FORM NRC-2
(7-77)
10 CFR 40

Approved by GAO
R0203

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR SOURCE MATERIAL LICENSE

Pursuant to the regulations in Title 10, Code of Federal Regulations, Chapter 1, Part 40, application is hereby made for a license to receive, possess, use, transfer, deliver or import into the United States, source material for the activity or activities described.

1. (Check one)
- ☐ (a) New license
- ☐ (b) Amendment to License No. _____
- ☒ (c) Renewal of License No. SUA-1337
- ☐ (d) Previous License No. _____

2. NAME OF APPLICANT
WESTERN NUCLEAR, INC.

3. PRINCIPAL BUSINESS ADDRESS
134 Union Blvd., Suite 640
Lakewood, CO 80228

4. STATE THE ADDRESS(ES) AT WHICH SOURCE MATERIAL WILL BE POSSESSED OR USED
CHRISTENSEN RANCH, CAMPBELL COUNTY, WYOMING

5. NAME OF PERSON TO BE CONTACTED CONCERNING THIS APPLICATION
Grey Bogden

6. TELEPHONE NO. OF INDIVIDUAL NAMED IN ITEM 5
303/986-4571

7. DESCRIBE PURPOSE FOR WHICH SOURCE MATERIAL WILL BE USED
A research and development project to test the economic and environmental feasibility of applying in-situ leaching technology to the uranium orebody.

8. STATE THE TYPE OR TYPES, CHEMICAL FORM OR FORMS, AND QUANTITIES OF SOURCE MATERIAL YOU PROPOSE TO RECEIVE, POSSESS, USE, OR TRANSFER UNDER THE LICENSE

(a) TYPE	(b) CHEMICAL FORM	(c) PHYSICAL FORM (*Including % U or Th.*)	(d) MAXIMUM AMOUNT AT ANY ONE TIME *(kilograms)*
NATURAL URANIUM	$UO_4 \cdot 2H_2O$	Concentrated slurry	450
URANIUM DEPLETED IN THE U-235 ISOTOPE			
THORIUM (ISOTOPE)			

(e) MAXIMUM TOTAL QUANTITY OF SOURCE MATERIAL YOU WILL HAVE ON HAND AT ANY TIME *(kilograms)*
450

9. DESCRIBE THE CHEMICAL, PHYSICAL, METALLURGICAL, OR NUCLEAR PROCESS OR PROCESSES IN WHICH THE SOURCE MATERIAL WILL BE USED, INDICATING THE MAXIMUM AMOUNT OF SOURCE MATERIAL INVOLVED IN EACH PROCESS AT ANY ONE TIME, AND PROVIDING A THOROUGH EVALUATION OF THE POTENTIAL RADIATION HAZARDS ASSOCIATED WITH EACH STEP OF THOSE PROCESSES
Refer to Section C. Minerals Extraction Plan (attached)

10. LIST THE NAMES AND ATTACH A RESUME OF THE TECHNICAL QUALIFICATIONS, INCLUDING TRAINING AND EXPERIENCE, OF APPLICANT'S SUPERVISORY PERSONNEL AND THE PERSON RESPONSIBLE FOR THE RADIATION SAFETY PROGRAM (OR OF APPLICANT IF AN INDIVIDUAL).
Refer to Sections 5.1 and 5.4 (attached)

11. DESCRIBE THE EQUIPMENT AND FACILITIES WHICH WILL BE USED TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE OR PROPERTY AND RELATE THE USE OF THE EQUIPMENT AND FACILITIES TO THE OPERATIONS LISTED IN ITEM 9. INCLUDE: (a) RADIATION DETECTION AND RELATED INSTRUMENTS (including film badges, dosimeters, counters, air sampling, and other survey equipment as appropriate. The description of radiation detection instruments should include the instrument characteristics such as type of radiation detected, window thickness, and the range(s) of each instrument).
Refer to Sections 5.6, 5.7, and 5.7.1 through 5.7.10 (attached)

(b) METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED IN (a) ABOVE, INCLUDING AIR SAMPLING EQUIPMENT (for film badges, specify method of calibrating and processing, or name supplier).
Refer to Sections 5.7.2.1, 5.7.2.2, 5.7.3.2, 5.7.6, and 5.7.7 (attached)

DUPE 8308230754 3PP

11(c). VENTILATION EQUIPMENT WHICH WILL BE USED IN OPERATIONS WHICH PRODUCE DUST, FUMES, MISTS, OR GASES, INCLUDING PLAN VIEW SHOWING TYPE AND LOCATION OF HOOD AND FILTERS, MINIMUM VELOCITIES MAINTAINED AT HOOD OPENINGS AND PROCEDURES FOR TESTING SUCH EQUIPMENT

Refer to Section C.2.a of the Minerals Extraction Plan and Section 5.7.1 (attached)

12 DESCRIBE PROPOSED PROCEDURES TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE AND PROPERTY AND RELATE THESE PROCEDURES TO THE OPERATIONS LISTED IN ITEM 9. INCLUDE (a) SAFETY FEATURES AND PROCEDURES TO AVOID NONNUCLEAR ACCIDENTS, SUCH AS FIRE, EXPLOSION, ETC., IN SOURCE MATERIAL STORAGE AND PROCESSING AREAS

Refer to Section 5.7.11 (attached)

(b) EMERGENCY PROCEDURES IN THE EVENT OF ACCIDENTS WHICH MIGHT INVOLVE SOURCE MATERIAL

Refer to Sections 5.7.10 and 5.7.11 (attached)

(c) DETAILED DESCRIPTION OF RADIATION SURVEY PROGRAM AND PROCEDURES

Refer to Sections 5.7.2, 5.7.3, and 5.7.6 (attached)

13. WASTE PRODUCTS: *If none will be generated, state "None" opposite (a), below. If waste products will be generated, check here* ☒ *and explain on a supplemental sheet:*

(a) Quantity and type of radioactive waste that will be generated. (attached)

(b) Detailed procedures for waste disposal. Refer to Sec. C Minerals Extraction Plan

14. IF PRODUCTS FOR DISTRIBUTION TO THE GENERAL PUBLIC UNDER AN EXEMPTION CONTAINED IN 10 CFR 40 ARE TO BE MANUFACTURED, USE A SUPPLEMENTAL SHEET TO FURNISH A DETAILED DESCRIPTION OF THE PRODUCT, INCLUDING:

(a) PERCENT SOURCE MATERIAL IN THE PRODUCT AND ITS LOCATION IN THE PRODUCT.

(b) PHYSICAL DESCRIPTION OF THE PRODUCT INCLUDING CHARACTERISTICS, IF ANY, THAT WILL PREVENT INHALATION OR INGESTION OF SOURCE MATERIAL THAT MIGHT BE SEPARATED FROM THE PRODUCT.

(c) BETA AND BETA PLUS GAMMA RADIATION LEVELS (*Specify instrument used, date of calibration and calibration technique used*) AT THE SURFACE OF THE PRODUCT AND AT 12 INCHES.

(d) METHOD OF ASSURING THAT SOURCE MATERIAL CANNOT BE DISASSOCIATED FROM THE MANUFACTURED PRODUCT.

CERTIFICATE

(*This item must be completed by applicant*)

15. *The applicant, and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 40, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.*

BY: Grey Bogden
(*Signature*)

Dated July 12, 1983

Grey Bogden
(*Print or type name*)

Department of Environmental & Industrial Safety
(*Title of certifying official authorized to act on behalf of the applicant*)

WARNING: 18 U.S.C. Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

Form NRC-2 (7-77)

AMBIENT PREOPERATIONAL RADON GAS CONCENTRATIONS[1]
CHRISTENSEN RANCH PROPOSED R & D SITE #1
Willow Creek

	Average Radon-222 Concentration ± Precision[2] (pCi/l)			
Sampling Period	Site A[3]	Site B[4]	Site C[5]	Site D[6]
6/13/82 to 7/24/82	0.09	0.07		
6/14/82 to 7/24/82			0.34	
6/15/82 to 7/24/82				0.2
7/24/82 to 8/13/82	Not Determined	0.20±0.10	0.26+0.13	0.08±0.05
8/13/82 to 11/03/82	0.09±0.04	0.02±0.03	0.33±0.16	0.05±0.04
11/03/82 to 12/15/82	0.06±0.04	0.03±0.02	0.24±0.11	0.09±0.05
12/15/82 to 01/19/83	0.03±0.02	0.05±0.03	0.14±0.07	0.04±0.03
01/19/83 to 02/21/83	0.06±0.04	0.06±0.04	0.09+0.05	0.07±0.04
02/21/83 to 03/29/83	0.05±0.04	0.08±0.05	0.13±0.07	0.07±0.04
03/29/83 to 04/21/83	0.10±0.07	0.07±0.06	0.14±0.08	0.11±0.07
04/21/83 to 06/10/83	0.10±0.06	0.06±0.04	0.14±0.07	0.19±0.10

[1]Sampling sites are shown in Section 5.0, OPERATIONS, Figures 5.5.7-2 and 5.5.7-3.

[2]Precision is 95% confidence level based on total uncertainty of individual measurement.

[3]Site A: at R&D Site #1, upwind (SW perimeter) sampling site

[4]Site B: at R&D site #1, downwind (N perimeter) sampling site

[5]Site C: at nearest residence, Christensen Ranch

[6]Site D: at remote background location, Innes Ranch

07/11/83

CONTENTS

LIST OF TABLES

List of Tables - continued

LIST OF FIGURES

List of Figures - continued

LIST OF MAPS

LIST OF PLATES

APPENDIX D-1

PAST AND PRESENT LAND USE OF THE AREA

Overview

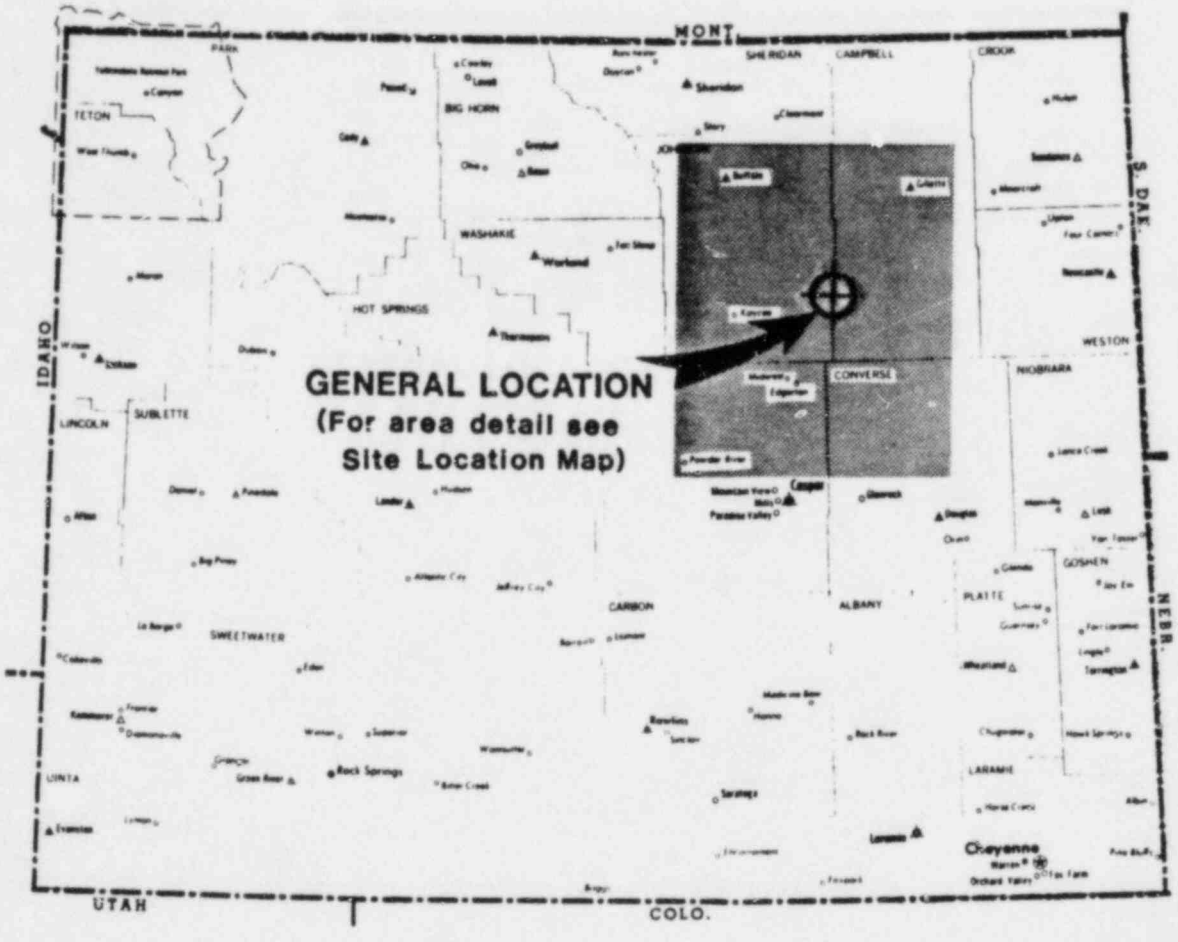
The Willow Creek R&D #1 permit area is in northeastern Wyoming in the Powder River Basin. It is located along the Campbell-Johnson County boundary approximately 26 miles west of Reno Junction, 30 miles north-northeast of Midwest, 50 miles southwest of Gillette, Wyoming (see Maps D-1-1, D-1-2, D-1-3, and D-1-4.) The property is in Sections 17 and 20, T44N, R76W, Campbell County. The nearest communities are Pine Tree Junction and Wright, about 12 and 24 miles distant, respectively. Access is via graded oil field service roads to within 0.5 mile of the site.

Climate of the area as described in Appendix D-4 is characterized as semi-arid with average annual precipitation of about 14 inches. The area has a relatively short growing season, averaging 116 days between the average date of last freeze and first freeze. Temperatures range from winter lows near -30°F to summer highs above 90°F.

The permit area and vicinity are composed mainly of tablelands of moderate topographic relief. Vegetation consists of rangelands characteristic of the shortgrass prairie. There are limited acreages of irrigated hay along Willow Creek. Campbell County does not contain any prime farmland, according to the U.S.D.A. Soil Conservation Service (SCS), because irrigation water of sufficient quantity and quality is lacking and the fallow system of producing crops does not permit crops to be grown seven out of ten years (Cranston, Mike, SCS, personal communication, 1982).

The most common rangeland type occurs on non-saline soils and has not been improved. Plants frequently found in this area include blue grama, Sandberg bluegrass, junegrass, and western wheatgrass. Big sagebrush and silver sage also occur. Average production from this vegetation type is about 800 to 1,000 pounds per acre.

Saline rangelands occur along major drainages and have vegetation consisting of salt-tolerant species. Typical plants include saltgrass and spike rush. Forage production from these lands averages about 2,000 pounds per acre.



North

15 60

0 30 120

Scale

1" EQUALS 60 MILES

Christensen Ranch ISL Project

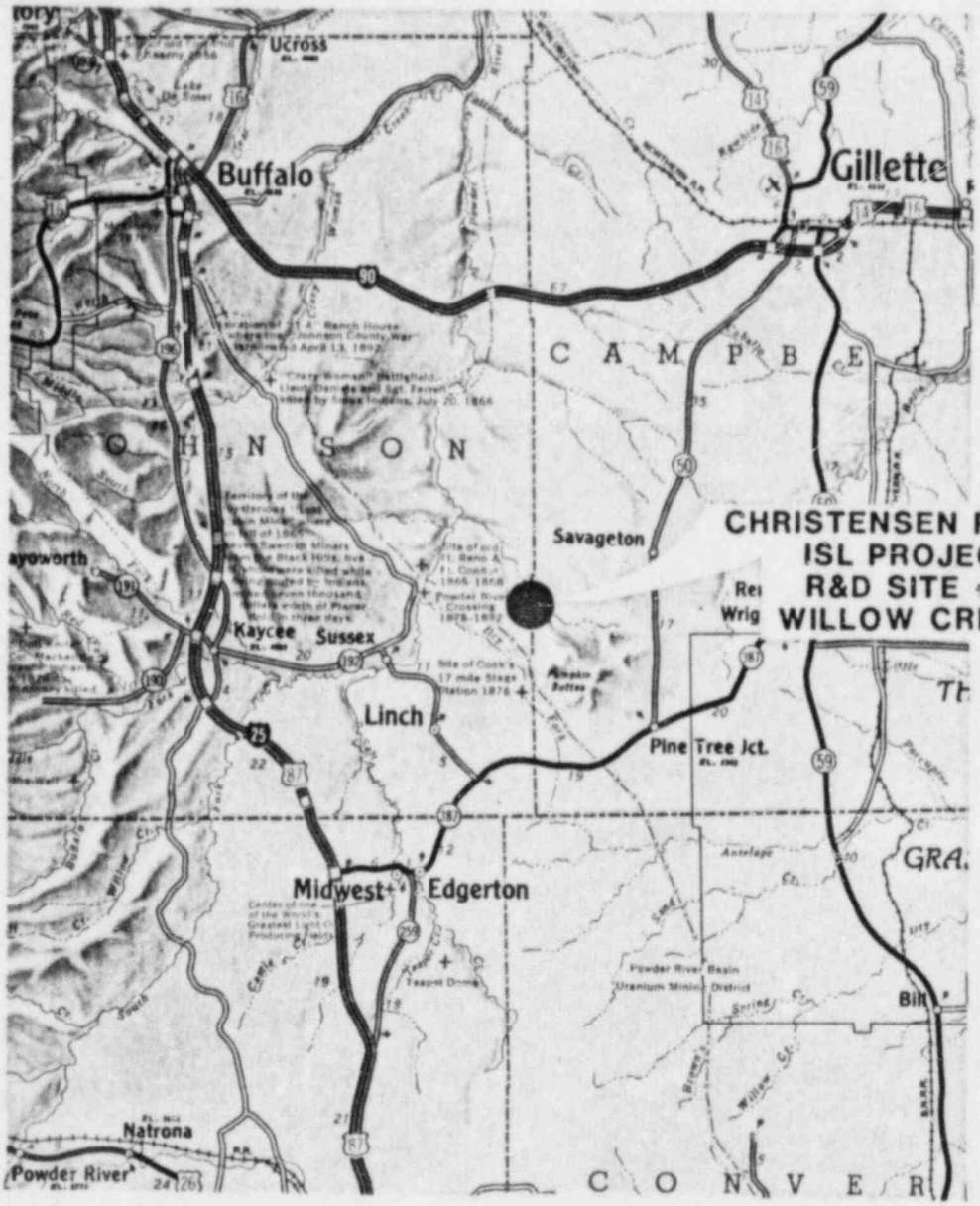
R&D Site No. 1

WILLOW CREEK

WYOMING STATE MAP GENERAL LOCATION

MAP D-1-1

WESTERN NUCLEAR, INC.



REFERENCE:

Official Highway Map
of Wyoming, Wyoming State
Highway Commission Dated 1979.

0 9 18 36

Scale

1" EQUALS 18 MILES

Christensen Ranch ISL Project

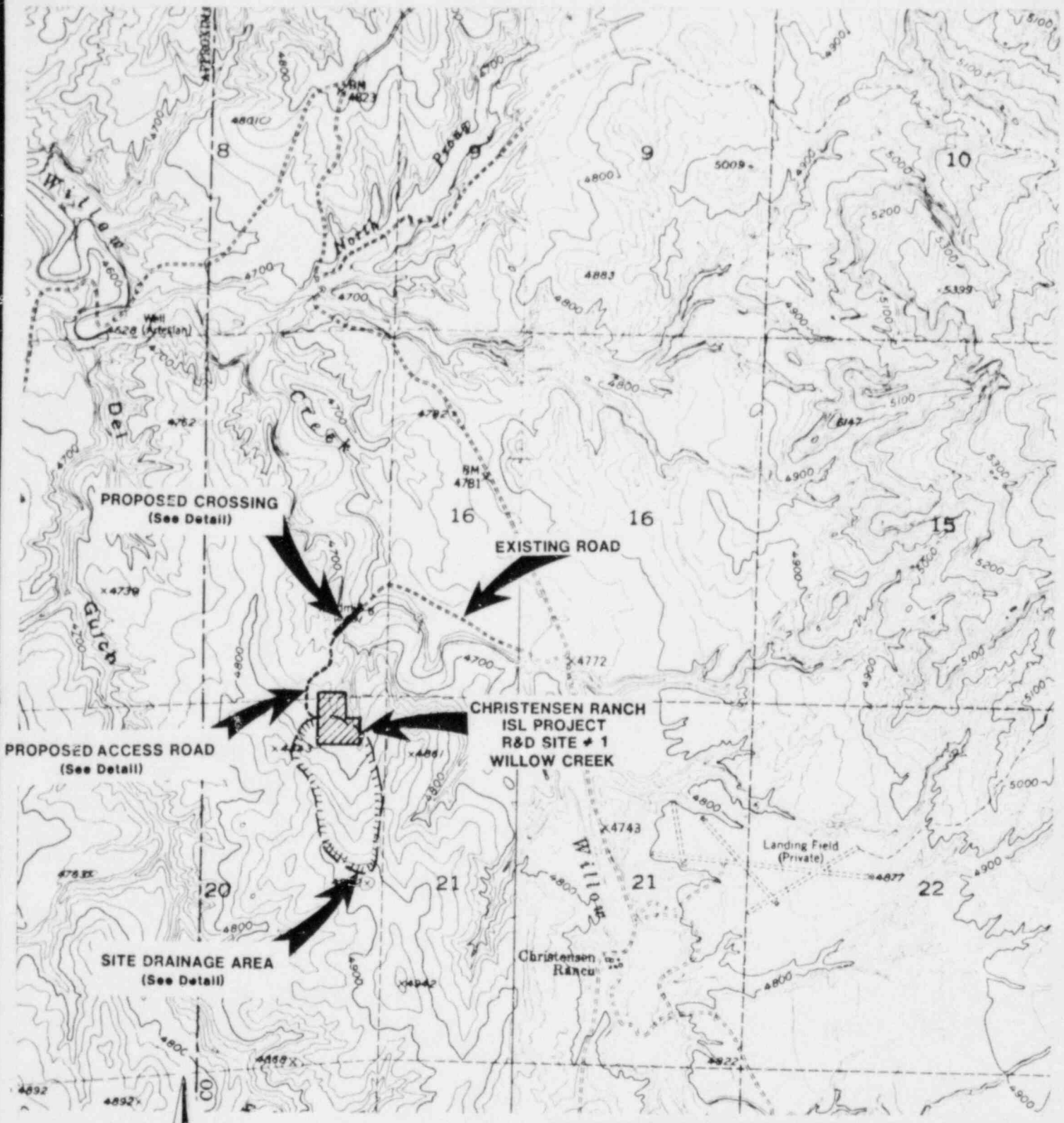
R&D Site No. 1

WILLOW CREEK

SITE LOCATION MAP

MAP D-1-2

WESTERN NUCLEAR, INC.



D-1-4

Christensen Ranch ISL Project

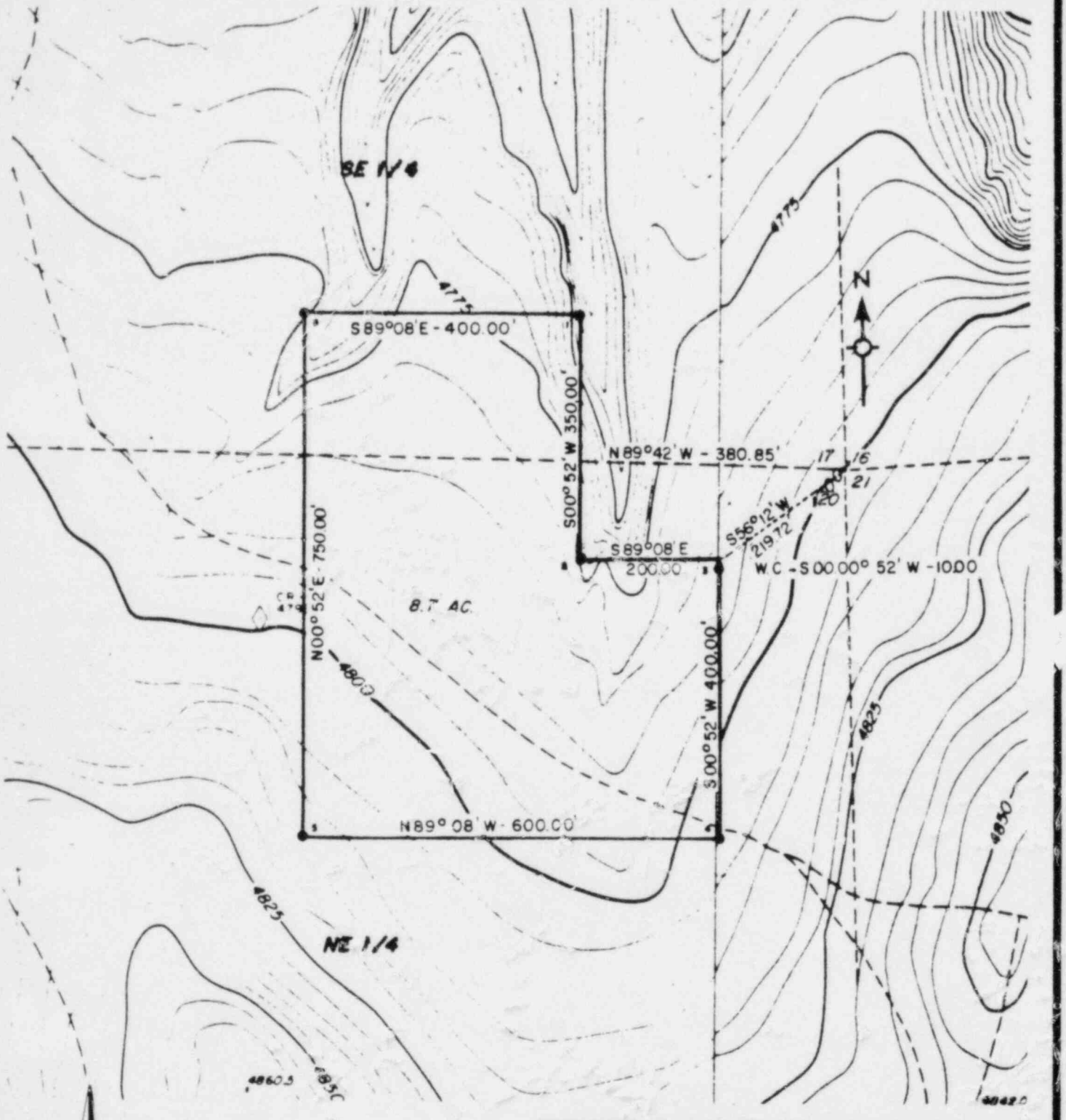
R&D Site No. 1

WILLOW CREEK

LOCATION MAP

MAP D-1-3

WESTERN NUCLEAR, INC.



D-1-5

Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

LEGAL DESCRIPTION

Sec. 17 &20 , T44N. R76W, 6th P.M.

Campbell County, Wyoming

MAP D-1-4

WESTERN NUCLEAR, INC.

Grazing Use

Grazing is the major land use at the proposed site. The Willow Creek permit area is owned by J. F. Christensen and family. Rangeland at the sites has been utilized for cattle and sheep grazing since 1900 and this use is expected to continue in the future (Christensen, J. F., personal communication, 1982).

Another use of the area has been for wildlife forage and shelter. Wildlife found in the site vicinity include pronghorn, mule deer, jackrabbits, golden eagles, furbearers, and a variety of small mammals and song birds (Appendix D-9).

Recreation

Recreational use of the permit area is limited because of the private ownership and remoteness. Hunting is the only historic recreation land use, and it occurs on a very small scale, primarily by local residents.

Mineral Development

Oil and gas development is conducted in the vicinity of the site in the Pumpkin Butte, Hartzog, and Collins fields. However, no activity is now underway on or adjacent to the study sites. Uranium exploration has occurred throughout the area as evidenced by abandoned drill holes on the proposed permit area and in the general project vicinity.

Potential Impacts to Grazing

The Willow Creek permit area will have a total affected area of 8.7 acres with a disturbed area of 1.8 acres. The disturbance area contains rangeland vegetation common to this portion of Campbell County. Based on average production of 1,500 pounds per acre and about 20 acres per AUM (Christensen, J. F., personal communication, 1982), the potential loss of grazing forage in the permit area amounts to about 0.4 AUM. The total acreage involved is less than .5 percent of the rangeland owned and leased by J. F. Christensen and family. Therefore, it is anticipated that the proposed project will not have a significant adverse effect on livestock operations.

Once R&D activity is complete, disturbed lands will be revegetated to a better than or equal to current condition, or will be developed into a production facility, pending further agency approval.

APPENDIX D-3
ARCHAEOLOGICAL AND PALEONTOLOGICAL RESOURCES

Greg Smith, an archaeologist with the Wyoming Department of Environmental Quality (DEQ), conducted a pedestrian inventory of the proposed Western Nuclear R&D site in May 1982. His subsequent recommendation was that no further work be required in regard to these resources, with the exception that should any cultural or paleontological remains be discovered during the project, the Administrator, Wyoming DEQ/Land Quality Division, would be notified within five days prior to further disturbance. (See the attached correspondence).

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Department of Environmental Quality

LAND QUALITY DIVISION

401 WEST 19TH STREET TELEPHONE 307-777-7756 CHEYENNE, WYOMING 82002

June 29, 1982

Sophie Sawyer
Senior Project Coordinator
Environmental Research and Technology, Inc.
P.O. Box 2105
Fort Collins, CO 80522

Dear Sophie:

I'm sorry to be so long in getting this report to you but an extended period of hospitalization temporarily interrupted all my work.

I conducted an intensive pedestrian inventory of the proposed Western Nuclear R & D permit areas on May 20. I found no surficial evidence of either cultural or paleontological remains. I will recommend that no further work be required in regard to these resources, with the exception that should any cultural or paleontological remains be discovered during excavation for the project the Administrator, WDEQ/LQD, be notified within 5 days prior to any further disturbance.

Thanks again for your patience.

Sincerely,

Greg Smith
Archeologist

GS:lmk

APPENDIX D-4

CLIMATOLOGY

This section identifies and discusses the meteorological and climatological characteristics of the permit area. Specifically addressed are temperature, precipitation, and wind data. The permit area is classified as having a semi-arid climate.

Local Geography and Available Meteorological Data

The permit area is located along the Campbell-Johnson County boundary, about 30 miles (48 km) north-northeast of the town of Midwest, Wyoming. The site is along the western edge of Pumpkin Buttes, the most significant terrain feature of the area, rising slightly more than 1,000 feet over the permit area base elevation. Otherwise, the regional topography is dominated by rolling hills and ridges along the Powder, Belle Fourche, and North Platte River drainages. Major topographic barriers of the region are the Big Horn Mountains (50 miles to the west and northwest), the Laramie Mountains (65 miles to the south), and the Black Hills (120 miles to the east).

Extensive meteorological data records are not available for the permit area. However, a good climatological data base is available for several locations surrounding the permit area. The closest meteorological data sites are at Midwest and Kaycee, both about 30 miles to the southwest and west, respectively. Additional data are available at Gillette, approximately 50 miles to the northeast. The period of record most recently available from the National Oceanic and Atmospheric Administration (NOAA) covers 30 years at Midwest, 27 years at Kaycee, and 24 years at Gillette. The use of long-term records is better than a single year of data to define the mean and extreme meteorological conditions.

The long-term NOAA climatological data base has been supplemented by the installation of meteorological monitoring equipment at nearby industrial sites, primarily coal mines in Campbell County. Records from these facilities are particularly useful in helping to define area wind patterns.

These sources provide a more than adequate data base from which to make a valid assessment of the climatology of the permit area.

Temperature

Monthly values of mean and extreme temperature readings taken at Midwest, Kaycee, and Gillette are presented in Table D-4-1. Temperatures show a wide range between summer and winter, and between daily minimums and maximums. This is primarily due to the high elevation of the region and the relatively dry air which enhances the incoming and outgoing solar radiation at the surface. Outbreaks of arctic air invade the permit area during the winter and subject the region to extremely cold temperatures. However, these episodes are generally short-lived, and for the most part, winter-time temperatures are higher than would be expected at this elevation. These milder temperatures are the consequence of downslope compression which typically occurs with the prevailing westerly synoptic scale winds.

Freezing temperatures are common during the late spring and early fall in the permit area. Table D-4-2 shows the average growing seasons for Midwest, Kaycee, and Gillette based on 32°F and 28°F. Average growing seasons are longest at Midwest, 5 to 10 days shorter at Gillette, and about 20 days shorter at Kaycee.

Precipitation

Monthly mean and daily extreme precipitation data are presented in Table D-4-3. Mean monthly precipitation peaks in the spring and early summer months. These months also show the greatest frequency of precipitation events. Maximum daily precipitation amounts are greater during the summer months, and are typically associated with thunderstorm events.

Most summer-time precipitation comes from convective showers and thundershowers, while winter-time precipitation usually falls as snow. During the spring and fall, moisture is derived from a combination of convective showers and steady rain or snow. There is great variation in precipitation amounts from month-to-month and year-to-year. The record maximum monthly precipitation in the area is 10.0 inches at Gillette in June of 1964, but several months exist on record at all stations when little or no precipitation was received.

Monthly mean and daily extreme snowfall data are presented in Table D-4-4. Monthly mean snowfall shows only slight variation over the winter months, with peaks at Gillette and Midwest during March and

TABLE D-4-1

MONTHLY MEAN AND DAILY EXTREME TEMPERATURE DATA[1]

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Monthly Mean Temperature (°F)													
Midwest	24.1	27.3	34.1	45.0	54.9	64.4	73.0	71.2	61.1	49.8	34.8	28.2	47.3
Kaycee	21.6	26.0	31.0	42.9	52.4	60.5	69.3	67.5	57.2	47.0	32.7	25.4	44.5
Gillette	21.1	26.5	31.7	42.1	52.8	62.1	70.5	69.5	58.2	47.9	33.1	24.8	45.0
Monthly Mean Maximums (°F)													
Midwest	36.3	40.2	47.5	59.7	70.1	80.8	91.1	89.5	78.9	65.9	47.6	39.9	62.3
Kaycee	37.4	41.0	45.3	57.8	67.3	76.5	87.8	86.6	75.3	64.7	48.1	40.8	60.7
Gillette	32.5	37.8	43.3	54.8	65.9	76.0	86.6	86.0	73.7	62.2	44.5	35.7	58.3
Monthly Mean Minimums (°F)													
Midwest	11.9	14.4	20.6	30.3	39.7	47.9	54.9	52.8	43.2	33.7	22.0	16.5	32.3
Kaycee	5.7	11.0	16.7	27.9	37.5	44.5	50.8	48.4	39.1	29.3	17.2	10.0	28.2
Gillette	9.7	15.2	20.1	29.3	39.7	48.2	54.3	52.9	42.7	33.6	21.7	13.9	31.8
Record Maximum Temperatures (°F)													
Midwest	62	69	77	89	94	102	106	105	100	89	76	69	106
Kaycee	66	71	76	83	92	104	105	103	97	87	77	66	105
Gillette	62	64	75	83	94	104	104	104	98	89	74	64	104
Record Minimum Temperatures (°F)													
Midwest	-39	-41	-20	-16	14	26	37	32	14	4	-26	-31	-41
Kaycee	-45	-34	-30	-3	12	25	33	28	13	-3	-37	-42	-45
Gillette	-34	-22	-23	-1	11	28	35	32	20	-3	-26	-31	-34

[1]Period of Record:

Midwest	1931-1960
Kaycee	1941-1967
Gillette	1951-1974

TABLE D-4-2

AVERAGE GROWING SEASON[1]

Station	No. of Days (32°F)	No. of Days (28°F)
Midwest	127	152
Kaycee	106	132
Gillette	122	143

[1]Period of record: Midwest 1931-1960
Kaycee 1941-1967
Gillette 1951-1974

TABLE D-4-3

MONTHLY MEAN AND DAILY EXTREME PRECIPITATION DATA[1]

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Monthly Mean Precipitation (inches)													
Midwest	0.55	0.55	1.01	1.72	2.21	1.74	1.19	0.80	0.93	0.90	0.72	0.52	12.84
Kaycee	0.40	0.32	0.61	1.56	1.97	2.20	1.01	0.66	1.09	0.82	0.51	0.35	11.50
Gillette	0.55	0.62	0.78	1.78	2.42	3.18	1.36	1.15	1.31	1.03	0.67	0.57	15.42
Record Daily Precipitation (inches)													
Midwest	0.63	0.90	1.50	2.35	2.29	1.38	1.74	2.69	3.56	1.53	0.62	0.60	3.56
Kaycee	0.58	0.40	0.56	1.52	1.60	3.62	0.92	1.72	1.19	1.58	0.39	0.45	3.62
Gillette	0.64	0.85	0.81	2.12	2.00	4.10	1.60	2.82	1.65	1.43	0.90	0.40	4.10

[1]Period of Record:

Midwest	1931-1960
Kaycee	1941-1967
Gillette	1951-1974

TABLE D-4-4

MONTHLY MEAN AND DAILY EXTREME SNOWFALL DATA[1]

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
						Monthly Mean Snowfall (inches)							
Midwest	8.3	7.7	9.5	8.3	1.6	0.1	0.0	0.0	0.2	2.4	7.5	7.2	52.8
Kaycee	7.0	6.0	6.4	6.4	2.8	0.1	0.0	0.0	0.6	2.9	6.0	6.3	44.5
Gillette	9.0	10.0	10.1	9.9	2.0	0.3	0.0	0.0	1.1	4.1	7.5	9.2	63.2
						Record Daily Snowfall (inches)							
Midwest	10.0	12.0	13.0	28.0	6.0	3.0	0.0	0.0	2.0	12.0	7.5	11.0	28.0
Kaycee	8.1	8.7	5.1	22.0	11.7	1.4	0.0	0.0	4.2	8.0	7.8	6.0	22.0
Gillette	14.0	12.0	7.0	13.0	10.0	2.0	0.0	0.0	4.0	8.0	12.0	8.0	14.0

[1]Period of record: Midwest 1931-1960
Kaycee 1941-1967
Gillette 1951-1974

January at Kaycee. Daily maximum snowfall typically occurs during the spring. Snow has occurred at each station during every month except July and August.

Wind Patterns

Synoptic scale winds in the permit area have a dominant westerly component, but at any one time the local surface winds are dependent on the regional weather patterns and topographic features.

Wind speeds at Midwest and Gillette are estimated to average approximately 13 miles per hour (mph) annually and about 8 mph at Kaycee. Stronger winds are typical of all sites during the winter and spring months, while weakest winds are common during the summer. Daytime wind velocities are also usually higher than nighttime wind velocities. Damaging winds with speeds of over 75 mph sometimes occur during severe thunderstorm events.

Predominate wind directions usually follow the significant terrain features. In the permit area, this means the winds are oriented along a northwest-southeast axis. Wind data collected at Campbell County coal mining projects show this pattern and should be indicative of wind patterns in the permit area. Annual wind roses for the Cordero and Caballo mines are presented in Figures D-4-1 and D-4-2, respectively.

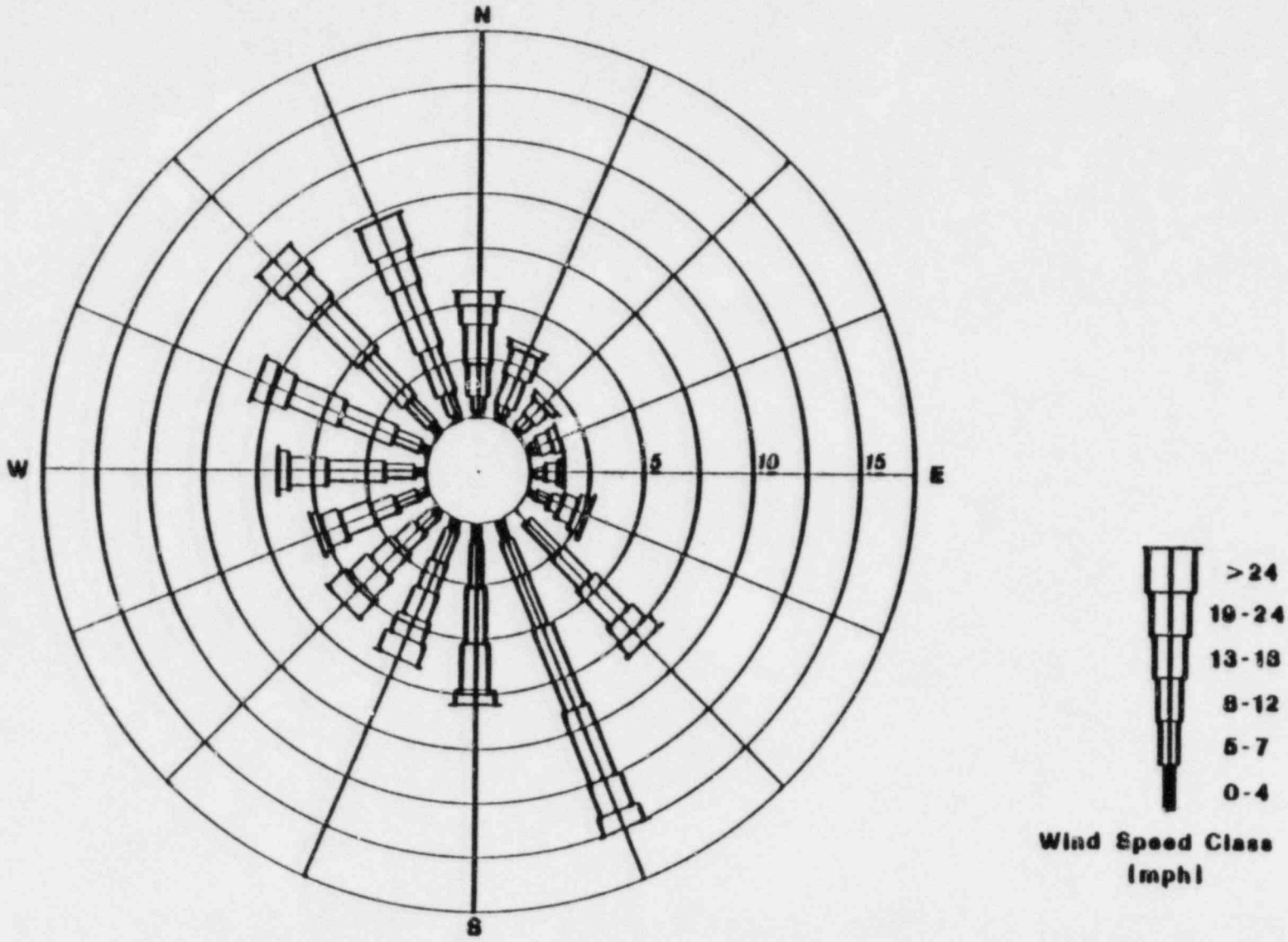


Figure D-4-1 Annual Wind Rose for the Cordero Mine

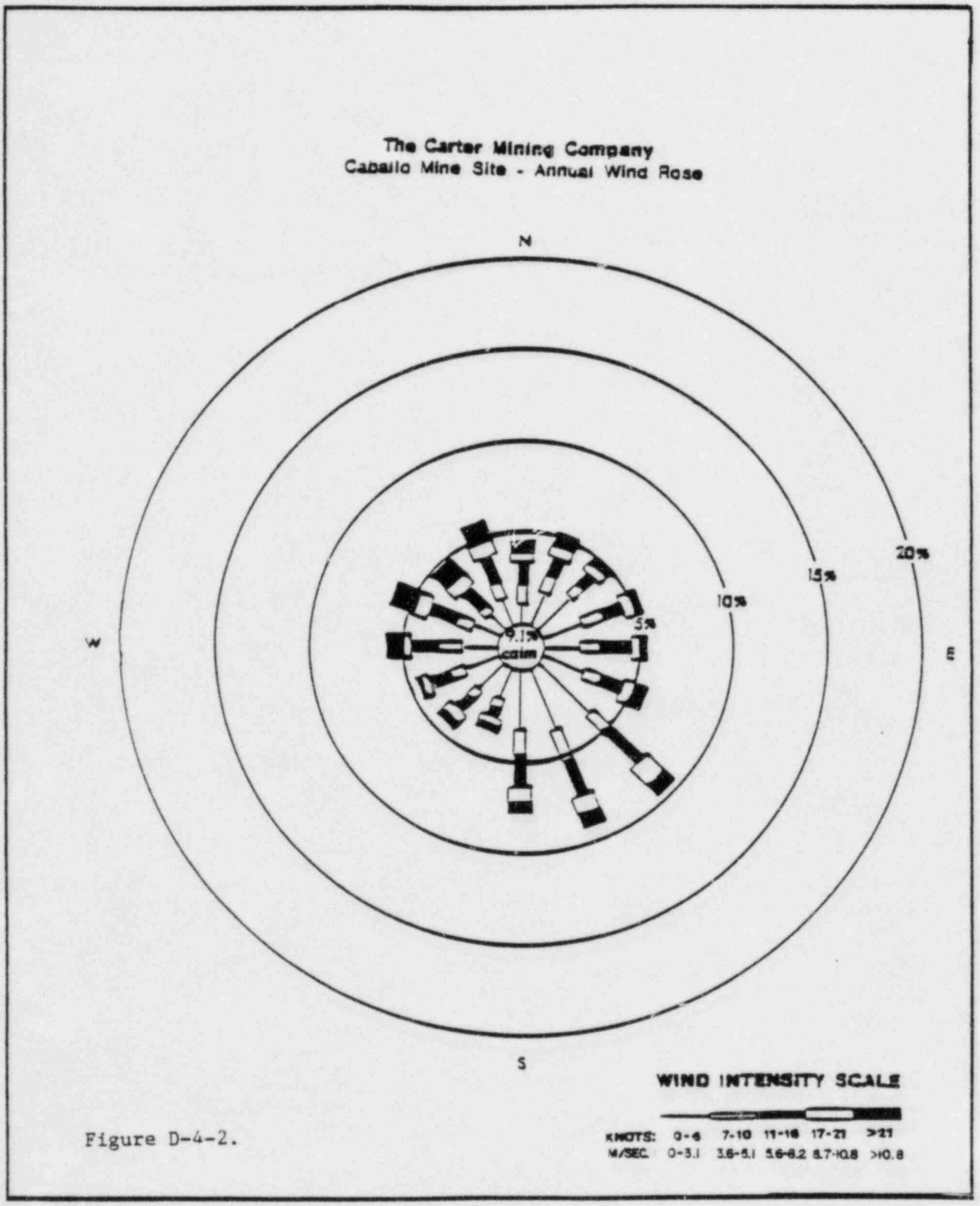

The Carter Mining Company
Caballo Mine Site - Annual Wind Rose
N
W
E
S
5%
10%
15%
20%
9.1%
calm
WIND INTENSITY SCALE
KNOTS: 0-6 7-10 11-16 17-21 >21
M/SEC. 0-3.1 3.6-5.1 5.6-8.2 8.7-10.8 >10.8

Figure D-4-2.

APPENDIX D-5

GEOLOGIC ASSESSMENT

Geology of the Christensen Ranch

Introduction and General Description

The Christensen Ranch property is situated in the south-central portion of the Powder River Basin in Johnson and Campbell Counties, Wyoming. Sediments of the Powder River Basin are of Tertiary Age and consist primarily of the Paleocene Age, Fort Union, and the unconformably overlying Late Paleocene or Early Eocene Wasatch Formation. Both the Fort Union and Wasatch Formations are typical fluvial deposits not unlike those of other Wyoming Tertiary basins.

The Wasatch Formation is the uranium-bearing unit of the Christensen Ranch. Within the Wasatch there are four mineralized sands which have been informally designated, in descending order, as the J sand, K-1 sand, K-2 sand, and K-3 sand (see Figures D-5-1, D-5-2, and D-5-3 at the end of Appendix D-5). The Wasatch sediments are considered to be a single sedimentological entity with only a general stratigraphic separation based upon distinct, but interrelated, characteristics of the fluvial system that deposited the sands.

The host rock for the uranium mineralization is fine-to-coarse grained, arkosic to subarkosic sand occurring as a channel fill, a point bar, or an overbank deposit. The Wasatch is a sequence of claystones, siltstones, sandstones, and coals deposited in a fluvial environment by a major river system flowing northward through the Powder River Basin. The Wasatch Formation may obtain a thickness in excess of 1,400 feet in portions of the Christensen Ranch; however, this is not common. Regionally, the formation dips 1° to 2° west-northwest toward the basin center. Structural deformation is mild, with only regional dip being of any consequence.

The mineralized sands of the Wasatch Formation may be up to 300 feet thick and may vary from narrow channel fill, within a floodplain mud bank, to sheets 20 to 30 miles wide and tens of miles long. The sands were deposited by rivers constituting a spectrum of types from braided streams to broad meandering rivers.

Unoxidized sands are various shades of grey and contain variable amounts of carbonaceous materials, pyrite, and calcareous cementing agents. The oxidized sands are various shades of red and contain ferric iron in the form of hematite, geothite, and limonite. The major sand units correlate with a fair degree of reliability utilizing a lignite marker bed found extensively throughout the property.

Uranium mineralization at the Christensen Ranch is in the form of roll fronts found at the periphery of large tongues of altered sandstones. These fronts were created when preexisting pyrite was oxidized by dissolved oxygen contained in meteoric groundwater migrating through the sands. Uranium, and lesser amounts of selenium and vanadium, were deposited at the interface between the oxidized and unoxidized portions of the sands. Uranium-bearing fronts may not be present along the edges of all the oxidized tongues, but tend to concentrate in areas where the necessary physical and geochemical conditions were more favorable. The more important factors controlling uranium deposition are the porosity, permeability, and geometry of the sands and the quantity of pyrite and carbonaceous material present (controlling the Eh and pH environment). Uranium was commonly deposited in the form of uraninite (UO_2) or as coffinite ($U(SiO_4)$ $(OH)_4$) with minor quantities of tyuyamunite ($Ca(UO_2)_2$ $(VO_4)_2$ H_2O).

Geology of the Central Willow Creek - R&D Site #1

The geology of the Willow Creek area is not remarkably different from the rest of the Christensen Ranch. The depositional environment was the same general fluvial system that carried all of the sands throughout the ranch. The only exceptions are the K-1 and K-3 sands, which are poorly developed and do not appear to be a channel fill sequence as the K-2 exhibits.

J Sand (Shallow Aquifer) Unit. The J sand unit within the central Willow Creek area has been relatively well developed, consisting of a fine-to-coarse grained, unaltered sandstone which becomes silty toward the bottom and grades into a dark brown to black mudstone. The J sands in Willow Creek are unaltered and do not contain any uranium mineralization,

although in other parts of the Christensen Ranch this unit may be mineralized. The J sand has been identified as the shallow aquifer for the R&D site. Depth to the J sand is approximately 265 feet, and the average thickness is on the order of 30 feet.

Coal Marker Bed (CMB). The lignite marker bed is easily identified throughout the Christensen Ranch by the extreme shift of the resistance log track to the right and the corresponding depressed gamma log. The coal marker bed is normally a thin (less than 3 feet), extremely poor quality lignite bounded above and below by massive mudstones. The CMB is of no economic or geologic importance.

K-1 Sand Unit. Through the Central Willow Creek area, the K-1 is poorly developed and defined. It is typically nonmineralized and commonly less than 25 feet in thickness. As the unit is traced from the south to the north, it exhibits a facies change from the thick, massive bedded channel sands characteristic of channel fill deposits, to that of fine-grained silts, mudstones, and muddy sands characteristic of overbank and floodplain facies. This facies change is evident in the R&D area as the K-1 is a well sorted, fine-grained, silty sandstone becoming even more so to the north. The K-1 is not an adequate host for uranium mineralization in the Willow Creek R&D site. Depth to the K-1 is approximately 350 feet and it is approximately 15 feet thick.

K-2 Sand Unit. As the K-1 sand tends to thin and pinch out, the K-2 sand thickens appreciably and, in some places within the Willow Creek area, merges with the K-1. The K-2 varies from 100 feet to greater than 200 feet in thickness and averages about 145 feet within the R&D boundaries. Depth to the top of the K-2 sand is about 365 feet.

The K-2 unit is the mineralized host rock in the central Willow Creek area and contains approximately 3,600,000 pounds of uranium reserves. The unit is typically a massive bedded, fine-to-coarse grained, subarkosic sandstone containing thin, discontinous mudstone lenses. The K-2 aquifer in this area represents one of the large oxidized sand tongues as described earlier.

In some areas where the K-sand series has merged due to the dominate nature of the K-2, the entire sand sequence is labeled as K-2.

K-3 Sand Unit. The K-3 sand in Willow Creek is poorly developed and exhibits many of the same characteristics of the K-1 series. It is typically nonmineralized and less than 10 feet thick at a depth of around 510 feet. The sands are normally fine-to-medium grained, becoming silty and muddy toward the bottom. In the R&D area, the K-3 has merged with the K-2 and is not identifiable as an individual unit.

L Sand Unit (Deep Aquifer). The L sand within Willow Creek is a well-developed, mature, fine-to-coarse grained sandstone containing numerous discontinuous mudstone lenses. Not much is known about the L sand as it is not mineralized within the Christensen Ranch area and is therefore not a drilling target. The L sand is bounded above and below by massive mudstones and is separated from the K-3 sand unit by approximately 120 feet of continuous mudstones and siltstones (see Figure D-5-4 at the end of Appendix D-5). The L sand is about 40 feet thick at a depth of 640 feet. This sand has been identified as the deep aquifer for the R&D site.

Table D-5-1 is a geologic description of drill hole WCOW-28D, the deep aquifer monitoring well.

TABLE D-5-1

GEOLOGIC DESCRIPTION OF DRILL HOLE WCOW-28D

Unit	Depth To Top (in feet)	Elevation To Top (in feet)	Thickness (in feet)	Geologic Description
Quaternary Alluvium	0	4,790	15	Soils, subsoils, fine sand, red to brown, oxidized.
Mudstone	15	4,775	25	Mudstone, fine grained, green to grey.
Sandstone	40	4,750	25	Sandstone, medium-to-fine grained, yellow, limonitic, oxidized.
Mudstone/Sandstone	65	4,725	198	Mudstone w/interbedded thin sands, fine-to-medium grain, yellow to grey.
J Sand*	263	4,527	29	Sandstone, fine-to-coarse grain, grey, silty in parts.
Mudstone	292	4,498	12	Mudstone, fine grain, green to grey, coal in parts.
Coal Marker Bed	304	4,486	2	Lignite, fine grain, black to brown, muddy, contains sulphur.
Mudstone	306	4,484	46	Mudstone, fine grain, green to grey, some coal stains, minor sands.
K-1 Sand*	352	4,438	15	Sandstone, fine-to-coarse grain, grey, some hematite, silty in parts.
K-2 Sand*	376	4,423	145	Sandstone, fine-to-coarse grain, grey to yellow, interbedded mudstones.
K-3 Sand*	512	4,278	8	Sandstone, fine-to-medium grain, grey, silty toward bottom.
Mudstone	520	4,270	120	Mudstone, fine-to-medium grain, green to grey, sandy in parts.
L Sand*	640	4,150	41	Sandstone, fine-to-medium grain, dark grey, silty in parts.
Mudstone	681	4,109	79	Mudstone, fine grain, green to grey, some coal, sandy in parts
	760	4,030	T.D.	Hole T.D. in mudstone.

*Indicates water-bearing strata.

NOTE: Modified from original geologic description by N.H. Jerome, dated June 26, 1982

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APPENDIX D-6

HYDROLOGY

D-6A Surface Water

D-6A-1 Surface Hydrology

There are no perennial streams within the permit area. The area is drained by Willow Creek, an ephemeral stream which will be crossed by the access road to the proposed site. Map D-6A-1 delineates the drainage area for the Willow Creek R&D #1 Site. As shown on the map, a catchment area of 35.1 acres drains northward into the permit area. Runoff in the small drainage area is not channeled into any significant creek or ravine until it passes through the permit area and joins Willow Creek. The mean downhill gradient for the length of the drainage area is approximately 8 percent.

D-6A-1.1 Peak Flow and Culvert Size Calculations for Willow Creek Crossing (Access to R&D Site #1)

As is shown in Map D-6A-2 (see Map Pocket at the end of Appendix D-6), the drainage area for the proposed Willow Creek Crossing is approximately 34 square miles. U.S.G.S. water resources investigation No. 76-112, "Techniques for Estimating Flow Characteristics of Wyoming Streams" (1976), gives correlations for calculating peak flows based upon the drainage area. Since the planned life of the structure is approximately 7 years, design shall be for a 25-year peak flow and is described by

$$P_{25} = 742\ (A)^{0.37}$$

where A = the drainage area in square miles, and

P = the peak flow in cubic feet per second (cfs).

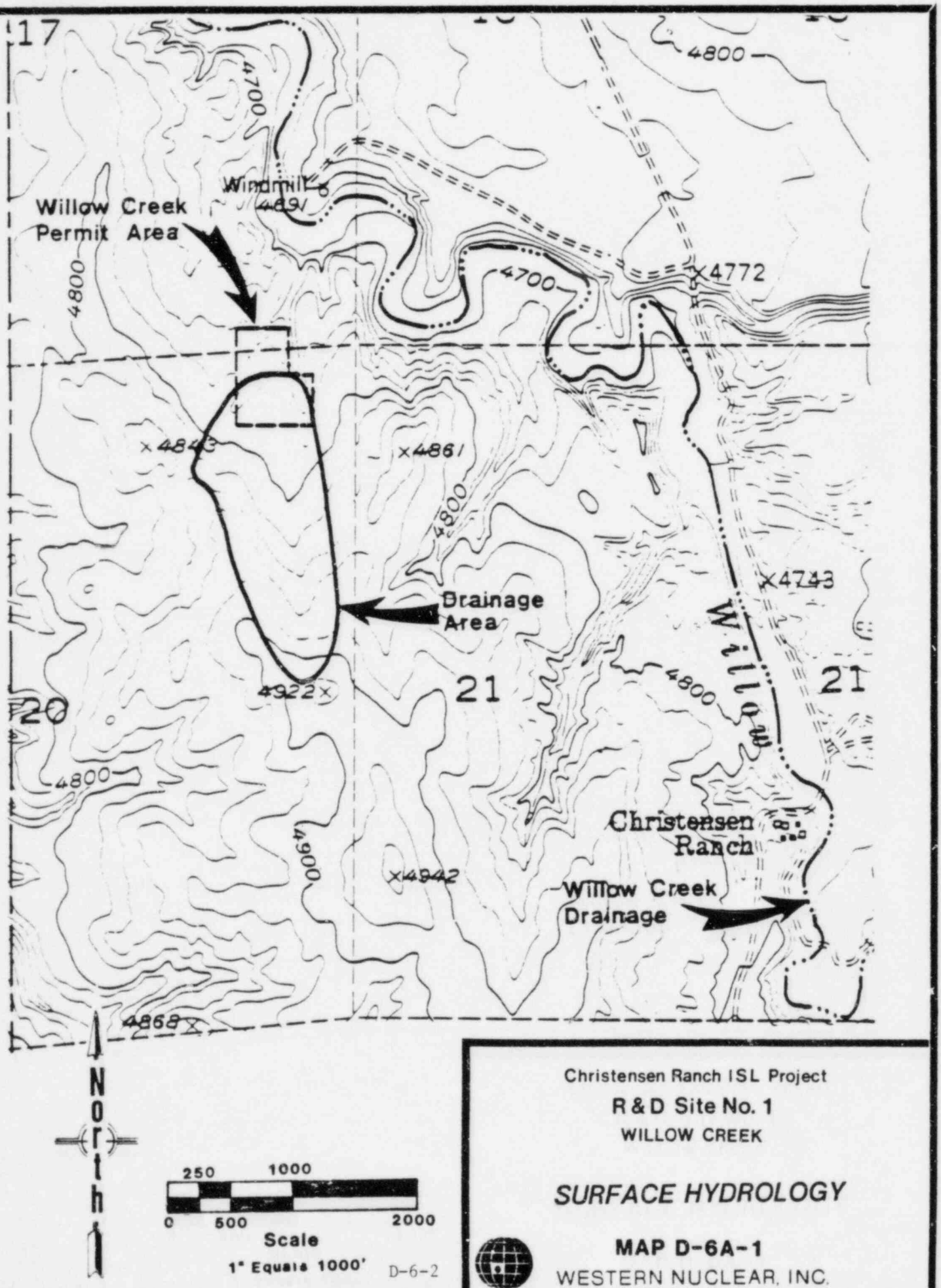
Substitution yields

$$P_{25} = 742(34)^{0.37} = 2{,}736 \text{ cfs}$$

Using data obtained in Design of Small Dams (1977), U.S. Department of the Interior, Bureau of Reclamation, the culvert size required to handle this flow can be calculated.

Initial plans are to install eight culverts within the structure. This requires each to be capable of handling

$$2{,}736/8 = 342 \text{ cfs}$$



Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

SURFACE HYDROLOGY

MAP D-6A-1

WESTERN NUCLEAR, INC.

Assume each culvert is 6 feet in diameter. Using Table B-3 of Design of Small Dams and assuming d/D = 0.80,

$$\frac{Qn}{D^{8/3}\,S^{1/2}} = 0.453$$

where

Q = volumetric flow rate (cfs)

n = Manning coefficient (from Design of Small Dams, page 555)

D = culvert diameter (feet)

S = friction slope (assumed ~ equal to the basin slope).

Substituting values for this case,

$$\frac{342(0.024)}{D^{8/3}(0.01)^{1/2}} = 0.453$$

$$D = 7.03 \text{ feet}$$

Now, using D = 7 feet, check the assumption of n = 0.024,

$$\frac{342(0.024)}{7^{8/3}(0.01)^{1/2}} = 0.458$$

Therefore, d/D = 0.81,

and $A/D^2 = 0.6815$

where A = cross-sectional area of the flowing water (ft^2).

$A = 33.4\ ft^2$

Now, V = Q/A

where V = velocity of the flowing water (ft/sec)

V = 342/33.4 = 10.2 ft/sec

Darcy's equation states (see Figure B-7 of Design of Small Dams)

$$h_f = f(\frac{L}{D})(\frac{V^2}{2g})$$

where h_f = head loss due to friction (feet of fluid flowing)

f = friction factor

L, D = length and diameter of culvert (ft)

V = fluid velocity (ft/sec)

g = gravitational constant

Substitution yields

$$1.2 = f\left(\frac{80}{6}\right)\left[\frac{(10.2)^2}{2(32.174)}\right]$$

$$f = 0.056$$

and

$$f = \frac{185n^2}{D^{1/3}}$$

Therefore, n = 0.024

Therefore, eight 7-foot diameter culverts will handle the 25-year peak flow.

D-6A-2 Surface Water Sampling

Since no surface water exists within the permit area, no surface water sampling is proposed. However, as a precautionary measure, Willow Creek will be sampled upstream and downstream of the test site prior to startup and when sufficient precipitation occurs to cause flow. Exact location of the sampling points will be determined in the field and will be influenced by access conditions.

D-6B Groundwater

D-6B-1 Groundwater Hydrology

D-6B-1.1 General Description

The Powder River Basin has a relatively independent groundwater system. Recharge to the Wasatch Formation primarily comes from the eastern front of the Big Horn Mountains and the western front of the Black Hills, and additional influx from precipitation over the remainder of the basin. Pumpage, evaporation, transpiration, and seepage to rivers, streams, and springs account for most of the discharge from the Wasatch Formation. The principal natural discharge of groundwater is along the Powder River and the Little Powder River and their tributaries.

Groundwater development has been mostly for stock and domestic use. Wells are designed to satisfy only these requirements. Hence, groundwater levels exhibit only minor seasonal fluctuations. This indicates that recharge and discharge in the Powder River Basin, unlike many portions of the United States, are approximately in balance.

The regional groundwater movement is slow, usually on the order of 1 to 10 feet per year. The general direction of regional groundwater flow is northward, but local drainages control movement of water, especially in the aquifers near the land surface.

D-6B-1.2 Summary and Conclusions

A multiwell pump test was conducted by In-situ, Inc. at Western Nuclear's Willow Creek R&D Site #1 in July 1982. All nine test wells were completed into the Wasatch Formation. A fiberglass tape was used to make static water level measurements. Pressure transducers interfaced with a computerized data acquisition system were used to measure and record transient water level data. A mechanical flow regulator was used to maintain a constant flow rate.

The assumptions used in the data analysis were examined in detail. It was concluded that these assumptions were closely approximated, as was evidenced by the excellent type-curve matches.

The overlying and underlying shale layers were found to be nonleaky, since monitor wells in the shallow sand unit and the deep sand unit showed no water level response to pumping in the production zone.

Well WCPW-21, located in the center of the test pattern, was the pumped well. The flow rate of 13.0 gallons per minute (gpm) was maintained for 24 hours. The resulting radius of influence was 710 feet (36 acres). No hydrologic barriers, sources, or sinks were detected during the test.

Hantush's unsteady-state, partial penetration well function was used to analyze the individual well data. The mean values obtained from these analyses were:

storage coefficient = 7×10^{-4}

transmissivity = 679 gallons per day (gpd)/ft

permeability = 216 millidarcies (md)

ratio of horizontal to vertical permeabililty = 17

This value of permeability is typical in the vicinity of Pumpkin Buttes. The relatively high ratio of horizontal to vertical permeability predicts good vertical containment of the leach solution for in situ operations.

Papadopulos' method was used to study the directional permeability of the formation. The statistical approach applied to all combinations of three wells yielded the following mean values:

T_{major} = 1,466 gpd/ft (465 md)

T_{minor} = 314 gpd/ft (100 md)

$T_{geometric\ mean}$ = 679 gpd/ft (216 md)

direction of major transmissivity = N 56° W

storage coefficient = 4×10^{4}

The production specific capacity and the injection specific capacity of the pumped well were estimated to be 0.063 gpm/ft and 0.037 gpm/ft, respectively. The maximum productivity of well WCPW-21 and the injectivity at 80 psi of wellhead pressure were both about 12 gpm.

Based on a potentiometric surface map constructed for the site, the local groundwater flow was calculated to be at a velocity of 5 feet per year in the direction N 57° W, which is consistent with the regional groundwater flow.

Hydrologic conditions, therefore, appear favorable to in situ mining.

The groundwater quality data collected to date has been subjected to exhaustive statistical analysis and has resulted in the following conclusions:

1) No statistically significant differences in water quality were evident as a result of airlifting versus pumping as a method of casing evacuation.

2) There are no statistically significant differences in quality between the K1 and K2 aquifers. They are considered one aquifer system.

3) Minor differences occur between various laboratory assays. None will influence groundwater classification, leaching, or restoration requirements.

4) Some groundwater quality varience versus time was evident but no pattern is yet identifiable.

5) The K2 aquifer does not appear suitable for any use due to elevated pH and radionuclide values.

D-6B-1.3 Previous Investigations

Two previous groundwater studies in the general area of the Willow Creek site are particularly noteworthy. These are the "Water Resources of the Powder River Basin and Adjacent Areas, Northeastern Wyoming" by Hodson, Pearl, and Druse (1973) and the "Environmental Statements Related to Operation of WMC Irigaray Solution Mining Project" by Wyoming Mineral Corporation (1978).

Hodson, Pearl, and Druse (1973) provide fundamental information about the water resources of the Powder River Basin. Their work incorporates the findings of many previous investigations. The Cleveland-Cliffs Iron Company used groundwater level information from this work to supplement other water level information in constructing a regional potentiometric surface map in a study contained in their application for a pilot-plant license for the Collins Draw property (1978), which is only 10 miles southeast of the Willow Creek site.

Wyoming Mineral Corporation and the Nuclear Regulatory Commission (NRC) made a regional study for a commercial application at the Irigaray Ranch, 12 miles northwest of the Willow Creek site. Site-specific

hydrologic data (water level measurements in particular) along with information from the previous Hodson, et al. study are included in the NRC report.

D-6B-1.4 Purpose of Present Investigation

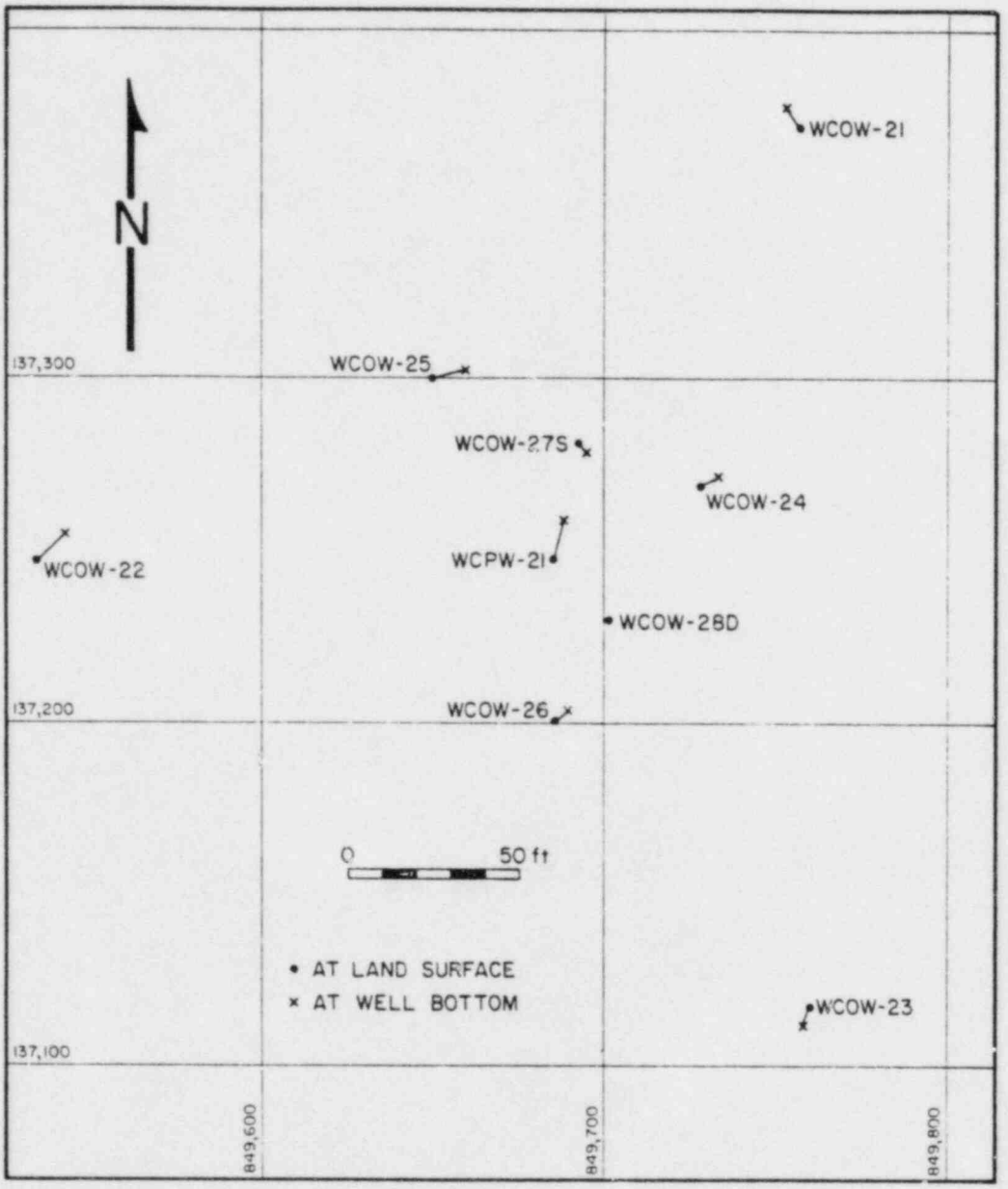
The purpose of this investigation was to study the site-specific hydrologic characteristics of Western Nuclear's Willow Creek R&D #1 Site. The test objectives were to determine the following:

- local groundwater flow;
- mean transmissivity, hydraulic conductivity, and permeability;
- directional transmissivity;
- storage coefficient;
- radius of influence of pumping;
- location of hydraulic boundaries that may be present within the radius of influence of pumping;
- degree of hydraulic communication between adjacent aquifers;
- well efficiency of the pumped well; and
- specific capacity of the pumped well.

D-6B-1.5 Test Wells

The design of the wellfield pattern maximizes the hydrologic information that can be obtained from the multi-well pump test conducted in the study area. A test pattern of nine wells (Figure D-6B-1) was completed in the Wasatch Formation at depths ranging from 260 to 660 feet. The main aquifer consists of three water-bearing sands (designated K1, K2, and K3) at a depth of approximately 350 to 520 feet. A shallow aquifer (designated J sand) lies at a depth of approximately 260 to 280 feet; a deep aquifer (designated L sand) lies at a depth of approximately 640 to 670 feet.

The test pattern consisted of 1) one pumped well (WCPW-21) in the K2 sand; 2) four K2 sand monitor wells (WCOW-22, WCOW-23, WCOW-25, and WCOW-26); 3) one K1 sand monitor well (WCOW-24); 4) one K3 sand monitor well (WCOW-21); 5) one shallow sand monitor well (WCOW-27S); and 6) one



Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

WESTERN NUCLEAR, INC.	WELL LOCATION MAP	
In-situ Inc.	PREPARED BY: B.K.	DATE: 8/3/82
	CHECKED BY: B.K.	DATE: 8/30/82
	DRAWN BY: ALLORY DEISS	FIGURE NO. **D-6B-1**

deep sand monitor well (WCOW-28D) (see Figures D-5-1, D-5-2, D-5-3, and D-5-4 in Appendix D-5, Geologic Assessment).

The shallow J-sand unit is separated from the production zone by approximately 70 feet of mudstones. The deep L-sand unit is separated from the production zone by approximately 120 feet of mudstones and clays. Water level measurements made during the pump test indicate that both the shallow and deep sand units are apparently isolated from the production zone. The leaching operation will not affect either of these two units.

All field data are contained in ATTACHMENT A to APPENDIX D-6B

D-6B-1.5.a Individual Well Information

Table D-6B-1 summarizes the pertinent information about the test wells. The pumped well (WCPW-21) and four monitor wells (WCOW-22, WCOW-23, WCOW-25, and WCOW-26) were completed in the K2 sand unit. Monitor well WCOW-24 was completed in the K1 sand unit and WCOW-27 in the K3 sand unit. Monitor well WCOW-27S was completed in the shallow J-sand unit and well WCOW-28D in the deep L-sand unit. All wells were developed prior to the test.

A drift survey (Figure D-6B-1) shows that the wells were nearly vertical with a maximum deviation of 11.9 feet for the pumped well, WCPW-21.

D-6B-1.5.b Test Preparation, Instruments, and Procedures

All of the test wells had been drilled, completed, and developed before the collection of the baseline water level data and before the start of the pump test.

Baseline water level measurements were made with a fiberglass measuring tape equipped with an acoustic sounding device. The tape was precisely marked in 2 millimeter increments. These measurements were used along with well-collar elevations from survey records to determine the water level elevations in each of the observation wells.

An automatic flow regulator, which maintains the flow rate to ± 1.5% of the set point, was used to achieve the constant flow rate required by the analytical solutions In Situ, Inc. used to evaluate the test data.

Christensen Ranch ISL Project
R & D Site No. 1
WILLOW CREEK

TABLE
D-6B-1

CHRISTENSEN RANCH PUMP TEST
AND
BASELINE GROUNDWATER SAMPLING WELLS

FIELD ID NO.	WYOMING PERMIT NO.	CASING DEPTH(FT)	TOTAL DEPTH(FT)	SCREENED INTERVAL(FT)	AQUIFER REPRESENTED	ELEVATIONS(FT) GROUND	WELL HEAD	POTENTIOMETRIC SURFACE *	COORDINATES N	E
WCPW-21	U.W.60385	445	460	445-455	K2	4,790	4,792	-	137,247	849,685
WCOW-21	U.W.60386	490	505	490-500	K2	4,783	4,784	4,646.0	137,374	849,756
WCOW-22	U.W.60387	440	455	440-450	K2	4,795	4,796	4,645.6	137,247	849,535
WCOW-23	U.W.60388	447	462	447-457	K2	4,793	4,795	4,646.4	137,117	849,760
WCOW-24	U.W.60389	345	360	345-355	K1	4,788	4,789	4,644.5	137,269	849,727
WCOW-25	U.W.60390	440	455	440-450	K2	4,790	4,791	4,645.9	137,300	849,650
WCOW-26	U.W.60391	445	460	445-455	K2	4,792	4,793	4,646.2	137,200	849,685
WCOW-27S	U.W.60392	260	275	260-270	Shallow Aq.	4,789	4,790	4,680.3	137,282	849,683
WCOW-28D	U.W.60393	645	660	645-655	Deep Aquifer	4,790	4,791	4,632.0	137,229	849,702

Note: All holes were drilled with a 7 7/8 inch drill bit and completed with 4.95 inch O.D. casing.
All wells are located in the NE¼, NE¼, Section 20, T44N, R76W

* Measured on July 21, 1982

The flow rate was measured periodically using a Badger flow meter with a totalizing register. To verify the Badger meter measurements, the flow rate was calculated from the time required to collect a known volume of discharge.

Nine pressure transducers were used to measure the depth to water in each of the test wells during the test. Each transducer was sensitive to a pressure change of 0.01 pounds per square inch (psi) and accurate to ± 0.5% of full scale. The transducers were temperature compensated and unresponsive to changes in barometric pressure.

A computerized data acquisition system automatically converted transducer signals to drawdown in the well and recorded the data on magnetic tape. The computer collected data more frequently at the beginning of the test when drawdown changed rapidly, allowing for early collection of reliable data. Periodic measurement of water levels using the fiberglass tape verified the data collected with the automatic data acquisition system.

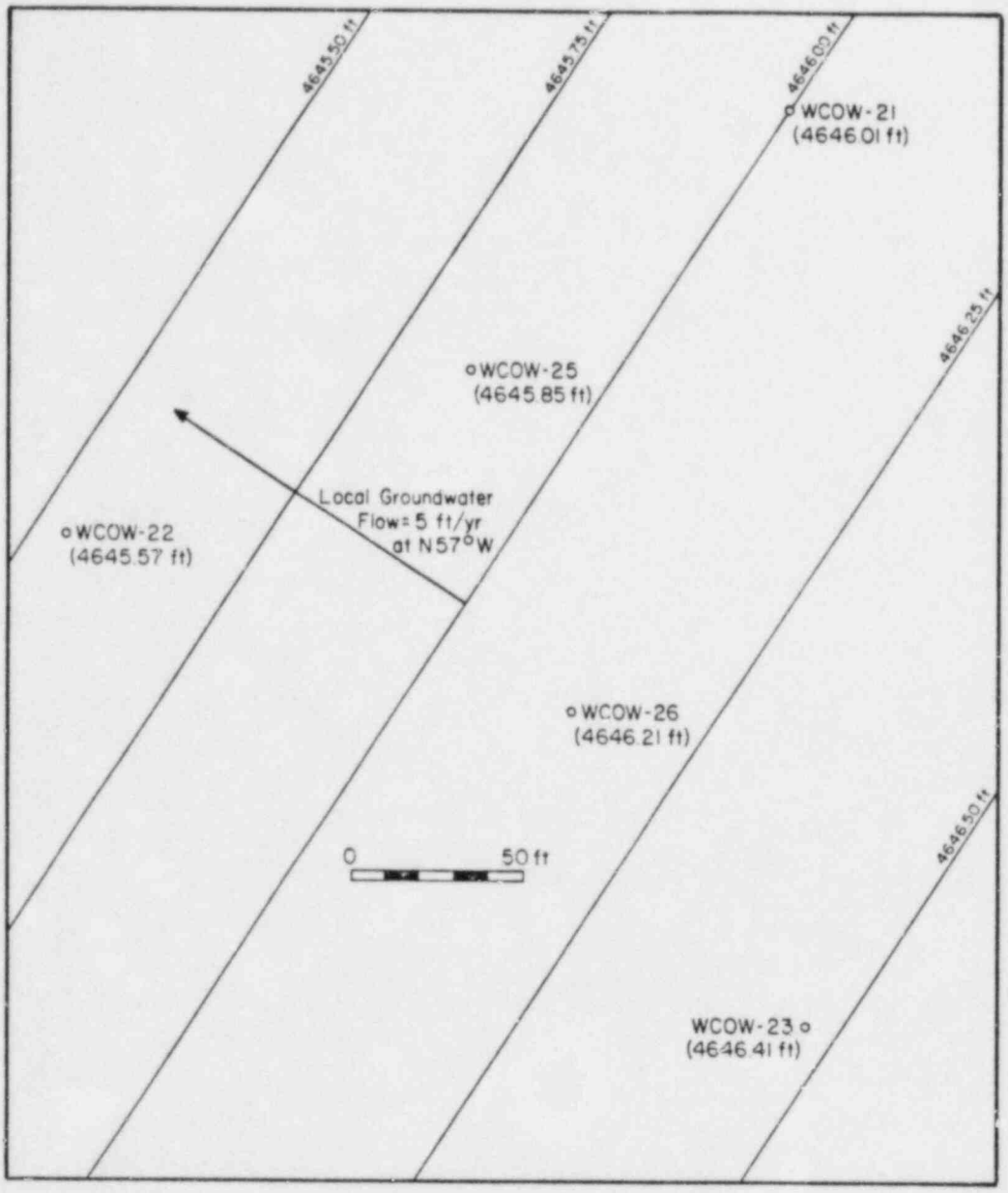
The computer visually displayed the data so that test progress could be monitored continually. The computer also produced graphic displays upon request, making evaluation of data in the field possible. These preliminary analyses provided a basis for determining the radius of influence, the possible existence of a hydraulic boundary, optimal duration of the test, etc.

D-6B-1.5.c Local Potentiometric Surface

Figure D-6B-2 represents the potentiometric surface at the site. The contours were inferred from water elevation measurements made with a fiberglass tape on July 21, 1982.

D-6B-1.5.d Local Groundwater Flow

The hydraulic gradient used to calculate the natural groundwater flow is based on the contours shown in Figure D-6B-3. With the values of directional transmissivity and thickness of the aquifer previously reported and a porosity of 30%, a natural groundwater flow of 5 feet per year in the direction of N 57° W was computed. These values are compatible with the trend of regional groundwater flow.

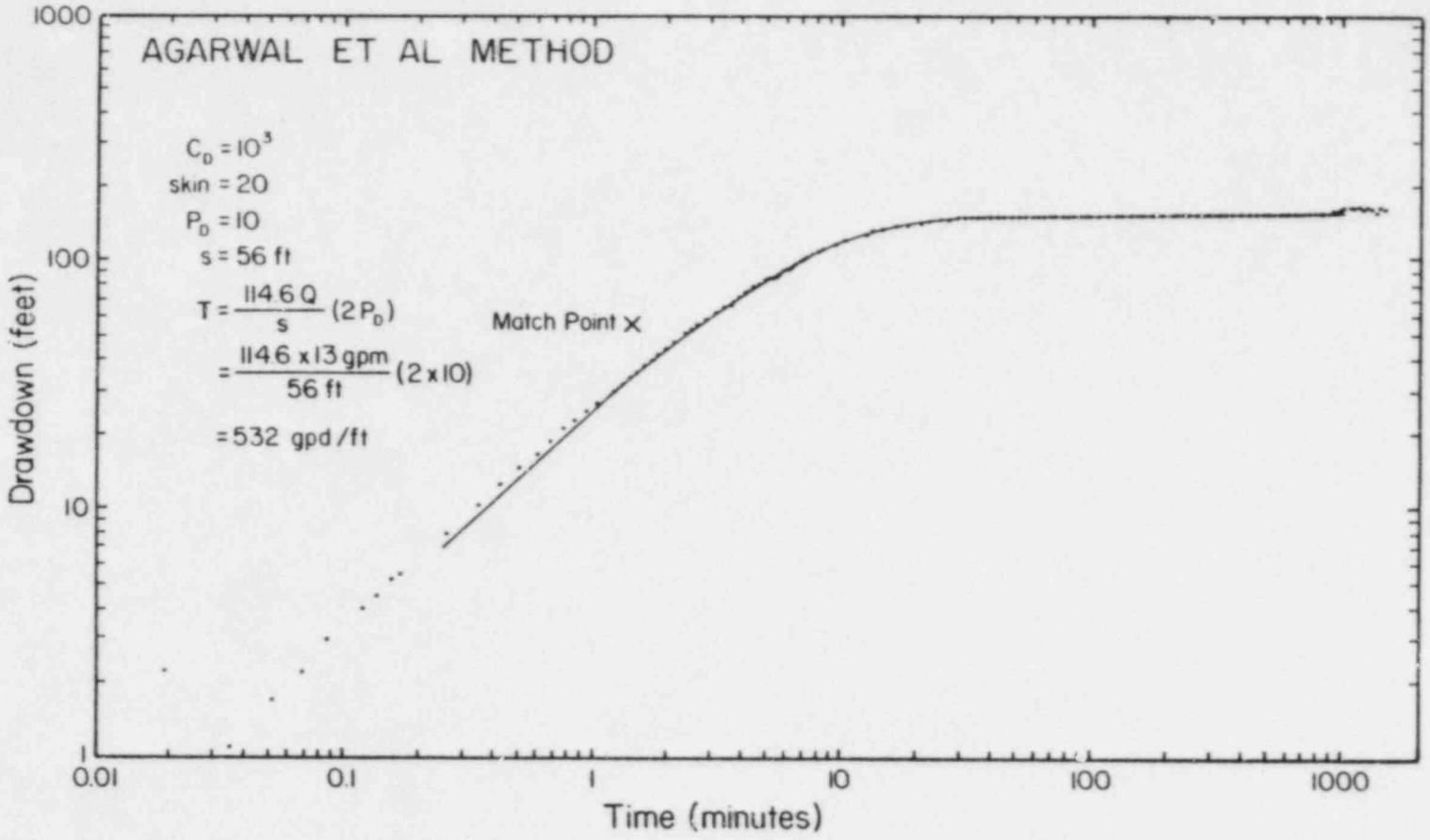


Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

WESTERN NUCLEAR, INC.	LOCAL PIEZOMETRIC SURFACE MAP	
In-situ Inc.	PREPARED BY: T W	DATE: 8/13/82
	CHECKED BY: T W	DATE: 8/30/82
	DRAWN BY ALLORY DEISS	FIGURE NO. **D-6B-2**



Christensen Ranch ISL Project **R & D Site No. 1** **WILLOW CREEK**	WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST PUMPING WELL WCPW-21	
	In-situ Inc.	PREPARED BY: B K.	DATE: 8/20/82
		CHECKED BY: B K.	DATE: 8/30/82
		DRAWN BY ALLORY DEISS	FIGURE NO. **D-6B-3**

This flow is clearly negligible and should cause no problem during the life of the in situ operation.

D-6B-1.6 Method of Analysis and Assumptions

Hantush's unsteady-state, partial penetration well function was used to analyze the data from each well. The following assumptions are implicit in the derivation of Hantush's solution:

1. the aquifer is confined,
2. the aquifer is homogeneous within the radius of influence,
3. the thickness of the aquifer is uniform within the radius of influence,
4. the pumped well has an infinitesimal radius, and
5. water is released instantaneously from storage with decline in pressure.

The following observations were made about these assumptions:

- Assumption 1

  Water level measurements and well logs suggest the aquifer is confined. Water levels are approximately 150 feet below the tops of the well casings, and the top of the aquifer is at approximately 350 feet below the land surface. A confined aquifer is by definition one in which the water level in wells is above the top of the aquifer. Furthermore, the mean value of the storage coefficient (4×10^{-4}) determined from the analysis of the pump test data is consistent with the typical storage coefficient of a confined aquifer.

- Assumption 2

  Homogeneity can be substantiated by examining the transmissivity values obtained from the individual well data. Note that the values of transmissivity listed in Table D-6B-2, with only one exception, vary from the mean value (679 gpd/ft) by less than 22%. Some heterogeneity exists; however, it would appear that gross order of magnitude errors would not result under these conditions. The results should provide good engineering approximations.

- Assumption 3

  Reference to the well logs reveals only a few percent variation in thickness over the site area, which validates Assumption 3.

Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

TABLE
D-6B-2

SUMMARY OF PUMP TEST RESULTS

WELL	TRANSMISSIVITY (gpd/ft)	CONDUCTIVITY (gpd/ft^2)	PERMEABILITY (millidarcies)	STORAGE COEFFICIENT	R*	LEAKAGE
WCOW-21	582	3.33	190	1.6×10^{-3}	15	none
WCOW-22	626	3.58	204	3.0×10^{-4}	15	none
WCOW-23	550	3.14	180	2.6×10^{-4}	25	none
WCOW-24	616	3.52	201	1.1×10^{-3}	15	none
WCOW-25	1090	6.23	356	1.7×10^{-3}	25	none
WCOW-26	613	3.50	200	4.4×10^{-4}	5	none
WCPW-21	532	3.04	174	---	--	none

*R = ratio of horizontal to vertical permeabilities.

- Assumption 4

  The pumped well has a small finite radius, restricting the application of Hantush's solution to the pumped well.

- Assumption 5

  This assumption is closely approximated since the release of water from storage in a confined aquifer is an elastic phenomenon. As such, the only delay in water release due to pressure decline occurs when equilibrium is reached. This happens in approximately the time a stress wave takes to make 10 transversals over the thickness of the aquifer. A value of 1.6×10^{-5} psi for the bulk modules results from the mean storage coefficient determined from the test. Therefore, the wave speed is approximately 2,300 feet per second and the equilibrium time is 0.8 second. This delay of less than 1 second may be regarded as negligible for all practical purposes, yielding instantaneous water release from storage with pressure decline.

Allowing for restrictions noted above, it is concluded that Hantush's solution closely simulates the hydrologic conditions and that this analytical procedure is sufficiently accurate to meet the study objectives, giving reliable values for the aquifer properties.

D-6B-1.7 Data Analysis

A constant flow rate of 13.0 gpm was maintained during the multi-well pump test begun on July 23, 1982. The test lasted for 24 hours and resulted in a radius of influence of 710 feet (36 acres). The drawdown in the pumped well (WCPW-21) was 162.5 feet at the end of the test. Table D-6B-3 lists the distances of the observation well from the pumped well.

Hantush's unsteady-state, partial penetration well function was used to analyze individual well data (Figures D-6B-4 to D-6B-9). Table D-6B-2 summarizes the results. The formulas used in the accompanying analyses are shown in Figure D-6B-10.

All of the observation wells yielded consistent values for storage coefficient; the mean value was 7×10^{-4}. The mean value of transmissivity was 679 gpd/ft (0.22 darcies). The lowest value of 550 gpd/ft (0.18 darcies) was observed in well WCOW-23; the highest value of 1,090 gpd/ft (0.35 darcies) was observed in well WCOW-25. In the Pumpkin Buttes area, transmissivity values typically are in the range of 200 to 800 gpd/ft. The mean ratio of horizontal to vertical permeability was 17.

Christensen Ranch ISL Project

R&D Site No. 1

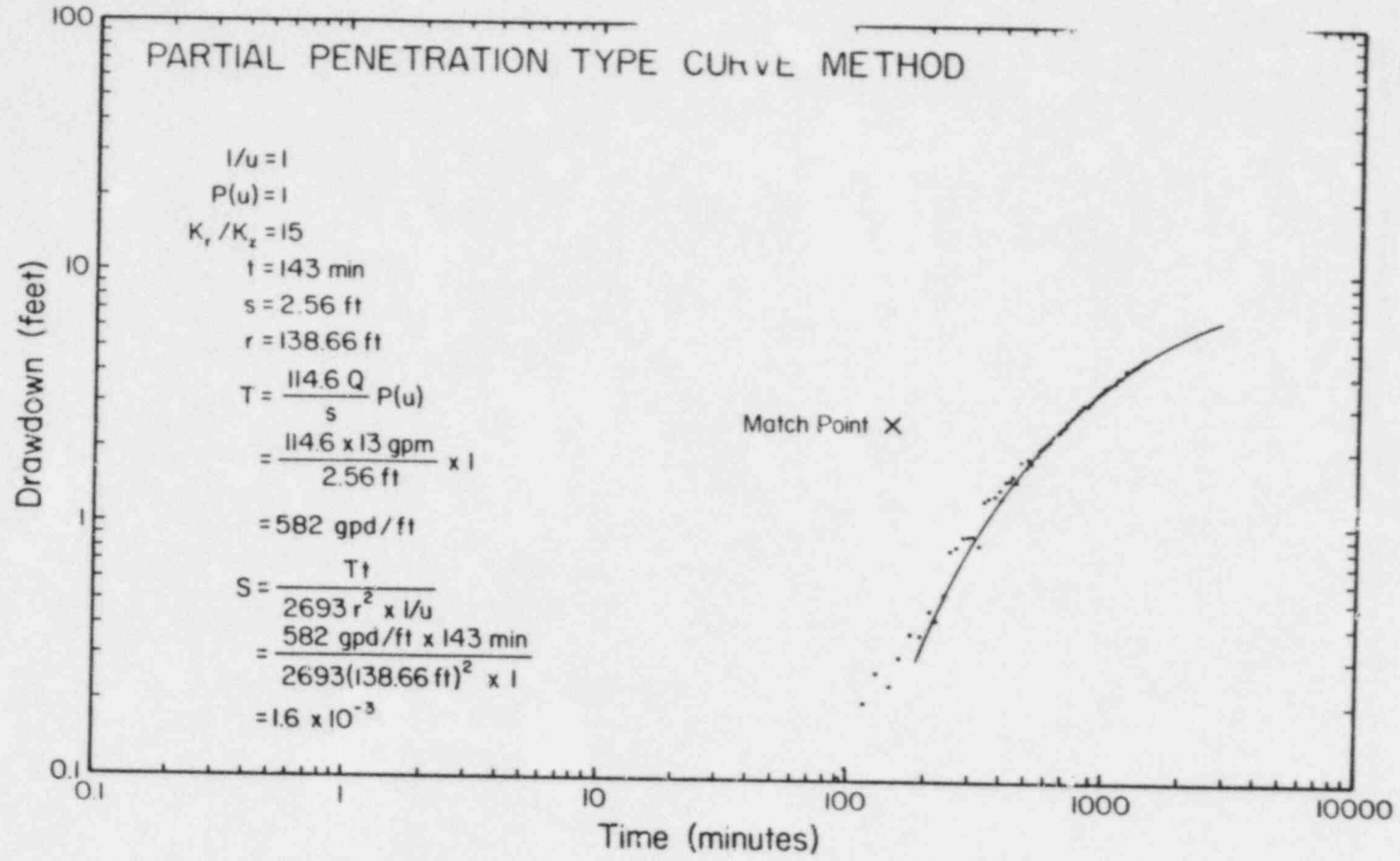
WILLOW CREEK

TABLE
D-6B-3

DISTANCE FROM PUMPED TO OBSERVATION WELLS

WELL NO.	WELL TYPE	DISTANCE* TO THE PUMPED WELL (ft)
WCPW-21	Pumped	-0-
WCOW-21	Observation	138.66
WCOW-22	Observation	146.91
WCOW-23	Observation	162.90
WCOW-24	Observation	45.77
WCOW-25	Observation	53.78
WCOW-26	Observation	53.99
WCOW-27S	Shallow Aquifer Monitor	21.62
WCOW-28D	Deep Aquifer Monitor	Approx. 30

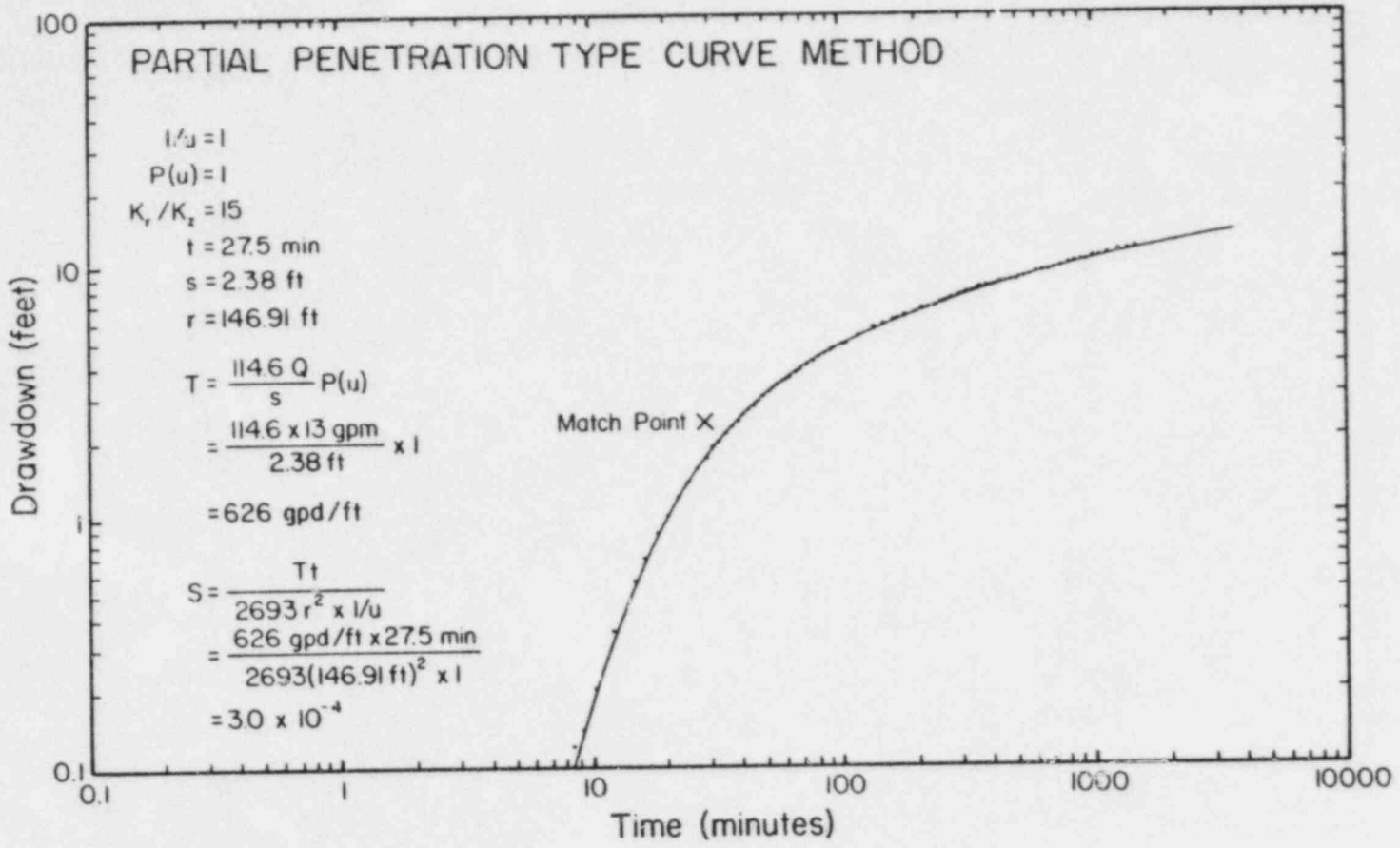
*Measured from hole bottom



D-6-19

Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK

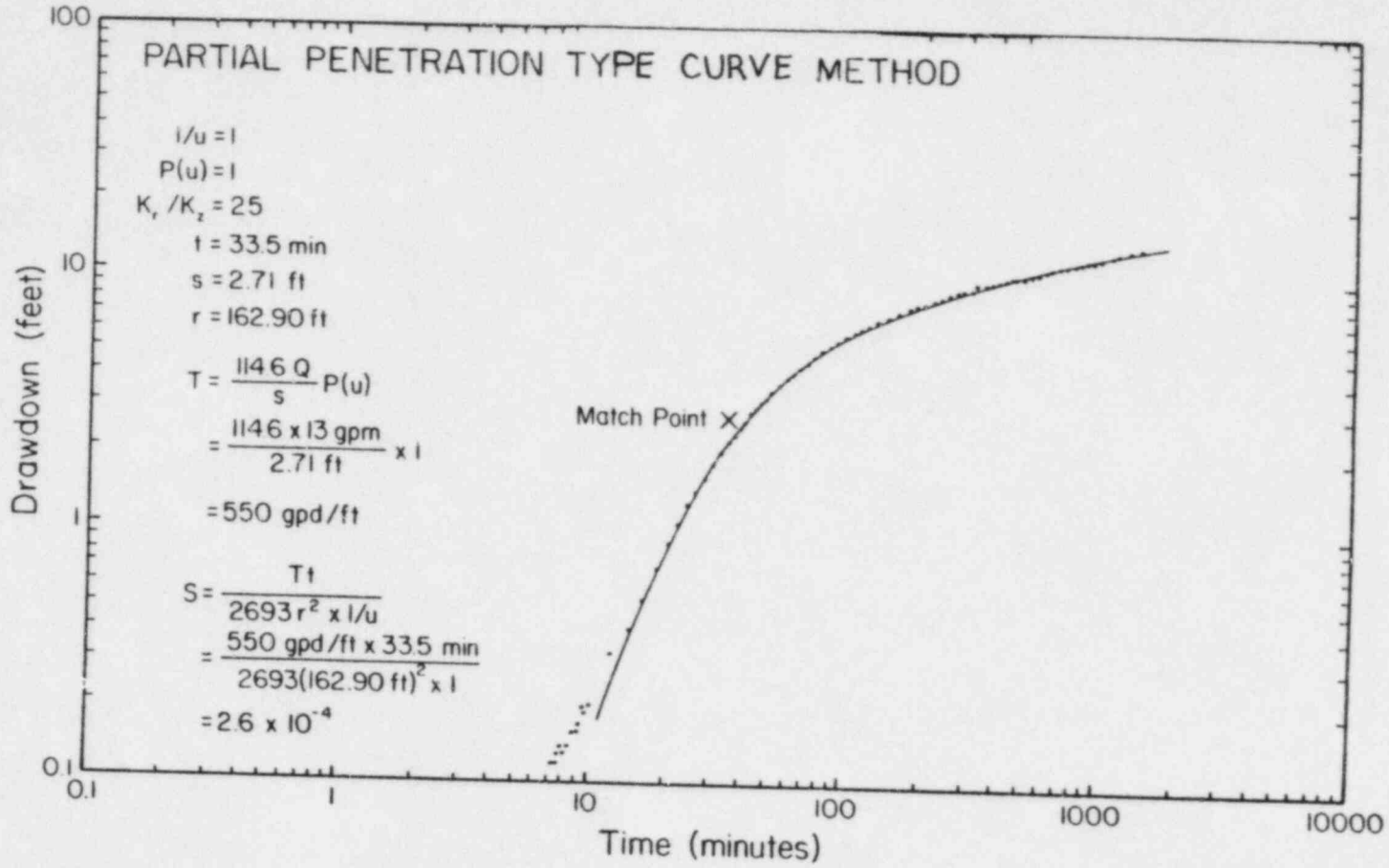
WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-21
In-situ Inc.	PREPARED BY: B.K. — DATE: 8/20/82
	CHECKED BY: B.K. — DATE: 6/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-4**



D-6-20

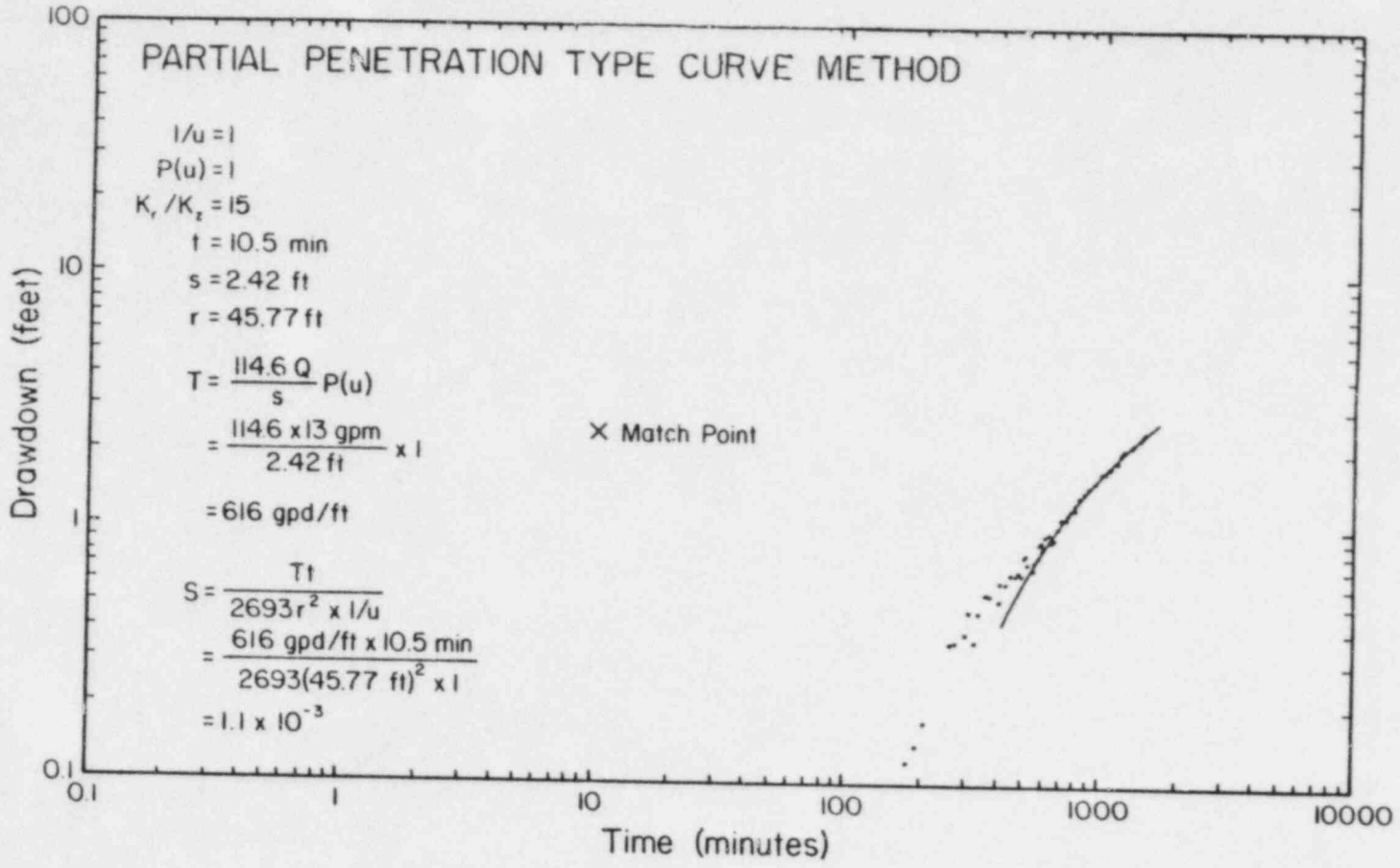
Christensen Ranch ISL Project
R & D Site No. 1
WILLOW CREEK

WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-22
In-situ Inc.	PREPARED BY: B K — DATE: 8/20/82
	CHECKED BY: B K — DATE: 8/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-5**



Christensen Ranch ISL Project
R & D Site No. 1
WILLOW CREEK

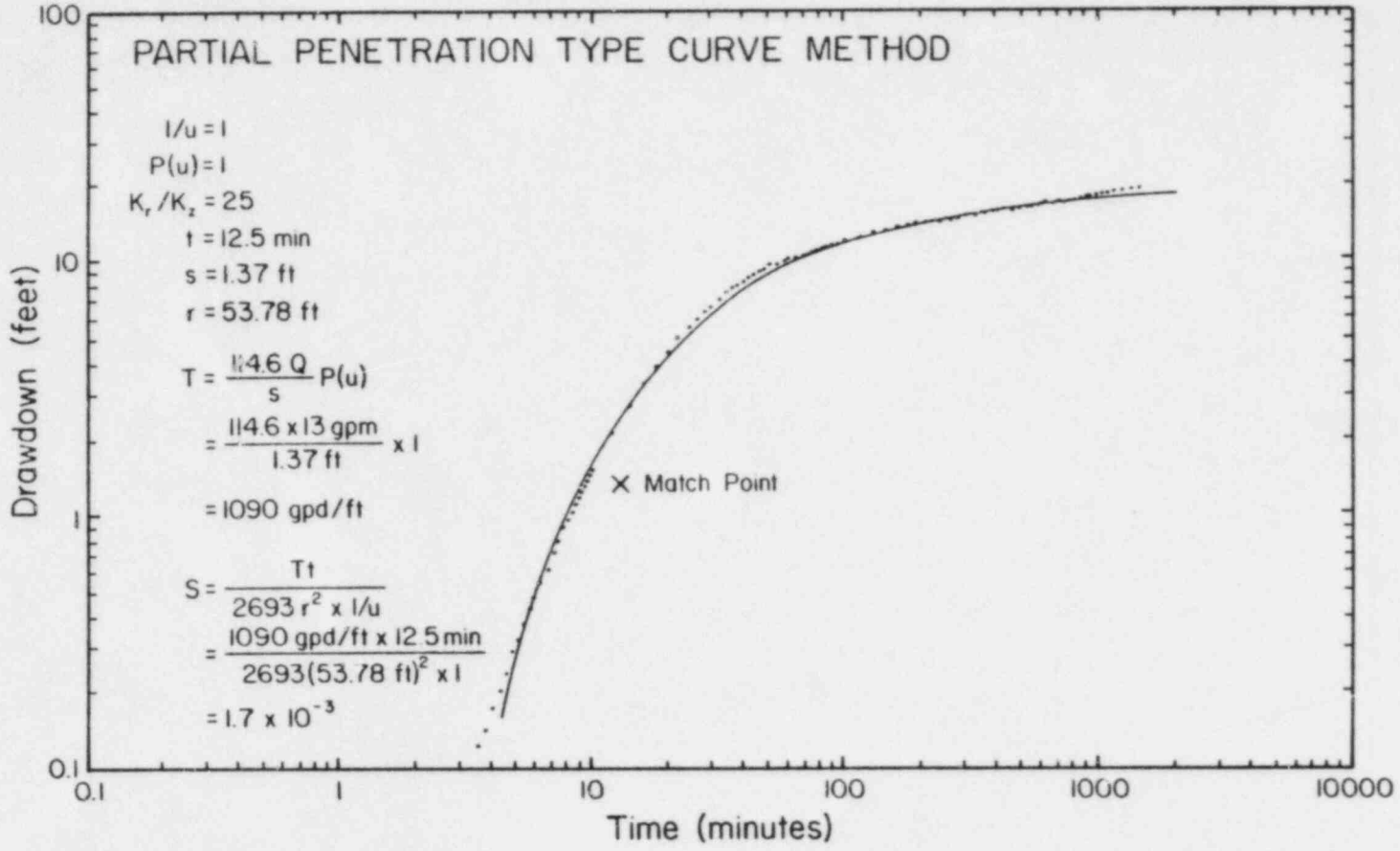
WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-23
In-situ Inc.	PREPARED BY: B.K. — DATE: 8/20/82
	CHECKED BY: B.K. — DATE: 8/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-6**



D-6-22

Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK

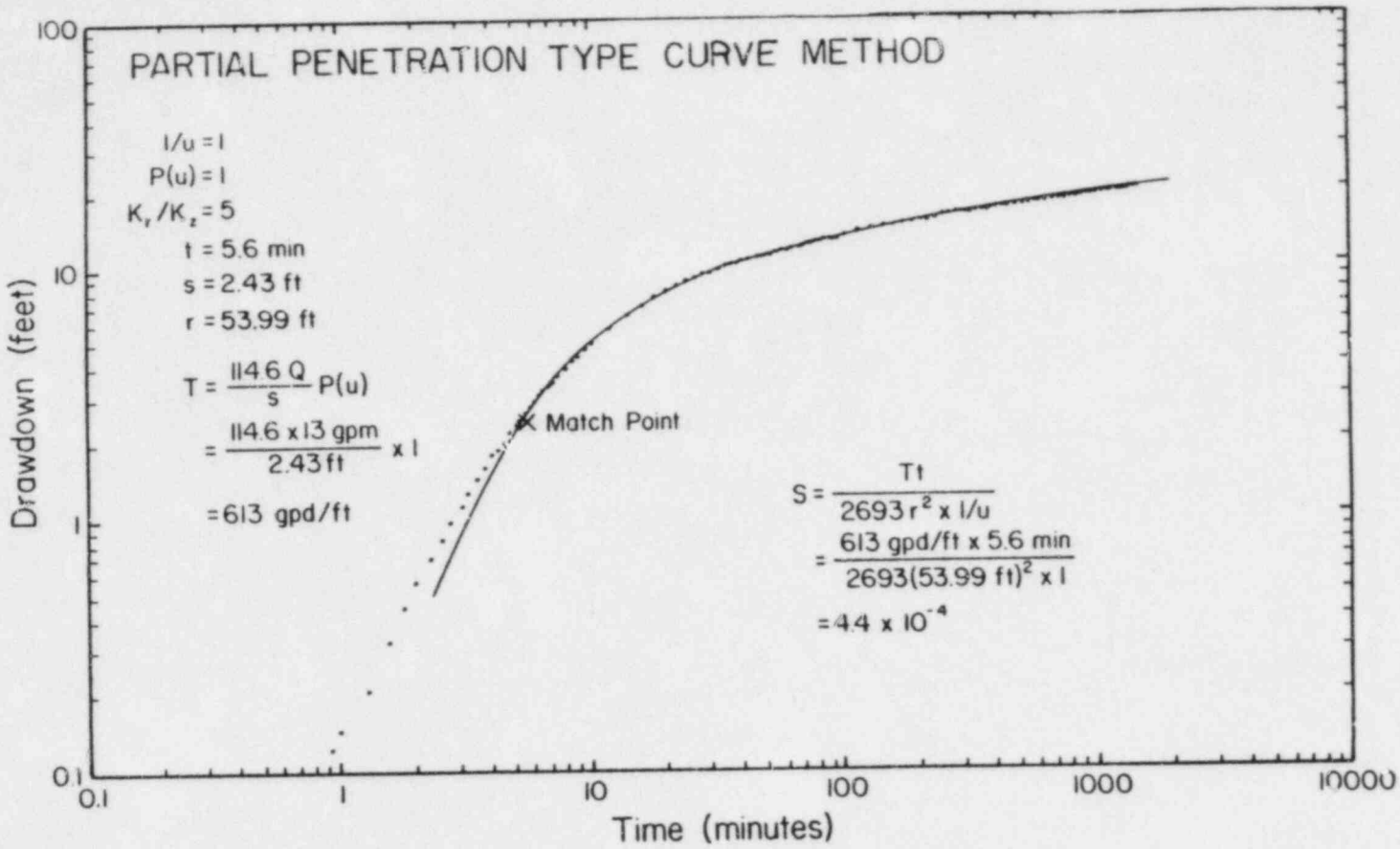
WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-24
In-situ Inc.	PREPARED BY: B.K. — DATE: 8/20/82
	CHECKED BY: B.K. — DATE: 8/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-7**



D-6-23

Christensen Ranch ISL Project
R & D Site No. 1
WILLOW CREEK

WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-25
In-situ Inc.	PREPARED BY: B.K. — DATE: 8/30/82
	CHECKED BY: B.K. — DATE: 8/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-8**



D-6-24

Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK

WESTERN NUCLEAR, INC.	CONSTANT RATE PUMP TEST OBSERVATION WELL WCOW-26
In-situ Inc.	PREPARED BY: B.K. — DATE: 8/20/82
	CHECKED BY: B.K. — DATE: 8/30/82
	DRAWN BY ALLORY DEISS — FIGURE NO. **D-6B-9**

I. Hantush's Unsteady State Partial Penetration Well Function (Hantush 1964)

$$s = \frac{Q}{4\pi T} [W(u) + f] \qquad (1.1)$$

$$u = \frac{r^2 S}{4Tt} \qquad (1.2)$$

where

f = partial penetration correction function

s = drawdown in observation well (L)

Q = flow rate (L^3/T)

T = transmissivity (L^2/T)

S = storage coefficient

t = time since pumping started (T)

W(u) = well function

II. Papadopulos' Method (Papadopulos 1965)

$$s = \frac{Q}{4\pi(T_{xx}T_{yy} - T_{xy}^2)^{1/2}} W(U_{xy}) \qquad (2.1)$$

$$U_{xy} = \frac{S}{4t} \frac{T_{xx}Y^2 + T_{yy}X^2 - 2T_{xy}XY}{T_{xx}T_{yy} - T_{xy}^2} \qquad (2.2)$$

$$T_{major} = \frac{1/2}{[(T_{xx} + T_{yy}) + [(T_{xx} - T_{yy})^2 + 4T_{xy}^2]^{1/2}}$$

$$T_{minor} = \frac{1/2}{[(T_{xx} + T_{yy}) - [(T_{xx} - T_{yy})^2 + 4T_{xy}]^{1/2}} \qquad (2.4)$$

$$\theta = \arctan \frac{T_{major} - T_{minor}}{T_{xy}}, \qquad (2.5)$$

Figure D-6B-10. Mathematical Formulas.

where

s = drawdown (L)

Q = flow rate (L^3/T)

$W(U_{xy})$ = well function

T_{xx}, T_{yy}, T_{xy} = components of transmissivity tensor (L^2/T)

T_{major}, T_{minor} = principal transmissivities (L^2/T)

X, Y = coordinates of observation well relative to the pumped well (L)

θ = angle between x and the major axis

Example: Multi-well pump test

Q = 13.0 gpm

MATCH POINT INFORMATION

Well No.	X (ft)	Y (ft)	t (min)	s (ft)	U_{xy}	$W(Y_{xy})$
WCOW-22	-146.9	-3.8	27.5	2.38	1	1
WCOW-23	68.6	-147.8	33.5	2.71	1	1
WCOW-26	-200.0	-54.0	5.6	2.43	1	1

Based on above information, we can compute T_{xx}, T_{yy}, T_{xy} and S using equations (2.1) and (2.2). T_{major}, T_{minor} and θ can then be calculated by the use of equations (2.3) to (2.5). The results are

T_{major} = 1,026 gpd/ft.

T_{minor} = 346 gpd/ft.

θ = N 58° W

$S = 3.0 \times 10^{-4}$

Figure D-6B-10 (Continued).

Papadopulos' method was then applied to determine the directional permeability of the formation. This method requires at least three observation wells at three different directions to the pumped well. Any combination of three wells in a homogeneous, isotropic medium should give the same result. However, most formations are heterogeneous and anisotropic. In many cases, anisotropy may be due to small-scale features such as fractures or interwoven stream channels. Therefore, different combination of wells can give different results because of the spacing and the angular distribution of such features.

In this study, seven combinations of three wells yielded values for directional transmissivity and storage coefficient. Table D-6B-4 lists these values. Although a different direction of major transmissivity resulted from various well combinations, all except one tend toward the northwest as shown in Figure D-6B-11. A least squares fit applied to all the wells gave the mean values for directional transmissivity and storage coefficient listed below:

T_{major} = 1,466 gpd/ft (465 md)

T_{minor} = 314 gpd/ft (100 md)

$T_{geometric\ mean}$ = 679 gpd/ft (216 md)
direction of major transmissivity = N 56° W
storage coefficient = 4×10^{-4}

The production aquifer is effectively isolated from the adjacent sand units. During the pump test, water levels in the J-sand monitor well (WCOW-27S) and the L-sand monitor well (WCOW-28D) rose a few hundredths of a foot. If leakage from these aquifers had occurred, a decline rather than a slight increase in the water levels should have resulted. This small increase in water level is due solely to elastic stress changes induced by pumping and is called the Noordbergum Effect (Verruijt 1969).

All of the water levels in the production aquifer monitor wells (WCOW-21, WCOW-22, WCOW-23, WCOW-24, WCOW-25, WCOW-26) declined with pumping. Thus, hydraulic connection between the production zone and the monitor wells was verified.

Christensen Ranch ISL Project

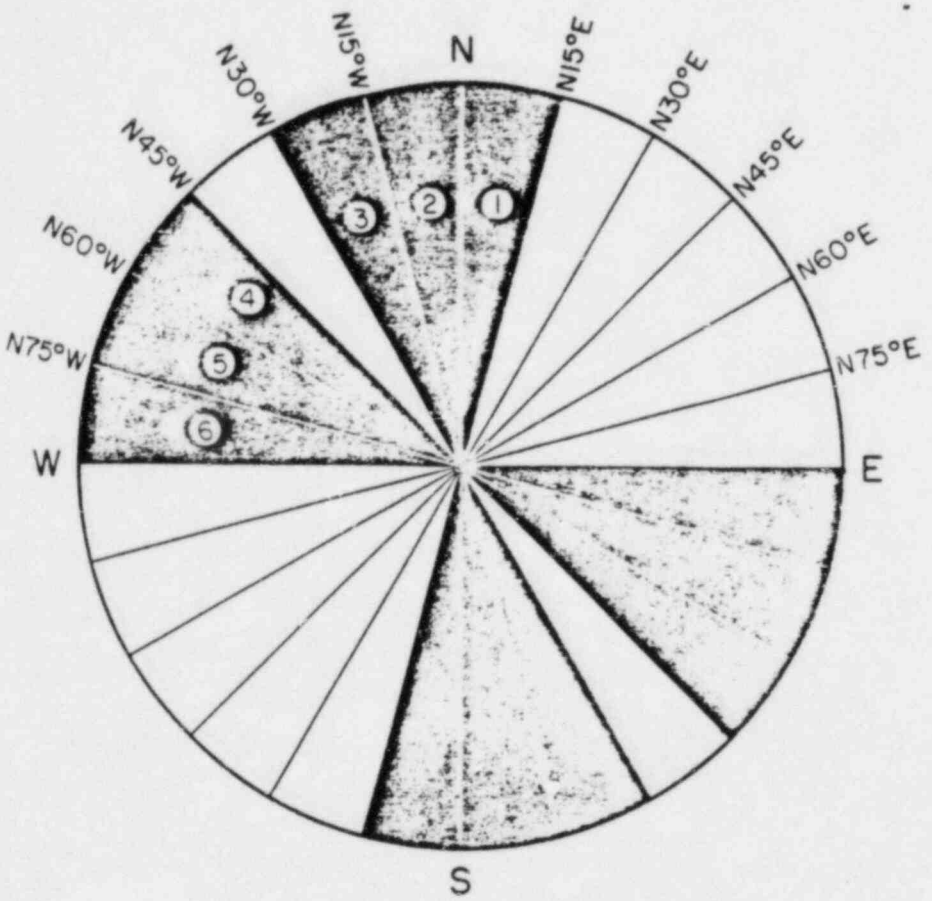
R&D Site No. 1

WILLOW CREEK

TABLE
D-6B-4

DIRECTIONAL TRANSMISSIVITIES
USING VARIOUS WELL COMBINATIONS

WELL NOS.	TRANSMISSIVITY (gpd/ft)			DIRECTION OF MAJOR TRANSMISSIVITY	STORAGE COEFFICIENT
	MAJOR	MINOR	MEAN		
All Wells	1466	314	679	N 56° W	3.8×10^{-4}
WCOW-21, 22, 25	2261	259	765	N 78° W	7.6×10^{-4}
WCOW-21, 23, 26	2373	142	581	N 16° W	7.9×10^{-4}
WCOW-21, 24, 25	1165	498	761	N 65° W	1.4×10^{-3}
WCOW-21, 25, 26	2671	217	761	N 10° W	1.4×10^{-3}
WCOW-22, 23, 26	1026	346	596	N 58° W	3.0×10^{-4}
WCOW-23, 24, 26	1190	295	593	N 25° W	5.6×10^{-4}
WCOW-24, 25, 26	1535	388	772	N 15° E	9.1×10^{-4}



① WELLS WCOW-24, 25, 26

② WELLS WCOW-21, 25, 26

③ WELLS WCOW-21, 23, 26

WELLS WCOW-23, 24, 26

④ WELLS WCOW-22, 23, 26

⑤ WELLS WCOW-21, 24, 25

⑥ WELLS WCOW-21, 22, 25

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

WESTERN NUCLEAR, INC.	DIRECTION OF MAJOR TRANSMISSIVITY	
In-situ Inc.	PREPARED BY: B.K	DATE: 8/23/82
	CHECKED BY: B.K	DATE: 8/30/82
	DRAWN BY ALLORY DEISS	FIGURE NO. **D-6B-11**

The test revealed no hydraulic boundaries or impermeable boundaries. Well WCOW-21 and well WCOW-24 showed delayed responses to pumping, probably because of partial penetration effects. The open interval of well WCOW-21 is 35 feet below the open interval of the pumped well, while the open interval of well WCOW-24 is 85 feet above the open interval of the pumped well. All the remaining wells in the production zone were completed at the same depth as the pumped well. The flowlines for well WCOW-21 and well WCOW-24 to the pumped well were much longer, no doubt causing the delayed response.

D-6B-1.8 Well Productivity and Injectivity

The productivity and injectivity of a well are determined by the size of the well, the available drawdown, the wellhead pressure, and formation properties such as transmissivity and storage coefficient. Since the computation is very complicated, the concept of specific capacity was introduced to achieve a rapid and convenient way to estimate the productivity and the injectivity of a well. Specific capacity is defined as follows:

$$\text{Specific capacity} = Q/s$$

where

Q = well flow rate (L^3T^{-1})

s = water level decline (L).

A production specific capacity of 0.063 gpm/ft for the pumped well (WCPW-21) was computed based on the performance and the hydrologic properties of the production zone observed in the pump test. Theoretically, the injection specific capacity should be equal to the production specific capacity. We have observed in many cases, however, that the injection specific capacity is less than the production specific capacity for a given well by a factor of 1.5 to 2. Therefore, the injection specific capacity for well WCPW-21 is 0.037 gpm/ft, which is approximately 58% of the production specific capacity.

Table D-6B-5 shows the maximum productivity and the injectivities at various wellhead pressures. These values are based on the production specific capacity, the injection specific capacity, and the static water level.

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CPEEK

TABLE
D-6B-5

WELL PRODUCTIVITY AND INJECTIVITY

		FLOW RATE (gpm)
PRODUCTIVITY		12.2
INJECTIVITY	0 psi*	5.6
	20 psi	7.3
	40 psi	9.0
	60 psi	10.7
	80 psi	12.4
	100 psi	14.1

*Wellhead injection pressure

The maximum productivity and the injectivity at 80 psi of wellhead pressure are both about 12 gpm. The formation fracture pressure is about 140 psi of wellhead pressure.

D-6B-2 Groundwater Quality

The groundwater quality data collected to date have been subjected to exhaustive statistical analysis and have yielded the following conclusions:

1. No statistically significant differences in water quality are evident as a result of airlifting versus pumping as a method of casing evacuation.

2. No statistically significant differences in quality exist between the K1 and K2 aquifers. Therefore, K1 and K2 are considered as one aquifer system.

3. Minor differences occur between various laboratory assays. However, none of these differences will influence groundwater classification, leaching, or restoration requirements.

4. Some groundwater quality variance versus time is evident but no pattern is yet identifiable.

5. The K2 aquifer does not appear suitable for any use due to elevated pH and radionuclide values.

Details of the analyses performed to generate the above conclusions are outlined in the following sections.

D-6B-2.1 Sampling and Preservation Methods

Two sampling methods have been employed during the sample collection period: namely, pumping and bailing. One preservation method, consistent with EPA preservation methods, was used.

The pumping method was performed by placing a submersible centrifugal pump in the well. The pump was started and the flow adjusted to the estimated capacity of the well. Solution was pumped through an in-line 0.45-micron filter. Periodic readings of temperature, pH, and conductivity were taken and recorded. Upon stabilization of these readings the samples were taken and preserved as described below.

The bailing method consisted of lowering a 2-inch stainless steel bailing unit into the screened interval (or 450 feet, whichever was attainable) to retrieve the sample. Two methods of casing evacuation were used to achieve stabilization of field readings. For the better producing wells, 300 feet of 1-inch airline was lowered into the well. Airlifting from this depth allowed approximately a 150-foot buffer distance to be kept between the air introduction depth and the actual sampling depth. Airlifting commenced until field measurements had stabilized. Flow rates were estimated using the bucket and stopwatch method. Upon stabilization of the field measurements, airlifting was halted and the well was allowed to recharge (usually 8 hours). After recharge, the sample was bailed from the screened interval. Since the shallow and deep wells (WCOW-27S and WCOW-28D) are poor producers, they were repeatedly bailed until the desired stabilization occurred. A final sample was bailed after the well was allowed to recharge and it was preserved as described below.

All samples taken by the pumping method were filtered prior to the sample being taken. The bailing method required the samples to be filtered using a portable battery-operated centrifugal pump and small disposable 0.45-micron filter cartridges. The filtered sample was split into three segments with nitric acid (HNO_3) being added to one, sulfuric acid (H_2SO_4) being added to the second, while the third remained unaltered. All three portions were then stored in either insulated ice chests or a refrigerator until analyzed.

Completion details for all sampled wells appear in Table D-6B-1.

D-6B-2.2 Sampling Results

Three aquifers were sampled during the sampling program: the shallow, production, and the deep sand systems. Results of all field measurements and laboratory assays can be viewed in Table D-6B-6.

Upon receiving the data from the laboratories, preliminary tests were run to check validity. The tests included anion and cation balances, calculated total dissolved solids (TDS) versus measured TDS, and carbonate/bicarbonate distribution versus theoretical distribution as predicted by pH measurements. No major discrepancies were encountered and all charge balances fell within the WDEQ/LQD recommended 5 % error limit.

TABLE D-6B-6
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	TDS	Na^+	K^+	Ca	Mg	$SO_4^=$
WCPW-21	8-09-82		429	128	5	7	3	190
	8-29-82		425	133	6	10	3	185
	9-23-82	4	423	129	6	11	2	188
	9-23-82	3	420	130	3.6	8.3	1.2	190
	3-28-83	5 6	425	142	4	9	2	193
	3-28-83	3	410	120	2.3	9	1	190
WCOW-21	8-11-82		412	137	6	2	2	185
	9-23-82		412	134	6	7	3	185
	3-29-83		416	139	3	8	1	188
WCOW-22	8-12-82		417	135	9	4	2	190
	3-23-83		414	140	7	4	1	204
WCOW-23	8-12-82		471	139	5	9	3	200
	9-24-82		416	130	5	10	2	180
	3-28-83		426	139	3	10	2	188
WCOW-24	8-11-82		457	139	9	6	2	200
	8-31-82		415	132	8	10	2	170
	9-23-82	4	412	130	8	7	2	185
	9-23-82	3	440	130	4.6	7.6	0.4	190
	3-26-83		426	138	7	8	1	180
WCOW-25	8-10-82		432	142	17	2	1	192
	9-01-82		429	130	14	6	2	165
	9-23-82	2 4	414	130	14	5	2	182
	9-23-82	3	410	120	8.6	4.0	0.3	180
	3-28-83		438	142	21	1	0	176
WCOW-26	8-12-82		414	136	4	4	3	184
	8-30-82		416	132	5	8	3	170
	9-23-82	4	411	129	4	9	2	180
	9-23-82	3	410	130	2.0	7.9	1.2	200
	3-28-83		426	143	3	8	2	200
WCOW-27S	8-10-82	7	85J	144	56	123	6	146
	9-01-82		379	124	11	5	2	138
	9-24-82	4	392	122	11	6	1	138
	9-24-82	3	370	120	6.8	4.2	0.4	150
	3-29-83	6 7	564	147	53	4	2	144
	3-29-83	3 7	560	120	43	2	0.09	150
WCOW-28D	9-01-82		438	169	17	5	1	3
	9-23-82	4	408	158	12	3	1	2
	9-23-82	3	400	158	6.9	2.4	0.6	31
	3-28-83	6	482	168	34	2	1	0
	3-28-83	3	510	130	30	1.6	0.54	15

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	Cl^-	$CO_3^=$	HCO_3^-	pH [1]	TEMP.[1] °C	COND.[1] MHOS/CM 25°C
WCPW-21	8-09-82		7	24	92	9.0	15.0	649
	8-29-82		19	19	112	9.0	15.0	545
	9-23-82	4	12	17	107	9.1	13.0	551
	9-23-82	3	10	9	120	-	-	-
	3-28-83	5 6	8	35	84	9.5	13.0	700
	3-28-83	3	8	20	100	-	-	-
WCOW-21	8-11-82		10	46	37	10.0	18.0	759
	9-23-82		14	36	68	9.6	12.5	571
	3-29-83		8	43	59	9.8	13.0	700
WCOW-22	8-12-82		9	36	61	9.5	14.5	681
	3-23-83		8	43	44	10.3	14.0	740
WCOW-23	8-12-82		10	27	98	8.7	15.0	681
	9-24-82		13	19	110	9.0	12.0	558
	3-28-83		8	14	117	9.2	13.0	700
WCOW-24	8-11-82		10	76	33	9.7	14.5	629
	8-31-82		17	34	81	8.9	15.0	571
	9-23-82	4	13	22	93	9.2	13.0	564
	9-23-82	3	9	10	120	-	-	-
	3-28-83		10	48	54	9.9	13.0	705
WCOW-25	8-10-82		8	67	0	10.5	16.5	778
	9-01-82		18	67	12	9.5	13.0	564
	9-23-82	2 4	10	68	7	9.9	13.0	584
	9-23-82	3	10	55	43	-	-	-
	3-28-83		8	53	0	11.3	13.0	890
WCOW-26	8-12-82		8	36	67	9.2	16.0	562
	8-30-82		17	0	142	8.4	14.0	519
	9-23-82	4	12	12	105	9.0	13.0	545
	9-23-82	3	8	6	120	-	-	-
	3-28-83		8	14	117	9.1	13.0	690
WCOW-27S	8-10-82	7	9	0	0	11.9	17.5	2854
	9-01-82		17	48	63	9.3	13.0	538
	9-24-82	4	16	38	81	9.6	12.0	506
	9-24-82	3	11	18	120	-	-	-
	3-29-83	6 7	10	120	0	11.5	12.0	1000
	3-29-83	3 7	17	152	0	-	-	-
WCOW-28D	9-01-82		21	154	142	9.6	14.0	642
	9-23-82	4	12	106	224	9.5	15.0	558
	9-23-82	3	8	54	300	-	-	-
	3-28-83	6	8	154	195	9.8	12.0	800
	3-28-83	3	8	120	260	-	-	-

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	LAB COND. MHOS 25°C	MAJOR CATIONS MEQ/L	MAJOR ANIONS MEQ/L	CHARGE BALANCE	NH_3 (AS N)
WCPW-21	8-09-82		686	6.30	6.46	1.25	<.05
	8-29-82		662	6.69	6.86	1.25	<.05
	9-23-82	4	659	6.47	6.57	0.77	<.05
	9-23-82	3	680	6.26	6.50	1.92	<.20
	3-28-83	5 6	650	6.89	6.79	0.77	<.10
	3-28-83	3	680	5.81	6.49	5.51	<.2
WCOW-21	8-11-82		691	6.37	6.27	0.79	<.05
	9-23-82		659	6.58	6.56	0.15	0.17
	3-29-83		690	6.60	6.54	0.49	<.10
WCOW-22	8-12-82		670	6.46	6.40	0.47	<.05
	3-23-83		690	6.55	6.63	0.58	<.10
WCOW-23	8-12-82		675	6.88	6.95	0.51	<.05
	9-24-82		659	6.45	6.54	0.69	<.05
	3-28-83		690	6.79	6.52	1.97	<.10
WCOW-24	8-11-82		670	6.74	6.84	0.74	<.05
	8-31-82		662	6.60	6.48	0.92	<.05
	9-23-82	4	687	6.37	6.48	0.86	<.05
	9-23-82	3	660	6.18	6.51	2.56	<.2
	3-28-83		670	6.66	6.51	1.13	<.10
WCOW-25	8-10-82		751	6.80	6.69	0.82	<.05
	9-01-82		662	6.48	6.37	0.86	<.05
	9-23-82	2 4	680	6.43	6.45	0.20	0.12
	9-23-82	3	690	5.66	6.57	7.39	<.2
	3-28-83		790	6.76	5.66	8.92	<.1
WCOW-26	8-12-82		664	6.47	6.36	0.86	<.05
	8-30-82		640	6.52	6.35	1.32	<.05
	9-23-82	4	645	6.33	6.20	0.96	<.05
	9-23-82	3	660	6.80	6.56	2.80	<.2
	3-28-83		670	6.86	6.77	0.64	<.10
WCOW-27S	8-10-82	7	2754	14.32	15.70	4.60	0.36
	9-01-82		607	6.08	5.98	0.83	0.18
	9-24-82	4	618	5.97	5.92	0.48	<.05
	9-24-82	3	620	5.64	6.00	3.13	<.2
	3-29-83	6 7	950	8.11	7.28	5.42	0.30
	3-29-83	3 7	1000	6.43	8.67	14.85	0.30
WCOW-28D	9-01-82		684	8.12	8.11	0.06	0.15
	9-23-82	4	659	7.41	7.58	1.13	0.13
	9-23-82	3	660	7.22	7.59	2.49	<.2
	3-28-83	6	730	8.36	8.55	1.15	0.18
	3-28-83	3	820	6.55	8.80	14.67	<.2

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	$NO_3^=$ (AS N)	NO_2^- (AS N)	F	B	Al	As	Ba
WCPW-21	8-09-82		0.02	0.002	0.15	0.19	<.10	<.001	<.10
	8-29-82		0.20	<.001	0.20	0.12	<.10	<.001	<.10
	9-23-82	4	0.13	<.001	0.17	0.14	<.10	<.001	<.10
	9-23-82	3	<.05	(TOTAL)	<.5	<.1	-	<.005	<.2
	3-28-83	5 6	<.10	<.01	0.16	0.10	<.1	<.01	<.05
	3-28-83	3	<.05	<.05	<.5	0.1	<.5	<.005	<.2
WCOW-21	8-11-82		0.02	<.001	0.17	0.38	<.10	<.001	<.10
	9-23-82		0.22	0.001	<.05	0.04	<.10	<.001	<.10
	3-29-83		<.10	<.01	0.14	<.10	<.1	<.01	<.05
WCOW-22	8-12-82		0.02	0.001	0.17	0.25	<.10	<.001	<.10
	3-23-83		<.10	<.01	0.17	<.10	<.1	<.01	<.05
WCOW-23	8-12-82		0.13	0.009	0.17	0.35	<.10	<.001	<.10
	9-24-82		0.17	0.001	0.17	0.19	<.10	<.001	<.10
	3-28-83		<.10	<.01	0.19	0.11	<.1	<.01	0.10
WCOW-24	8-11-82		0.14	0.010	0.20	0.32	<.10	0.003	<.10
	8-31-82		0.20	<.001	0.20	0.09	<.10	<.001	<.10
	9-23-82	4	0.20	<.001	0.18	0.11	<.10	<.001	<.10
	9-23-82	3	<.05	(TOTAL)	<.5	<.1	-	<.005	<.2
	3-28-83		<.10	<.01	0.21	0.10	1.1	<.01	0.15
WCOW-25	8-10-82		0.02	0.001	0.18	0.36	<.10	0.004	<.10
	9-01-82		0.20	<.001	0.20	0.06	<.10	<.001	<.10
	9-23-82	2 4	0.09	0.001	0.19	0.07	<.10	<.001	<.10
	9-23-82	3	<.05	(TOTAL)	<.5	<.1	-	<.005	<.20
	3-26-83		<.10	0.01	0.19	0.10	0.1	<.01	<.15
WCOW-26	8-12-82		0.02	0.04	0.20	0.27	<.10	<.001	<.10
	8-30-82		0.11	<.001	0.22	0.13	<.10	<.001	<.10
	9-23-82	4	0.20	0.005	0.20	0.21	<.10	<.001	<.10
	9-23-82	3	<.05	(TOTAL)	<.5	0.1	-	<.005	<.2
	3-28-83		<.10	<.01	0.15	<.10	<.1	<.01	<.05
WCOW-27S	8-10-82	7	0.08	0.04	0.27	0.24	<.10	<.001	1.00
	9-01-82		0.10	<.001	0.45	<.01	<.10	<.001	<.10
	9-24-82	4	0.31	0.005	0.45	0.05	<.10	<.001	<.10
	9-24-82	3	<.05	(TOTAL)	0.6	<.1	-	<.005	<.20
	3-29-83	6 7	0.19	0.02	0.54	<.10	1.5	<.01	0.13
	3-29-83	3 7	<.05	<.05	0.6	0.10	<.5	<.005	<.2
WCOW-28D	9-01-82		0.09	<.001	0.74	0.07	<.10	<.001	<.10
	9-23-82	4	0.12	0.002	0.45	0.25	<.10	<.001	<.10
	9-23-82	3	<.05	(TOTAL)	0.8	0.1	-	<.005	<.2
	3-28-83	6	<.10	<.01	0.77	0.11	0.6	<.01	0.15
	3-28-83	3	0.07	<.05	0.7	0.10	<.5	<.005	<.2

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	Cd	Cr	Cu	Fe	Pb	Mn	Hg
WCPW-21	8-09-82		0.004	<.01	0.01	0.30	<.05	<.01	<.0002
	8-29-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	4	<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	3	0.013	<.01	<.005	0.02	<.005	<.005	<.0001
	3-28-83	5 6	<.01	<.05	<.02	<.03	<.05	<.01	<.0004
	3-28-83	3	<.005	-	<.005	<.01	<.005	<.005	<.0001
WCOW-21	8-11-82		0.003	<.01	<.01	0.02	<.05	<.01	<.0002
	9-23-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	3-29-83		<.01	<.05	<.02	<.03	<.05	<.01	<.0004
WCOW-22	8-12-82		0.004	<.01	<.01	0.13	0.06	<.01	<.0002
	3-23-83		<.01	<.05	<.02	<.03	<.05	<.01	<.0004
WCOW-23	8-12-82		0.004	<.01	<.01	1.81	0.06	0.04	<.0002
	9-24-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	3-28-83		<.01	<.05	<.02	<.03	<.05	<.01	<.0004
WCOW-24	8-11-82		0.004	<.01	<.01	2.31	<.05	0.08	<.0002
	8-31-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	4	<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	3	0.012	<.01	<.005	0.02	0.005	<.005	<.0001
	3-28-83		<.01	<.05	<.02	0.25	<.05	<.01	0.0004
WCOW-25	8-10-82		<.002	<.01	0.01	<.31	0.09	0.02	<.0002
	9-01-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	2 4	<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	3	0.010	<.01	<.005	0.02	0.005	<.005	<.0001
	3-28-83		<.01	<.05	<.02	<.03	<.05	<.01	<.0004
WCOW-26	8-12-82		<.002	<.01	<.01	0.03	0.18	<.01	<.0002
	8-30-82		<.002	<.01	<.01	0.01	<.05	<.01	<.0002
	9-23-82	4	<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-23-82	3	0.010	<.01	<.005	0.02	0.042	<.005	<.0001
	3-28-83		<.01	<.05	<.02	<.03	<.05	<.01	<.0004
WCOW-27S	8-10-82	7	0.006	<.01	0.07	0.44	1.40	<.01	<.0002
	9-01-82		<.002	<.01	<.01	<.01	<.05	<.01	<.0002
	9-24-82	4	<.002	<.01	0.02	0.02	<.05	<.01	<.0002
	9-24-82	3	0.009	<.01	0.008	0.02	<.005	0.005	<.0001
	3-29-83	6 7	<.01	<.05	<.02	0.32	<.05	<.01	<.0004
	3-29-83	3 7	<.005	-	<.005	0.09	0.011	<.005	0.0002
WCOW-28D	9-01-82		<.002	<.01	<.01	0.19	<.05	<.01	<.0002
	9-23-82	4	<.002	<.01	<.01	0.04	<.05	<.01	<.0002
	9-23-82	3	0.006	<.01	<.005	0.16	<.005	<.005	<.0001
	3-28-83	6	<.01	<.05	<.02	0.15	<.05	<.01	<.0004
	3-28-83	3	<.005	-	<.005	0.10	0.039	<.005	<.0001

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	Ni	Se	Zn	Mo	V_2O_5
WCPW-21	8-09-82		<.02	<.001	<.005	<.10	<.10
	8-29-82		<.02	<.001	<.005	<.10	<.10
	9-23-82	4	<.02	<.001	<.005	<.10	<.10
	9-23-82	3	0.03	<.005	<.005	0.006	<.005
	3-28-83	5 6	<.04	<.01	<.01	<.10	<.05
	3-28-83	3	<.02	0.007	<.005	<.005	0.006
WCOW-21	8-11-82		<.02	<.001	<.005	<.10	<.10
	9-23-82		<.02	<.001	<.005	<.10	<.10
	3-29-83		<.04	<.01	<.01	<.1	<.05
WCOW-22	8-12-82		<.02	<.001	<.005	<.10	<.10
	3-23-83		<.04	<.01	<.01	<.1	<.05
WCOW-23	8-12-82		<.02	<.001	0.014	<.10	<.10
	9-24-82		<.02	<.001	<.005	<.10	<.10
	3-28-83		<.04	<.01	<.01	<.10	<.05
WCOW-24	8-11-82		<.02	<.001	0.068	<.10	<.10
	8-31-82		<.02	<.001	<.005	<.10	1.30
	9-23-82	4	<.02	<.001	<.005	<.10	<.10
	9-23-82	3	<.02	<.005	<.005	0.007	<.05
	3-29-83		<.04	<.01	<.01	<.1	<.05
WCOW-25	8-10-82		0.02	<.001	<.005	<.10	<.10
	9-01-82		<.02	<.001	<.005	<.10	0.65
	9-23-82	2 4	<.02	<.001	<.005	<.10	<.10
	9-23-82	3	<.02	<.005	<.005	0.006	0.065
	3-28-83		<.04	<.01	<.01	<.1	0.06
WCOW-26	8-12-82		<.02	<.001	0.014	<.10	<.10
	8-30-82		<.02	<.001	<.005	<.10	<.10
	9-23-82	4	<.02	<.001	<.005	<.10	<.10
	9-23-82	3	<.02	<.005	<.005	0.005	<.005
	3-28-83		<.04	<.01	0.06	<.1	<.05
WCOW-27S	8-10-82	7	0.02	<.001	0.555	<.10	<.10
	9-01-82		<.02	<.001	<.005	<.10	0.22
	9-24-82	4	<.02	<.001	0.065	<.10	<.10
	9-24-82	3	<.02	<.005	<.005	0.009	<.005
	3-29-83	6 7	<.04	< 01	<.01	<.1	<.05
	3-29-83	3 7	<.02	<.005	<.005	<.005	<.005
WCOW-28D	9-01-82		<.02	<.001	<.005	<.10	0.44
	9-23-82	4	<.02	<.001	<.005	<.10	<.10
	9-23-82	3	<.02	<.005	<.005	0.008	<.005
	3-28-83	6	<.04	<.01	<.01	<.1	<.05
	3-28-83	3	<.02	<.005	<.005	<.005	<.005

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Well No.	Date Sampled	Foot Notes	U_3O_8 (PPb)	Ra-226 Pci/L	Th-230 Pci/L	Pb-210 Pci/L	Po-210 Pci/L
WCPW-21	8-09-82		35	24±5	-	-	-
	8-29-82		8	31±6	-	-	-
	9-23-82	4	15	52±6.5	-	-	-
	9-23-82	3	26	80±4	-	-	-
	3-28-83	5 6	49	53±2	0.2±0.3	397±16	49±3
WCOW-21	8-11-82		3	3.8±1.3	-	-	-
	9-23-82		3	1.9±1.2	-	-	-
	3-29-83		3	1.9±0.3	0.2±0.2	1.7±0.6	0.1±0.2
WCOW-22	8-12-82		8	3.9±1.8	-	-	-
	3-23-83		6	0.2±0.2	0.1±0.1	5.8±0.8	0.4±0.4
WCOW-23	8-12-82		39	17±3.9	-	-	-
	9-24-82		10	11±2.9	-	-	-
	3-28-83		15	13±1	0.3±0.3	47±3	3.7±0.7
WCOW-24	8-11-82		4	4.3±2.0	-	-	-
	8-31-82		1	10.7±3.2	-	-	-
	9-23-82	4	1	4.6±1.9	-	-	-
	9-23-82	3	<1	2.2±0.7	-	-	-
	3-28-83		<1	0.7±0.2	0.1±0.2	1.1±0.7	0.1±0.2
WCOW-25	8-10-82		39	18.8±3.2	-	-	-
	9-01-82		12	17.9±4.2	-	-	-
	9-23-82	2 4	9	15.1±3.3	-	-	-
	9-23-82	3	26	51±4			
	3-28-83		12	0.7±0.2	0.1±0.2	1.1±0.7	0.1±0.2
WCOW-26	8-12-82		24	14.8±2.6	-	-	-
	8-30-82		11	12.9±3.5	-	-	-
	9-23-82	4	11	5.8±2.1	-	-	-
	9-23-82	3	28	24±2	-	-	-
	3-28-83		28	13±1	0.3±0.3	92±4	8.9±1.2
WCOW-27S	8-10-82	7	7	34±5	-	-	-
	9-01-82		<1	1.6+1.2	-	-	-
	9-24-82	4	17	2.0±1.3	-	-	-
	9-24-82	3	-	-	-	-	-
	3-29-83	6 7	<1	0.7±0.2	0.1±0.2	3.6±0.8	0.9±0.4
WCOW-28D	9-01-82		1	1.0±1.0			
	9-23-82	4	1	1.3±1.0			
	9-23-82	3	<1	0.3±0.3			
	3-28-83	6	1	3.0±0.4	0.2±0.3	1.9±0.8	0.5±0.4

*All Assays in mg/l Unless Noted

TABLE D-6B-6 (cont)
Christensen Ranch ISL Project
R & D Site #1 Willow Creek
Baseline Groundwater Quality Assays*

Foot Notes

1 Field Measurement

2 Average of Three (3) Replicate Samples

3 Split sample (CDM Lab Assay)

4 Split Sample (WAMCO Lab Assay)

5 Average of Five (5) Replicate Samples

6 Split Sample (Core Lab Assay)

7 Sample Considered an Outlier

Upon acceptance of the data, the second condition Student t test (Chemical Engineers Handbook 1973) was applied to (1) pumped versus airlift evacuation data; (2) K1 versus K2 aquifer data; (3) various laboratory cross check data; and (4) all samplings relative to the last sampling to check for seasonal variations. The tests were performed on all major cations, major anions, TDS, and field measured conductivity to find any statistically significant differences.

(1) Pumping Versus Airlifting Evacuation

As was described under "Sampling and Preservation Procedures", air was introduced during the evacuation at a point which should eliminate any effect on the bailed sample (150 feet above the sampling point). The well was then allowed to recharge to ensure that representative water existed in the screened interval. The Student t test was applied to the data sets. A statistically significant difference occurred with chloride assays only. If the evacuation method had indeed affected the samples, $CO_3^{=}$, HCO_3^{-}, and probably conductivity readings should have been affected. It is concluded that this evacuation method does not affect the representativeness of the sample.

(2) K1 versus K2 Aquifer

Site hydrologic investigations indicated strong communication between the K1 and K2 systems. It was assumed that this communication should result in the aquifers being chemically similar. Performance of the Student t test yielded no significant differences. The K1 and K2 systems are chemically and hydrologically one unit, and shall be considered as the same unit.

(3) Laboratory Quality Control Checks

During the sampling program, selected samples were split and submitted to different laboratories for cross check analyses. While minor differences occurred in a few assays (usually only in the ppm range), none will affect the groundwater classification or the baseline determination. In addition to the split sampling, replicate samples were submitted to the primary laboratories to estimate potential laboratory error. In general, laboratory error was acceptable. Results of replicate samplings were first averaged and then reported in Table D-6B-6.

(4) Seasonal Variations of Groundwater Quality

The last sampling data set was compared to each of the previous data sets using the Student t test. Some statistical variations occurred with Mg, Na, Cl, conductivity, and TDS.

- Magnesium - Assay for magnesium generally decreased as sampling progressed. This change was approximately 1 mg/l and is not considered important because of the extremely low levels of Mg present ($\bar{x}$ = 2±1 mg/l)

- Sodium - Assays for sodium appear to have some cyclical trends, the averages ranging from 130-141 mg/l. These levels will not affect groundwater classification or restoration efforts.

- Chloride - Average assays for chloride ranged from 9 to 18 mg/l, but showed a cyclic trend which was not in phase with sodium.

- Conductivity and TDS - both assays follow the same pattern as is expected. They are also "in phase" with the sodium assays.

In conclusion, it initially appears as though some variation of groundwater over time is evident. A pattern, however, cannot yet be defined.

Field conductivity measurements for the samples taken during 1982 were taken at the average aquifer temperature encountered, 13°C. Correction of these values can be made by the equation (Standard Methods for Examination of Water and Wastewater, 1980):

$$(\text{COND @ } 25°\text{C}) = \frac{(\text{COND @ T°C})(\text{CELL CONSTANT})}{1 - [0.0191\ (25°\text{C} - \text{T°C})]}$$

The cell constant for the meter used is 1.0, resulting in a correction factor of 1.297. Field conductivity measurements reported in Table D-6B-6 are corrected values.

D-6B-2.3 Removal of Outliers

The samples taken from well WCOW-27S on August 10, 1982 and March 29, 1983 are the only samples considered to be outliers. This determination was made after all major cations, major anions, TDS, and conductivity measurements were subjected to a G_N statistical test. This test is designed to test whether extreme values are statistically different from the rest of the data. Sampling of this well will continue to allow a stronger data base to be developed.

Groundwater Classification

Three aquifers were sampled during this program, the K series, upper, and lower sand systems. Each will be discussed separately.

K1 and K2 Sands: It has already been shown that these two "portions" of the K series are indeed hydrologically and chemically one, and will be considered as the K unit from here on. Review of the data for the K series indicates water quality unsuitable for any use without treatment mainly due to elevated radionuclides and pH.

Upper and Lower Aquifers: Sampling of both these aquifers again yielded elevated pH values indicating a water quality unsuitable for any use without treatment. Again elevated pH is the cause.

As stated in section D.1.a of the Reclamation Plan, the restoration goal will be to return all aquifers affected by the R&D operation back to at least the highest value obtained during baseline groundwater quality sampling.

D-6B-2.4 Excursion Indicators and Upper Control Limits (UCLs)

As is discussed in section C.5.c of the Mineral Extraction Plan, the proposed excursion-indicating parameters are sodium, carbonate, bicarbonate, calcium, chloride, uranium, and electrical conductivity. UCLs are generally chosen such that when that level is attained in any particular sample, one may conclude that an excursion is occurring. One method for determining the UCL is described in WDEQ Guideline No. 4 Appendix 1, and is represented by the equation

$$UCL = \bar{x} + \frac{ts}{\sqrt{n}}$$

Where

UCL = upper control limit

$\bar{x}$ = mean of baseline data

t = student "t" value taken from the appropriate statistical table

s = standard deviation of the baseline data

n = number of data points

This method was applied to the baseline data and resulted in UCLs which, in several cases, were lower than some of the baseline data itself. For example,

Well No. WCOW-24, Conductivity Data: 629, 571, 564, 705

$n = 4$, $\bar{x} = 617$, $s = 65$, $t = 2.353$

$$UCL = 617 + \frac{2.353\ (65)}{\sqrt{4}} = 693 < 705$$

Other examples include:

Well	WCPW-21	Na, $CO_3^{=}$, Cl^{-}, CA^{++}, U_3O_8
	WCOW-22	Ca^{++}
	WCOW-24	$CO_3^{=}$, Cl^{-}, CA^{++}
	WCOW-25	COND, HCO_3^{-}, Cl^{-}, CA^{++}
	WCOW-26	COND, Na, $CO_3^{=}$, Cl^{-}
	WCOW-27S	Cl^{-}, CA^{++}

It is, therefore, proposed that UCLs be defined as 20% above the highest baseline value obtained or the highest baseline value plus 10 ppm, whichever is higher. The only exception to this rule will be U_3O_8. Since U_3O_8 levels during baseline sampling were all well below 1 ppm, an action level of 5 ppm is proposed. The resultant upper control levels for each well are presented in Table D-6B-7. This should still allow adequate control of the process, yet will not cause wells to incorrectly be placed in excursion status.

D-6C. Water Rights

No adjudicated water rights exist within one-half mile of the permit area according to the State Engineer's records. Some stock watering wells exist approximately one mile from the site, but operations will not affect these wells.

TABLE D-6B-7

PROPOSED UCL's FOR EXISTING WELLS
WHICH WILL BE USED AS MONITOR WELLS
(All assay in mg/ℓ unless noted)

Parameter	WCOW-21	WCOW-22	WCOW-23	WCOW-27S	WCOW-28D
Conductivity μMHOS/cm(25°)	840	888	840	646	960
NA^{+}	167	168	167	149	203
$CO_3^{=}$	56	53	37	58	185
HCO_3^{-}	82	73	140	97	269
Cl^{-}	14	19	23	27	41
Ca^{++}	18	14	20	16	15
U_3O_8	5	5	5	5	5

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ATTACHMENT A TO APPENDIX D-6B

FIELD DATA FOR HYDROLOGIC EVALUATION

WILLOW CREEK R&D SITE #1

IN-SITU, INC.

```
SE200A CONSTANT RATE TEST V2.2

JOB RSD-001     RUN  6    07/23/82

WESTERN NUCLEAR TEST 1
WILLOW CREEK AREA
WATER SAMPLES COLLECTED

PUMP SCHEDULE:

   PUMP FOR: 1440 Min
   RECOVERY: 1440 Min

   PUMP RATE: 12 GPM
   PUMP SETTING: 450 Feet

TRANSDUCER TABLE:

INPUT 1 WELL WCPW-21     *FAST*
   TRANSDUCER-
      S/N: 20882
      SF: 290.32
      SETTING: 390 Feet
   INITIAL LEVEL: 145 Feet

INPUT 2 WELL WCOW-22
   TRANSDUCER-
      S/N: 20880
      SF: 99.875
      SETTING: 190 Feet
   INITIAL LEVEL: 150 Feet

INPUT 3 WELL WCOW-23
   TRANSDUCER-
      S/N: 2A918
      SF: 50.06
      SETTING: 190 Feet
   INITIAL LEVEL: 148 Feet

INPUT 4 WELL WCOW-24A
   TRANSDUCER-
      S/N: 2F034
      SF: 100.06
      SETTING: 220 Feet
   INITIAL LEVEL: 145 Feet

INPUT 5 WELL WCOW-25
   TRANSDUCER-
      S/N: 2F023
      SF: 100.13
      SETTING: 220 Feet
   INITIAL LEVEL: 145 Feet

INPUT 6 WELL WCOW-26
   TRANSDUCER-
      S/N: 20878
      SF: 100.25
      SETTING: 220 Feet
   INITIAL LEVEL: 147 Feet

INPUT 7 WELL WCOW-27S
   TRANSDUCER-
      S/N: 20877
      SF: 9.901
      SETTING: 120 Feet
   INITIAL LEVEL: 110 Feet

INPUT 8 WELL WCOW-28D
   TRANSDUCER-
      S/N: 20876
      SF: 9.956
      SETTING: 170 Feet
   INITIAL LEVEL: 159 Feet

INPUT 9 WELL WCOW-21A
   TRANSDUCER-
      S/N: 2E163
      SF: 49.67
      SETTING: 190 Feet
   INITIAL LEVEL: 138 Feet

INPUT 10 WELL WCOW-21B
   TRANSDUCER-
      S/N: 20881
      SF: 99.26
      SETTING: 190 Feet
   INITIAL LEVEL: 138 Feet
```

SE200P CONSTANT RATE TEST V2 2

*** POWER FAILED ***

DRAWDOWN DATA

RUN STARTED AT: 10:29
DRAWDOWN LASTED 1440.2 Min

Input 1 Well WCPW-21 *FAST*

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178	147.24	2.24
0.0345	146.12	1.12
0.0511	146.72	1.72
0.0678	147.24	2.24
0.0845	148.01	3.01
0.1011	148.62	3.62
0.1178	149.05	4.05
0.1345	149.56	4.56
0.1511	150.25	5.25
0.1678	150.51	5.51
0.2588	153.09	8.09
0.3422	155.42	10.42
0.4255	157.66	12.66
0.5088	159.89	14.89
0.5922	161.87	16.87
0.6755	163.94	18.94
0.7588	166.18	21.18
0.8422	167.82	22.82
0.9255	169.62	24.62
1.0088	171.69	26.69
1.3012	177.37	32.37
1.5513	182.28	37.28
1.8012	186.76	41.76
2.0513	191.15	46.15
2.3012	195.19	50.19
2.5513	199.07	54.07
2.8012	202.68	57.68
3.0513	206.39	61.39
3.3013	209.66	64.66
3.5513	213.01	68.01
3.8012	216.20	71.20
4.0513	219.21	74.21
4.3012	222.14	77.14
4.5513	224.90	79.90
4.8012	227.56	82.56
5.0513	230.06	85.06
5.3013	232.47	87.47
5.5513	234.79	89.79
5.8013	237.12	92.12
6.0513	239.19	94.19
6.3013	241.34	96.34
6.5513	243.32	98.32
6.8012	245.12	100.12
7.0513	247.11	102.11
7.3012	248.74	103.74
7.5513	250.46	105.46
7.8012	252.01	107.01
8.0513	253.65	108.65
8.3012	255.37	110.37
8.5513	256.57	111.57
8.8012	258.04	113.04
9.0513	259.33	114.33
9.3012	260.53	115.53
9.5513	261.83	116.83
9.8012	262.86	117.86
10.0510	264.24	119.24
12.0940	271.98	126.98
14.0940	277.67	132.67
16.1500	282.06	137.06
18.1500	284.99	139.99
20.0930	287.05	142.05
22.0950	288.69	143.69
24.0950	289.81	144.81
26.0950	291.01	146.01
28.0950	291.96	146.96
30.0950	292.48	147.48
32.0950	292.99	147.99
34.0950	293.42	148.42
36.0950	293.85	148.85
38.0930	294.28	149.28
40.0950	294.63	149.63
42.0950	294.97	149.97
44.1330	294.97	149.97
46.1330	295.32	150.32
48.1330	295.49	150.49
50.1330	295.75	150.75
52.2200	295.75	150.75
54.0930	295.83	150.83
56.0950	295.92	150.92
58.0930	295.92	150.92
60.0950	296.26	151.26
62.0930	296.09	151.09
64.3450	296.18	151.18
66.3050	296.26	151.26
68.1220	296.52	151.52
70.1220	296.26	151.26
72.1220	296.35	151.35
74.1220	296.44	151.44
76.1220	296.44	151.44
78.1220	296.78	151.78
80.1220	296.61	151.61
82.1220	296.78	151.78
84.1220	296.87	151.87
86.1220	296.87	151.87
88.1220	296.87	151.87
90.1220	296.78	151.78
92.1220	296.87	151.87
94.1220	296.70	151.70
96.1220	296.95	151.95
98.1220	296.87	151.87

100	1200
115	1700
130	1700
145	1700
160	1700
175	1700
190	1700
205	1700
220	1700
235	1700
250	1800
265	1700
280	1700
295	1700
310	1700
325	1800
340	1800
355	1800
370	1800
385	1800
400	1800
415	1800
430	1800
445	1800
460	1800
475	1700
490	1700
505	2300
520	2300
535	5700
550	2300
565	2300
580	2300
595	2300
610	2300
625	2300
640	2300
655	2300
670	2300
685	2300
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760	2300
775	2300
790	2300
805	2300
820	2300
835	2300
850	2300
865	2300
880	2300
895	2300
910	2300
925	2300
940	2300
955	2300
970	2300
985	2300

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297	30
297	56
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297	81
297	64
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299	62
299	97
299	88
299	97
299	97
300	48
300	91
300	66
300	14
300	05
300	31
300	31
300	14
300	22
300	14
300	14
300	05
299	71
300	05
300	05
300	91
301	00
302	38
302	03
301	00
300	91
300	83
301	00
301	09
301	95
303	24
301	09
300	31
300	66
302	03
302	89
303	24
303	50
303	67
303	41
303	41
302	38
301	26
301	17
301	09
301	95
302	29
303	06
305	31
305	99

151	97
152	12
151	87
152	30
152	56
152	54
152	54
152	81
152	64
153	42
154	62
154	97
154	89
154	97
154	97
155	48
155	91
155	66
155	14
155	05
155	31
155	31
155	14
155	22
155	14
155	14
155	05
154	71
155	05
155	05
155	91
156	99
157	38
157	03
156	00
155	91
155	83
156	00
156	09
156	95
158	24
156	09
155	31
155	66
157	03
157	89
158	24
158	50
158	67
158	41
158	41
157	78
156	26
156	17
156	09
156	95
157	29
158	06
160	31
160	99

1000	2000
1015	3000
1030	3000
1045	3000
1060	3000
1075	3000
1090	3000
1105	3000
1120	3000
1135	3000
1150	3000
1165	3000
1180	3000
1195	3000
1210	3000
1225	3000
1240	3000
1255	3000
1270	3000
1285	7000
1300	3000
1315	3000
1331	2000
1345	3000
1360	3000
1375	3000
1390	3000
1405	3000
1420	7000
1435	3000

307	11
307	03
305	39
305	94
307	03
308	23
308	06
307	80
307	37
307	54
307	46
308	15
307	63
307	37
306	85
307	11
306	77
306	25
305	99
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305	39
305	73
304	96
303	15
303	50
307	11
307	54
307	63
307	46
307	54

162	11
162	03
160	39
161	94
162	03
163	23
163	06
162	80
162	37
162	54
162	46
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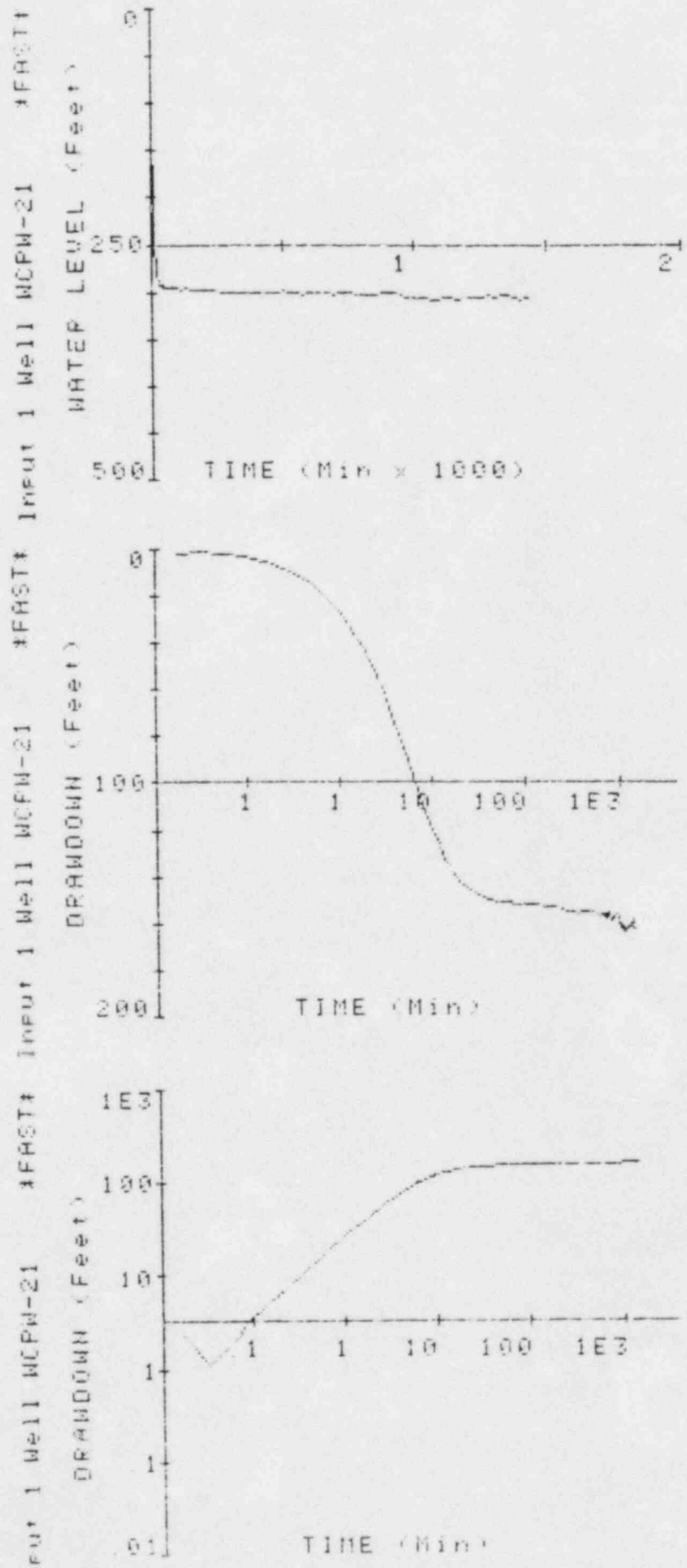
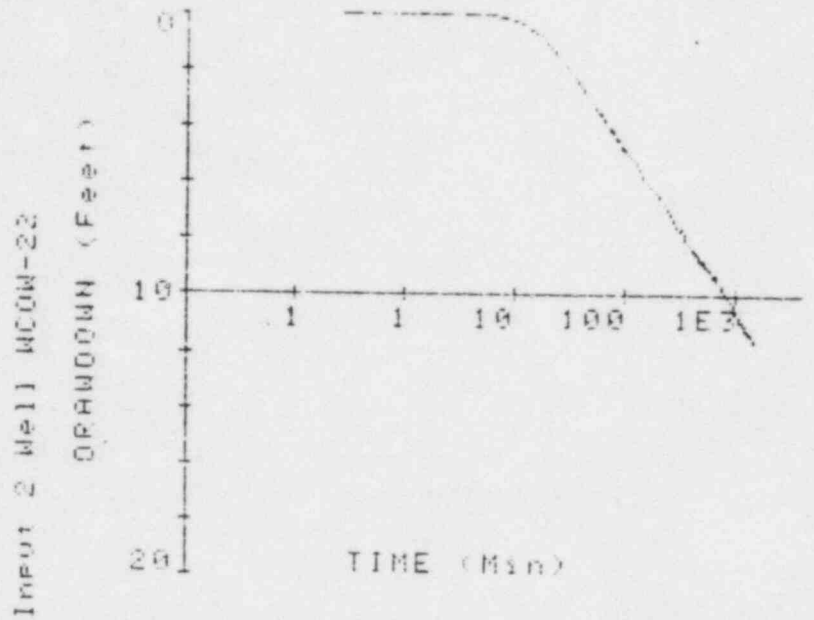
162	11
161	77
161	25
160	99
159	70
160	39
160	73
159	96
158	15
158	50
162	11
162	54
162	63
162	46
162	54

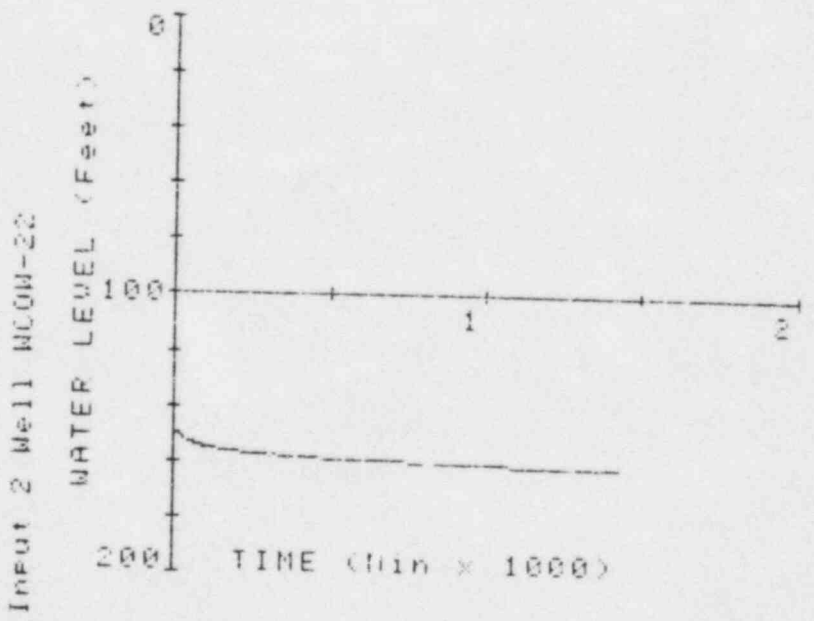

FAST Input 1 Well WCPW-21
WATER LEVEL (Feet)
0
250
500
1
2
TIME (Min x 1000)
FAST Input 1 Well WCPW-21
DRAWDOWN (Feet)
0
100
200
1
1
10
100
1E3
TIME (Min)
Input 1 Well WCPW-21 *FAST*
DRAWDOWN (Feet)
1E3
100
10
1
1
.01
1
1
10
100
1E3
TIME (Min)

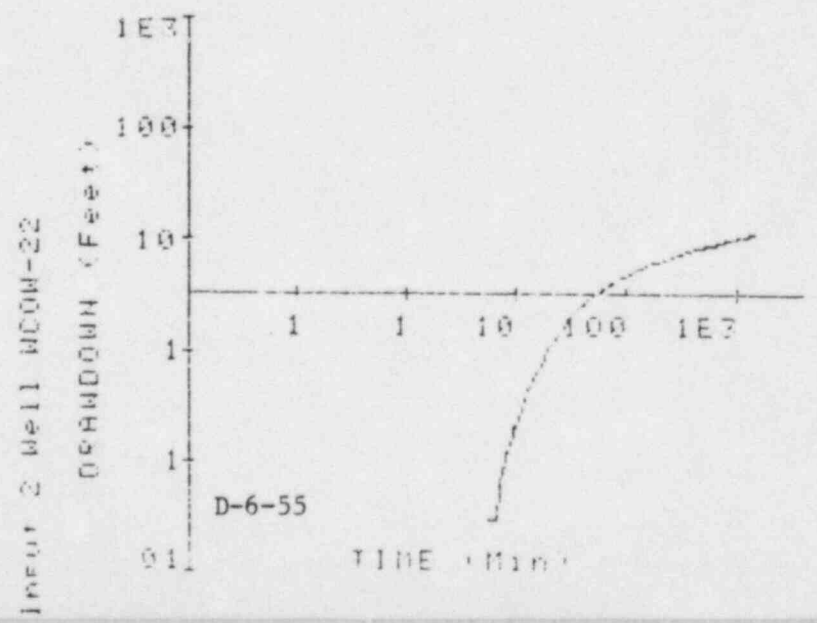
Input 2 Well WCOW-22

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178		
0.0345		
0.0511		
0.0678		
0.0845		
0.1011		
0.1178		
0.1345		
0.1511		
0.1678		
0.2588	150.00	0.00
0.3422	150.00	0.00
0.4255	150.00	0.00
0.5088	150.00	0.00
0.5922	150.00	0.00
0.6755	150.00	0.00
0.7589	150.00	0.00
0.8422	150.00	0.00
0.9255	150.00	0.00
1.0088	150.00	0.00
1.0912	150.00	0.00
1.1513	150.00	0.00
1.2012	150.00	0.00
2.0513	150.00	0.00
2.1012	150.00	0.00
2.1513	150.00	0.00
2.2012	150.00	0.00
2.2513	149.97	-0.03
3.1012	149.97	-0.03
3.1513	150.00	0.00
3.2012	150.00	0.00
4.0513	150.00	0.00
4.1012	150.00	0.00
4.1513	150.00	0.00
4.2012	150.00	0.00
5.0513	150.00	0.00
5.1012	150.00	0.00
5.1513	150.00	0.00
5.2012	150.03	0.03
6.0513	150.03	0.03
6.1012	150.03	0.03
6.1513	150.03	0.03
6.2012	150.03	0.03
7.0513	150.06	0.03
7.1012	150.06	0.03
7.1513	150.09	0.03
7.2012	150.09	0.03
8.0513	150.09	0.03
8.1012	150.12	0.03
8.1513	150.12	0.03
8.2012	150.12	0.03
9.0513	150.14	0.03
9.1012	150.14	0.03
9.1513	150.17	0.03
9.2012	150.20	0.03
10.0510	150.20	0.03
12.0940	150.35	0.03
14.0940	150.49	0.03
16.1500	150.66	0.03
18.1500	150.84	0.03
20.0930	151.01	0.03
22.0950	151.18	0.03
24.0950	151.35	0.03
26.0950	151.53	0.03
28.0950	151.67	0.03
30.0950	151.84	0.03
32.0950	151.99	0.03
34.0950	152.13	0.03
36.0950	152.25	0.03
38.0930	152.39	0.03
40.0950	152.51	0.03
42.0950	152.67	0.03
44.1330	152.77	0.03
46.1330	152.85	0.03
48.1330	152.97	0.03
50.1330	153.08	0.03
52.2200	153.17	0.03
54.0930	153.26	0.03
56.0950	153.34	0.03
58.0930	153.43	0.03
60.0950	153.49	0.03
62.0930	153.57	0.03
64.3450	153.69	0.03
66.3050	153.75	0.03
68.1220	153.83	0.03
70.1220	153.89	0.03
72.1220	153.98	0.03
74.1220	154.04	0.03
76.1220	154.12	0.03
78.1220	154.18	0.03
80.1220	154.24	0.03
82.1220	154.29	0.03
84.1220	154.35	0.03
86.1220	154.44	0.03
88.1220	154.50	0.03
90.1220	154.55	0.03
92.1220	154.61	0.03
94.1220	154.67	0.03
96.1220	154.73	0.03
98.1220	154.76	0.03

100	1300	154.91	4	5.5	6.6	6.31	1000	2000	160.49	10.43	
115	1700	155.15	5.5	6.6	6.51	1015	3000	160.55	10.55		
130	1700	155.48	5.5	6.6	6.57	1030	3000	160.51	10.51		
145	1700	155.71	5.5	6.6	6.77	1045	3000	160.56	10.56		
160	1700	155.94	5.5	6.6	7.09	1060	3000	160.59	10.59		
175	1700	156.17	5.5	6.6	7.21	1075	3000	160.72	10.72		
190	1700	156.31	5.5	6.6	7.35	1090	3000	160.81	10.81		
205	1700	156.51	5.5	6.6	7.49	1105	3000	160.84	10.84		
220	1700	156.57	5.5	6.6	7.61	1120	3000	160.87	10.87		
235	1700	156.77	5.5	6.6	7.77	1135	3000	160.92	10.92		
250	1800	157.09	5.5	6.6	7.99	1150	3000	160.95	10.95		
265	1700	157.21	5.5	6.6	8.21	1165	3000	160.98	10.98		
280	1700	157.35	5.5	6.6	8.35	1180	3000	161.04	11.04		
295	1700	157.49	5.5	6.6	8.49	1195	3000	161.07	11.07		
310	1700	157.61	5.5	7.7	8.61	1210	3000	161.15	11.16		
325	1800	157.58	5.5	7.7	8.58	1225	3000	161.18	11.18		
340	1800	157.90	5.5	7.7	8.90	1240	3000	161.21	11.21		
355	1800	157.98	5.5	7.7	8.98	1255	3000	161.24	11.24		
370	1800	158.04	5.5	7.7	9.04	1270	3000	161.30	11.30		
385	1800	158.16	5.5	7.7	9.16	1285	7000	161.36	11.35		
400	1800	158.13	5.5	7.7	9.13	1300	3000	161.21	11.21		
415	1800	158.33	5.5	7.7	9.33	1315	3000	161.24	11.24		
430	1800	158.36	5.5	7.7	9.36	1331	2000	161.30	11.30		
445	1800	158.45	5.5	7.7	9.45	1345	3000	161.30	11.30		
460	1800	158.45	5.5	7.7	9.45	1350	3000	161.33	11.33		
475	1700	158.65	5.5	7.7	9.65	1375	3000	161.39	11.39		
490	1700	158.65	5.5	7.7	9.65	1390	3000	161.41	11.41		
505	2300	158.76	5.5	8.8	9.76	1405	3000	161.47	11.47		
520	2300	158.73	5.5	8.8	9.73	1420	3000	161.59	11.59		
535	5700	158.85	5.5	8.8	9.85	1435	3000	161.53	11.53		
550	2300	158.91	5.5	8.8	9.91						
565	2300	158.99	5.5	8.8	9.99						
580	2300	159.05	5.5	8.8	9.95						
595	2300	159.11	5.5	8.8	9.11						
610	2300	159.17	5.5	8.8	9.17						
625	2300	159.25	5.5	8.8	9.25						
640	2300	159.28	5.5	8.8	9.28						
655	2300	159.25	5.5	8.8	9.25						
670	2300	159.34	5.5	8.8	9.34						
685	2300	159.43	5.5	8.8	9.43						
700	2300	159.48	5.5	8.8	9.48						
715	2300	159.57	5.5	8.8	9.57						
730	2300	159.66	5.5	8.8	9.66						
745	2300	159.68	5.5	8.8	9.68						
760	2300	159.74	5.5	8.8	9.74						
775	2300	159.80	5.5	8.8	9.80						
790	2300	159.86	5.5	8.8	9.86						
805	2300	159.92	5.5	8.8	9.92						
820	2300	159.97	5.5	8.8	9.97						
835	2300	160.03	5.5	8.8	10.03						
850	2300	160.06	5.5	8.8	10.06						
865	2300	160.09	5.5	8.8	10.09						
880	2300	160.12	5.5	8.8	10.12						
895	2300	160.15	5.5	8.8	10.15						
910	2300	160.18	5.5	8.8	10.18						
925	2300	160.23	5.5	8.8	10.23						
940	2300	160.26	5.5	8.8	10.26						
955	2300	160.32	5.5	8.8	10.32						
970	2300	160.38	5.5	8.8	10.38						
985	2300	160.43	5.5	8.8	10.43						


Input 2 Well MCOW-22
DRAWDOWN (Feet)
0
10
20
1
1
10
100
1E3
TIME (Min)


Input 2 Well MCOW-22
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 2 Well MCOW-22
DRAWDOWN (Feet)
1E3
100
10
1
.1
.01
1
1
10
100
1E3
TIME (Min)

Input 3 Well WCOW-23

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178		
0.0345		
0.0511		
0.0678		
0.0845		
0.1011		
0.1178		
0.1345		
0.1511		
0.1678		
0.2588	148.01	0.01
0.3422	148.00	0.00
0.4255	148.00	0.00
0.5088	148.00	0.00
0.5922	148.00	0.00
0.6755	148.00	0.00
0.7588	148.00	0.00
0.8422	148.01	0.01
0.9255	148.00	0.00
1.0088	148.00	0.00
1.3012	148.01	0.01
1.5513	148.01	0.01
1.8012	148.01	0.01
2.0513	148.01	0.01
2.3012	148.01	0.01
2.5513	148.00	0.00
2.8012	148.01	0.01
3.0513	148.01	0.01
3.3013	148.01	0.01
3.5513	148.03	0.03
3.8012	148.03	0.03
4.0513	148.04	0.04
4.3012	148.06	0.06
4.5513	148.04	0.04
4.8012	148.06	0.06
5.0513	148.06	0.06
5.3013	148.07	0.07
5.5513	148.06	0.06
5.8013	148.06	0.06
6.0513	148.07	0.07
6.3013	148.07	0.07
6.5513	148.09	0.09
6.8012	148.07	0.07
7.0513	148.09	0.09
7.3012	148.12	0.12
7.5513	148.12	0.12
7.8012	148.13	0.13
8.0513	148.14	0.14
8.3012	148.13	0.13
8.5513	148.14	0.14
8.8012	148.16	0.16
9.0513	148.16	0.16
9.3012	148.17	0.17
9.5513	148.20	0.20
9.8012	148.19	0.19
10.0519	148.20	0.20
12.0940	148.33	0.33
14.0940	148.43	0.43
16.1500	148.58	0.58
18.1500	148.72	0.72
20.0930	148.87	0.87
22.0950	149.05	1.05
24.0950	149.26	1.26
26.0950	149.42	1.42
28.0950	149.59	1.59
30.0950	149.81	1.81
32.0950	149.98	1.98
34.0950	150.17	2.17
36.0950	150.33	2.33
38.0930	150.51	2.51
40.0950	150.69	2.69
42.0950	150.85	2.85
44.1330	151.01	3.01
46.1330	151.15	3.15
48.1330	151.34	3.34
50.1330	151.48	3.48
52.2200	151.63	3.63
54.0930	151.73	3.73
56.0950	151.86	3.86
58.0930	152.00	4.00
60.0950	152.10	4.10
62.0930	152.25	4.25
64.3450	152.38	4.38
66.3050	152.48	4.48
68.1220	152.59	4.59
70.1220	152.70	4.70
72.1220	152.80	4.80
74.1220	152.91	4.91
76.1220	153.00	5.00
78.1220	153.11	5.11
80.1220	153.19	5.19
82.1220	153.27	5.27
84.1220	153.37	5.37
86.1220	153.48	5.48
88.1220	153.56	5.56
90.1220	153.66	5.66
92.1220	153.72	5.72
94.1220	153.78	5.78
96.1220	153.84	5.84
98.1220	153.92	5.92

100	1200
115	1700
130	1700
145	1700
160	1700
175	1700
190	1700
205	1700
220	1700
235	1700
250	1800
265	1700
280	1700
295	1700
310	1700
325	1800
340	1800
355	1800
370	1800
385	1800
400	1800
415	1800
430	1800
445	1800
460	1800
475	1700
490	1700
505	2300
520	2300
535	5700
550	2300
565	2300
580	2300
595	2300
610	2300
625	2300
640	2300
655	2300
670	2300
685	2300
700	2300
715	2300
730	2300
745	2300
760	2300
775	2300
790	2300
805	2300
820	2300
835	2300
850	2300
865	2300
880	2300
895	2300
910	2300
925	2300
940	2300
955	2300
970	2300
985	2300

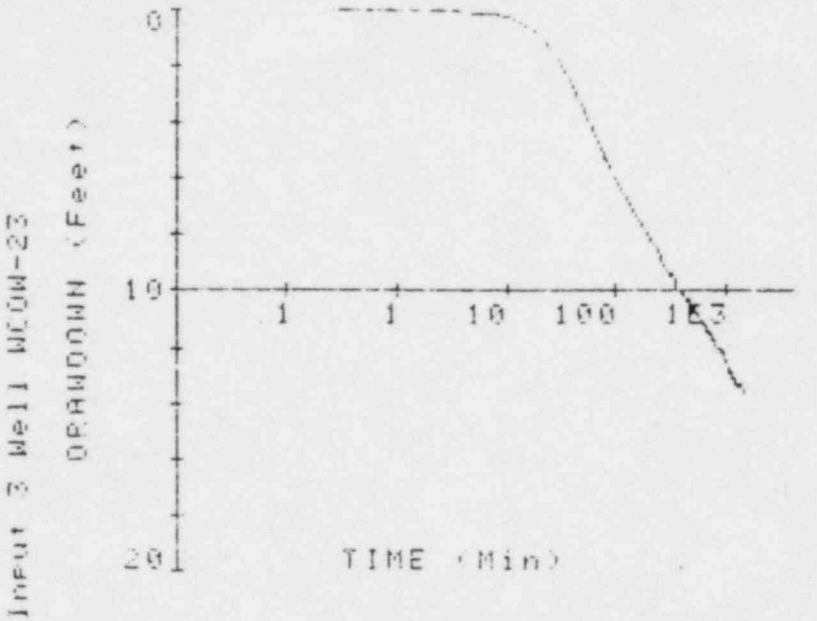
153	.37
154	.46
154	.91
155	.17
155	.45
155	.74
155	.92
156	.15
156	.22
156	.48
156	.86
156	.97
157	.12
157	.26
157	.42
157	.52
157	.75
157	.87
157	.91
158	.03
157	.90
158	.20
158	.24
158	.32
158	.29
158	.52
158	.49
158	.66
158	.59
158	.72
158	.82
158	.88
158	.95
159	.02
159	.05
159	.18
159	.21
159	.17
159	.27
159	.37
159	.41
159	.50
159	.56
159	.53
159	.59
159	.73
159	.82
159	.86
159	.90
159	.99
160	.01
160	.05
160	.09
160	.14
160	.18
160	.19
160	.24
160	.28
160	.35
160	.41

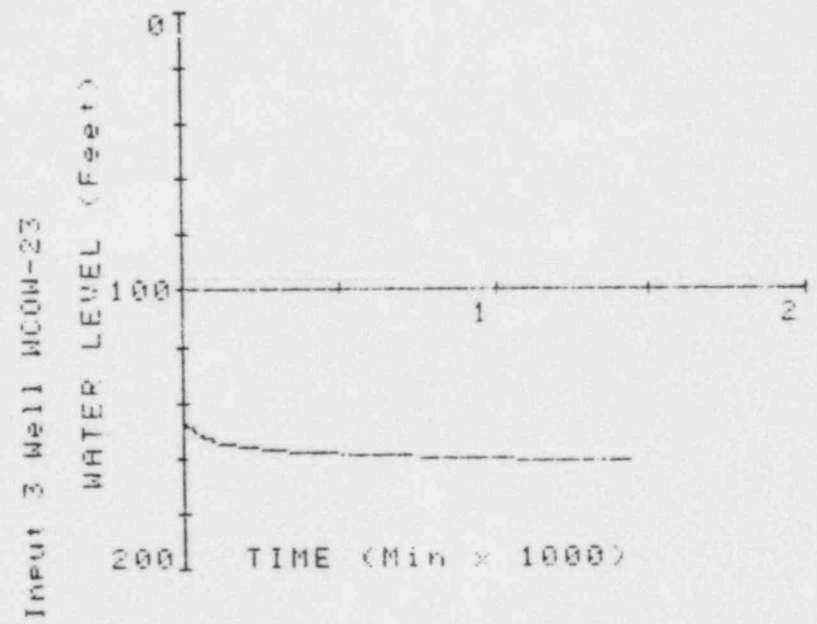
5	.97
5	.46
7	.91
7	.17
7	.45
7	.74
7	.92
8	.15
8	.22
8	.48
8	.86
8	.97
9	.12
9	.26
9	.42
9	.52
9	.75
9	.87
9	.91
10	.03
9	.90
10	.20
10	.24
10	.32
10	.29
10	.62
10	.49
10	.66
10	.59
10	.72
10	.82
10	.88
10	.95
11	.02
11	.05
11	.18
11	.21
11	.17
11	.27
11	.37
11	.41
11	.50
11	.56
11	.53
11	.69
11	.73
11	.82
11	.86
11	.90
11	.99
12	.01
12	.05
12	.09
12	.14
12	.18
12	.19
12	.24
12	.28
12	.35
12	.41

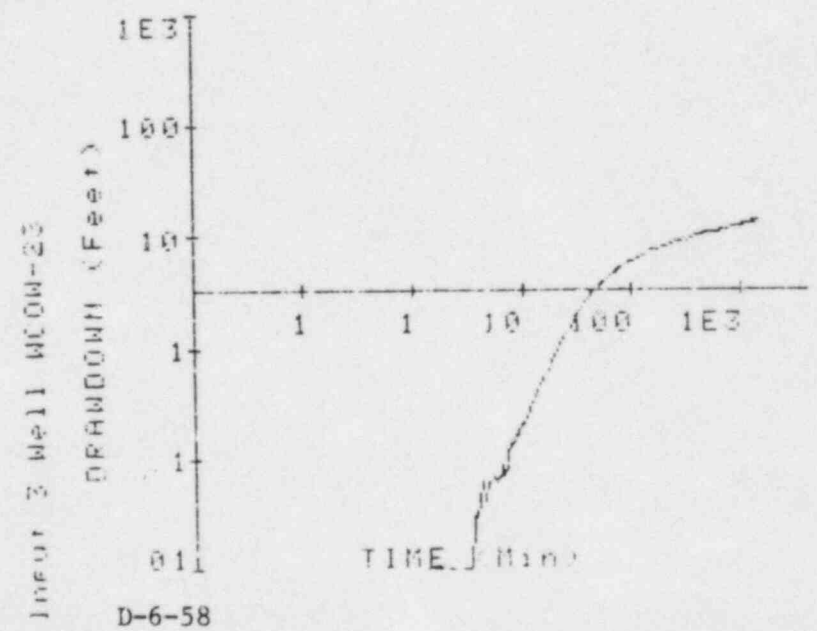
1000	2000
1015	3000
1030	3000
1045	3000
1060	3000
1075	3000
1090	3000
1105	3000
1120	3000
1135	3000
1150	3000
1165	3000
1180	3000
1195	3000
1210	3000
1225	3000
1240	3000
1255	3000
1270	3000
1285	7000
1300	3000
1315	3000
1331	2000
1345	3000
1360	3000
1375	3000
1390	3000
1405	3000
1420	3000
1435	3000

160	.47
160	.53
160	.50
160	.54
160	.58
160	.74
160	.79
160	.86
160	.89
160	.94
160	.97
161	.05
161	.07
161	.13
161	.22
161	.20
161	.26
161	.31
161	.35
161	.44
161	.25
161	.25
161	.31
161	.31
161	.36
161	.39
161	.45
161	.51
161	.61
161	.55

12	.47
12	.53
12	.60
12	.54
12	.68
12	.74
12	.79
12	.86
12	.89
12	.94
12	.97
13	.05
13	.07
13	.13
13	.22
13	.20
13	.26
13	.31
13	.35
13	.44
13	.25
13	.25
13	.31
13	.31
13	.36
13	.39
13	.45
13	.51
13	.61
13	.55


Input 3 Well WC0W-23
DRAWDOWN (Feet)
0
10
20
1
1
10
100
1E3
TIME (Min)

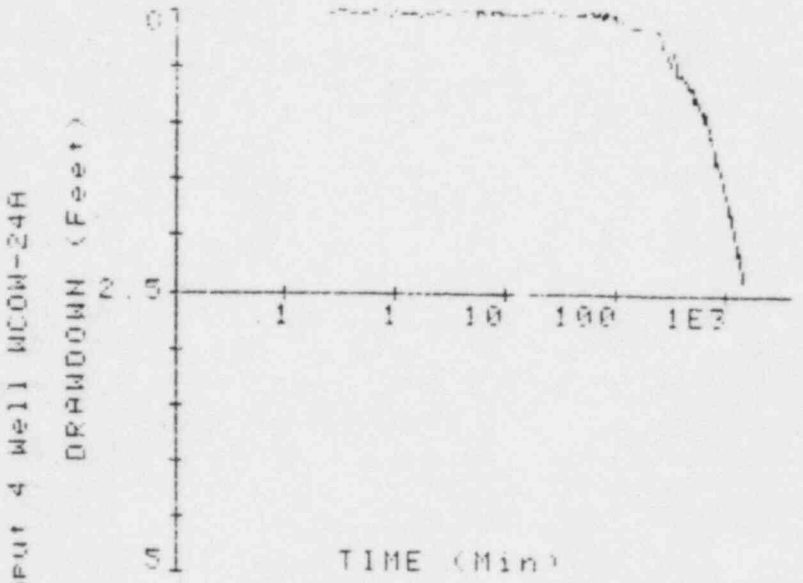

Input 3 Well WC0W-23
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

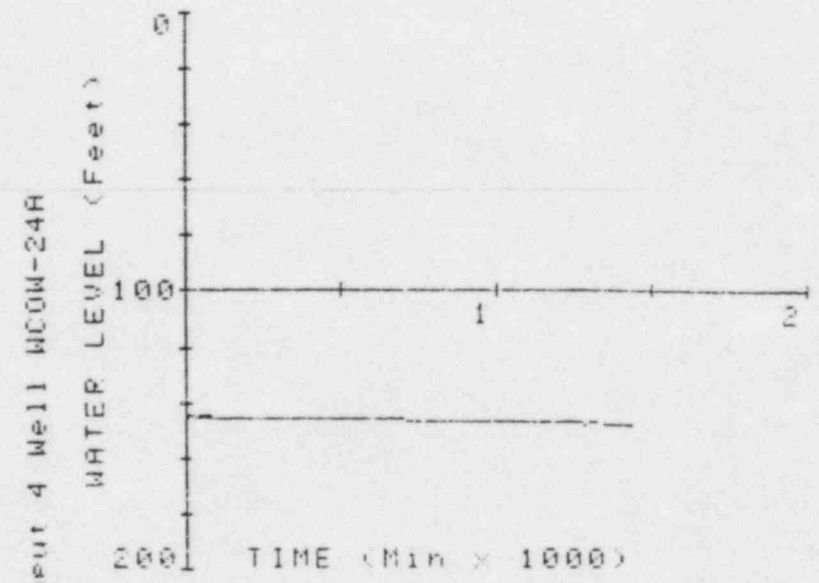

Input 3 Well WC0W-23
DRAWDOWN (Feet)
1E3
100
10
1
1
0.1
1
1
10
100
1E3
TIME (Min)

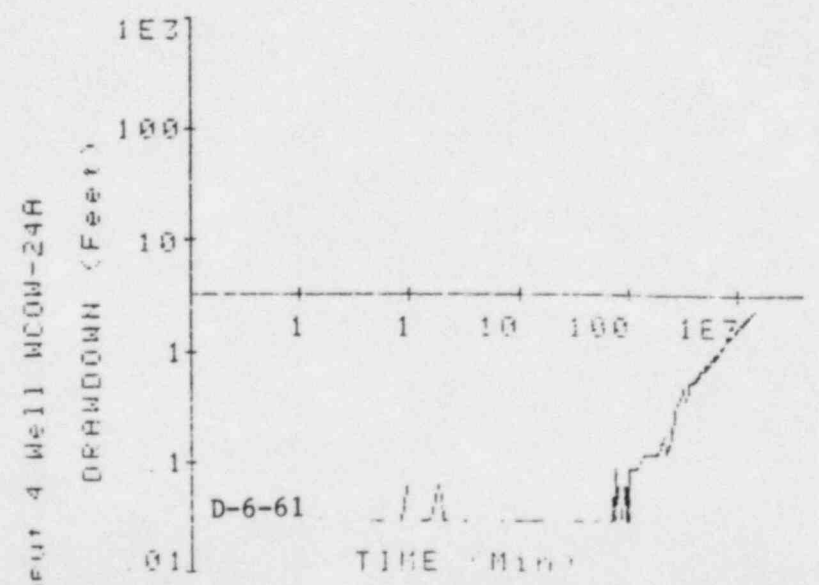
Input 4 Well WCOW-24P

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178		
0.0345		
0.0511		
0.0678		
0.0845		
0.1011		
0.1178		
0.1345		
0.1511		
0.1678		
0.2588	145.03	0.03
0.3422	145.00	0.00
0.4255	145.03	0.03
0.5088	145.03	0.03
0.5922	145.03	0.03
0.6755	145.00	0.00
0.7588	145.00	0.00
0.8422	145.03	0.03
0.9255	145.06	0.06
1.0088	145.00	0.00
1.3012	145.03	0.03
1.5513	145.03	0.03
1.8012	145.06	0.06
2.0513	145.03	0.03
2.3012	145.03	0.03
2.5513	145.00	0.00
2.8012	145.00	0.00
3.0513	145.03	0.03
3.3013	145.03	0.03
3.5513	145.00	0.00
3.8012	144.97	-0.03
4.0513	144.97	-0.03
4.3012	145.00	0.00
4.5513	145.00	0.00
4.8012	145.00	0.00
5.0513	145.03	0.03
5.3013	145.00	0.00
5.5513	145.06	0.06
5.8013	145.00	0.00
6.0513	145.00	0.00
6.3013	145.03	0.03
6.5513	145.00	0.00
6.8012	145.03	0.03
7.0513	145.03	0.03
7.3012	145.03	0.03
7.5513	145.03	0.03
7.8012	145.00	0.00
8.0513	145.03	0.03
8.3012	145.00	0.00
8.5513	145.00	0.00
8.8012	145.00	0.00
9.0513	145.00	0.00
9.3012	145.03	0.03
9.5513	145.03	0.03
9.8012	145.03	0.03
10.0510	145.03	0.03
12.0940	145.03	0.03
14.0940	145.03	0.03
16.1500	145.03	0.03
18.1500	145.00	0.00
20.0930	145.00	0.00
22.0950	145.00	0.00
24.0950	144.97	-0.03
26.0950	145.00	0.00
28.0950	145.00	0.00
30.0950	145.03	0.03
32.0950	145.03	0.03
34.0950	145.03	0.03
36.0950	145.03	0.03
38.0930	145.03	0.03
40.0950	145.00	0.00
42.0950	145.03	0.03
44.1330	145.03	0.03
46.1330	145.03	0.03
48.1330	145.03	0.03
50.1330	145.00	0.00
52.2200	145.03	0.03
54.0930	145.03	0.03
56.0950	145.03	0.03
58.0930	145.00	0.00
60.0950	145.03	0.03
62.0930	144.97	-0.03
64.3450	145.03	0.03
66.3050	145.03	0.03
68.1220	145.00	0.00
70.1220	145.03	0.03
72.1220	145.09	0.09
74.1220	145.03	0.03
76.1220	145.06	0.06
78.1220	145.06	0.06
80.1220	145.00	0.00
82.1220	145.00	0.00
84.1220	145.03	0.03
86.1220	145.06	0.06
88.1220	145.06	0.06
90.1220	145.06	0.06
92.1220	145.03	0.03
94.1220	145.06	0.06
96.1220	145.06	0.06
98.1220	145.03	0.03

100	1200	145.09	0.09	1000	2000	146.55	1.55
115	1700	145.09	0.09	1015	3000	146.52	1.52
130	1700	145.12	0.12	1030	3000	146.55	1.55
145	1700	145.12	0.12	1045	3000	146.57	1.57
160	1700	145.12	0.12	1060	3000	146.57	1.57
175	1700	145.12	0.12	1075	3000	146.73	1.73
190	1700	145.14	0.14	1090	3000	146.79	1.79
205	1700	145.17	0.17	1105	3000	146.76	1.76
220	1700	145.12	0.12	1120	3000	146.79	1.79
235	1700	145.17	0.17	1135	3000	146.85	1.85
250	1800	145.32	0.32	1150	3000	146.82	1.82
265	1700	145.35	0.35	1165	3000	146.88	1.88
280	1700	145.35	0.35	1180	3000	146.91	1.91
295	1700	145.38	0.38	1195	3000	146.93	1.93
310	1700	145.46	0.46	1210	3000	146.99	1.99
325	1800	145.35	0.35	1225	3000	147.02	2.02
340	1800	145.46	0.46	1240	3000	147.02	2.02
355	1800	145.55	0.55	1255	3000	147.05	2.05
370	1800	145.55	0.55	1270	3000	147.08	2.08
385	1800	145.58	0.58	1285	7000	147.14	2.14
400	1800	145.52	0.52	1300	3000	147.08	2.08
415	1800	145.61	0.61	1315	3000	147.11	2.11
430	1800	145.61	0.61	1331	2000	147.11	2.11
445	1800	145.66	0.66	1345	3000	147.14	2.14
460	1800	145.66	0.66	1350	3000	147.17	2.17
475	1700	145.69	0.69	1375	3000	147.22	2.22
490	1700	145.66	0.66	1390	3000	147.25	2.25
505	2300	145.78	0.78	1405	3000	147.28	2.28
520	2300	145.72	0.72	1420	3000	147.37	2.37
535	5700	145.78	0.78	1435	3000	147.31	2.31
550	2300	145.78	0.78				
565	2300	145.84	0.84				
580	2300	145.87	0.87				
595	2300	145.90	0.90				
610	2300	145.87	0.87				
625	2300	145.95	0.95				
640	2300	145.98	0.98				
655	2300	145.90	0.90				
670	2300	145.92	0.92				
685	2300	145.98	0.98				
700	2300	146.01	1.01				
715	2300	146.10	1.10				
730	2300	146.10	1.10				
745	2300	146.13	1.13				
760	2300	146.18	1.18				
775	2300	146.21	1.21				
790	2300	146.21	1.21				
805	2300	146.27	1.27				
820	2300	146.33	1.33				
835	2300	146.30	1.30				
850	2300	146.36	1.36				
865	2300	146.36	1.36				
880	2300	146.39	1.39				
895	2300	146.41	1.41				
910	2300	146.44	1.44				
925	2300	146.53	1.53				
940	2300	146.50	1.50				
955	2300	146.53	1.53				
970	2300	146.56	1.56				
985	2300	146.59	1.59				


Input 4 Well WCOW-24A
DRAWDOWN (Feet)
.1
2.5
5
1
1
10
100
1E3
TIME (Min)

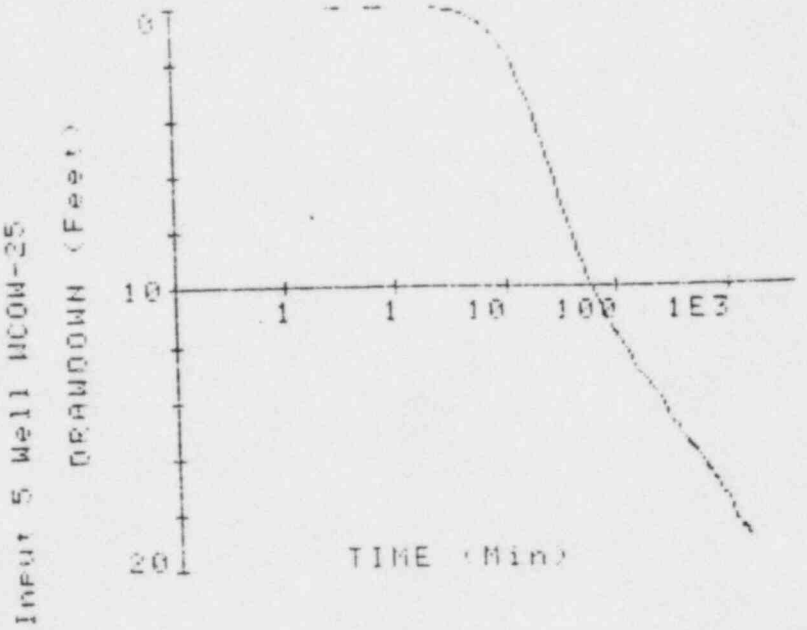

Input 4 Well WCOW-24A
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

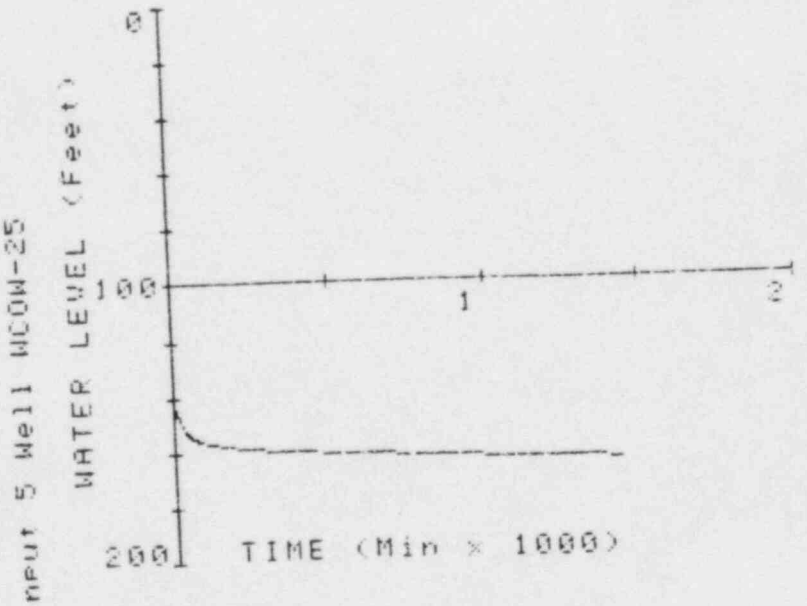

Input 4 Well WCOW-24A
DRAWDOWN (Feet)
1E3
100
10
1
.1
.01
1
1
10
100
1E3
TIME (Min)

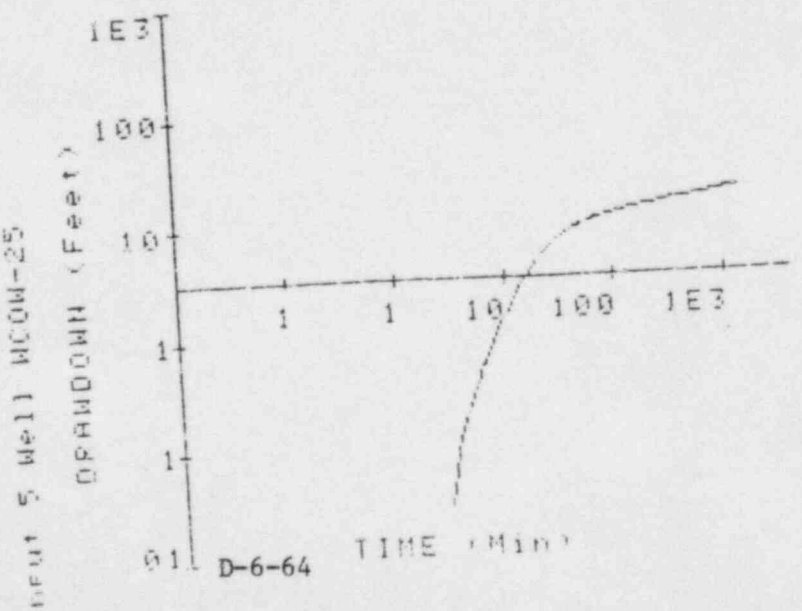
Input 5 Well WCOW-25

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0178		
0 0345		
0 0511		
0 0678		
0 0845		
0 1011		
0 1178		
0 1345		
0 1511		
0 1678		
0 2588	145.00	0.00
0 3422	145.00	0.00
0 4255	144.97	-0.03
0 5088	144.97	-0.03
0 5922	145.00	0.00
0 6755	145.00	0.00
0 7588	145.00	0.00
0 8422	145.00	0.00
0 9255	144.97	-0.03
1 0089	144.97	-0.03
1 3012	144.97	-0.03
1 5513	144.97	-0.03
1 8012	144.97	-0.03
2 0513	144.97	-0.03
2 3012	145.00	0.00
2 5513	145.00	0.00
2 8012	145.03	0.03
3 0513	145.06	0.06
3 3013	145.09	0.09
3 5513	145.12	0.12
3 8012	145.14	0.14
4 0513	145.17	0.17
4 3012	145.20	0.20
4 5513	145.23	0.23
4 8012	145.29	0.29
5 0513	145.32	0.32
5 3013	145.38	0.38
5 5513	145.40	0.40
5 8013	145.46	0.46
6 0513	145.52	0.52
6 3013	145.55	0.55
6 5513	145.61	0.61
6 8012	145.66	0.66
7 0513	145.72	0.72
7 3012	145.78	0.78
7 5513	145.84	0.84
7 8012	145.90	0.90
8 0513	145.95	0.95
8 3012	146.04	1.04
8 5513	146.10	1.10
8 8012	146.16	1.16
9 0513	146.24	1.24
9 3012	146.30	1.30
9 5513	146.36	1.36
9 8012	146.44	1.44
10 0510	146.50	1.50
12 0940	147.08	2.08
14 0940	147.69	2.69
16 1500	148.27	3.27
18 1500	148.84	3.84
20 0930	149.36	4.36
22 0950	149.88	4.88
24 0950	150.37	5.37
26 0950	150.84	5.84
28 0950	151.24	6.24
30 0950	151.65	6.65
32 0950	152.02	7.02
34 0950	152.34	7.34
36 0950	152.65	7.65
38 0930	152.95	7.95
40 0950	153.21	8.21
42 0950	153.47	8.47
44 1330	153.70	8.70
46 1330	153.93	8.93
48 1330	154.10	9.10
50 1330	154.28	9.28
52 2200	154.48	9.48
54 0930	154.62	9.62
56 0950	154.77	9.77
58 0930	154.91	9.91
60 0950	155.03	10.03
62 0930	155.17	10.17
64 3450	155.32	10.32
66 3050	155.40	10.40
68 1220	155.52	10.52
70 1220	155.61	10.61
72 1220	155.72	10.72
74 1220	155.81	10.81
76 1220	155.89	10.89
78 1220	155.98	10.98
80 1220	156.04	11.04
82 1220	156.13	11.13
84 1220	156.21	11.21
86 1220	156.30	11.30
88 1220	156.39	11.39
90 1220	156.44	11.44
92 1220	156.53	11.53
94 1220	156.59	11.59
96 1220	156.65	11.65
98 1220	156.70	11.70

100	1200	155.76	11.75	1000	2000	162.92	17.92
115	1700	157.15	12.19	1015	3000	163.00	18.00
120	1700	157.54	12.54	1030	3000	163.00	18.00
145	1700	157.83	12.83	1045	3000	163.09	18.09
160	1700	158.06	13.06	1060	3000	163.12	18.12
175	1700	158.32	13.32	1075	3000	163.21	18.21
190	1700	158.47	13.47	1090	3000	163.26	18.26
205	1700	158.64	13.64	1105	3000	163.32	18.32
220	1700	158.76	13.76	1120	3000	163.35	18.35
235	1700	158.93	13.93	1135	3000	163.38	18.38
250	1800	159.22	14.22	1150	3000	163.41	18.41
265	1700	159.39	14.39	1165	3000	163.44	18.44
280	1700	159.56	14.56	1180	3000	163.52	18.52
295	1700	159.71	14.71	1195	3000	163.55	18.55
310	1700	159.85	14.85	1210	3000	163.58	18.58
325	1800	159.85	14.85	1225	3000	163.61	18.61
340	1800	160.11	15.11	1240	3000	163.64	18.64
355	1800	160.20	15.20	1255	3000	163.64	18.64
370	1800	160.29	15.29	1270	3000	163.64	18.64
385	1800	160.37	15.37	1285	7000	163.67	18.67
400	1800	160.40	15.40	1300	3000	163.58	18.58
415	1800	160.55	15.55	1315	3000	163.61	18.61
430	1800	160.60	15.60	1331	2000	163.64	18.64
445	1800	160.69	15.69	1345	3000	163.61	18.61
460	1800	160.72	15.72	1360	3000	163.61	18.61
475	1700	160.84	15.84	1375	3000	163.67	18.67
490	1700	160.86	15.86	1390	3000	163.81	18.81
505	2300	160.95	15.95	1405	3000	163.90	18.90
520	2300	160.98	15.98	1420	3000	163.96	18.96
535	5700	161.04	16.04	1435	3000	163.96	18.96
550	2300	161.10	16.10				
565	2300	161.21	16.21				
580	2300	161.30	16.30				
595	2300	161.41	16.41				
610	2300	161.41	16.41				
625	2300	161.47	16.47				
640	2300	161.50	16.50				
655	2300	161.50	16.50				
670	2300	161.59	16.59				
685	2300	161.67	16.67				
700	2300	161.76	16.76				
715	2300	161.85	16.85				
730	2300	161.85	16.85				
745	2300	161.88	16.88				
760	2300	161.96	16.96				
775	2300	162.05	17.05				
790	2300	162.14	17.14				
805	2300	162.22	17.22				
820	2300	162.28	17.28				
835	2300	162.34	17.34				
850	2300	162.37	17.37				
865	2300	162.40	17.40				
880	2300	162.40	17.40				
895	2300	162.40	17.40				
910	2300	162.40	17.40				
925	2300	162.45	17.45				
940	2300	162.51	17.51				
955	2300	162.57	17.57				
970	2300	162.59	17.59				
985	2300	162.90	17.80				


Input 5 Well WCOW-25
DRAWDOWN (Feet)
0
10
20
1
1
10
100
1E3
TIME (Min)


Input 5 Well WCOW-25
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 5 Well WCOW-25
DRAWDOWN (Feet)
1E3
100
10
1
1
01
1
1
10
100
1E3
TIME (Min)

Input 6 Well WCOW-26

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0179		
0 0345		
0 0511		
0 0678		
0 0845		
0 1011		
0 1178		
0 1345		
0 1511		
0 1678		
0 2588	147.00	0.00
0 3422	146.97	-0.03
0 4255	147.00	0.00
0 5088	147.00	0.00
0 5922	147.00	0.00
0 6755	147.03	0.03
0 7588	147.06	0.06
0 8422	147.06	0.06
0 9255	147.12	0.12
1 0088	147.14	0.14
1 3012	147.20	0.20
1 5513	147.32	0.32
1 8012	147.43	0.43
2 0513	147.55	0.55
2 3012	147.69	0.69
2 5513	147.81	0.81
2 8012	147.95	0.95
3 0513	148.10	1.10
3 3013	148.24	1.24
3 5513	148.39	1.39
3 8012	148.53	1.53
4 0513	148.71	1.71
4 3012	148.82	1.82
4 5513	148.97	1.97
4 8012	149.14	2.14
5 0513	149.28	2.28
5 3013	149.43	2.43
5 5513	149.57	2.57
5 8013	149.72	2.72
6 0513	149.84	2.84
6 3013	149.98	2.98
6 5513	150.10	3.10
6 8012	150.24	3.24
7 0513	150.38	3.38
7 3012	150.50	3.50
7 5513	150.65	3.65
7 8012	150.76	3.76
8 0513	150.91	3.91
8 3012	151.02	4.02
8 5513	151.14	4.14
8 8012	151.25	4.25
9 0513	151.37	4.37
9 3012	151.48	4.48
9 5513	151.60	4.60
9 8012	151.69	4.69
10 0510	151.80	4.80
12 0940	152.61	5.61
14 0940	153.31	6.31
16 1500	153.89	6.89
18 1500	154.41	7.41
20 0930	154.84	7.84
22 0950	155.22	8.22
24 0950	155.56	8.56
26 0950	155.88	8.88
28 0950	156.14	9.14
30 0950	156.34	9.34
32 0950	156.58	9.58
34 0950	156.75	9.75
36 0950	156.95	9.95
38 0930	157.13	10.13
40 0950	157.27	10.27
42 0950	157.44	10.44
44 1330	157.59	10.59
46 1330	157.73	10.73
48 1330	157.85	10.85
50 1330	157.94	10.94
52 2200	158.08	11.08
54 0930	158.17	11.17
56 0950	158.25	11.25
58 0930	158.37	11.37
60 0950	158.49	11.49
62 0930	158.54	11.54
64 3450	158.66	11.66
66 3050	158.75	11.75
68 1220	158.80	11.80
70 1220	158.95	11.95
72 1220	159.01	12.01
74 1220	159.06	12.06
76 1220	159.18	12.18
78 1220	159.24	12.24
80 1220	159.30	12.30
82 1220	159.33	12.33
84 1220	159.41	12.41
86 1220	159.50	12.50
88 1220	159.56	12.56
90 1220	159.61	12.61
92 1220	159.67	12.67
94 1220	159.70	12.70
96 1220	159.82	12.82
98 1220	159.85	12.85

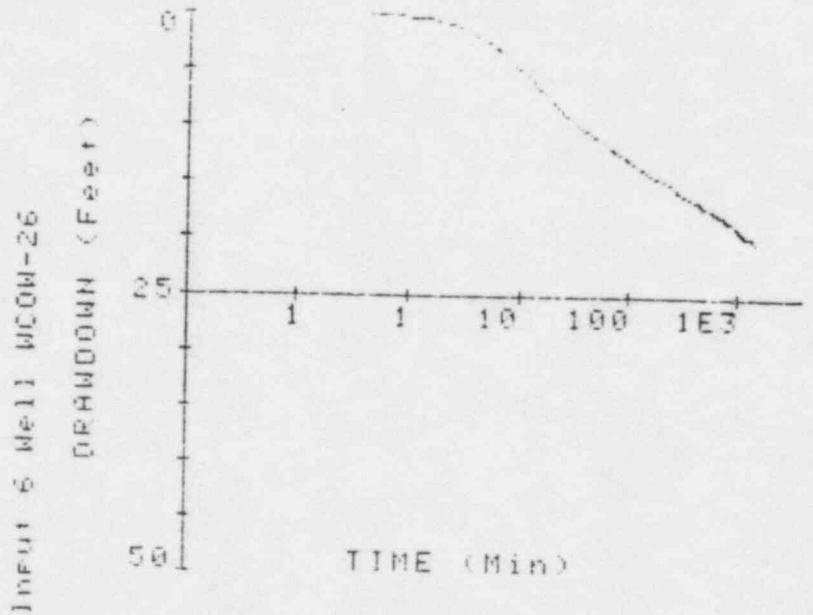
100	1200
115	1700
130	1700
145	1700
160	1700
175	1700
190	1700
205	1700
220	1700
235	1700
250	1800
265	1700
280	1700
295	1700
310	1700
325	1800
340	1800
355	1800
370	1800
385	1800
400	1800
415	1800
430	1800
445	1800
460	1800
475	1700
490	1700
505	2300
520	2300
535	5700
550	2300
565	2300
580	2300
595	2300
610	2300
625	2300
640	2300
655	2300
670	2300
685	2300
700	2300
715	2300
730	2300
745	2300
760	2300
775	2300
790	2300
805	2300
820	2300
835	2300
850	2300
865	2300
880	2700
895	2300
910	2300
925	2300
940	2300
955	2300
970	2300
985	2300

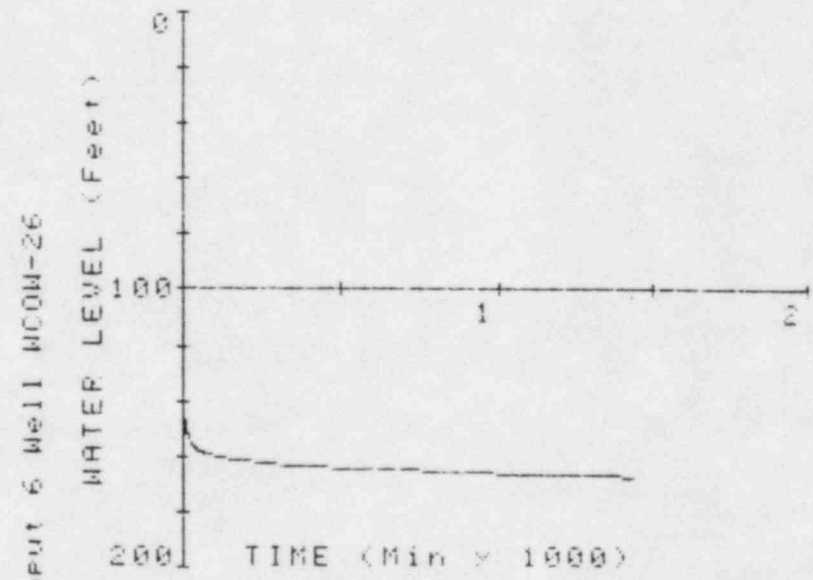
159	.10
160	.33
160	.90
160	.96
161	.09
161	.32
161	.49
161	.73
161	.78
161	.99
162	.30
162	.48
162	.59
162	.77
163	.08
162	.86
163	.17
163	.29
163	.35
163	.40
163	.38
163	.61
163	.61
163	.75
163	.72
163	.90
163	.90
164	.01
163	.98
164	.07
164	.16
164	.24
164	.39
164	.42
164	.45
164	.50
164	.56
164	.50
164	.59
164	.71
164	.85
164	.91
164	.91
164	.91
165	.02
165	.14
165	.23
165	.26
165	.34
165	.37
165	.43
165	.43
165	.40
165	.40
165	.43
165	.49
165	.55
165	.60
165	.81
165	.89

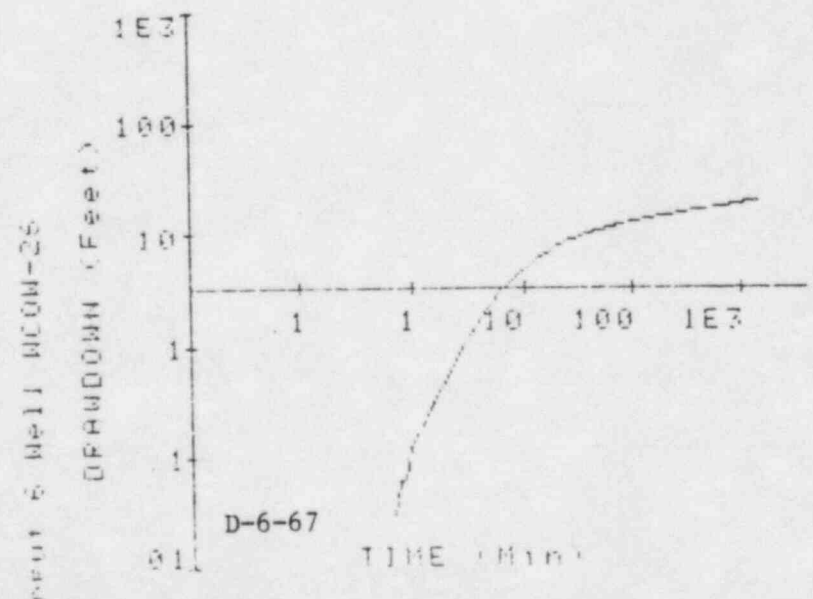
12	.90
13	.28
13	.50
13	.86
14	.09
14	.32
14	.49
14	.73
14	.78
14	.99
15	.30
15	.48
15	.59
15	.77
15	.88
15	.88
16	.17
16	.29
16	.35
16	.40
16	.38
16	.61
16	.61
16	.75
16	.72
16	.90
16	.90
17	.01
16	.98
17	.07
17	.16
17	.24
17	.39
17	.42
17	.45
17	.50
17	.56
17	.50
17	.59
17	.71
17	.85
17	.91
17	.91
17	.91
18	.02
18	.14
18	.23
18	.26
18	.34
18	.37
18	.43
18	.43
18	.40
18	.40
18	.43
18	.49
18	.55
18	.60
18	.81
18	.89

1000	2000
1015	3000
1030	3000
1045	3000
1060	3000
1075	3000
1090	3000
1105	3000
1120	3000
1135	3000
1150	3000
1165	3000
1180	3000
1195	3000
1210	3000
1225	3000
1240	3000
1255	3000
1270	3000
1285	7000
1300	3000
1315	3000
1331	2000
1345	3000
1360	3000
1375	3000
1390	3000
1405	3000
1420	3000
1435	3000

166	.01
166	.11
166	.04
166	.14
166	.24
166	.30
166	.36
166	.41
166	.44
166	.50
166	.56
166	.62
166	.64
166	.70
166	.67
166	.76
166	.70
166	.73
166	.76
166	.64
166	.67
166	.70
166	.64
166	.64
166	.85
166	.93
167	.05
167	.11
167	.05


Input 6 Well MCOW-26
DRAWDOWN (Feet)
0
25
50
1
1
10
100
1E3
TIME (Min)


Input 6 Well MCOW-26
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 6 Well MCOW-26
DRAWDOWN (Feet)
1E3
100
10
1
.1
1
10
100
1E3
TIME (Min)

Inf.ur 7 Well WCOW-276

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178		
0.0345		
0.0511		
0.0678		
0.0845		
0.1011		
0.1178		
0.1345		
0.1511		
0.1678		
0.2588	110.03	0.03
0.3422	110.03	0.03
0.4255	110.03	0.03
0.5088	110.06	0.06
0.5922	110.02	0.02
0.6755	110.03	0.03
0.7588	110.04	0.04
0.8422	110.03	0.03
0.9255	110.03	0.03
1.0088	110.03	0.03
1.3012	110.02	0.02
1.5513	110.01	0.01
1.8012	110.02	0.02
2.0513	110.03	0.03
2.3012	110.03	0.03
2.5513	110.03	0.03
2.8012	110.03	0.03
3.0513	110.03	0.03
3.3013	110.04	0.04
3.5513	110.03	0.03
3.8012	110.02	0.02
4.0513	110.03	0.03
4.3012	110.03	0.03
4.5513	110.02	0.02
4.8012	110.01	0.01
5.0513	110.01	0.01
5.3013	110.02	0.02
5.5513	110.03	0.03
5.8013	110.01	0.01
6.0513	110.01	0.01
6.3013	109.99	-0.01
6.5513	110.01	0.01
6.8012	110.01	0.01
7.0513	110.00	0.00
7.3012	110.00	0.00
7.5513	110.02	0.02
7.8012	110.02	0.02
8.0513	110.03	0.03
8.3012	110.01	0.01
8.5513	110.01	0.01
8.8012	110.01	0.01
9.0513	110.03	0.03
9.3012	110.03	0.03
9.5517	110.03	0.03
9.8012	110.04	0.04
10.0510	110.03	0.03
12.0940	110.06	0.06
14.0940	110.03	0.03
16.1500	110.03	0.03
18.1500	110.02	0.02
20.0930	110.02	0.02
22.0950	110.01	0.01
24.0950	110.00	0.00
26.0950	110.03	0.03
28.0950	110.04	0.04
30.0950	110.04	0.04
32.0950	110.05	0.05
34.0950	110.02	0.02
36.0950	110.02	0.02
38.0930	110.03	0.03
40.0950	110.03	0.03
42.0950	110.04	0.04
44.1330	110.03	0.03
46.1330	110.03	0.03
48.1330	110.03	0.03
50.1330	110.02	0.02
52.2200	110.01	0.01
54.0930	110.01	0.01
56.0950	110.00	0.00
58.0930	110.00	0.00
60.0950	110.03	0.03
62.0930	110.01	0.01
64.3450	110.01	0.01
66.3050	110.04	0.04
68.1220	110.04	0.04
70.1220	110.02	0.02
72.1220	110.02	0.02
74.1220	110.03	0.03
76.1220	110.02	0.02
78.1220	110.01	0.01
80.1220	110.04	0.04
82.1220	110.05	0.05
84.1220	110.02	0.02
86.1220	110.02	0.02
88.1220	110.04	0.04
90.1220	110.03	0.03
92.1220	110.03	0.03
94.1220	110.01	0.01
96.1220	110.01	0.01
98.1220	110.00	0.00

100	1200	110.01	0.01
115	1700	110.04	0.04
130	1700	110.01	0.01
145	1700	110.02	0.02
160	1700	109.94	-0.06
175	1700	109.95	-0.05
190	1700	109.95	-0.05
205	1700	109.95	-0.05
220	1700	109.94	-0.06
235	1700	109.88	-0.12
250	1800	109.88	-0.12
265	1700	109.87	-0.13
280	1700	109.88	-0.12
295	1700	109.85	-0.15
310	1700	109.82	-0.18
325	1800	109.80	-0.20
340	1800	109.80	-0.20
355	1800	109.79	-0.21
370	1800	109.78	-0.22
385	1800	109.80	-0.20
400	1800	109.75	-0.25
415	1800	109.78	-0.22
430	1800	109.74	-0.26
445	1800	109.74	-0.26
460	1800	109.73	-0.27
475	1700	109.70	-0.30
490	1700	109.79	-0.21
505	2300	109.83	-0.17
520	2700	109.77	-0.23
535	5700	109.74	-0.26
550	2300	109.77	-0.23
565	2300	109.73	-0.27
580	2300	109.70	-0.30
595	2300	109.73	-0.27
610	2300	109.66	-0.34
625	2300	109.70	-0.30
640	2300	109.66	-0.34
655	2300	109.60	-0.40
670	2300	109.53	-0.47
685	2300	109.51	-0.49
700	2300	109.43	-0.57
715	2300	109.47	-0.53
730	2300	109.49	-0.51
745	2300	109.51	-0.49
760	2700	109.55	-0.45
775	2300	109.59	-0.41
790	2700	109.55	-0.45
805	2300	109.59	-0.41
820	2300	109.57	-0.43
835	2300	109.58	-0.42
850	2700	109.60	-0.40
865	2300	109.60	-0.40
880	2300	109.59	-0.41
895	2300	109.63	-0.37
910	2300	109.62	-0.38
925	2300	109.59	-0.41
940	2300	109.65	-0.35
955	2300	109.59	-0.41
970	2300	109.62	-0.38
985	2300	109.59	-0.41
1000	2000	109.59	-0.41
1015	3000	109.58	-0.42
1030	3000	109.60	-0.40
1045	3000	109.63	-0.37
1060	3000	109.59	-0.41
1075	3000	109.64	-0.36
1090	3000	109.59	-0.41
1105	3000	109.59	-0.41
1120	3000	109.59	-0.41
1135	3000	109.57	-0.43
1150	3000	109.57	-0.43
1165	3000	109.56	-0.44
1180	3000	109.62	-0.38
1195	3000	109.63	-0.37
1210	3000	109.63	-0.37
1225	3000	109.62	-0.38
1240	3000	109.62	-0.38
1255	3000	109.62	-0.38
1270	3000	109.67	-0.33
1285	7000	109.65	-0.35
1300	3000	109.73	-0.27
1315	3000	109.71	-0.29
1331	2000	109.71	-0.29
1345	3000	109.71	-0.29
1360	3000	109.68	-0.32
1375	3000	109.74	-0.26
1390	3000	109.77	-0.23
1405	3000	109.75	-0.25
1420	3000	109.79	-0.21
1435	3000	109.82	-0.18

Input 7 Well MCOW-278
DRAWDOWN (Feet)
0
.5
1
.1
1
10
100
1E3
TIME (Min)

Input 7 Well MCOW-278
WATER LEVEL (Feet)
0
100
200
1
TIME (Min x 1000)

Input 7 Well MCOW-278
DRAWDOWN (Feet)
1E3
100
10
1
.1
.01
1
1
10
100
1E3
TIME (Min)

Input 8 Well MCOW-28D

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0178		
0.0345		
0.0511		
0.0678		
0.0845		
0.1011		
0.1178		
0.1345		
0.1511		
0.1678		
0.2588	159.00	0.00
0.3422	158.99	-0.01
0.4255	159.00	0.00
0.5088	158.99	-0.01
0.5922	159.00	0.00
0.6755	159.00	0.00
0.7588	158.99	-0.01
0.8422	159.00	0.00
0.9255	159.00	0.00
1.0088	159.00	0.00
1.0912	159.00	0.00
1.1513	159.00	0.00
1.2012	159.00	0.00
2.0513	159.00	0.00
2.3012	159.00	0.00
2.5513	159.00	0.00
2.8012	159.00	0.00
3.0513	159.00	0.00
3.3013	158.99	-0.01
3.5513	158.99	-0.01
3.8012	159.00	0.00
4.0513	158.99	-0.01
4.3012	158.99	-0.01
4.5513	158.99	-0.01
4.8012	158.99	-0.01
5.0513	158.99	-0.01
5.3013	158.99	-0.01
5.5513	158.99	-0.01
5.8013	159.00	0.00
6.0513	158.99	-0.01
6.3013	158.99	-0.01
6.5513	158.99	-0.01
6.8012	158.99	-0.01
7.0513	159.00	0.00
7.3012	159.00	0.00
7.5513	158.99	-0.01
7.8012	159.00	0.00
8.0513	159.00	0.00
8.3012	159.00	0.00
8.5513	159.00	0.00
8.8012	159.00	0.00
9.0513	159.00	0.00
9.3012	159.01	0.01
9.5513	159.00	0.00
9.8012	159.00	0.00
10.0510	159.00	0.00
12.0940	158.99	-0.01
14.0940	158.99	-0.01
16.1500	158.99	-0.01
18.1500	158.98	-0.02
20.0930	158.99	-0.01
22.0950	158.99	-0.01
24.0950	158.99	-0.01
26.0950	159.00	0.00
28.0950	159.00	0.00
30.0950	159.00	0.00
32.0950	159.01	0.01
34.0950	159.01	0.01
36.0950	159.01	0.01
38.0930	159.01	0.01
40.0950	159.00	0.00
42.0950	159.01	0.01
44.1330	159.01	0.01
46.1330	159.02	0.02
48.1330	159.01	0.01
50.1330	159.01	0.01
52.2200	159.00	0.00
54.0930	159.00	0.00
56.0950	159.00	0.00
58.0930	159.00	0.00
60.0950	158.99	-0.01
62.0930	159.00	0.00
64.3450	158.99	-0.01
66.3050	158.99	-0.01
68.1220	158.99	-0.01
70.1220	159.01	0.01
72.1220	159.01	0.01
74.1220	159.00	0.00
76.1220	158.99	-0.01
78.1220	158.99	-0.01
80.1220	158.99	-0.01
82.1220	158.99	-0.01
84.1220	159.00	0.00
86.1220	159.00	0.00
88.1220	159.01	0.01
90.1220	159.03	0.03
92.1220	159.03	0.03
94.1220	159.01	0.01
96.1220	159.01	0.01
98.1220	159.00	0.00

100	1200	158.99	0.00
115	1700	158.91	0.02
130	1700	158.94	0.04
145	1700	158.99	0.00
160	1700	158.98	-0.02
175	1700	158.97	-0.03
190	1700	158.94	-0.06
205	1700	158.95	-0.05
220	1700	158.84	-0.16
235	1700	158.84	-0.16
250	1800	158.97	-0.03
265	1700	158.96	-0.04
280	1700	158.97	-0.03
295	1700	158.97	-0.03
310	1700	158.98	-0.02
325	1800	158.84	-0.16
340	1800	158.98	-0.02
355	1800	158.97	-0.03
370	1800	158.95	-0.05
385	1800	158.98	-0.02
400	1800	158.83	-0.17
415	1800	158.93	-0.07
430	1800	158.91	-0.09
445	1800	158.89	-0.11
460	1800	158.84	-0.16
475	1700	158.93	-0.07
490	1700	158.85	-0.15
505	2300	158.89	-0.11
520	2300	158.82	-0.18
535	5700	158.84	-0.16
550	2300	158.82	-0.18
565	2300	158.84	-0.16
580	2300	158.83	-0.17
595	2300	158.82	-0.18
610	2300	158.81	-0.19
625	2300	158.83	-0.17
640	2300	158.82	-0.18
655	2300	158.73	-0.27
670	2300	158.75	-0.25
685	2300	158.77	-0.23
700	2300	158.78	-0.22
715	2300	158.80	-0.20
730	2300	158.83	-0.17
745	2300	158.85	-0.15
760	2300	158.87	-0.13
775	2300	158.88	-0.12
790	2300	158.89	-0.11
805	2300	158.90	-0.10
820	2300	158.90	-0.10
835	2300	158.90	-0.10
850	2300	158.89	-0.11
865	2300	158.88	-0.12
880	2300	158.87	-0.13
895	2300	158.87	-0.13
910	2300	158.87	-0.13
925	2300	158.87	-0.13
940	2300	158.88	-0.12
955	2300	158.88	-0.12
970	2300	158.89	-0.11
985	2300	158.89	-0.11
1000	2000	158.89	-0.11
1015	3000	158.89	-0.11
1030	3000	158.89	-0.11
1045	3000	158.90	-0.10
1060	3000	158.89	-0.11
1075	3000	158.89	-0.11
1090	3000	158.89	-0.11
1105	3000	158.88	-0.11
1120	3000	158.89	-0.11
1135	3000	158.89	-0.11
1150	3000	158.89	-0.11
1165	3000	158.89	-0.11
1180	3000	158.90	-0.10
1195	3000	158.92	-0.08
1210	3000	158.98	-0.02
1225	3000	158.96	-0.04
1240	3000	158.96	-0.04
1255	3000	158.98	-0.02
1270	3000	158.98	-0.02
1285	7000	159.02	0.02
1300	3000	158.90	-0.10
1315	3000	158.89	-0.11
1331	2000	158.90	-0.10
1345	3000	158.90	-0.10
1360	3000	158.92	-0.08
1375	3000	158.94	-0.06
1390	3000	158.95	-0.05
1405	3000	158.95	-0.04
1420	3000	159.00	0.00
1435	3000	158.97	-0.03

Input 8 Well MCOW-280
DRAWDOWN (Feet)
0
5
1
1
1
10
100
1E3
TIME (Min)

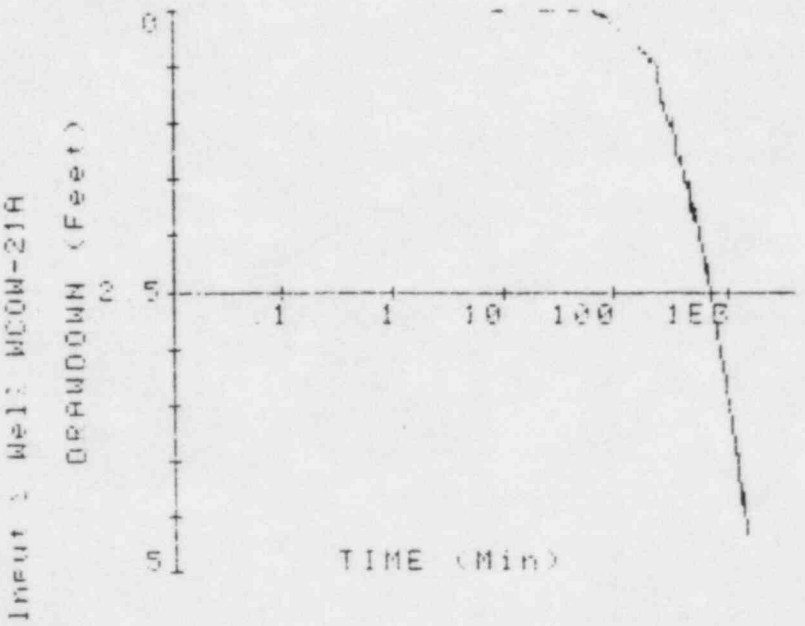
Input 8 Well MCOW-280
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

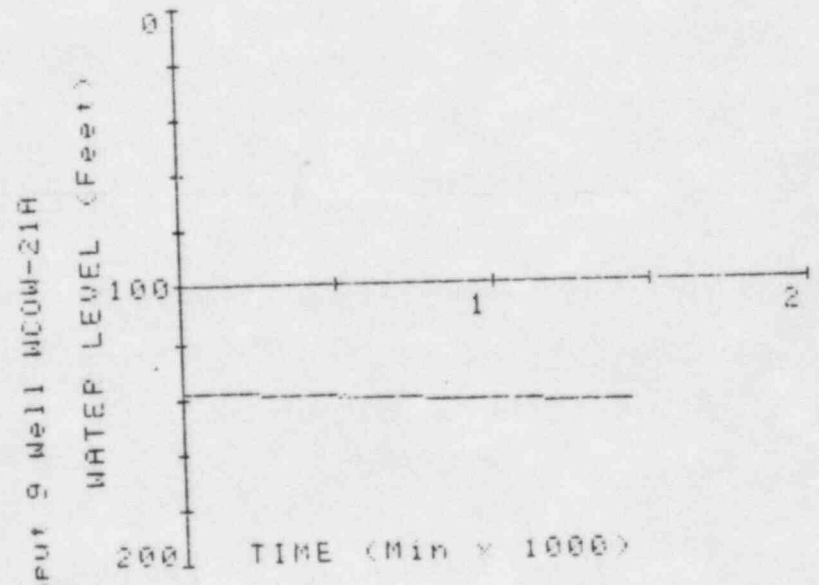
Input 8 Well MCOW-280
DRAWDOWN (Feet)
1E3
100
10
1
1
01
1
1
10
100
1E3
TIME (Min)

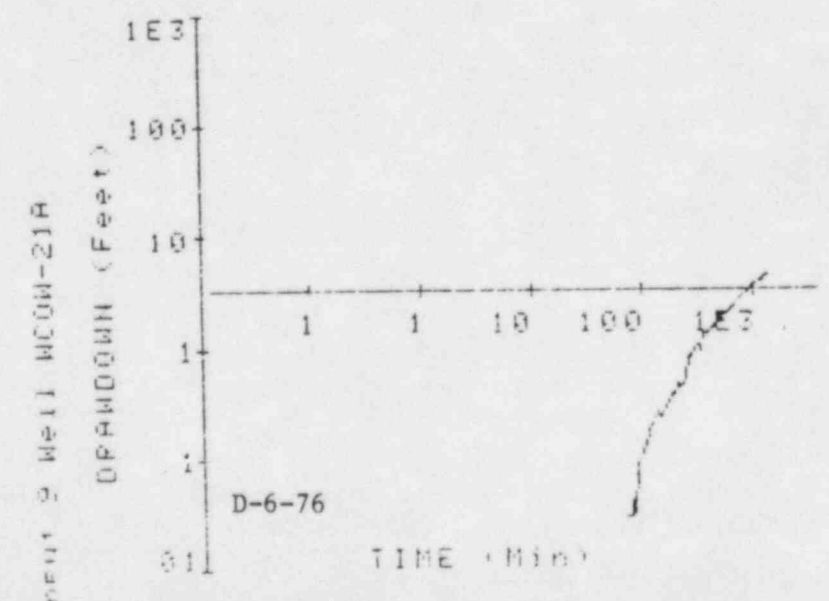
Input 9 Well MCOW-21A

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0178		
0 0345		
0 0511		
0 0678		
0 0845		
0 1011		
0 1178		
0 1345		
0 1511		
0 1678		
0 2588	137.99	-0.01
0 3422	137.99	-0.01
0 4255	137.99	-0.01
0 5088	137.99	-0.01
0 5922	137.99	-0.01
0 6755	137.99	-0.01
0 7588	137.99	-0.01
0 8422	137.99	-0.01
0 9255	137.99	-0.01
1 0088	137.99	-0.01
1 0930	137.99	-0.01
1 1330	138.00	0.00
1 1730	137.99	-0.01
2 0513	137.97	-0.02
2 3012	137.96	-0.04
2 5513	137.97	-0.03
2 8012	137.97	-0.03
3 0512	137.97	-0.03
3 3013	137.99	-0.01
3 5513	137.97	-0.03
3 8012	137.97	-0.03
4 0513	137.97	-0.03
4 3012	137.97	-0.03
4 5513	137.97	-0.03
4 8012	137.97	-0.03
5 0513	137.97	-0.03
5 3013	137.99	-0.01
5 5513	137.99	-0.01
5 8013	137.99	-0.01
6 0513	137.99	-0.01
6 3013	137.99	-0.01
6 5513	137.99	-0.01
6 8012	137.99	-0.01
7 0513	137.99	-0.01
7 3012	137.99	-0.01
7 5513	137.99	-0.01
7 8012	137.99	-0.01
8 0513	138.00	0.00
8 3012	137.99	-0.01
8 5513	138.00	0.00
8 8012	138.00	0.00
9 0513	138.00	0.00
9 3012	138.00	0.00
9 5513	138.00	0.00
9 8012	138.00	0.00
10 0510	138.01	0.01
12 0940	137.97	-0.03
14 0940	137.97	-0.03
16 1500	137.97	-0.03
18 1500	137.97	-0.03
20 0930	137.99	-0.01
22 0950	138.00	0.00
24 0950	138.00	0.00
26 0950	138.00	0.00
28 0950	138.00	0.00
30 0950	138.00	0.00
32 0950	137.99	-0.01
34 0950	137.99	-0.01
36 0950	137.99	-0.01
38 0930	137.99	-0.01
40 0950	138.00	0.00
42 0950	137.99	-0.01
44 1330	138.00	0.00
46 1330	138.01	0.01
48 1330	138.00	0.00
50 1330	138.00	0.00
52 2200	137.99	-0.01
54 0930	137.95	-0.04
56 0950	137.96	-0.04
58 0930	137.96	-0.04
60 0950	137.96	-0.04
62 0930	137.97	-0.03
64 3450	137.99	-0.01
66 3050	138.00	0.00
68 1220	138.00	0.00
70 1220	138.03	0.03
72 1220	138.03	0.03
74 1220	138.03	0.03
76 1220	138.03	0.03
78 1220	138.03	0.03
80 1220	138.04	0.04
82 1220	138.03	0.03
84 1220	138.04	0.04
86 1220	138.06	0.06
88 1220	138.06	0.06
90 1220	138.09	0.09
92 1220	138.10	0.10
94 1220	138.10	0.10
96 1220	138.11	0.11
98 1220	138.11	0.11

100	1200	138.11	0.11
115	1700	138.20	0.20
130	1700	138.26	0.26
145	1700	138.23	0.23
160	1700	138.30	0.30
175	1700	138.37	0.37
190	1700	138.37	0.37
205	1700	138.46	0.46
220	1700	138.42	0.42
235	1700	138.53	0.53
250	1800	138.80	0.80
265	1700	138.82	0.82
280	1700	138.89	0.89
295	1700	138.95	0.95
310	1700	139.03	1.03
325	1800	138.93	0.93
340	1800	139.25	1.25
355	1800	139.29	1.29
370	1800	139.30	1.30
385	1800	139.39	1.39
400	1800	139.28	1.28
415	1800	139.51	1.51
430	1800	139.52	1.52
445	1800	139.58	1.58
460	1800	139.53	1.53
475	1700	139.79	1.79
490	1700	139.69	1.69
505	2300	139.85	1.85
520	2300	139.76	1.76
535	5700	139.99	1.99
550	2300	139.94	1.94
565	2300	140.04	2.04
580	2300	140.06	2.06
595	2300	140.14	2.14
610	2300	140.16	2.16
625	2300	140.28	2.28
640	2300	140.32	2.32
655	2300	140.25	2.25
670	2300	140.37	2.37
685	2300	140.42	2.42
700	2300	140.49	2.49
715	2300	140.57	2.57
730	2300	140.65	2.65
745	2300	140.69	2.69
760	2300	140.77	2.77
775	2300	140.84	2.84
790	2300	140.88	2.88
805	2300	140.92	2.92
820	2300	140.97	2.97
835	2300	141.01	3.01
850	2300	141.07	3.07
865	2300	141.10	3.10
880	2300	141.12	3.12
895	2300	141.18	3.18
910	2300	141.21	3.21
925	2300	141.27	3.27
940	2300	141.31	3.31
955	2300	141.35	3.35
970	2300	141.43	3.43
985	2300	141.45	3.45
1000	2000	141.48	3.48
1015	3000	141.50	3.50
1030	3000	141.57	3.57
1045	3000	141.64	3.64
1060	3000	141.64	3.64
1075	3000	141.68	3.68
1090	3000	141.73	3.73
1105	3000	141.77	3.77
1120	3000	141.83	3.83
1135	3000	141.83	3.83
1150	3000	141.87	3.87
1165	3000	141.96	3.96
1180	3000	141.96	3.96
1195	3000	142.03	4.03
1210	3000	142.10	4.10
1225	3000	142.13	4.13
1240	3000	142.19	4.19
1255	3000	142.24	4.24
1270	3000	142.31	4.31
1285	7000	142.39	4.39
1300	3000	142.24	4.24
1315	3000	142.24	4.24
1331	2000	142.31	4.31
1345	3000	142.34	4.34
1360	3000	142.40	4.40
1375	3000	142.47	4.47
1390	3000	142.49	4.49
1405	3000	142.56	4.56
1420	3000	142.56	4.56
1435	3000	142.62	4.62


Input 1 Well WCOW-21A
DRAWDOWN (Feet)
0
5
5
1
1
10
100
1E3
TIME (Min)

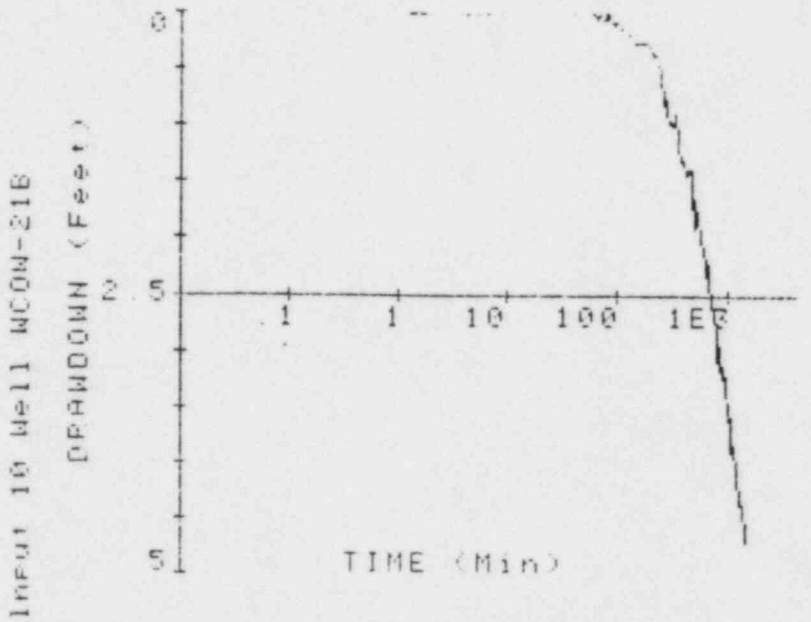

Input 9 Well WCOW-21A
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

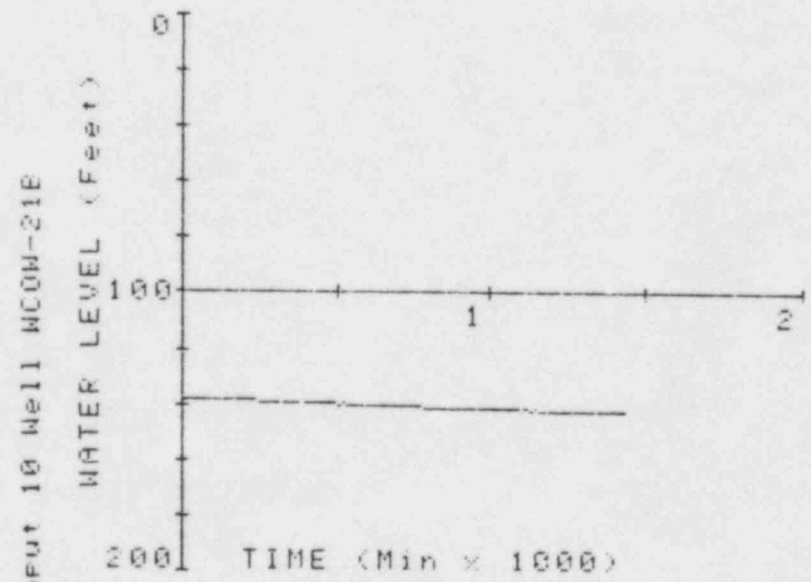

Input 9 Well WCOW-21A
DRAWDOWN (Feet)
1E3
100
10
1
.1
.01
1
1
10
100
1E3
TIME (Min)

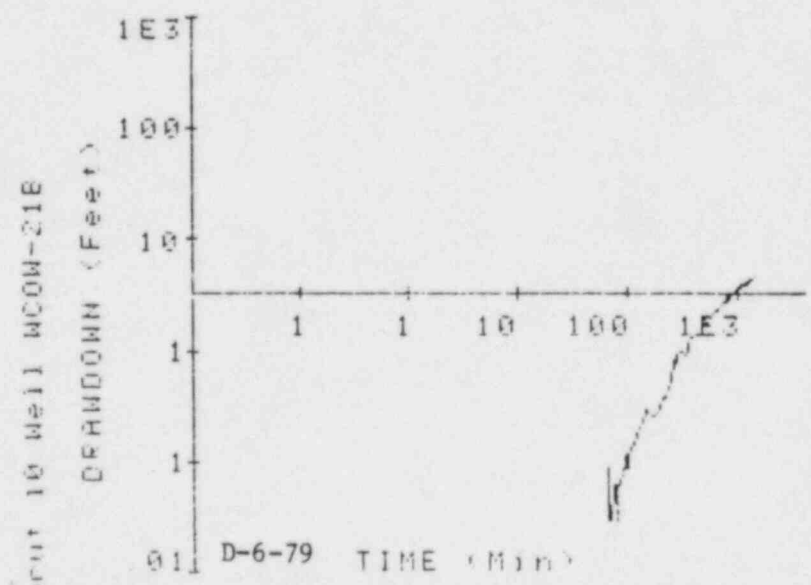
Input 10 Well WCOW-21E

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0178		
0 0345		
0 0511		
0 0678		
0 0845		
0 1011		
0 1178		
0 1345		
0 1511		
0 1678		
0 2588	137.94	-0.06
0 3422	137.97	-0.03
0 4255	137.94	-0.06
0 5088	137.97	-0.03
0 5922	137.94	-0.06
0 6755	137.91	-0.09
0 7588	137.94	-0.06
0 8422	137.94	-0.06
0 9255	137.94	-0.06
1 0088	137.94	-0.06
1 3012	138.00	0.00
1 5513	138.00	0.00
1 8012	138.00	0.00
2 0513	138.00	0.00
2 3012	137.94	-0.06
2 5513	138.00	0.00
2 8012	137.97	-0.03
3 0513	137.97	-0.03
3 3013	137.97	-0.03
3 5513	137.97	-0.03
3 8012	137.97	-0.03
4 0513	138.00	0.00
4 3012	137.97	-0.03
4 5513	138.03	0.03
4 8012	137.91	-0.09
5 0513	137.91	-0.09
5 3013	137.91	-0.09
5 5513	137.97	-0.03
5 8013	138.00	0.00
6 0513	137.91	-0.09
6 3013	137.97	-0.03
6 5513	137.97	-0.03
6 8012	138.00	0.00
7 0513	138.00	0.00
7 3012	137.91	-0.09
7 5513	137.97	-0.03
7 8012	137.97	-0.03
8 0513	137.97	-0.03
8 3012	137.97	-0.03
8 5513	137.94	-0.06
9 8012	137.94	-0.06
9 0513	138.00	0.00
9 3012	138.03	0.03
9 5513	137.94	-0.06
9 8012	137.94	-0.06
10 0510	138.00	0.00
12 0940	137.97	-0.03
14 0940	137.97	-0.03
16 1500	137.94	-0.06
18 1500	137.97	-0.03
20 0930	137.94	-0.06
22 0950	137.89	-0.11
24 0950	137.94	-0.06
26 0950	137.91	-0.09
28 0950	137.89	-0.11
30 0950	138.00	0.00
32 0950	137.80	-0.20
34 0950	137.89	-0.11
36 0950	137.89	-0.11
38 0930	137.94	-0.06
40 0950	138.00	0.00
42 0950	137.91	-0.09
44 1330	137.94	-0.06
46 1330	137.97	-0.03
48 1330	137.94	-0.06
50 1330	137.94	-0.06
52 2200	137.89	-0.11
54 0930	137.97	-0.03
56 0950	137.97	-0.03
58 0930	138.00	0.00
60 0950	138.03	0.03
62 0930	138.00	0.00
64 3450	138.09	0.09
66 3050	138.03	0.03
68 1220	137.97	-0.03
70 1220	138.03	0.03
72 1220	138.06	0.06
74 1220	138.06	0.06
76 1220	138.06	0.06
78 1220	138.03	0.03
80 1220	137.97	-0.03
82 1220	138.00	0.00
84 1220	138.06	0.06
86 1220	138.09	0.09
88 1220	138.09	0.09
90 1220	138.09	0.09
92 1220	138.09	0.09
94 1220	138.11	0.11
96 1220	138.09	0.09
98 1220	138.09	0.09

100	1200	136.11	0.11
115	1700	138.17	0.17
130	1700	138.23	0.23
145	1700	138.29	0.29
160	1700	138.26	0.26
175	1700	138.26	0.26
190	1700	138.32	0.32
205	1700	138.37	0.37
220	1700	138.37	0.37
235	1700	138.52	0.52
250	1800	138.80	0.80
265	1700	138.77	0.77
280	1700	138.92	0.92
295	1700	138.97	0.97
310	1700	139.00	1.00
325	1800	138.89	0.89
340	1800	139.12	1.12
355	1800	139.20	1.20
370	1900	139.29	1.29
385	1800	139.35	1.35
400	1800	139.32	1.32
415	1800	139.43	1.43
430	1800	139.38	1.38
445	1800	139.40	1.40
460	1800	139.40	1.40
475	1700	139.72	1.72
490	1700	139.66	1.66
505	2300	139.92	1.92
520	2300	139.75	1.75
535	5700	139.80	1.80
550	2300	140.01	2.01
565	2300	140.03	2.03
580	2300	140.09	2.09
595	2300	140.12	2.12
610	2300	140.21	2.21
625	2300	140.23	2.23
640	2300	140.32	2.32
655	2300	140.23	2.23
670	2300	140.35	2.35
685	2300	140.43	2.43
700	2300	140.52	2.52
715	2300	140.58	2.58
730	2300	140.56	2.56
745	2300	140.72	2.72
760	2300	140.75	2.75
775	2300	140.75	2.75
790	2300	141.01	3.01
805	2300	141.07	3.07
820	2300	141.09	3.09
835	2300	141.04	3.04
850	2300	140.95	2.95
865	2300	141.15	3.15
880	2300	141.24	3.24
895	2300	141.15	3.15
910	2300	141.18	3.18
925	2300	141.27	3.27
940	2300	141.38	3.38
955	2300	141.41	3.41
970	2300	141.44	3.44
985	2300	141.49	3.49
1000	2000	141.52	3.52
1015	2000	141.51	3.51
1030	3000	141.55	3.55
1045	2000	141.51	3.51
1060	3000	141.51	3.51
1075	3000	141.70	3.70
1090	3000	141.81	3.81
1105	3000	141.90	3.90
1120	3000	141.87	3.87
1135	3000	141.92	3.92
1150	3000	141.84	3.84
1165	3000	141.95	3.95
1180	3000	142.01	4.01
1195	3000	142.07	4.07
1210	3000	142.10	4.10
1225	3000	142.18	4.18
1240	3000	142.18	4.18
1255	3000	142.30	4.30
1270	3000	142.33	4.33
1285	7000	142.38	4.38
1300	3000	142.27	4.27
1315	3000	142.27	4.27
1331	2000	142.47	4.47
1345	3000	142.41	4.41
1360	3000	142.38	4.38
1375	3000	142.44	4.44
1390	3000	142.47	4.47
1405	3000	142.55	4.55
1420	3000	142.70	4.70
1435	3000	142.61	4.61


Input 10 Well WCOW-21B
DRAWDOWN (Feet)
0
5
5
1
1
10
100
1E3
TIME (Min)


Input 10 Well WCOW-21B
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 10 Well WCOW-21B
DRAWDOWN (Feet)
1E3
100
10
1
1
01
1
1
10
100
1E3
TIME (Min)

SE200R CONSTANT RATE TEST V2.2

*** POWER FAILED ***

RECOVERY DATA

RECOVERY LASTED 1440 Min

Input 1 Well WCPW-21 *FAST*

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844	305.31	160.31
0.1677	303.58	158.58
0.2511	301.95	156.95
0.3344	300.23	155.22
0.4177	296.42	153.42
0.5011	296.87	151.87
0.5844	295.23	150.23
0.6677	293.58	148.68
0.7511	292.13	147.13
0.8344	290.58	145.58
0.9178	289.12	144.12
1.0011	287.66	142.66
1.2941	282.49	137.49
1.5442	278.10	133.10
1.7942	274.14	129.14
2.0442	270.27	125.27
2.2942	266.13	121.13
2.5442	262.35	117.35
2.7942	258.73	113.73
3.0442	255.20	110.20
3.2942	252.01	107.01
3.5442	248.74	103.74
3.7942	245.56	100.56
4.0442	242.46	97.46
4.2942	239.62	94.62
4.5442	236.78	91.78
4.7942	234.11	89.11
5.0442	231.44	86.44
5.2942	228.94	83.94
5.5442	226.53	81.53
5.7942	224.21	79.21
6.0442	221.80	76.80
6.2942	219.73	74.73
6.5442	217.49	72.49
6.7942	215.25	70.25
7.0442	213.36	68.36
7.2942	211.47	66.47
7.5442	209.56	64.56
7.7942	208.02	63.02
8.0442	206.04	61.04
8.2942	204.40	59.40
8.5442	202.77	57.77
8.7942	201.30	56.30
9.0442	199.57	54.57
9.2942	198.29	53.29
9.5442	196.83	51.83
9.7942	195.45	50.45
10.0440	194.16	49.16
12.0870	184.86	39.86
14.0870	177.97	32.97
16.0870	172.64	27.64
18.0870	168.51	23.51
20.0870	165.23	20.23
22.0870	162.91	17.91
24.0870	160.76	15.76
26.0870	159.21	14.21
28.0870	157.92	12.92
30.0870	156.88	11.88
32.0870	156.11	11.11
34.0870	155.24	10.24
36.0870	154.56	9.56
38.0870	154.04	9.04
40.0870	153.53	8.53
42.0870	153.09	8.09
44.0870	152.92	7.92
46.0870	152.56	7.56
48.0870	152.32	7.32
50.0870	151.89	6.89
52.0870	151.53	6.53
54.0870	151.37	6.37
56.0870	151.20	6.20
58.0870	151.20	6.20
60.0870	150.94	5.94
62.0870	150.86	5.86
64.0870	150.68	5.68
66.0870	150.51	5.51
68.0870	150.43	5.43
70.0870	150.17	5.17
72.0870	150.25	5.25
74.0870	150.08	5.08
76.0870	149.91	4.91
78.0870	149.82	4.82
80.0870	149.74	4.74
82.0870	149.48	4.48
84.0870	149.65	4.65
86.0870	149.48	4.48
88.0870	149.31	4.31
90.0870	149.22	4.22
92.0870	149.31	4.31
94.0870	149.22	4.22
96.0870	148.88	3.88
98.0870	148.79	3.79

100	0900
115	1400
130	1400
145	1400
160	1400
175	1300
190	1300
205	1300
220	1300
235	1300
250	1300
265	1300
280	1300
295	1300
310	1300
325	1300
340	1300
355	1300
370	1300
385	1300
400	1300
415	1300
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505	1300
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550	1300
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595	1300
610	1300
625	1300
640	1300
655	1300
670	1300
685	1300
700	1300
715	1300
730	1300
745	1300
760	1300
775	1300
790	1300
805	1300
820	1300
835	1300
850	1300
865	1300
880	1300
895	1300
910	1300
925	1300
940	1300
955	1300
970	1300
985	1300

148	70
148	27
148	01
147	58
147	41
146	98
146	81
146	64
146	47
146	29
146	29
146	04
145	95
145	78
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145	52
145	43
145	52
145	26
145	09
145	09
145	00
144	92
144	92
144	66
144	66
144	57
144	48
144	40
144	40
144	31
144	31
144	23
144	23
144	14
144	05
144	05
143	88
143	97
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143	88
143	88
143	62
143	45
143	62
143	54
143	54
143	54
143	45
143	45
143	45
143	28
143	28
143	19
143	28
143	19
143	19
143	19
143	11
142	95

3	70
3	27
2	01
2	58
2	41
1	98
1	81
1	64
1	47
1	29
1	29
1	04
0	95
0	78
0	52
0	52
0	43
0	52
0	26
0	09
0	09
0	00
-0	08
-0	08
-0	34
-0	34
-0	43
-0	52
-0	60
-0	60
-0	69
-0	69
-0	77
-0	77
-0	86
-0	95
-0	95
-1	12
-1	03
-1	12
-1	12
-1	12
-1	38
-1	55
-1	38
-1	46
-1	46
-1	46
-1	55
-1	55
-1	55
-1	72
-1	72
-1	81
-1	72
-1	81
-1	81
-1	81
-1	89
-2	15

1000	1000
1015	2000
1030	2000
1045	2000
1060	2000
1075	2000
1090	2000
1105	2000
1120	2000
1135	2000
1150	2000
1165	2000
1180	2000
1195	2000
1210	2000
1225	2000
1240	2000
1255	2000
1270	2000
1285	2000
1300	2000
1315	2000
1330	2000
1345	2000
1360	2000
1375	2000
1390	2000
1405	2000
1420	2000
1435	2000

143	11
142	85
142	85
142	85
142	85
142	94
142	85
142	76
142	85
142	76
142	68
142	59
142	68
142	59
142	51
142	68
142	51
142	51
142	51
142	51
142	51
142	59
142	51
142	51
142	59
142	59
142	51
142	42
142	51

-1	89
-2	15
-2	15
-2	15
-2	15
-2	06
-2	15
-2	24
-2	15
-2	24
-2	32
-2	32
-2	41
-2	32
-2	41
-2	49
-2	32
-2	49
-2	49
-2	49
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-2	41
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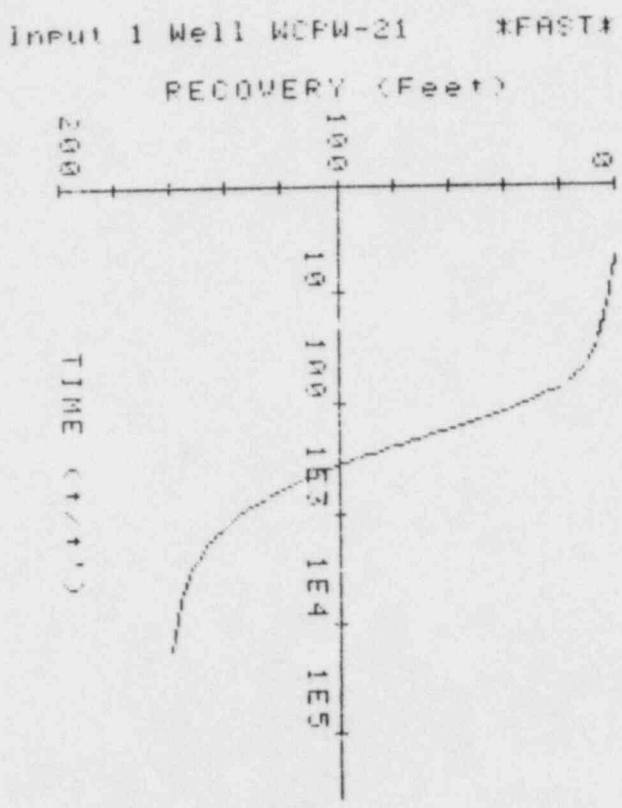
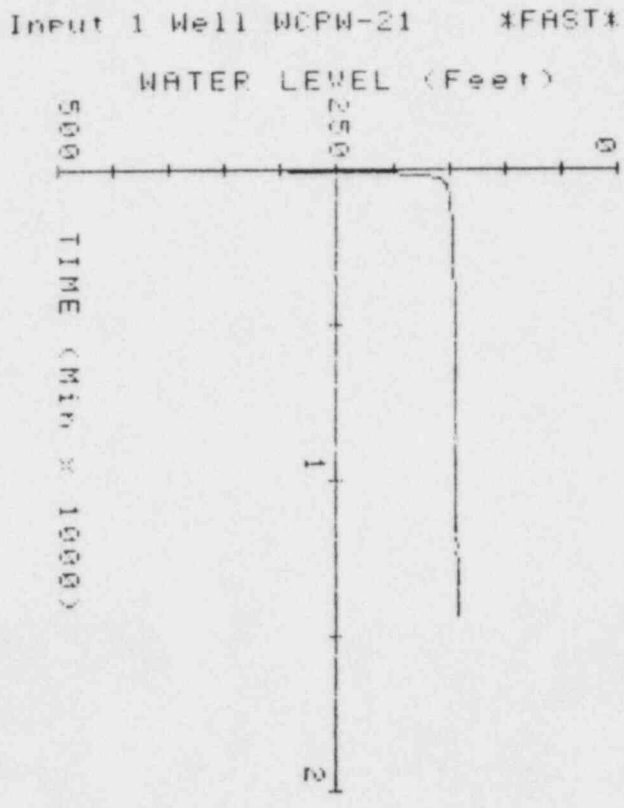
-2	49
-2	41
-2	41
-2	49
-2	58
-2	49


Input 1 Well WCPW-21 *FAST*
RECOVERY (Feet)
200
100
0
TIME (t/t')
10
100
1E3
1E4
1E5


Input 1 Well WCPW-21 *FAST*
WATER LEVEL (Feet)
500
250
0
TIME (Min x 1000)
1
2

Input 2 Well WCOW-22

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	161.50	11.50
0.3344	161.50	11.50
0.4177	161.50	11.50
0.5011	161.50	11.50
0.5844	161.50	11.50
0.6677	161.50	11.50
0.7511	161.50	11.50
0.8344	161.50	11.50
0.9178	161.50	11.50
1.0011	161.50	11.50
1.2941	161.50	11.50
1.5442	161.50	11.50
1.7942	161.47	11.47
2.0442	161.47	11.47
2.2942	161.47	11.47
2.5442	161.47	11.47
2.7942	161.47	11.47
3.0442	161.47	11.47
3.2942	161.47	11.47
3.5442	161.47	11.47
3.7942	161.47	11.47
4.0442	161.47	11.47
4.2942	161.47	11.47
4.5442	161.47	11.47
4.7942	161.47	11.47
5.0442	161.47	11.47
5.2942	161.44	11.44
5.5442	161.44	11.44
5.7942	161.44	11.44
6.0442	161.44	11.44
6.2942	161.44	11.44
6.5442	161.44	11.44
6.7942	161.41	11.41
7.0442	161.41	11.41
7.2942	161.41	11.41
7.5442	161.41	11.41
7.7942	161.41	11.41
8.0442	161.41	11.41
8.2942	161.38	11.38
8.5442	161.38	11.38
8.7942	161.35	11.35
9.0442	161.35	11.35
9.2942	161.35	11.35
9.5442	161.33	11.33
9.7942	161.33	11.33
10.0440	161.33	11.33
12.0870	161.24	11.24
14.0870	161.10	11.10
16.0870	160.98	10.98
18.0870	160.84	10.84
20.0870	160.66	10.66
22.0870	160.55	10.55
24.0870	160.40	10.40
26.0870	160.23	10.23
28.0870	160.06	10.06
30.0870	159.97	9.97
32.0870	159.88	9.88
34.0870	159.71	9.71
36.0870	159.54	9.54
38.0870	159.39	9.39
40.0870	159.31	9.31
42.0870	159.19	9.19
44.0870	159.11	9.11
46.0870	159.02	9.02
48.0870	158.93	8.93
50.0870	158.79	8.79
52.0870	158.67	8.67
54.0870	158.50	8.50
56.0870	158.30	8.30
58.0870	158.13	8.13
60.0870	158.04	8.04
62.0870	158.01	8.01
64.0870	157.95	7.95
66.0870	157.87	7.87
68.0870	157.81	7.81
70.0870	157.72	7.72
72.0870	157.67	7.67
74.0870	157.64	7.64
76.0870	157.58	7.58
78.0870	157.49	7.49
80.0870	157.43	7.43
82.0870	157.35	7.35
84.0870	157.26	7.26
86.0870	157.18	7.18
88.0870	157.09	7.09
90.0870	157.05	7.06
92.0870	157.03	7.03
94.0870	157.00	7.00
96.0870	156.94	6.94
98.0870	156.89	6.89

100	0900
115	1400
130	1400
145	1400
160	1400
175	1300
190	1300
205	1300
220	1300
235	1300
250	1300
265	1300
280	1300
295	1300
310	1300
325	1300
340	1300
355	1300
370	1300
385	1300
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415	1300
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460	1300
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490	1300
505	1300
520	1300
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550	1300
565	1300
580	1300
595	1300
610	1300
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640	1300
655	1300
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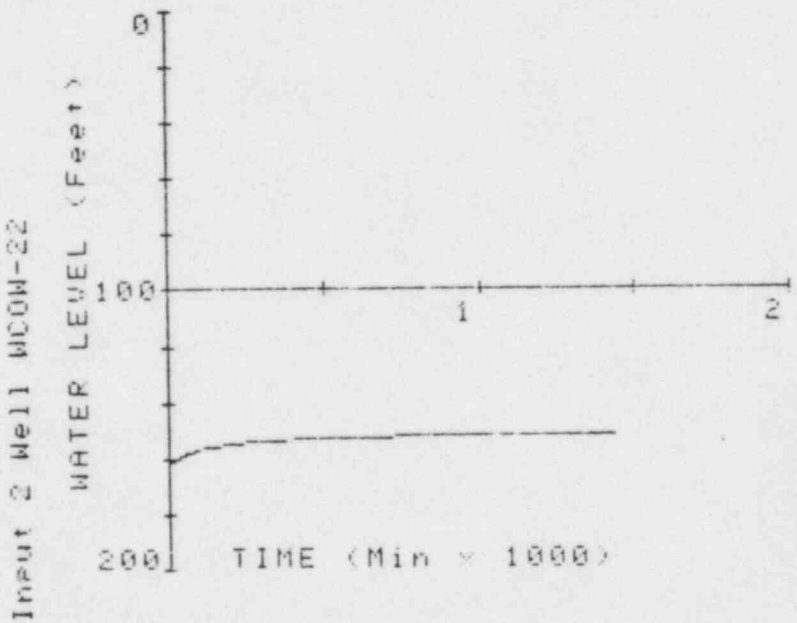
775	1300
790	1300
805	1300
820	1300
835	1300
850	1300
865	1300
880	1300
895	1300
910	1300
925	1300
940	1300
955	1300
970	1300
985	1300

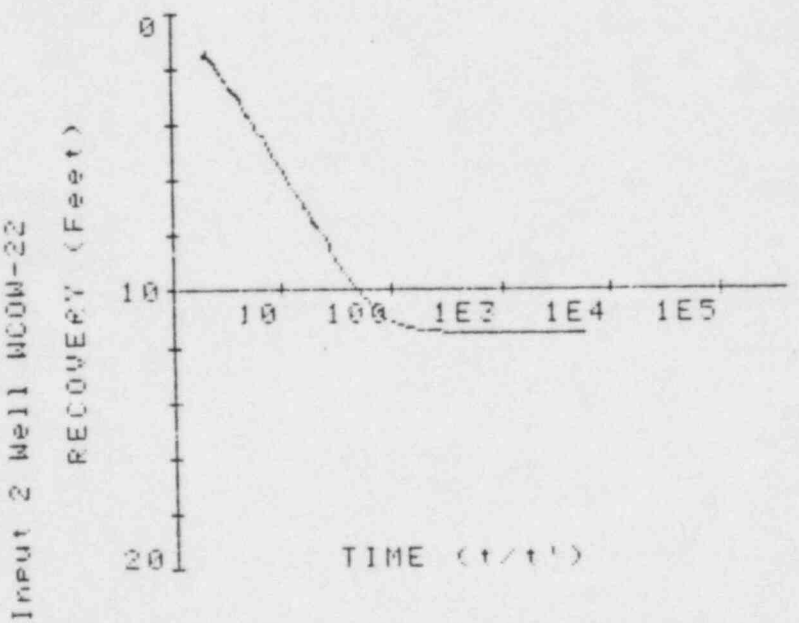
156	.83
156	.37
156	.14
155	.85
155	.59
155	.36
155	.19
154	.98
154	.78
154	.64
154	.44
154	.35
154	.29
154	.12
153	.98
153	.92
153	.80
153	.66
153	.63
153	.60
153	.37
153	.31
153	.20
153	.05
153	.00
153	.00
152	.91
152	.88
152	.88
152	.82
152	.79
152	.77
152	.74
152	.68
152	.65
152	.59
152	.56
152	.54
152	.48
152	.45
152	.42
152	.36
152	.33
152	.30
152	.25
152	.22
152	.19
152	.16
152	.13
152	.13
152	.07
152	.04
152	.02
151	.99
151	.96
151	.96
151	.90
151	.87
151	.87
151	.84

1000	1000
1015	2000
1030	2000
1045	2000
1060	2000
1075	2000
1090	2000
1105	2000
1120	2000
1135	2000
1150	2000
1165	2000
1180	2000
1195	2000
1210	2000
1225	2000
1240	2000
1255	2000
1270	2000
1285	2000
1300	2000
1315	2000
1330	2000
1345	2000
1360	2000
1375	2000
1390	2000
1405	2000
1420	2000
1435	2000

151	.81
151	.79
151	.79
151	.76
151	.73
151	.70
151	.70
151	.67
151	.67
151	.67
151	.64
151	.64
151	.58
151	.58
151	.58
151	.54
151	.54
151	.50
151	.58
151	.58
151	.47
151	.41
151	.38
151	.61
151	.56
151	.32
151	.56
151	.53
151	.47
151	.47

1	.81
1	.79
1	.79
1	.76
1	.73
1	.70
1	.70
1	.67
1	.67
1	.67
1	.64
1	.64
1	.58
1	.58
1	.58
1	.64
1	.64
1	.50
1	.58
1	.58
1	.47
1	.41
1	.38
1	.61
1	.56
1	.32
1	.56
1	.53
1	.47
1	.47


Input 2 Well WCOW-22
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 2 Well WCOW-22
RECOVERY (Feet)
0
10
20
10
100
1E3
1E4
1E5
TIME (t/t')

Input 3 Well WCOW-23

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	161.54	13.54
0.3344	161.54	13.54
0.4177	161.54	13.54
0.5011	161.54	13.54
0.5844	161.54	13.54
0.6677	161.54	13.54
0.7511	161.54	13.54
0.8344	161.54	13.54
0.9178	161.52	13.52
1.0011	161.52	13.52
1.2941	161.51	13.51
1.5442	161.52	13.52
1.7942	161.51	13.51
2.0442	161.51	13.51
2.2942	161.51	13.51
2.5442	161.52	13.52
2.7942	161.51	13.51
3.0442	161.51	13.51
3.2942	161.51	13.51
3.5442	161.49	13.49
3.7942	161.51	13.51
4.0442	161.49	13.49
4.2942	161.49	13.49
4.5442	161.49	13.49
4.7942	161.49	13.49
5.0442	161.49	13.49
5.2942	161.48	13.48
5.5442	161.48	13.48
5.7942	161.49	13.49
6.0442	161.48	13.48
6.2942	161.48	13.48
6.5442	161.48	13.48
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7.2942	161.47	13.47
7.5442	161.45	13.45
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8.0442	161.45	13.45
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9.5442	161.42	13.42
9.7942	161.42	13.42
10.0440	161.42	13.42
12.0870	161.36	13.36
14.0870	161.28	13.28
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18.0870	161.05	13.05
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22.0870	160.79	12.79
24.0870	160.61	12.61
26.0870	160.43	12.43
28.0870	160.19	12.19
30.0870	160.08	12.08
32.0870	159.93	11.93
34.0870	159.70	11.70
36.0870	159.53	11.53
38.0870	159.36	11.36
40.0870	159.20	11.20
42.0870	159.04	11.04
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50.0870	158.39	10.39
52.0870	158.22	10.22
54.0870	158.03	10.03
56.0870	157.78	9.78
58.0870	157.58	9.58
60.0870	157.45	9.45
62.0870	157.35	9.35
64.0870	157.26	9.26
66.0870	157.17	9.17
68.0870	157.06	9.06
70.0870	156.93	8.93
72.0870	156.81	8.81
74.0870	156.73	8.73
76.0870	156.64	8.64
78.0870	156.55	8.55
80.0870	156.44	8.44
82.0870	156.35	8.35
84.0870	156.25	8.25
86.0870	156.13	8.13
88.0870	156.05	8.05
90.0870	155.98	7.98
92.0870	155.92	7.92
94.0870	155.85	7.85
96.0870	155.74	7.74
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910	1300
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985	1300

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2.10
2.05
2.01
2.00
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1000	1000
1015	2000
1030	2000
1045	2000
1060	2000
1075	2000
1090	2000
1105	2000
1120	2000
1135	2000
1150	2000
1165	2000
1180	2000
1195	2000
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1330	2000
1345	2000
1360	2000
1375	2000
1390	2000
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1435	2000

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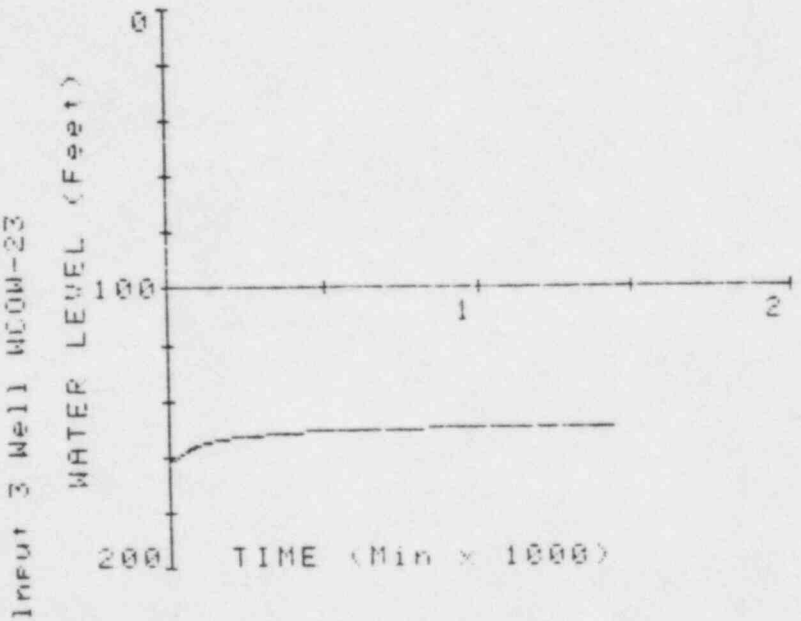
Ineur 3 Well WC0W-23
WATER LEVEL (Feet)
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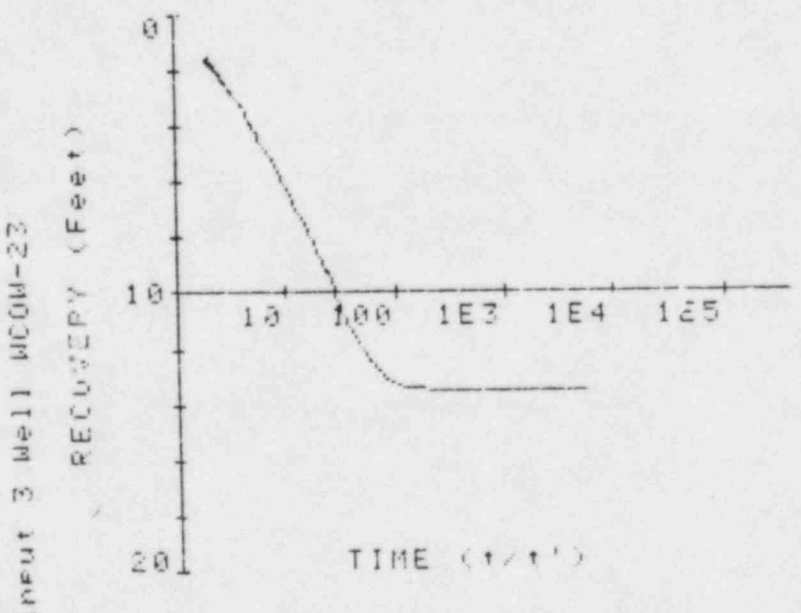
2
TIME (Min x 1000)


Ineur 3 Well WC0W-23
RECOVERY (Feet)
0
10
20
10
100
1E3
1E4
1E5
TIME (t/t')

Input 4 Well MCOW-24A

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0844		
0 1677		
0 2511	147.25	
0 3344	147.22	
0 4177	147.22	
0 5011	147.28	
0 5844	147.28	
0 6677	147.28	
0 7511	147.22	
0 8344	147.28	
0 9178	147.25	
1 0011	147.22	
1 2941	147.25	
1 5442	147.22	
1 7942	147.19	
2 0442	147.25	
2 2942	147.22	
2 5442	147.22	
2 7942	147.22	
3 0442	147.25	
3 2942	147.22	
3 5442	147.22	
3 7942	147.22	
4 0442	147.22	
4 2942	147.22	
4 5442	147.22	
4 7942	147.22	
5 0442	147.25	
5 2942	147.25	
5 5442	147.19	
5 7942	147.25	
6 0442	147.22	
6 2942	147.19	
6 5442	147.22	
6 7942	147.22	
7 0440	147.22	
8 0870	147.25	
8 2942	147.25	
8 5442	147.22	
8 7942	147.25	
9 0442	147.25	
9 2942	147.25	
9 5442	147.19	
9 7942	147.22	
10 0440	147.22	
12 0870	147.25	
14 0870	147.25	
16 0870	147.22	
18 0870	147.28	
20 0870	147.31	
22 0870	147.31	
24 0870	147.31	
26 0870	147.31	
28 0870	147.35	
30 0870	147.39	
32 0870	147.42	
34 0870	147.39	
36 0870	147.42	
38 0870	147.42	
40 0870	147.39	
42 0870	147.42	
44 0870	147.48	
46 0870	147.48	
48 0870	147.48	
50 0870	147.48	
52 0870	147.48	
54 0870	147.42	
56 0870	147.36	
58 0870	147.39	
60 0870	147.39	
62 0870	147.45	
64 0870	147.45	
66 0870	147.42	
68 0870	147.39	
70 0870	147.45	
72 0870	147.42	
74 0870	147.48	
76 0870	147.48	
78 0870	147.45	
80 0870	147.45	
82 0870	147.45	
84 0870	147.42	
86 0870	147.45	
88 0870	147.45	
90 0870	147.45	
92 0870	147.45	
94 0870	147.42	
96 0870	147.45	
98 0870		

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115	1400	147	36
130	1400	147	39
145	1400	147	36
160	1400	147	36
175	1300	147	36
190	1300	147	36
205	1300	147	34
220	1300	147	25
235	1300	147	28
250	1300	147	25
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415	1300	146	99
430	1300	146	93
445	1300	146	87
460	1300	146	87
475	1300	146	82
490	1300	146	79
505	1300	146	76
520	1300	146	76
535	1300	146	79
550	1300	146	79
565	1300	146	84
580	1300	146	84
595	1300	146	82
610	1300	146	87
625	1300	146	79
640	1300	146	82
655	1300	146	82
670	1300	146	79
685	1300	146	76
700	1300	146	79
715	1300	146	73
730	1300	146	73
745	1300	146	73
760	1300	146	70
775	1300	146	64
790	1300	146	67
805	1300	146	64
820	1300	146	64
835	1300	146	61
850	1300	146	61
865	1300	146	61
880	1300	146	56
895	1300	146	56
910	1300	146	53
925	1300	146	53
940	1300	146	56
955	1300	146	56
970	1300	146	47
985	1300	146	47

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1		1	56
1		1	47
1		1	47

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1015	2000	146	47
1030	2000	146	47
1045	2000	146	47
1060	2000	146	41
1075	2000	146	38
1090	2000	146	38
1105	2000	146	41
1120	2000	146	35
1135	2000	146	35
1150	2000	146	38
1165	2000	146	38
1180	2000	146	38
1195	2000	146	35
1210	2000	146	35
1225	2000	146	38
1240	2000	146	44
1255	2000	146	32
1270	2000	146	35
1285	2000	146	38
1300	2000	146	30
1315	2000	146	30
1330	2000	146	24
1345	2000	146	35
1360	2000	146	38
1375	2000	146	24
1390	2000	146	32
1405	2000	146	35
1420	2000	146	32
1435	2000	146	32

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1		1	30
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1		1	24
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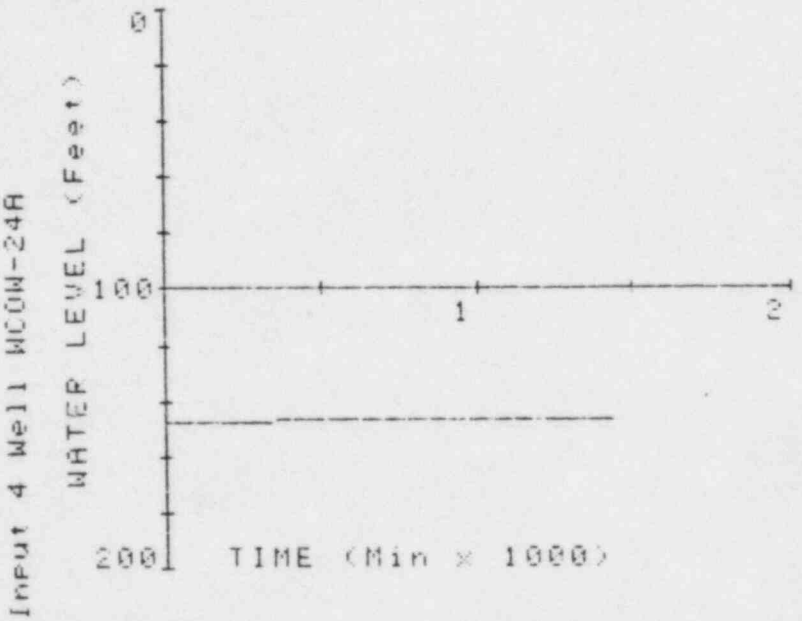
1		1	35
1		1	32
1		1	32


Input 4 Well MCOW-24A
WATER LEVEL (Feet)
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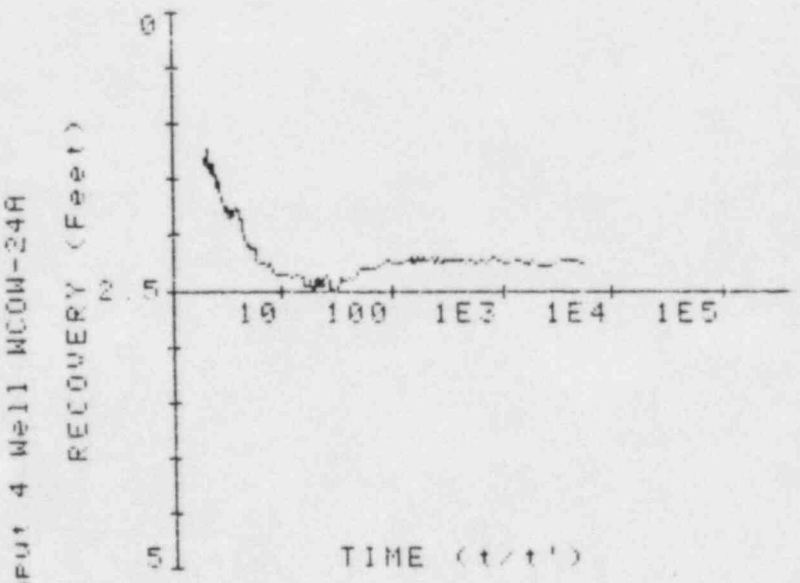
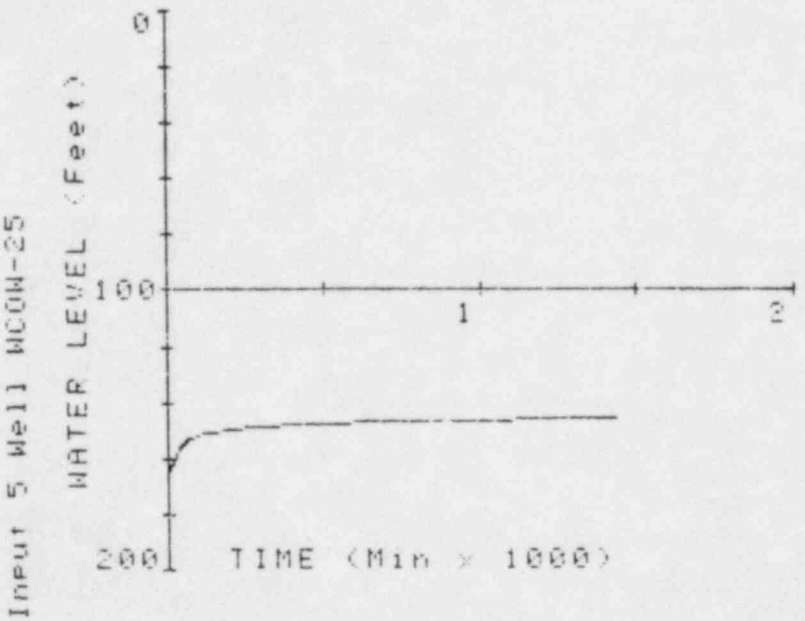
100
200
1
2
TIME (Min x 1000)

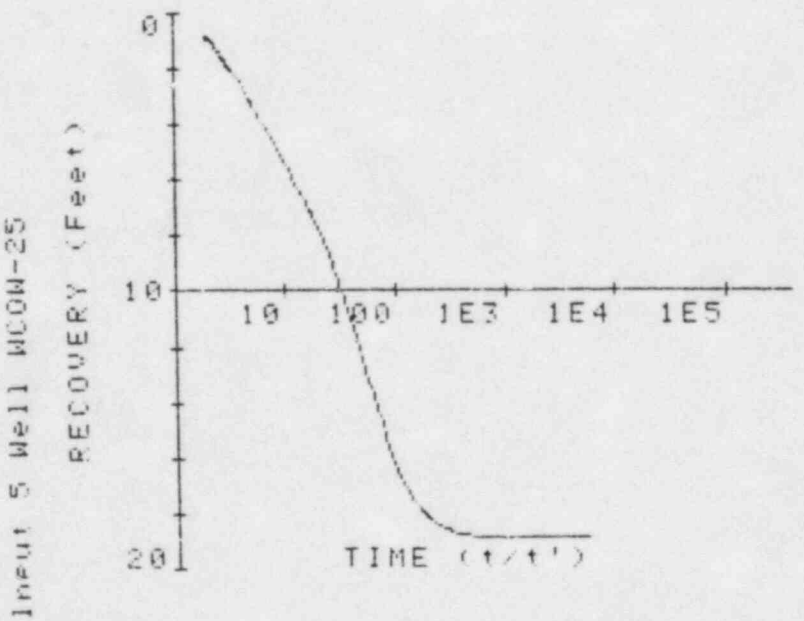

Input 4 Well MCOW-24A
RECOVERY (Feet)
0
2.5
5
10
100
1E3
1E4
1E5
TIME (t/t')

Input 5 Well MCOW-25

TIME (Min)	LEVEL (F)	Δ LEVEL
0 0844		
0 1677		
0 2511	163.90	18.90
0 3344	163.90	18.90
0 4177	163.90	18.90
0 5011	163.90	18.90
0 5844	163.90	18.90
0 6677	163.90	18.90
0 7511	163.90	18.90
0 8344	163.90	18.90
0 9178	163.90	18.90
1 0011	163.90	18.90
1 2941	163.90	18.90
1 5442	163.90	18.90
1 7942	163.90	18.90
2 0442	163.87	18.87
2 2942	163.87	18.87
2 5442	163.84	18.84
2 7942	163.84	18.84
3 0442	163.81	18.81
3 2942	163.78	18.78
3 5442	163.75	18.75
3 7942	163.75	18.75
4 0442	163.70	18.70
4 2942	163.70	18.70
4 5442	163.67	18.67
4 7942	163.61	18.61
5 0442	163.58	18.58
5 2942	163.55	18.55
5 5442	163.52	18.52
5 7942	163.47	18.47
6 0442	163.44	18.44
6 2942	163.38	18.38
6 5442	163.35	18.35
6 7942	163.29	18.29
7 0442	163.23	18.23
7 2942	163.21	18.21
7 5442	163.15	18.15
7 7942	163.09	18.09
8 0442	163.03	18.02
8 2942	162.97	17.97
8 5442	162.92	17.92
8 7942	162.86	17.86
9 0442	162.80	17.80
9 2942	162.74	17.74
9 5442	162.69	17.69
9 7942	162.63	17.63
10 0440	162.57	17.57
12 0870	162.02	17.02
14 0870	161.44	16.44
16 0870	160.89	15.89
18 0870	160.32	15.32
20 0870	159.77	14.77
22 0870	159.22	14.22
24 0870	158.73	13.73
26 0870	158.24	13.24
28 0870	157.77	12.77
30 0870	157.34	12.34
32 0870	156.99	11.99
34 0870	156.59	11.59
36 0870	156.27	11.27
38 0870	155.95	10.95
40 0870	155.66	10.66
42 0870	155.40	10.40
44 0870	155.14	10.14
46 0870	154.94	9.94
48 0870	154.71	9.71
50 0870	154.51	9.51
52 0870	154.31	9.31
54 0870	154.10	9.10
56 0870	153.90	8.90
58 0870	153.73	8.73
60 0870	153.58	8.58
62 0870	153.47	8.47
64 0870	153.35	8.35
66 0870	153.21	8.21
68 0870	153.09	8.09
70 0870	152.98	7.98
72 0870	152.89	7.89
74 0870	152.77	7.77
76 0870	152.69	7.69
78 0870	152.57	7.57
80 0870	152.51	7.51
82 0870	152.43	7.43
84 0870	152.34	7.34
86 0870	152.25	7.25
88 0870	152.17	7.17
90 0870	152.08	7.08
92 0870	152.02	7.02
94 0870	151.96	6.96
96 0870	151.88	6.88
98 0870	151.79	6.79

100	0900	151.73	6.73
115	1400	151.27	6.27
130	1400	150.90	5.90
145	1400	150.58	5.58
160	1400	150.29	5.29
175	1300	150.06	5.06
190	1300	149.83	4.83
205	1300	149.62	4.62
220	1300	149.42	4.42
235	1300	149.25	4.25
250	1300	149.08	4.08
265	1300	148.96	3.96
280	1300	148.84	3.84
295	1300	148.67	3.67
310	1300	148.53	3.53
325	1300	148.44	3.44
340	1300	148.32	3.32
355	1300	148.18	3.18
370	1300	148.12	3.12
385	1300	148.06	3.06
400	1300	147.92	2.92
415	1300	147.83	2.83
430	1300	147.75	2.75
445	1300	147.63	2.63
460	1300	147.54	2.54
475	1300	147.52	2.52
490	1300	147.40	2.40
505	1300	147.34	2.34
520	1300	147.31	2.31
535	1300	147.28	2.28
550	1300	147.23	2.23
565	1300	147.20	2.20
580	1300	147.17	2.17
595	1300	147.11	2.11
610	1300	147.08	2.08
625	1300	147.02	2.02
640	1300	146.99	1.99
655	1300	146.97	1.97
670	1300	146.94	1.94
685	1300	146.88	1.88
700	1300	146.85	1.85
715	1300	146.79	1.79
730	1300	146.76	1.76
745	1300	146.71	1.71
760	1300	146.68	1.68
775	1300	146.65	1.65
790	1300	146.62	1.62
805	1300	146.59	1.59
820	1300	146.59	1.59
835	1300	146.56	1.56
850	1300	146.50	1.50
865	1300	146.47	1.47
880	1300	146.42	1.42
895	1300	146.39	1.39
910	1300	146.39	1.39
925	1300	146.36	1.36
940	1300	146.36	1.36
955	1300	146.30	1.30
970	1300	146.30	1.30
985	1300	146.27	1.27
1000	1000	146.24	1.24
1015	2000	146.21	1.21
1030	2000	146.19	1.19
1045	2000	146.19	1.19
1060	2000	146.16	1.16
1075	2000	146.13	1.13
1090	2000	146.13	1.13
1105	2000	146.10	1.10
1120	2000	146.07	1.07
1135	2000	146.07	1.07
1150	2000	146.04	1.04
1165	2000	146.04	1.04
1180	2000	146.01	1.01
1195	2000	145.98	0.98
1210	2000	145.98	0.98
1225	2000	146.04	1.04
1240	2000	146.01	1.01
1255	2000	145.93	0.93
1270	2000	145.95	0.95
1285	2000	145.93	0.93
1300	2000	145.87	0.87
1315	2000	145.87	0.87
1330	2000	145.81	0.81
1345	2000	145.93	0.93
1360	2000	145.93	0.93
1375	2000	145.81	0.81
1390	2000	145.90	0.90
1405	2000	145.93	0.93
1420	2000	145.87	0.87
1435	2000	145.87	0.87

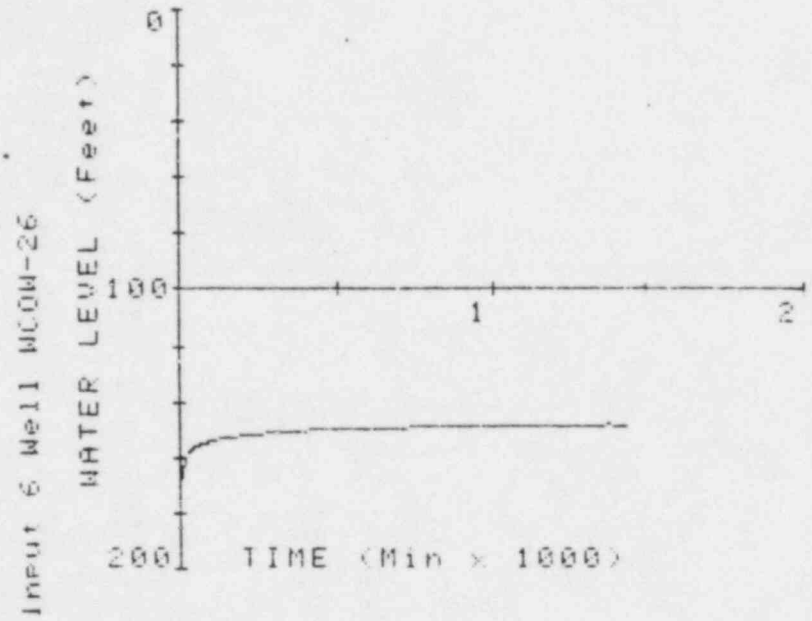

Input 5 Well WCOW-25
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

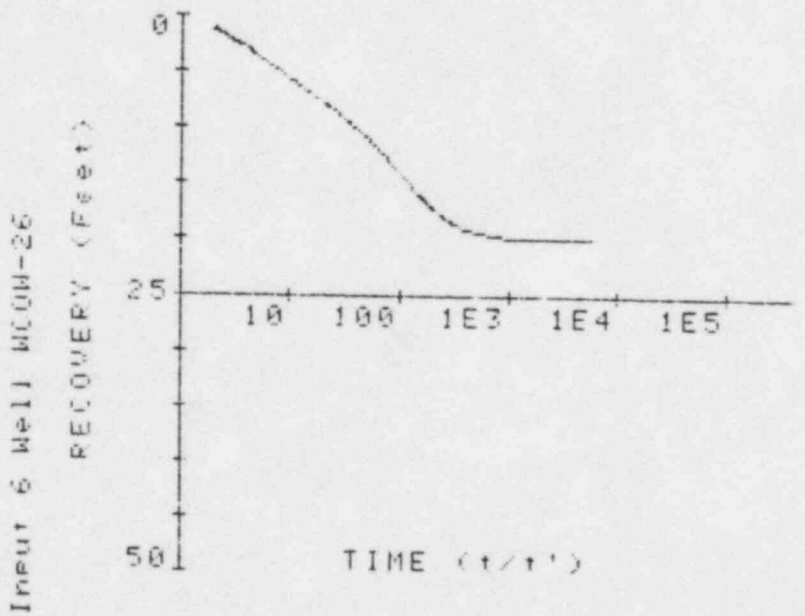

Input 5 Well WCOW-25
RECOVERY (Feet)
0
10
20
10
100
1E3
1E4
1E5
TIME (t/t')

Input 6 Well WCOW-26

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	167.02	20.02
0.3344	167.02	20.02
0.4177	167.02	20.02
0.5011	167.02	20.02
0.5844	167.02	20.02
0.6677	167.02	20.02
0.7511	167.02	20.02
0.8344	166.99	19.99
0.9178	166.99	19.99
1.0011	166.96	19.96
1.2941	166.88	19.88
1.5442	166.85	19.85
1.7942	166.76	19.76
2.0442	166.67	19.67
2.2942	166.59	19.59
2.5442	166.47	19.47
2.7942	166.38	19.38
3.0442	166.27	19.27
3.2942	166.21	19.21
3.5442	166.09	19.09
3.7942	165.98	18.98
4.0442	165.83	18.83
4.2942	165.69	18.69
4.5442	165.57	18.57
4.7942	165.46	18.46
5.0442	165.34	18.34
5.2942	165.20	18.20
5.5442	165.08	18.08
5.7942	164.94	17.94
6.0442	164.85	17.85
6.2942	164.71	17.71
6.5442	164.53	17.53
6.7942	164.45	17.45
7.0442	164.33	17.33
7.2942	164.18	17.18
7.5442	164.04	17.04
7.7942	163.92	16.92
8.0442	163.81	16.81
8.2942	163.69	16.69
8.5442	163.55	16.55
8.7942	163.43	16.43
9.0442	163.32	16.32
9.2942	163.20	16.20
9.5442	163.09	16.09
9.7942	162.97	15.97
10.0440	162.85	15.85
12.0870	162.91	15.91
14.0870	161.26	14.26
16.0870	160.53	13.53
18.0870	160.08	13.08
20.0870	159.58	12.58
22.0870	159.18	12.18
24.0870	158.80	11.80
26.0870	158.40	11.40
28.0870	158.08	11.08
30.0870	157.85	10.85
32.0870	157.65	10.65
34.0870	157.41	10.41
36.0870	157.21	10.21
38.0870	157.01	10.01
40.0870	156.87	9.87
42.0870	156.69	9.69
44.0870	156.55	9.55
46.0870	156.43	9.43
48.0870	156.29	9.29
50.0870	156.14	9.14
52.0870	156.00	9.00
54.0870	155.85	8.85
56.0870	155.65	8.65
58.0870	155.48	8.48
60.0870	155.42	8.42
62.0870	155.33	8.33
64.0870	155.27	8.27
66.0870	155.19	8.19
68.0870	155.07	8.07
70.0870	154.99	7.99
72.0870	154.87	7.87
74.0870	154.87	7.87
76.0870	154.78	7.78
78.0870	154.70	7.70
80.0870	154.61	7.61
82.0870	154.52	7.52
84.0870	154.46	7.46
86.0870	154.38	7.38
88.0870	154.29	7.29
90.0870	154.26	7.26
92.0870	154.20	7.20
94.0870	154.12	7.12
96.0870	154.06	7.06
98.0870	154.00	7.00

100	0900	153.94	5.94
115	1400	153.51	5.51
130	1400	153.19	5.19
145	1400	152.87	5.87
160	1400	152.64	5.64
175	1300	152.41	5.41
190	1300	152.15	5.15
205	1300	152.01	5.01
220	1300	151.80	4.80
235	1300	151.60	4.60
250	1300	151.43	4.43
265	1300	151.34	4.34
280	1300	151.22	4.22
295	1300	151.05	4.05
310	1300	150.91	3.91
325	1300	150.85	3.85
340	1300	150.70	3.70
355	1300	150.56	3.56
370	1300	150.50	3.50
385	1300	150.47	3.47
400	1300	150.30	3.30
415	1300	150.21	3.21
430	1300	150.10	3.10
445	1300	149.98	2.98
460	1300	149.92	2.92
475	1300	149.86	2.86
490	1300	149.78	2.78
505	1300	149.69	2.69
520	1300	149.69	2.69
535	1300	149.66	2.66
550	1300	149.63	2.63
565	1300	149.57	2.57
580	1300	149.57	2.57
595	1300	149.55	2.55
610	1300	149.49	2.49
625	1300	149.40	2.40
640	1300	149.40	2.40
655	1300	149.37	2.37
670	1300	149.31	2.31
685	1300	149.29	2.29
700	1300	149.23	2.23
715	1300	149.23	2.23
730	1300	149.17	2.17
745	1300	149.14	2.14
760	1300	149.08	2.08
775	1300	149.05	2.05
790	1300	149.05	2.05
805	1300	149.03	2.03
820	1300	149.00	2.00
835	1300	148.97	1.97
850	1300	148.91	1.91
865	1300	148.85	1.85
880	1300	148.85	1.85
895	1300	148.79	1.79
910	1300	148.76	1.76
925	1300	148.76	1.76
940	1300	148.74	1.74
955	1300	148.71	1.71
970	1300	148.68	1.68
985	1300	148.65	1.65
1000	1000	148.65	1.65
1015	2000	148.62	1.62
1030	2000	148.62	1.62
1045	2000	148.59	1.59
1060	2000	148.53	1.53
1075	2000	148.53	1.53
1090	2000	148.50	1.50
1105	2000	148.53	1.53
1120	2000	148.48	1.48
1135	2000	148.48	1.48
1150	2000	148.45	1.45
1165	2000	148.48	1.48
1180	2000	148.42	1.42
1195	2000	148.39	1.39
1210	2000	148.42	1.42
1225	2000	148.48	1.48
1240	2000	148.45	1.45
1255	2000	148.33	1.33
1270	2000	148.42	1.42
1285	2000	148.39	1.39
1300	2000	148.24	1.24
1315	2000	148.24	1.24
1330	2000	148.19	1.19
1345	2000	148.39	1.39
1360	2000	148.36	1.36
1375	2000	148.13	1.13
1390	2000	148.33	1.33
1405	2000	148.33	1.33
1420	2000	148.27	1.27
1435	2000	148.24	1.24

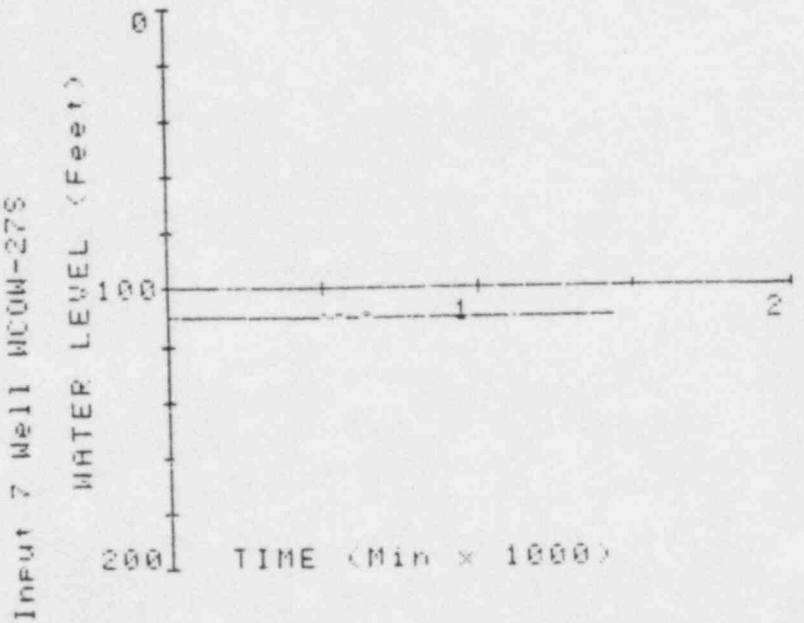

Input 6 Well MCOW-26
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

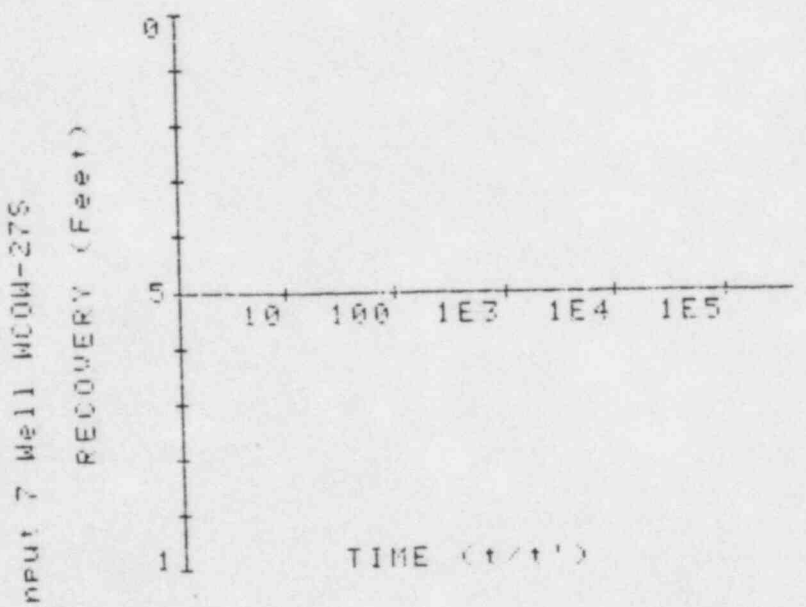

Input 6 Well MCOW-26
RECOVERY (Feet)
0
25
50
10
100
1E3
1E4
1E5
TIME (t/t')

Input 7 Well WCOW-279

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	109.76	-0.24
0.3344	109.76	-0.24
0.4177	109.76	-0.24
0.5011	109.76	-0.24
0.5844	109.76	-0.24
0.6677	109.77	-0.23
0.7511	109.77	-0.23
0.8344	109.77	-0.23
0.9178	109.77	-0.23
1.0011	109.77	-0.23
1.2941	109.78	-0.22
1.5442	109.77	-0.23
1.7942	109.77	-0.23
2.0442	109.76	-0.24
2.2942	109.76	-0.24
2.5442	109.76	-0.24
2.7942	109.76	-0.24
3.0442	109.75	-0.25
3.2942	109.76	-0.24
3.5442	109.76	-0.24
3.7942	109.78	-0.22
4.0442	109.77	-0.23
4.2942	109.77	-0.23
4.5442	109.78	-0.22
4.7942	109.77	-0.23
5.0442	109.77	-0.23
5.2942	109.76	-0.24
5.5442	109.77	-0.23
5.7942	109.77	-0.23
6.0442	109.78	-0.22
6.2942	109.77	-0.23
6.5442	109.78	-0.22
6.7942	109.77	-0.23
7.0443	109.78	-0.22
7.2942	109.78	-0.22
7.5442	109.77	-0.23
7.7942	109.77	-0.23
8.0442	109.79	-0.21
8.2942	109.78	-0.22
8.5442	109.77	-0.23
8.7942	109.78	-0.22
9.0442	109.78	-0.22
9.2942	109.81	-0.19
9.5442	109.80	-0.20
9.7942	109.80	-0.20
10.0440	109.81	-0.19
12.0870	109.79	-0.21
14.0870	109.79	-0.21
16.0870	109.80	-0.20
18.0870	109.83	-0.17
20.0870	109.80	-0.20
22.0870	109.79	-0.21
24.0870	109.81	-0.19
26.0870	109.79	-0.21
28.0870	109.77	-0.23
30.0870	109.80	-0.20
32.0870	109.80	-0.20
34.0870	109.83	-0.17
36.0870	109.83	-0.17
38.0870	109.85	-0.15
40.0870	109.80	-0.20
42.0870	109.81	-0.19
44.0870	109.81	-0.19
46.0870	109.81	-0.19
48.0870	109.80	-0.20
50.0870	109.80	-0.20
52.0870	109.80	-0.20
54.0870	109.78	-0.22
56.0870	109.71	-0.29
58.0870	109.75	-0.25
60.0870	109.77	-0.23
62.0870	109.79	-0.21
64.0870	109.78	-0.22
66.0870	109.79	-0.21
68.0870	109.81	-0.19
70.0870	109.82	-0.18
72.0870	109.79	-0.21
74.0870	109.83	-0.17
76.0870	109.80	-0.20
78.0870	109.78	-0.22
80.0870	109.78	-0.22
82.0870	109.78	-0.22
84.0870	109.81	-0.19
86.0870	109.78	-0.22
88.0870	109.78	-0.22
90.0870	109.82	-0.18
92.0870	109.82	-0.18
94.0870	109.79	-0.21
96.0870	109.81	-0.19
98.0870	109.79	-0.21

100.0900	109.78	-0.22
115.1400	109.78	-0.22
130.1400	109.82	-0.18
145.1400	109.75	-0.25
160.1400	109.78	-0.22
175.1300	109.76	-0.24
190.1300	109.78	-0.22
205.1300	109.77	-0.23
220.1300	109.74	-0.26
235.1300	109.77	-0.23
250.1300	109.74	-0.26
265.1300	109.79	-0.21
280.1300	109.77	-0.23
295.1300	109.73	-0.27
310.1300	109.74	-0.26
325.1300	109.73	-0.27
340.1300	109.75	-0.25
355.1300	109.73	-0.27
370.1300	109.71	-0.29
385.1300	109.67	-0.33
400.1300	109.63	-0.37
415.1300	109.61	-0.39
430.1300	109.59	-0.41
445.1300	109.54	-0.46
460.1300	109.48	-0.52
475.1300	109.46	-0.54
490.1300	109.44	-0.56
505.1300	109.42	-0.58
520.1300	109.44	-0.56
535.1300	109.43	-0.57
550.1300	109.39	-0.61
565.1300	109.41	-0.59
580.1300	109.45	-0.55
595.1300	109.48	-0.52
610.1300	109.49	-0.51
625.1300	109.43	-0.57
640.1300	109.33	-0.67
655.1300	109.41	-0.59
670.1300	109.45	-0.55
685.1300	109.49	-0.51
700.1300	109.49	-0.51
715.1300	109.53	-0.47
730.1300	109.50	-0.50
745.1300	109.49	-0.51
760.1300	109.51	-0.49
775.1300	109.50	-0.50
790.1300	109.51	-0.49
805.1300	109.51	-0.49
820.1300	109.51	-0.49
835.1300	109.51	-0.49
850.1300	109.50	-0.50
865.1300	109.51	-0.49
880.1300	109.48	-0.52
895.1300	109.51	-0.49
910.1300	109.49	-0.51
925.1300	109.50	-0.50
940.1300	109.53	-0.47
955.1300	109.54	-0.46
970.1300	109.53	-0.47
985.1300	109.51	-0.49
00.1000	109.51	-0.49
15.2000	109.52	-0.48
30.2000	109.51	-0.49
1045.2000	109.51	-0.49
1060.2000	109.50	-0.50
1075.2000	109.51	-0.49
1090.2000	109.56	-0.44
1105.2000	109.53	-0.47
1120.2000	109.56	-0.44
1135.2000	109.51	-0.49
1150.2000	109.54	-0.46
1165.2000	109.56	-0.44
1180.2000	109.53	-0.47
1195.2000	109.54	-0.46
1210.2000	109.55	-0.45
1225.2000	109.58	-0.42
1240.2000	109.60	-0.40
1255.2000	109.59	-0.41
1270.2000	109.65	-0.35
1285.2000	109.69	-0.31
1300.2000	109.69	-0.31
1315.2000	109.72	-0.28
1330.2000	109.68	-0.32
1345.2000	109.70	-0.30
1360.2000	109.77	-0.23
1375.2000	109.78	-0.22
1390.2000	109.80	-0.20
1405.2000	109.86	-0.14
1420.2000	109.92	-0.08
1435.2000	109.95	-0.05


Input 7 Well MCOW-27S
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)

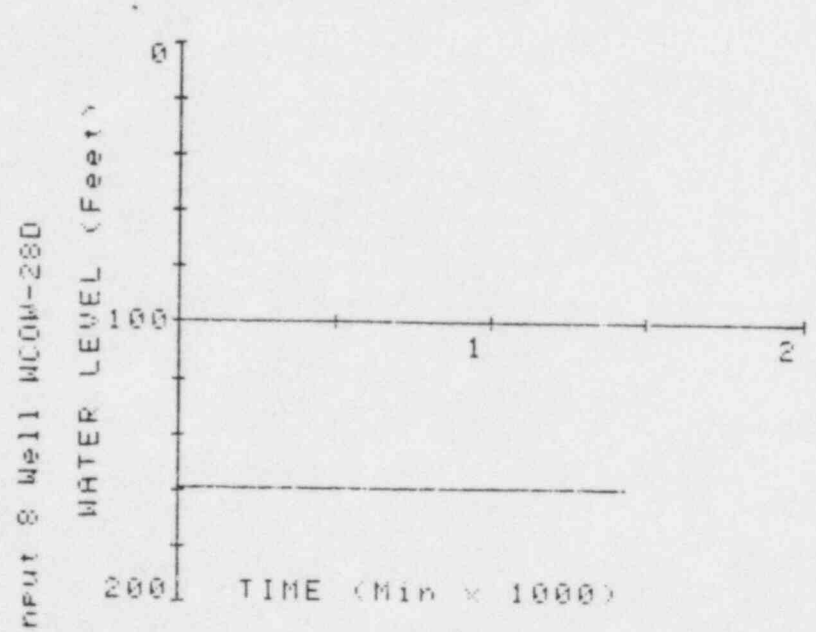

Input 7 Well MCOW-27S
RECOVERY (Feet)
0
5
1
10
100
1E3
1E4
1E5
TIME (t/t')

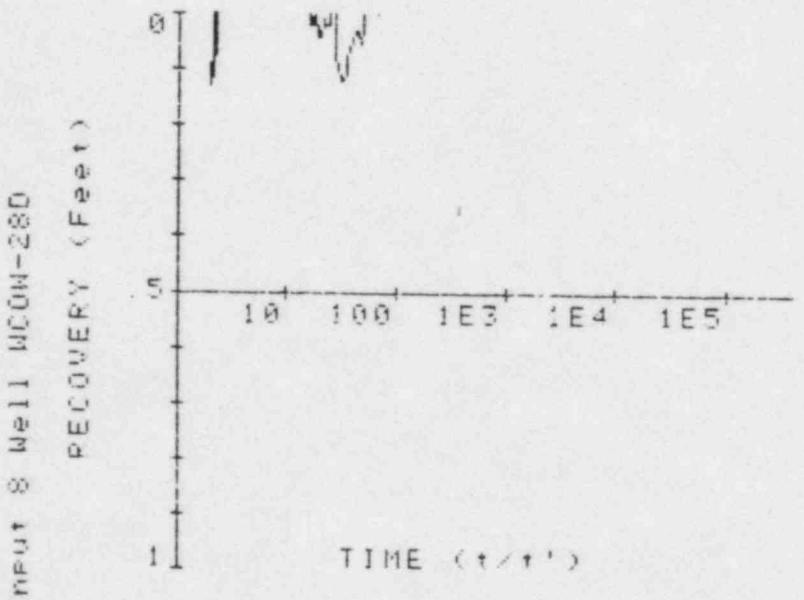
Input @ Well WCOW-28D

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	158.95	-0.05
0.3344	158.95	-0.05
0.4177	158.94	-0.06
0.5011	158.94	-0.06
0.5844	158.94	-0.06
0.6677	158.94	-0.06
0.7511	158.94	-0.06
0.8344	158.94	-0.06
0.9178	158.94	-0.06
1.0011	158.94	-0.06
1.2941	158.94	-0.06
1.5442	158.94	-0.06
1.7942	158.94	-0.06
2.0442	158.94	-0.06
2.2942	158.94	-0.06
2.5442	158.94	-0.06
2.7942	158.94	-0.06
3.0442	158.93	-0.07
3.2942	158.94	-0.06
3.5442	158.93	-0.07
3.7942	158.93	-0.07
4.0442	158.93	-0.07
4.2942	158.93	-0.07
4.5442	158.93	-0.07
4.7942	158.93	-0.07
5.0442	158.93	-0.07
5.2942	158.92	-0.08
5.5442	158.92	-0.08
5.7942	158.93	-0.07
6.0442	158.93	-0.07
6.2942	158.93	-0.07
6.5442	158.93	-0.07
6.7942	158.93	-0.07
7.0442	158.93	-0.07
7.2942	158.93	-0.07
7.5442	158.93	-0.07
7.7942	158.94	-0.06
8.0442	158.94	-0.06
8.2942	158.94	-0.06
8.5442	158.94	-0.06
8.7942	158.94	-0.06
9.0442	158.94	-0.06
9.2942	158.94	-0.06
9.5442	158.94	-0.06
9.7942	158.94	-0.06
10.0440	158.94	-0.06
12.0870	158.94	-0.06
14.0870	158.95	-0.05
16.0870	158.96	-0.04
18.0870	158.97	-0.03
20.0870	158.98	-0.02
22.0870	159.00	0.00
24.0870	158.99	-0.01
26.0870	158.99	-0.01
28.0870	158.98	-0.02
30.0870	159.02	0.02
32.0870	159.06	0.06
34.0870	159.03	0.03
36.0870	159.03	0.03
38.0870	159.05	0.05
40.0870	159.06	0.06
42.0870	159.09	0.09
44.0870	159.11	0.11
46.0870	159.12	0.12
48.0870	159.12	0.12
50.0870	159.11	0.11
52.0870	159.10	0.10
54.0870	159.07	0.07
56.0870	158.98	-0.02
58.0870	158.97	-0.03
60.0870	158.98	-0.02
62.0870	159.00	0.00
64.0870	159.02	0.02
66.0870	159.02	0.02
68.0870	159.02	0.02
70.0870	159.01	0.01
72.0870	159.02	0.02
74.0870	159.04	0.04
76.0870	159.04	0.04
78.0870	159.04	0.04
80.0870	159.03	0.03
82.0870	159.02	0.02
84.0870	159.02	0.02
86.0870	159.00	0.00
88.0870	159.00	0.00
90.0870	159.01	0.01
92.0870	159.02	0.02
94.0870	159.02	0.02
96.0870	159.00	0.00
98.0870	158.99	-0.01

100 0900	158.93	-0.01	
115 1400	158.96	-0.04	
130 1400	158.97	-0.03	
145 1400	158.94	-0.05	
160 1400	158.94	-0.06	
175 1300	158.94	-0.06	
190 1300	158.93	-0.07	
205 1300	158.94	-0.06	
220 1300	158.92	-0.08	
235 1300	158.91	-0.09	
250 1300	158.88	-0.12	
265 1300	158.90	-0.10	
280 1300	158.91	-0.09	
295 1300	158.87	-0.13	
310 1300	158.85	-0.15	
325 1300	158.87	-0.13	
340 1300	158.84	-0.16	
355 1300	158.80	-0.20	
370 1300	158.84	-0.16	
385 1300	158.88	-0.12	
400 1300	158.78	-0.22	
415 1300	158.77	-0.23	
430 1300	158.75	-0.25	
445 1300	158.68	-0.32	
460 1300	158.70	-0.30	
475 1300	158.68	-0.32	
490 1300	158.66	-0.34	
505 1300	158.64	-0.36	
520 1300	158.69	-0.31	
535 1300	158.73	-0.27	
550 1300	158.74	-0.26	
565 1300	158.78	-0.22	
580 1300	158.82	-0.18	
595 1300	158.84	-0.16	
610 1300	158.86	-0.14	
625 1300	158.85	-0.15	
640 1300	158.86	-0.14	
655 1300	158.88	-0.12	
670 1300	158.87	-0.13	
685 1300	158.88	-0.12	
700 1300	158.89	-0.11	
715 1300	158.90	-0.10	
730 1300	158.89	-0.11	
745 1300	158.88	-0.12	
760 1300	158.88	-0.12	
775 1300	158.88	-0.12	
790 1300	158.90	-0.10	
805 1300	158.91	-0.09	
820 1300	158.91	-0.09	
835 1300	158.91	-0.09	
850 1300	158.91	-0.09	
865 1300	158.90	-0.10	
880 1300	158.89	-0.11	
895 1300	158.89	-0.11	
910 1300	158.90	-0.10	
925 1300	158.91	-0.09	
940 1300	158.91	-0.09	
955 1300	158.90	-0.10	
970 1300	158.90	-0.10	
985 1300	158.90	-0.10	

1000 1300	158.91	-0.09	
1015 2000	158.92	-0.08	
1030 2000	158.91	-0.09	
1045 2000	158.92	-0.08	
1060 2000	158.92	-0.08	
1075 2000	158.92	-0.08	
1090 2000	158.92	-0.08	
1105 2000	158.92	-0.08	
1120 2000	158.93	-0.07	
1135 2000	158.94	-0.06	
1150 2000	158.95	-0.05	
1165 2000	158.98	-0.02	
1180 2000	158.95	-0.05	
1195 2000	158.95	-0.05	
1210 2000	158.98	-0.02	
1225 2000	159.08	0.08	
1240 2000	159.07	0.07	
1255 2000	158.97	-0.03	
1270 2000	159.06	0.06	
1285 2000	159.05	0.05	
1300 2000	158.94	-0.06	
1315 2000	158.94	-0.06	
1330 2000	158.92	-0.08	
1345 2000	159.09	0.09	
1360 2000	159.09	0.09	
1375 2000	158.94	-0.06	
1390 2000	159.11	0.11	
1405 2000	159.13	0.13	
1420 2000	159.09	0.09	
1435 2000	159.09	0.09	


Input 8 Well WC0W-280
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 8 Well WC0W-280
RECOVERY (Feet)
0
5
1
10
100
1E3
1E4
1E5
TIME (t/t')

Input 9 Well WCOW-21P

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	142.56	4.56
0.3344	142.56	4.56
0.4177	142.56	4.56
0.5011	142.54	4.54
0.5844	142.54	4.54
0.6677	142.54	4.54
0.7511	142.54	4.54
0.8344	142.54	4.54
0.9178	142.54	4.54
1.0011	142.54	4.54
1.2941	142.53	4.53
1.5442	142.53	4.53
1.7942	142.54	4.54
2.0442	142.53	4.53
2.2942	142.53	4.53
2.5442	142.53	4.53
2.7942	142.53	4.53
3.0442	142.52	4.52
3.2942	142.52	4.52
3.5442	142.52	4.52
3.7942	142.52	4.52
4.0442	142.52	4.52
4.2942	142.52	4.52
4.5442	142.52	4.52
4.7942	142.52	4.52
5.0442	142.52	4.52
5.2942	142.52	4.52
5.5442	142.52	4.52
5.7942	142.53	4.53
6.0442	142.52	4.52
6.2942	142.52	4.52
6.5442	142.52	4.52
6.7942	142.52	4.52
7.0442	142.52	4.52
7.2942	142.52	4.52
7.5442	142.52	4.52
7.7942	142.50	4.50
8.0442	142.53	4.53
8.2942	142.52	4.52
8.5442	142.52	4.52
8.7942	142.53	4.53
9.0442	142.53	4.53
9.2942	142.53	4.53
9.5442	142.53	4.53
9.7942	142.53	4.53
10.0440	142.53	4.53
12.0870	142.54	4.54
14.0870	142.59	4.59
16.0870	142.62	4.62
18.0870	142.60	4.60
20.0870	142.63	4.63
22.0870	142.66	4.66
24.0870	142.70	4.70
26.0870	142.73	4.73
28.0870	142.70	4.70
30.0870	142.73	4.73
32.0870	142.82	4.82
34.0870	142.82	4.82
36.0870	142.80	4.80
38.0870	142.83	4.83
40.0870	142.86	4.86
42.0870	142.89	4.89
44.0870	142.92	4.92
46.0870	142.93	4.93
48.0870	142.92	4.92
50.0870	142.90	4.90
52.0870	142.90	4.90
54.0870	142.83	4.83
56.0870	142.66	4.66
58.0870	142.60	4.60
60.0870	142.64	4.64
62.0870	142.67	4.67
64.0870	142.75	4.75
66.0870	142.75	4.75
68.0870	142.72	4.72
70.0870	142.70	4.70
72.0870	142.73	4.73
74.0870	142.73	4.73
76.0870	142.73	4.73
78.0870	142.73	4.73
80.0870	142.72	4.72
82.0870	142.70	4.70
84.0870	142.69	4.69
86.0870	142.67	4.67
88.0870	142.66	4.66
90.0870	142.64	4.64
92.0870	142.67	4.67
94.0870	142.67	4.67
96.0870	142.66	4.66
98.0870	142.63	4.63

100	0900
115	1400
130	1400
145	1400
160	1400
175	1300
190	1300
205	1300
220	1300
235	1300
250	1300
265	1300
280	1300
295	1300
310	1300
325	1300
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730	1300
745	1300
760	1300
775	1300
790	1300
805	1300
820	1300
835	1300
850	1300
865	1300
880	1300
895	1300
910	1300
925	1300
940	1300
955	1300
970	1300
985	1300

142.53
142.51
142.53
142.49
142.43
142.39
142.34
142.30
142.21
142.14
142.03
142.03
141.99
141.90
141.78
141.80
141.71
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141.63
141.66
141.43
141.40
141.28
141.18
141.20
141.15
141.08
141.04
141.05
141.04
141.02
141.01
140.98
140.95
140.94
140.87
140.84
140.81
140.77
140.74
140.71
140.68
140.65
140.61
140.57
140.54
140.52
140.49
140.47
140.42
140.39
140.37
140.32
140.31
140.27
140.27
140.24
140.19
140.16
140.15

4	53
4	57
4	53
4	49
4	43
4	39
4	34
4	30
4	21
4	14
4	03
4	03
3	99
3	90
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3	18
3	20
3	15
3	08
3	04
3	05
3	04
3	02
3	01
2	98
2	95
2	94
2	87
2	84
2	81
2	77
2	74
2	71
2	68
2	65
2	61
2	57
2	54
2	52
2	49
2	47
2	42
2	39
2	37
2	32
2	31
2	27
2	27
2	24
2	19
2	16
2	15

1000	1000
1015	2000
1030	2000
1045	2000
1060	2000
1075	2000
1090	2000
1105	2000
1120	2000
1135	2000
1150	2000
1165	2000
1180	2000
1195	2000
1210	2000
1225	2000
1240	2000
1255	2000
1270	2000
1285	2000
1300	2000
1315	2000
1330	2000
1345	2000
1360	2000
1375	2000
1390	2000
1405	2000
1420	2000
1435	2000

140.14
140.12
140.09
140.08
140.04
140.02
139.99
139.98
139.95
139.95
139.92
139.95
139.92
139.88
139.85
139.88
139.96
139.94
139.79
139.91
139.89
139.71
139.68
139.65
139.92
139.86
139.55
139.86
139.82
139.75
139.72

2.14
2.12
2.09
2.08
2.04
2.02
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1.98
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1.95
1.92
1.88
1.85
1.88
1.96
1.94
1.79
1.91
1.89
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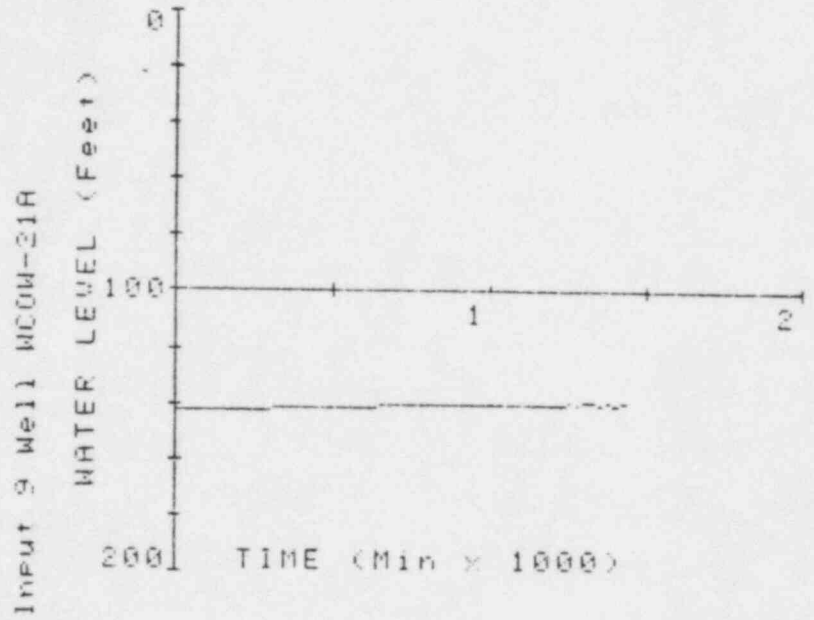
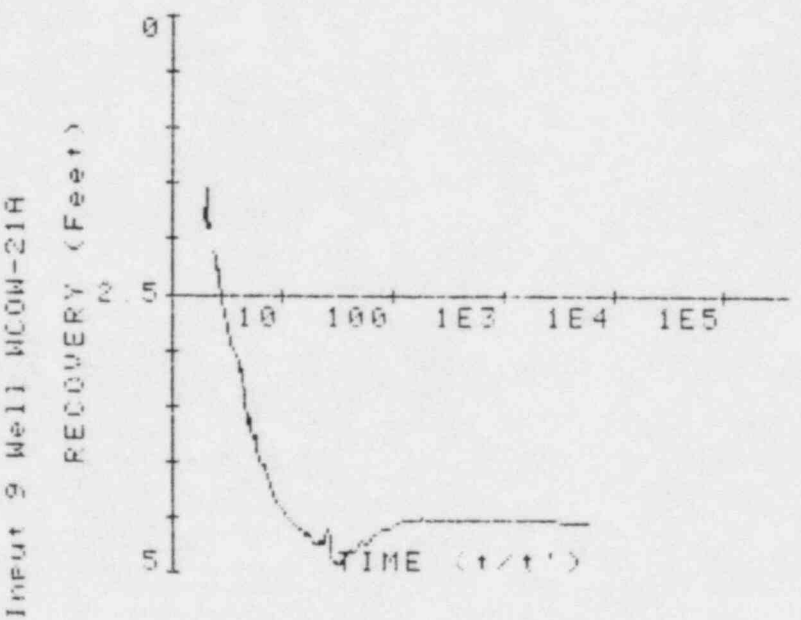
1.75
1.72


Input 9 Well WCOW-21A
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 9 Well WCOW-21A
RECOVERY (Feet)
0
5
5
10
100
1E3
1E4
1E5
TIME (t/t')

Input 10 well WCOW-216

TIME (Min)	LEVEL (F)	Δ LEVEL
0.0844		
0.1677		
0.2511	142.76	4.76
0.3344	142.64	4.64
0.4177	142.59	4.59
0.5011	142.62	4.62
0.5844	142.56	4.56
0.6677	142.59	4.59
0.7511	142.59	4.59
0.8344	142.59	4.59
0.9178	142.59	4.59
1.0011	142.59	4.59
1.2941	142.59	4.59
1.5442	142.56	4.56
1.7942	142.56	4.56
2.0442	142.56	4.56
2.2942	142.53	4.53
2.5442	142.56	4.56
2.7942	142.56	4.56
3.0442	142.53	4.53
3.2942	142.53	4.53
3.5442	142.53	4.53
3.7942	142.56	4.56
4.0442	142.59	4.59
4.2942	142.59	4.59
4.5442	142.50	4.50
4.7942	142.53	4.53
5.0442	142.53	4.53
5.2942	142.53	4.53
5.5442	142.50	4.50
5.7942	142.50	4.50
6.0442	142.50	4.50
6.2942	142.50	4.50
6.5442	142.53	4.53
6.7942	142.53	4.53
7.0442	142.47	4.47
7.2942	142.50	4.50
7.5442	142.53	4.53
7.7942	142.50	4.50
8.0442	142.56	4.56
8.2942	142.53	4.53
8.5442	142.50	4.50
8.7942	142.50	4.50
9.0442	142.50	4.50
9.2942	142.50	4.50
9.5442	142.56	4.56
9.7942	142.56	4.56
10.0440	142.59	4.59
12.0870	142.50	4.50
14.0870	142.44	4.44
16.0870	142.50	4.50
18.0870	142.59	4.59
20.0870	142.59	4.59
22.0870	142.59	4.59
24.0870	142.62	4.62
26.0870	142.64	4.64
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32.0870	142.52	4.52
34.0870	142.70	4.70
36.0870	142.70	4.70
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40.0870	142.82	4.82
42.0870	142.82	4.82
44.0870	142.87	4.87
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48.0870	142.87	4.87
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62.0870	142.56	4.56
64.0870	142.59	4.59
66.0870	142.64	4.64
68.0870	142.64	4.64
70.0870	142.64	4.64
72.0870	142.64	4.64
74.0870	142.64	4.64
76.0870	142.64	4.64
78.0870	142.67	4.67
80.0870	142.67	4.67
82.0870	142.64	4.64
84.0870	142.62	4.62
86.0870	142.62	4.62
88.0870	142.59	4.59
90.0870	142.59	4.59
92.0870	142.59	4.59
94.0870	142.62	4.62
96.0870	142.67	4.67
98.0870	142.64	4.64

100.0900	141.62	4.62
115.1400	142.56	4.56
130.1400	142.50	4.50
145.1400	142.36	4.36
160.1400	142.36	4.36
175.1300	142.36	4.36
190.1300	142.24	4.24
205.1300	142.19	4.19
220.1300	142.10	4.10
235.1300	142.13	4.13
250.1300	141.96	3.96
265.1300	141.90	3.90
280.1300	141.93	3.93
295.1300	141.76	3.76
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400.1300	141.33	3.33
415.1300	141.24	3.24
430.1300	141.16	3.16
445.1300	140.98	2.98
460.1300	141.04	3.04
475.1300	140.98	2.98
490.1300	140.87	2.87
505.1300	140.81	2.81
520.1300	140.93	2.93
535.1300	140.93	2.93
550.1300	140.81	2.81
565.1300	140.84	2.84
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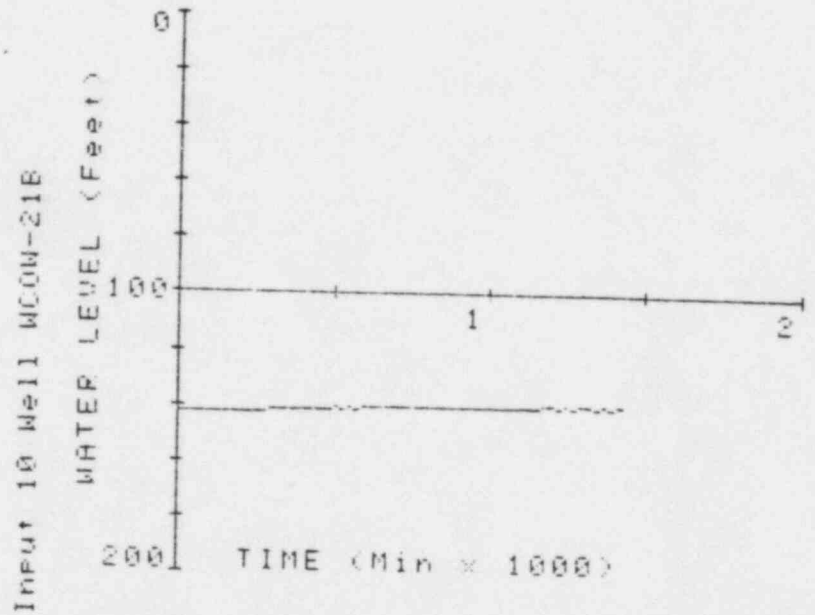
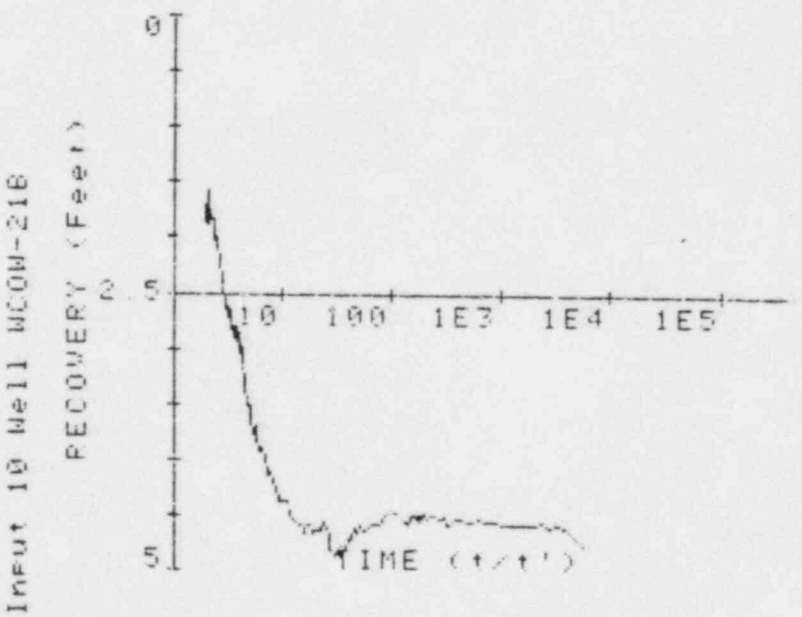
670.1300	140.64	2.64
685.1300	140.61	2.61
700.1300	140.64	2.64
715.1300	140.55	2.55
730.1300	140.50	2.50
745.1300	140.50	2.50
760.1300	140.50	2.50
775.1300	140.38	2.38
790.1300	140.35	2.35
805.1300	140.38	2.38
820.1300	140.30	2.30
835.1300	140.24	2.24
850.1300	140.21	2.21
865.1300	140.21	2.21
880.1300	140.18	2.18
895.1300	140.15	2.15
910.1300	140.15	2.15
925.1300	140.10	2.10
940.1300	140.12	2.12
955.1300	140.10	2.10
970.1300	140.07	2.07
985.1300	140.12	2.12
1000.1000	140.01	2.01
1015.2000	139.95	1.95
1030.2000	139.92	1.92
1045.2000	139.89	1.89
1060.2000	140.01	2.01
1075.2000	139.87	1.87
1090.2000	139.92	1.92
1105.2000	139.84	1.84
1120.2000	139.84	1.84
1135.2000	139.81	1.81
1150.2000	139.81	1.81
1165.2000	139.84	1.84
1180.2000	139.78	1.78
1195.2000	139.78	1.78
1210.2000	139.75	1.75
1225.2000	139.84	1.84
1240.2000	139.84	1.84
1255.2000	139.69	1.69
1270.2000	139.84	1.84
1285.2000	139.84	1.84
1300.2000	139.64	1.64
1315.2000	139.67	1.67
1330.2000	139.61	1.61
1345.2000	139.87	1.87
1360.2000	139.89	1.89
1375.2000	139.58	1.58
1390.2000	139.84	1.84
1405.2000	139.87	1.87
1420.2000	139.69	1.69
1435.2000	139.75	1.75


Input 10 Well WC0W-21B
WATER LEVEL (Feet)
0
100
200
1
2
TIME (Min x 1000)


Input 10 Well WC0W-21B
RECOVERY (Feet)
0
5
5
10
100
1E3
1E4
1E5
TIME (t/t')

DOCUMENT/ PAGE PULLED

ANO. 8308230754

NO. OF PAGES 1

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APPENDIX D-7

SOIL ASSESSMENT

Introduction

This report presents information about the soil resources on the 8.7-acre Willow Creek ISL R&D permit area in western Campbell County, Wyoming. Map D-7 and data contained in this report have been prepared to assist Western Nuclear Inc. and the Wyoming Department of Environmental Quality (DEQ) in examining the soil resources of the area with respect to their potential use in mined land reclamation efforts.

A field soil survey at the site was conducted on July 8 and 9, 1982. Prior to field sampling, Soil Conservation Service (SCS) information was gathered at Gillette, Wyoming. The investigations were conducted in accordance with DEQ Guideline No. 4 (February 1980).

General Nature of the Area

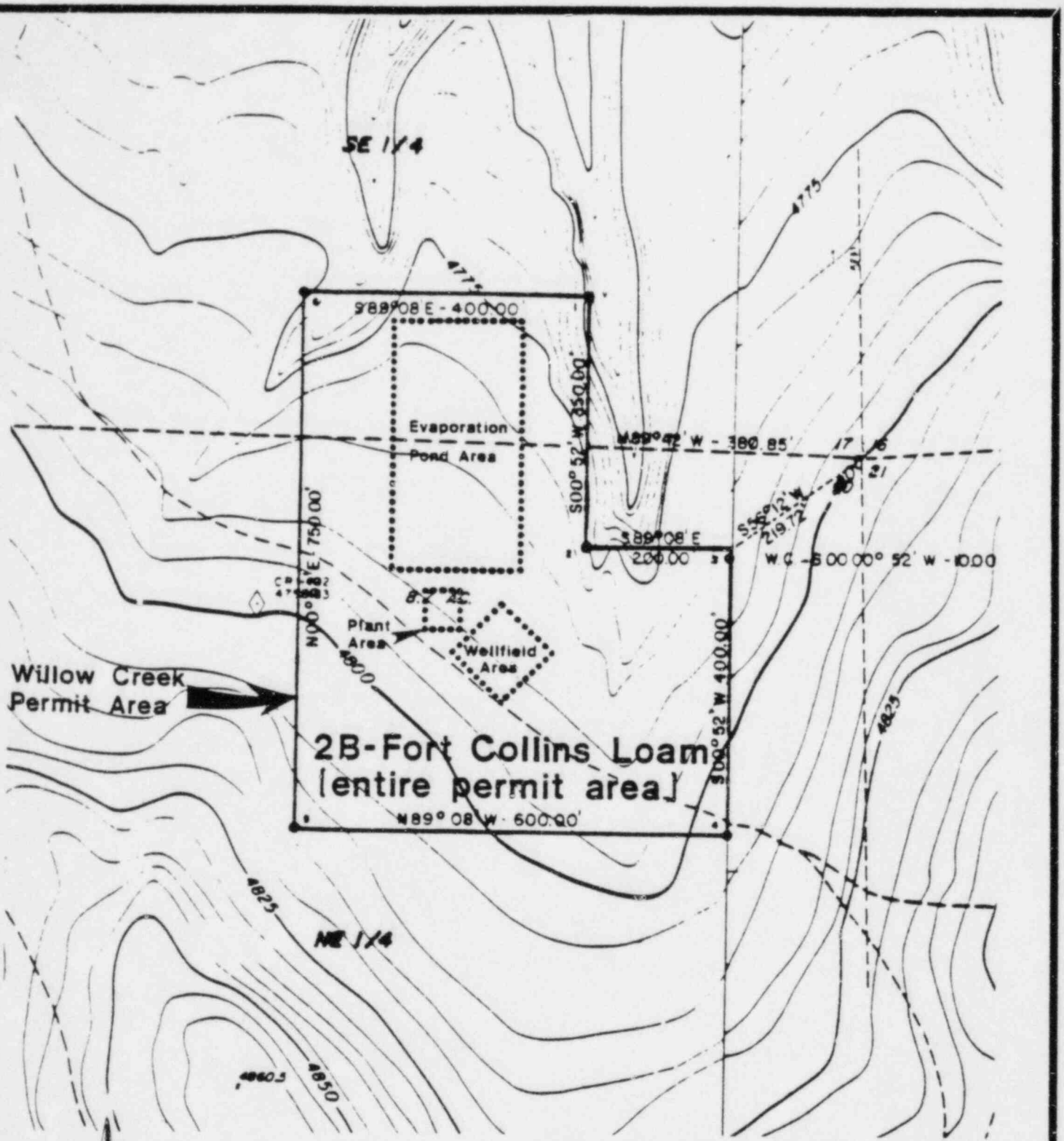
The Willow Creek ISL site is located in a semi-arid area of nearly level to moderately sloping grassland which is dissected by ephemeral drainageways. The soils of the area typically have soil moisture deficits during the growing season as a result of the quantity and distribution of precipitation. The elevation within the study area averages 4,790 feet. The area is drained by Willow Creek. The soils which developed in the area were derived from local alluvium and aoelian materials from very fine sandy and silty shale. They are characteristically moderately well developed, deep, and calcareous soils.

Scope and Objectives

The basic objectives of the field investigations were to map and sample the soils of the study area in sufficient detail to characterize their physical and chemical properties and the depths to which they may be salvaged as a source of topsoil for mine reclamation purposes.

Survey and Sampling Methodology

The methodology utilized during the program reflected standard techniques and procedures of the National Cooperative Soil Survey. The



North

Scale
1" Equals 200'

50 200
0 100 400

D-7-2

Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK

SOILS

MAP D-7

WESTERN NUCLEAR, INC.

draft guidelines for preparation of a research and development in situ testing license were developed for soils investigations by the Wyoming DEQ (Guideline No. 4, February 1980, Draft 3) and formed the procedural basis for this work.

The area, including the study site, has been mapped by the Soil Conservation Service in a survey in progress. This mapping is at a reconnaissance (Order 3) level of intensity, and thus served as a general background to the field program.

The study area was first examined in a reconnaissance manner to determine the validity of the previous soil survey and to familiarize the field personnel with the area. Soil cores were taken on a systematic basis according to the configuration of the landscape. Information derived from these cores was correlated with existing data to determine which soils were likely to occur in specific physiographic positions. No soil samples were taken for laboratory analysis during this preliminary activity.

Following the low intensity orientation survey, a more intense soil survey was conducted on those areas to be disturbed. Soil profiles were exposed as necessary to determine the nature and extent of soils present on the study area. Pits were hand-dug to depths of about 25 inches. In general, this was more than sufficient to expose the genetic horizons and much of the substrata. Below the 25-inch depth, the soils were examined by means of 3-inch diameter hand auger to 60 inches. Each soil profile was characterized and then correlated with available SCS series criteria.

Series phases and phases of series variants were delineated on the basis of slope, surface texture, volume of coarse fragments, or reaction classes. Small areas of steeper or flatter slopes or slightly different surface textures were included in the phase mapping. After determining the soil series or variant and the soil phase to which each profile belonged, the soil phase boundaries were determined throughout their length in the field by means of additional test holes and by analysis of relative landscape position, parent materials, and vegetative indicators.

One profile per soil phase within the Order 1 area was sampled for laboratory analyses, due to the size of the study area. One 2-quart sample was taken to represent each natural soil horizon or contrasting

layer within the depth to 60 inches. Natural horizons more than 18 inches thick in the substrata were subdivided such that no sample represented greater than 18 inches of soil material. Surface or subsoil horizons were sampled to represent no greater than 12 inches of soil material.

The physical and, where possible, chemical nature of each horizon within the sampled profile was described and recorded in the field using standard SCS survey techniques. Among the properties determined were relative position of soil horizons; depth and thickness of horizons; soil color; structure; texture; dry, moist, and wet consistencies; coarse fragment content; depth and abundance of roots; effervescence with 0.1 N HCl; and type of horizon boundary. Slope, physiographic position, internal drainage, depth to rock or water table, or salt or alkali, and vegetation were also described for each sample site.

Samples were taken with either a spade or hand auger. The sampled soil material was placed in clean, labeled, polyethylene plastic bags, and was kept cool and as dry as possible to limit chemical changes. At the end of the sampling program, the air-dried samples were delivered to Inter-Mountain Laboratories, Inc., Sheridan, Wyoming, for certain soils analyses (Table D-7-1) listed in the Wyoming DEQ, Land Quality Division, Guideline No. 1 (Soils and Overburden), March 1980, revised.

Soil Characteristics

A description of the mapping unit used on the Willow Creek ISL site is included in the following section. The mapping unit description discusses the physiographic and climatic setting of the soils, and includes a description of physical characteristics such as depth, drainage, and permeability, and the soil's suitability as a source of topsoil. Also included in the mapping unit narrative is a brief description, in lay terminology, of the soil's typical profile.

Following the mapping unit description is a series profile description. This is a site-specific, technical narrative of the soils sampled at Willow Creek. It includes a brief description of the soil's climatic and physiographic characteristics, and the soil's classification to the family level according to SCS 1975 and SCS 1977. Following this is a technical narrative describing each soil horizon in the typical sampled profile and the profile location. The last part of the profile description discusses the soil's present land use and associated vegetation.

All mapping unit descriptions and profile descriptions for the mapped area are written site specific to the Willow Creek ISL site. A tabulation of laboratory sample data follows in Table D-7-1.

Post-Mining Erosion Hazards

Wind erodibility is of primary concern when dealing with topsoil materials in the Willow Creek area. Soils may have surface layers which, when disturbed or denuded of vegetation, are highly susceptible to wind erosion. Impacts from mining and construction may destroy some of the aggregate stability of disturbed soils, thus creating a potential wind erosion hazards.

The soils on the Willow Creek ISL site are generally moderately susceptible to water erosion. Also, particle analysis indicates that the soils in the study area have a large percentage of silt-sized particles in their profiles.

Protective measures such as establishment of vegetation and mulching will be used to control wind and water erosion on topsoil stockpiles and reclaimed sites. Long unbroken slopes will be avoided as a means of minimizing sediment runoff and gullying.

TABLE D-7-1

TOPSOIL ANALYSIS FOR WILLOW CREEK ISL RSD PERMIT AREA

INTER-MOUNTAIN LABORATORIES, INC.

1633 Terra Avenue
Sheridan, Wyoming

DATE: July 21, 1982
FORM: WYOMING DEQ

Sample Location	Depth In.	Lab No.	pH	Conductivity mmhos/cm	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR[1]	% Organic Matter	Selenium ppm	% Very Fine Sand	Sand %	Silt %	Clay %	Texture
06092																
A1	0-3	14203	6.5	0.80	50.4	4.58	2.62	0.95	0.50	1.9	-0.02	15.4	29.1	47.3	23.6	Loam
B21tCa	3-8	14204	7.0	0.58	56.3	3.19	1.89	0.89	0.56	1.3	-0.02	11.6	29.1	38.2	32.7	Clay Loam
B22tCa	8-22	14205	7.9	0.36	48.8	1.87	1.49	1.22	0.94	0.6	-0.02	13.8	29.1	41.8	29.1	Clay Loam
B3Ca	22-40	14206	8.1	0.43	42.8	1.29	0.92	2.68	2.55	0.3	-0.02	11.6	29.1	43.6	27.3	Clay Loam
C1	40-49	14207	8.0	1.47	42.1	3.04	3.09	9.13	5.22	0.3	-0.02	13.7	30.0	44.5	25.5	Loam
C2	49-60	14208	7.8	3.13	43.7	10.5	9.05	19.4	6.21	0.3	-0.02	10.9	30.0	45.5	24.5	Loam

[1]SAR = Sodium Adsorption Ratio

MAPPING UNIT DESCRIPTION

2B Fort Collins Loam, 0 to 4 Percent Slopes

These deep, well-drained soils occur on alluvial fans and terraces in the study area at elevations ranging from 4,700 to 4,850 feet. They developed in alluvium from sandstone, shale, and local aeolian material. Average annual precipitation ranges from 10 to 14 inches, and the frost-free season is 105 to 120 days. Mean annual soil temperature ranges from 47° to 58°F. Slopes are level to gently sloping.

Typically the surface layer is a brown loam 2 inches thick. The upper part of the subsoil is a dark yellowish brown clay loam about 5 inches thick. The middle part of the subsoil is a light brownish gray clay loam about 14 inches thick. The lower part of the subsoil is a light yellowish brown clay loam about 18 inches thick. The upper part of the substratum is a light yellowish brown loam about 9 inches thick. The lower part of the substratum is a light olive brown loam to 60 inches.

Permeability of the Fort Collins soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow and the hazard of erosion by wind and water is moderate. The unit is presently in native range.

Topsoil Suitability

The Fort Collins soil exhibits good suitability as topsoil material to a depth of 18 inches.

Fort Collins Series

The Fort Collins series consists of deep, well-drained soils that formed mainly in alluvium. Fort Collins soils are on terraces and alluvial fans and have slopes of 0 to 10 percent. The mean annual precipitation is about 14 inches and the mean annual air temperature is about 47°F.

Taxonomic Class - Fine-loamy, mixed, mesic, Ustollic Haplargids.

Typical Pedon - Fort Collins loam, 1 to 4 percent slopes, located 50 feet N., 50 feet W., of SE corner of proposed evaporation pond area. (Colors are for dry soil unless otherwise noted.) Profile sampling number 06092.

A1--1 to 2 inches; brown (10YR 5/3) loam; very dark grayish brown (10YR 3/2) moist; weak coarse platy structure parting to weak medium subangular blocks; slightly acid (pH 6.4); clear smooth boundary.

B21t--3 to 8 inches; dark yellowish brown (10YR 4/4) clay loam; dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to medium moderate subangular blocks; slightly hard, very friable, slightly sticky, and slightly plastic; few thin, patchy clay films on ped faces; many fine and medium roots; noncalcareous, neutral (pH 7.0); clear smooth boundary.

B22t--8 to 22 inches; light brownish gray (2.5Y 6/2) clay loam; dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky, and slightly plastic; few thin, patchy clay films on ped faces; common fine and medium roots to 16 inches; slightly calcareous, moderately alkaline (pH 7.9); clear smooth boundary.

B3ca--22 to 40 inches; light yellowish brown (2.5Y 6/4) clay loam; brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky, and slightly plastic; calcareous, moderately alkaline (pH 8.3); few gravels (5 percent); few hard modules (5 percent); clear smooth boundary.

C1ca--40 to 49 inches; light yellowish brown (10YR 6/4) loam; yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky, and slightly plastic; calcareous, moderately alkaline (pH 8.0); clear smooth boundary.

C2ca--49 to 60 inches; light olive brown (2.5Y 5/4) loam; light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, slightly sticky, and slightly plastic; calcareous, moderately alkaline (pH 7.8).

Use and Vegetation

Fort Collins soils are being used as native range and wildlife habitat. Associated vegetation includes blue grama, junegrass, Sandberg bluegrass, and Wyoming big sagebrush.

REFERENCES

Soil Conservation Service. 1975. Soil Taxonomy. U.S. Department of Agriculture Handbook No. 436. 754 pp.

Soil Conservation Service. 1977. Soil series of the United States, Puerto Rico, and the Virgin Islands: their taxonomic classification. U.S. Department of Agriculture. 307 pp.

APPENDIX D-8

VEGETATION INVENTORY

A field reconnaissance was conducted in June 1982, on the proposed Willow Creek ISL R&D permit area located in Campbell County, Wyoming. Vegetation information was collected at the prescribed level of effort outlined by Wyoming Department of Environmental Quality Guideline No. 4 (February 1980).

The 8.7-acre permit area occurs within the Grama-Needlegrass-Wheatgrass (Boutelona - Stipa - Agropyron) community common to northeastern Wyoming (Kuchler 1964). Elevation of this area averages 4,790 feet with about 14 inches of annual precipitation.

The majority of the permit area occurs within the grassland vegetation type which is dominated by perennial grass species. The sagebrush vegetation type primarily exists along the steep (up to 100 percent slope) drainage which intersects the gently sloping (3-5 percent) grassland areas (Map D-8). These two vegetation types exibit relatively low species diversity. Approximately 33 species were observed on the project site. These species and their scientific names are presented on Table D-8-1.

This grassland community of the northern mixed prairie region averaged approximately 45 percent plant canopy cover; litter and bare ground averaged 15 and 40 percent, respectively (Plate D-8A). Dominant species included blue grama (≅ 13 percent canopy cover [c.c.]), Sandberg bluegrass (≅ 5 percent c.c.), prairie junegrass (≅ 5 percent c.c.), western wheatgrass (≅ 4 percent c.c.), threadleaf sedge (≅ 3 percent c.c.), Japanese brome (≅ 3 percent c.c.), pale alyssum (≅ 3 percent c.c.), big sagebrush (≅ 1 percent c.c.), and other grasses and forbs (≅ 8 percent c.c.) The scattered sagebrush averaged heights of approximately 30 cm. The soils of this grassland area are generally loamy.

The sagebrush vegetation type averaged approximately 35 percent plant canopy cover; litter and bare ground averaged 15 and 50 percent, respectively (Plate D-8B). Dominant species included big sagebrush (≅ 7 percent c.c.), blue grama (≅ 5 percent c.c.), prairie junegrass (≅ 5 percent c.c.), western wheatgrass (≅ 5 percent c.c.), threadleaf sedge (≅ 5 percent c.c.), pricklypear cactus (≅ 3 percent c.c.), and other

grasses and forbs (≅ 5 percent c.c.). The sagebrush heights averaged 30 cm. Soils are generally loamy. Productivity for the permit area, combining both vegetation types, was estimated to range from 800 to 1,000 pounds per acre. Vigor of the plants appeared to be good.

No threatened or endangered plant species are known to occur in Campbell County, however, several rare plant species, as defined by the Wyoming Natural Heritage Program, occur in the county (Clark and Dorn, 1979) No threatened, endangered, or rare plant species were encountered during the field reconnaissance.

REFFERENCES CITED

Clark, T. W. and R. D. Dorn. 1979. Rare and endangered vascular plants and vertebrates of Wyoming. Wyoming Natural Heritage Program. 78 pp.

Kuchler, A. W. 1964. Potential natural vegetation of the conterminous United States. Am. Geog. Soc. Spec. Publ. 36. 154 pp.

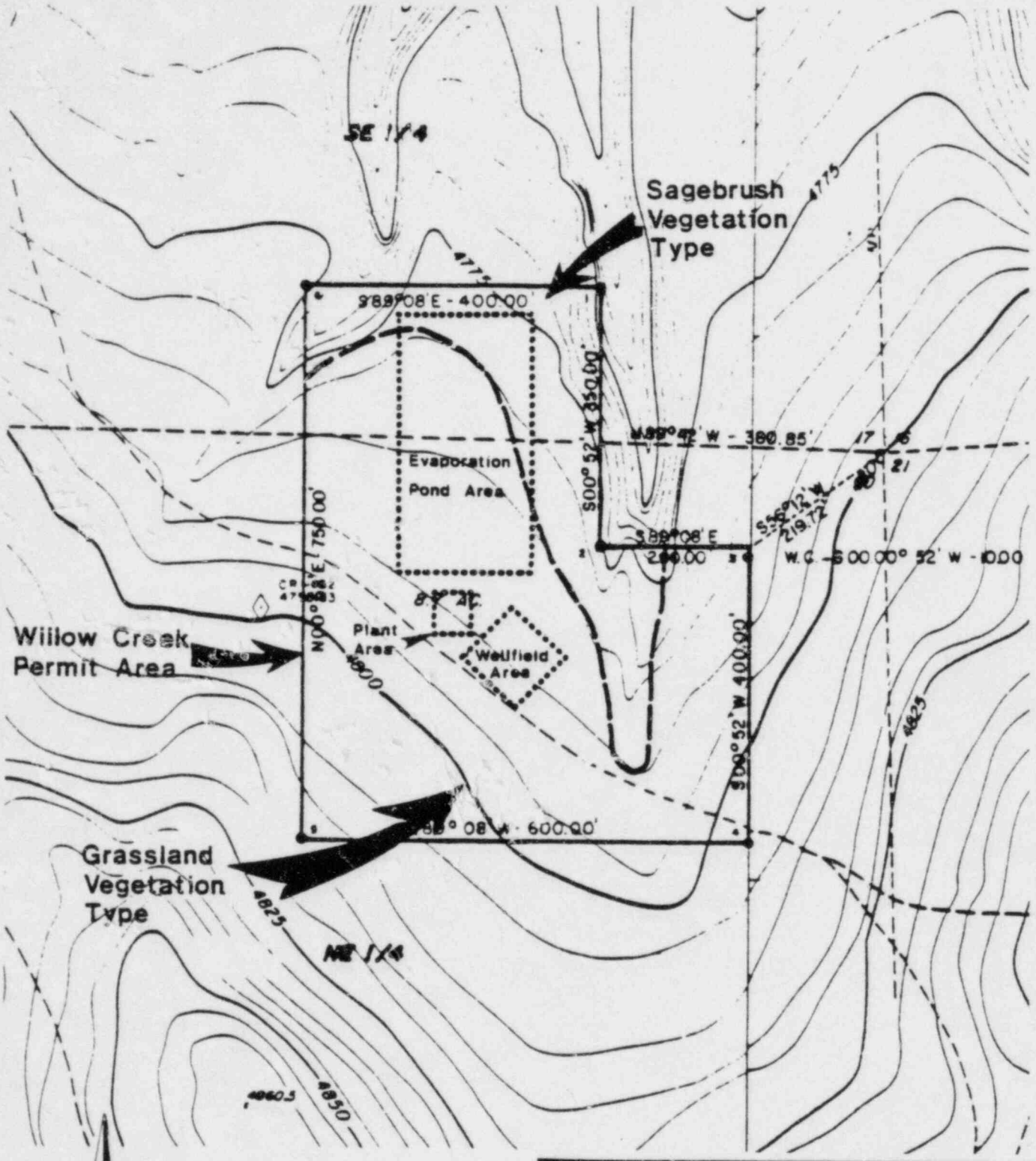
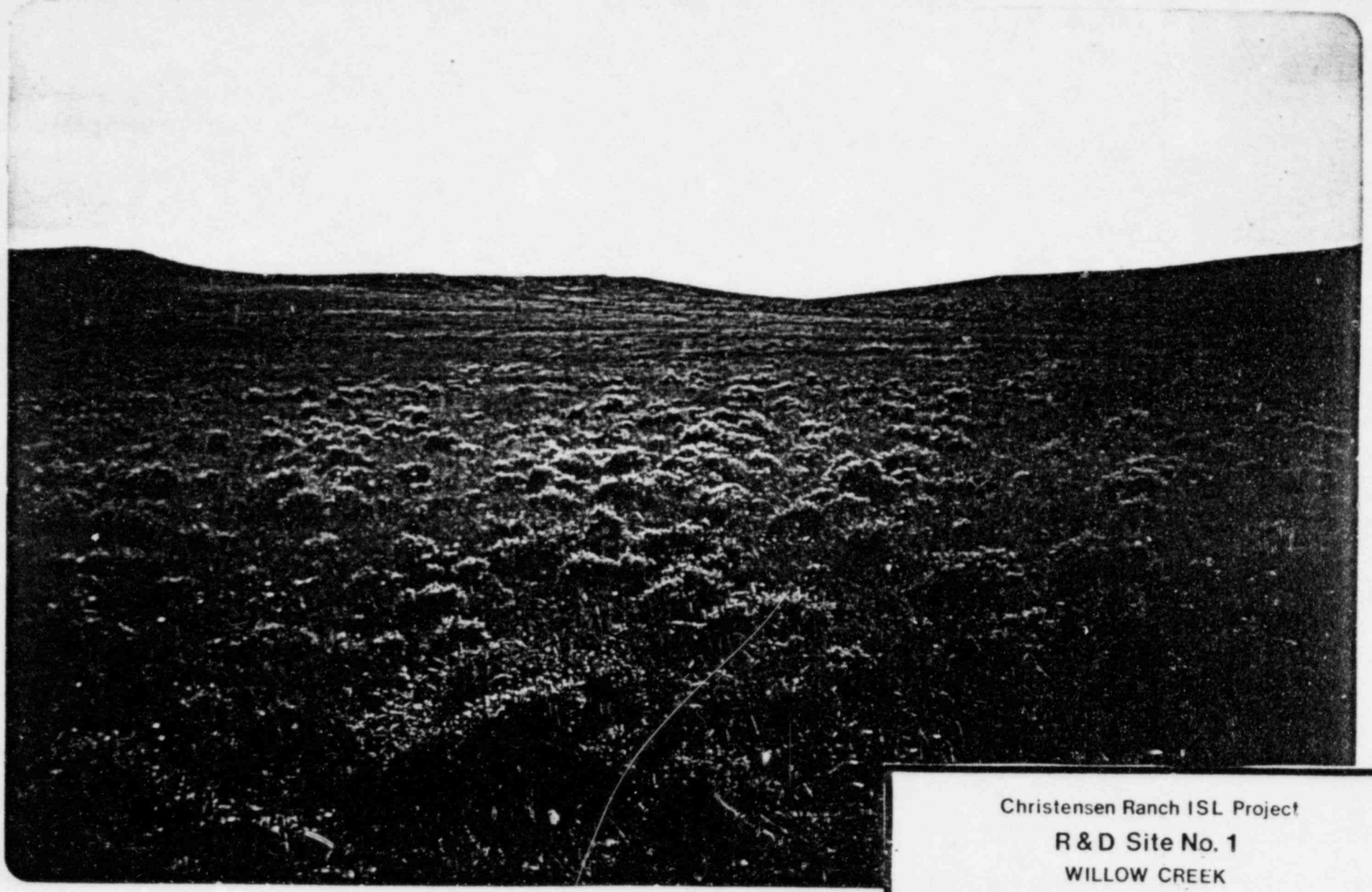

SE 1/4
Sagebrush
Vegetation
Type
S89°08 E - 400.00'
Evaporation
Pond Area
S00°52' W 350.00'
S89°08' W - 380.85'
S89°08' E
200.00'
S56°13' W
219.72'
W.C. - S 00°00° 52' W - 10.00
N00°52' E 750.00'
Willow Creek
Permit Area
Plant
Area
Wellfield
Area
S00°52' W 400.00'
S89°08' W - 600.00'
Grassland
Vegetation
Type
NE 1/4
4825
4850
4775
4825
North
50
200
0
100
400
Scale
1" Equals 200'
D-8-3
Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK
VEGETATION
MAP D-8
WESTERN NUCLEAR, INC.

TABLE D-8-1

PLANT SPECIES OBSERVED ON WILLOW CREEK SITE

Scientific Name	Common Name
(Grasses/Grass-Like)	
Agropyron smithii	western wheatgrass
Agropyron sp.	wheatgrass
Agropyron spicatum	bluebunch wheatgrass
Bouteloua gracilis	blue grama
Bromus japonicus	Japanese brome
Bromus tectorum	cheatgrass brome
Carex filifolia	threadleaf sedge
Koeleria cristata	prairie junegrass
Poa sandbergii	Sandberg bluegrass
Stipa comata	needle-and-thread
Stipa sp.	needlegrass
(Forbs)	
Achillea millefolium	western yarrow
Allium sp.	wild onion
Alyssum alyssoides	pale alyssum
Antennaria sp.	pussytoes
Arenaria sp.	sandwort
Descurainia pinnata	pinnate tansymustard
Erigeron sp.	fleabane
Haplopappus nuttallii	goldenweed
Lomatium sp.	desert parsley
Lupinus sp.	lupine
Penstemon sp.	beardtongue
Phacelia sp.	phacelia
Phlox hoodii	Hood's phlox
Psoralea tenuiflora	slimflower scurf-pea
Salsola kali	Russian thistle
Spaeralcea coccinea	scarlet globemallow
Vicia sp.	vetch
(Shrubs)	
Artemisia frigida	fringed sagebrush
Artemisia tridentata	big sagebrush
Ceratoides lanata	winterfat
Gutierrezia sarothrae	broom snakeweed
Opuntia sp.	pricklypear cactus



D-8-5

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

PLATE D-8A

WESTERN NUCLEAR, INC.

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

PLATE D-8B

WESTERN NUCLEAR, INC.

APPENDIX D-9

WILDLIFE

Wildlife habitats on the proposed Willow Creek ISL R&D permit area were examined during a field reconnaissance in June 1982. As described in the vegetation section, Appendix D-8, two vegetation/wildlife habitat types occur on the 8.7-acre site. The majority of the permit area exhibits a gently sloping grassland type; sagebrush occurs in greater densities adjacent to a steep-sided intermittent drainage to Willow Creek along the eastern boundary of the permit area. A small portion of this drainage is included in the site (Map D-8). Photographs D-8A and D-8B depict these habitats. This climax ecosystem supports a limited diversity and low density of plant species. There are no aquatic habitats present.

Wildlife species occurring on and adjacent to the permit area are typical of the Powder River Basin. Pronghorn were observed during reconnaissance and are the predominant big game animal in the area. Mule deer were also seen in the site vicinity though they tend to favor stream bottoms and drainages more so than do pronghorn which use upland habitats such as those that characterize the permit area. Wyoming Game and Fish Department has classified the area as winter/yearlong habitat for both species.

Other characteristic mammals include the coyote, red fox, and badger, the area's predominant medium-sized mammalian predators. Long-tailed weasels are an important small carnivore. Jackrabbits, both white-tailed and black-tailed, and the desert cottontail are important herbivores and prey species. Jackrabbit sign was observed in several locations in the permit area and a cottontail was seen in the upper end of the intermittent drainage. A least chipmunk was also observed. Other common small mammals in the area are the deer mouse, thirteen-lined ground squirrel, and the northern grasshopper mouse.

The sage grouse is the most important gamebird expected to use the site. Sage grouse sign was observed during reconnaissance. The mourning dove, another game species, was seen there.

Area raptors include the great horned owl, red-tailed hawk, and golden eagle; none of which were observed on or over the permit area.

Golden eagles were seen soaring in the general project vicinity. Other raptor species may also use the area. There are no known raptor nests within 2 miles of the permit area. Scattered cottonwood trees in Willow Creek bottom less than one-half mile away may offer some raptor nesting habitat; no nests were observed.

Songbirds noted during reconnaissance were western meadowlark, horned lark, western kingbird, and vesper sparrow.

Tables D-9-1, D-9-2, and D-9-3 contain listings of mammals, birds, reptiles, and amphibians (both observed and hypothetical) found in the Pumpkin Buttes Regional Study Area. These observations encompassed approximately 500 square miles in southwestern Campbell County and southeastern Johnson County, Wyoming, and were adapted from "Collection and Analysis of Background Data on the Terrestrial and Aquatic Wildlife of the Pumpkin Buttes Project, Northeastern Wyoming" as cited in Cleveland Cliffs Iron Company's In-Situ Mining Application submitted to the Wyoming Department of Environmental Quality, 1979. The Willow Creek site is within the larger regional study area.

Rare, Threatened, or Endangered Species or Golden Eagles

There are no known records of rare, threatened, or endangered species, or golden eagle nesting within one-half mile of the permit area. A small black-tailed prairie dog colony was identified during a 1980 field study by Environmental Research & Technology, Inc. personnel approximately 0.6 mile west of the proposed site, and investigations at that time failed to reveal any potential sign of black-footed ferret occurrence. There is no suitable habitat for peregrine falcons or bald eagles though both species may potentially pass through the area during migration. Both of these species depend on aquatic habitats for feeding (fish, waterfowl), therefore, the permit area is not important habitat for either species. Golden eagles and prairie falcons are both known to nest in the project vicinity on Pumpkin Butte approximately 3 miles ENE of the permit area.

TABLE D-9-1

PUMPKIN BUTTES REGIONAL MAMMALIAN SPECIES LIST AND CLASSIFICATION; OBSERVED AND HYPOTHETICAL[1]

Common Name	Genus species	Observed On The Regional Study Site
Masked Shrew	Sorex cinereus	
Vagrant Shrew	Sorex vagrans	
Water Shrew	Sorex palustris	
Merriam's Shrew	Sorex merriami	
Little Brown Myotis	Myotis lucifugus	
Keens Myotis	Myotis keenii	
Long-eared Myotis	Myotis evotis	
Long-legged Myotis	Myotis volans	
Small-footed Myotis	Myotis leibii	
Silver-haired Bat	Lasionyteris noctivagans	
Big Brown Bat	Eptesicus fuscus	
Red Bat	Lasiurus borealis	
Hoary Bat	Lasiurus cinereus	
Townsend's Big-eared Bat	Plecotus townsendii	
Spotted Bat	Euderma maculatum	
Nuttall's Cottontail	Sylvilagus nuttallii	
Desert Cottontail	Sylvilagus audubonii	X
White-tailed Jackrabbit	Lepus townsendii	X
Black-tailed Jackrabbit	Lepus californicus	X
Least Chipmunk	Eutamias minimus	X
Thirteen-lined Ground Squirrel	Spermophilus tridecemlineatus	X
Black-tailed Prairie Dog	Cynomys ludovicianus	X
Northern Flying Squirrel	Glaucomys sabrinus	
Northern Pocket Gopher	Thomomys talpoides	
Olive-backed Pocket Mouse	Perognathus fasciatus	X
Silky Pocket Mouse	Perognathus flavus	
Hispid Pocket Mouse	Perognathus hispidus	
Ords Kangaroo Rat	Dipodomys ordii	X

TABLE D-9-1 (CONTINUED)

Common Name	Genus species	Observed On The Regional Study Site
Plains Harvest Mouse	Reithrodontomys montanus	
Western Harvest Mouse	Reithrodontomys megalotis	X
Deer Mouse	Peromyscus maniculatus	X
Northern Grasshopper Mouse	Onychomys leucogaster	X
Bushy-tailed Woodrat	Neotoma cinerea	
Meadow Vole	Microtus pennsylvanicus	
Long-tailed Vole	Microtus longicaudus	
Prairie Vole	Microtus ochrogaster	
Sagebrush Vole	Lagurus curtatus	X
Muskrat	Ondatra zibethicus	
Western Jumping Mouse	Zapus princeps	
Porcupine	Erethizon dorsatum	X
Coyote	Canis latrans	X
Red Fox	Vulpes vulpes	X
Swift Fox	Vulpes velox	
Gray Fox	Urocyon cinereoargenteus	
Raccoon	Procyon lotor	X
Ermine	Mustela erminea	
Long-tailed Weasel	Mustela frenata	
Black-footed Ferret	Mustela nigripes	
Mink	Mustela vison	
Badger	Taxidea taxus	X
Eastern Spotted Skunk	Spilogale putorius	
Striped Skunk	Mephitis mephitis	X
Mountain Lion	Felis concolor	X
Bobcat	Lynx rufus	X
American Elk	Cervus elaphus	
Mule Deer	Odocoileus hemionus	X

TABLE D-9-1(CONTINUED)

Common Name	Genus species	Observed On The Regional Study Site
White-tailed Deer	Odocoileus virginianus	
Pronghorn	Antilocapra americana	X

[1]Adapted from the Technical Report, "Collection and Analysis of Background Data on the Terrestrial and Aquatic Wildlife of the Pumpkin Buttes Project, Northeastern Wyoming," as cited in Cleveland Cliffs Iron Company's In-Situ Mining Application submitted to Wyoming Department of Environmental Quality, 1979.

TABLE D-9-2

PUMPKIN BUTTES REGIONAL AVIAN SPECIES
OBSERVED AND HYPOTHETICAL[1]

Common Name	Genus species	Observed On Regional Study Area	Not Observed But May Nest On Study Area
Horned Grebe	Podiceps auritus		
Eared Grebe	Podiceps caspicus		
Western Grebe	Aechmophorus occidentalis		
Pied-billed Grebe	Podilymbus podiceps	X	
Great Blue Heron	Ardea herodias		
Canada Goose	Branta canadensis		
Mallard	Anas platyrhynchos	X	
Gadwall	Anas strepera	X	
Pintail	Anas acuta	X	
Green-winged Teal	Anas crecca	X	
Blue-winged Teal	Anas discors	X	
Cinnamon Teal	Anas cyanoptera		
American Widgeon	Anas americana	X	
Northern Shoveler	Anas clypeata	X	
Redhead	Aythya americana	X	
Ring-necked Duck	Aythya collaris		
Canvasback	Aythya valisineria		
Lesser Scaup	Aythya affinis		
Common Goldeneye	Bucephala clangula		
Bufflehead	Bucephala albeola		
Ruddy Duck	Oxyura jamaicensis		
Turkey Vulture	Cathartes aura		X
Goshawk	Accipiter gentilis		
Sharp-shinned Hawk	Accipiter striatus		
Cooper's Hawk	Accipiter cooperii	X	
Red-tailed Hawk	Buteo jamaicensis	X	
Swainson's Hawk	Buteo swainsoni	X	
Rough-legged Hawk	Buteo lagopus	X	
Ferruginous Hawk	Buteo regalis	X	
Golden Eagle	Aquila chrysaetos	X	
Bald Eagle	Haliaeetus leucocephalus	X	
Marsh Hawk	Circus cyaneus	X	
Prairie Falcon	Falco mexicanus	X	
Merlin	Falco columbarius	X	
American Kestrel	Falco sparverius	X	
Sharp-tailed Grouse	Pedioecetes phasianellus		
Sage Grouse	Centrocercus urophasianus	X	
Gray Partridge	Perdix perdix	X	

TABLE D-9-2 (CONTINUED)

Common Name	Genus species	Observed On Regional Study Area	Not Observed But May Nest On Study Area
Sora	Porzana carolina	X	
American Coot	Fulica americana	X	
Semipalmated Plover	Charadruis semipalmatus		
Killdeer	Charadrius vociferus	X	
Mountain Plover	Eupoda montana		X
Common Snipe	Capella gallinago		X
Upland Sandpiper	Bartramia longicauda		X
Spotted Sandpiper	Actitis mascularia	X	
Solitary Sandpiper	Tringa solitaria	X	
Willet	Catoptrophorus semipalmatus		
Greater Yellowlegs	Tringa melanoleucus		
Lesser Yellowlegs	Tringa flavipes		
Pectoral Sandpiper	Erolia melanotos		
Baird's Sandpiper	Calidris bairdii		
Least Sandpiper	Calidris minutilla		
Long-billed Dowitcher	Limnodromus scolopaceus		
Semipalmated Sandpiper	Calidris pusillus		
Buff-breasted Sandpiper	Tryngites subruficollis		
Marbled Godwit	Limosa fedoa		
American Avocet	Recurvirostra americana		
Wilson's Phalarope	Steganopus tricolor		
Northern Phalarope	Lobipes lobatus		
Rock Dove	Columba livia		X
Mourning Dove	Zenaida macroura	X	
Great-horned Owl	Bubo virginianus	X	
Burrowing Owl	Athene cunicularia		X
Short-eared Owl	Asio flammeus		X
Poor-will	Phalaenoptilus nuttallii	X	
Common Nighthawk	Chordeiles minor	X	
Belted Kingfisher	Megaceryle alcyon	X	
Common Flicker	Colaptes auratus	X	
Red-headed Woodpecker	Melanerpes erythrocephalus	X	
Hairy Woodpecker	Picoides villosus		
Downy Woodpecker	Picoides pubescens	X	
Eastern Kingbird	Tyrannus tyrannus	X	
Western Kingbird	Tyrannus verticalis	X	
Cassin's Kingbird	Tyrannus vociferans	X	
Say's Phoebe	Sayornis saya	X	
Willow Flycatcher	Empidonax traillii		
Least Flycatcher	Empidonax minimus		

TABLE D-9-2 (CONTINUED)

Common Name	Genus species	Observed On Regional Study Area	Not Observed But May Nest On Study Area
Dusky Flycatcher	Empidonax oberholseri		
Western Flycatcher	Empidonax difficilis		
Western Pewee	Contopus sordidulus	X	
Olive-sided Flycatcher	Nuttallornis borealis		
Horned Lark	Eremophila alpestris	X	
Violet-green Swallow	Tachycineta thalassina		
Tree Swallow	Irodoprocne bicolor		
Bank Swallow	Riparia riparia	X	
Rough-winged Swallow	Stelgidopteryx ruficollis		
Barn Swallow	Hirundo rustica	X	
Cliff Swallow	Petrochelidon pyrrhonota	X	
Black-billed Magpie	Pica pica		X
Common Crow	Corvus brachyrhynchos	X	
Pinon Jay	Gymnorhinus cyanocephalus	X	
Black-capped Chickadee	Parus atricapillus		
Mountain Chickadee	Parus gambeli		
White-breasted Nuthatch	Sitta carolinensis		
Red-breasted Nuthatch	Sitta canadensis	X	
Brown Creeper	Certhia familiaris	X	
House Wren	Troglodytes aedon	X	
Rock Wren	Salpinctes obsoletus	X	
Northern Mockingbird	Mimus polyglottos	X	
Gray Catbird	Dumetella carolinensis		
Brown Thrasher	Toxostoma rufum	X	
Sage Thrasher	Oreoscoptes montanus		X
American Robin	Turdusk migratorius	X	
Hermit Thrush	Cartharus guttatus		
Swainson's Thrush	Cartharus ustulatus		
Veery	Cartharus fuscescens		
Mountain Bluebird	Sialia currucoides	X	
Townsend's Solitaire	Myadestes townsendi	X	
Ruby-crowned Kinglet	Regulus calendula		
Water Pipit	Anthus spinoletta	X	
Sprague's Pipit	Anthus spragueii		
Bohemian Waxwing	Bombycilla garrulus	X	
Cedar Waxwing	Bombycilla cedrorum		
Northern Shrike	Lanius excubitor	X	
Loggerhead Shrike	Lanius ludovicianus	X	
European Starling	Sturnus vulgaris	X	
Solitary Vireo	Vireo solitarius		

TABLE D-9-2 CONTINUED)

Common Name	Genus species	Observed On Regional Study Area	Not Observed But May Nest On Study Area
Red-eyed Vireo	Vireo olivaceus		
Warbling Vireo	Vireo gilvus	X	
Orange-crowned Warbler	Vermivora celata	X	
Yellow Warbler	Dendroica petechia	X	
Yellow-rumped Warbler	Dendroica coronata		
Ovenbird	Seiurus aurocapillus		
MacGillivray's Warbler	Oporornis tolmiei	X	
Common Yellowthroat	Geothlypis trichas		X
Yellow-breasted Chat	Icteria virens		
Wilson's Warbler	Wilsonia pusilla	X	
American Redstart	Setophaga ruticilla	X	
House Sparrow	Passer domesticus	X	
Bobolink	Dolichonyx oryzivorus		X
Western Meadowlark	Sturnella neglecta	X	
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	X	
Red-winged Blackbird	Agelaius phoeniceus	X	
Northern Oriole	Icterus galbula	X	
Brewer's Blackbird	Euphagus cyanocephalus	X	
Common Grackle	Quiscalus quiscula		X
Brown-headed Cowbird	Molothrus ater		X
Western Tanager	Piranga ludoviciana		
Black-headed Grosbeak	Pheucticus melanocephalus		
Lazuli Bunting	Passerina amoena	X	
Dickcissel	Spiza americana		X
House Finch	Carpodacus mexicanus		
Pine Siskin	Carduelis pinus	X	
American Goldfinch	Carduelis tristis	X	
Green-tailed Towhee	Chlorura chlorurus		
Rufous-sided Towhee	Pipilo erythrophthalmus		
Lark Bunting	Calamospiza melanocorys	X	
Savannah Sparrow	Passerculus sanwichensis	X	
Grasshopper Sparrow	Ammodramus savannarum	X	
Baird's Sparrow	Ammodramus bairdii		
Vesper Sparrow	Pooecetes gramineus	X	
Lark Sparrow	Chondestes grammacus	X	
Dark-eyed Junco	Junco hyemalis	X	
Tree Sparrow	Spizella arborea	X	
Chipping Sparrow	Spizella passerina	X	
Clay-colored Sparrow	Spizella pallida		X
Brewer's Sparrow	Spizella breweri	X	

TABLE D-9-2 (CONTINUED)

Common Name	Genus species	Observed On Regional Study Area	Not Observed But May Nest On Study Area
White-crowned Sparrow	Zonotrichia leucophrys		
Fox Sparrow	Passerella iliaca		
Lincoln's Sparrow	Melosphiza lincolnii		
Song Sparrow	Melospiza melodia		
McCown's Longspur	Rhynchophanes mccownii	X	
Lapland Longspur	Calcarius lapponicus	X	
Chestnut-collared Longspur	Calcarius ornatus		
Snow Bunting	Plectrophenax nivalis	X	

[1]Adapted from the Technical Report, "Collection and Analysis of Background Data on the Terrestrial and Aquatic Wildlife of the Pumpkin Buttes Project, Northeastern Wyoming," as cited in Cleveland Cliffs Iron Company's In-Situ Mining Application submitted to the Wyoming Department of Environmental Quality, 1979.

TABLE D-9-3

PUMPKIN BUTTES REGIONAL REPTILIAN AND AMPHIBIAN SPECIES LIST AND CLASSIFICATIONS OBSERVED AND HYPOTHETICAL[1]

Common Name	Genus species	Observed On The Regional Study Site
Snapping Turtle	Chelydra serpentina	
Western Painted Turtle	Chrysemys picta	
Western Spiny Softshell Turtle	Trionyx spiniferus	
Eastern Short-horned Lizard	Phrynosoma douglassi	X
Sagebrush Lizard	Sceloporus graciosus	X
Eastern Yellow-bellied Racer	Coluber constrictor	X
Plains Hognose Snake	Heterodon nasicus	
Milk Snake	Lampropeltis triangulum	
Gopher Snake	Pituophis melanoleucas	X
Western Garter Snake	Thamnophis elegans	X
Plains Garter Snake	Thamnophis radix	
Common Garter Snake	Thamnophis sirtalis	
Prairie Rattlesnake	Crotalus viridis	X
Tiger Salamander	Ambystoma tigrinum	X
Plains Spadefoot Toad	Scaphiopus bombifrons	
Great Plains Toad[2]	Bufo cognatus	X
Woodhouse's Toad	Bufo woodhousii	
Boreal Chorus Frog	Pseudacris triseriata	X
Leopard Frog	Rana pipiens	X

[1]Adapted from the Technical Report, "Collection and Analysis of Background Data on the Terrestrial and Aquatic Wildlife of the Pumpkin Buttes Project, Northeastern Wyoming," as cited in Cleveland Cliffs Iron Company's In-Situ Mining Application submitted to Wyoming Department of Environmental Quality, 1979.

[2]A juvenile toad of the genus Bufo was collected but not identified to species.

APPENDIX D-10

BASELINE RADIOLOGICAL ASSESSMENT, PROPOSED IN SITU R&D SITE #1

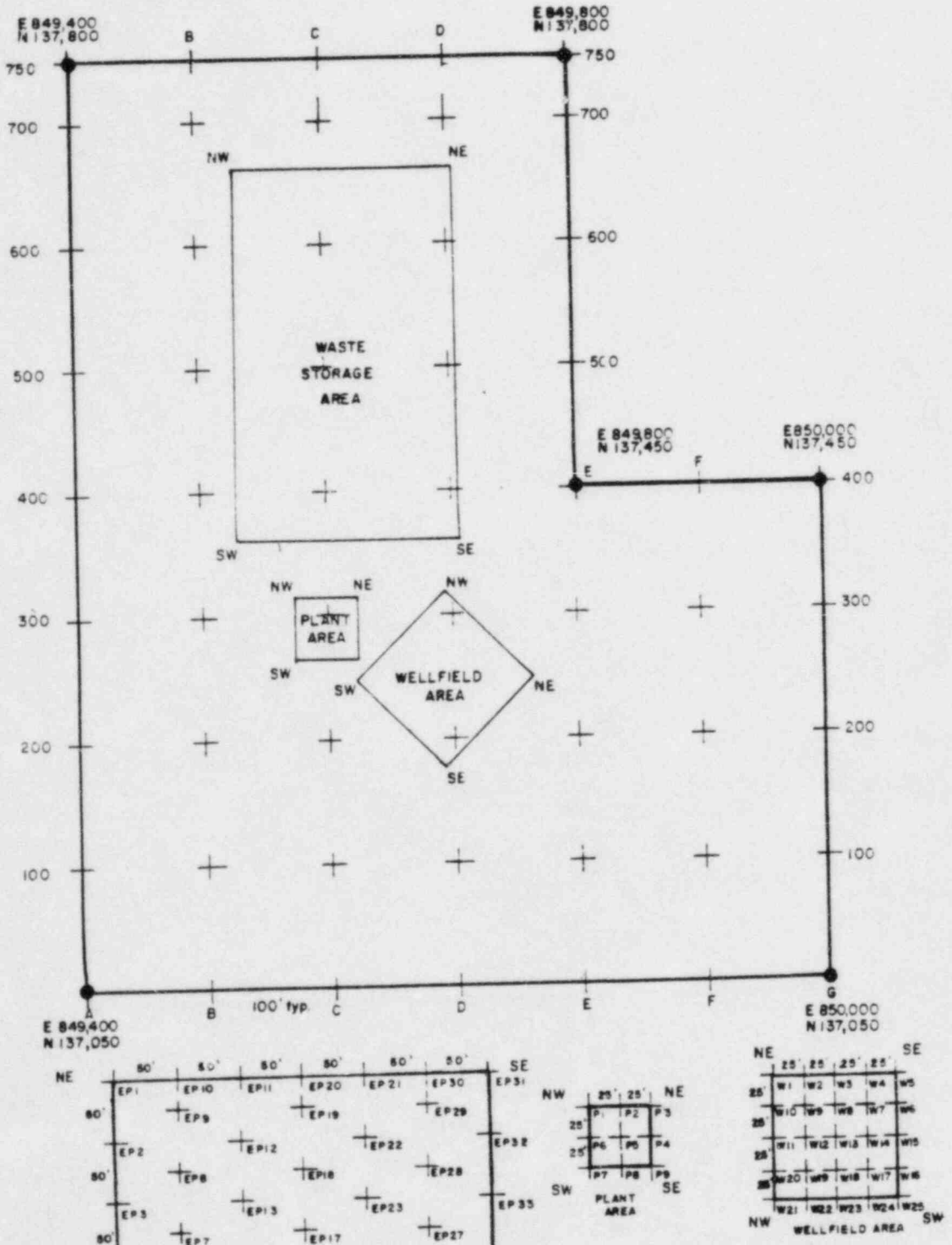
On June 13, 1982, an exposure rate survey of the Christensen Ranch proposed in situ R&D #1 Site, Willow Creek, was conducted. The survey meter used was a PRM-7 Scintillation Survey Meter. The instrument was cross-calibrated against a pressurized ion chamber (PIC) at Colorado State University on May 11, 1982. The PIC was calibrated against an NBS radium-226 source. The PRM-7 was calibrated at exposure rates comparable to background environmental exposure rates. (Details of the cross-calibration procedure are on file at Colorado State University, Fort Collins, Colorado 80523).

Throughout the entire R&D site, a grid system was established with measurement points designated at approximately 100-foot intervals. More detailed surveys were conducted in the areas of the evaporation ponds, the plant, and the wellfield. In the evaporation pond area, measurement points were designated at 50-foot intervals, whereas in both the plant and the wellfield areas, measurement points were designated at 25-foot intervals. Figure D-10-1 shows the survey grid array.

The exposure rate was recorded at each measurement point at approximately one meter above the ground surface. Table D-10-1 lists the measured exposure rate for the site. All values are given in μR/hr.

Table D-10-2 lists the arithmetic means and standard deviations from each area for all measurement points. These values were calculated assuming the distribution of observed values would follow a normal distribution. Since environmental data are often observed to follow a log-normal frequency distribution, corresponding geometric means and geometric standard deviations were evaluated for each data set as well. However, since the arithmetic mean and geometric mean values were almost identical for all areas, it was assumed normal distribution statistics were adequate to describe the premining conditions of the in situ area.

On June 17, 1982, a series of 20 measurements were taken over a period of 20 minutes at a fixed location with the PRM-7 instrument. The coefficient of variation of the readings was 5% of the mean value. The variance calculated from this value was subtracted from all observed



Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

NE 1/4, NE 1/4, SEC. 20

FIGURE D-10-1

TABLE D-10-1: Exposure Rate Measurements at Proposed In Situ R & D Site 1, Willow Creek

Measurement Point	$\dot{X}$(μR/hr)	Measurement Point	$\dot{X}$(μR/hr)	Measurement Point	$\dot{X}$(μR/hr)
I. R & D SITE		C_{400}	12	F_0	13
A_0	14	C_{500}	12	F_{100}	14
A_{100}	12	C_{600}	13	F_{200}	12
A_{200}	12	C_{700}	12	F_{300}	12
A_{300}	11	C_{750}	13	F_{400}	12
A_{400}	13	D_0	11	G_0	11
A_{500}	13	D_{100}	12	G_{100}	12
A_{600}	12	D_{200}	13	G_{200}	11
A_{700}	14	D_{300}	11	G_{300}	12
A_{750}	11	D_{400}	13	G_{400}	11
B_0	13	D_{500}	12	II. EVAPORATION PONDS	
B_{100}	13	D_{600}	13	EP_1	13
B_{200}	14	D_{700}	12	EP_2	13
B_{300}	12	D_{750}	12	EP_3	12
B_{400}	13	E_0	12	EP_4	12
B_{500}	14	E_{100}	11	EP_5	12
B_{600}	13	E_{200}	11	EP_6	12
B_{700}	12	E_{300}	11	EP_7	12
B_{750}	14	E_{400}	14	EP_8	13
C_0	12	E_{500}	12	EP_9	12
C_{100}	13	E_{600}	15	EP_{10}	13
C_{200}	12	E_{700}	14	EP_{11}	13
C_{300}	12	E_{750}	15	EP_{12}	13

TABLE D-10-1 (continued)

Measurement Point	$\dot{X}$(μR/hr)	Measurement Point	$\dot{X}$(μR/hr)	Measurement Point	$\dot{X}$(μR/hr)
II. EVAPORATION PONDS (continued)		EP_{35}	13	W_{12}	12
EP_{13}	12	III. PLANT SITE		W_{13}	13
EP_{14}	12	P_1	14	W_{14}	12
EP_{15}	13	P_2	12	W_{15}	13
EP_{16}	13	P_3	12	W_{16}	13
EP_{17}	13	P_4	12	W_{17}	13
EP_{18}	12	P_5	12	W_{18}	13
EP_{19}	12	P_6	12	W_{19}	13
EP_{20}	12	P_7	13	W_{20}	11
EP_{21}	13	P_8	13	W_{21}	12
EP_{22}	12	P_9	13	W_{22}	12
EP_{23}	13	IV. WELLFIELD		W_{23}	13
EP_{24}	15	W_1	11	W_{24}	13
EP_{25}	13	W_2	14	W_{25}	12
EP_{26}	12	W_3	13		
EP_{27}	13	W_4	12		
EP_{28}	13	W_5	12		
EP_{29}	13	W_6	13		
EP_{30}	13	W_7	12		
EP_{31}	12	W_8	12		
EP_{32}	12	W_9	12		
EP_{33}	12	W_{10}	12		
EP_{34}	13	W_{11}	12		

TABLE D-10-2: Analysis of Exposure Rate Data From Proposed In Situ R & D Site 1, Willow Creek

Area	$\bar{X}$ (μR/hr)	σ(μR/hr)	σ_c(μR/hr)[1]
R & D Site	1.2 E(+1)	1.1 E(+0)	8.8 E(-1)
Evaporation Ponds	1.3 E(+1)	6.5 E(-1)	2.2 E(-1)
Plant	1.3 E(+1)	7.3 E(-1)	3.8 E(-1)
Wellfield	1.2 E(+1)	7.1 E(-1)	3.7 E(-1)

$\bar{X}$, σ ≡ arithmetic mean and standard deviation for normal distribution. $\bar{X} \pm \sigma$ will include 68% of values around mean.

[1] σ_c has been corrected to remove instrument variation and σ_c is therefore a measure of the true environmental variation.

variances and, therefore, the arithmetic standard deviations reported are a measure of the true environmental variation.

Vegetation Sampling

Vegetation samples from the evaporation ponds, the plant, and the wellfield areas were collected on June 13, 1982. Results of radium-226 and lead-210 analyses are reported in Table D-10-3.

Soil Sampling

The Nuclear Regulatory Commission requires soil sampling to depths of 0-5 cm and 5-15 cm with analyses for uranium, radium-226, and thorium-230. Because of the small incremental depths to be sampled, soil sampling will be delayed until suitable topsoil materials have been removed during the construction phase prior to production activities. Because the plant area is so small, only one sample will be collected from the plant area, whereas three samples will be collected from the evaporation ponds and two will be collected from the wellfield area.

Conclusions

This report quantifies baseline radiological conditions at the proposed in situ R&D site. Again, soil samples will be collected during construction prior to production.

TABLE D-10-3

VEGETATION[1]
PROPOSED IN SITU R&D
Site 1, Willow Creek

Area	Ra-226 + Precision[2,3] [E-7 µCi/kg(wet)]	Pb-210 + Precision[2,3] [E-6 µCi/kg(wet)]
Recovery Plant	10.1 ± 3.4	2.8 ± 2.6
Wellfield	8.0 ± 3.0	1.6 ± 2.2
Evaporation Ponds	8.4 ± 3.2	2.9 ± 2.6

[1]Samples were collected June 13, 1982.

[2]Precision refers to the estimated total analytical error at 95% confidence level (2σ).

[3]Lower Limits of Detection (LLD) listed below comply with values specified in U.S. NRC Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills" (Revision 1, April 1980):

Ra-226: 5(E-8) µCi/kg(wet)
Pb-210: 1(E-6) µCi/kg(wet)

C. MINERALS EXTRACTION PLAN

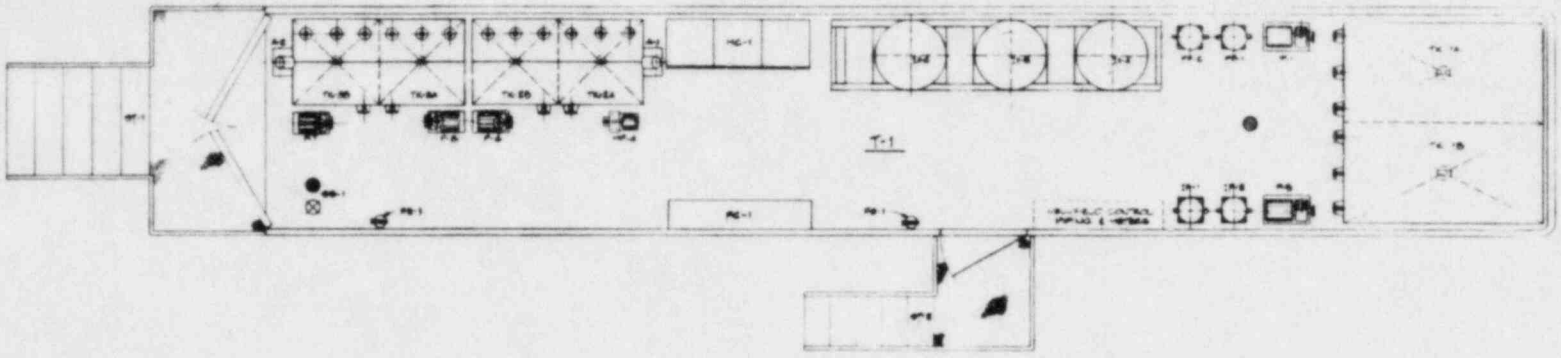
C.1 Introduction

The proposed research and development facility is intended to test the economic and environmental feasibility of applying in-situ leaching (ISL) technology to this orebody. Preliminary laboratory investigations indicate economic headgrades to be attainable and restoration of groundwater to the required levels to be achievable. Leaching kinetics, product quality, and equipment operating performance (i.e., recovery percentage) under field conditions will be investigated. Of particular concern will be the processing requirements and limitations of groundwater restoration.

C.2. General Discussion

Western Nuclear, Inc. proposes to mine the Christensen Ranch uranium orebody using ISL technology. ISL involves the introduction of both an oxidant and a complexing agent into the ore-containing aquifer to effect mobilization of the uranium. Introduction is accomplished using a series of injection wells completed into the ore zone. A series of production wells outfitted with submersible pumps is used to recover the uranium-bearing solution. This solution is then pumped to the processing plant for uranium recovery and chemical reconstitution before being reinjected into the ore zone. Upon depletion of uranium reserves, the affected aquifer will be restored to its original quality using standard water treatment methods.

The research and development facility is designed to be as small as possible to minimize any adverse environmental effects and yet yield useful engineering and performance data. While the general flow sheet, chemistry, and products (by-products, waste streams, etc.) will be very similar to those of a commercial operation, all factors regarding equipment size will vary. Equipment used for in-situ leaching is similar to equipment used in any fluid processing operation. Centrifugal pumps, filters, piping networks, ion exchange columns, and storage tanks comprise the major process equipment. Major process equipment lists appear in Figures C.2-1, C.2-2, and C.2-3.



EQUIPMENT LIST

KEY	DESCRIPTION
A-1	CHEMICAL MAKE-UP AGITATOR
A-2	BARREN ELUANT TANK
FC-1	FAN COIL UNIT #1
FE-1	FIRE EXTINGUISHER
IF-1	INJECTION FILTER #1
IF-2	INJECTION FILTER #2
IX-A	ION EXCHANGE COLUMN A
IX-B	ION EXCHANGE COLUMN B
IX-C	ION EXCHANGE COLUMN C
MC-1	MOTOR CONTROL CENTER SWITCHBOARD
MP-4	METERING PUMP #4
P-1	PRODUCTION PUMP
P-5	INJECTION PUMP
P-6	IX RINSE PUMP
P-7	IX ELUTION PUMP
P-8	SPARE PUMP
PF-1	PRODUCTION FILTER #1
PF-2	PRODUCTION FILTER #2
SM-1	STATIC MIXER #1
SM-2	STATIC MIXER #2
SS-1	SAFETY SHOWER/EYEWASH
ST-1	STAIRWELL #1
ST-2	STAIRWELL #2
T-1	8'W x 45'L INSULATED TRAILER
TK-1A	PRODUCTION SURGE TANK
TK-1B	INJECTION SURGE TANK
TK-2A	SODA ASH MAKE-UP TANK
TK-2B	IX RINSE TANK
TK-3A	BARREN ELUANT TANK
TK-3B	SPARE TANK

Christensen Ranch ISL Project
R & D Site No. 1
WILLOW CREEK

REV NO.	DESCRIPTION	DATE

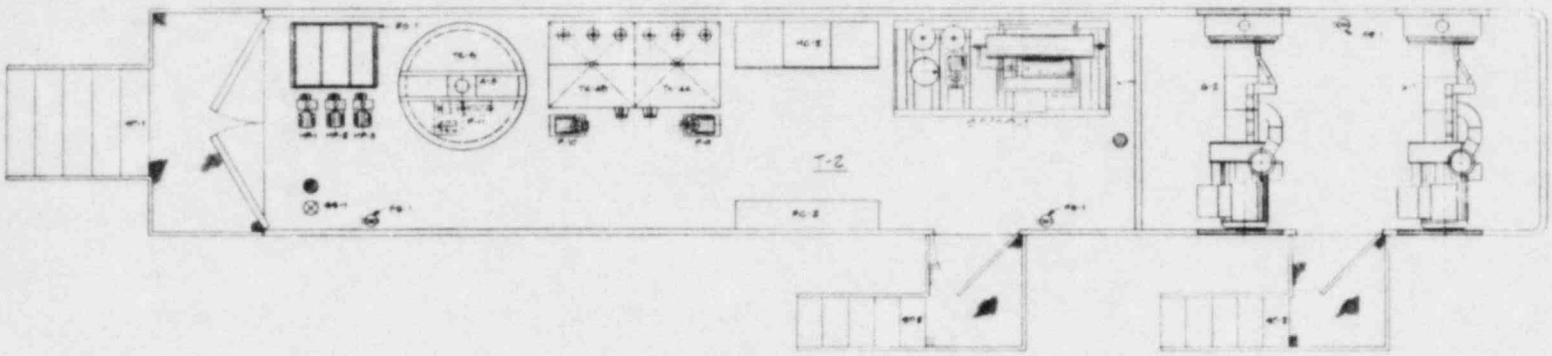
Behrect Engineering Company
DENVER COLO 80211

25 GPM ISL TEST UNIT

RECOVERY / INJECTION TRAILER T-1

FIGURE C.2- 1

C-2



NOTE:

FUEL TANKS TO BE LOCATED OUTSIDE TRAILER CONTAINMENT AREA IN A SEPARATE BERMED CONTAINMENT APEA.

EQUIPMENT LIST

KEY	DESCRIPTION
A-3	PRECIPITATION AGITATOR
FC-2	FAN COIL UNIT #2
FE-1	FIRE EXTINGUISHER
G-1	DIESEL POWERED GENERATOR NO. 1
G-2	DIESEL POWERED GENERATOR NO. 2
MC-2	MOTOR CONTROL CENTER SWITCHBOARD
MP-1	METERING PUMP #1
MP-2	METERING PUMP #2
MP-3	METERING PUMP #3
P-9	LOW PREGNANT TRANSFER PUMP
P-10	HIGH PREGNANT TRANSFER PUMP
P-11	PRECIPITATION TRANSFER PUMP
RO/ED-1	REVERSE OSMOSIS OR ELECTRODIALYSIS UNIT
RS-1	REAGENT STORAGE RACK
SS-1	SAFETY SHOWER/EYEWASH
ST-1	STAIRWELL #1
ST-2	STAIRWELL #2
T-2	8'W x 45'L INSULATED TRAILER
TK-4A	LOW PREGNANT FRP TANK
TK-4B	HIGH PREGNANT FRP TANK
TK-5	PRECIPITATION TANK
TK-6	DIESEL OIL FUEL TANK
TK-7	DIESEL OIL FUEL TANK

Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

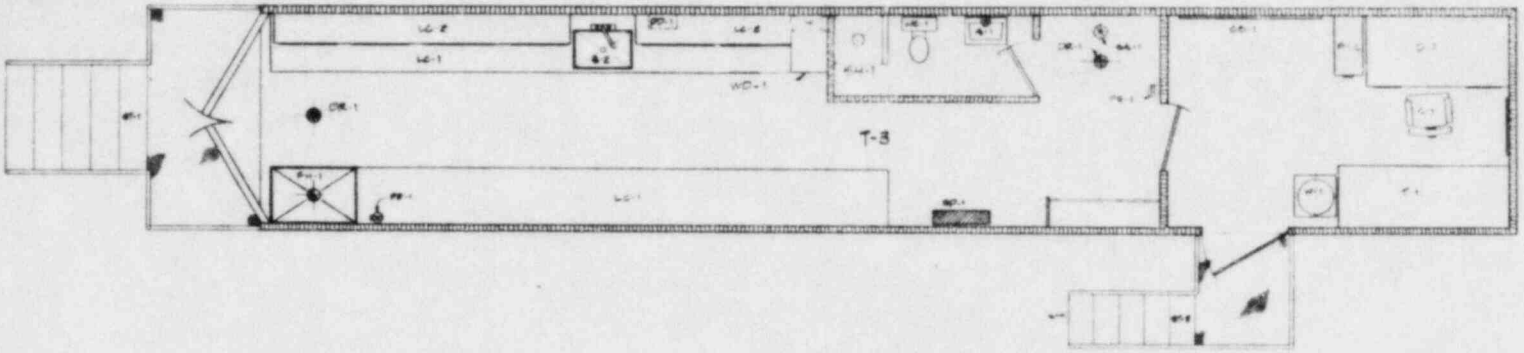
REV. NO.	DESCRIPTION	DATE

Behrent Engineering Company
DENVER COLO 80211

25 GPM ISL TEST UNIT

AUXILARY SUPPORT TRAILER T-2

FIGURE C.2-2



EQUIPMENT LIST

KEY	DESCRIPTION
C-1	CHAIR
CB-1	CHALK BOARD 36" x 60"
D-1	DESK
DR-1	FLOOR DRAIN
EP-1	ELECTRICAL PANEL
FI-C	FILING CABINET
FE-1	FIRE EXTINGUISHER
FH-1	FUME HOOD
LC-1	LABORATORY COUNTER WITH ACID RESISTANT TOP AND STORAGE
LC-2	LABORATORY CABINET
PD-1	PAPER TOWEL DISPENSER
S-1	RESTROOM SINK (IF REQUIRED)
s-2	LABORATORY SINK
SS-1	SAFETY SHOWER/EYEWASH
ST-1	STAIRWELL NO. 1
ST-2	STAIRWELL NO. 2
T-1	REFERENCE TABLE 30" x 72"
T-3	8'W x 45'L INSULATED TRAILER
W-1	WATER COOLER
WC-1	TOILET (IF REQUIRED)
WH-1	WATER HEATER
SH-1	SHOWER STALL
WD-1	CLOTHES WASHER/DRYER UNIT

Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

Bechtel Engineering Company
DENVER, COLO. 80211

25 GPM ISL TEST UNIT

LABORATORY/OFFICE TRAILER T-3

FIGURE C.2-3

The proposed R&D facility is a nominal 25-gpm unit with a wellfield based on a standard 5-spot pattern on 25-foot centers. Preliminary laboratory investigations indicate that as many as 40 pore volume displacements (PVDs) may be required to achieve 70% extraction, while restoration may require 15 PVDs. As will be shown below under Facilities Description, this may require up to 126 days to complete the extraction/restoration cycle. This extraction/restoration cycle would allow operations to be performed during the warmer periods of the year and would avoid the potential complications associated with winter operations.

A general schedule of activities is presented in Figure C.2-4. Site preparation, leaching, and restoration will occur during the last three quarters of 1984. Reclamation of the ponds and the immediately adjacent area would not occur for approximately one and one-half years following the restoration demonstration to allow for evaporation of most of the liquid wastes. The remaining sludge would then be trucked to WNI's Split Rock Mill facility for disposal. Site reclamation would then be completed.

Specific investigations will include both uranium response as a function of various operating conditions (oxidant concentration, carbonate concentration, etc.) and a technical/economic evaluation of reverse osmosis or electrodialysis as a means of water treatment for restoration. A more detailed description of the proposed research appears in Section E.

No oil and gas production occurs in the immediate vicinity of the R&D location. Some production does occur further from the site and occurs from much deeper formations. The R&D operation will have no effect on this production. No other mineral production occurs in the general area.

C.2.a Facilities Description

C.2.a.1 Processing Facility.

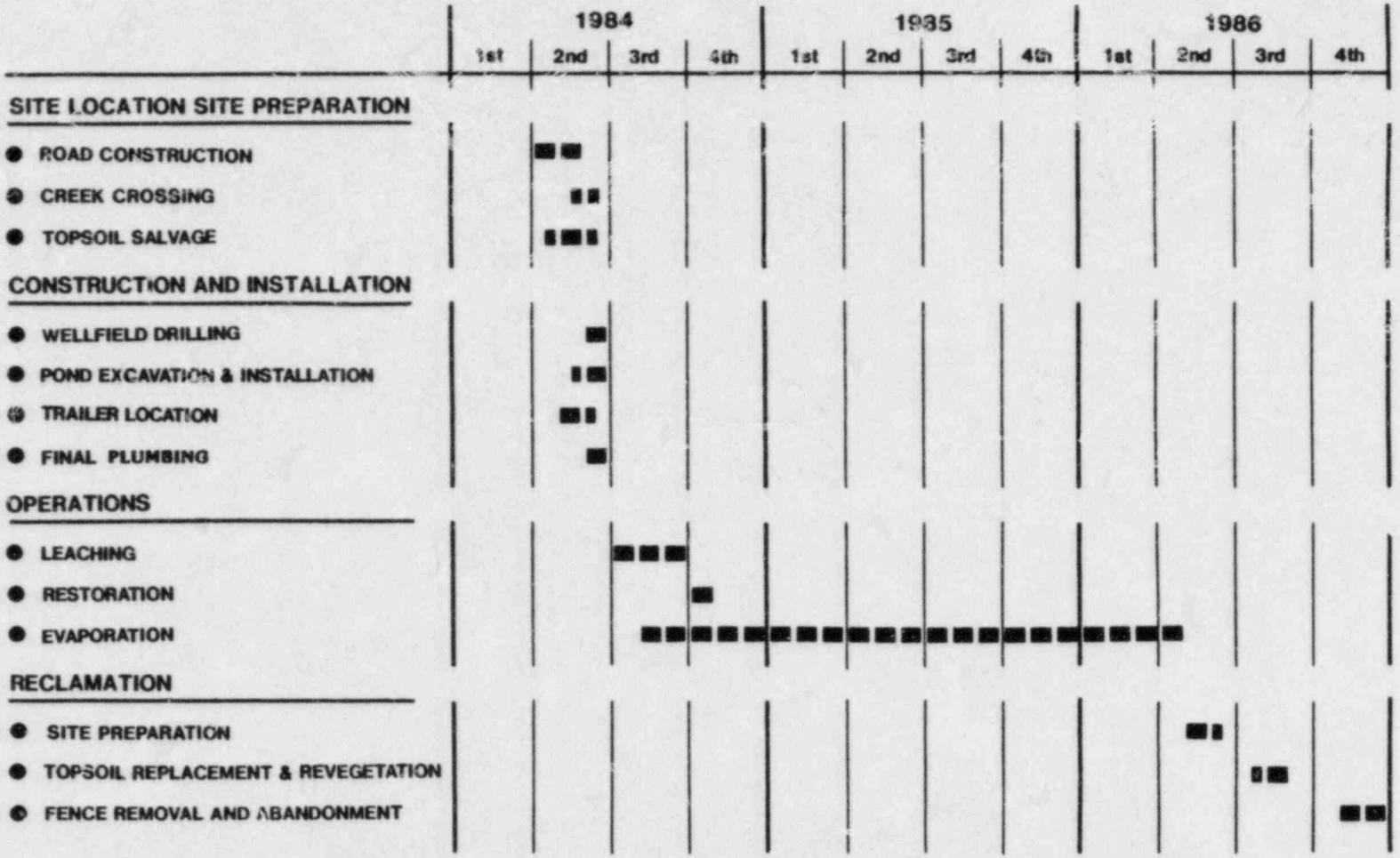
1. Physical Description and Operating Characteristics. The 25 gpm uranium in-situ leach pilot plant consists of three truck trailers with spillage containment system, all associated process equipment and piping, power generation system, reagent bulk storage systems, and flow-controlled

FIGURE C.2- 4

CHRISTENSEN RANCH ISL PROJECT

R&D SITE NO. 1 WILLOW CREEK

PROJECT SCHEDULE



wellfield equipment. All equipment associated with the pilot plant will be installed with compliance to all Federal, State, and local codes and regulations.

All three trailers will be van type with nominal dimensions of 45 feet long x 8 feet wide x 8 feet 6 inches high. These trailers consist of:

T-1 Recovery/Injection Trailer,

T-2 Auxiliary Support Trailer, and

T-3 Laboratory/Office Trailer.

Each trailer will be insulated and includes stairways and platforms as shown on the trailer drawings (Figures C.2-1, C.2-2, and C.2-3). All stairways and platforms will have steel frames and "grip strut" type grating with OSHA-approved handrails.

The Recovery/Injection Trailer consists of all equipment associated with processing and handling barren and pregnant leachate, including an ion exchange uranium recovery unit. All leachate transfer between the wellfield and the pilot plant will be routed through this trailer. This trailer is also equipped with a motor control center switchboard, fan coil unit heater, two OSHA-approved fire extinguishers, and a safety shower/eyewash station. The Ion Exchange Unit is skid mounted, complete with three downflow fixed bed columns, all associated piping, instrumentation, and ion exchange resin. A major equipment list (excluding instrumentation and piping) and scaled equipment layout is provided in Figure C.2-1.

The Auxiliary Support Trailer consists of all equipment associated with uranium recovery, reverse osmosis or electrodialysis unit (used for wellfield restoration), and the power generation system. The uranium recovery system includes a chemical precipitation tank with rake mechanism, three reagent storage day tanks, two pregnant eluant tanks, and all related transfer pumps. The restoration equipment will include a reverse osmosis or electrodialysis unit, chemical pretreatment equipment, and a feed pump. The power generation system consists of two diesel-driven generators which are separated from all other equipment in the trailer by a sound and fire resistant wall. Under normal operating conditions, the generators included in this trailer are sized for handling all equipment associated with all three trailers with one generator used as a standby power source. During parallel leaching and restoration

operations, both generators could be operating continuously. This trailer is also equipped with a motor control center switchboard, fan coil heater, three OSHA-approved fire extinguishers (including one in the generator room), and a safety shower/eyewash station. Two 500-gallon diesel fuel storage tanks mounted on a steel support frame will be located in a spillage containment area separate from the trailer containment area. A major equipment list (excluding all instrumentation and piping) and scaled equipment layout is provided in Figure C.2-2.

The Laboratory/Office Trailer consists of a research and development laboratory and office. The laboratory includes 82 square feet counterspace with acid resistant countertop, 40 square feet cabinet space, water heater, and floor drain. The office is separated from the rest of the trailer with a private entrance. This trailer is also equipped with two OSHA-approved fire extinguishers, safety shower, fan coil heater, eyewash station, and two floor drains. A major equipment list and scaled equipment layout is provided in Figure C.2-3.

All equipment selected for the pilot plant was designed for manual control. The process equipment materials of construction will be compatible with the chemistry associated with sodium carbonate leaching, gaseous oxygen injection, and hydrogen peroxide precipitation. The process equipment associated with this pilot plant will be designed to handle a 25-gpm production and injection flowrate. Unless otherwise noted, all chemical process piping inside each trailer will be PVC. All trailer interconnecting piping will be flexible type chemical duty hose with "Kamlok" type quick disconnect couplings. All on-off valves will be PVC ball-type or coated gate valves. The general transfer pumps will be ANSI chemical duty centrifugal pumps with carbon steel body and stainless steel impeller. The metering pumps will be diaphragm type with manual stroke adjustment. All flow instrumentation will include turbine type flowmeters with local indicators and totalizers. All process tankage will be heavy duty fiberglass construction.

The bulk storage systems include the oxygen reagent storage and vaporization system, carbon dioxide reagent storage and vaporization system and diesel fuel storage. The diesel fuel storage tanks shall be installed in a bermed area providing total tank volume containment. These chemical storage systems will be located outside the spillage

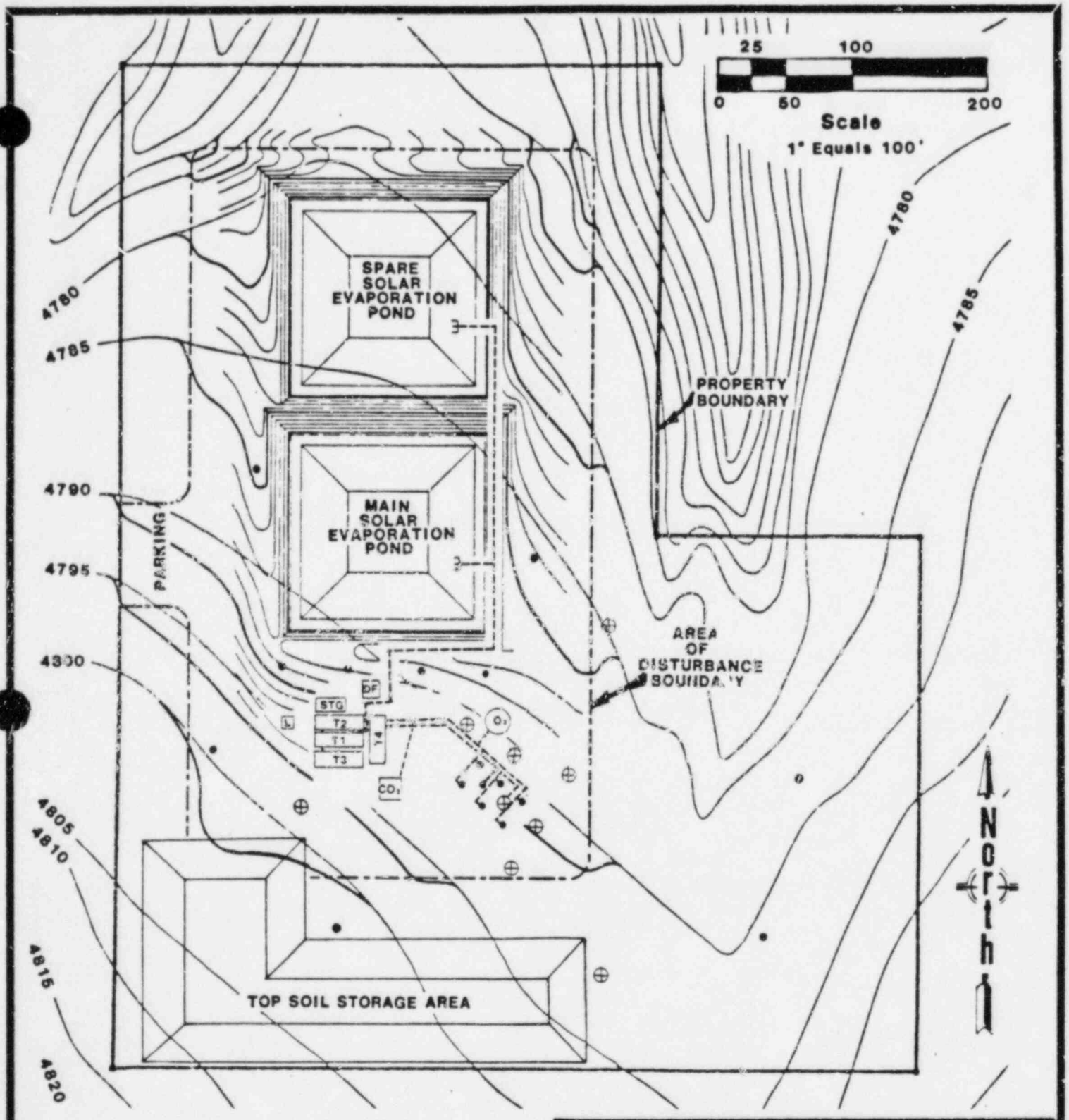
containment area and comply with appropriate Federal, State, and local codes and regulations. These storage systems will be used on a rental basis. A fourth trailer will be used as a dry chemical storage area and a general warehouse. For location of the storage systems, see Figure C.2-5.

All wellfield equipment will include downhole submersible pumps, flow control instrumentation, and associated piping required to deliver a minimum of 25 gpm of pregnant leachate to the Recovery/ Injection Trailer.

2. Trailer Ventilation System. The Recovery/Injection Trailer and the Auxiliary Support Trailer (T-1 and T-2) shall be provided with both positive tankage ventilation and fresh air ventilation systems. The Lab/Office Trailer (T-3) shall be provided with a fresh air ventilation system only.

The positive tankage ventilation shall provide control, containment, and discharge of any fumes, airborne particulates, and gases (particularly radon emission) related to the operation of the pilot plant. All atmospheric process tankage shall be provided with complete secured covers. A 2-inch inlet and outlet shall be located on each tank cover or top. A central sealed system of galvanized ductwork shall be installed with connections to each tank inlet and outlet. Each tank outlet shall be equipped with a butterfly style damper for system balance. The inlet air shall be provided from the outside via a louvered/dampered opening through the outside wall of each trailer unit. The discharged air is exhausted via an industrial type exhauster located on the discharge ductwork at the trailer wall. Trailer T-1 exhaust fan shall operate at 160 cubic feet per minute and 5 inches of static pressure. Trailer T-2 exhaust fan shall operate at 60 cubic feet per minute and 5-inch static pressure.

Fresh air ventilation shall be provided to all trailer units via "through-wall" fans. An intake louver complete with a gravity damper opens when the fan unit starts to provide outside air. This inlet will be located as far from the tank ventilation as possible to prevent any short circulation of air from one system to the other. Each fan shall be rated at 300 cubic feet per minute and 7/8 inch static pressure which will provide a minimum of four air changes per hour in each trailer unit



T1	WELLFIELD SOLUTION PROCESSING TRAILER
T2	SUPPORT TRAILER
T3	OFFICE & LAB TRAILER
T4	REAGENT STORAGE AND WAREHOUSE
STG	PRODUCT SLURRY STORAGE PAD
DF	DIESEL FUEL
CO_2	CARBON DIOXIDE STORAGE
O_2	OXYGEN STORAGE
L	PORTABLE CHEMICAL TOILETS
⊕	EXISTING WELLS
•	PROPOSED WELLS
------	PIPING (TYP.)

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

FACILITIES LOCATION AND GENERAL PIPING LAYOUT

FIGURE C.2-5

WESTERN NUCLEAR, INC.

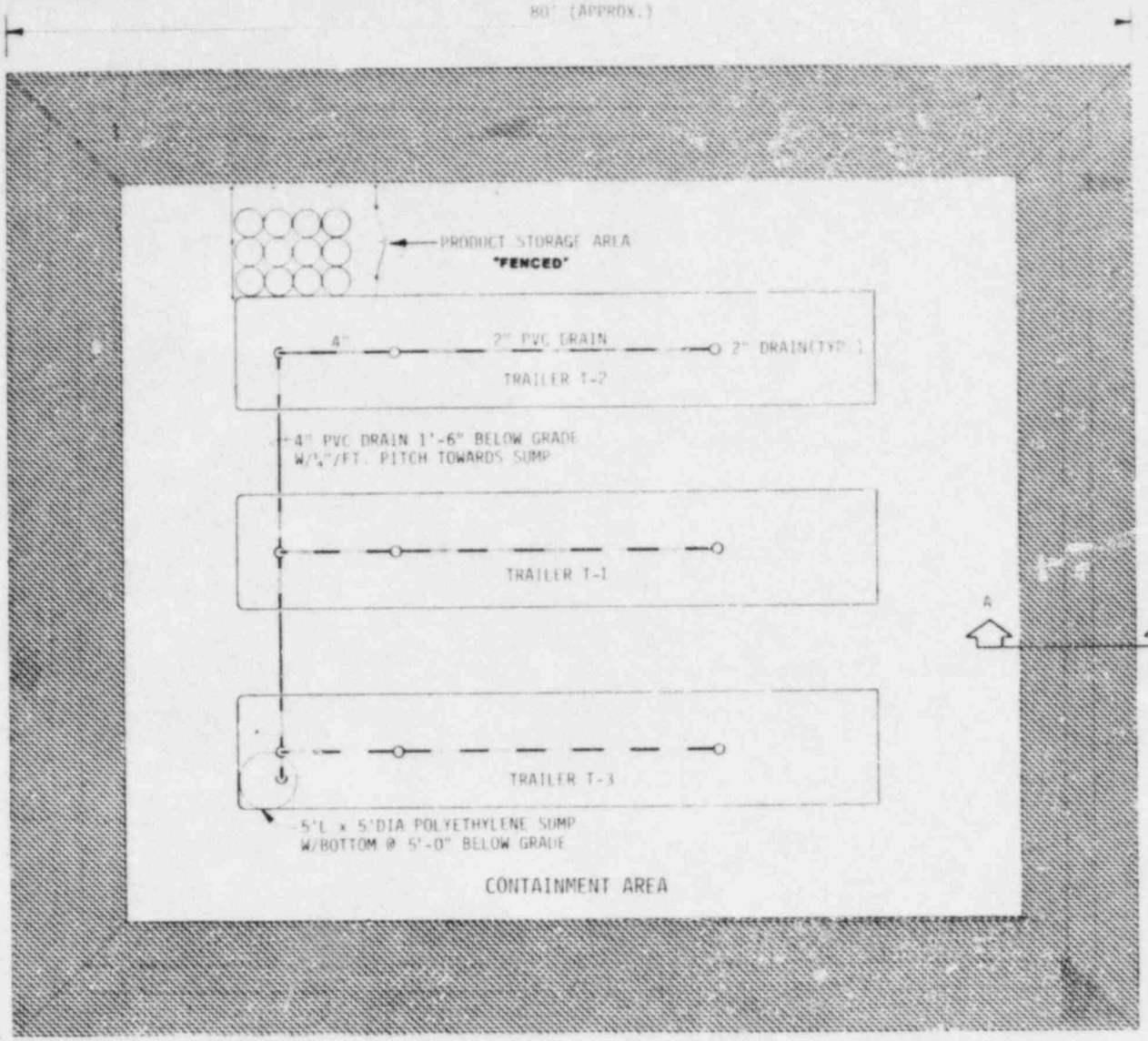
with adequate pressure to remove any fumes or airborne particulates not removed by the tank ventilation system. The fresh air system shall also be operable with the exterior trailer doors open during warmer weather. During periods of cold weather, the trailer heating system shall be capable of heating with the fresh air ventilation system in operation.

3. Chemical Spillage Containment Design. The trailer test plant shall be installed in an area approximately 80 feet x 70 feet. The predetermined depth of topsoil shall be removed and temporarily stored in a designated area. The trailers will set directly on the subsoil. A perimeter subsoil berm shall be provided to contain the total liquid capacity of 13,600 gallons or 1,809 cubic feet. The total liquid capacity of the trailer units is 4,800 gallons, or 640 cubic feet, at any time during operation. The extra capacity of the bermed area is intended for storm drainage. The berm shall be built up subsoil compacted to 90% proctor density and minimum height of 6 inches. The final berm height will be determined during construction. The trailer units shall be provided with individual floor pans with 6-inch high (minimum) barriers on the interior walls and integral curbs at all openings. Each trailer shall also be provided with two floor drains piped in series to a common FVC drain manifold routed to a sump located in the outside spillage containment area. The sump shall consist of a 5 foot diameter x 5 foot deep polyethylene tank buried 5 feet below the final grade with a non-metallic grating cover at the finished grade.

The system described above shall provide containment for routine discharge including washdown in the process areas as well as any emergency requirements.

The auxiliary support and storage facilities including carbon dioxide, oxygen, and diesel fuel are not included within the spillage containment area. The diesel fuel storage system shall be provided with an independent bermed containment area with capacity to hold the full contents of the storage vessels. The product storage area shall be within the spill containment area alongside trailer T-2 toward the front of the trailer.

Refer to the Spill Containment Layout (Figure C.2-6) for clarification regarding the above description.

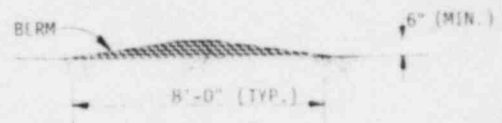


PLAN VIEW

SCALE: 1/8" = 1'-0"

NOTES:

1. DRAINAGE DIVERSION SHALL BE PROVIDED AS REQUIRED OUTSIDE OF CONTAINMENT AREA.
2. FINAL GRADE ELEVATION IN CONTAINMENT AREA SHALL BE DETERMINED IN FIELD. CONTAINMENT AREA SHALL BE PITCHED TOWARD SUMP TO PROVIDE FOR STORM DRAINAGE.
3. DIMENSIONS SHOWN ARE APPROXIMATE. FINAL DIMENSION SHALL BE FIELD DETERMINED.



SECTION A

SCALE: 1/4" = 1'-0"

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

Behrent Engineering Company
DENVER COLO 80211

25 GPM ISL TEST UNIT

SPILL CONTAINMENT LAYOUT

FIGURE C.2-6

4. Major Process Design Description. The proposed in-situ leaching uranium plant has been designed to handle an average of 25 gpm production and injection flow capacity. The pilot plant is designed to accommodate a sodium carbonate leaching strategy with hydrogen peroxide precipitation. The chemical process scheme for the plant is divided into four major circuits discussed below.

- Wellfield Circuit. The wellfield units will consist of a series of injection and recovery wells sufficient to deliver 25 gpm of leachate solution to and from the process trailers. The downhole submersible pumps will transfer the leach solution to either the Production Surge Tank during uranium recovery, or the restoration (R.O. or E.D.) equipment during restoration.

  The injection solution shall be transferred from the Injection Tank to the wellfield for direct injection into the wells. The injection pressure is designed not to exceed 110 psi. Uranium oxidation in the wellfield will be accomplished by the direct dissolution of gaseous oxygen in the main injection line. The leachate utilized will be a sodium carbonate/bicarbonate solution with total carbonate concentrations of approximately 1-3 grams per liter. The preparation of injection solution is highlighted in the process description of the extraction circuit.

- Extraction Circuit. The pregnant leachate in the Production Surge Tank will be filtered and transferred to the Ion Exchange vessels at an average flow rate of 25 gpm. Only two of the three vessels will be loading uranium in series simultaneously. During this time, the other vessel will be eluted batchwise (refer to elution circuit). This column will be introduced downstream of the column train only when the lead column is ready to be taken off line (i.e., when lead column resin is saturated with uranium). These Ion Exchange vessels have been designed for downflow operation. A "strong base anion" ion exchange resin will be utilized for uranium recovery in the vessels.

  An average of 97% of the tails leaving the Ion Exchange vessels will be transferred to the Injection Surge Tank. A sodium carbonate solution will be metered into the injection tanks to increase the residual bicarbonate (HCO_3^-) to the desired level for wellfield injection. The carbonate concentrate solution will be prepared in the Soda Ash Make-Up Tank by dissolving solid sodium carbonate in the aqueous solution. Before leaving the Recovery/Injection Trailer for the wellfield, the leachate is filtered, pH adjusted by dissolving appropriate amounts of carbon dioxide in line, and finally injected with controlled amounts of oxidant (gaseous oxygen).

- Elution Circuit. As the ion exchange resin reaches uranium saturation, the vessel will be taken off line. Once the vessel is isolated from the ion exchange loading loop, the uranium will be stripped off of the resin using three batchwise stripping and rinsing steps. In the first step, the resin is batch-eluted with "low pregnant" uranium strip solution (preparation of this solution is discussed later). The "uranium-rich" solution is transferred to the High Pregnant Tank for temporary storage. After a sufficient amount of high pregnant solution is stockpiled, the solution will be transferred to the Precipitator. Once the Ion Exchange vessel has been sufficiently stripped (approximately 90% of the saturated amount of uranium is extracted) using the low pregnant eluant solution, the second step is ready to begin. In this step, the residual uranium (approximately 10%) is stripped from the resin by eluting with a fresh batch of barren eluant solution. The fresh eluant solution is prepared in the Barren Eluant Tank by dissolving sufficient amounts of granular sodium chloride in a sodium carbonate solution which is prepared in and transferred from the Soda Ash Make-Up Tank. After the barren eluant solution has stripped off most of the residual uranium, the resulting eluant (referred to as "low pregnant eluant") is transferred to the Low Pregnant Tank. This solution will eventually be utilized in stripping uranium from the next available loaded Ion Exchange vessel. In the third step, the Ion Exchange resin is rinsed with a solution transferred from the IX Rinse Tank. Once this final step is completed, the Ion Exchange column and resin are ready to be reintroduced back into the extraction loop for resin loading.

- Precipitation Circuit. After sufficient quantities of high pregnant eluate have been stockpiled, the entire amount is batch fed to the precipitation tank (precipitator). Here, the solution is pretreated with hydrochloric acid and then treated with hydrogen peroxide for precipitation uranium. The chemical precipitation is pH controlled with sodium hydroxide. After a suitable digestion period, the uranium precipitate ($UO_4.2H_2O$) is transferred to storage containers as a slurry containing approximately 25% solids.

Since no permanent structures or buildings are necessary with the system described in Section C.2.a, environmental impacts are minimized. In turn, successful surface reclamation will be more readily achieved.

C.2.a.2 Solar Evaporation Ponds.

Capacity. The evaporation ponds have been conservatively sized to handle three main waste streams: namely, the over-recovery waste stream,

the eluant bleed stream, and the restoration process brine stream. As shown by Figure C.2-7, (in Map Pocket at the end of section C), an average of 945 gallons of waste water will be produced during each day of the leaching operation while an estimated 10,824 gallons per day will be produced during restoration. One pore volume affected by the leaching operation can be represented by the equation

$$(L)(W)(T)(F_H)(F_V)(P)(CONV) = PVD$$

where

L = wellfield length (ft)
W = wellfield width (ft)
T = screened interval thickness (ft)
F_H = horizontal flaring factor
F_V = vertical flaring factor
P = porosity
CONV = conversion from cubic feet to gallons
PVD = pore volume displacement (gallons)

If flaring of 30% in the four horizontal directions and 10% flaring in both vertical directions is assumed, the two flaring factors become

$$F_H = (1.3)^4 = 2.86$$
$$F_V = (1.1)^2 = 1.21$$

Substitution of the other appropriate values for this site yields

$$(50)(25)(10)(2.86)(1.21)(0.26)(7.481) = PVD$$
$$PVD = 84,024 \text{ gallons}$$

This shall be defined as one pore volume displacement (PVD). Since the average ore thickness in this area is approximately 7 feet, and the average grade is 0.12%, the reserves contained within the wellfield pattern are

$$(25)(50)(7)\left(\frac{2000}{18}\right)(0.0012) = 1,167 \text{ pounds as } U_3O_8$$

If leaching takes place until 70% extraction is achieved, 817 pounds U_3O_8 will be recovered. At an average recovery rate of 25 gpm and an average head grade of 30 ppm, leaching would require

$$817/[(30)(25)(0.012)] = 91 \text{ days.}$$

It has been estimated from laboratory investigations that restoration could be achieved with 15 PVDs or fewer. Fifteen PVDs would require:

$$15(84,024)/[(25)(1,440)] = 35 \text{ days.}$$

The resultant waste volume is

$$(91)(945) + 35(10,800) = 463,995 \text{ gallons.}$$

Each pond presented in Figure C.2-8 (in Map Pocket at the end of section C) has base dimensions of 60 feet by 60 feet, a 3 to 1 side slope, and would, therefore, fill to a depth of 8.3 feet. Three feet of freeboard has been added, resulting in a total depth of approximately 11.5 feet (approximately 70% excess capacity). Three feet is considered sufficient freeboard based on the extremely short fetch (0.02 miles). Therefore, each pond is capable of containing all anticipated waste streams during the project life, and is considered to be of conservative design.

Design. The two ponds will occupy an area approximately 180 feet by 350 feet. Each pond will be lined with reinforced hypalon or other acceptable material of at least 36 mils (0.036 inch) in thickness, and will be equipped with a leak detection system.

The ground in the area of the ponds will be excavated to a depth of about 7 feet. The first 18 inches of material will be salvaged as topsoil and stored on the topsoil stockpile (see Figure C.2-5). The remaining 5½ feet will be used as construction material for the berm of the ponds. The bottom of the ponds will be sufficiently graded to allow any leak to drain to its respective leak detection collection pipe. The underdrain system will be made of 3-inch PVC pipe with slots on the top and sides and will be laid in shallow grooves across the bottom. These pipes will collect into a 3-inch unslotted PVC pipe which will drain to an inspection sump. The drain system will be covered with fine gravel and 6 inches of compacted, clean, washed sand which will be smoothed. The hypalon liner will then be placed over the leak detection system, along the sides, across the berm, and anchored into backfilled trenches near the middle of the berm. To check for leaks and to prevent wind damage, both ponds will have enough water added to cover the bottom (approximately 6 inches).

The inspection sump shall be monitored daily. Should water exist in the sump, a sample will be taken and analyzed for the excursion

indicators as defined in Section C.5.c. If it can be determined that a leak has occurred, the pond liquid level will be lowered by pumping its contents into the spare pond to such a level as to allow repair of the leak.

Daily inspection of the pond liners shall also be made.

C.2.a.3 Support and Ancillary Facilities. Due to the relatively short duration of the R&D testing, planning has been done to minimize permanent structures and facilities. In this light, drinking water and required laboratory deionized water will be bottled. Nonpotable water (safety showers, washdown water, laboratory glassware wash water) will be stored in a 500-gallon surge tank filled initially from the deep aquifer. Water quality data for this aquifer is discussed in Appendix D-6B. This tank will be refilled as necessary. A septic system will be eliminated by contracting for an outdoor portable chemical toilet service.

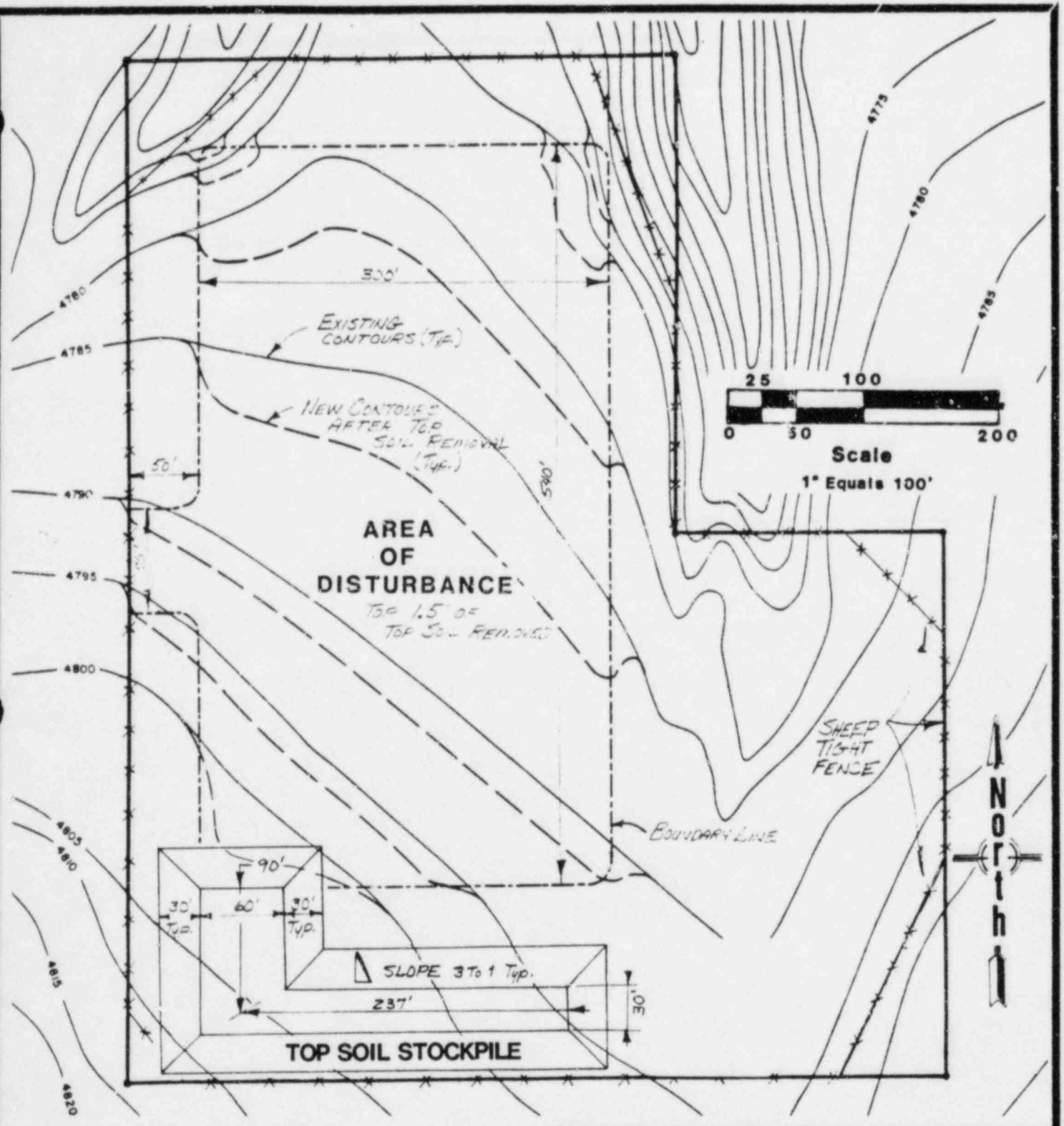
Power for all support facilities is supplied by the diesel generators described in Section C.2.a.

As shown in Figure C.2-7 (Map Pocket), an estimated 7 gallons of product slurry will be produced each day. It will be stored in 55-gallon drums and placed within the fenced product storage area as shown in Figure C.2-6. An estimated 12 drums of slurry will be produced and will be shipped to WNI's Jeffrey City, Wyoming mill for processing upon completion of the leaching phase of the R&D project.

C.3 Site Preparation Activities

C.3.a Introduction

Site preparation activities are anticipated to begin as early in the year as weather will allow. This is tentatively scheduled for early to mid-April. Activities will include topsoil removal from the access road route and the area of disturbance as shown in Figure C.3-1 and construction of the Willow Creek crossing (see Figure C.3-2 in the Map Pocket at the end of section C and Appendix D-6A). Upon completion of these activities, well drilling and pond construction will commence. Total site preparation is estimated to require up to two months, with wellfield drilling, pond construction, and plant plumbing to be completed



AREA OF DISTURBANCE
Volume Calculations

$$\frac{[(300 \times 540) + (75 \times 50)] \times 1.5}{27} =$$

Total Volume 9,208 cu. yds.

TOP SOIL STOCKPILE
Volume Calculations

$$\frac{10 \times \left[90^2 + \left(\frac{60^2}{3}\right) + .5\left[30(30+60) + (237 \times 60)\right]\right]}{27} =$$

Total Volume 9,211 cu. yds.

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

AREAS OF DISTURBANCE

FIGURE C.3-1

WESTERN NUCLEAR, INC.

in one month. A mid-June to early July startup is scheduled (see Figure C.2-4).

Location of the anticipated area of disturbance can be seen in Figure C.3-1. The evaporation ponds, recovery facilities, and the wellfield areas will be the major disturbances. The parking area and reagent storage areas will contribute to the total disturbance but are a small portion of the total.

The top 18 inches of material will be salvaged as topsoil.

C.3.b Solar Evaporation Ponds

The two solar evaporation ponds are anticipated to occupy an area approximately 180 feet by 350 feet (1.2 acres). Samples will then be taken of the subsoil for background radiochemical analyses as described in Appendix D-10. Topsoil will be stored as shown in Figure C.3-1.

C.3.c Recovery Plant and Wellfield Area

The recovery trailers described in Section C.2.a will occupy an area approximately 60 feet by 75 feet (0.1 acre), and the estimated disturbance for the entire wellfield area, including that for monitor and trend wells, is approximately 2,000 square feet (0.05 acre).

C.3.d Roads and Access.

Access Roads. Gravel and dirt roads currently exist to within about one-half mile of the test site. These roads are currently used mainly as oilfield service roads and as access to the Christensen Ranch located approximately one mile southeast of the R&D site.

Approximately 2,000 feet of road will have to be constructed for proper access to the site. This stretch of road is currently only a track. Eighteen inches of topsoil will be removed from the route and placed as shallow berms along the road. The topsoil will be windrowed and broadcast-seeded to reduce erosion. A crushed stone road surface is planned (see Figure C.3-2, Map Pocket) and will be 15 feet wide.

Portions of the existing road will need to be upgraded. Dirt fill and gravel cover are planned for these portions. These areas consist mainly of "low-spots" and must be upgraded to prevent "bogs" during wet weather.

Willow Creek Crossing. The existing and proposed roads will be connected by an earthen structure which crosses Willow Creek and will contain eight 72-inch diameter culverts. Details of the surface hydrology and culvert size calculations may be viewed in Appendix D-6A. The road surface is also anticipated to be 15 feet wide and will be approximately 10 feet high. Side slopes of the crossing will be approximately 3 horizontal to 1 vertical. The upstream slope will be covered with riprap to prevent erosion. Riprap may consist of round stone not subject to disintegration from the action of water or broken concrete without reenforcement and may range from 1 to 18 inches in equivalent diameter.

The design of the crossing may be viewed in Figure C.3-2 (Map Pocket). It is estimated that approximately 7,800 cubic yards of material will be required to build the structure. Generally all soil will be compacted to 95% Proctor density and within 2% of the optimum moisture content.

C.3.e Miscellaneous Disturbances

Currently, only the area shown in Figure C.3-1 is planned for disturbance and will have topsoil removed. If disturbance of other areas is anticipated, topsoil will first be salvaged.

C.3.f Topsoil Storage Pile

The topsoil storage pile has been located in the southwest corner of the permit area. It is anticipated that this location will aid any surface drainage from the small drainage area (see Map D-6A-1) in reaching the draws feeding Willow Creek located northeast and northwest of the area. The stockpile is sized to contain approximately 9,200 cubic yards of topsoil from the area of disturbance shown in Figure C.3-1. All the topsoil stockpile will be protected from erosion by seeding (see section D, Reclamation Plan). The stockpile will be signposted and left undisturbed except for stabilization requirements.

C.3.g Fences

It is proposed the area designated as the permit area be enclosed by a Type II sheep-tight fence (see Figure C.3-1).

The area containing the product storage drums will have a 5-foot chainlink fence around it with a locked gate. No additional fencing is warranted.

C.3.h Surface Water Hydrologic Control Features

Because of the small drainage area feeding the R&D site, no surface hydrologic control is necessary and consequently no permits are required (see Appendix D-6A).

C.3.i Wildlife Mitigation

Measures which have been taken to mitigate effects to wildlife include:

1. Planning to keep the project size to a minimum.
2. Fencing of the entire area.
3. No firearms, bows, etc. will be allowed onsite.
4. Operators will be instructed as to the importance of protecting the natural environment.

C.4 Production Processes and Timetables

C.4.a Fluid and Chemical Flowpaths

The in-situ leaching process occurs in two steps, oxidation and mobilization. Oxidation is accomplished through the introduction of an oxidant such as gaseous oxygen or hydrogen peroxide into the orebody with the injection stream. The uranium, existing in the insoluble +4 valence state, is oxidized to the more soluble +6 valence by either of the following reactions:

$UO_2 + H_2O_2 \rightarrow UO_3 + H_2O$ (Reaction 1)

$UO_2 + \frac{1}{2}O_2 \rightarrow UO_3$ (Reaction 2)

Gaseous oxygen is the laboratory-tested oxidant for this R&D facility, although hydrogen peroxide will be available onsite should field testing of oxygen yield poor results.

Once the uranium has been oxidized to the +6 valence state, a complexing agent aids in mobilization (solubilization). While several

methods are possible, WNI proposes to use an alkaline leach solution of sodium bicarbonate. Sodium bicarbonate will be added to the lixiviant by the addition of sodium carbonate (soda ash) and gaseous carbon dioxide. The following reactions occur:

$$Na_2CO_3 + CO_2 + H_2O \rightarrow 2\ Na^+ + 2\ HCO_3^- \qquad \text{(Reaction 3)}$$

$$UO_3 + 2\ NaHCO_3 \rightarrow Na_2UO_2(CO_3)_2 + H_2O \qquad \text{(Reaction 4)}$$

$$UO_3 + Na_2CO_3 + 2\ NaHCO_3 \rightarrow Na_4UO_2(CO_3)_3 + H_2O \qquad \text{(Reaction 5)}$$

Reaction 5, the formation of the uranyl tricarbonate, is the more dominant reaction at the intended pH of approximately 8.5. Reactions 4 and 5 both yield soluble sodium salts of uranium which are therefore mobilized.

The uranium solution is then recovered through pumping and proceeds to the ion exchange portion of the recovery plant. The uranium solution is passed through a bed of strong base anion exchange resin where the uranyl tricarbonate ions are exchanged for chloride ions according to the following:

$$UO_2(CO_3)_3^{4-} + 4\ RCl \rightarrow R_4UO_2(CO_3)_3 + 4\ Cl^- \qquad \text{(Reaction 6)}$$

where R represents the organic functional group of the ion exchange resin.

Once the resin bed is saturated with respect to uranium capacity, the column is removed from the adsorption circuit and placed into the elution circuit. Elution is the stripping of the uranyl tricarbonate ion from the resin by replacing the chloride ion in the bead. To achieve this, a strong sodium chloride solution (approximately 1.0-1.5M) is passed through the resin bed. The high concentration of chloride ions causes the reverse of Reaction 6 to occur.

$$R_4UO_2(CO_3)_3 + 4\ Cl^- \rightarrow 4\ RCl + UO_2(CO_3)_3^{4-} \qquad \text{(Reaction 7)}$$

Carbonate is also added to the resin stripping solution, or barren eluant, to prevent precipitation of uranium during the elution process.

The resultant uranium-bearing solution, pregnant eluate, undergoes precipitation via a two-step process. Since the uranyl tricarbonate ion is soluble at the pH levels used in the elution process (7.5-9.0), the carbonate is destroyed by the addition of acid to "free" the uranium.

The pH of the resulting solution is then increased and hydrogen peroxide is added to precipitate the uranium. The following reactions occur:

$$Na_4UO_2(CO_3)_3 + 6\ HCl \rightarrow UO_2Cl_2 + 3\ CO_2 \uparrow + NaCl + 3\ H_2O \qquad \text{(Reaction 8)}$$

$$UO_2Cl_2 + H_2O_2 + 2\ H_2O \rightarrow UO_4 \cdot 2\ H_2O + 2\ HCl \qquad \text{(Reaction 9)}$$

During the carbonate destruction step, excess acid is added (to pH ~ 2) to ensure complete removal of the carbonate species. The precipitated product, uranyl peroxide, is then gravity thickened and stored in plastic-lined steel drums suitable for shipment to WNI's Jeffrey City, Wyoming mill for storage and further processing.

Discussion of the restoration process appears in section D, Reclamation Plan.

The proposed flow sheet and material balance for the above process appears in Figure C.2-7 (Map Pocket). Basic assumptions made during the preparation of the flow sheet are described below:

1. A nominal 25 gpm flow rate (36,000 gpd) for the recovery flow (stream 1).

2. A nominal 3% over-recovery bleed (stream 5). This solution is used to prepare a 10% Na_2CO_3 solution and as a resin wash after elution. The remainder is bled to the solar evaporation pond.

3. A nominal 0.5 gpl total carbonate consumption within the leach circuit. This results in 123.6 lbs. of Na_2CO_3/day and 52.2 lbs/day CO_2 (streams 17 and 13, respectively) being added to the circuit. Additionally, it is assumed that the lixiviant pH is held constant at 8.5. These streams (7 and 13) will be added to an inline static mixer and 100% dissolution efficiency is therefore assumed.

4. Oxygen addition of 235 ppm is assumed to be made in an inline static mixer (approximately 70 psig).

5. 720 gpd is the assumed flow within the elution circuit. This process will be performed in a batch mode and flow rates should not exceed 5 gpm at any time.

6. Chloride ions lost during ion exchange and eluant bleed (stream 11) are partially replaced by the addition of HCl during carbonate destruction (stream 23). The remainder is added as NaCl to the barren eluant mix tank (stream 19).

7. It is assumed that a negligible amount of chloride is lost to the resin wash stream (stream 24).

The material balance indicates that under typical (that is, estimated) operating conditions, a total liquid waste discharge from the process will be 945 gpd (streams 6 and 11). A minimum waste volume estimate would eliminate stream 25 and would, therefore, be 352 gpd. Anticipated flow rates and composition of the various liquid waste streams appear in Table D-1 in the Reclamation Plan (section D). These liquid streams will all report to the solar evaporation pond.

The final decision between a backwash filtering system and a disposable cartridge filtering system has not yet been made. If the backwash system is used, it is estimated that 200 gpd would be required as backwash solution. This solution would be IX tails solution and would report to the evaporation pond. In the flow sheet (Figure C.2-7, Map Pocket), stream 25 would be diverted to first backwash the filters before reporting to the ponds. No change in pond design criteria would be necessary. If disposable cartridge filters are used, spent filters will be drummed and stored for shipment to WNI's Split Rock Mill tailings impoundment for disposal. Again, no change in facility design is necessary.

Other wastes produced during operation will include refuse and laboratory solutions. Laboratory waste will consist mainly of excess liquid from process samples. The volume produced will be negligible when compared to other liquid wastes and will be disposed in the solar evaporation ponds. It is currently anticipated that uncontaminated refuse will be collected and compressed in a trash compactor. Contaminated refuse (rags, etc.) will be collected and drummed. These compacted containers and drums of contaminated waste will be periodically shipped to the Split Rock Mill (or other licensed landfill) for disposal.

C.4.b Surface Hydraulic Equipment

Western Nuclear proposes the operation of an R&D facility with a nominal flow of 25 gpm. This requires the operation of two 5-spot patterns as a wellfield. Figure C.2-5 shows the piping arrangement planned for the wellfield operation, piping for waste disposal to the evaporation pond, and the location of all associated wells (production, injection, and monitor). The wellfield is plumbed to allow easy access by maintenance equipment and drilling rigs from either the southwest or the northeast.

Each individual well (excluding monitor wells) is fitted with a wellhead, pressure gauge (0 - 125 psi), indicating and totalizing flow meter, sampling valve, and a manual flow control valve (diaphragm). In addition, each recovery well is equipped with a submersible pump and all associated electrical equipment. All surface plumbing and valves are PVC within the wellfield (schedule 40 pipe). The submersible pumps are all stainless steel multi-stage centrifugals. Other process equipment not directly associated with the wellfield is discussed in Section C.2.a.

No critical bends or areas of unusual hydraulic stress exist. Connections between cells are typical solvent weld connections of PVC pipe as outline in Figure C.2-5.

C.4.c Production Zone Location

A regional and local description of the geology of the proposed R&D site is given in Appendix D-5. As shown in Figures D-5-1 through D-5-4 in Appendix D-5, the K2 sand unit extends well beyond the limits of the permit area. The production zone consists of the K1 and K2 sand units because communication between these units has been demonstrated.

The major geochemical reactions anticipated are the oxidation and dissolution of the uranium ore (see Section C.4.a). Other potential reactions are the dissolution of calcium and other metals (vanadium, for example) and the ion exchange of sodium with any clays which may be present. Neither of these minor reactions is anticipated to play a major role in either the leaching or the restoration aspects of the project.

C.4.d Production Zone Confinement

Confinement of the production zone has been well documented. Pumping tests within the R&D wellfield indicated no communication between the K sands and shallow or deep sands (see Appendix D-6). Static water levels are approximately 200 feet above the upper boundary of the aquifer, providing further evidence of a confined aquifer. As stated in Section C.4.c, the K1 and K2 portions of the K system are hydrologically connected. Monitoring of the K1 for internal WNI trend analysis shall be via well WCOW-24. For a more detailed description of the geology, see Appendix D-5.

All injection equipment has been sized to prevent excessive injection pressures. The injection pressure is anticipated to be 50 to 70 psig. An expected maximum injection pressure would be 110 psig. Fracture pressure of the zone has been estimated at 140 psig of wellhead pressure, consequently confinement of the production will not be affected even if the maximum injection pressure is attained

C.4.e Well Completion and Development Techniques

C.4.e.1 Well Drilling

C.4.e.1.1 Pilot Hole. A 5-inch pilot will be drilled to depth as directed by the site geologist or drilling supervisor. This hole is drilled to establish the presence of ore, to determine continuity of local stratigraphy, and to provide a pilot for the larger overream bit. To ensure the pilot hole does not exceed a maximum deviation of 3° from vertical, at least 40 feet of stabilized drill collars will be run above the bit. Drilling equipment will be conventional rotary type rigs.

C.4.e.1.2 Geophysical Survey. Upon completion of the pilot hole, the logging operations will begin as soon as possible.

The minimum number of logs to be run per hole include a natural gamma ray, spontaneous potential, and resistivity. Three-point caliper logs will be run on special occasions and drift surveys will be run.

Gamma rays logs will be run from total depth (TD) to surface in each hole. The gamma tool will be calibrated with a sleeve source at the start of each shift and each time the tool is changed.

The spontaneous potential and resistivity logs will be run from TD to fluid level and the logs will be run on each hole.

Caliper logs will be run on each cased hole to check casing depths, well screen intervals, and casing damage or separation. Prior to running any caliper log, the tool will be calibrated to record interval openings of 2, 3, 4, 6, and 8-inches.

Drift surveys will be run periodically to ensure the pilot and overream bore holes are sufficiently straight and to get an exact bottom hole location.

C.4.e.1.3 Overream Bore Hole. Upon completion of the logging operations, ore tops, casing depths, and the proposed screen intervals will be determined. At this time, a 7-7/8-inch three-wing, four-step carbide insert drag bit will be used to overream the pilot hole to accept the casing string. If drilling proves too difficult for a drag bit, a medium-soft formation tri-cone roller bit will be used. Drill collars will be used to ensure minimum hole deviation and to increase penetration rates. Upon drilling to the specified depth, the bore will be circulated for no more than 10-15 minutes. This is to be done to ensure a clean bore and to open up the lower portion of the bore to accept cement. A cleanup trip will be made, using a rock bit, prior to any casing operations.

C.4.e.1.4 Drilling Muds and Mixtures

Bentonitic Base Drilling Muds. An ideal mud mixture should have an approximate weight of 8.5-8.8 pounds per gallon, and a sand content of less than 2%. Results of mud lab tests should yield a 1/32-inch wall cake, a filtrate loss of 16 cc's, and a marsh funnel viscosity of 35-38 seconds. Muds should be mixed via an airjet mixing hopper in earthen pits. Two pits are required per hole, one pit to be used for suction and the other pit for settling. Total pit volume should be 2.5-3.0 times that of the final hole volume. Mud mixtures can be maintained by either adding additional dry mud or water.

Bentonitic base muds will be used on all pilot holes, overream holes, and any wells where filtrate loss or mud penetration into the bore will not affect the well's performance.

Polymer Base Drilling Muds. Ideal mixtures for this type mud should have an approximate weight of 8.4-8.5 pounds per gallon. Results of mud lab tests should yield a wall cake of 1/32 inch, a marsh funnel viscosity of 38-40 seconds, and a filtrate loss of 10-15 cc's. A pH range of 6.0 to 7.0 units must be maintained with 7.5 pH units the upper limit. The pH can be checked with litmus paper and adjusted downward by the addition of HCl.

Care must be exercised in mixing and selection of mix waters. Mix water must not exceed 300 ppm boron, 1 gram per liter total sulphur, and

be free of organic organisms. If mix water has to be treated, add approximately 1/2 pound calcium hypochlorite (HTH) per 1,000 gallons. Mixing should be done through an airjet hopper into earthen pits. Mud mixtures can be adjusted by addition of dry mud or water.

Polymer base muds will be used in situations where extensive drilling or agitation of the ore interval is expected. Holes that are cored or underreamed should be drilled with polymer-based muds. Specialized jobs, such as side-wall sampling, fishing or drilling out well screens, and well workovers will be done with polymer base muds.

C.4.e.1.5 Drilling Out Cement Plugs. After casing and cementing operations are completed, approximately 5-10 feet of cement should remain in the casing. This plug must be removed prior to underreaming and setting the well screen.

Rock bits should be used in this operation to remove all cement from the casing and to minimize the possibility of cutting into or through the casing. This operation should be done, using clear water for a fluid mixture, approximately 48 hours after cementing to allow the cement to cure.

Once the cement plug is removed and the casing end cap or guide shoe is drilled off, the bit will be run down the rat hole through the ore. This is done to open up the bore to accept the underreaming tool.

C.4.e.2 Casing Procedures

C.4.e.2.1 Casing Size and Type. Casing to be used will be either 4-inch or 4-1/2-inch ID, Type I polyvinyl chloride (PVC) 1120, Schedule 40 bell and spigot thermoplastic pipe. Minimum wall thickness should be 0.258-inch with a pressure rating of a minimum of 210 psi at 75°F. The bell end of the joint should be of sufficient depth, 4-inch minimum, to allow the socket to fit deeply enough to ensure joint integrity. The OD of the casing should be uniform to ±0.010 inch to ensure adequate wall strength and snug sockets. PVC casing will be limited to wells less than 300 feet deep. Wells in excess of 300 feet will be cased with yellomine SDR-17 casing material.

C.4.e.2.2 Casing Preparation Prior to Placement in Well Bore.

Prior to casing being lowered into the well bore, certain preparations will have to be done to the casing. While the rig is still drilling, the crew will clean the joints of all excess dirt, mud, and moisture. Also, a maximum of three 1/8-inch holes will be drilled into the bell end of each joint to accept the 1/2-inch #8 pan-head screws required per joint. A slip end cap will have a maximum of three 1-inch weep holes drilled through the bottom and solvent-welded to the first joint of the casing string. Exact measurements will be made of the entire string and any excess casing removed from the last joint to be lowered. To this last joint, a 4-inch socket by thread female adapter will be solvent-welded and held in place by three pan-head screws. This operation will be done prior to the casing being lowered to allow adequate set time for the solvent welds.

C.4.e.2.3 Lowering Casing Into Well Bore. The drilling rig set on the hole will be used to lower the casing. Casing depth will have been picked by either the geologist or the drilling supervisor on site. The first joint to be lowered will have a drilled slip collar, guide shoe, attached. Lowering will be accomplished by using either the rig's hoisting or sand line. Latch-type elevators will be used to secure the pipe to be hoisted. Either a retainer plate or a set of friction slips will be used to secure the pipe from falling into the open bore.

The elevators will be attached to the bell end of the pipe. The pipe will be hoisted high enough to clear the rig's rotary table and lowered through the table into the open bore. The retainer plate or slips will be placed on the table to secure the casing. The second joint of casing will be picked up and solvent-welded into the first joint held by the retainer plate or slips. At this time, the 1/2-inch #8 pan-head screws will be inserted and tightened to further secure the socket. This process will continue until the casing string is in place.

Full-size, three-bow, latch-type mild steel casing centralizers will be placed evenly along the casing string to ensure the string is centered in the bore.

If the casing string is retrieved, a clean-up trip with a rock bit and fresh water will clean the bore and allow the casing to be lowered.

C.4.e.3 Cementing Operations

C.4.e.3.1 Cement Type and Mixtures. Cement used will be a sulfate resistant type. These cements are commonly referred to as API Class B or ASTM-C-150 Type II. Bentonite will be added until a 2% to 4% by weight mixture is obtained. Coarse mica-tex or other lost circulation material will be added if required. The cement mixture will be a dry mix fed by a continuous feed system. Water will not be added until the slurry is ready to be pumped. This will be a continuous non-stop operation until displacement waters are pumped down and the well shut-in.

C.4.e.3.2 Cement Volume Calculations. Slurry volumes will be of sufficient quantity to completely fill the annular space, displace a minimum of 0.25 to 0.50 barrels of slurry back to the surface, and leave 10 feet of cement plug in the casing. Final cement slurry weight will be approximately 14.0 to 14.5 pounds per gallon.

Example: Cased Hole

Given:
1. Bore 7-7/8" 400' deep
2. Casing 5" OD, 4.5" ID

Calculations:

1. Volume and height between casing and hole = 0.2019 ft^3/linear foot (lf)

2. Displacement volume 5" OD casing = 0.0196 barrels/lf

3. Mix Calculations:

400' x 0.2019 ft^3/lf =	80.76 ft^3
+ 25% excess for washouts =	20.19 ft^3
+ 10' column left in casing =	2.019 ft^3
Slurry Required =	102.96 ft^3 (103 ft^3)

4. Sacks of Cement Required:

$$\frac{103\ ft^3}{1.55\ ft^3/94\#\ sk\ cement} = 66\ sacks$$

5. Bentonite Blend (4%)

0.04 x 66 sk x 94#/sk cement

$$\frac{248\ pounds\ bentonite}{50\#/sk} = 4.9\ (5)\ sacks$$

6. Mixing Requirements:

$$\frac{\text{8.0 gals water/94\# sk cement x 66 sks}}{\text{42 gal/barrel}} = \text{12.5 barrels water}$$

7. Displacement Water:

400' - 10' = 390' displacement =
0.0196 barrels/lf x 390' = 7.6 barrels displacement

C.4.e.3.3 Cementing Procedures

C.4.3.3.3.1 Cased Hole. After casing the bore, a 30-40 barrel slug of fresh water will be pumped through and circulated back to the surface through the casing. This water slug cleans the casing inside diameter (ID) of loose dirt and debris, removes mud pack from the end cap ports, cleans the bottom of the bore for cement circulation, and removes wall cake and bridges from annular space to ensure circulation between the casing and bore wall.

The cement slurry will not be pumped at a rate over 100 gpm, or at pressures of over 100 psi. The best flow and pressure ranges are 30-40 gpm and 50-60 psi.

Displacement of the cement slurry with a calculated volume of water will follow. Cement "returns" to the surface should be between 0.25-0.50 barrels, thus ensuring an adequate cement job.

Upon drying or "curing," the cement in the annular space will shrink and leave a void from 5-10 feet below ground level. Dry Type II cement will poured evenly around the casing until this area is filled. Normally, this will require from one to five sacks.

C.4.e.4 Completion Methods

C.4.e.4.1 Well Screen Selection and Placement. Well screen selections are based on several criteria. Probably the most important is matching slot size to sand grain size. The second criterion used is the screen's resistance to corrosion. The two most common corrosion-resistant materials used in manufacturing well screens are stainless steel and plastic. Due to the relatively short life of these wells and the cost differential between stainless steel and plastic screens, PVC will be chosen as the well screen material.

Strength and rigidity is the third criterion used in selection of well screen. The strength and rigidity of screens are based on the materials used, type of bonding, and type of design.

The desirable features of a properly designed well screen are:

1. Openings in the form of slots which are continuous and uninterrupted around the circumference of the screen.

2. Close spacing of slot openings to provide maximum percent of open area.

3. V-shaped slot openings that open inward.

4. Maximum open area consistent with adequate strength.

5. Full series of accessories and end fittings to facilitate screen installation and well completion operations.

C.4.e.4.2 Well Screen Installation. After the proper length of well screen has been selected, it is fitted with the proper accessories and placed down the casing. The end of the screen will be closed off by solvent-welding an end cap to the pipe end; a blank piece of pipe the same outside diameter (OD) as the screen will be fitted to the top of the screen by the use of a socket-to-socket collar. This blank will be used for the packer and to place the packer above the underream cut. A socket by thread male adapter will be solvent-welded to the blank pipe. The packer used will have a minimum of two rings, will be threaded right-by-right, and will be constructed of PVC. The packer will have the same ID as the screen and will have to be the same OD as the casing. If the screen and blank are 3-inches and the casing ID is 4.5 inches, the packer will have to be a 3-inch x 4.5-inch right-by-right.

The packers prevent fluids from either passing down the casing into the well screen or from the well screen up the casing.

The well screen is placed inside the casing and gently pushed down to the proper depth by the drill rods. Inside the 4.5-inch casing, a 3-7/8-inch rock bit is used to lower the casing. There will be no bit rotation or pumping action during this operation. If the screen tends to float and the packer tends not to seat, the screen will be filled with clear water for added weight.

After the screen is in place and held down by the drill rods, the rig will gently waterjet and airjet the well screen for approximately

one hour or until water returns are clean and free of sand and mud. If sand is being generated after the initial airlifting, the screen will have to be removed and inspected for breaks. In some situations, a twin packer setup will be required to completely seal off the screen.

Once the rig gets clean water returns, a portable air compressor will be set on the well and airlifting will continue for an additional three to four hours or until water returns contain less than 5% solids. This additional airlifting ensures the screen has a uniform and evenly distributed sand pack, all drilling fluids have been removed, and the screen is clean and free of debris.

C.4.e.5 Summary. In summary, the order of events that take place to produce a completed injection or recovery well are as follows:

1. Drill a 5-inch pilot hole.
2. Run the series of geophysical logs.
3. Make decision to complete well or plug and abandon.
4. Pick ore tops, casing depths, and screen intervals.
5. Overream with 7-7/8-inch bit to casing point.
6. Set casing to proper depth.
7. Cement casing into bore.
8. Drill out cement column in casing.
9. Set well screen in proper interval.
10. Complete well and sand pack screen with air compressor and waterjet tools.

C.4.f Mechanical Integrity of Wells

A mechanical integrity test shall be performed on all injection and recovery wells prior to the commencement of any injection activity. Mechanical integrity testing shall consist of the following procedures:

1. Place a Baker inflatable packer approximately one foot above the well screen riser pipe.

2. Fill the well with water and pressurize to a maximum of 110 psi[1].

[1]110 psi is the maximum intended injection pressure.

3. Close in the well and monitor the pressure for one hour with pressure readings being recorded at least every 15 minutes.

4. If, after ½ hour, the pressure remains within 10% of the original shut-in pressure, deem the well casing competent for injection.

5. If the pressure falls to less than 90% of the original shut-in pressure, reseat the packer and repeat the test.

6. If, after three tests, the pressure still drops below 90% of the original shut-in pressure, deem the casing incompetent for injection.

7. Either repair and retest the incompetent well until deemed competent, or plug and abandon according to acceptable practice.

The 10% allowable pressure decline is variance inserted to account for leakage past the packer due to poor seating (rough casing, etc.)

Because of the short time frame encompassed by the total project, a yearly review of well integrity is not necessary.

All integrity test results will be kept on file at the test site. Upon completion of the R&D operation, all records will be transferred to WNI's Lakewood, Colorado office.

C.5 Excursions

C.5.a Introduction

An excursion is generally defined as any unwanted or unauthorized movement of lixiviant out of the production zone as a result of in-situ mining activity. Excursions can be horizontal or vertical in nature and are undesirable from both economic and environmental considerations. Proper design and installation of a monitoring system can minimize both the frequency and the impact of an excursion.

Two general programs are implemented to reduce the potential for excursions: (a) integrity testing of wells prior to operation (discussed in Section C.4.f) and (b) monitoring via the monitor well pattern to facilitate detection and control of excursions.

C.5.b The Monitoring Network

The monitor well configuration to be used during this R&D project consists of a ring of 11 monitor wells (MW-01 through MW-08 and WCOW-21 through WCOW-23) along with one shallow and one deep aquifer monitor well (WCOW-27S and WCOW-28D, respectively) (see Figure C.5-1). These wells shall be sampled once every two weeks and analyzed for chloride and electrical conductivity. Once per month, the entire excursion-indicating parameter set (Section C.5.c) will be analyzed. Prior to any sampling, a water level measurement will be taken.

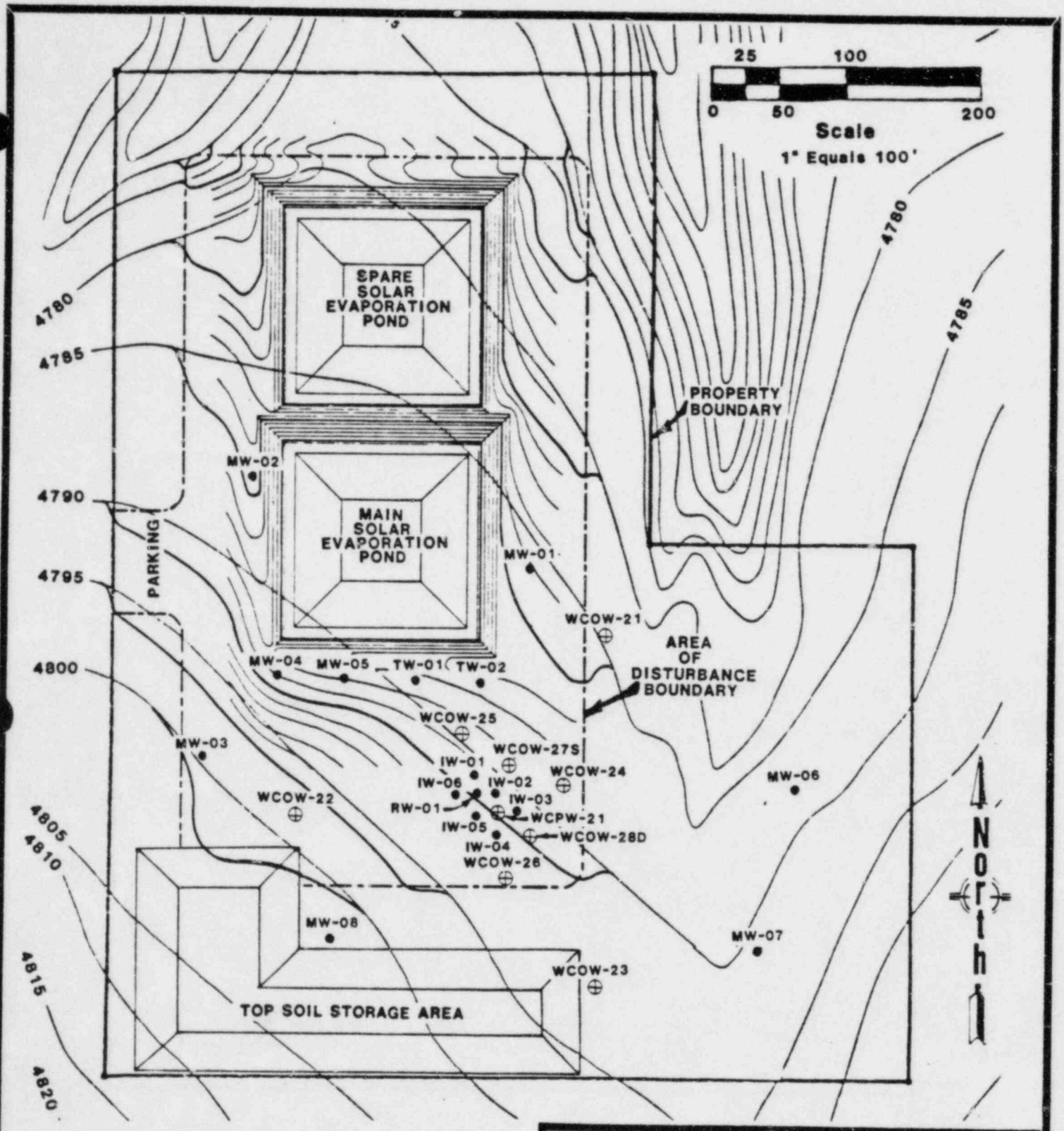
In addition to the above-listed monitor wells, five wells will be used internally by WNI as trend wells. It is anticipated trend wells will be sampled weekly and analyzed for chloride and electrical conductivity.

Of the 16 wells to be used as monitor and trend wells, 8 are contained within the northwest quadrant of the permit area (using the wellfield as the center point) to reflect the probability of an excursion occurring along the line of major transmissivity (N56°W). All wells will be constructed in the same fashion as were the wells of Table D-6B-1 (see Appendix D-6). Proposed depths of wells yet to be installed appear in Table C.5-1.

As standard practice, a small over-recovery is planned to aid in excursion prevention. This over-recovery, expected to average less than 3% of the total flow, will create a hydraulic cone of depression within the wellfield area. This hydraulic low will allow the influx of surrounding groundwater while inhibiting the outward flux of lixiviant. The over-recovery solution will be disposed of as a bleed stream and directed to the solar evaporation ponds.

C.5.c Excursion Parameters

Excursion-indicating parameters were chosen such to verify that any increase in a particular parameter indicates an excursion is occurring as a result of in-situ mining activity rather than some other, perhaps naturally occurring, event. Parameters chosen are sodium, carbonate, bicarbonate, calcium, chloride, uranium, and electrical conductivity. The excursion-indicating parameters have been chosen for the following reasons:



IW	INJECTION WELLS
RW	RECOVERY WELLS
TW	TREND WELLS
MW	MONITOR WELLS
WCOW, WCPW	PUMPING TEST OBSERVATION AND PUMP WELLS

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

WELL LOCATIONS

FIGURE C.5-1

WESTERN NUCLEAR, INC.

TABLE C.5-1

CHRISTENSEN RANCH ISL PROJECT
R & D #1 Willow Creek
Proposed Wells

Type	Field Identification	Anticipated* Depth (Ft)	Aquifer* Represented	Estimated* Ground Elev. (Ft)
Monitor	MW-01	440-460	K2	4784
	MW-02	440-460	K2	4785
	MW-03	440-460	K2	4800
	MW-04	440-460	K2	4789
	MW-05	440-460	K2	4788
	MW-06	440-460	K2	4787
	MW-07	440-460	K2	4790
	MW-08	440-460	K2	4802
Trend	TW-01	440-460	K2	4787
	TW-02	440-460	K2	4786
Injection	IW-01	440-460	K2	4790
	IW-02	440-460	K2	4790
	IW-03	440-460	K2	4790
	IW-04	440-460	K2	4791
	IW-05	440-460	K2	4791
	IW-06	440-460	K2	4791
Recovery	RW-01	440-460	K2	4790

* Drilling and surveying to be performed during Spring/Summer 1984. See Figure C.5-1 for proposed locations.

- Sodium, Carbonate, and Bicarbonate. The proposed lixiviant is sodium bicarbonate based. Concentrations of these species will be significantly elevated in affected groundwater and may indicate an excursion.

- Chloride. As discussed in Section C.4.a, chloride is the exchanged ion during the uranium recovery process. As a result, wellfield solutions will show elevated levels of chloride as the project continues. The extreme mobility (i.e., solubility) of chloride makes it a very reliable excursion indicator.

- Calcium. Preliminary laboratory metallurgical work has indicated elevated calcium concentrations in the lixiviant after contact with ore. Thus, it is expected calcium will be a good indicator.

- Uranium. Baseline uranium concentrations are two or more orders of magnitude below those expected during mining activity. Uranium is, therefore, an excursion indicator.

- Electrical Conductivity. Electrical conductivity of leach solutions is much higher than that of baseline quality water. An increase in conductivity may indicate an excursion.

Not all of the above indicators may be ideal for detecting an excursion. One of the purpose of choosing the above parameters is to determine the best parameters for the site-specific process and location considered, should it be determined to proceed with commercial operations.

C.5.d Corrective Actions

Should any two parameters exceed their upper control limit (UCL), or any one parameter exceed its upper control limit by greater than 20%, a confirming sample will be taken within 48 hours. If it is then determined the first sample was nonrepresentative either through a sampling problem or analytical error, no further action will be taken If the confirming sample does indeed indicate an excursion, both the Wyoming DEQ Land Quality Division and the NRC shall be notified within 24 hours by phone and a letter of confirmation outlining the corrective actions will be sent within seven working days.

Corrective action shall initially be to increase over-recovery in the vicinity of the affected well. Sampling frequency for the affected well shall increase to once every other day and will be analyzed for the elevated excursion parameters. Once per week the entire suite of excursion indicating parameters will be assayed. This shall continue

until all elevated parameters are within their UCLs. Weekly samples will be split to detect any analytical errors.

Should the excursion prove to be in the shallow or deep aquifer, pumping of the affected aquifer shall commence. Sampling frequency shall be the same as outlined above. Simultaneously, various injection wells will be shut down in an attempt to locate the source of the excursion. If successful, any damaged wells will either be repaired or plugged and abandoned by acceptable methods. If unsuccessful, other investigations into the possible cause will be undertaken.

In all cases, the pumped solutions shall be disposed in the evaporation ponds.

C.5.e Reporting Procedures

As indicated in Section C.5.d, the Wyoming DEQ Land Quality Division (LQD) and the NRC shall be notified by telephone within 24 hours of a confirmed excursion. Within seven working days, a letter of confirmation outlining corrective actions will be sent to both agencies.

In all cases, all assays of monitor well samples and reports will be kept on file at the site until completion of groundwater restoration at which time all records will be transferred to WNI's Lakewood, Colorado office. It will be the responsibility of the Operations Engineer to ensure these records are kept intact and up-to-date. During an excursion, a special log book will be kept by the Operations Engineer. This log book will include a daily summary of any significant events and a copy of any assays which are relevant to the excursion. Comments by operators will be included as appropriate. Weekly reports will be submitted to the Director of Solution Mining in Lakewood, Colorado. The Wyoming LQD and the NRC will be kept informed with quarterly reports (or at a frequency deemed appropriate under the given conditions).

C.6 Subsidence

The quantity of minerals to be removed is insignificant with respect to the entire sandstone/aquifer system and will not cause any subsidence. This section and Section D.1.c, Subsidence Monitoring, are not applicable to this project.

C.7 Permits

Western Nuclear, Inc. will apply for permits, licenses, or authorization from the following:

1. Source Material License Amendment/Renewal - U.S. Nuclear Regulatory Commission, License No. SUA-1337.

2. Miner Training and Operating Plan - Mine Safety and Health Administration.

3. Research and Development In-Situ Permit - Wyoming Department of Environmental Quality/Land Quality Division/Water Quality Division.

4. Permit to Construct - WDEQ/Air Quality Division

5. Permit to Construct Evaporation Ponds - WDEQ/Land Quality Division/Water Quality Division

6. Permit to Construct Evaporation Ponds - Wyoming State Engineer's Office/WDEQ Water Quality Division.

7. Water Well Permits - Wyoming State Engineer.

8. Access and Use Agreement - Landowners.

Western Nuclear, Inc. currently holds permits for the water wells listed in Table D-6B-1 in Appendix D-6. Copies of the permits appear in ATTACHMENT A to Section C.

ATTACHMENT A TO SECTION C

MINERAL EXTRACTION PLAN

PERMITS

FORM U. W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60385

WATER DIVISION NO. 2 DISTRICT 8

U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-1-23

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCPW-21

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457

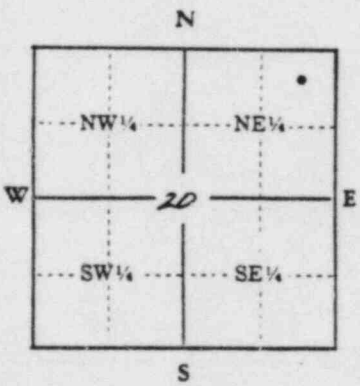
2. Address of applicant(s) 132 Union Blvd., Suite 640, Lakewood, CO Zip: 80228

3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Test for water supply

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

7. Estimated depth of the well is 450 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A

10. If for irrigation use:
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below. N/A
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
										N/A									

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

Permit No. U.W. 60385

SEE REVERSE SIDE

Book No. 384 Page No. 17

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret F. Christensen
J.O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — Signature of Applicant or Authorized Agent

April 19 — Date, 1982

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A.M.

Permit No. U.W. 60385

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

This application is for test purposes only; no water will be beneficially used. This permit will be automatically cancelled on December 31, 1983 or upon receipt of an acceptable Statement of Completion. PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER (FORM U.W. 8) IS WAIVED UNDER THIS PERMIT.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 83.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 23 day of , A.D. 19 82

for George L. Christopulos State Engineer

FORM U. W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60386

WATER DIVISION NO. 2 DISTRICT 8

U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-2-230

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-21

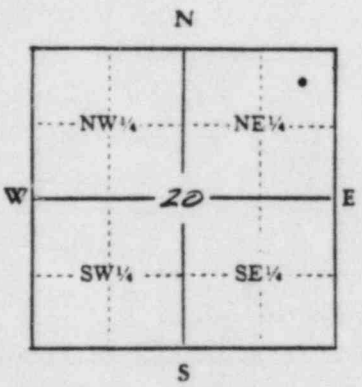
1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457

2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228

3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden; Western Nuclear, Inc.; 134 Union Blvd. #640; Lakewood, CO 80228

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [x] (Describe completely and accurately) Observation well

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 450 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A

10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
										N/A									

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

SEE REVERSE SIDE

Permit No. U.W. 60386 Book No. 384 Page No. 18

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret E. Christensen
J.O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — Signature of Applicant or Authorized Agent
April 19 — Date, 19 82

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A.M.

Permit No. U.W. 60386

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required under this permit. This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 82.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 21st day of April, A.D. 19 82

George L. Christopulos — State Engineer

FORM U.W.-1
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

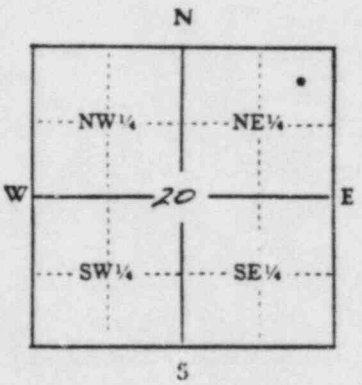
PERMIT NO. U.W. 60387
WATER DIVISION NO. 2 DISTRICT 8
U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-3-230

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.
ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.

NAME AND NUMBER OF WELL WCOW-22

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457
2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228
3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden; Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228
4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation well
5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____
6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources
7. Estimated depth of the well is 450 feet.
8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A
10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
									NA										

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

SEE REVERSE SIDE

Permit No. U.W. 60387 Book No. 384 Page No. 19

12. The well is to be constructed on lands owned by J. F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret Christensen
J.O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Daugh — April 19, 19 82
Signature of Applicant or Authorized Agent — Date

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A. M.

Permit No. U.W. 60387

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required under this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 82.

~~The amount of appropriation shall be limited to the quantity which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May, A.D. 19 82

George L. Christensen — State Engineer
for

FORM U.W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60388

WATER DIVISION NO. 2 DISTRICT 2

U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-4-233

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-23

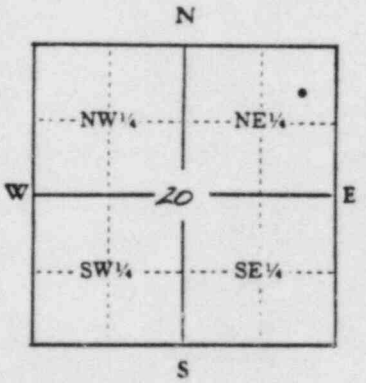
1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457

2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228

3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation Well

5. Location of the well: (NOTE: Quarter-quarter (40-ac. subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12 Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot ____, Block ____ of the ____ Subdivision (or Add'n) of ____



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, streams, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 450 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A

10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
									N/A										

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

SEE REVERSE SIDE

Permit No. U.W. 60388 Book No. 384 Page No. 20

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret E. Christensen
J.O. Christensen
Judy B. and G. Russell Morrenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyle — Signature of Applicant or Authorized Agent

April 19 — Date, 1982

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A. M.

Permit No. U.W. 60388

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

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No final Proof of Appropriation of Ground Water is required under this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 82.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 23rd day of May, A.D. 19 82

George L. Christopulos — State Engineer

for

FORM U.W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60389

WATER DIVISION NO. 2 DISTRICT 8

U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-5-330

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-24

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457

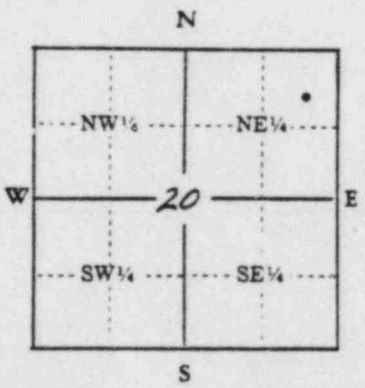
2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228

3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden
Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation well

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

7. Estimated depth of the well is 350 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A

10. If for irrigation use: N/A
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
   b. [ ] Land will be irrigated from this well only.
   c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
									NA										

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

Permit No. U.W. 60389

SEE REVERSE SIDE

Book No. 384 Page No. 21

12. The well is to be constructed on lands owned by I. F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * I. F. & Margaret E. Christensen
I. O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boden — Signature of Applicant or Authorized Agent
April 19 — Date, 19 82

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A. M.

Permit No. U.W. 60389

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required under this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 83

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May A.D. 19 82

State Engineer

George L. Christopulos

FORM U. W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60390

WATER DIVISION NO. 2 DISTRICT 2

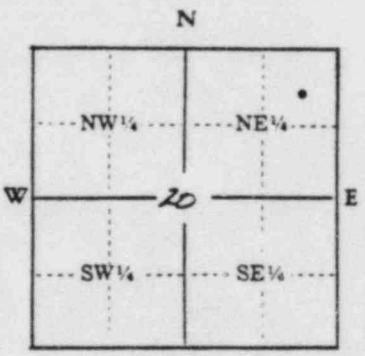
U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-6-238

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-25

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-45
2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228
3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228
4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [x] (Describe completely and accurately) Observation well
5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.
6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.
7. Estimated depth of the well is 500 feet.
8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A
10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
										NA									

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

SEE REVERSE SIDE

Permit No. U.W. 60390 Book No. 384 Page No. 22

12. The well is to be constructed on lands owned by J. F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J. F. & Margaret E. Christensen
J. O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — April 19, 19 82
Signature of Applicant or Authorized Agent — Date

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A.M.

Permit No. U.W. 60390

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required under this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 82.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May A.D. 19 82

George L. Christopulos for State Engineer

FORM U. W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60391

WATER DIVISION NO. 2 DISTRICT 8

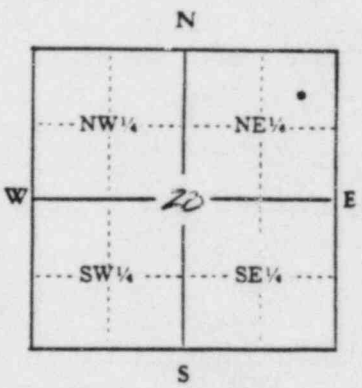
U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-7-230

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.
ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.

NAME AND NUMBER OF WELL WCOW-26

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303) 986-457
2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228
3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640, Lakewood, CO 80228
4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation well
5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.
6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.
7. Estimated depth of the well is 450 feet.
8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A
10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
									NA										

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

SEE REVERSE SIDE

Permit No. U.W. 60391

Book No. 384 Page No. 23

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret E. Christensen
J.O. Christensen
Judy B. and G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — Signature of Applicant or Authorized Agent
April 19 — Date, 19 82

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A. M.

Permit No. U.W. 60391

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required uner this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 82.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May, A.D. 19 82.

George L. Christopulos — State Engineer

FORM U. W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60392

WATER DIVISION NO. 2 DISTRICT 8

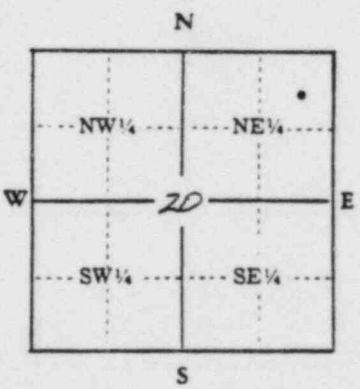
U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-8-230

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-27S

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303) 986-457
2. Address of applicant(s) 134 Union Blvd., #640, Lakewood, CO Zip: 80228
3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640, Lakewood, CO 80228
4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation well
5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.
6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.
7. Estimated depth of the well is 250 feet.
8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A
10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
										NA									

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

Permit No. U.W. 60392

SEE REVERSE SIDE

Book No. 384 Page No. 24

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: *J.F. & Margaret E. Christensen
J.O. Christensen
Judy B. & G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — Signature of Applicant or Authorized Agent
April 19 — Date, 1982

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 19 82, at 9:30 o'clock A M.

Permit No. U.W. 60392

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required uner this permit. This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation~~.

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 83.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May A.D. 19 82

for George L. Christopulos State Engineer

FORM U.W. 5
Rev. 5-79
FILING FEE SCHEDULE
ON REVERSE SIDE

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
BARRETT BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 60393

WATER DIVISION NO. 2 DISTRICT 8

U.W. DISTRICT Campbell Co.

Temporary Filing No. U.W. 16-9-230

NOTE: Do not fold this form. Use typewriter or print neatly with black ink. **ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.**

NAME AND NUMBER OF WELL WCOW-28D

1. Name of applicant(s) WESTERN NUCLEAR, INC. Phone: (303)986-457

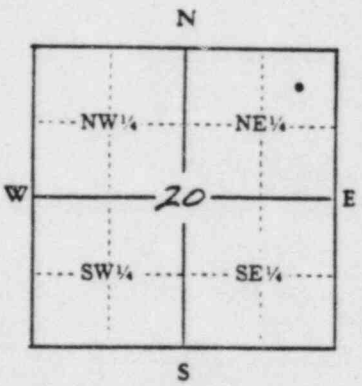
2. Address of applicant(s) 134 Union Blvd., #640; Lakewood, CO Zip: 80228

3. Name & address of agent to receive correspondence and notices Mr. Grey Bogden, Western Nuclear, Inc.; 134 Union Blvd., #640; Lakewood, CO 80228

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [X] (Describe completely and accurately) Observation well

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼NW¼ of Sec. 12, Township 14 North, Range 68 West.) Campbell County, NE ¼ NE ¼ of Sec. 20 T. 44 N., R. 76 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, **also** provide Lot _____, Block _____ of the _____ Subdivision (or Add'n) of _____.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.

7. Estimated depth of the well is 700 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 0 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below. N/A

10. If for irrigation use: N/A
    a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
									N/A										

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc. N/A

Permit No. U.W. 60393

SEE REVERSE SIDE

Book No. 384 Page No. 25

12. The well is to be constructed on lands owned by J.F. Christensen, et al*
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by N/A
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: * J.F. & Margaret E. Christensen
J.O. Christensen
Judy B. & G. Russell Mortenson

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Gary Boyden — Signature of Applicant or Authorized Agent
April 19 — Date, 1982

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES (Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)	$10.00
IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS	$25.00
MONITOR (For water level measurements or chemical quality sampling)	NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING)
) ss.
STATE ENGINEER'S OFFICE)

This instrument was received and filed for record on the 21 day of April, A. D. 1982, at 9:30 o'clock A. M.

Permit No. U.W. 60393

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

No final Proof of Appropriation of Ground Water is required under this permit.
This permit will be reviewed in two (2) years from the date of approval.

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, ~~including pump installation.~~

Completion of construction ~~and completion of the beneficial use of water~~ for the purposes specified in Item 4 of this application will be made by December 31, 19 83.

~~The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.~~

Witness my hand this 3rd day of May, A.D. 1982

George L. Christopulos — State Engineer

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D. RECLAMATION PLAN

D.1 Aquifer Restoration

D.1.a Introduction

Restoration, for the purpose of this R&D operation, shall be defined as a return of all groundwater affected by this R&D operation to background quality as defined by WDEQ, based on baseline groundwater sampling. Classification of aquifers shall be made prior to the commencement of injection activity.

It is currently anticipated that restoration activity will begin within 15 days of cessation of leaching activity and should take approximately 30 days to complete. Based upon preliminary laboratory investigations, as many as 15 pore volume displacements (PVDs) may be required to achieve restoration.

D.1.b Methodology

As previously stated, a maximum of 15 PVDs, or an estimated 1.3 million gallons, will be pumped from the aquifer. The influx of surrounding groundwater is known as groundwater sweep and is the basis for the restoration method to be used at Christensen Ranch. Through the use of water treatment methods, 70% of this water will be reinjected after treatment to minimize both the required evaporation pond size and groundwater consumption.

The restoration method proposed is groundwater sweep with either Reverse Osmosis (R.O.) or Electrodialysis (E.D.) treatment. Reverse Osmosis is the separation of water and various salts across a membrane which transmits hydrogen bounding compounds. A pressure gradient is the driving force for the process which results in a 60% to 90% separation, depending on initial concentrations. E.D. is similar to R.O. in that it is also a membrane separation process, but uses an electrical potential as a driving force instead of a pressure gradient. (For a detailed description of E.D. and R.O., see Section E.2). The concentrate, or brine, from the separation process is pumped to the solar evaporation pond while the purified water is reinjected into the wellfield.

The volume of the brine stream will vary as the restoration process progresses. Initially, the wellfield lixiviant will contain the highest contaminant concentration. The composition of the brine stream will be the controlling force that determines the process split. Precipitation (scaling) must be avoided during membrane separation processes.

To prevent precipitation due to supersaturation on the brine side of the membranes, the "split," or ratio of permeate to brine solution, may initially only be 1.5:1. As the restoration process continues and the groundwater quality improves, this ratio may approach 9:1.

It is currently anticipated that complete restoration can be achieved with a flush of 15 PVDs, although this is a major research aspect of the restoration phase. The recovery solution will be fed to a surge tank and, if high calcium or carbonate concentrations exist, will be pH adjusted to aid in the prevention of scaling during the concentration operation. A small amount (probably less than one gallon per day) of sodium hydroxide may be added to the injection stream to raise the pH closer to the baseline value. A reductant will be added to the injected stream to aid in the reversal of the oxidation process. A conservative estimation of waste would assume a 70%/30% split over the entire restoration time and would, therefore, produce

$$15 \text{ PVD } \left[\frac{84{,}024 \text{ gals}}{\text{PVD}}\right] \left[\frac{0.3 \text{ gals brine}}{\text{gal treated}}\right] = 378{,}108 \text{ gals brine}$$

When combined with wastes produced during the leaching operation, the pond wastes should not exceed 8.5 feet in depth (479,000 gallons) (see Section C.2.b.1). An estimate of the concentration range of each of the waste streams to be produced during the R&D project appears in Table D.1.

D.1.c Subsidence Monitoring

Subsidence monitoring is not warranted for this process (see Section C.6).

TABLE D.1

ESTIMATED FLOW AND COMPOSITION RANGE
OF LIQUID WASTE STREAMS

(All units in mg/ℓ unless specified)

	Over-Recovery	Eluant Bleed	Restoration Brine
Flow (GPM)	.25 - 1.25	.10 - .25	5 - 10
Na^+	1000 - 3500	23,000-34,500	4000 - 10,000
Ca^+	100 - 300	50 - 200	400 - 1200
Cl^-	1000 - 3000	35,000-53,000	4000 - 12,000
$CO_3^=/HCO_3^-$	2000 - 5000	10 - 50	8000 - 20,000
$SO_4^=$	100 - 300	5000 - 10,000	400 - 1200
U_3O_8	1 - 3	3 - 50	1 - 20
Ra^{226}(pCi/ℓ)	100 - 800	100 - 800	100 - 800

D.1.d Monitoring Water Quality

During the restoration phase, the two wellfield recovery wells, RW-01, and WCPW-21, shall be the primary sampling wells. They will provide the best indication of groundwater quality at any given time because of their continuous operation. They will be routinely sampled (once per day) and analyzed for the excursion parameters listed in Section C.5.c. These two wells shall also be sampled once every week and assayed for the entire baseline suite of parameters listed in WDEQ Guideline 8, thorium-230, lead-210, and polonium-210.

In addition to the recovery wells, monitor wells listed in Section C.5.b, excluding trend wells, will be sampled once every week and assayed for the excursion parameter set. Should any well be on excursion status upon initiation of restoration activity, the sampling schedule discussed in Section C.5.d shall supercede the above schedule for that well. All well locations are presented in Figure C.5-1 of Section C.5.b.

Upon completion of restoration, a groundwater stabilization monitoring program will begin in which the two recovery wells, RW-01 and WCPW-21, and any monitor wells contaminated during the mining operation, will be sampled and assayed for WDEQ Guideline 8 parameters, thorium 230, lead-210, and polonium-210. If six samples taken at least one month apart show that groundwater quality has remained within its water classification as determined by the baseline groundwater quality sampling, stabilization shall be deemed complete.

D.2 Surface Restoration

The following restoration plan provides procedural techniques for reclaiming disturbed areas on Western Nuclear's Willow Creek ISL R&D #1 site. These disturbed areas include the plant site and associated well pads, evaporation pond, and soil stockpile site. Table D.2-1 provides the area disturbed by each component.

The techniques and seed mixtures described herein were chosen to reflect local climatic conditions, as well as site-specific environmental data, and are responsive to current regulations.

TABLE D.2-1

AREA OF DISTURBANCE ASSOCIATED WITH CONSTRUCTION OF PROJECT FACILITIES ON THE WILLOW CREEK SITE #1

Component	Area (sq. ft.)	Acres
Plant Area	3,125	0.07
Well Field	10,000	0.23
Evaporation Pond	63,438	1.46
Access Roads	97,574	2.24
	Total	4.00

D.2.1 Post-Mining Land Use

The project area has historically been used for domestic cattle and sheep grazing along with limited hunting activity. The disturbed site will be reclaimed to provide for these uses after project abandonment, or will be developed into a production facility pending further agency approval.

D.2.2 Disposal of Buildings and Other Facilities

After aquifer restoration has been accomplished, injection and production pipelines will be removed from the property. Lines that are not reusable will be disposed at a licensed landfill. Salvageable lines will be held for use in other in-situ leach activities. All wellhead equipment, such as valves, meters, or control panels, will likewise be salvaged or destroyed.

Because the plant will consist of portable trailered units, no building disposal will be necessary.

D.2.3 Hazardous Wastes

No wastes classified as hazardous (by EPA definition, 40CFR Part 261) will be generated as a result of this project. Some low-level radioactive residues may be produced and would be disposed of in the following manner.

All liquids held in the evaporation pond will be evaporated. Any remaining solid waste will be examined for radium-226. If significant radioactivity is found, the residue and pond liner will be drummed and transported to the licensed disposal facility at Jeffrey City. Following this removal, a survey will be performed on the earth at the pond bottom; any contaminated material will be removed. Subsurface soils in both the plant area and pond bottom will be analyzed to verify that pertinent radionuclide concentrations are within acceptable levels.

D.2.4 Topography

There will be almost no excess material generated by the project that will require surface disposal on the site. The only changes in topography will be temporary and will result from soil salvage

procedures. Once topsoil is replaced, all reclaimed areas will be regraded to blend with the surrounding natural grasslands and revegetated with a species mixture that is compatible with existing land uses. Since no major drainages exist within the site, surface drainage will remain essentially unaffected.

D.2.5 Surface Preparation and Revegetation

Soil materials to be removed from construction areas will be salvaged prior to the initiation of construction. Any vegetation that would inhibit the salvage of soil materials will be removed from those areas. Soils will then be recovered to specified depths according to the type of construction which is to take place. Based on soils data taken on the site, the A and B horizons (approximately 18 inches) will be salvaged from the plant area site and drill sites within the well field; an average of 60 inches of sub-soil will be salvaged from the evaporation pond site and used as berm fill material. Soil survey results indicate no significant revegetation problems should be encountered.

Salvaged soil materials will be taken to a stockpile. The stockpile will be positioned approximately perpendicular to the prevailing wind direction and will be maintained in a low profile to reduce wind erosion potential. Out-slopes of the stockpile will be no steeper than 3:1. The stockpiles will not be disturbed or rehandled, except for stabilization purposes, until the soil is to be distributed on a graded surface. The soil stockpile will be protected from vehicular traffic, waste disposal, construction, or other disturbances to avoid unnecessary compaction or contamination. The stockpile will be clearly marked with signs for identification.

At the completion of soil salvage and stockpile operations, the soil stockpile will be vegetatively stabilized to reduce soil loss through wind erosion. Revegetation methods to be applied are described in later paragraphs.

Surface preparation which will take place prior to topsoil replacement will include backfilling of the pond excavation with subsoil, compaction, and preliminary grading. Any contaminated soil will have been removed and disposed at WNI's Split Rock mill tailings facility in Jeffrey City, Wyoming. The general reclamation schedule is included in Figure C.2-4 (see the Mineral Extraction Plan, Section C).

Upon completion of stabilization of the groundwater quality, approximately 464,000 gallons will be held in the evaporation pond (8.3 feet in depth). Since the net evaporation rate in this part of the state is 42 inches per year, approximately two years will be required for total evaporation. After approximately one and one-half years, a small enough volume will be left in the pond to allow haulage to Jeffrey City to begin. The beginning of pond reclamation will, therefore, occur in the Spring of 1986 and will take two months to complete.

During the evaporation period (the period between completion of groundwater restoration and surface reclamation), the site will be routinely inspected for pond leakage and linear integrity. Should any erosional problems appear during these inspections, they will be promptly mitigated.

All grading, soil application, seedbed preparation, and mulching operations will be completed on the contour or perpendicular to the prevailing wind direction on level sites. Soil from the stock piles will be reapplied to disturbed sites using a front-end loader. Subsoil will be applied before topsoil on the evaporation pond. Depending upon availability, soil will be applied to a depth of approximately 6 inches above the grade of the surrounding terrain to account for some soil settling over time. An average of 18 inches of soil will be reapplied to the plant area and drill sites; a minimum of 60 inches of soil (topsoil plus subsoil) will be applied to the floor of the evaporation pond. The general standard for regrading will be a final grade that will blend with the adjacent topography.

The revegetation program will be implemented after final grading has been completed. Planting will be completed either during the fall after October 15, or in the early spring before April 15. Seed will be drilled to a depth of 0.5 inch on an 8-inch row spacing with a rangeland or comparable drill. The following mixture and pounds/acre of pure live seed (PLS) is recommended:

Green needlegrass (Stipa viridula) var. "Lodorm"	5 lbs/acre
Western wheatgrass (Agropyron smithii) var. "Rosana"	5 lbs/acre
Thickspike wheatgrass (Agropyron dasystachum)	3 lbs/acre
Yellow sweetclover (Melilotus officinalis)	1 lb/acre
Total	14 lbs/acre

Commercial sources for these species are listed on Table D.2-2.

Small areas or steep slopes that can not be effectively drilled will be broadcast seeded. Broadcast seeding rates will be double those for drilling. Landowner's wishes will be considered for alternatives to this seed mixture plan.

Fertilizer application will be based on a fertility analysis of the topsoil stockpile. A general prescription for soils in this climatic region would be 40 lbs/acre of nitrogen (total nitrogen) and 60 lbs/acre of available phosphorus. Fertilizer will be broadcast onto seeded areas prior to mulching.

To insure proper revegetation, on-going maintenance of the reclaimed area will be provided. Livestock will be fenced away from all reclaimed areas until vegetation is established.

Inspections of reclaimed areas will be conducted twice yearly in the spring and fall until bond release. Where significant erosion or soil slumping has occurred, these conditions will be remedied by re-grading, seeding, mulching, etc., as necessary.

Where seeding attempts have failed, the soil surface will be roughened and seeded again using the appropriate method. The area will again be fertilized and/or mulched again, as necessary.

D.3 Reclamation Schedule and Cost

Estimation of Groundwater Restoration Costs

Preliminary estimates indicate processing costs for both reverse osmosis and electrodialysis to be between $3.00 and $5.00 per 1,000 gallons treated. For the purpose of estimating bond requirements, $4.00 per 1,000 gallons is used. The only other operating costs connected with restoration are assay and haulage costs. Total estimated restoration costs are summarized in Table D.3-1.

Estimation of Surface Restoration Costs

A cost estimate for surface restoration is provided in Table D.3-2.

D.4 Bonding

A bond in the amount of $73,744 for restoration and reclamation costs will be filed with the Wyoming DEQ Land Quality Division.

TABLE D.2-2

PLANT MATERIAL SOURCES

Species	Sources
Green needlegrass (Stipa viridula)	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13
Streambank wheatgrass (Agropyron riparium)	1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13
Thickspike wheatgrass (Agropyron dasystachyum)	1, 2, 4, 6, 7, 8, 9, 10, 12, 13
Western wheatgrass (Agropyron smithii)	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12
Yellow sweetclover (Melilotus officinalis)	1, 2, 5, 6, 9, 10, 12, 13

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Potential Seed Dealers

1. Arkansas Valley Seeds, Inc.
   Rocky Ford, Colorado 81067
   (303) 254-7460 or 254-7469

2. Boyd E. Goble and Sons Seed Company
   P.O. Box 175
   Gunnison, Utah 84634
   (801) 528-3234

3. C and S Intermountain Seed Enterprise
   Box 62
   Ephraim, Utah 84627
   (801) 283-4383 or 789-0109

4. CENEX Seed Company
   P.O. Box 1748
   Billings, Montana 59103
   (406) 656-7150

5. Globe Seed and Feed Company
   P.O. Box 445
   Twin Falls, Idaho 83301
   (208) 733-1373

TABLE D.2-2 (CONTINUED)

POTENTIAL SEED DEALERS

6. Horizon Seeds, Inc.
1540 Cornhusker Highway
P.O. Box 81823
Lincoln, Nebraska 68501
(402) 475-1232

7. Native Plants
360 Wakara Way
Salt Lake City, Utah 84108
(801) 582-0144 or 486-8154

8. Northplan Seed Producers, N.A.P.G., Inc.
P.O. Box 9107
Moscow, Idaho 83843
(208) 822-8040

9. Northrup King Co.
51 Bowen, P.O. Box 998
Longmont, Colorado 80501
(303) 776-1320

10. Riggs Seed Co., Inc.
Shoshoni, Wyoming 82649
(307) 856-3004

11. The SEXAUER Company
P.O. Box 58
Brookings, South Dakota 57006
(605) 692-6171

12. Sharp Bros. Seed Co.
Healy, Kansas 67850
(316) 398-2231

13. Western Seed and Supply, Inc.
Box 57
Charlo, Montana 59824
(406) 664-2202

and

Box 67
Ronan, Montana 59864
(406) 676-3900 or 676-4100

TABLE D.3-1

ESTIMATE OF GROUNDWATER RESTORATION COSTS

Capital Costs:	
R.O. (or E.D.) Unit	$30,000
Membranes	6,000
	$36,000
Operating Costs:	
15 PVDs @ $4.00/1,000 gals	$5,041
Sampling:	
Daily samples	2,240
Weekly samples	2,418
Baseline Suites	6,250
Pond residue removal (to Jeffrey City)	10,500
TOTAL	62,449

TABLE D.3-2

SURFACE RESTORATION COST ESTIMATE FOR
WILLOW CREEK R&D SITE #1

	Unit Cost	Total Cost
Equipment Removal		$1,260
Backfilling, Grading and Re-topsoiling (10,500 yd^3)	0.75/yd^3	7,875
Seeding (4 acres)	110/acre	440
Fertilizing (4 acres)	60/acre	240
Mulching (4 acres)	120/acre	480
Fencing		1,000
	Total	$11,295

E. RESEARCH SECTION

E.1 Introduction

Several items will be addressed during the research and development phase of the project. Generally, leaching kinetics and restoration methods will be investigated for technical and economic viability.

The investigations include the following:

- Pattern extraction rates; confirm or refute predictions from the laboratory.
- Determine the effect of various lixiviant component concentrations on the extraction curve.
- Evaluate loading and elution characteristics under field conditions.
- Estimate the quality of precipitated product with respect to molybdenum, vanadium, sodium, etc.
- Investigate the requirements and limits of aquifer restoration.

As noted earlier, waste stream compositions and any potential effects on background conditions, whether short- or long-term, will be evaluated.

E.2 Identification and Description

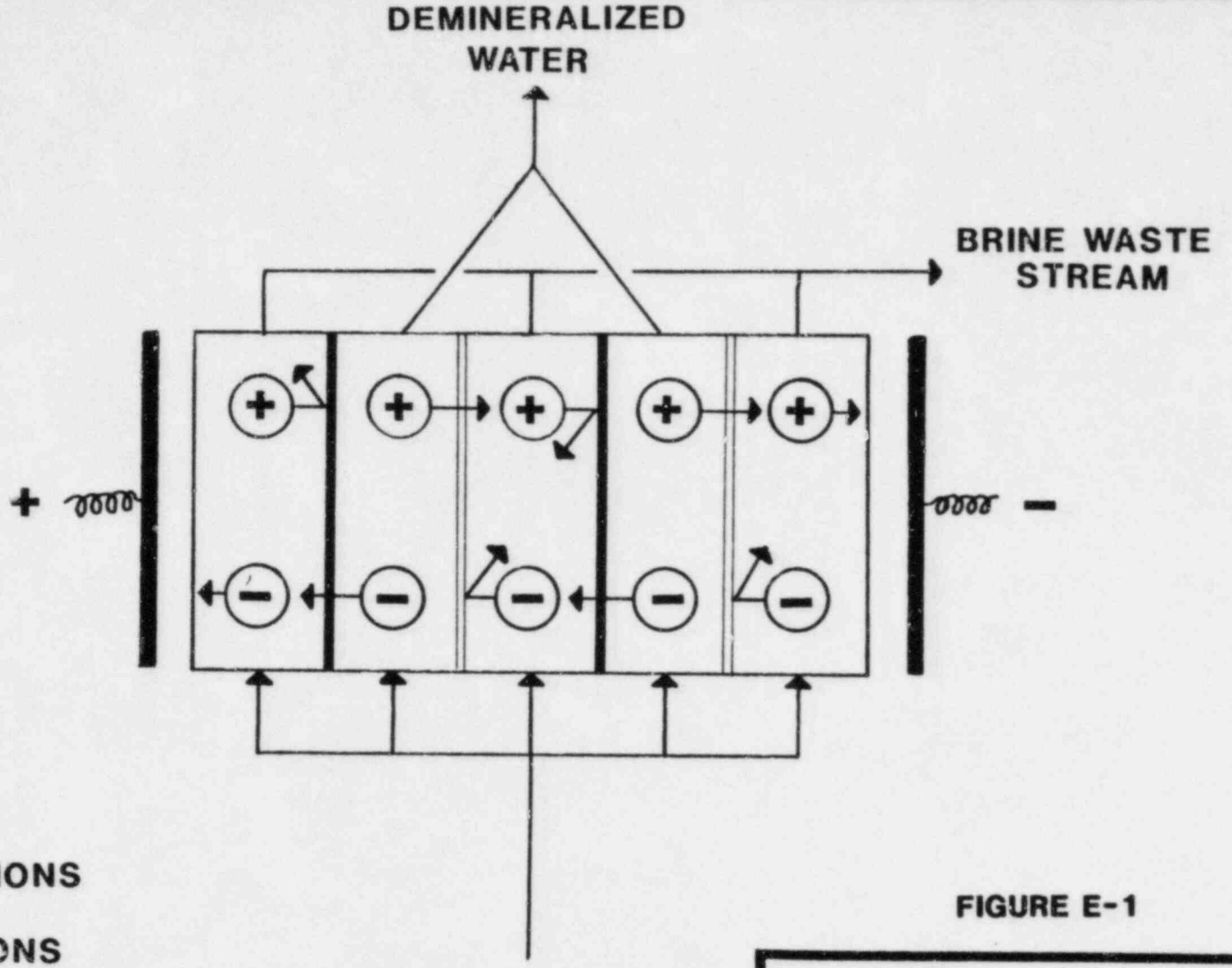
The first research area to be investigated will be the uranium extraction rate (leaching kinetics). Recovered uranium concentration (headgrade) is a major factor affecting the capital requirements and operating costs for a given production rate. Preliminary estimates indicated 70% of the ore can be leached in no more than 40 pore volume displacements (PVDs). A complete extraction curve (% extraction versus PVDs) will be generated to determine the economic headgrade cut-off point. This information, in conjunction with various ion exchange equilibrium and kinetic studies, will allow accurate sizing of the commerical ion exchange recovery plant to meet the desired production goals. Data to be collected for these investigations include injection or recovery flow rate per well, injection and recovery uranium concentrations, injection pressures, and reagent inventories. All field readings will be recorded on shift log sheets and submitted to the Operations Engineer or designate daily.

Other investigations will be conducted within the recovery plant and will focus on optimizing elution and precipitation chemistries. The in-plant investigations are not as important as the wellfield investigations because of the high degree of in-plant reproducibility anticipated from laboratory results. In general, elution and precipitation flow rates and various parameter assays are required to optimize this process.

One investigation vital to the overall viability of an ISL operation is the restoration of the affected aquifers to their premining condition. A conventional groundwater sweep with water treatment and recycle is proposed. Two possible methods of water treatment are being considered: reverse osmosis (R.O.) and electrodialysis (E.D.). Reserve osmosis is a membrane separation technique utilizing a pressure gradient as a driving force. Hydrogen bonding of water molecules with the membrane material allows water passage while restricting salts from passage. The brine stream is disposed in the evaporation pond while the permeate stream is reinjected into the wellfield.

Electrodialysis is similar to R.O. in that it also is a membrane separation process, whereas E.D. utilizes an electrical potential as a driving force. An E.D. unit is made of cation exchange membranes and anion exchange membranes alternated in a parallel array (see Figure E-1). Cation exchange membranes will only allow the passage of cations, while anion exchange membranes only allow passage of anions. The entire membrane bank is held between two electrodes. Application of a potential across the electrodes causes the dissolved ions to begin migrating toward their respective electrodes (cations to the cathode and anions to the anode). Ions can therefore transfer through the first membrane encountered but are restricted from passage through the second membrane. Concentration occurs in alternating sections, while purification occurs in the others. The brine stream and purified streams are drawn off and pumped to the evaporation pond and wellfield, respectively.

Final selection of this unit operation equipment has yet to be made pending further investigation into capital and operating costs of each unit. Selection of the unit is not anticipated to affect the quantity or concentration of the produced wastes nor to adversely affect the degree of restoration attainable since both units perform the same function.



ADAPTED FROM LACEY, R.E. MEMBRANE SEPARATION PROCESSES, CHEM. ENG. SEPT. 1972

FIGURE E-1

Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

SCHEMATIC REPRESENTATION OF ELECTRODIALYSIS WATER PURIFICATION

WESTERN NUCLEAR, INC.

The amount of HCl, NaOH, and reductant required (as described in Section D.1.b) to efficiently aid restoration will be another research topic.

Accurate records of both total flow injected and recovered, along with all assays as outlined in Section D.1.d, will be maintained as described in Section E.3.

E.3 Records and Reporting

An operator log sheet, completed on a shift basis, will be kept and will contain all flow meter readings, pressure gauge readings, field assays, process sampling times, and comments pertinent to the restoration operation. These reports will be submitted to, and reviewed by, the Operations Engineer or designate on a daily basis. Any discrepancies regarding flow meter readings or lab assays will be investigated. A log book will be kept by the Operations Engineer containing a daily summary of events. These logs will be the basis for technical report preparations, both internal and external, and for correspondence to various agencies.

All groundwater restoration assays will be retained as discussed in Section C.5.e.

The U.S.N.R.C. shall be supplied with a semi-annual report which summarizes the status of the R&D operation. The report will include all data necessary to support the statements made in the report. All environmental monitoring data will be included.

The Wyoming DEQ shall be supplied with annual reports containing the same information as listed above.

Both the U.S.N.R.C. and the Wyoming DEQ will be supplied with a final report upon completion of the restoration and reclamation phases. This report will include all research results, logs, procedures, and conclusions reached during the research operation.

5.0 OPERATIONS

All operations will be conducted in conformance with applicable laws, regulations, and requirements of the various regulatory agencies involved. The programs described below have been designed to both ensure compliance and further implement the Western Nuclear, Inc. (WNI) policy for providing a safe working environment with cost-effective incorporation of the philosophy of maintaining radiation exposures as low as is reasonably achievable (ALARA).

5.1 Project Organization

Figure 5.1-1 depicts the organizational chart of personnel responsible for the development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and groundwater monitoring programs with associated quality assurance programs, and routine and nonroutine maintenance activities.

5.1.1 Management Responsibilities

- Director of Solution Mining. The Director of Solution Mining, WNI Corporate Headquarters, Denver, Colorado, is responsible for the entire R&D operation, to include overall direction of R&D planning, adherence to budgets, and administration. The Director of Solution Mining reports directly to the President, WNI, Denver, Colorado.

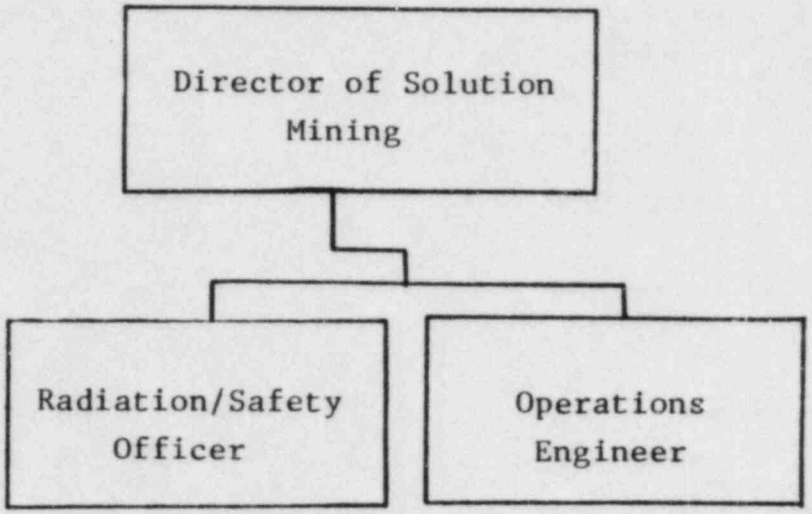
- Operations Engineer. The Operations Engineer is responsible for all technical aspects of the R&D operation, for permit compliance, and for evaluation of groundwater monitoring. The position requires technical and economic analyses of the process, performance optimization, and design scale-up of R&D data to commercial scale. Both plant and wellfield operators, as well as laboratory technicians, report to the Operations Engineer. The Operations Engineer reports directly to the Director of Solution Mining.

- Radiation/Safety Officer. The Radiation/Safety Officer (RSO) is responsible for the development and implementation of all safety programs, including emergency procedures. The RSO will personally inspect facilities to verify compliance with all applicable requirements in the areas of radiological health and safety as well as industrial health and safety. The RSO will work closely with the Operations Engineer to ensure established programs are maintained.

  The RSO is responsible for the orderly collection and interpretation of all monitoring data, to include data from industrial safety, radiological safety, and environmental

Figure 5.1-1

ORGANIZATIONAL CHART



monitoring programs (excluding groundwater monitoring data). The RSO recommends measures as necessary to improve any and all safety-related controls. The RSO reports directly to the Director of Solution Mining.

Corporate management and professional review, guidance, and assistance from the WNI corporate management headquarters is provided as necessary. When necessary, outside consultants will be utilized to review, evaluate, and recommend remedial action.

5.2 Management Control Program

To ensure all activities are conducted in accordance with applicable requirements, WNI will incorporate both a management control program and administrative procedures as outlined below.

5.2.1 Written Operating Procedures

Written operating procedures (WOP) will be developed prior to commencement of operations for all production and nonproduction aspects of the R&D operations. All required approvals, procedures, and precautions will be incorporated into written procedural manuals to be developed for the following:

1. Operations.
2. Radiation Safety Program (including Quality Assurance provisions).
3. Environmental Monitoring Program (including Quality Assurance provisions).

The written operating procedures will be formally reviewed and approved by appropriate supervisors, including the Operations Engineer and the Director of Solution Mining. Since the project lifetime is not anticipated to exceed six months, annual review/revision of the WOP is not necessary.

For any nonroutine work or maintenance activities not covered by any effective operating procedure, a special radiation work permit will be reviewed and approved by the RSO prior to commencement of operations.

In the case of nonroutine maintenance where employee exposure limits are approached, the RSO will instruct the Operations Engineer to remove affected employees from the designated work area.

In addition to the required approvals discussed above, if it has been determined any process or operation proves an immediate radiation hazard to employees, the RSO will recommend to the Operations Engineer to cease operations until the hazard has been mitigated. If the Operations Engineer does not concur with the RSO's recommendations, both the RSO and the Operations Engineer will confer immediately with the Director of Solution Mining or his designate for prompt resolution of the problem.

5.2.2 Internal Monitoring Reports

Once per month, the RSO will prepare a report addressing the following:

1. All monitoring data, excluding groundwater monitoring data, including graphical presentation where appropriate.

2. Employee exposure calculations.

3. Correlations, where appropriate, of survey data with employee exposures.

4. Trend analysis (for upward and downward trends) including graphical presentation where appropriate.

5. Summary of weekly inspections by RSO or designate.

6. Unusual discharges.

7. Problem areas.

8. Recommendations and proposed schedule for necessary corrective actions and followup of previous recommendations.

9. Adequacy of implementation of license conditions.

10. Items of regulatory noncompliance with schedule for achieving full compliance.

11. Review results vis-á-vis the ALARA philosophy/make recommendations with proposed schedule for corrective actions.

12. Recommendations for improving the radiation safety program.

The monthly reports prepared by the RSO will be formally submitted to appropriate supervisors for review.

Once per month, the Operations Engineer (OE) will prepare a report addressing the groundwater monitoring program. The report will include an evaluation of all groundwater monitoring data and will be submitted

to the Director of Solution Mining for review. Should an excursion occur, the OE will submit weekly reports to the Director of Solution Mining regarding the excursion and corrective actions taken until such time as it has been determined the excursion has been controlled.

5.3 Management Audit and Inspection Program

5.3.1 Inspections

Because of the limited degree of potential hazard as well as limited occupancy times in process trailers, the RSO or designate will perform an inspection once per week of all facilities and practices with respect to radiation safety. The results of the inspection will be documented. Any conditions of noncompliance or deviations from proper radiation protection practices will be documented and reported to the Operations Engineer for corrective action.

5.3.2 Management Audits

During the operational and reclamation phases, management audits will be performed once every three months. However, during the evaporation/reclamation phases, these audits will be performed annually. The audit will be conducted by a minimum of two individuals, one representing radiation health and the other the onsite RSO. Operating procedures, exposure records, inspection reports, training programs, safety meeting reports, nonroutine maintenance activities, and results of all monitoring data, including environmental monitoring data, will be reviewed. An inspection of the facilities will also be conducted. Results of the audit and recommendations made by the Audit Committee will be reported to the "As Low As Reasonably Achievable" (ALARA) Committee which is comprised of the Audit Committee and the Operations Engineer. Results of the audit and recommendations made by the ALARA Committee will be submitted in writing to the Director of Solution Mining. Corrective actions taken in response to the audit/ALARA recommendations will be documented via internal memorandum.

5.3.3. ALARA Program

Mechanisms through which WNI will continue to ensure that employee exposures and effluent releases are maintained ALARA are listed below:

1. The ALARA Committee, as a result of findings and recommendations made by the in-house audit, will submit written recommendations to the Director of Solution Mining to maintain employee exposures as well as effluent releases ALARA.

2. Monthly reports written by the RSO will specifically address implementation of the ALARA philosophy.

3. It is a continuing policy of WNI to review on a cost-effective basis any additional engineering controls to maintain both exposures and effluent releases ALARA.

4. In addition to both "classroom" and on-the-job training of new employees, WNI maintains a continuing education program for all employees. Discussed during safety meetings will be methods through which the employees as well as WNI can improve radiation safety aspects of operations.

Furthermore, employees will be instructed regarding their responsibility to adhere to all rules, notices, policies, and operating procedures as well as their responsibility to report to appropriate supervisors any equipment malfunction or violation of standard practices/ procedures that could result in an increased radiological hazard to either employees or the public.

5.4 Qualifications

Minimum qualifications for the Radiation/Safety Officer are enumerated below:[1]

1. Education. A Bachelor's Degree in the physical sciences or engineering from an accredited college or university.

2. General Experience. One year of supervisory experience and one year of experience in uranium mill or related industry.

3. Health Physics Experience. One year of work experience in applied health physics, radiation protection, industrial hygiene, or similar work. This experience will involve actually working with radiation protection measurement equipment rather than only administrative or "desk" work.

4. Specialized Training. A formalized intensive course(s) in health physics of at least four weeks' duration. At least one week of the course will be specifically applicable to health physics in uranium milling/in-situ operations. In addition, if operations continue, the RSO will attend a refresher course on uranium mill health physics every two years.

5. Specialized Knowledge. A thorough knowledge of the proper application and use of all health physics used in the mill, the chemical and analytical procedures used for radiological sampling and monitoring, and methodologies used to calculate personnel exposure to uranium and its daughters.

Where specific individual appointments have been made for the Director of Solution Mining, the Operations Engineer, and the Radiation/Safety Officer, the resumes are attached in Attachment A to this section.

If the RSO does not meet the educational requirements specified above, but possesses prior work experience in radiation safety, WNI will consider two years of applied radiation safety work experience as a substitute for each year of the college level educational requirement.

5.5 Training

The purposes of the in-house radiation safety training program include:

1. Place in proper perspective for the employee the short and long-term radiation hazards associated with the job.

2. Instruct and train employees in practices instituted by management to maintain occupational exposures ALARA.

3. Assure each employee has an understanding (both initially and over the duration of his employment) of the radiation safety procedures which should be followed.

4. Stress most radiation safety procedures are "common sense" procedures just as are occupational safety procedures that have been implemented to protect the employee.

5. Emphasize the employee's personal responsibility to protect himself by adhering to all safety procedures.

Prior to commencement of work, all employees will receive instruction in plant and personal safety, including radiation protection procedures taken to minimize radiation exposures. The content of the initial training will include the following:[1,2,3]

1. General theory of radiation, types of radiation.

2. Fundamental principles of radiation protection, including the ALARA concept and risks associated with occupational exposure.[2,3]

3. Respirator usage; eating/drinking/smoking/chewing only in designated areas; decontamination.

4. Facility-provided protection, including cleanliness, safety design features of process equipment/ventilation and effluent controls; written operating procedures; and security/access control provisions.

5. Health protection measurements.

6. Radiation protection regulations including regulatory authority of NRC, MSHA, and State of Wyoming; employee rights (10 CFR 19)[4]; and applicable provisions of NRC regulations[4,5,6] and licenses.

7. Emergency procedures.

The extent of these instructions will be commensurate with potential radiological health protection problems in the restricted area.[4]

To verify employee comprehension of the radiation protection training outlined above, a written test with a predetermined minimum passing score will be provided all employees. Any incorrect answers to test questions will be discussed and any employees who fail the initial test will be retested after further training. The tests will be maintained in employee files.

Since the project lifetime is not anticipated to extend to one year, formal documented retraining (routinely performed once per year) is not necessary. However, safety meetings will provide additional radiological health protection information specific to the operation, to include problem areas, changes in applicable requirements, and exposure trends. The safety meetings will be documented.

In addition to the formal "classroom" training/retraining detailed above, all employees including supervisors will be given on-the-job training regarding the radiation health and safety aspects of their specific jobs. Again, retraining on an annual basis will not be necessary.

Any visitors will be required to register at the office and will not be permitted within the plant area without proper authorization from the Operations Engineer or designate. Visitors who have not received appropriate training regarding specific precautions/hazards will be escorted.

Contractors having work assignments, such as equipment repair, will be given appropriate security, safety, and radiation protection and orientation commensurate with their duties while in the restricted area.

5.6 Security

At least one individual will be onsite at all times. Access to the restricted area will be controlled via fencing and a gate. Furthermore, the yellowcake slurry storage area will be fenced with a chain link fence and a locked gate. (See Section C.3.g.)

The restricted area will be fenced and posted in accordance with 10 CFR 20.203(e)[5], i.e., posting with "Caution -- Radioactive Material". In addition, all entrances to the property will be posted with the sign, "Any building or container within this area may contain radioactive material". Rather than post individual containers in process facilities, entrances to facility buildings containing source materials will be posted with signs stating, "Caution -- Radioactive Materials".

Access to any "airborne radioactivity area" as defined by 10 CFR 20.203(d)[5] will be controlled by caution signs and operating procedures.

5.7 Radiation Safety Controls and Monitoring

Through facility design and administrative practices, WNI will continue to assure radiation exposures for employees, contractors, visitors, and members of the general public will be maintained ALARA. Since the implementation of a successful ALARA program is the responsibility of everyone incidental to the processing of uranium, responsibility for conducting an effective ALARA program is shared by WNI management, the Radiation Safety Officer, and all employees.

WNI management will provide the following:

1. Information policy statements.
2. Periodic management audits of procedural operational efforts to maintain exposures ALARA.
3. Continuing management evaluation of the health physics program, staff, and allocation of adequate space and money.
4. Appropriate briefings and training in radiation protection, including ALARA concepts.

The Radiation Safety Officer will be responsible for the following:

1. Through the Operations Engineer, enforce regulations and administrative policies that affect the radiation protection program.
2. Develop and administer the ALARA program.

3. In conjunction with the Operations Engineer, review and approve plans for new equipment, process changes, changes in operating procedures to assure effectiveness of the ALARA program.

All operators and laboratory personnel will be responsible for the following:

1. Adhering to rules, notices, and operating procedures for radiation protection as established by WNI.

2. Reporting promptly to the RSO or Operations Engineer any malfunction of equipment or violation of standard practices/ procedures that could result in an increased radiation hazard to any individual.

3. Suggesting improvements to the ALARA program.

5.7.1 Effluent Control Techniques

Design of process facilities is detailed in the Minerals Extraction Plan. As stated in section C.2.a of the Minerals Extraction Plan, ventilation rates in operating trailers will be on the order of four air changeovers per hour. Since process tanks are vented directly to the atmosphere, the design effectively minimizes exposure to airborne radionuclides and radioactive materials within process trailers.

Although the R&D project is not anticipated to exceed a six-month period, should the project life be extended beyond a six-month period, the ventilation systems will be inspected on an annual basis to verify that it is operating at its reasonably best expected performance.

Since the process is entirely a wet process, any spills will be cleaned up immediately. If ventilation equipment in any of the process trailers should fail, access to the trailers will be restricted until ventilation is again returned and monitoring determines the concentrations of radioactive materials.

Only a limited amount of packaging of yellow cake slurry for processing at the Split Rock Mill, Jeffrey City, Wyoming will be performed. Packaging will be performed by pumping yellowcake slurry from the precipitation tank through the process trailer wall to a barrel placed outside in the access-controlled yellowcake storage area. Any yellowcake spills will be cleaned up immediately after packaging ceases. Since a very limited amount of packaging will be performed and the wet packaging will occur outside rather than in a process trailer, exposure to airborne uranium will be minimized.

5.7.2 External Radiation Exposure Monitoring Program

5.7.2.1 Surveys

On the basis of once per quarter, external gamma radiation exposure rate surveys will be performed at operator-occupied stations. (See Figures 5.7.2-1 and 5.7.2-2.) Where an action level of 1.0 mR/hour is exceeded at any survey location, not only a more detailed survey will be conducted to determine the probable source, but also, the frequency of gamma surveys will be increased to once per month until values are below 0.5 mR/hour. Decontamination procedures will be instituted as appropriate.

Results of external gamma exposure rate surveys will be correlated with personal dosimetry data to verify applicable levels are in compliance with applicable standards.

If a source of unusual external radiation is noted, appropriate corrective action will be taken to lower the levels of radiation as far below limits as specified in 10 CFR 20[5] as is reasonably achievable and to ensure that no unnecessary exposure occurs in the future.

If results of gamma surveys show radiation levels which delineate a "radiation area" (as defined by 10 CFR 20.203(b)(2))[5], access to the area will be restricted and occupants in the area for working purposes will be controlled.

External gamma exposure rate survey equipment will have the following minimum specifications (or equivalent):

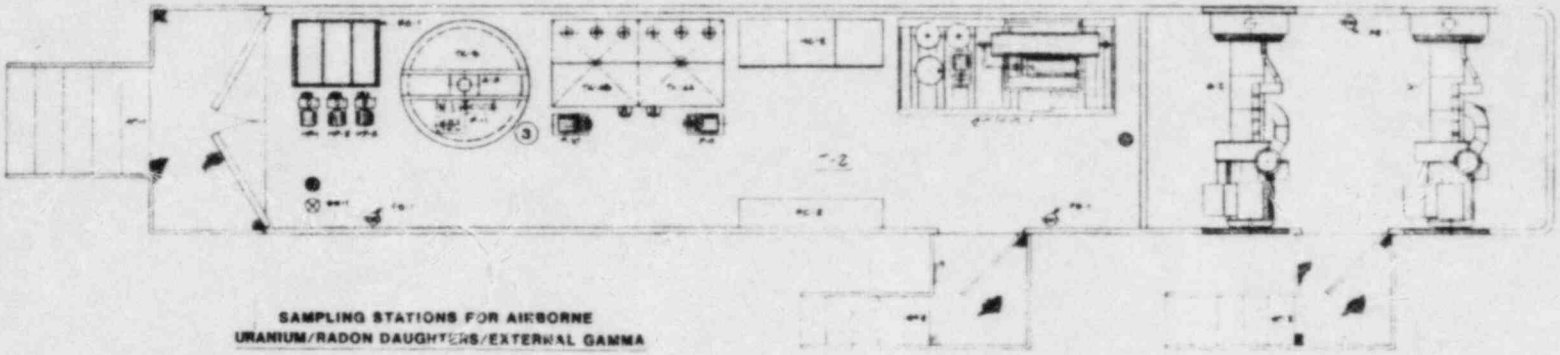
1. Range. Lowest range not to exceed 100 microRoentgens per hour full-scale with highest range to read at least 5 milliRoentgens (mR/hour) full-scale.

2. Battery-operated and portable.

3. Must be operational from approximately 40°F to 120°F.

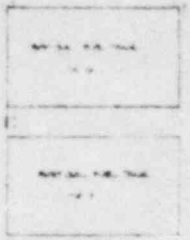
4. Examples of satisfactory meters include Eberline Instruments Corporation Model PRM-7 or Ludlum Instrument, Inc. Model 19 Micro-Meter.

Calibrations will be conducted at least every six months. In addition, prior to each use, the performance of the instrument will be verified with a manufacturer-supplied check source.



SAMPLING STATIONS FOR AIRBORNE
URANIUM/RADON DAUGHTERS/EXTERNAL GAMMA

(3) PRECIPITATION TANK



NOTE:

FUEL TANKS TO BE LOCATED OUTSIDE TRAILER CONTAINMENT AREA IN A SEPARATE BERMED CONTAINMENT AREA.

EQUIPMENT LIST

KEY	DESCRIPTION
A-3	PRECIPITATION AGITATOR
FC-2	FAN COIL UNIT #2
FE-1	FIRE EXTINGUISHER
G-1	DIESEL POWERED GENERATOR NO. 1
G-2	DIESEL POWERED GENERATOR NO. 2
MC-2	MOTOR CONTROL CENTER SWITCHBOARD
MP-1	METERING PUMP #1
MP-2	METERING PUMP #2
MP-3	METERING PUMP #3
P-9	LOW PREGNANT TRANSFER PUMP
P-10	HIGH PREGNANT TRANSFER PUMP
P-11	PRECIPITATION TRANSFER PUMP
RO/ED-1	REVERSE OSMOSIS OR ELECTRODIALYSIS UNIT
RS-1	REAGENT STORAGE RACK
SS-1	SAFETY SHOWER/EYEWASH
ST-1	STAIRWELL #1
ST-2	STAIRWELL #2
T-2	8'W x 45'L INSULATED TRAILER
TK-4A	LOW PREGNANT FRP TANK
TK-4B	HIGH PREGNANT FRP TANK
TK-5	PRECIPITATION TANK
TK-6	DIESEL OIL FUEL TANK
TK-7	DIESEL OIL FUEL TANK

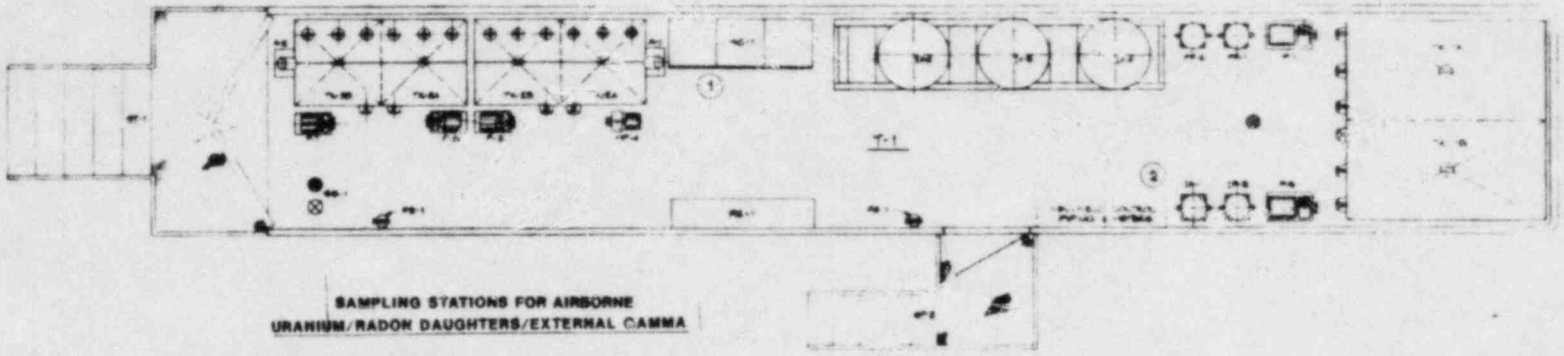
Christensen Ranch ISL Project
R&D Site No. 1
WILLOW CREEK

Bureau Engineering Company
DENVER COLO 80231

MONITORING LOCATIONS

AUXILARY SUPPORT TRAILER T-2

FIGURE 5.7.2-1



SAMPLING STATIONS FOR AIRBORNE URANIUM/RADON DAUGHTERS/EXTERNAL GAMMA

(1) BY MAKE-UP TANKS CONTROL PANEL

(2) WELLFIELD CONTROL PANEL

(3) PRECIPITATION TANK (SEE FIGURE 5. 7. 3-2)

EQUIPMENT LIST

KEY	DESCRIPTION
A-1	CHEMICAL MAKE-UP AGITATOR
A-2	BARREN ELUANT TANK
FC-1	FAN COIL UNIT #1
FE-1	FIRE EXTINGUISHER
IF-1	INJECTION FILTER #1
IF-2	INJECTION FILTER #2
IX-A	ION EXCHANGE COLUMN A
IX-B	ION EXCHANGE COLUMN B
IX-C	ION EXCHANGE COLUMN C
MC-1	MOTOR CONTROL CENTER SWITCHBOARD
MP-4	METERING PUMP #4
P-1	PRODUCTION PUMP
P-5	INJECTION PUMP
P-6	IX RINSE PUMP
P-7	IX ELUTION PUMP
P-8	SPARE PUMP
PF-1	PRODUCTION FILTER #1
PF-2	PRODUCTION FILTER #2
SM-1	STATIC MIXER #1
SM-2	STATIC MIXER #2
SS-1	SAFETY SHOWER/EYEWASH
ST-1	STAIRWELL #1
ST-2	STAIRWELL #2
T-1	8'W x 45'L INSULATED TRAILER
TK-1A	PRODUCTION SURGE TANK
TK-1B	INJECTION SURGE TANK
TK-2A	SODA ASH MAKE-UP TANK
TK-2B	IX RINSE TANK
TK-3A	BARREN ELUANT TANK
TK-3B	SPARE TANK

Christensen Ranch ISL Project

R&D Site No. 1

WILLOW CREEK

Bechtel Engineering Company

DENVER COLO. 80201

MONITORING LOCATIONS

RECOVERY / INJECTION TRAILER T-1

FIGURE 5.7.2-2

5.7.2.2 Personnel Dosimeters

All employees will be issued personnel dosimeters that will be exchanged on a once-per-quarter basis. Dosimeters will be worn on the front of the body between the neck and waist, not on the back of hard hats.

All exposure records will be maintained in accordance with regulations set forth in 10 CFR 20.102.[5] Any investigations of exposures will be documented.

Where the results of personnel dosimeters reveal a gamma dose in excess of 25% of 1.25 rem in any calendar quarter, an investigation to determine where and how the exposure occurred will be performed. Also, external gamma ray exposure rate survey data will be evaluated to verify the work area has no unusual external radiation and, if necessary, additional gamma exposure rate surveys of the area will be conducted to determine potential cause of the elevated levels of external radiation. Results of dosimeter readings for other employees working in the same area will be reviewed to verify there is no excessive exposure.

5.7.2.3 Data Evaluation

For both trend analysis and verification of personnel dosimetry results, gamma survey results will be correlated with personnel dosimetry results.

5.7.2.4 Access Control

No person of age 18 years or under will be allowed to work in the facilities. Exposure of an occasional visitor who is less than 18 years of age is automatically limited by the limited period of contact and the controlled environment required in the restricted area. No visitor will spend more time than would result in exposure values exceeding 10% of the levels specified in 10 CFR 20.101.[5]

5.7.3 Airborne Radiation Monitoring Program

Exposure to airborne radioactive materials will be determined from both occupancy factors and concentrations of airborne radionuclides.

5.7.3.1 Sampling Locations

Sampling locations have been selected on the basis of the knowledge of possible hazards, on general appearance of the area, and on occupancy levels in the area. Sampling locations for airborne particulates and radon daughters will be the same and are shown in Figures 5.7.2-1 and 5.7.2-2. Because of the small dimensions of the process trailers (approximately 45 X 8 X 8.5 feet), all process tanks will be either directly vented to the outside or completely enclosed, and because no operator will be permanently located at any site in either of the process trailers, a minimum number of sampling sites have been chosen.

5.7.3.2 Air Sampling

Fixed location sampling for airborne uranium particulates will be performed monthly at operator-occupied stations unless sampling results for any period indicate employee time-weighted exposures could exceed 10% of MPC. For fixed location sampling of airborne uranium, sample volumes will be adequate to achieve a lower limit of detection of 10% of the MPC for uranium in air.[5,7] Air sample filters will be analyzed by the most cost-effective approach which may include x-ray analysis of uranium, fluorimetry, or gross alpha counting.

Radon daughter sampling will be performed monthly at operator-occupied stations. Sample analysis will be performed using standard procedures such as the Modified Kusnetz or Rollée method.

For work inside any process equipment that routinely contains radioactive materials, special monitoring to include radon daughter sampling, beta and gamma surveys prior to commencement of work, and continuous airborne uranium sampling will be performed. Results of all surveying/monitoring will be documented.

5.7.3.3 Exposure Control Limits

Action levels for more frequent sampling are depicted below:

Radon Daughters	Action Level	Action Required
Radon Daughters	0.08 WL	Additional samples will be collected at least weekly during the following month til the results of four consecutive samples are below 0.08 WL.

5.7.4 Exposure Calculations

5.7.4.1 Time Exposure Records

Documented time studies will be performed on all operators to determine the amount of time spent in each area. Time studies will be performed once per six-month period for operators in each working area.

5.7.4.2 Employee Exposure Calculations

Employee exposure calculations will be determined in accordance with 10 CFR 20.103.[5] Depending upon the solubility classification of each airborne radioactive species, weekly or quarterly exposures will be determined.

In accordance with 10 CFR 20.103(a)(3)[5], when assessment of a particular individual's intake of airborne radioactive materials is such that the intake would be less than 10% of MPC based on a time-weighted exposure, exposure calculations will not be determined.

If calculations of employee exposure show values in excess of 25% of MPC based on time-weighted studies, an investigation will be performed to identify unknown problem areas. In addition, if either any airborne uranium sample or radon daughter sample value, except for samples taken in a "controlled airborne radioactivity area", exceeds the applicable MPC for the airborne radionuclide in air[5], the RSO shall institute an investigation. Any noted problem areas will be studied and necessary corrective actions taken to ensure that exposures are ALARA. The evaluations will be documented and maintained on file.

Although it is a continuing WNI policy to maintain exposures to airborne radioactive materials ALARA, it may be necessary to use respirators under certain conditions. Therefore, WNI hereby applies for NRC approval/authorization of WNI Respirator Protection Program detailed in Attachment B where the respirator protection program has been designed in accordance with NRC Regulatory Guide 8.15[8], "Acceptable Programs for Respiratory Protection". Where respirators are used in compliance with the above, a variance will be applied when computing employee exposures to airborne radioactive materials.

5.7.5 Bioassay Program

Since employees will be exposed only to soluble airborne uranium, only bioassay consisting of urinalyses will be performed. Bioassay samples will be collected prior to commencement of work for all employees, and on the frequency of once every other week thereafter unless action levels specified in NRC Regulatory Guide 8.22[9] are exceeded.

If an action level of 15 µg U(nat)/liter is exceeded, an investigation including resampling will be initiated and documented to verify the sample result. Corrective actions will be taken as necessary to prevent recurrence.

5.7.6 Contamination Control Program

Prior to exiting the restricted area, employees will monitor their work clothes and shoes. When an action level of 1,000 dpm total alpha per 100 cm^2 is exceeded, employees will shower and clothing will be washed onsite. If, for any reason, monitoring is not performed, personnel will shower. Either protective shoe coverings or rubber boots will be issued for wear at all times in process facility trailers.

Employees performing yellowcake packaging or maintenance of the precipitation tank will be issued coveralls that will be laundered onsite. Gloves will also be issued for wear. Again, protective shoe coverings or rubber boots are required to be worn at all times in process trailers.

Employees will be required to wash prior to eating. Eating areas will only be provided in the office trailer. Office surfaces and eating areas will be surveyed on the basis of once per week for alpha contamination. Where an action level of either 1,000 dpm total alpha per 100 cm^2 or 250 dpm removable alpha per 100 cm^2 is exceeded, cleanup will be initiated. Where cleanup actions are necessary, documentation of the findings, requirements for cleanup, and results of surveys after cleanup will be required.

Alpha contamination in process areas other than the yellowcake precip are not anticipated to be significant. Therefore, alpha contamination surveys of surface working areas, sinks, and drains will be performed on a quarterly basis with the exception alpha surveys in the yellowcake precip area (including drains and wall surfaces) will be

performed on the basis of once per month. Where an action level of 1,000 dpm total alpha per 100 cm^2 is exceeded, surveys for both removable and total alpha contamination will be performed. Where an action level of 1,000 dpm removable alpha per 100 cm^2 or an action level of a maximum of 15,000 dpm total alpha per 100 cm^2 and an average 5,000 dpm total alpha per 100 cm^2 is exceeded[10], cleanup will be initiated. Where cleanup of contamination levels in process areas below the action levels specified in this paragraph is not possible, documentation of such will be made and the area will continue to be surveyed as required on a monthly basis.

Alpha monitoring equipment will have an approximate range so that the low range will not exceed 100 dpm full-scale with a high range to reach at least 30,000 dpm. The survey instrument should be battery-operated and must be operational from approximately 40°F to 120°F. Calibration will be on the basis of at least twice per year with performance verification conducted prior to each use with a manufacturer-supplied check source. If results of the check source reading vary by more than ± 30% of the check source reading made at the time of calibration, the instrument will be sent off for recalibration.

Equipment to be released from the restricted area will not exceed an action level of 1,000 dpm removable alpha per 100 cm^2 and 5,000 dpm average total alpha per 100 cm^2 with a maximum of 15,000 dpm total alpha per 100 cm^2.[1]

5.7.7 Airborne Effluent and Environmental Monitoring Program

The environmental impacts of the proposed R&D site are insignificant since no yellowcake drying operations will be performed. See Figure 5.7.7-1 for an outline of the environmental monitoring program. See Figures 5.7.7-2 and 5.7.7-3 for environmental sampling locations.

5.7.7.1 Baseline Data

Baseline environmental surveys at the proposed project site have been performed. During June 1982, both an external gamma ray exposure rate survey and vegetation sampling were performed. After topsoil has been stripped and prior to construction activities, soil sampling to a total depth of 15 cm will be conducted. (See Appendix D-10).

FIGURE 5.7.7-1

ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY	NO.	SAMPLE COLLECTION			SAMPLE MEASUREMENT	
		LOCATION	TYPE	FREQUENCY	FREQUENCY	PARAMETER
AIR RADON	4	1. One directly upwind on-site 2. One downwind on-site 3. John Christensen Ranch (nearest residence) 4. Innes Ranch (remote background)	Continuous	At least one week per calendar month representing approximately the same period each month.	Monthly	Rn-222
DIRECT RADIATION	4	Same locations as for radon in air	Continuous passive integrating devices[1] -or- Gamma radiation survey instrument calibrated against a portable ion chamber	Quarterly exchange of dosimeters -or- Reading of survey instrument	Quarterly	External gamma ray exposure rate
SURFACE WATER		None proposed				
GROUND-WATER						
1) Operational	13	Wells MW-01 thru MW-08, WCOW-21, WCOW-22, WCOW-23, WCOW-27S, WCOW-28D	Grab (screened interval)	Twice/month	Twice/month	Cl^-, Conductivity (25°C)
					Once/month	Assay Suite A[2]
2) Restoration	2	RW-01 WCPW-21	Grab (screened interval)	Daily	Daily	Assay Suite A[2]
					Once/week	Assay Suite B[3], Th-230, Pb-210, Po-210
	13	MW-01 thru MW-08, WCOW-21, WCOW-22, WCOW-23, WCOW-27S, WCOW-28D	Grab (screened interval)	Once/week	Once/week	Assay Suite A[2]

- continued

FIGURE 5.7.7-1

ENVIRONMENTAL MONITORING PROGRAM

(Continued)

		SAMPLE COLLECTION			SAMPLE MEASUREMENT	
EXPOSURE PATHWAY	NO.	LOCATION	TYPE	FREQUENCY	FREQUENCY	PARAMETER
3) Post Restoration	2	RW-01, WCPW-21 (plus any monitor well affected during operations)	Grab (screened interval)	Once/month	Once/month	Assay Suite B[3], Th-230, Pb-210, Po-210

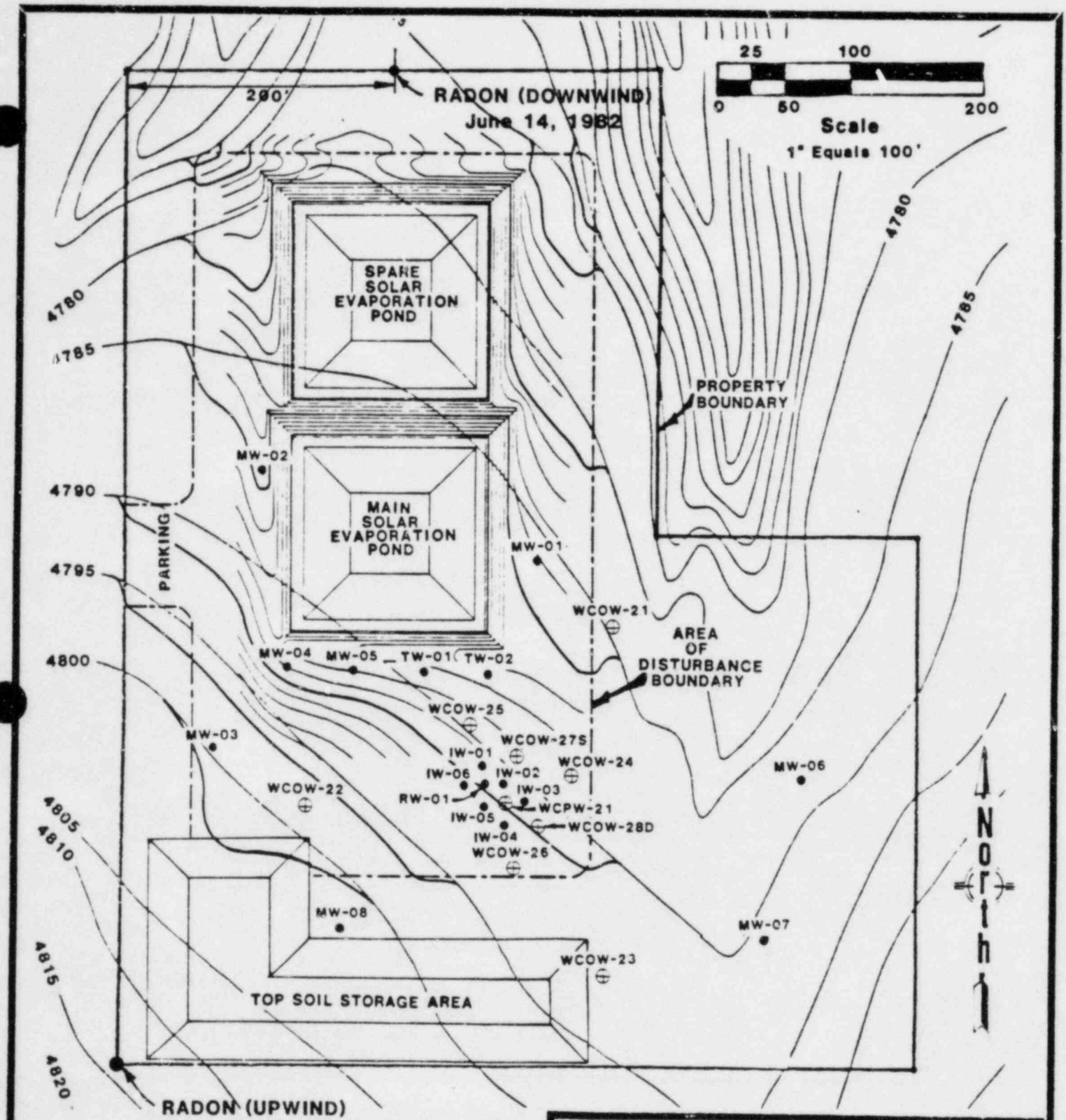
---

[1]Where thermoluminescent dosimeters are used, two or more readings from each dosimeter should be provided for averaging.

[2]Suite A = Na^+, $CO^{=}_{3(T)}$, Cl^-, Ca^{++}, U_3O_8, Conductivity (25°C)

[3]Suite B = Entire suite of Wyoming Department of Environmental Quality, Land Quality Division Guideline #8 (Rev. 2, January 1980):

NH_3, Al, As, Ba, B, Cd, Ca, Cr, Cl, Cu, F, Fe, Pb, Mn,
Mg, Hg, Mo, Ni, NO_2, NO_3, K, Ra-226, Na, SO_4, Se, U, V,
Zn, HCO_3^-, $CO_3^=$, TDS, pH



IW	INJECTION WELLS
RW	RECOVERY WELLS
TW	TREND WELLS
MW	MONITOR WELLS
WCOW, WCPW	PUMPING TEST OBSERVATION AND PUMP WELLS

Christensen Ranch ISL Project

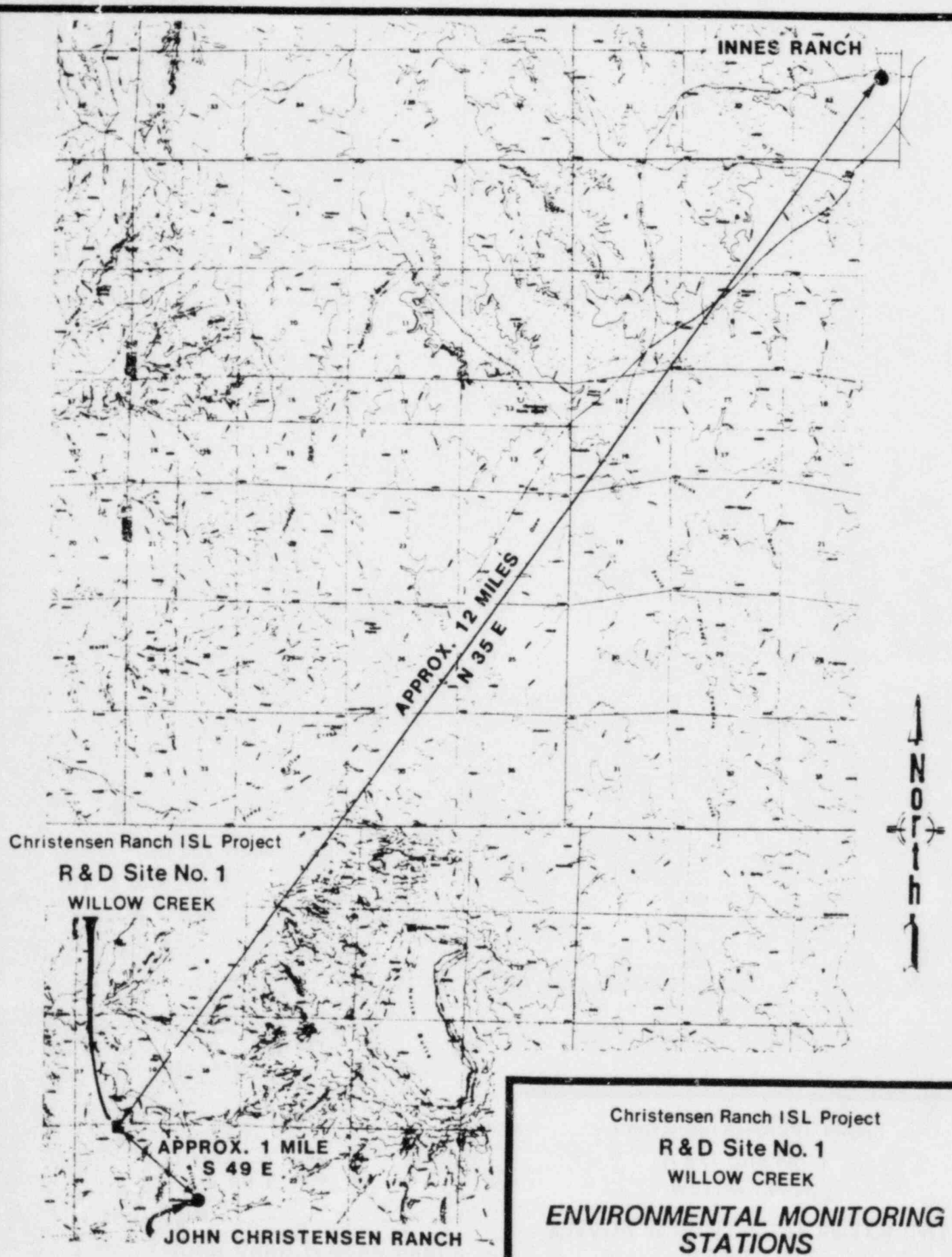
R & D Site No. 1

WILLOW CREEK

ENVIRONMENTAL MONITORING STATIONS

Figure 5. 7. 7.-2

WESTERN NUCLEAR, INC.



Christensen Ranch ISL Project

R & D Site No. 1

WILLOW CREEK

ENVIRONMENTAL MONITORING STATIONS

Figure 5. 7. 7.-3

WESTERN NUCLEAR, INC.

Because environmental impacts will be insignificant, meteorological data from the region were reviewed to determine predominant wind directions. As described in Appendix D-4, Climatology, for the Cordero mine, the predominant wind direction is from the south/southeast, whereas the least dominant wind direction is from the northeast. Therefore, radon gas sampling stations were sited both upwind and downwind of the proposed R&D site during June 1982. (See Figure 5.7.7-2.). Radon gas sampling stations were also located at the nearest residence (John Christensen Ranch) and at a remote background location (Innes Ranch) (See Figure 5.7.7-3).

5.7.7.2 Operational Sampling

- Air Sampling. Radon gas sampling will continue at the stations sampled during the baseline phase: at both upwind and downwind stations from the site, at the nearest residence (John Christensen Ranch), and at a remote background location (Innes Ranch). Radon-222 gas will be sampled at least one week per month. (See Figures 5.7.7-2 and 5.7.7-3).

- External Gamma. Either continuous external gamma TLD badges will be placed at radon sampling stations prior to commencement of operations and exchanged on a quarterly basis or an external gamma exposure rate survey will be taken once per quarter.

5.7.8 Groundwater and Surface Water Monitoring Program

5.7.8.1 Surface Water

Since there are no perennial streams in the permit area, no surface water sampling is proposed.

5.7.8.2 Groundwater Monitoring

Baseline groundwater monitoring data are presented in Appendix D-6. Groundwater sampling will be conducted during the operational phase of the project as presented in Figure 5.7.7-1.

5.7.9 Quality Assurance

Quality assurance validates program performance. WNI will implement a quality assurance program in accordance with NRC Regulatory Guide 4.15[11] which will include:

1. Formal delineation of organizational structure and management/operational responsibilities. Responsibilities for both review/approval of written procedures and preparation/review/and evaluation of monitoring data/reports are provided for.

2. Adhering to minimum qualifications for individuals performing radiological monitoring.

3. Training commensurate with potential radiological health hazards involved in the facility will be provided with provisions for testing and retraining.

4. Provision for written operating procedures to address all operational and nonoperational aspects of the project.

5. Maintenance of records necessary to document activities are performed in accordance with applicable requirements. Where laboratories perform analytical services, WNI will obtain letters from the laboratories verifying compliance with Regulatory Guide 4.15. Records will be maintained for a minimum period of five years.

6. Provision for periodic management audits to verify the quality assurance program is effectively implemented as well as to verify compliance with all applicable rules, regulations, and license requirements and to protect employee and public health and safety by maintaining effluent releases and exposures ALARA.

7. Provisions to assure an adequate quantity of operable and calibrated survey/monitoring equipment is available at all times for monitoring routine operating conditions.

5.7.10 Emergency Notification

In accordance with the conditions of 10 CFR 20.402, "Reports of Theft or Loss of Licensed Material;" 10 CFR 20.403, "Notifications of Incidents;" and 10 CFR 20.405, "Report of Overexposures and Excessive Levels and Concentrations,"[5] Western Nuclear, Inc. will take the appropriate actions immediately to notify the appropriate authorities. The appropriate management of WNI will also be notified of any such instances.

Where appropriate, an investigation shall be made of the instance and a written report shall be prepared. Reports submitted to the U.S. Nuclear Regulatory Commission shall be in accordance with Sections 20.402, 20.403, and 20.405 of 10 CFR 20.[5]

In the case of a confirmed excursion, NRC will be notified within 24 hours. Upon determination of corrective actions, a confirmation letter summarizing the events and corrective actions to be taken will be submitted.

For shipments of yellowcake concentrate, drivers of transport vehicles will be given instructions in accordance with applicable Department of Transportation regulations.[12] In addition, for the possible case of an accident occurring during transport of yellowcake concentrate, an emergency response plan will be available.

For possible emergencies such as fires, floods, etc., an emergency action plan will be included in the written procedural manual for operations. Incorporated in the action plan will be the procedures necessary to notify the appropriate supervisors.

In accordance with 10 CFR 21,[6] notification of reportable incidents to NRC will be through the delegated Executive Officer. The Executive Officer is the President, Western Nuclear, Inc., Denver, Colorado.

5.7.11 Accidents

Accidents during the operation of the R&D test will be minimized through: 1) the proper design, manufacture, and operation of the process equipment; 2) adherence to known solution mining procedures; and 3) incorporation of a safety program designed to establish and maintain safe operations.

5.7.11.1 Surface Accidents

Failure of Chemical Storage

Leach and eluant solutions will be stored in fiberglass tanks under atmospheric pressure. The likelihood of rupture of a tank that is vented to the atmosphere is small. It is more likely that the tank would develop a small leak. If a leak were to occur, fluids released in the processing trailers would be caught in the drain system, drained to the outside sump, and then be pumped to the solar evaporation ponds.

Oxygen (O_2) and carbon dioxide (CO_2) will be stored onsite in pressurized tanks. Rupture of the external piping to these storage tanks would not result in a significant release of gases because a drop in pressure would automatically close the excess-flow valve to be installed on each tank.

Pipeline Failures

The rupture of a trunkline, an injection well feeder line, or a production well collection line would result in either barren or

pregnant leach solution contaminating the soil near the break. The maximum volume that reasonably would be expected to be released from a trunkline rupture is estimated to be 750 gallons (25 gpm x 30 minutes of release). The potential for such a failure is considered to be very unlikely.

To minimize the volume of fluid that could be lost due to a pipeline rupture, the piping systems will be inspected routinely during operations.

If fluid were released by a pipeline rupture, the localized area potentially affected by the leach solution would be surveyed. Any contaminated material would be transferred to the solar evaporation ponds, and the contaminated area would ultimately be reclaimed.

Fires and Explosions

The fire and explosion hazard of the uranium process plant will be minimal. The plant will not use flammable liquids in the uranium extraction processes. Diesel fuel will be stored in standard fuel storage tanks located behind trailer T-2. Because the uranium in the process plant will be in solution, adsorbed on ion exchange resin, or in the form of yellowcake slurry, an explosion would not appreciably disperse the uranium. Spilled liquids or slurries would be confined to the sump and pumped to the solar evaporation ponds.

To be prepared for potential fires, adequate fire extinguishers will be located throughout the facilities so as to quickly contain any fire.

Solar Evaporation Pond Leakage

The leak detection system for the solar evaporation ponds has been previously described in Section C.2.a.2 of the Mineral Extraction Plan. Should a leak develop, the contents of the leaking pond and process effluents will be pumped into the second pond while the leak is repaired. Contamination of underlying materials would be confined to soil and strata directly beneath the pond. If the contamination is determined to be radioactive, the materials will be disposed of during reclamation as described in Section D.2 of the Reclamation Plan.

5.7.11.2 Subsurface Accidents

Well Casing Failure

If a well casing cracks, leach solution from an injection well or pregnant solution from a recovery well could seep into and contaminate aquifers overlying or underlying the producing zone. The amount of solution that could seep through a crack is potentially very small for the R&D test. If a crack was not detected for seven days, however, the maximum volume of solution escaping from an injection well would be 40,000 gallons (4.0 gpm x 7 days) and from a recovery well would be 121,000 gallons (12 gpm x 7 days). This is a worst case estimate and assumes that the crack is large enough and the overlying aquifer is permeable enough to allow the total fluid flow from the well to infiltrate the aquifer.

To detect a casing failure, monitor wells will be completed in the aquifers above and below the producing zone aquifer. The water levels and water quality of water in these wells will be analyzed regularly to check for leach solution excursions. (See Section C.5.)

Leakage Through Old Exploration Holes

Leakage of leach solution between aquifers through old exploration holes is considered very unlikely at the test site. At the low aquifer pressures which will be induced by in situ extraction, the drilling mud column is believed to be an effective seal against fluid movement between various aquifer units penetrated by the drilling. Additional sealing has probably occurred by the rapid swelling and bridging of the isolated mudstones between the aquifer units. Aquifer tests performed at the site have demonstrated that a lack of hydraulic communication exists between aquifers at the site. In the event that leakage between aquifers does occur through old drill holes, the old holes responsible for the leakage will be reentered and replugged. Wells completed in the contaminated aquifer would then be pumped to reduce to acceptable levels the concentration of any contaminating fluids.

Wellfield Excursions

Wellfield excursions are considered potentially normal events during operation; therefore, they have been previously discussed in Section C.5. The proposed degree of monitoring and corrective actions

are believed to be sufficient to result in minimal effects on the aquifer units.

5.7.11.3 Transportation Accidents

Yellowcake Transportation

An accident involving vehicles transporting the yellowcake slurry from the process plant to the Split Rock Mill could result in the spillage of some yellowcake. The likelihood of such a spill is considered low because the slurry will be transported over county and state highways where vehicle traffic is light. The effects of such a spill would be minimal because only a few drums containing yellowcake slurry would be transported at any given time. If a spill occurred, dust would not disperse because the yellowcake is wet. Soils contaminated by the spill would be removed and processed through the ____ to recover the yellowcake. All areas disturbed would be reclaimed in accordance with applicable requirements.

Shipment of Chemicals

The operation of the process plant will require the periodic shipment of process chemicals and fuel to the site. The shipment of solid sodium carbonate presents almost no risk of injury to individuals. The handling of other chemicals and fuels is also expected to present minimal effects.

5.7.11.4 On-Site Accidents

Due to the type of equipment used and design of in situ extraction processes, the potential for serious accidents using this extraction technique is considered to be much smaller than for other types of uranium mining and milling operation. The usual hazards associated with op n pit or underground mining are not present. For example, no heavy equipment is used, no dust is generated, no blasting is required, and subsidence is not present. Within the process plant, the major equipment items having moving or rotating parts are pumps and small submerged agitators. The injury frequency rate for existing in situ operations is believed to be less than at conventional mines and mills.

The wellfield and plant equipment will be operated by experienced operators. A training program will be given to all personnel to describe the hazards associated with operation of all equipment. All applicable regulations will be followed relative to equipment maintenance.

Adequate ventilation systems exist to control any dust, mists, fumes, or gases which may accumulate.

The site will be fenced as described in section C.3g of the Mineral Extraction Plan. The site will also be posted with appropriate signs to keep out unauthorized visitors and to caution the general public regarding radioactive materials present in the restricted area.

Adequate protective clothing, safety showers, and wash facilities will be maintained on site to provide for safe handling of chemicals and packaging of yellowcake slurry into drums.

In addition to the regular NRC and MSHA health and safety inspections, WNI management and safety supervisory personnel will frequently inspect the test site to identify and rectify potential health and safety hazards.

Diligent inspection and the use of accepted industrial working procedures will be used to prevent accidents resulting especially from the storage, distribution, and use of chemical reagents.

Insofar as possible, the design of surface facilities and equipment will be specified and constructed to withstand, without failure, foreseeable weather extremes.

Source material will be stored as shown in Figure C.2-6 of the Mineral Extraction Plan. Only small (5 to 10 drums) quantities of yellowcake will be stored on the site at any time. The yellowcake will be packaged for storage and transportation in compliance with U.S. Department of Transportation regulations.[12] An emergency response plan will be developed for transportation accidents.

REFERENCES FOR SECTION 5

[1]U.S. Nuclear Regulatory Commission, August 1980, "Draft Regulatory Guide Task OH941-4, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be As Low As Reasonably Achievable," Office of Standards Development.

[2]U.S. Nuclear Regulatory Commission, November 1975, NRC Regulatory Guide 8.13 (Revision 1), "Instruction Concerning Prenatal Radiation Exposure," Office of Standards Development.

[3]U.S. Nuclear Regulatory Commission, May 1980, Draft Regulatory Guide Task OH902-1, "Instruction Concerning Risk from Occupational Radiation Exposure," Office of Standards Development.

[4]Title 10, Code of Federal Regulations, "Part 19--Notices, Instructions and Reports to Workers, Inspectors."

[5]Title 10, Code of Federal Regulations, "Part 20--Standards for Protection Against Radiation."

[6]Title 10, Code of Federal Regulations, "Part 21--Reporting of Defects and Noncompliance."

[7]U.S. Nuclear Regulatory Commission, August 1980, Draft Regulatory Guide Task OH710-4, "Health Physics Surveys In Uranium Mills," Office of Standards Development.

[8]U.S. Nuclear Regulatory Commission, 1976, Regulatory Guide 8.15--"Acceptable Programs for Respiratory Protection," Office of Standards Development.

[9]U.S. Nuclear Regulatory Commission, 1978, Regulatory Guide 8.22--"Bioassay At Uranium Mills," Office of Standards Development.

[10]U.S. Nuclear Regulatory Commission, November 1976, "Guidelines For Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For Byproduct, Source, or Special Nuclear Material," Division of Waste Management.

[11]U.S. Nuclear Regulatory Commission, February 1979, Revision 1 to Regulatory Guide 4.15--"Quality Assurance For Radiological Monitoring Programs (Normal Operations)--Effluent Streams and The Environment," Office Standards Development.

[12]Title 49, Code of Federal Regulations, Part 173--"Shippers - General Requirements for Shipments and Packagings."

ATTACHMENT A
RESUMES

1. Director of Solution Mining: ROLAND W. COLLINS
   Degree: B.S., Geology, 1967

a.	Director of Solution Mining	Western Nuclear, Inc. 1982-Present
b.	Project Engineer, Solution Mining	Western Nuclear, Inc. 1980-1982
c.	Mine Manager	1978-1980
d.	Chief Engineer	1977-1978
e.	Chief Geologist	1975-1976
f.	Mine Superintendent	1973-1975

2. Operations Engineer: Not designated.

3. Radiation/Safety Officer: Not designated.

ATTACHMENT B

RESPIRATOR PROTECTION MANUAL FOR USE OF RESPIRATORS IN ATMOSPHERES CONTAINING RADIOACTIVE PARTICULATES

I. Introduction

A. In accordance with Section 20.103, "Exposures of Individuals to Concentrations of Radioactive Materials in Air to Restricted Areas" of 10 CFR Part 20, "Standards for Protection Against Radiation" which permits licensees to make allowance for the use of respiratory protection in estimating exposures of individuals to airborne radioactive material and Annex A of Western Nuclear's license SUA-56, "Conditions for Use of Respiratory Protective Equipment" pursuant to paragraphs 20.103(c)(1) and (3), 10 CFR 20, WNI has initiated a Respiratory Protection Program for the purpose of using the allowance as specified in the U.S. Nuclear Regulatory Commission Regulatory Guide 8.15.[1]

Respiratory protective equipment is provided by Western Nuclear, Inc. and shall be used in accordance with the procedures set forth in this manual whenever airborne radioactive materials or toxic materials can exceed acceptable concentrations. The respirator program will be administered by the Radiation Safety Officer (RSO).

II. Respiratory Protection Policies and Responsibilities

A. Respirators will be used only for operations where it is not feasible to prevent atmospheric contamination by effective engineering controls such as process enclosure or ventilation. However, respirator use is no substitute for practicable engineering controls; therefore, respirators will be used only while engineering controls are being evaluated/instituted or, in cases of maintenance, in tanks/other enclosures that routinely contain radioactive materials. Only approved or certified respiratory equipment will be used. Certification or approval is granted by the National Institute for Occupational Safety and Health (NIOSH), the Mine Enforcement and Safety Administration (MESA), or the Energy Research and Development Administration (ERDA).

B. Written operating procedures are required before workers are assigned to precipitation cleanup and/or maintenance which requires respiratory protection. Procedures for respirator use are included in Section V. These procedures are to be followed by all employees when using respiratory protection. Employees will not enter areas where radioactive contaminants exceed acceptable standards until the RSO has evaluated the exposure and selected the proper respiratory protection and until fitting and training is completed.

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[1]U.S. Nuclear Regulatory Commission, 1976 Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," Office of Standards Development.

C. Responsibilities. Each Employee is responsible for:

1. Using the respirator issued to him in accordance with instruction and training provided by the RSO.

2. Informing his Supervisor of any personal health problem that could be aggravated by the use of respiratory protection equipment.

3. Not disassembling, modifying, or in any way altering a respirator other than changing cartridges, if necessary.

4. Reporting any observed or suspected malfunctioning respirator to the RSO.

5. Using only those brands and types of equipment for which he has been trained and can obtain a satisfactory fit.

6. Maintaining a shaven face where nothing interferes with the seal of tight-fitting face pieces against the skin. Any worker who is not clean-shaven shall not be allowed to wear a respirator, even though he has previously obtained a satisfactory fit with a particular device.

Supervisors are responsible for:

1. Notifying the RSO whenever it is necessary for an employee to enter an area in which airborne radioactive contaminants may exceed acceptable standards.

2. Enforcing the use of respirators in situations that require respiratory protection.

3. Consulting with the RSO for evaluation of exposure hazards whenever it is suspected that airborne radioactive or toxic contaminants could exceed acceptable standards.

4. Notifying the RSO of any employee known to have an active medical work restriction and obtain RSO clearance for such employee prior to assignment of job requiring the use of respiratory protection.

The RSO is responsible for:

1. Providing necessary respiratory equipment to protect the health of the employees.

2. Maintaining equipment in serviceable condition.

3. Fitting employees with proper respirators and training them in their use.

4. Evaluating employee exposures and work conditions, including monitoring of the airborne radioactive concentrations during the time the employees are working.

5. Random inspections of respirator use.

6. Establishing and keeping records of the medical approval required.

III. Respiratory Protective Equipment Selection

A. Respiratory protective equipment is available and has been chosen to offer protection against potential airborne radioactive hazards to be encountered. At WNI, the function of respirator selection is assigned to the RSO.

Several factors govern respiratory selection. These include:

1. Nature and extent of the hazard.

2. Work requirements and conditions.

3. Limitation of respiratory equipment.

4. Availability of certified or approved equipment.

B. The types of respirators that may be used here include the half-mask, full-face respirators and the powered air purifying half-mask respirators with cartridges or canisters certified for radioactive airborne contaminants.

C. Protection Factors. The overall protection given by a certain respirator is defined in terms of its protection factor (PF). These are outlined in Table I, U.S. Nuclear Regulatory Guide 8.15.

The PF is a measure of degree of protection afforded by a respirator defined as the ratio of the concentration of contaminants outside the face mask or hood to that inside the equipment under conditions of use. For example, a half-mask may be used for protection in atmospheres with a contaminant concentration up to 10 times the permissible exposure limit. In the case of employee-measured intake of airborne radioactive contaminants, the ambient concentration in the air is divided by the protection factor to determine actual intake. The PFs are based on laboratory tests which show how much leakage can occur between face piece seal and the face on a cross-section of different facial types and sizes after each wearer was properly fitted with various types of equipment. Therefore, the PFs may only be used on those people who are found to have a satisfactory fit with the device they are wearing. (See NRC Regulatory Guide 8.15 for appropriate protection factors.)

D. Air-Purifying Respirators. Air-purifying respirators remove specific gases and vapors or any particulates from the ambient air to make it suitable for breathing. Except for disposable dust masks, the purifying filters and sorbents are contained

in cartridges or canisters that are periodically replaced to assure continued protection. The two major limitations are 1) they add no oxygen to the air and 2) the degree of protection against chemical vapors and gases is governed by the efficiency of the sorbent in removing them. Air-purifying respirators may not be used for protection against any radioactive gases or vapors, but may be used for protection against any airborne particulates at concentrations within the allowable protection factors.

1. Half-Mask Respirators
   The half-mask respirator is the most widely used respirator. These are available through the RSO. An employee is to use only those brands with which he can obtain a satisfactory fit. Each face piece is supplied with high efficiency filter elements, which give protection against low concentrations of radioactive and toxic particulates. These cartridges are kept by the RSO.

2. Full-Face Respirators
   Full-face masks provide more protection than half-masks because, due to their shape, they usually form a better face piece to face-seal. They also provide eye protection in atmospheres containing irritating chemicals or particulates. In addition, most filter and chemical sorbent canisters used with full-face masks are larger than half-masks and so have a longer service life. The users must be trained, fitted, and medically approved.

3. Powered Air-Purifying Respirators
   Powered air-purifying full-face or half-mask respirators provide more protection than regular full-face or half-mask respirators, because they provide a continuous positive flow of filtered air (4 CFM) to the face piece. This causes a positive pressure inside the face piece which significantly reduces leakage into the mask.

IV. Respirator Fitting

A. Every respirator wearer must be properly fitted before using a respirator for health protection. The fitting process involves trying on different brands of face pieces to identify those that fit well and are comfortable to wear. During periods of precipitation cleanup and certain maintenance, employees will be fitted and periodically trained before performing their work duties. The respirators will be returned to the RSO after work is completed (for maintenance and cleaning). (See Enclosure 1.)

1. Half-Mask Fitting
   The half-mask respirator may be used when the average concentrations of airborne radioactive contaminants do not exceed 10 times the maximum permissible concentrations as set forth in 10 CFR, Part 20. Each wearer will be trained as outlined in Part V of this manual. In order

to ensure a proper fit, the face-to-face piece seal will be tested using irritant smoke.

2. Full-Face Fitting
The full-face respirator may be used when the average concentrations of airborne radioactive contaminants do not exceed 50 times the maximum permissible concentrations as set forth in 10 CFR, Part 20. Each wearer will be trained as outlined in Part V of this manual. In order to ensure a proper fit, the face-to-face piece seal will be tested using irritant smoke.

3. Powered Air-Purifying Respirator Fitting
Both the full-face and half-mask provide a protection factor of 1000 and may be used when the average radioactive airborne contamination does not exceed 1000 times the maximum permissible concentrations as set forth in 10 CFR, Part 20. Each wearer will be trained as outlined in Part V of this manual. In order to ensure a proper fit, the face-to-face piece seal will be tested using irritant smoke.

V. Training

A. Every employee who may have to wear a respirator for health protection must be trained in the proper selection, maintenance, and use of the respirator and its limitations. This training provides the opportunity to:

1. Handle the respirator.

2. Have it fitted by competent personnel.

3. Test its face piece to face seal under normal face/head movements that could cause leakage.

4. Wear it in normal air for a familiarization period.

5. Wear it in a test atmosphere.

6. Learn how to wear it, adjust it, and test it for proper fit before each wearing.

B. Training will be conducted by the RSO for all employees who must wear respirators.

VI. Medical Approval
Medical approval is required for anyone who needs or may have the need to wear a respirator. This approval must be given on an annual basis. (See Enclosure 2.)

VII. Operating Procedures for Respiratory Equipment

This procedure outlines the safe use of respiratory equipment when breathing hazards may exist. When respirators have been used in atmospheres containing soluble airborne uranium, employees will participate in a bioassay program consisting of urinalyses as specified by NRC Regulatory Guide 8.22.[2]

Acceptable Equipment. Each type of respiratory device has limitations based on its ability to protect health.

A. Using an Air-Purifying Half-Mask Respirator

1. General. This type of respirator can be used for protection against low concentrations of toxic vapors, gases, and particulates. They have a protection factor of 10*. Since the proper air-purifying elements must be selected for each new application, consult the RSO.

2. Limitations. This respirator does not supply air and so is not for use in an oxygen deficient atmosphere. Do not use in any atmosphere that is immediately hazardous to life or health. Respirators are to be used only for protection against contaminants listed on the cartridge. Wearer must leave the area immediately if gas or vapor can be detected inside the mask or if the filter clogs. Contact lenses may not be worn while wearing any type of respiratory protection. Battery packs are good for up to five hours. When not using the respirator, the unit must be turned off. NOTE: Each respirator user may leave the area at any time for relief from respirator use in the event of respirator malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that might require such relief.

3. Medical Qualifications. Any individual with an active work restriction (temporary or permanent) must consult with the RSO before using any half-mask respirator.

4. Donning the Mask

a. Choose a brand of mask that fits well.

b. Hold the mask so that the narrow nose cup points up.

c. Grasp both lower straps and hook behind the neck.

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[2]U.S. Nuclear Regulatory Commission, 1978, Regulatory Guide 8.22, "Bioassay at Uranium Mills," Office of Standards Development.

*For a powered half-mask respirator, the protection factor is 1000.

d. Grasp both top straps and hook behind the neck. The top straps must fit above the ears for proper fit.

e. Adjust the straps so the fit is snug, but comfortable.

f. In the field, check for leaks by covering the filter elements with palm of hand, inhale gently, and hold the breath for 10 seconds. If the mask remains pulled toward the face, the fit is good.

B. Using a Full-Face Mask Respirator

1. General. Full-face masks can be used with air-purifying canisters or air-supplied systems, such as air lines or self-contained units. Consult with the RSO before using any respirator in a new situation. Fitting and training must be completed before a respirator is used for health protection.

2. Limitations. Do not wear with standard eyeglasses that interfere with the face-to-mask seal. Obtain special glasses from the RSO. Contact lenses may not be worn while wearing any type respiratory protection. For limitations of the air-purifying canisters, see the section on air-purifying half-masks.

3. Medical Qualifications. Medical approval is required before using any type of full-face respirator device.

4. Donning the Mask

a. Loosen all straps, pull harness over head, and place chin in mask chin cup.

b. Pull head harness well down on the back of the head.

c. Tighten harness gently, beginning with the lower, then middle, and finally the top straps.

d. Check the fit by closing off the air hose or canister opening with the palm of your hand and inhale gently. Hold your breath for 10 seconds. A good fit is indicated if the mask remains collapsed toward the face while holding your breath.

e. Return used masks to the RSO for cleaning and maintenance.

C. Using an Air-Purifying Powered Half-Mask Respirator

1. Limitations. Air-purifying powered respirators can be used with high efficiency cartridges only. They cannot be used in atmospheres containing toxic chemicals or in atmospheres containing less than 19.5% oxygen. See the

sections on half-mask and/or full-face mask respirators for other limitations.

2. Medical Qualifications. Medical approval is required before using any type of air-purifying powered respirator.

3. Donning the Mask.

   a. Fasten battery pack and blower with high efficiency cartridges attached around waist using belt provided.

   b. Two face pieces are provided. One has the air hose connection on the bottom of the face piece, the other has the connection from the side.

   c. Don the mask as outlined under the half-mask air-purifying respirator.

   d. Select the face piece that you feel most comfortable with and adjust the battery pack and blower so that the hose is not bent, kinked, or pulling against the face piece.

   e. Make sure all hose connections are hand tight.

   f. Check for seal by covering both exhalation ports.

VIII. Procedures for Maintenance, Cleaning, Disinfection, Decontamination, and Storage of Respirators

Respirators will be cleaned and maintained by the RSO. Proper hygienic procedures require that respirators being issued for use in airborne radionuclide environments be surveyed for alpha surface contamination and have respirator filter cartridges checked for proper air flow on a daily basis. The entire respirator must also be cleaned and sanitized on a weekly basis. If stored for future use, respirators must be inspected on a monthly basis. This procedure will minimize the possibility of breathing radioactive surface contamination into the lungs, ensure the user has an adequate supply of air without the ill health effects associated with breathing across a large pressure drop, and minimize the possibility of entraining infections, viruses, or bacteria in the respirator unit. Any respirators being stored for emergency use must be inspected at least monthly and after each use to assure they are in satisfactory working condition.

An inventory of respirators and parts shall be performed at least every three months during the operation and restoration phases.

A. Maintaining Issued Respirators

1. At the end of each shift, the respirator must be returned to the RSO.

2. Remove the respirator cartridges and check the pressure drop across the cartridge. If the pressure drop is above MSA specifications, the cartridge must be thrown away. The cartridge must also be discarded if yellowcake has dried on it, or if both cartridges combined have removable surface contamination above 100 dpm alpha/100cm^2.

3. Wipe the respirator inside and out with a 2.5 cm paper filter. Count the filter. If the calculated alpha dpm is above 100, the respirator must be washed and sanitized.

4. Inspect respirator for such items including tightness of connections and condition of component parts (NUREG-0041, Section 9.2).[3]

5. Place in respirator bag and seal.

6. Record the results of the swipe sampling and cartridge check on the respirator issuance form. The respirator must be smoke-tested when it is reissued.

B. Respirator Cleaning and Sanitizing

Respirators should be routinely cleaned/sanitized on at least a monthly basis. Emergency devices are to be cleaned after each use.

1. Place all used respirators in a covered container.

2. Before washing the respirator, remove the head band yoke and unsnap the head band straps.

3. Allow the washing machine to fill and rinse with hot water.

4. Fill the washer about two-thirds full with respirators and parts. Fill the washer with warm water and add one package of respirator sanitizer per gallon of water (approximately six packages).

5. Rinse the respirators in warm water.

6. Dry the respirators and place them in a suitable container to avoid losing any parts. If using an automatic dryer, remove metal head band yoke prior to drying on low heat for 60 minutes.

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[3]U.S. Nuclear Regulatory Commission, October 1976, NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials," Office of Standards Development.

7. Assemble the respirator as follows:

   a. Replace missing inhalation valves.

   b. Replace missing cartridge gaskets.

   c. Count the head band yoke on the respirator (use correct size).

   d. Snap head band straps with D-rings on the top and bottom of the head band yoke (on the left side of the yoke with the respirator in the donning position).

   e. Snap a short clasping strap on the right bottom of the yoke and a long clasping strap on the right top of the yoke.

   f. Double-check to make sure no valves or gaskets are missing and that no internal sediment will interfere with valve or gasket sealing.

   g. Screw radionuclide cartridges into each respirator.

8. Do a swipe survey on 10% of the washed respirators. If any respirator surveys at above an action level of 80 dpm alpha, all the respirators in that batch will have to be swipe-surveyed. Any respirators that exceed the action level of 80 dpm alpha must be recleaned.

9. Write a serial number on the yoke of the respirator.

10. Place each respirator in a respirator bag. Write the date, name of the person preparing the respirator, and the survey results on the outside of the bag and seal it with a wire tie.

The RSO will make random inspection of both respirator fit and conditions during periods of use by employees. Any employee found to have a poor fit and/or a respirator that is unserviceable will be removed from the area, the employee refitted, and/or the respirator repaired. No protection factor will be used for the period of time the employee had an improper fit or unserviceable respirator.

_____ _____

Director of Solution Mining Date

Enclosure 1

RESPIRATOR ISSUANCE RECORD

I, _____, have been issued the following respirator:

_____ Half-Mask

_____ Full-Face Mask

_____ Powered Air Purifying (full- or half-mask)

Respirator Survey

	Date Issued	Issued By	I have been smoke-tested	100 dpm/100 cm^2 removable alpha ( )
1.				
2.				
3.				
4.				
5.				

This respirator is issued for a maximum of five days and must be returned to the RSO at the end of each shift for alpha survey and cartridge check.

This cartridge _____(type) has a maximum allowable pressure drop of _____mm water and had the following pressure drop(s) on the listed issue dates:

Pressure Drop: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____

COMMENTS: _____

_____

_____

_____
Mill RSO (signature)