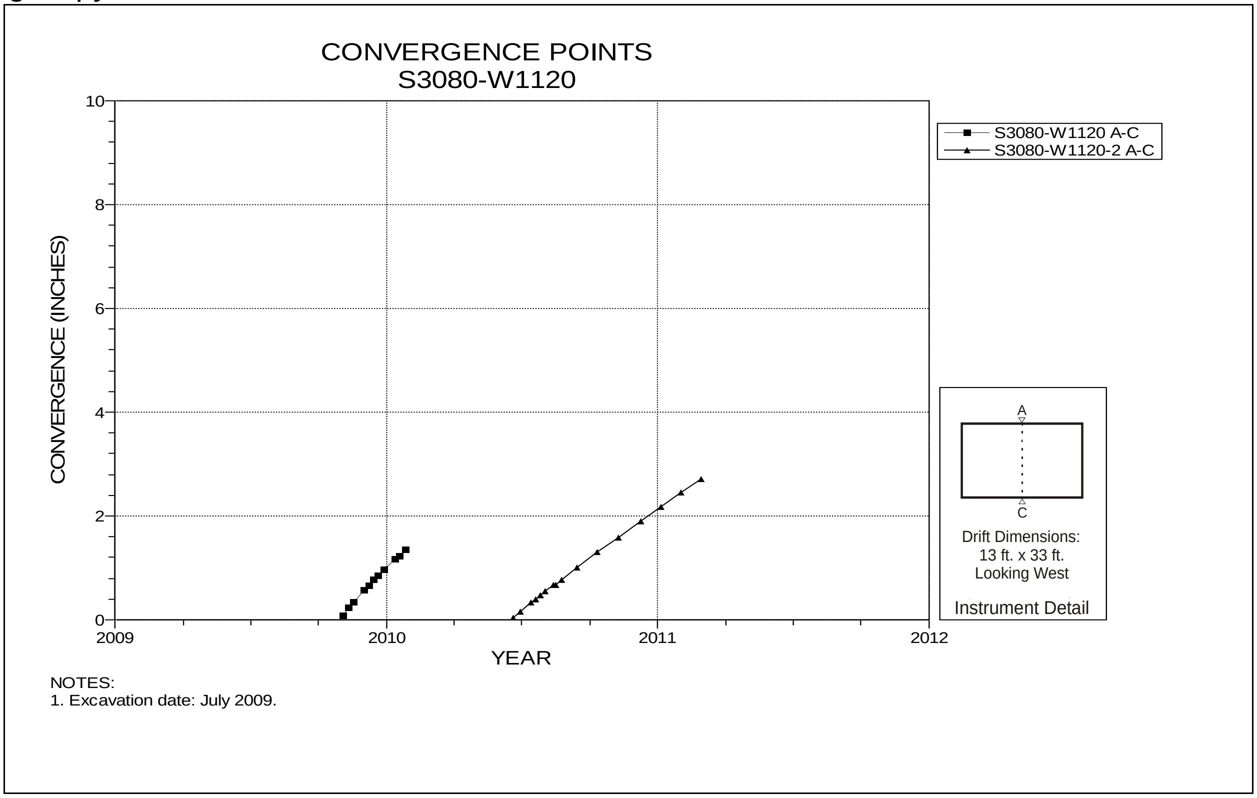


Figure 5-122 Convergence Point Array
S3080 W1120 – Roof to Floor

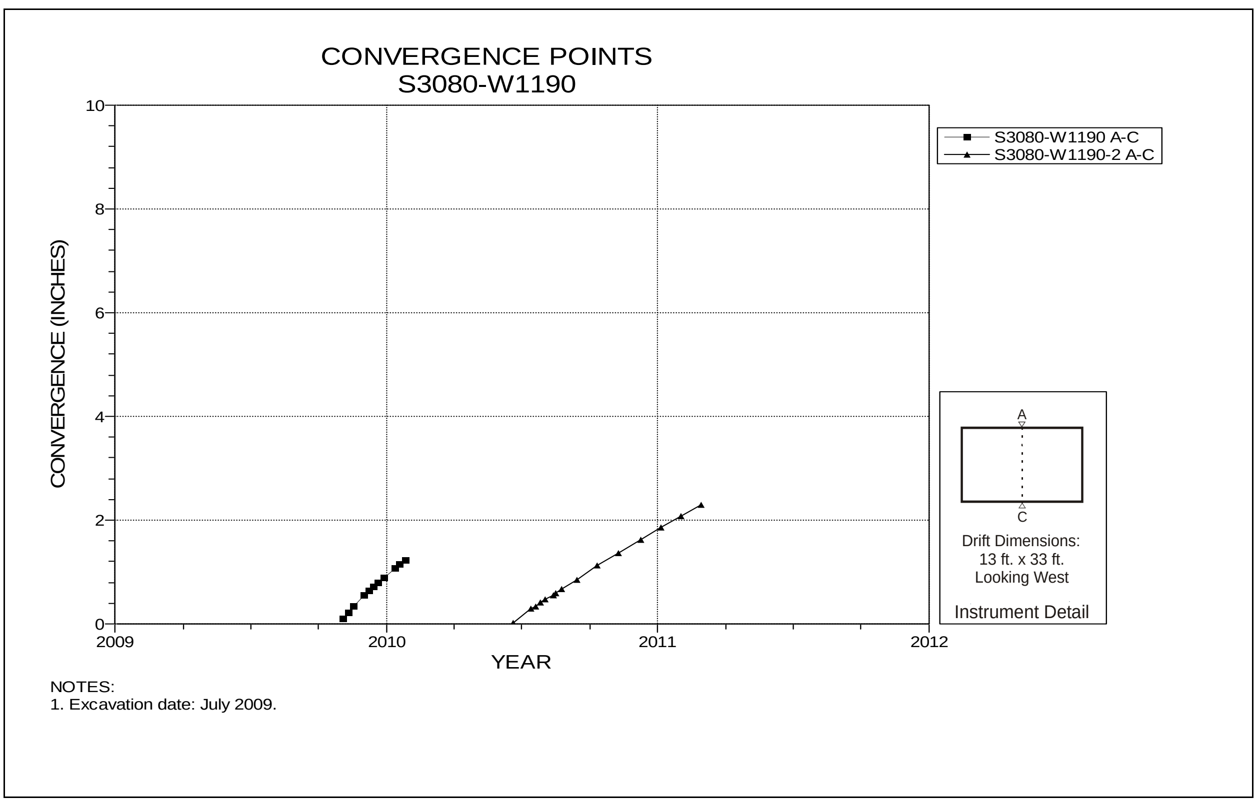


Figure 5-123 Convergence Point Array
S3080 W1190 Intersection (Room 7, Panel 6) – Roof to Floor

Table 5-7
Panel 7 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011 Date	Last Reading 2010 to 2011 Inches	Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)[1]	Rate Change Percent[1]	Comments
S2180-W285-2 A-C	S2180-W285	5-124	06/28/11	0.146	0.592	2.56	N/A	N/A	
S2180-W390-2 A-C	S2180-W390	5-125	06/28/11	0.269	1.200	3.82	N/A	N/A	Rate is from the original install.
S2180-W460-2 A-C	S2180-W460	5-126	06/28/11	0.428	1.550	10.23	N/A	N/A	
S2180-W520-2 A-C	S2180-W520	5-127	06/28/11	0.607	2.109	13.21	N/A	N/A	
S2180-W585-2 A-C	S2180-W585	5-128	06/28/11	0.658	2.136	15.28	N/A	N/A	
S2180-W660-2 A-C	S2180-W660	5-129	06/28/11	0.979	2.627	22.71	N/A	N/A	
S2180-W725-2 A-C	S2180-W725	5-130	06/28/11	0.734	1.464	15.58	N/A	N/A	
S2180-W790-2 A-C	S2180-W790	5-131	06/28/11	0.613	1.919	13.94	N/A	N/A	
S2180-W855-2 A-C	S2180-W855	5-132	06/28/11	0.767	2.124	17.59	N/A	N/A	
S2180-W920-2 A-C	S2180-W920	5-133	06/28/11	0.699	2.202	16.74	N/A	N/A	
S2180-W985-2 A-C	S2180-W985	5-134	06/28/11	1.272	2.624	29.16	N/A	N/A	
S2180-W1050 A-C	S2180-W1050	5-135	06/28/11	0.901	0.901	22.89	N/A	N/A	
S2180-W1120 A-C	S2180-W1120	5-136	06/28/11	0.906	0.906	20.88	N/A	N/A	
S2180-W1190 A-C	S2180-W1190	5-137	05/17/11	1.354	1.354	6.43	N/A	N/A	
W390-S2275 A-C	W390-S2275	5-138	04/12/11	4.875	4.875	7.11	N/A	N/A	
W390-S2350 A-C	W390-S2350	5-139	04/18/11	4.884	4.884	6.97	N/A	N/A	
W390-S2425 A-C	W390-S2425	5-140	06/28/11	5.702	5.702	6.42	N/A	N/A	
W520-S2275 A-C	W520-S2275	5-141	06/28/11	4.532	4.532	6.60	N/A	N/A	
W520-S2350 A-C	W520-S2350	5-142	06/28/11	4.470	4.470	6.42	N/A	N/A	
W520-S2425 A-C	W520-S2425	5-143	06/28/11	4.653	4.653	6.69	N/A	N/A	
W660-S2275 A-C	W660-S2275	5-144	06/28/11	4.622	4.622	6.96	N/A	N/A	
W660-S2350 A-C	W660-S2350	5-145	06/28/11	4.926	4.926	7.39	N/A	N/A	
W660-S2425 A-C	W660-S2425	5-146	06/28/11	5.061	5.061	7.56	N/A	N/A	
W790-S2275 A-C	W790-S2275	5-147	06/28/11	2.298	2.298	7.49	N/A	N/A	
W790-S2350 A-C	W790-S2350	5-148	06/28/11	2.092	2.092	6.69	N/A	N/A	
W790-S2425 A-C	W790-S2425	5-149	06/28/11	2.057	2.057	6.53	N/A	N/A	
W920-S2275 A-C	W920-S2275	5-150	06/28/11	2.375	2.375	7.24	N/A	N/A	
W920-S2350 A-C	W920-S2350	5-151	06/28/11	2.276	2.276	6.87	N/A	N/A	

Table 5-7, (Continued)
Panel 7 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2010 to 2011		Cumulative Displacement (inches)	Closure Rate 2010 to 2011 (in/year)	Closure Rate 2009 to 2010 (in/year)[1]	Rate Change Percent[1]	Comments
			Date	Inches					
W920-S2425 A-C	W920-S2425	5-152	06/28/11	2.305	2.305	6.95	N/A	N/A	
W1050-S2275 A-C	W1050-S2275	5-153	06/06/11	2.134	2.134	8.33	N/A	N/A	
W1050-S2350 A-C	W1050-S2350	5-154	06/06/11	2.140	2.140	8.31	N/A	N/A	
W1050-S2425 A-C	W1050-S2425	5-155	06/06/11	2.141	2.141	8.32	N/A	N/A	
W1190-S2275 A-C	W1190-S2275	5-156	05/17/11	1.672	1.672	8.03	N/A	N/A	
W1190-S2350 A-C	W1190-S2350	5-157	05/31/11	1.914	1.914	7.59	N/A	N/A	
W1190-S2425 A-C	W1190-S2425	5-158	05/31/11	2.015	2.015	7.87	N/A	N/A	
S2520-W285-2 A-C	S2520-W285	5-159	06/28/11	0.502	2.046	3.32	N/A	N/A	
S2520-W390 A-C	S2520-W390	5-160	06/28/11	3.994	3.994	5.68	N/A	N/A	
S2520-W455 A-C	S2520-W455	5-161	06/28/11	4.439	4.439	6.24	N/A	N/A	
S2520-W520 A-C	S2520-W520	5-162	06/28/11	7.292	7.292	7.30	N/A	N/A	
S2520-W585 A-C	S2520-W585	5-163	06/28/11	4.910	4.910	7.42	N/A	N/A	
S2520-W660 A-C	S2520-W660	5-164	06/28/11	5.328	5.328	8.00	N/A	N/A	
S2520-W725 A-C	S2520-W725	5-165	06/28/11	2.130	2.130	6.89	N/A	N/A	
S2520-W790 A-C	S2520-W790	5-166	06/28/11	2.219	2.219	7.19	N/A	N/A	
S2520-W855 A-C	S2520-W855	5-167	06/28/11	2.149	2.149	6.98	N/A	N/A	
S2520-W920 A-C	S2520-W920	5-168	06/28/11	2.169	2.169	7.00	N/A	N/A	
S2520-W985 A-C	S2520-W985	5-169	06/28/11	2.374	2.374	7.65	N/A	N/A	
S2520-W1050 A-C	S2520-W1050	5-170	06/06/11	2.042	2.042	8.11	N/A	N/A	
S2520-W1120 A-C	S2520-W1120	5-171	06/06/11	1.940	1.940	7.91	N/A	N/A	
S2520-W1190 A-C	S2520-W1190	5-172	06/06/11	1.637	1.637	6.33	N/A	N/A	

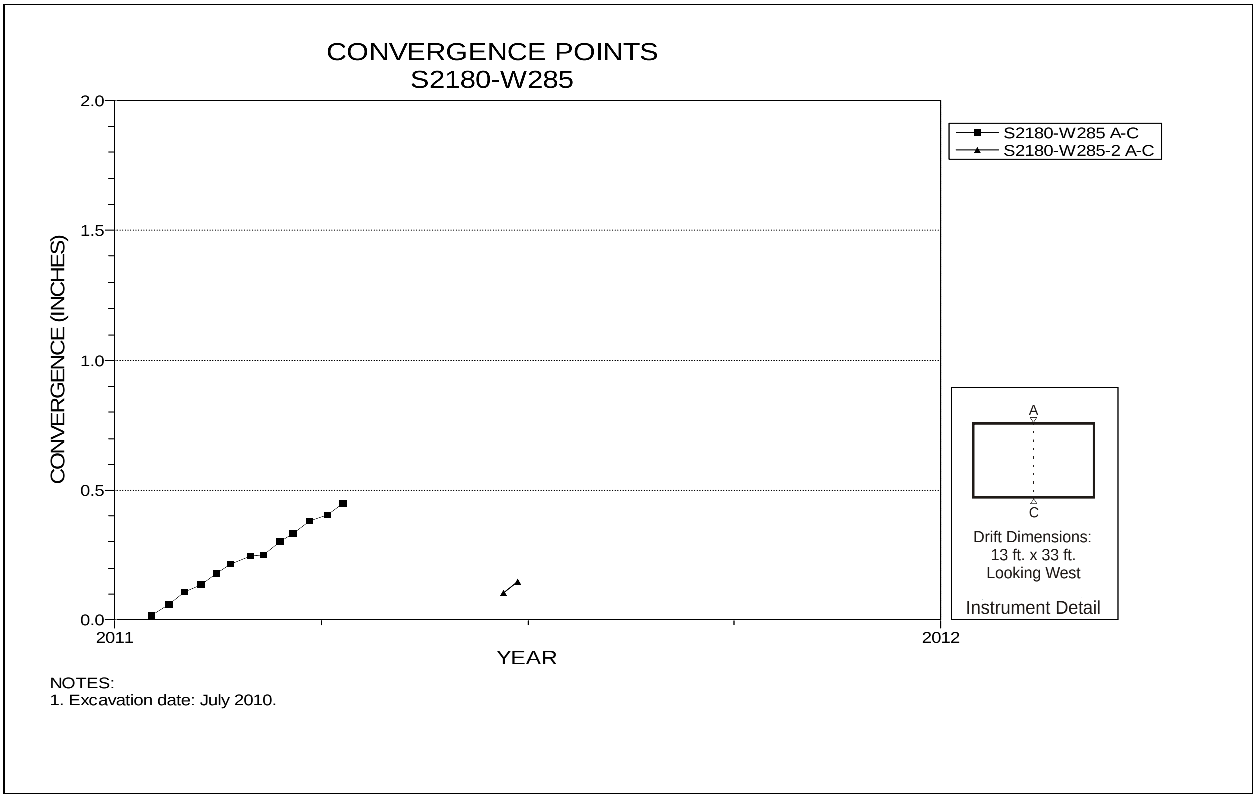


Figure 5-124 Convergence Point Array
S2180 W285 – Roof to Floor

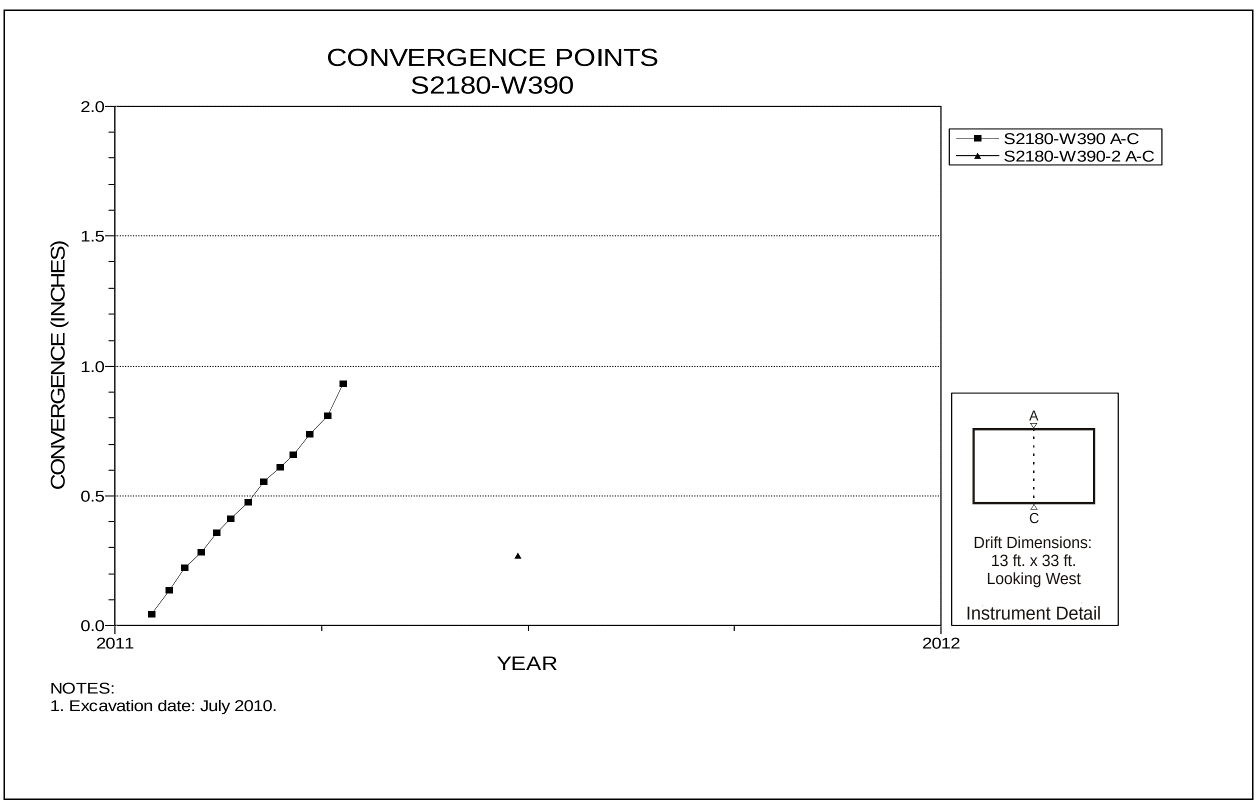


Figure 5-125 Convergence Point Array
S2180 W390 Intersection (Room 1, Panel 7) – Roof to Floor

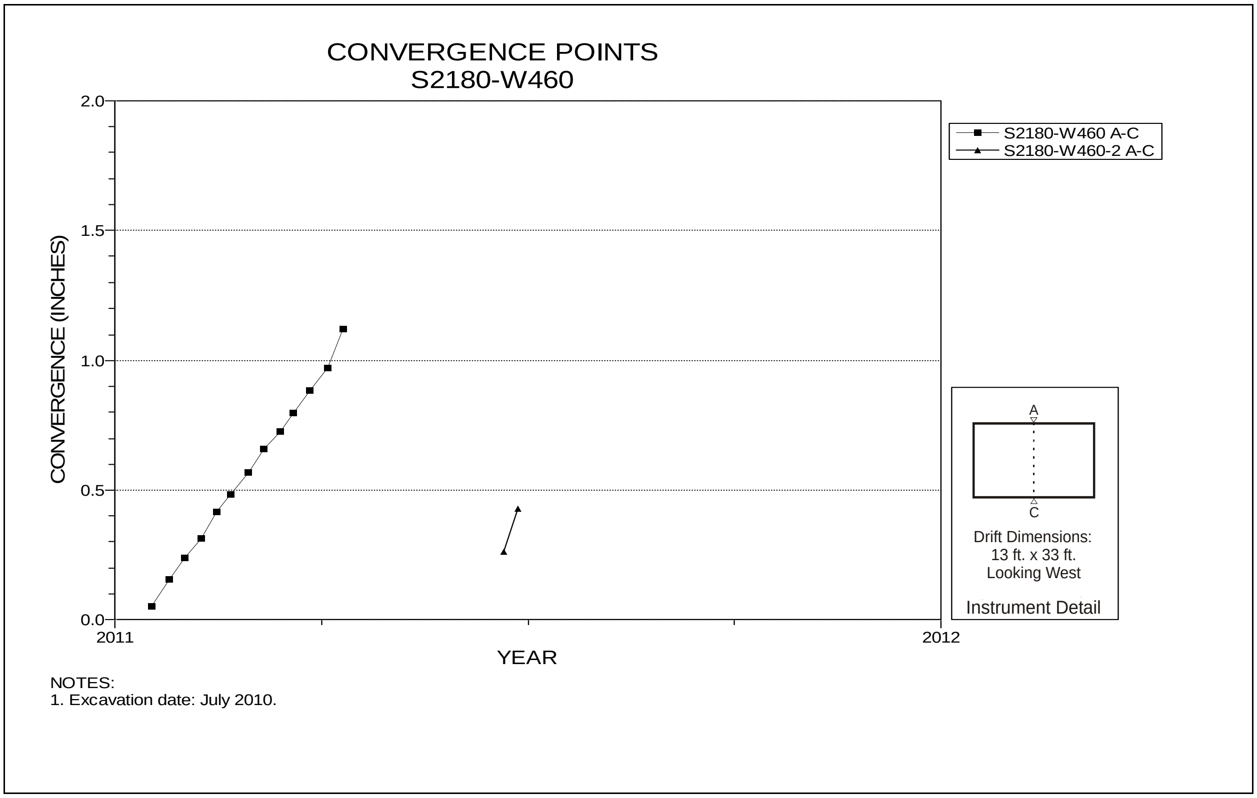


Figure 5-126 Convergence Point Array
S2180 W460 – Roof to Floor

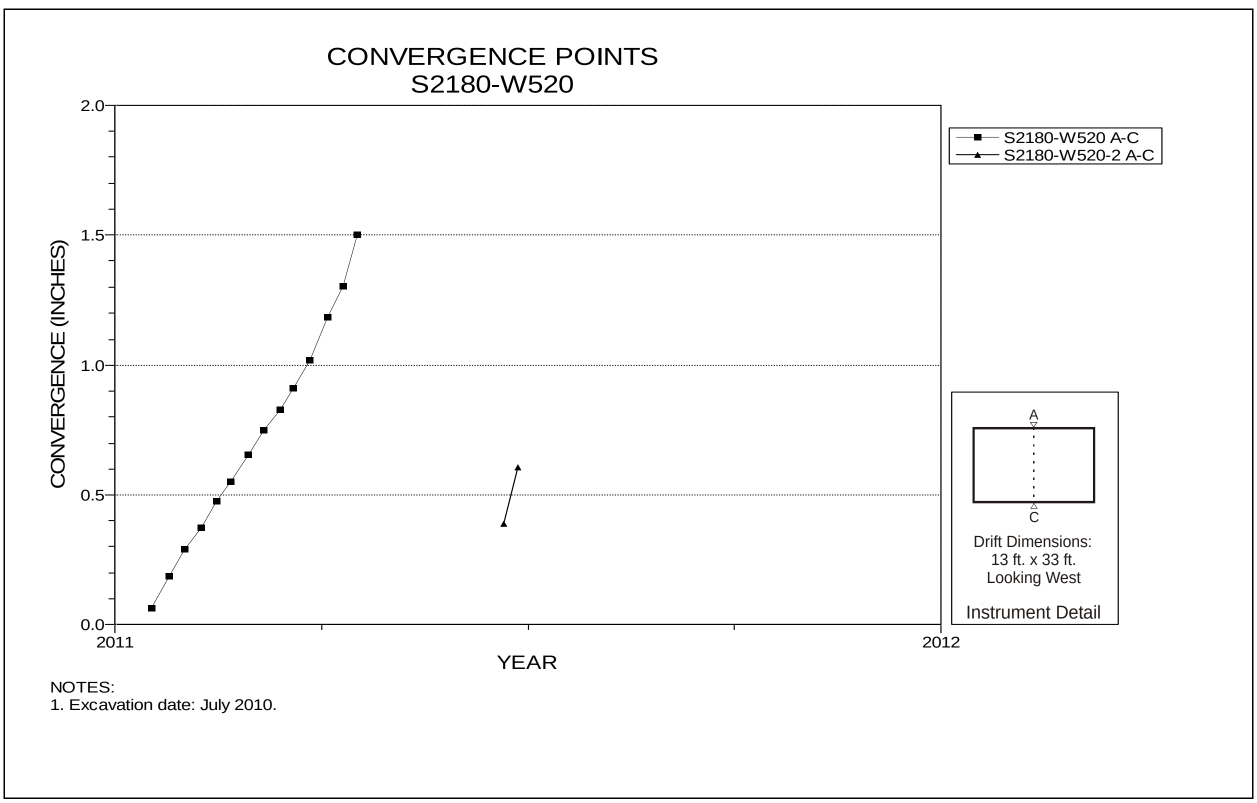


Figure 5-127 Convergence Point Array
S2180 W520 Intersection (Room 2, Panel 7) – Roof to Floor

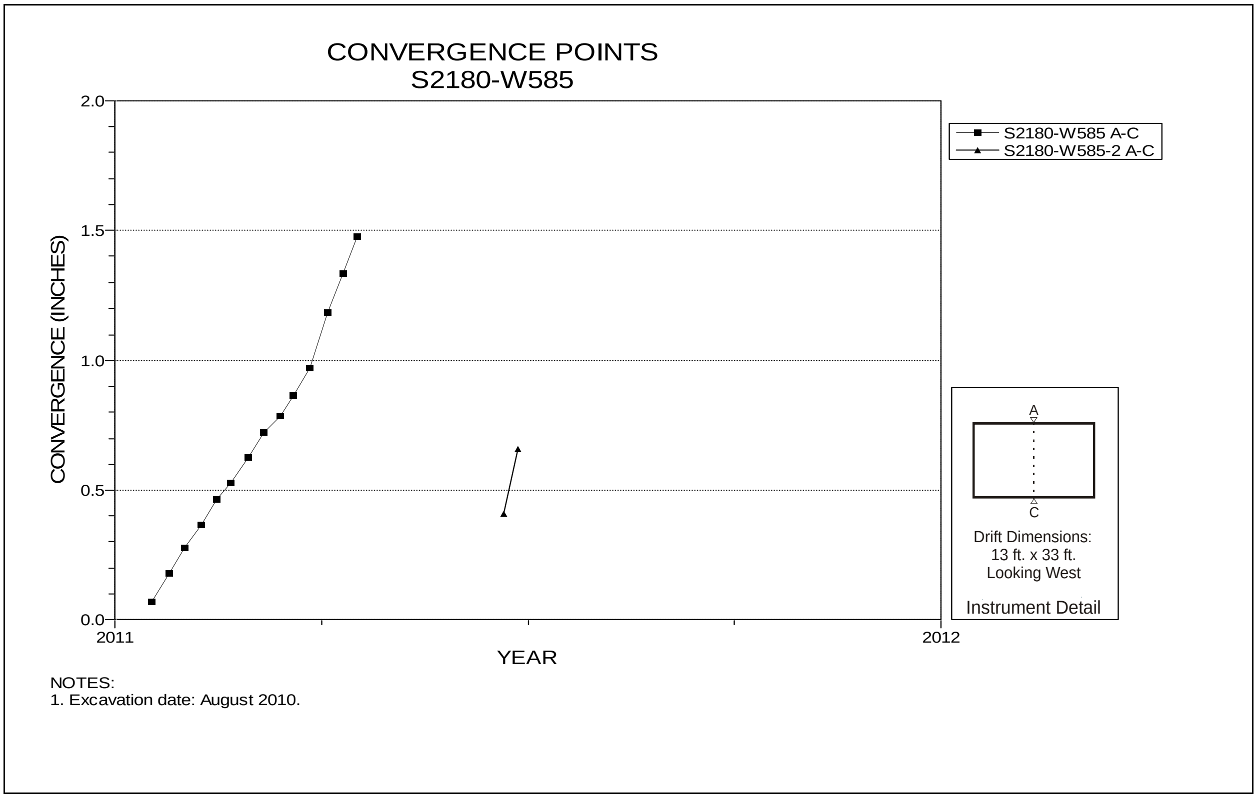


Figure 5-128 Convergence Point Array
S2180 W585 – Roof to Floor

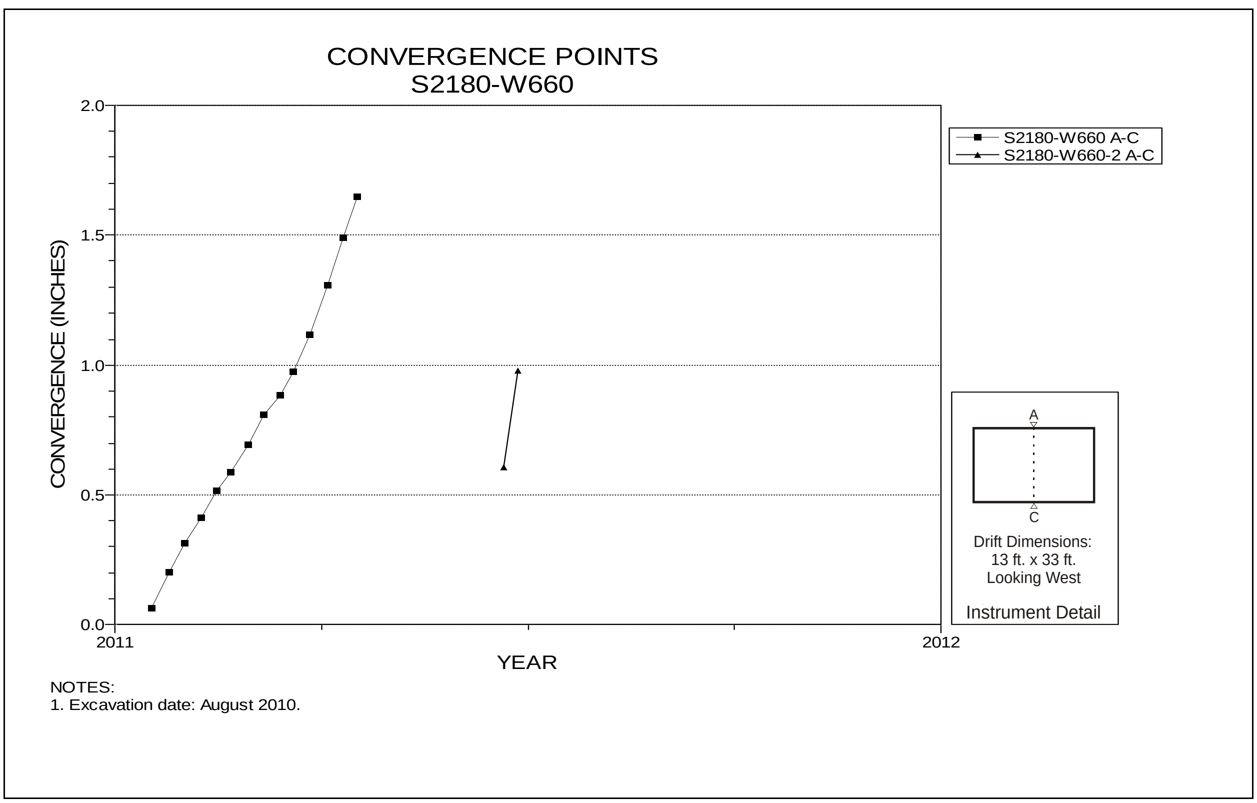


Figure 5-129 Convergence Point Array
S2180 W660 Intersection (Room 3 Panel 7) – Roof to Floor

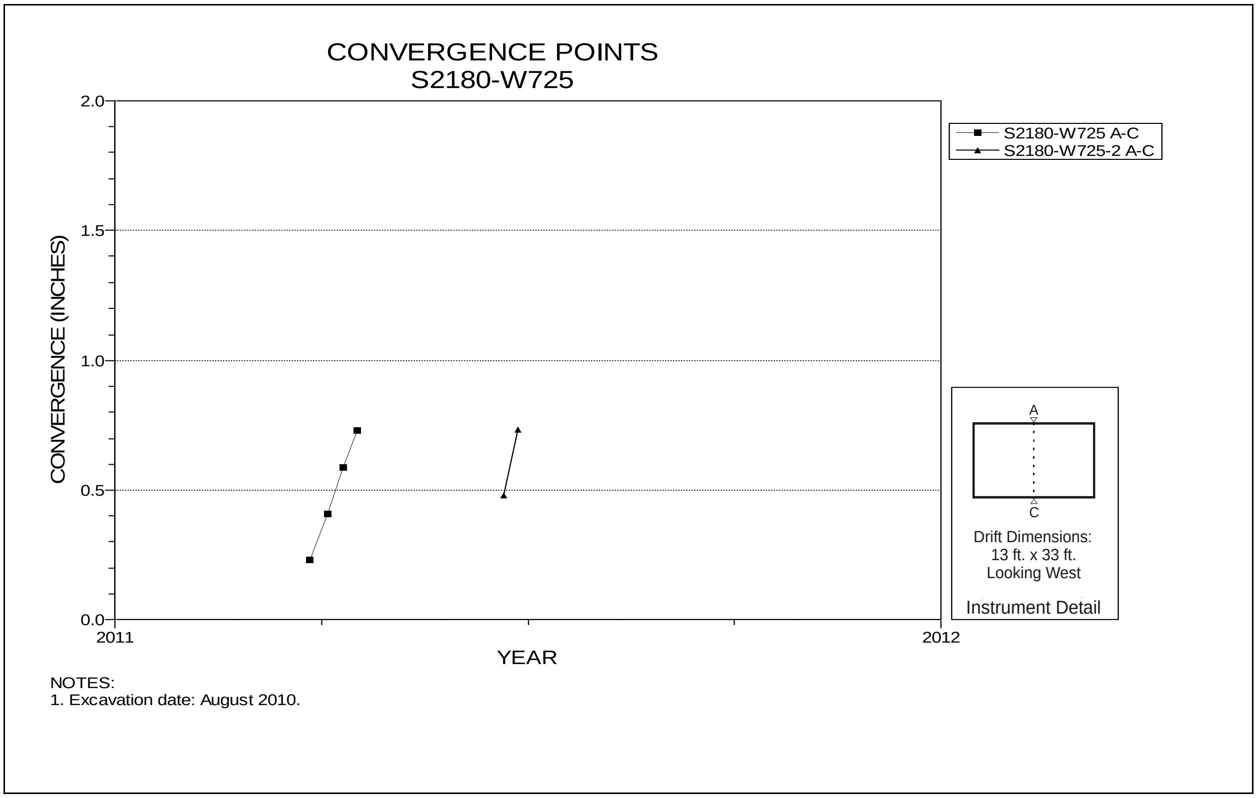
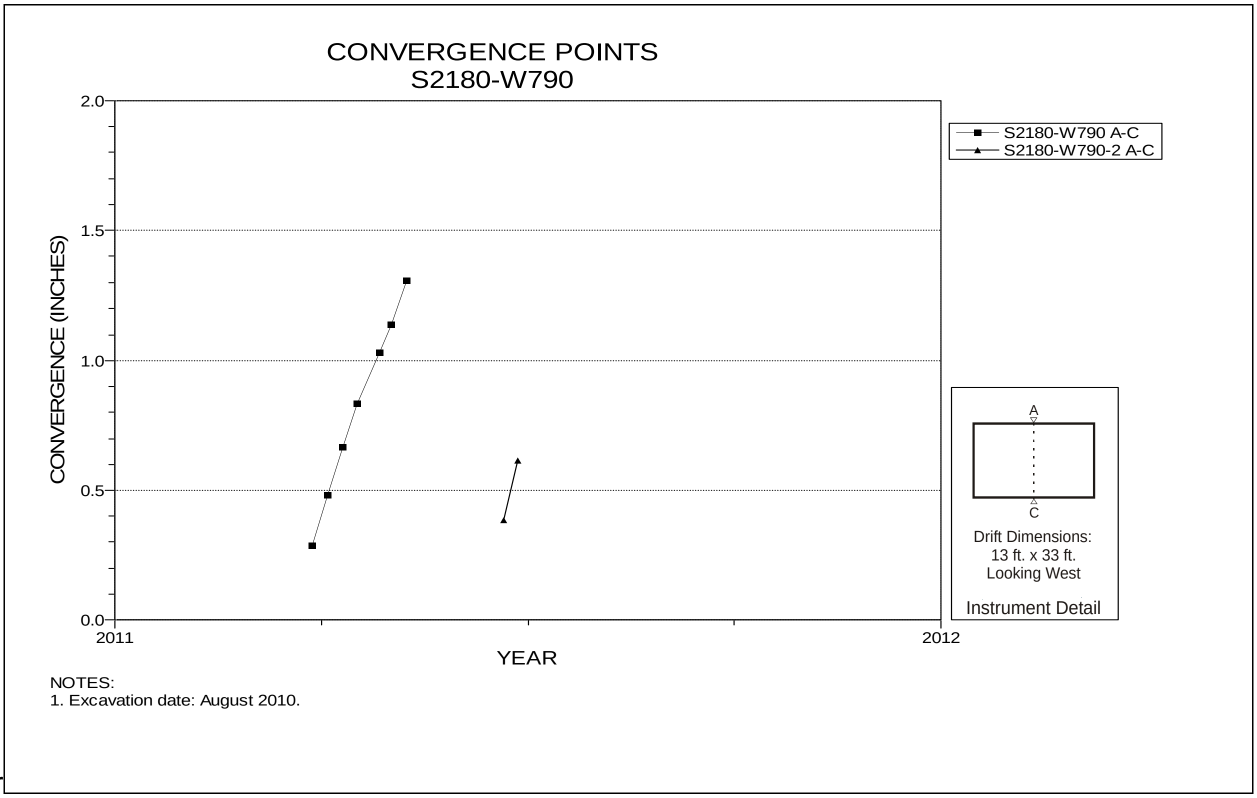


Figure 5-130 Convergence Point Array
S2180 W725 – Roof to



Floor

Figure 5-131 Convergence Point Array
S2180 W790 Intersection (Room 4, Panel 7) – Roof to Floor

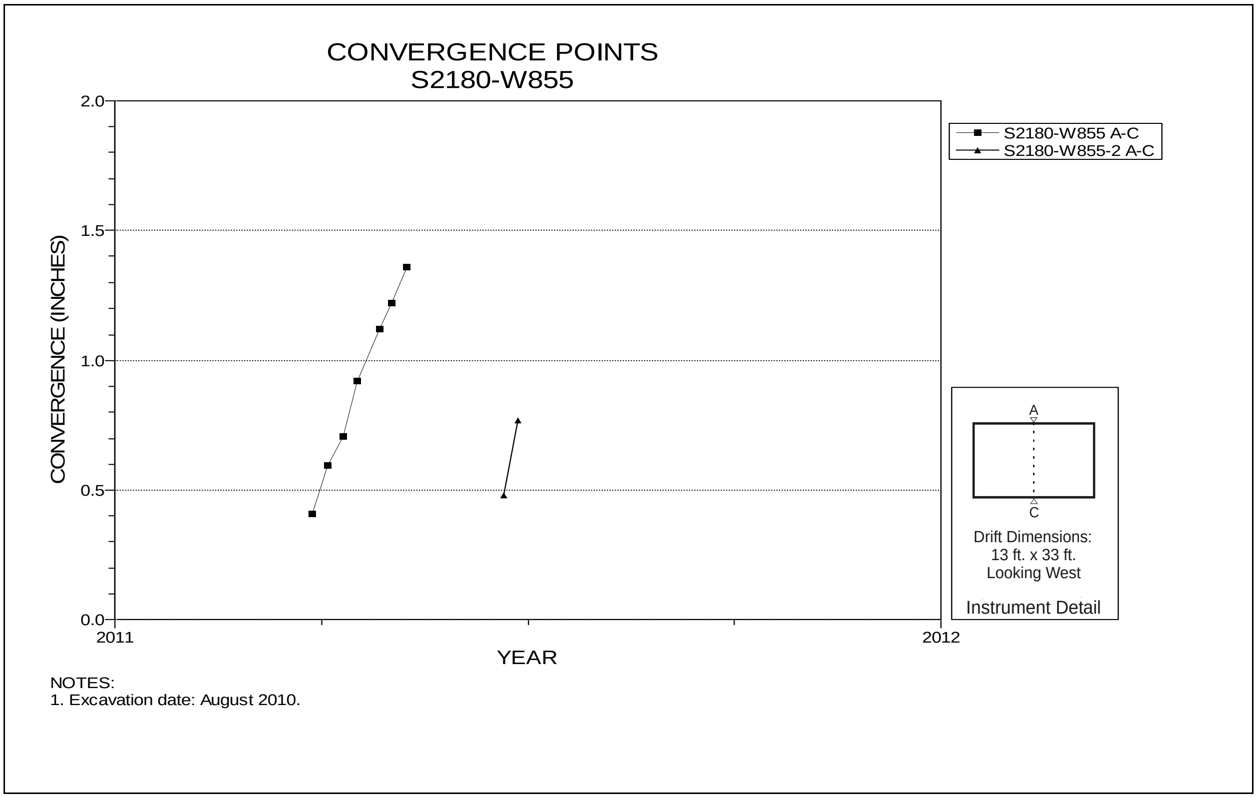


Figure 5-132 Convergence Point Array
S2180 W885 – Roof to Floor

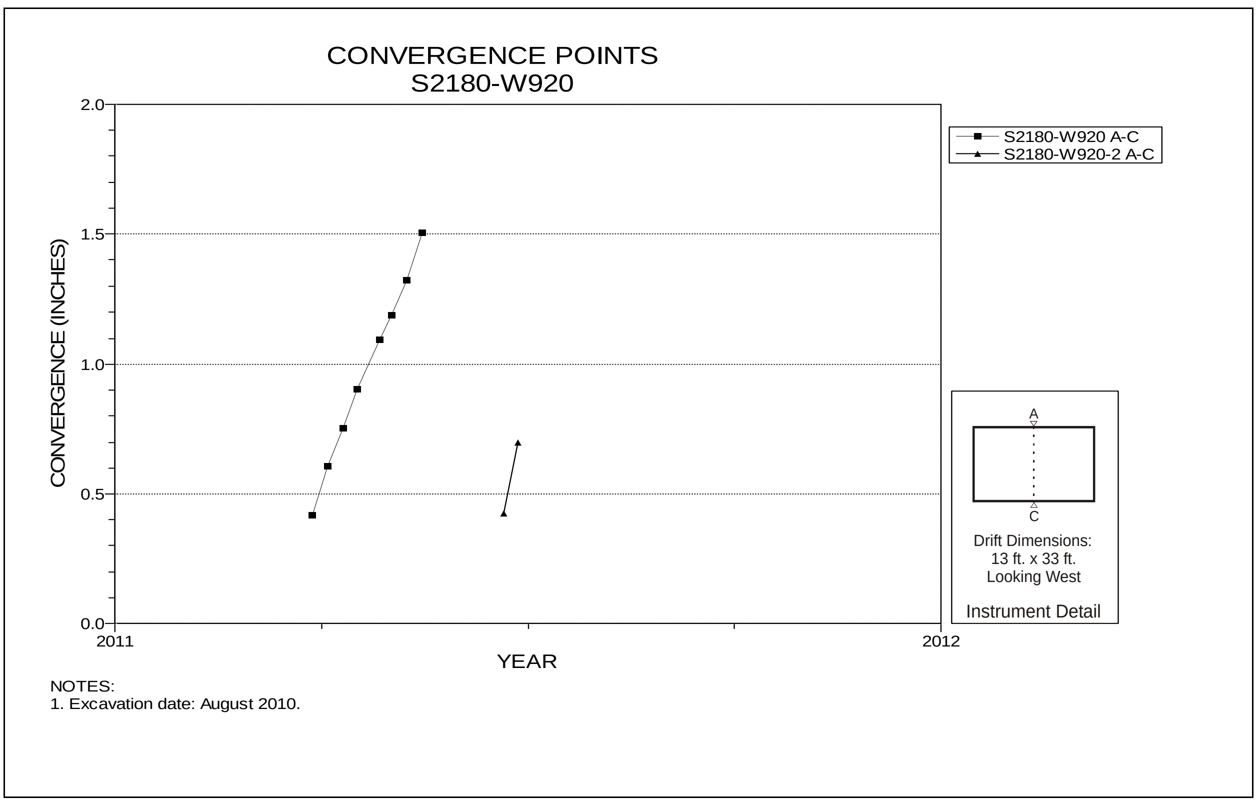


Figure 5-133 Convergence Point Array
S2180 W920 Intersection (Room 5, Panel 7) – Roof to Floor

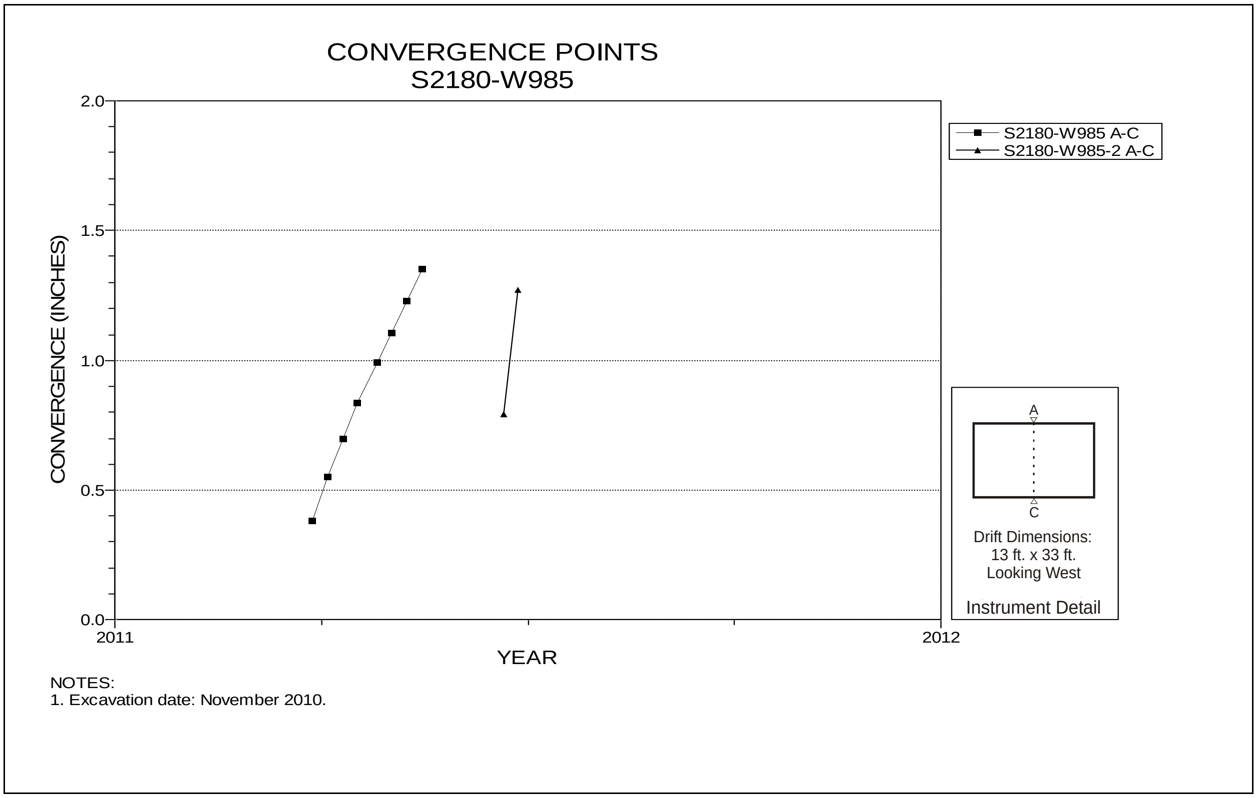


Figure 5-134 Convergence Point Array
S2180 W985 – Roof to Floor

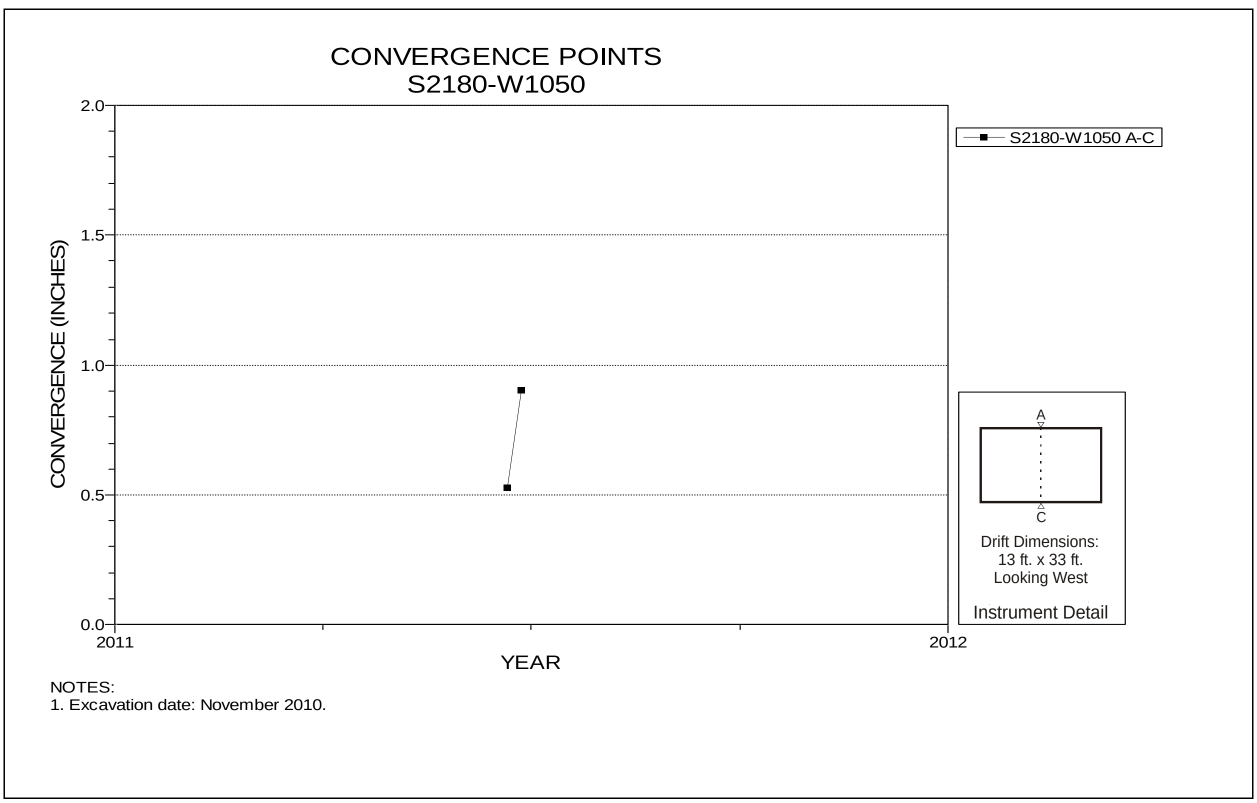


Figure 5-135 Convergence Point Array
S2180 W1050 Intersection (Room 6, Panel 7) – Roof to Floor

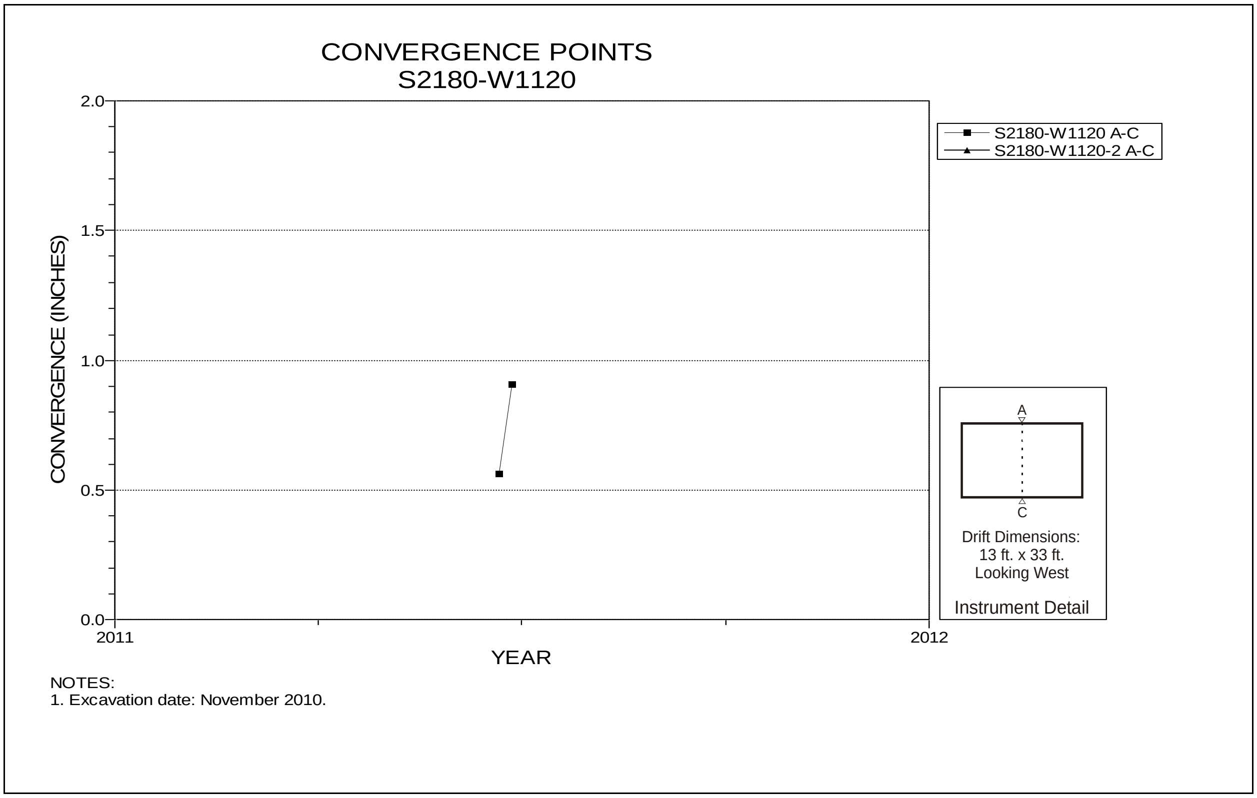


Figure 5-136 Convergence Point Array
S2180 W1120 – Roof to Floor

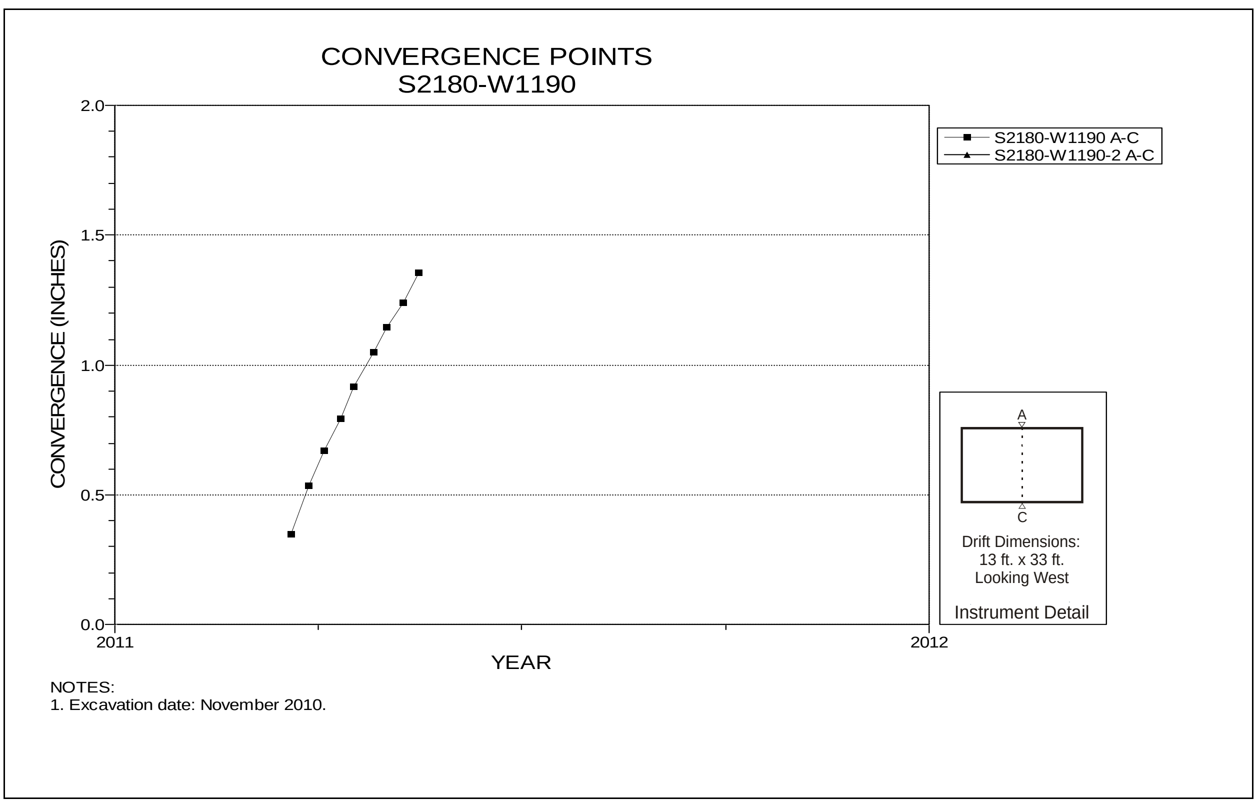


Figure 5-137 Convergence Point Array
S2180 W1190 Intersection (Room 7, Panel 7) – Roof to Floor

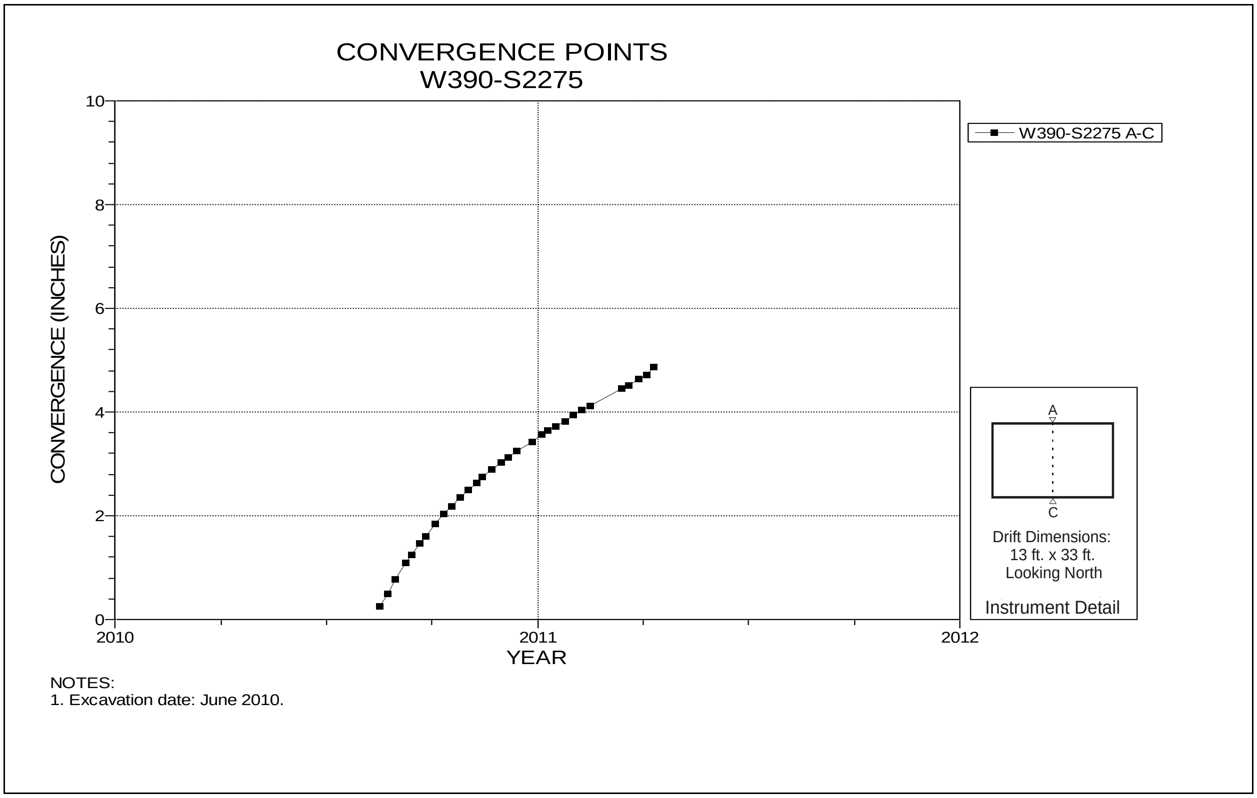


Figure 5-138 Convergence Point Array
Room 1, Panel 7 at W390 S2275 – Roof to Floor

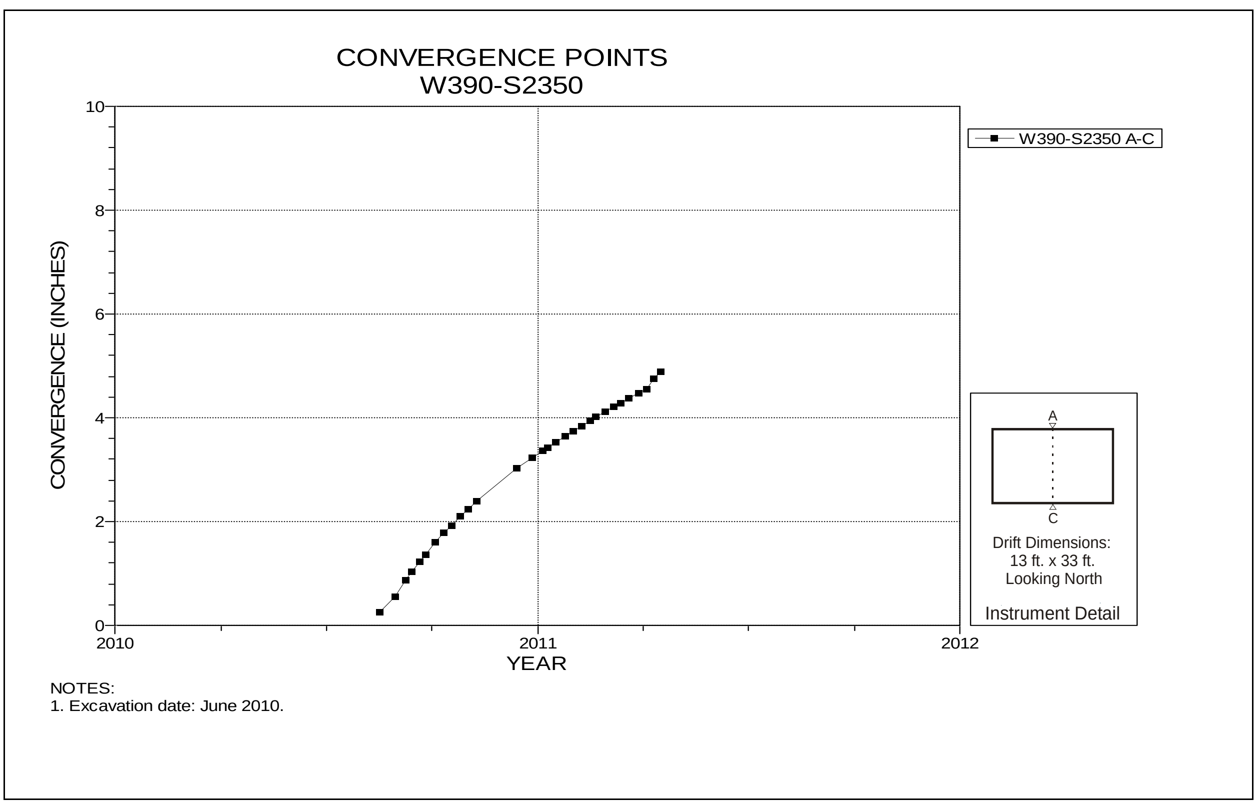


Figure 5-139 Convergence Point Array
Room 1, Panel 7 at W390 S2350– Room Center – Roof to Floor

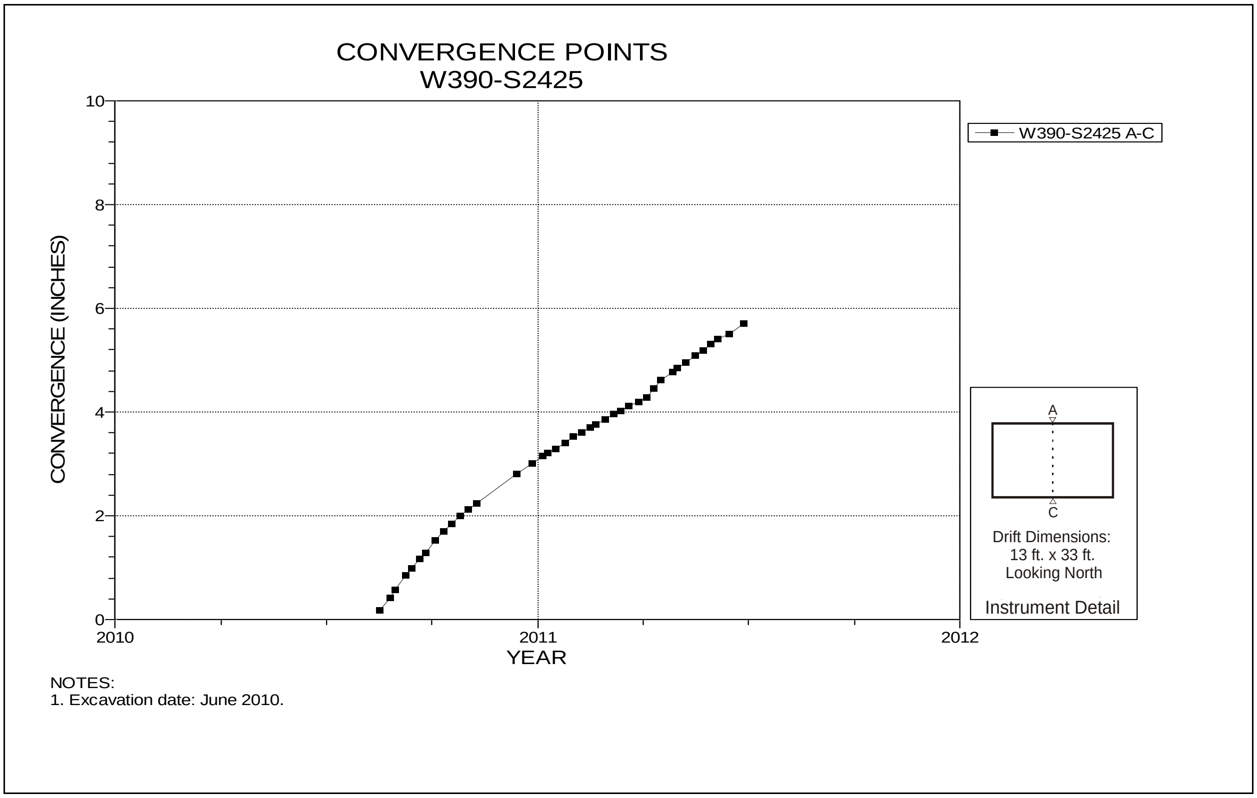


Figure 5-140 Convergence Point Array
Room 1, Panel 7 at W390 S2425 – Roof to Floor

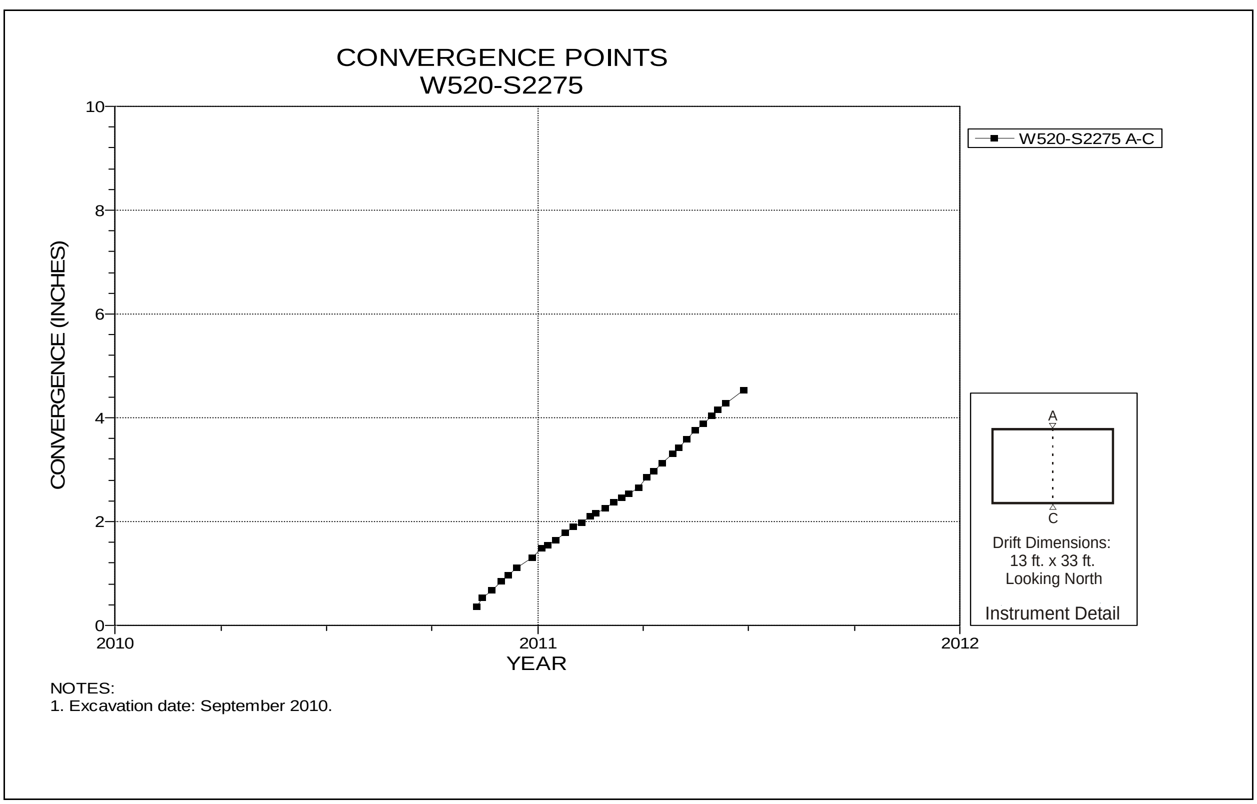


Figure 5-141 Convergence Point Array
Room 2, Panel 7 at W520 S2275 – Roof to Floor

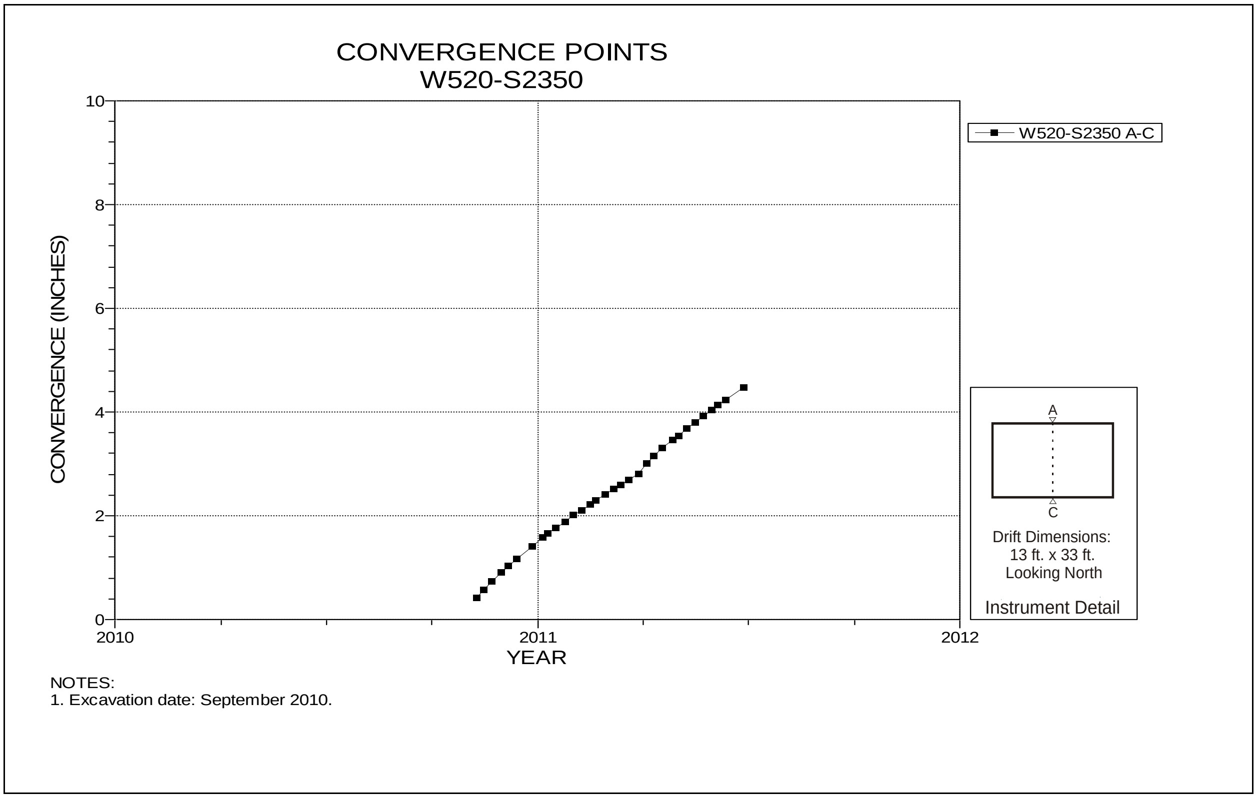


Figure 5-142 Convergence Point Array
Room 2, Panel 7 at W520 S2350– Room Center – Roof to Floor

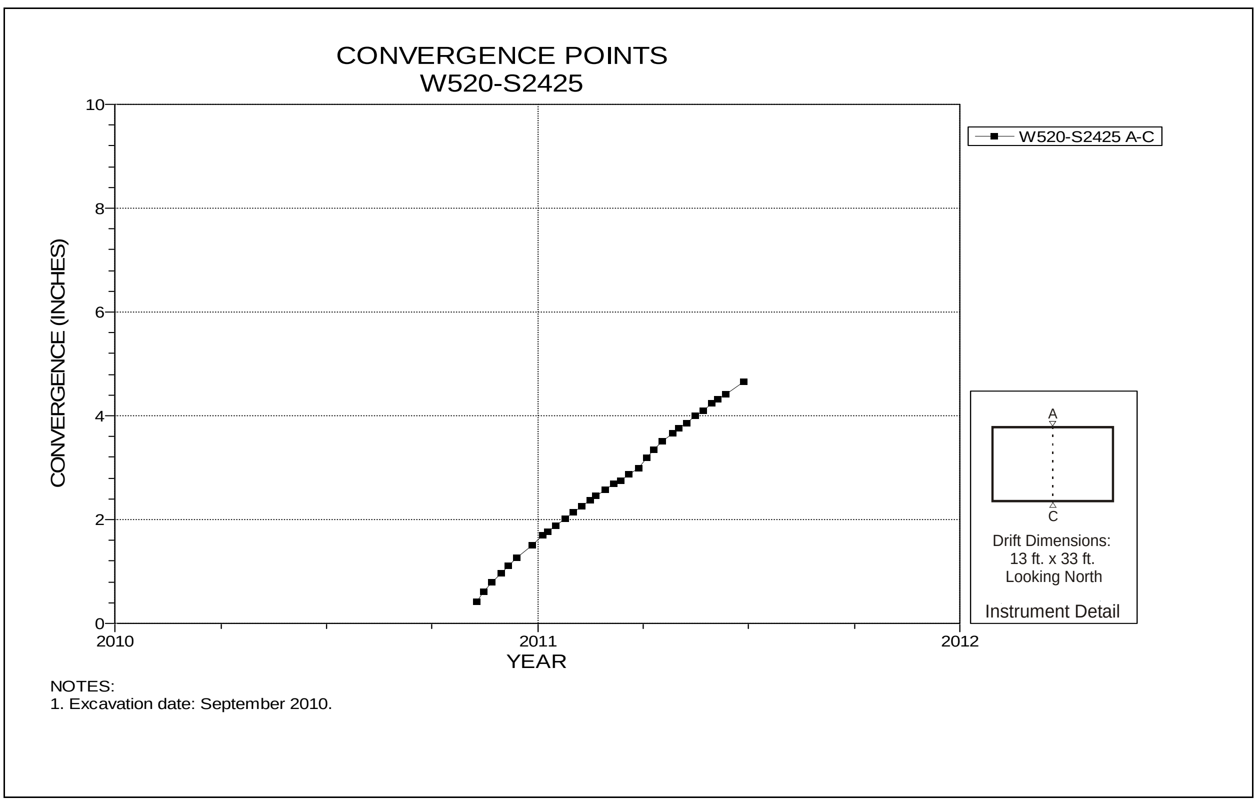


Figure 5-143 Convergence Point Array
Room 2, Panel 7 at W520 S2425 – Roof to Floor

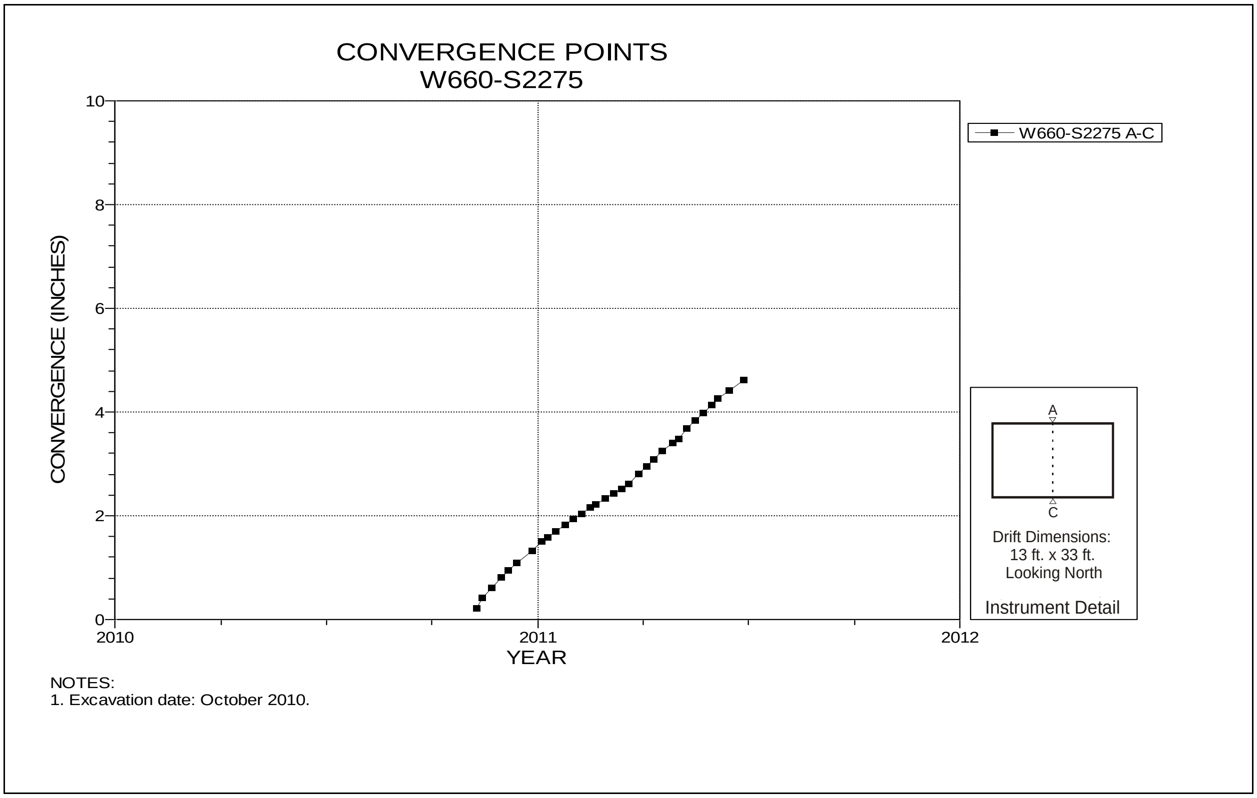


Figure 5-144 Convergence Point Array
Room 3, Panel 7 at W660 S2275 – Roof to Floor

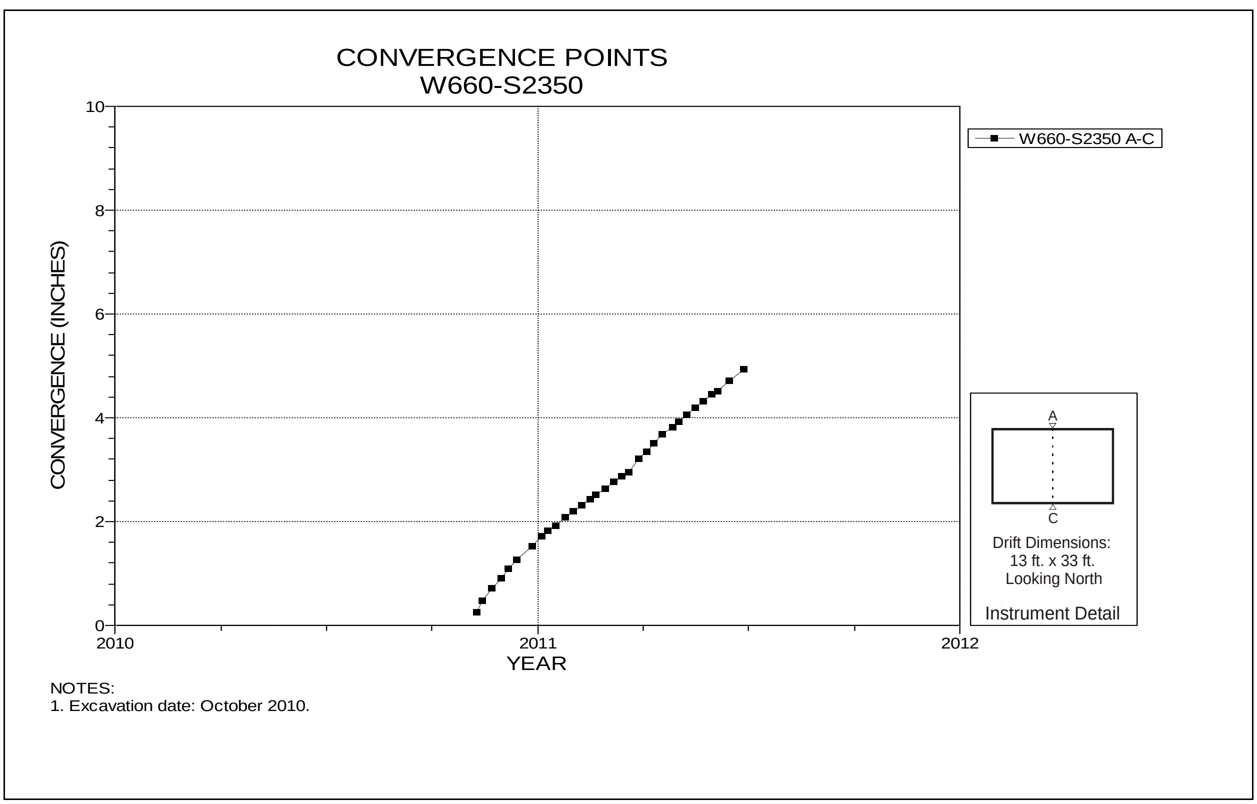


Figure 5-145 Convergence Point Array
Room 3, Panel 7 at W660 S2350– Room Center – Roof to Floor

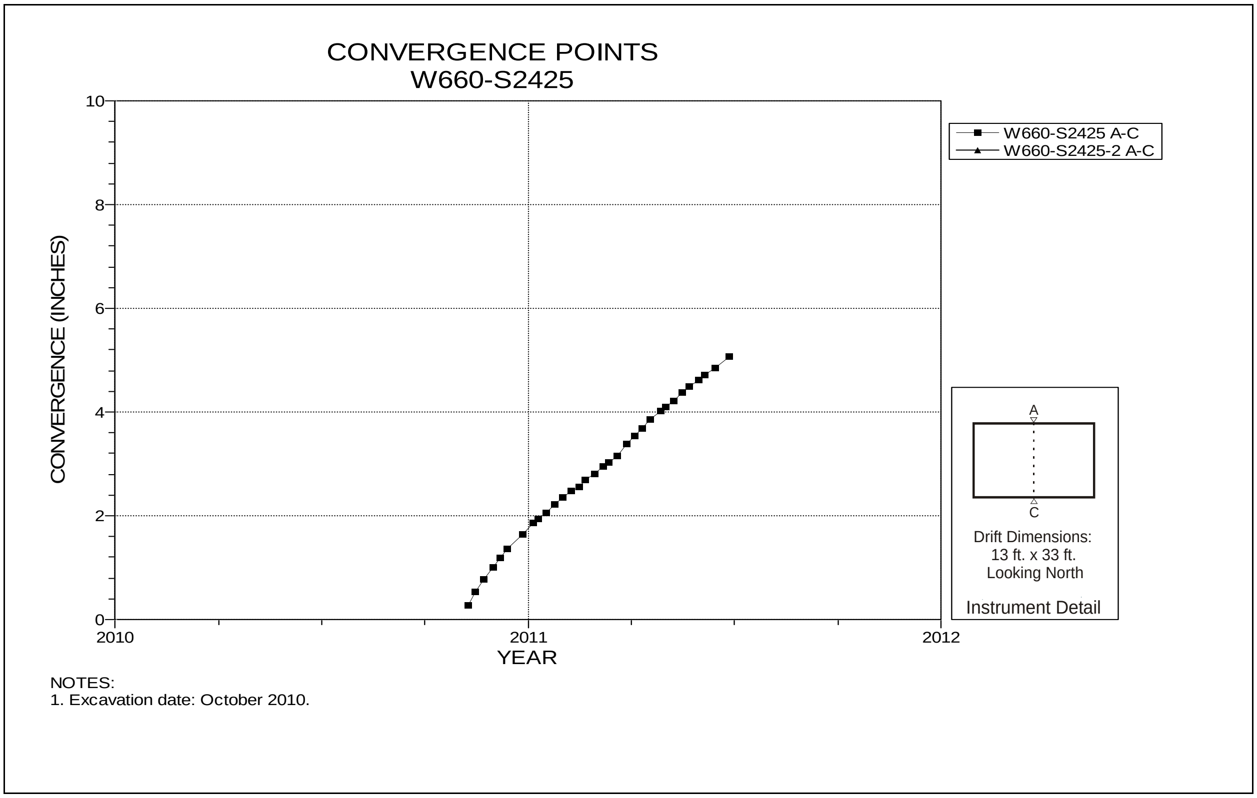


Figure 5-146 Convergence Point Array
Room 3, Panel 7 at W660 S2425 – Roof to Floor

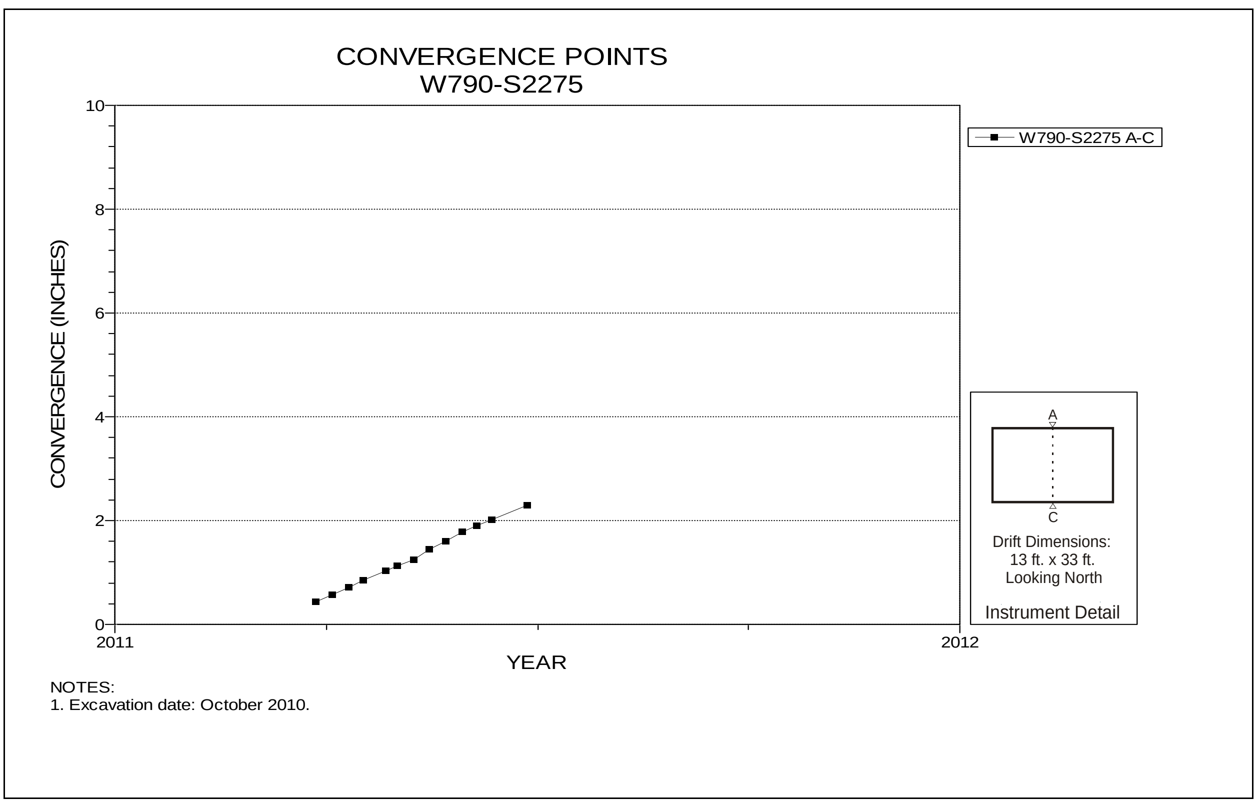


Figure 5-147 Convergence Point Array
Room 4, Panel 7 at W790 S2275 – Roof to Floor

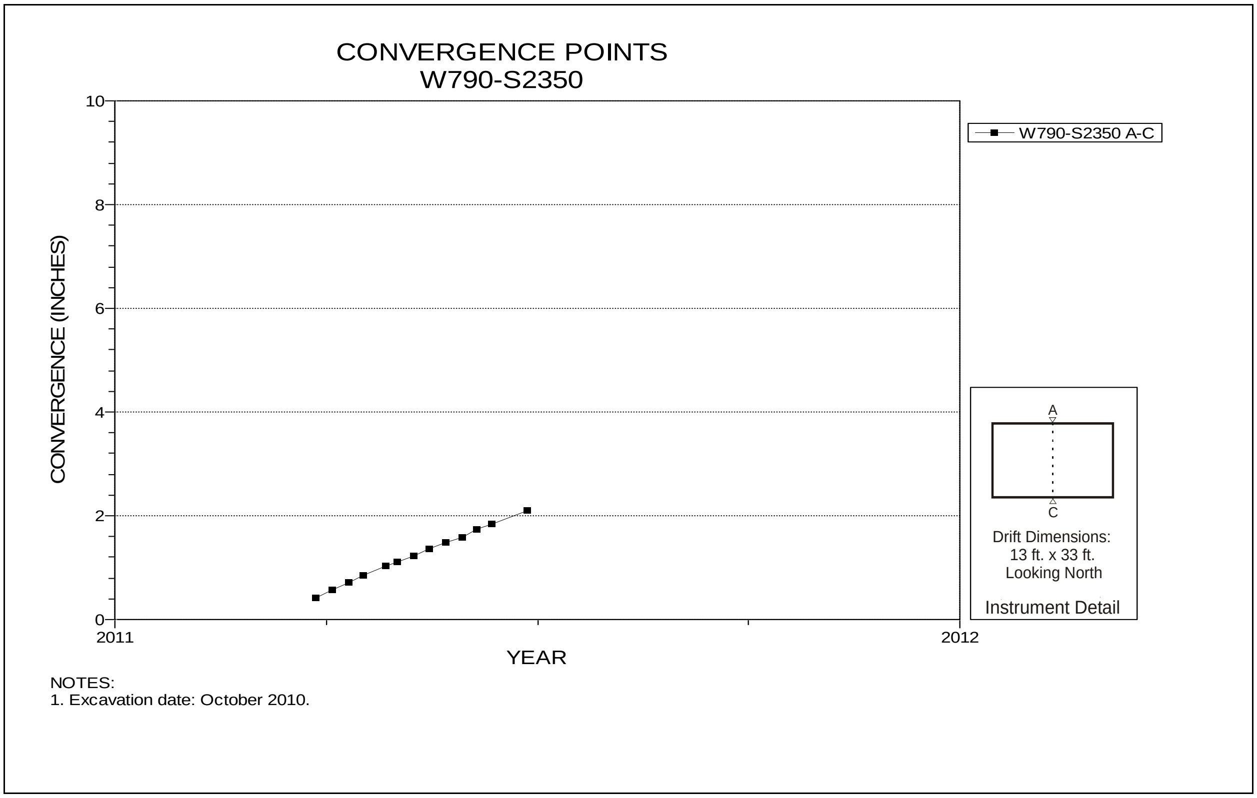


Figure 5-148 Convergence Point Array
Room 4, Panel 7 at W790 S2350– Room Center – Roof to Floor

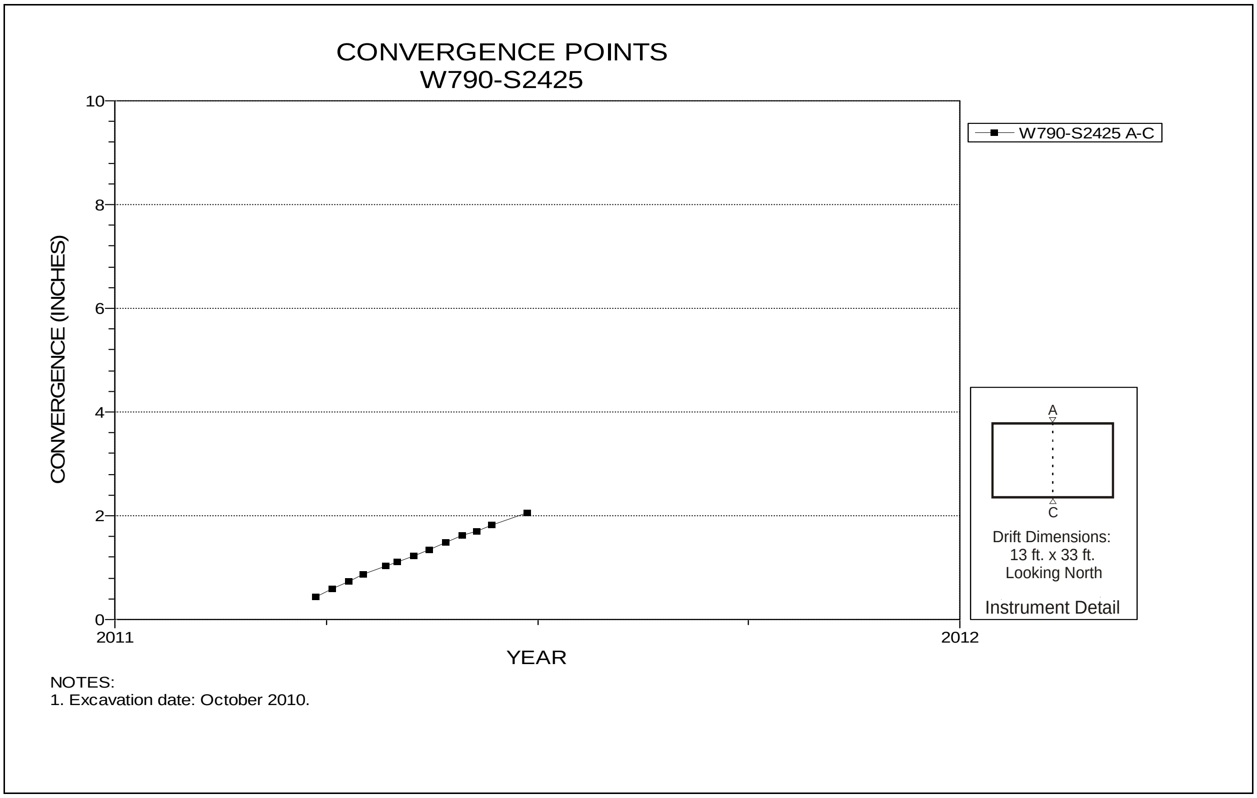


Figure 5-149 Convergence Point Array
Room 4, Panel 7 at W790 S2425 – Roof to Floor

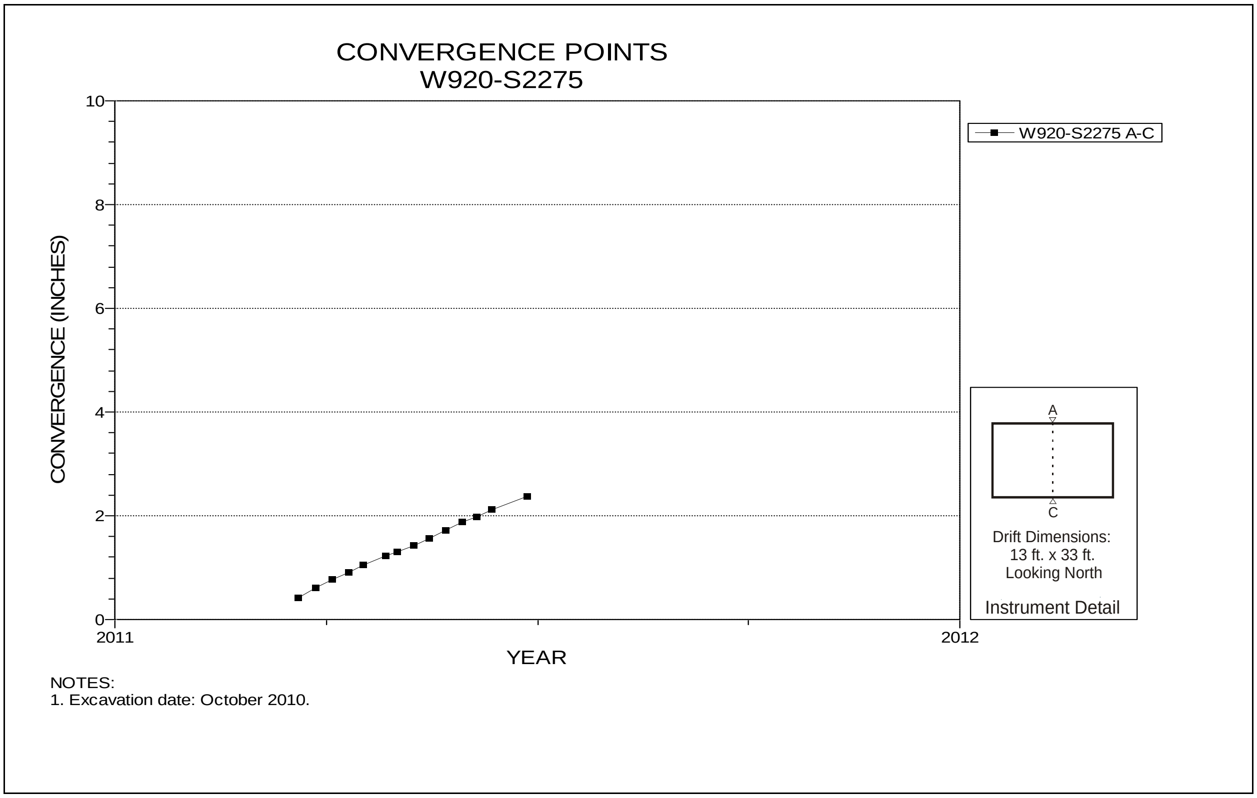


Figure 5-150 Convergence Point Array
Room 5, Panel 7 at W920 S2275 – Roof to Floor

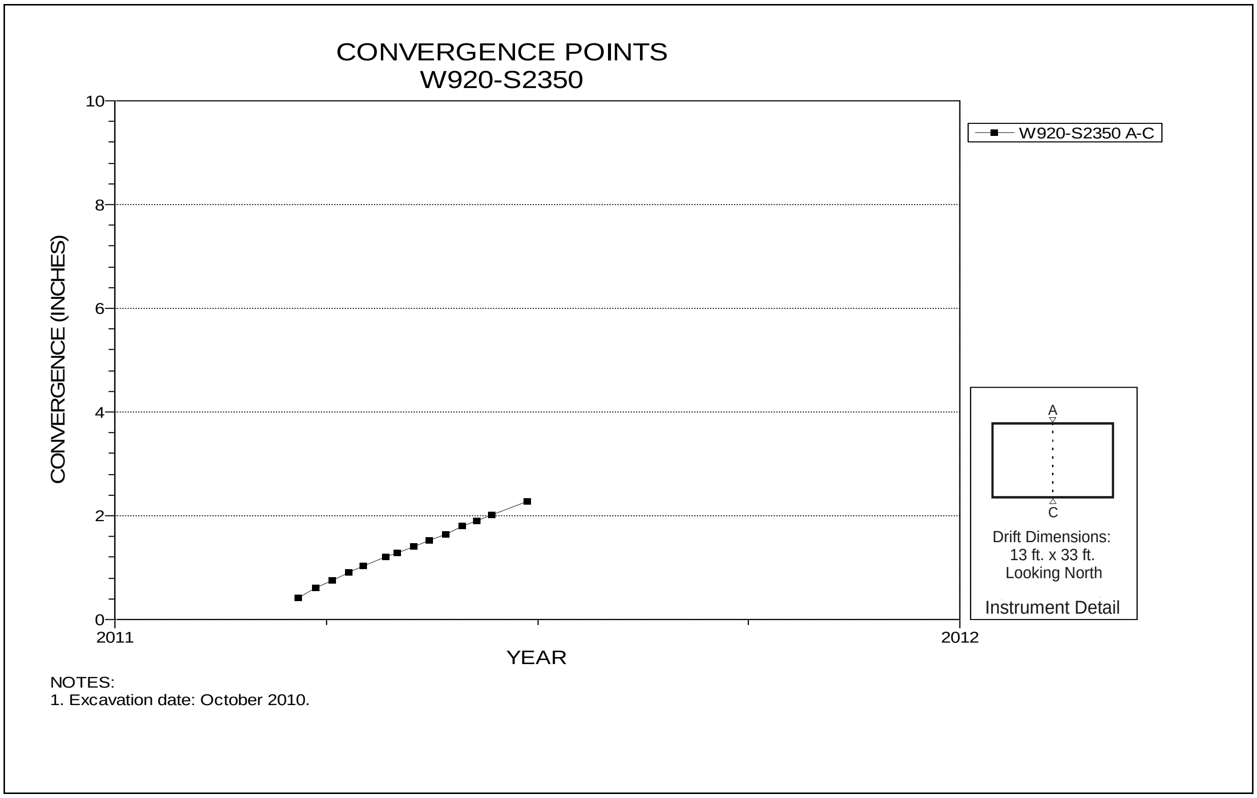


Figure 5-151 Convergence Point Array
Room 5, Panel 7 at W920 S2350– Room Center – Roof to Floor

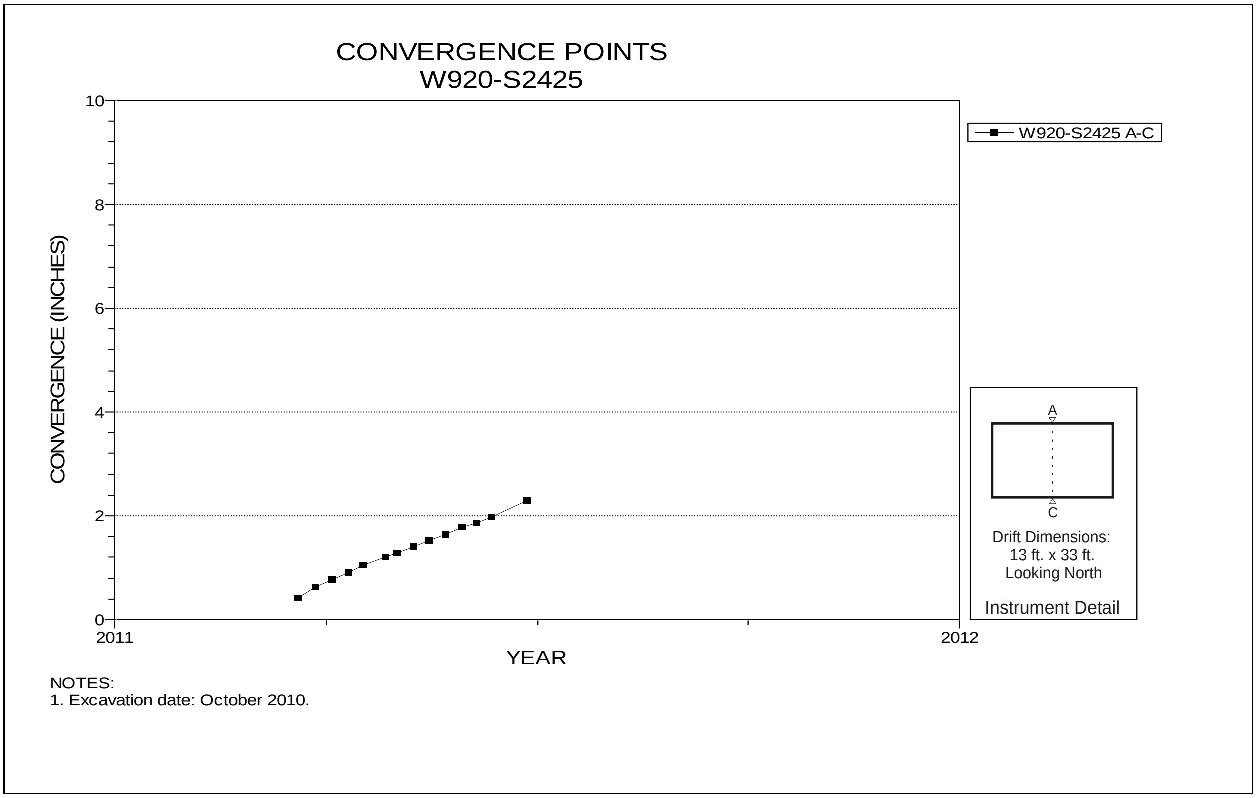


Figure 5-152 Convergence Point Array
Room 5, Panel 7 at W920 S2425 – Roof to Floor

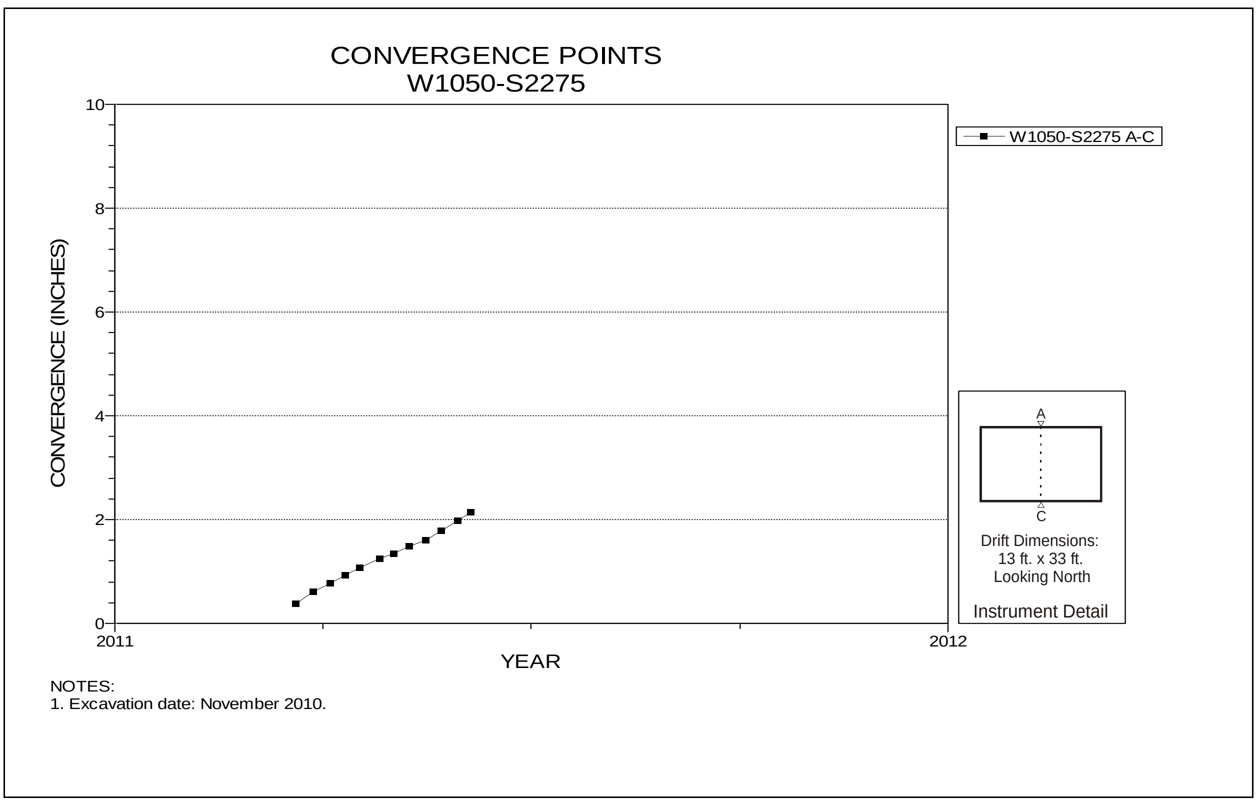


Figure 5-153 Convergence Point Array
Room 6, Panel 7 at W1050 S2275 – Roof to Floor

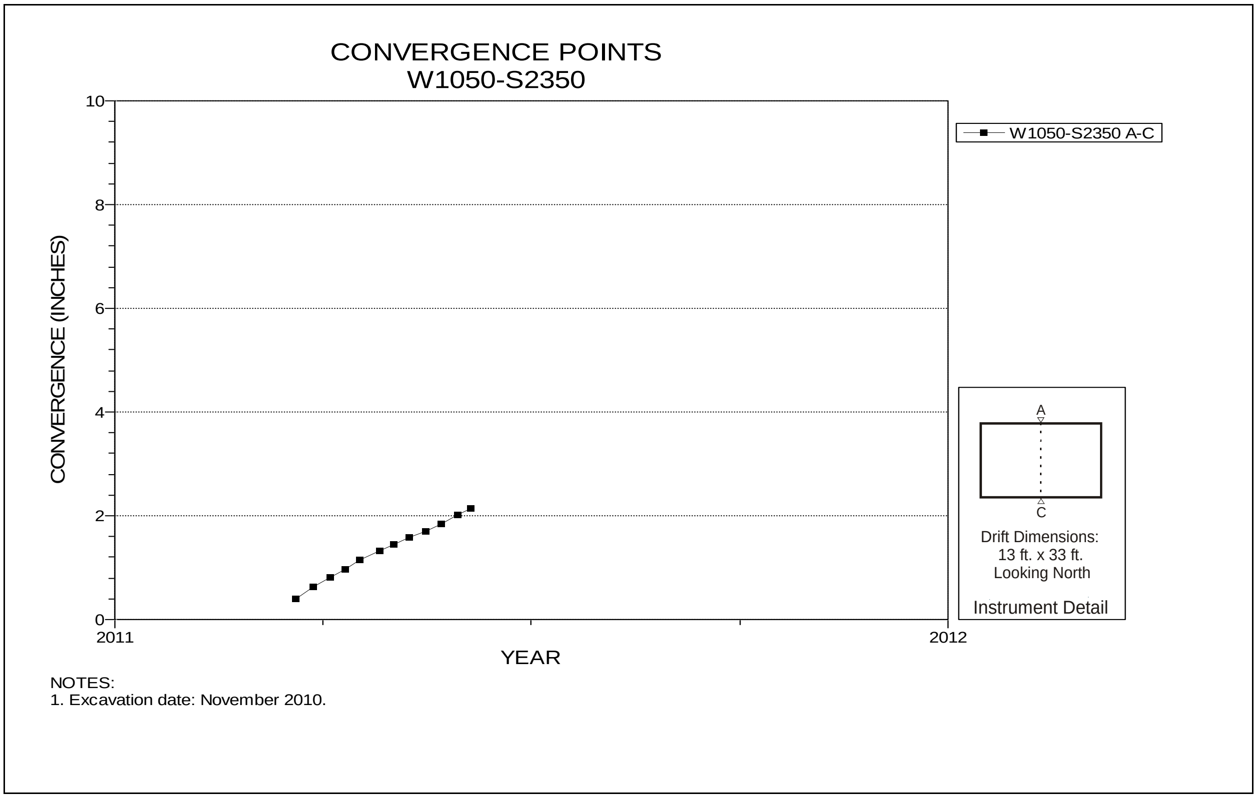


Figure 5-154 Convergence Point Array
Room 6, Panel 7 at W1050 S2350– Room Center – Roof to Floor

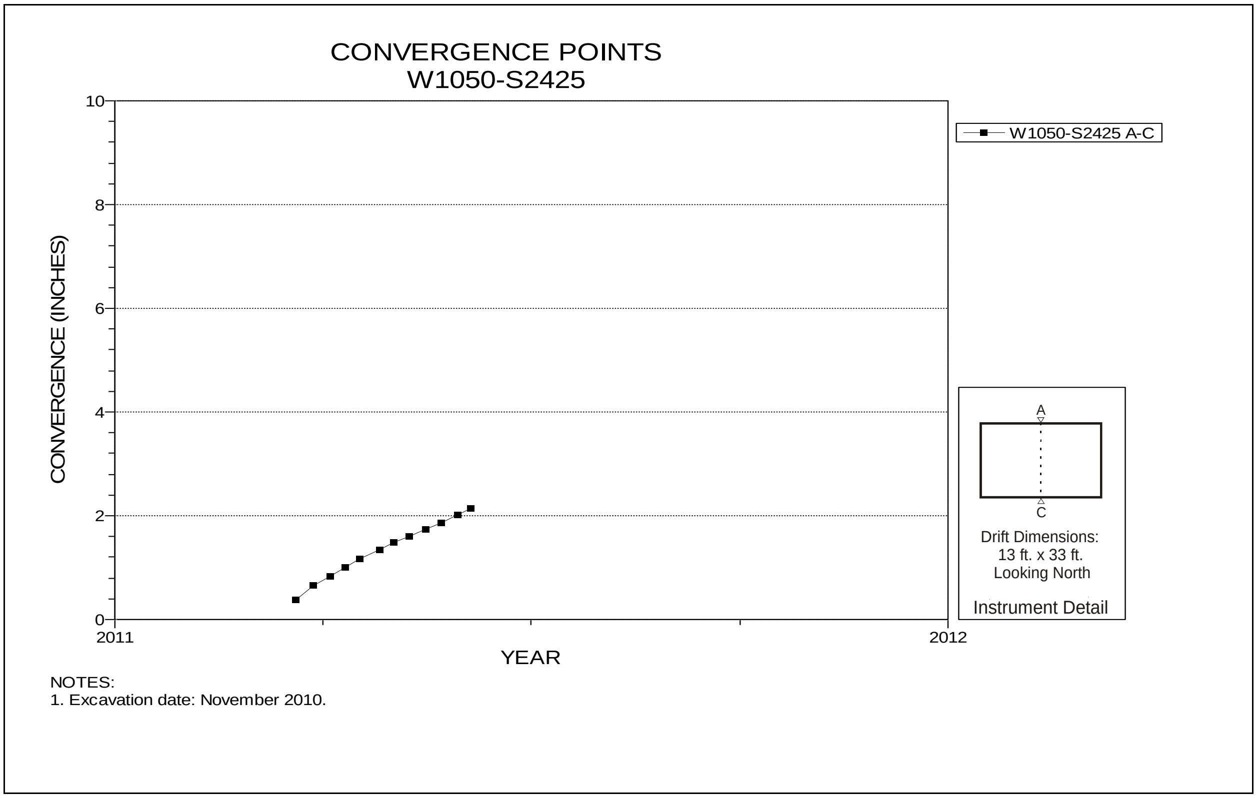


Figure 5-155 Convergence Point Array
Room 6, Panel 7 at W1050 S2425 – Roof to Floor

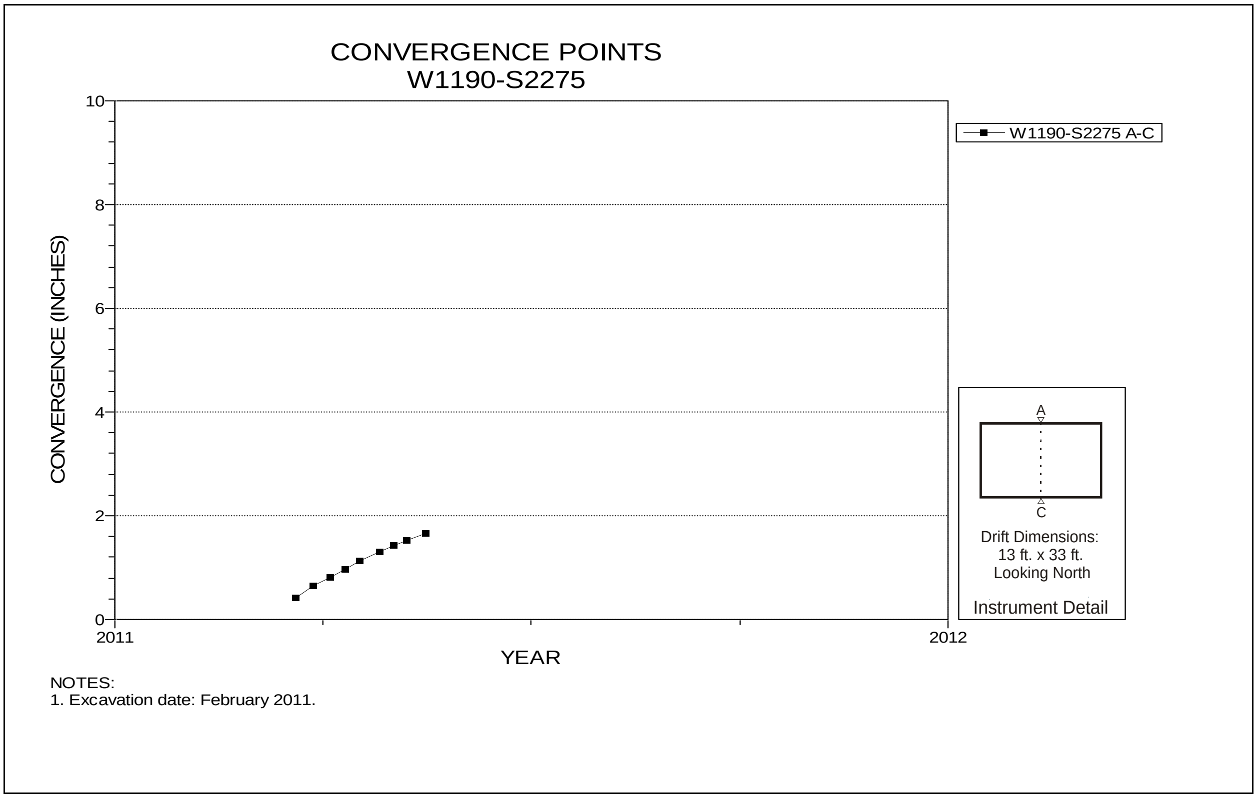


Figure 5-156 Convergence Point Array
Room 7, Panel 7 at W1190 S2275 – Roof to Floor

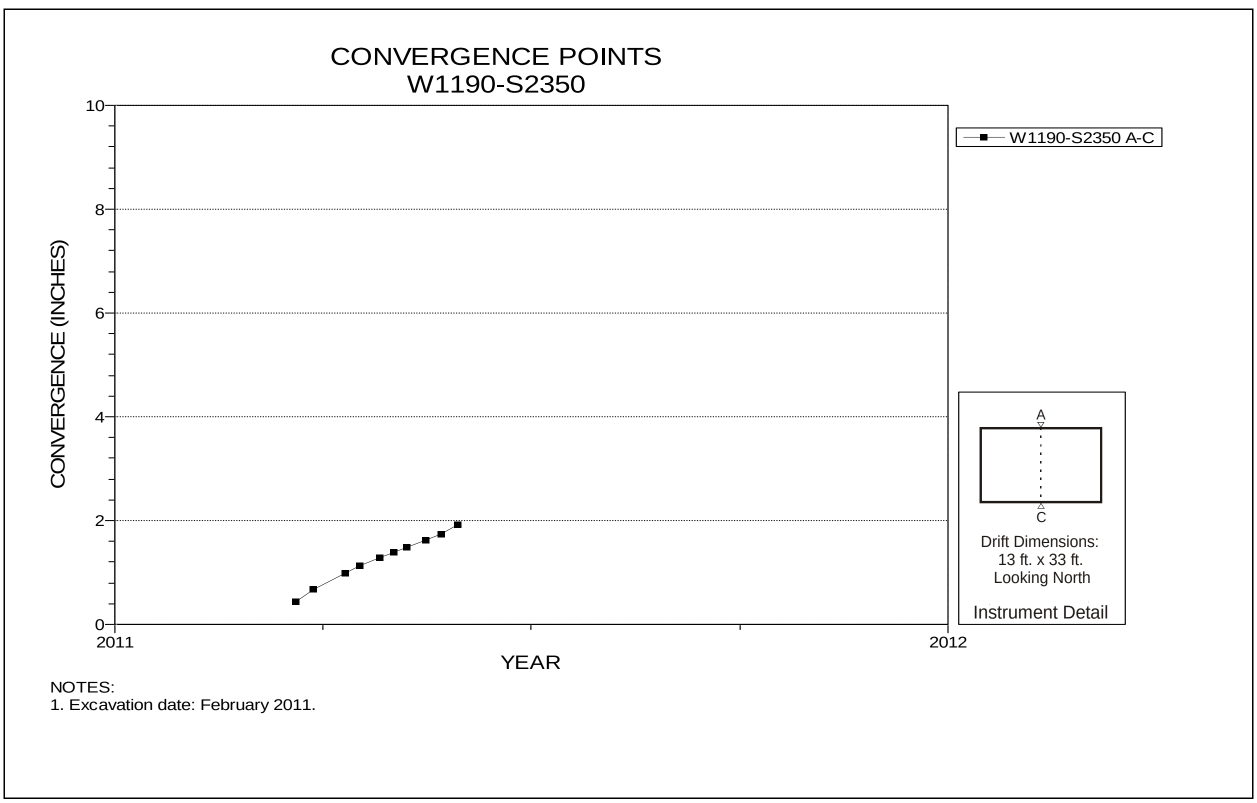


Figure 5-157 Convergence Point Array
Room 7, Panel 7 at W1190 S2350– Room Center – Roof to Floor

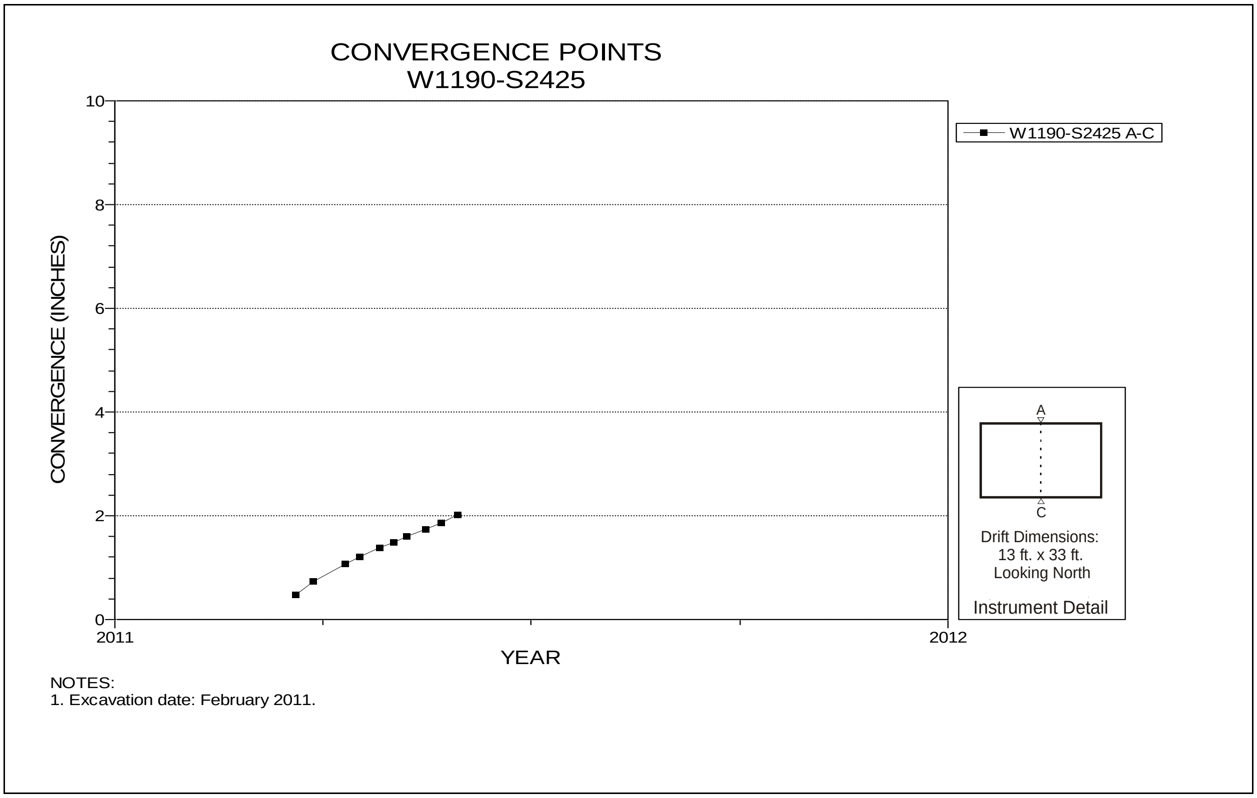


Figure 5-158 Convergence Point Array
Room 7, Panel 7 at W1190 S2425 – Roof to Floor

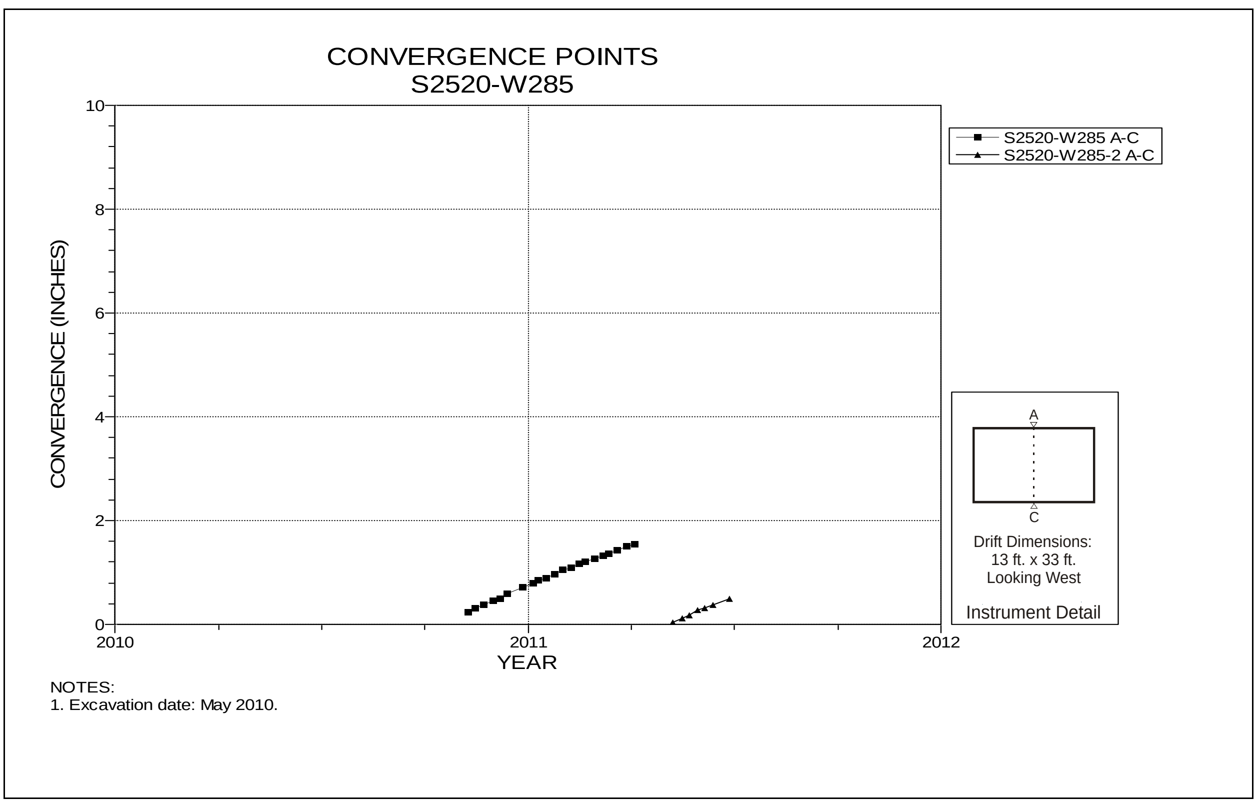


Figure 5-159 Convergence Point Array
S3080 W285 – Roof to Floor

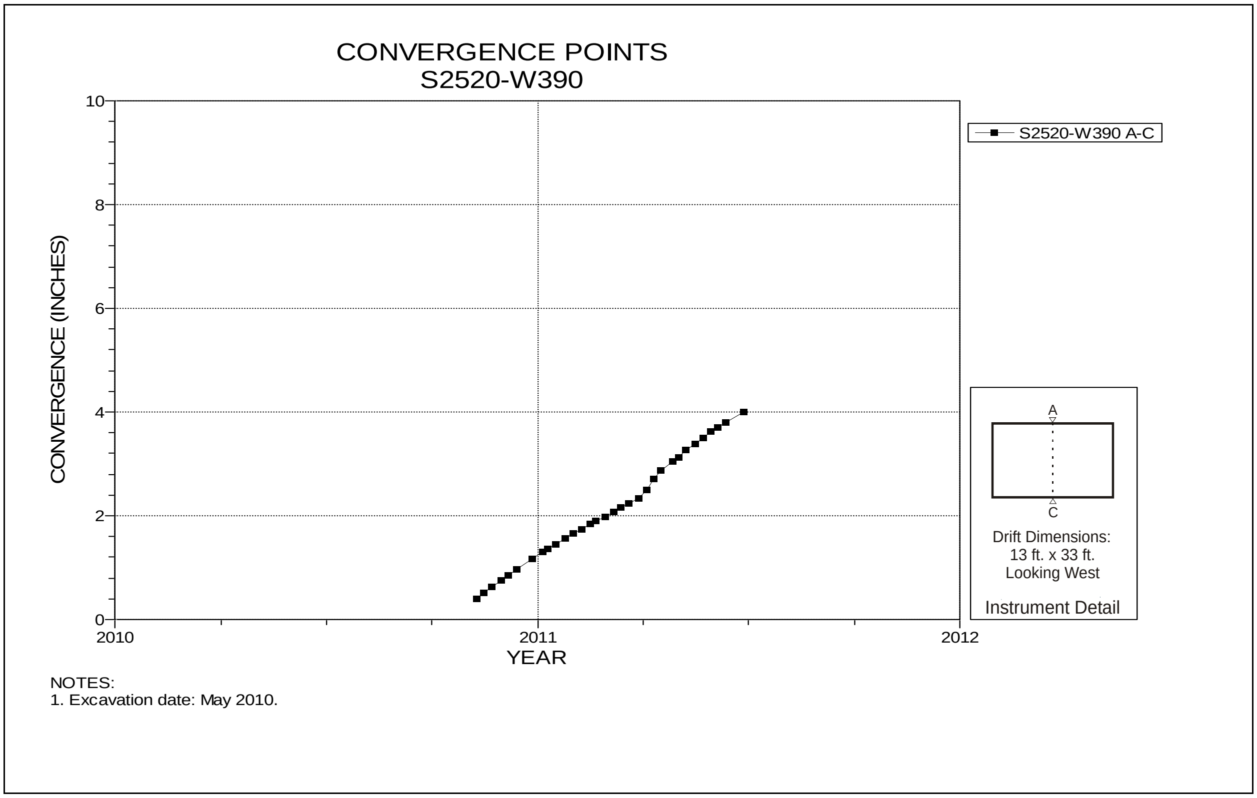


Figure 5-160 Convergence Point Array
S2520 W390 Intersection (Room 1, Panel 7) – Roof to Floor

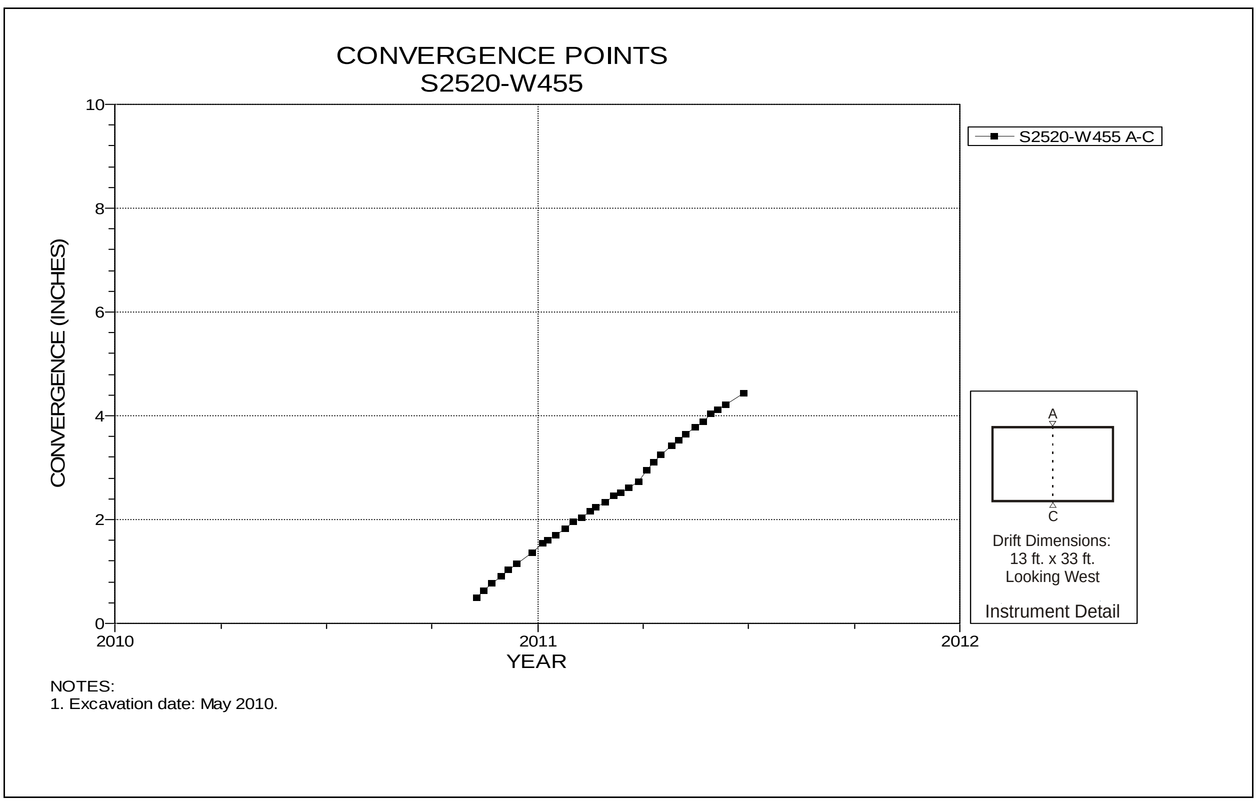


Figure 5-161 Convergence Point Array
S2520 W455 – Roof to Floor

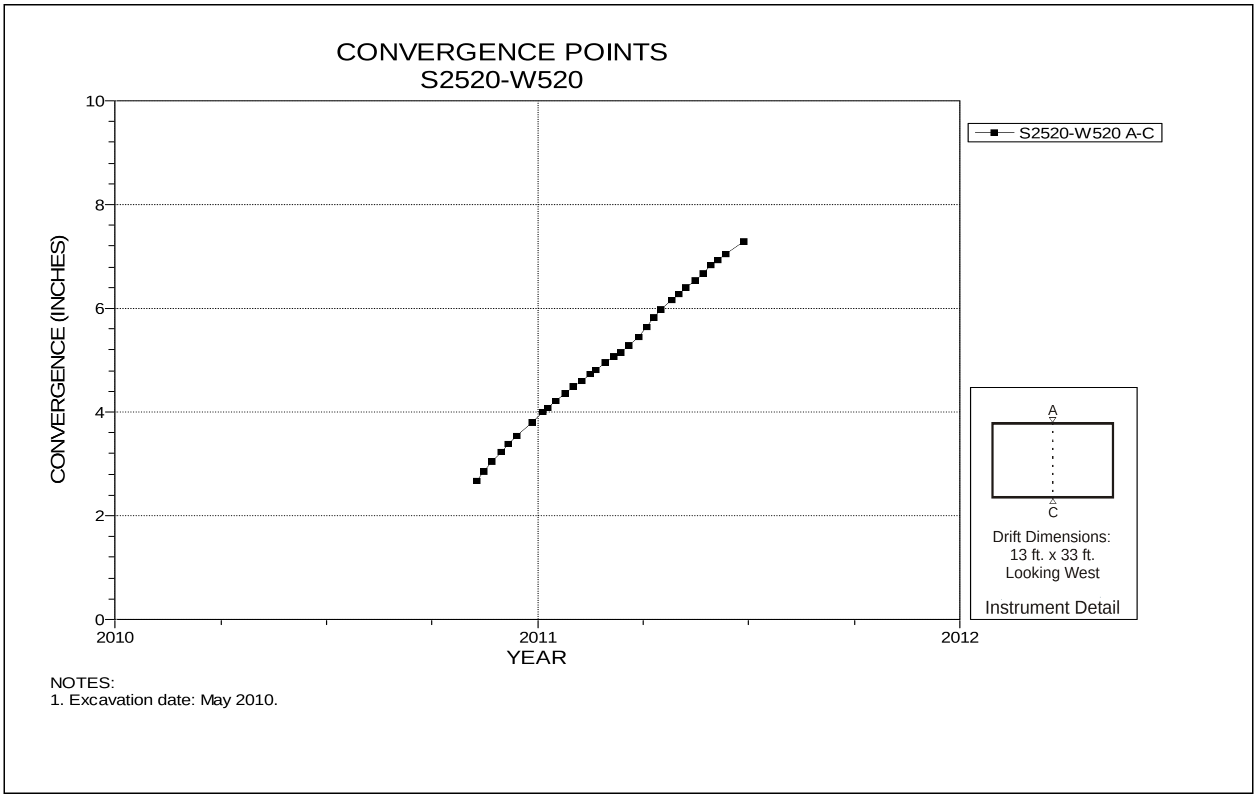


Figure 5-162 Convergence Point Array
S2520 W520 Intersection (Room 2, Panel 7) – Roof to Floor

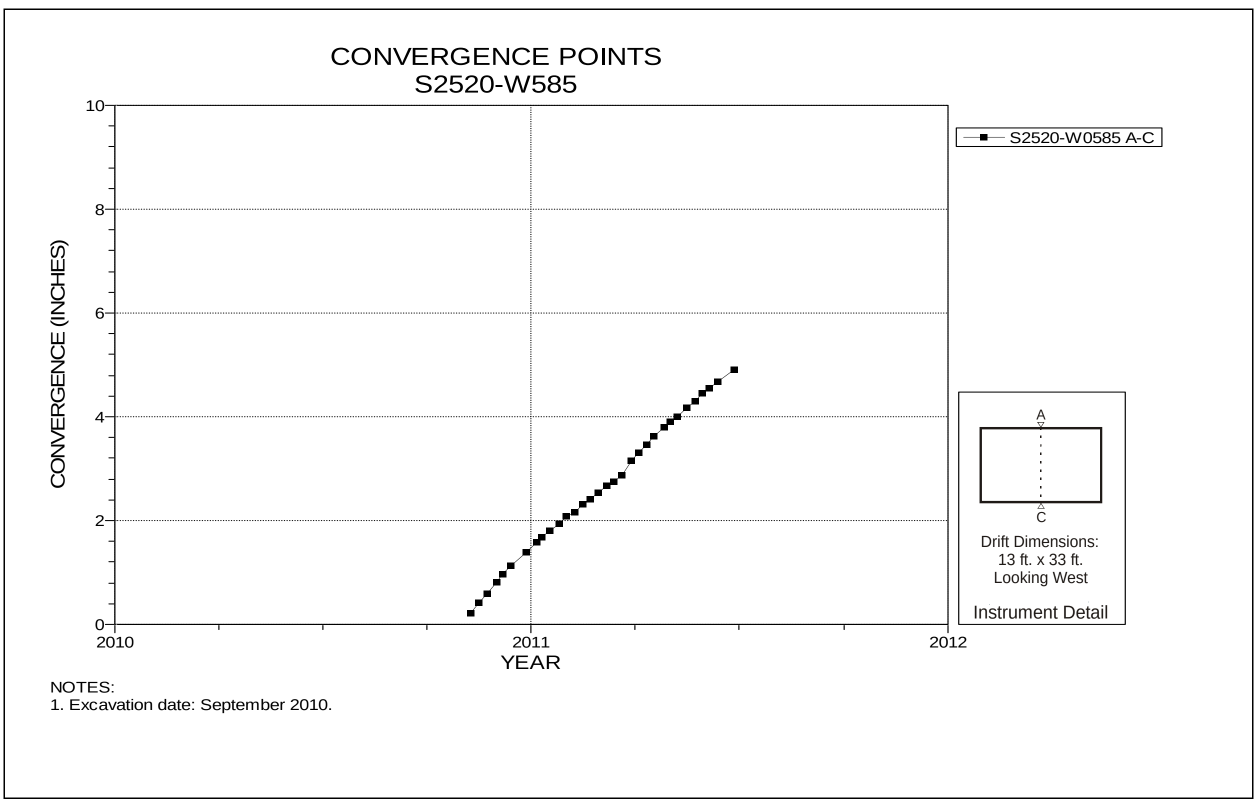


Figure 5-163 Convergence Point Array
S2520 W585 – Roof to Floor

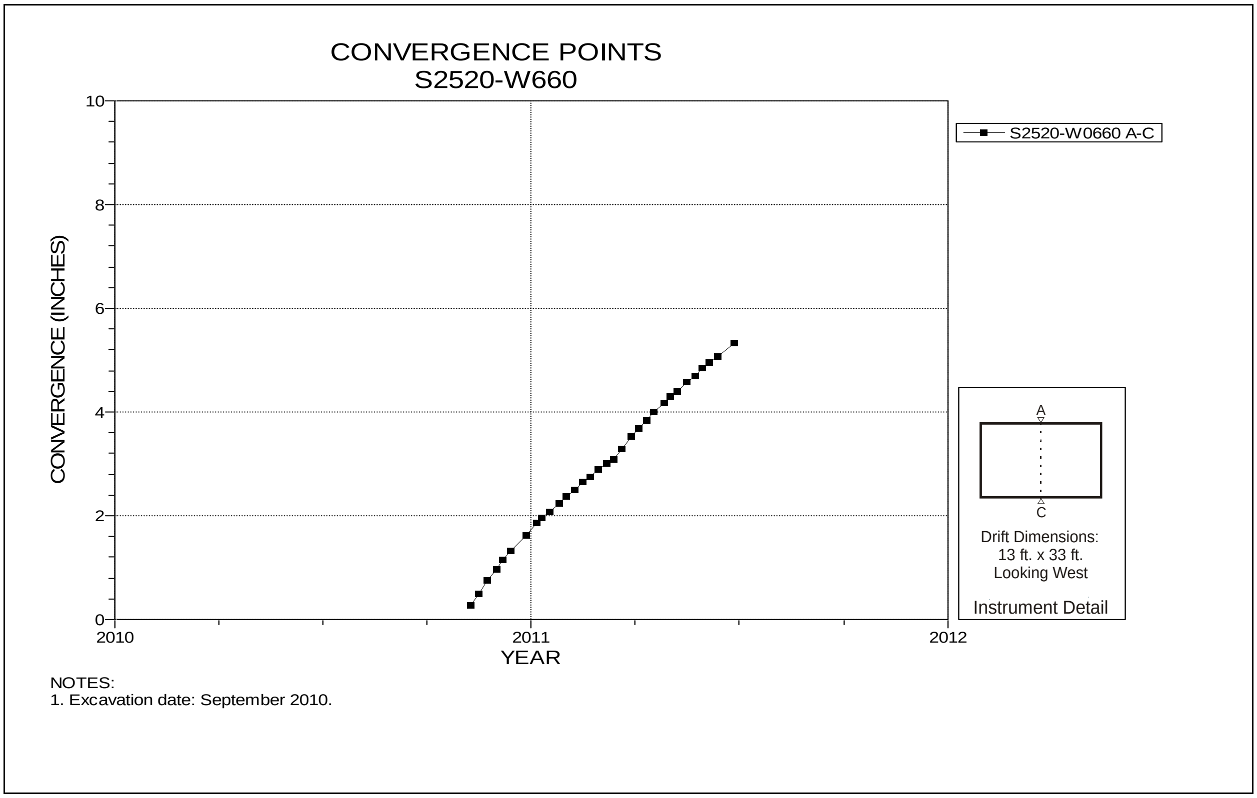


Figure 5-164 Convergence Point Array
S2520 W660 Intersection (Room 3, Panel 7) – Roof to Floor

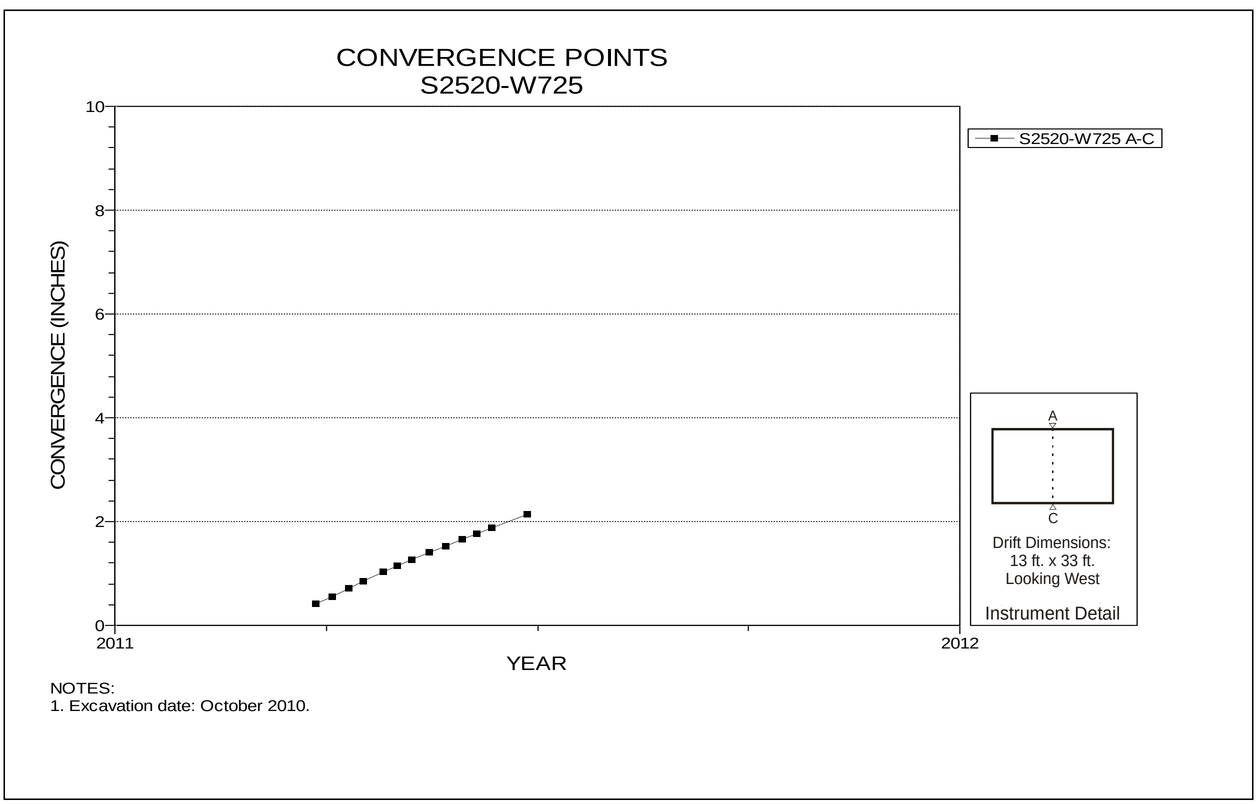


Figure 5-165 Convergence Point Array
S2520 W725 – Roof to Floor

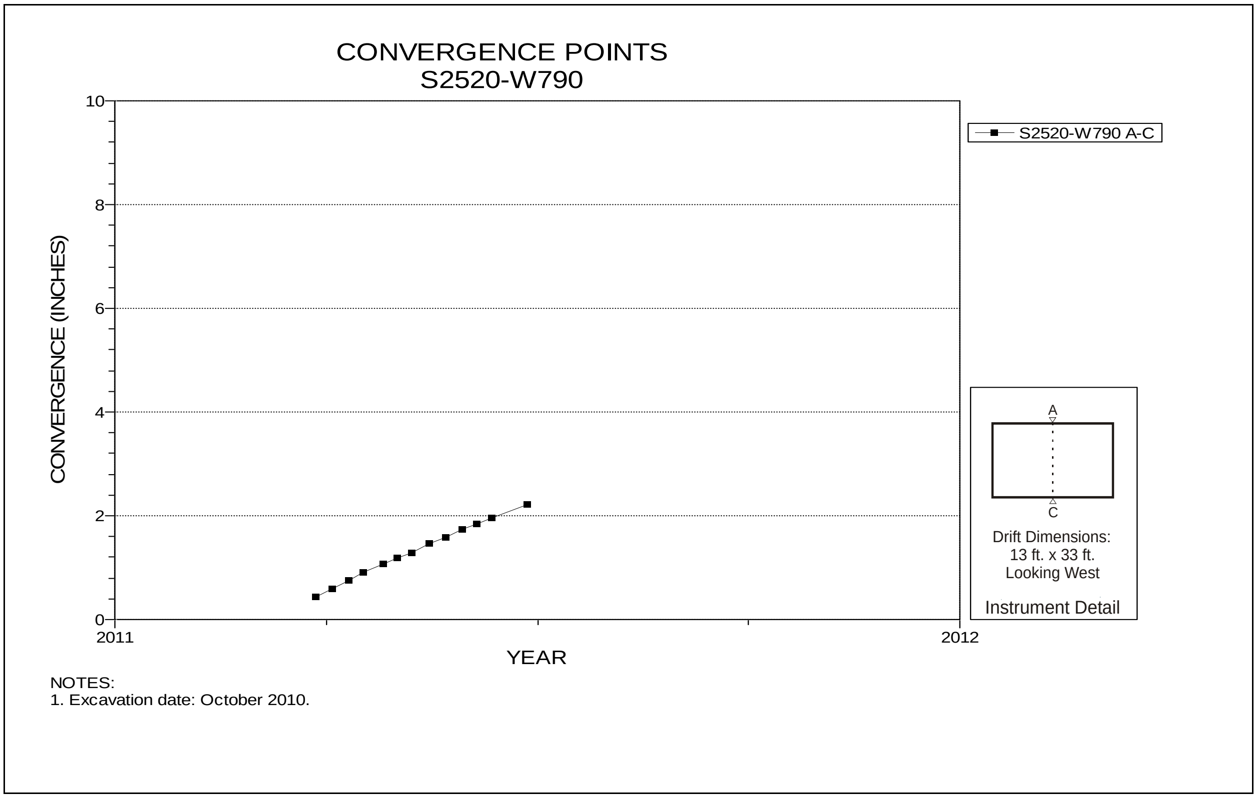


Figure 5-166 Convergence Point Array
S2520 W790 Intersection (Room 4, Panel 7) – Roof to Floor

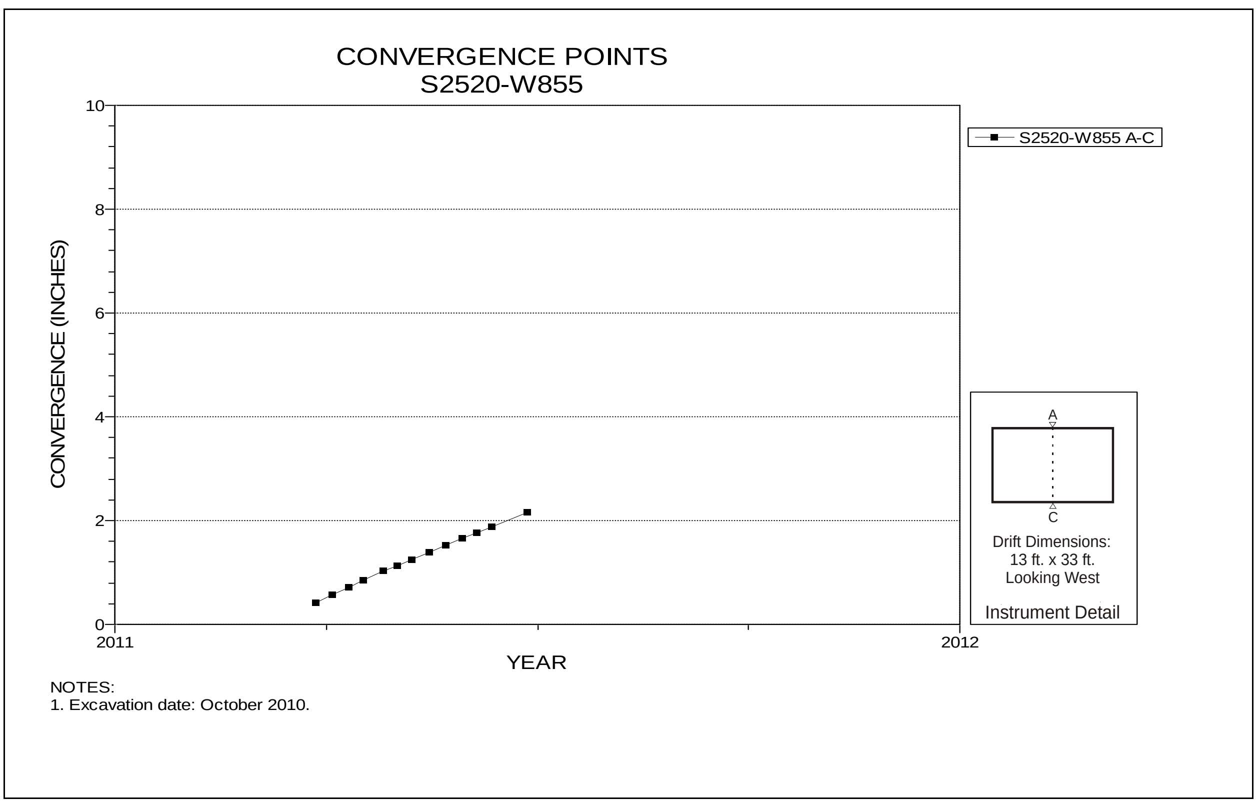


Figure 5-167 Convergence Point Array
S2520 W855 – Roof to Floor

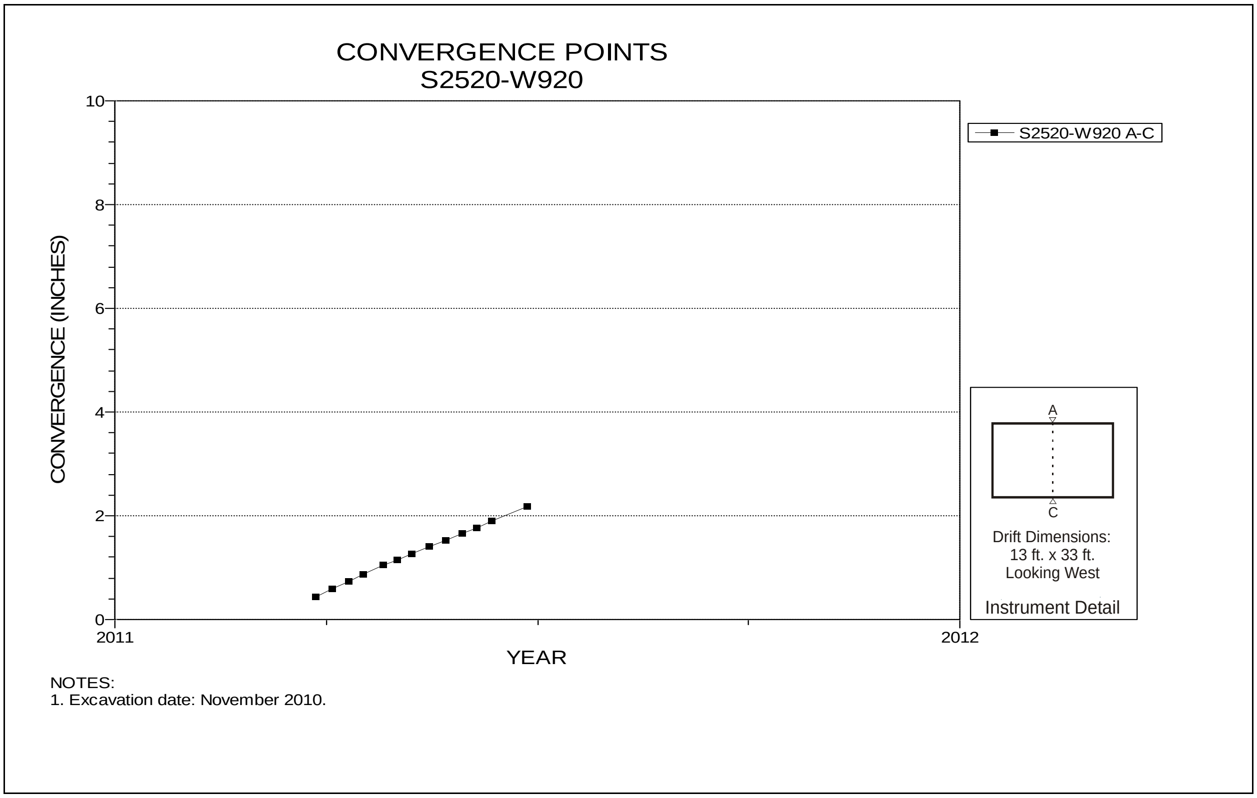


Figure 5-168 Convergence Point Array
S2520 W920 Intersection (Room 5, Panel 7) – Roof to Floor

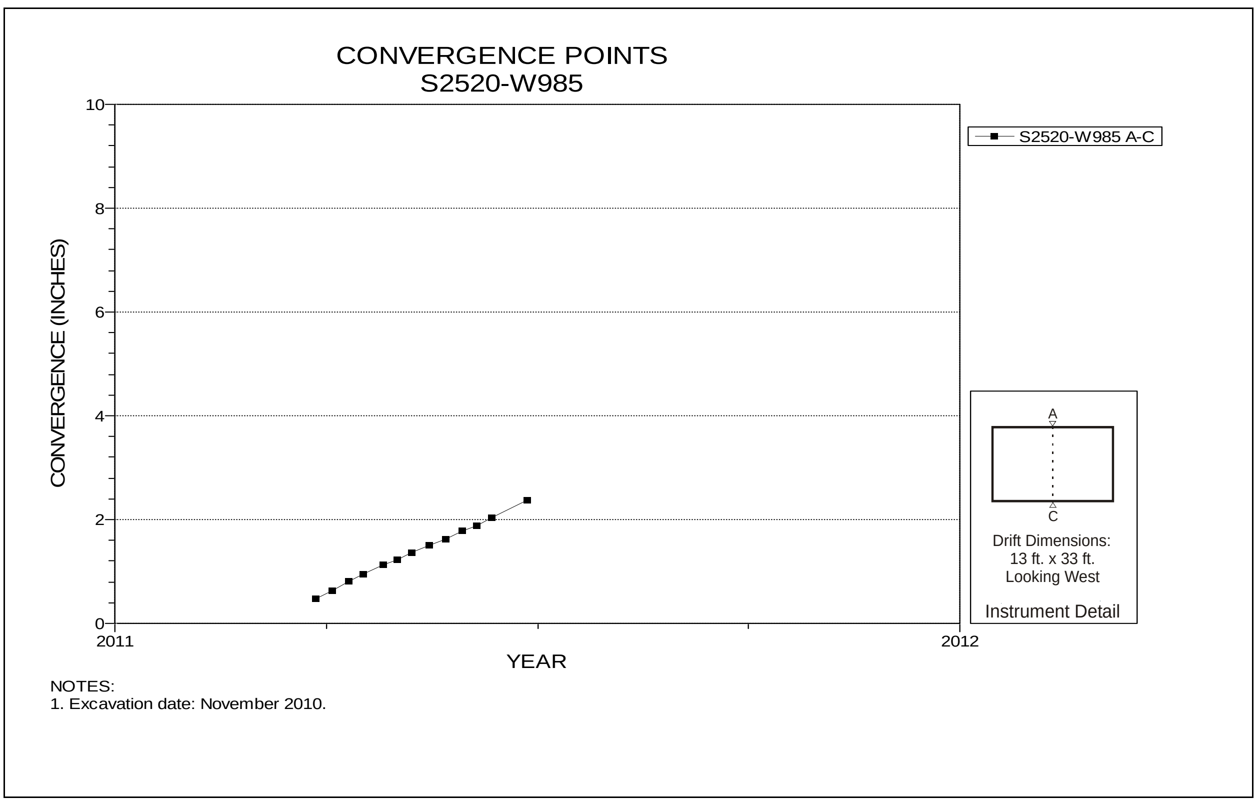


Figure 5-169 Convergence Point Array
S2520 W985 – Roof to Floor

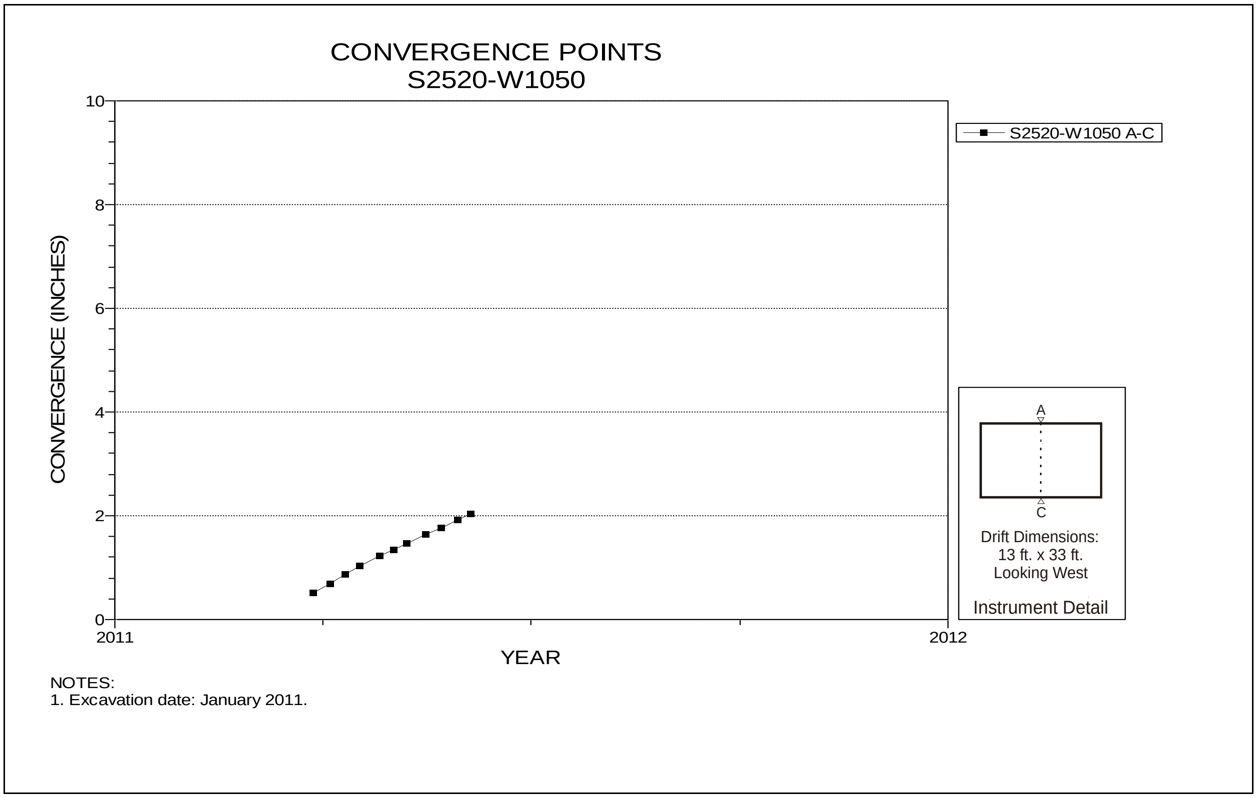


Figure 5-170 Convergence Point Array
S2520 W1050 Intersection (Room 6, Panel 7) – Roof to Floor

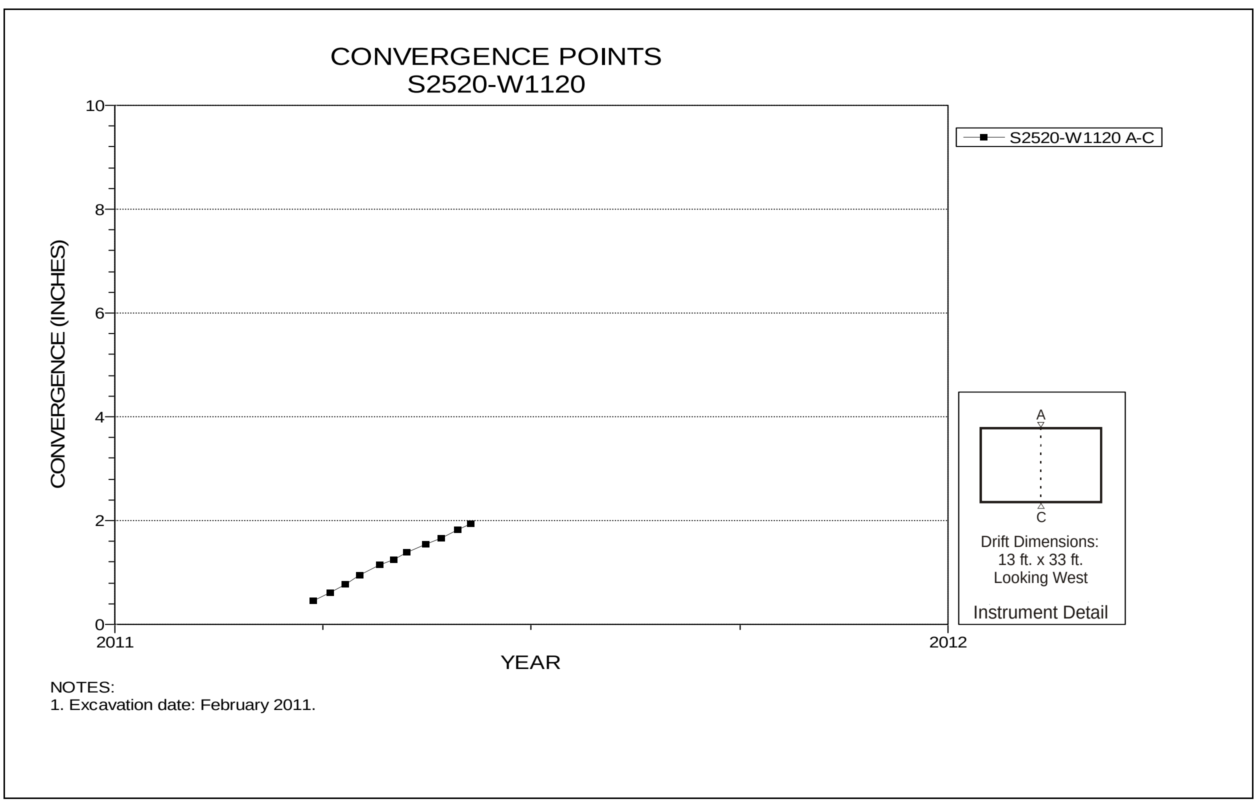


Figure 5-171 Convergence Point Array
S2520 W1120 – Roof to Floor

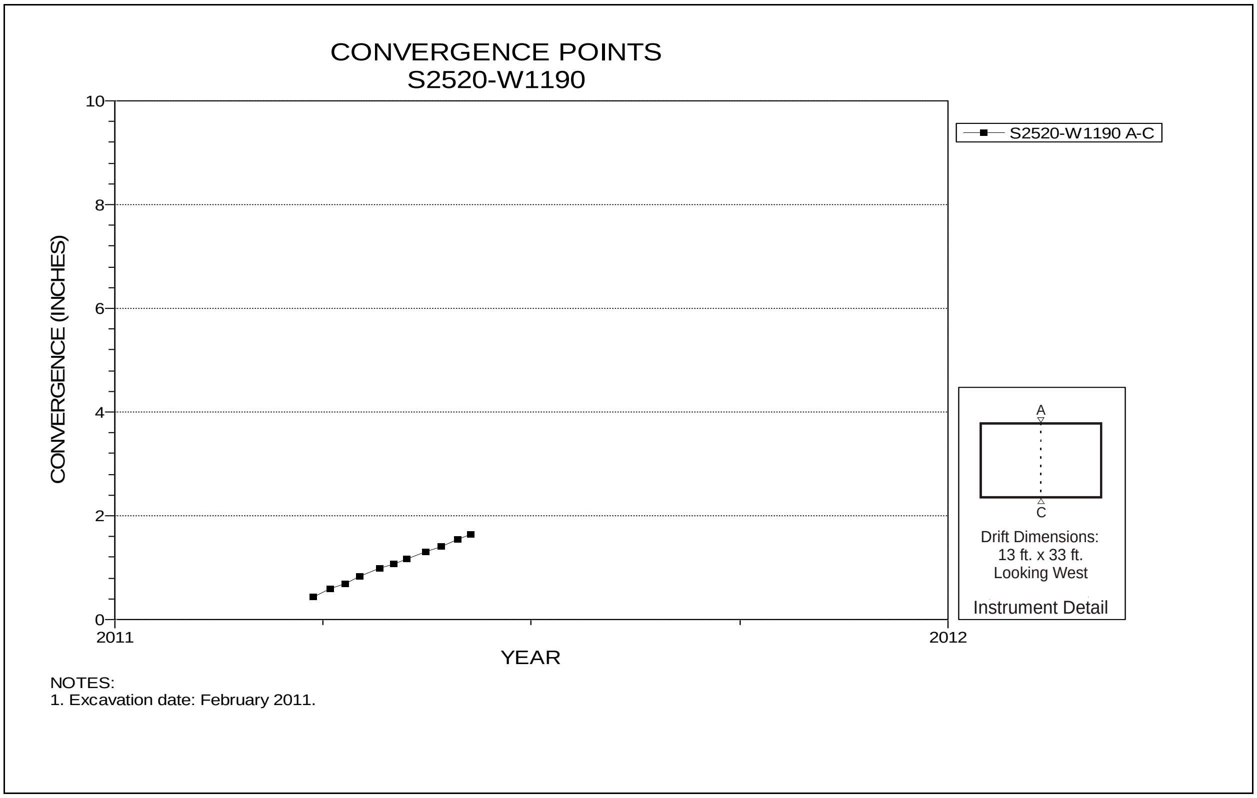


Figure 5-172 Convergence Point Array
S2520 W1190 Intersection (Room 7, Panel 7) – Roof to Floor

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6.0 Instrumentation Summary for the Waste Disposal Area

This chapter presents supporting data acquired as part of the Geoscience Program. It includes observations of clay seam displacements and other features in vertical observation holes, fracture maps of excavation surfaces, and stratigraphic mapping of new panel excavations.

6.1 Borehole Inspections

This section presents a summary of the clay seam displacements (offsets) and fracture densities measured in observation boreholes located through the WIPP underground facility. Relative lateral displacement of rock strata above and below a clay layer is measured as offset within a borehole. Fracture density is a calculated parameter based on the number of fractures (separations) and fracture zones observed in an observation borehole. Fracture density is calculated to be the number of fractures plus twice the number of fracture zones in a roof beam divided by the thickness of the beam (in feet). Table 6-1 presents the observed offset data for boreholes, the observed fractures and fracture zones, and the calculated fracture densities. Table 6-2 is a summary of new boreholes drilled during this reporting period.

6.2 Fracture Mapping

This section presents graphical results of the fracture mapping done in Panel 6 of the Waste Disposal Area. Figures 6-1 through 6-39 are plan view fracture maps for the roof.

6.3 Stratigraphic Mapping

This section presents graphical results of stratigraphic mapping performed in Panel 7 of the Waste Disposal Area. At the time of this report only Room 7 was completed to final as mined. Figure 6-40 is a plan view for the west rib in Room 7.

Table 6-1
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH485	E140-N1400	1/7/04	6/21/11				Separation		1.3	0.13	0.13	S	0.04	0.02
OH485		1/7/04	6/21/11				Separation		1.7	0.13	0.00			
OH485		1/7/04	6/21/11	2		6.3	Hangup	0.3	6.3	0.00	1.50	S	0.50	0.20
OH485		1/7/04	6/21/11				BOH		20.4	0.00	0.00			
OH484	E140-N1265	1/7/04	6/21/11				Separation		1.5	1.00	0.25	W	0.08	0.03
OH484		1/7/04	6/21/11	1		5.3	Separation	0.2	5.3	0.06	0.13	E	0.04	0.02
OH484		1/7/04	6/21/11				Rough Spot		5.8	0.00	0.25	W	0.08	0.03
OH484		1/7/04	6/21/11				Separation		5.9	0.25	0.25	W	0.08	0.03
OH484		1/7/04	6/21/11				BOH		20.5	0.00	0.00			
OH483	E140-N90	1/7/04	6/21/11				Separation		1.3	0.50	1.00	W	0.33	0.13
OH483		1/7/04	6/21/11				Separation		1.4	0.75	0.13	W	0.04	0.02
OH483		1/7/04	6/21/11				Separation		2.5	0.25	0.13	W	0.04	0.02
OH483		1/7/04	6/21/11				Separation		3.3	0.50	0.00			
OH483		1/7/04	6/21/11	4		7.0	Separation	0.6	7.0	0.13	1.75	W	0.58	0.23
OH483		1/7/04	6/21/11				Separation		7.4	0.25	0.00			
OH483		1/7/04	6/21/11				BOH		20.7	0.00	0.00			
OH492	E140-N790	1/9/04	6/21/11	0		6.6	Separation	0.0	6.6	0.25	0.25	W	0.08	0.03
OH492		1/9/04	6/21/11				BOH		20.3	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH521	E140-N90	11/20/04	6/20/11	0		6.8	Separation	0.0	6.8	0.13	0.19	E	0.06	0.03
OH521		11/20/04	6/20/11				Separation		8.1	0.13	0.00			
OH521		11/20/04	6/20/11				Separation		9.1	0.25	0.00			
OH521		11/20/04	6/20/11				Separation		9.9	0.13	0.13	E	0.04	0.02
OH521		11/20/04	6/20/11				BOH		20.3	0.00	0.00			
OH523	E140-S164	11/20/04	6/20/11				Rough Spot		5.5	0.00	0.00			
OH523		11/20/04	6/20/11	0		5.5	Separation	0.0	7.6	0.13	0.00			
OH523		11/20/04	6/20/11				Separation		8.3	0.13	0.00			
OH523		11/20/04	6/20/11				Separation		8.9	0.13	0.00			
OH523		11/20/04	6/20/11				BOH		20.4	0.00	0.00			
OH498-1	E140-N415	3/2/09	3/21/11	0		6.4	Separation	0.0	6.4	0.25	0.13	W	0.04	0.06
OH498-1		3/2/09	3/21/11				Separation		6.6	0.25	0.13	W	0.04	0.06
OH498-1		3/2/09	3/21/11				BOH		12.9	0.00	0.00			
OH499-1	E140-S520	3/2/09	6/7/11				BOH		12.4	0.00	0.00			
OH620	E140-S700	11/17/05	6/7/11				Separation		4.3	0.13	0.00			
OH620		11/17/05	6/7/11				Separation		4.8	0.13	0.00			
OH620		11/17/05	6/7/11	2		5.8	Separation	0.3	5.8	0.50	0.00			
OH620		11/17/05	6/7/11				Separation		6.1	0.13	0.00			
OH620		11/17/05	6/7/11				BOH		16.8	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH874	E140-S850	3/2/09	6/7/11				Separation		3.6	0.13	1.75	W	0.58	0.77
OH874		3/2/09	6/7/11				Separation		3.8	2.50	0.00			
OH874		3/2/09	6/7/11				Separation		4.3	0.13	0.00			
OH874		3/2/09	6/7/11				Separation		4.9	0.13	0.00			
OH874		3/2/09	6/7/11	4		6.3	Separation	0.6	6.3	0.13	0.50	E	0.17	0.22
OH874		3/2/09	6/7/11				Separation		7.1	0.13	1.00	E	0.33	0.44
OH874		3/2/09	6/7/11				Separation		7.2	0.25	0.00			
OH874		3/2/09	6/7/11				BOH		20.1	0.00	0.00			
OH575	E140-S1000	6/16/05	6/7/11				Separation		3.5	0.13	0.00			
OH575		6/16/05	6/7/11				Separation		4.2	2.50	3.00		1.00	0.50
OH873	E140-S1145	3/2/09	6/7/11				Separation		1.1	0.13	2.75	E	0.92	1.21
OH873		3/2/09	6/7/11				Separation		1.7	0.13	0.00			
OH873		3/2/09	6/7/11				Separation		2.5	0.75	0.00			
OH873		3/2/09	6/7/11				Separation		3.0	0.13	0.00			
OH873		3/2/09	6/7/11				Separation		3.7	2.50	0.00			
OH873		3/2/09	6/7/11				Separation		5.1	0.13	0.00			
OH873		3/2/09	6/7/11	6		5.2	Separation	1.2	5.2	1.50	0.00			
OH873		3/2/09	6/7/11				Separation		6.1	0.50	0.00			
OH873		3/2/09	6/7/11				BOH		6.6	0.13	0.00			
OH578	E140-S1300	6/16/05	6/7/11	0		6.7	Separation	0.0	6.7	0.13	0.00			
OH578		6/16/05	6/7/11				BOH		20.3	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH872	E140-S1390	3/2/09	6/7/11				Separation		1.5	0.25	0.13	W	0.04	0.06
OH872		3/2/09	6/7/11				Separation		3.0	0.38	0.13	W	0.04	0.06
OH872		3/2/09	6/7/11	2		5.2	Separation	0.4	5.2	0.13	0.00			
OH872		3/2/09	6/7/11				Separation		6.5	0.13	0.00			
OH872		3/2/09	6/7/11				Separation		7.0	0.13	0.00			
OH872		3/2/09	6/7/11				BOH		21.1	0.00	0.00			
OH580-1	E140-S1463	6/16/05	6/7/11				Separation		0.9	0.13	0.38	W	0.13	0.06
OH580-1		6/16/05	6/7/11				Separation		1.0	0.13	0.13	W	0.04	0.02
OH580-1		6/16/05	6/7/11				Separation		1.6	1.25	0.13	W	0.04	0.02
OH580-1		6/16/05	6/7/11				Separation		2.5	3.00	0.25	W	0.08	0.04
OH580-1		6/16/05	6/7/11				Separation		4.1	0.13	0.00			
OH580-1		6/16/05	6/7/11				Separation		4.3	2.50	0.19	W	0.06	0.03
OH580-1		6/16/05	6/7/11				Separation		4.7	0.13	0.19	W	0.06	0.03
OH580-1		6/16/05	6/7/11	7		5.1	Separation	1.4	5.1	5.00	0.00			
OH580-1		6/16/05	6/7/11				Separation		5.6	0.25	0.00			
OH580-1		6/16/05	6/7/11				Separation		6.4	0.50	0.00			
OH580-1		6/16/05	6/7/11				Separation		7.0	0.25	0.00			
OH580-1		6/16/05	6/7/11				Separation		7.5	0.13	1.25	W	0.42	0.21
OH580-1		6/16/05	6/7/11				BOH		20.4	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH582	E140-S1600	6/16/05	6/7/11	0		6.6	Separation	0.0	6.6	0.25	0.00			
OH582		6/16/05	6/7/11				Separation		6.2	0.13	0.06	E	0.02	0.01
OH582		6/16/05	6/7/11				BOH		20.3	0.00	0.00			
OH871	E140-S1680	3/2/09	6/7/11				Separation		1.1	0.13	0.13	W	0.04	0.06
OH871		3/2/09	6/7/11				Separation		1.7	0.00	0.00			
OH871		3/2/09	6/7/11				Separation		2.7	0.00	0.00			
OH871		3/2/09	6/7/11	3		5.2	Separation	0.6	5.2	0.25	0.50	E	0.17	0.22
OH871		3/2/09	6/7/11				Separation		5.3	4.00	0.75	NW	0.25	0.33
OH871		3/2/09	6/7/11				Separation		6.4	0.75	2.00	W	0.67	0.88
OH871		3/2/09	6/7/11				Separation		6.7	0.38	0.00			
OH871		3/2/09	6/7/11				BOH		20.5	0.00	0.00			
OH143-3	E140-S1782	3/2/09	6/7/11				Separation		1.1	0.13	0.00			
OH143-3		3/2/09	6/7/11				Separation		1.6	0.75	0.38	W	0.13	0.17
OH143-3		3/2/09	6/7/11				Separation		2.6	4.00	0.38	W	0.13	0.17
OH143-3		3/2/09	6/7/11				Separation		4.0	3.00	0.19	NE	0.06	0.08
OH143-3		3/2/09	6/7/11	4		5.2	Separation	0.8	5.2	2.50	0.00			
OH143-3		3/2/09	6/7/11				Separation		5.5	0.13	0.00			
OH143-3		3/2/09	6/7/11				Separation		6.3	0.13	0.00			
OH143-3		3/2/09	6/7/11				BOH		7.1	1.00	3.00		1.00	1.32

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH146-3	E140-S1832	3/2/09	6/7/11				Separation		0.8	0.13	0.00			
OH146-3		3/2/09	6/7/11				Separation		1.4	0.50	0.00			
OH146-3		3/2/09	6/7/11				Separation		2.3	5.50	0.00			
OH146-3		3/2/09	6/7/11				Separation		3.8	2.50	0.25	W	0.08	0.11
OH146-3		3/2/09	6/7/11	4		4.8	Separation	0.8	4.8	6.50	0.50	E	0.17	0.22
OH146-3		3/2/09	6/7/11				Separation		6.5	6.00	0.50	E	0.17	0.22
OH146-3		3/2/09	6/7/11				BOH		7.0	0.00	3.00		1.00	1.32
OH583	E140-S1950	6/16/05	6/7/11				Separation		1.9	0.25	0.25	E	0.08	0.04
OH583		6/16/05	6/7/11				Separation		2.0	0.06	0.00			
OH583		6/16/05	6/7/11				Rough Spot		5.1	0.00	0.13	E	0.04	0.02
OH583		6/16/05	6/7/11				Separation		5.7	0.06	0.25	W	0.08	0.04
OH583		6/16/05	6/7/11	4		6.0	Separation	0.7	6.0	2.00	1.25	E	0.42	0.21
OH583		6/16/05	6/7/11				Separation		6.8	0.13	0.00			
OH583		6/16/05	6/7/11				Rough Spot		7.1	0.00	0.00			
OH583		6/16/05	6/7/11				BOH		20.6	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH474-1	E140-S2000	3/24/09	3/14/11				Separation		1.4	1.50	0.13	E	0.04	0.06
OH474-1		3/24/09	3/14/11				Separation		2.8	1.25	0.00			
OH474-1		3/24/09	3/14/11				Separation		3.2	2.00	0.13	S	0.04	0.06
OH474-1		3/24/09	3/14/11	3		5.3	Separation	0.6	5.3	0.25	0.50	E	0.17	0.25
OH474-1		3/24/09	3/14/11				Separation		5.4	0.25	0.00			
OH474-1		3/24/09	3/14/11				Separation		5.7	0.50	0.00			
OH474-1		3/24/09	3/14/11				Separation		6.2	1.25	0.50	E	0.17	0.25
OH474-1		3/24/09	3/14/11				Separation		6.6	0.25	0.00			
OH474-1		3/24/09	3/14/11				Separation		6.7	0.25	0.00			
OH474-1		3/24/09	3/14/11				Separation		7.0	1.00	0.00			
OH474-1		3/24/09	3/14/11				Separation		7.3	0.25	0.00			
OH474-1		3/24/09	3/14/11				BOH		20.5	0.00	0.00			
OH472-1	E140-S2333	3/1/09	6/7/11				Separation		4.9	0.13	0.00			
OH472-1		3/1/09	6/7/11				Separation		5.3	0.50	0.00			
OH472-1		3/1/09	6/7/11	2		5.9	Separation	0.3	5.9	1.00	0.00			
OH472-1		3/1/09	6/7/11				Separation		6.2	0.75	0.00			
OH472-1		3/1/09	6/7/11				Separation		6.5	0.13	0.00			
OH472-1		3/1/09	6/7/11				BOH		20.2	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH586-1	E140-S2358	3/2/09	6/6/11				Separation		1.4	0.75	0.00			
OH586-1		3/2/09	6/6/11				Separation		2.0	0.25	0.25	E	0.08	0.11
OH586-1		3/2/09	6/6/11				Separation		2.3	0.75	0.50	E	0.17	0.22
OH586-1		3/2/09	6/6/11				Separation		3.6	6.00	0.00			
OH586-1		3/2/09	6/6/11	4		4.6	Separation	0.9	4.6	0.25	3.00		1.00	1.33
OH870	E140-S2456	3/24/09	6/6/11				Separation		1.7	0.25	0.25	W	0.08	0.11
OH870		3/24/09	6/6/11				Separation		3.6	1.50	0.50	W	0.17	0.23
OH870		3/24/09	6/6/11				Separation		5.5	0.25	0.00			
OH870		3/24/09	6/6/11	3		5.9	Separation	0.5	5.9	5.00	0.00			
OH870		3/24/09	6/6/11				Separation		6.4	3.00	0.00			
OH870		3/24/09	6/6/11				Separation		7.1	1.00	2.50	W	0.83	1.13
OH588	E140-S2520	6/16/05	6/6/11				Separation		1.5	0.25	0.25	E	0.08	0.04
OH588		6/16/05	6/6/11				Separation		2.1	0.13	2.50	E	0.83	0.42
OH588		6/16/05	6/6/11	2		5.4	Separation	0.4	5.4	0.00	0.00			
OH468-1	E140-S2640	3/1/09	6/6/11				Separation		0.9	1.00	0.00			
OH468-1		3/1/09	6/6/11				Separation		1.7	2.00	0.25	E	0.08	0.11
OH468-1		3/1/09	6/6/11				Separation		2.4	3.00	0.25	E	0.08	0.11
OH468-1		3/1/09	6/6/11				Separation		4.7	1.50	0.25	E	0.08	0.11
OH468-1		3/1/09	6/6/11				Separation		5.0	0.25	0.50	E	0.17	0.22
OH468-1		3/1/09	6/6/11	5		5.6	Separation	0.9	5.6	0.50	1.00	E	0.33	0.44
OH468-1		3/1/09	6/6/11				Separation		5.7	0.50	0.00			
OH468-1		3/1/09	6/6/11				Separation		6.5	1.00	0.00			
OH468-1		3/1/09	6/6/11				Separation		20.6	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH589-1	E140-S2750	3/15/09	6/6/11	0		5.1	Separation	0.0	5.1	0.25	0.25	S	0.08	0.11
OH589-1		3/15/09	6/6/11				Separation		5.6	0.50	0.00			
OH589-1		3/15/09	6/6/11				Separation		6.8	0.75	0.00			
OH589-1		3/15/09	6/6/11				Separation		7.7	1.00	0.25	NE	0.08	0.11
OH589-1		3/15/09	6/6/11				BOH		20.3	0.00	0.00			
OH500-1	E140-S2920	3/15/09	3/14/11				Separation		1.0	0.50	2.00	E	0.67	1.00
OH500-1		3/15/09	3/14/11				Separation		2.0	0.75	1.00	E	0.33	0.50
OH500-1		3/15/09	3/14/11				Separation		4.6	0.13	0.00			
OH500-1		3/15/09	3/14/11	3		5.6	Separation	0.5	5.6	2.50	0.00			
OH500-1		3/15/09	3/14/11				Separation		5.3	0.13	0.00			
OH500-1		3/15/09	3/14/11				Separation		5.9	0.38	0.00			
OH500-1		3/15/09	3/14/11				BOH		6.4	0.00	3.00		1.00	1.50
OH501-1		3/15/09	3/14/11				Separation		0.8	1.50	0.19	E	0.06	0.09
OH501-1	E140-S2984	3/15/09	3/14/11				Separation		1.7	3.00	0.19	E	0.06	0.09
OH501-1		3/15/09	3/14/11				Separation		4.8	0.25	0.00			
OH501-1		3/15/09	3/14/11				Separation		5.4	2.00	0.00			
OH501-1		3/15/09	3/14/11	4		5.3	Separation	0.8	5.6	1.50	0.00			
OH501-1		3/15/09	3/14/11				BOH		5.8	0.00	3.00		1.00	1.50

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH590-1	E140-S3080	3/15/09	6/6/11				Separation		0.3	0.25	0.00			
OH590-1		3/15/09	6/6/11				Separation		1.4	0.25	0.25	SE	0.08	0.11
OH590-1		3/15/09	6/6/11				Separation		1.5	0.25	0.00			
OH590-1		3/15/09	6/6/11	3		5.4	Separation	0.6	5.4	0.25	0.50	E	0.17	0.22
OH590-1		3/15/09	6/6/11				Separation		5.6	0.13	0.00			
OH590-1		3/15/09	6/6/11				Separation		5.7	0.25	0.50	W	0.17	0.22
OH590-1		3/15/09	6/6/11				Separation		7.0	0.13	0.00			
OH590-1		3/15/09	6/6/11				BOH		20.2	0.00	0.00			
OH493-1	E140-S3180	3/15/09	6/6/11				Separation		1.0	0.25	0.00			
OH493-1		3/15/09	6/6/11				Separation		1.1	4.50	0.00			
OH493-1		3/15/09	6/6/11	2		5.4	Separation	0.4	5.4	0.50	1.25	E	0.42	0.56
OH493-1		3/15/09	6/6/11				Separation		5.7	1.50	0.50	NW	0.17	0.22
OH493-1		3/15/09	6/6/11				Separation		6.6	0.25	0.00			
OH493-1		3/15/09	6/6/11				Separation		8.2	0.25	0.00			
OH493-1		3/15/09	6/6/11				BOH		20.3	0.00	0.00			
OH605-1	E140-S3380	3/15/09	6/8/11				Separation		1.2	0.50	0.00			
OH605-1		3/15/09	6/8/11				Separation		2.0	2.50	0.00			
OH605-1		3/15/09	6/8/11				Separation		3.8	0.50	0.00			
OH605-1		3/15/09	6/8/11	3		4.7	Separation	0.6	4.7	0.25	2.00	E	0.67	0.90
OH605-1		3/15/09	6/8/11				BOH		20.4	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH606-1	E140-E3480	3/15/09	6/6/11				Separation		0.3	0.50	0.00			
OH606-1		3/15/09	6/6/11				Separation		4.3	0.25	1.50	W	0.50	0.67
OH606-1		3/15/09	6/6/11	3		4.5	Separation	0.7	4.5	0.50	0.25	NW	0.08	0.11
OH606-1		3/15/09	6/6/11				BOH		20.6	0.00	0.00			
OH571	E140-S3527	2/19/05	6/6/11				Separation		4.3	0.25	0.00			
OH571		2/19/05	6/6/11	1		4.4	Separation	0.2	4.4	0.25	0.38	E	0.13	0.06
OH571		2/19/05	6/6/11				Separation		5.0	0.50	0.25	E	0.08	0.04
OH571		2/19/05	6/6/11				Separation		5.3	0.25	1.00	W	0.33	0.16
OH571		2/19/05	6/6/11				BOH		20.9	0.00	0.00			
OH607	E140-S3580	9/1/05	6/6/11				Separation		0.8	0.13	0.25	E	0.08	0.04
OH607		9/1/05	6/6/11				Separation		1.0	0.13	0.00			
OH607		9/1/05	6/6/11				Separation		4.0	0.13	0.00			
OH607		9/1/05	6/6/11				Separation		5.2	0.25	0.00			
OH607		9/1/05	6/6/11				Separation		5.3	0.25	0.00			
OH607		9/1/05	6/6/11	5		5.4	Separation	0.9	5.4	0.25	0.25	N	0.08	0.04
OH607		9/1/05	6/6/11				Separation		7.0	1.00	0.00			
OH607		9/1/05	6/6/11				BOH		21.0	0.00	0.00			
OH567	E140-S3650	2/19/05	3/8/11	0		5.2	Separation	0.0	5.2	0.25	2.00	N	0.67	0.33
OH567		2/19/05	3/8/11				Separation		6.5	0.50	1.00	N	0.33	0.17

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH860	E0-N1266	3/8/09	6/21/11				Separation		1.5	2.50	0.00			
OH860		3/8/09	6/21/11	1		6.7	Separation	0.1	3.0	3.00	0.00			
OH860		3/8/09	6/21/11				Separation		6.7	0.25	0.00			
OH860		3/8/09	6/21/11				Separation		6.9	0.50	0.00			
OH860		3/8/09	6/21/11				Separation		7.3	0.13	0.00			
OH488	E0-N1100	1/7/04	6/21/11				Separation		1.1	0.75	0.13	S	0.04	0.02
OH488		1/7/04	6/21/11	1		6.0	Separation	0.2	6.0	0.50	0.25	SW	0.08	0.03
OH488		1/7/04	6/21/11				Separation		6.5	0.13	0.25	W	0.08	0.03
OH488		1/7/04	6/21/11				BOH		20.3	0.00	0.00			
OH859	E0-N920	3/8/09	6/21/11				Separation		1.0	0.75	0.00			
OH859		3/8/09	6/21/11	1		6.3	Separation	0.2	6.3	0.13	0.00			
OH859		3/8/09	6/21/11				BOH		20.2	0.00	0.00			
OH490	E0-N780	1/9/04	6/21/11				Separation		0.7	0.13	0.13	E	0.04	0.02
OH490		1/9/04	6/21/11				Separation		1.3	0.13	0.13	E	0.04	0.02
OH490		1/9/04	6/21/11				Separation		2.0	0.25	0.13	E	0.04	0.02
OH490	E0-N780	1/9/04	6/21/11	3		6.0	Rough Spot	0.5	6.0	0.00	1.00	E	0.33	0.13
OH490		1/9/04	6/21/11				Separation		6.2	0.13	1.00	E	0.33	0.13
OH490		1/9/04	6/21/11				Separation		6.6	0.06	0.00			
OH490		1/9/04	6/21/11				BOH		20.4	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH888	W30-S700	3/8/09	6/13/11	0		8.4	Separation	0.0	8.4	0.25	0.00			
OH888		3/8/09	6/13/11				BOH		20.1	0.00	0.00			
OH887	W30-S870	3/10/09	6/13/11	N/A			Separation		1.7	0.25	0.00			
OH887		3/10/09	6/13/11				BOH		20.0	0.00	0.00			
OH886	W30-S1000	3/3/09	6/13/11	0		8.7	Separation	0.0	8.7	0.25	0.25	SW	0.08	0.11
OH886		3/3/09	6/13/11				BOH		20.0	0.00	0.00			
OH885	W30-S1150	3/3/09	6/13/11				Separation		0.5	0.25	0.13	SW	0.04	0.05
OH885		3/3/09	6/13/11				Separation		0.7	0.25	0.13	W	0.04	0.05
OH885		3/3/09	6/13/11				Separation		1.4	0.25	0.13	W	0.04	0.05
OH885		3/3/09	6/13/11				Separation		2.0	0.50	0.50	W	0.17	0.22
OH885		3/3/09	6/13/11	4		6.1	Separation		6.1	0.50	0.50	W	0.17	0.22
OH885		3/3/09	6/13/11				BOH		20.2	0.00	0.00			
OH884	W30-S1300	3/3/09	6/13/11				Separation		0.7	0.25	0.00			
OH884		3/3/09	6/13/11	1		8.4	Hangup	0.1	8.4	0.00	0.00			
OH884		3/3/09	6/13/11				BOH		20.1	0.00	0.00			
OH883	W30-S1485	3/3/09	6/14/11				BOH		20.2	0.00	0.00			
OH882	W30-S1600	3/3/09	6/14/11	0		7.8	Separation	0.0	7.8	0.25	0.00			
OH882		3/3/09	6/14/11				BOH		20.0	0.00	0.00			
OH881	S30-S1780	3/3/09	6/14/11				BOH		20.5	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH880	S30-S1950	3/3/09	6/14/11	0		8.2	Separation	0.0	8.2	0.13	0.00			
OH880		3/3/09	6/14/11				BOH		20.9	0.00	0.00			
OH879	W30-S2060	3/3/09	6/15/11				BOH		20.1	0.00	0.00			
OH877	W30-S2350	3/11/09	6/14/11				Separation		0.7	0.38	0.00			
OH877		3/11/09	6/14/11	1		7.9	Separation	0.1	7.9	0.13	0.00			
OH877		3/11/09	6/14/11				BOH		20.1	0.00	0.00			
OH876	W30-S2520	3/2/09	6/14/11				Separation		0.6	0.13	0.00			
OH876		3/2/09	6/14/11	1		7.1	Rough Spot	0.1	7.1	0.00	0.00			
OH876		3/2/09	6/14/11				BOH		17.8	0.00	0.00			
OH875	W30-S2750	3/2/09	6/14/11				Rough Spot		4.9	0.00	0.00			
OH875		3/2/09	6/14/11	1		5.6	Separation	0.2	5.6	0.13	0.13	S	0.04	0.05
OH875		3/2/09	6/14/11				Separation		5.8	0.13	0.19	S	0.06	0.08
OH875		3/2/09	6/14/11				Separation		6.0	0.13	0.00			
OH875		3/2/09	6/14/11				Separation		6.4	0.13	0.00			
OH875		3/2/09	6/14/11				Rough Spot		7.0	0.00	0.00			
OH875		3/2/09	6/14/11				Separation		7.4	0.13	0.00			
OH875		3/2/09	6/14/11				BOH		20.2	0.00	0.00			
OH455	W30-S2850	8/1/03	5/31/11				Separation		1.2	0.13	0.50	W	0.17	0.06
OH455		8/1/03	5/31/11				Separation		1.8	0.25	0.50	W	0.17	0.06
OH455		8/1/03	5/31/11				Separation		2.7	4.00	0.00			
OH455		8/1/03	5/31/11	3		6.0	Separation	0.5	6.0	0.13	0.00			
OH455		8/1/03	5/31/11				Separation		6.8	0.25	0.00			
OH455		8/1/03	5/31/11				BOH		20.4	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH456	W30-S2950	8/1/03	5/31/11				Separation		1.5	1.00	0.25	W	0.08	0.03
OH456		8/1/03	5/31/11	1		5.0	Separation	0.2	5.0	0.13	0.00			
OH456		8/1/03	5/31/11				BOH		20.3	0.00	0.00			
OH463	W30-S3080	9/2/03	5/31/11				Separation		1.4	4.00	1.75	NE	0.58	0.23
OH463		9/2/03	5/31/11	1		5.9	Separation		5.9	0.50	1.75	NE	0.58	0.23
OH465	W30-S3200	9/2/03	5/31/11				Separation		0.9	0.13	0.75	E	0.25	0.10
OH465		9/2/03	5/31/11				Separation		1.4	0.75	0.25	E	0.08	0.03
OH465		9/2/03	5/31/11	2		5.5	Separation	0.4	5.5	0.50	0.00			
OH465		9/2/03	5/31/11				Hangup		5.9	0.00	0.00			
OH465		9/2/03	5/31/11				BOH		22.2	0.00	0.00			
OH449	S30-S3310	8/15/03	5/31/11				Separation		4.9	0.25	0.25	NW	0.08	0.03
OH449		8/15/03	5/31/11				Separation		5.6	0.25	0.00			
OH449		8/15/03	5/31/11	2		5.9	Separation	0.3	5.9	0.50	0.50	SE	0.17	0.06
OH449		8/15/03	5/31/11				Separation		6.5	0.25	0.00			
OH449		8/15/03	5/31/11				BOH		21.5	0.00	0.00			
OH514-1	W30-S3400	3/15/09	5/31/11				Separation		1.3	0.25	0.25	E	0.08	0.11
OH514-1		3/15/09	5/31/11	1		5.4	Separation	0.2	5.4	0.25	0.00			
OH514-1		3/15/09	5/31/11				Separation		6.6	0.13	0.00			
OH514-1		3/15/09	5/31/11				BOH		20.1	0.00	0.00			
OH515-1	W30-S3490	3/15/09	5/31/11				Separation		1.4	0.25	0.00			
OH515-1		3/15/09	5/31/11	1		5.7	Separation	0.2	5.7	0.13	0.00			
OH515-1		3/15/09	5/31/11				BOH		20.2	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH565	W30-S3650	2/15/09	6/6/11	0		5.6	Separation	0.0	5.6	0.50	0.00			
OH565		2/15/09	6/6/11				Separation		5.9	0.13	0.00			
OH565		2/15/09	6/6/11				Separation		6.1	0.25	1.25	N	0.42	0.54
OH565		2/15/09	6/6/11				Separation		7.1	0.13	0.00			
OH565		2/15/09	6/6/11				Clay		16.1	0.00	0.00			
OH565		2/15/09	6/6/11				BOH		20.7	0.00	0.00			
OH899	W170-S1000	3/24/09	5/24/11	0		9.1	Separation	0.0	9.1	0.06	0.50	E	0.17	0.23
OH899		3/24/09	5/24/11				BOH		20.0	0.00	0.00			
OH898	W170-S1150	3/24/09	5/24/11				BOH		21.1	0.00	0.00			
OH897	W170-S1300	3/24/09	5/24/11	0		8.4	Separation	0.0	8.4	0.13	0.00			
OH897	W170-S1300	3/24/09	5/24/11				BOH		20.1	0.00	0.00			
OH896	W170-S1482	3/24/09	5/24/11	0		8.3	Separation	0.0	8.3	0.13	0.00			
OH896		3/24/09	5/24/11				Separation		14.9	0.06	0.00			
OH896		3/24/09	5/24/11				BOH		17.3	0.00	0.00			
OH895	W170-S1600	3/24/09	5/24/11	0		8.7	Separation	0.0	8.7	0.25	0.25	E	0.08	0.12
OH895		3/24/09	5/24/11				BOH		20.0	0.00	0.00			
OH894	W170-S1780	3/24/09	5/24/11				BOH		20.0	0.00	0.00			
OH893	W170-S1950	3/24/09	5/24/11				Separation		0.8	0.13	0.00			
OH893		3/24/09	5/24/11	1		8.3	Separation	0.1	8.3	0.06	0.00			
OH893		3/24/09	5/24/11				BOH		20.0	0.00	0.00			
OH892	W170-S2055	3/24/09	5/24/11				Separation		1.0	0.06	0.00			
OH892		3/24/09	5/24/11				BOH		19.4	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH891	W170-S2180	3/24/09	5/24/11	0		7.6	Separation	0.0	7.6	0.25	0.00			
OH891		3/24/09	5/24/11				BOH		20.0	0.00	0.00			
OH890	W170-S2345	3/11/09	12/7/10	0		7.9	Hangup	0.0	7.9	0.00	0.13	E	0.04	0.07
OH890		3/11/09	12/7/10				BOH		20.1	0.00	0.00			
OH889	W170-S2520	3/11/09	12/9/10				Separation		1.7	0.13	0.00			
OH889		3/11/09	12/9/10	1		7.9	Clay G	0.1	7.9	0.00	0.00			
OH889		3/11/09	12/9/10				BOH		20.0	0.00	0.00			
OH900	W170-S2635	3/11/09	12/9/10				Separation		2.6	0.25	0.00			
OH900		3/11/09	12/9/10				Separation		3.1	0.25	0.25	E	0.08	0.14
OH900		3/11/09	12/9/10				Separation		3.7	0.38	0.00			
OH900		3/11/09	12/9/10				Separation		3.8	0.13	0.00			
OH900		3/11/09	12/9/10	4		4.3	Separation	1.0	4.3	0.25	0.00			
OH900		3/11/09	12/9/10				Separation		20.3	0.00	0.00			
OH442	W170-S2820	8/15/03	5/31/11				Separation		1.4	0.25	0.75	W	0.25	0.10
OH442		8/15/03	5/31/11				Separation		2.3	2.00	0.50	W	0.17	0.06
OH442		8/15/03	5/31/11				Separation		2.8	0.13	0.00			
OH442		8/15/03	5/31/11	3		4.9	Separation	0.6	4.9	0.25	0.00			
OH443-1	W170-S2900	3/1/09	12/9/10				Separation		0.4	1.00	0.00			
OH443-1		3/1/09	12/9/10				Separation		2.6	0.25	0.06	E	0.02	0.04
OH443-1		3/1/09	12/9/10				Separation		3.1	0.25	1.25	E	0.42	0.70
OH443-1		3/1/09	12/9/10	3		6.0	Separation*	0.5	3.7	0.25	0.00			
OH443-1		3/1/09	12/9/10				BOH		20.0	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH444	W170-S3000	8/15/03	5/31/11				Separation		0.9	0.13	0.13	NW		
OH444		8/15/03	5/31/11				Separation		1.3	1.00	0.25	NW	0.08	0.03
OH444		8/15/03	5/31/11				Separation		1.4	0.25	0.00			
OH444		8/15/03	5/31/11				Separation		2.3	6.00	0.50	S	0.17	0.06
OH444		8/15/03	5/31/11				Separation		4.5	0.50	0.00			
OH444		8/15/03	5/31/11	5		4.7	Separation	1.1	4.7	3.00	1.25	E	0.42	0.16
OH444		8/15/03	5/31/11				Separation		20.8	0.00	0.00			
OH446	W170-S3200	8/15/03	5/31/11				Separation		1.5	0.50	1.75	E	0.58	0.22
OH446		8/15/03	5/31/11				Separation		4.8	0.25	0.00			
OH446		8/15/03	5/31/11				Separation		5.3	0.13	0.00			
OH446		8/15/03	5/31/11	3		5.4	Separation	0.6	5.4	0.75	0.00			
OH446		8/15/03	5/31/11				BOH		24.0	0.00	0.00			
OH447	W170-S3310	8/15/03	3/31/11				Separation		1.4	0.13	0.00			
OH447		8/15/03	3/31/11	1		5.5	Separation	0.2	5.5	0.13	0.00			
OH447		8/15/03	3/31/11				BOH		23.0	0.00	0.00			
OH608-1	W170-S3395	3/1/09	5/31/11				Separation		0.7	0.50	0.50	E	0.17	0.22
OH608-1		3/1/09	5/31/11				Separation		1.2	0.75	0.25	E	0.08	0.11
OH608-1		3/1/09	5/31/11				Separation		2.0	3.00	0.25	E	0.08	0.11
OH608-1		3/1/09	5/31/11	3		6.1	Separation	0.5	6.1	0.50	0.00			
OH608-1		3/1/09	5/31/11				Separation		6.3	0.13	0.00			
OH608-1		3/1/09	5/31/11				BOH		20.5	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH609-1	W170-S3485	3/1/09	5/31/11				Separation		1.2	0.25	0.13	E	0.04	0.06
OH609-1		3/1/09	5/31/11				Separation		2.2	3.00	0.00			
OH609-1		3/1/09	5/31/11	2		5.9	Separation	0.3	5.9	0.50	0.00			
OH609-1		3/1/09	5/31/11				BOH		20.4	0.00	0.00			
OH610-1	W170-S3580	3/1/09	12/6/10	0		5.7	Separation	0.0	5.7	0.38	0.00			
OH610-1		3/1/09	12/6/10				BOH		20.2	0.00	0.00			
OH573	W170-S3650	4/27/05	12/6/10	0		5.4	Separation	0.0	5.4	0.13	0.00			
OH573		4/27/05	12/6/10				BOH		50.0	0.00	0.00			
OH869	E300-S1430	3/24/09	6/2/11	0		8.0	Rough Spot	0.0	8.0	0.00	0.00			
OH869		3/24/09	6/2/11				BOH		20.0	0.00	0.00			
OH868	E300-S1780	3/24/09	6/2/11	0		7.7	Rough Spot	0.0	7.7	0.00	0.00			
OH868		3/24/09	6/2/11				BOH		20.1	0.00	0.00			
OH867	E300-S2060	3/24/09	6/2/11				BOH		20.0	0.00	0.00			
OH866	E300-S2340	3/24/09	6/2/11	0		8.0	Separation	0.0	1.1	0.25	0.00			
OH866		3/24/09	6/2/11				BOH		20.0	0.00	0.00			
OH865	E300-S2630	3/24/09	6/2/11				Separation		4.0	1.00	1.25	E	0.42	0.57
OH865		3/24/09	6/2/11	1		7.2	Clay	0.1	7.2	0.00	0.00			
OH865		3/24/09	6/2/11				BOH		20.3	0.00	0.00			
OH422	E300-S2825	8/15/03	6/2/11	0		6.4	Separation	0.0	6.4	0.25	0.00			
OH422		8/15/03	6/2/11				BOH		20.7	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH423	E300-S2890	7/30/03	6/2/11				Separation		0.9	0.25	0.13	NE	0.04	0.02
OH423		7/30/03	6/2/11				Separation		1.2	1.00	0.50	E	0.17	0.06
OH423		7/30/03	6/2/11				Separation		1.6	0.50	0.00			
OH423		7/30/03	6/2/11				Separation		4.8	0.25	0.50	W	0.17	0.06
OH423		7/30/03	6/2/11				Separation		5.0	0.13	0.00			
OH423		7/30/03	6/2/11	5		5.4	Separation	0.9	5.4	0.25	0.00			
OH423		7/30/03	6/2/11				BOH		18.5	0.00	0.00			
OH425	E300-S3020	7/30/03	6/2/11				Separation		0.3	0.25	0.00			
OH425		7/30/03	6/2/11				Separation		1.6	1.50	0.00			
OH425		7/30/03	6/2/11				Separation		2.6	0.25	0.00			
OH425		7/30/03	6/2/11	3		5.9	Separation	0.5	5.9	0.25	0.00			
OH425		7/30/03	6/2/11				Separation		6.9	0.50	0.00			
OH425		7/30/03	6/2/11				Rough Spot		11.8	0.00	0.00			
OH425		7/30/03	6/2/11				BOH		20.1	0.00	0.00			
OH459	E300-S3140	8/1/03	6/20/11				Separation		1.0	0.13	0.00			
OH459		8/1/03	6/20/11				Separation		1.6	0.13	0.00			
OH459		8/1/03	6/20/11	2		5.7	Separation	0.4	5.7	0.13	0.00			
OH459		8/1/03	6/20/11				BOH		20.5	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH458	E300-S3200	8/1/03	6/21/11				Separation		1.6	0.50	0.00			
OH458		8/1/03	6/21/11				Separation		4.9	0.13	0.00			
OH458		8/1/03	6/21/11	2		5.3	Separation	0.4	5.3	0.25	0.00			
OH458		8/1/03	6/21/11				Separation		5.8	0.13	0.00			
OH458		8/1/03	6/21/11				Separation		6.4	0.13	0.00			
OH458		8/1/03	6/21/11				BOH		20.5	0.00	0.00			
OH457	E300-S3260	8/1/03	6/21/11				Separation		1.3	0.25	0.19	E	0.06	0.02
OH457		8/1/03	6/21/11	1		5.2	Separation	0.2	5.2	0.13	0.13	E	0.04	0.02
OH457		8/1/03	6/21/11				Separation		5.3	0.13	0.00			
OH457		8/1/03	6/21/11				Hangup		6.2	0.00	0.00			
OH457		8/1/03	6/21/11				BOH		21.0	0.00	0.00			
OH453	E300-S3310	8/15/03	6/21/11	0		5.2	Separation	0.0	5.2	0.13	1.50	W	0.50	0.19
OH453		8/15/03	6/21/11				Separation		5.7	0.13	0.00			
OH453		8/15/03	6/21/11				Separation		5.9	0.13	0.00			
OH453		8/15/03	6/21/11				Separation		6.2	0.38	0.00			
OH622	E300-S3400	6/15/06	6/21/11				Separation		1.0	0.38	0.38	E	0.13	0.07
OH622		6/15/06	6/21/11				Separation		4.2	0.06	0.00			
OH622		6/15/06	6/21/11				Separation		4.4	0.06	0.00			
OH622		6/15/06	6/21/11				Separation		4.8	0.13	0.00			
OH622		6/15/06	6/21/11				Separation		5.0	0.13	0.00			
OH622		6/15/06	6/21/11	5		5.6	Separation	0.9	5.6	0.13	0.00			
OH622		6/15/06	6/21/11				BOH		20.6	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH604	E300-S3480	7/18/05	12/6/10				Separation		1.3	0.13	0.13	E	0.04	0.02
OH604		7/18/05	12/6/10	1		0.4	Separation	2.5	5.4	0.38	0.00			
OH604		7/18/05	12/6/10				BOH		20.6	0.00	0.00			
OH623	E300-S3450	6/15/06	6/21/11				Separation		1.3	0.38	0.19	E	0.06	0.04
OH623		6/15/06	6/21/11	1		5.5	Separation	0.2	5.5	0.25	0.13	E	0.04	0.02
OH623		6/15/06	6/21/11				Hangup		5.7	0.00	0.13	E	0.04	0.02
OH623		6/15/06	6/21/11				BOH		20.7	0.00	0.00			
OH624	E300-S3550	6/15/06	6/20/11	0		5.8	Separation	0.0	5.8	0.38	0.06	E	0.02	0.01
OH624		6/15/06	6/20/11				Separation		6.2	0.13	0.00			
OH624		6/15/06	6/20/11				BOH		20.7	0.00	0.00			
OH569	E300-S3650	4/20/05	6/20/11	0		5.0	Separation	0.0	5.0	0.38	1.00	N	0.33	0.16
OH569		4/20/05	6/20/11				Separation		5.8	0.13	0.00			
OH569		4/20/05	6/20/11				BOH		20.8	0.00	0.00			
OH564	W90-S3650	4/20/05	6/6/11				Separation		1.3	1.50	0.50	S	0.17	0.08
OH564		4/20/05	6/6/11	1		5.7	Separation	0.2	5.7	3.00	0.75	N	0.25	0.12
OH564		4/20/05	6/6/11				BOH		20.9	0.00	0.00			
OH566	E50-S3650	4/20/05	6/6/11	0		6.3	Separation	0.0	6.3	0.13	0.00			
OH566		4/20/05	6/6/11				Clay		6.7	0.00	0.00			
OH566		4/20/05	6/6/11				Separation		7.3	0.25	0.25	S	0.08	0.04
OH566		4/20/05	6/6/11				BOH		20.8	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH464	E65-S3080	9/2/03	12/6/10				Separation		1.3	0.50	0.38	S	0.13	0.05
OH464		9/2/03	12/6/10				Separation		2.1	0.25	0.00			
OH464		9/2/03	12/6/10	2		4.4	Rubble	0.5	4.4	0.25	0.00			
OH464		9/2/03	12/6/10				BOH		18.5	0.00	0.00			
OH462	W100-S3080	9/2/03	5/31/11				Separation		1.8	0.25	0.25	S	0.08	0.03
OH462		9/2/03	5/31/11				Separation		2.6	2.50	0.00			
OH462		9/2/03	5/31/11	2		5.2	Separation	0.4	5.2	0.75	1.00	N	0.33	0.13
OH462		9/2/03	5/31/11				Separation		5.4	0.50	0.00			
OH462		9/2/03	5/31/11				Separation		5.5	0.13	0.00			
OH462		9/2/03	5/31/11				Separation		5.9	0.25	0.00			
OH462		9/2/03	5/31/11				Separation		6.4	0.25	0.00			
OH462		9/2/03	5/31/11				Separation		6.6	0.13	0.00			
OH462		9/2/03	5/31/11				BOH		22.6	0.00	0.00			
OH503-1	E230-S3080	6/14/10	6/20/11				Separation		1.3	2.50	1.00	S	0.33	0.98
OH503-1		6/14/10	6/20/11				Separation		2.3	0.13	0.00			
OH503-1		6/14/10	6/20/11				Separation		3.6	0.13	0.00			
OH503-1		6/14/10	6/20/11				Separation		5.2	0.13	0.00			
OH503-1		6/14/10	6/20/11	4		5.7	Separation	0.7	5.7	0.25	0.13	S	0.04	0.12
OH503-1		6/14/10	6/20/11				BOH		20.1	0.00	0.00			
OH460	W100-S2750	9/2/03	5/31/11				Separation		1.5	1.50	0.75	S	0.25	0.10
OH460		9/2/03	5/31/11				Separation		2.6	7.00	0.00			
OH460		9/2/03	5/31/11	2		7.0	Separation	0.3	7.0	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH861	E386-S1950	3/24/09	6/20/11				Separation		2.6	0.75	0.00			
OH861		3/24/09	6/20/11	1		4.4	Separation	0.2	4.4	0.75	1.50	S	0.50	0.67
OH861		3/24/09	6/20/11				Separation		5.5	0.38	1.75	N	0.58	0.78
OH861		3/24/09	6/20/11				BOH		7.5	0.00	3.00			
OH862	E227-S1950	3/24/09	6/20/11	0		4.8	Separation	0.0	4.8	0.13	2.50	S	0.83	1.12
OH862		3/24/09	6/20/11				Separation		6.5	0.25	0.00			
OH862		3/24/09	6/20/11				BOH		20.3	0.00	0.00			
OH863	E386-S1600	3/24/09	6/20/11				BOH		20.1	0.00	0.00			
OH864	E227-S1600	3/24/09	6/20/11	0		5.4	Separation	0.0	5.4	0.13	0.00			
OH864		3/24/09	6/20/11				Separation		6.0	0.13	0.00			
OH864		3/24/09	6/20/11				BOH		20.1	0.00	0.00			
OH855	S90-W380	3/4/09	6/14/11				BOH		20.1	0.00	0.00			
OH856	S90-W620	3/4/09	6/14/11				Separation		1.0	0.13	0.00			
OH856		3/4/09	6/14/11	1		8.9	Separation	0.1	8.9	0.25	0.13	W	0.04	0.05
OH856		3/4/09	6/14/11				BOH		20.1	0.00	0.00			
OH857	S90-W880	3/4/09	6/14/11	0		8.8	Rough Spot	0.0	8.8	0.00	0.00			
OH857		3/4/09	6/14/11				BOH		20.4	0.00	0.00			
OH850	W80-N300	3/8/09	6/21/11				Separation		2.9	0.06	0.00			
OH850		3/8/09	6/21/11				Separation		4.4	0.13	0.00			
OH850		3/8/09	6/21/11				Separation		6.9	0.25	0.00			
OH850		3/8/09	6/21/11	3		8.3	Separation	0.4	8.3	0.13	1.00	S	0.33	0.44
OH850		3/8/09	6/21/11				BOH		20.1	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH858	N216-W469	3/8/09	6/21/11				Separation		5.5	0.25	0.00			
OH858		3/8/09	6/21/11	1		6.9	Separation	0.1	6.9	0.25	0.25	S	0.08	0.11
OH858		3/8/09	6/21/11				BOH		20.0	0.00	0.00			
OH852	E195-N785	3/8/09	6/21/11	0		5.1	Separation	0.0	5.1	0.13	0.00			
OH852		3/8/09	6/21/11				Separation		5.8	0.25	1.25	S	0.42	0.55
OH852		3/8/09	6/21/11				Separation		6.2	0.25	1.00	N	0.33	0.44
OH852		3/8/09	6/21/11				BOH		20.0	0.00	0.00			
OH901-1	W395-S2832	2/7/11	5/23/11				Separation		1.7	0.50	0.00			
OH901-1		2/7/11	5/23/11				Separation		4.3	0.25	0.13	SE	0.04	0.43
OH901-1		2/7/11	5/23/11				Separation		4.4	0.25	0.00			
OH901-1		2/7/11	5/23/11				Separation		4.5	0.13	0.00			
OH901-1		2/7/11	5/23/11	4		5.2	Separation	0.8	5.2	0.50	0.25	W	0.08	0.87
OH901-1		2/7/11	5/23/11				Separation		5.3	2.00	0.50	E	0.17	1.74
OH901-1		2/7/11	5/23/11				Separation		5.7	2.50	0.25	E	0.08	0.87
OH901-1		2/7/11	5/23/11				BOH		20.0	0.00	0.00			
OH902-1	W395-S2912	2/7/11	5/23/11				Separation		1.1	0.13	0.13	E	0.04	0.43
OH902-1		2/7/11	5/23/11				Separation		2.1	0.25	0.13	NE	0.04	0.43
OH902-1		2/7/11	5/23/11				Separation		5.1	0.13	0.00			
OH902-1		2/7/11	5/23/11	3		5.3	Separation	0.6	5.3	0.50	1.00	E	0.33	3.48
OH902-1		2/7/11	5/23/11				Separation		5.4	1.00	0.00			
OH902-1		2/7/11	5/23/11				Separation		5.7	3.00	0.25	E	0.08	0.87
OH902-1		2/7/11	5/23/11				BOH		20.1	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH903-1	W395-S2994	2/7/11	5/23/11				Separation		0.4	0.50	0.00			
OH903-1		2/7/11	5/23/11				Separation		4.7	1.00	0.00			
OH903-1		2/7/11	5/23/11	2		5.1	Separation	0.4	5.1	3.00	0.00			
OH903-1		2/7/11	5/23/11				BOH		20.0	0.00	0.00			
OH904	W525-S2843	12/17/08	5/23/11				Separation		0.9	0.25	0.25	E	0.08	0.10
OH904		12/17/08	5/23/11				Separation		4.9	0.50	0.00			
OH904		12/17/08	5/23/11				Separation		5.2	0.50	0.00			
OH904		12/17/08	5/23/11	3		5.3	Separation	0.6	5.3	1.00	0.75	E	0.25	0.31
OH904		12/17/08	5/23/11				BOH		20.5	0.00	0.00			
OH905	W525-S2912	3/12/09	5/23/11				Separation		1.5	0.25	0.50	SE	0.17	0.23
OH905		3/12/09	5/23/11				Separation		4.9	0.25	0.25	E	0.08	0.11
OH905		3/12/09	5/23/11				Separation		5.1	0.13	0.13	W	0.04	0.06
OH905		3/12/09	5/23/11				Separation		5.2	0.13	0.13	W	0.04	0.06
OH905		3/12/09	5/23/11	4		5.4	Separation	0.7	5.4	0.50	0.13	E	0.04	0.06
OH905		3/12/09	5/23/11				Separation		5.9	2.00	0.00			
OH905		3/12/09	5/23/11				BOH		20.6	0.00	0.00			
OH906	W525-S2942	3/12/09	5/23/11	0		5.1	Separation	0.0	5.1	4.00	0.50	E	0.17	0.23
OH906		3/12/09	5/23/11				BOH		20.4	0.00	0.00			
OH907	W656-S2800	4/25/09	3/8/11				Separation		1.1	0.13	0.19	E	0.06	0.10
OH907		4/25/09	3/8/11				Separation		5.2	0.13	0.00			
OH907		4/25/09	3/8/11				Separation		5.3	0.38	0.00			
OH907		4/25/09	3/8/11	3		5.4	Separation	0.6	5.4	2.00	0.50	E	0.17	0.27
OH907		4/25/09	3/8/11				BOH		20.9	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH908	W656-S2895	4/25/09	6/20/11	0		5.6	Separation	0.0	5.6	3.00	0.75	E		
OH908		4/25/09	6/20/11				BOH		20.9	0.00	0.00			
OH909	W656-S3000	4/25/09	6/20/11				Separation		5.2	0.38	0.38	E	0.13	0.17
OH909		4/25/09	6/20/11	1		5.6	Separation	0.2	5.6	0.75	1.75	E	0.58	0.81
OH909		4/25/09	6/20/11				BOH		20.7	0.00	0.00			
OH910	W790-S2800	6/24/09	5/23/11				Separation		5.4	1.00	0.00			
OH910		6/24/09	5/23/11	1		5.6	Separation	0.2	5.6	0.50	0.75	E	0.25	0.39
OH910		6/24/09	5/23/11				BOH		20.4	0.00	0.00			
OH911	W790-S2895	6/24/09	5/23/11	0		5.4	Separation	0.0	5.4	2.00	0.25	E	0.08	0.13
OH911		6/24/09	5/23/11				BOH		20.4	0.00	0.00			
OH912	W790-S3000	6/24/09	5/23/11				Separation		5.1	0.25	0.00			
OH912		6/24/09	5/23/11	1		5.4	Separation	0.2	5.4	1.50	0.50	E	0.17	0.26
OH912		6/24/09	5/23/11				BOH		20.6	0.00	0.00			
OH913	W920-S2800	8/14/09	5/23/11	0		4.5	Separation	0.0	4.5	0.50	0.25	E	0.08	0.14
OH913		8/14/09	5/23/11				Separation		5.1	0.75	0.00			
OH913		8/14/09	5/23/11				BOH		20.4	0.00	0.00			
OH914	W920-S2895	8/14/09	5/23/11	0		4.1	Separation	0.0	4.1	1.50	0.13	N	0.04	0.07
OH914		8/14/09	5/23/11				BOH		20.4	0.00	0.00			
OH915	W920-S3000	8/14/09	5/23/11				Separation		3.9	0.13	0.25	E	0.08	0.14
OH915		8/14/09	5/23/11	1		5.4	Separation	0.2	5.4	0.50	0.75	E	0.25	0.42
OH915		8/14/09	5/23/11				BOH		20.3	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH916	W1060-S2842	10/4/09	5/17/11				Separation		4.3	0.13	0.00			
OH916		10/4/09	5/17/11	1		5.2	Separation	0.2	5.2	0.38	0.06	E	0.02	0.04
OH916		10/4/09	5/17/11				BOH		20.4	0.00	0.00			
OH917	W1060-S2918	10/4/09	6/20/11				Separation		3.3	0.25	0.19	E	0.06	0.11
OH917		10/4/09	6/20/11				Separation		4.3	0.13	0.00			
OH917		10/4/09	6/20/11	2		4.8	Separation	0.4	4.8	1.00	0.00			
OH917		10/4/09	6/20/11				BOH		20.6	0.00	0.00			
OH918	W1060-S2993	10/4/09	6/20/11				Separation		5.0	0.13	0.00			
OH918		10/4/09	6/20/11	1		5.1	Separation	0.2	5.1	0.13	0.19	E	0.06	0.11
OH918		10/4/09	6/20/11				Separation		6.6	0.13	0.00			
OH918		10/4/09	6/20/11				BOH		20.5	0.00	0.00			
OH919	W1195-S2837	10/3/09	3/8/11				Separation		5.1	0.13	0.06	W	0.02	0.04
OH919		10/3/09	3/8/11	1		5.3	Separation	0.2	5.3	0.13	0.06	E	0.02	0.04
OH919		10/3/09	3/8/11				BOH		20.5	0.00	0.00			
OH920	W1195-S2921	10/3/09	3/8/11	0		5.0	Separation	0.0	5.0	1.75	0.13	E	0.04	0.09
OH920		10/3/09	3/8/11				BOH		20.4	0.00	0.00			
OH921	W1195-S2990	10/3/09	3/8/11	0		5.1	Separation	0.0	5.1	0.13	0.00			
OH921		10/3/09	3/8/11				Separation		6.6	0.13	0.00			
OH921		10/3/09	3/8/11				BOH		19.5	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH922-1	W394-S2750	2/6/11	5/17/11				Separation		1.0	1.00	0.13	S	0.04	0.46
OH922-1		2/6/11	5/17/11				Separation		4.5	0.25	0.00			
OH922-1		2/6/11	5/17/11				Separation		5.3	0.75	0.00			
OH922-1		2/6/11	5/17/11	3		5.7	Separation	0.5	5.7	1.50	0.00			
OH922-1		2/6/11	5/17/11				Separation		5.9	0.13	0.00			
OH922-1		2/6/11	5/17/11				Separation		7.2	0.13	0.00			
OH922-1		2/6/11	5/17/11				Separation		8.2	0.06	0.00			
OH922-1		2/6/11	5/17/11				BOH		20.0	0.00	0.00			
OH923-1	W461-S2750	2/6/11	5/17/11				Separation		1.1	1.25	0.13	S	0.04	0.46
OH923-1		2/6/11	5/17/11				Separation		2.2	0.13	0.00			
OH923-1		2/6/11	5/17/11				Separation		2.7	0.25	0.00			
OH923-1		2/6/11	5/17/11				Separation		3.5	0.13	0.00			
OH923-1		2/6/11	5/17/11	4		5.6	Separation	0.7	5.6	3.00	0.38	S	0.13	1.37
OH923-1		2/6/11	5/17/11				Separation		6.1	3.00	0.00			
OH923-1		2/6/11	5/17/11				BOH		20.2	0.00	0.00			
OH924-1	W528-S2750	2/6/11	5/17/11				Separation		0.9	0.13	0.00			
OH924-1		2/6/11	5/17/11				Separation		5.2	1.00	0.13	S	0.04	0.46
OH924-1		2/6/11	5/17/11	2		5.6	Separation	0.4	5.6	3.50	0.06	S	0.02	0.23
OH924-1		2/6/11	5/17/11				BOH		20.1	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH925-1	W618-S2750	2/6/11	5/17/11				Separation		4.5	0.13	0.00			
OH925-1		2/6/11	5/17/11				Separation		4.8	0.38	0.00			
OH925-1		2/6/11	5/17/11	2		5.2	Separation	0.4	5.2	2.00	0.50	S	0.17	1.83
OH925-1		2/6/11	5/17/11				Separation		6.2	0.13	0.00			
OH925-1		2/6/11	5/17/11				BOH		20.1	0.00	0.00			
OH926-1	W656-S2750	2/11/11	5/17/11				Separation		1.2	0.13	0.00			
OH926-1		2/11/11	5/17/11				Separation		4.7	0.13	0.00			
OH926-1		2/11/11	5/17/11	2		5.4	Separation	0.4	5.4	3.50	0.13	SE	0.04	0.48
OH926-1		2/11/11	5/17/11				BOH		20.1	0.00	0.00			
OH927-1	W725-S2750	2/6/11	5/17/11				Separation		0.9	0.13	0.13	S	0.04	0.46
OH927-1		2/6/11	5/17/11				Separation		4.6	0.25	0.00			
OH927-1		2/6/11	5/17/11				Separation		5.4	0.06	0.00			
OH927-1		2/6/11	5/17/11	3		5.1	Separation	0.6	5.1	2.00	0.13	S	0.04	0.46
OH927-1		2/6/11	5/17/11				BOH		20.4	0.00	0.00			
OH928-1	W790-S2750	2/6/11	5/17/11				Separation		5.4	0.75	0.00			
OH928-1		2/6/11	5/17/11	1		5.8	Separation	0.2	5.8	3.00	0.00			
OH928-1		2/6/11	5/17/11				BOH		20.0	0.00	0.00			
OH929-1	W860-S2750	2/6/11	5/17/11				Separation		4.6	0.13	0.00			
OH929-1		2/6/11	5/17/11				Separation		5.0	0.13	0.00			
OH929-1		2/6/11	5/17/11				Separation		5.1	0.38	0.00			
OH929-1		2/6/11	5/17/11	3		5.4	Separation	0.6	5.4	1.00	0.00			
OH929-1		2/6/11	5/17/11				BOH		20.3	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH930-1	W920-S2750	2/6/11	5/17/11				Separation		1.0	0.13	0.00			
OH930-1		2/6/11	5/17/11	1		5.3	Separation	0.2	5.3	0.50	1.25	S	0.42	4.56
OH930-1		2/6/11	5/17/11				Separation		6.1	0.25	0.00			
OH930-1		2/6/11	5/17/11				Separation		6.8	0.13	0.00			
OH930-1		2/6/11	5/17/11				Hangup		15.9	0.00	0.00			
OH930-1		2/6/11	5/17/11				BOH		21.0	0.00	0.00			
OH931-1	W985-S2750	2/6/11	5/17/11				BOH		20.4	0.00	0.00			
OH932-1	W1060-S2750	2/6/11	5/17/11	0		5.8	Separation	0.0	5.8	0.06	1.75	S	0.58	6.39
OH932-1		2/6/11	5/17/11				Separation		6.4	0.13	0.00			
OH932-1		2/6/11	5/17/11				Hangup		15.9	0.00	0.00			
OH932-1		2/6/11	5/17/11				BOH		20.4	0.00	0.00			
OH933	W1125-S2750	6/3/09	3/8/11	0		5.6	Separation	0.0	5.6	0.50	0.25	S	0.08	0.14
OH933		6/3/09	3/8/11				BOH		20.3	0.00	0.00			
OH934-1	W1185-S2750	2/6/11	2/10/11	0		6.0	Separation	0.0	6.0	0.13	0.00			
OH934-1		2/6/11	2/10/11				BOH		20.1	0.00	0.00			
OH935-1	W395-S3080	2/7/11	5/17/11				Separation		5.2	0.75	0.00			
OH935-1		2/7/11	5/17/11	1		5.6	Separation	0.2	5.6	4.00	0.19	NW	0.06	0.69
OH935-1		2/7/11	5/17/11				BOH		19.9	0.00	0.00			
OH936-1	W464-W3080	2/7/11	5/17/11				Separation		1.3	0.50	2.00	S	0.67	7.37
OH936-1		2/7/11	5/17/11				Separation		4.7	0.13	0.00			
OH936-1		2/7/11	5/17/11	2		5.6	Separation	0.4	5.6	4.00	1.00	S	0.33	3.69
OH936-1		2/7/11	5/17/11				BOH		20.6	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH937-1	W525-S3080	2/7/11	5/17/11				Separation		1.2	0.13	0.00			
OH937-1		2/7/11	5/17/11	1		5.4	Separation	0.2	5.4	2.25	0.13	N	0.04	0.46
OH937-1		2/7/11	5/17/11				Separation		6.0	0.25	0.00			
OH937-1		2/7/11	5/17/11				BOH		20.1	0.00	0.00			
OH938-1	W590-S3080	2/7/11	5/17/11				Separation		1.1	0.13	0.00			
OH938-1		2/7/11	5/17/11	1		5.1	Separation	0.2	5.1	1.25	0.38	E	0.13	1.38
OH938-1		2/7/11	5/17/11				Separation		4.7	0.13	0.00			
OH938-1		2/7/11	5/17/11				Separation		5.6	0.25	0.00			
OH938-1		2/7/11	5/17/11				Separation		5.7	1.00	3.00		1.00	11.06
OH939-1	W660-S3080	2/7/11	5/17/11				Separation		1.2	0.25	0.00			
OH939-1		2/7/11	5/17/11	1		5.2	Separation	0.2	5.2	4.50	0.38	N	0.13	1.38
OH939-1		2/7/11	5/17/11				BOH		20.0	0.00	0.00			
OH940	W730-S3080	3/12/09	5/17/11				Separation		5.0	2.00	0.00			
OH940		3/12/09	5/17/11				Separation		5.6	0.25	0.00			
OH940		3/12/09	5/17/11	2		5.8	Separation	0.3	5.8	3.00	0.13	N	0.04	0.06
OH940		3/12/09	5/17/11				BOH		20.1	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH941-1	W790-S3080	2/7/11	5/17/11				Separation		0.9	0.13	0.00			
OH941-1		2/7/11	5/17/11				Separation		4.9	2.00	0.13	NE	0.04	0.46
OH941-1		2/7/11	5/17/11	2		5.3	Separation	0.4	5.3	1.00	0.00			
OH941-1		2/7/11	5/17/11				Separation		5.6	2.00	0.00			
OH941-1		2/7/11	5/17/11				Separation		5.8	2.00	0.00			
OH941-1		2/7/11	5/17/11				Separation		6.6	0.13	0.13	NW	0.04	0.46
OH941-1		2/7/11	5/17/11				Separation		7.0	0.13	0.00			
OH941-1		2/7/11	5/17/11				BOH		20.0	0.00	0.00			
OH942-1	W860-S3080	2/7/11	5/17/11				Separation		0.9	0.13	0.00			
OH942-1		2/7/11	5/17/11				Separation		4.1	1.50	0.19	N	0.06	0.69
OH942-1		2/7/11	5/17/11	2		4.9	Separation	0.4	4.9	5.00	0.50	NE	0.17	1.84
OH942-1		2/7/11	5/17/11				BOH		20.2	0.00	0.00			
OH942-1		2/7/11	5/17/11				Separation		5.6	0.38	0.25	N	0.08	0.92
OH943-1	W920-S3080	2/7/11	5/17/11	0		5.1	Separation	0.0	5.1	2.50	0.06	N	0.02	0.23
OH943-1		2/7/11	5/17/11				BOH		20.0	0.00	0.00			
OH944	W980-S3080	7/18/09	5/17/11	0		5.2	Separation	0.0	5.2	1.50	0.00			
OH944		7/18/09	5/17/11				BOH		20.3	0.00	0.00			
OH945	W1060-S3080	7/18/09	5/17/11	0		5.3	Separation	0.0	5.3	0.13	1.75	N	0.58	0.96
OH945		7/18/09	5/17/11				Separation		6.8	0.13	0.00			
OH945		7/18/09	5/17/11				BOH		20.3	0.00	0.00			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH946	W1120-S3080	10/3/09	3/8/11				Separation		5.3	0.13	0.00			
OH946		10/3/09	3/8/11	1		5.4	Separation	0.2	5.4	0.50	0.13		0.04	0.09
OH946		10/3/09	3/8/11				BOH		20.3	0.00	0.00			
OH947-1	W1185-S3080	2/7/11	2/10/11	0		5.3	Separation	0.0	5.3	0.13	0.00			
OH947-1		2/7/11	2/10/11				BOH		20.0	0.00	0.00			
OH1001	W390-S2271	9/23/10	5/23/11	0		8.5	Separation	0.0	8.5	0.06	0.1	E	0.04	0.19
OH1001		9/23/10	5/23/11				BOH		20.3	0.00	0.0			
OH1002	W390-S2350	9/23/10	5/23/11				BOH		0.0	0.00	0.0			
OH1003	W390-S2422	9/23/10	5/23/11				BOH		19.9	0.00	0.0			
OH1004	W520-S2271	9/14/10	5/24/11	0		8.0	Rough Spot	0.0	8.0	0.00	0.0			
OH1004		9/14/10	5/24/11				BOH		20.4	0.00	0.0			
OH1005	W520-S2350	9/14/10	5/24/11	0		8.6	Hangup	0.0	8.6	0.00	0.1	E	0.02	0.09
OH1005		9/14/10	5/24/11				BOH		20.3	0.00	0.0			
OH1006	W520-S2422	9/14/10	5/24/11				BOH		19.9	0.00	0.0			
OH1007	W660-S2271	11/15/10	5/24/11	0		8.1	Hangup	0.0	8.1	0.00	0.0			
OH1007		11/15/10	5/24/11				BOH		20.3	0.00	0.0			
OH1008	W660-S2350	11/15/10	5/24/11				BOH		20.3	0.00	0.0			
OH1009	W660-S2422	11/15/10	5/24/11				BOH		20.2	0.00	0.0			
OH1010	W790-S2271	11/15/10	5/24/11				BOH		20.3	0.00	0.0			
OH1011	W790-S2350	11/15/10	5/24/11				BOH		20.3	0.00	0.0			
OH1012	W790-S2422	12/21/10	5/24/11	0		6.5	Separation	0.0	6.5	0.13	0.0			
OH1012		12/21/10	5/24/11				BOH		20.3	0.00	0.0			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH1013	W920-S2271	3/1/11	5/24/11				BOH		20.3	0.00	0.0			
OH1014	W920-S2350	3/1/11	5/24/11	0		7.4	Separation	0.0	7.4	0.25	0.0			
OH1014		3/1/11	5/24/11				BOH		20.3	0.00	0.0			
OH1015	W920-S2422	3/1/11	5/24/11				BOH		20.2	0.00	0.0			
OH1016	W1050-S2520	3/1/11	5/24/11				BOH		20.0	0.00	0.0			
OH1017	W1050-S2350	3/1/11	5/24/11				BOH		19.9	0.00	0.0			
OH1018	W1050-S2422	3/1/11	5/24/11				BOH		19.9	0.00	0.0			
OH1019	W1190-S2271	3/21/11	5/24/11				BOH		20.0	0.00	0.0			
OH1020	W1190-S2350	3/21/11	5/24/11	0		7.8	Separation	0.0	7.8	0.06	0.0			
OH1020		3/21/11	5/24/11				BOH		20.3	0.00	0.0			
OH1021	W1190-S2422	3/21/11	5/24/11				BOH		20.3	0.00	0.0			
OH1022	W390-S2180	9/14/10	5/23/11	0		8.4	Separation	0.0	8.4	0.13	0.5	S	0.17	0.73
OH1022		9/14/10	5/23/11				Separation		14.5	0.06	0.3	S	0.08	0.36
OH1022		9/14/10	5/23/11				BOH		20.4	0.00	0.0			
OH1023	W455-S2180	9/14/10	5/23/11	0		8.4	Separation	0.0	8.4	0.06	0.3	N	0.08	0.36
OH1023		9/14/10	5/23/11				BOH		20.3	0.00	0.0			
OH1024	W520-S2180	9/14/10	5/23/11	0		8.4	Separation	0.0	8.4	0.06	0.5	S	0.17	0.73
OH1024		9/14/10	5/23/11				BOH		20.2	0.00	0.0			
OH1025	W590-S2180	9/14/10	5/23/11	0		8.5	Separation	0.0	8.5	0.13	0.3	N	0.08	0.36
OH1025		9/14/10	5/23/11				BOH		20.3	0.00	0.0			
OH1026	W660-S2180	9/14/10	5/23/11	0		8.0	Separation	0.0	8.0	0.06	1.0	S	0.33	1.45
OH1026		9/14/10	5/23/11				BOH		20.1	0.00	0.0			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH1027	W725-S2180	9/14/10	5/23/11	0		7.9	Separation	0.0	7.9	0.06	0.8	N	0.25	1.09
OH1027		9/14/10	5/23/11				BOH		20.3	0.00	0.0			
OH1028	W790-S2180	9/14/10	5/23/11	0		8.0	Separation	0.0	8.0	0.13	0.3	S	0.08	0.36
OH1028		9/14/10	5/23/11				BOH		20.0	0.00	0.0			
OH1029	W855-S2180	9/14/10	5/23/11	0		8.1	Separation	0.0	8.1	0.13	1.0	N	0.33	1.45
OH1029		9/14/10	5/23/11				BOH		20.3	0.00	0.0			
OH1030	W920-S2180	9/14/10	5/23/11	0		8.3	Separation	0.0	8.3	0.13	0.8	S	0.25	1.09
OH1030		9/14/10	5/23/11				BOH		20.0	0.00	0.0			
OH1031	W985-S2180	9/14/10	5/23/11	0		7.8	Separation	0.0	7.8	0.25	0.3	N	0.08	0.36
OH1031		9/14/10	5/23/11				BOH		20.4	0.00	0.0			
OH1032	W1050-S2180	9/14/10	5/23/11	0		7.3	Separation	0.0	7.3	0.25	0.3	S	0.08	0.36
OH1032		9/14/10	5/23/11				BOH		20.6	0.00	0.0			
OH1033	W1120-S2180	3/1/11	5/23/11				BOH		20.3	0.00	0.0			
OH1034	W1190-S2180	3/21/11	5/23/11	0		6.9	Hangup	0.0	6.9	0.00	0.3	SE	0.08	1.45
OH1034		3/21/11	5/23/11				BOH		20.0	0.00	0.0			
OH1035	W390-S2520	9/10/10	5/23/11	0		7.8	Separation	0.0	7.8	0.13	0.0			
OH1035		9/10/10	5/23/11				Separation		13.7	0.25	0.0			
OH1035		9/10/10	5/23/11				BOH		20.2	0.00	0.0			
OH1036	W455-S2520	9/10/10	5/23/11				BOH		19.4	0.00	0.0			
OH1037	W520-S2520	11/15/10	5/23/11	0		7.7	Separation	0.0	7.7	0.13	0.0			
OH1037		11/15/10	5/23/11				Separation		13.8	0.06	0.0			
OH1037		11/15/10	5/23/11				BOH		20.4	0.00	0.0			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-1, (Continued)
Observation Borehole Fractures and Offset Data Summary

Hole	Location	Initial Inspection Date	Recent Inspection Date	FR[1]	FZ[2]	Beam Height (ft)	Feature	Fracture Density[3]	Feature Depth (ft)	Separation (in)	Offset (in.)	Compass	Hole Closure (%)	Offset Rate (in/yr)
OH1038	W590-S2520	11/15/10	5/23/11	0		7.9	Separation	0.0	7.9	0.25	0.0			
OH1038		11/15/10	5/23/11				BOH		21.6	0.00	0.0			
OH1039	W660-S2520	11/15/10	5/23/11	0		7.6	Separation	0.0	7.6	0.06	0.0			
OH1039		11/15/10	5/23/11				Separation		13.4	0.06	0.0			
OH1039		11/15/10	5/23/11				BOH		20.3	0.00	0.0			
OH1040	W725-S2520	11/15/10	5/23/11				BOH		20.2	0.00	0.0			
OH1041	W790-S2520	11/15/10	5/23/11	0		7.7	Separation	0.0	7.7	0.06	1.0	N	0.33	1.93
OH1041		11/15/10	5/23/11				BOH		20.2	0.00	0.0			
OH1042	W855-S2520	11/15/10	5/23/11	0		6.9	Separation	0.0	6.9	0.06	0.0			
OH1042		11/15/10	5/23/11				Separation		20.3	0.00	0.0			
OH1043	W920-S2520	3/1/11	5/23/11	0		7.9	Separation	0.0	7.9	0.25	0.0			
OH1043		3/1/11	5/23/11				Hangup		14.3	0.00	0.0			
OH1043		3/1/11	5/23/11				BOH		20.0	0.00	0.0			
OH1044	W985-S2520	3/1/11	5/23/11				BOH		20.2	0.00	0.0			
OH1045	W1050-S2520	3/1/11	5/23/11	0		7.4	Separation	0.0	7.4	0.25	0.0			
OH1045		3/1/11	5/23/11				Separation		13.7	0.06	0.0			
OH1045		3/1/11	5/23/11				BOH		20.2	0.00	0.0			
OH1046	W1120-S2520	3/21/11	5/23/11				BOH		20.2	0.00	0.0			
OH1047	W1190-S2520	3/21/11	5/23/11	0		7.2	Separation	0.0	7.2	0.25	0.3	NE	0.08	1.45
OH1047		3/21/11	5/23/11				BOH		20.3	0.00	0.0			

[1] Number of fractures (FR) in immediate roof beam

[2] Number of fracture zones (FZ) in immediate roof beam, FZ = 0 unless otherwise noted

[3] Fracture Density = (FR + 2 FZ)/Beam Height

Table 6-2 Summary of New Boreholes[1]

Hole	Location	Northing	Easting	Drill Date	Depth (feet)	Dia. (inches)	Purpose Of Hole
OH901-1	W395-S2832	6855	6500	2/6/2011	19.9	3	Observation
OH902-1	W395-S2912	6775	6500	2/6/2011	20	3	Observation
OH903-1	W395-S2994	6693	6500	2/6/2011	20	3	Observation
OH922-1	W395-S2750	6937	6500	2/6/2011	20	3	Observation
OH923-1	W461-S2750	6937	6433	2/6/2011	20	3	Observation
OH924-1	W528-S2750	6937	6367	2/6/2011	20	3	Observation
OH925-1	W618-S2750	6937	6277	2/6/2011	20	3	Observation
OH926-1	W656-S2750	6937	6235	2/6/2011	20	3	Observation
OH927-1	W725-S2750	6937	6170	2/6/2011	20	3	Observation
OH928-1	W790-S2750	6937	6105	2/6/2011	19.9	3	Observation
OH929-1	W860-S2750	6937	6035	2/6/2011	20.1	3	Observation
OH930-1	W920-S2750	6937	5975	2/6/2011	20	3	Observation
OH931-1	W985-S2750	6937	5915	2/6/2011	20	3	Observation
OH932-1	W1060-S2750	6937	5835	2/6/2011	20	3	Observation
OH934-1	W1185-S2750	6937	5710	2/6/2011	20.1	3	Observation
OH935-1	W395-S3080	6607	6500	2/7/2011	19.9	3	Observation
OH936-1	W463-S3080	6607	5432	2/7/2011	20	3	Observation
OH937-1	W529-S3080	6607	6370	2/7/2011	20	3	Observation
OH938-1	W590-S3080	6607	6305	2/7/2011	20	3	Observation
OH939-1	W662-S3080	6607	6235	2/7/2011	20	3	Observation
OH940-1	W730-S3080	6607	6185	2/7/2011	20	3	Observation
OH941-1	W795-S3080	6607	6105	2/7/2011	21.5	3	Observation
OH942-1	W860-S3080	6607	6035	2/7/2011	20	3	Observation
OH943-1	W925-S3080	6607	5975	2/7/2011	20.1	3	Observation
OH1001	S2271-W390	7416	6505	9/23/2010	20.3	3	Observation
OH1002	S2350-W390	7337	6505	9/23/2010	20.3	3	Observation
OH1003	S2422-W390	7265	6505	9/23/2010	19.9	3	Observation
OH1004	S2271-W520	7416	6375	9/14/2010	20.5	3	Observation
OH1005	S2350-W520	7337	6375	9/14/2010	20.3	3	Observation
OH1006	S2422-W520	7265	6375	9/14/2010	20	3	Observation
OH1007	S2271-W660	7416	6235	11/15/2010	20.1	3	Observation
OH1008	S2350-W660	7337	6235	11/15/2010	20.2	3	Observation
OH1009	S2422-W660	7265	6235	11/15/2010	20.1	3	Observation
OH1010	S2271-W790	7416	6105	11/15/2010	20.3	3	Observation
OH1011	S2350-W790	7337	6105	11/15/2010	20.3	3	Observation
OH1012	S2422-W790	7265	6105	12/21/2010	20.2	3	Observation

Table 6-2 (Continued) Summary of New Boreholes [1]

Hole	Location	Northing	Easting	Drill Date	Depth (feet)	Dia. (inches)	Purpose OF Hole
OH1013	S2271-W920	7416	5975	3/1/2011	20.3	3	Observation
OH1014	S2350-W920	7337	5975	3/1/2011	20.2	3	Observation
OH1015	S2422-W920	7265	5975	3/1/2011	20.2	3	Observation
OH1016	S2271-W1050	7416	5845	3/1/2011	20.1	3	Observation
OH1017	S2350-W1050	7337	5845	3/1/2011	20	3	Observation
OH1018	S2422-W1050	7265	5845	3/1/2011	20	3	Observation
OH1019	S2271-W1190	7416	5705	3/21/2011	20	3	Observation
OH1020	S2350-W1190	7337	5705	3/21/2011	20.2	3	Observation
OH1021	S2422-W1190	7265	5705	3/21/2011	20.1	3	Observation
OH1022	S2180-W390	7507	6505	9/14/2010	20.4	3	Observation
OH1023	S2180-W455	7507	6440	9/14/2010	20.3	3	Observation
OH1024	S2180-W520	7507	6375	9/14/2010	20.3	3	Observation
OH1025	S2180-W590	7507	6305	9/14/2010	20.1	3	Observation
OH1026	S2180-W620	7507	6235	9/14/2010	20.1	3	Observation
OH1027	S2180-W725	7507	6170	9/14/2010	20.2	3	Observation
OH1028	S2180-W790	7507	6105	9/14/2010	20.2	3	Observation
OH1029	S2180-W855	7507	6040	9/14/2010	20.3	3	Observation
OH1030	S2180-W920	7507	5975	9/14/2010	20.1	3	Observation
OH1031	S2180-W985	7507	5910	9/14/2010	20.3	3	Observation
OH1032	S2180-W1050	7507	5845	9/14/2010	20.4	3	Observation
OH1033	S2180-W1120	7507	5775	3/1/2011	20.2	3	Observation
OH1034	S2180-W1190	7507	5705	3/21/2011	20	3	Observation
OH1035	S2180-W390	7167	6505	9/10/2010	21.3	3	Observation
OH1036	S2180-W455	7167	6440	9/10/2010	21.4	3	Observation
OH1037	S2180-W520	7167	6375	11/15/2010	20.5	3	Observation
OH1038	S2180-W590	7167	6305	11/15/2010	21.5	3	Observation
OH1039	S2180-W660	7167	6235	11/15/2010	20.2	3	Observation
OH1040	S2180-W725	7167	6170	11/15/2010	20.1	3	Observation
OH1041	S2180-W790	7167	6105	11/15/2010	20.1	3	Observation
OH1042	S2180-W855	7167	6040	11/15/2010	20.2	3	Observation
OH1043	S2180-W920	7167	5975	3/1/2010	20.1	3	Observation
OH1044	S2180-W985	7167	5910	3/1/2010	20.2	3	Observation
OH1045	S2180-W1050	7167	5845	3/1/2010	20.1	3	Observation
OH1046	S2180-W1120	7167	5775	3/21/2010	20.1	3	Observation
OH1047	S2180-W1190	7167	5705	3/21/2010	20.1	3	Observation

[1] All Boreholes drilled vertically upwards into the back.

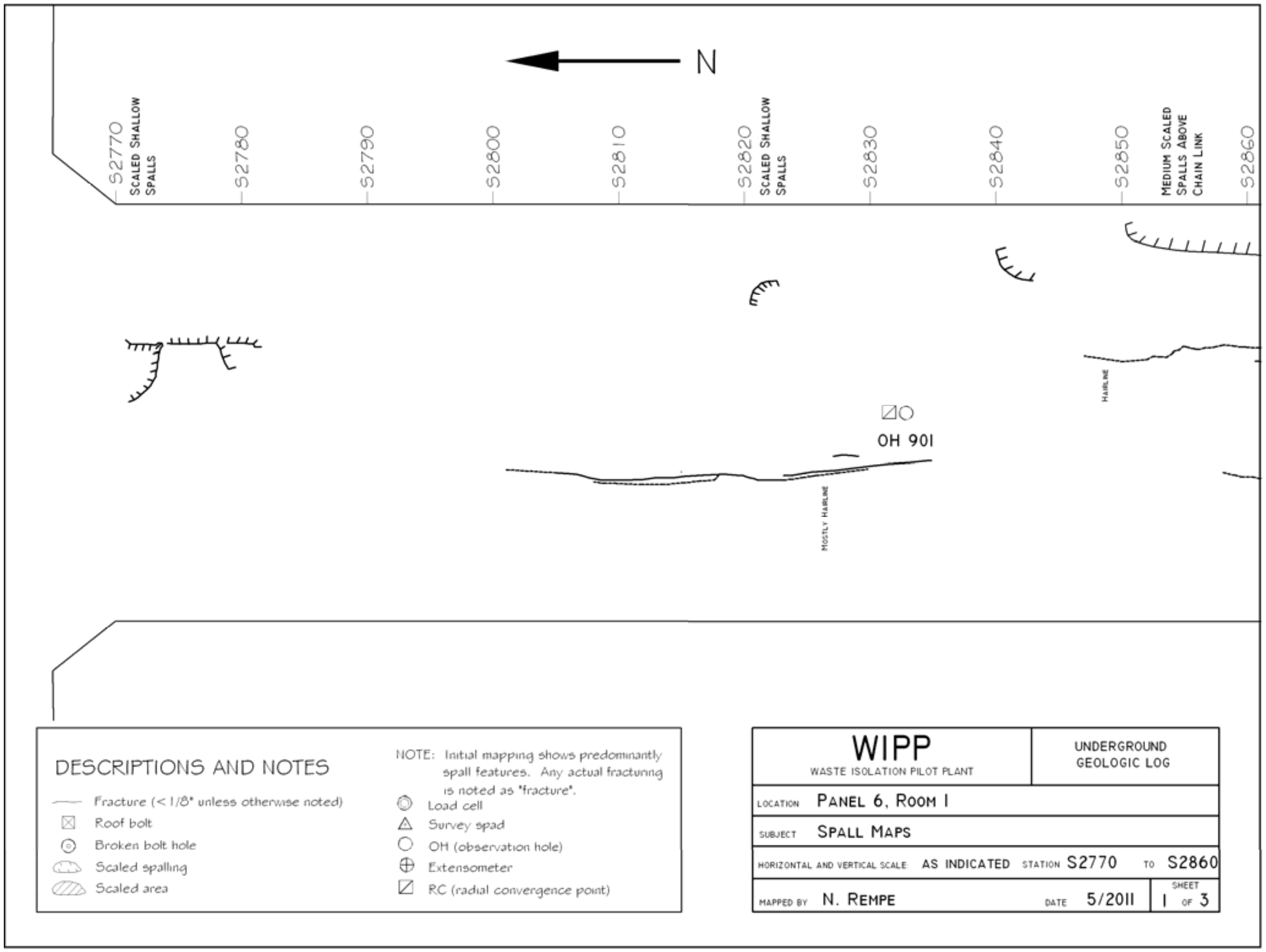

Figure 6-1 Panel 6 Room 1, S2770 S3060 Roof Fractures (Sheet 1 of 3)

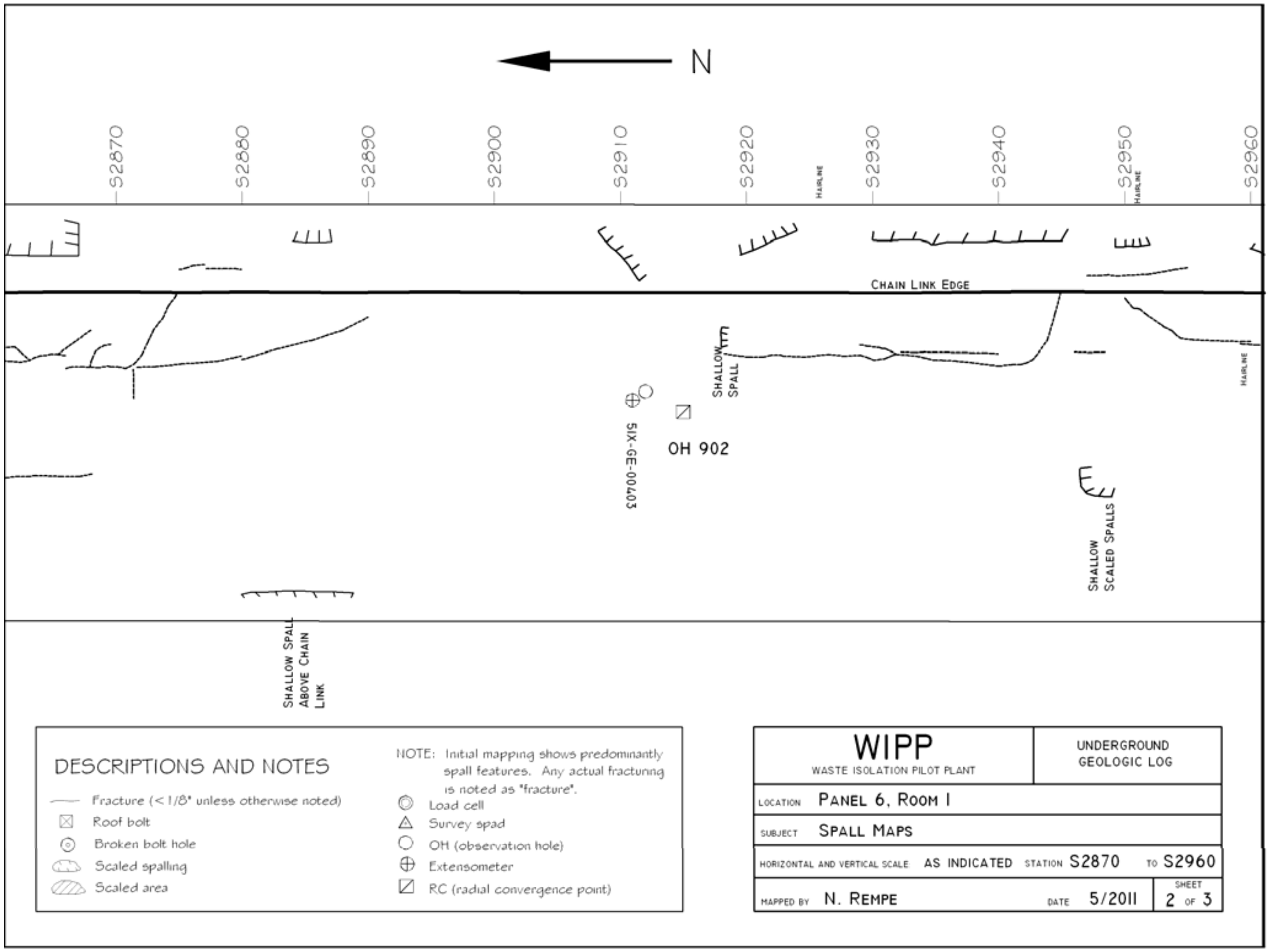

Figure 6-2 Panel 6 Room 1, S2770 S3060 Roof Fractures (Sheet 2 of 3)

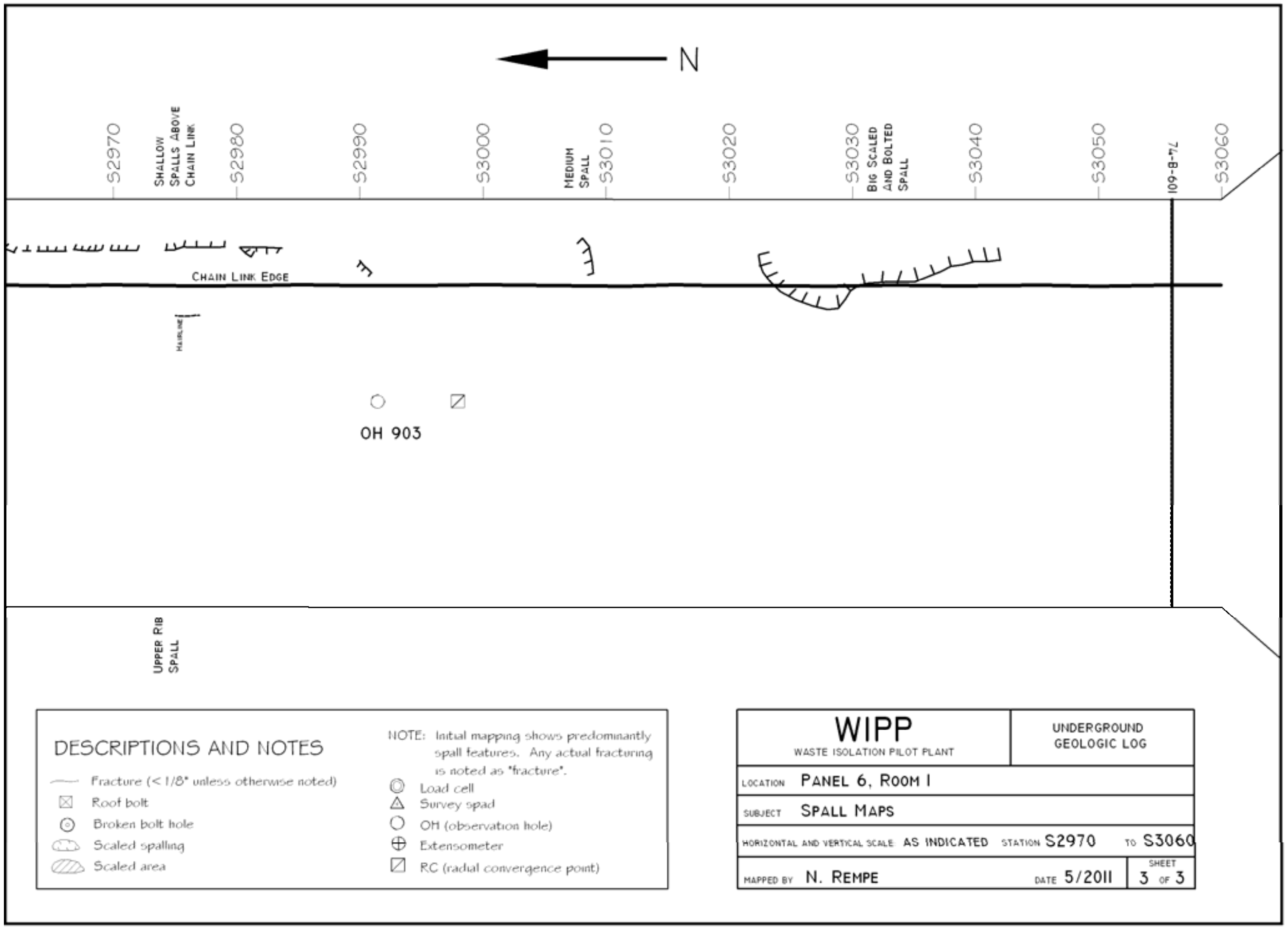

Figure 6-3 Panel 6 Room 1, S2770-S3060 Roof Fractures (Sheet 3 of 3)

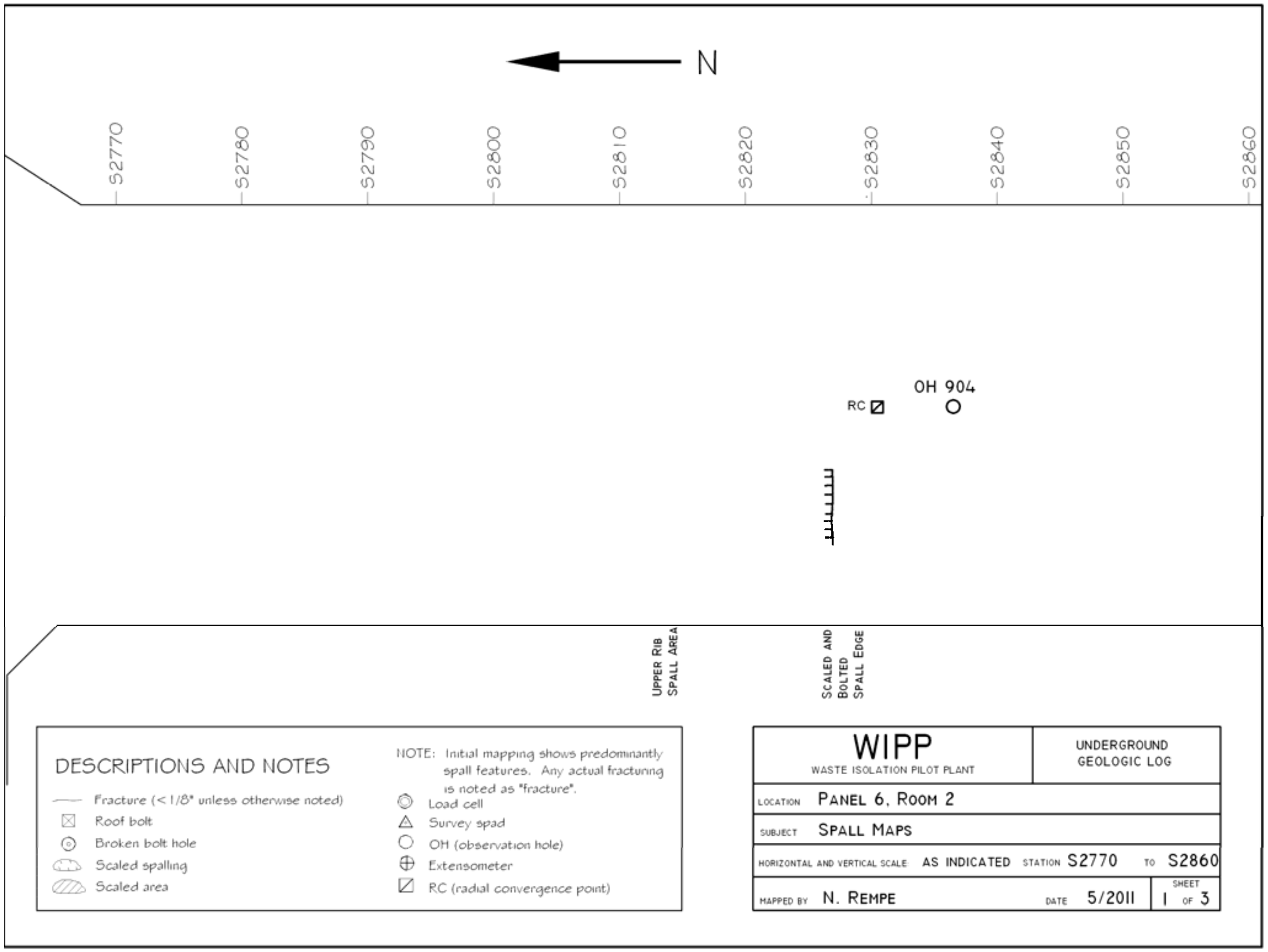

Figure 6-4 Panel 6 Room 2, S2770-S3060 Roof Fractures (Sheet 1 of 3)

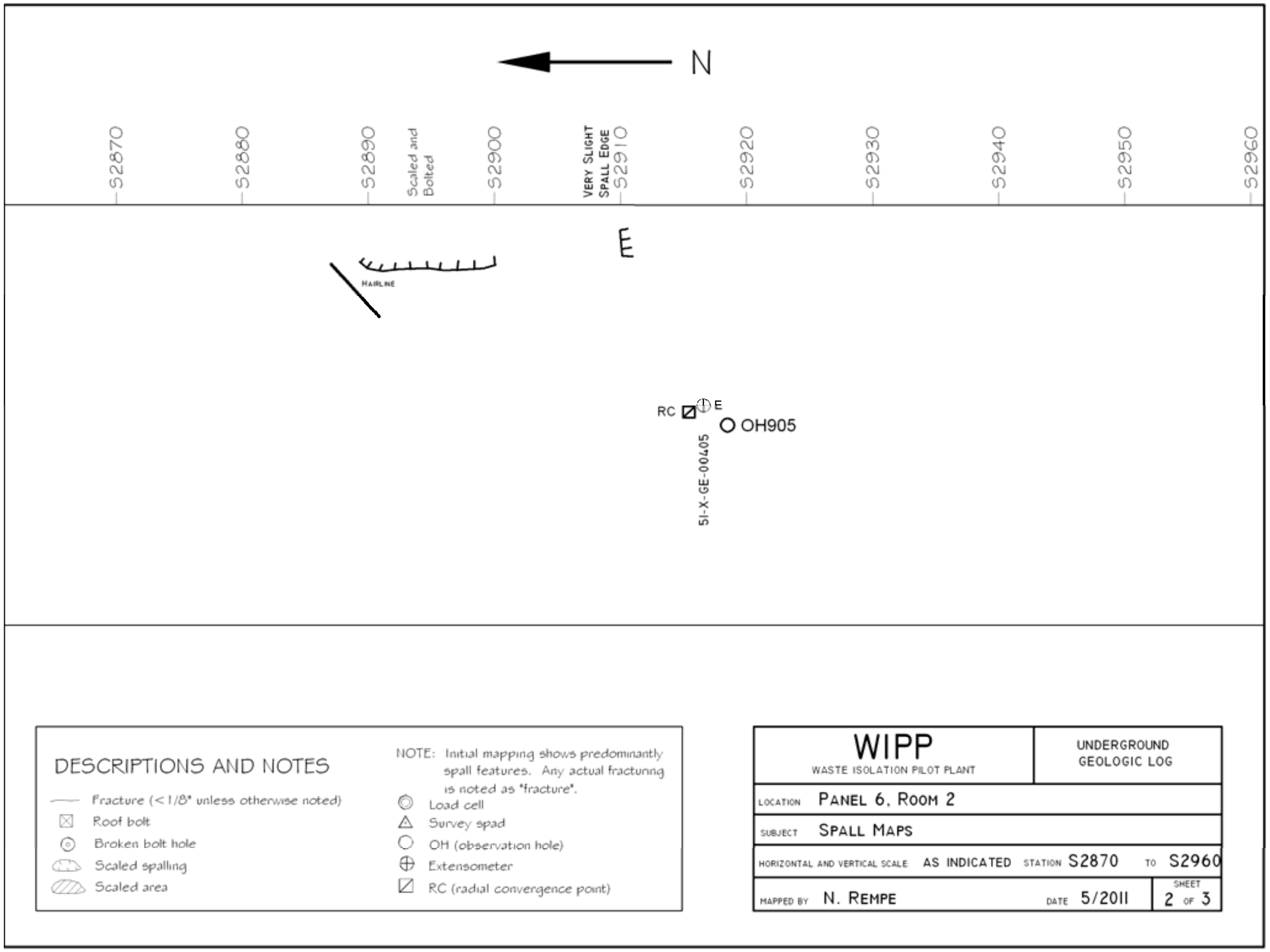

Figure 6-5 Panel 6 Room 2, S2770-S3060 Roof Fractures (Sheet 2 of 3)

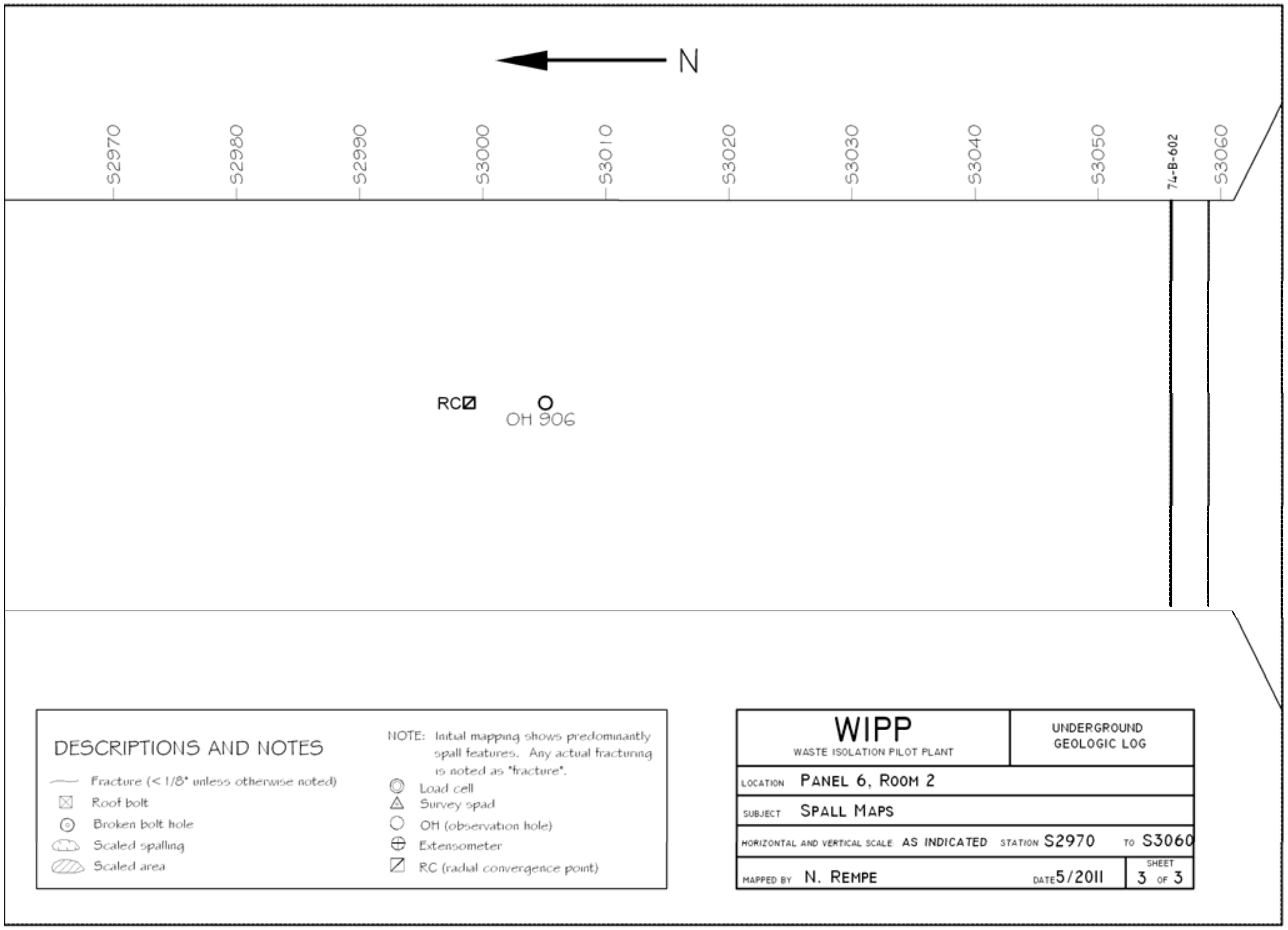

Figure 6-6 Panel 6 Room 2, S2770-S3060 Roof Fractures (Sheet 3 of 3)

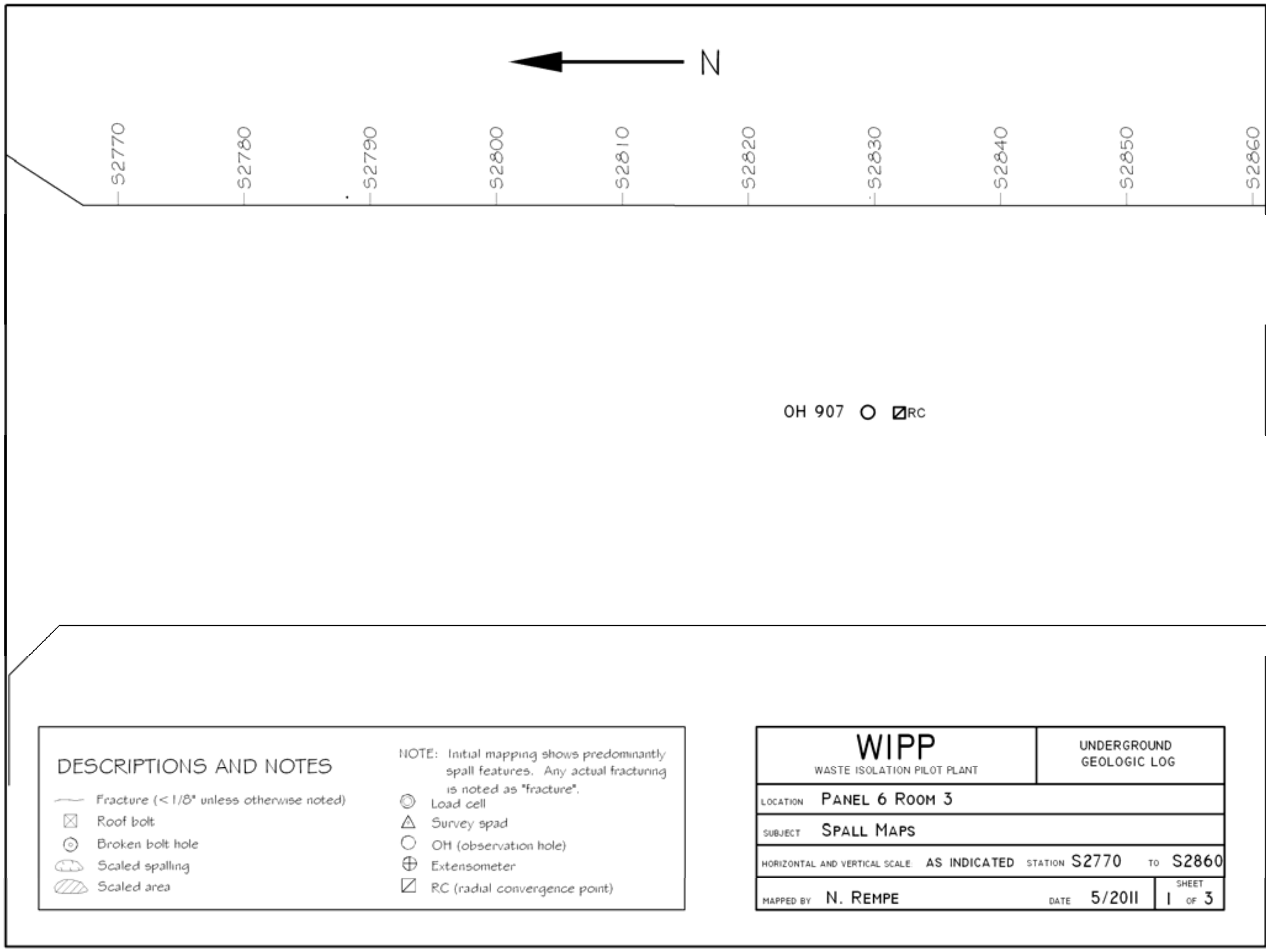

Figure 6-7 Panel 6 Room 3, S2770-S3060 Roof Fractures (Sheet 1 of 3)

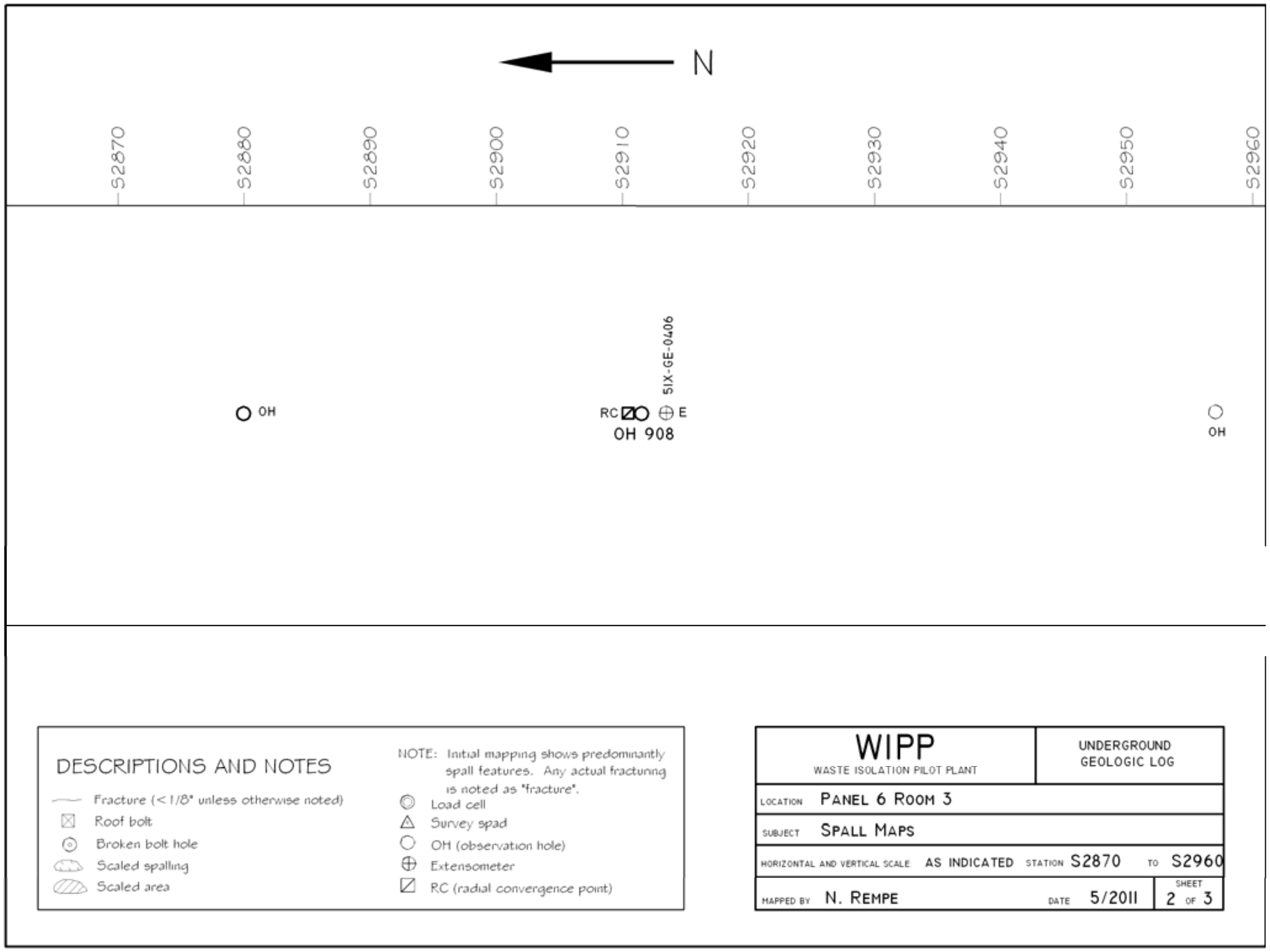

Figure 6-8 Panel 6 Room 3, S2770-S3060 Roof Fractures (Sheet 2 of 3)

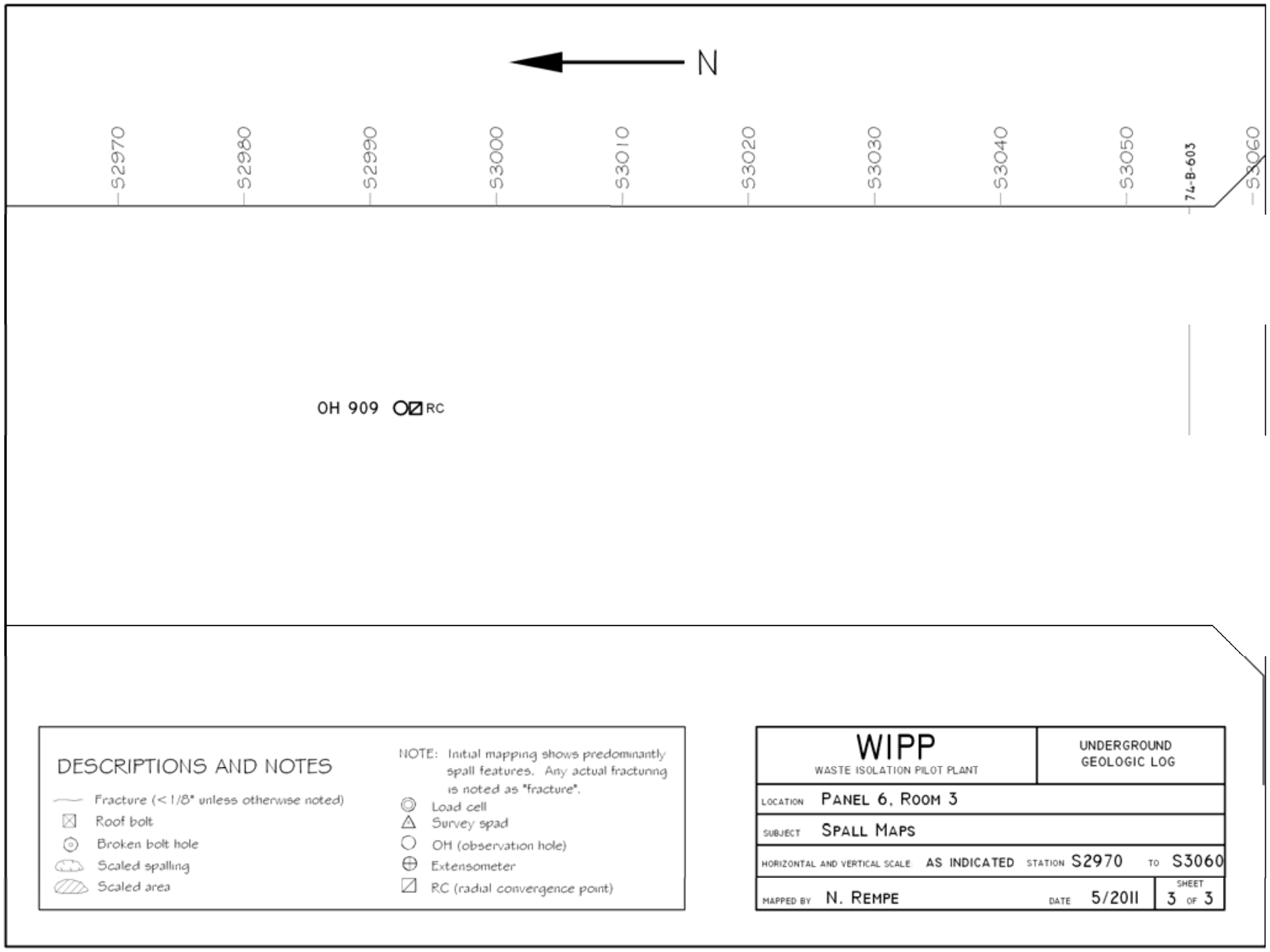

Figure 6-9 Panel 6 Room 3, S2770-S3060 Roof Fractures (Sheet 3 of 3)

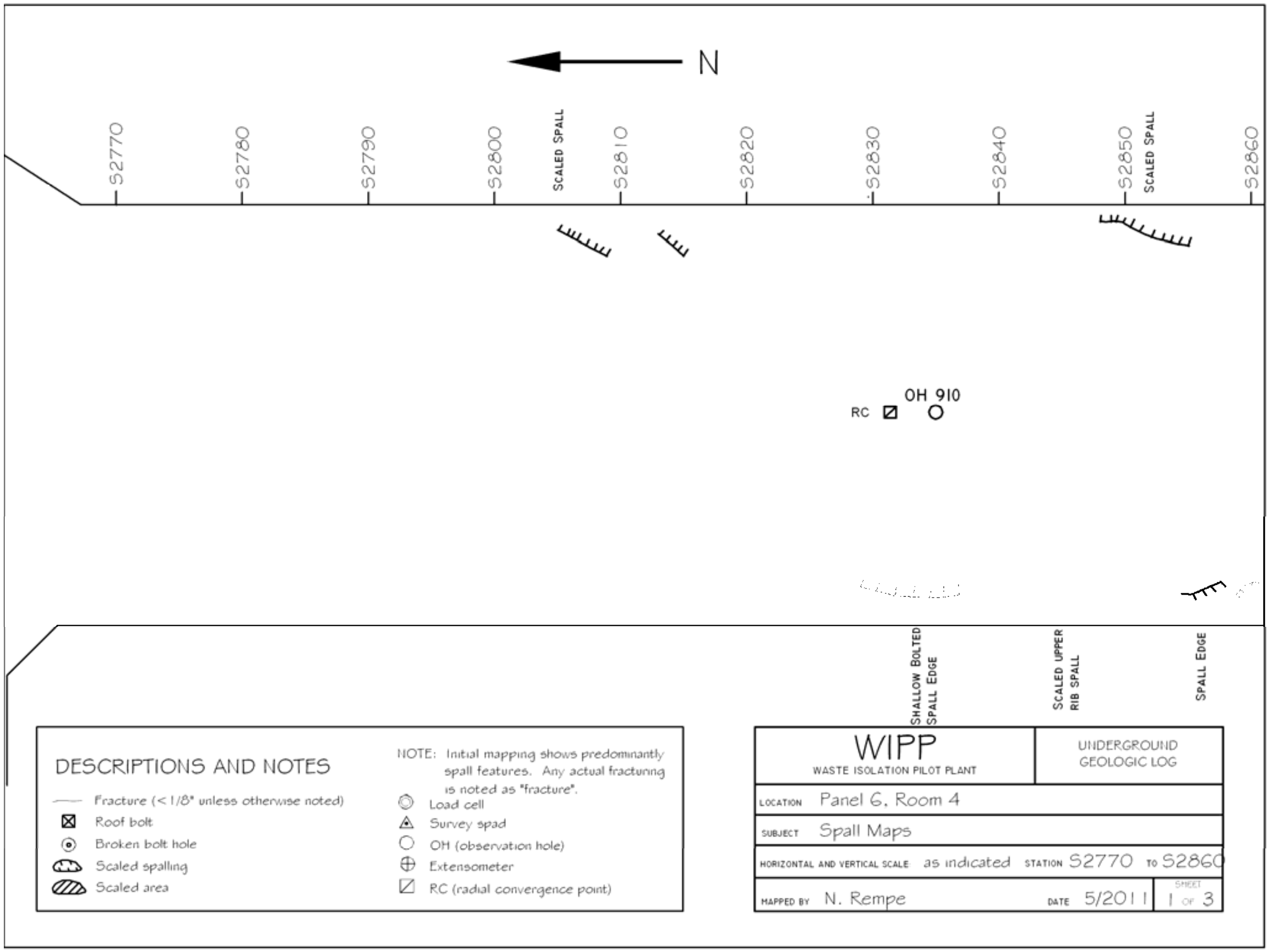

Figure 6-10 Panel 6 Room 2, S2770-S3060 Roof Fractures (Sheet 1 of 3)

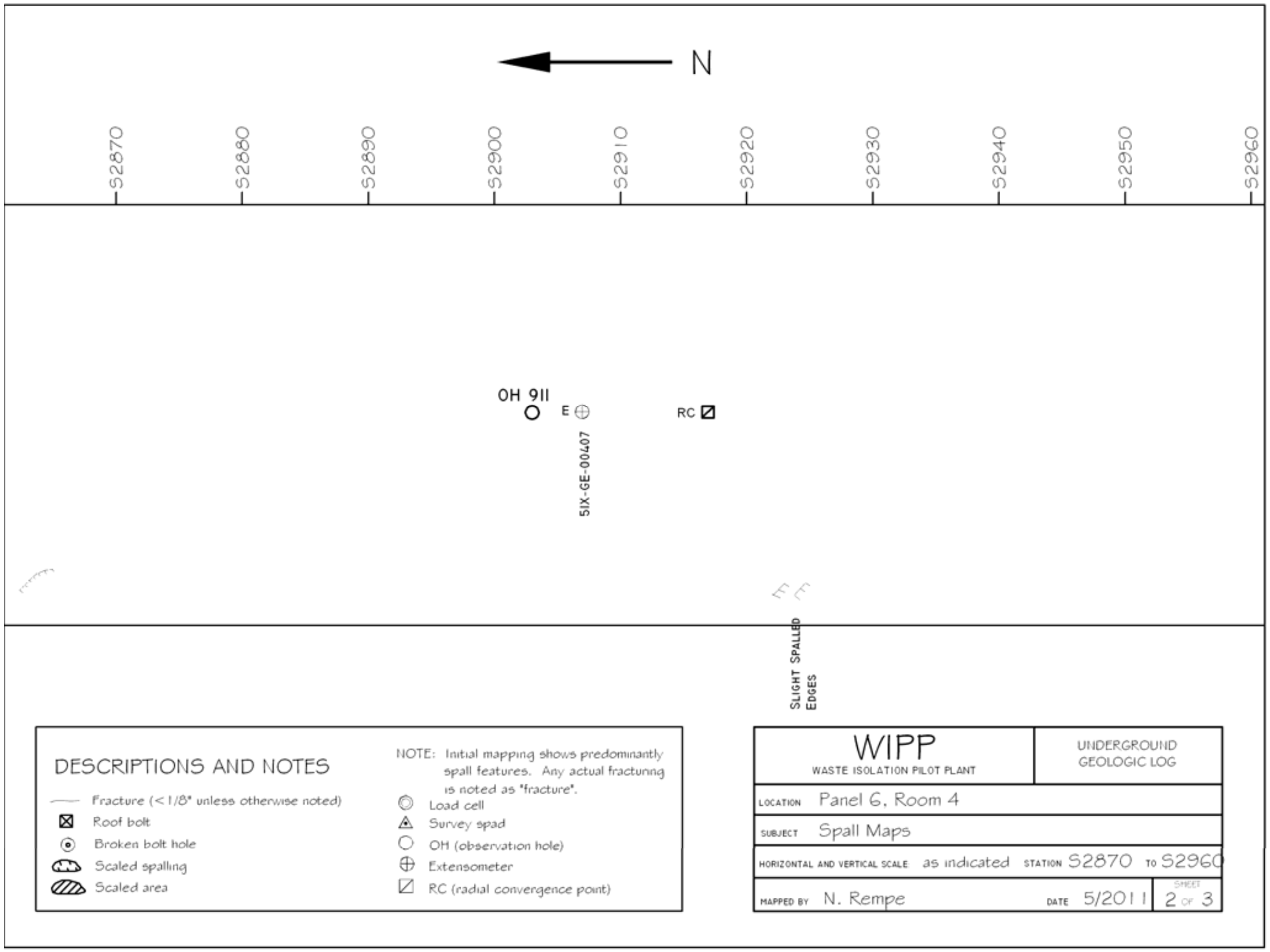

Figure 6-11 Panel 6 Room 4, S2770-S3060 Roof Fractures (Sheet 2 of 3)

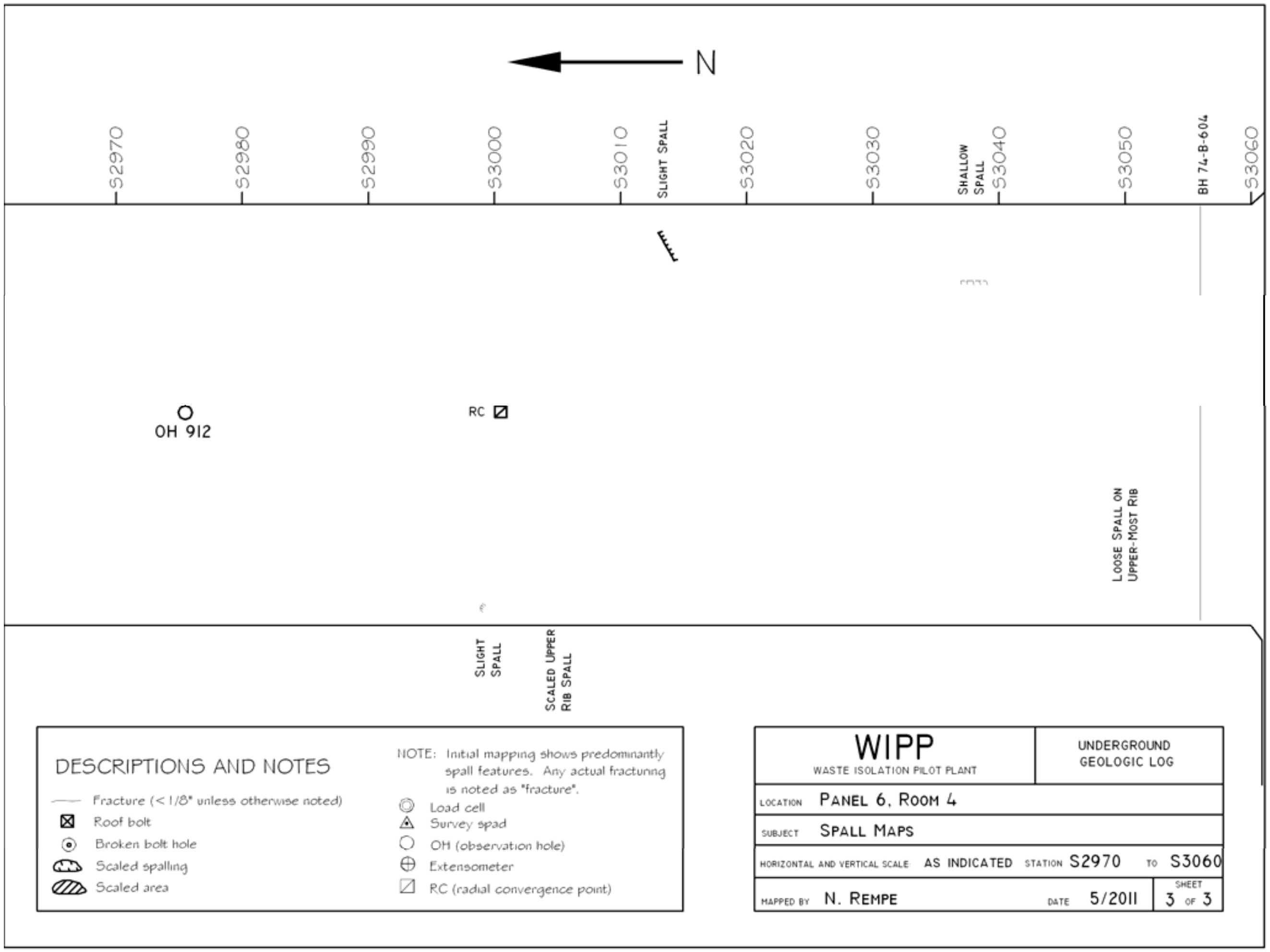

Figure 6-12 Panel 6 Room 4, S2770-S3060 Roof Fractures (Sheet 3 of 3)

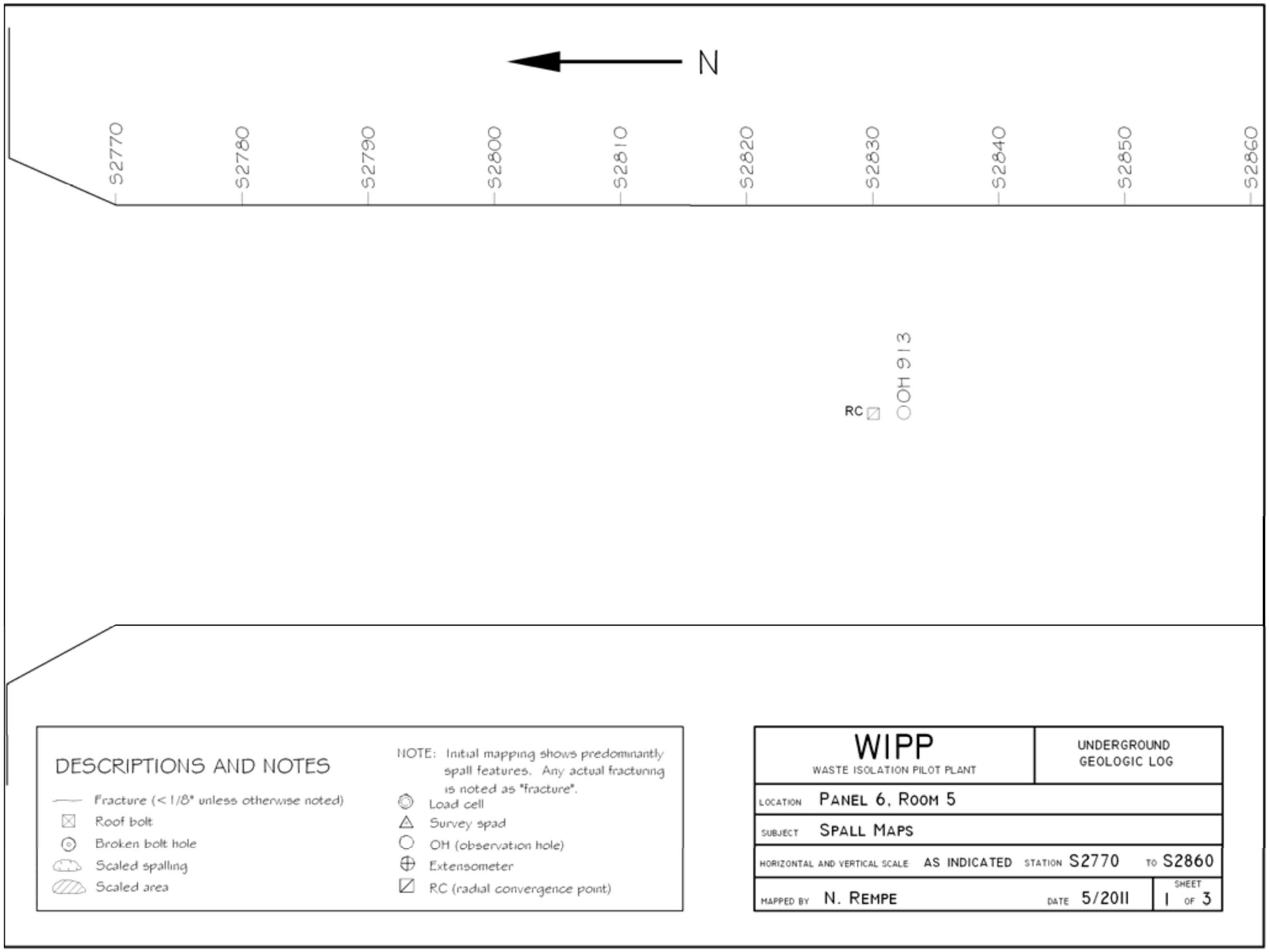

Figure 6-13 Panel 6 Room 5, S2770-S3060 Roof Fractures (Sheet 1 of 3)

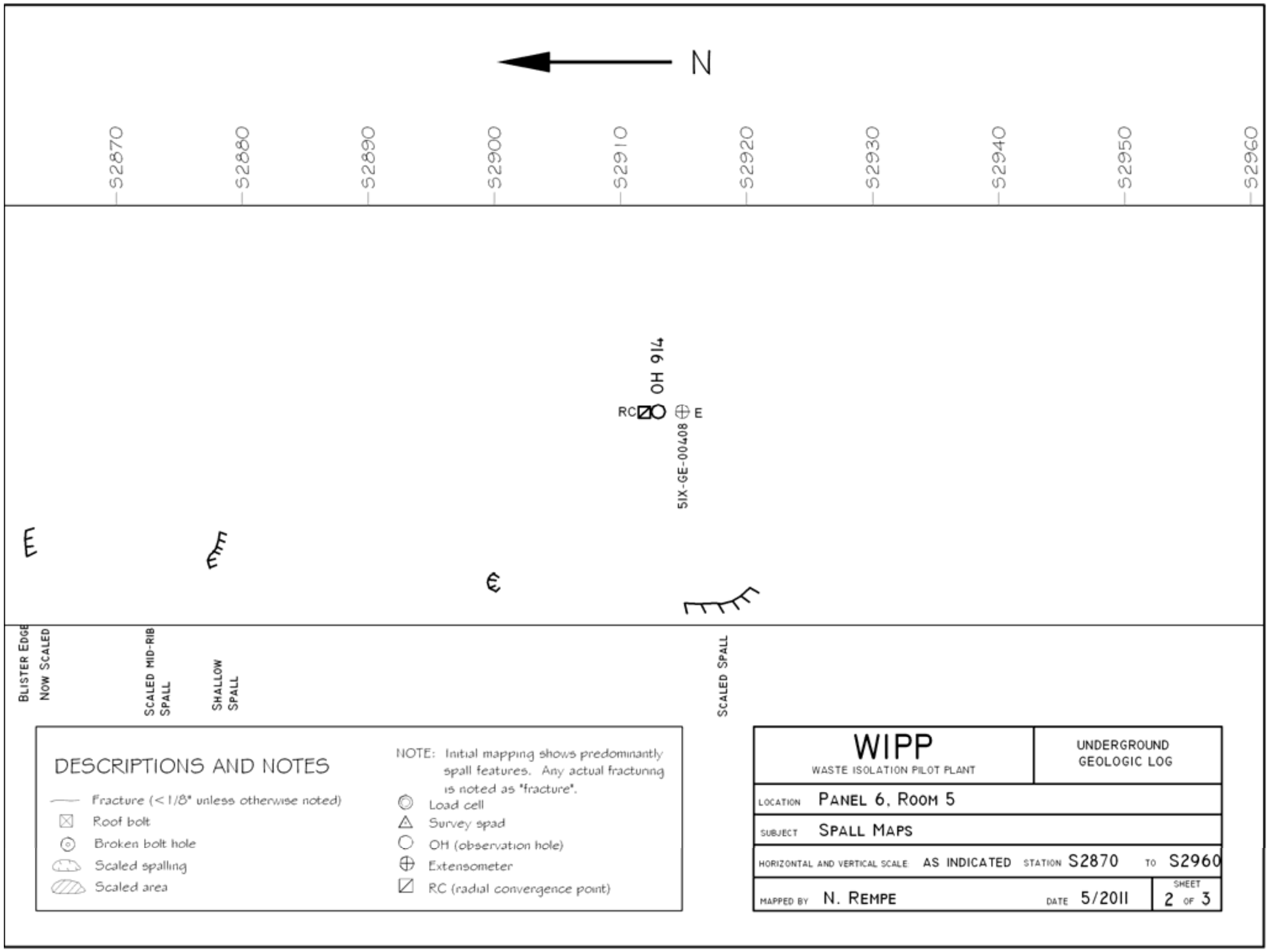

Figure 6-14 Panel 6 Room 4, S2770-S3060 Roof Fractures (Sheet 2 of 3)

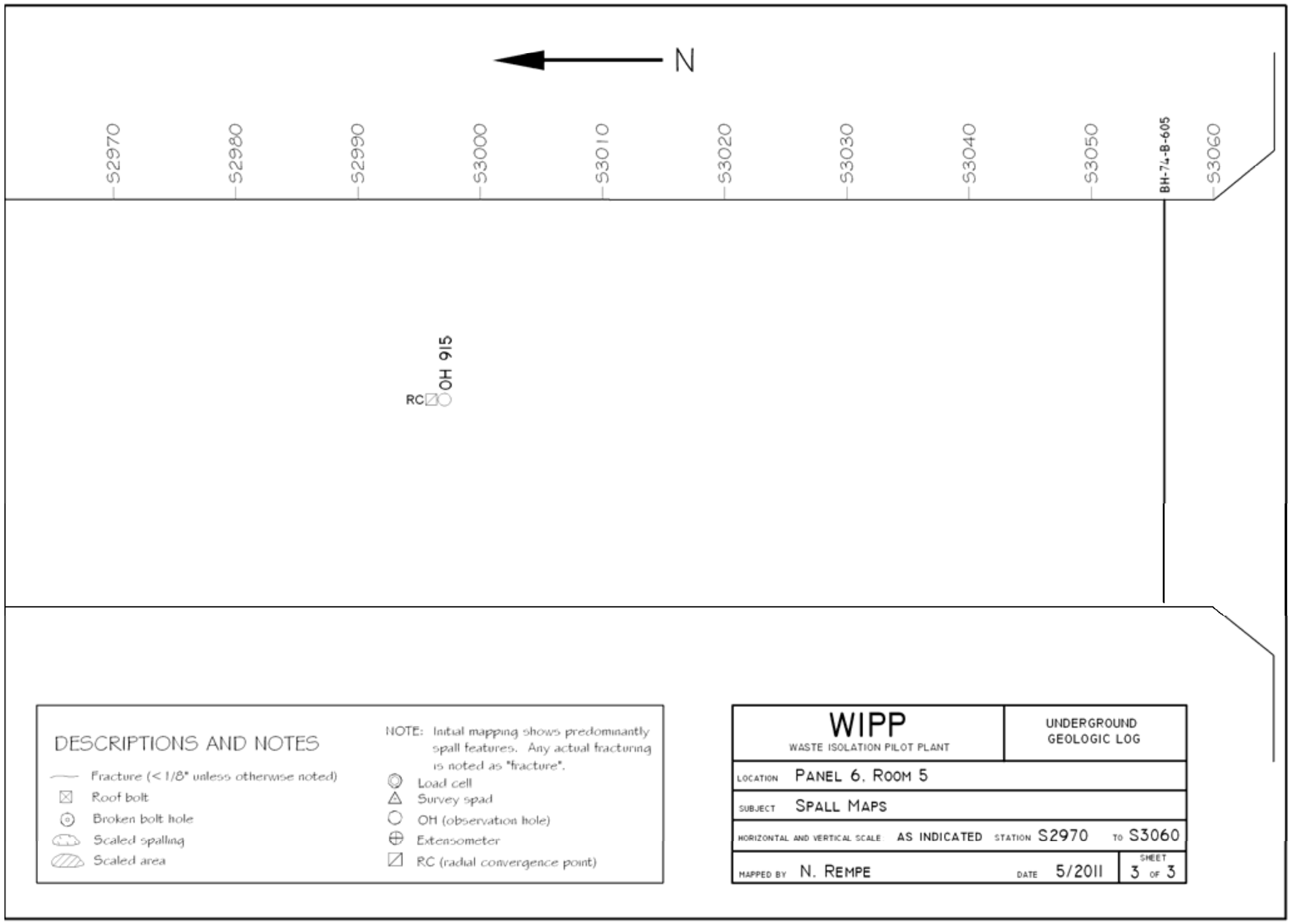

Figure 6-15 Panel 6 Room 5, S2770-S3060 Roof Fractures (Sheet 3 of 3)

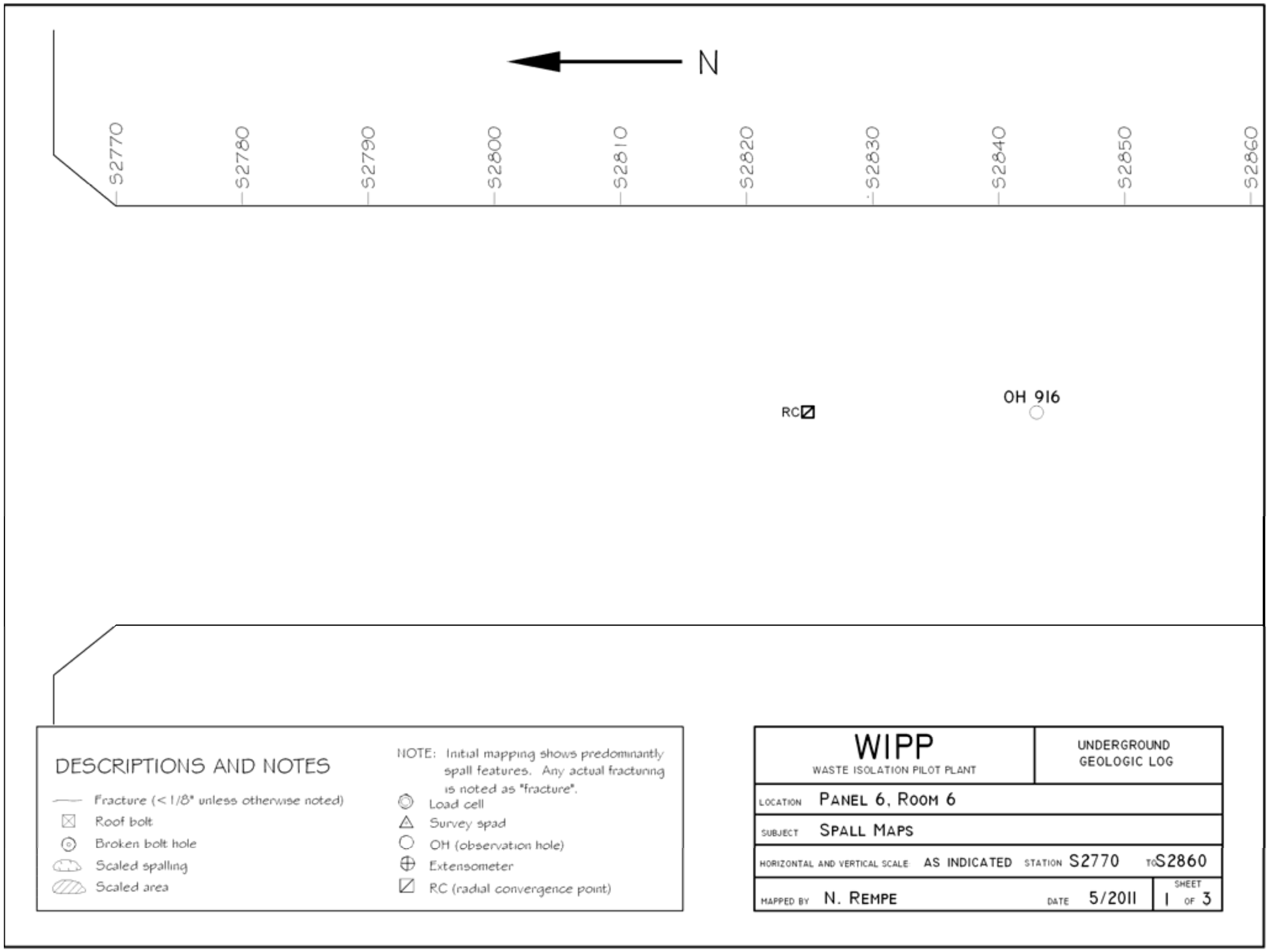

Figure 6-16 Panel 6 Room 6, S2770-S3060 Roof Fractures (Sheet 1 of 3)

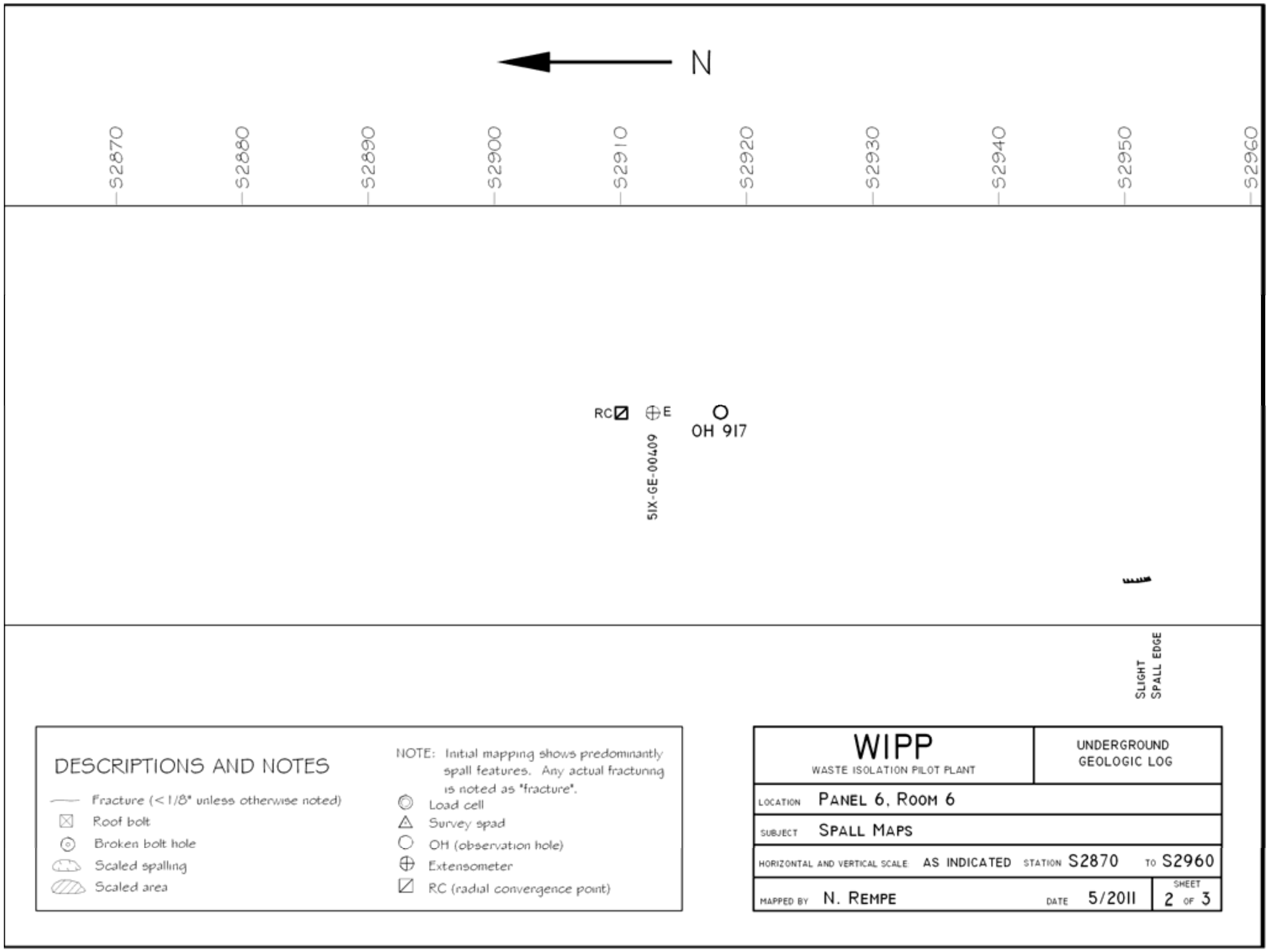

Figure 6-17 Panel 6 Room 6, S2770-S3060 Roof Fractures (Sheet 2 of 3)

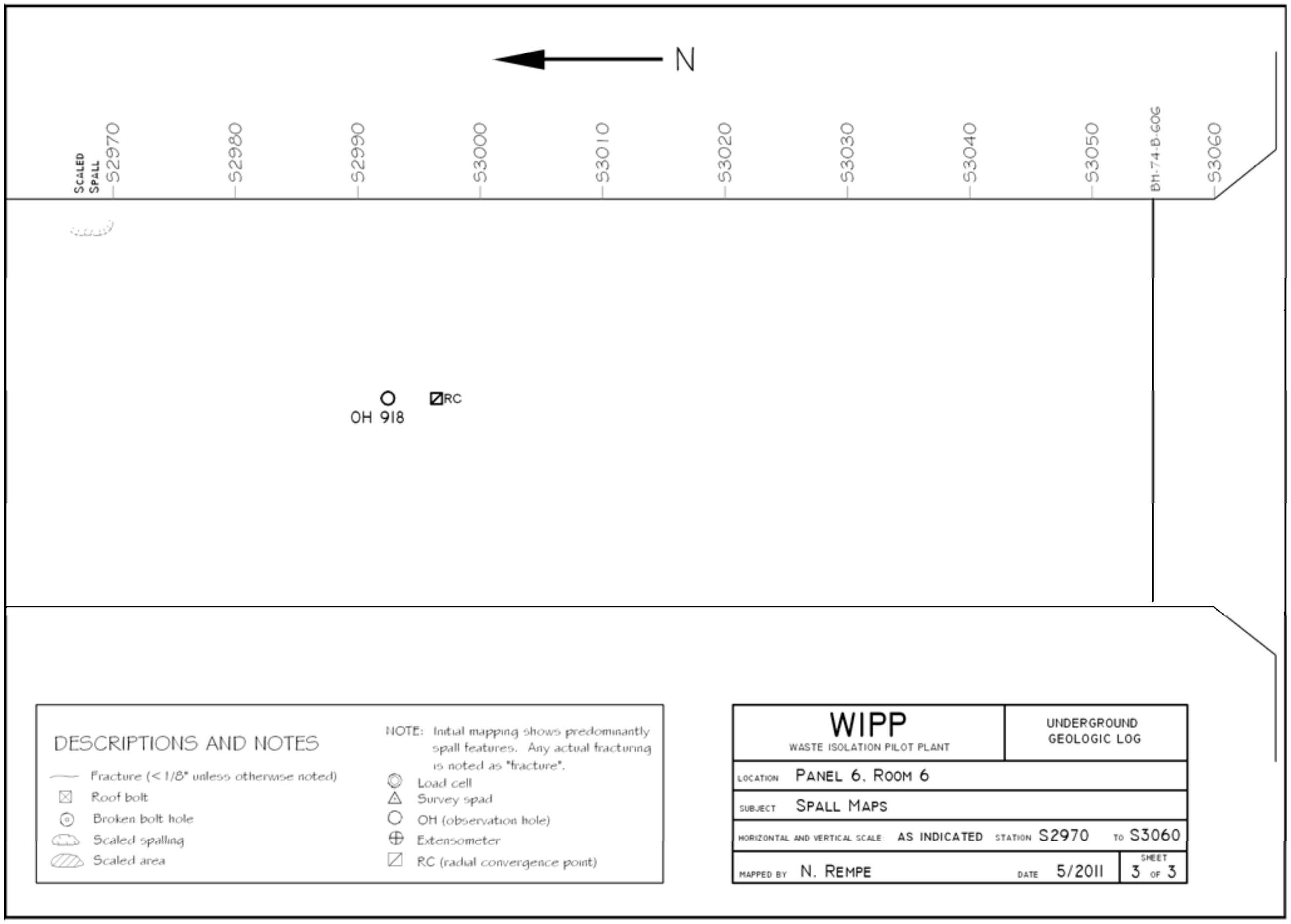

Figure 6-18 Panel 6 Room 6, S2770-S3060 Roof Fractures (Sheet 3 of 3)

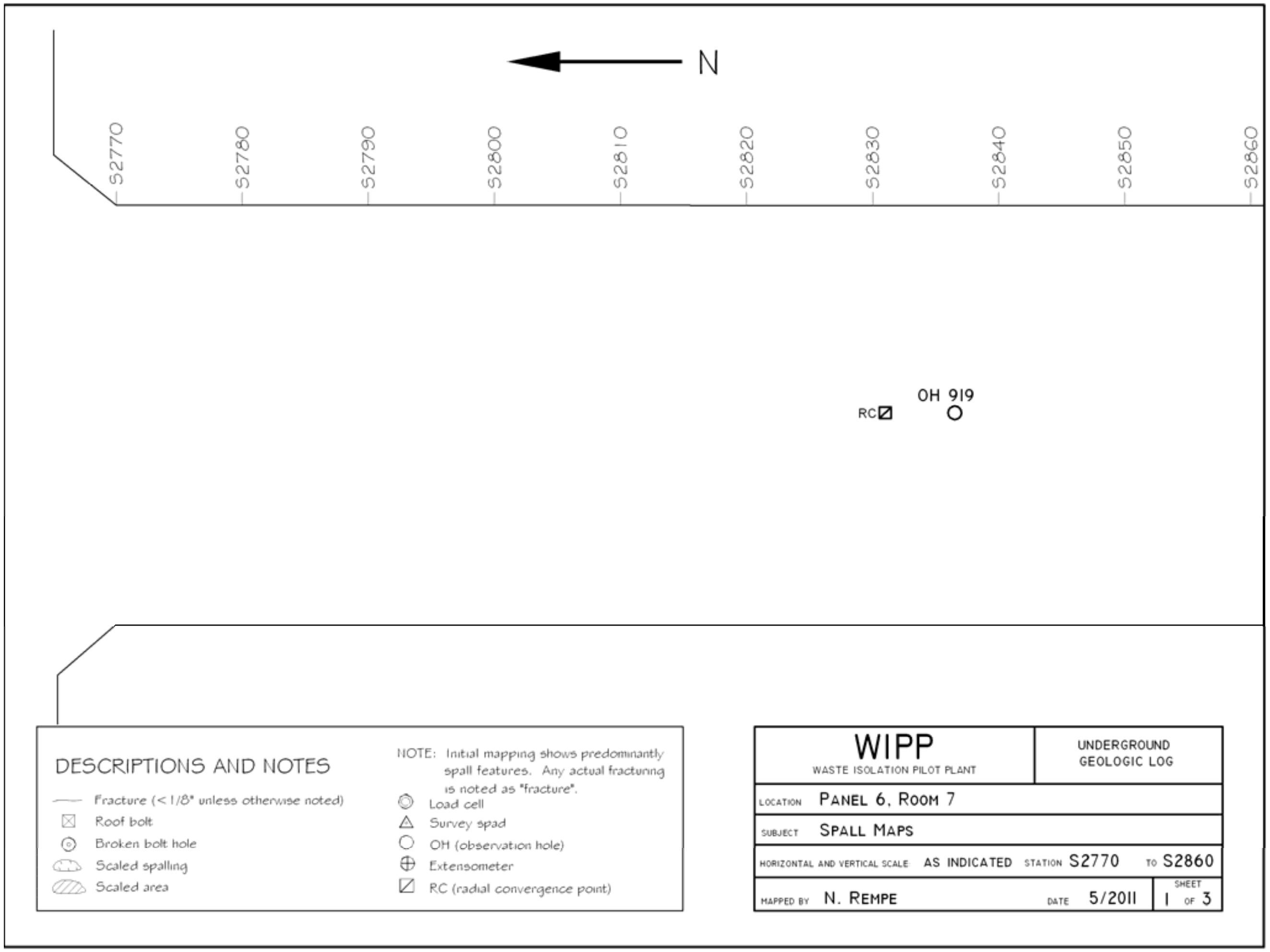

Figure 6-19 Panel 6 Room 7, S2770-S3060 Roof Fractures (Sheet 1 of 3)

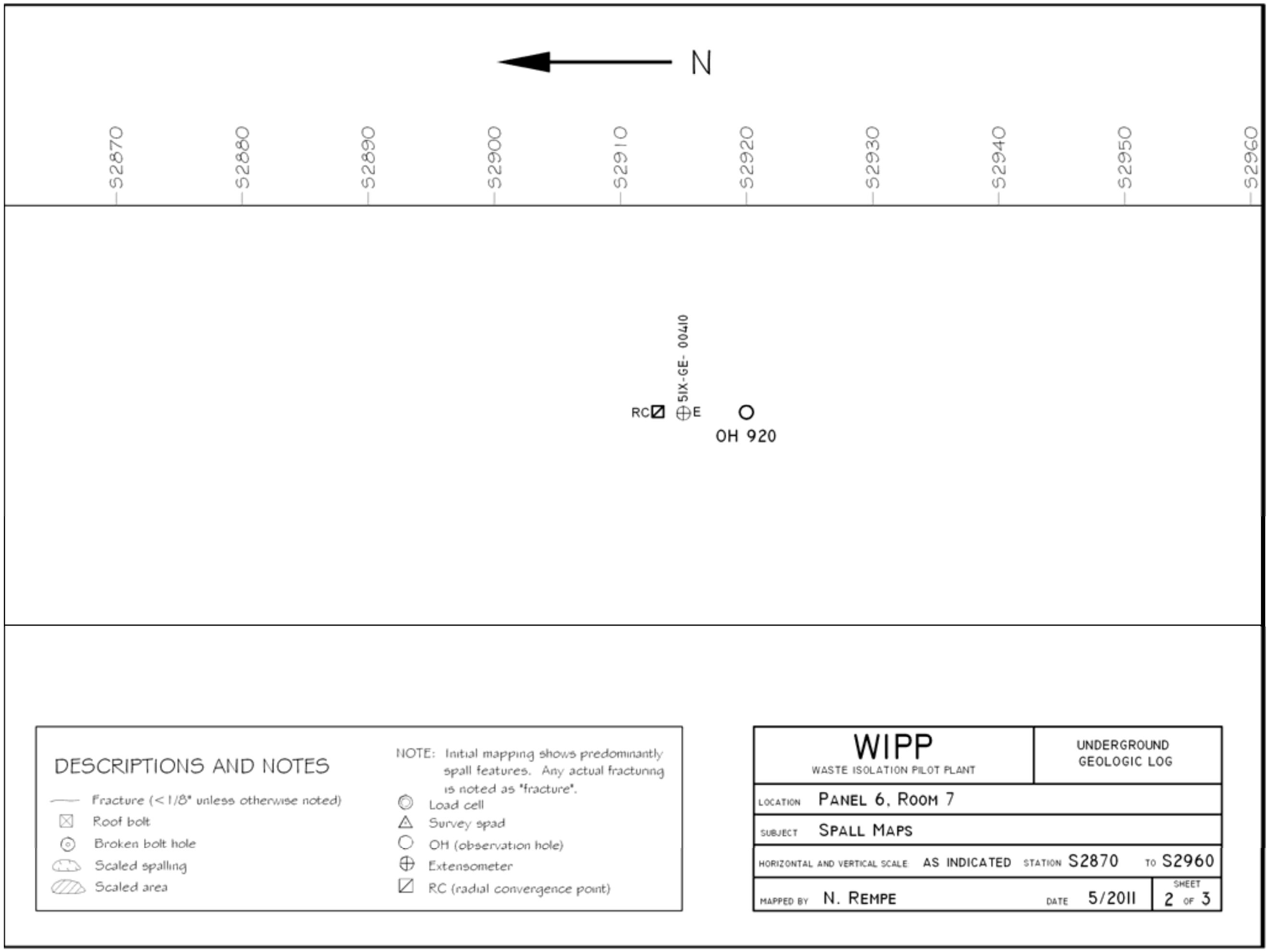

Figure 6-20 Panel 6 Room 7, S2770-S3060 Roof Fractures (Sheet 2 of 3)

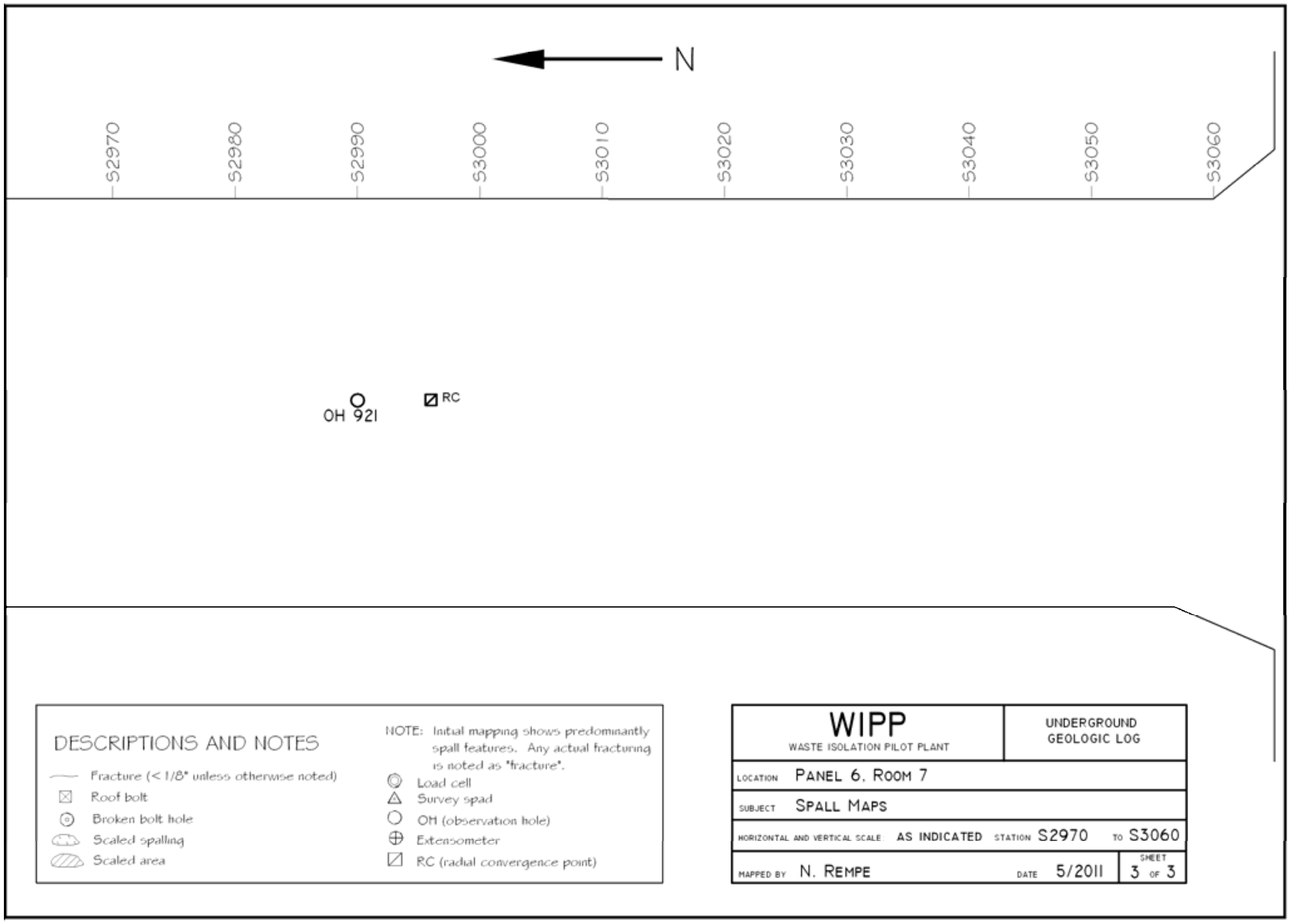

Figure 6-21 Panel 6 Room 7, S2770-S3060 Roof Fractures (Sheet 3 of 3)

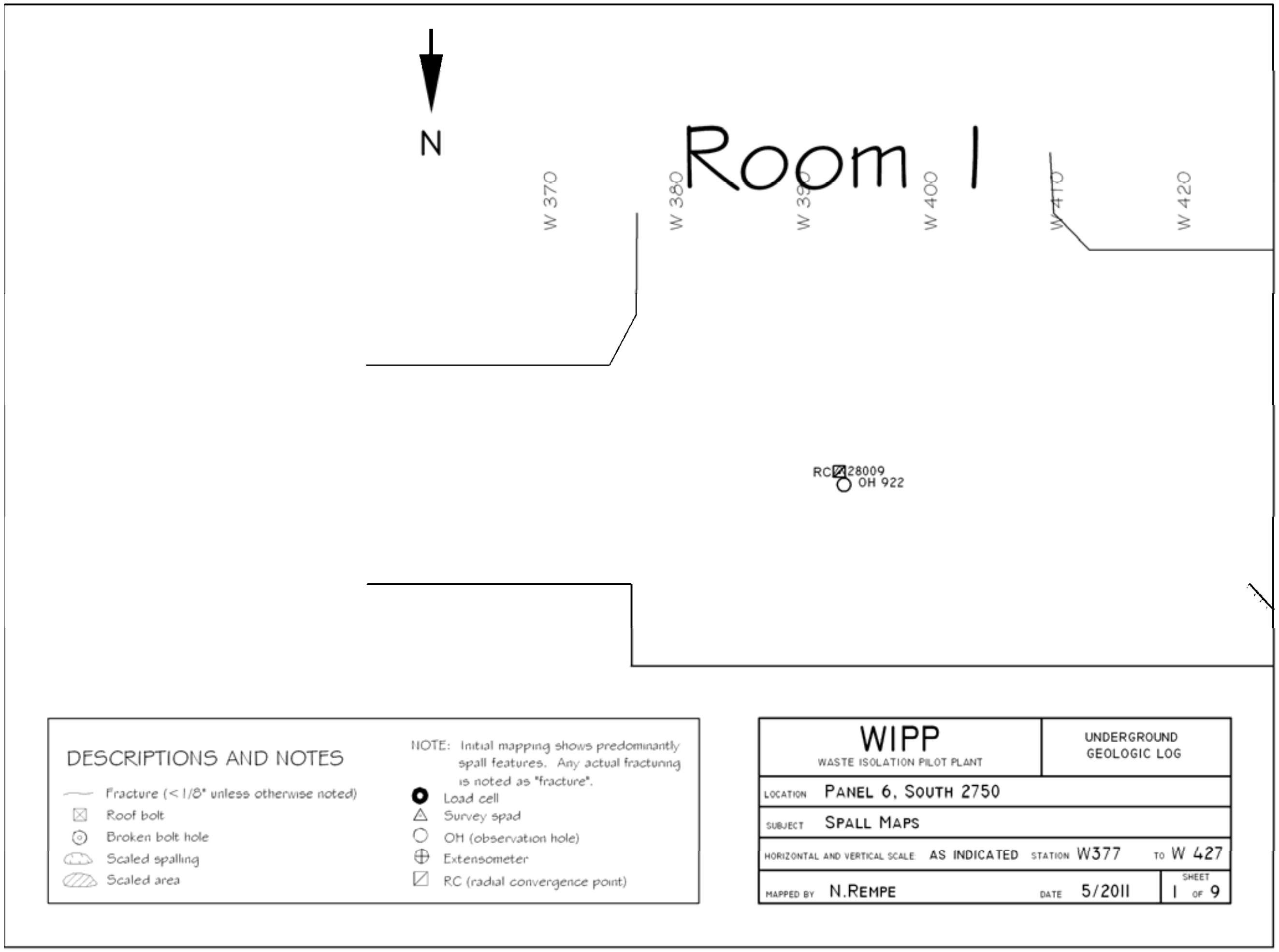

Figure 6-22 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 1 of 9)

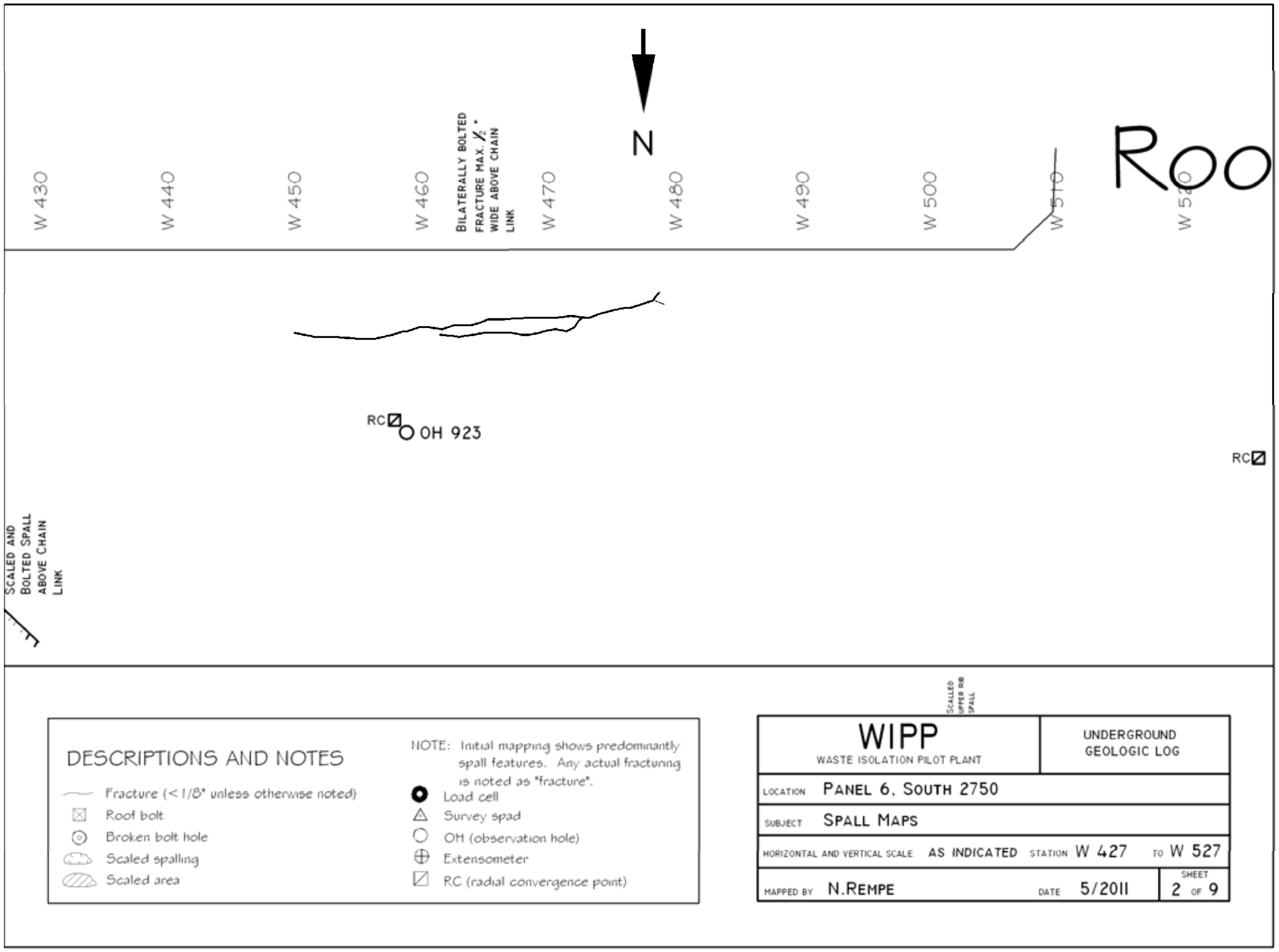

Figure 6-23 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 2 of 9)

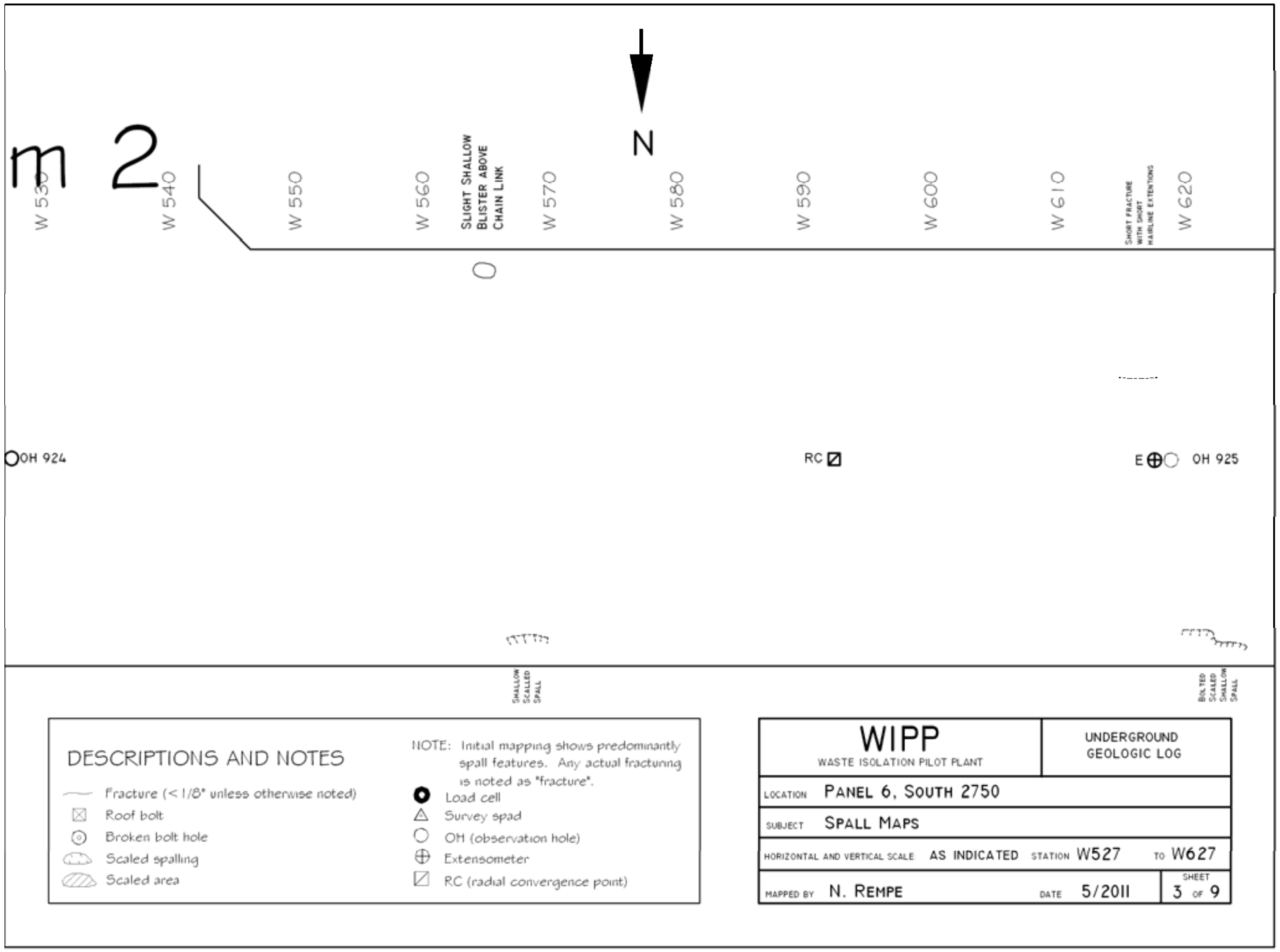

Figure 6-24 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 3 of 9)

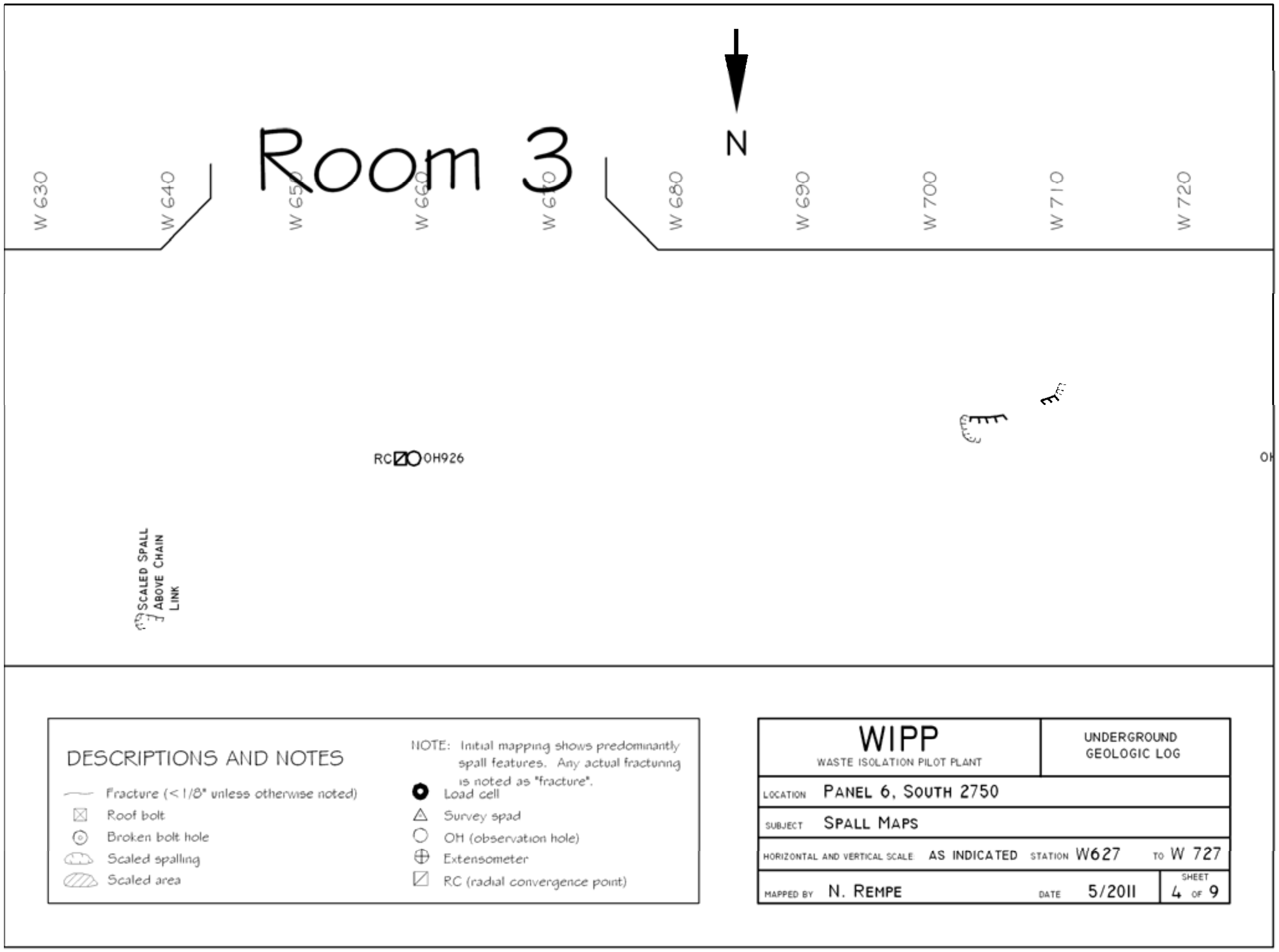

Figure 6-25 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 4 of 9)

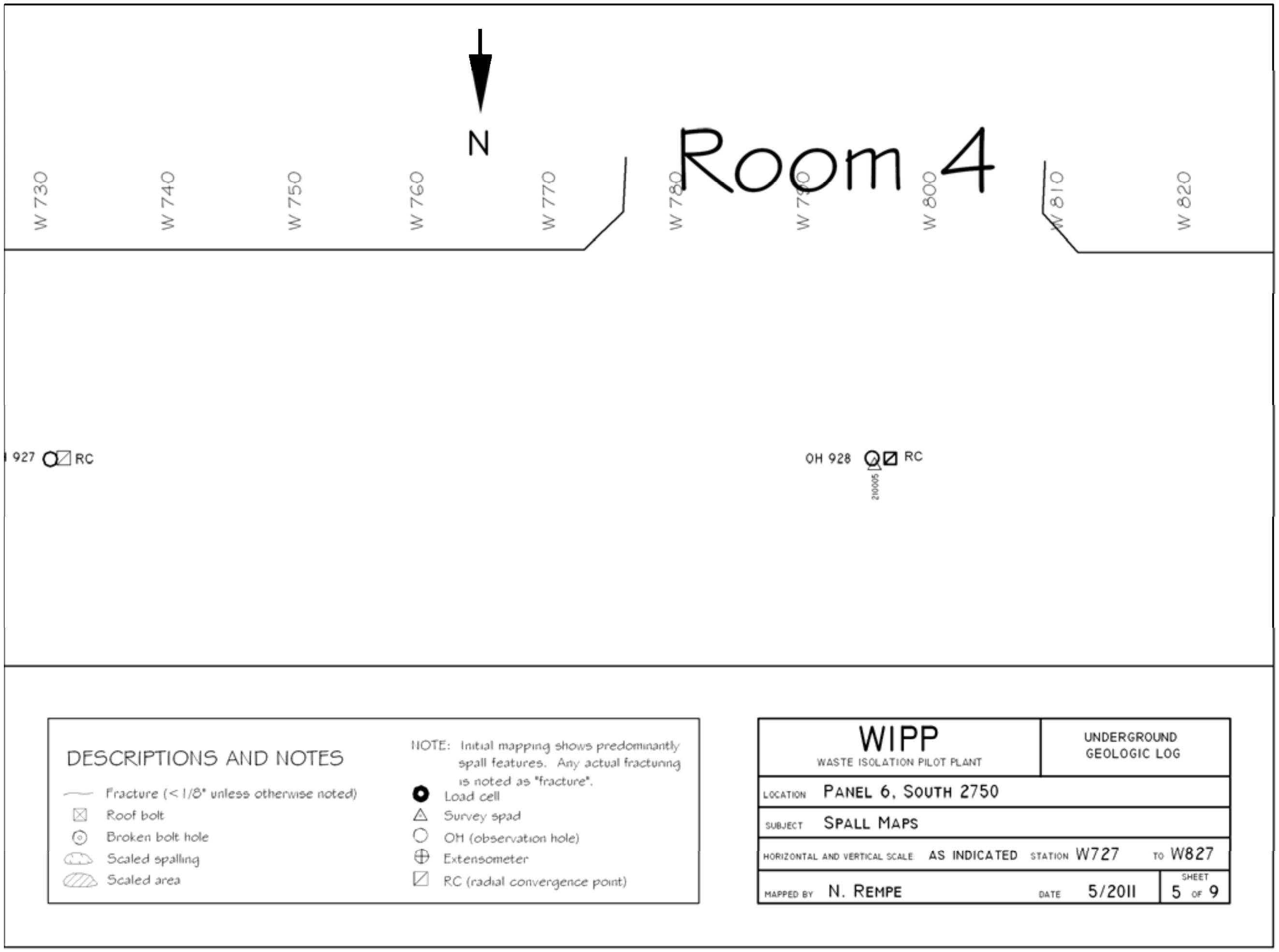

Figure 6-26 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 5 of 9)

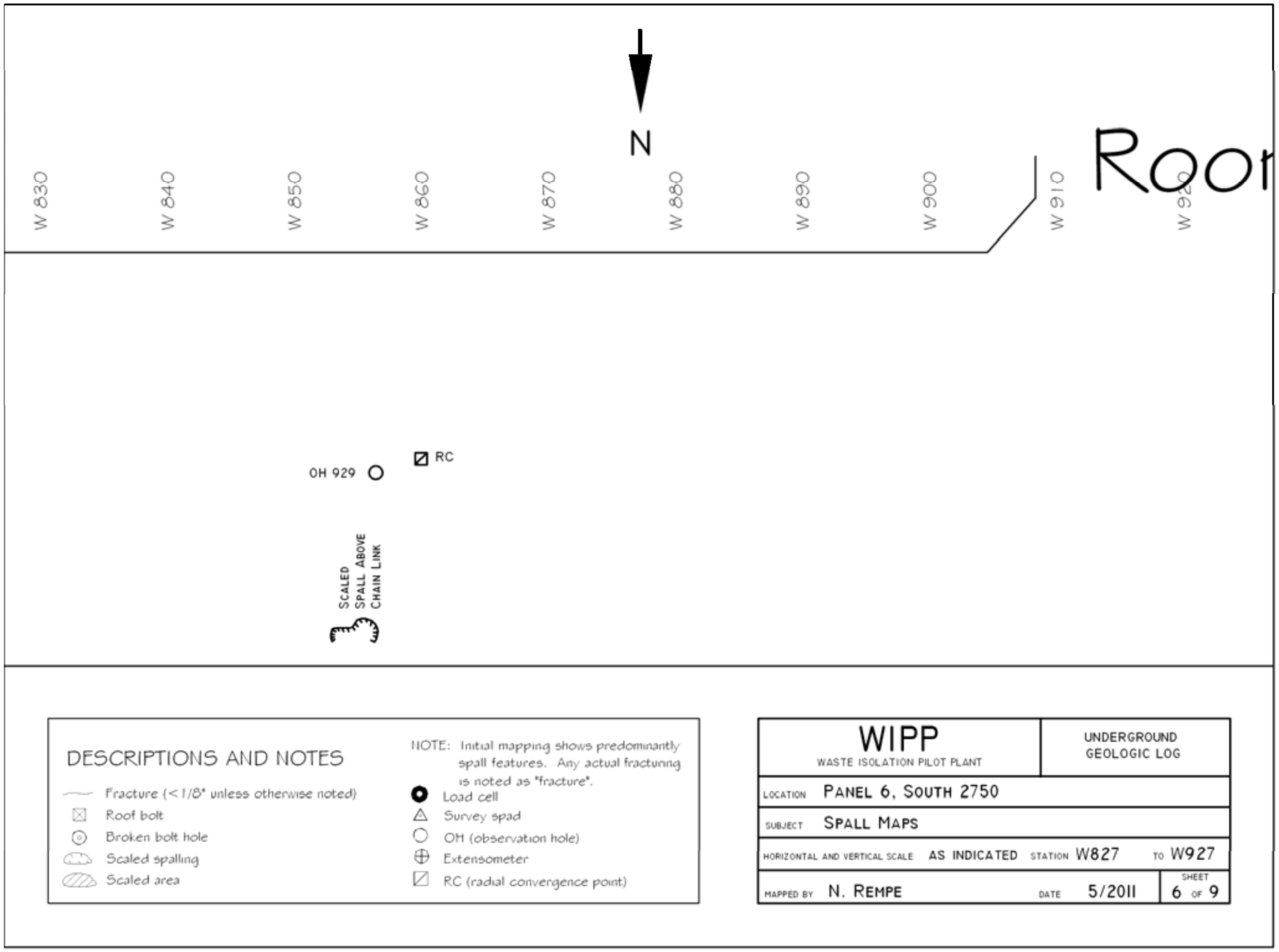

Figure 6-27 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 6 of 9)

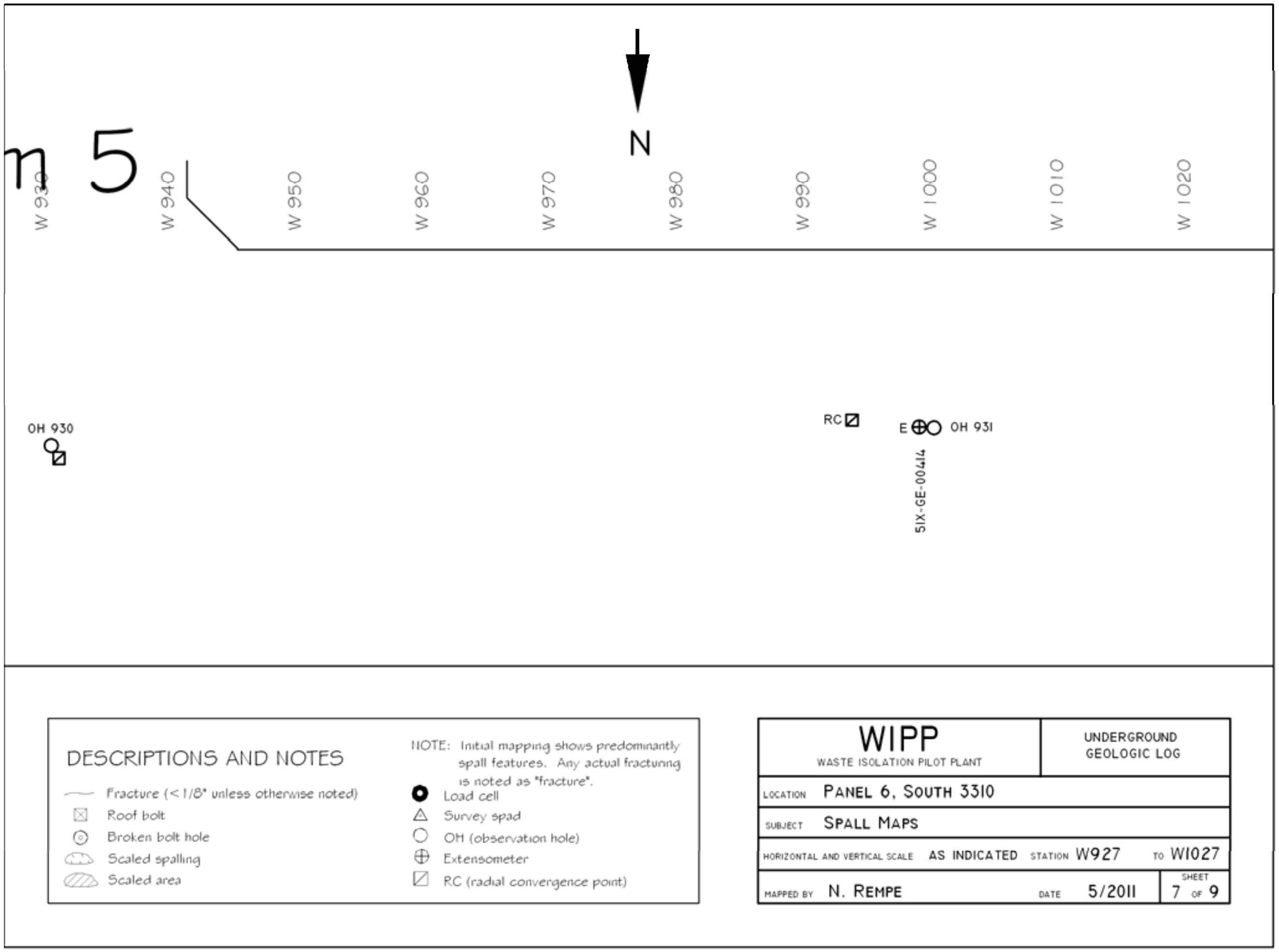

Figure 6-28 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 7 of 9)

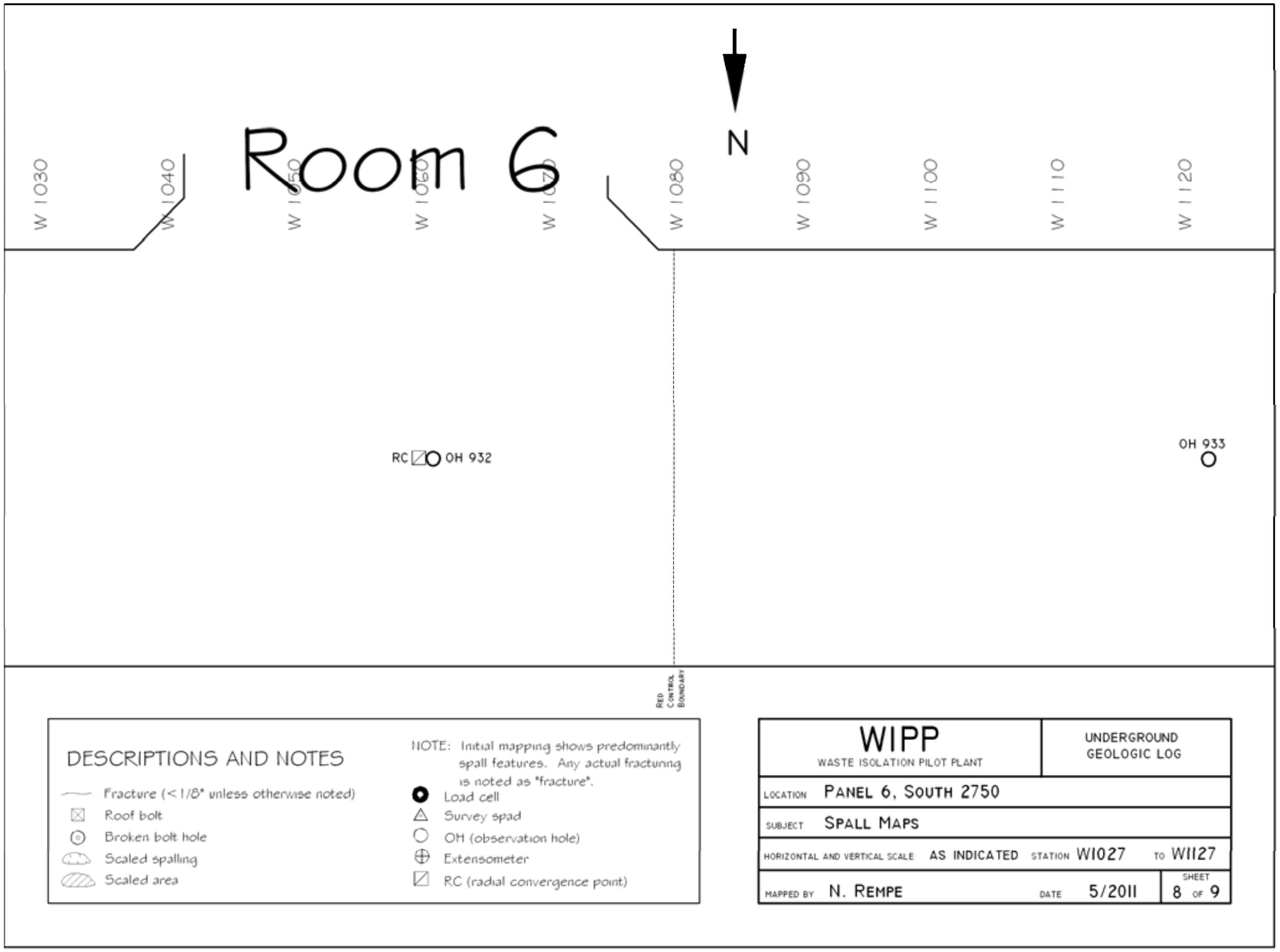

Figure 6-29 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 8 of 9)

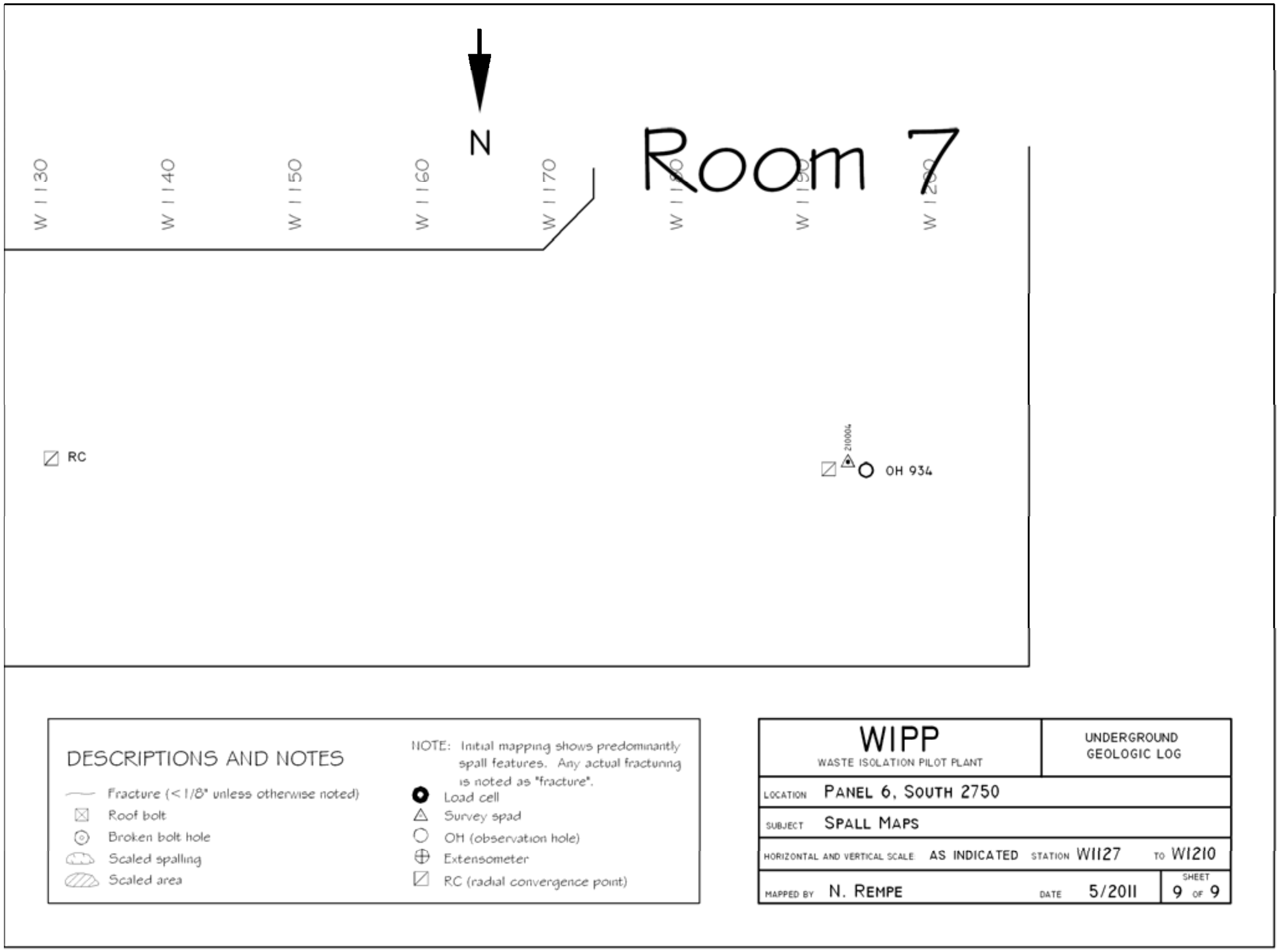

Figure 6-30 Panel 6 S2750, W390-W1210 Roof Fractures (Sheet 9 of 9)

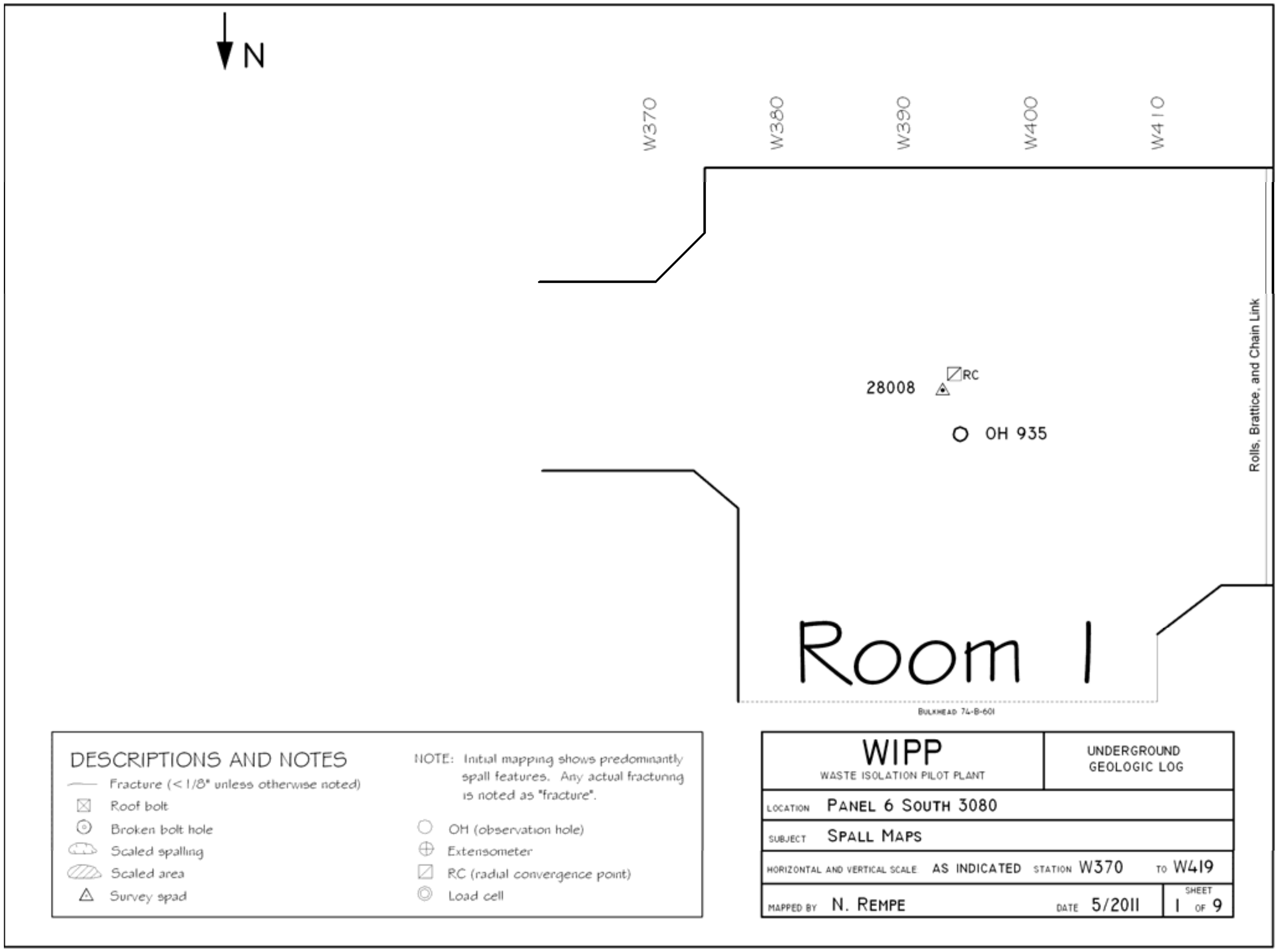

Figure 6-31 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 1 of 9)

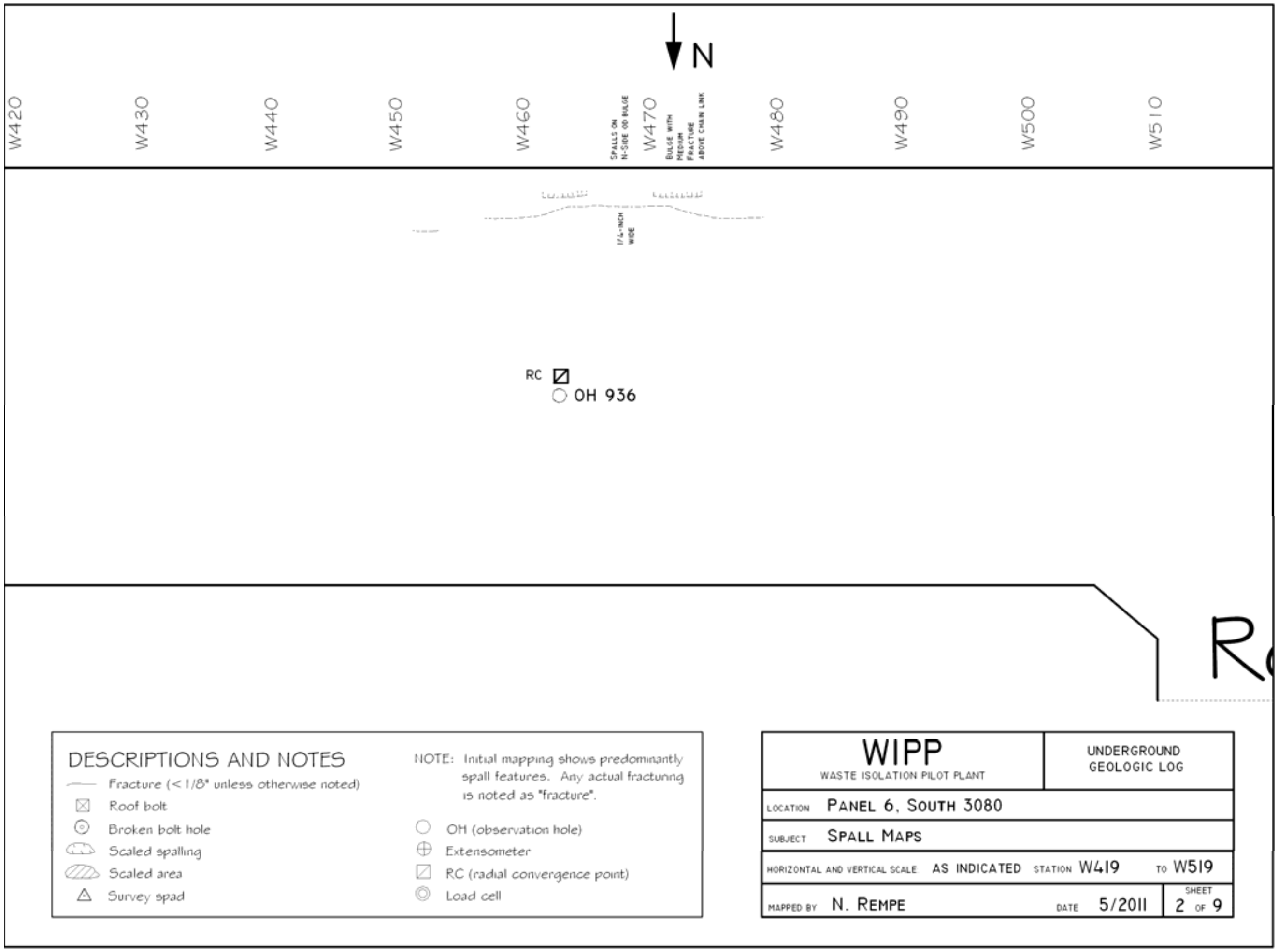

Figure 6-32 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 2 of 9)

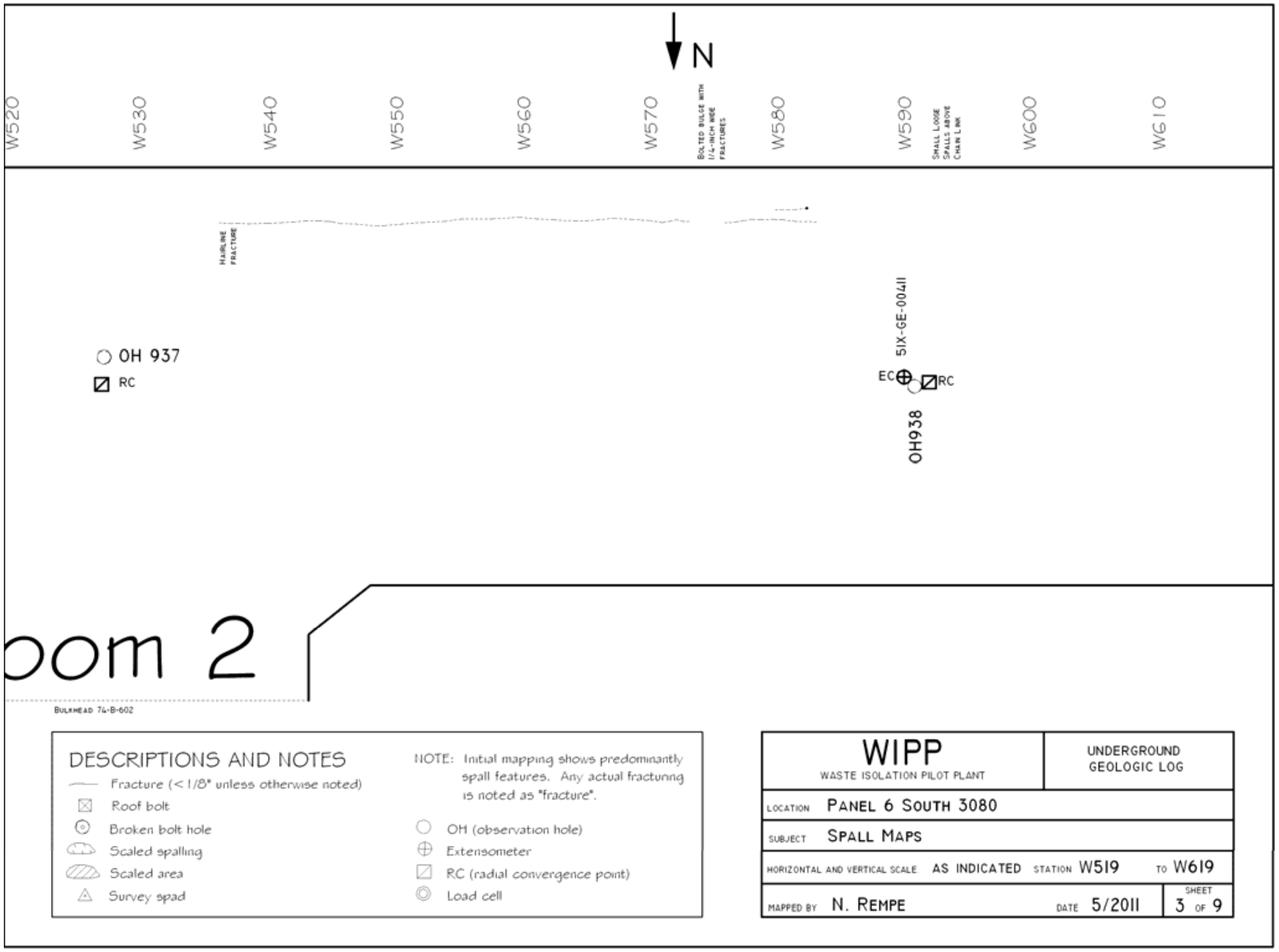

Figure 6-33 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 3 of 9)

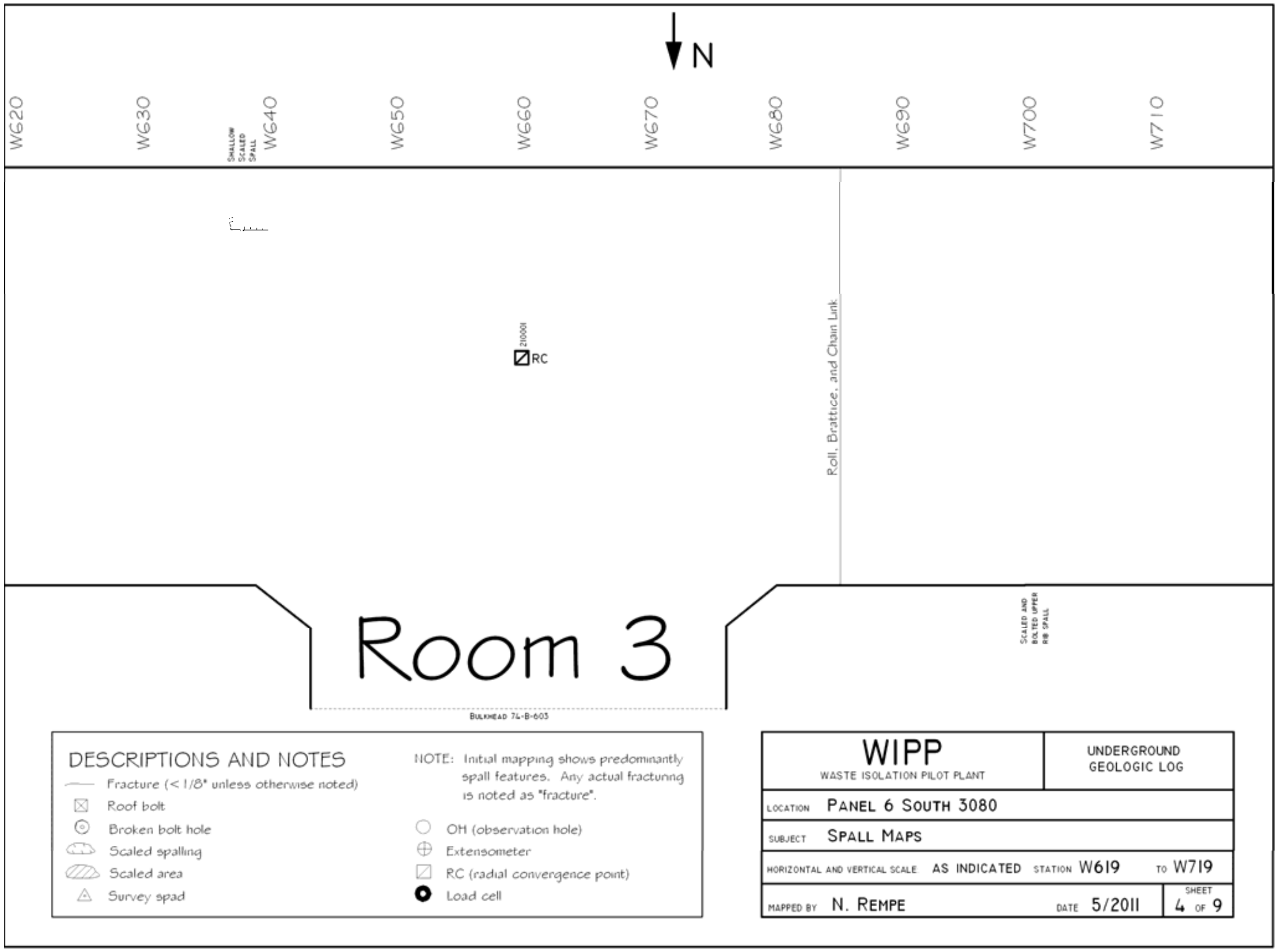

Figure 6-34 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 4 of 9)

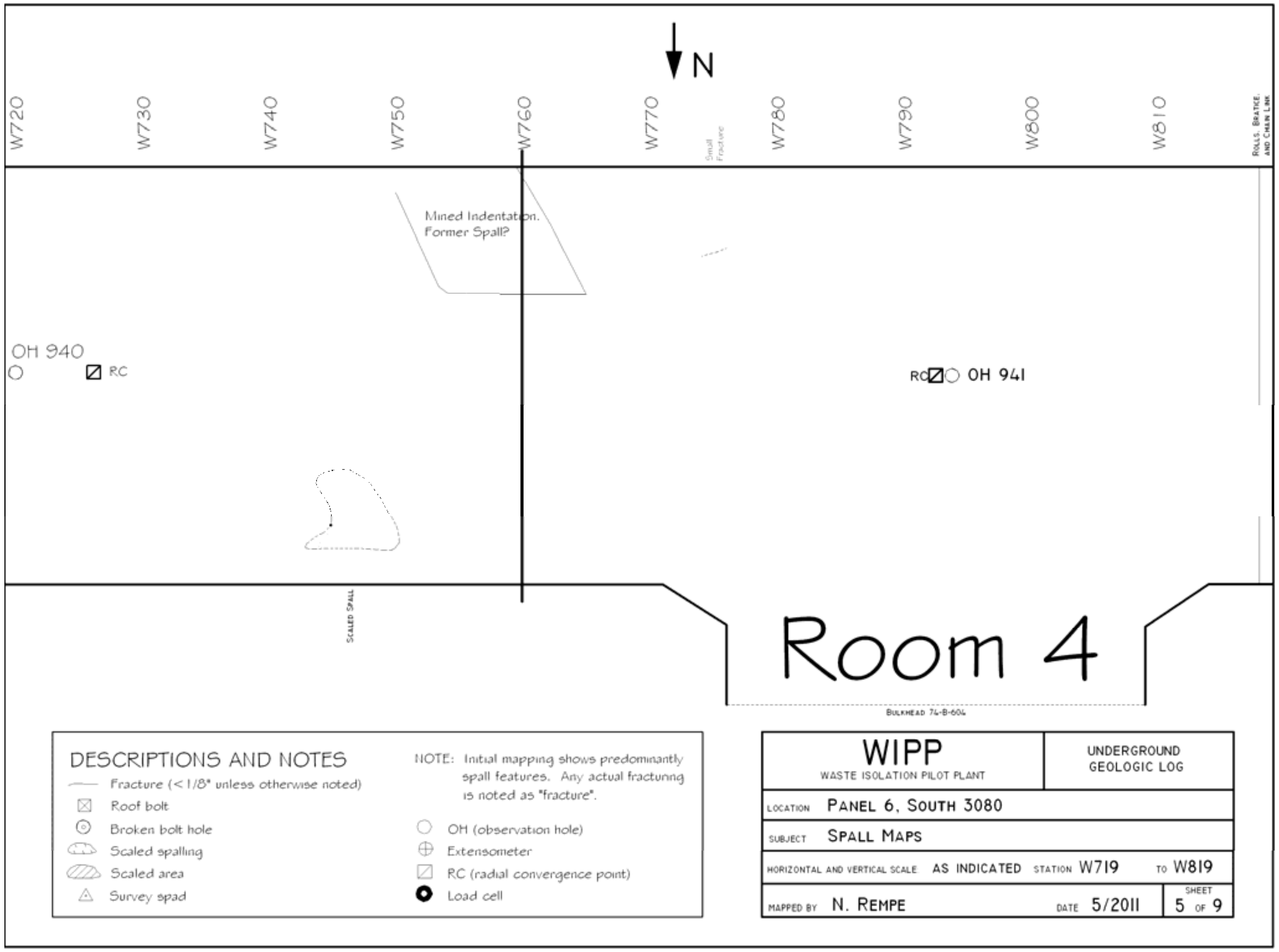

Figure 6-35 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 5 of 9)

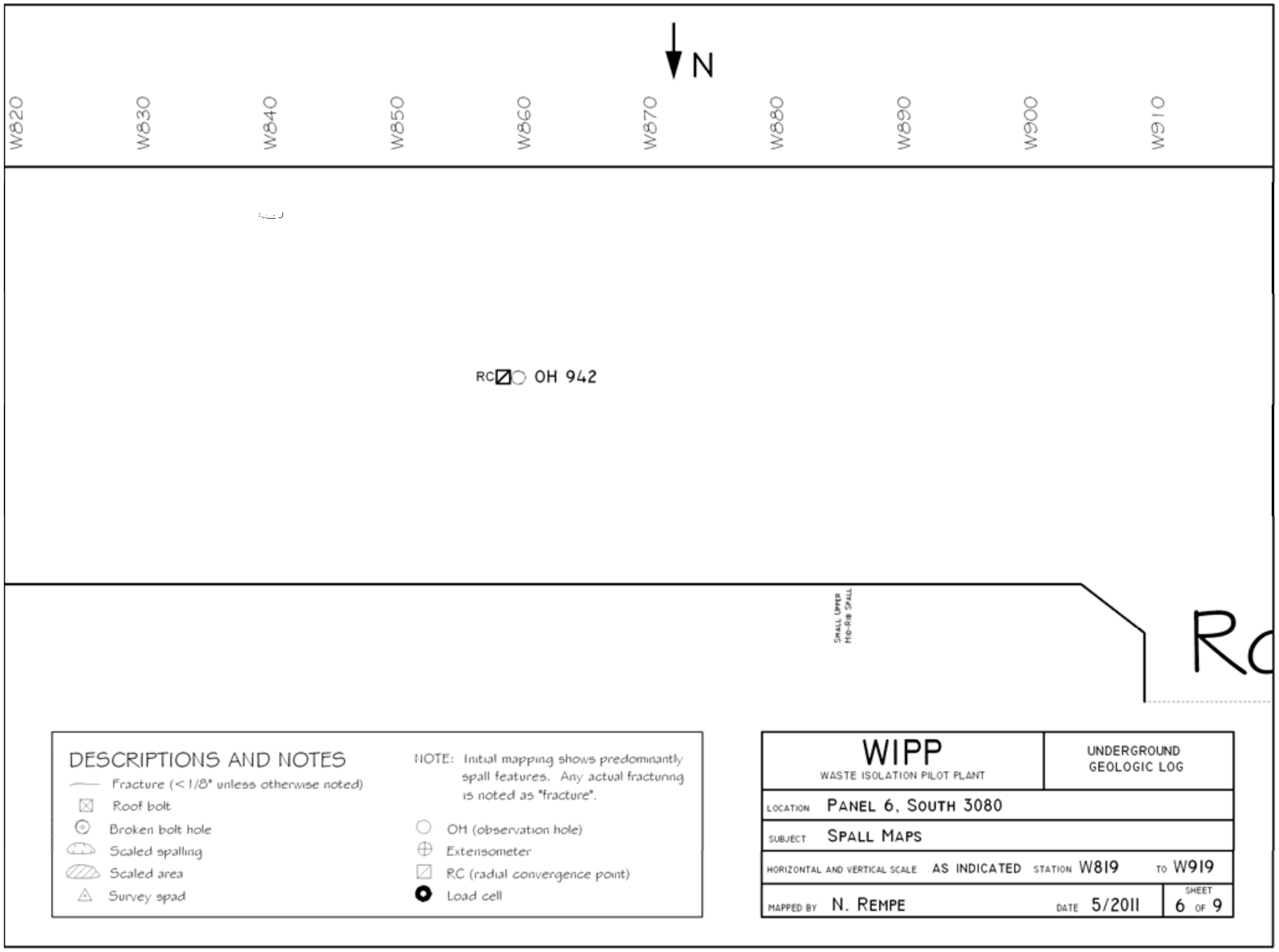

Figure 6-36 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 6 of 9)

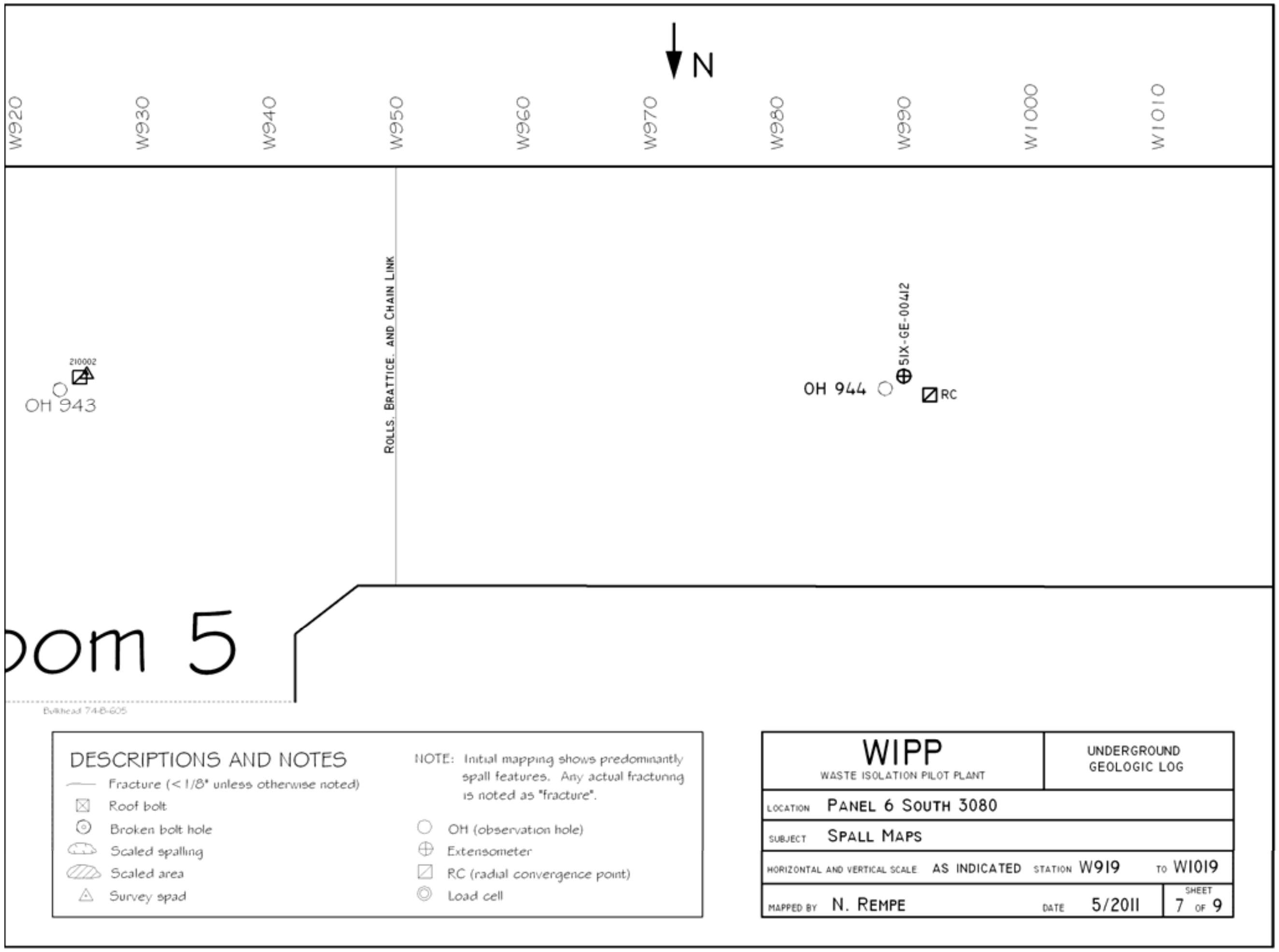

Figure 6-37 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 7 of 9)

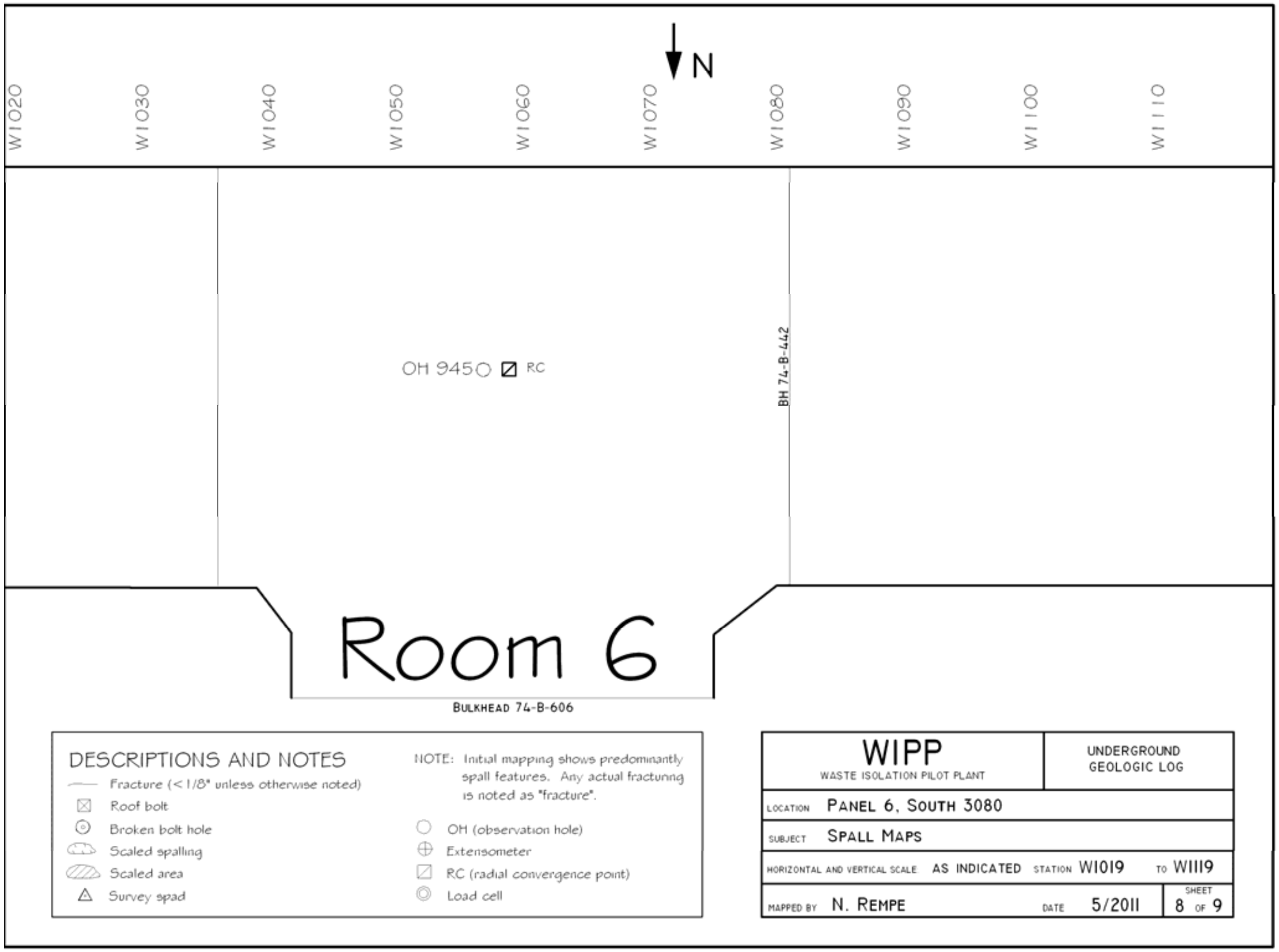

Figure 6-38 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 8 of 9)

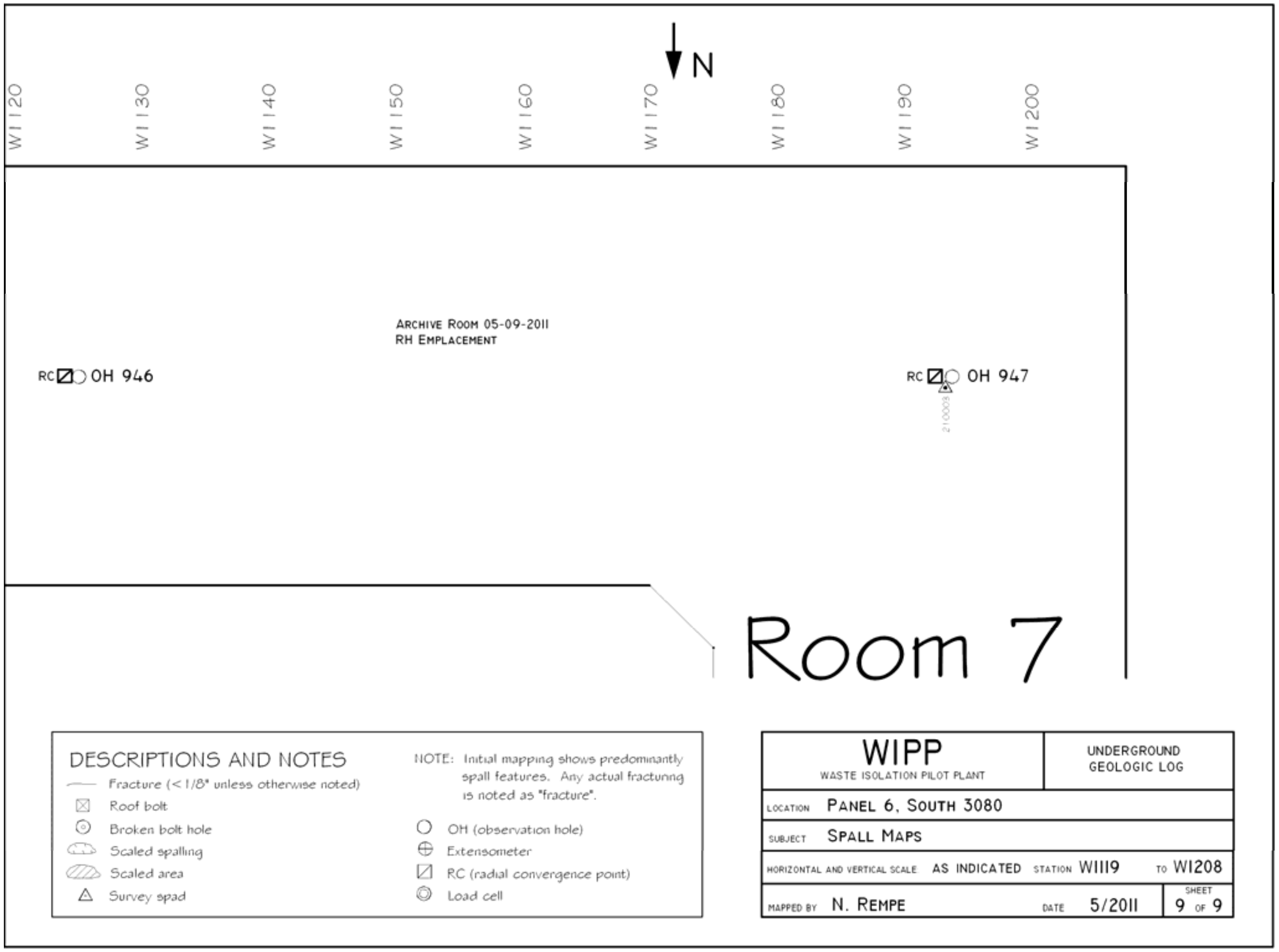

Figure 6-39 Panel 6 S3080, W390-W1210 Roof Fractures (Sheet 9 of 9)

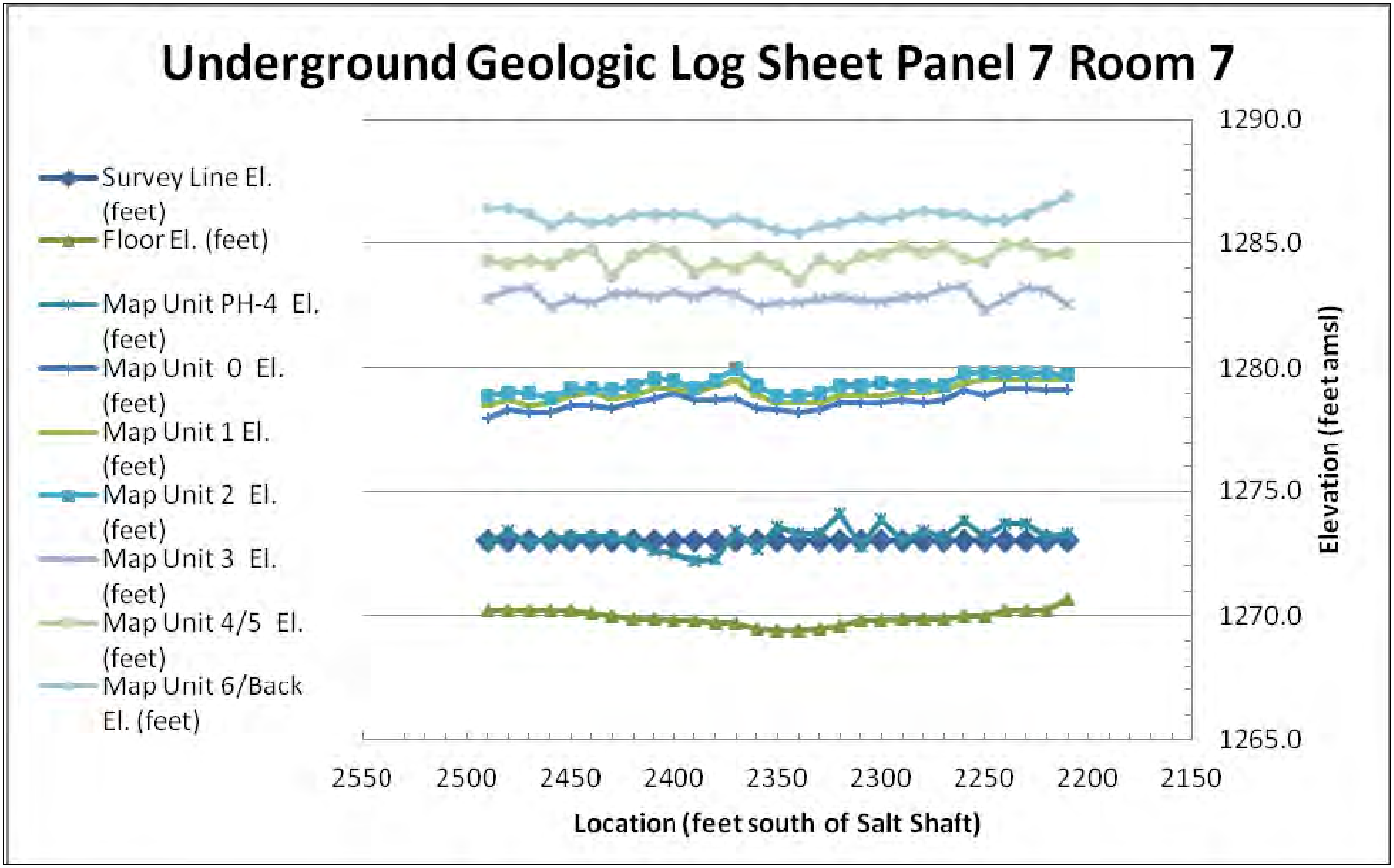

Figure 6-40 Panel 7 Room 7 W1190, S2210-S2490 Stratigraphic Map