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Meeting Record

Purpose: DQO Meeting to Recommend Characterization Activities for Well R-2, Pueblo Canyon	Meeting Date: 12/12/02

Background Information:

The Hydrogeologic Workplan rationale for R-2 was to understand contaminant distribution downgradient of the former TA-1 and TA-45 effluents.

Geology –

The geology of the area is known from TW-4. An early log shows Bandelier Tuff overlying Puye sediments and Tschicoma lavas. Another log from TW-4 shows no Puye, so it not clear if the Puye Formation is present at this location or not. Neither log indicates that the Cerros del Rio lavas extend this far west. The well location is close to the trace of the Guaje Mountain Fault, but it is uncertain whether that fault extends as far south as Pueblo Canyon. Logistically this is a narrow part of the canyon and it is difficult to access.

Hydrology –

Vadose zone: TW-2A has two perched zones. Two perched zones have been observed in other wells in Pueblo Canyon, but they are in different stratigraphic units. Simple models predict travel times would increase down canyon as the Bandelier thins. In Pueblo Canyon the Bandelier is fairly thin, so it is likely that the travel times are short. Data collected in Pueblo and Los Alamos canyons should be aimed at getting a better picture of the nature and extent of contamination. Sufficient information is needed to do a contaminant mass balance. How does the effluent released move in the subsurface – does it spread out laterally or dive down?

Regional aquifer: One question is: how far north do the conditions found at R-25 (thick perched zone and downward gradients) extend? This is a low priority well for regional aquifer hydrology because it won't add much new information.

Geochemistry-

The contaminants that were released are: mobile chemicals, actinides, fission products. At TW-2A (perched zone) there is tritium (2000 pCi/L), but in TW-2 the regional aquifer has no detectable tritium. POI-4, R-5, TW-1A, TW-1 (360 pCi/L), O-1 (30 pCi/L) also have some tritium. O-1 also has perchlorate (4-5 ppb) and nitrate (2 mg/L). The difference in tritium in TW-1 and O-1 suggests that O-1 is drawing on a large inventory of tritium. There are indications from several wells in perched and regional aquifers that these are chemicals from Laboratory operations.

Recommendations:

Based on discussions at the R-2 DQO meeting, a recommendation is made that R-2 be sited in Pueblo Canyon about one quarter mile down-gradient of Acid Canyon in order to characterize maximum impacts to intermediate-depth perched groundwater and regional groundwater from effluent discharges from the former TA-1 and TA-45 wastewater treatment facility. This goal is consistent with the original criteria for siting this well in the Hydrogeologic Workplan.

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The upper Pueblo Canyon site is designed to address the following data needs:

- To determine subsurface distribution of contaminants in an area expected to contain the maximum groundwater contamination from recharge emanating from Acid Canyon. These data are needed to bound maximum risk levels associated with deep groundwater contamination in the near-source area.
- To evaluate groundwater pathways and interconnections between the surface and deep groundwater recharge in upper Pueblo Canyon; these data are needed to properly constrain the vadose-zone numerical flow and transport model for Pueblo Canyon.
- To identify geologic and hydrologic controls on groundwater pathways; these data are part of the general characterization of groundwater conditions beneath the Laboratory and support ongoing efforts to improve the hydrogeologic conceptual model.
- To provide water-level, aquifer characteristics, and chemistry data for improving the regional flow and transport model.

It is recommended that R-2 be completed as a well with a single screen just below the regional aquifer water table, to a total depth of approximately 100 ft below the regional aquifer table. The screen will provide access to groundwater so that contaminant concentration at the top of the regional aquifer can be determined.

It is recommended that R-2 be drilled as an open borehole, using air with minimal fluids. The open hole will facilitate the use of borehole geophysics, which can be used to characterize moisture distribution and identify perched groundwater in the vadose zone. Open-hole geophysics will also provide data to characterize the hydraulic properties of saturated rocks in the regional aquifer as well as provide key information for the selection of well screen depth.

The desire for open-hole characterization data will be balanced against the potential for creating a groundwater pathway to the regional aquifer. If perched groundwater is encountered during drilling, borehole water samples shall be collected and submitted for rapid turn-around analyses for non-sorbing potential contaminants (e.g. ClO_4, NO_3); these screening analyses will be used to evaluate whether contaminants in perched water zones should be isolated with drill casing before the regional aquifer is penetrated.

Hydraulic testing is planned to determine the conductivities of each well screen . Testing will consist of injection tests or aquifer pumping tests.

The upper portion of the boring will be cored in order to determine contaminant distribution, moisture, and anion/^{3}H /isotope profiles in the vadose zone. Cuttings will be collected every 5 feet by the subcontractor to identify geologic contacts, describe rock characteristics, and provide samples for additional geologic characterization. These data will be used to prepare a lithologic log of the borehole.

A summary of the data needs and data collection is shown in the following table:

Data Needed	Data Collection
Stratigraphy	Core, cuttings, and geophysical logs
Perched zone identification	Driller observations, borehole video, drill with minimal fluids
Perched zone water chemistry	Borehole screening sample, if perched water is encountered
Contaminant distribution in vadose zone	Core in upper portion; cuttings for sorbing species
Regional aquifer water level	Measure water level in borehole and well
Regional aquifer water chemistry	Collect water samples from well
Regional aquifer hydraulic characteristics	Hydrologic testing

Action Items:	Action Assigned To:
1. Update cost estimates based on approved R-2 work scope.	McCann
2. Brief NMED/OB on work scope and location for R-2	Nylander
3. Finalize R-2 well site location	McCann/Pearson/

4. Prepare FIP for R-2	Broxton Broxton/WGII
Participants: David Rogers Elizabeth Keating Bruce Gallaher Charlie Nylander Pat Longmire David Broxton David Vaniman Tom Whitacre Bob Enz Mat Johansen Bruce Robinson Brent Newman John McCann Howard Granzow Kelly Bitner Steve Pearson Ann Lee	
Meeting Record Prepared By Kelly Bitner	**Date:** 12/18/02

Meeting Record

Purpose: DQO Meeting to Recommend Characterization Activities for Well R-4, Pueblo Canyon	Meeting Date: 12/12/02

Background Information:

The Hydrogeologic Workplan rationale for R-4 was to understand contaminant distribution downgradient of releases in Pueblo Canyon, but upgradient of the Los Alamos County wastewater treatment plant.

Geology –

R-4 could help answer the following geologic questions:

- Western extent of the Cerros del Rio basalt
- Older units are higher than expected in the east, and they are expected to drop down somewhere towards the west and this well may constrain where the drop occurs;
- To the east at O-1 and R-5 there is heavy alteration at the base of the Cerros del Rio basalt and below, possibly a fossil hydrothermal system. A question is whether this altered zone extends this far to the west.
- Presence or absence of transmissive sediments ("Chaquehui") and their character in this area.

The stratigraphic understanding would be greatly enhanced if R-4 went through the Totavi and into the Santa Fe.

Hydrology –

Vadose zone: The most important data need in the vadose zone is contaminant distribution. That is the only way to trace pathways of migration. Two perched zones have been observed in wells in Pueblo Canyon, but they are in different stratigraphic units.

Regional aquifer: In this area, the gradient in the regional aquifer is expected to be fairly horizontal, although substantial chemical gradients are possible because lots of water has been added to the canyon. However, the downward vertical gradients up the canyon are likely to have taken any contaminants deeper into the aquifer, so a deeper well would provide the best information on maximum contaminant levels. Hydrologic testing to estimate permeability in the Puye and basalt would help in the regional aquifer modeling.

Geochemistry-

The contaminants that were released are: mobile chemicals, actinides, and fission products. At TW-2A (perched zone) there is tritium (2000 pCi/L), but in TW-2 the regional aquifer has no detectable tritium. POI-4, R-5, TW-1A, TW-1 (360 pCi/L), O-1 (30 pCi/L) also have some tritium. O-1 also has perchlorate (4-5 ppb) and nitrate (2 mg/L). The difference in tritium in TW-1 and O-1 suggests that O-1 is drawing on a large inventory of tritium. No vapor samples are necessary because VOCs were not part of the source term. There are indications from several wells in perched and regional aquifers that these are chemicals from Laboratory operations.

Recommendations:

Based on discussions at the R-4 DQO meeting, a recommendation is made that R-4 be

sited in Pueblo Canyon as shown on the map in order to characterize groundwater in the intermediate-depth perched groundwater (if present) and regional groundwater down gradient of releases in Pueblo Canyon and above effluent discharges from the Los Alamos County wastewater treatment facility. This goal is consistent with the original criteria for siting this well in the Hydrogeologic Workplan.

The R-4 Pueblo Canyon site is designed to address the following data needs:

- To determine subsurface distribution of contaminants in an area down gradient of releases in Pueblo Canyon and to characterize groundwater quality up gradient of the treatment plant effluent. These data are needed to understand the contributions to groundwater from treatment plant discharges.
- To evaluate groundwater pathways and interconnections between the surface and deep groundwater recharge in Pueblo Canyon; these data are needed to properly constrain the vadose-zone numerical flow and transport model for Pueblo Canyon.
- To identify geologic and hydrologic controls on groundwater pathways; these data are part of the general characterization of groundwater conditions beneath the Laboratory and support ongoing efforts to improve the hydrogeologic conceptual model.
- To provide water-level, aquifer characteristics, and chemistry data for improving the regional flow and transport model.

Although the regional aquifer flow gradient in this area is expected to be horizontal, the gradient up the canyon near the source terms is downward, based on existing data and modeling. In order to detect contamination, the R-4 well screen should be located deep enough to intercept deep flowpaths. Therefore, it is recommended that the R-4 completion be determined after analysis of R-5 data and particle-tracking simulation to determine how deep contaminants from Pueblo Canyon might be expected. The screen will provide access to groundwater so that contaminant concentration at the expected maximum within the regional aquifer can be determined.

It is recommended that R-4 be drilled as an open borehole, using air with minimal fluids. The open hole will facilitate the use of borehole geophysics, which can be used to characterize moisture distribution and identify perched groundwater in the vadose zone. Open-hole geophysics will also provide data to characterize the hydraulic properties of saturated rocks in the regional aquifer as well as provide key information for the selection of well screen depth.

The desire for open-hole characterization data will be balanced against the potential for creating a groundwater pathway to the regional aquifer. If perched groundwater is encountered during drilling, borehole water samples shall be collected and submitted for rapid turn-around analyses for non-sorbing potential contaminants (e.g. ClO_4, NO_3); these screening analyses will be used to evaluate whether contaminants in perched water zones should be isolated with drill casing before the regional aquifer is penetrated.

Hydraulic testing is planned to determine the conductivity at the well screen . Testing will consist of injection tests or aquifer pumping tests.

The upper portion of the boring will be cored in order to determine contaminant distribution, moisture, and anion/^{3}H /isotope profiles in the vadose zone. Cuttings will be collected every 5 feet by the subcontractor to identify geologic contacts, describe rock characteristics, and provide samples for additional geologic characterization. These data will be used to prepare a lithologic log of the borehole.

A summary of the data needs and data collection is shown in the following table:

Data Needed	**Data Collection**
Stratigraphy	Core, cuttings, and geophysical logs
Perched zone identification	Driller observations, borehole video, drill with minimal fluids
Perched zone water chemistry	Borehole screening sample, if perched water is encountered
Contaminant distribution in vadose zone	Core in upper portion; cuttings for sorbing species
Regional aquifer water level	Measure water level in borehole and well
Regional aquifer water chemistry	Collect water samples from well
Regional aquifer hydraulic characteristics	Hydrologic testing

Action Items:	Action Assigned To:
1. Conduct particle tracking simulations to assess depth of screened interval	Keating
2. Update cost estimates based on approved R-4 work scope.	McCann
3. Brief NMED/OB on work scope and location for R-4	Nylander
4. Finalize R-4 well site location	McCann/Pearson/
5. Prepare FIP for R-4	Broxton Broxton/WGII

Participants:

David Rogers
Elizabeth Keating
Bruce Gallaher
Charlie Nylander

Pat Longmire
David Broxton
David Vaniman
Tom Whitacre
Bob Enz
Mat Johansen
Bruce Robinson
Brent Newman
John McCann
Howard Granzow
Kelly Bitner
Steve Pearson
Ann Lee

Meeting Record Prepared By	Date:
Kelly Bitner	12/18/02

Meeting Record

Purpose: DQO Meeting to Recommend Characterization Activities for Well R-6, Los Alamos Canyon	Meeting Date: 12/12/02

Background Information:

The Hydrogeologic Workplan rationale for R-6 was to provide stratigraphic information, background water chemistry, and hydrologic information in the recharge zone.

Geology –

The R-6 location is near H-19. In boring H-19, the stratigraphy encountered was: dacite, Tschicoma dacite, Puye Formation fanglomerates, more Tschicoma dacite, Totavi, and a deeper Tschicoma dacite. This is a surprising stratigraphy because Totavi river gravels are interspersed between dacitic lavas . It is important to know if the Totavi, a transmissive unit, really extends that far west. Confirming the presence of the Totavi that far west is important in structural basin development. There is poor control on the Tschicoma and Cerros del Rio basalts, which overlap in time and composition, and potentially older dacites of Keres age. The distribution of dacite has significant impact on the 3-D geologic model and the ages of the dacites will be necessary to know where in the stratigraphic column the dacites belong. The 3-D model currently assumes thick dacite flows, but if they are thinner and more laterally extensive, that will make a difference in 3D structure of lavas for the model.

Hydrology –

Vadose zone: There was a perched zone about 25 feet thick in the Guaje pumice in H-19. This perched zone is probably continuous down canyon to LADP-4. The oxygen isotopes measured in perched zone water in R-9i have values that indicate the water comes from the same elevation as the R-6 location.

Regional aquifer: Expect to have downward vertical gradients, similar to those measured in R-25. It would be useful to measure the vertical gradient in screened intervals that approximately match the two uppermost regional aquifer screens in R-25. The permeability of the Totavi lentil is also important to know.

Geochemistry-

There is a recent recharge component in the Guaje perched water. R-6 will provide recharge chemistry and background regional aquifer water chemistry.

Recommendations:

Based on discussions at the R-6 DQO meeting, a recommendation is made that R-6 be sited in Los Alamos Canyon west of Los Alamos Canyon bridge order to characterize the intermediate-depth perched groundwater (if present) and regional groundwater upgradient of all Laboratory activities. This goal is consistent with the original criteria for siting this well in the Hydrogeologic Workplan.

The R-6 Los Alamos Canyon site is designed to address the following data needs:

- To determine the water quality in an area up gradient of all releases from Laboratory operations. These data are needed to understand the contribution to groundwater quality from Laboratory operations.

- To identify geologic and hydrologic controls on groundwater pathways; particularly the western extent of the Totavi lentil and to measure ages of the dacites that were encountered in H-19. These data are part of the general characterization of hydrogeologic units beneath the Laboratory and support ongoing efforts to improve the hydrogeologic conceptual model.
- To provide water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model.

The regional aquifer gradient in this area is expected to be downward, based on existing data and modeling. In order to measure the vertical gradient, the R-6 well should be constructed with two screened intervals in the regional aquifer. It would be optimal if the screens could be placed to approximately match the two upper regional aquifer screens in R-25. It is anticipated that the well will penetrate about 300 feet into the regional aquifer. The screens will provide access to groundwater so that background water quality can be measured and that the head can be measured in each screen to allow the calculation of vertical gradients.

It is recommended that R-6 be drilled using methods determined by the driller to be optimal. This background location is not expected to have Laboratory-derived contaminants, thus using air with minimal fluids is not required. If an open hole drilling method is effective, it would facilitate the use of borehole geophysics, which can be used to characterize moisture distribution and identify perched groundwater in the vadose zone. Open-hole geophysics will also provide data to characterize the hydraulic properties of saturated rocks in the regional aquifer as well as provide key information for the selection of well screen depths.

Hydraulic testing is planned to determine the conductivities of each well screen . Permeability of the Totavi lentil and the dacite are of particular importance. Testing will consist of injection tests or aquifer pumping tests.

Cuttings will be collected every 5 feet by the subcontractor to identify geologic contacts, describe rock characteristics, and provide samples for additional geologic characterization. These data will be used to prepare a lithologic log of the borehole.

A summary of the data needs and data collection is shown in the following table:

Data Needed	**Data Collection**
Stratigraphy	Cuttings and geophysical logs
Perched zone identification	Driller observations and borehole video
Perched zone water chemistry	Borehole screening sample, if perched water is

Regional aquifer water level	Measure water level at the top of the regional aquifer and in both screened intervals
Regional aquifer water chemistry	Collect water samples from well
Regional aquifer hydraulic characteristics	Hydrologic testing

Action Items:	**Action Assigned To:**
1. Update cost estimates based on approved R-6 work scope.	McCann
2. Brief NMED/OB on work scope and location for R-6	Nylander
3. Finalize R-6 well site location	McCann/Pearson/Broxton
4. Prepare FIP for R-6	Broxton/WGII

Participants:	
David Rogers Elizabeth Keating Bruce Gallaher Charlie Nylander Pat Longmire David Broxton David Vaniman Tom Whitacre Bob Enz Mat Johansen Bruce Robinson Brent Newman John McCann Howard Granzow Kelly Bitner Steve Pearson Ann Lee	
Meeting Record Prepared By Kelly Bitner	**Date:** 12/18/02

Meeting Record

Purpose:	Meeting Date:
DQO Meeting to Recommend Characterization Activities for Well R-26, Cañon de Valle	12/12/02

Background Information:

The Hydrogeologic Workplan rationale for R-26 was to serve as the western well in a pair of wells to straddle the Pajarito Fault. The pair of wells were proposed to understand the effect of faults on the hydrologic system. The eastern well of the pair would be R-25.

Geology –

The geology of the area is poorly known. There may be Tschicoma dacites (although these were not present at R-25); drilling may also encounter Puye fanglomerates, axial gravels (Totavi), and Santa Fe Group sediments. The stratigraphic data needs are:

- Number and thickness of Tschicoma flows if present.
- Presence of underlying or intercalated sediments (Puye, Totavi, or Santa Fe); the nature of the major sediment type strongly influences construction of the 3-D geologic model
- Presence or absence of Keres group volcanic rocks
- Aerial EM surveys show areas of high conductivity close to the surface in this area. Moisture profile in this borehole could be very useful determining if the high conductivity areas in the EM data are saturated zones.

Hydrology –

Vadose zone: the western extent of the thick perched zone encountered in R-25 – is it present on both sides of the fault?

Regional aquifer: The most important data for the regional aquifer model is piezometric surface and hydraulic heads with depth to measure the vertical gradient. Recharge rates are not well constrained in this area. Anion profiles would help assess recharge.

Geochemistry-

R-26 will provide recharge chemistry and background regional aquifer water chemistry.

Recommendations:

Based on discussions at the R-26 DQO meeting, a recommendation is made that R-26 be sited between Ancho Ranch Road and West Jemez Road in order to characterize groundwater in the intermediate-depth perched groundwater (if present) and regional groundwater upgradient of all Laboratory activities. The location should be finalized after conferring with Brent Newman and Don Hickmott, and taking into account electrical data from the Fugro aerial survey that covers this area. This goal is consistent with the original criteria for siting this well in the Hydrogeologic Workplan.

The R-26 site is designed to address the following data needs:

- To determine the water quality in an area up gradient of all releases from Laboratory operations. These data are needed to understand the contribution to groundwater quality from Laboratory operations.
- To identify geologic and hydrologic controls on groundwater pathways; particularly the effect of the Pajarito fault on groundwater flow and the presence or absence of a

perching horizon similar to what is present at R-25. These data are part of the general characterization of the groundwater conditions beneath the Laboratory and support ongoing efforts to improve the hydrogeologic conceptual model.

- To provide water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model.

The R-26 well should be constructed such that there are two screened intervals: one in the perched zone (if present) and one in the regional aquifer. The R-26 site could be constructed with two separate wells to monitor the perched and regional aquifer if that would be more cost effective than a well with multiple screens. It is anticipated that the well total depth will be about 1500 ft and will penetrate about 100 feet into the regional aquifer. The screens will provide access to groundwater so that background water quality can be measured in both perched and regional water zones.

It is recommended that R-26 be drilled using air with minimal fluids. This background location is not expected to have Laboratory-derived contaminants, but the use of air will facilitate the identification of perched water. If an open hole drilling method is effective, it would allow the use of borehole geophysics, which can be used to characterize moisture distribution and help identify perched groundwater in the vadose zone. Open-hole geophysics will also provide data to characterize the hydraulic properties of saturated rocks in the regional aquifer as well as provide key information for the selection of well screen depths.

Hydraulic testing is planned to determine the conductivities of each well screen. Hydrologic properties of the regional aquifer in this area are particularly important. Testing will consist of injection tests or aquifer pumping tests.

Core will be collected in the upper 200-foot portion of the borehole to measure moisture and anion profiles. Below 200 feet, cuttings will be collected every 5 feet by the subcontractor to identify geologic contacts, describe rock characteristics, and provide samples for additional geologic characterization. These data will be used to prepare a lithologic log of the borehole.

A summary of the data needs and data collection is shown in the following table:

Data Needed	**Data Collection**
Stratigraphy	Core, cuttings and geophysical logs
Moisture and anion profiles	Core in the upper 200 feet of the borehole
Perched zone identification	Driller observations and borehole video
Perched zone water chemistry	Water samples collected from well, if encountered

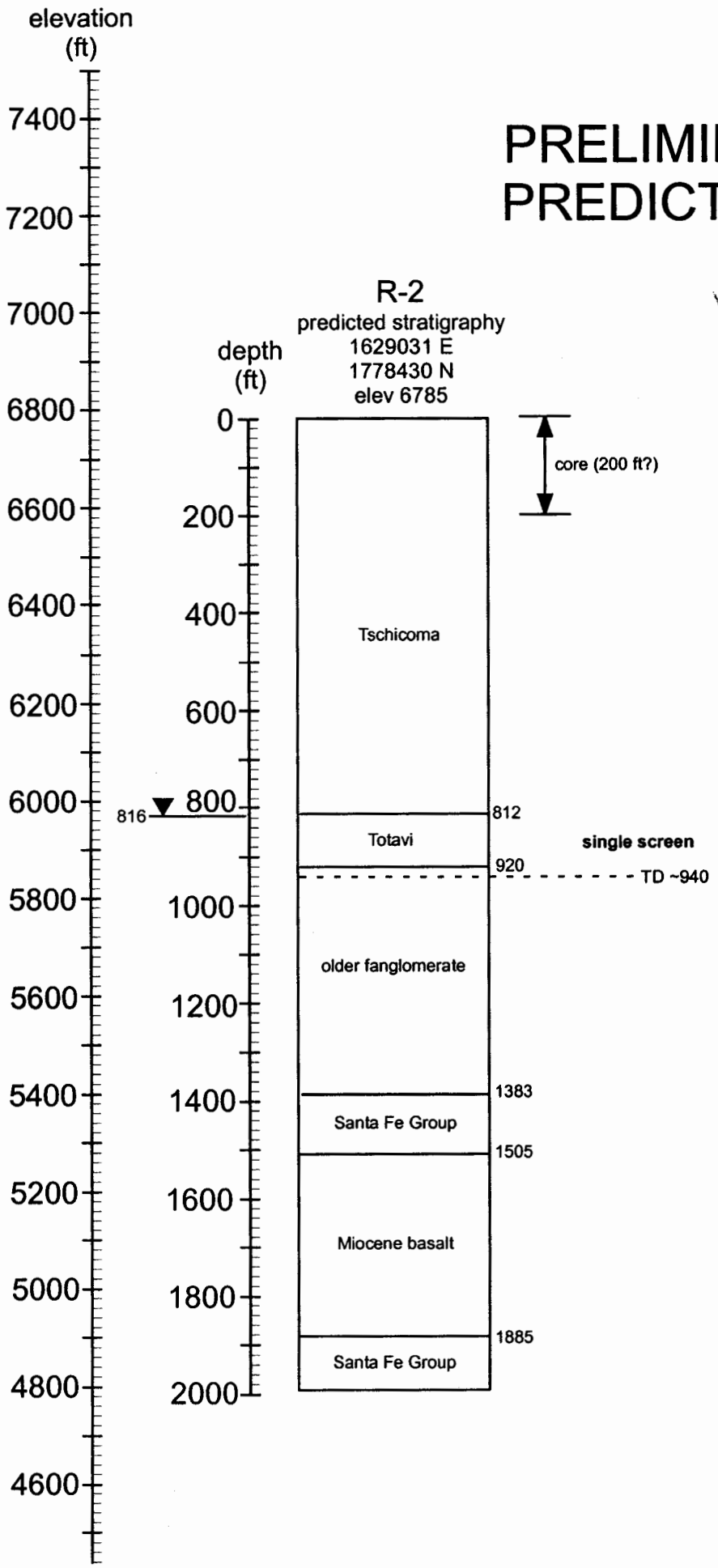
Regional aquifer water level	Measure water level of the regional aquifer
Regional aquifer water chemistry	Collect water samples from well
Regional aquifer hydraulic characteristics	Hydrologic testing

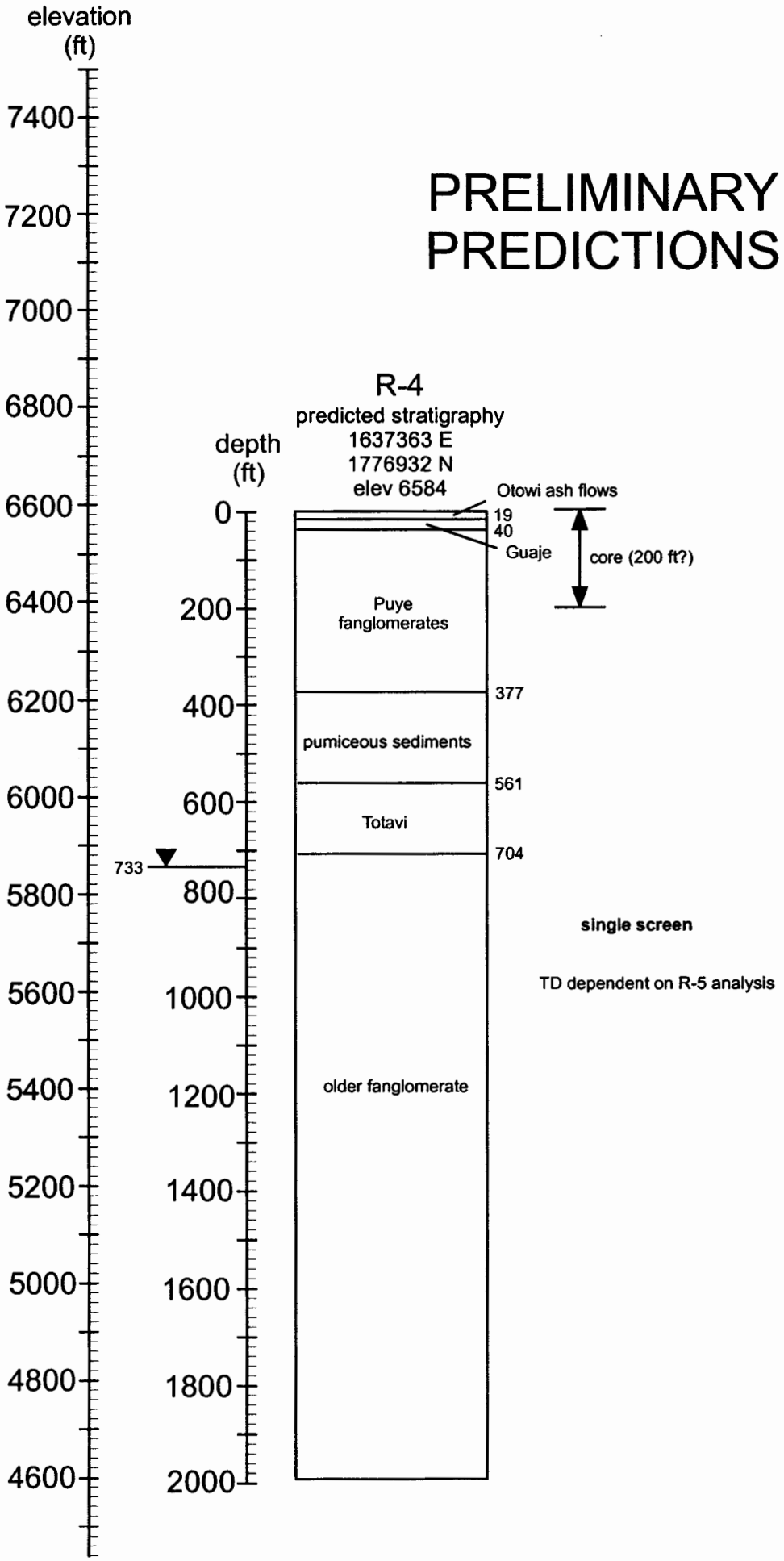
Action Items:	**Action Assigned To:**
1. Update cost estimates based on approved R-26 work scope.	McCann
2. Brief NMED/OB on work scope and location for R-26	Nylander
3. Finalize R-26 well site location	McCann/Pearson/Broxton
4. Prepare FIP for R-26	Broxton

Participants:	
David Rogers Tom Whitacre Elizabeth Keating Bob Enz David Broxton Kelly Bitner David Vaniman	
Meeting Record Prepared By Kelly Bitner	**Date:** 12/18/02

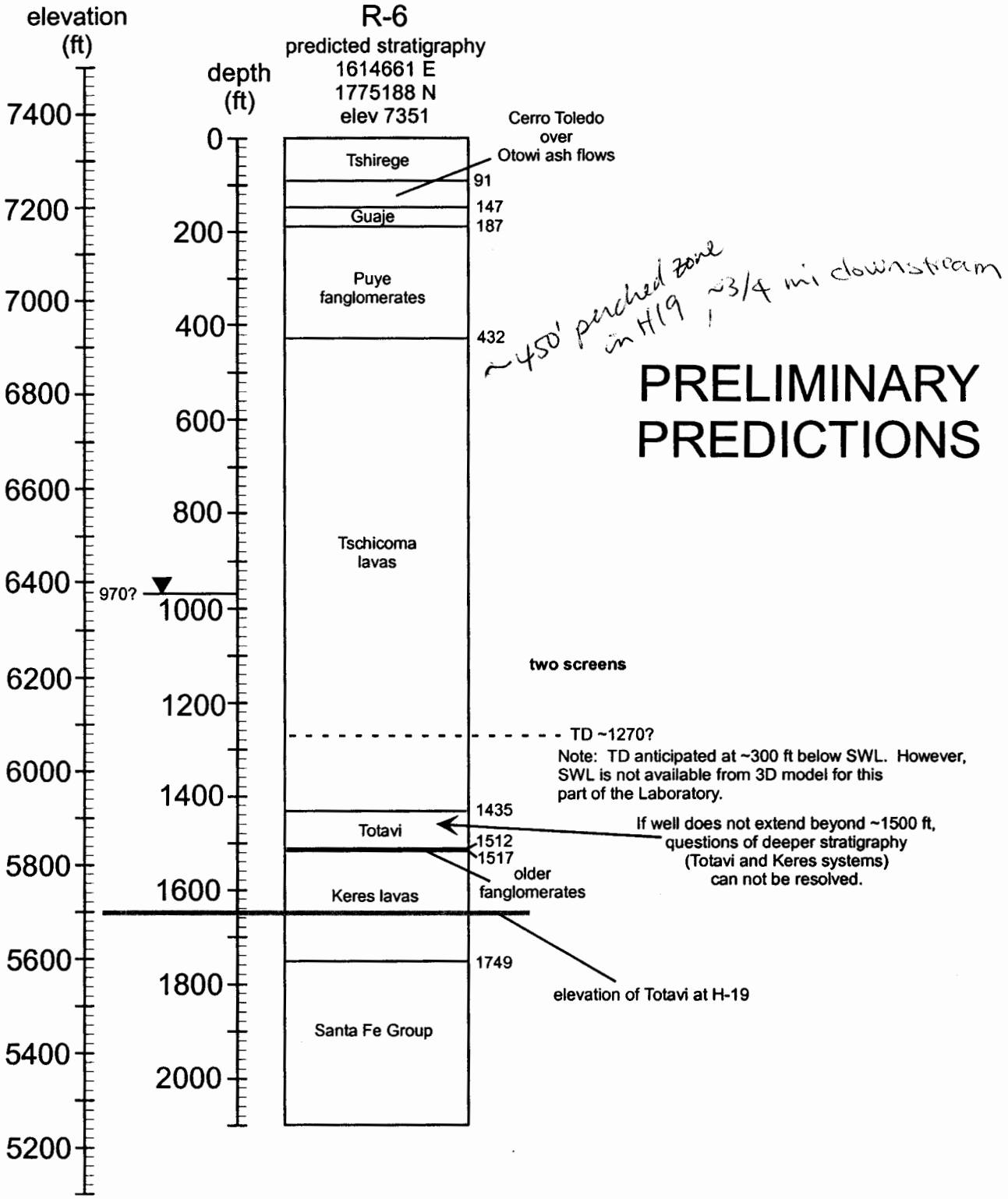
PRELIMINARY PREDICTIONS

move ~ 1/2 mile downstream

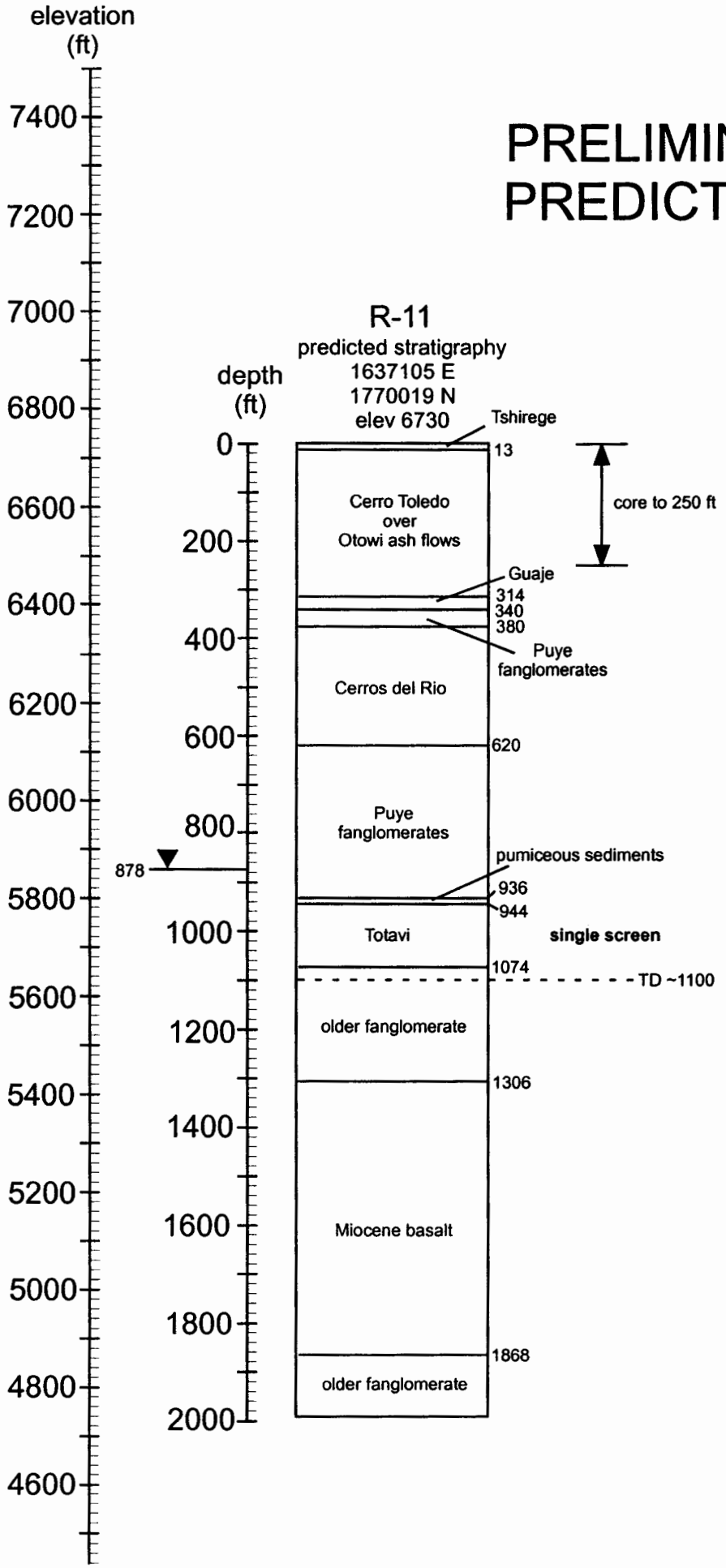


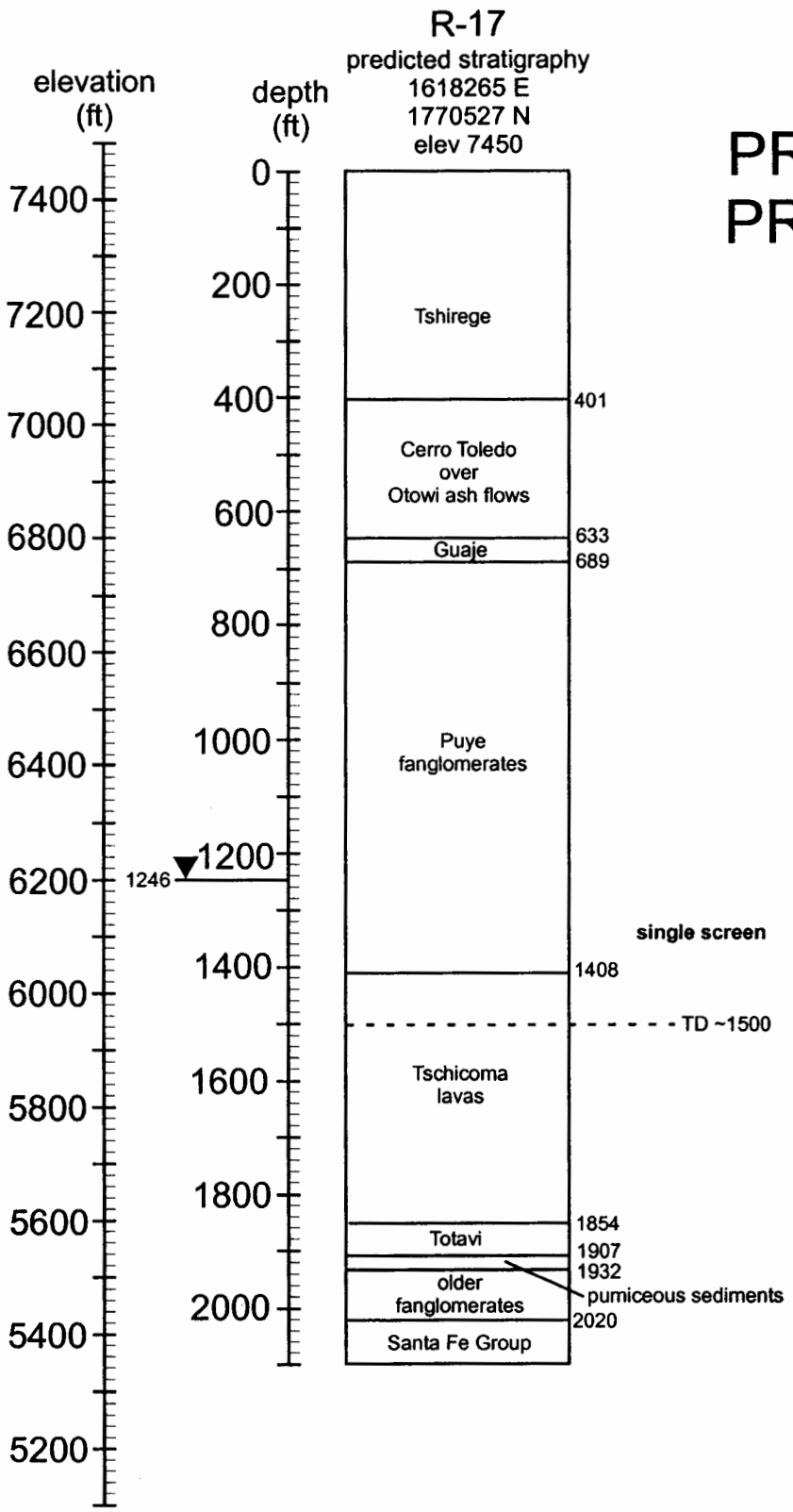


PRELIMINARY PREDICTIONS


R-6
predicted stratigraphy
1614661 E
1775188 N
elev 7351
elevation (ft)
depth (ft)
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
5200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
970?
Tshirege
Guaje
Puye fanglomerates
Tschicoma lavas
Totavi
Keres lavas
Santa Fe Group
91
147
187
432
1435
1512
1517
1749
Cerro Toledo over Otowi ash flows
~450' perched zone in H19, ~3/4 mi downstream
PRELIMINARY PREDICTIONS
two screens
TD ~1270?
Note: TD anticipated at ~300 ft below SWL. However, SWL is not available from 3D model for this part of the Laboratory.
If well does not extend beyond ~1500 ft, questions of deeper stratigraphy (Totavi and Keres systems) can not be resolved.
older fanglomerates
elevation of Totavi at H-19

PRELIMINARY PREDICTIONS





PRELIMINARY PREDICTIONS

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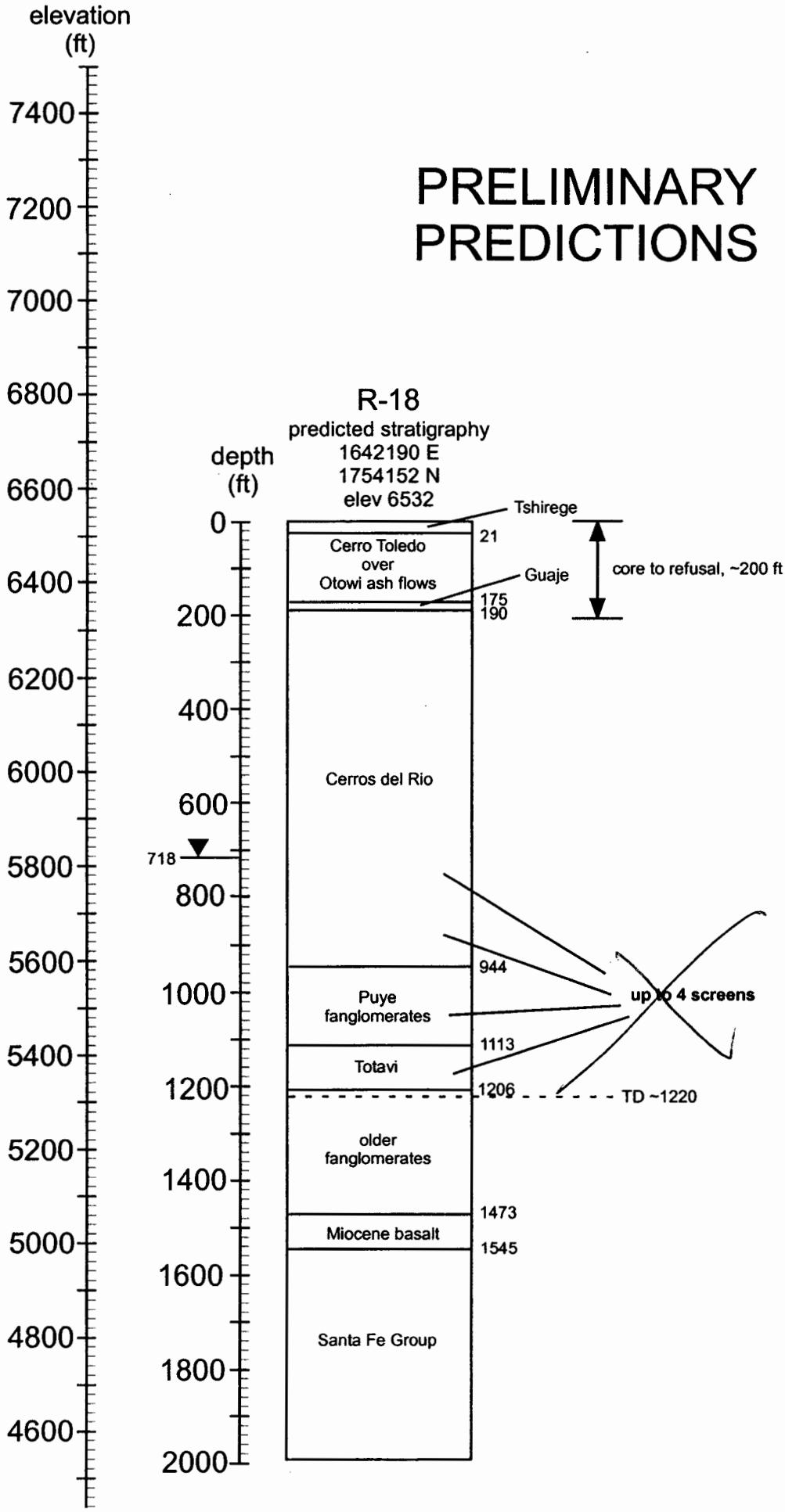
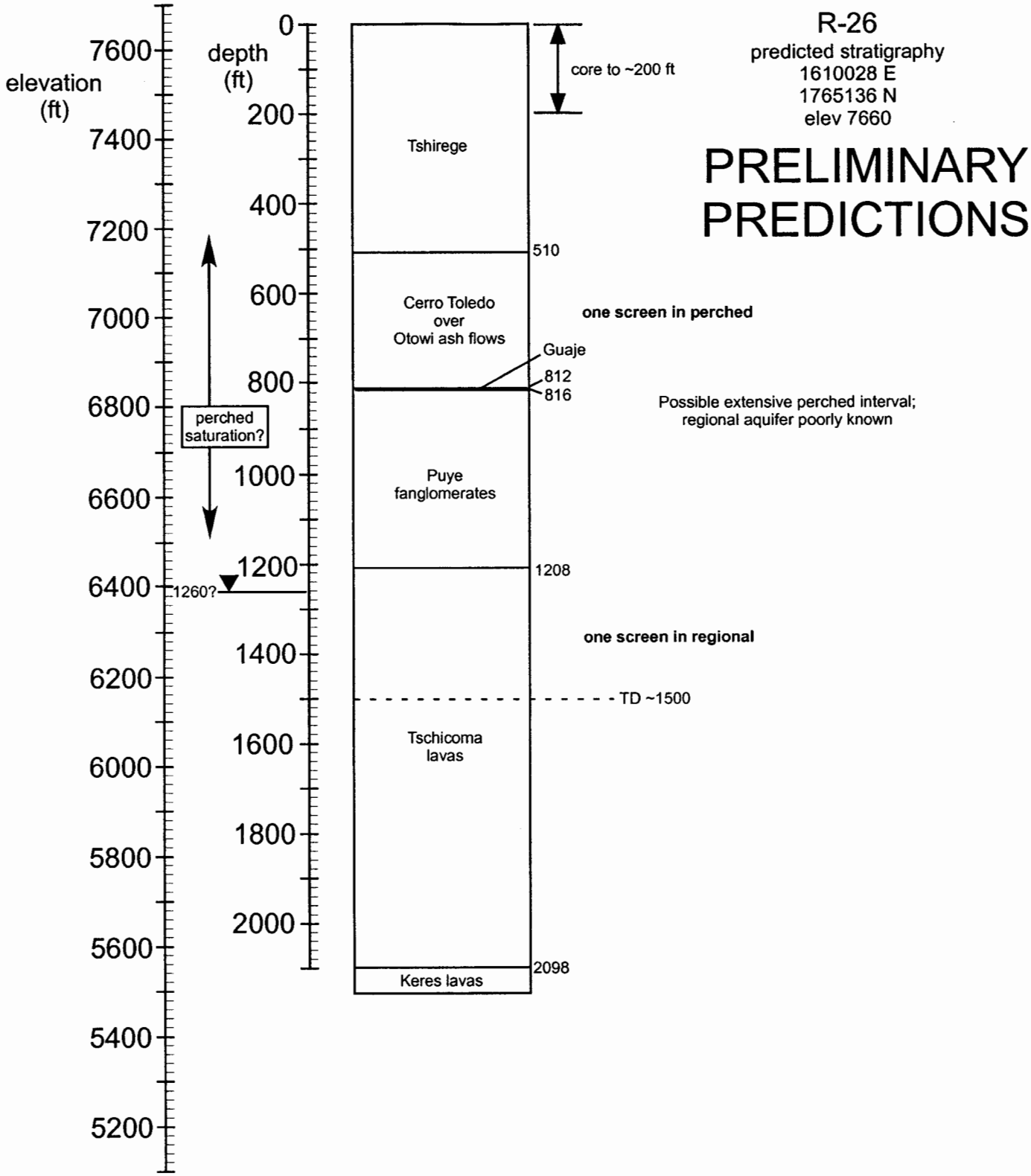
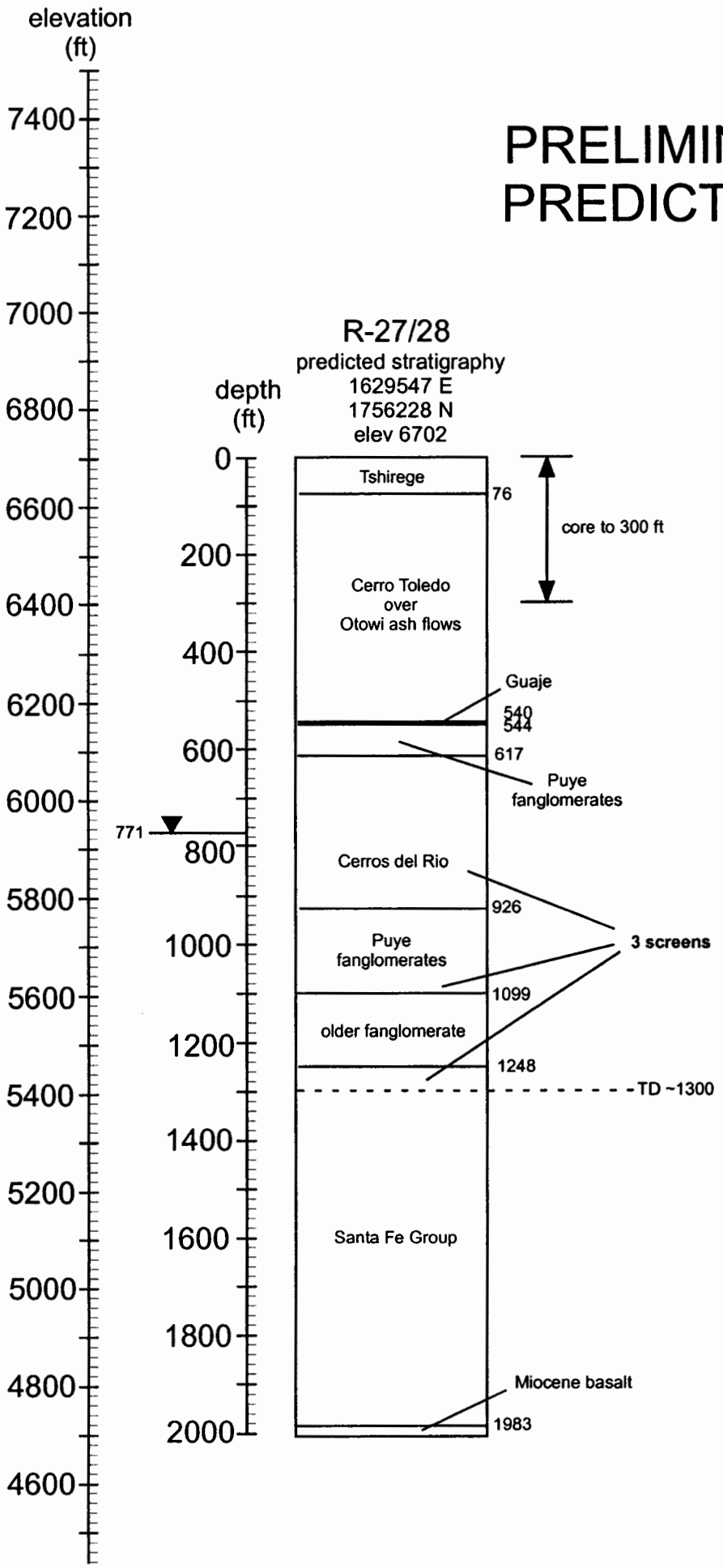


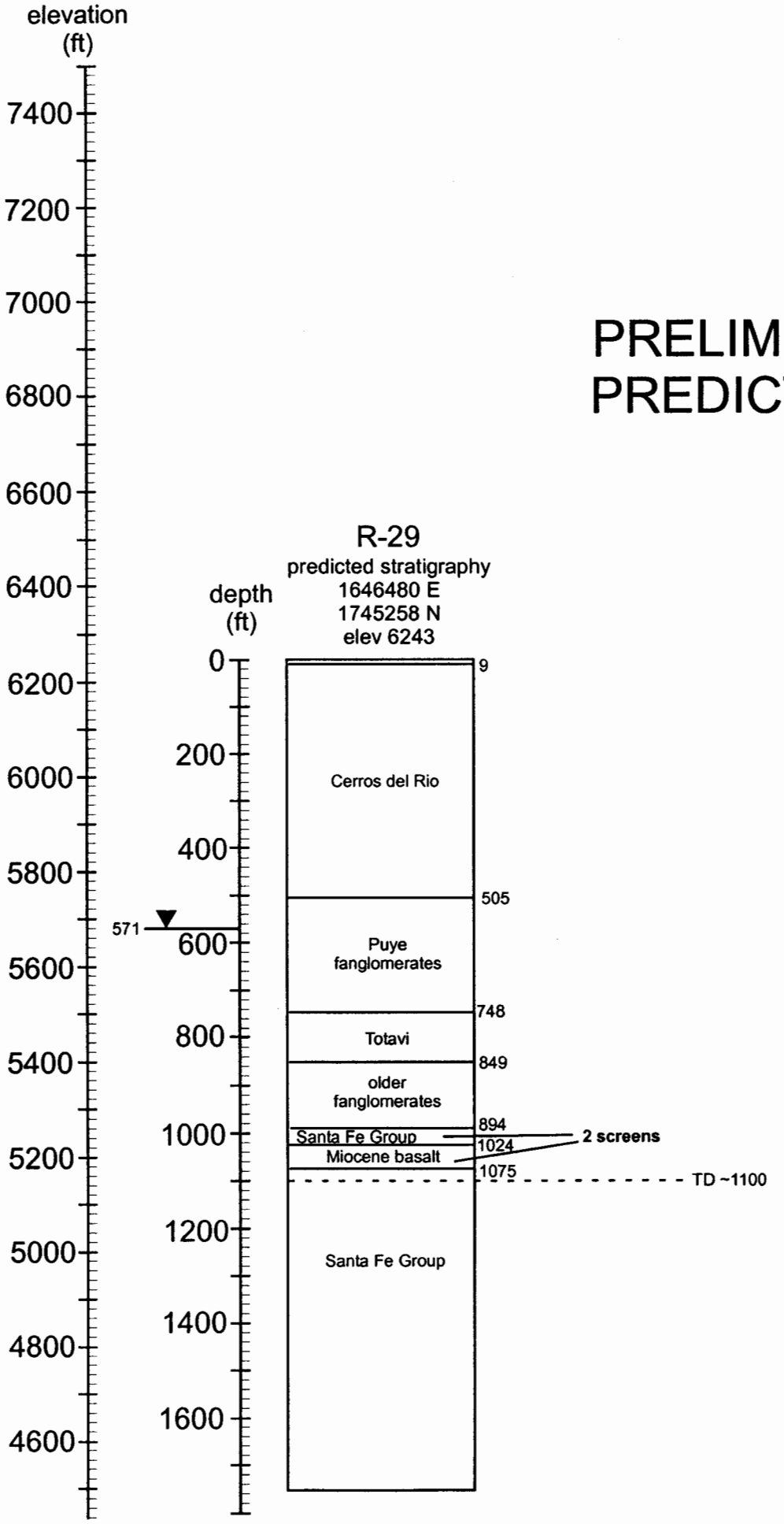
3 screens in regional

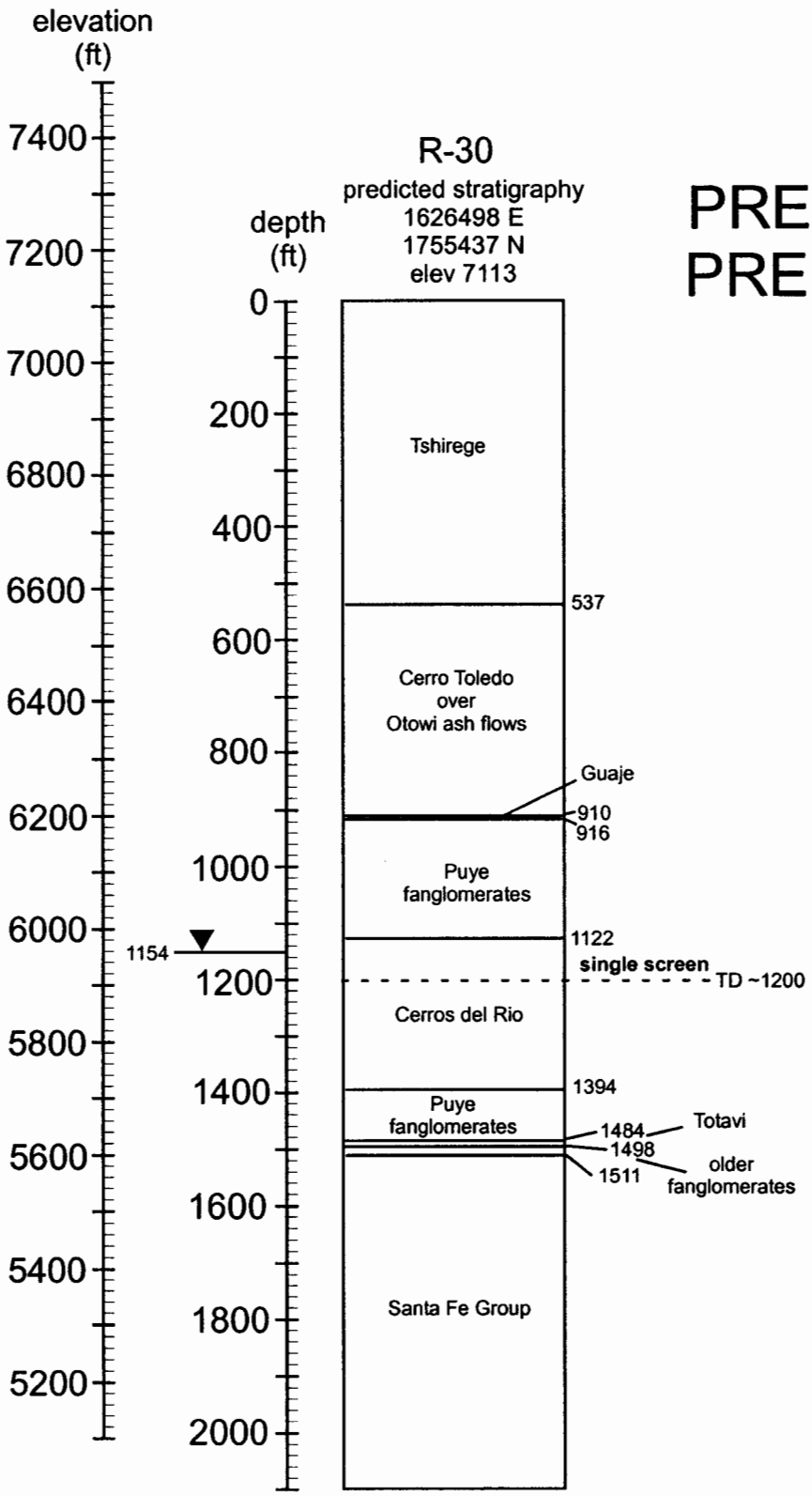

R-26
predicted stratigraphy
1610028 E
1765136 N
elev 7660
PRELIMINARY PREDICTIONS
elevation (ft)
depth (ft)
7600
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
5200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
core to ~200 ft
Tshirege
510
Cerro Toledo over Otowi ash flows
one screen in perched
Guaje
812
816
Possible extensive perched interval; regional aquifer poorly known
perched saturation?
Puye fanglomerates
1208
1260?
one screen in regional
TD ~1500
Tschicoma lavas
2098
Keres lavas

PRELIMINARY PREDICTIONS



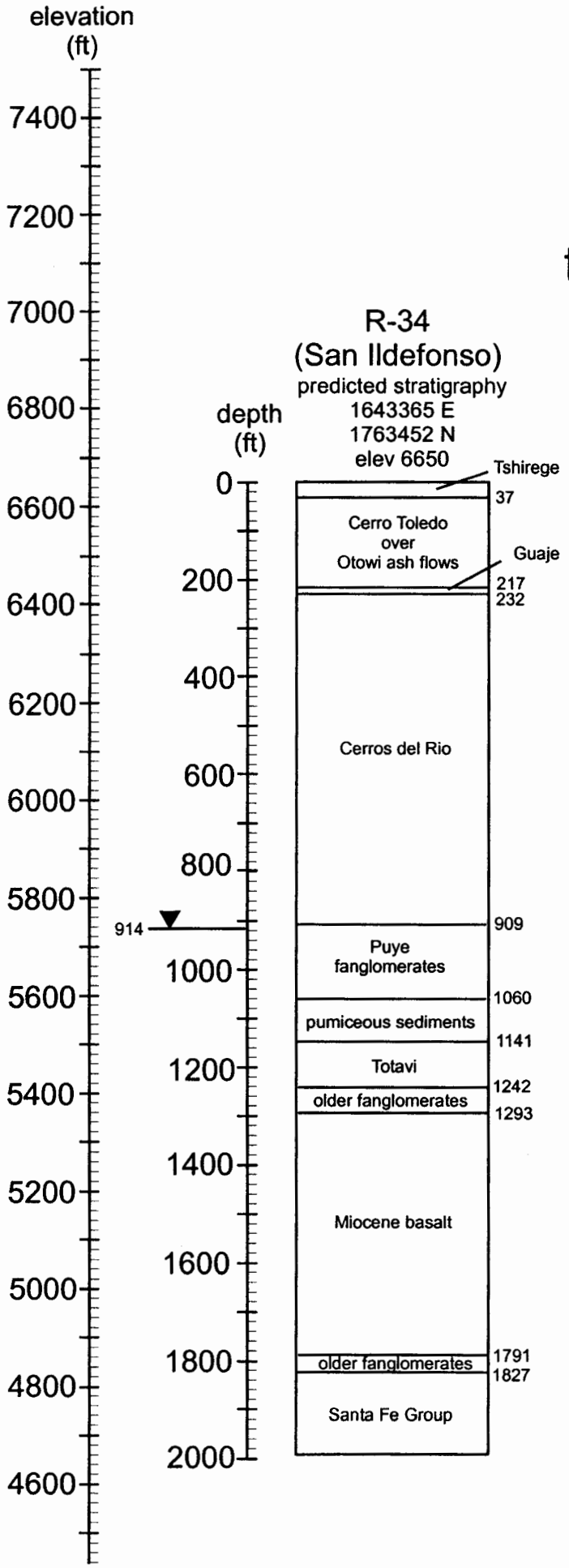
PRELIMINARY PREDICTIONS





PRELIMINARY PREDICTIONS

PRELIMINARY PREDICTIONS; tentative location



San I well - Mort. Cyn. @ SR4
- Data access?

Any Perchlorate in TW8? check YES (integrity of TW-8?) → Test & Replace?

Regional well between TW8 & PM-5

Replace MCOBT-4.4 (intermediate)

(Letter by 4/15 to LANL w/ 3 wells)

• Proposing: R16, R26, R29 ; then: 4.4 Repl, San I (Neg.), Mort. b/t TW8 + PM5

~~Coring depths?~~

want to schedule field visit to look at well sites this spring

from LANL WQDB:

TW-8: perchlorate

6/4/01	3.26 ug/L
11/6/01	2.37
	1.74

2002: reported as <1.45

PM-5: perchlorate

11/29/01	1.6 ug/L
	1.29