NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

TEST PLAN

TITLE:	Revision: **0**
Test Plan for Seismic Reflection Survey Near NC-EWDP-29P	Date: **10-1-07**
	Page: **1 of 11**

TEST PLAN NUMBER:	SUPERSEDES:
TPN-12.1	**None**

APPROVAL	CONCURRENCE
Project Manager — Date: 10/8/07	On-Site Geotechnical Representative — Date: Kathy Gilmore for OSGR 10/1/07
	Principal Investigator — Date: 10/1/07
	Quality Assurance Officer — Date: 10/1/07

1.0 INTRODUCTION

This Nye County Nuclear Waste Repository Project Office (NWRPO) test plan (TPN) provides instructions for conducting a seismic reflection survey near well site NC-EWDP-29P (29P) in August, 2007. Work plan WP-12.0, *Surface Geophysical Surveys*, provides the background, purpose, and general objectives of Independent Scientific Investigations Program (ISIP) surface geophysical surveys. This work is being conducted with the assistance of the University of Texas at Austin (UT Austin).

The purpose of this survey is to determine the feasibility of imaging the alluvium/bedrock contact near the southwestern corner of the Nevada Test Site (NTS) using the seismic reflection method with a vibratory source. This survey is also being conducted to confirm the results of a large-scale dipole-dipole direct-current resistivity survey conducted by the NWRPO and the

USGS in late 2006/early 2007, as well as test the general utility of the method for mapping lithostratigraphic units in the area. If successful, the reflection method will be applied on a larger scale to determine the extent of shallow (~300 to 400 feet [ft] below ground surface [bgs]) bedrock between wells 24P, 29P, and 19D, in support of future tracer tests between fractured volcanic bedrock and alluvium.

2.0 BACKGROUND AND PURPOSE

The NWRPO is currently conducting a natural gradient alluvial tracer test (NGTT; TPN-9.5) at Site 22, on the NTS. During the NGTT and previous tracer tests at Site 22 (TPNs -9.2, -9.3, and -9.4) it became evident that other types of tracer tests were desirable (i.e., alluvium to bedrock and bedrock to bedrock tests) to thoroughly characterize the hydraulic properties and groundwater flow characteristics of both general geologic media types in the flow path south of the proposed high-level nuclear waste repository at Yucca Mountain.

The termination of the tuff units of the Paintbrush Canyon group near the Highway 95 fault (Los Alamos National Laboratory, 2005) provides the optimal location for a bedrock to alluvium tracer test (this is the direction of groundwater flow, north to south). In order to accurately determine the locations of future wells to address this need, more detailed knowledge of the point where the volcanic units truncate (between 29P and 19D) is required. This seismic reflection survey is designed to determine the feasibility of imaging the alluvium/bedrock contact in this area as well as imaging this potential reflector as extensively as possible, given the time constraints.

3.0 SCOPE OF WORK

3.1 Responsibilities

The Principle Investigator (PI) is responsible for supervising the data collection activities described in this TPN. NWRPO personnel, including staff and contract geologists and technicians, are responsible for conducting the activities described in this TPN.

The Field Safety Supervisor (FSS) is responsible for monitoring the health and safety of workers relative to the guidelines established in the NWRPO Health and Safety Plan for General Field Activities (HASP).

The Site Supervisor is responsible for ensuring the completion of work in a safe manner according to the guidelines established in this TPN.

Nye County Field Personnel, as assigned by the PI, FSS, or Site Supervisor are responsible for the completion of the activities described in this TPN.

3.2 Survey Area

This survey will be conducted along the road between wells 24P, 29P, and 19D (Figure 1). The extent of the line surveyed will depend on field conditions, the speed at which the survey progresses and other factors, and may change at the discretion of the PI.

3.3 Equipment Requirements

Seismic equipment required for this survey can be classified into 3 categories: transmitting equipment, receiving equipment, and general survey supplies. Transmitting equipment is provided by UT Austin, and receiving equipment is provided by Geometrics, Inc. (Geometrics), in San Jose, California. General survey supplies will be supplied by the NWRPO. A comprehensive list of the required equipment is provided in Table 1, below.

Table 1
List of required equipment.

Description	Quantity
Transmitting Equipment (provided by UT Austin)	
Mini-vibrator source truck "Thumper"	1
RTS radio link for transmission of trigger and reference signals	1
Personnel to operate Thumper	2
Receiving Equipment (provided by Geometrics)	
3-pin Bendix to BNC adapter cable	1
Geophones, 14-Hz vertical component	52
Stratavisor NZ-48 II seismograph (48 channel)	1
Takeout cables, 20-ft spaced 24 takeout each	2
General Survey Supplies (provided by NWRPO)	
12-volt deep cycle batteries	2
Multimeter	1
Radios, 2-way	8

3.4 Safety and Environmental Compliance

NWRPO health and safety information, responsibilities, and procedures are described in detail in Health and Safety Plan HSP-1.0, *Independent Scientific Investigations Program Health and Safety Plan for General Field Activities*. NWRPO personnel will adhere to the provisions of HSP-1.0 when conducting the activities described in this WP. In addition, the NWRPO will provide water for personnel working on this survey.

No land-disturbing activities (e.g., building of roads for access, or the use of explosives as a seismic source) are necessary for this survey; thus no permits, permissions, or waivers are necessary.

Processes to ensure compliance with applicable federal and state of Nevada requirements for the handling of hazardous, nonhazardous, and universal wastes are described in Environmental

Management Procedure EP-1.0, *Waste Management*. Wastes generated during the activities described in this WP will be handled and disposed of by NWRPO personnel in accordance with EP-1.0.

4.0 SURVEY DESIGN AND DATA COLLECTION

The design of this survey is based primarily upon the depth of investigation required in unsaturated alluvium on this.

Before the survey commences, personnel will measure the line, and place pin flags every 20 ft. These pin flags will have their location (i.e., footage) written on them, to assist with identification during the survey. During the survey, geophones will be placed at the pin flagged locations, and "shots" will occur at lateral offsets from them. The lateral offset of Thumper from the geophones will be determined by the PI prior to data collection.

The survey geometry will depend on field conditions and will be determined by the PI. Survey geometry will be recorded on the form in Attachment 1, and the scientific notebook, as necessary. A table showing sample shot and active geophone locations is included in Attachment 2.

Additional survey parameters (the frequency limits and time duration of Thumper's sweep, sample frequency, listen time, record length, gain and stack settings, filter settings, data display settings, saved file name, etc.) will be recorded on the form in Attachment 1 and/or in the appropriate scientific notebook. Descriptions of these settings may be found in the Geometrics StrataVisor NZ manual, *ES-3000, Geode™, and StrataVisor™ NZ/NZC Operator's Manual P/N 28519-01 Rev K* (on file at the NWRPO QARC). Note that these settings are likely to vary from shot to shot, and will be determined by the PI as data are collected.

4.1 Data Processing

Data will be correlated with the reference signal (collected on channel 1 of the seismograph) in the field and stored on the hard drive of the seismograph. Post-processing of data will occur at the NWRPO using the WinSeis Turbo software package, published by the Kansas Geological Survey. Required processing steps will be determined by the PI, and may include data reduction, convolution, frequency filtering, velocity analysis, common-midpoint stacking, apparent-velocity (apparent-dip) filtering, the p-τ transform, relative-amplitude processing, and migration (Telford, et. al., 1990).

4.2 Records

Seismic data collected as part of this survey are recorded electronically by the seismograph. Additional survey parameters will be recorded on the form in Attachment 1, and in the scientific notebook, as appropriate. Electronic data will be archived at the NWRPO QARC at the end of each week (data may be transferred from the seismograph to a personal computer via a standard RJ-45 network cable).

5.0 REFERENCES

Geometrics, Inc., ES-3000, Geode™, and StrataVisor™ NZ/NZC Operator's Manual, P/N 28519-01, Rev K: Geometrics, Inc.

Kelley, R.E., 2005, 1999 and 2004 Aeromagnetic surveys, named magnetic anomalies, existing and proposed borehole locations, map number m201425: Los Alamos National Laboratory.

Potter, C.J., et. al., 2002, Geologic map of the Yucca Mountain region, Nye County, Nevada: USGS Geologic Investigations Series I-2755.

Telford, W.M., L.P. Geldart, and R.E. Sheriff, 1990, Applied geophysics, second edition: Cambridge University Press.

TPN-9.2, *Single-Well Push/Pull Tracer Tests at Well NC-EWDP-22S*, Test Plan: Nye County Nuclear Waste Repository Project Office. Pahrump, Nevada.

_TPN-9.3, *Cross-Hole, Multiple-Well Tracer Test at Site 22.*

_TPN-9.4, *Site 22 Cross-Hole Tracer Test Using Perrhenate and Iodide.*

_TPN-9.5, *Natural Gradient Cross-Hole Tracer Test at Site 22.*

WP-12.0, *Surface Geophysical Surveys,* Work Plan: Nye County Nuclear Waste Repository Project Office. Pahrump, Nevada.

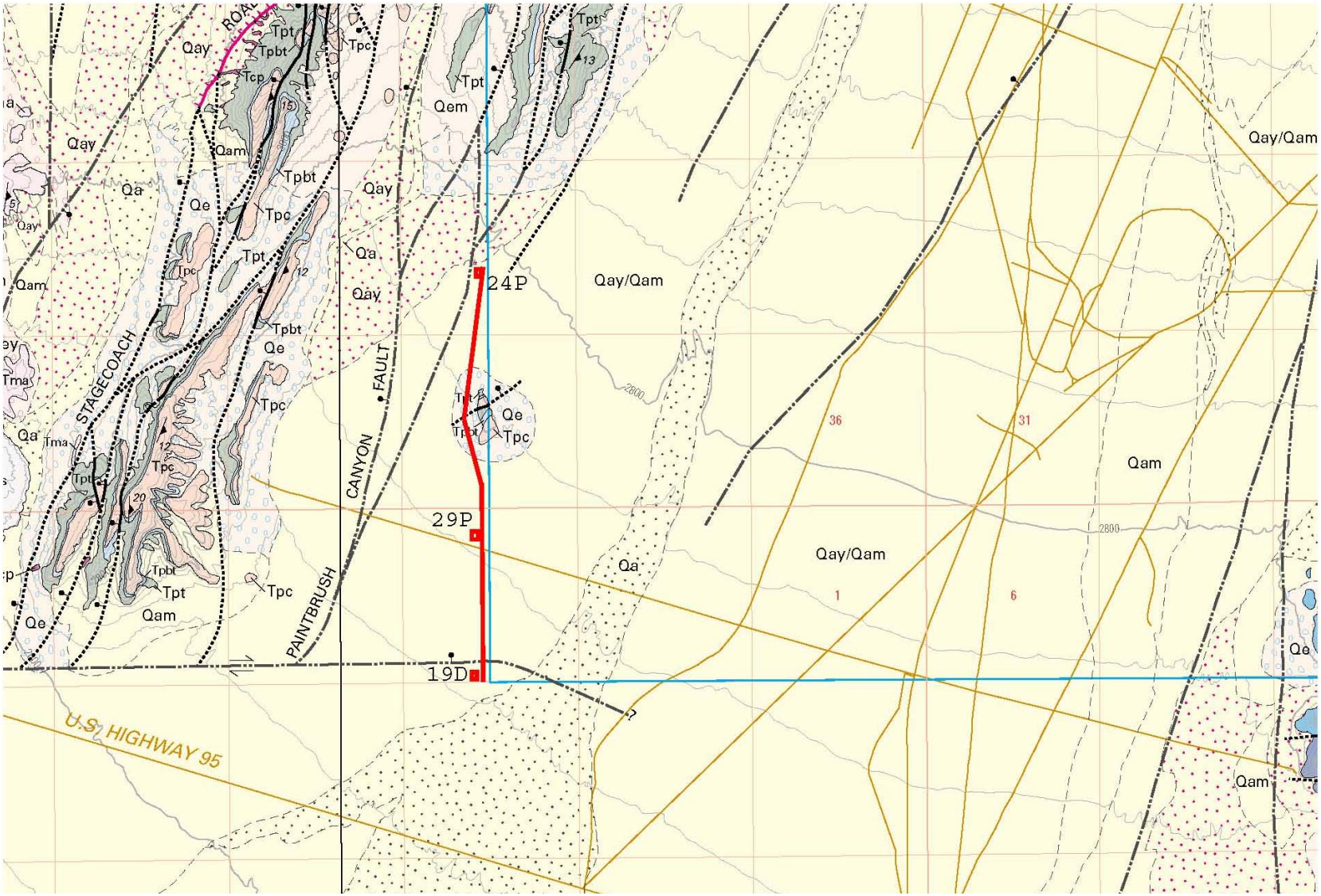

Figure 1
Seismic reflection line location. Base map modified from Potter, et. al., 2002.

Attachment 1
Survey geometry and parameter form

Shot	Position (ft)																							
	Channel																							
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot	Sweep						Display Gain						
	Start (Hz)	End (Hz)	Duration (s)	Stacks	Data Gain Type	Filter Type	Type	Window Length		Saved File Name		Comments	

Shot	Position (ft)																							
	Channel																							
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot	Sweep						Display Gain						
	Start (Hz)	End (Hz)	Duration (s)	Stacks	Data Gain Type	Filter Type	Type	Window Length		Saved File Name		Comments	

Shot	Position (ft)																							
	Channel																							
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot	Sweep						Display Gain						
	Start (Hz)	End (Hz)	Duration (s)	Stacks	Data Gain Type	Filter Type	Type	Window Length		Saved File Name		Comments	

Attachment 2
Example shot and active geophone locations

NOTE: THIS LAYOUT IS CORRECT FOR A SURVEY WITH THUMPER WHERE REFERENCE SIGNAL INPUT TO SEISMOGRAPH IS ALWAYS ON CHANNEL 1

Array 1			
SP	First active geophone position (ft)	Last active geophone position (ft)	Shot #
20	0	-440	1
0	-20	-460	2
-20	-40	-480	3
-40	-60	-500	4
-60	-80	-520	5
-80	-100	-540	6
-100	-120	-560	7
-120	-140	-580	8
-140	-160	-600	9
-160	-180	-620	10
-180	-200	-640	11
-200	-220	-660	12
-220	-240	-680	13
-240	-260	-700	14
-260	-280	-720	15
-280	-300	-740	16
-300	-320	-760	17
-320	-340	-780	18
-340	-360	-800	19
-360	-380	-820	20
-380	-400	-840	21
-400	-420	-860	22
-420	-440	-880	23
-440	-460	-900	24
-460	-480	-920	25

* = Shot Point o = Live Geophone

Shot 1	Position (ft)	20	0	-20	-40	-60	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440
	Channel	1	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 2	Position (ft)	0	-20	-40	-60	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460
	Channel	1	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 3	Position (ft)	-20	-40	-60	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480
	Channel	1	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 4	Position (ft)	-40	-60	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500
	Channel	1	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 4	Position (ft)	-60	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520
	Channel	1	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 6	Position (ft)	-80	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540
	Channel	1	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 7	Position (ft)	-100	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560
	Channel	1	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 8	Position (ft)	-120	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580
	Channel	1	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 9	Position (ft)	-140	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600
	Channel	1	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 10	Position (ft)	-160	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620
	Channel	1	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 11	Position (ft)	-180	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640
	Channel	1	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 12	Position (ft)	-200	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660
	Channel	1	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 13	Position (ft)	-220	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680
	Channel	1	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 14	Position (ft)	-240	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700
	Channel	1	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 15	Position (ft)	-260	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720
	Channel	1	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 16	Position (ft)	-280	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740
	Channel	1	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 17	Position (ft)	-300	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760
	Channel	1	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 18	Position (ft)	-320	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780
	Channel	1	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 19	Position (ft)	-340	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800
	Channel	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 20	Position (ft)	-360	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820
	Channel	1	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 21	Position (ft)	-380	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820	-840
	Channel	1	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 22	Position (ft)	-400	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820	-840	-860
	Channel	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 23	Position (ft)	-420	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820	-840	-860	-880
	Channel	1	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 24	Position (ft)	-440	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820	-840	-860	-880	-900
	Channel	1	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Shot 25	Position (ft)	-460	-480	-500	-520	-540	-560	-580	-600	-620	-640	-660	-680	-700	-720	-740	-760	-780	-800	-820	-840	-860	-880	-900	-920
	Channel	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
		*	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o