JAN 2 1987

MEMORANDUM FOR: Frank A. Costanzi, Chief, Waste Management Branch, DES

THRU: Richard P. Grill, Section Leader, Performance Section, WMB

FROM: Donald Chery, Project Manager-Hydrogeologist

SUBJECT: TRIP REPORT ON IN-SITU SITE VISIT (12/01/86) SPOKANE, WASHINGTON AND NRC-DOE DATA REVIEW MEETING (12/02-05/86) RICHLAND, WASHINGTON

On the evening of November 30, 1986, I arrived in Spokane, Washington, and met with Dr. Tim Steele and Mr. Jim Paschis of In-Situ, Inc. to make final plans for the next day meeting and field trip. Monday morning, December 1, 1986, we began the orientation meeting on the In-Situ, Inc. project (FIN D1163) at 8:00 a.m. I introduced Dr. Tim Steele, In-Situ's project manager and then he with the assistance of two other In-Situ staff members explained the objectives and study tasks to the group. A copy of his viewgraphs are enclosed (Enclosure A). Jim Paschis showed slides of the field site and the recent In-Situ drilling and coring activities. He prepared a packet of materials with general geological information for the area, a summary of the recent test borings and an itinerary for the field trip (copies of these materials are in Enclosure B).

Aside from the In-Situ personnel (3) and me, 14 people attended the meeting. The NRC/NMSS contingent had Tilack Verma, Neil Coleman, Mike Weber and Harold Lefevre and they were accompanied by five consultants. Mike Thompson was attending from the Richland DOE office and he was accompanied by one consultant. Jack Wittman was representing the Yakima Indian Nation and he was accompanied by a consultant. Ted Olson from the State of Washington Department of Ecology was present. See Enclosure C for a copy of the attendance list.

After the presentations there was discussion with the following requests being made or issues raised:

a) DOE requested a copy of the statement of work from the Request for Proposal.

b) The Yakima Indian Nation expressed their desire to be kept informed on the progress and findings of the study.

c) The issue of "transferability of the data" to the Basalt Waste Isolation Project (BWIP) at Hanford was raised. Opinions were expressed that the study should be moved to and done at the BWIP site.

d) The issue of quality assurance (QA) procedures was raised for this research project, and NRC/NMSS voiced opinions that QA procedures as vigorous as those they are requiring for licensing review should apply to research work.

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e) The issue of documenting and reporting the preliminary site characterization data was raised. Could the exploratory work be considered "tests"?

Assurances were given that all parties would be kept informed and the issues were discussed; however, resolution of the issues raised was not germane to the purpose of the meeting and thus was not pursued.

After the orientation meeting, the group divided into one contingent that went to visit the Bunker Hill mine in Kellogg, Idaho, (a University of Idaho research project on mine effluent) and another desiring to see the In-Situ, Inc. field site. Those touring the field site were Mike Weber, NMSS, Gerry Winter, Williams & Associates, Fred Marinelli and Michael Galloway, Terra Therma Inc., Mike Thompson, US DOE, Richland, and Randolph Stone, Rockwell/BWIP. Jack Wittman and Vielchan Nguyen (Yakima Indran Natron) were also planning to join the field tour, but I was later told they thought it was too foggy to tour the field site. The tour began with a look at a road cut through the Roza formation a short distance northeast of Creston, then wells 3-C, OW-2, 16-C and the Dreger well were visited. At well 16-C, the collection of automatically recorded pressure data was demonstrated. Indeed, it was quite foggy when the tour began before noon but by the conclusion of the tour at the Dreger Well the sun was shinning brightly with scattered clouds in the sky.

The In-Situ personnel stayed in the field to gather additional data and the others headed for Richland. One vehicle had the noble objective of seeing some of the basalt formations to the west along the Columbia River, but the falling sun soon changed those plans and the course was altered to head directly for Richland. That evening NRC/NMSS held a short pre-meeting planning session conducted by Mike Weber. Objectives of the Data Review meeting were discussed and reference information and a sample review comment form distributed (see Enclosure D for copies of these materials).

The Data Review meeting began at 8:00 a.m., December 2, 1986. Dave Dahlem of the DOE Richalnd office opened the meeting and officiated on behalf of DOE. NRC was represented by Paul Hildenbrand, Telack Verma, and Neil Coleman. In response to NRC's data request and meeting schedule letter of October 6, 1986 (see Enclosure E), the DOE had assembled the requested data and brought it to the meeting room in the hotel. An inventory list of the available data had been prepared by DOE and a copy of this inventory is in Enclosure F. The data were arranged in five groups for review and NRC assigned one person responsible for the review. They were:

1. Monitoring Installations (Mike Galloway)
2. Geologic Information (Ron Williams)
3. Hydraulic Head (Gerry Winter)
4. Hydraulic Testing Data (Dale Ralston)
5. Hydrochemistry (G. Jacobs)

I had expressed primary interest in the hydraulic testing data and hydraulic head data and was assigned to these review teams in the opening session. I spent one and a half days with Gerry Winter reviewing the head data and collection

procedures, and discussing the process with Rockwell personnel doing the work. We found all Rockwell people with whom we talked open, candid, helpful and competent. In general, the head data may be taken as quite good, collected by good procedures and thoroughly checked by the quality assurance procedures (although daily measurements are interrupted each weekend, no measurements are taken on Saturday and Sunday). Even with all the checking, occasional errors do occur in the final data set (NOMAD File). We made a couple of suggestions for improvements to the data processing procedures. Samples of the type of information that we reviewed have been placed in Enclosure G.

I discussed the hydraulic testing data with Dale Ralston, monitoring data with Mike Galloway, and the geologic data with Harold Leflevre and Steven Hart (Council of Energy Resource Tribes) who reviewed geophysical logs with me to some extent.

Wednesday afternoon I had a long discussion with Ralph Patt (Oregon Water Resources Department). He was quite interested in the In-Situ Research project and told me about a cyanide contamination problem at an aluminum plant near the Dalles in which the integrity of the claystone layer below the Roza Formation played an important role in containing the contamination. He informed me that Geraghty and Miller were consultants to the plant for clean up of the contamination and that David Smith of their Aiken, South Carolina office was very familiar with the hydrogeology of the site. He also recommended Marv Beeson, geologist at Portland State University, as another expert on the basalt formations being considered for the In-Situ, Inc. tests.

In reviewing a DOE draft of "Piezometer Responses in Basalt Waste Insolation Project Monitoring Wells During Construction and Testing of DC-23W and DC-23GR," I read on page 2, "Mean hydraulic conductivities for Roza and Middle Sentinal Bluff flow interiors are 10^{-12} m/s; for the Untanum flow interior, 10^{-13} m/s."

Thursday morning I spent some time discussing with a Rockwell person the features of their NOMAD data base and management system. It is a commercial data base management system marketed by Dunn & Bradstreet.

In the afternoon I visited Battelle Pacific Northwest Laboratory where I visited with Dr. Michael J. Graham, Manager Hydrology Section; Marcel Bergeron, Richard Skaggs, Mike Foley, Charlie Cole and Charlie Kincaid.

That evening NRC/NMSS with state and Indian representatives present spent a considerable amount of time compiling and preparing the meeting summary report. (See Enclosure H.)

Friday morning, NRC and DOE reconvened with state representatives and Indian tribes present. NRC presented DOE with a 13 page meeting summary that included some comments from Indian tribes, and requested DOE sign to acknowledge participation in the meeting. DOE requested and took a 45 minute recess to review the Meeting Summary notes. They returned to say that they were not willing to sign the notes as they were presented. They would need adequate time to review them and negotiate with NRC on some of the representations in the report. They suggested that they review the report until about 3:00 p.m. and then reconvene with NRC and work out the final meeting summary notes.

T. Verma responded for NRC saying that NRC had met for a couple of hours each evening and feel that the comments are accurate. He said that DOE's signature only acknowledge receipt of the report.

DOE took another recess to caucus. They returned unwilling to sign the meeting notes as they stood and with the suggestion that notes of the meeting be separated with notes by each participant - NRC, states and tribes. They offered to review the NRC comments over the weekend and discuss them with Telach Verma by telephone on Monday. They also offered to discuss the notes in the afternoon with anyone remaining in Richland (all NRC personnel and contractors except Neil Coleman were departing from Richland by 1:00 p.m.). DOE would respond formally at a latter date. Dave Dahlem offered an opportunity for discussion and/or comments. All was quiet and he then adjourned the meeting.

Relevant Issues for Research

1. Originally representatives from In-Situ, Inc. were planning to attend the Data Review, but on 11/10/86 I had a phone call from Mike Weber informing me that In-Situ, Inc. representatives could not attend because of a DOE limitation on the number of people that they could accommodate. As it developed, there was no reduction in any other contingent to the data review and with the meeting being held at the motel there were no problems with gaining access. Why did this situation occur with the In-Situ, Inc. personnel?

2. To what extent do Quality Assurance procedures and standards employed by NMSS for license approval apply to Research?

3. What is the role and function of Research personnel's participation in an NMSS (or should that read NRC) review?

Original Signed By

Donald L. Chery, Project Manager
Performance Section
Waste Management Branch, DES

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"in situ draft"

WMB/DES	WMB/DES
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encl. to trip Rpt. on
In-Situ Site Visit (12/01/86)
Rec'd 1/12/87

101

A

CONTRACT WITH In-Situ Inc.

Laramie Wyoming — Lakewood Colorado

FIN—D1163

OBJECTIVE:

Improve NRC ability to characterize and assess flow and contaminant transport in saturated fractured rock.

Aim of the Study:

The objective of the In-Situ contract is to provide the U.S. Nuclear Regulatory Commission (NRC) research findings that will support and/or confirm the basis of technical positions on acceptable methods and techniques for characterizing and assessing flow and contaminant transport in saturated fractured rocks. These techniques eventually will be used to evaluate U.S. Department of Energy's determinations of ground-water flow and contaminant transport for a proposed high-level waste repository site.

The contract has the following seven technical tasks:

1. Evaluate relationship between field measurements of hydrologic and transport parameters to length scales used in models. Can a representative elementary volume (REV) be defined for each parameter?

2. Investigate the characterization of potentially important discrete hydrologic features (i.e., fractures, faults, abandoned bore holes and shafts, dikes, low-permeability strata, etc.) and assess their importance and inclusion in flow and transport modeling.

3. Provide NRC guidance on the appropriateness of continuum versus discrete fracture models for representing flow and contaminant transport in saturated fractured rock.

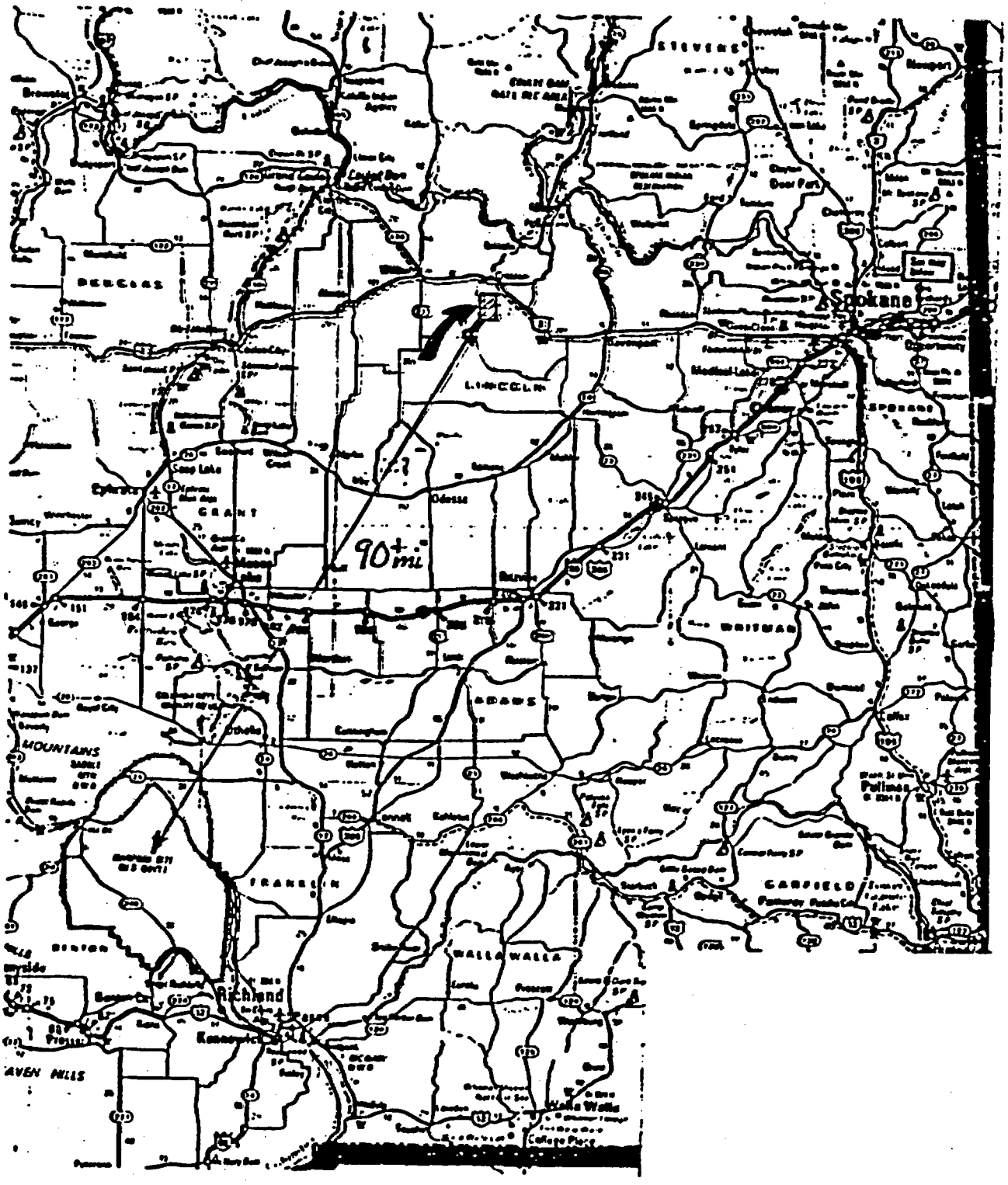
4. Investigate methods by which to determine effective porosity more accurately with respect to the modeling needs.

5. Test theories of spatially projecting (from near field measurements to far field model parameters) dispersivity field measurements.

6. Test to distinguish between matrix diffusion, hydrodynamic dispersion and sorption, if Task 3 indicates that these tests are needed.

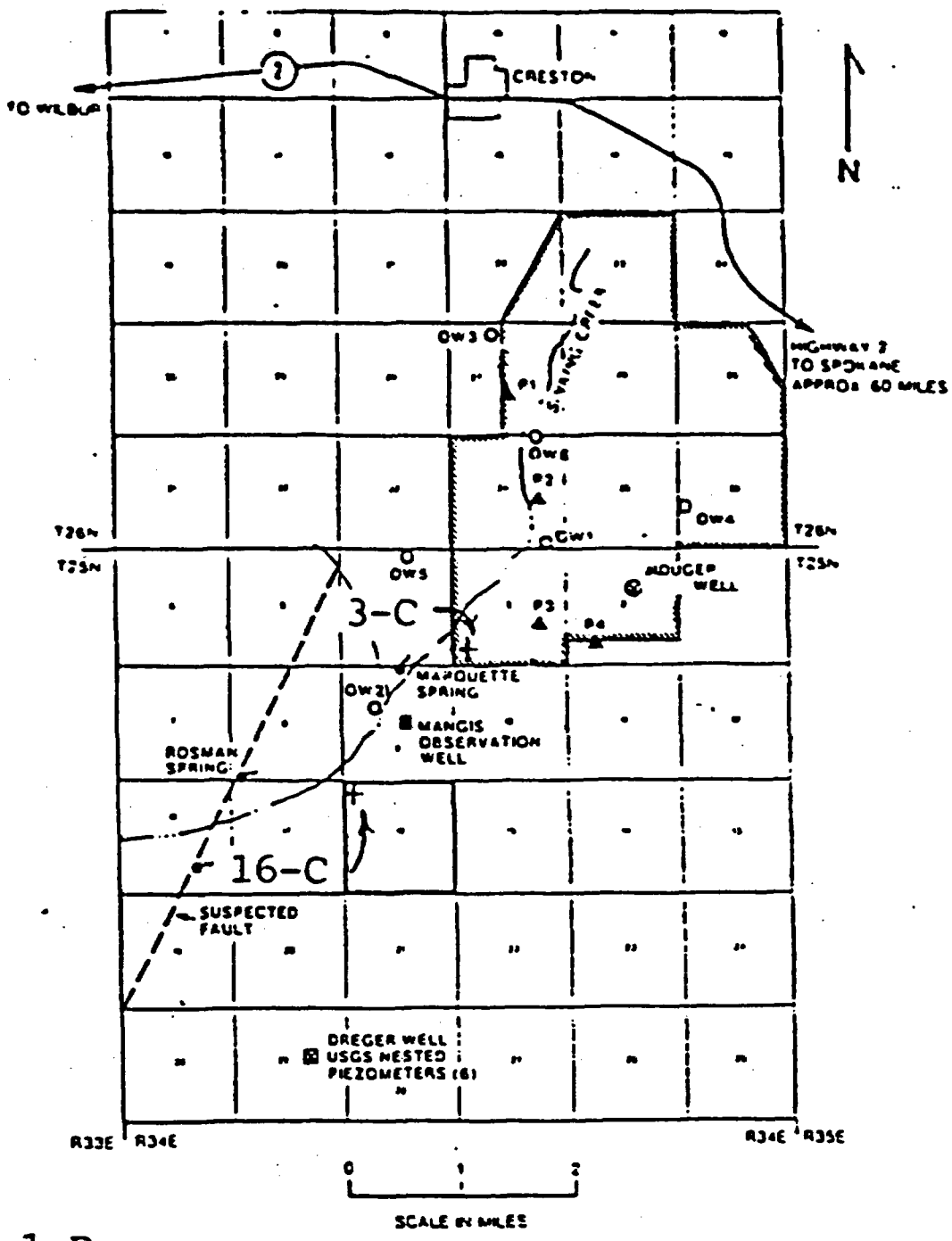
7. Investigate, experimentally and theoretically, ways to calibrate models based on ground water dating and hydraulic parameter estimation using environmental tracers.

In-Situ Inc.



Map Showing General Location of the Creston Study Area, Washington

Project No. 1057	Fig. 1



1 B

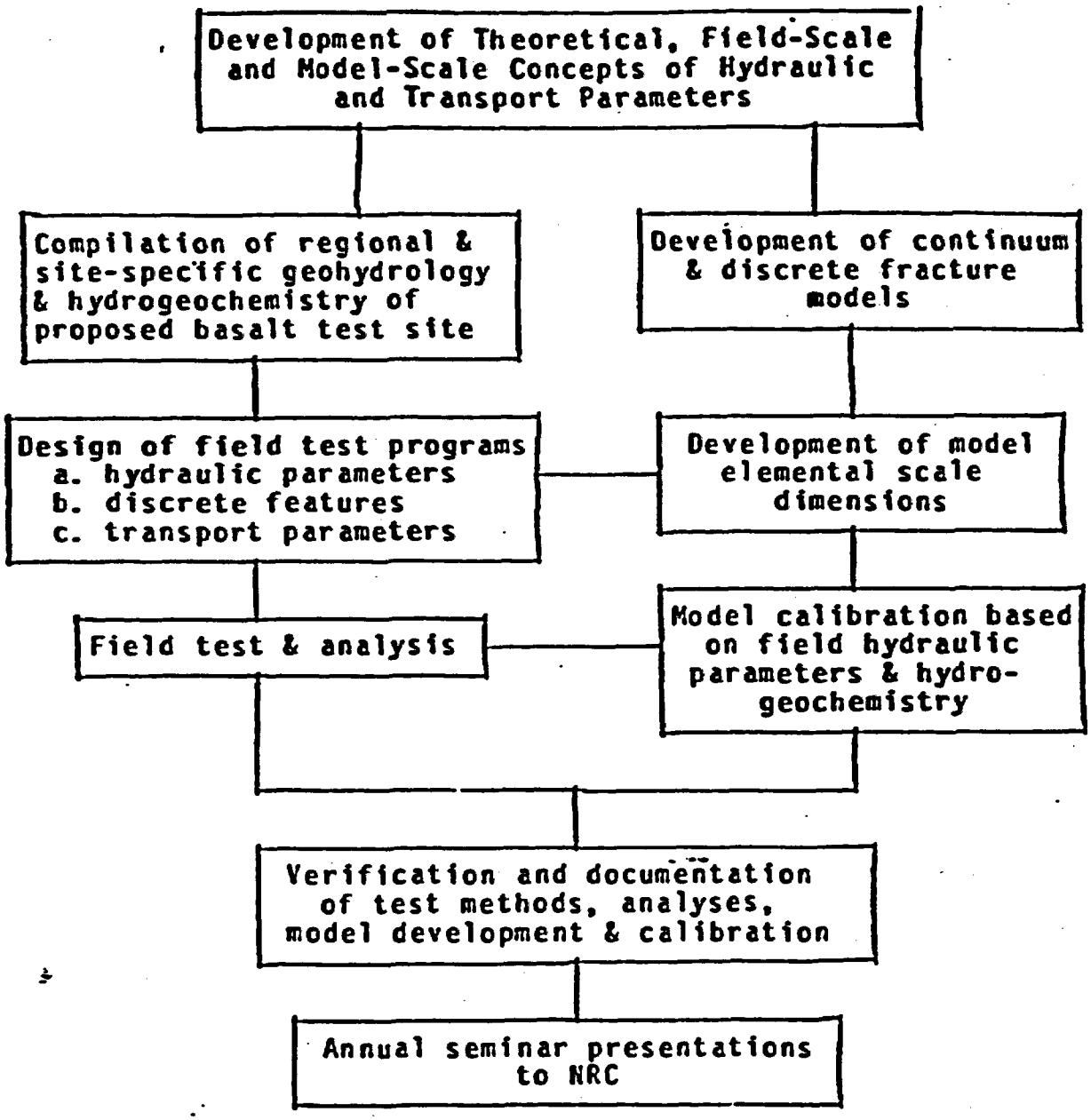
STUDY AREA WELLS

OW: OBSERVATION WELL

P: PUMPING WELL

⊗: IRRIGATION WELL

+: CORED WELLS, 16-C, 3-C


Development of Theoretical, Field-Scale and Model-Scale Concepts of Hydraulic and Transport Parameters
Compilation of regional & site-specific geohydrology & hydrogeochemistry of proposed basalt test site
Development of continuum & discrete fracture models
Design of field test programs
a. hydraulic parameters
b. discrete features
c. transport parameters
Development of model elemental scale dimensions
Field test & analysis
Model calibration based on field hydraulic parameters & hydro-geochemistry
Verification and documentation of test methods, analyses, model development & calibration
Annual seminar presentations to NRC

B

PROGRAM WORK SUMMARY AND FIELD-SITE TRIP

NRC & Subcontractor Field Visit -- Creston Study Area, Washington
December 1, 1986

NRC Contract No. NRC-04-85-114, Flow of Groundwater and Transport of Contaminants through Saturated Fractured Geologic Media from High-Level Radioactive Waste (In-Situ Project No. 1057)

Meeting 0800 hours, Gateway Hotel, Spokane, Washington

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1. Following introductions of attendees, In-Situ, Inc. will present a 35-mm slide program on the following aspects of the Creston Study Area: location, land use, site setting, basalt stratigraphy and selected well data; the second half of the presentation will highlight vertical and angle core drilling results, geophysical logging, acquisition of hydrologic data, and plans for the 1987 field season.

2. Materials available for examination include: Creston Study Area map, representative samples of drill core, color photographs of cored wells 16-C and 3-C, and selected reference materials.

Field Site Trip: Spokane to Creston, Washington

To meet the schedule of the Hanford site participants, the trip schedule of June 26th (enclosed) will be abbreviated. Today's trip will incorporate several prior stops but also several stops relating to recent field activities. These new stops include:

13. View of basement granite east of Creston.

14. Outcrop inspection of stratigraphy showing PriestRapids / Roza / Vantage / Grande Ronde.

15. Core drilled well 16-C, showing nitrogen-inflated packer, piezometers and hydrologic-data collection.

Additional materials supplied include:

Figure 11. Spokane, Creston, Richland road map

Figure 12. Geologic map of Washington

Figure 13. Geologic story of the Columbia Basin

Figure 14. Geologic cross section, based upon 16-C and 3-C core drilling

Figure 15. Well 16-C packer placement and water-level monitoring

Figure 16. Well 3-C packer placement and water-level monitoring

Item 17. Highlights of planned hydrologic testing, 1987 field season

Figure 18. Pump-performance curves for Model SP 27.

FIELD-SITE TRIP JUNE 26, 1986
Creston, Washington NRC Project 1057

This one-day site visit to Creston, Washington, pertains to topics in the "Geologic Report, Creston Study Area, Lincoln County, Washington," discussed at the Laramie Project Review Meeting on June 25, 1986.

Figure 1 shows the location of the study area, south of Creston, about 60 miles west of Spokane, Washington. US Highway 2 west from Spokane passes near the northern edge of the Columbia River Plateau. The rocks here are mainly basalts covered by unconsolidated sediments (which make very productive cropland) and minor granite, as shown in Figure 2.

The basalts underlying the Creston study area emanated from chemically distinct mantle magmas conveyed through particular sets of crustal fissures (Swanson et al., 1979), shown in Figure 3. This diagram illustrates the widespread distribution of the Grande Ronde Formation and Priest Rapids Member of the Wanapum Formation. These basalts were deposited in a series of voluminous lava flows and constitute the earlier portion of the Columbia River Basalt Group shown in Figures 4 and 5 (after Hooper, 1982). Field Stops 3 and 4 will provide an opportunity to view Grande Ronde features northeast of the study area.

Older basement rocks of granite and quartzite (Stop 5) floor the two basalts of the study area, shown in Figures 6 and 7. The cross section of Figure 7 is oriented across the northern part of the study area.

A series of pumping and observation wells (designated "P" and "OW," respectively, on Figure 6) were installed for the Washington Water Power Company as part of a baseline study at

the proposed Creston coal-fired electric-power site. These wells may be used where applicable in the present study. This research will include detailed observations for the characterization of water and tracer flow in fractured basalts of the Wanapum Formation.

The covering soils and vegetation allow only segmented evaluation of the study-area rock units and their contacts. At Stop 6, two portions of basalt cooling structures near OW-3 may be seen. An entire basalt flow cooling unit is exposed at Sinking Creek and depicted in Figure 8. The outcrop exposure at Stop 7 affords an opportunity to examine details of the basalt cooling texture and accompanying fracture sets. Sinking Creek, immediately to the east, is a narrow channel, commonly flowing during spring runoff. At this date and location, the flow has disappeared beneath pasturelands. Sinking Creek represents a location on the upper piezometric surface coinciding with the "first shallow aquifer" or flow top A.

At Stop 8, approximately two miles south-southeast, an irrigation well yielding a flow in excess of 500 gallons per minute (gpm) is operated by the Hougers. This well taps waters from the "middle zone aquifer" of Wildrick (1982). The Hougers also have a nearby domestic well which taps water in the "upper zone aquifer." The productive zone may be coincident with flow top A. They report no impairing drawdown in the domestic well during heavy pumping of the adjacent irrigation well. These wells are shown in cross section in Figure 9, taken from Plate 3 of Wildrick (1982).

The southern cluster of wells is planned on Section 16, Stop 9. Very little outcrop can be seen here. Diamond-core dril-

ling and geophysical logging will contribute to interpretations and understanding of the subsurface hydrogeology.

At Stop 10, Ted Olson will discuss the Dreger observation well. Figure 10 illustrates the piezometer arrangements; further detail about these piezometers is given in Appendix 1.

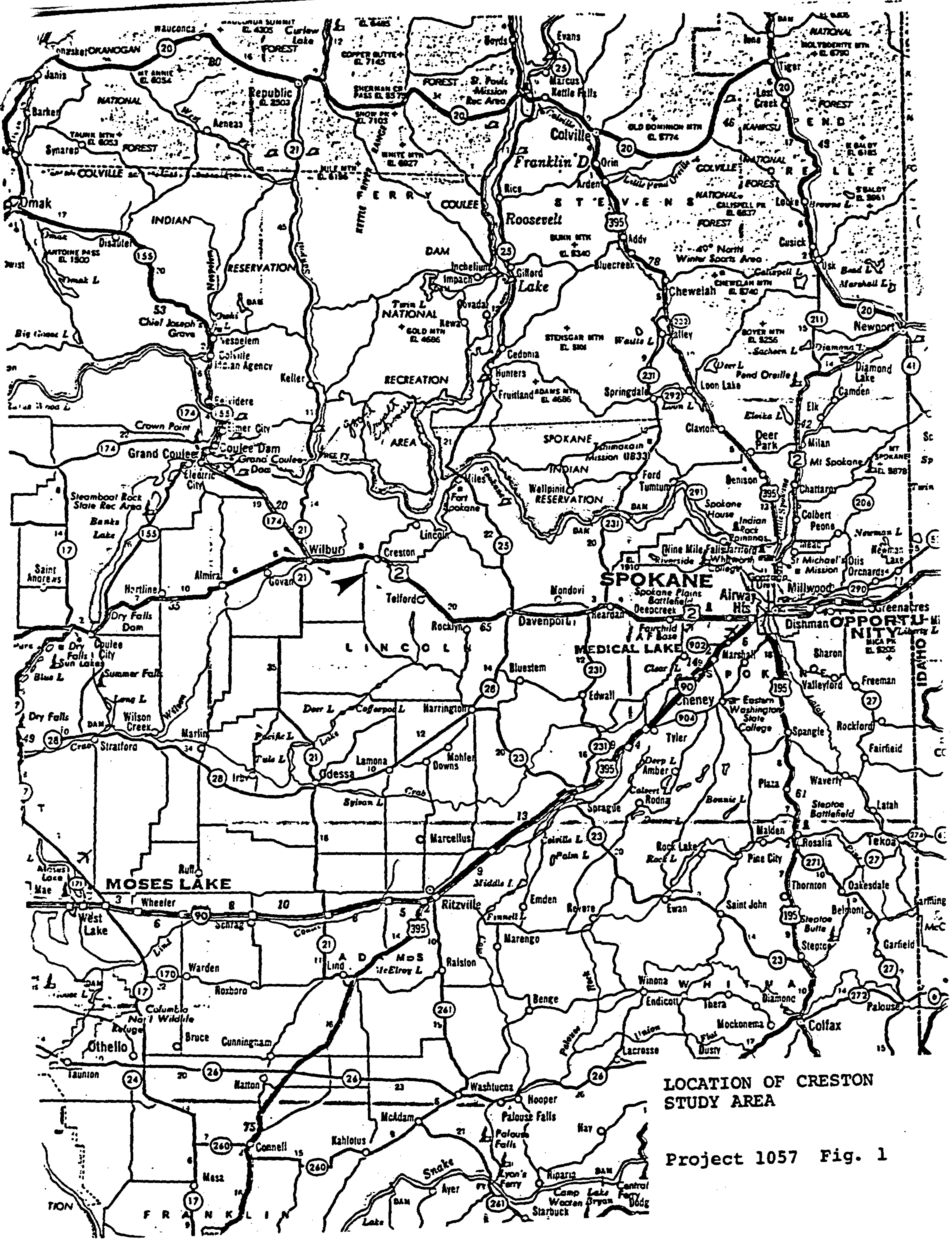
REFERENCES

Hooper, P. R., 1982. The Columbia River basalts. Science, v. 215, pp. 1463-1468.

Olson, T. M., 1984. Dreger observation well near Creston, Washington. Washington State Department of Ecology, Olympia, Office Rept. ER843, December.

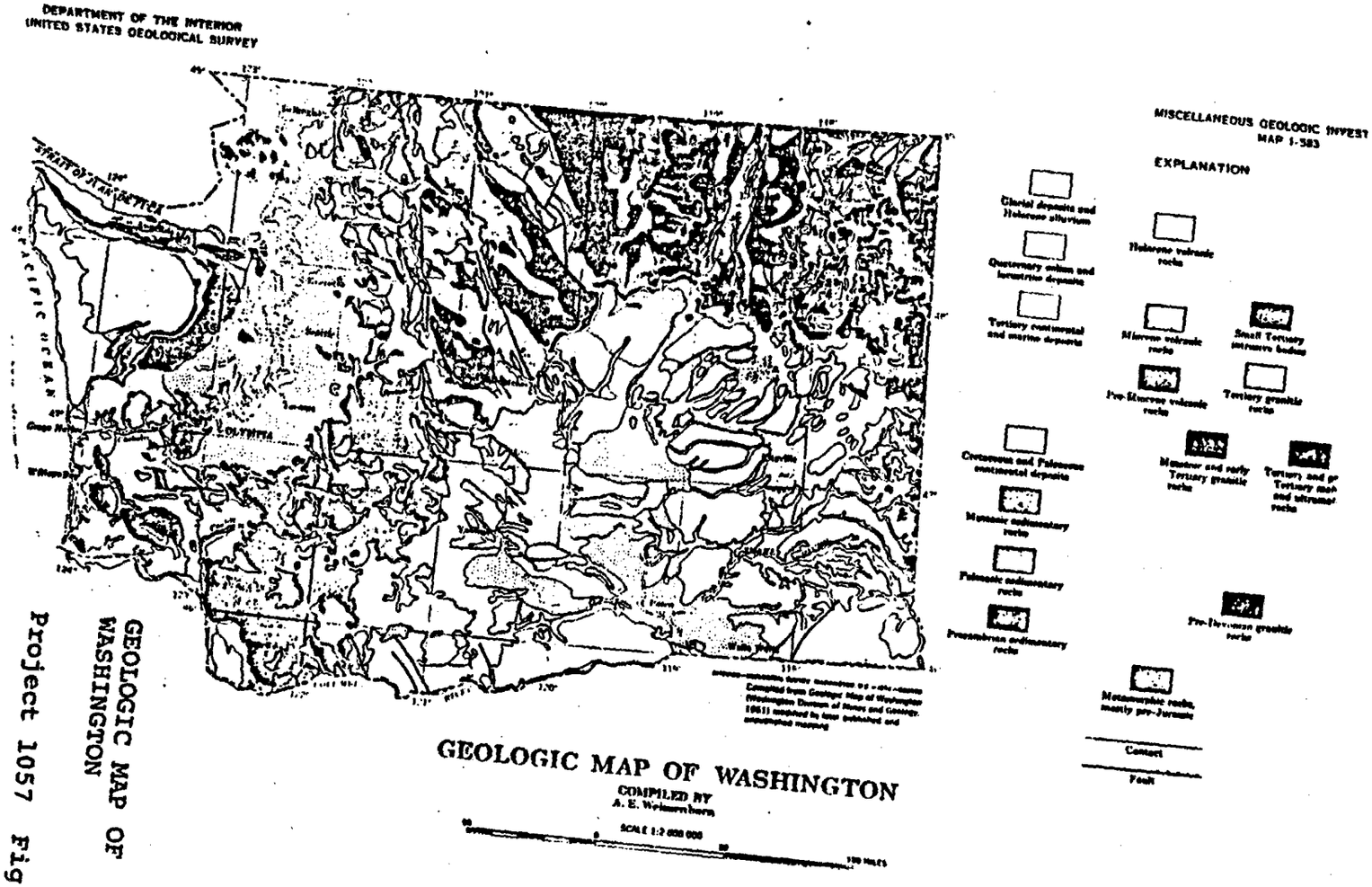
Swanson, D. A., T. L. Wright, P. R. Hooper, and R. D. Bentky, 1979. Revisions in stratigraphic nomenclature of the Columbia River Basalt group. U.S. Geological Survey Bull. 1457-G.

Wildrick, Linton, 1982. Decreasing stream flow and possible ground water depletion in the Sinking Creek watershed, Lincoln County, Washington. Washington State Department of Ecology, Olympia, December.



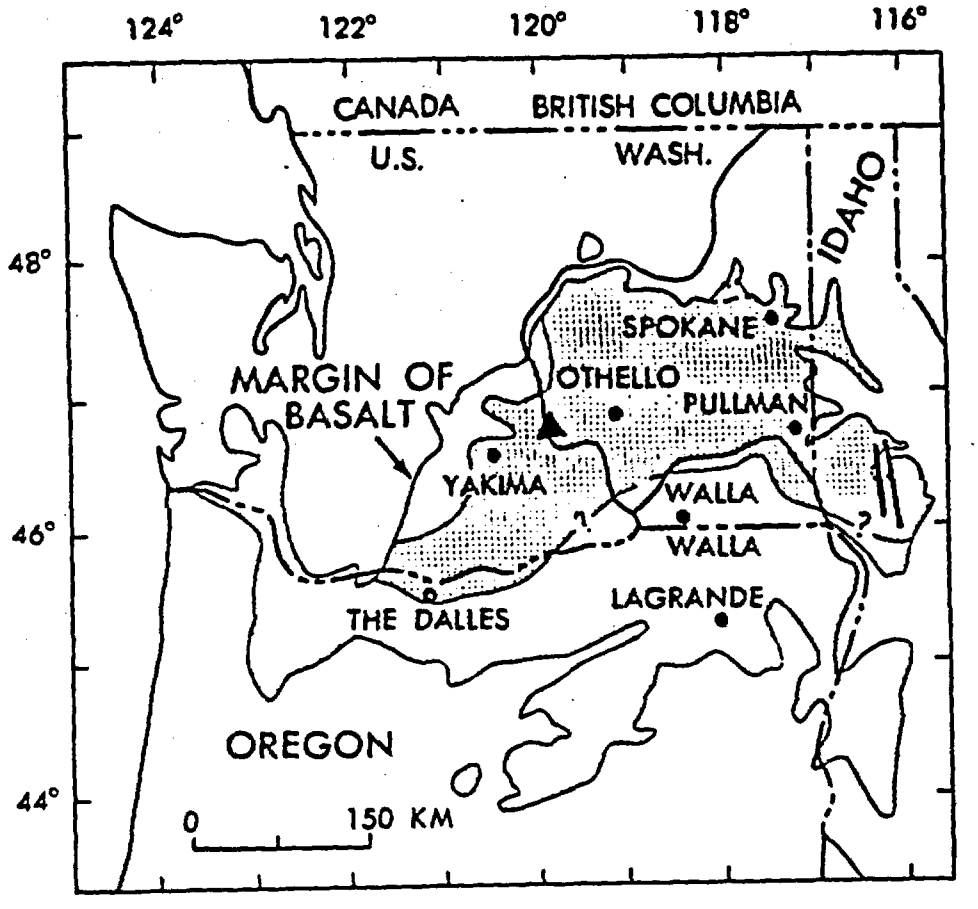
LOCATION OF CRESTON STUDY AREA

Project 1057 Fig. 1

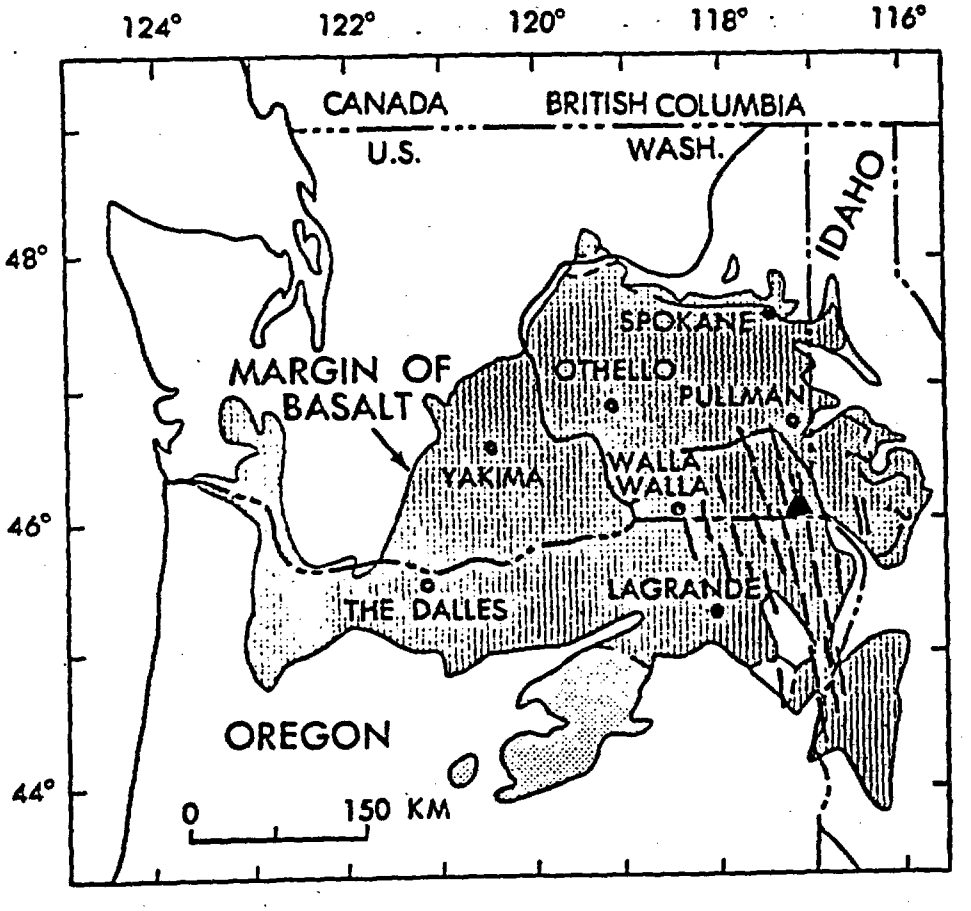


GEOLOGIC MAP OF WASHINGTON

Project 1057 Fig. 2



G PRIEST RAPIDS MEMBER



C GRANDE RONDE BASALT

Wanapum Basalt

and Grande Ronde Basal

▲ Type locality

Known and inferred feeder dikes
Shown schematically

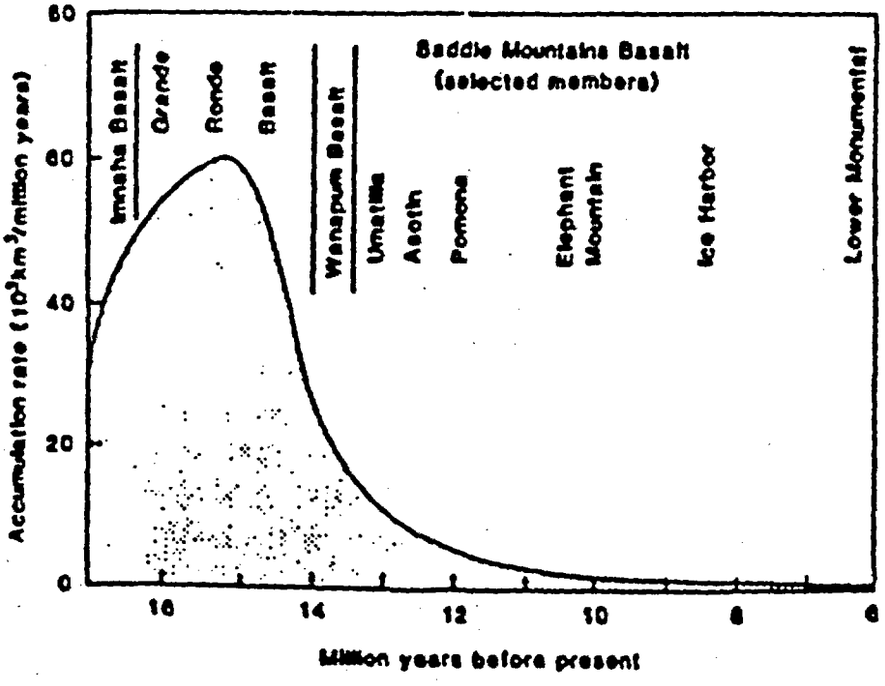
DISTRIBUTION OF WANAPUM AND GRANDE RONDE BASALTS

Project 1057 Fig. 3

		Formation	Member	Magnetic Polarity	K / Ar Dates
Columbia River Basalt Group	Yakima Basalt Subgroup	Saddle Mountains Basalt	Lower Monumental	N	6 my
			Ice Harbor	N, R	8 my
			Buford	R	
			Elephant Mountain	N, T	
			Pomona	R	12 my
			Esquatzel	N	
			Weissenfels Ridge	N	
			Asotin	N	
			Wilbur Creek	N	
			Umatilla	N	13.5 my
		Wanapum Basalt	Priest Rapids	R_3	
			Roza	T, R_3	
			Frenchman Springs	N_2	
			Eckler Mountain	N_2	14.5 my
		Grande Ronde Basalt		N_2	
		Picture Gorge Basalt R_2		R_2	
		Picture Gorge Basalt N_1		N_1	
				R_1	16.5 my
		Imnaha Basalt	T	N_0	
			R_0 ?		17.0 my

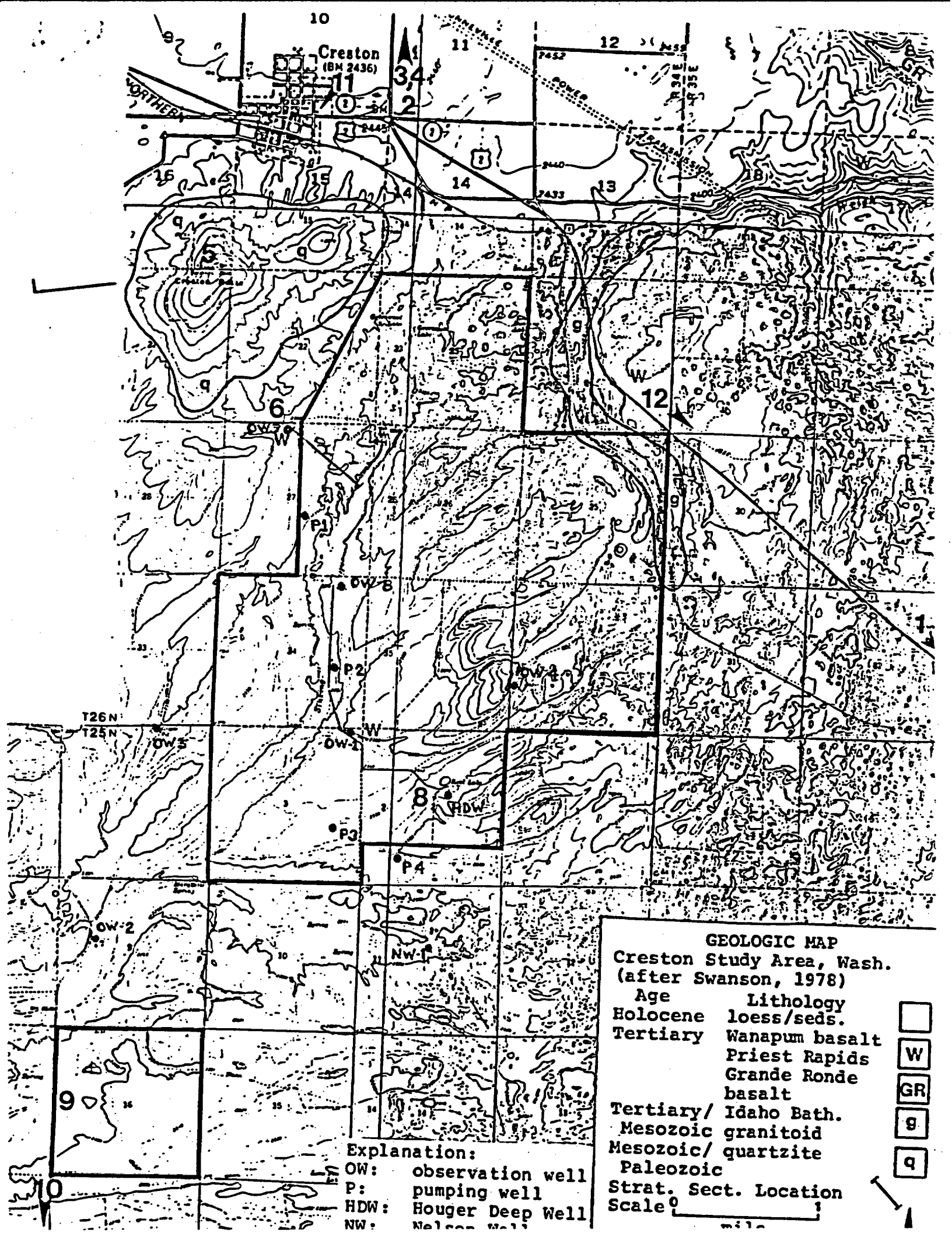
STRATIGRAPHY OF THE COLUMBIA RIVER BASALT GROUP

Project 1057 Fig. 4



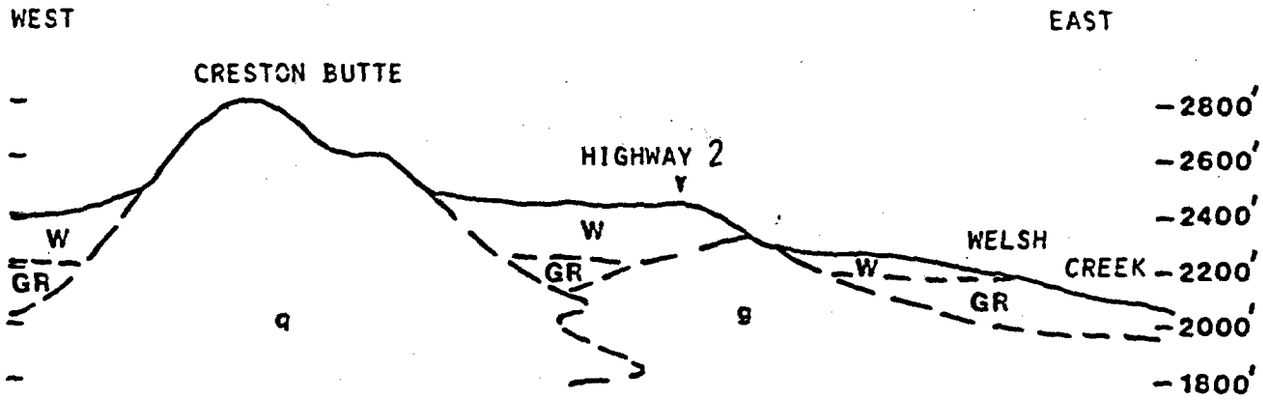
VOLUME OF ERUPTIONS OVER
TIME ON THE COLUMBIA
RIVER PLATEAU

Project 1057 Fig. 5


Creston
(BM 2436)
NORTHERN
T26N
T25N
OW-1
OW-2
OW-3
OW-4
OW-5
OW-6
P1
P2
P3
P4
HDW
NW-1
GEOLOGIC MAP
Creston Study Area, Wash.
(after Swanson, 1978)
Age
Lithology
Holocene
loess/seds.
Tertiary
Wanapum basalt
Priest Rapids
Grande Ronde
basalt
Tertiary/
Mesozoic
Idaho Bath.
granitoid
Mesozoic/
Paleozoic
quartzite
W
GR
g
q
Strat. Sect. Location
Scale
Explanation:
OW: observation well
P: pumping well
HDW: Houger Deep Well
NW: Nelson Well

In-Situ Inc.

GEOLOGIC CROSS SECTION



EXPLANATION

VERTICAL EXAGGERATION x7

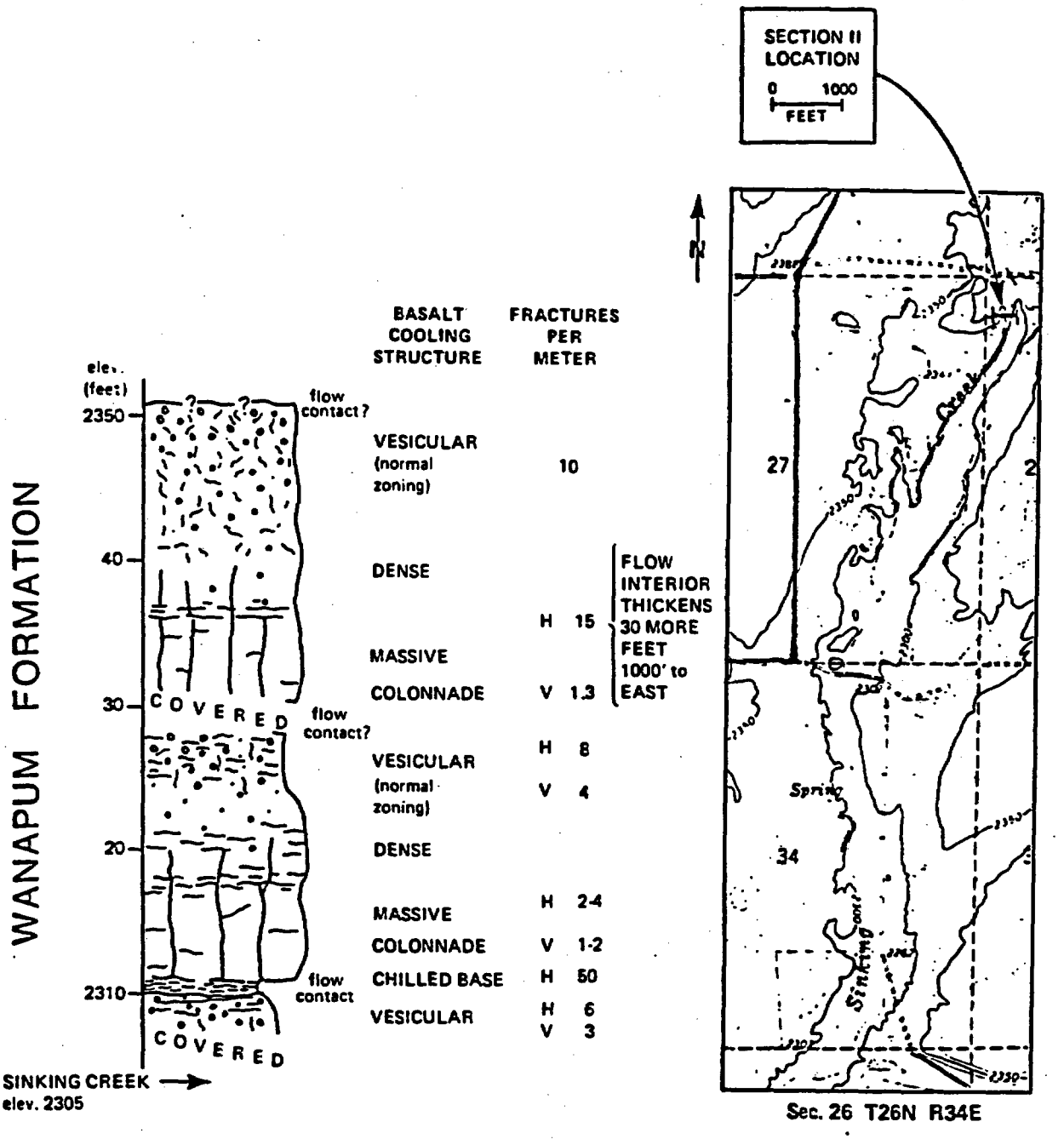
ONE MILE

AGE	LITHOLOGY	
TERTIARY	WANAPUM BASALT (PRIEST RAPIDS MEMBER)	W
	GRANDE RONDE BASALT	GR
TERTIARY/ MESOZOIC	IDAHO BATHOLITH GRANITOID	g
MESOZOIC/ PALEOZOIC	UNNAMED QUARTZITE	q

Creston Butte-Welsh Creek Geologic Cross Section (LOCATION SHOWN IN FIGURE 6)

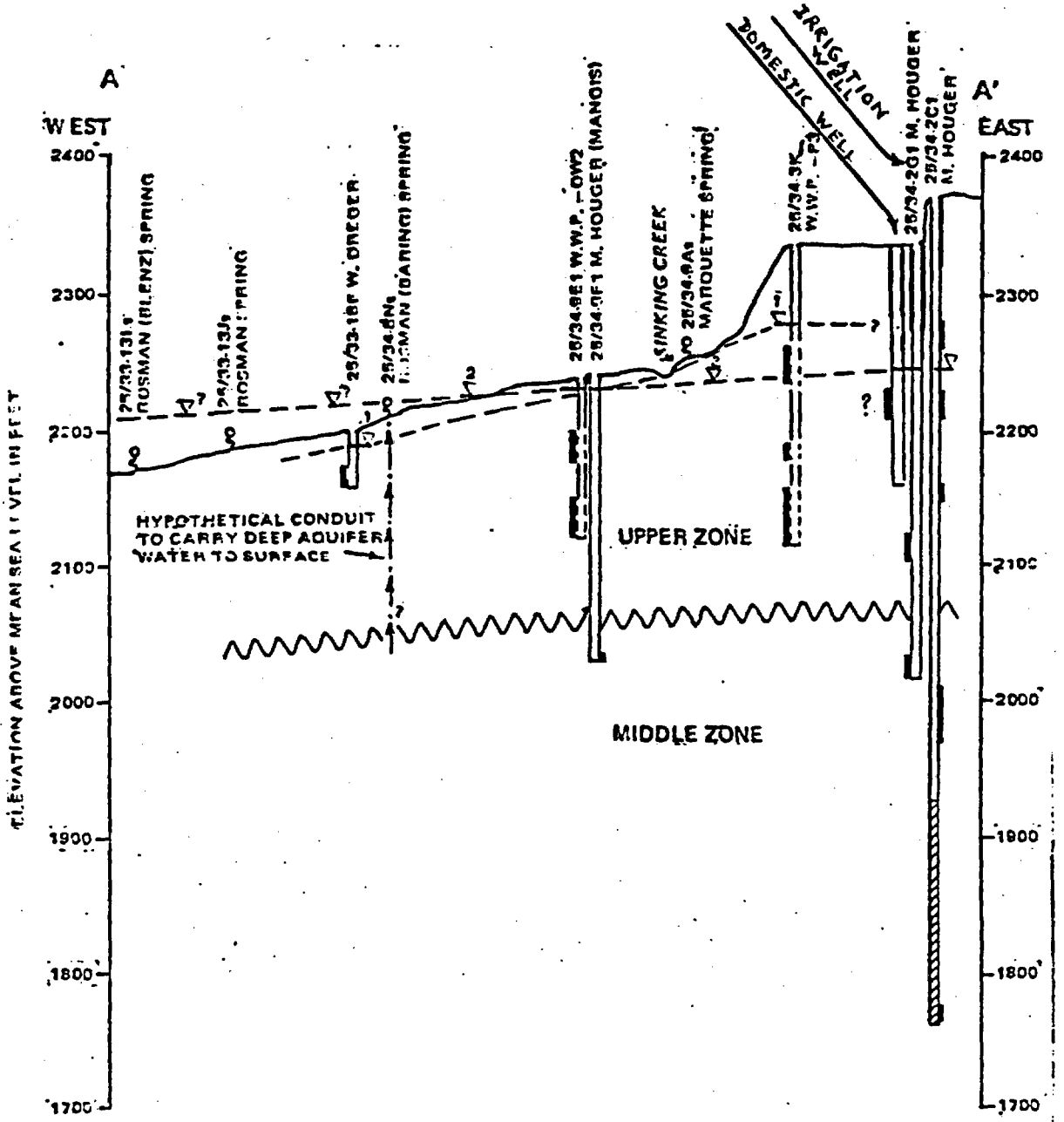
Project 1057 | Figure 7

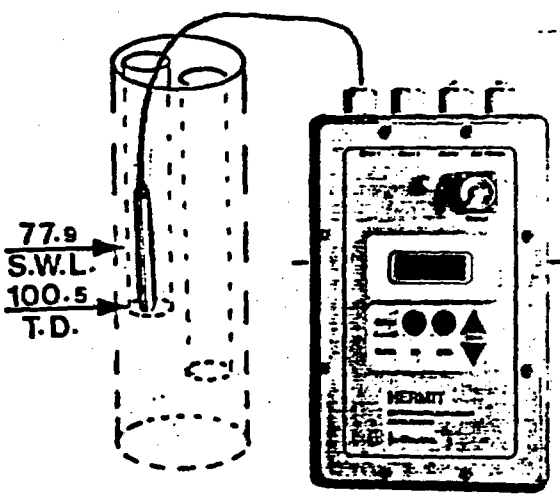
In-Situ Inc.



Stratigraphic Section II, Section 26, T26N, R34E, near Creston Washington

Project 1057	Figure 8





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Seven day level test

The HERMIT is a versatile, two-channel, programmable data logger built to measure, record, and electronically transfer data to data processing equipment. It is designed to measure and store water level data for both surface and ground water applications under extreme environmental conditions.

SELECTED WELLS, SOUTHERN PART OF THE CRESTON STUDY AREA

Project 1057 Fig. 9

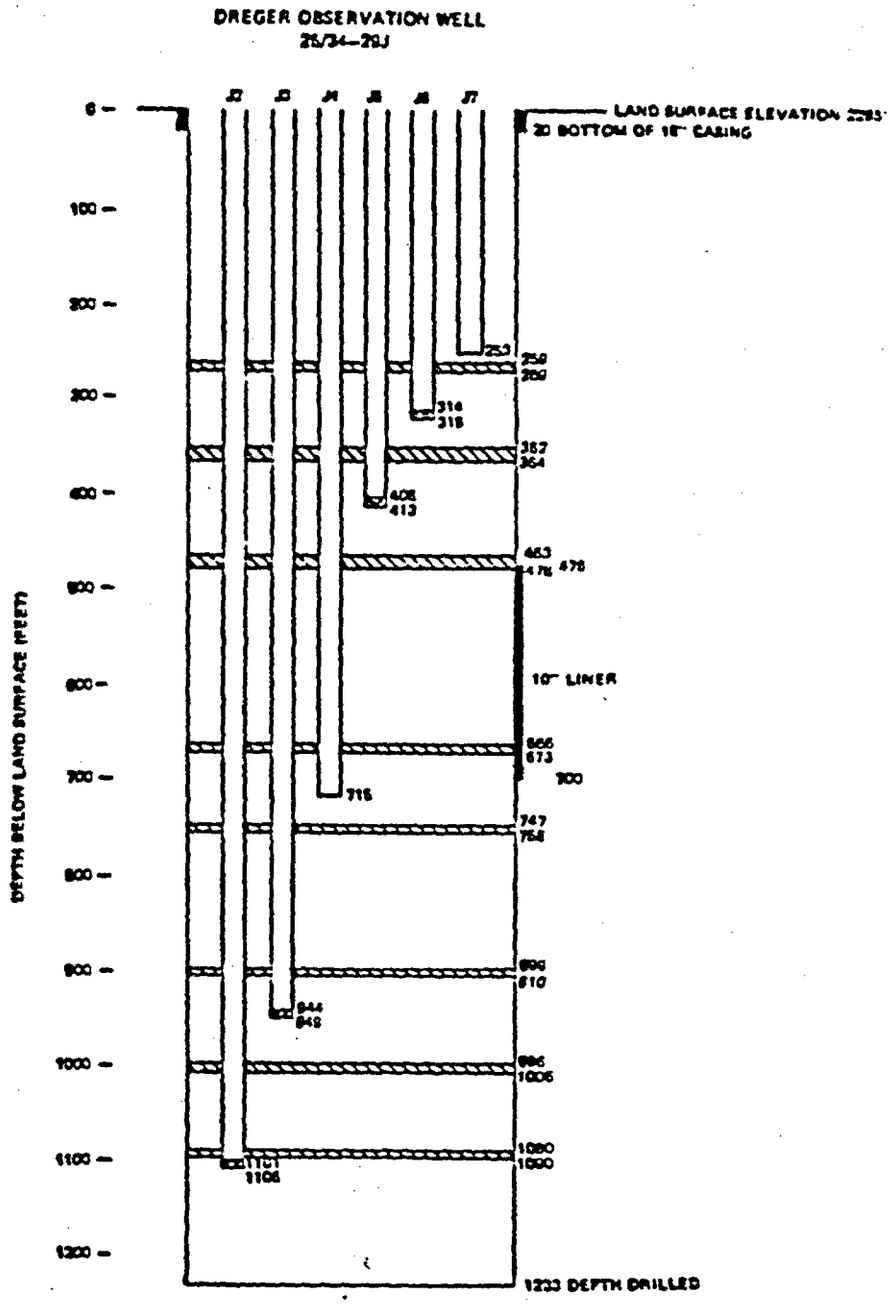


DIAGRAM OF PIEZOMETER INSTALLATION.

DREGER OBSERVATION WELL
PIEZOMETER INSTALLATION

Project 1057 Fig. 10

APPENDIX 1

Piezometers

Piezometers are installed to determine zones of differing head in the multiple aquifers. (A piezometer is a pipe that extends from land surface to a predetermined depth in the well. The lower end of the pipe is open to a water-bearing zone within the borehole and is isolated from water-bearing zones above and below by sealing material.)

Each piezometer allows monitoring of the potentiometric head in the isolated zone. Without piezometers and plugs, the water level in a well represent a composite hydraulic head of all the water-bearing zones open to the well. (Figure 6 shows the installation of the piezometers in the Dreger well.)

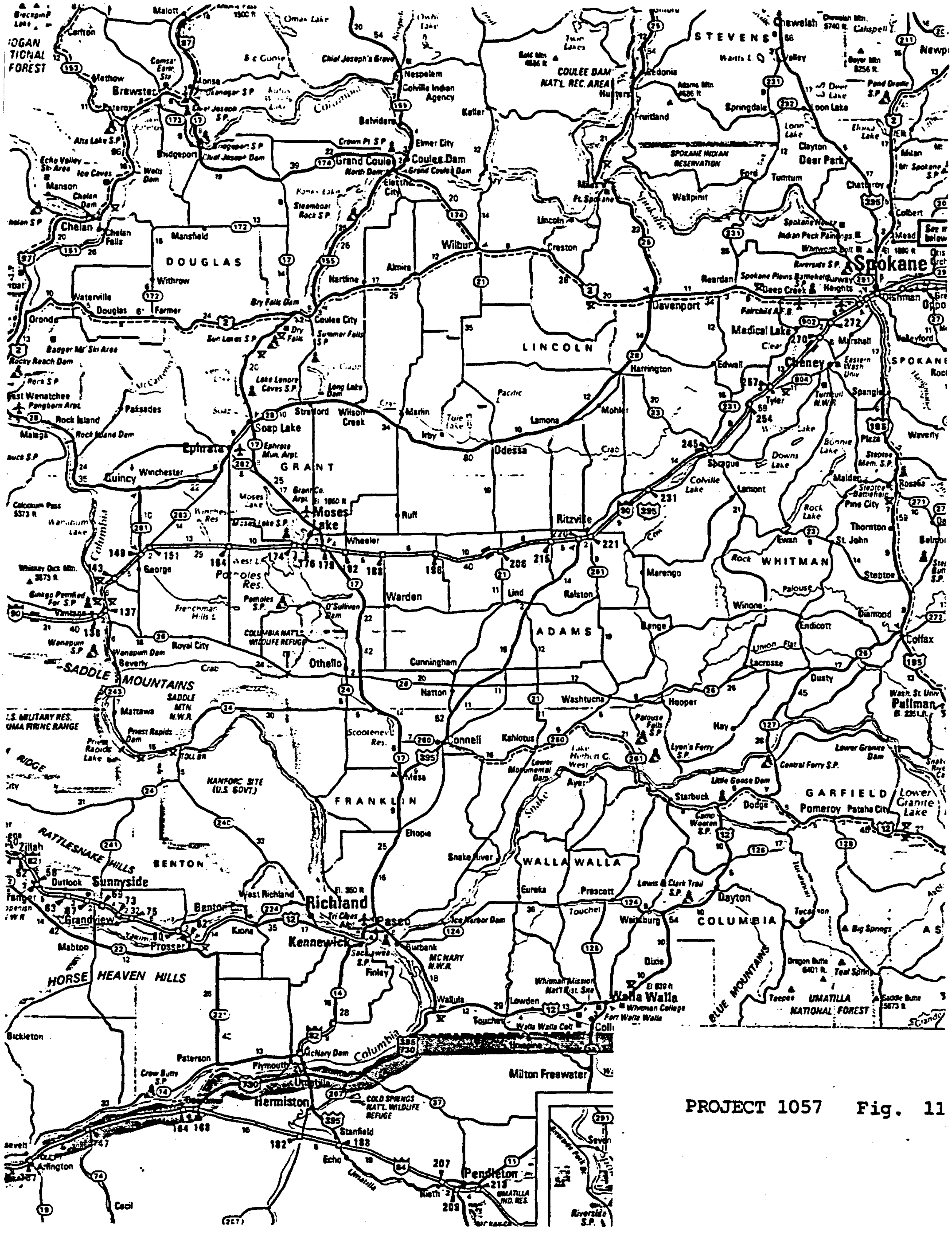
The piezometers were installed between September 23 and 29, 1983 by Marlatt Drilling Company of Milton-Freewater, Oregon, under supervision of USGS. The measured depth of the well was 1,233 feet (as compared to a reported total drilled depth of 1,225 feet on the water well report).

Six piezometer pipes were installed using 1¼-inch galvanized pipe with a 5-foot stainless steel, wire-wound screen at the bottom of the pipe. Slot size of all screens is 0.060 inch.

Details of the piezometer installation:

Piezometer	Interval Monitored	Plug Depth
J2	1,090 - 1,233	1,080 - 1,090 996 - 1,006
J3	910 - 996	899 - 910 747 - 758
J4*	673 - 747	666 - 673 463 - 478
J5	364 - 463	352 - 364
J6	269 - 352	253 - 259
J7	0 - 253	

* The 5-foot stainless steel screen broke off at 476 feet as the piezometer was being lowered through the 10-inch liner.



PROJECT 1057 Fig. 11

GCP-417
(10/83)-140

THE GEOLOGIC STORY OF THE COLUMBIA BASIN

The rock formations of the Columbia Basin were formed by some of the most unusual and catastrophic processes in geologic history.

During the early stages of the Columbia Basin formation, granite rock was slowly created by heat and pressure deep in the crust of the earth. Then the crust was uplifted, exposing the granite, creating mountains similar to the Okanogan Highlands north of Grand Coulee Dam.

Forty to sixty million years ago the formation of the outline of the Columbia Basin was complete. The land had subsided below sea level, and a large inland sea had formed.

The land was again uplifted and then, 10-15 million years ago, was flooded with volcanic lava. The boundaries of the "flood lava" were located in almost the same position as the former seashore. Many layers of lava were needed to build up to a 5,000-feet (1500 meter) thickness and form the smooth surfaced Columbia Plateau.

The Ice Age (or Pleistocene epoch) began at the end of the Pliocene epoch, 2 million years ago. Glaciers 5-10,000 feet (1500-3000 meters) thick in northern Washington pushed down the Okanogan Valley and crossed the Columbia River near the present site of Chief Joseph Dam. Ice filled the Columbia Valley and pushed onto the Waterville Plateau as far south as Coulee City. Water, backed up by the ice dam, spilled over the Columbia Plateau into the Columbia Basin.

During this time, the Grand Coulee began its process of formation since the original river channel had been lost by burial in ice. The length of time that it took to form the Grand Coulee has been the subject of much controversy. Some geologists think that it was formed by a succession of large floods, others believe that it was formed by a gradual process of erosion as the Columbia River sought to form a new river channel.

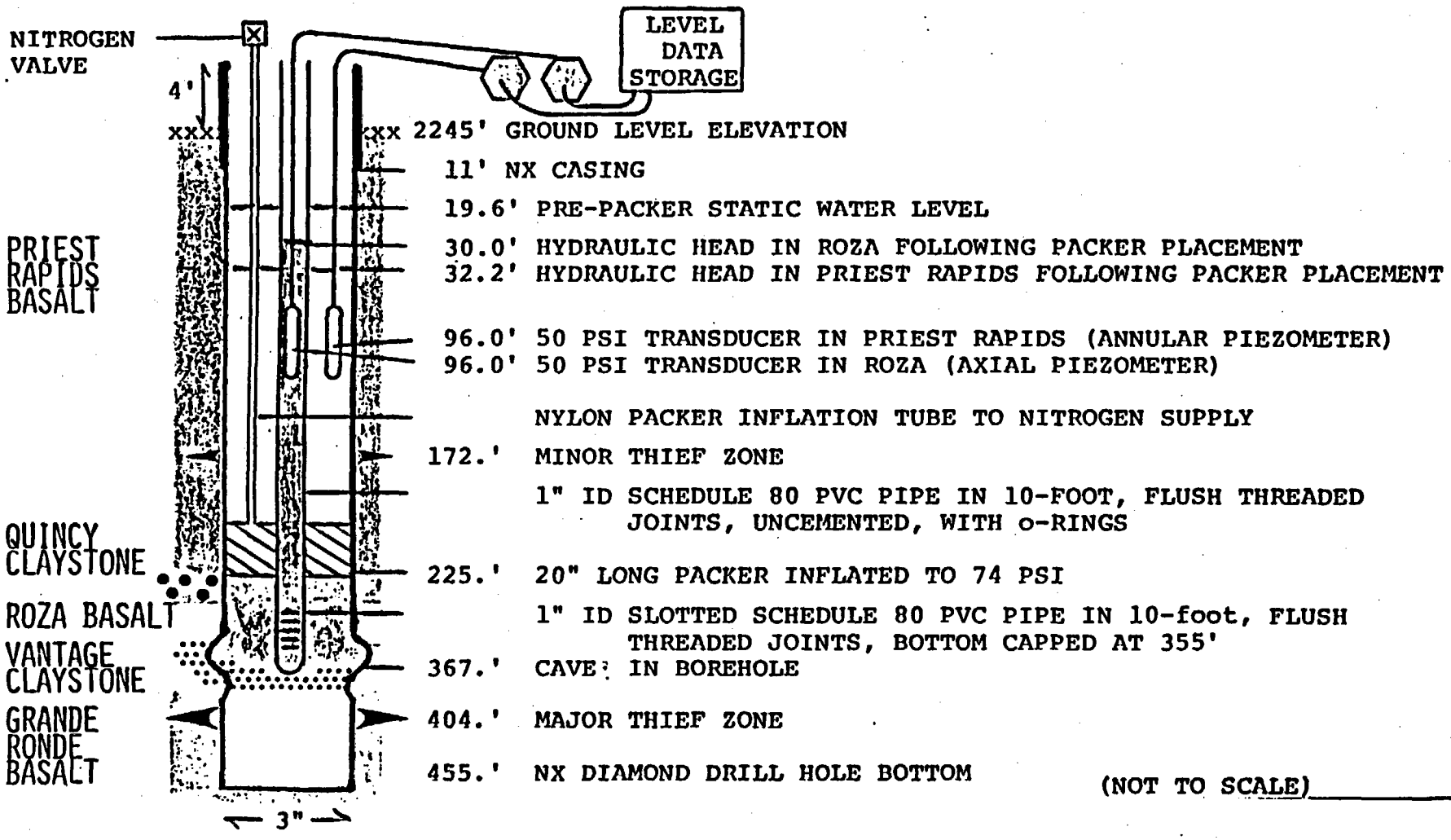
During the Ice Age, the old Cascade Mountains were also formed. Their outline still remains on the western slopes of the Cascades. The uplifting mountains were not able to completely block the flow of the Columbia River, and a deep Columbia River gorge was formed.

Near the end of the Ice Age the volcanoes of the high Cascades rose to elevations of 14,000-15,000 feet (4000-4500 meters). Older volcanoes, such as Mt. Hood and Mt. Rainier, were sculptured by glaciers of the Ice Age; others such as Mt. St. Helens remained unsculptured, retaining their original volcanic form.

Eighteen thousand years ago the Columbia Basin was nearly covered by floodwaters when an ice dam at Lake Missoula in western Montana broke. Large boulders were strewn near the outlet of the Lower Coulee (Lake Lenore). Other boulders were carried in icebergs as far as western Oregon. The floodwaters were 800 feet (250 meters) deep near Pasco and 400 feet (125 meters) deep at Portland.

After the Ice Age, the Columbia River returned to its former channel. The channeled scablands and large coulees that had been formed were left stranded 500-1600 feet (150-500 meters) above the present river floor and serve as a constant reminder of some of the most unusual episodes in geologic history.

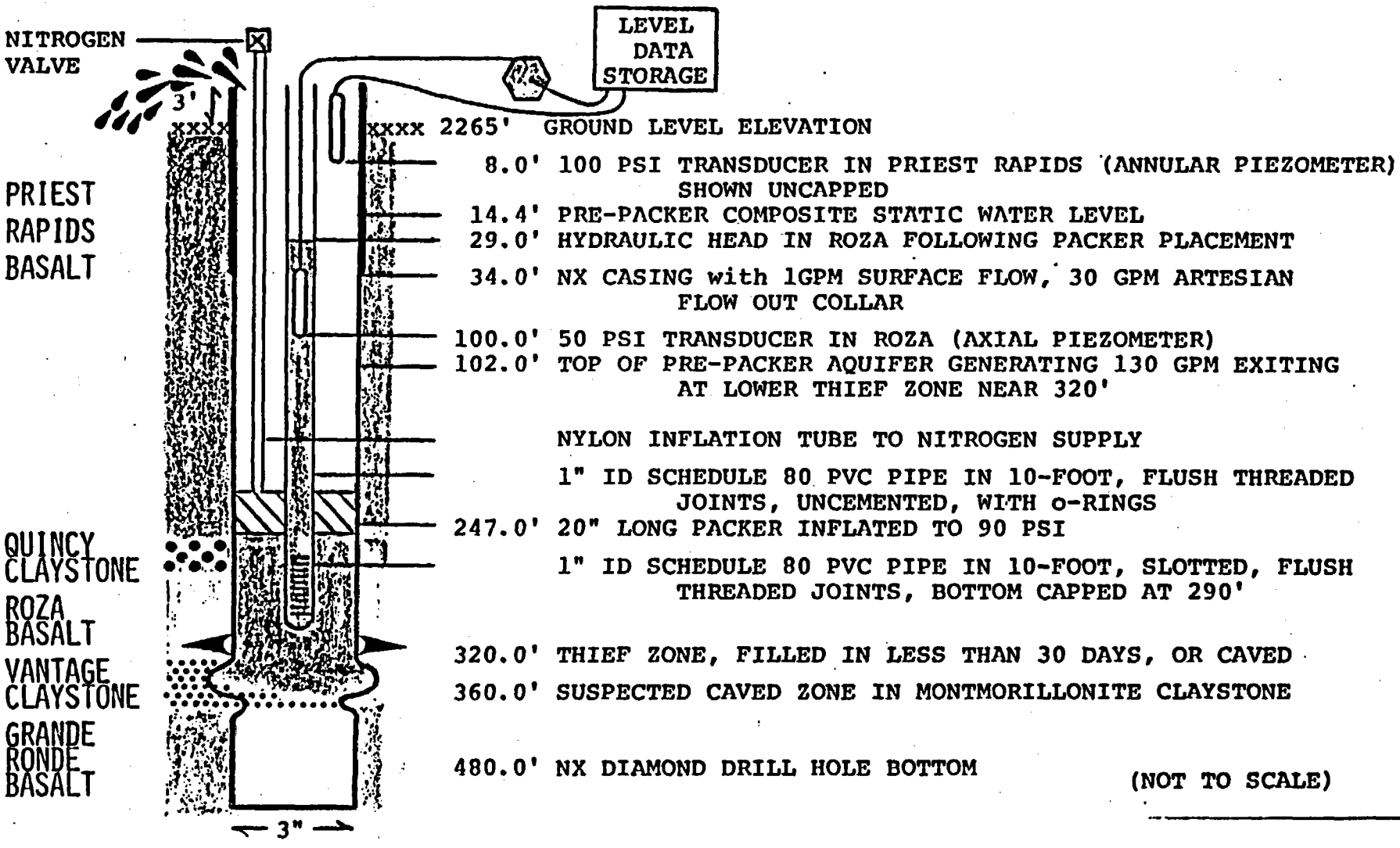
WELL 16-C PACKER PLACEMENT AND WATER LEVEL MONITORING, CRESTON, WASHINGTON



(NOT TO SCALE)

PROJECT 1057 Fig. 15

WELL 3-C PACKER PLACEMENT AND WATER LEVEL MONITORING, CRESTON, WASHINGTON



(NOT TO SCALE)

PROJECT 1057 Fig. 16

Project No. 1057 NRC Basalt Aquifer Study

Wellfield Design Criteria

I. Tracer-Test Design Criteria

A. Dilution factor (by natural ground-water flow)

B. Instrument-detection limit

C. Ground-water velocity - effective porosity
hydraulic gradient
hydraulic conductivity

II. Pump-Test Design Criteria

A. Pumping rate - available drawdown
hydraulic conductivity
storage coefficient

B. Selection of pump - minimum well size

C. Drawdown versus distance (instrument detection limit)

III. Purposes of Testing

A. Directional properties of the formation (wells at different directions)

B. Scaling effect (wells at different distances)

IV. Barametric Efficiency - gives indication of storage coefficient

A. Barometric pressure change

B. Static water-level change

V. Slug Tests - hydraulic-conductivity profiles

VI. Linear-Flow Testing versus Radial-Flow Testing

A. Linear-flow testing - tracer test (let natural flow carry the tracer)

B. Radial-flow testing - tracer test (under conditions of induced ground-water flow)

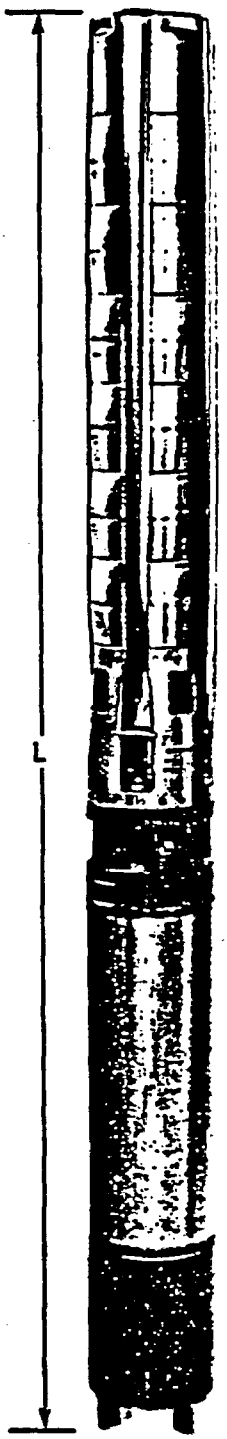
- pump test (to get directional properties)

TDS/for SCW
11/28/86

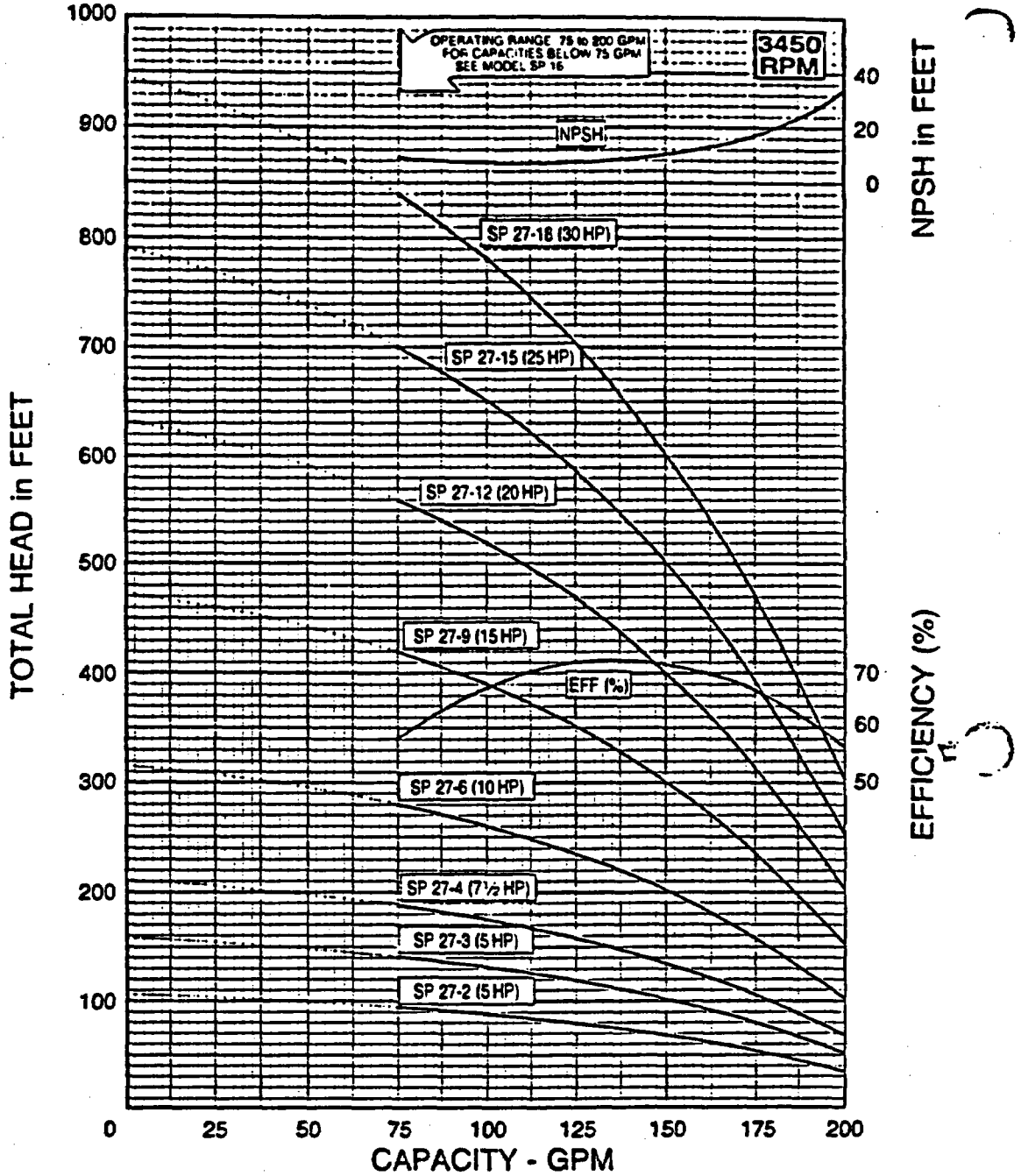
MODEL

SP 27

NOM. FLOW RATE
135 GPM
FLOW RANGE
75 to 200 GPM
PUMP OUTLET
3" NPT



Performance Curves



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	MIN. WELL SIZE	LENGTH (L)	APPROX. UNIT SHIPPING WT. (LBS.)
SP 27-2	5Φ	6"	42½"	84
SP 27-3	5Φ	6"	47"	88
SP 27-4	7½	6"	51½"	146
SP 27-6	10	6"	59⅞"	167
SP 27-9	15	6"	73"	186
SP 27-12	20	6"	86¼"	225
SP 27-15	25	6"	99¼"	243
SP 27-18	30	6"	112⅜"	268

Φ 4 Inch Motor

Specifications are subject to change without notic

PROJECT 1057 Fig. 18

C

NRC Meeting
Participants

12/1/86 Spokane, WA

Tim D Stark	In Situ Inc	Laramie, Co
JACK WITTMAN	YAKIMA INDIAN NATION	Toppenish,
VIETCHAU NGUYEN	ENA / YIN	Minneapolis, MN
Teek Verma	NRC	Silver Spring MD.
ADRIAN BROWN	NUCLEAR WASTE CONS	LITTLETON CO
James R Kunkel	IN-SITU, INC.	LAKEWOOD, CO
MICHAEL WEBER	NRC	SILVER SPRING, MD
Jim A. Paschis	In Situ Inc	Laramie WY
Donald L. Chery	NRC RES	Wash. D.C.
Gerry Winter	Williams & Assoc	Viola, Id
Fred Marinelli	Terra Therma	Littleton, CO
PAUL DAVIS	SANDIA LABS	Albuquerque, N.
Mike Thompson	US Dept. Energy	Richland, Wa.
Randolph Stone	Rockwell/BWIP	Richland, W.
LED OLSON	WASHINGTON DEPT. OF ECOLOGY	SPO.
HAROLD LEFEVRE	US NRC	WASH, D.C.
MICHAEL GALLOWAY	TERRA THERMA	DENVER, CO
Neil Coleman	NRC	Wash DC

D

(Draft)

CONCLUSIONS OF NRC BWIP HYDROLOGY REVIEW TEAM MEETING
NOVEMBER 6-7, 1986

° STP 1.1 still provides a viable strategy for hydrologic testing at BWIP, although it should be amended to provide for characterization of effective porosity. The strategy is compatible with both deterministic and pseudo-stochastic (deterministic-stochastic) approaches to predict groundwater travel time because it provides for the collection of defensible data at a variety of scales.

° Piezometric baseline may be established with respect to (1) pre-testing piezometric trends, (2) conceptual model development, and (3) predicting groundwater travel time and other performance measures.

° There is a consensus that adequate LHS testing needs to be conducted at Hanford prior to installation of the Exploratory Shaft. This consensus is based on observed complications that have occurred at WIPP and on professional judgement about the hydrogeologic system at BWIP.

° Unresolved questions associated with the hydrologic testing strategy in STP 1.1 include:

- At what scale(s) should effective porosity be characterized at Hanford to support compliance demonstrations against 10 CFR Part 60?

- How should DOE determine (and NRC review) the adequacy of hydraulic testing relative to site performance? STP 1.1 provides the logic, but how should this be implemented?

- What types of hydrologic information will be needed for licensing the Hanford site but are not provided for in STP 1.1?

- Does the strategy in STP 1.1 address all the uncertainties associated with hydrologic testing that were discussed at the uncertainty workshop on November 4-5?

- Is the testing strategy presented in STP 1.1 the <u>only</u> strategy that would be acceptable to the NRC? What are <u>likely</u> alternative strategies?

NOTES ON QA CHECKLIST FOR BWIP HYDROLOGY DATA REVIEW

Before we can judge the adequacy of the QA measures applied to these data, we need to know how they are to be used. If they will become part of the license application, they will need to meet Subpart G of Part 60 by meeting all of the specific requirements there, or undergo a qualification process as outlined in our GTP of qualification of existing data. It is highly unlikely that the QA for these data will meet all of the specific provisions of Subpart G (or the QA Review Plan) at this time. The BWIP QA program is not qualified now and it is not likely that the data collected under it in the last two years will meet all of the specifics in Subpart G. If DOE asserts that the program has met Subpart G, we will have to independently verify that assertion or prove to them that it does not. Some specific QA areas to look at which are likely to be troublesome for them are the following:

1. Is there a history of audits by technical and QA staff for verifying the quality of work?

2. Have inspections/surveillances been performed during the conduct of tests to verify that procedures were followed?

3. How were deviations from procedures documented and controlled?

4. Is there evidence of a training and indoctrination program for persons preparing test procedures, collecting data, analyzing data, etc.?

5. Has there been involvement by an independent QA organization in auditing, inspection, sign-off on procedures, etc.?

6. Have periodic management assessments of the effectiveness of the QA program been made?

7. Has the QA program been conducted under a Plan/manual which meets the guidance in the QA Review Plan?

If these data are expected to be used in licensing, it may be possible to do so through one or several of the processes outlined in our GTP on qualification of existing data. In this case, the documentation of what was done, and assessing its technical adequacy, are the most important things to look for and the questions now in the DWM data review procedure are pretty good, along with the "prompts" prepared by WMGT for this data review. For reference, the questions from the data review procedure are the following:

1.Is the procedure traceable and complete, and is it in written form?

2. Is it a "standard" procedure?

3. If non-standard, how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) purposes.

4. Have there been revisions, and how were the revisions reviewed, documented, approved, and implemented?

5. What instrumentation is used for the test?

6. How were the reliabilities of the instruments established?

7. What are the instrument calibration histories?

8. Are the calibrations traceable to national standards?

It would be useful if our technical staff could make some preliminary judgments about whether there is enough documentation to possibly support use of these data in licensing. We expect DOE to try to qualify data, not just at BWIP but at other sites too, and this is a good opportunity to begin todetermine whether specific data meet the requirements in our GTP on qualifying data.

JEK
11/25/86

Record Number BH86-_____

Page ___ of ___
Reviewer(s) _____
_____
_____
Affiliation _____
Date _____

HYDROLOGY DATA REVIEW CHECKLIST

TOPIC: _____

TYPE OF DATA (circle one):

a. hydraulic head b. hydraulic characteristic c. structural/stratigraphic
d. ext. boundary e. hydrochemistry f. geophysical
G. other _____

TESTING INFORMATION (applicable) (not applicable)

Identifier _____ Depth Interval _____ (ft) (m)

Unit _____ Effective Depth Interval _____ (ft) (m)

Test Type _____ Reference _____

Time _____ Date _____

REFEPENCED PROCEDURE _____

_____

COMMENTS:

Borehole _____ Unit _____ Depth Interval _____

Record Number BH86-_____

Page ___ of ___
Reviewer(s) _____
_____
Affiliation _____
Date _____

HYDROLOGY DATA REVIEW CHECKLIST
CONTINUATION SHEET

COMMENTS:

Borehole _____ Unit _____ Depth Interval _____

E

DISTRIBUTION
WM File 101 (w/o sec.info)
NMSS r/f (w/o sec.info)
WMGT r/f (w/o sec.info)
RBrowning
MBell
JLinehan
PJustus
MFliegel
MWeber & r/f
NColeman
DChery (RES)
FRCook
PDR (w/o security in
RJohnson
NStill

OCT 6 1986

MEMORANDUM FOR: Paul Hildenbrand, BWIP Project Manager
WMRP, Division of Waste Management

FROM: Michael F. Weber, WMGT
Division of Waste Management

SUBJECT: PREPARATION PACKAGE FOR BWIP HYDROLOGY DATA REVIEW. DECEMBER 2-5, 1986

In accordance with guidance provided by WMRP on the preparation for NRC-DOE HLW Data Reviews, this memorandum provides the products required by items 1-8 of the guidance [cf. memorandum dated March 28, 1985, from Miller to Barrett and others]. I am submitting this to you in preparation for a BWIP Hydrology Data Review at Richland, Washington from December 2-5, 1986. Please note that we plan to visit outcrops of the Columbia River Basalts at Creston, Washington, on Monday before the data review. This site is being investigated by In-Situ Incorporated under contract to NRC(RES) to study groundwater flow and contaminant transport in saturated fractured geologic media. The visit and the data review have been coordinated with Don Chery (RES), NRC project officer for the In-Situ contract. We endorse Dr. Chery's consideration of RES contractor (In-Situ) participation in the data review. The data review pre-meeting is being planned with SNL, NWC, Williams and Associates, and RES staff and contractors for the middle of October (October 16-17, 1986). Please contact me if you have any questions or comments about this memorandum or the enclosed documents.

Item 1: Establish Need for Data Review

WM needs to perform this data review to assess the scope and reliability of hydrologic characterization data for the Hanford site to prepare for review of the SCP and the BWIP Hydrologic Testing Strategy. Subordinate objectives include:

A. To obtain recent hydrologic characterization information [no Data Reviews have been performed since December 1984; information available to NRC staff is, in general, more than one year old (i.e., the lag time between data collection and release to NRC is greater than one year)].

B. To initiate technical assessment of recent hydrologic characterization information.

C. To identify types of hydrologic characterization information that are currently available to BWIP and will likely be considered in the SCP.

8610246143 58pp.

D. To continue assessment of hydrologic characterization techniques already implemented by BWIP.

E. To continue assessment of past QA procedures and practices used for hydrologic characterization.

Travel funds have been budgeted within WMGT for M. Weber and N. Coleman to attend a Data Review/Meeting during the month of December.

Item 2: Letter of Request

A letter to DOE requesting the data review is provided as Enclosure 1. The letter identifies the specific types of data that NRC wants to review and requests a catalog of data that DOE wishes to bring to NRC's attention. The letter also invites DOE to attend the visit to the Creston site on the day before the data review.

Item 3: Inform On-Site Representative

I notified F. Robert Cook about the tentative dates for the data review during the week of September 29, 1986.

Item 4: Coordinate Participants

NRC staff participants in the data review include M. Weber and N. Coleman from WMGT, P. Hildenbrand from WMRP, Don Chery from RES. Contractor participants include Williams and Associates--Gerry Winters, Roy Williams, and Dale Ralston; Nuclear Waste Consultants--Mike Galloway, Fred Marinelli, and Adrian Brown; Sandia National Laboratory--Paul Davis; and a representative from In-Situ Incorporated (RES contractor). The schedule for the data review and a sample data review checklist are included as enclosures to a draft letter to DOE that transmits security information for data review participants (Enclosure 2). The review checklists may be modified, as appropriate, by individual reviewers based on the type of information under review.

Item 5: Logistics

Time and place for the data review have not been established as of this date. They should be identified by DOE-RL once the data review is firmly established and endorsed by NRC and DOE. Once the data review is confirmed with DOE-RL, we should hold a conference call with DOE-RL to confirm the availability of data and finalize the logistics for the data

OFC	WMGT	WMGT					
NAME	MWeber	MFliegel					
DATE	86/10/	86/10/					

review. There are no special requirements or materials requested from DOE for the data review. We plan to use F. Robert Cook's Personal Computer during the data review for tracking data review checklists and comment preparation.

Item 6: Specific Data Needs

Specific data needs have been identified in the letter to DOE requesting the data review (see Enclosure 1).

Item 7: Transmittal of Schedule, Checklist, and Security Information

Enclosure 2 is a letter to DOE that transmits the schedule, checklist, and security information for NRC participants in the data review. This letter can be transmitted once NRC staff (WMGT, WMRP, and OR) reaches agreement on the schedule and checklist for the data review. We are awaiting additional security information from RES.

Item 8: Travel Authorizations

Travel authorizations for M. Weber and N. Coleman are in preparation.

I will brief NRC staff and contractor participants about conduct of NRC-DOE data reviews at the pre-meeting to ensure that all team members understand and accept their responsibilities and the ground rules for data reviews. Specific review responsibilities will also be assigned. Several contractors participated in the last BWIP hydrology data review, so they should already be familiar with the scope and conduct of HLW data reviews. Please contact me if you wish to discuss the scope, objectives, and content of the pre-meeting.

/S/

Michael F. Weber
Geotechnical Branch
Division of Waste Management

Enclosures:
As Stated

Record note: Coordinated development of package with N. Coleman (WMGT) and P. Hillenbrand (WMRP) prior to transmittal. (MFW) 10/3

OFC	:WMGT MW	:WMGT MFW	:	:	:	:	:
NAME	:MWeber	:MFliegel	:	:	:	:	:
DATE	:86/10/3	:86/10/10	:	:	:	:	:

101/MFW/86/09/04/LTTR

Mr. O. L. Olson
Director
Basalt Waste Isolation Division
U. S. Department of Energy
Richland Operations Office
P. O. Box 550
Richland, WA 99352

Dear Mr. Olson:

In response to telephone conversations between our staffs, NRC is proposing a Data Review for hydrologic characterization information from the Hanford site during December 2 through 5, 1986. We propose that the data review start on Tuesday morning at 8:00 and terminate on Friday afternoon at 3:00. The data review should be conducted on the Hanford Site, where relevant data are easily accessible. The purpose of the data review is to assess the scope and reliability of hydrologic characterization information to help prepare NRC for review of the Hanford Site Characterization Plan and BWIP's hydrologic testing strategy.

The enclosed list identifies the specific types of data that we would like to evaluate during the data review. The list distinguishes between data that NRC wants to review and data that NRC may review if time permits. If there is additional hydrologic information that you wish to call to our attention, please provide us with a "data catalog" of this information by November 30, 1986. This catalog should describe the type, amount, and availability of relevant data.

We also invite your staff to participate in a pre-review visit on December 1 to Creston, Washington, where In-Situ Incorporated is performing hydrologic stress and tracer tests under contract to NRC. The purpose of the testing is to evaluate groundwater flow and contaminant transport in saturated fractured media, which is of significant interest to BWIP because the testing will be conducted in the Columbia River Basalts. NRC staff and contractors will drive to the site from Spokane, Washington, and will conclude the trip by driving to Richland along the Columbia River north of the Hanford site.

OFC	WMGT	WMGT	WMGT	WMGT	WMRP	WMRP	WMRP
NAME	MWeber	NColeman	MFliegel	PJustus	PHildenbrand	RJohnson	JLinehan
DATE	86/10/	86/10/	86/10/	86/10/	86/10/	86/10/	86/10/

Please contact Paul Hildenbrand (427-4672) of my staff to arrange the logistics of the Data Review or Michael Weber (427-4746) to discuss the technical information to be reviewed or the pre-review visit to Creston.

John J. Linehan, Section Leader
Repository Projects Branch
Division of Waste Management
Office of Nuclear Material
Safety and Safeguards

Enclosure:
As Stated

cc: JKnight, DOE-HQ

OFC	WMGT	WMGT	WMGT	WMGT	WMRP	WMRP	WMRP
NAME	MWeber	NColeman	MFliegel	PJustus	PHildenbrand	RJohnson	JLinehan
DATE	86/10/	86/10/	86/10/	86/10/	86/10/	86/10/	86/10/

LIST OF INFORMATION FOR REVIEW AT THE
BWIP HYDROLOGIC DATA REVIEW, DECEMBER 2-5, 1986

I. Information to be Reviewed

*A. Water level data collected at primary monitoring facilities (e.g., DC-19/20/22 and the RRL-2 clusters; RRL-14; DC-4; DC-23; McGee Well) since May 1985.

B. Reduction of water level data to filter out external influences such as barometric and earth tidal effects (e.g., use of HEADCO or similar procedures to process water level and pressure data).

*C. Documentation of pressure responses of piezometers during packer inflation (e.g., packer inflation in RRL-2C flow interior piezometers).

D. Results of recent (since 6/85) laboratory calibration tests on downhole pressure transducers.

*E. Results of recent (since 12/84) hydraulic testing conducted in conjunction with drill and test programs (e.g., DC-18) and well construction and development programs (e.g., DC-23 and RRL-2B/C).

*F. Records pertaining to drilling fluid losses that occurred during drilling of DC-23, DC-18, and RRL-17.

*G. Hydrochemistry data from the site collected since 1/85, especially data from DC-23W/GR, RRL-2, DC-18, and the Westbay Installation in RRL-14.

H. Current operational status of the Westbay Installation at RRL-14.

I. Analysis and control of the composition of water actually used to fill piezometer tubes in DC-19/20/22/23, RRL-2C, and other monitoring facilities.

II. Information that may be Reviewed

A. Interval testing reports that have not yet been formally documented and/or released.

B. Results and procedures used to test the permeability of grout used in the nested piezometers installations (e.g., RRL-2C).

*C. Stratigraphic, geophysical, and completion data for DC-23W/GR.

D. Geophysical and water level information relevant to characterization of the "Yakima Barricade" structure (i.e., Cold Creek "Barrier").

* NRC may request this information in releasable hard copy.

ALL DATA ON
DC-18, DC-23GR, AND DC-23W
FOR
NRC DATA REVIEW

Available on Request

DAP NO.	BRMC NO.	SUBJECT	BOREHOLE
03-00085	B062701	BOREHOLE GEOLOGIC LOGS	DC-23GR
03-00103	B070011	SHIFT REPORTS	DC-23W
03-00104	B070017	GEOLOGIC LOGS	DC-23W
03-00106	B067922	GEOLOGRAPH LOGS	DC-23W
03-00107	B070016	MUD ENGINEERING REPORTS	DC-23W
03-00108	B070014	DEVIATION SURVEYS	DC-23W
03-00109	B067942	METHANE DETECTION	DC-23W
03-00124	B085767	SHIFT REPORTS	DC-23GR
03-00147	B067915	BOREHOLE SEDIMENT CORE DATA LOGS	DC-18
03-00148	B067916	BOREHOLE BASALT CORE DATA LOGS	DC-18
03-00161	B085582	SHIFT REPORTS	DC-23W
03-00216	B062785	VISULOGGERS (VISULOGS)	DC-23W
03-00218	B062783	GEOPHYSICAL LOGS	DC-18
03-00220	B062974	BOREHOLE INFORMATION SHEETS	DC-23W
03-00235	B089157	GEOPHYSICAL LOGS	DC-18
03-00239	B088332	SHIFT REPORTS	DC-18
03-00240	B089154	GEOLOGRAPH CHARTS	DC-18
03-00241	B088331	SHIFT REPORTS	DC-23GR
03-00242	B089153	GEOLOGRAPH CHARTS	DC-23GR
03-00243	B089161	MUD ENGINEERING REPORTS	DC-23GR
03-00244	B089152	VISULOGS	DC-23GR
03-00265	B088560	BOREHOLE TEST INFORMATION	DC-23W
03-00272	B088559	GEOPHYSICAL LOGS	DC-18
03-00303	B089868	SENTINEL GAP FLOW TOP TESTING DC-23 TEST DATA	DC-23GR
03-00311	B089880	ROSALIA FLOW TOP HYDRAULIC TEST DATA	DC-23GR
03-00316	B093012	GEOPHYSICAL LOGS	DC-18
03-00323	B093023	DEVIATION SURVEY	DC-23GR
03-00324	B093020	BOREHOLE GEOLOGIC LOGS	DC-23GR
03-00325	B089908	IADC REPORTS	DC-23GR
03-00326	B093022	SHIFT REPORTS	DC-23GR
03-00329	B093025	GEOLOGRAPH CHARTS	DC-23GR
03-00337	B089888	WELL SERVICE REPORT	DC-23GR
03-00338	B089889	WELL SERVICE REPORT	DC-23GR
03-00339	B089890	WELL SERVICE REPORT	DC-23GR
03-00340	B089891	WELL SERVICE REPORT	DC-23GR
03-00341	B089892	VISULOGS	DC-23GR
03-00342	B089895	SHIFT REPORTS	DC-18
03-00343	B089893	GEOLOGRAPH CHARTS	DC-18
03-00347	B089899	BOREHOLE INFORMATION SHEETS	DC-23W
03-00367	B095106	SHIFT REPORTS	DC-18
03-00368	B095102	GEOLOGRAPH CHARTS	DC-18

ALL DATA ON
DC-18, DC-23GR, AND DC-23W
FOR
NRC DATA REVIEW

Available on Request

DAP NO.	BRMC NO.	SUBJECT	BOREHOLE
03-00372	B093357	SHIFT REPORTS	DC-23GR
03-00441	B095306	SHIFT REPORTS	DC-18
03-00442	B095308	GEOLOGRAPH CHARTS	DC-18
03-00444	B095309	SHIFT REPORTS	DC-23GR
03-00465	B083610	SHIFT REPORTS	DC-18
03-00466	B083611	GEOLOGRAPH CHARTS	DC-18
03-00468	B083613	SHIFT REPORTS	DC-23GR

GEOPHYSICAL LOGS
FOR
DC-23GR AND DC-23W

NRC DATA REVIEW

One-of-a-Kind Available Wed Morning

DAP NO.	BRMC NO.	SUBJECT	BOREHOLE
03-00184	B085701	GEOPHYSICAL LOGS	DC-23W
03-00201	B062745	GEOPHYSICAL LOGS	DC-23GR
03-00212	B089155	GEOPHYSICAL LOGS	DC-23GR
03-00217	B062784	GEOPHYSICAL LOGS	DC-23GR
03-00237	B089159	GEOPHYSICAL LOGS	DC-23GR
03-00263	B088556	GEOPHYSICAL LOGS	DC-23GR
03-00273	B088558	GEOPHYSICAL LOGS	DC-23GR
03-00318	B093010	GEOPHYSICAL LOGS	DC-23GR
03-00320	B093011	GEOPHYSICAL LOGS	DC-23GR
03-00321	B093013	GEOPHYSICAL LOGS	DC-23GR
03-00361	B093232	GEOPHYSICAL LOGS	DC-23GR
03-00363	B093230	GEOPHYSICAL LOGS	DC-23GR
03-00447	B094048	GEOPHYSICAL LOGS	DC-18 DC-23GR DB-15
03-00448	B083607	GEOPHYSICAL LOGS	DC-23GR
03-00449	B094049	GEOPHYSICAL LOGS	DC-23GR

CALIBRATION RECORDS
FOR
NRC DATA REVIEW

One-of-a-kind Available Wed Morning

DAP NO.	BRMC NO.	SUBJECT
03-00072	B057390	CALIBRATION RECORDS FOR SELING SINGLE SUBSURFACE PROBES
03-00073	B057391	CALIBRATION RECORDS FOR SELING TRIPLE SUBSURFACE PROBES
03-00074	B057392	CALIBRATION RECORDS FOR SELING SINGLE SUBSURFACE PROBES
03-00075	B057393	CALIBRATION RECORDS FOR SELING TRIPLE SUBSURFACE PROBES
03-00076	B057394	CALIBRATION RECORDS FOR SELING SUBSURFACE PROBES
03-00457	B094052	CALIBRATION RECORDS FOR SELING SINGLE SUBSURFACE PROBES
03-00458	B083609	CALIBRATION RECORDS FOR SELING SINGLE SUBSURFACE PROBES

FIELD TEST REQUIREMENTS FORM/
FIELD TEST INSTRUCTION
FOR
NRC DATA REVIEW

FTRF	FTI	BRMC NO.	BOREHOLE	STRATIGRAPHIC HORIZONS	LOCATION
60901	60901	B094099	RRL-14	SADDLE MNT. WANAPUM GRANDE RONDE	BOOK 4

G Jacobs, N. Coleman, M. Webster

V. Hydrochemistry

- Hydrochemical data since January 1985 for DC-23 W/GR — BOP C-2.4, BOP C-4.71

- Data used in the EQ3/6 model — N/A

DATA REVIEW SCHEDULE

DOE-NRC HYDROLOGY DATA REVIEW FOR
THE HANFORD SITE, DECEMBER 2-5, 1986

Tuesday, December 2

8:00	Introduction and Objectives	Hildenbrand/NRC Mecca/DOE
8:15	Initiate Review	NRC
	Water level data Filtering for External Influences Packer pressure responses Calibration lab tests	
11:30	Information Requests/Clarifications	NRC DOE
12:00	Lunch	
1:00	Resume Review	NRC
	Water level data (continued)	
4:00	Information Requests/Clarifications	NRC DOE
4:30	Summary (if appropriate)	NRC/DOE
4:45	Break	

Wednesday, December 3

8:00	Resume Review	NRC
	Hydraulic testing results	
11:30	Information Requests/Clarification	NRC DOE
12:00	Lunch	
1:00	Resume Review	NRC
	Hydraulic testing (continued)	
4:00	Information Requests/Clarification	NRC DOE

4:30	Summary (if appropriate)	NRC/DOE
4:45	Break	

Thursday, December 4

8:00	Resume Review	NRC
	Hydrochemistry data Westbay operation Piezometer tubes	
	Carry-over information	
11:30	Information Requests/Clarification	NRC DOE
12:00	Lunch	
1:00	Resume Review	NRC
	Hydrochemistry data (continued) Carry-over (continued)	
4:00	Information Requests/Clarification	NRC DOE
4:30	Summary (if appropriate)	NRC/DOE
5:00	Break	

Friday, December 5

8:00	Resume Review	NRC
	Carry-over information Category II information	
11:30	Information Requests/Clarification	NRC DOE
11:45	Lunch	
12:45	NRC Caucus	NRC
1:30	Summary of Immediate Observations and Data Review Wrap-Up	NRC/DOE
2:30	Adjourn	

Record Number BH86-_____

Reviewer _____
Affiliation _____
Date _____

HYDROLOGY DATA REVIEW CHECKLIST

TOPIC: _____

TYPE OF DATA (circle one):

a. hydraulic head b. hydraulic characteristic c. structural/stratigraphic
d. ext. boundary e. hydrochemistry f. geophysical
g. QA Record h. other _____

TESTING INFORMATION (applicable) (not applicable)

Identifier _____ Depth Interval _____ (ft) (m)

Unit _____ Effective Depth Interval _____ (ft) (m)

Test Type _____ Reference _____

REFERENCED PROCEDURE _____

_____

COMMENTS:

Borehole _____ Unit _____ Depth Interval _____

Record Number BH86-_____

Reviewer _____
Affiliation _____
Date _____

HYDROLOGY DATA REVIEW CHECKLIST
CONTINUATION SHEET

Page ___ of ___

COMMENTS:

Borehole _____ Unit _____ Depth Interval _____

PERSONNEL INFORMATION FOR NRC STAFF/CONTRACTORS
ATTENDING HYDROLOGY DATA REVIEW (DECEMBER 2-5, 1986)

Name	Social Security Number	Birthdate	Affiliation[1]
Michael F. Weber	[redacted]	[redacted]	NRC
Neil M. Coleman	[redacted]	[redacted]	NRC
Paul Hildenbrand	[redacted]	[redacted]	NRC
James E. Kennedy	[redacted]	[redacted]	NRC
Gerry Winter	[redacted]	[redacted]	WA
Roy Williams	[redacted]	[redacted]	WA
Dale Ralston	[redacted]	[redacted]	WA
Michael Galloway	[redacted]	[redacted]	NWC
Fred Marinelli	[redacted]	[redacted]	NWC
Adrian Brown[2]	[redacted]	[redacted]	NWC
Paul Davis	[redacted]	[redacted]	SNL

[1]NRC= U.S. Nuclear Regulatory Commission; WA= Williams and Associates Inc.; NWC= Nuclear Waste Consultants, Inc.; SNL= Sandia National Laboratory

[2]Adrian Brown
[redacted]

F

Mike Galloway - Roy Williams, Mike Webber
Fred Marinelli

I. Monitoring Installation	
- Drilling fluid losses	Desk Instruction DI-75220-029 Appendix to SD-BWI-TC-026
- Integrity testing status	BOP C 2.8
- Operational status of Westbay at RRL-14	Statement of Work Verification Plan
- Composition of water in piezometers	BOP C-2.4 BOP C-4.71 Desk Instruction DI-75220-030
- Procedures and results of grout testing	BOP C-4.61
- Completion data for DC-23W/GR	See SD-BWI-TC-026

INDEX OF INFORMATION

I. Monitoring Installation

1. Drilling Fluid Losses

   - Tabulation of RRL-17 losses
   - Responses in wells during construction and testing of DC-23W and DC-23GR
   - Daily drilling status
   - RRL-2B/2C completion report (SD-BWI-TI-329)
   - Effects of drilling and testing at DC-23W (SD-BWI-TI-313)

2. Integrity Testing Status

   - Draft integrity testing report for RRL monitoring boreholes

3. Operational Status of Westbay at RRL-14

   - Westbay's site visit reports
   - Meeting Minutes

4. Composition of Water in Piezometers

   - RRL-2B/2C completion report (SD-BWI-TI-329)
   - DC-19,20, and 22 completion report (SD-BWI-TI-226)
   - Chemical data bailed from DC-19, 20, 22, and RRL-2C
   - RRL-14 Westbay probe chemistry data

5. Procedures and Results of Grout Testing

   -RRL-2B2C completion report (SD-BWI-TI-329)

6. Completion Data for DC-23WGR

   - As-builts of DC-23W
   - Effects of drilling and testing at DC-23W (SD-BWI-TI-313)
   - Drilling and Testing Specifications for DC-23WGR (SD-BWI-TC-026)

II. Geologic Information - Hydrogeology (Roy Williams, Paul Davis, H. Lefever, M. Weber, G Jacobs

- Stratigraphy and geophysical data for DC-23W/GR — BOP C-2.10

- Geophysical and water-level data relative to Yakima Barricade impedement — BOP C-2.12 (<8/27/86)
  TOP HT-ES-201 (>8/27/86)
  BOP C-3.6

GEOPHYSICAL DATA OF THE YAKIMA BARRICADE AREA

Simple Bouguer Gravity Map.

Ground Magnetic Map..

SupraBasalt Stratigraphic Section G-G'.

Reprocessing and Interpretation Seismic Reflection.
Data, Hanford Site, Pasco Basin, South-Central Washington.

SD-BWI-TI-177

Plates 9a,15,28 and 29

DCR

III. Hydraulic Head Related Information Available

Gary Winter P. Davis A. Brown M. Galloway ~~H. Brown~~

- Water-level data at primary monitoring facilities since May 1985	BOP C-2.12 (<8/27/86) TOP HT-ES-201 (>8/27/86)
- Reduction of water-level data to filter out external influence	Comp. Brief #00263 RHO-BWI-ST-71P (HEADCO) Density comp.
- Lab calibration of pressure transducers	BOP C-1.3 QAPP 12.101 HEDL Procedures

DOE - Richland E. L. Price

Bryan Aldson

Water level data and hydrographs are available for these facilities.

```
00001: ENYEART
00002: FORD
00003: MCGEE/RCT        ROCKY COULEE FLOW TOP
00004: OBRIAN
00005: BH-17
00006: DB-1
00007: DB-2
00008: DB-4
00009: DB-7
00010: DB-9
00011: DB-12
00012: DB-13
00013: DB-14/MBI        MABOTN INTERBED
00014: DB-14/ROT        ROSALIA FLOW TOP
00015: DB-15
00016: DC-1/GRC1        GRANDE RONDE - SCHWANA SEQUENCE (LOWER)
00017: DC-1/GRC2        GRANDE RONDE - SCHWANA SEQUENCE (UPPER)
00018: DC-1/UTB         UMTANUM FLOW BOTTOM
00019: DC-1/UTT         UMTANUM FLOW TOP
00020: DC-1/WPC         COMPOSITE WANAPUM
00021: DC-2
00022: DC-4
00023: DC-5
00024: DC-7
00025: DC-12
00026: DC-15
00027: DC-16B
00028: DC-16C
00029: DDH-3
00030: DH-8B
00031: DH-27
00032: DH-28
00033: RRL-2A
00034: RRL-2B
00035: RRL-6B
00036: 299-E25-10
00037: 299-E26-1
00038: 299-E26-8
00039: 299-W19-1
00040: 299-W19-4/BRS    BASAL RINGOLD
00041: 299-W19-4/MRS    MIDDLE RINGOLD
00042: 699-25-70
00043: 699-32-70B
00044: 699-32-72
00045: 699-32-77
00046: 699-35-78A
00047: 699-37-82A
00048: 699-42-40ABC     3 DATA FILES   1 COLOR PLOT
00049: 699-43-42
X
00049: 699-43-42
00050: 699-43-88
00051: 699-47-50
```

00001: ENYEART

00052:	699-49-79	
00053:	699-50-53	
00054:	699-50-85	MIDDLE RINGOLD
00055:	699-50-85/LR	LOWER RINGOLD
00056:	699-52-46A	
00057:	699-53-50	
00058:	699-54-45A	
00059:	699-54-45B	
00060:	699-54-57	
00061:	699-55-50A	
00062:	699-55-50C	
00063:	699-55-50D	
00064:	699-55-57	
00065:	699-56-53	
00066:	699-59-55	
00067:	699-61-62	
00068:	DC-19A,D	3 DATA FILES
00069:	DC-19C	6 DATA FILES
00070:		
00071:	DC-20A,D	3 DATA FILES
00072:	DC-20C	6 DATA FILES
00073:		
00074:	DC-22A,D	3 DATA FILES
00075:	DC-22C	6 DATA FILES
00076:		
00077:	DC-23W	3 DATA FILES
00078:		
00079:	RRL-2	6 DATA FILES

00001: ENYEART

00052:	699-49-79	
00053:	699-50-53	
00054:	699-50-85	MIDDLE RINGOLD
00055:	699-50-85/LR	LOWER RINGOLD
00056:	699-52-46A	
00057:	699-53-50	
00058:	699-54-45A	
00059:	699-54-45B	
00060:	699-54-57	
00061:	699-55-50A	
00062:	699-55-50C	
00063:	699-55-50D	
00064:	699-55-57	
00065:	699-56-53	
00066:	699-59-55	
00067:	699-61-62	
00068:	DC-19A,D	3 DATA FILES
00069:	DC-19C	6 DATA FILES
00070:		
00071:	DC-20A,D	3 DATA FILES
00072:	DC-20C	6 DATA FILES
00073:		
00074:	DC-22A,D	3 DATA FILES
00075:	DC-22C	6 DATA FILES
00076:		
00077:	DC-23W	3 DATA FILES
00078:		
00079:	RRL-2	6 DATA FILES

Dale Ralston, P. Davis, ~~[illegible]~~ H. Brown, H. Lafever, DLC
F. Marinelli

IV. Hydraulic Testing Data

- Document pressure responses in piezometers	BOP C-2.12 BOP C-2.13
- Results of recent hydraulic testing	BOP C-2.8
- Well construction and development program since December 1984	Drilling and Testing Specification
- Internal testing reports not yet formally released	N/A

PROCEDURES FOR
FIELD TEST REQUIREMENTS FORM/
FIELD TEST INSTRUCTION
FOR
NRC DATA REVIEW

QAPP 11-205	DATA ACQUISITION PACKAGE
PMPM 8-113	RECRODS SUBMITTAL VIA CERTIFIED TRANSMITTAL PACKAGES
QAPP 17-101	BWIP RECORDS MANAGEMENT SYSTEM
BOP C-2.16	(INTERIM) BOREHOLE TEST REQUIREMENTS FORM
BOP C-2.17	(INTERIM) BOREHOLE TEST INSTRUCTION
BOP C-2.16	(EXTENSION) BOREHOLE TEST REQUIREMENTS FORM
BOP C-2.17	(EXTENSION) BOREHOLE TEST INSTRUCTION
BOP C-2.4	GROUNDWATER SAMPLING AND ANALYSIS
BOP C-2.8	HYDROLOGIC FIELD TESTING PROCEDURES
BOP C-2.10	GEOPHYSICAL WELL LOGGING
BOP C-2.12	HYDRAULIC HEAD MONITORING PROCEDURES
BOP C-2.13	TRANSMITTAL OF PIEZOMETRIC DATA
BOP C-4.71	GROUNDWATER SAMPLING, OFFSITE SHIPMENT, AND STORAGE
BOP C-4.73	SOLUTION CHEMISTRY LABORATORY OPERATING PROCEDURES
BOP C-4.82	FIELD ANALYSIS METHOD
SD-BWI-TC-013 (REV. 3)	DRILLING AND TESTING SPECIFICATIONS FOR BOREHOLE
SD-BWI-TC-026 (REV. 2)	HYDROLOGIC CHARACTERIZATION
SD-BWI-TC-026 (REV. 3)	HYDROLOGIC CHARACTERIZATION

PROCEDURES FOR
CALIBRATION RECORDS
FOR
NRC DATA REVIEW

QAPP 12-101	CALIBRATION AND CONTROL OF MEASURING AND TEST EQUIPMENT
BOP C-1.3 (4/84)	MEASURING AND TEST EQUIPMENT CALIBRATION
BOP C-1.3 (10/82)	INSTRUMENT CALIBRATION

BOREHOLE TEST REQUIREMENTS FORM/
BOREHOLE TEST INSTRUCTION
FOR
NRC DATA REVIEW

BTRF	BTI	BRMC NO.	BOREHOLE	STRATIGRAPHIC HORIZONS	LOCATION
60301	60301	B088760	DC-23GR	GINKGO	BOOK 1
60403	60403	B093024	DC-23GR	WANAPUM	BOOK 1
60402	60402	B088764	DC-23GR	ROCKY COULEE	BOOK 1
60405	60405	B088804	DC-23GR	COHASSETT	BOOK 1
60406	60406	B093008	DC-23GR	BIRKETT	BOOK 1
	60406-A	B094051	DC-23GR	GRANDE RONDE	BOOK 2
60602	60602	B083608	DC-23GR	GRANDE RONDE	BOOK 2
	60602-A	B094050	DC-23GR	GRANDE RONDE	BOOK 2
60304	60304	B089835	DC-18	PRIEST RAPIDS	BOOK 3
	60304	B093231	DC-18	PRIEST RAPIDS	BOOK 3
60305	60305	B089870	DC-18	ROZA	BOOK 3
	60305-B	B093014	DC-18	SENTINEL GAP	BOOK 3
	60305	B093228	DC-18	ROZA	BOOK 3
60503	60503	B093229	DC-18		BOOK 3
60601	60601-A	B095131	DC-18	FRENCHMAN SPRINGS	BOOK 3
	60601-B	B095132	DC-18	FRENCHMAN SPRINGS	BOOK 3
60306	60306	B088678	DC-02-A2	UMTANUM	BOOK 4
60501	60501	B093544	DH-33	HANFORD - RINGOLD	BOOK 4
60603	60603	B093545	DH-33		BOOK 4
60604	60604	B093795	RRL-14	UMTANUM MCCOY CANYON BIRKETT COHASSETT 1 COHASSETT 2 ROCKY COULEE GRANDE RONDE 2	BOOK 4 BOOK 4
60803	60803	B095318	RRL-14	GRANDE RONDE	BOOK 4

HYDROCHEMISTRY DATA INDEX

Part 1 - Introductory Material

1. Index
2. Abstract and illustrations: "Evaluation of Groundwater Tracers for Columbia Plateau Basalt Aquifers at the Hanford Site, Washington."

Part 2 - Hydrochemistry for Borehole DC-18

1. Stratigraphic column for DC-18
2. Rosalia Flow Top
3. Roza Flow Top
4. Sentinel Gap Flow Top
5. Frenchman Springs Tectonic Zone
6. Ginkgo Flow Top

Part 3 - Hydrochemistry for Boreholes DC-23/W and DC-23/GR

1. DC-23/W (open hole through Wanapum)
2. Rosalia Flow Top
3. Sentinel Gap Flow Top
4. Ginkgo Flow Top
5. Umtanum Flow Top
6. "Borehole Development History at DC-23/GR" (Draft Summary Report)

Part 4 - Notebooks

1. DC-23/W Field Notebook - Hydrochemistry
2. DC-23/GR Field Notebook - Hydrochemistry
3. DC-18 Field Notebook - Hydrochemistry
4. Sample Log Book, Vol. 1
5. Sample Log Book, Vol. 2

Part 5 - Database Printout, Since 1/1/85

1. Development Samples
2. Formal Samples
3. General Samples

(This Part excludes DC-18 and DC-23 data, which have been inserted into Parts 2 and 3, respectively).

<u>Organization of Parts 2 and 3</u>:

A. These data packages are arranged in stratigraphic sequence.

B. The organization of data for each stratum is as follows:

1. Summary of results (or appropriate production data, etc.) where available.
2. The results of FORMAL sampling and analysis, at the end of the pumping campaign.
3. Results of laboratory analysis of PRE-DEVELOPMENT samples (e.g., drilling fluid, "system" water, etc.)
4. Results of laboratory analysis of DEVELOPMENT samples (i.e., time-series samples collected during development pumping).
5. Results of FIELD ANALYSIS of pre-development or development samples. These data sheets include dates, times, and volumes.

Caution:

The FORMAL sample results are the results of laboratory analysis and have not been corrected for residual contamination by drilling fluids. Further, the Hydrochemistry Unit considers the FORMAL oxygen measurements to be in error (see DC-18 internal letters summarizing the results of field analysis).

G

WATER LEVEL MEASUREMENTS DATA SHEET (Steel Tape Method)

Borehole: DC-19-C

Test Interval: Priest Rapids Interflow Zone

Last Water Depth Measurement From Previous Sheet: 231.68'

Measuring Point Elevation: 631.62' above MSL

Measuring Point: Top of Piezo tube

Surface Control Datum Elevation: 629.17' above MSL

Datum: Brass cap in concrete

Measuring Device (Unless Otherwise Indicated): 300' steel tape #2

Date	Time (Hrs) PST	Water Depth (ft)	Temp Factor (°C)	Pressure Reading (psi)	Comments	Measured By
10/15/84	1155	231.82				LW
10/15/84	1156	231.82				LW
10/16/84	1308	231.55				LW
10/16/84	1310	231.55				LW
10/17/84	1211	231.58				LW
10/17/84	1213	231.58				LW
10/18/84	1235	231.79				LW
10/18/84	1236	231.80				LW
10/19/84	1111	231.75				LW
10/19/84	1114	231.76				LW
10/20/84	0900	231.84			More problems with tape stuck on cable	LW
10/20/84	0902	231.85				LW

DISTRIBUTION:
White - Basalt Records Ret. Center
Canary - Author
Pink - Drilling & Testing Group
Goldenrod - Site Department

Reviewed By: W. W. Pelson (Name) [illegible] (Title) 26 Oct 1984 (Date)

BC-6400-156.1 (7-84)

HP File

2 Dec 1986 14: 4

Program: WHYDAT Rev 6.3
File name: A_BRS00
Directory Pathname: DATA/MONITORING/ST85/DC19/
Borehole Number: DC-19A
Hydrogeologic unit: BASAL RINGOLD
Borehole location: N 433,655 E 2,224,918
Latitude: 0
Longitude: 119.3623616
Probe seat depth: 527.9 feet (below Control Datum)
Borehole depth: 804.1 feet (below Control Datum)
Measuring point elevation: 630.13 feet (above MSL)
Measuring point identifier: Top of piezo tube
Measuring point description: Datum + 2.71 feet (Piezo tube stick-up)
Control Datum elevation 627.42 feet (above MSL)
Control datum identifier: Brass cap
Monitored interval: 497-577 feet (below Control Datum)
Barometric Efficiency: 59.0%
Comments: Water Level Data
Comments:
Records in file: 299

FEET BELOW MEASURING POINT

rec.	date	depth	flags	rec	date	depth	flags
243	85.0803135300	179.400	.FT20B	252	85.0916132500	179.400	.FT20B
244	85.0804134400	179.330	.FT20B	253	85.0917135500	179.220	.FT20B
245	85.0805132400	179.190	.FT20B	254	85.0918132100	179.440	.FT20B
246	85.0806135800	179.190	.FT20B	255	85.0919123300	179.770	.FT20B
247	85.0809132500	179.470	.FT20B	256	85.0920134200	179.930	.FT20B
248	85.0810141000	179.500	.FT20B	257	85.0923135700	179.960	.FT20B
249	85.0811133700	179.410	.FT20B	258	85.0925140500	179.900	.FT20B
250	85.0812125900	179.520	.FT20B	259	85.0927095400	179.770	.FT20B
251	85.0813131800	179.570	.FT20B	260	85.0930142600	179.860	.FT20B

2 Dec 1986 14: 2

Program:	WHYDAT Rev 6.3
File name:	C_ROT00
Directory Pathname:	DATA/MONITORING/ST85/DC19/
Borehole Number:	DC-19C
Hydrogeologic unit:	ROSALIA FLOW TOP
Borehole location:	N 433,933 E 2,225,012
Latitude:	NA
Longitude:	NA
Probe seat depth:	1662.0 feet (below Control Datum)
Borehole depth:	3983.0 feet (below Control Datum)
Measuring point elevation:	631.62 feet (above MSL)
Measuring point identifier:	Top of piezo tube
Measuring point description:	Datum + 2.45 feet (Piezo tube stick-up)
Control Datum elevation	629.17 feet (above MSL)
Control datum identifier:	Brass cap
Monitored interval:	1647-1686 feet (below Control Datum)
Barometric Efficiency:	70.0%
Comments: Water Level Data	
Comments:	
Records in file: 302	

FEET BELOW MEASURING POINT

rec	date	depth	flags	rec	date	depth	flags
244	85.0503133600	231.360	.FT20B	253	85.0916125000	231.250	.FT20B
245	85.0504132400	231.280	.FT20B	254	85.0917133800	231.140	.FT20B
246	85.0505130900	231.150	.FT20B	255	85.0918130500	231.380	.FT20B
247	85.0506134300	231.200	.FT20B	256	85.0919122200	231.560	.FT20B
248	85.0509130700	231.370	.FT20B	257	85.0920132400	231.570	.FT20B
249	85.0510135500	231.420	.FT20B	258	85.0923133700	231.690	.FT20B
250	85.0511132000	231.320	.FT20B	259	85.0925134700	231.670	.FT20B
251	85.0512124200	231.500	.FT20B	260	85.0927093700	231.650	.FT20B
252	85.0513125900	231.520	.FT20B	261	85.0930141300	231.670	.FT20B

85.2105583	450.77	07	29	85	13	24	00
85.2115569	450.78	07	30	85	13	22	00
85.2125819	450.78	07	31	85	13	58	00
85.2134292	450.73	08	01	85	10	18	00
85.2144479	450.71	08	02	85	10	45	00
85.2153181	450.71	08	03	85	07	38	00
85.2164181	450.72	08	04	85	10	02	00
85.2175500	450.75	08	05	85	13	12	00
85.2185694	450.73	08	06	85	13	40	00
85.2196042	450.78	08	07	85	14	30	00
85.2205556	450.79	08	08	85	13	20	00
85.2215312	450.74	08	09	85	12	45	00
85.2223118	450.74	08	10	85	07	29	00
85.2234736	450.72	08	11	85	11	22	00
85.2246035	450.77	08	12	85	14	29	00
85.2255660	450.76	08	13	85	13	35	00
85.2264722	450.69	08	14	85	11	20	00
85.2275667	450.78	08	15	85	13	36	00
85.2285979	450.78	08	16	85	14	21	00
85.2293028	450.82	08	17	85	07	16	00
85.2304972	450.79	08	18	85	11	56	00
85.2315868	450.76	08	19	85	14	05	00
85.2324722	450.79	08	20	85	11	20	00
85.2335715	450.74	08	21	85	13	43	00
85.2345549	450.73	08	22	85	13	19	00
85.2355840	450.71	08	23	85	14	01	00
85.2364854	450.72	08	24	85	11	39	00
85.2374125	450.75	08	25	85	09	54	00
85.2385875	450.78	08	26	85	14	06	00
85.2395833	450.78	08	27	85	14	00	00
85.2405854	450.76	08	28	85	14	03	00
85.2415993	450.73	08	29	85	14	23	00
85.2425868	450.77	08	30	85	14	05	00
85.2465785	450.73	09	03	85	13	53	00
85.2475722	450.73	09	04	85	13	44	00
85.2485583	450.78	09	05	85	13	24	00
85.2495819	450.83	09	06	85	13	58	00
85.2525590	450.68	09	09	85	13	25	00
85.2535903	450.70	09	10	85	14	10	00
85.2545674	450.67	09	11	85	13	37	00
85.2555410	450.70	09	12	85	12	59	00
85.2565542	450.67	09	13	85	13	18	00
85.2595590	450.65	09	16	85	13	25	00
85.2605799	450.77	09	17	85	13	55	00
85.2615562	450.76	09	18	85	13	21	00
85.2625229	450.57	09	19	85	12	33	00
85.2635708	450.37	09	20	85	13	42	00
85.2665812	450.39	09	23	85	13	57	00
85.2685868	450.41	09	25	85	14	05	00
85.2704125	450.50	09	27	85	09	54	00
85.2736014	450.43	09	30	85	14	26	00
85.2755903	450.49	10	02	85	14	10	00
85.2776090	450.43	10	04	85	14	37	00
85.2805764	450.64	10	07	85	13	50	00
85.2827521	450.46	10	09	85	18	03	00

85.2846028	450.54	10	11	85	14	28	00
85.2876056	450.45	10	14	85	14	32	00
85.2895944	450.57	10	16	85	14	16	00
85.2915812	450.52	10	18	85	13	57	00
85.2945542	450.64	10	21	85	13	18	00
85.2965875	450.57	10	23	85	14	06	00
85.2985396	450.43	10	25	85	12	57	00
85.3016347	450.47	10	28	85	15	14	00
85.3026312	450.36	10	29	85	15	09	00
85.3036215	450.37	10	30	85	14	55	00
85.3046625	450.44	10	31	85	15	54	00
85.3056243	450.45	11	01	85	14	59	00
85.3086382	450.50	11	04	85	15	19	00
85.3106181	450.46	11	06	85	14	50	00
85.3126229	450.53	11	08	85	14	57	00
85.3155854	450.51	11	11	85	14	03	00
85.3176354	450.43	11	13	85	15	15	00
85.3196410	450.41	11	15	85	15	23	00
85.3226403	450.66	11	18	85	15	22	00
85.3296139	450.63	11	25	85	14	44	00
85.3316424	450.61	11	27	85	15	25	00
85.3337917	450.61	11	29	85	19	00	00
85.3366424	450.53	12	02	85	15	25	00
85.3385201	450.61	12	04	85	12	29	00
85.3404035	450.50	12	06	85	09	41	00
85.3434076	450.55	12	09	85	09	47	00
85.3455243	450.52	12	11	85	12	35	00
85.3475986	450.60	12	13	85	14	22	00
85.3506000	450.65	12	16	85	14	24	00
85.3525944	450.66	12	18	85	14	16	00
85.3544465	450.72	12	20	85	10	43	00
85.3576424	450.73	12	23	85	15	25	00
85.3606042	450.77	12	26	85	14	30	00
85.3616424	450.79	12	27	85	15	25	00
85.3646056	450.81	12	30	85	14	32	00
86.0019104	450.83	01	01	86	21	51	00
86.0034292	450.83	01	03	86	10	18	00
86.0064931	450.70	01	06	86	11	50	00
86.0086361	450.60	01	08	86	15	16	00
86.0106125	450.59	01	10	86	14	42	00
86.0133771	450.59	01	13	86	09	03	00
86.0155910	450.68	01	15	86	14	11	00
86.0174875	450.72	01	17	86	11	42	00
86.0206174	450.56	01	20	86	14	49	00
86.0225021	450.47	01	22	86	12	03	00
86.0244236	450.55	01	24	86	10	10	00
86.0274944	450.47	01	27	86	11	52	00
86.0296083	450.58	01	29	86	14	36	00
86.0315604	450.62	01	31	86	13	27	00
86.0346125	450.50	02	03	86	14	42	00
86.0366285	450.44	02	05	86	15	05	00
86.0386187	450.39	02	07	86	14	51	00
86.0416396	450.49	02	10	86	15	21	00
86.0436507	450.52	02	12	86	15	37	00
86.0446340	450.54	02	13	86	15	13	00

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SUMMARY NOTES FOR BWIP HYDROLOGY DATA REVIEW

December 2-4, 1986

1.0 BACKGROUND

U. S. Nuclear Regulatory Commission (NRC) staff and their Technical Assistance contractors working on the Basalt Waste Isolation Project (BWIP) conducted a review of hydrologic data for the BWIP site on December 2 through 4, 1986. U. S. Department of Energy, Basalt Waste Isolation Division (DOE) made the requested data (Attachment 1) available to NRC at the Rivershore Inn located at Richland, Washington. Representatives of the Yakima, Nez Perce and Umatilla Indian Nations, and the States of Oregon and Washington also participated in the review of available hydrologic data. Attachment 2 contains the list of participants.

2.0 OBJECTIVES

1. To become familiar with types and quality of data being collected, data collection techniques and procedures, and documentation of data.

2. To gain an understanding of how and where the data are being collected and documented.

3. To the extent practicable, identify and obtain data to be evaluated by the NRC staff at a later date.

4. To review hydrologic data from the Hanford Site in preparation for the upcoming DOE/NRC meeting about the BWIP hydrologic testing strategy.

5. To examine the application of BWIP's data collection, documentation and quality assurance procedures used between January 1984 and the present.

3.0 REVIEW ACTIVITIES

The BWIP hydrologic data made available by DOE (Attachment 3) was examined by five review teams consisting of NRC staff and their contractors (Attachment 4). Representatives of the States and affected Indian Nations were also invited to join these teams in the area of their interest and/or expertise. Review sheets (Attachment 5) were used to document review comments by the

review teams. These comments are of a preliminary nature and subject to change after further review by the NRC staff.

A request was made to DOE in the afternoon of December 3, 1986 to allow the NRC staff and contractors to continue reviewing data after 5:00 P. M. This request was denied by DOE.

3.1 NRC OBSERVATIONS

The NRC general observations are given below. More specific observations made by the review teams are included in the review sheets (Attachment 5)..

3.1.1 INFORMATION REQUESTS

Requests for additional information were made to DOE to clarify information evaluated during the review. These information requests were made on "Forms" provided by DOE (Attachment 6). Only about a third of these requests were responded to by DOE during the course of the data review.

3.1.2 HYDROLOGIC TESTING

The hydrologic testing information reviewed consisted primarily of data from holes DC-23GR and DC-18 and hydrologic field test procedures. Information from the field controlled notebook and the data book for DC-23GR form a relatively complete record of the data and decisions involved in the testing program. However, the quality of information recorded in the field-controlled notebook is inconsistent because several different field hydrologists recorded the information for this well. A field controlled notebook was not available to compare with the data book for DC-18 for our review despite frequent requests.

Problems identified during this portion of the hydrologic data review are discussed below under three headings: procedures, data collection, and data presentation. In addition, a brief discussion is presented concerning the implications of the data review analysis with respect to LHS testing.

PROCEDURES: The Hydrologic Field Testing Procedures (BOP C-2.8) do not provide guidance for multiple well testing or data analysis. Procedures for identification of hydrologically similar intervals for observation, selection of locations of observation sites at varying horizontal distances and locations of observation sites in overlying or underlying flow tops or interiors are not specified.

The procedures presented in BOP C-2.8 do not provide guidance for analysis of test results other than quotation of example references for analytical models. The procedures do not address the following questions:

- o Which analytical models should be used for data analysis?
- o How are observed deviations of data from ideal responses analyzed?
- o How are hydrologic coefficients selected from a suite of values calculated using alternative analytical models?

In addition, BOP (C-2.8) does not address the placement of transducers up-hole or down-hole for measurement of pressures during hydrologic tests. Problems associated with transducer placement are discussed in the following sections about data collection.

DATA COLLECTION: Problems in data collection identified during the review may be grouped under three general categories: up-hole versus down-hole transducers, data handling failures, and failure to optimize testing opportunities. Previous NRC data reviews identified problems with interpreting test results based on up-hole placement of transducers. Data reviewed during this data review illustrate the problems associated with the lack of specification of transducer placement. Hydrologic testing in DC-23GR used a combination of downhole and up-hole transducer placement. However, testing in DC-18 was performed with up-hole transducer placement for all long-term constant discharge tests and for all tests below about 1000 feet. The lack of consistency in transducer placement between concurrently tested holes introduces uncertainty in comparison of testing results. In addition, interpretation of testing results from DC-18 may be difficult because of problems inherent in using up-hole transducers or water level measurements. For example, constant discharge test data from the Rosalia flow in DC-18 will be difficult to interpret because of inconsistencies in drawdown/recovery data resulting from uphole transducer placement.

Experience at DC-23GR suggests that field data handling systems are subject to frequent failures. Failures have been observed to occur in pressure transducers, surface-based computer systems, printers, and power supplies. For example, six major breaks in data collection occurred because of equipment failures during the recovery period following airlift testing of the Ginkgo flow top (3/26-3/31, 1986).

In some cases, appropriate testing methodologies were used, but actual performance of the tests limited their utility with regard to analysis. For example, several constant discharge tests performed in DC-18 used pumping rates that were insufficient to adequately stress the system. The small drawdowns observed in

these tests contribute to uncertainties in calculated values of hydraulic coefficients.

DATA PRESENTATION: Review of data books for DC-23GR and DC-18 and the controlled notebook for DC-23GR revealed limitations in data presentation that impair independent review of testing data. First, graphical data presentations are not included in either the data books or the controlled notebook. The absence of data plots inhibits visual evaluation of test results for consistency with analytical models and data gaps. Second, information for DC-23GR is contained in the data book, the field controlled notebook prepared by the hydrologist, and a field notebook prepared by a person supervising the driller. A reasonably complete account of field activities appears to exist between these records. However, it is difficult for a reviewer to search the different accounts for information such as the diameter of the riser pipe for slug test analysis and the depth of the air line for air-lift pumping. A single controlled notebook for each drillhole could provide a complete chronology of activities at that hole, which could avoid the current possibility of omissions or conflicting descriptions of the same activity. Despite requests for it from the NRC review team, the lack of a controlled notebook for DC-18 prevented more thorough review of the testing at this hole.

IMPLICATIONS FOR LHS TESTING: The NRC review team identified four potential problems associated with LHS testing. The first is the lack of a set of procedures for running a multiple well hydrologic test on a large scale. Second, a procedure does not exist to guide analysis of data from single well or multiple well tests. Such a procedure is essential for interpretation of results to aid in conceptualization of the hydrogeologic framework as well as the estimation of hydrologic coefficients. Third, the limited accuracy of pressure transducers was evident from discussions with BWIP personnel and with team members reviewing hydraulic head data. These limitations may preclude utilization of down-hole or up-hole transducers for measurement of responses from LHS tests. The lack of automated data collection using transducers may be a serious limitation on LHS testing. Finally, the failure of the Westbay equipment in RRL-14 eliminates an important source of data for hydraulic responses in flow interiors. Only RRL-2C is presently designed to allow monitoring of hydraulic responses in flow interiors.

3.2.3 GEOLOGIC INFORMATION

Review of data related to the Cold Creek Syncline Hydrologic Anomaly (the "Yakima Barrier") is presented below.

GEOPHYSICAL DATA: Information provided were in the form of processed data (contour maps and synthetic seismograms), rather

than the original data sets. Thus the reviewers had to rely on DOE's interpretations of the data. The use of ground magnetic data to identify geologic features that could be associated with the Cold Creek hydrologic anomaly is questionable due to the subtle nature of the identified magnetic anomaly in the area and due to the existence of similar magnetic anomalies in other nearby areas where hydrologic anomalies have not been observed.

The Bouguer anomaly pattern observed in the vicinity of drill holes DH-27 and DH-28 is even less apparent than the anomaly observed on the magnetic map. In addition, the identified anomaly may be located to the east of where it has been drawn. Little evidence of an anomaly exists north of drill holes DH-27 and DH-28. However, the apparent anomaly continues south and east which raises questions about correlations between gravity and hydrologic anomalies that have not been inferred to extend farther south and east.

Identification of geologic structures that may be associated with the hydrologic anomaly using the reprocessed seismic data provided to the NRC review team is highly speculative. It is difficult to identify any structures or even any continuous reflectors using this data.

STRATIGRAPHY: A documented procedure and accompanying criteria for the identification of individual basalt flows within and among boreholes was not provided. Neither the detailed rock descriptions nor the geophysical logs contained any indication or notation concerning the identification of the basalt flows. The cross sections provided to the reviewers had the names of the flows but no description of how the flows were identified. DOE provided one table that listed graphic logs or geophysical logs as sources of such information, but the document did not provide criteria for stratigraphic identification. Although DOE indicated that stratigraphic identification procedures are described in data package DP-0-35, NRC reviewers requested but did not receive this data package. According to DOE contractor staff, rock chemistry apparently provides the most reliable data for differentiating individual basalt flows. However, the reviewers have not been provided with procedures for the identification of basalt flows based on rock chemistry. In addition, rock units correlated on the basis of geophysical data are not necessarily consistent with units correlated on the basis of rock chemistry.

HYDRAULIC HEAD DATA: Head data from DH-27 and DH-28 reveal a difference of only 42 feet. The head in DH-27 is approximately 475 feet (MSL) and the head in DH-28 is about 433 feet (ms). Although these heads are significantly lower than the 900 feet (MSL) in the Priest Rapids flow in the McGee well, the heads in DH-27 and DH-28 are considered to be composite heads over a combined zone that includes the Pomona Flow and the Selah Interbed.

GENERAL OBSERVATIONS: Operating procedures have not yet been developed for newer geophysical exploration techniques such as the vertical seismic profiling which was used by DOE in July 1985 at drill holes DH-27 and DH-28.

BWIP operating procedures (for example, geophysical surveys and geophysical well logging) are supposed to be reviewed on an annual or biannual basis. However, based on entries noted on the procedures forms, the user has no way of knowing if the revised procedures are being followed. For example, the most recent dates on several of the procedures are 1983. example, 1983.

Despite requests from NRC reviewers, DOE did not provide a composite borehole location and status chart. The absence of such a chart may impair the dissemination and utilization of borehole data among geologic and hydrologic reviewers.

Some of the data requested by NRC reviewers, specifically the geophysical logs, were not annotated and did not include a strata identification key. The reviewers requested this key, but were not provided with it during the data review. Without this key, the reviewers could not independently assess or verify DOE's interpretation.

Data collected during aquifer testing at the McGee well do not provide evidence for the existence of a hydrologic barrier west of the RRL. Although DOE has used these data to support the hypothesis of a barrier, DOE's analysis of the testing data was inconsistent with the assumptions of the analytical method. It is apparent that the reviewed data are insufficient to demonstrate the existence of a hydrologic barrier west of the RRL in the vicinity of the Yakima Barricade.

3.1.4 HYDRAULIC HEAD DATA

The water level data in the "NOMAD" data base are manually verified with the original site record. Adjusted water levels are computed for barometric effects in the Hewlett-Packard (HP) site files. Adjusted water levels also are computed separately in the "NOMAD" system. The two separate data files of barometrically adjusted water levels are not verified individually or cross-correlated.

DOE is dependent on manually measured water levels for establishing hydrologic baseline because DOE does not consider the transducer data to be of sufficient accuracy. DOE considers that transducer data are of primary value only for the monitoring of hydrogeologic tests. The absolute accuracy of Seling pressure transducers is insufficient to provide further resolution in

determining hydraulic gradients within the RRL (compared to current water level measurements).

Anomalous water level data are not checked immediately upon observation. The water level data appear to be checked only at the end of the period of record, approximately one week.

The Stevens continuous record water level charts are not digitized and placed in the data-computer acquisition system. Only the initial and the final hand-measured water levels for a given recording period are entered in the data-computer system.

Analysis of the hydrographs requires knowledge of site activity information to correlate observed hydraulic responses with possible perturbations created by the site activities. The hydrographs do not indicate where long inactive monitoring intervals occur. Interpolation between data points is not evident on the hydrographs.

Printouts of head data and hydrographs do not contain references to data packages, procedures, or software used to process these data.

Barometric efficiencies are not recalculated periodically as additional data are collected. Such recalculation could improve the reliability of the calculated barometric efficiencies.

3.1.4 MONITORING INSTALLATIONS

FLUID LOSS/GAINS: Although all requested information was not received from DOE, DOE documents appear to describe drilling fluid losses and gains in sufficient detail for hydrologic evaluations. The calculations and field measurements which are used to determine drilling fluid losses/gains are contained in control notebooks, visulogs, and daily shift reports. Discussions of drilling fluid losses may be found in many documents (such as SD-BWI-TI-313), but may not be described in the daily shift report.

Daily drilling status reports for various wells included a summary of fluid losses/gains. These status reports are not considered by DOE contractors to be part of the official record because they are informal internal memoranda. However, since they were provided to NRC reviewers to summarize drilling fluid losses/gains, it would appear that they should be part of the official record. For example, several data reports were missing on days when actual fluid losses occurred based on drilling shift reports. This error was discovered in a limited review of RRL-17 drilling fluid records.

INTEGRITY TESTING: Results of integrity testing of DB-11,12,14 and RRL-2A revealed casing leaks in DB-14 and RRL-2A and casing shoe leaks in DB-11 and possibly in DB-12. The casing shoe annulus leak in DB-12 could not be verified because water may have been injected into the open hole below the casing shoe. Integrity testing of piezometer nests in DC-19,20,22 and RRL-2C/2B have not been reviewed as part of the data review.

WESTBAY SYSTEM (RRL-14): The Westbay MP system originally installed in RRL-14 is currently non-operational because it was removed from the borehole in October 1986 after pressure testing indicated casing packer leaks. Based on the records presented by DOE/RHO, it appears that RHO has acknowledged the problem detected in accordance with specified verification procedures and has begun to assess the significance and potential corrective measures associated with the problem. It should be noted that hydrologic and hydrochemical data collected in RRL-14 using the Westbay MP system subsequent to October 1985 are of questionable reliability because the exact time of failure of the packer seals and other MP components after initial testing has not been established.

COMPOSITION OF WATER IN PIEZOMETERS: Review of water quality data of shallow bailed samples collected from the piezometers suggests that the tubes are filled with mixtures of Hanford system water and formation water. High pH's (10-11.2) observed in many samples suggest that grout has possibly affected the water chemistry. Because of the limited sampling and incomplete or inconsistent data, the water chemistry (and therefore density) does not characterize the column of water in each piezometer for head corrections.

An additional concern is the apparent sign-off sequence for this data set. Many of the data sheets were signed more than a year after sampling (no analysis date was given). Several data sheets were signed the day before the data review began (12/01/86).

GROUT TESTING: To answer questions about grout permeability, Rockwell performed several tests in both a DOE materials testing lab and by an outside contractor's lab. The permeability testing results of several mix batches of type G cement were consistent between labs and with published literature. The density of the grout mixture was by far the largest factor in influencing permeability. Hydraulic conductivity values ranged from E-9 to E-12 cm/sec. The testing procedures were well outlined and documented, however the actual calculations were not included in the control notebook, nor have they been received in response to requests from the NRC reviewer.

The cement permeability testing considers only matrix permeability; it ignores "microannulus conductivity." The DOE

contractor considers that integrity testing of the various piezometers will adequately test for microannular connection between monitoring zones.

During future completions, reliability of cement seals could be enhanced by collecting grout samples from the actual batches and testing to determine hydraulic conductivities.

3.1.5 HYDROCHEMICAL DATA

Major deficiencies appear to exist in the reporting of hydrochemistry data in the NOMAD data base. The data base does not contain sufficient information to allow independent reviewers to utilize the hydrochemical data contained in NOMAD. For example, analysis of samples DT-86-439 and DT-86-440 illustrates deficiencies of the NOMAD database. The data base indicates that these two samples were collected on subsequent days from the same sampling interval in RRL-14. Although both samples are identified as "system" water, their chemistries differ considerably. Information provided in the NOMAD database is insufficient to explain this difference. NOMAD does not identify references for further information. Controlled notebook RHO-BW-NP-302, however, indicated that sample -439 was collected within the casing while sample -440 was collected outside the casing. Important sample information has been excluded from the NOMAD data base. Further, the data base does not contain information about important chemical constituents, identify methods of analysis for trace elements, provide cation-anion charge balances, or provide the date that the samples were analyzed.

UNREPORTED PARAMETERS: Important parameters measured by BWIP hydrology staff are not reported in the NOMAD data base (e. g., sulfide and nitrogen species sampled from DC-18 and DC-23).

DISSOLVED OXYGEN: NOMAD does not provide both of the dissolved oxygen concentrations as determined by the Solution Chemistry Team and Hydrology Testing Team. The Solution Chemistry Team uses an electrode method while the Hydrology Testing Team uses Chemetrics and Hach spectrographic methods. Yet the NOMAD data base only provides the DO value determined by the Solution Chemistry Team.

TRACE ELEMENTS: For trace elements, knowledge of the analytical method used is necessary to evaluate the reliability of their concentrations. However, NOMAD does not indicate the analytical method used for trace element analysis.

ION BALANCES: Cation/anion charge balances and other parameters used in assessing sample reliability are not provided in the NOMAD database.

ANALYSIS DATE: Although the NOMAD data base identifies the date that the samples were collected, it does not identify when the samples were analyzed. BWIP Operating Procedures specify that the samples be analyzed as soon as possible. However, prolonged storage of samples prior to analysis may degrade the reliability of the sample analysis. In addition, the absence of the analysis date prevents cross-checking the sample analysis by referencing the controlled laboratory notebook.

3.2 DOE OBSERVATIONS

3.3 STATE OF WASHINGTON OBSERVATIONS

3.4 STATE OF OREGON OBSERVATIONS

3.5 YAKIMA INDIAN NATION OBSERVATIONS

The following draft comments are preliminary, and have been prepared for the meeting summary record. The official and complete comments will be submitted in the near future, and after YIN has received all requested data.

I. General Comments

1. We believe that all affected parties under NWPA should have access to data and technical information at all stages of the data collection or information gathering development which will be used in the site characterization process. We are concerned that the QA procedures sometimes may be used to limit the access. Therefore, if the affected parties can justify their request of access to the raw data, such data should be made available in a timely fashion.

2. The differentiation between data and data interpretation can have negative effects on the quality of the data, and the manner in which the data is collected. Limited analysis of data should be carried out and considered as part of the QA procedure in the data collection process.

3. As a consequence, the data review process should be allowed to include some types of raw data, and the analysis conducted during this collection. This will help in the understanding of the data in its final form.

II. Comments on QA details necessary for the data review

1. There are three formats under which information and data are presented:
   a. Hard copies and specifications documents,
   b. Drawings and maps, and
   c. Computer files (tapes).

   Step-by-step quality assurance/quality control should be adequate and traceable to take into account the different nature of such formats.

2. The QA procedures used in data collection and information gathering should document all technical and management steps involved in the creation of the end products so that the objectivity and errors may be evaluated accordingly. Certain internal QA mechanisms should permit dissenting opinions and disagreement to register in the formulation of the data base.

III. Technical Comments

All specific and detailed technical comments will be made in writing after the Yakima Nation has received the requested information, and has an opportunity to carefully review them.

3.6 UMATILLA AND NEZ PERCE INDIAN TRIBE OBSERVATIONS

1. The documentation was presented in three ways:
   a. Signed and numbered documents.
   b. Unsigned and/or unnumbered drafts.
   c. Personal files of DOE/Rockwell employees.

2. No annotated data on geological or geophysical logs of boreholes was presented. They had to use "draft" cross sections to interpret raw data.

3. Some data documents were signed over one year after they were completed.

4. During Rockwell Management Discussion: Only documentation with signatures and document numbers are

considered official; documents without numbers and/or signatures do not officially exist according to Rockwell, even though they were presented at the meeting. That presents a problem in examining data. We are not certain that the data being examined is official.

5. Data is not easily available. DOE could not find all information requested during the meeting.

6. The meeting was poorly organized and poorly planned. The data was unorganized.

7. Lack of coordination both among DOE contractors and among disciplines within DOE and its contractors was evident.

8. Some of DOE contractor's personnel are not "experts" in the field in which they are working and have had to be trained on the job.

9. How stable is grout in high alkalinity (pH up to 11.0)? Cement testing wasn't formalized and may not be adequate.

10. There was no annotated data for water level perturbations on the hydrographs, so perturbations had to be explained verbally during the meeting by Rockwell employees.

11. RHO-BWI-MA-4 (BWIP Operating Procedure) indicated that operating procedures were reviewed annually, but the last date on some pages was 1983 or 1984.

12. Hydrochemical analysis needs a set of operating procedures that define the species to be analyzed and the indicated detection limits. Are data points representing one test, or are they averages of several tests?

13. Incorrect date on Hydrograph discovered by review team was changed by a Rockwell employee during a review meeting without proper QA procedures.

14. The meeting was a good attempt at a coordinated data review on Hydrology.

4.0 DATA PROVIDED TO NRC

Although DOE initially indicated that the data provided for review and referenced in Attachment 3 could be retained by the NRC at the end of the data review, the NRC was subsequently informed by DOE at the close of the data review that DOE would have to release the data through their document management system to ensure that it was releasable.

5.0 DATA REQUESTED BY NRC

Data requested by NRC but not provided by the DOE during the course of the data review will be forwarded to the NRC by January 30, 1987 in accordance with Section 3.C of the Site Specific Procedural Agreement. These items include:

These summary review notes have been discussed in a meeting with the DOE and their contractors. These notes constitute the official record of the Hanford Site Hydrology Data Review performed at Richland, Washington from December 2-4, 1986.

NRC	DOE/RL
NRC	DOE/RL

State of Washington

State of Oregon

Yakima Indian Nation

Umatilla Indian Tribe

Nez Perce Indian Tribe

Tilak R. Verma 12/5/86
NRC (WMGT)

DOE/RL

12/5/86
NRC (WMRP)

DOE/RL

12/5/86
State of Washington

12/5/86
State of Oregon

Yakima Indian Nation

12/5/86
Umatilla Indian Tribe

12/5/86
Nez Perce Indian Tribe

NOTE:

These data review summary notes were discussed with DOE on Dec. 5, 1986. DOE declined to acknowledge these notes until they review and formally respond to the observations made by the review teams.

12/5/86

Tilak R. Verma 12/5/86